



rosstarrant architects

Woodford County High School Phase 1

Woodford County Board of Education
Versailles, Kentucky

RTA 1916
BG 19-353

Project Manual

Volume 1 of 1
December 2021

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FOR
Woodford County High School Phase 1
Versailles, Kentucky
BG 19-353
RTA 1916**

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PART 1 GENERAL

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- A. A geotechnical exploration of the site was conducted by S&ME, dated May 28, 2020.
 - 1. A digital copy in color may be requested of the Architect.
- B. The report of the geotechnical exploration is appended hereto for reference only and is not a part of the Contract Documents. The boring layout and log of borings is appended to the set of contract drawings. No warranty of content or accuracy is expressed or implied. Neither the Owner nor the Architect will be responsible for interpretations or conclusions drawn from this report by the Contractor. This data is made available solely for the convenience of the Contractor.

END OF SECTION 012400



Report of Geotechnical Exploration
Woodford County High School
Versailles, Kentucky
S&ME Project No. 1183-20-006

PREPARED FOR:

Woodford County Board of Education
330 Pisgah Pike
Versailles, Kentucky 40383

PREPARED BY:

S&ME, Inc.
2020 Liberty Road, Suite 105
Lexington, Kentucky 40505

May 28, 2020



May 28, 2020

Woodford County Board of Education
330 Pisgah Pike
Versailles, Kentucky 40383

Attention: Mr. Scott Hawkins - Superintendent

Reference: **Report of Geotechnical Exploration
New Woodford County High School**
Versailles, Kentucky
S&ME Project No. 1183-20-006

Dear Mr. Hawkins:

S&ME, Inc. (S&ME) has completed our geotechnical exploration for the new Woodford County High School campus in Versailles, Kentucky. We performed our work in accordance with S&ME Proposal No. 11-200008 dated January 10, 2020 as authorized via PO# 20204177. The purpose of this exploration was to obtain subsurface data at the site and provide geotechnical recommendations for design and construction of the new high school campus.

This report explains our understanding of the project, documents our findings, and presents our conclusion and engineering recommendations.

Sincerely,

S&ME, Inc.

A handwritten signature in blue ink, appearing to read 'A. Fiehler'.

Andrew M. Fiehler, PE
Project Engineer
Licensed Kentucky 23,977

A handwritten signature in blue ink, appearing to read 'C. Lee'.

Craig S. Lee, PE
Senior Engineer / Vice President



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1.0 INTRODUCTION

S&ME, Inc. (S&ME) has completed our geotechnical exploration for the new Woodford County High School campus in Versailles, Kentucky. We performed our work in accordance with S&ME Proposal No. 11-200008 dated January 10, 2020 as authorized via PO# 20204177. The purpose of this exploration was to obtain subsurface data at the site and provide geotechnical recommendations for design and construction of the new high school campus.

This report explains our understanding of the project, documents our findings, and presents our conclusion and engineering recommendations.

2.0 PROJECT INFORMATION

The proposed high school structure will have a total square footage of 174,000 square feet. The classroom wings are planned to be two stories tall while the gymnasium, auditorium, and cafeteria portions will be single-story with tall eave heights. The construction is currently planned to consist of load bearing Concrete Masonry Units (CMU) with a brick veneer. Mr. Charles Haynes, PE with Structural Design Group indicated that loads of 8 kips per linear foot (klf) for the walls and 75 kips for columns are anticipated for the majority of the building. The storm shelter area will have wall loads of about 12 klf with 150-kip columns. Settlement tolerances of the structure are noted as 1-inch of total settlement and 1/2-inch of differential settlement.

New asphalt pavement for driveways and parking lots are also planned for the campus. The new natural grass football field with running track and grandstands will be constructed as an add-alternate to the initial site development.

S&ME was provided with a preliminary grading plan prepared by Ross Tarrant Architects. Based on a finished floor elevation of 892 feet, we anticipate about cuts of up to eight feet and fills of one to two feet in the high school building pad from the current ground surface elevations. Grading for the new football field and track complex will require cuts of up to five feet and fills of up to 14 feet. Settlement tolerances for the track and field event areas are more stringent than the proposed building. KHSAA requires less than 0.1 percent gradient of the track and runway areas.

3.0 REGIONAL GEOLOGY

3.1 USGS Mapped Geology

A review of the USGS geologic map of the Versailles Quadrangle (1964) indicates the site is underlain by Cynthiana Limestone Member of the Middle Ordovician Geologic Age. The Cynthiana Limestone Member consists of limestone that is medium to dark-gray, medium to coarse grained, with fossiliferous beds. Chert and calcite nodules are also common within the limestone. Our borings encountered bedrock at depths ranging from 0.4 feet to 12.2 feet below the existing ground surface with an average depth of about 5 feet consistent with the reported geologic mapping and further detailed below.



The refusal materials at this site were explored by rock coring methods in the upper 10 feet of refusal materials from six of our borings - B-1, B-15, B-16, B-26, B-28 and B-29. Our observation of the recovered rock cores indicated that the bedrock consists of predominantly limestone that is consistent with the geologic mapping of the limestone of the Cynthiana Limestone in the site vicinity.

3.2 Karst Geology Discussion

The Cynthiana Limestone, as with carbonate based bedrock, is prone to differential weathering and solutioning, including sinkhole formation. The result is an erratic top of rock profile with open fractures, cavities, channels and soil filled, solution enlarged joints in the bedrock. Subsurface flow of water is partly controlled by solution widened joints and fractures and along horizontal bedding planes. Alignments of solution enlarged fractures, sinkholes, caverns and depressions commonly indicate fracture zones followed by subsurface water courses.

There are no closed contour depressions on the USGS geologic map in the Cynthiana Limestone within one half mile of the project site; however, there are numerous depressions and sinkholes within the formation in the Versailles area. Note that the contour interval of the mapping is 10 feet. Depressions less than 10 feet deep may not show at the mapped interval.

No obvious sinkholes or closed depressions were observed on the site during our field work. Another common feature of Karst topography associated with the Cynthiana Limestone are soil filled solution widened joints (commonly called slots) in the bedrock. Boring B-41 appeared to encounter a soil filled solution widened joints while drilling. While we did not encounter other obvious signs of Karst development in our borings, there is the possibility they may occur between our borings. The Kentucky Geological Survey (KGS) identifies this area of Woodford County as a "High Potential" for Karst activity. The map below from the KGS notes the majority of Woodford County as having "Intense Karst" potential.

The geophysical exploration identified several anomalies in the subsurface. Upon exploration of the noted anomalies via the soil test borings, we did not observe obvious signs of Karst formation at the explored locations. Additional discussion of the geophysical testing methods and findings are included in following sections of the report.

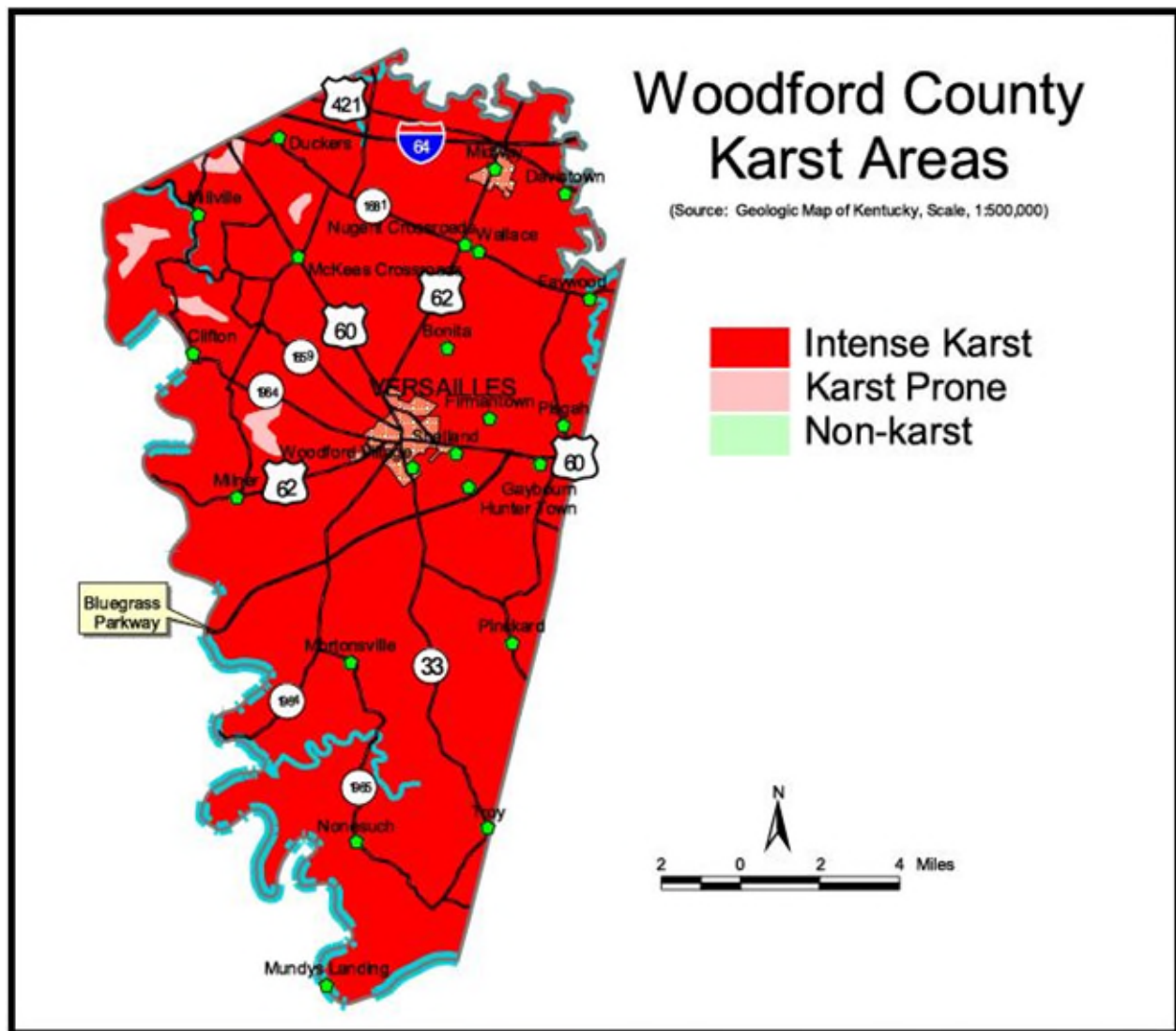


Figure 1 – Woodford County Karst Areas

The Kentucky Geological Survey (KGS) website interactive mapping program has a database of mapped geologic hazards throughout the state. These hazards include faults, landslides, and sinkholes. Figure 1 above shows the regional risk for sinkhole development in Woodford County. The Kentucky Geological Survey map assigns an "Intense Karst" (high risk) for the project area. Figure No. 2 below is an excerpt from the KGS website and shows mapped sinkholes in the project area outlined in red.



Figure 2- Mapped Sinkholes Outlined in Red (source: Kentucky Geological Survey)

Our services included performing Electrical Resistivity Tomography (ERT) at the project site to help identify Karst features prior to performing the soil test borings and rock coring. The initial boring locations were selected by the architect. Following completion of the ERT, nine of the boring locations were adjusted to allow for further exploration of anomalies identified by the ERT program. The ERT exploration and findings are summarized in the following sections with graphical results included in Appendix II. For more detailed descriptions of the data obtained from our borings, please refer to our Test Boring Records in Appendix II and the Laboratory Test Data in Appendix III.

4.0 EXPLORATION METHODS

The procedures used by S&ME for field and laboratory sampling and testing are in general accordance with ASTM procedures and established engineering practice. Appendix II contains brief descriptions of the procedures used in this exploration.



4.1 Field Exploration

A total of 66 soil test borings (labeled B-1 through B-66) were performed for this project. Mr. Andrew Fiehler, PE, and Mr. Jason Haydu, GIT from S&ME were on-site during drilling to observe pertinent surface and site features indicative of the site geology and to direct the drilling operations. Prior to drilling, the boring locations were staked and ground surface elevations were measured by an S&ME surveyor using survey grade GPS.

The borings were drilled by a track-mounted Diedrich D-50 drill rig using 4-1/4 inch O.D. solid flight augers. Soil samples were obtained using a split-barrel sampler driven by an automatic hammer system in general accordance with ASTM D1586. We also obtained relatively undisturbed (Shelby) tube samples of the soil using direct push methods. Bulk samples of auger cuttings from the planned cut portions of the site were obtained for laboratory testing. Rock coring was performed in six of our borings in general accordance with ASTM D2113. The stratification lines shown on the boring record represent the approximate boundaries between soil and rock types. The transitions may be more gradual than shown. A general description of our field procedures, a test boring record legend and Test Boring Records are provided in Appendix II of this report. Also included in Appendix II is a summary of the weathered bedrock and auger refusal depths and elevations for the borings.

4.2 Laboratory Testing

Following retrieval, the recovered soil samples were placed in plastic storage bags. The recovered samples were returned to our laboratory where applicable laboratory tests were performed to assess the engineering properties of the soil. The soil samples were visually classified by our engineer and geologist according to the Unified Soil Classification System in accordance with ASTM D2487. S&ME conducted natural moisture content determinations and Atterberg limits tests on selected samples to aid in classification. We performed unconfined compressive strength testing of representative undisturbed soil and rock core samples.

We also performed standard Proctor and a California Bearing Ratio (CBR) test of the bulk samples of auger cuttings from borings in the planned cut portions of the site. A one-dimensional consolidation test was also performed of a remolded sample of the fat clay at 95 percent of the maximum dry density. The tested sample was selected due to the prevalence of fat clay, particularly in the cut portion of the site. A summary of laboratory tests performed and results of the laboratory testing are included in Appendix III.

4.3 Geophysical Services

4.3.1 Geophysical Methodology, Field Services, and Data Processing

Between February 19, 2020 and February 21, 2020, S&ME completed an Electrical Resistivity Tomography (ERT) survey within the accessible portions of the requested areas to identify lateral changes in subsurface materials with emphasis on Karst features such as large voids or soil filled solution enlarged joints.

The ERT method introduces a known amount of direct current into the ground and measures the corresponding response in order to identify variations in subsurface electrical potentials. By introducing a known amount of current into the ground, the measured voltage potential at the surface is used to calculate the resistivity of subsurface material. In general, clayey and moist soils result in lower resistivity (higher conductivity) readings, while dry sands, gravels, chert, and limestone/dolomite exhibit higher resistivity values (lower conductivity). The resistivity of materials also partially depends on the substance filling its pore or void space. If a cavity or fracture is



air-filled, a highly resistive anomaly within the limestone unit is expected. If it is water- or clay-filled, an anomaly more conductive than the surrounding limestone unit is expected. Natural variations in porosity and grain size distribution can also cause such anomalies.

An ERT survey typically uses a series of stainless-steel electrodes that are inserted into the ground along a linear array and attached to data cables, which are connected to a transmitter/recording instrument (resistivity meter). The resistivity meter generates an induced current at two of the electrodes (current electrodes) and then measurements are acquired from the voltage potential difference between two other electrodes (potential electrodes). Material included between the potential electrodes is essentially averaged so the depth and resolution of the measurements is dependent upon the distance between these electrodes. Therefore, limitations of this method exist depending on the necessary resolution of data acquisition versus the depth of a target/feature. It is important to also note that actual ground resistivity is not collected during a resistivity survey. The survey is used to collect the apparent resistivity of a volume of material. Actual resistivities are later determined through a data inversion process. In addition, ERT data is collected using various array configurations set up in the software (Dipole-Dipole, Wenner, etc.), which is stored in the resistivity meter for later processing and analysis. Array considerations are dependent on the objectives of the survey (e.g., soil and bedrock profiling, Karst exploration, etc.).

We used an Advanced Geosciences, Inc. (AGI) SuperSting™ R8/IP resistivity system configured with 56 electrodes in general accordance with ASTM D6431 *"Using DC Resistivity for Subsurface Investigations"*. A total six (6) ERT profiles were collected (Lines ERT-1 through ERT-6); however, site constraints such as thick vegetation required line segmentation which were designated as A and B (Figures A and B in Appendix I). The Dipole-Dipole array configuration was used and electrodes were spaced at 10 feet. ERT data was processed using AGI's EarthImager 2D software and Golden Software's Surfer® was used to grid and plot the data. Elevations used for our models were derived from provided CAD files rather than actual field survey measurements performed by S&ME, and as such, should be considered approximate.

4.3.2 *Geophysical Results*

The following summarizes the results of the geophysical survey performed at the site:

- The ERT results presented in Figures C and D in Appendix I indicate a varying resistivity contrast across the surveyed area that generally range from approximately 10 ohmmeters (ohm-m) to 10,000 ohm-m.
- Presented depths of the ERT profiles are a function of the inversion process and generally about 30 to 80 feet below ground surface (bgs).
- Based on adjacent geotechnical borings, the ERT data profiles generally exhibit two (2) interpreted layers (Layers 1 and 2).
- Layer 1 consists of both relatively conductive and resistive materials ranging from about 10 to 2,000 ohm-m that appear to be primarily related to residual Fat Clay (CH) with the upper more resistive values likely related to Lean Clay (CL). The variations in resistance of the soil layers is due to the varying moisture contents of the different soil types.
- Layer 2 generally consists of resistive material greater than about 100 ohm-m that are related to the underlying bedrock.
- Approximate locations of adjacent geotechnical borings and an interpreted top of bedrock are presented on the ERT profiles.
- Two types of anomalous features were interpreted in the ERT data sets (Type I and Type II anomalies).



- Type I anomalies are associated with relatively conductive zones within the underlying bedrock (less than about 1,000 ohm-m) that are also typically characterized by slight topographic lows along the interpreted bedrock surface, which suggests these areas may be related to solutioning within the upper portions of the bedrock.
- Type II anomalies are characterized by anomalous zones greater than about 5,000 ohm-m. Air has an infinite resistivity due to the inability to hold a charge, and as such, Type II anomalies may be related to areas of air-filled cavities within the bedrock. However, Type II anomalies identified in the data sets are not necessarily diagnostic regarding size of the potential feature as significant contrasts in values are typically exaggerated, and as such, relative sizes in the figures should be considered larger than the actual conditions. Chert and calcite nodules or beds have higher resistances than limestone and can appear as anomalies within otherwise intact bedrock. Our soil test borings and rock cores observed chert and calcite within the soil and recovered rock core samples. The mapped geology also notes chert and calcite to be present within the formation.
- Interpreted Type I and Type II anomalies are highlighted on the ERT profiles in Figures C and D and presented on the location plan in Figure B in Appendix I.
- Soil test borings, some with rock core, advanced at the identified anomalies did not encounter voids or other significant Karst features. Other Karst features, such as a soil filled solution widened joints, may be present in the noted areas; however, our borings did not encounter these relatively small features.

4.3.3 *Geophysical Methodology Limitations*

Regardless of the thoroughness of a geophysical survey, there is always a possibility that actual conditions may not match the interpretations. The results should be considered accurate only to the degree implied by the methods used and the method's limitations and data coverage. Accordingly, the possibility exists that not all features at a project site will be located due to either subsurface soil conditions or the occurrence of features outside the lateral limits and below the depth of penetration of the methods used. As with most surface geophysical methods, resolution of the subsurface also decreases with depth. As such, the size and/or contrast of geologic layers and/or features compared to the imaged subsurface media must be significant enough to produce the anticipated response.

The geophysical method used for this survey also has inherent limitations. Site metallic features (e.g., buried utilities, etc.) and overhead transmission lines can produce excessive noise and/or false responses in ERT data. Depth of exploration for an ERT survey is also limited by the allowable length of the collected data profile. Limiting factors due to site constraints such as property boundaries, surficial obstructions, heavy vegetation, exposed bedrock, etc. can reduce profile lengths. In general, depth is about 20-30% of the line length.

5.0 SUBSURFACE CONDITIONS

Our borings encountered from one to 11 inches of topsoil with an average topsoil thickness of about 5 ½ inches. Two borings, B-42 and B-56, did not encounter topsoil; however, these borings were located in construction driveway areas where the topsoil was likely removed by previous grading activities.

Beneath the topsoil our borings encountered low plasticity (lean) clay (CL) overlying high plasticity (fat) clay (CH) overlying a layer of weathered limestone bedrock.



The Lean Clay horizon, where present, varied in thickness from about one to five feet though the Lean Clay. Some areas of the site appear to have been cut to the current grades and portions of the Lean Clay horizon appear to have been removed. The Lean Clay averaged about 2 ½ feet thick when present. Atterberg Limits testing of the Lean Clay indicated Liquid Limits (LL) ranging from 46 to 48 percent with Plasticity Indices (PI) ranging from 24 to 26 percent. Natural moisture contents of the Lean Clay ranged from about 23 to 29 percent.

The Fat Clay horizon varied in thickness from about one to five feet thick with an average thickness of about 2 ½ feet thick. Natural moisture contents of the Fat Clay ranged from about 28 to 35 percent. Atterberg Limits tests on the Fat Clay (CH) indicated LL ranging from 57 to 66 percent with PI ranging from 30 to 39 percent.

Beneath the fat clay our borings encountered weathered limestone bedrock overlying the auger refusal materials which we interpret as intact bedrock. At our boring locations, the weathered bedrock horizon was observed to be up to 1.1 feet thick with an average thickness of about 5 inches. Weathered bedrock was observed in 46 of the 66 borings. Beneath the weathered bedrock our borings encountered limestone as described in the Geology section above (Section 3). Two representative rock core samples were subjected to unconfined compressive strength testing which indicated unconfined compressive strengths of 7,054 psi and 9,695 psi.

Our borings were dry upon soil augering. Seasonal and periodic variations in precipitation can affect the observed water level conditions. Perched water is often encountered near the soil/bedrock transition and should not be considered the static groundwater table which is encountered at much greater depths in central Kentucky.

Detailed Test Boring Records and a Test Boring Summary are included in Appendix II which include specific measurements from the individual soil test borings as well as a Boring Summary with the noted soil and bedrock depths and elevations.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General Discussion

The following recommendations are based upon a planned finished floor elevation (FFE) of 892 feet and the provided site grading. The shallow bedrock elevation relative to the planned site grading is the major challenge to developing the project site.

The geophysical exploration identified several anomalies within the bedrock. Our experience in the region suggests that the most likely Karst related feature will be soil filled, solution widened joints in the bedrock. With the planned site grading and development, we expect such features to be readily identifiable and treatable if encountered.

6.1.1 Karst Potential

As discussed above, the project site is located in a region of "intense" Karst activity. Our ERT identified several anomalies; however, when explored with our soil test borings we did not observe significant features such as open voids or caves. There exists a potential for Karst features between our ERT and borings that we did not identify. In our opinion, the most likely Karst features at the project site are variable top of rock surface profile and soil filled solutioned enlarged joints. Large caves and/or latent sinkholes were not identified in either our borings or in the



ERT survey. Both the soil filled joints and erratic bedrock surface will likely have some affect during foundation construction. Anticipate encountering soil filled joints in the bedrock that could be one to four feet wide. These will have to be cleaned out and backfilled with either flowable fill or lean concrete or have a design detail for the foundation to span the feature. Usually the soil is removed until the joint narrows.

The erratic rock profile will create areas where the top of rock surface is below the foundation bearing elevation. Where that occurs the foundation should extend down to the bedrock surface or backfilled to re-establish the foundation bearing elevation. The project budget should include a contingency for these two scenarios.

6.1.2 Shallow Bedrock and Bedrock Excavation

Weathered bedrock and bedrock are relatively shallow at the site. Expect that utility excavations and site grading in areas of cut greater than about 2 to 4 feet will encounter bedrock. We anticipate that the highly weathered bedrock can be excavated with conventional excavation equipment; however, isolated layers or deeper excavations may require hoe-ramming or other hard rock removal methods. For example, borings B-15, B-16, B-26 and B-29 all have auger refusal (bedrock) above the planned foundation bearing elevation of 888 feet.

The design team is planning to over-excavate the bedrock in the building footprint to a depth of four feet below the planned finished floor elevation (FFE = 892 ft / Cut = 888 ft) and backfill to the plan subgrade with compacted structural fill.

6.1.3 Moderate to High Plasticity Clay

Atterberg limits testing performed during this exploration identified high plasticity (fat) clay (CH). Soils with plasticity indices greater than 30 percent have proven a tendency to shrink or swell with changes in moisture content. Lightly loaded structural elements such as slabs-on-grade, sidewalks, pavement areas and non-load bearing walls are most susceptible to damage from shrinking and swelling soils. Additionally, the high plasticity clay at this site will lose strength and will pump and rut when exposed to water and repeated construction traffic. If this occurs, expect that the soft, wet clay will require removal and replacement with specified fill or crushed stone prior to proceeding with construction in these areas.

6.1.4 Structurally Significant Settlement

The proposed high school building foundations will be supported by bedrock so settlement of the structure is expected to be within structural tolerances of 1-inch of total settlement and ½-inch of differential settlement.

However, the current site grading plans indicate about 14 feet of fill is planned on the northern end of the track. Soil fills of greater than 10 feet in height tend to exhibit self-weight consolidation over time which could result in the track and field event areas settling beyond the KHSAA tolerances. There are multiple approaches that can be used to control the potential settlement including surcharging or pre-loading the deep fill areas and using shot-rock to reduce the magnitude and rate of potential settlement of the fill.

Additional discussion for the fill and recommendations to help control the long-term settlement of the fill are included in the following sections.



6.1.5 *Existing Utilities*

There is an existing sanitary force main that crosses the new high school footprint. We understand that the sewer line will be relocated as part of the site development. During relocation of the piping, the pipe trench excavation beneath new pavement or the building footprint should be backfilled with structural fill as outlined in Section 6.3 below.

The utility company also noted a water main on the east-northeast portion of the site; however, the main appears to be outside of the development area.

6.2 **Site Preparation**

The vegetation, topsoil, tree stumps, underground utilities and other debris should be removed from the proposed construction areas. Topsoil can be stockpiled for use in lawn/greenspace areas. We recommend that entire rootball from any trees be removed. The resulting holes from rootballs should be backfilled with compacted structural fill if it is required to reach subgrade elevation.

During our site work we observed two stockpiles of material along the western side of the site that appeared to have been placed during construction of an adjacent apartment complex. The smaller northern stockpile appeared to be topsoil. The larger southern stockpile appeared to be a mixture of clay with limestone pieces that we would classify as a soil/shot-rock mix. Discussions on use of these two material types are included in the following sections.

As mentioned, the building footprint is to be over-excavated to an elevation of 888 feet and backfilled with compacted structural fill. We understand that the design team would prefer to use either soil or Dense Graded Aggregate (DGA) for the building footprint backfill. The upper three feet of the floor slab subgrade, soil backfill should consist of material with a Plasticity Index (PI) of 30 percent or less. The upper horizon of soil across the site classified as Lean Clay with a PI of less than 30 percent. DGA meets this plasticity requirement. It is possible to set up a portable on-site crusher to create DGA using excavated bedrock from the site; however, the economics of doing so with portable equipment may not be feasible. Crushed on-site limestone should be tested to determine the gradation for its use on-site. Where fat clay is present within three (3) feet of the building pad subgrade elevation, we recommend undercutting and replacing with lean clay. Fat clay can be used as structural fill in deeper fill areas. If suspect soils are observed during site grading, additional Atterberg Limits testing should be performed. Atterberg Limits testing is needed during construction to confirm the upper three feet of backfill has a PI of less than 30.

Once the initial site preparation is complete, an S&ME engineer should be retained to visit the site and assess the exposed grade before fill is placed. Observed soft areas should be remediated at the S&ME engineer's discretion before moving on to subsequent tasks. The exposed bedrock surface should also be observed for discontinuities that could affect construction. Remediation of such discontinuities will likely be more readily performed prior to backfilling the site.

It is important an S&ME representative observes site stripping to assess that adequate (but not excessive) material has been stripped. Previously unexplored or unknown conditions could become evident during these operations. Weak, organic, or fat clay soils within three feet of the building footprint subgrade should be removed and replaced with acceptable structural fill. S&ME must judge whether the recommendations in this report should be modified in view of the conditions encountered.



Once the initial site stripping has occurred, we recommend a proofroll the soil subgrade of the at-grade areas and areas to receive structural fill. Proofrolling consists of observing a loaded dump truck or scraper traffic over the planned fill area. Proofrolling of the exposed bedrock is not necessary; however, the bedrock surface should be observed for loose rock pieces or soil filled solution widened joints prior to placing soil fill. Proofrolled areas observed to exhibit excessive rutting and/or deflection should be remediated at the engineer's direction. Areas where planned construction bears at or near the existing site grades may require stabilizing prior to beginning construction. Either undercutting and backfilling with structural fill or aerating/drying and re-compaction of the soil will likely be required.

Rock Removal

Expect that rock excavation below the weathered bedrock horizon will require hard rock removal methods such as trenching, blasting or hoe ramming. To assist the contractor in determining the appropriate rock removal method, selection of bits or teeth, and the ease or difficulty of rock excavation, S&ME performed unconfined compressive strength tests on selected samples of the recovered limestone. Please reference the previous Laboratory Data Summary in Appendix III of this report for a summary of the determined unconfined compressive strengths. S&ME offers the following considerations for trenching and blasting:

Trenching:

A combination of heavy-duty rock trenching equipment and hoe-ramming may be used to perform the required mass rock excavation or utility installation for this project. If the contractor chooses to perform mass rock removal by trenching, the following items should be considered:

- ◆ Trenching will not require a comprehensive pre-blast survey to be conducted on all structures that have the potential to be impacted by blasting operations.
- ◆ Trenching will reduce the ground vibrations compared to blasting
- ◆ Trenching will offer more control over rock excavation but will extend over a longer period of time.
- ◆ Dust control measures will need to be implemented during trenching operations.

Blasting:

If the contractor chooses to perform mass rock removal by blasting, the following items should be considered:

- ◆ Seismographs should be set up by the blasting contractor to record peak particle velocities.
- ◆ The blasting plan should include the use of blasting mats and dust and air blast control measures.
- ◆ Typically, blasting contractors will overshoot the rock to depths below the required elevations. Remove any disturbed or heaved rock resulting from blasting operations to expose the underlying intact bedrock. "Heave rock" is not adequate for supporting the proposed building and pavement areas.

Rock Evaluation

Once the mass excavation has been performed, we recommend that any exposed bedrock be evaluated by an S&ME engineer to assess the presence of solution features, and provide remediation recommendations, if required. Once the exposed bedrock is observed by an S&ME engineer, construction can continue in accordance with the recommendations presented later in this report.



6.3 Structural Fill Placement

6.3.1 Soil Fill

Structural soil fill is defined as inorganic natural soil with a maximum particle size of 3 inches and maximum dry density of at least 100 pounds per cubic foot (pcf) when tested by the standard Proctor method (ASTM D698) and a plasticity index (PI) of less than 30 percent. The lean clay (CL) satisfies the criteria for structural soil fill. Additional Proctor and Atterberg Limits testing of the proposed fill soils should be performed before and during grading operations.

Atterberg limits testing performed on the fat clay (CH) sample indicated a plasticity index range from 30 to 39 percent. High plasticity clay with a PI of 30 percent or greater should not be used within three (3) feet of the proposed subgrade level of floor slabs for structures and rigid pavement or sidewalks adjacent to the building.

Structural fill placement should occur in relatively thin (6 to 8-inch) layers and be compacted to at least 98 percent of the standard Proctor maximum dry density beneath the foundation and 95 percent of the standard Proctor maximum dry density in pavement areas. For fills greater than 10 feet in height, we recommend at least 100 percent of the standard Proctor maximum dry density below 10 feet of the planned finished grade. The moisture content of the fill should be maintained within 2 percent of the soil's optimum moisture content even though compaction may be achieved at moisture contents outside the specified range.

The upper three feet of structural fill beneath building pads and the adjacent sidewalks and pavements should consist of lean clay soils with a plasticity index less than 30 percent, KYDOT Dense Graded Aggregate (DGA) or quarry screenings, or shot-rock. Do not use fat clay with a PI of 30 percent or greater as fill within three feet of subgrade beneath the building, sidewalks, and pavements, as the expansive properties of the fat clay may result in unwanted swell and distress to lightly loaded structural elements such as sidewalks, pavements, etc.

It is imperative that, during construction, standard Proctor testing and additional Atterberg limits testing of fill soils should be performed by S&ME for compliance with the project specifications before they are used as fill material. If soils are imported to the site, we recommend the soils be tested for conformance with the project specifications before being transported to the site. Please realize laboratory conformance testing usually takes three to four business days to complete; therefore, the Contractor should plan accordingly.

In-place density testing must be performed on structural fill as a check that the recommended compaction criteria have been achieved. This allows our project engineer to evaluate the quality of the fill construction and assess that the design criteria is being achieved in the field. We further recommend these tests be performed on a full-time basis by S&ME. The testing frequency for density tests performed on a full-time basis can be determined by our personnel based on the area to be tested, the grading equipment used, and construction schedule. Tests should be performed at vertical intervals of 8-inches or less (the recommended lift thickness) as the fill is being placed.

6.3.2 Soil/Shot-Rock Mix Fill

The mass excavation will generate material that consists of both soil and rock. The mixture of soil and rock is the most problematic fill material we encounter. It is difficult to place correctly and must be placed under strict supervision in order to achieve adequate compaction. It has been our experience that a majority of building and pavement distress issues are associated with structures and pavements constructed on a soil/rock mix that was



improperly placed during construction. Our experience is that compaction problems occur when the soil/rock mix is placed using "normal rock placement procedures" (i.e. – thick lifts). If used, the soil/rock mix must be placed in strict accordance with our recommendations. We recommend the soil/shot-rock mix material not be placed beneath structures or planned structure footprints.

Placing this material using modified soil fill procedures reduces the potential for problems. If the mix contains more than 15 percent soil, it should be placed using the modified soil fill procedures described in this paragraph. For the soil/rock mix, the lift thickness should be maintained between 8 and 12 inches and the moisture content of the soil portion should be near the optimum moisture content or slightly above. The maximum particle size should be limited to 12 inches in any one dimension after compactive effort is applied. Larger rock pieces can be used if it can be demonstrated that the compaction process breaks the larger pieces into the specified dimensions. A combination of tracked equipment, heavy rubber-tired vehicles (haul trucks, scrapers, etc.), and a Caterpillar 815 or larger sheepsfoot compactor are typically adequate for placing this material. If the soil/rock mix will be overlain by soil, the soil/rock mix should be "choked" with smaller rock pieces with some rock fines content to prevent the migration of the soil into the void spaced of the soil/rock mix over time.

Approval of the lift placement and compaction will be determined by a S&ME engineer on the basis of the moisture content of the soil within the matrix, the blend of rock pieces, uniformity of the compactive effort, use of the specified equipment, and the behavior of the fill material under the compactive effort. The goal is to achieve the specified compaction of the soil while minimizing voids and promoting the breakdown of weak point-to-point contact of the rock pieces.

6.3.3 *Shot-Rock Fill*

Shot-rock fill is defined as clean, durable shot-rock that contains less than 15 percent soil content. The following criteria are recommended for shot-rock fill construction:

- ◆ The subgrade must be free of ponded water and stable prior to and during shot-rock fill placement.
- ◆ In areas where soil will be placed over shot-rock fill, the shot-rock fill should be covered with a non-woven geotextile filter fabric, in order to reduce the potential for the migration of soil into the underlying shot-rock. Structural soil fill criteria and placement recommendations are outlined above. The shot-rock fill should also contain filter fabric covered, perforated pipes (4-inch diameter) at the downhill portion of the shot-rock fill where it meets the soil, to inhibit water from building up within the shot rock fill matrix. The drainage pipe should be outfitted with a headwall at the outlet end and should drain to daylight away from the construction area. Consider the use of a channel lined ditch at the end of the headwall to reduce erosion.
- ◆ Shot-rock fill may be used up to the design subgrade elevation in pavement areas. If shot-rock fill is used, we recommend that it be "capped" with a thin (3 to 4-inch thick) layer of dense graded aggregate (DGA) (or similar) prior to constructing the pavement section. Limit the maximum particle size to 12 inches in any one dimension.
- ◆ Shot-rock should have adequate smaller rock pieces to effectively "choke" the larger rock pieces by filling the voids or open spaces. The larger rock pieces should lie flat and not overlap each other. The percentage of fines in the fill should be limited to a maximum of 15 percent by visual observation of the Geotechnical Engineer.
- ◆ Place the clean shot-rock fill in maximum 18-inch thick lifts.



- ◆ Adequate compaction of shot-rock fill normally requires six to eight passes of heavy construction equipment on the fill surface. Typically, the equipment used consists of bulldozers and dump trucks. The geotechnical engineer should evaluate the adequacy of the proposed compaction equipment and techniques. Approval of the lift placement and compaction will be determined by a S&ME engineer or geotechnician.

Monitoring of Fill Placement

In-place density testing of structural soil fill must be performed as a check that the previously recommended compaction criteria have been achieved. This allows our project engineer to monitor the quality of the fill construction and verify that his design criterion is being achieved in the field. Performance of slabs-on-grade and foundations will depend directly on the quality of the fill construction. We further recommend that these tests be performed on a full-time basis by S&ME. The testing frequency for density tests performed on a full-time basis can be determined by our personnel based on the area to be tested, the grading equipment used, and construction schedule. Tests should be performed at vertical intervals of 8-inches or less (i.e. - each lift) as the fill is being placed. We recommend that an engineering technician working under the direction of our project geotechnical engineer perform the density tests.

Monitoring of shot-rock and soil/rock mix must be done visually by an experienced geotechnician working under strict supervision by one of S&ME's senior geotechnical engineers. Placement of these materials is a blend of art and science and the experience of the equipment operator and testing personnel are crucial to achieving the desired performance from the fill. Key indicators include material type, gradation, soil percentage and moisture content, equipment used to place the material, uniformity of compactive effort, reduction of voids between rock pieces, and how the fill material reacts under the equipment. The placement criteria will vary somewhat as the material varies. For example - as the soil content increases, the lift thickness should be decreased.

6.4 Settlement Monitoring

The current grading plans will require up to 14 feet of fill in the track area. To evaluate the potential settlement of the soil fill, a bulk sample of soil from the cut portion of the site was remolded based on the standard Proctor maximum dry density of the sample. The test specimen was then subjected to a one-dimensional consolidation test. The one-dimensional consolidation testing results indicates a potential consolidation of one to two inches of consolidation under 14 feet of newly placed fill even with adequate compaction being obtained during placement.

To help control settlement to less than the required 0.1 percent deflection for the new track and field event areas, we recommend that the fill soils be placed and monitored to allow the consolidation to occur prior to construction of the track and field event areas. Approximately 95 percent of the estimated consolidation must occur to maintain the KHSAA tolerances. Our analyses indicates between 60 to 90 days will be required to allow a sufficient percentage of consolidation to occur. The estimated 60 to 90 days is based on the fill being placed in a relatively short time frame of one to two weeks. If fill placement occurs over a longer time frame, then lesser amounts of consolidation will likely be observed in the monuments.

Pre-loading or surcharging of the deep fill areas can also help expedite the consolidation. However, there is an increased cost to surcharging a fill as the surcharge material must be handled multiple times. Once the final composition of the fill is determined, and whether or not surcharging is to be performed, we can refine our estimate of the magnitude and duration of settlement and the associated monitoring period.



Monitoring of the consolidation is recommended to verify that adequate consolidation has occurred prior to beginning track and event area construction. To monitor the actual magnitude and rate of consolidation we recommend installing a series of surface monuments immediately after fill construction is complete. The monuments should be placed on the outside limits of the track in the deeper portions of the fill. We recommend at least five monuments be installed.

Each surface monument should be constructed by excavating a minimum 4-inch diameter hole four feet into the ground, filling it with concrete to the surface, and embedding a 4-foot long piece of #4 or #5 reinforcing steel into the center so that about an inch of the reinforcing steel protrudes from the concrete. After monitoring is completed, the monitoring points can be removed or cut off below grade.

Establish the elevation of the top of each surface monument (i.e. reinforcing steel) after the concrete has set. Use a stable benchmark and record the elevation on a weekly basis. Retain S&ME to evaluate the surface monument readings so we can let the Contractor know when construction can begin. Monitoring should be performed on a weekly basis until sufficient consolidation has occurred. Elevation measurements should be made using differential leveling techniques relative to benchmarks set outside of the fill area.

Pre-loading or surcharging of the track area soils can expedite the consolidation of the soils. If surcharging of the track area is performed, we recommend the surcharge fill be placed in the filled portion of the track, plus a buffer of 10 feet outside the limits of the track. The thickness of the surcharge material is a balance of the cost of placing/removing the surcharge soil and the project schedule. A thicker surcharge can increase the rate of consolidation; however, it will be more expensive to place and remove. After the settlement measurements indicate the desired consolidation has occurred, the surcharge soil can be removed and used as soil fill elsewhere on the site.

Use of shot-rock as fill beneath the track will also help expedite consolidation of the soils as it will provide a means of additional drainage.

6.5 Foundation Recommendations

S&ME recommends the foundations for the new building bear on weathered bedrock or bedrock. We recommend the use of an allowable bearing pressure to **20,000 psf** (pounds per square foot) to size the foundations. Note that portions of the foundations will require over-excavation to expose bedrock. Our borings indicate that up to five feet of over-excavation is anticipated in the western end of the building (near boring B-5) and four feet in the northern corner of the building (near boring B-27). Where over-excavation is required, lean concrete can be used to re-establish the foundation bearing elevation after the bedrock surface has been observed.

To evaluate the bedrock beneath the foundations, we recommend that 2-inch diameter probe holes be drilled to assess the continuity of the underlying bedrock. We recommend at least one probe hole be drilled every 25 feet along continuous footings. Additionally, at least one probe hole may be requested for each column footing. Two or more probe holes may be required, at the discretion of the engineer, when the footing sizes exceed 25 square feet. We recommend that the project budget contain a unit price contingency for additional probe hole drilling if additional probe holes are required based on encountered subsurface conditions.

The probe holes should be drilled to a depth of 5 feet into the bedrock-bearing material for all spread footing foundations. These probe holes are usually drilled with a pneumatic percussion drill. The engineering technician



should check the probe hole using a hooked-end steel feeler rod to assess the bedrock continuity. If this check indicates a discontinuous or compressible seam in the bedrock, the foundation should be excavated deeper. Additional probe holes may be required by the Geotechnical Engineer to check foundations supported on marginal material.

Since the foundations will bear on bedrock, the frost depth requirement will not apply. We recommend all foundations have a minimum footing width of 24 inches to allow for hand cleaning of footing subgrades disturbed by the excavation process and the placement of reinforcing steel. The reinforcing steel should be clean and dry prior to concrete placement.

6.6 Seismic Site Classification

The current seismic design procedures outlined in the NEHRP (National Earthquake Hazard Reduction Program) guidelines mandate structural design loads to be based on the seismic coefficients of the site. Based on the results of our exploration and the geology of the area, we recommend a site seismic classification of "B" for this project site. This classification is further defined in the Building Code.

6.7 Floor Slab Recommendations

The planned building will have a first floor FFE of 892 feet MSL. Based on the observed surface elevations and planned site development, the floor slab will be supported on newly placed and compacted fill. We recommend the upper three feet of the building pad subgrade consist of low plasticity fill with a plasticity index (PI) of less than 30 percent, Dense Graded Aggregate (DGA), or quarry screenings.

We recommend that control joints be placed in the slab around columns and along footing supported walls to reduce cracking due to minor differential settlements. We recommend that ACI 302.1R-96 "GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION" be followed for design and placement of concrete floor slabs, see attached form in Appendix IV to this report.

Between completion of grading and slab construction, floor slab subgrades are often disturbed by weather, footing and utility line installation, and other construction activities. For this reason, the subgrade should be evaluated by an S&ME engineer immediately prior to constructing the slab.

6.8 Pavement Recommendations

In order for the pavement to perform satisfactorily, the subgrade soils must have sufficient strength and be stable enough to avoid deterioration from construction traffic and support the paving equipment. In addition, the completed pavement section must resist freeze/thaw cycles and wheel loads from traffic. Generally, construction traffic loading is more severe than the traffic after construction.

We understand that a significant volume of bedrock excavation is anticipated to grade the site. Placing shot-rock fill beneath pavement areas will improve the subgrade strength allowing for a thinner pavement section while still providing sufficient strength to support the anticipated traffic. We understand that at least one-foot of shot rock will be placed beneath the pavement areas of the site. The recommended pavement section given below is based on the assumption that the newly placed shot-rock is placed and compacted as described above.



Minimizing infiltration of water into the subgrade and rapid removal of subsurface water are essential for the successful long-term performance of the pavement. Both the subgrade and the pavement surface should have a minimum slope of one-quarter inch per foot to promote surface drainage. Edges of the pavement should provide a means of water outlet by extending the aggregate base course through to side ditches. Side ditches should be at least 2 feet below the pavement surface. The soil subgrade beneath the shot-rock should grade to drain away from the pavement areas. Storm sewers or other utilities that are bedded in open graded crushed stone will aid in draining the shot-rock. Adding perforated drain piping to areas where storm sewers are not nearby should be considered.

The pavement materials should conform and be placed and compacted in accordance with the applicable sections of the Kentucky Transportation Cabinet (KTC) Standard Specifications for Road and Bridge Construction, latest edition. We used the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993) as a basis for our flexible pavement thickness analysis. The total pavement thickness requirement is a function of the CBR. While the laboratory testing indicated a CBR value of 5.3 percent, we used a CBR of 5 percent for our calculations, based on our experience of similar soils in the vicinity of the project site.

Anticipated traffic data was not available at the time of this report. The following pavement design recommendations are based on the assumptions of a 20-year service life, a CBR value of 5 percent, a minimum of one-foot of shot-rock beneath the base stone, 10,000 ESAL's for light duty pavement (light duty parking lot) and 20,000 ESAL's for heavy duty pavement (drive lanes and drop off lanes). If actual or anticipated traffic volumes exceed the estimated ESAL value used for this design, S&ME must re-evaluate the pavement thickness recommendations. The total pavement thickness requirement is obtained from the AASHTO nomograph in terms of a structural number (SN), a weighted sum of the pavement layer thicknesses accounting for their structural and drainage properties.

S&ME recommends that the pavement section (base stone and asphalt) be placed after the majority of the new building construction has been completed. S&ME recommends that both binder and surface mix asphalt be placed sequentially before traffic is allowed on the new pavement. **S&ME recommends that the light duty pavement section be used for automobile parking only.**

The following pavement thickness design recommendations will not provide a sufficient pavement for haul roads. If construction sequencing requires that new pavement areas be constructed prior to substantial completion of the building, do not allow construction traffic on the finished pavement.

S&ME recommends the following flexible asphalt pavement sections for this project:

Table 6-1 – Flexible Pavement Bearing on Shot-Rock

Material	Light Duty	Heavy Duty	KY Transportation Cabinet Specification
Asphalt Surface Course	1-½ Inches	1-½ Inches	Section 400
Asphalt Binder Course	3 Inches	4 Inches	Section 400
Dense Graded Aggregate (DGA)	4 Inches	5 Inches	Section 303



Our pavement recommendations are based on the assumption that S&ME is retained to monitor the installation of the asphalt and base, check the installed thickness of the aggregate materials, and perform in-place density tests. Asphalt placement should be monitored full-time to observe placement and compaction procedures. Asphalt samples should be collected periodically and tested for asphalt cement content, aggregate gradation, and density.

Impervious Concrete Pavement Alternative – We recommend that in areas where heavy, concentrated loads (i.e., dumpster area, entrances, loading docks, etc.) are expected, a rigid (concrete) pavement section be used. For dumpster areas, we recommend that rigid pavement be extended beyond the dumpster pad for the entire length of the garbage truck loading area. The pavement subgrade should be stabilized in accordance with the recommendations for the asphalt paved areas, and the related recommendations in this report. We recommend that the concrete pavement be supported by at least a 6-inch layer of compacted DGA. The DGA should be compacted to a minimum of 95 percent of the standard Proctor maximum dry density. Shot-rock can be placed beneath the DGA. We recommend a minimum concrete section of 6 inches for this site. The concrete should be air-entrained and have a 28-day compressive strength of 4,500 psi. Joint spacing should be at a maximum spacing of 15 feet each way.

7.0 FOLLOW-UP SERVICES

Our services should not end with the submission of this geotechnical report. S&ME should be kept involved throughout the design and construction process to maintain continuity and to assess whether our recommendations are properly interpreted and implemented. To achieve this, we should be retained to review project plans and specifications with the designers to see that our recommendations are fully incorporated. We also should be retained to observe and test the site preparation, foundation excavation, and building construction. If we are not allowed the opportunity to continue our involvement on this project, we cannot be held responsible for the recommendations in this report.

Our familiarity with the site and with the foundation recommendations will make us a valuable part of your construction quality assurance team. In addition, a qualified engineering technician should observe and test all structural concrete and steel. Only experienced, qualified persons trained in geotechnical engineering and familiar with foundation construction should be allowed to evaluate and test foundation excavations. Normally, full-time observations and testing of the site work and foundation installation is appropriate.

8.0 LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If



conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and monitoring of earthwork and foundation construction activities.

For more information on the use and limitations of this report, please read the Geoprofessional Business Association (GBA) document that follows this page.

Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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e-mail: info@geoprofessional.org www.geoprofessional.org

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Appendix I – Site Location Plan / Boring Location Plan

Geophysical Electrical Resistivity Tomography Figures

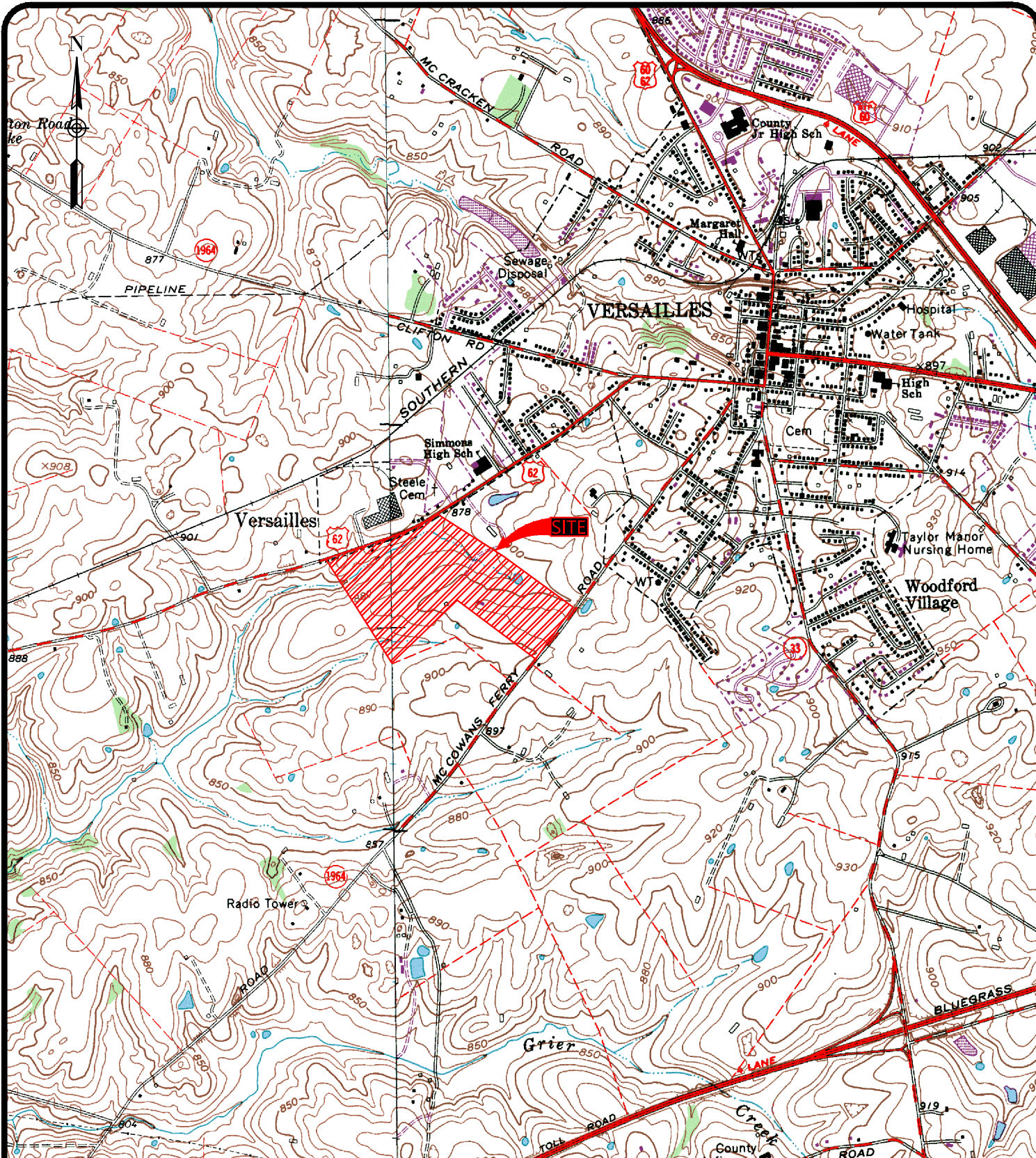
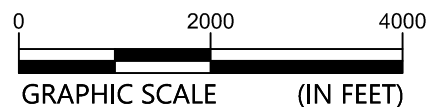


IMAGE SOURCE: USGS QUADD



VICINTIY MAP

WOODFORD COUNTY HIGH SCHOOL
SCHOOL HOUSE ROAD
VERSAILLES, KENTCUKY

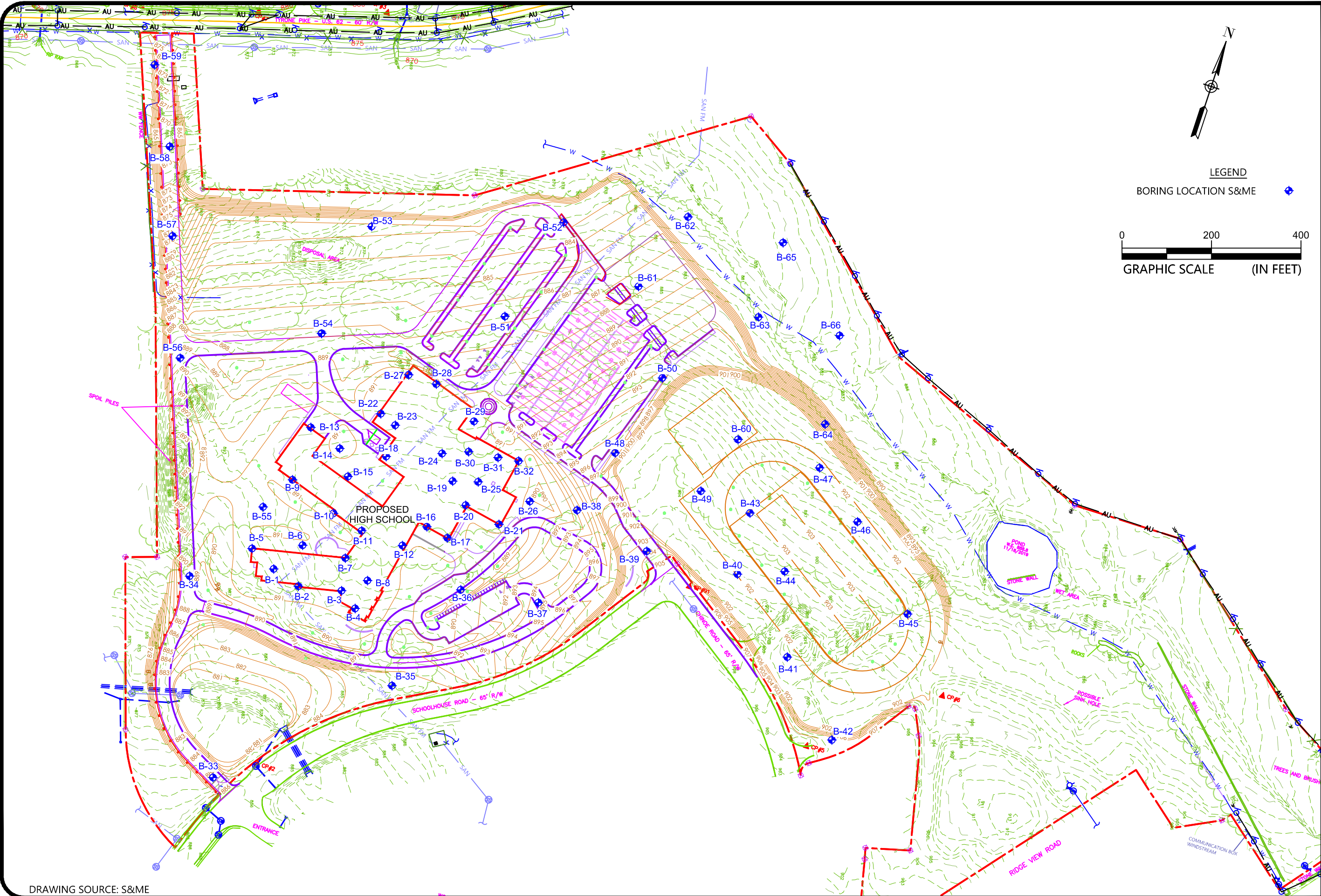
SCALE:
1IN = 2000FT
DATE:
3/16/2020
PROJECT NUMBER
1183-20-006

FIGURE NO.

1

Drawing path: I:\Projects\2020\GEO\1183-20-006 Woodford County High School\Graphics\FIGURE SHEETS.dwg

DRAWING SOURCE: S&ME



BORING LOCATION PLAN

WOODFORD COUNTY HIGH SCHOOL
SCHOOL HOUSE ROAD
VERSAILLES, KENTUCKY

SCALE:
1IN = 200FT
DATE:
5/19/2020
PROJECT NUMBER
1183-20-006
FIGURE NO.



**GEOPHYSICAL SURVEY LOCATION PLAN
WITH BORING PLAN OVERLAY**

WOODFORD COUNTY HIGH SCHOOL
VERSAILLES, KENTUCKY

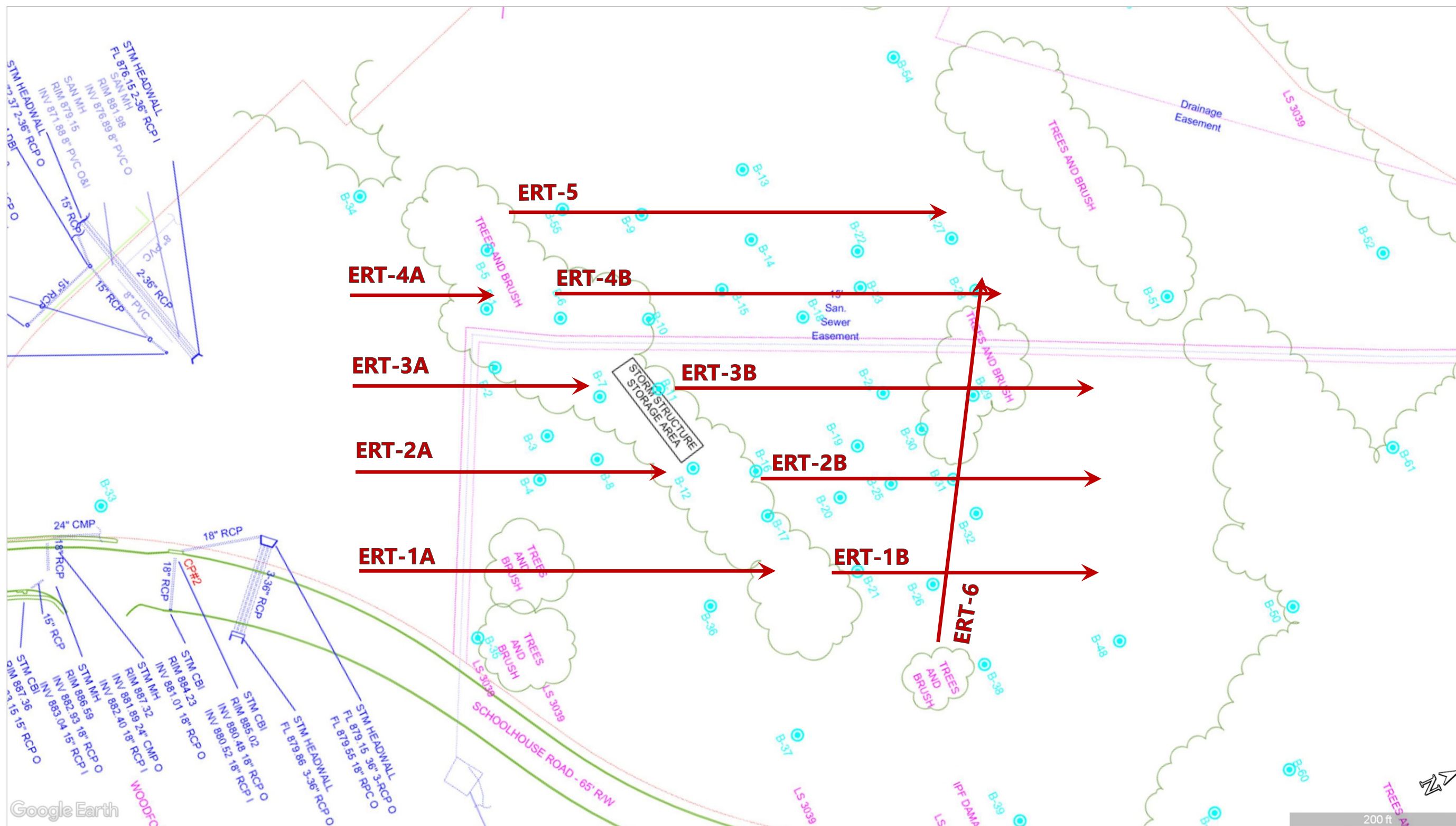
SCALE:
AS SHOWN

DATE:
5/18/2020

PROJECT NUMBER	1183-20-006
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FIGURE NO.

A



LEGEND



Approximate ERT Profile Location



REFERENCE:
GOOGLE EARTH PRO AERIAL PHOTOGRAPH
(DATED APRIL 18, 2018)

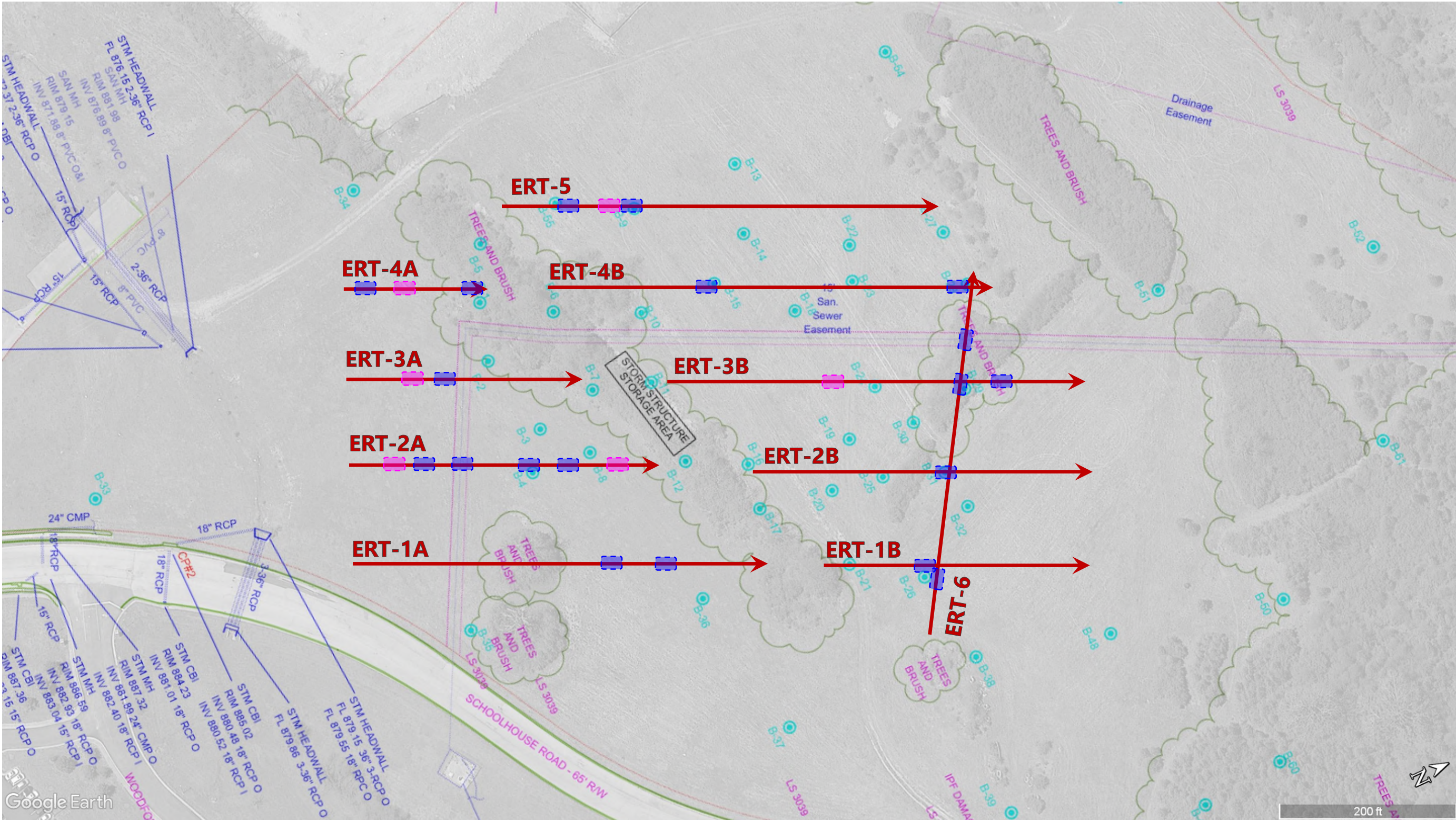


GEOPHYSICAL SURVEY ANOMALY LOCATION PLAN
WITH BORING PLAN OVERLAY (SEMI-TRANSPARENT)

WOODFORD COUNTY HIGH SCHOOL
VERSAILLES, KENTUCKY

SCALE:
AS SHOWN
DATE:
5/18/2020
PROJECT NUMBER
1183-20-006
FIGURE NO.

B



LEGEND

Approximate ERT Profile Location

Approximate Location of Type I Anomaly

Approximate Location of Type II Anomaly



GEOPHYSICAL DATA PROFILES – ERT-4 THROUGH ERT-6

WOODFORD COUNTY HIGH SCHOOL
VERSAILLES, KENTUCKY

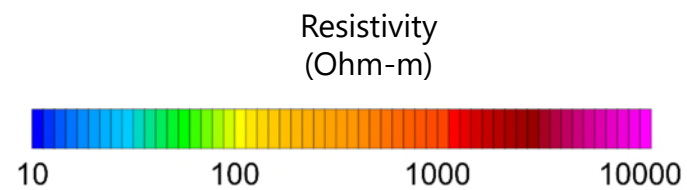
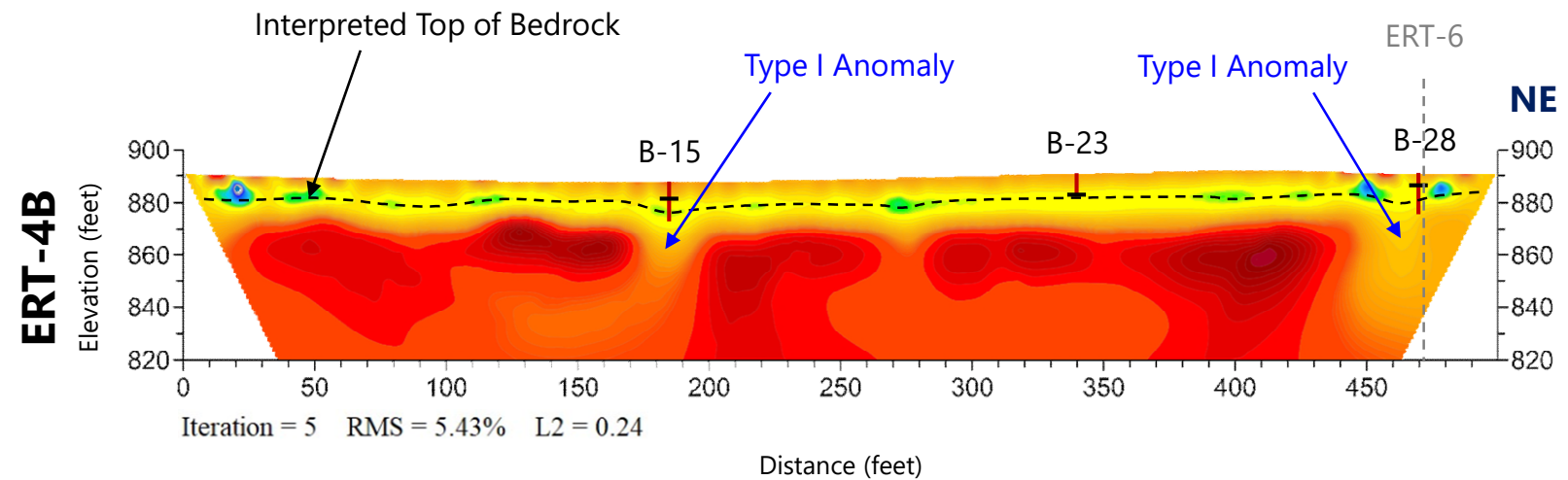
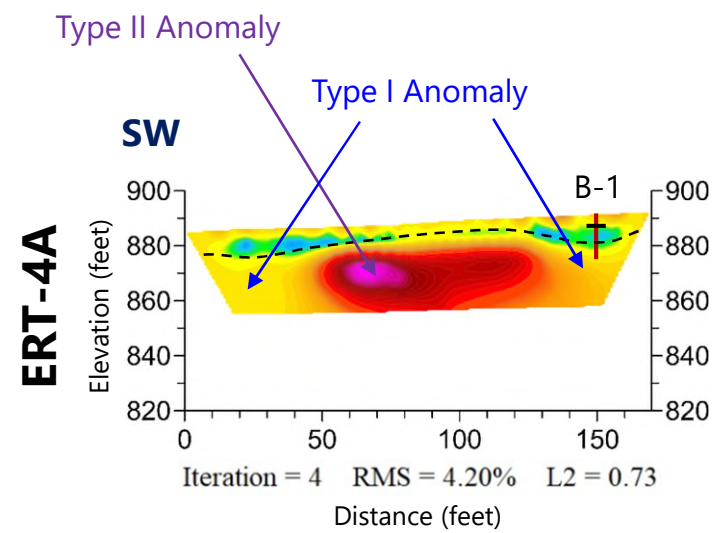
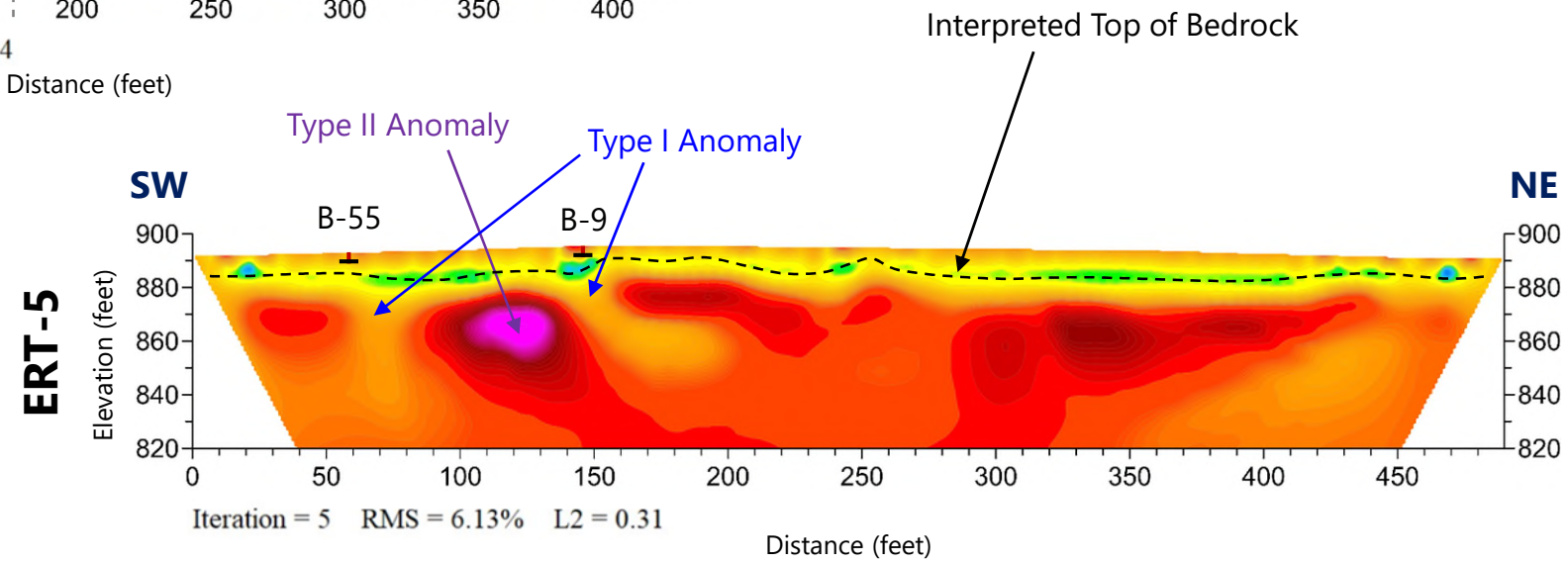
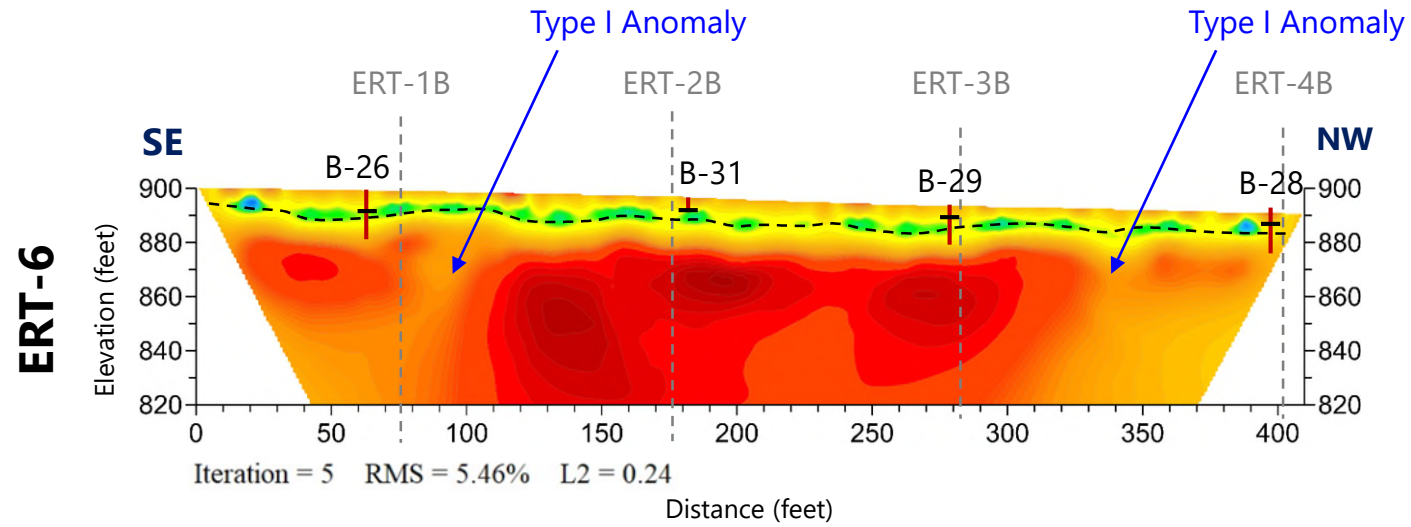
SCALE:
AS SHOWN

DATE:
5/18/2020

PROJECT NUMBER
1183-20-006

FIGURE NO.

C



Approximate Boring Location
(black hash mark indicates auger refusal)





GEOPHYSICAL DATA PROFILES – ERT-1 THROUGH ERT-3

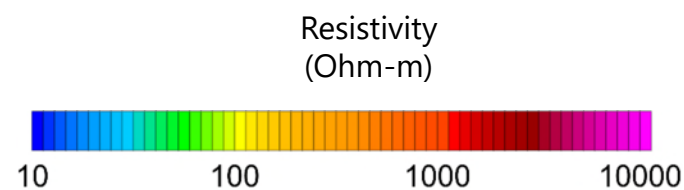
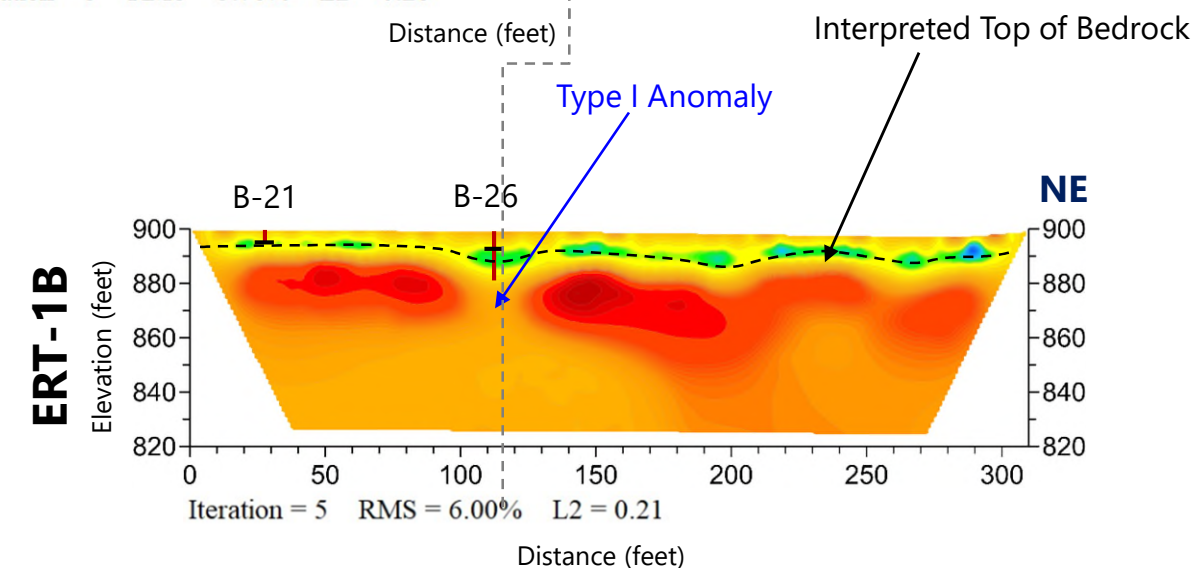
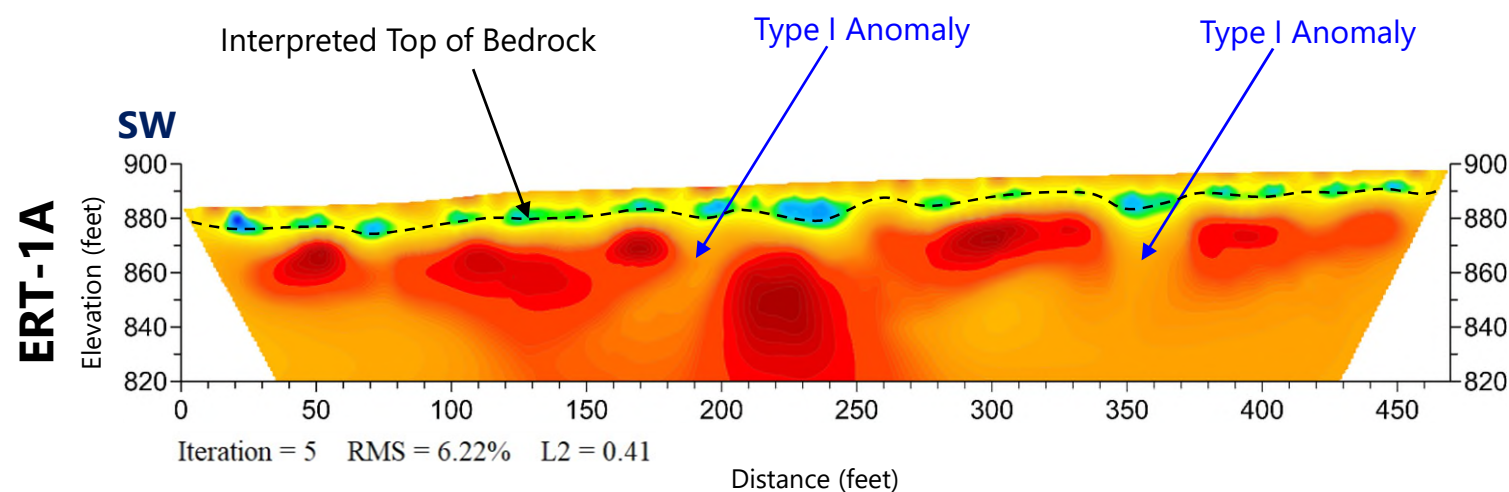
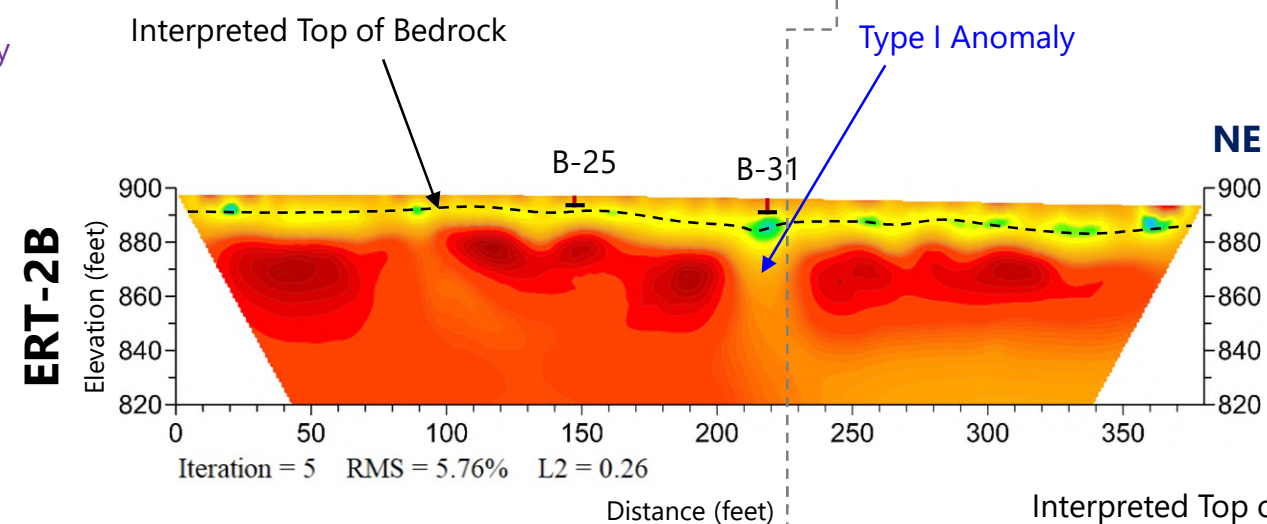
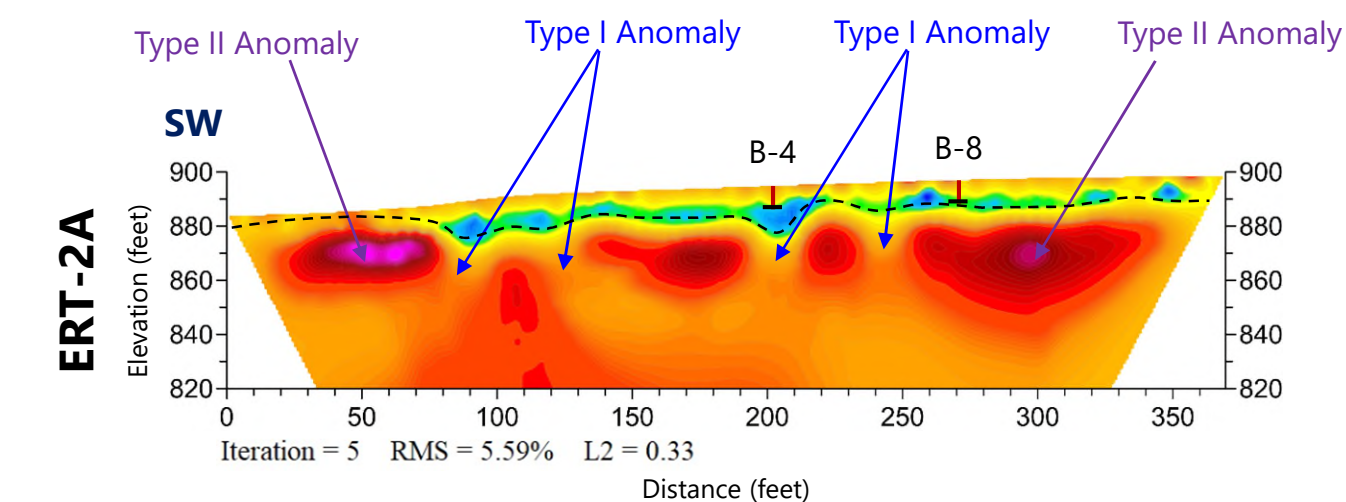
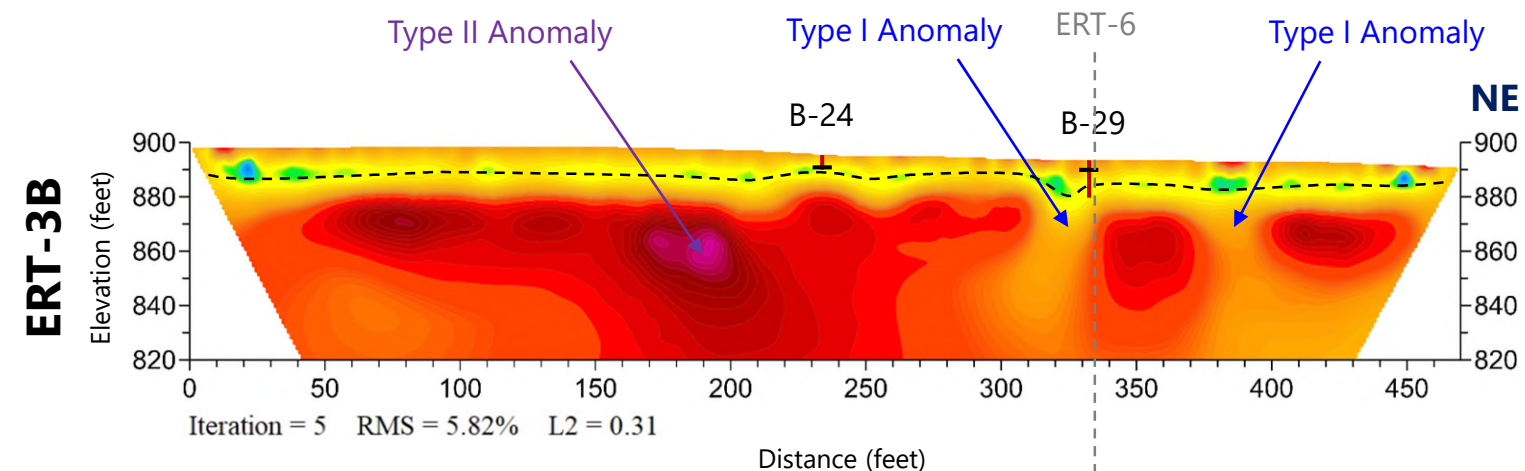
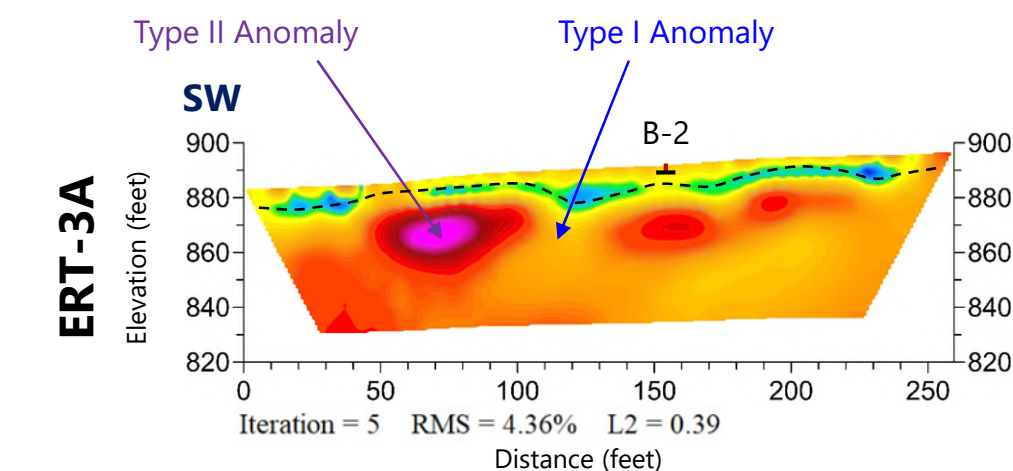
WOODFORD COUNTY HIGH SCHOOL
VERSAILLES, KENTUCKY

SCALE:
AS SHOWN

DATE:
5/18/2020
PROJECT NUMBER
1183-20-006

FIGURE NO.

D



Approximate Boring Location
(black hash mark indicates auger refusal)





Appendix II – Test Boring Records / Boring and Sounding Summary

TEST BORING RECORD LEGEND

FINE AND COARSE GRAINED SOIL INFORMATION

COARSE GRAINED SOILS (SANDS & GRAVELS)		FINE GRAINED SOILS (SILTS & CLAYS)			PARTICLE SIZE	
N	Relative Density	N	Consistency	Qu, KSF Estimated		
0-4	Very Loose	0-1	Very Soft	0-0.5	Boulders	Greater than 300 mm (12 in)
5-10	Loose	2-4	Soft	0.5-1	Cobbles	75 mm to 300 mm (3 to 12 in)
11-20	Firm	5-8	Firm	1-2	Gravel	4.74 mm to 75 mm (3/16 to 3 in)
21-30	Very Firm	9-15	Stiff	2-4	Coarse Sand	2 mm to 4.75 mm
31-50	Dense	16-30	Very Stiff	4-8	Medium Sand	0.425 mm to 2 mm
Over 50	Very Dense	Over 31	Hard	8+	Fine Sand	0.075 mm to 0.425 mm
					Silts & Clays	Less than 0.075 mm


































The **STANDARD PENETRATION TEST** as defined by ASTM D 1586 is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The blow counts required to drive the sampler the final two increments are added together and designate the N-value defined in the above tables.

ROCK PROPERTIES








ROCK QUALITY DESIGNATION (RQD)		ROCK HARDNESS	
Percent RQD	Quality		
0-25	Very Poor	Very Hard:	Rock can be broken by heavy hammer blows.
25-50	Poor	Hard:	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
50-75	Fair	Moderately Hard:	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken with light hammer blows.
75-90	Good	Soft:	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
90-100	Excellent	Very Soft:	Rock disintegrates or easily compresses when touched; can be hard to very hard soil.

Recovery =			Core Diameter		Inches
$\frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100$		63 REC	BQ		1-7/16
		NQ	NQ		1-7/8
		43 RQD	HQ		2-1/2
RQD =					
$\frac{\text{Sum of 4 in. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100$					

SYMBOLS

KEY TO MATERIAL TYPES				SOIL PROPERTY SYMBOLS	
	Topsoil		High Plasticity Inorganic Silt or Clay	N:	Standard Penetration, BPF
	Asphalt		Organic Silts/Clays	M:	Moisture Content, %
	Crushed Limestone		Well-Graded Gravel	LL:	Liquid Limit, %
	Fill Material		Poorly-Graded Gravel	PI:	Plasticity Index, %
	Shot-rock Fill		Silty Gravel	Qp:	Pocket Penetrometer Value, TSF
	Low Plasticity Inorganic Silt		Clayey Gravel	Qu:	Unconfined Compressive Strength Estimated Qu, TSF
	High Plasticity Inorganic Silt		Well-Graded Sand	γ_d :	Dry Unit Weight, PCF
	Low Plasticity Inorganic Clay		Poorly-Graded Sand	F:	Fines Content
	High Plasticity Inorganic Clay		Silty Sand		
	Low Plasticity Inorganic Silt or Clay		Clayey Sand		
	Peat		Limestone		
	Sandstone		Siltstone		
	Claystone		Weathered Rock		
	Dolomite		Granite		
	Gneiss		Schist		
	Amphibolite				
	Metagraywacke				
	Phyllite				

SAMPLING SYMBOLS

	Undisturbed Sample		No Sample Recovery
	Split-Spoon Sample		Water Level After Drilling
	Rock Core Sample		Extended Time Reading
	Auger or Bag Sample		

Woodford County High School Boring Summary

S&ME Project No. 1183-20-006

	Surface Elevation (ft)	Top of Weathered Rock Depth (ft)	Top of Weathered Rock Elevation (ft)	Auger Refusal Depth (ft)	Auger Refusal Elevation (ft)
B-1	892.4	5.0	887.4	5.2	887.2
B-2	892.9	N/E	N/E	2.1	890.8
B-3	896.2	N/E	N/E	8.7	887.5
B-4	894.9	N/E	N/E	8.2	886.7
B-5	891.6	N/E	N/E	8.5	883.1
B-6	895.5	N/E	N/E	4.5	891.0
B-7	898.7	5.4	893.3	5.8	892.9
B-8	897.5	7.1	890.4	7.9	889.6
B-9	895.7	N/E	N/E	3.8	891.9
B-10	898.2	4.0	894.2	4.1	894.1
B-11	899.3	4.1	895.2	4.7	894.6
B-12	899.6	6.7	892.9	7.4	892.2
B-13	894.4	4.6	889.8	5.2	889.2
B-14	896.4	2.9	893.5	3.4	893.0
B-15	898.2	5.1	893.1	6.1	892.1
B-16	899.7	3.0	896.7	3.2	896.5
B-17	899.7	4.8	894.9	5.1	894.6
B-18	897.3	N/E	N/E	8.3	889.0
B-19	898.2	4.1	894.1	4.2	894.0
B-20	898.5	4.1	894.4	4.2	894.3
B-21	899.8	4.1	895.7	4.2	895.6
B-22	894.1	6.5	887.6	6.7	887.4
B-23	894.5	6.1	888.4	7.3	887.2
B-24	896.5	4.3	892.2	4.4	892.1
B-25	898.2	2.4	895.8	3.1	895.1
B-26	899.5	N/E	N/E	7.2	892.3
B-27	890.5	6.1	884.4	6.8	883.7
B-28	890.8	5.2	885.6	5.3	885.5
B-29	894.0	2.6	891.4	3.0	891.0
B-30	895.8	4.0	891.8	4.2	891.6
B-31	896.5	4.0	892.5	4.1	892.4
B-32	897.6	4.2	893.4	4.4	893.2

N/E - Not Encountered

Woodford County High School Boring Summary

S&ME Project No. 1183-20-006

	Surface Elevation (ft)	Top of Weathered Rock Depth (ft)	Top of Weathered Rock Elevation (ft)	Auger Refusal Depth (ft)	Auger Refusal Elevation (ft)
B-33	882.5	6.4	876.1	7.2	875.3
B-34	885.0	N/E	N/E	8.8	876.2
B-35	888.1	N/E	N/E	3.7	884.4
B-36	896.8	4.4	892.4	4.5	892.3
B-37	899.6	4.1	895.5	5.1	894.5
B-38	901.0	8.0	893.0	8.4	892.6
B-39	904.8	6.8	898.0	8.2	896.6
B-40	905.0	3.6	901.4	4.4	900.6
B-41	911.1	N/E	N/E	8.0	903.1
B-42	906.5	N/E	N/E	0.4	906.1
B-43	900.4	7.8	892.6	8.7	891.7
B-44	902.7	5.5	897.2	6.5	896.2
B-45	897.7	2.5	895.2	2.8	894.9
B-46	895.2	4.5	890.7	4.7	890.5
B-47	891.6	4.5	887.1	4.6	887.0
B-48	899.2	5.5	893.7	5.6	893.6
B-49	902.6	9.5	893.1	9.6	893.0
B-50	895.4	N/E	N/E	6.2	889.2
B-51	887.0	4.0	883.0	4.1	882.9
B-52	879.2	6.5	872.7	6.6	872.6
B-53	876.5	N/E	N/E	12.2	864.3
B-54	886.2	3.0	883.2	3.4	882.8
B-55	893.0	4.0	889.0	4.4	888.6
B-56	886.7	N/E	N/E	1.5	885.2
B-57	871.2	5.5	865.7	5.9	865.3
B-58	862.8	N/E	N/E	3.5	859.3
B-59	871.2	2.0	869.2	3.1	868.1
B-60	896.4	7.5	888.9	7.9	888.5
B-61	884.7	N/E	N/E	8.2	876.5
B-62	878.8	N/E	N/E	4.0	874.8
B-63	882.9	N/E	N/E	3.5	879.4
B-64	887.0	N/E	N/E	3.6	883.4
B-65	879.7	2.1	877.6	2.7	877.0
B-66	881.9	2.5	879.4	2.8	879.1

N/E - Not Encountered

S&ME NEW LOGO WCHS BORING LOGS.GPJ QOR_CORP.GDT 5/22/20



TEST BORING RECORD

BORING NO: **B-2**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 892.9	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	892.8	0	Topsoil - 5 inches			6									5 - 50/5"
	892.0		Fat Clay (CH), with black oxide nodules, FIRM, reddish-brown, moist.												
	890.8		Weathered Limestone with clay seams. Auger Refusal Encountered at 2.1 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-3**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 896.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	896.2	0	Topsoil - 5 inches												
	895.8		Lean Clay (CL), VERY STIFF, light brown, moist.			18					•				7 - 9 - 8
	894.7		Fat Clay (CH), with black oxide nodules, STIFF, light brown, moist.			8					•				3 - 5 - 8
		5				14					•				4 - 6 - 7
						13					•				4 - 7 - 7
	887.5		Auger Refusal Encountered at 8.7 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-4**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 894.9		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	894.9	0	Topsoil - 6 inches							
	894.4		Lean Clay (CL), with trace rootlets, STIFF, brown, damp.			18				4 - 6 - 7
	893.9		Fat Clay (CH), with black oxide nodules at 4 feet, STIFF, reddish-brown, moist.			14				3 - 5 - 6
		5				18				4 - 4 - 7
						18				4 - 6 - 5
	886.7		Auger Refusal Encountered at 8.2 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-5**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 891.6	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			





Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	891.6 891.3	0	Topsoil - 4 inches Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18		3,267 psf							2 - 3 - 4
						18									3 - 4 - 5
						16									
	886.6	5	Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			13									5 - 6 - 7
	883.1		Auger Refusal Encountered at 8.5 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-6**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 895.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			









Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	895.5 895.1	0	Topsoil - 5 inches			18									2 - 3 - 4
			Lean Clay (CL), with black oxide nodules, with trace organics, FIRM, reddish-brown, moist.												
	893.5		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown, moist.			18									5 - 8 - 10
	891.5 891.0		Weathered Limestone.			4									50/4"
		5	Auger Refusal Encountered at 4.5 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-7**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 898.7		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
									01020304050	
	898.7	0	Topsoil - 6 inches							
	898.2		Lean Clay (CL) with black oxide nodules, FIRM, brown, moist.			18				3 - 3 - 4
	896.7		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			12				3 - 5 - 8
						7				
	893.3	5	Weathered Limestone.							
	892.9		Auger Refusal Encountered at 5.8 feet.							4 - 5 - 50/5"
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-8**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 897.5		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	897.5	0	Topsoil - 5 inches												
	897.1		Lean Clay (CL), with trace organics, STIFF, dark brown, damp.			18				•					6 - 6 - 7
	896.4		Lean Clay (CL), STIFF, dark brown, damp.			9				•					4 - 6 - 7
	893.5	5	Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			14				•					5 - 5 - 4
	890.4		Weathered Limestone.			3								•	4 - 5 - 50/1"
	889.6		Auger Refusal Encountered at 7.9 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-9**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 895.7	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	895.7 895.3	0	Topsoil - 5 inches Lean Clay (CL), STIFF, light brown, moist.			18									4 - 5 - 7
	893.7		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown.			18									6 - 9 - 10
	891.9		Auger Refusal Encountered at 3.8 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-10**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 898.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			





Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	898.2	0	Topsoil - 5 inches												
	897.8		Lean Clay (CL), with black oxide nodules, FIRM, brown.			18									2 - 2 - 5
	896.7		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown.			18									5 - 7 - 10
	894.2		Weathered Limestone.			2									50/1"
	894.1		Auger Refusal Encountered at 4.1 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-11**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.3	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.3	0	Topsoil - 5 inches												
	898.9		Lean Clay (CL), with black oxide nodules, FIRM, brown.			18				●					1 - 3 - 3
	897.3		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown.			18					●				3 - 5 - 8
						5								●	50/5"
	894.6	5	Auger Refusal Encountered at 4.7 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-12**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.6	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	899.6	0	Topsoil - 7 inches							
	899.0		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				2 - 3 - 3
						18				5 - 5 - 7
	896.6		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.							
		5				18				5 - 6 - 7
	892.9		Weathered Limestone.			5				3 - 50/2"
	892.2		Auger Refusal Encountered at 7.4 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-13**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 894.4	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	894.4	0	Topsoil - 7 inches												
	893.8		Lean Clay (CL), with oxide nodules, STIFF, reddish-brown, moist.			18									3 - 4 - 6
						13									5 - 4 - 7
	891.4		Fat Clay (CH), with oxide nodules, STIFF, reddish-brown, moist.			18		1,914 psf							
	889.8	5	Weathered Limestone.												
	889.2		Auger Refusal Encountered at 5.2 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-14**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 896.4	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	896.4	0	Topsoil - 6 inches												
	895.9		Lean Clay (CL), with black oxide nodules, STIFF, reddish-brown, moist.			18									4 - 5 - 4
	894.9		Fat Clay (CH), with black oxide nodules, STIFF, light brown, moist.			8									4 - 6 - 50/4"
	893.5		Weathered Limestone.												
	893.0		Auger Refusal Encountered at 3.4 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-15**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 898.2	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	898.2	0	Topsoil - 6 inches							
	897.7		Fat Clay (CH), FIRM, brown, moist.			18				Woh - 3 - 5
						8				3 - 6 - 7
						13				4 - 5 - 50/5"
	893.1	5	Weathered limestone.							
	892.1		Auger Refusal Encountered at 6.1 feet / Begin Coring.							
			Limestone with few thin Shale partings, gray, fossiliferous. Moderately weathered to intact, moderately hard to hard.			53/60	18	9,695 psi		
		10								
						56/60	77			
		15								
	882.1		Coring Terminated at 16.1 feet.							
		20								



TEST BORING RECORD

BORING NO: **B-16**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.7	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.7 899.3	0	Topsoil - 5 inches Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18	8								2 - 4 - 5
	896.7 896.5		Weathered Limestone. Auger Refusal Encountered at 3.2 feet / Begin Coring.												4 - 4 - 50/3"
		5	Limestone, thinly bedded, fossiliferous. Moderately weathered to intact, moderately hard to hard.			56/60	7								
		10				60/60	40								
		15				60/60	65								
	881.5		Coring Terminated at 18.2 feet.												
		20													



TEST BORING RECORD

BORING NO: **B-17**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.7	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.7 899.4	0	Topsoil - 4 inches												
			Lean Clay (CL), with black oxide nodules, FIRM, dark brown, damp.			18									3 - 2 - 3
	898.2		Fat Clay (CH), STIFF, reddish-brown, moist.			18									5 - 6 - 6
	894.9 894.6	5	Weathered Limestone.			9									9 - 13 - 50/5"
			Auger Refusal Encountered at 5.1 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-18**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 897.3	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			




Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	897.3	0	Topsoil - 5 inches												
	896.9		Lean Clay (CL), FIRM, dark brown, damp.			18				•					2 - 3 - 3
						18				•					2 - 2 - 4
	892.8	5	Fat Clay (CH), STIFF, reddish-brown, moist.			18					•				5 - 7 - 8
						10					•				4 - 7 - 8
	889.0		Auger Refusal Encountered at 8.3 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-19**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 898.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	898.2 897.9	0	Topsoil - 4 inches Lean Clay (CL), FIRM, dark brown, moist.			18									3 - 3 - 5
	896.2		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			13									4 - 5 - 5
	894.1 894.0	5	Weathered Limestone. Auger Refusal Encountered at 4.2 feet.			0									50/1"
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-20**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 898.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	898.5	0	Topsoil - 1 inches			18									2 - 3 - 5
	896.5		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.												
			Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			13									5 - 5 - 5
	894.4		Weathered Limestone.			0									50/1"
	894.3	5	Auger Refusal Encountered at 4.2 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-21**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.8	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			











Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.8 899.5	0	Topsoil - 4 inches Lean Clay (CL), with black oxide nodules, FIRM, dark brown, damp.			19									3 - 3 - 4
	897.8		Fat Clay (CH), with black oxide nodules, STIFF, reddish brown, moist.			18									4 - 6 - 6
	895.7 895.6	5	Weathered Limestone. Auger Refusal Encountered at 4.2 feet.			0									50/1"
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-22**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 894.1		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						






Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	894.1 893.8	0	Topsoil - 4 inches							
			Lean Clay (CL), with black oxide nodules, FIRM, light brown, moist.			18				2 - 2 - 3
						18				4 - 6 - 7
	891.1		Fat Clay (CH), STIFF, reddish brown, moist.							
		5				24		1,539 psf		
	887.6 887.4		Weathered Limestone.			8				
			Auger Refusal Encountered at 6.7.							4 - 50/3"
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-23**

PROJECT: Woodford County High School			JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY				
ELEVATION: 894.5		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.				




Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	894.5	0	Topsoil - 6 inches												
	894.0		Lean Clay (CL), with black oxide nodules, STIFF, brown, damp.			18				10					3 - 3 - 6
						16					20				3 - 6 - 10
	891.5		Fat Clay (CH), with black oxide nodules, VERY STIFF, light brown, moist.												
		5				14					30				6 - 7 - 9
	888.4		Weathered Limestone.			1								50	50/1"
	887.2		Auger Refusal Encountered at 7.3 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-24**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 896.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	896.5 896.1	0	Topsoil - 5 inches Lean Clay (CL), with black oxide nodules, FIRM, brown, damp.			18				•					1 - 3 - 5
	894.5		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18				•					5 - 5 - 6
	892.2 892.1	5	Weathered Limestone. Auger Refusal Encountered at 4.4 feet.			2								•	50/4"
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-25**

PROJECT: Woodford County High School	JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY		
ELEVATION: 898.2	BORING STARTED: 3/23/2020	BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50	HAMMER: AUTO
GROUNDWATER (ft): N/A	BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.		

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	898.2 897.8	0	Topsoil - 5 inches Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18				Woh - 2 - 3
	896.2 895.8		Fat Clay (CH), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			16				3 - 5 - 50/4"
	895.1		Weathered Limestone. Auger Refusal Encountered at 3.1 feet.							
		5								
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-26**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.5	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.5	0	Topsoil - 6 inches												
	899.0		Lean Clay (CL), with black oxide nodules, STIFF, reddish-brown, moist.			18				•					3 - 4 - 6
						18				•					5 - 6 - 9
	896.5		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, gray.												
		5				12				•					5 - 7 - 7
	892.3		Auger Refusal Encountered at 7.2 feet / Begin Coring.			7									
			Limestone with clay seams, fossiliferous. Moderately weathered to intact, moderately hard to hard.												
		10	Minor solutioning in top 3.0 feet. High angle joint at 11.0 feet.			48/60	30								
	887.3		Limestone with thin Shale seams, fossiliferous. Moderately weathered to intact, moderately hard to hard.												
		15				56/60	62								
	882.3		Coring Terminated at 17.2 feet.												
		20													



TEST BORING RECORD

BORING NO: **B-27**

PROJECT: Woodford County High School			JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY				
ELEVATION: 890.5		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.				



Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	890.5 890.2	0	Topsoil - 4 inches Lean Clay (CL), with rootlets, FIRM, brown, damp.			18				2 - 3 - 4
						15				4 - 5 - 5
	885.5	5	Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			14				2 - 4 - 4
	884.4		Weathered Limestone.			1				50/1"
	883.7		Auger Refusal Encountered at 6.8 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-27A**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 890.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" HSA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	890.5 890.2	0	Topsoil - 4 inches Lean Clay (CL), with rootlets, FIRM, brown, damp (Fill).												
						24									
	885.5	5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-28**

PROJECT: Woodford County High School	JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY		
ELEVATION: 890.8	BORING STARTED: 3/23/2020	BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50	HAMMER: AUTO
GROUNDWATER (ft): N/A	BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.		

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	890.8	0	Topsoil - 6 inches												
	890.3		Lean Clay (CL) with black oxide nodules, STIFF, brown, moist.			18									3 - 3 - 6
						12									3 - 6 - 7
	887.8		Fat Clay (CH) with black oxide nodules, STIFF, reddish brown grading to reddish brown and gray, moist.												
						8									4 - 3 - 50/4"
	885.6	5	Weathered Limestone.												
	885.5		Auger Refusal Encountered at 5.3 feet / Begin Coring.												
			Limestone, gray, thinly bedded, fossiliferous. Minor solutioning at 6.4 feet. Moderately weathered to intact, moderately hard to hard.			59/60	30								
		10													
						60/60	42								
		15													
	875.5		Coring Terminated at 15.3 feet.												
		20													



TEST BORING RECORD

BORING NO: **B-29**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 894.0	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	894.0	0	Topsoil - 6 inches												
	893.5		Lean Clay (CL) with black oxide nodules, FIRM, light brown, moist.			18									2 - 4 - 4
	892.5		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			6									5 - 9 - 50/2"
	891.4		Weathered Limestone.												
	891.0		Auger Refusal Encountered at 3.0 feet / Begin Coring.												
	890.0	5	Limestone, gray, thinly bedded. Moderately weathered to intact, moderately hard to hard.			56/60	47								
			Limestone, gray, fossiliferous, thinly bedded. Moderately weathered to intact, moderately hard to hard.												
		10				60/60	57								
	881.0		Coring Terminated at 13.0 feet.												
		15													
		20													



TEST BORING RECORD

BORING NO: **B-30**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 895.8	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	895.8	0	Topsoil - 3 inches												
	895.8		Lean Clay (CL) with black oxide nodules, STIFF, light brown, moist.			18									Woh - 4 - 5
	893.8		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18									4 - 6 - 7
	891.6		Auger Refusal Encountered at 4.2 feet.			2									50/2"
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-31**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 896.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	896.5	0	Topsoil - 5 inches												
	896.1		Lean Clay (CL), with black oxide nodules, FIRM, reddish-brown, moist.			18									3 - 3 - 4
						13									4 - 4 - 5
	893.9		Fat Clay (CH), with black oxide nodules, STIFF, light brown, reddish-brown, moist.												
	892.4		Auger Refusal Encountered at 4.1 feet.			1									50/1"
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-32**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 897.6	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	897.6 897.2	0	Topsoil - 5 inches Lean Clay (CL), silty, FIRM, dark brown, damp.			18									3 - 2 - 5
	895.6		Fat Clay (CH), with oxide nodules, STIFF, reddish-brown, moist.			18									5 - 8 - 8
	893.4 893.2	5	Weathered Limestone. Auger Refusal Encountered at 4.4 feet.			2									50/2"
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-33**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 882.5	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"	
									0	10	20	30	40	50		
	882.5	0	Topsoil - 2 inches			18										4 - 4 - 4
			Lean Clay (CL), FIRM to STIFF, brown and gray, moist.			12										4 - 5 - 7
	879.5		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18										4 - 4 - 6
		5				5										50/5"
	876.1		Weathered Limestone.													
	875.3		Auger Refusal Encountered at 7.2 feet.													
		10														
		15														
		20														



TEST BORING RECORD

BORING NO: **B-34**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 885.0	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	885.0	0	Topsoil - 3 inches												
	884.8		Lean Clay (CL), with black oxide nodules, STIFF, brown, moist.			18					•				5 - 6 - 8
						13					•				4 - 6 - 7
	881.0	5	Fat CLay (CH), with black oxide nodules, STIFF to VERY STIFF, reddish-brown, moist.			18					•				4 - 6 - 8
			Chert fragments below 5.0 feet.			16					•				3 - 8 - 8
	876.2		Auger Refusal Encountered at 8.8 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-35**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 888.1	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	888.1	0	Topsoil - 5 inches												
	887.7		Lean Clay (CL), dark brown, with trace organics, STIFF, damp.			14									5 - 6 - 7
	886.6		Fat Clay (CH), with black oxide nodules, rock fragments, STIFF, reddish-brown, moist.			5									4 - 6 - 6
	884.4		Auger Refusal Encountered at 3.7 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-36**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 896.8	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	896.8	0	Topsoil - 5 inches												
	896.4		Lean Clay (CL), with trace organics, STIFF, dark brown, damp.			15									5 - 6 - 7
	895.6		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown, moist.			14									5 - 7 - 9
						4									
	892.4		Weathered Limestone.												50/4"
	892.3	5	Auger Refusal Encountered at 4.5 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-37**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.6	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	899.6	0	Topsoil - 6 inches												
	899.1		Lean Clay (CL), STIFF, dark brown, moist.			17									4 - 5 - 7
	897.6		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			7									3 - 5 - 5
	895.5		Weathered Limestone.			6									8 - 50/3"
	894.5	5	Auger Refusal Encountered at 5.1 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-38**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 901.0		BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	901.0	0	Topsoil - 6 inches												
	900.5		Lean Clay (CH), silty, STIFF, brown, moist to wet.			18				•					4 - 4 - 5
						18				•					4 - 5 - 7
	897.0	5	Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18				•					4 - 6 - 6
						18				•					4 - 6 - 7
	893.0		Weathered Limestone.												
	892.6		Auger Refusal Encountered at 8.4 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-39**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 904.8	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	904.8	0	Topsoil - 6 inches												
	904.3		Lean Clay (CL), with black oxide nodules, STIFF, brown, moist.			18				•					5 - 4 - 5
						18					•				4 - 6 - 8
	901.8		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.												
		5				18					•				5 - 6 - 9
	898.0		Weathered Limestone.			10					•				4 - 5 - 6
	896.6		Auger Refusal Encountered at 8.2 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-40**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 905.0	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			





















Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	905.0	0	Topsoil - 5 inches												
	904.6		Lean Clay (CL), with black oxide nodules, STIFF, reddish-brown, moist.			18					•				4 - 7 - 8
	903.5		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown, moist.			18					•				8 - 9 - 8
	901.5		Weathered Limestone.												
	900.6		Auger Refusal Encountered at 4.4 feet.			3								•	50/3"
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-41**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 911.1		BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
									01020304050	
	911.1	0	Topsoil - 9 inches							
	910.3		FILL - Fat Clay (CH), organics, with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				2 - 2 - 4
						18				3 - 5 - 6
	907.6		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.							
		5				18				4 - 4 - 5
	905.1		Fat Clay (CH), with weathered rock fragments, VERY STIFF, reddish-brown, moist.							
						18				7 - 12 - 8
	903.1		Boring Terminated at 8 feet - Augers walking into slot in bedrock.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-42**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 906.5	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	906.5 906.1	0	Fat Clay (CH), rock fragments, HARD, reddish-brown. Auger Refusal Encountered at 0.4 feet.			3									50/3"
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-43**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 900.4	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			











Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	900.4	0	Topsoil - 9 inches												
	899.6		Lean Clay (CL), with black oxide nodules, STIFF, reddish-brown, moist.			18				•					1 - 2 - 4
						18					•				4 - 6 - 9
	896.9		Fat Clay (CH), STIFF, reddish-brown, moist.												
		5				18					•				3 - 6 - 7
	892.6		Weathered Limestone.			18									3 - 7 - 9
	891.7		Auger Refusal Encountered at 8.7 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-44**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 902.7	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			





Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
									01020304050	
	902.7	0	Topsoil - 11 inches							
	901.8		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				1 - 2 - 4
						18				7 - 8 - 9
	899.2		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.							
		5				18				4 - 3 - 7
	897.2		Weathered Limestone.							
	896.2		Auger Refusal Encountered at 6.5 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-45**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 897.7	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	897.7 897.3	0	Topsoil - 5 inches												
			Lean Clay (CL), with oxide nodules, STIFF, reddish-brown, moist.			18									3 - 4 - 7
	896.2		Fat Clay (CH), with oxide nodules, VERY STIFF, reddish-brown, moist.			14									
	895.2 894.9		Weathered Limestone.												8 - 9 - 50/2"
			Auger Refusal Encountered at 2.8 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-46**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 895.2	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	895.2	0	Topsoil - 9 inches							
	894.4		Lean Clay (CL), with black oxide nodules, STIFF to VERY STIFF, reddish-brown, moist.			18				8 - 3 - 5
	891.7		Fat Clay (CH), with black oxide nodules, VERY STIFF, reddish-brown, moist.			18				8 - 10 - 11
	890.7		Weathered Limestone.			9				4 - 50/3"
	890.5	5	Auger Refusal Encountered at 4.7 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-47**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 891.6	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			
















Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	891.6	0	Topsoil - 8 inches												
	890.9		Lean Clay (CL) with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18									2 - 3 - 5
						18									7 - 7 - 7
	888.1		Fat Clay (CH) with black oxide nodules, STIFF, reddish-brown, moist.												
	887.1		Weathered Limestone.			7									3 - 50/1"
	887.0	5	Auger Refusal Encountered at 4.6 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-48**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 899.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
									01020304050	
	899.2	0	Topsoil - 8 inches							
	898.5		Lean Clay (CL), with black oxide nodules, FIRM to VERY STIFF, reddish-brown, moist.			18				2 - 3 - 5
						18				6 - 8 - 9
	895.7		Fat Clay (CH), with black oxide nodules, with wx fragments, STIFF, reddish-brown, orange.							
		5				18				5 - 5 - 6
	893.7		Weathered Limestone.							
	893.6		Auger Refusal Encountered at 5.6 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-49**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 902.6	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	902.6	0	Topsoil - 11 inches							
	901.7		Lean Clay (CL), with black oxide nodules, FIRM to VERY STIFF, reddish-brown, moist.			18				2 - 3 - 5
						18				7 - 9 - 8
	899.1		Fat Clay (CH), with black oxide nodules, STIFF, orange, gray, moist.			18				3 - 4 - 5
		5				18				3 - 5 - 7
	893.1					8				4 - 50/2"
	893.0	10	Weathered Limestone. Auger Refusal Encountered at 9.6 feet.							
		15								
		20								



TEST BORING RECORD

BORING NO: **B-50**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 895.4	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	895.4	0	Topsoil - 6 inches												
	894.9		Lean Clay (CL), with black oxide nodules, FIRM to VERY STIFF, reddish-brown, moist.			18									1 - 2 - 4
						18									7 - 8 - 9
	891.9		Fat Clay (CH), with black oxide nodules, FIRM, reddish-brown, moist.												
		5				18									3 - 3 - 4
	889.2		Auger Refusal Encountered at 6.2 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-51**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 887.0	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	887.0	0	Topsoil - 6 inches												
	886.5		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18									2 - 3 - 4
						18									6 - 8 - 7
	884.0		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.												
	883.0		Weathered Limestone.			1									50/1"
	882.9		Auger Refusal Encountered at 4.1 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-52**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 879.2		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	879.2	0	Topsoil - 6 inches												
	878.7		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				•					2 - 3 - 4
						18				•					4 - 5 - 4
	876.2		Fat Clay (CH), with chert fragments, FIRM, reddish-brown, moist.												
		5				18				•					2 - 2 - 3
	872.7 - 872.6		Weathered Limestone. Auger Refusal Encountered at 6.6 feet.			1								•	50/1"
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-53**

PROJECT: Woodford County High School			JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY				
ELEVATION: 876.5		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.				

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	876.5	0	Topsoil - 6 inches							
	876.0		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				3 - 4 - 5
						18				6 - 7 - 8
		5				18				3 - 6 - 7
	870.5		Fat Clay (CH), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18				4 - 4 - 3
		10				18				4 - 5 - 7
	864.3		Auger Refusal Encountered at 12.2 feet.							
		15								
		20								



TEST BORING RECORD

BORING NO: **B-54**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 886.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	886.2	0	Topsoil - 6 inches												
	885.7		Fat Clay (CH), with black oxides nodules, STIFF to VERY STIFF, reddish-brown, moist.			18									2 - 4 - 6
						18									7 - 9 - 13
	883.2		Weathered Limestone.												
	882.8		Auger Refusal Encountered at 3.4 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-55**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 893.0	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			


Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	893.0	0	Topsoil - 7 inches												
	892.4		Lean Clay (CL), with black oxide nodules, FIRM, reddish brown, moist (Fill).			18									2 - 2 - 3
	891.0		Fat Clay (CH), with black oxide nodules, with trace organics, VERY STIFF, reddish brown (Fill).			18									5 - 8 - 8
	889.0		Weathered Limestone.			3									50/3"
	888.6	5	Auger Refusal Encountered at 4.4 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-56**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 886.7	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"	
	886.7	0	Fat Clay (CH), with black oxide nodules, with wx fragments, STIFF, reddish-brown, moist.			15				0	10	20	30	40	50	2 - 6 - 9
	885.2		Auger Refusal Encountered at 1.5 feet.													
		5														
		10														
		15														
		20														



TEST BORING RECORD

BORING NO: **B-57**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 871.2		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	871.2	0	Topsoil - 6 inches												
	870.7		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18				•					2 - 3 - 5
						18					•				5 - 8 - 9
	868.2		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.												
		5				10				•					2 - 2 - 5
	865.7		Weathered Limestone.												
	865.3		Auger Refusal Encountered at 5.9 feet.												
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-58**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 862.8	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): 1.0		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	862.8	0	Topsoil - 11 inches							
	861.9		Fat Clay (CH), with oxide nodules, FIRM, reddish-brown, very moist to wet.			18				1 - Woh - 1
						18				3 - 3 - 3
	859.3		Auger Refusal Encountered at 3.5 feet.							
		5								
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-59**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 871.2	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	871.2	0	Topsoil - 6 inches												
	870.7		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18									2 - 2 - 14
	870.2		Fat Clay (CH), with wx fragments, VERY STIFF, reddish-brown, moist to very moist.			8									2 - 50/2"
	869.2		Weathered Limestone.												
	868.1		Auger Refusal Encountered at 3.1 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-60**

PROJECT: Woodford County High School	JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY		
ELEVATION: 896.4	BORING STARTED: 3/23/2020	BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50	HAMMER: AUTO
GROUNDWATER (ft): N/A	BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.		

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	896.4	0	Topsoil - 6 inches							
	895.9		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18			•	2 - 2 - 4
						18			•	6 - 7 - 8
	893.4		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, orange, moist.			20				
		5				18			•	3 - 5 - 6
	888.9		Weathered Limestone.			11				
	888.5		Auger Refusal Encountered at 7.9 feet.							• 3 - 50/5"
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-61**

PROJECT: Woodford County High School			JOB NO: 1183-20-006		REPORT NO: 821090172	
PROJECT LOCATION: Versailles, KY						
ELEVATION: 884.7		BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020		
DRILLING METHOD: 4" SFA		RIG TYPE: D-50		HAMMER: AUTO		
GROUNDWATER (ft): N/A			BORING DIAMETER (IN): 4		SHEET 1 OF 1	
Remarks: Boring location staked and elevation measured by S&ME surveyor.						

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)	BLOWS /6"
	884.7	0	Topsoil - 6 inches							
	884.2		Lean Clay (CL), with black oxide nodules, FIRM to STIFF, reddish-brown, moist.			18			•	2 - 2 - 3
						18			•	5 - 5 - 8
	881.2		Fat Clay (CH), with black oxide nodules, with chert fragments, STIFF, reddish-brown, moist.			18			•	5 - 5 - 6
		5				18			•	4 - 4 - 6
	876.5		Auger Refusal Encountered at 8.2 feet.							
		10								
		15								
		20								



TEST BORING RECORD

BORING NO: **B-62**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 878.8	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	878.8	0	Topsoil - 6 inches												
	878.3		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18									2 - 2 - 5
	876.8		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18									6 - 7 - 9
	874.8		Auger Refusal Encountered at 4 feet.			0									50/0"
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-63**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 882.9	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	882.9	0	Topsoil - 6 inches												
	882.4		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18									2 - 3 - 3
	881.4		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18									5 - 5 - 7
	879.4		Auger Refusal Encountered at 3.5 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-64**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 887.0	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	887.0	0	Topsoil - 7 inches												
	886.4		Lean Clay (CL), with black oxide nodules, FIRM, brown, moist.			18									2 - 3 - 4
	885.5		Fat Clay (CH), with black oxide nodules, STIFF, reddish-brown, moist.			18									6 - 7 - 7
	883.4		Auger Refusal Encountered at 3.6 feet												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-65**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 879.7	BORING STARTED: 3/23/2020		BORING COMPLETED: 3/23/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	879.7	0	Topsoil - 7 inches												
	879.1		Fat Clay (CH), with black oxide nodules, with trace organics, FIRM to STIFF, reddish-brown, moist.			18									1 - 2 - 4
	877.6		Weathered Limestone.			7									5 - 50/1"
	877.0		Auger Refusal Encountered at 2.7 feet.												
		5													
		10													
		15													
		20													



TEST BORING RECORD

BORING NO: **B-66**

PROJECT: Woodford County High School		JOB NO: 1183-20-006	REPORT NO: 821090172
PROJECT LOCATION: Versailles, KY			
ELEVATION: 881.9	BORING STARTED: 3/24/2020		BORING COMPLETED: 3/24/2020
DRILLING METHOD: 4" SFA	RIG TYPE: D-50		HAMMER: AUTO
GROUNDWATER (ft): N/A		BORING DIAMETER (IN): 4	SHEET 1 OF 1
Remarks: Boring location staked and elevation measured by S&ME surveyor.			

Groundwater	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	Lithology	Sample Type	Recovery (in)	RQD (%)	Qu	STANDARD PENETRATION RESISTANCE (N)						BLOWS /6"
									0	10	20	30	40	50	
	881.9	0	Topsoil - 6 inches												
	881.4		Fat Clay (CH), with black oxide nodules, FIRM, reddish-brown, moist.			18									1 - 2 - 2
	879.4		Weathered Limestone.			16									2 - 3 - 50/4"
	879.1		Auger Refusal Encountered at 2.8 feet.												
		5													
		10													
		15													
		20													



FIELD TESTING PROCEDURES

Field Operations: The general field procedures employed by S&ME, Inc. are summarized in ASTM D 420 which is entitled "Investigating and Sampling Soils and Rocks for Engineering Purposes." This recommended practice lists recognized methods for determining soil and rock distribution and ground water conditions. These methods include geophysical and in situ methods as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternate techniques depending upon the subsurface conditions. These techniques are:

- a. Continuous 2-1/2 or 3-1/4 inch I.D. hollow stem augers;
- b. Wash borings using roller cone or drag bits (mud or water);
- c. Continuous flight augers (ASTM D 1425).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field test boring record by a field engineer who is on site to direct the drilling operations and log the recovered samples. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are on file in our office.

The soil and rock samples plus the field boring records are reviewed by a geotechnical engineer. The engineer classifies the soils in general accordance with the procedures outlined in ASTM D 2488 and prepares the final boring records that are the basis for all evaluations and recommendations.

The final boring records represent our interpretation of the contents of the field records based on the results of the engineering examinations and tests of the field samples. These records depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at these boring locations. The lines designating the interface between soil or refusal materials on the records and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring records are included with this report. The detailed data collection methods used during this study are discussed on the following pages.

Soil Test Borings: Soil test borings were made at the site at locations shown on the attached Boring Plan. Soil sampling and penetration testing were performed in accordance with ASTM D 1586.

The borings were made by mechanically twisting a 5-5/8" outer diameter auger into the soil. At regular intervals, the drilling tools were removed and samples obtained with a standard 1.4 inch I.D., 2 inch O.D., split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance".

Representative portions of the samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. Test Boring Records are attached which graphically show the soil descriptions and penetration resistances.

Soil Auger Soundings: Soil auger soundings were made at the site at the locations shown on the attached Boring Location Plan. The soundings were performed by mechanically twisting a steel auger into the soil. However, unlike the soil test borings, a smaller diameter solid stem auger was used and no split-spoon samples were obtained. The driller provided a general description of the soil encountered by observing the soils brought to the surface by the twisting auger. The auger was advanced until refusal materials were encountered and the refusal depth was noted by the driller. The auger is then withdrawn and the depths to water or caved materials are then measured and recorded by the driller.

Soil auger soundings provide a rapid, economical method of obtaining the approximate bedrock depth, groundwater depth, and general soil conditions at locations where detailed soil testing and sampling is not required.

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the "Test Boring Records". These readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. Where impervious soils are encountered (clayey soils) the amount of water seepage into the boring is small, and it is generally not possible to establish the location of the hydrostatic water table through water level readings. The ground water table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

The time of boring water level reported on the boring records is determined by field crews as the drilling tools are advanced. The time of boring water level is detected by changes in the drilling rate, soil samples obtained, etc. Additional water table readings are generally obtained at least 24 hours after the borings are completed. The time lag of at least 24 hours is used to permit stabilization of the ground water table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface. Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring records.



Appendix III – Laboratory Testing Results

Lab Summary



S&ME, Inc - Lexington 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.: 1183-20-006

Report Date: 04/23/20

Project Name: Woodford County High School

Client Name: Woodford County Board of Education

Client Address: 330 Pisgah Pike, Versailles, KY 40383

BORING NO.	SAMPLE DEPTH, FT.	SAMPLE TYPE	USCS	NATURAL MOISTURE CONTENT, %	ATT. LIMITS			APPROX % RET. ON #40	MAX DRY DENSITY, PCF @ OPT MC % (STD. PROCTOR)	WET UNIT WEIGHT, PCF	DRY UNIT WEIGHT, PCF	APPROX ROCK UNCONFINED COMPRESSIVE STRENGTH, PSI	SOIL UNCONFINED COMPRESSIVE STRENGTH, PSF	% FINER THAN NO. 200	INTER-POLATED AT 95% CBR, %
					L.L.	P.L.	P. I.								
Multiple		BULK	CH		65	26	39	5	95.6 @ 25.5						5.3
B-1	1.5-3.0	SPT		34.7											
B-1	4-5.2	SPT		31.6											
B-3	4-5.5	SPT	CH	26.9	58	28	30	<5							
B-3	6.5-8	SPT		35.2											
B-4	4-5.5	SPT	CH	29.0	57	24	33	<5							
B-4	6.5-8	SPT		31.7											
B-5	1.5-3	SPT		26.6											
B-5	3.0-5.0	UD	CL	27.3	48	22	26	20		124.0	97.4		3,267		
B-5	5-6.5	SPT		32.7											
B-13	1.5-3	SPT		29.6											
B-13	3-5	UD	CH	33.0	66	27	39	5		120.8	90.8		1,914		

Notes:† - Gravel significant portion of sample and was included in MC.

Jacob Folsom
Technical Responsibility

Jacob Folsom
Signature

Associate Project Manager
Position

04/23/20
Date

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Lab Summary


S&ME, Inc - Lexington 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.: 1183-20-006

Report Date: 04/23/20

Project Name: Woodford County High School

Client Name: Woodford County Board of Education

Client Address: 330 Pisgah Pike, Versailles, KY 40383

BORING NO.	SAMPLE DEPTH, FT.	SAMPLE TYPE	USCS	NATURAL MOISTURE CONTENT, %	ATT. LIMITS			APPROX % RET. ON #40	MAX DRY DENSITY, PCF @ OPT MC % (STD. PROCTOR)	WET UNIT WEIGHT, PCF	DRY UNIT WEIGHT, PCF	APPROX ROCK UNCONFINED COMPRESSIVE STRENGTH, PSI	SOIL UNCONFINED COMPRESSIVE STRENGTH, PSF	% FINER THAN NO. 200	INTER-POLATED AT 95% CBR, %
					L.L.	P.L.	P. I.								
B-15	1.5-3	SPT	CH	29.4	56	25	31	<5							
B-15	4-5.5	SPT		36.3	†										
B-15	7.0-10	CORE		0.3						166.8	166.4	9,695			
B-22	1.5-3	SPT		26.6											
B-22	4.0-6.0	UD	CH	33.0	63	30	33	<5		120.0	90.2		1,539		
B-24	1.5-3	SPT		29.8											
B-27	3.0-5	UD	CL	26.2	46	22	24	10		124.3	98.5		3,537		
B-26	1.5-3	SPT		28.0											
B-26	4-5.5	SPT		36.5											
B-26	11.0-15	CORE		0.2						166.8	166.5	7,054			
B-33	1.5-3	SPT		23.0											
B-33	4-5.5	SPT		30.1											

Notes:† - Gravel significant portion of sample and was included in MC.

Lab Summary



S&ME, Inc - Lexington 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.: 1183-20-006

Report Date: 04/23/20

Project Name: Woodford County High School

Client Name: Woodford County Board of Education

Client Address: 330 Pisgah Pike, Versailles, KY 40383

BORING NO.	SAMPLE DEPTH, FT.	SAMPLE TYPE	USCS	NATURAL MOISTURE CONTENT, %	ATT. LIMITS			APPROX % RET. ON #40	MAX DRY DENSITY, PCF @ OPT MC % (STD. PROCTOR)	WET UNIT WEIGHT, PCF	DRY UNIT WEIGHT, PCF	APPROX ROCK UNCONFINED COMPRESSIVE STRENGTH, PSI	SOIL UNCONFINED COMPRESSIVE STRENGTH, PSF	% FINER THAN NO. 200	INTER-POLATED AT 95% CBR, %
					L.L.	P.L.	P. I.								
B-38	1.5-3	SPT		28.9											
B-38	4-5.5	SPT		31.7											
B-38	6.5-8	SPT		33.4											
B-52	1.5-3	SPT		28.2											
B-52	4-5.5	SPT	CH	32.7	53	23	30	<5							
B-53	1.5-3	SPT		28.2											
B-53	4-5.5	SPT		29.2											
B-53	6.5-8	SPT		33.4											
B-53	9-10.5	SPT		31.4											
B-60	1.5-3	SPT		30.2											
B-60	3.0-5	UD	CH	27.9	61	28	33			123.6	96.6		1,628		
B-60	5-6.5	SPT		36.8											

Notes:† - Gravel significant portion of sample and was included in MC.

UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

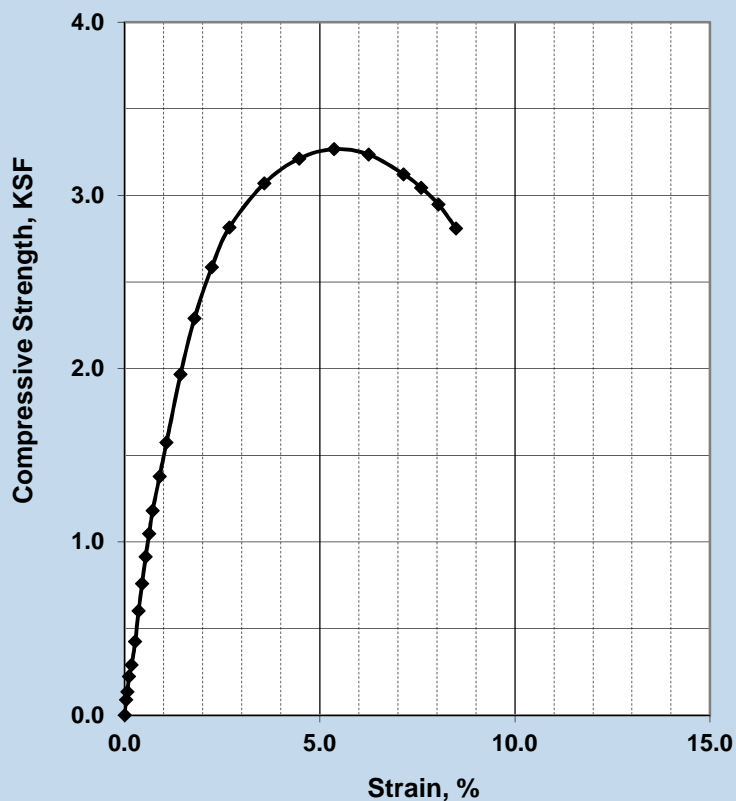


ASTM D2166

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	4/13/2020
Project Name:	Woodford County High School	Test Date(s):	4/3/2020
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Versailles, KY 40383		
		Sample Date:	3/23/2020
Location:	B-5	Depth (ft.):	3.0 - 5.0
Sample Description:	Reddish brown Lean clay		CL

Unconfined Compressive Strength



Failed Specimen

Type of Sample: IntactSource of Moisture Sample: Entire SpecimenLiquid Limit: 48Plasticity Index: 26Height to Diameter Ratio: 2.0Rate of Strain (%/min.): 0.9Strain at Failure: 5.4Initial Dry Unit Weight: 97.4 pcf Initial Water Content: 27.3%Unconfined Compressive Strength, q_u : **3.267** KSFUndrained Shear Strength, s_u : **1.633** KSF

References / Comments / Deviations:

Jacob Folsom

Technical Responsibility

Signature

Associate Project Manager

Position

4/13/2020

Date

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

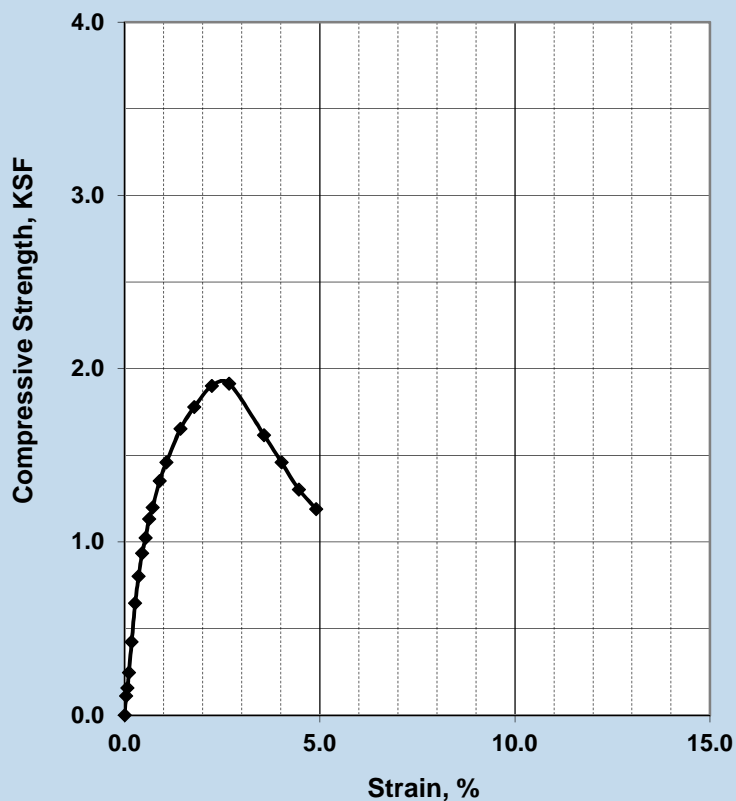


ASTM D2166

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	4/13/2020
Project Name:	Woodford County High School	Test Date(s):	4/3/2020
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Versailles, KY 40383		
		Sample Date:	3/23/2020
Location:	B-13	Depth (ft.):	3.0 - 5.0
Sample Description:	Reddish brown Fat clay		CH

Unconfined Compressive Strength



Failed Specimen

Type of Sample: IntactSource of Moisture Sample: Entire SpecimenLiquid Limit: 66Plasticity Index: 39Height to Diameter Ratio: 2.0Rate of Strain (%/min.): 0.9Strain at Failure: 2.7Initial Dry Unit Weight: 90.8 pcf Initial Water Content: 33.0%Unconfined Compressive Strength, q_u : **1.914** KSFUndrained Shear Strength, s_u : **0.957** KSF

References / Comments / Deviations:

Jacob Folsom

Technical Responsibility

Signature

Associate Project Manager

Position

4/13/2020

Date

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UNIAXIAL COMPRESSIVE STRENGTH OF ROCK



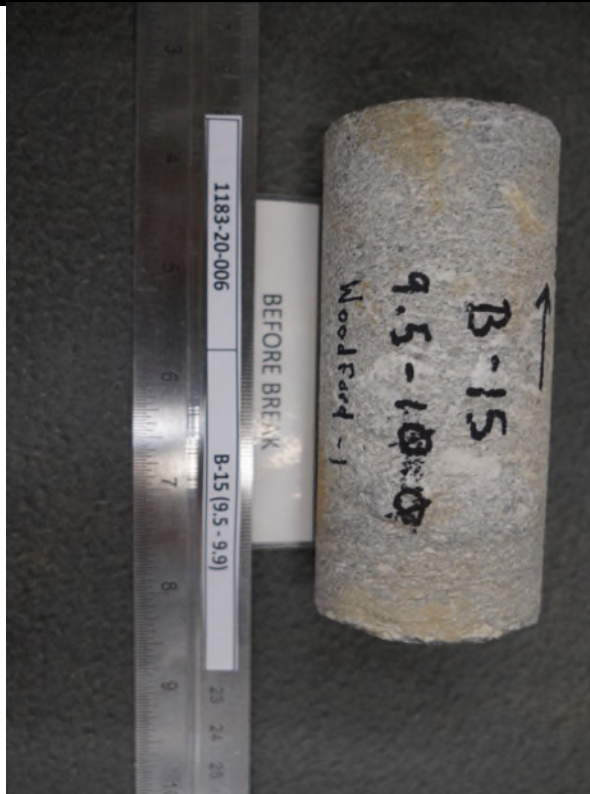
S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	04/22/20
Project Name:	Woodford County High School	Test Date(s):	04/21/20
Client Name:	Woodford County Board of Education	Sampled by:	S&ME, Inc.
Client Address:	330 Pisgah Pike, Versailles, KY 40383	Received Date:	03/25/20
Boring ID:	B-15	Depth/Elev., ft:	9.5 - 10.0
Sample Description:	Gray Limestone		

Angle of load relative to lithology: Approximately perpendicular to bedding plane

Test Results

Moisture Content 0.3 % Dry Unit Weight 166.4 pcf
Compressive Strength 9,695 psi



Strain rate: 0.015 in/min.

Notes / Deviations / References:

Jacob Folsom
Technical Responsibility

Jacob Folsom
Signature

Associate Project Manager
Position

4/23/2020
Date

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UNIAXIAL COMPRESSIVE STRENGTH**OF ROCK**

ASTM D 7012 Method C

**S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505**Project Name: **Woodford County High School**Boring ID: **B-15**Depth, feet: **9.5 - 10.0****Summary of Specimen Tolerances**Length/diameter target: **MET**Perpendicularity target: **MET**Side straightness target: **MET**Planeness target: **MET**Parallelism target: **MET**

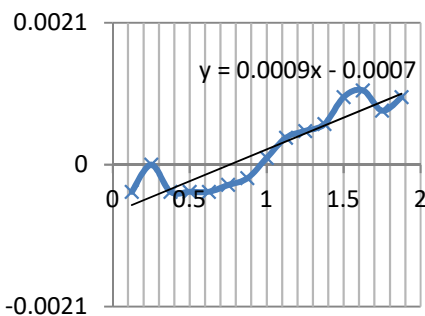
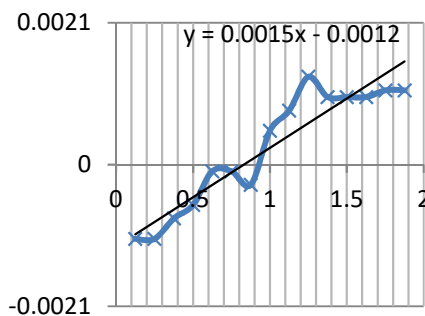
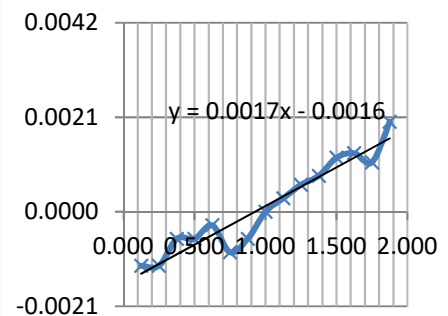
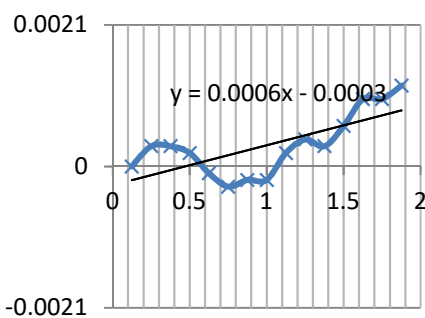
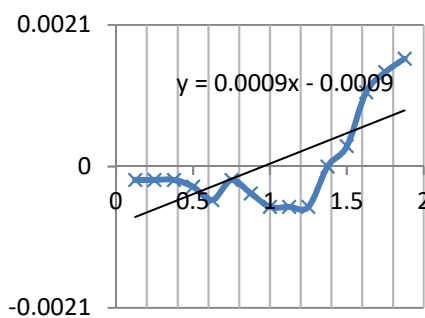
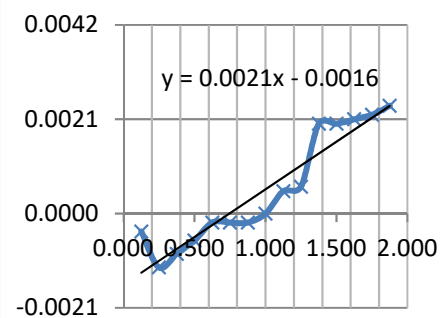
*ASTM D4543-08 Standard Practice for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerance, Section 1.2 - "Rock is a complex engineering material that can vary greatly as a function of lithology, stress history, weathering, moisture content, chemistry, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens that satisfy the desirable tolerances given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant or weak (or both) structural features. For these and other rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a specimen in accordance with this practice and for the intended test procedure. However, when it has been determined by trial that this is not possible, the rock specimen will be prepared to the closest tolerance practicable and be considered the best effort and report it as such. If allowable or necessary for the intended test, capping the ends of the specimen as discussed in ASTM D7012 is permitted."

Length to Diameter RatioLength, inches: **4.34** Diameter, inches: **1.868**Ratio: **2.32** length to 1 diameter

Target tolerance: L:D ratio between 2 to 1 and 2.5 to 1

Side StraightnessMaximum gap between side of core and reference plate, inches: **< .02**

Target tolerance: Maximum gap less than .02 inches

Top Dia. 1**Top Dia. 2****Top Dia. 3****Bottom Dia. 1****Bottom Dia. 2****Bottom Dia. 3**

Target Tolerance: No individually measured point should deviate from the best fit line by more than .001 inches.

Target Tolerance: The ends of the specimen shall not depart from perpend. to the axis of the specimen by more than 0.25°

ParallelismSlope difference, Diameter 1, degrees: **0.02**Slope difference, Diameter 2, degrees: **0.03**Slope difference, Diameter 3, degrees: **0.02**

Target Tolerance: Difference between slopes on each end less than 0.25°

Test InformationStrain rate, in/min: **0.015**

OR

Stress rate, lbs/sec:

Time to failure, min: **0.1**Temperature: **room temperature**

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

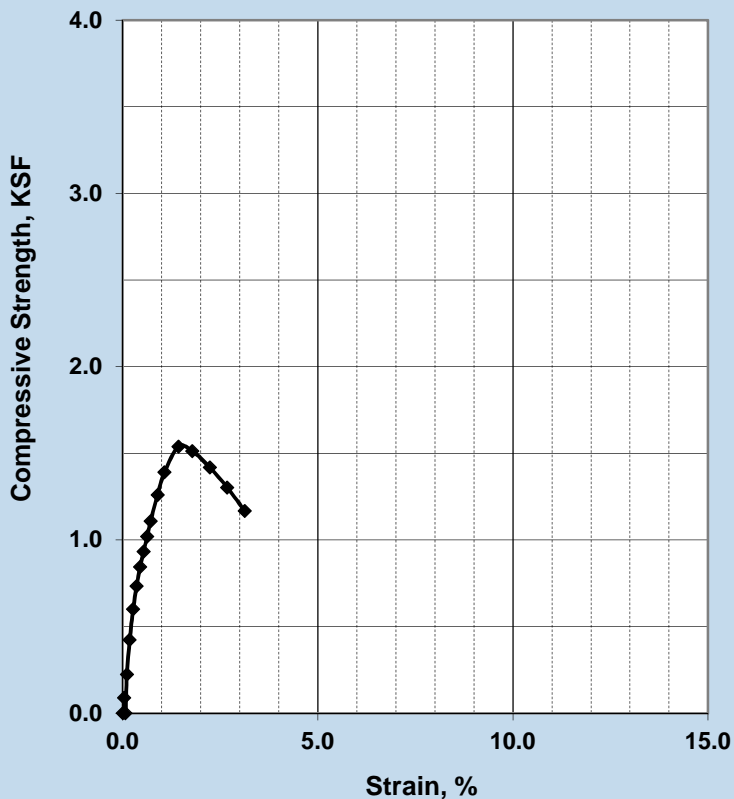


ASTM D2166

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	4/13/2020
Project Name:	Woodford County High School	Test Date(s):	4/3/2020
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Versailles, KY 40383		
		Sample Date:	3/23/2020
Location:	B-22	Depth (ft.):	3.0 - 5.0
Sample Description:	Reddish brown Fat clay		CH

Unconfined Compressive Strength



Failed Specimen

Type of Sample: IntactSource of Moisture Sample: Entire SpecimenLiquid Limit: 63Plasticity Index: 33Height to Diameter Ratio: 2.0Rate of Strain (%/min.): 0.9Strain at Failure: 1.4Initial Dry Unit Weight: 90.2 pcf Initial Water Content: 33.0%Unconfined Compressive Strength, q_u : **1.539** KSFUndrained Shear Strength, s_u : **0.770** KSF

References / Comments / Deviations:

Jacob Folsom

Technical Responsibility

Signature

Associate Project Manager

Position

4/13/2020

Date

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UNIAXIAL COMPRESSIVE STRENGTH OF ROCK



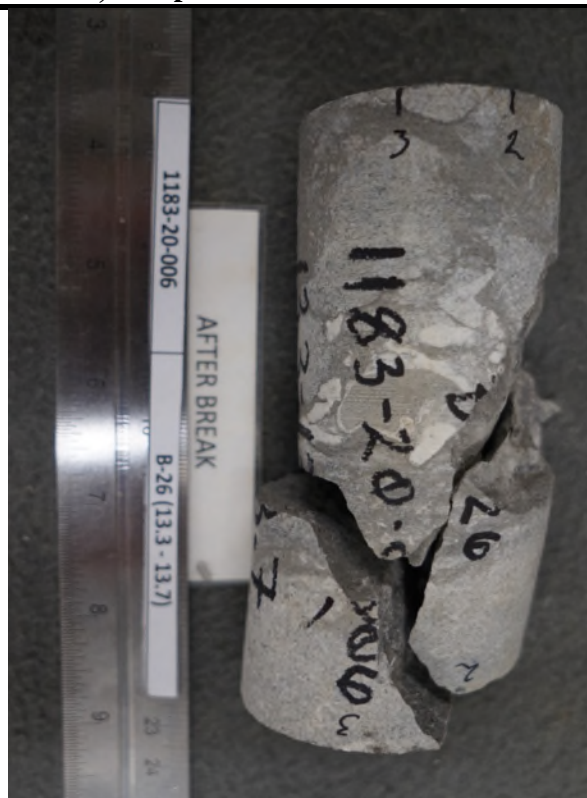
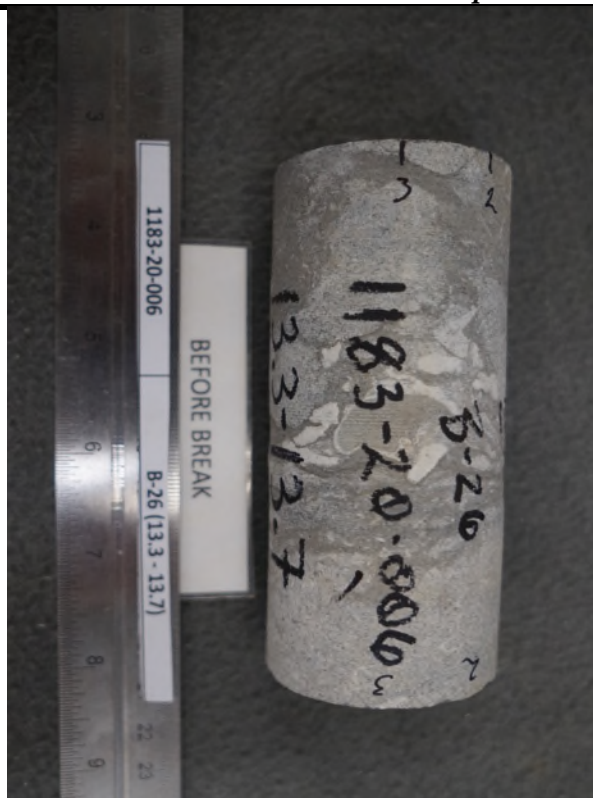
S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	04/22/20
Project Name:	Woodford County High School	Test Date(s):	04/21/20
Client Name:	Woodford County Board of Education	Sampled by:	S&ME, Inc.
Client Address:	330 Pisgah Pike, Versailles, KY 40383	Received Date:	03/25/20
Boring ID:	B-26	Depth/Elev., ft:	13.3 - 13.7
Sample Description:	Gray Limestone		

Angle of load relative to lithology: Approximately perpendicular to bedding plane

Test Results

Moisture Content 0.2 % Dry Unit Weight 166.5 pcf
Compressive Strength 7,054 psi



Strain rate: 0.015 in/min.

Notes / Deviations / References:

Jacob Folsom

Technical Responsibility

Jacob Folsom

Signature

Associate Project Manager

Position

4/23/2020

Date

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UNIAXIAL COMPRESSIVE STRENGTH**OF ROCK**

ASTM D 7012 Method C

**S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505**Project Name: **Woodford County High School**Boring ID: **B-26**Depth, feet: **13.3 - 13.7****Summary of Specimen Tolerances**Length/diameter target: **MET**Perpendicularity target: **MET**Side straightness target: **MET**Planeness target: **MET**Parallelism target: **MET**

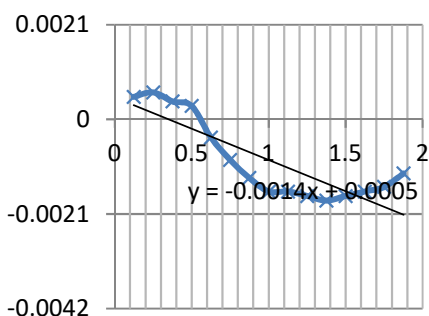
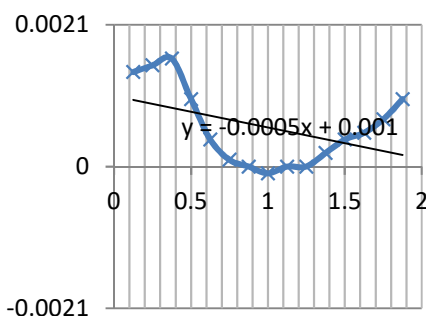
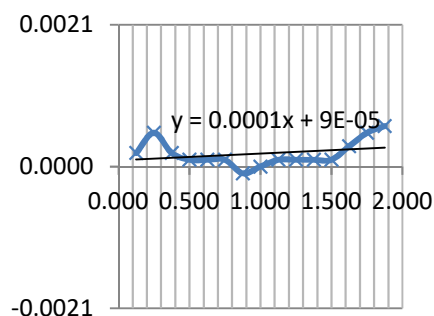
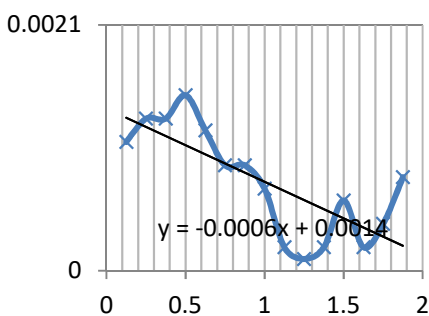
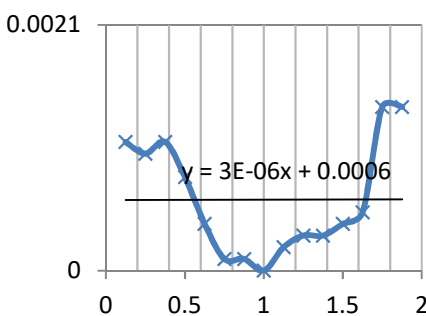
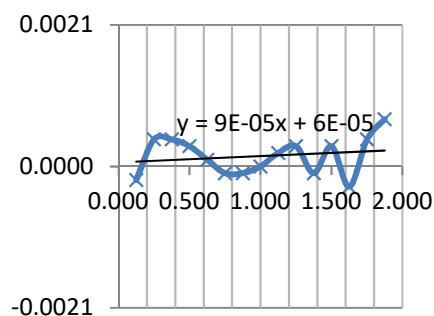
*ASTM D4543-08 Standard Practice for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerance, Section 1.2 - "Rock is a complex engineering material that can vary greatly as a function of lithology, stress history, weathering, moisture content, chemistry, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens that satisfy the desirable tolerances given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant or weak (or both) structural features. For these and other rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a specimen in accordance with this practice and for the intended test procedure. However, when it has been determined by trial that this is not possible, the rock specimen will be prepared to the closest tolerance practicable and be considered the best effort and report it as such. If allowable or necessary for the intended test, capping the ends of the specimen as discussed in ASTM D7012 is permitted."

Length to Diameter RatioLength, inches: **4.40** Diameter, inches: **1.873**Ratio: **2.35** length to 1 diameter

Target tolerance: L:D ratio between 2 to 1 and 2.5 to 1

Side StraightnessMaximum gap between side of core and reference plate, inches: **< .02**

Target tolerance: Maximum gap less than .02 inches

Top Dia. 1**Top Dia. 2****Top Dia. 3****Bottom Dia. 1****Bottom Dia. 2****Bottom Dia. 3**

Target Tolerance: No individually measured point should deviate from the best fit line by more than .001 inches.

Target Tolerance: The ends of the specimen shall not depart from perpend. to the axis of the specimen by more than 0.25°

ParallelismSlope difference, Diameter 1, degrees: **0.04**Slope difference, Diameter 2, degrees: **0.03**Slope difference, Diameter 3, degrees: **0.00**

Target Tolerance: Difference between slopes on each end less than 0.25°

Test InformationStrain rate, in/min: **0.015**

OR

Stress rate, lbs/sec:

Time to failure, min: **0.1**Temperature: **room temperature**

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

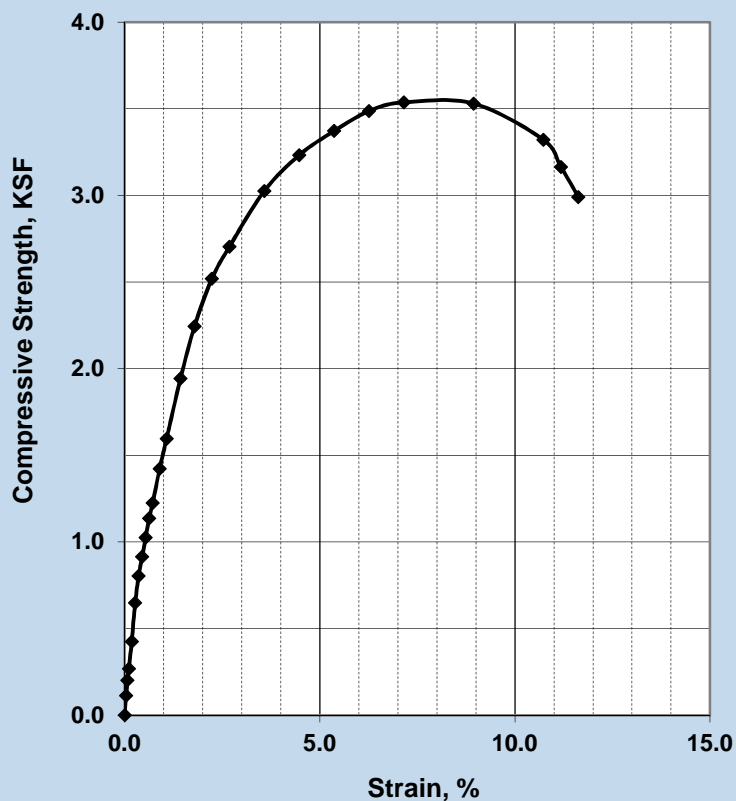


ASTM D2166

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	4/13/2020
Project Name:	Woodford County High School	Test Date(s):	4/3/2020
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Versailles, KY 40383		
		Sample Date:	3/23/2020
Location:	B-27	Depth (ft.):	3.0 - 5.0
Sample Description:	Brown Lean clay		CL

Unconfined Compressive Strength



Failed Specimen

Type of Sample: IntactSource of Moisture Sample: Entire SpecimenLiquid Limit: 46Plasticity Index: 24Height to Diameter Ratio: 2.0Rate of Strain (%/min.): 0.9Strain at Failure: 7.2Initial Dry Unit Weight: 98.5 pcf Initial Water Content: 26.2%Unconfined Compressive Strength, q_u : **3.537** KSFUndrained Shear Strength, s_u : **1.769** KSF

References / Comments / Deviations:

Jacob Folsom

Technical Responsibility

Signature

Associate Project Manager

Position

4/13/2020

Date

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UNCONFINED COMPRESSIVE STRENGTH OF COHESIVE SOILS

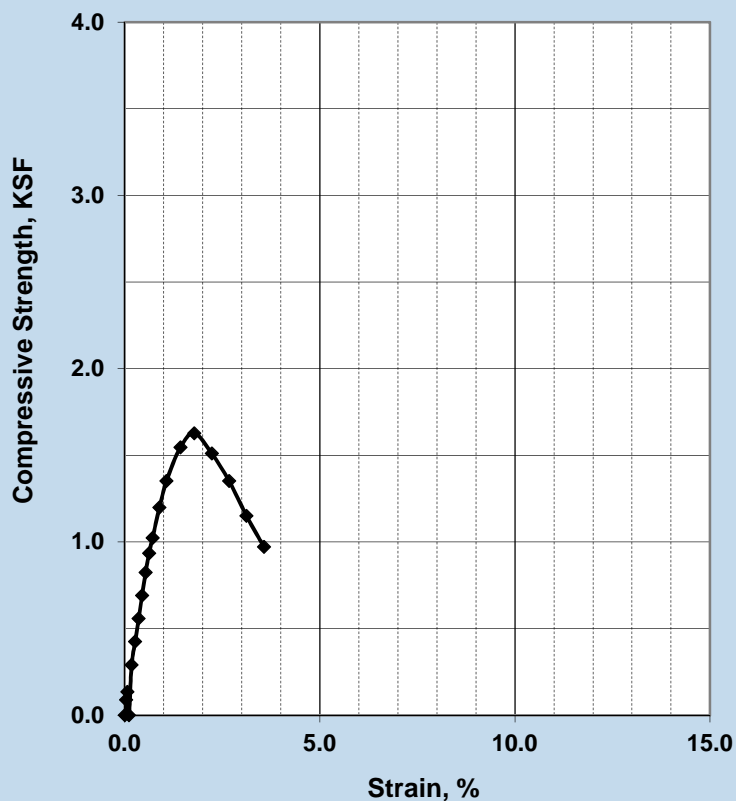


ASTM D2166

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project No.:	1183-20-006	Report Date:	4/13/2020
Project Name:	Woodford County High School	Test Date(s):	4/3/2020
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Versailles, KY 40383		
		Sample Date:	3/23/2020
Location:	B-60	Depth (ft.):	3.0 - 5.0
Sample Description:	Yellowish brown Fat clay		CH

Unconfined Compressive Strength



Failed Specimen

Type of Sample: IntactSource of Moisture Sample: Entire SpecimenLiquid Limit: 61Plasticity Index: 33Height to Diameter Ratio: 2.0Rate of Strain (%/min.): 0.9Strain at Failure: 1.8Initial Dry Unit Weight: 96.6 pcf Initial Water Content: 27.9%Unconfined Compressive Strength, q_u : **1.628** KSFUndrained Shear Strength, s_u : **0.814** KSF

References / Comments / Deviations:

Jacob Folsom

Technical Responsibility

Signature

Associate Project Manager

Position

4/13/2020

Date

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MOISTURE - DENSITY REPORT

Quality Assurance

ASTM D 698 Method A

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

S&ME Project #: 1183-20-006

Report Date: 04/13/20

Project Name: Woodford County High School

Test Date(s): 04/02/20

Client Name: Woodford County Board of Education

Client Address: 330 Pisgah Pike, Versailles, KY 40383

Sample Date: 03/23/20

Location: Multiple

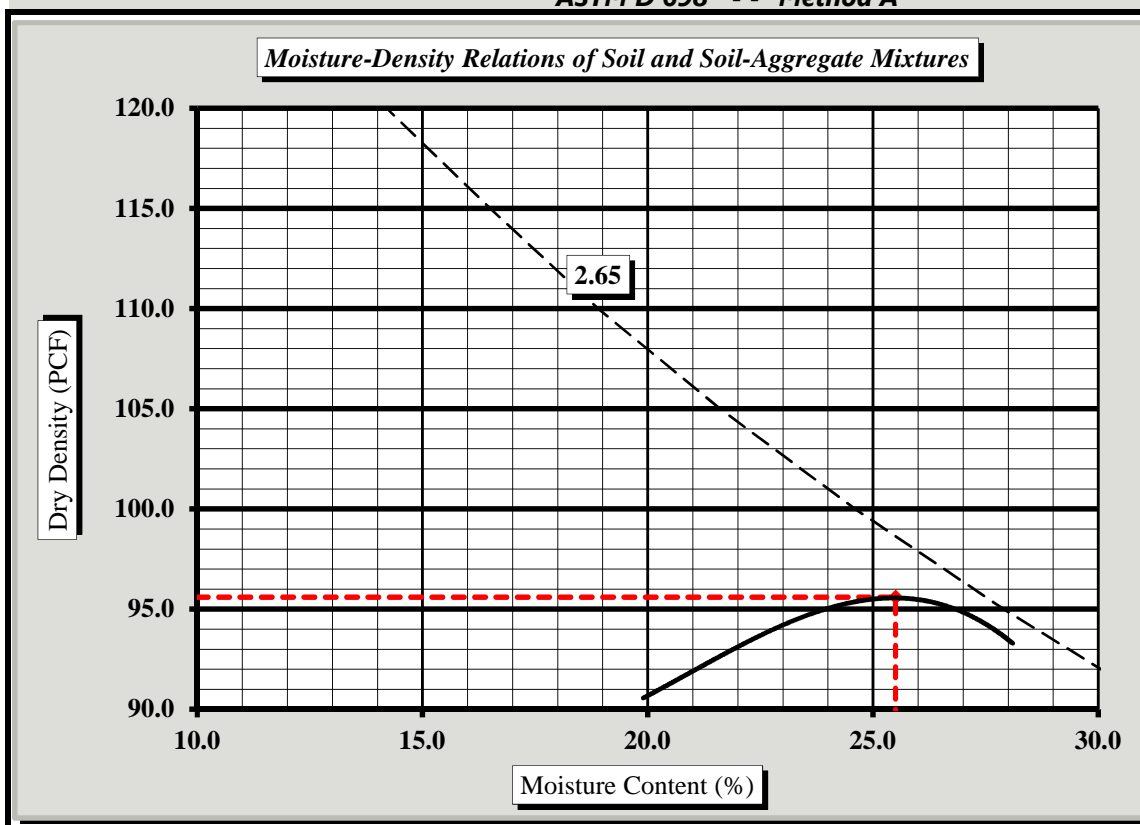
Depth (ft.): NP

Sample Description: Reddish brown Fat clay

CH

Maximum Dry Density 95.6 PCF.

Optimum Moisture Content 25.5%

ASTM D 698 - - Method A**Soil Properties**As Received
Moisture Content ND

Specific Gravity of Soil ND

Liquid Limit 65

Plastic Limit 26

Plastic Index 39

% Passing

3/4" ND

3/8" ND

#4 ND

#10 ND

#40 ND

#60 ND

#200 ND

Oversize Fraction

Bulk Gravity ND

% Moisture ND

% Oversize <5%

MDD NA

Opt. MC NA

Moisture-Density Curve Displayed: Fine Fraction ☒Corrected for Oversize Fraction (ASTM D 4718) ☐Sieve Size used to separate the Oversize Fraction: #4 Sieve ☒3/8 inch Sieve ☐3/4 inch Sieve ☐Mechanical Rammer ☒Manual Rammer ☐Moist Preparation ☐Dry Preparation ☒

References / Comments / Deviations: NA = Not Applicable; ND = Not Determined

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D 698: Laboratory Compaction Characteristics of Soil Using Standard Effort

Jacob Folsom

Technical Responsibility

Jacob Folsom

Signature

Associate Project Manager

Position

4/23/2020

Date

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CBR (California Bearing Ratio) of Laboratory Compacted Soil

ASTM D 1883



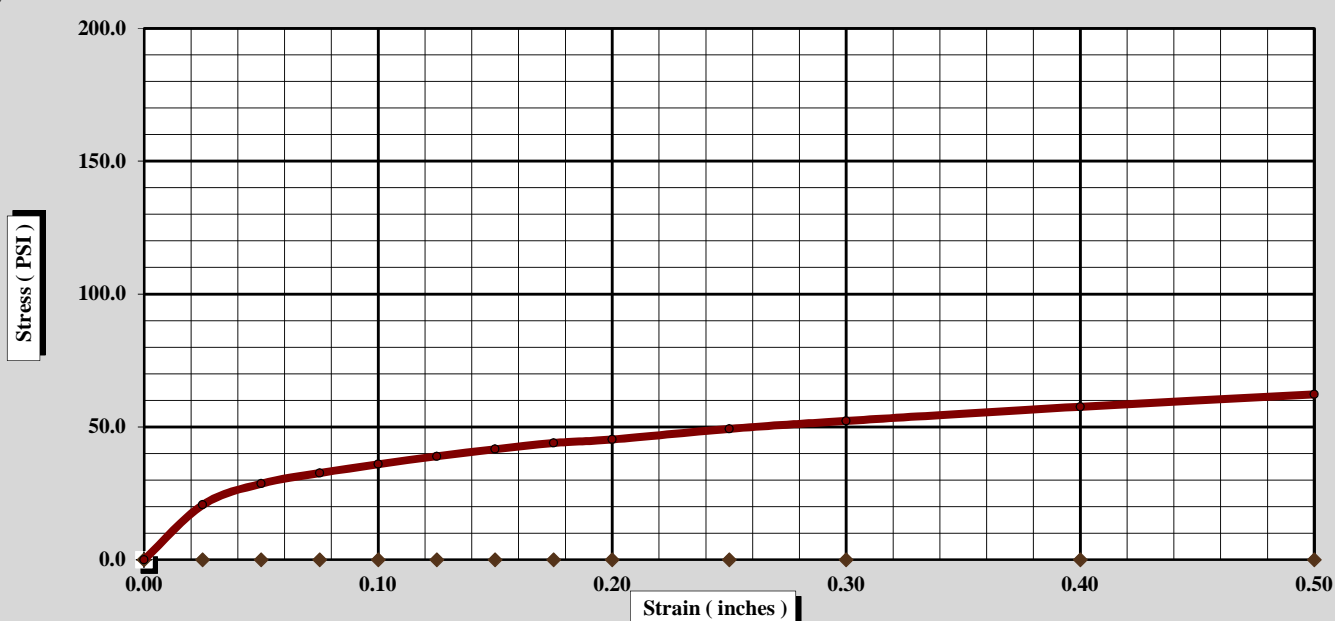
Quality Assurance

S&ME, Inc. - Lexington 2020 Liberty Road, Lexington, KY 40505

S&ME Project #:	1183-20-006	Report Date:	04/14/20
Project Name:	Woodford County High School	Test Date(s):	04/09/20
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Varsailles, KY 40383		
Location:	Multiple	Sample No:	Bulk
		Sample Date:	03/23/20

Sample Description:	Reddish brown Fat clay	CH
ASTM D 698 Method A	Maximum Dry Density: 95.6 PCF	Optimum Moisture Content: 25.5%
	Compaction Test performed on grading complying with CBR spec.	% Retained on the 3/4" sieve: 0.0%

Uncorrected CBR Values		Corrected CBR Values	
CBR at 0.1 in.	3.6	CBR at 0.1 in.	3.6
CBR at 0.2 in.	3.0	CBR at 0.2 in.	3.0



CBR Sample Preparation:	<i>The entire gradation was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1</i>
--------------------------------	--

Before Soaking		After Soaking	
Compactive Effort (Blows per Layer)	20	Final Dry Density (PCF)	86.4
Initial Dry Density (PCF)	88.3	Average Final Moisture Content	29.7%
Moisture Content of the Compacted Specimen	26.1%	Moisture Content (top 1" after soaking)	32.3%
Percent Compaction	92.4%	Percent Swell	2.5%
Soak Time:	96 hrs.	Surcharge Weight	10.0
Liquid Limit	65	Surcharge Wt. per sq. Ft.	51.0
		Plastic Index	39

Notes/Deviations/References:

Jacob Folsom
Technical Responsibility

Jacob Folsom
Signature

Associate Project Manager
Position

4/23/2020
Date

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CBR (California Bearing Ratio) of Laboratory Compacted Soil

ASTM D 1883

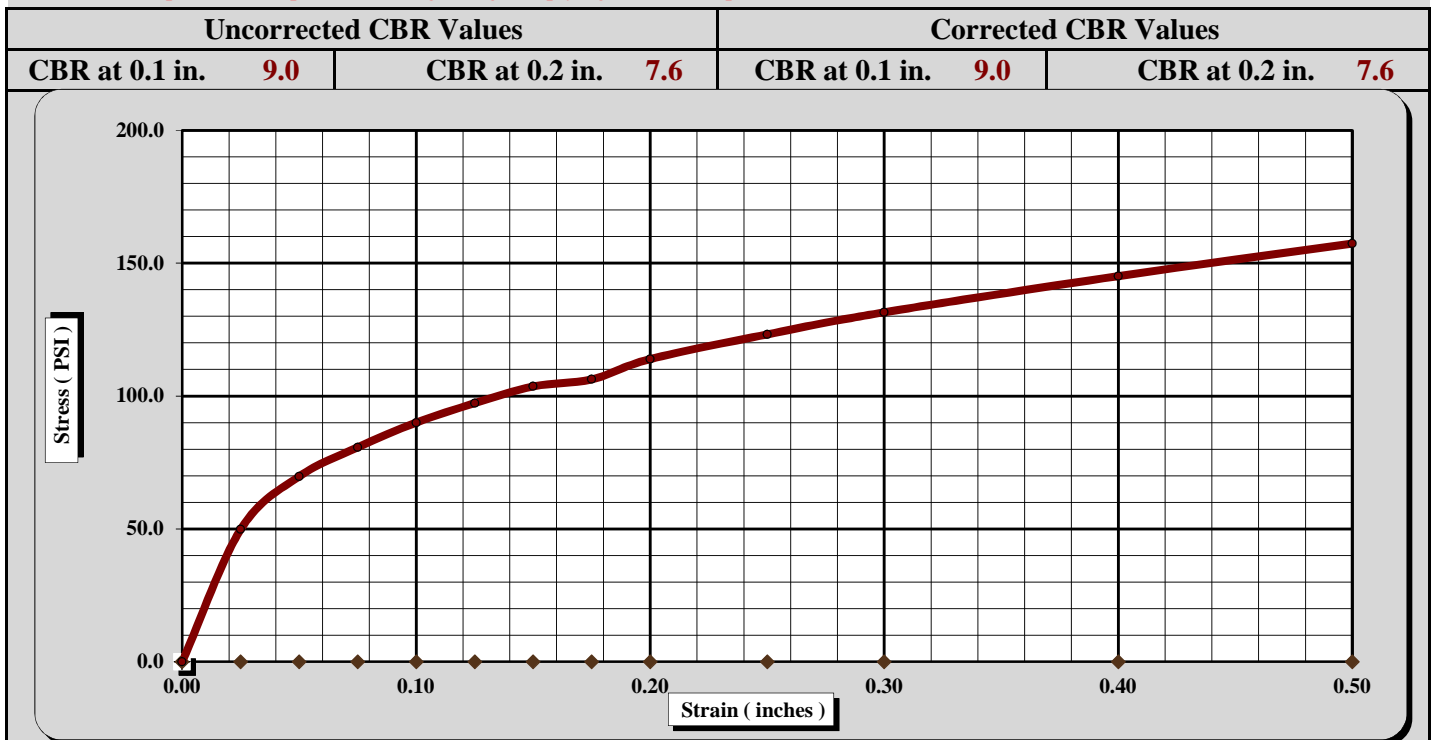


Quality Assurance

S&ME, Inc. - Lexington 2020 Liberty Road, Lexington, KY 40505

S&ME Project #:	1183-20-006	Report Date:	04/14/20
Project Name:	Woodford County High School	Test Date(s):	04/09/20
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Varsailles, KY 40383		
Location:	Multiple	Depth (ft.):	Bulk
		Sample Date:	03/23/20

Sample Description:	Reddish brown Fat clay	CH
ASTM D 698 Method A	Maximum Dry Density: 95.6 PCF	Optimum Moisture Content: 25.5%
	Compaction Test performed on grading complying with CBR spec.	% Retained on the 3/4" sieve: 0.0%



CBR Sample Preparation:			
<i>The entire gradation was used and compacted in a 6" CBR mold in accordance with ASTM D1883, Section 6.1.1</i>			
<i>Before Soaking</i>		<i>After Soaking</i>	
Compactive Effort (Blows per Layer)	56	Final Dry Density (PCF)	95.0
Initial Dry Density (PCF)	96.3	Average Final Moisture Content	26.7%
Moisture Content of the Compacted Specimen	25.9%	Moisture Content (top 1" after soaking)	29.6%
Percent Compaction	100.8%	Percent Swell	1.6%
Soak Time:	96 hrs.	Surcharge Weight	10.0
Liquid Limit	65	Surcharge Wt. per sq. Ft.	51.0
		Plastic Index	39
Notes/Deviations/References:			

Jacob Folsom
Technical Responsibility

Jacob Folsom
Signature

Associate Project Manager
Position

4/23/2020
Date

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CBR (California Bearing Ratio) of Laboratory Compacted Soil

ASTM D 1883



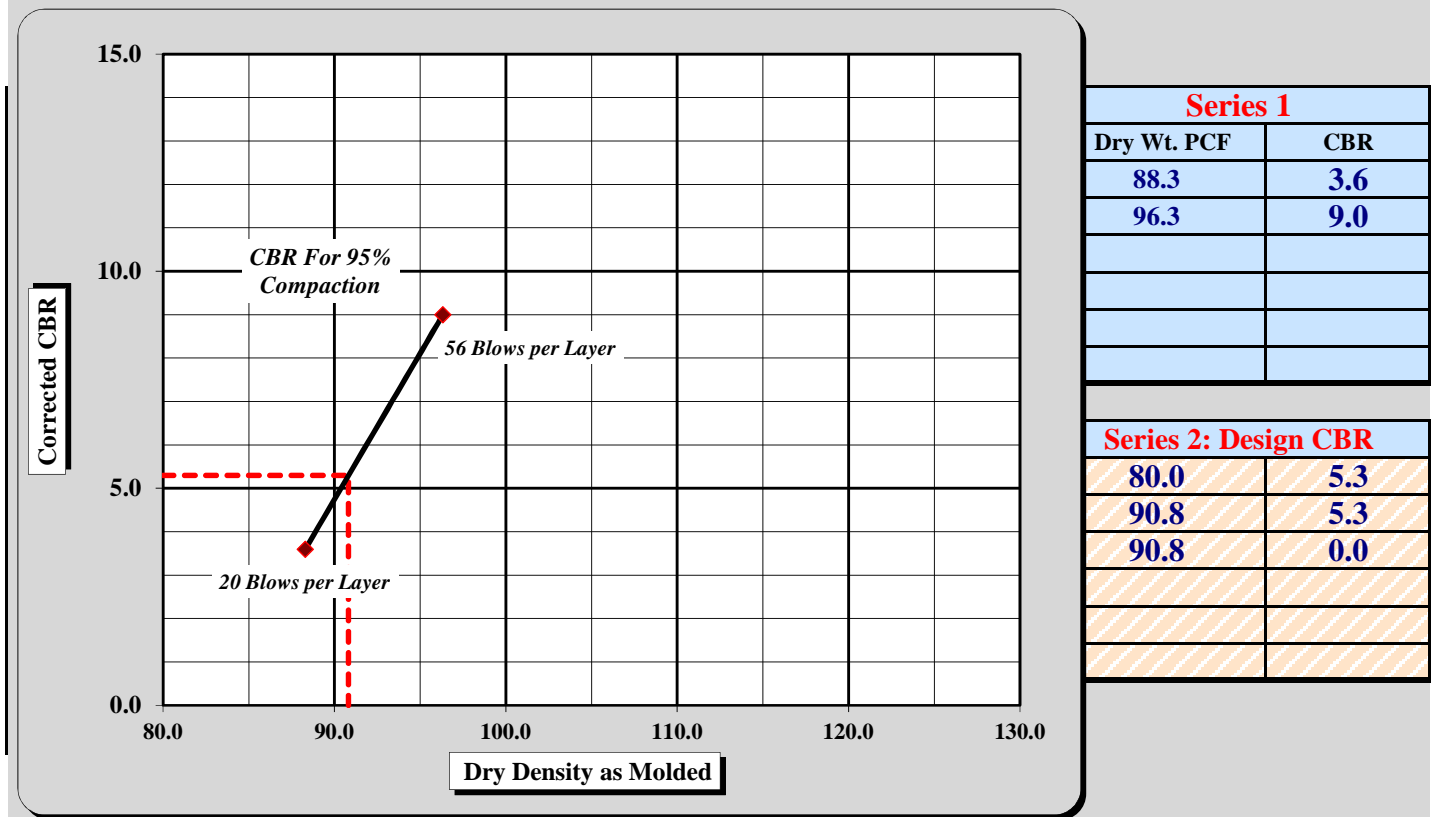
Quality Assurance

S&ME, Inc. - Lexington 2020 Liberty Road, Lexington, KY 40505

Project #:	1183-20-006	Report Date:	04/14/20
Project Name:	Woodford County High School	Test Date(s)	04/09/20
Client Name:	Woodford County Board of Education		
Client Address:	330 Pisgah Pike, Varsailles, KY 40383		
Location:	Multiple	Sample No:	Bulk
		Sample Date:	03/23/20

Sample Description: **Reddish brown Fat clay** CH

Dry Unit Weight vs. Corrected CBR Values



Notes / Deviations / References: **Interpolated CBR value at 95% is: 5.3**

Jacob Folsom
Technical Responsibility

Jacob Folsom
Signature

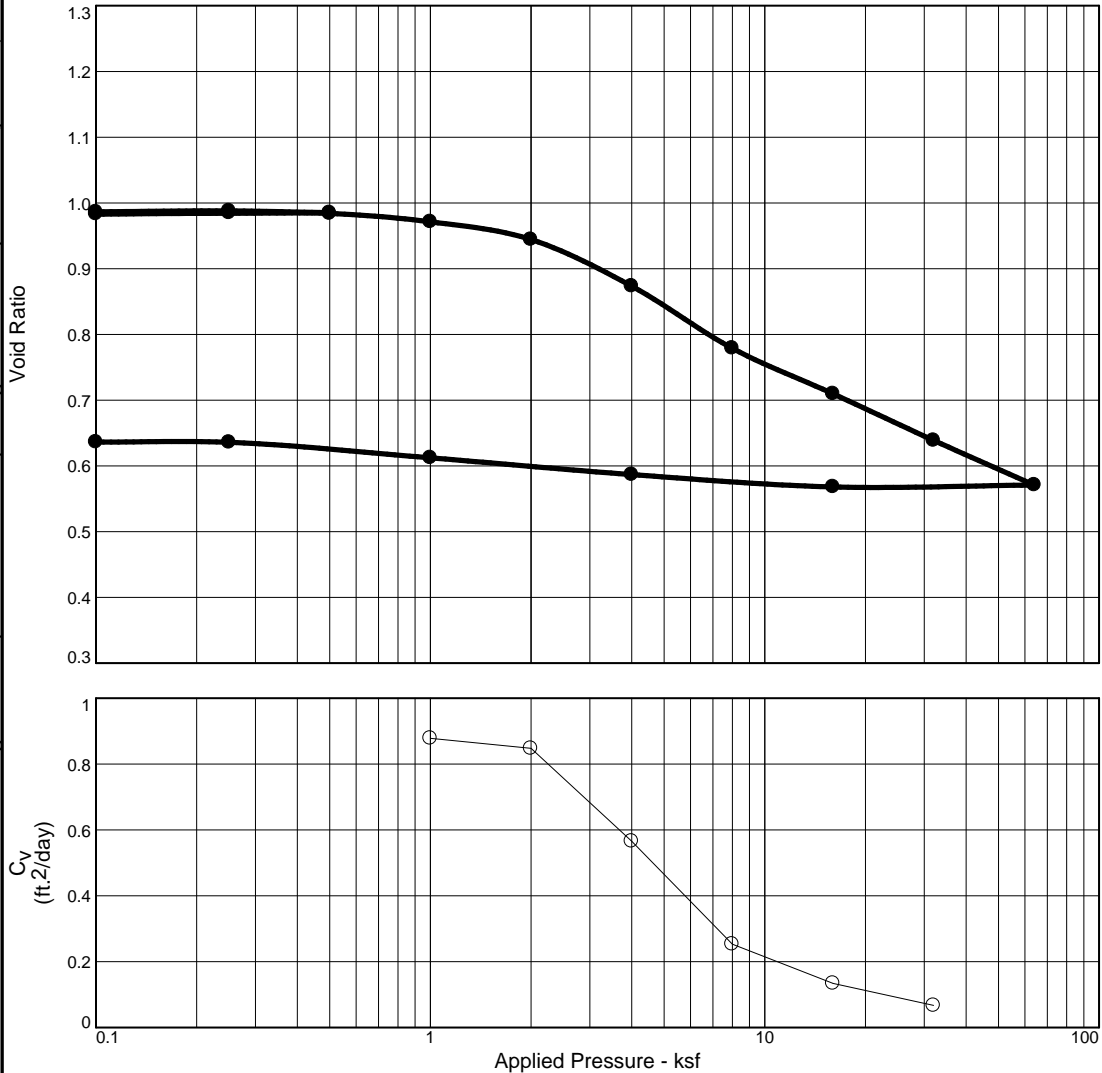
Associate Project Manager
Position

4/23/2020
Date

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Cc, Pc, etc are not test results but an interpretation of the test results. The designer is responsible for interpreting test data as provided by S&ME, Inc.

ASTM D2435 CONSOLIDATION TEST REPORT



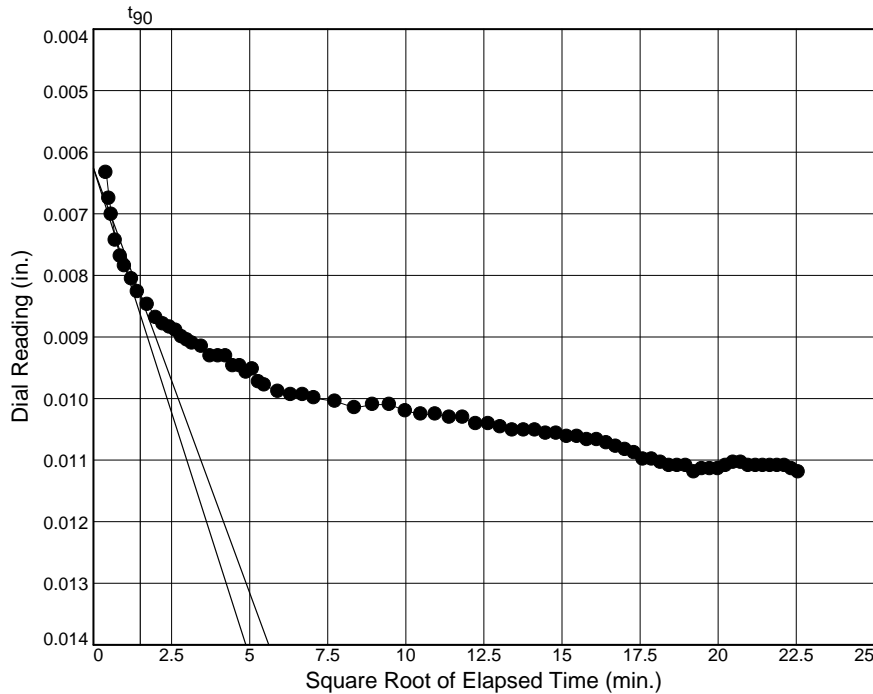
MATERIAL DESCRIPTION										USCS	
Reddish brown Fat clay										CH	
LL	PI	Sp. Gr.	Dry Dens. (pcf)		Moisture		Saturation		Void Ratio		
			Init.	Final	Init.	Final	Init.	Final	Init.	Final	
65	39	2.70	84.9	103.5	25.3 %	25.1	69.2 %	100.0	0.989	0.636	
Preparation Process: Remolded								D2435 Method			
Condition of Test: Inundated								B			
Project No. 118320006 Client: Woodford County Board of Education								Remarks: Sample remolded at 95% MDD at optimum moisture content.			
Project: Woodford County High School											
Location: Multiple								Checked By: J. Folsom			
S&ME, Inc.								Title: Associate Project Manager			
Lexington, Kentucky								Figure 1			

Tested By: J. LaMothe

Dial Reading vs. Time

Project No.: 118320006
Project: Woodford County High School

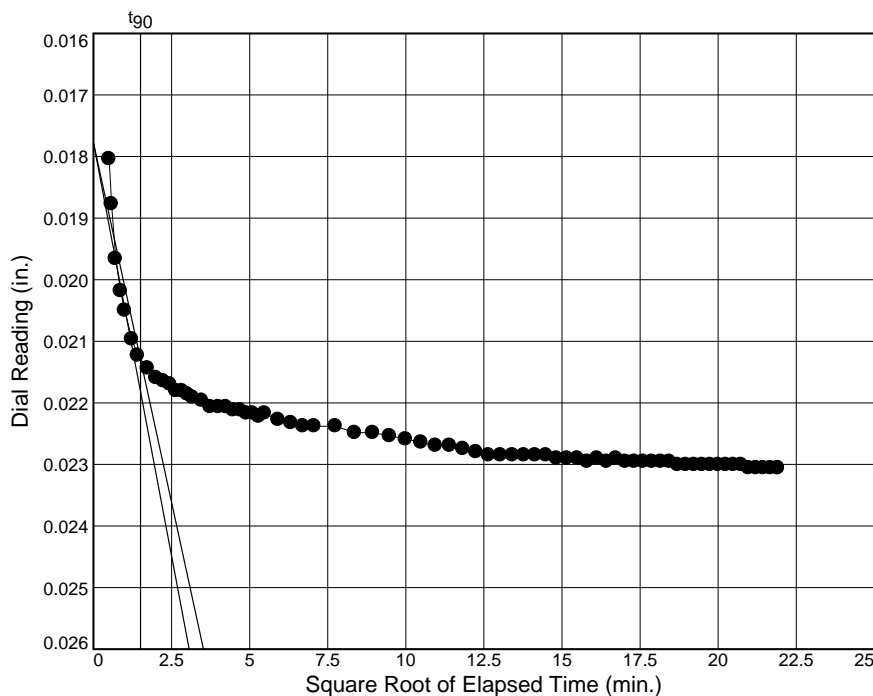
Location: Multiple



Load No.= 7
Load=1.00 ksf
 $D_0 = 0.0063$
 $D_{90} = 0.0083$
 $D_{100} = 0.0086$
 $T_{90} = 2.24$ min.

$C_v @ T_{90}$

0.878 ft.²/day



Load No.= 8
Load=2.00 ksf
 $D_0 = 0.0178$
 $D_{90} = 0.0213$
 $D_{100} = 0.0217$
 $T_{90} = 2.26$ min.

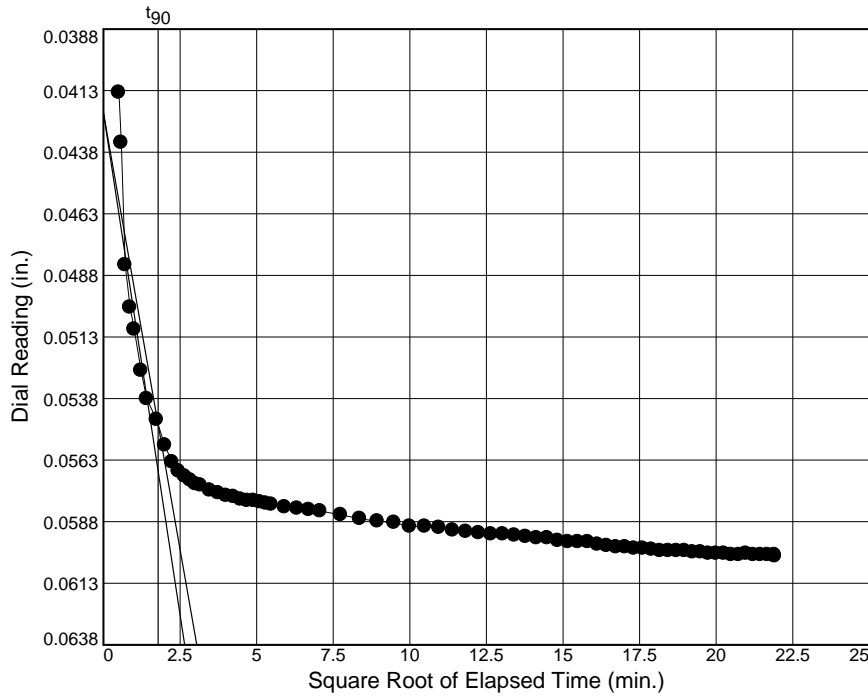
$C_v @ T_{90}$

0.848 ft.²/day

Dial Reading vs. Time

Project No.: 118320006
Project: Woodford County High School

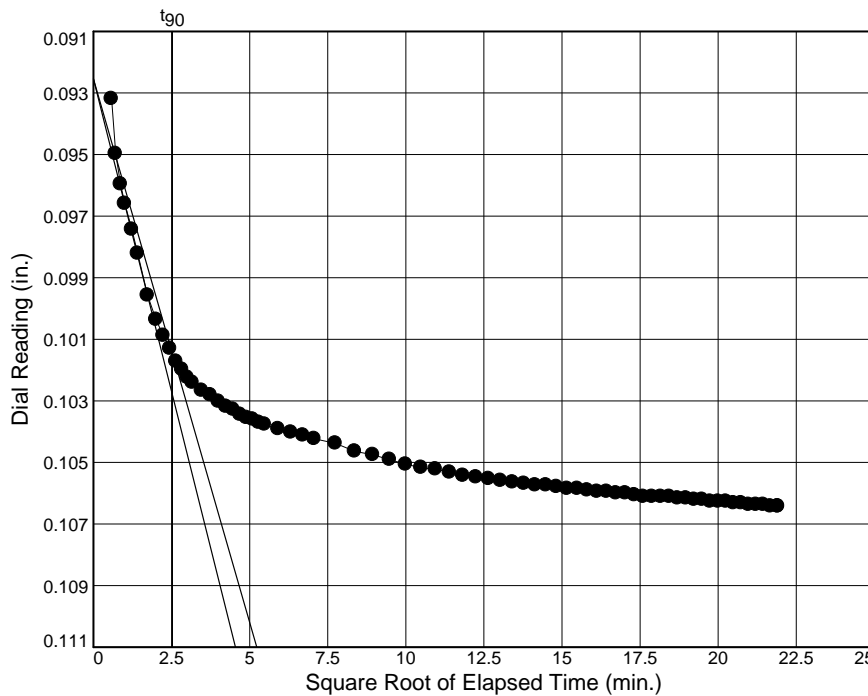
Location: Multiple



Load No.= 9
Load=4.00 ksf
 $D_0 = 0.0422$
 $D_{90} = 0.0549$
 $D_{100} = 0.0563$
 $T_{90} = 3.18$ min.

$C_v @ T_{90}$

0.566 ft.²/day



Load No.= 10
Load=8.00 ksf
 $D_0 = 0.0925$
 $D_{90} = 0.1015$
 $D_{100} = 0.1025$
 $T_{90} = 6.39$ min.

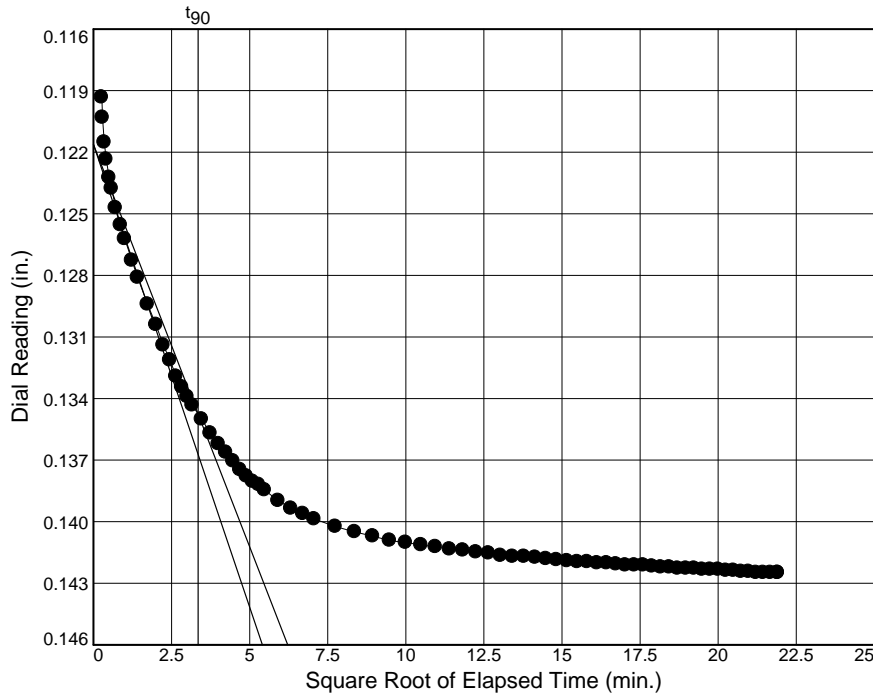
$C_v @ T_{90}$

0.253 ft.²/day

Dial Reading vs. Time

Project No.: 118320006
Project: Woodford County High School

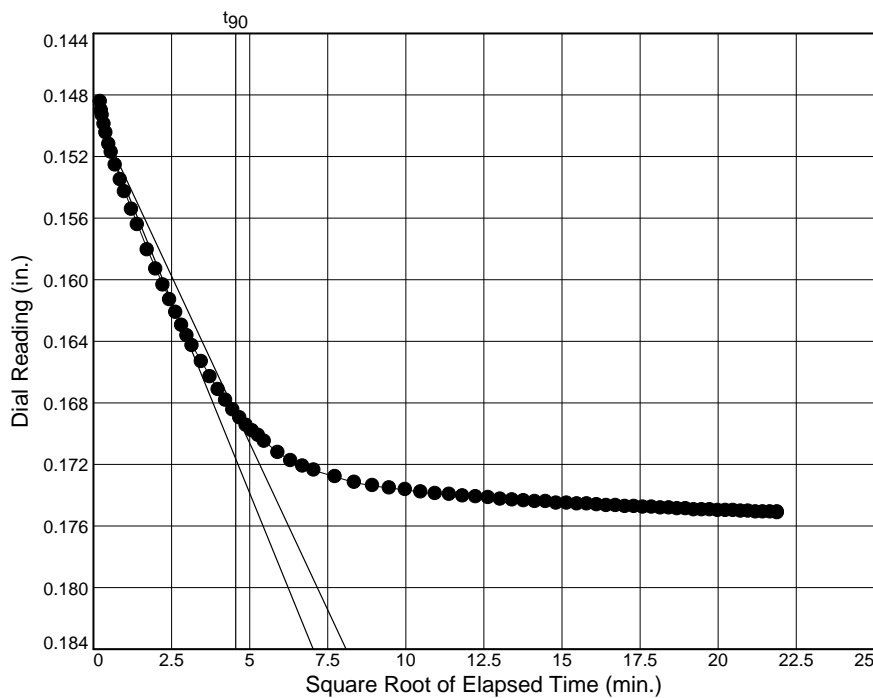
Location: Multiple



Load No.= 11
Load= 16.00 ksf
 $D_0 = 0.1216$
 $D_{90} = 0.1347$
 $D_{100} = 0.1362$
 $T_{90} = 11.21 \text{ min.}$

$C_v @ T_{90}$

0.134 ft.²/day



Load No.= 12
Load= 32.00 ksf
 $D_0 = 0.1489$
 $D_{90} = 0.1687$
 $D_{100} = 0.1709$
 $T_{90} = 20.72 \text{ min.}$

$C_v @ T_{90}$

0.067 ft.²/day



LABORATORY TESTING PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our "Test Boring Records."

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D 2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

Compaction Tests: Compaction tests are run on representative soil samples to determine the dry density obtained by a uniform compactive effort at varying moisture contents. The results of the test are used to determine the moisture content and unit weight desired in the field for similar soils. Proper field compaction is necessary to decrease future settlements, increase the shear strength of the soil and decrease the permeability of the soil.

The two most commonly used compaction tests are the Standard Proctor test and the Modified Proctor test. They are performed in accordance with ASTM D 698 and D 1557, respectively. Generally, the Standard Proctor compaction test is run on samples from building or parking areas where small compaction equipment is anticipated. The Modified compaction test is generally performed for heavy structures, highways, and other areas where large compaction equipment is expected. In both tests a representative soil sample is placed in a mold and compacted with a compaction hammer. Both tests have three alternate methods.

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/Layer
Standard D 698	A	5.5 lb./12"	4"	No. 4 sieve	3	25
	B	5.5 lb./12"	4"	3/8" sieve	3	25
	C	5.5 lb./12"	6"	3/4" sieve	3	56

Test	Method	Hammer Wt./Fall	Mold Diam.	Run on Material Finer Than	No. of Layers	No. of Blows/Layer
Standard D 1557	A	10 lb./18"	4"	No. 4 sieve	5	25
	B	10 lb./18"	4"	3/8" sieve	5	25
	C	10 lb./18"	6"	3/4" sieve	5	56

The moisture content and unit weight of each compacted sample is determined. Usually 4 to 5 such tests are run at different moisture contents. Test results are presented in the form of a dry unit weight versus moisture content curve. The compaction method used and any deviations from the recommended procedures are noted in this report.

Atterberg Limits: Portions of the samples are taken for Atterberg Limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D 4318.

Moisture Content: The Moisture Content is determined according to ASTM D 2216.



Appendix IV – ACI 302.1R-96 “GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION”

ADDENDUM
GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION
(302.1R-96)
Vapor Retarder Location

The report of ACI Committee 302, “Guide for Concrete Floor and Slab Construction (ACI 302.1R-96)” states in section 4.1.5 that “if a vapor barrier or retarder is required due to local conditions, these products should be placed under a minimum of 4 in. (100 mm) of trimable, compactible, granular fill (not sand).” ACI Committee 302 on Construction of Concrete Floors, and Committee 360 on Design of Slabs on Ground have found examples where this approach may have contributed to floor covering problems.

Based on the review of the details of problem installations, it became clear that the fill course above the vapor retarder can take on water from rain, wet-curing, wet-grinding or cutting, and cleaning. Unable to drain, the wet or saturated fill provides an additional source of water that contributes to moisture-vapor emission rates from the slab well in excess of the 3 to 5 lb/1000 ft²/24 h (1.46 to 2.44 kg/100 m²/24 h) recommendation of the floor covering manufacturers.

As a result of these experiences, and the difficulty in adequately protecting the fill course from water during the construction process, caution is advised on the use of the granular fill layer when moisture-sensitive finishes are to be applied to the slab surface.

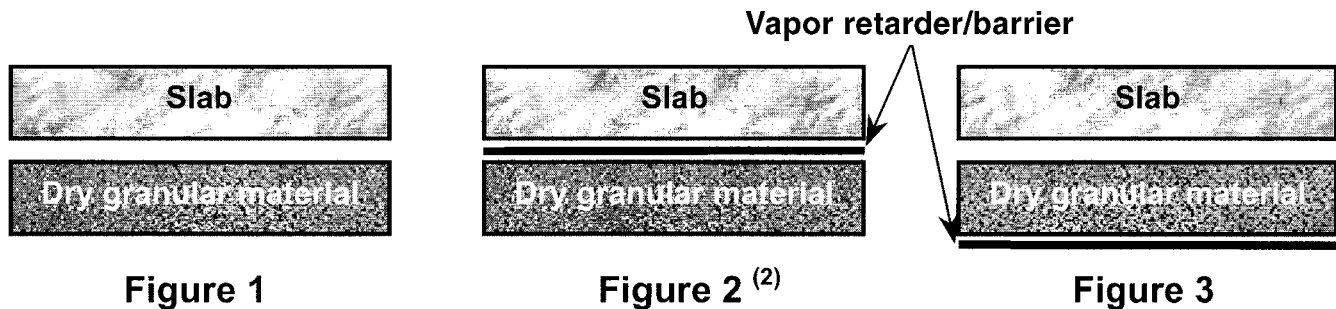
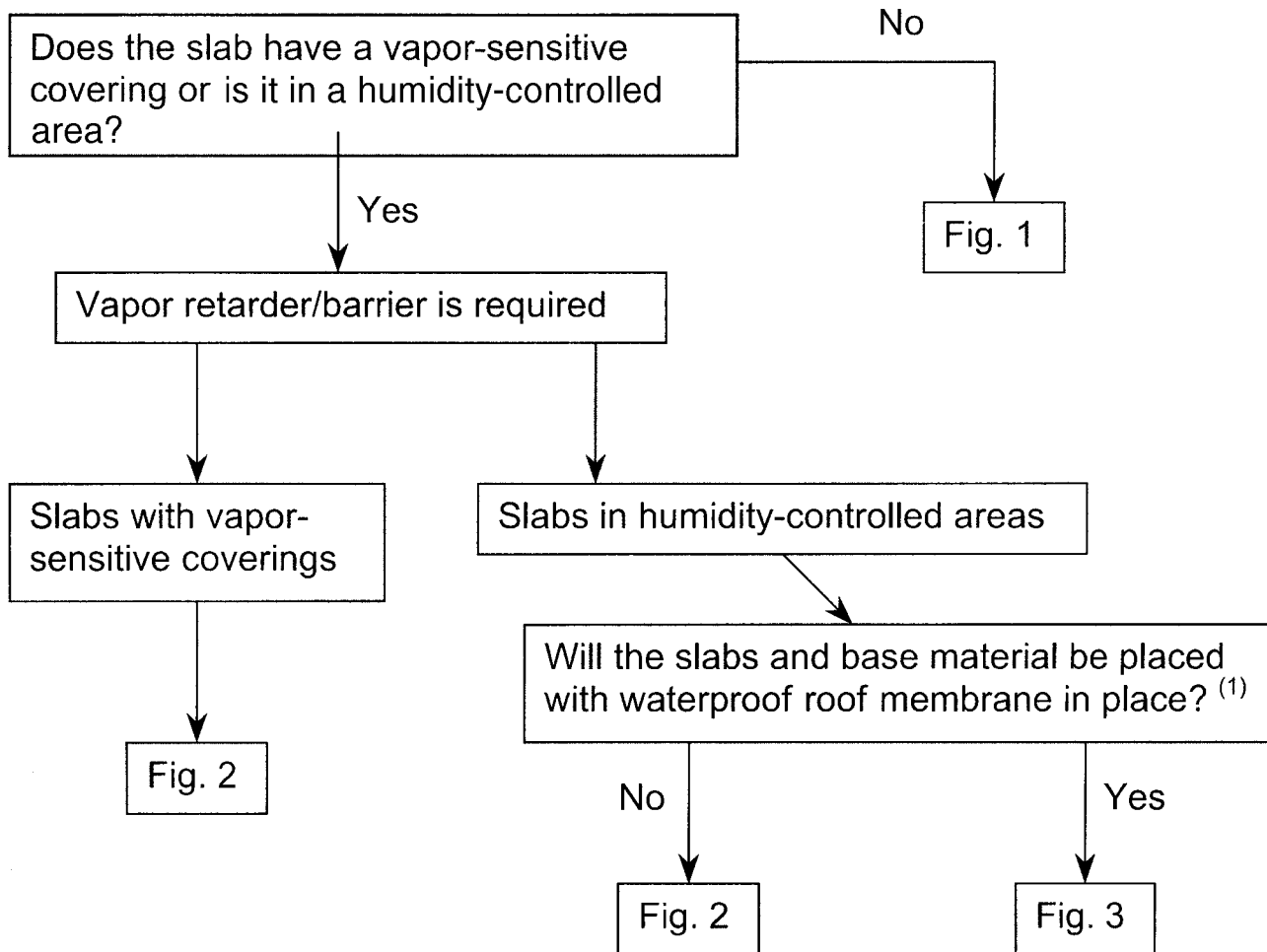
The committees believe that when the use of a vapor retarder or barrier is required, the decision whether to locate the retarder or barrier in direct contact with the slab or beneath a layer of granular fill should be made on a case-by-case basis.

Each proposed installation should be independently evaluated by considering the moisture sensitivity of subsequent floor finishes, anticipated project conditions and the potential effects of slab curling and cracking.

The following chart can be used to assist in deciding where to place the vapor retarder. The anticipated benefits and risks associated with the specified location of the vapor retarder should be reviewed with all appropriate parties before construction.

ADDENDUM
GUIDE FOR CONCRETE FLOOR AND SLAB CONSTRUCTION
(302.1R-96)

Flow Chart for Location of Vapor Retarder/Barrier



(1) If granular material is subject to future moisture infiltration, use Fig. 2

(2) If Fig. 2 is used, reduced joint spacing, a concrete with low shrinkage potential, or other measures to minimize slab curling will likely be required.

SECTION 013324 - STRUCTURAL SUBMITTALS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Structural submittals include shop drawings, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project.

1.02 RELATED SECTIONS

- A. Division 1 Sections

1.03 SUBMITTAL PROCEDURES

- A. Submittals shall be accompanied by a transmittal letter with the following information:
 - 1. Project name.
 - 2. Contractor's name.
 - 3. Date submitted.
 - 4. Description of items submitted; identify Work and product by Specification Section.
 - 5. Number of drawings and other pertinent data.
- B. Provide blank space on each submittal for the Architect/Structural Engineer's review stamp.
- C. The type and number of submittals for each item shall be in accordance with Section 013300.
- D. Contractor shall direct specific attention on the submittal to any deviation from the Construction Documents.

1.04 CONTRACTOR RESPONSIBILITY

- A. Contractor shall make all submittals in advance of installation or construction to allow the Architect/Structural Engineer sufficient time for review.
- B. Contractor shall review all submittals and shall stamp and sign each sheet of shop drawings and product data and sign each sample to certify compliance with requirements of Construction Documents. SUBMITTALS RECEIVED WITHOUT THE CONTRACTOR'S STAMP OF REVIEW WILL BE RETURNED TO THE CONTRACTOR FOR REVIEW AND RESUBMITTAL.
- C. Contractor shall understand that the submittal of the required documents does not constitute compliance with the requirements of the Construction Documents; only submittals reviewed by the Architect/Structural Engineer constitute compliance.
- D. It is the Contractor's responsibility to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted as well as the Construction Documents. Proprietary items specified herein only establish a minimum functional and aesthetic standard and it is incumbent upon the Contractor to ascertain conformance of these proprietary items or any proposed substitution with the codes and authorities.
- E. By reviewing, approving and submitting shop drawings, product data, or samples, Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, member sizes catalog numbers, and similar data and that he has checked and coordinated shop drawings with the requirements of the Project and of the Construction Documents.

- F. Work requiring shop drawings, whether called for by the Construction Documents or requested by the Contractor, shall not commence until the Architect/Structural Engineer has reviewed the submission. Work may commence if the Contractor verifies the accuracy of the Architect/Structural Engineer's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

1.05 ARCHITECT / STRUCTURAL ENGINEER REVIEW

- A. Architect/Structural Engineer will review submittals with reasonable promptness.
- B. Architect/Structural Engineer's review or corrections refer only to the general arrangement and conformance of the subject of the submittals with the design concept of the Project and with the information given in the Construction Documents. Under no conditions should the Contractor consider the review to include the dimensions, quantities, and details of the items nor the approval of an assembly in which the item functions.
- C. Architect/Structural Engineer's review shall not relieve the Contractor from responsibility for errors or omissions in the submittals.
- D. Architect/Structural Engineer's review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Construction Documents unless the Contractor has directed specific attention to the deviation at the time of submission and the Architect/Structural Engineer has given written approval to the specific deviation.
- E. Architect/Structural Engineer's review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

1.06 SHOP DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail of Construction Documents.
- B. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- C. Identify field dimensions; show relationship to adjacent or critical features of Work or products.
- D. A copy of the marked structural shop drawings with the Architect/Structural Engineer's review stamp is to be maintained at the job site.

1.07 PRODUCT DATA

- A. Submit only pages that are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.
- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information that is not applicable.
- C. Provide manufacturer's preparation, assembly, and installation instructions.

1.08 SAMPLES

- A. Submit full range of manufacturer's standard finishes, except where more restrictive requirements are specified, indicating colors, textures, and patterns.
- B. Submit samples to illustrate functional characteristics of products, including parts and attachments as required by Architect/Structural Engineer.
- C. Approved samples that are of proper size may be incorporated in Work.
- D. Label each sample with identification.
- E. Field Finishes: Provide full samples at Project, at location acceptable to Architect/Structural Engineer, as required by individual Specification Section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed Work.

1.09 RESUBMITTALS

- A. When submittals are returned to the Contractor with the Architect/Structural Engineer's corrections the Contractor shall make the required corrections. Upon request, resubmit one corrected set.
- B. Contractor shall direct specific attention on the resubmittal to all revisions including those requested by the Architect/Structural Engineer on previous submission.

1.10 DISTRIBUTION

- A. Distribute reproductions of shop drawings, copies of product data, and samples which bear the Architect/Structural Engineer's review stamp to job site file, Record Documents file, subcontractors, suppliers, other affected contractors, and other entities requiring information.
- B. Work shall be in accordance with and performed from the reviewed drawings.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION 013324

SECTION 014524 - STRUCTURAL SPECIAL INSPECTIONS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Section summarizes the responsibility of the Contractor and the Special Inspector in the performance of the special inspections required in the Construction Documents.
- B. Neither the observation of the Architect/Structural Engineer in the administration of the contract, nor tests/inspections by the Special Inspector, nor approvals by persons other than the Architect/Structural Engineer shall relieve the Contractor from his obligation to perform the Work in accordance with the Construction Documents.

1.02 RELATED SECTIONS

- A. Section 013324 - Structural Submittals.
- B. Section 014500 - Quality Control.

1.03 REFERENCES

- A. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
- B. American Council of Independent Laboratories – Recommended Requirements for Independent Laboratories Qualifications.

1.04 SELECTION AND PAYMENT

- A. Owner will employ and pay for the structural testing/inspection services that are required by the Construction Documents.
- B. Contractor shall pay for any additional structural testing/inspection required for Work or materials not complying with Construction Documents due to negligence or nonconformance.
- C. Contractor shall pay for any additional structural testing/inspection required for his convenience.

1.05 STRUCTURAL TESTING/INSPECTION REQUIREMENT SUMMARY

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings for the required tests/inspections.

PART 2 MATERIALS

Not Used.

PART 3 EXECUTION**3.01 STRUCTURAL PRECONSTRUCTION MEETING**

- A. A structural preconstruction meeting may be conducted at the construction site by the Structural Engineer to discuss quality issues. The parties involved may be the Architect, Contractor, Special Inspector, appropriate subcontractors, suppliers, and detailers.

3.02 SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Cooperate with the Contractor and provide timely service.
- B. Upon arriving at the construction site, sign in and notify the Contractor of presence.
- C. Select the representative samples that are to be tested/inspected.
- D. Perform tests/inspections as outlined in Construction Documents, the applicable codes, and as directed by the Structural Engineer.
- E. Report results of tests/inspections in accordance with the Construction Documents and the Building Code. Work and materials not complying with Construction Documents shall be immediately reported to the Contractor and Structural Engineer.
- F. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of Work or materials tested/inspected, whether the work or materials complies with Construction Documents and name of the Structural Testing/Inspection Agency's representative.
- G. Report and distribute results of tests/inspections promptly in the form of written reports as directed by the Structural Engineer.
- H. Special Inspector shall not alter requirements of Construction Documents, approve or reject any portion of the Work, or perform duties of the Contractor.
- I. Submit written confirmation at end of construction that, to the best of their knowledge, the structural Work conforms to the Construction Documents.

3.03 CONTRACTOR'S RESPONSIBILITIES

- A. Provide copy of Construction Documents to the Special Inspector.
- B. Arrange the preconstruction meeting to discuss quality issues.
- C. Notify the Special Inspector sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
- D. Cooperate with Special Inspector and provide access to Work.
- E. Provide samples of materials to be tested in required quantities.
- F. Furnish copies of mill test reports when requested.
- G. Provide storage space for Special Inspector's exclusive use, such as for storing and curing concrete testing samples.
- H. Provide labor to assist the Special Inspector in performing tests/inspections.

3.04 OPTIONS

- A. If the Structural Testing/Inspection Agency is located at such a distance from the Project that travel expenses will be a consideration, or if the amount of sampling performed is minor, and by mutual

agreement of the Architect/Structural Engineer and Contractor, the Contractor may be requested to take samples and forward them to the Structural Testing/Inspection Agency for testing/inspection.

END OF SECTION 014524

SECTION 015713 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED REQUIREMENTS

- A. Section 311000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- B. Section 312200 - Grading: Temporary and permanent grade changes for erosion control.
- C. Section 321123 - Aggregate Base Courses: Temporary and permanent roadways.
- D. Section 329219 - Seeding: Permanent turf for erosion control.

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus; 2014.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).
- C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- H. FHWA FLP-94-005 - Best Management Practices for Erosion and Sediment Control; 1995.
- I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2009.

1.04 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of State of Kentucky Erosion and Sedimentation Control Manual.
- C. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

- D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
 - 2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- E. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- F. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.
 - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 - 1. Prevent windblown soil from leaving the project site.
 - 2. Prevent tracking of mud onto public roads outside site.
 - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
 - 1. Submit within 2 weeks after Notice to Proceed.

2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 3. Obtain the approval of the Plan by authorities having jurisdiction.
 4. Obtain the approval of the Plan by Owner.
- C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures used during construction and temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mulch: Use one of the following:
1. Straw. Do not use hay.
 2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
 8. Manufacturers: subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. TenCate: www.tencate.com/#sle.
 - b. North American Green: www.nagreen.com/#sle.
 - c. Propex Geosynthetics: www.geotextile.com/#sle.

- D. Silt Fence Posts: One of the following, minimum 5 feet long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Hardwood, 2 by 2 inches in cross section.
- E. Gravel: See Section 321123 for aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.
 - d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- E. Crushed Stone Silt Checks: Stone check dams located along drainage swales and above headwalls. Silt checks are to be installed as required to reduce the sediment load of the runoff to local, State and Federal requirements. Construction is to be in accordance with the contract documents and KTC requirements.
- F. Soil Stockpiles: Protect using one of the following measures:
 1. Cover with polyethylene film, secured by placing soil on outer edges.
 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw; do not use hay.
- G. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.

1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- H. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
1. Excavate minimum of 6 inches.
 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
- B. Silt Fences:
1. Store and handle fabric in accordance with ASTM D4873.
 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 5. Install with top of fabric at nominal height and embedment as specified.
 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 7. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gage, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gage, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
 8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
 9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Mulching Over Large Areas:
1. Dry Straw: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
 2. Wood Waste: Apply 6 to 9 tons per acre.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- D. Mulching Over Small and Medium Areas:
1. Dry Straw: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- E. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.

7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Stone Silt Checks: Remove accumulated sediment when it reaches 1/3 of the height of the check.
- E. Clean out temporary sediment control structures weekly and relocate soil on site.
- F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 01 Sections
- B. Section 032000 - Concrete Reinforcing.
- C. Section 033000 - Cast-in-Place Concrete.

1.02 REFERENCES

ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

ACI 301 – Standard Specifications for Structural Concrete.

ACI 318 – Building Code Requirements for Structural Concrete.

ACI 347 – Guide to Formwork for Concrete.

ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

ASTM D6817 – Standard Specification for Rigid Cellular Polystyrene Geofoam.

ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

ASTM E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

ASTM E1643 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

ASTM E1745 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

ASTM E1993 – Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

ASTM F1249 – Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

1.03 DEFINITIONS

- A. Architectural Concrete: All concrete members exposed to public view are classified as Architectural Concrete and shall comply with the Architectural Concrete provisions in this specification and ACI 301.

1.04 SUBMITTALS

- B. Submit manufacturer's data for:
 - 1. Vapor Retarder

2. Expansion/Isolation Joint Filler.
3. Waterstops.

1.05 DESIGN OF FORMWORK

- A. Design of formwork, shoring, and reshoring and its removal is the Contractor's responsibility.
- B. Design of formwork, shoring, and reshoring shall conform to ACI 117, ACI 301, ACI 318, and ACI 347.
- C. Design formwork in a manner such that existing or new construction is not overloaded.

1.06 ARCHITECTURAL CONCRETE MOCK-UP

- A. Provide a mock-up as shown in the Drawings using the products and practices specified for Architectural Concrete to be reviewed and approved by the Architect.
- B. Mock-up shall be protected for the duration of the construction and will be used as the basis of acceptance for constructed work.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Form Material: Wood, plywood, metal, fiberglass or a combination of these, with sufficient strength to prevent distortion.
- B. Form Definitions
 1. Standard Forms: No form-facing material required. Standard forms are acceptable everywhere except for Architectural Concrete elements.
 2. Architectural Concrete Forms: Form-facing material shall be plywood, tempered concrete-form-grade hardboard, metal (unrusted) or plastic that will produce a smooth, uniform texture on the concrete. Do not use form-facing material with raised grain, torn edges, worn edges, patches, dents, or other defects that will impair the texture of the exposed concrete surfaces. Intent is that when the forms are removed, the exposed concrete surfaces will be free from all blemishes. Architectural concrete forms are required for all concrete elements indicated as Architectural Concrete.

2.02 FORMWORK ACCESSORIES

- A. Formwork Accessories: Commercially manufactured products, including ties and hangers. Do not use nonfabricated wire form ties.

2.03 FORM RELEASE AGENT

- A. Form release agent shall not bond with, stain, nor adversely affect concrete surfaces.

2.04 VAPOR RETARDER

- A. Vapor Retarder
 1. Polyethylene sheet, not less than 10 mils thick, complying with ASTM E1745, Class A, B, and C.
 2. Maximum Permeance: ASTM E96: 0.04 perms (US).
 3. Seam Tape: High Density Polyethylene Tape with pressure sensitive adhesive; minimum width of 4 inches.

4. Pipe Boots: Construct pipe boots from vapor barrier material and seam tape in accordance with manufacturer's instructions.

- B. Vapor Retarder for areas to receive Wood Flooring: Waterproof and vaporproof membrane complying with ASTM E1993 such as W.R. Meadows Premoulded Membrane Vapor Seal with Plasmatic Core.

2.05 EXPANSION / ISOLATION JOINT FILLER

- A. Expansion / Isolation Joint Filler: ASTM D1751, asphalt impregnated premolded fiberboard, 3/8-inch thick by full thickness of slab or joint, unless indicated otherwise in the Structural Drawings.

2.06 CONSTRUCTION JOINTS

- A. Slabs On Grade: Steel plate dowel (1/4" thick) such as manufactured by PNA Construction Technologies, Inc., Greenstreak Group, Inc., or approved equal.
 1. Plate Thickness: 1/4-inch thick for slabs up to 6 inches in thickness; 3/8-inch for slabs over 6 inches and up to 8 inches in thickness; 3/4-inch thick for slabs over 8 inches in thickness and up to 12 inches in thickness.

2.07 WATERSTOPS

- A. Waterstops at construction joints and contraction joints indicated in the Structural Drawings shall be sized to suit the joints.
- B. Waterstops: Flat, dumbbell type or centerbulb type, Polyvinyl Chloride (PVC) waterstop extruded from elastomeric plastic material, of which the basic resin is prime, virgin polyvinyl chloride.

PART 3 EXECUTION

3.01 GENERAL

- A. Erect formwork in accordance with ACI 301 and ACI 347.
- B. Finished work shall comply with tolerances of ACI 117.
- C. Provide 3/4-inch chamfer at all formed corners.

3.02 FOUNDATION ELEMENTS

- A. Form foundation elements if soil or other conditions are such that earth trench forms are unsuitable.
- B. Sides of perimeter grade beams, foundation walls, and turned-down slabs shall be formed.
- C. Maintain minimum coverage of reinforcing steel as indicated in Structural Drawings.

3.03 VAPOR RETARDER

- A. Where indicated on Structural Drawings, place vapor retarder over granular subbase and behind expansion / isolation joints at walls. Place electrical conduits and ducts in granular subbase.
- B. Install vapor retarder in accordance with manufacturer's instructions and ASTM E1643.
 1. Lap vapor retarder six inches minimum at splices and seal with seam tape.
 2. Lap vapor retarder over footings and seal to walls.

3. Seal all pipe penetrations with pipe boot.
4. No penetration of vapor retarder is permitted except for reinforcing steel and permanent utilities.
5. Do not puncture vapor retarder; repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides.

C. Install waterproof and vaporproof membrane in accordance with manufacturer's recommendations.

3.04 FORM PREPARATION

- A. Seal form joints to prevent leakage.
- B. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed.
- C. Before reinforcement is placed, coat contact surfaces of form with form release agent in accordance with manufacturer's recommendations. Do not allow excess form release agent to accumulate in forms or come in contact with concrete surfaces against which fresh concrete will be placed.

3.05 INSERTS AND EMBEDMENT ITEMS

- A. Install and secure in position required inserts, embeds, hangers, sleeves, anchors, and nailers.
- B. Locate anchor bolts/rods in position in accordance with approved setting drawings and secure to prevent displacement during concrete placement.

3.06 PROVISIONS FOR OTHER TRADES

- A. Install openings in concrete formwork to accommodate work of other trades. Determine size and location of openings and recesses from trades requiring such items. Obtain approval from Structural Engineer for openings not shown in Structural Drawings.
- B. Accurately place and securely support items built into forms.

3.07 CONSTRUCTION JOINTS

- A. Slabs On Grade: Install steel plate dowels in accordance with manufacturer's recommendations. Place plate dowels at mid-depth of slab (+/-1/4-inch), unless noted otherwise in the Structural Drawings.
- B. Framed Construction:
1. Install construction joints in accordance with ACI 318.
 2. Obtain Architect/Structural Engineer's prior approval for use and location of joints.
 3. Provide 1½-inch deep key-type construction joints at end of each placement for framed slabs, beams, walls, and footings. Bevel forms for easy removal.
 4. Remove loose particles and latency from surface prior to placing the next lift. Chip the surface to a depth sufficient to expose sound concrete.

3.08 WATERSTOPS

- A. Install PVC waterstops in accordance with manufacturer's recommendations.

3.09 DOVETAILS

- A. Install continuous vertical dovetail anchoring slots with filler strips at intersections of concrete and masonry walls unless indicated otherwise on Drawings.

3.10 FORMWORK REMOVAL

- A. Remove formwork carefully in such manner and at such time as to ensure complete safety of structure. Do not remove formwork, shoring, or reshoring until members have acquired sufficient strength to support their weight and the load thereon safely.
- B. For conventionally reinforced framed slabs, formwork shall remain in place for a minimum of 5 days after concrete placement.
- C. For Architectural Concrete elements, remove forms as early as permissible and in such a manner as to not damage exposed surfaces.

3.11 FINISHES OF FORMED SURFACES

- A. Standard Form Finish: Patch tie holes and defects. Chip or rub off fins exceeding ¼ inch in height. Leave surface with the texture imparted by the forms.
- B. Architectural Concrete Finish: Patch tie holes and defects. Remove all fins completely. Produce finish on newly hardened concrete no later than the day following formwork removal. Wet the surface and rub it with carborundum or other abrasive until uniform color and texture are produced. Use no cement grout other than cement paste drawn from the concrete itself by the rubbing process.

3.12 GEOFOAM

- A. Protect and install Geofoam in accordance with manufacturer's recommendations.
- B. Provide positive mechanical means to prevent displacement during concrete placement.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 1 Sections
- B. Section 031000 – Concrete Forming and Accessories.
- C. Section 033000 – Cast-in-Place Concrete.

1.02 REFERENCES

ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

ACI 301 – Standard Specifications for Structural Concrete.

ACI 315 – Details and Detailing of Concrete Reinforcement.

ACI 318 – Building Code Requirements for Structural Concrete.

ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete Reinforcement.

ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

AWS D1.4 – Structural Weld Code - Reinforcing Steel.

AWS D12.1 – Recommended Practices for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction.

CRSI – Manual of Standard Practice.

1.03 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Shop Drawings:
 - 1. Notify Structural Engineer prior to detailing reinforcing steel shop drawings.
 - 2. Indicate size, spacing, location and quantities of reinforcing steel and wire fabric, bending and cutting schedules, splice lengths, stirrup spacing, supporting and spacing devices. Detail reinforcing steel in accordance with ACI 315 and CRSI Standards.
 - 3. Written description of reinforcement without adequate sections, elevations, and details is not acceptable.
 - 4. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- C. Submit manufacturer's data for tension and compression splicers.

1.04 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

1.05 STORAGE AND PROTECTING

- A. Store reinforcing steel above ground so that it remains clean. Maintain steel surfaces free from materials and coatings that might impair bond.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Deformed Reinforcing Steel: ASTM A615, refer to Structural Drawings for grade (Grade 60 minimum).
- B. Welded Steel Wire Reinforcement: ASTM A1064.
- C. Epoxy-Coated Reinforcing Steel: ASTM A775, Grade 60.

2.02 ACCESSORY MATERIALS

- A. Annealed Steel Tie Wire: 16½ gage minimum.
- B. Bar Supports: Plastic-tipped steel Class I bar supports conforming to CRSI Specifications. Concrete brick may be used to support reinforcement to obtain proper clearance from earth.

2.03 SPLICERS

- A. Tension Splicers: Capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.

2.04 DOWEL ADHESIVE

- A. Adhesive conforming to Simpson AT-XP (IAPMO-UES ER-263), Simpson SET-XP (ICC-ES ESR-2508), DeWalt/Powers Pure110+ (ICC-ES ESR-3298), DeWalt/Powers DeWalt AC200+ Adhesive (ICC-ES ESR-4027), Hilti HIT-HY 200 Safe Set Fast Cure Adhesive (ICC-ES ESR-3187), Hilti HIT-RE 500 V3 SAFE Set Adhesive (ICC-ES ESR-3814). Minimum Embedment = 12 times anchor diameter, UNO.

PART 3 EXECUTION**3.01 FABRICATION**

- A. Fabricate reinforcing steel in accordance with ACI 318 and CRSI standards.
- B. Bend bars cold. Do not heat or flame cut bars. No field bending of bars partially embedded in concrete is permitted, unless specifically approved Structural Engineer and checked by Testing and Inspection Agency for cracks.
- C. Weld only as indicated. Perform welding in accordance with AWS D1.4 and AWS D12.1.
- D. Tag reinforcing steel for easy identification.

3.02 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles and coatings.
- B. Place, support, and secure reinforcement against displacement in accordance with ACI 318 and CRSI standards. Do not deviate from alignment or measurement.
- C. Place concrete beam reinforcement support parallel to main reinforcement.
- D. Locate welded wire reinforcement in the top third of slabs. Overlap mesh one lap plus two inches at side and end joints.
- E. Furnish and install dowels or mechanical splices at intersections of walls, columns and piers to permit continuous reinforcement or development lengths at such intersections.
- F. Maintain cover and tolerances in accordance with ACI and CRSI Specifications, unless indicated otherwise on Structural Drawings.

3.03 SPLICES

- A. Do not splice reinforcement except as indicated on Structural Drawings.
- B. Tension couplers may be used and installed in accordance with manufacturer's recommendations.

3.04 DOWELS IN EXISTING CONCRETE

- A. Install dowels and dowel adhesive in accordance with manufacturer's recommendations.
- B. Minimum embedment length into the existing concrete shall be 12 bar diameters, unless noted otherwise.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 1 Sections
- B. Section 031000 – Concrete Forming and Accessories.
- C. Section 032000 – Concrete Reinforcing.
- D. Section 036200 – Non-shrink Grouting.

1.02 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referenced to within the text by the basic designation only.

ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

ACI 301 – Specifications for Structural Concrete.

ACI 305.1 – Specification for Hot Weather Concreting.

ACI 306.1 – Standard Specification for Cold Weather Concreting.

ACI 308.1 – Specification for Curing Concrete.

ACI 311.6 – Specification for Testing Ready Mixed Concrete

ACI 311.7 – Specification for Inspection of Concrete Construction

ACI 318 – Building Code Requirements for Structural Concrete.

ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

ASTM C33 – Standard Specification for Concrete Aggregates.

ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

ASTM C94 – Standard Specification for Ready-Mixed Concrete.

ASTM C138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

ASTM C150 – Standard Specification for Portland Cement.

ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.

ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

ASTM C469 – Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.

ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

ASTM C920 – Standard Specification for Elastomeric Joint Sealants

ASTM D994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

ASTM E1155 – Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

1.03 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Submit three copies of the concrete mix designs. Include the following:
 - 1. Documentation of mix design proportions complying with ACI 301.
 - 2. Type and quantities of materials including admixtures
 - 3. Slump
 - 4. Air content
 - 5. Water/cement ratio
 - 6. Fresh unit weight
 - 7. Aggregates sieve analysis
 - 8. Design compressive strength
 - 9. Location of placement in structure
 - 10. Method of placement
 - 11. Method of concrete curing
 - 12. Method of protection of concrete
 - 12. Seven-day and 28-day compressive strengths
- C. Mix design submittals not conforming to the above will be rejected.

1.04 QUALITY ASSURANCE

- A. The ready-mixed concrete plant shall be certified for conformance with the requirements of the National Ready Mix Concrete Association.
- B. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

PART 2 PRODUCTS

2.01 CONCRETE MIX DESIGN

- A. Establish concrete mix design proportions in accordance with Article 4.2.3 of ACI 301.
- B. Concrete Strength: See Structural Notes in Structural Drawings.

- C. Slump
 - 1. Design concrete with a slump between four and ten inches.
 - 2. If a slump greater than five inches is desired, use a water reducer.
- D. Water/Cementitious Materials Ratio (w/cm): See Structural Notes in Structural Drawings.
- E. Entrained Air Content: See Structural Notes in Structural Drawings.
- F. Fresh Unit Weight
 - 1. Normal weight concrete: Fresh unit weight of 137 to 148 pcf.

2.02 MATERIALS

- A. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
- B. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
- C. Obtain aggregate from single source.
- D. Obtain each type of admixture from single source from single manufacturer.
- E. Materials designated by specific manufacturer's trade names are approved, subject to compliance with the quality and performance indicated by the manufacturer. Instructions and recommendations, published by the manufacturer of such materials are included in and are a part of these Specifications.

2.03 CEMENT

- A. Cement: Portland cement – ASTM C150.

2.04 FLY ASH

- A. Fly Ash: Class C or Class F – ASTM C618. When fly ash is used, the quantity shall be a minimum amount of 15 percent and a maximum amount of 25 percent by weight of the total cementitious materials, unless otherwise specified.

2.05 AGGREGATE

- A. Fine Aggregate: Fine aggregate complying with ASTM C33. Natural sand is preferred to manufactured sand.
- B. Fine Aggregate in slabs: The gradation of fine aggregate in concrete mix designs for floor slabs shall meet the requirements in the Table below:

Sieve Designation	Percent Passing	
	Normalweight Aggregate	Lightweight Aggregate
3/8 in.	100	100
No. 4	85 to 100	85 to 100
No. 8	80 to 90	–
No. 16	50 to 75	40 to 80
No. 30	30 to 50	30 to 65

No. 50	10 to 20	10 to 35
No. 100	2 to 5	5 to 20

- C. The weight of fine aggregate in the mix proportion shall not exceed 50 percent of the total weight of fine plus coarse aggregate.
- D. Coarse Aggregate: Washed gravel or crushed stone conforming to ASTM C33. When a single size or combinations of two or more sizes of coarse aggregates are used, the final grading shall conform to the grading requirements of ASTM C33, unless otherwise specified or permitted.
1. Unless governed by the maximum size as specified in Section 2 below, the largest practical-size coarse aggregate shall be used. Except for topping slabs 3-in. thick or less the largest size of coarse aggregate in normalweight concrete shall be a nominal $\frac{3}{4}$ -in. and the largest size of coarse aggregate in lightweight concrete shall be a nominal $\frac{1}{2}$ -in. For topping slabs that are 3-in. thick or less the maximum size of coarse aggregate shall be $\frac{3}{8}$ inch.
 2. The nominal maximum size of coarse aggregate shall not exceed three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

2.06 WATER

- A. Water: Potable water

2.07 AIR ENTRAINING AGENT

- A. Air Entraining Agent: Air entraining agent shall conform with ASTM C260. For normalweight concrete air entrainment shall not be used in flatwork to receive a hard steel-troweled finish.

2.08 WATER REDUCER

- A. Water Reducer: Water reducing agent shall conform with ASTM C494.

2.09 ACCELERATORS

- A. Accelerators: Non-chloride accelerators shall conform with ASTM C494.

2.10 RETARDERS

- A. Retarders: Retarders shall conform with ASTM C494.

2.11 CHLORIDE

- A. Chlorides: Chlorides of any form shall not be used in concrete.

2.12 CURING COMPOUND

- A. Curing Compound: A water-based, VOC-compliant concrete curing agent, hardener, and dustproofing agent that complies with ASTM C309. The curing agent shall be residue-free and contains no wax, resin, or other materials that would inhibit the bond of subsequent coatings and/or treatments. An example of a curing compound that meets this specification is Med-Cure by W.R. Meadows. Coordinate curing compound with flooring supplier to ensure compatibility.

PART 3 EXECUTION**3.01 GENERAL**

- A. Prepare place of deposit, mix, convey, and place in accordance with ACI 301 and ACI 304. If concrete is pumped, use a 5-inch minimum hose diameter, except for placement of metal pan stair treads where a 2-inch minimum hose is permitted.
- B. Wet forms before placing concrete.
- C. Deposit concrete continuously and as near as practical to final position.
- D. Deposit concrete in one layer or in multiple layers. Do not place fresh concrete against concrete that would result in cold joints.
- E. Do no flowing of concrete with vibrators.
- F. Do not place concrete over columns or walls until concrete in columns and walls has reached final setting.
- G. For cast-in-place floor systems place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at same time as concrete for adjacent slabs.
- H. Place and finish concrete members to comply with tolerances in ACI 117.
- I. Do not use aluminum equipment in placing and finishing concrete.
- J. Normalweight concrete for slabs to receive a hard-troweled finish shall not contain an air-entraining admixture or have a total air content greater than 3 percent.

3.02 SLABS-ON-GROUND

- A. Place concrete for slabs-on-ground on properly prepared granular subbase with vapor barrier.
- B. Place thickened slabs for partitions integral with floor slabs.

3.03 WATER REDUCERS

- A. Water reducers are to be added at dosage recommended by the manufacturer. The slump of the concrete shall be one to four inches at the time the water reducers are added. Do not permit fresh concrete containing superplasticizers to come in contact with fresh concrete not containing superplasticizers.

3.04 ADDITION OF WATER AT JOB SITE

- A. Water may be added at the jobsite if neither the maximum permissible water/cement ratio nor the maximum slump is exceeded. All concrete delivery trucks will have actual batch weight tickets available that clearly indicate the quantity of water that may be added at the jobsite that will not exceed the maximum water/cement ratio.

3.05 TIME LIMIT

- A. Deposit concrete within one and one-half hours after batching.

3.06 VIBRATION

- A. Consolidate concrete by vibration. Consolidate concrete around reinforcement, embedded items, and into corners of forms. Use immersion-type vibrators with nonmetallic heads for consolidating concrete around epoxy-coated or zinc and epoxy dual-coated reinforcing bars.
- B. Do not use vibrators to move concrete in a manner that will result in segregation.
- C. Spacing of immersion vibrator insertions shall not exceed 1-1/2 times the vibrator's radius of action in concrete being consolidated.

3.07 WEATHER PROVISIONS

- A. Do not place concrete while rain, sleet, or snow is falling unless protection is provided. Do not allow precipitation to increase mixing water or to damage concrete surface.
- B. Perform cold weather concreting in accordance with ACI 306. Concrete temperatures at delivery shall meet the requirements of Section 4 in ACI 301. Do not place concrete in contact with surfaces less than 35°F. Unless otherwise specified, this requirement shall not apply to reinforcing steel.
- C. Perform hot weather concreting in accordance with ACI 305. Unless otherwise specified, concrete temperature as placed shall meet the requirements of Section 4 of ACI 301. If temperature of reinforcement, embedments, or forms is greater than 120°F, use a fine mist of water to moisten and cool hot surfaces. Remove standing water before placing concrete.
- D. Protect concrete from drying and excessive temperature for the first seven days. Protect fresh concrete from wind.

3.08 CONTRACTION JOINTS

- A. Obtain Architect/Structural Engineer's approval for location of contraction joints. Do not use contraction joints in framed floors or composite slabs, unless noted in Structural Drawings.
- B. Unless noted otherwise in the architectural or structural drawings, provide contraction joints in slabs-on-ground to form a regular grid with a maximum spacing as noted in the Structural Drawings. The long dimension of the grid shall not exceed 1.5 times the short dimension of the grid. Contraction joints may be saw cut if cut within 24 hours after placement of concrete. Saw cuts shall be a depth equal to one-fourth the slab thickness by one-eighth inch wide. Alternately, contraction joints may be provided by preformed plastic strip inserts.

3.09 CONSTRUCTION JOINTS

- A. Obtain Architect/Structural Engineer's approval for location of construction joints.
- B. Install construction joints in accordance with Section 2 in ACI 301. Remove laitance and thoroughly clean and dampen construction joints before placement of fresh concrete.
- C. Use an approved bonding agent applied in accordance with the manufacturer's requirements or portland-cement grout of the same proportions as the mortar in the concrete; or roughen the surface in an approved manner that exposes coarse aggregate and does not leave laitance, loosened aggregate particles, or damaged concrete at surface.

3.10 CONCRETE FINISHES

- A. Finish Concrete in accordance with ACI 301.
- B. After form removal, give each formed surface the specified finish. If the Architectural and Structural drawings do not specify a finish, provide a SF-1.0 finish on concrete surfaces not exposed to view and a SF-2.0 finish on concrete surfaces exposed to view.
 - Surface Finish 1.0 (SF1.0)
 - 1. No formwork facing material is specified
 - 2. Patch voids larger than 1-1/2 in. wide or 1/2 in. deep
 - 3. Remove projections larger than 1 in.
 - 4. Tie holes need not be patched
 - 5. Surface tolerance Class D as specified in ACI 117
 - 6. Mockup not required
 - Surface Finish 2.0 (SF2.0)
 - 1. Patch voids larger than 3/4 in. wide or 1/2 in. deep
 - 2. Remove projections larger than 1/4 in.
 - 3. Patch tie holes
 - 5. Surface tolerance Class B as specified in ACI 117
 - 6. Unless otherwise specified, provide mockup of concrete surface appearance and texture
- C. If a Rubbed Finish is specified in the Architectural or Structural drawings, produce the smooth-rubbed finish no later than the day following formwork removal. Wet the surface and rub it with an abrasive such as carborundum brick until uniform color and texture are produced. If insufficient cement paste can be drawn from the concrete itself by the rubbing process, use a grout made with cementitious materials from the same sources as used for in-place concrete.
- D. If a finish is not otherwise specified for the unformed surfaces the following finishes shall apply (Refer to Section 5 of ACI 301 for requirements of each finish):
 - 1. Scratch finish—For surfaces intended to receive bonded cementitious or setting beds
 - 2. Float finish—For walks; steps; and for surfaces intended to receive waterproofing, roofing, insulation, or sand-bed terrazzo
 - 3. Trowel finish—For interior floors
 - 4. Broom finish—For parking slabs and exterior surfaces, including slabs, ramps, walkways, and steps, light broom finish for exterior balconies.
- E. Finish slabs to the following flatness and levelness tolerances:
 - 1. F_F35/F_L25 minimum overall for composite of all measured values and F_F24/F_L15 minimum for any individual floor section.
 - 2. Slabs to receive wood flooring: F_F45/F_L30 minimum overall for composite of all measured values and F_F30/F_L20 minimum for any individual floor section.
 - 3. Architect/Structural Engineer will identify which sections of slabs are to be tested for flatness and levelness.
 - a. F_L values are applicable only if testing is performed within 72 hours of concrete placement, before tensioning of tendons, and before removal of formwork. F_L values are not applicable to unshored systems.
 - b. F_F values are applicable to all types of slab construction and are not subject to any time constraints.

3.11 CURING

- A. Begin curing procedures in accordance with Section 5 of ACI 301 immediately following the commencement of the finishing operation. If bleed water sheen is not visible on surface of concrete after

strikeoff and initial bull floating, provide initial curing by means of fogging or application of evaporation retarder until final curing method is applied. Do not use fogging in cold weather concreting.

- B. After the initial curing outlined in A., apply the curing procedure as specified below. Apply curing in a manner that prevents marring, marking, or discoloration of finished surface. The curing methods below refer to ACI 301 (Specifications for Structural Concrete) and ACI 308.1 (Specification for Curing Concrete). The curing methods below are described in detail in these documents and the provisions of the curing method specified shall be adhered to. In addition, ACI 308 (Guide to External Curing of Concrete) may be used as a reference guide.
- C. Unless otherwise specified, one or more of the following methods are acceptable for curing formed surfaces or as final curing for unformed surfaces. Continue curing measures for at least 7 days after placement.
 - 1. Continuous Fogging—See ACI 301 and ACI 308
 - 2. Ponding—See ACI 301 and ACI 308
 - 3. Continuous Sprinkling—See ACI 301 and ACI 308
 - 4. Curing Compound—Apply membrane-forming curing compound in accordance with manufacturer's recommendation for specified concrete finish as soon as water sheen has disappeared from the concrete surface. For rough surfaces, such as a scratch, float, or broom finish, apply curing compound in two applications at right angles to each other.
- D. If the concrete will be exposed with a polished or stained finish use curing water that is free of substances that will stain or discolor concrete. The staining ability of curing water can be evaluated by means of CRD-C 401.
- E. At the end of the required wet-curing period, cover materials shall be allowed to dry thoroughly before removal to provide uniform, slow drying of the concrete surface. Controlled and gradual termination of wet or moist curing is particularly critical in cold weather when there is a risk of freezing the freshly exposed water-saturated surface. ACI 306R and ACI 301 contain recommendations for gradual termination of curing and protection.
- F. For formed surfaces, unless otherwise specified, if formwork is loosened or removed so that concrete surface is exposed to ambient air less than 7 days from concrete placement continue curing by either continuous fogging, ponding, continuous sprinkling, or a membrane-forming curing compound as described above and in ACI 301 and ACI 308.
- G. Maintain concrete temperature to prevent freezing of concrete and to ensure strength development. Unless otherwise specified, duration of thermal protection shall be at least 3 days.
- H. Maintain curing measures until the concrete has reached a minimum of 70 percent of the specified 28-day strength compressive strength, f'_c , but not less than 7 days.

3.12 CUTTING CONCRETE

- A. Obtain Architect/Structural Engineer's written approval prior to cutting concrete for installation of other work.

3.13 PATCHWORK AND REPAIRS

- A. Repair tie holes and other surface defects in formed finishes unless otherwise specified. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.
- B. Notify Architect/Structural Engineer of any defective areas (other than tie holes) in concrete to be patched or repaired. Unless otherwise specified or permitted, repair surface defects by the following method.

Outline repair area with a 1/2 in. deep saw cut and remove defective concrete down to sound concrete. Leave chipped edges perpendicular to the saw-cut surface or slightly undercut. Do not feather edges. Dampen the area to be patched plus 6 in. around the patch area perimeter. Prepare scrub coat mix using one-part portland cement and one-part sand by loose volume with water. Thoroughly brush scrub coat into the surface. When the scrub coat begins to lose water sheen, apply patching mortar (for concrete exposed to view, mortar shall match adjacent concrete color) and thoroughly consolidate mortar into place. Strike off mortar, finishing flush to the final surface. Leave the patch undisturbed for 1 hour before finishing. Keep the patch damp for 7 days.

END OF SECTION 033000

SECTION 034100 - PRECAST STRUCTURAL CONCRETE**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Section includes the design, manufacture, and erection of structural precast members (including precast, prestressed concrete members).

1.02 RELATED SECTIONS

- A. Division 1 Sections.

1.03 REFERENCES

ACI 301 – Specifications for Structural Concrete Buildings.

ACI 318 – Building Code Requirements for Reinforced Concrete.

ASTM C33 – Standard Specification for Concrete Aggregates.

ICC 500-2014 – ICC/NSSA Standard for the Design and Construction of Storm Shelters

PCI MNL 116 – Manual for Quality Control for Plants and Production of Structural Concrete Products.

PCI MNL 120 – PCI Design Handbook – Precast and Prestressed Concrete.

PCI MNL 135 – Tolerance Manual for Precast and Prestress Concrete Construction.

1.04 DESIGN REQUIREMENTS

- A. Structural precast members and their connections shall be designed by an engineer licensed in the project state.
- B. Structural precast members shall be designed in accordance with ICC 500-14. See PRECAST MANUFACTURER'S Structural Notes for design requirements. Design shall be in compliance with ACI, Chapter 16 and the design recommendations of PCI MNL 120.
- C. Design modifications may be made only as necessary to meet field conditions, to ensure proper fitting of the work, and as acceptable to the Architect/Structural Engineer. Maintain the general design concept shown without increasing or decreasing sizes of members or altering profiles and alignment shown.
- D. Refer to Architectural Documents for fire rating requirements, if any.

1.05 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Submit manufacturer's and erector's qualifications demonstrating compliance with this specification with the bid.
- C. Shop drawings:
 - 1. Shall include the following:

- a. Amount and location of prestressing strands and reinforcement.
 - b. Location of openings and built-in work.
 - c. Bearing requirements.
 - d. Design loads.
 - e. Design camber.
 - f. Miscellaneous details.
 - 2. Submit to Architect/Structural Engineer for review.
 - 3. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- D. Maintain tensioning records, concrete records, and calibration records for jacking equipment at the project site, available for review by the Architect/Structural Engineer.

1.06 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings

1.07 QUALIFICATION OF MANUFACTURER

- A. Manufacturer shall have a minimum of five years of successful experience in the manufacturing of precast concrete units of quality and scope required on this project.
- B. Manufacturing plant shall be certified by the Prestressed Concrete Institute Plant Certification Program.

1.08 QUALIFICATION OF ERECTOR

- A. Erector shall have a minimum of five years of successful experience in erection of precast concrete units of quality and scope required on this project.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver precast concrete units to the project site in such quantities and at such times as will ensure the continuity of the installation. Store units at the project site to ensure against cracking, distortion, staining, or other physical damage. Lift and support units with suitable lifting devices only at the lifting or supporting points shown on the shop drawings.

PART 2 PRODUCTS

2.01 PRECAST PRESTRESSED UNITS

- A. Furnish precast prestressed units in accordance with PCI MNL 116.
- B. Design units according to ACI 318 for load and span conditions indicated.

2.02 MANUFACTURING TOLERANCES

- A. Comply with camber and dimensional tolerances of the PCI MNL 135.
- B. Machine cast units on long production lines in smooth rigid forms.

2.03 GROUT

- A. Non-shrink grout consisting of a premixed, packaged ferrous aggregate shrinkage-resistant grout complying with Corps of Engineers CRD-C588, Type M, and only enough water for a flowable mixture without segregation or bleeding.

2.04 ACCESSORIES

- A. Provide all bearing strips, clips, hangers, and other accessories required for installation of precast units and for support of subsequent construction or finishes.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Installer must examine all parts of the supporting structure and the conditions under which the precast concrete work is to be erected. Notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Verify dimensions of supporting structures at the project site and adjust final shop drawings to reflect actual field dimensions.
- C. Do not erect units until supporting members are completely in place.

3.02 INSTALLATION

- A. Install precast concrete framing structural members plumb, level, and in alignment within the specified limits of erection tolerances. Provide temporary supports and bracing as required to maintain position, stability and alignment as members are being permanently connected.
- B. Install flexible bearing pads where indicated as precast units are being erected. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed.
- C. Do not install precast units until concrete has attained its design ultimate compressive strength.
- D. Install precast units without exceeding the following tolerance limits:
 1. Variations from plumb: 1/4" in any 20' run or story height; 1/2" total in any 40' or longer run.
 2. Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.
 3. Variation from Theoretical Position in Plan: Plus or minus 1/4" maximum at any location.
 4. Offsets in Alignment of Adjacent Members at Any joint: 1/16" in any 10' run; 1/4" maximum.
- E. Grout open spaces at connections and joints, after precast concrete units have been placed and permanently connected.
- F. Provide forms or other method for retaining grout in place until hard enough to support itself. Pack spaces with grout by tamping or ramming until voids are completely filled.
- G. Perform cutting and fitting of precast slab units as required for the passage of other projecting or adjacent work. Provide straight and clean cuts without breaking or spalling edges.
- H. Do not cut any reinforcing steel members unless otherwise acceptable to the precast unit manufacturer and the Architect/Structural Engineer.

- I. Reinforce edges of cut openings where required to maintain the structural integrity of the precast units.
- J. Lifting devices shall be removed after units are in place.

3.03 CUTTING OPENINGS

- A. NO Openings may be field drilled or cut after the units are in place without written approval. Obtain written approval from the manufacturer before drilling or cutting.

END OF SECTION 034100

SECTION 035216 - LIGHTWEIGHT INSULATING CONCRETE**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cast-in-place cellular type lightweight insulating concrete fill over new structural metal roof decking.
 - 1. Metal deck is vented.
- B. Perimeter joint filler.

1.02 RELATED REQUIREMENTS

- A. Section 053100 - Steel Decking: Roof deck requirements.
- B. Section 075400 - Thermoplastic Membrane Roofing: Roof membrane and warranty information.
- C. Section 077100 - Roof Specialties: Installation of roof specialties.
- D. Section 077200 - Roof Accessories: Installation of roof accessories
- E. Refer to plumbing, mechanical and electrical specifications and drawings for roof drains, pipe, conduit and HVAC penetrations.

1.03 REFERENCE STANDARDS

- A. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- B. ASTM C 177/04 - Standard Test method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

1.04 TESTING REQUIREMENTS

- A. ASTM C 495 - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
- B. ASTM C 796 /80 - Standard Method of Testing for Foaming Agents for use in Producing Cellular Concrete Using Preformed Foam, 1986.
- C. ASTM C 869/91 - Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete, 1999.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate layout of slopes, drain locations, interruptions, terminations, insulation thickness, plans, sections, details, roof penetrations and roof perimeter.
- B. Product Data: Provide physical characteristics, thermal values, product limitations.
 - 1. Provide mixing and application instructions.
 - 2. Submit independent laboratory test results for the following performance criteria:
 - a. Thermal insulation value per ASTM C 177.
 - b. Mix design compressive strength per ASTM C 796.
 - c. Mix design wet and dry density range per ASTM C 796.
 - d. Expanded polystyrene (EPS) density per ASTM C 578.
- C. Certificates: Certify that products of this section meet or exceed specified requirements and that densities, indicated thicknesses, and thermal values have been achieved.
- D. Design mixes for each lightweight insulating concrete mix, including as-cast unit weight, oven-dry unit weight, and compressive strength.

- E. Submit documentation, from the manufacturer of the proposed lightweight insulating concrete system, confirming that the expanded polystyrene used as a component in the lightweight insulating concrete system is approved for use in the proposed lightweight insulating concrete system.
- F. Additional material certificates by lightweight insulating concrete manufacturer certifying that all other material items comply with requirements of the system specified.
- G. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence lightweight insulating concrete's compliance with building code in effect for Project.
- H. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed lightweight insulating concrete system confirming that the lightweight insulating concrete installer is approved to install the proposed lightweight insulating concrete system meeting the roof warranty specified.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Lightweight insulating concrete manufacturer is to have an indemnity arrangement with the selected roofing membrane manufacturer such that the lightweight insulating concrete can be included within the single source, 20 year, No Dollar Limit (NDL) warranty per the requirements of the Special Project Full System Roof Warranty in the roof specification section 075400.
- B. Installer Qualifications: Company specializing in placing lightweight insulating concrete of the type specified in this section with minimum 10 years of experience prior to the bid.
- C. Installer Qualifications: Engage an experienced Installer who has completed lightweight insulating concrete work similar in material, design, and extent to that indicated for this Project and who is approved or certified prior to bid by the manufacturer of the lightweight insulating concrete system to be a part of the single source, 20 year, No Dollar Limit (NDL) warranty per the requirements of the Special Project Full System Roof Warranty in the roof specification section 075400 and signed by the roof membrane manufacturer.
- D. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM C 1077 and ASTM E 329, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- E. Fire-Test-Response Characteristics: Where indicated, provide lightweight insulating concrete identical to that tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: As indicated by design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

1.07 PRE-INSTALLATION MEETING

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at project site. Meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and roof accessories, Architect, Owner, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers and test agencies. This meeting must be attended by the on-site Foreman overseeing the work.
 - 1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather

conditions, governing regulations, insurance requirements, and proposed installation procedures.

2. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.
3. Discuss water required for installation of the lightweight insulated concrete. Discuss local/regional water company regulations, metering, or permits required.
4. Record discussion, including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.08 FIELD CONDITIONS

- A. Do not place insulating concrete mix at ambient temperatures lower than 40 degrees F and rising without heating mix water to 90 to 110 degrees F.
- B. Do not place lightweight insulating concrete during rain snow or on surfaces covered with standing water, snow or ice.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original undamaged packages or acceptable bulk containers.
- B. Store packaged materials to protect them from elements or physical damage.
- C. Do not use cement that shows indications of moisture damage, caking or other deterioration.

1.10 WARRANTY

- A. Lightweight insulating concrete warranty to be provided within the Special Project Full System Roof Warranty as required under Section 075400. Lightweight insulating concrete warranty is not to be a separate pass-thru warranty attached to the roof warranty.
 1. The roofing subcontractor shall not offer the LWIC/roofing warranty cost as a deduct to their bid price.
 2. The roofing and lightweight insulated concrete warranty is to be provided by the roofing contractor and is not to be obtained at a later date by the General Contractor/ Construction Manager.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 1. Lightweight Insulating Concrete:
 - a. Celcore, Inc. : www.celcoreinc.com
 - b. Elastizell Corporation of America : www.elastizell.com
 - c. Siplast Inc: www.siplast.com
 - d. Aerix Industries (formerly Cellular Concrete Solutions); Mearlcrete Division: www.aerixindustries.com

2.02 MATERIALS

- A. Cement: ASTM C 150, Portland Type I, Type II or Type III gray color.
- B. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
- C. Foaming Agent; ASTM C 869
- D. Molded Polystyrene Insulation Board: ASTM Type C 578, Type 1, 0.90-lb/cu. ft. minimum density. Provide units with keying slots of approximately 3 percent of board gross surface area.

2.03 ACCESSORIES

- A. Roof Deck Gap and Hole Filler:
 - 1. Expandable sealant and other materials and methods of sealing gaps, holes and penetrations are acceptable, provided that they are approved by the lightweight insulating concrete manufacturer.

2.04 CONCRETE MIX

- A. Test for compressive strength in accordance with ASTM C 796, for wet density and for dry density after air drying.
- B. Provide concrete mix with the following properties:
 - 1. Compressive strength of 250 psi for fully adhered roofing membrane.
 - 2. As-cast unit weight of 34 to 48 lb/cu. ft. at point of placement, when tested according to ASTM C796.
 - 3. Dry weight of 27 to 36 lb/cu. ft., when tested according to ASTM C 796.
- C. Average Overall Thermal Resistance of Installed Fill:
 - 1. Average R-value of 30 minimum.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify joints in metal deck roof members are grouted or taped to prevent seepage of wet insulating concrete.
- B. Verify installation of metal deck is completed and acceptable to receive lightweight insulating concrete.

3.02 PREPARATION

- A. Interior of the Building: Prior to installation of the slurry coat, on the vented metal deck, the Lightweight Concrete Contractor is to coordinate with the General Contractor to provide and install sheet plastic, drop cloths or tarps to protect all items installed below roof deck such as ductwork, conduit and floor surfaces from lightweight concrete material excess.
- B. Exterior/Roof Area: Prior to installation of the lightweight insulating concrete material the Lightweight Concrete Contractor is to coordinate with the General Contractor to provide and install sheet plastic, drop cloths or tarps to protect all roof items, roof penetration blocking and installed parapet wall surfaces from lightweight concrete material excess.
- C. Installation of non-vented and vented deck install gap and hole fill material at:
 - 1. Perimeter of roof decking.
 - 2. Around penetrations through deck.
 - 3. Each change of deck direction on metal roof deck surfaces.
- D. Install appropriate fill material at all perimeter gaps, field gaps and small holes in the metal deck less than 1" in size.
- E. Excessive weld burn holes in the metal deck are to be filled by the metal deck installer.
 - 1. Any gap or hole determined to require additional structural support by the structural engineer shall be filled by the metal deck installer.
- F. General Contractor to coordinate with Lightweight Concrete Contractor to provide lightweight material barriers at areas of construction that will be completed at a later sequence/phase of the project.
- G. Prior to the installation of the insulating concrete material, the contractor shall plug/protect drain or other pipe openings to keep lines free of all concrete material.

- H. After installation of the lightweight concrete is complete, and prior to the permanent roof membrane being installed, the General Contractor is to coordinate with the Roofing Contractor and Lightweight Insulating Concrete Contractor to provide a temporary, watertight material over the entire roof drain sump to allow moisture to drain into the roof drain piping. This temporary, watertight material is to be installed to prevent moisture from penetrating below the lightweight material, at all roof drain sumps.

3.03 INSTALLATION

- A. Slurry deck surface; place insulation; use mix to fill holes and breaks.
- B. Place insulating concrete and screed surface to achieve minimum 2 inch thickness.
- C. Slope top surface to 1/4 inch/foot for roof surface drainage.

3.04 MIXING AND PLACING

- A. Mix and place lightweight insulating concrete according to manufacturer's instructions, using equipment and procedures to avoid segregation of mix and loss of air content.
- B. Install insulation according to lightweight insulating concrete manufacturer's recommendations. Place insulation in wet slurry poured a minimum of 1/8 inch (3 mm) above the structural substrate. Ensure full contact of insulation with slurry so that the slurry fills the locking and keying openings in the insulation. Stagger joints and tightly butt insulation boards.
 - 1. Install insulation in a stair-step configuration with maximum steps of 1" to provide slope for the roofing system.
- C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated. Provide a minimum thickness of two inches (2") over the top of the insulation board. Place insulating concrete within four (4) hours of placement of insulation boards.
- D. Finish top surface smooth, free of ridges and depressions, and maintain surface in acceptable condition to receive subsequent roofing application. Provide a uniform smooth trowel finish at slopes as indicated on the drawings, within plus or minus 1/4 inch in 10'-0".
- E. Monitor installation, checking below roof deck for lightweight concrete leaking onto CMU walls or floors. Remove lightweight before it adheres to CMU or floor to avoid filling cells of CMU surface, altering surface to receive paint or new flooring material. Remove all light weight from structural steel members or joists to remain exposed or be painted.
- F. Begin curing operations immediately after placement, and air cure for not less than 3 days according to manufacturer's recommendations.

3.05 CURING

- A. Cure in accordance with lightweight aggregate manufacturer's instructions and in conjunction with the roofing membrane manufacturer's substrate requirements for compatibility of curing compounds and roofing adhesives.
- B. Protect insulating concrete from excess evaporation of surface moisture.
- C. During low humidity conditions, sprinkle water over concrete surface to aid hydration and curing.

3.06 FIELD QUALITY CONTROL

- A. Contractor to engage a qualified, independent testing agency, acceptable to the Architect as specified in Section 014000, that will perform field inspection and testing for wet and dry density. Do not use same testing agency that provided initial mix designs.
 - 1. Take compressive strength and wet/dry density samples according to ASTM C 495 and C 796
 - 2. Testing Agency: Take three test samples from each 75 cu yd of insulating concrete placed.

3. Testing Agency: Take one additional test sample during cold weather concreting.
4. Report test results to Architect and lightweight insulating concrete producer within 24 hours of completion of each test.
5. Mechanically Fastened Membrane - Fastener Withdrawal Testing: Conduct a base ply fastener pull test three or more days following the application of the lightweight insulating concrete to ensure minimum withdrawal resistance of 40 pounds per fastener, fastening pattern required by the membrane manufacturer.

3.07 DEFECTIVE WORK

- A. Refinish or remove and replace, lightweight insulating concrete surfaces that are excessively scaled or too rough to receive roofing, according to current published requirements of the roofing manufacturer.
- B. Lightweight insulating concrete that fails to meet the compressive strength requirements: Perform additional pull out tests prior to removing the installed roof membrane and removing and replacing the defective lightweight insulating concrete material.

3.08 CLEAN-UP

- A. Excessive lightweight concrete material on structural steel and joists, metal deck, walls, floor surfaces and other surfaces inside the building are to be removed by the lightweight concrete installer.
- B. Excessive lightweight concrete material on parapet walls, roof penetration blocking, and other exterior or roof surfaces are to be removed by the lightweight concrete installer.

END OF SECTION

SECTION 036200 - NON-SHRINK GROUTING**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 1 Sections

1.02 REFERENCES

CRD-C621 – Specification for Non Shrink Grout Packaged Dry, Hydraulic-Cement Grout.

ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.03 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

1.04 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.

PART 2 PRODUCTS**2.01 GROUT**

- A. Grout: Flowable, non-shrink, non-metallic in accordance with CRD-C-621 and ASTM C1107.
- B. Compressive Strength: 5,000 psi minimum at 28 days.

2.02 WATER

- A. Water: Clean, potable water.

PART 3 EXECUTION**3.01 HANDLING**

- A. Store and protect from moisture and contamination.

3.02 PREPARATION

- A. Remove foreign materials including mud and dirt from areas to be grouted.
- B. Use forms to contain grout. Forms shall be a minimum 1½ inch larger on all sides than the item grouted.

3.03 MIXING

- A. Mix grout to its fluid, self-leveling consistency in accordance with manufacturer's recommendations. Mix grout in a paddle-type mortar mixer; do not mix by hand.

- B. Do not retemper grout. Do not exceed manufacturer's maximum limit on water content or use at a consistency that produces free bleeding.

3.04 PLACEMENT

- A. Consolidate to provide grout uniformity. Do not vibrate grout.

3.05 PROTECTION

- A. Protect grout and areas to be grouted from excessive heat and cold in accordance with manufacturer's Specifications. Protect grout from excessive drying shrinkage resulting from wind or direct sunlight. Protect areas grouted from excessive vibrations.

END OF SECTION 036200

SECTION 042000 - UNIT MASONRY**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.
- G. Installation of embedded items not specified in this section.
- H. Installation of natural stone units.
- I. Masonry Cleaners.
- J. Products furnished, but not installed, under this Section include the following:
 - 1. Dovetail slots for masonry anchors, installed under Division 3 Section 'Cast In Place Concrete'.
 - 2. Anchor section of adjustable masonry anchors for connecting to structural steel frame, installed under Division 5 Section "Structural Steel".
- K. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under Division 5 Section "Structural Steel Framing".
 - 2. Sheet metal flashings and manufactured reglets in masonry joints for metal flashing, furnished under Division 7 Section " Sheet Metal Flashing and Trim" and "Roof Specialties".
 - 3. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section " Steel Doors and Frames".
 - 4. Wood nailers and blocking built into unit masonry are specified in Division 6 " Rough Carpentry".

1.02 RELATED REQUIREMENTS

- A. Section 044200 - Exterior Stone Cladding: Stone laid as veneer units.
- B. Section 061000 - Rough Carpentry: Nailing strips built into masonry.
- C. Section 071113 - Bituminous Dampproofing: Dampproofing masonry surfaces.
- D. Section 072100 - Thermal Insulation: Insulation for cavity spaces.
- E. Section 078400 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- F. Section 079005 - Joint Sealers: Backing rod and sealant at control and expansion joints.
- G. Section 081113 - Hollow Metal Doors and Frames: Frame anchoring requirements.

1.03 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- F. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a (Reapproved 2014).
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- H. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile; 2013.
- I. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2014.
- J. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- L. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- P. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- Q. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- R. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- S. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout; 2009.
- T. ASTM E 119 - Standard Test Methods for Fire tests of Building Construction and materials.
- U. Brick Industry Association: Technical Notes on Brick Construction; Current Edition.
- V. IMIABC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- W. IMIABC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.
- X. UL (FRD) - Fire Resistance Directory; current edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings" and adhere to the following specifics regarding masonry pre-installation conference guidelines.
 - 1. The General Contractor/Construction Manager should organize and hold a meeting with the Owner, Architect, General Contractor/Construction Manager, site superintendent, masonry company owner, masonry foreman, all bricklayers, carriers and any other personnel from the masonry company that will be working at the project site. Also include testing and inspection agency representative, installers of cavity wall insulation, storefront, curtain wall, door and

window, installers of steel, joist and deck, installers of mechanical, electrical and plumbing items, installers of other work in and around the masonry that must precede or follow masonry work.

2. Review foreseeable methods and procedures related to masonry work, including but not necessarily limited to the following:
 - a. a) Sample and Mock-up Wall Sections:
 - 1) Size and Location
 - 2) Products and Detail required
 - 3) Protection Methods of Sample and Mock-up Wall Sections
 - 4) Approval Authority and Notification
 - b. Site Inspection:
 - 1) Identity of Responsible Person
 - 2) Frequency of Inspection
 - c. Materials:
 - 1) Storage & Protection
 - 2) Delivery Process
 - d. Submittals:
 - 1) Product Certification
 - 2) Shop Drawing Requirements
 - 3) Time Expectation
 - 4) Testing and Inspection Requirements
 - e. Construction Means and Methods:
 - 1) Hot & Cold Weather Protection
 - 2) Protection of Work in Process
 - 3) Material Handling Process
 - 4) Cleaning Process
 - f. Schedule:
 - 1) Product Availability
 - 2) Review of Associated Trades Responsibility
 - g. Project Closeout:
 - 1) Punch List Procedure
3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.05 FIELD REQUIREMENTS

- A. Protection of Masonry: During construction, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 2. Where one wythe of multiwythe masonry is completed in advance of other wythes, secure cover a of 24 inches down face next to unobstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over wall surface.
 2. Protect sills, ledges and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and as specified herein.
1. Cold Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
 2. Hot Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
 - a. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.
 3. Cold Weather Construction: When the ambient temperature is within the limits indicated, perform the following construction procedures. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10o F.
 - a. 40o F to 32o F:
 - 1) Mortar: Heat sand or mixing water to produce mortar temperature between 40o F and 120o F at time of mixing.
 - 2) Grout: Grout does not require heated materials, unless the temperature of materials is below 32o F.
 - 3) 32o F to 25o F:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40o F and 120o F; maintain temperature of mortar on boards above freezing.
 - (b) Grout: Heat grout materials to produce grout temperature between 70oF and 120o F. Maintain grout above 70oF until used in masonry.
 - 4) 25o F to 20o F:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40o F and 120o F; maintain temperature of mortar on boards above freezing.
 - (b) Grout: Heat grout materials to produce grout temperature between 40 and 120o F. Maintain grout above freezing until used in masonry. Heat masonry units to 40o F (4o C) prior to grouting.
 - (c) Heat both sides of walls under construction to 40oF..
 - (d) Use windbreaks or enclosures when wind is in excess of 15 mph.
 - 5) 20o F and below:
 - (a) Mortar: Heat mixing water and sand to produce mortar temperatures between 40o F and 120o F.
 - (b) Grout: Heat grout materials to produce grout temperature between 70oF and 120o F. Maintain grout above 70oF until used in masonry.
 - (c) Masonry Units: heat masonry units to 40o F.
 - (d) Provide enclosure and auxiliary heat on both sides of walls under construction to maintain temperatures within the enclosures above 32o F for a period until mortar sets and water is evaporated from mix to a point that mortar will not spall or lose effective strength due to freezing.

4. Cold-Weather Protection: When the mean daily temperature is within the limits indicated, provide the following protection:
 - a. 40o F to 25o F: Completely cover masonry with weather-resistant membrane for at least 24 hours after construction. Extend coverage time period to 48 hours for grouted masonry.
 - b. 25o F to 20o F: Completely cover masonry with weather-resistive insulating blankets or provide enclosure and heat for 24 hours after construction to prevent freezing. Extend coverage time period to 48 hours for grouted masonry. Install wind breaks when wind velocity exceeds 15 mph.
 - c. 20o F and below: Provide enclosure and heat to maintain temperatures above 32o F within the enclosure for 24 hours after construction. Extend coverage time period to 48 hours for grouted masonry.
5. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements:
 - a. For units with surface temperatures above 32o F, wet with water heated to above 70 o F .
 - 1) For units with surface temperatures below 32o F, wet with water heated to above 130o F.

1.06 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- B. Samples for Verification: For the following:
 1. Sample boards or boxes of each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
 2. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
 3. Weep holes/vents in color to match mortar color.
 4. Accessories embedded in the masonry.
- C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
 2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 3. Each material and grade indicated for reinforcing bars.
 4. Each type and size of joint reinforcement.
 5. Each type and size of anchor, tie, and metal accessory.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 1. The Owner will employ an independent agency qualified to perform the testing indicated to verify that the masonry meets the required specification per Chapter 17 of the 2015 International Building Code with KY Amendments. The Owner will be responsible to pay for testing during normal hours of business operation or non-overtime hours. Any testing expense incurred due to overtime work will be paid for by the installing Contractor. The installing Contractor shall notify the testing agency at least 24 hours prior to beginning any work that requires testing. Copies of all reports shall be forwarded to the Owner and Architect.
 2. Provide continuous inspection to verify compliance of the following:
 - a. Cleanliness of grout space prior to grouting.

- b. Placement of grout in reinforced cells.
 - c. Preparation of required grout and mortar specimens.
- 3. Provide periodic inspection to verify compliance of the following:
 - a. Proportions of site-prepared mortar or grout.
 - b. Construction of mortar joints.
 - c. Quantity, size, location, and support of reinforcing steel.
 - d. Quantity, size, and placement of horizontal joint reinforcement.
 - e. Type, size and location of anchors.
 - f. Protection of masonry during cold or hot weather
- 4. Verify compressive strength of concrete masonry units, mortar, and coarse grout for every 5,000 sq. ft. of surface area as follows:
 - a. Three (3) concrete masonry units shall be tested in accordance with ASTM C140.
 - b. Six (6) mortar cube specimens shall be tested, three (3) at 7-days and three (3) at 28-days, in accordance with ASTM C109.
 - c. Four (4) coarse grout specimens shall be tested, two (2) at 7-days and two (2) at 28-days, in accordance with ASTM C1019.
 - d. In lieu of individual tests of masonry units, mortar, and grout, perform one (1) prism test (which consists of three prisms) in accordance with ASTM E447.
- B. Fire Rated Assemblies: Conform to applicable code for UL Assembly No. located on the drawings.
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

1.08 MOCK-UP

- A. Construct a masonry wall as a mock-up panel size as provided in the drawings. Mock-up to include mortar and accessories, structural backup, flashings, and wall insulation.
 - 1. Mockups: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build mockups to comply with the following requirements, using materials indicated for the completed Work.
 - a. Construct mock-up panel as indicated on the drawing following this section of the specifications.
 - b. Locate panels in the locations indicated or, if not indicated, as directed by Architect.
 - c. Clean exposed faces of panels with masonry cleaner indicated.
 - d. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 - e. Protect approved mockup panels from the elements with weather-resistant membrane.
 - f. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 - g. Approval of mockup panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

- 1) Approval of mock-up panel does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically approved by Architect in writing.
- h. Demolish and remove mockup panels when directed.
- B. Mock-up may remain as part of work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 MASONRY PROJECT FORMAN/SUPERINTENDENT CERTIFICATION

- A. Both the Masonry Subcontractor Project Foremen and the General Contractor Superintendent shall provide a sworn notarized statement to the Owner and the Architect that the through wall flashing has been fully and installed following industry standards for a permanent watertight integrated system. All means, methods, and labor to perform this integration is fully part of this contract.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, jambs, bonding, sash, and other detailed conditions.
 - a. Provide bullnose units for outside corners, unless otherwise indicated.
 - b. Provide solid units at 45 degree angled corners.
 - 2. Size (Width): Manufactured to the following dimensions:
 - a. 4 inches, 3 5/8" actual.
 - b. 6 inches, 5 5/8" actual.
 - c. 8 inches, 7 5/8" actual.
 - d. 12 inches, 11 5/8" actual.
 - e. Standard units to have nominal face dimension of 8" x 16" unless otherwise indicated.
 - 3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi, but as required to achieve the compressive strength of masonry specified in the structural drawings.
 - 4. Non-Load-Bearing and Load-Bearing Units: ASTM C 90, lightweight.
 - a. Hollow block.
 - b. Exposed Faces: Manufacturer's standard color and texture.
 - 5. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:

- a. A. C. Krebs Company
- b. Lee Building Products/Meade Block & Stone/Hinkle Block and Masonry;
www.leebp.com
- c. Reading Rock; www.readingrock.com
- d. Boyle Block/L. Thorn Company; www.boyleblock.com
- e. Oberfields LLC; www.oberfields.com
- f. Wright Concrete and Construction: www.wrightconcrete.com

2.02 CLAY MASONRY UNITS - GENERAL

- A. General: Provide shapes indicated and as follows for each form of brick required:
 - 1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.
- B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, soldier and sailor courses, and turn-backs at window and door sills, jambs, heads and lintels.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - 3. Provide architectural quality brick with finished ends to match face at exposed exterior corners.

2.03 FACE BRICK

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Type 1: (Field) Pine Hall Brick - Spektra Wirecut Full Range Modular, Grade SW, Type FBS.
 - b. Type 2: (Accents as shown in elevations) Pine Hall Brick - Spektra Chocolate Wirecut Modular, Grade SW, Type FBS.
- B. Products by other manufacturers (listed below) may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. Additional acceptable manufacturers provided existing brick can be matched include:
 - 1. Equivalent brick matches to the basis of design selection are required to be submitted to Architect for review prior to last addendum for approval.
 - a. Brampton Brick: www.bramptonbrick.com
 - 1) Type 1: "Woodford Blend"
 - 2) Type 2: "Kodiak"
 - b. Boral Bricks, Inc: www.boralbricks.com.
 - c. Bowerston: www.bowerstonshale.com
 - d. Endicott Clay Products Co: www.endicott.com.
 - e. General Shale Brick: www.generalshale.com.
 - f. Forterra (formerly Hanson Brick): www.forterrabrick.com.
 - g. Sioux City Brick :www.siouxcitybrick.com
 - h. Belden Brick: beldenbrick.com
 - i. Glen-Gery Brick: www.glengerybrick.com
 - j. McAvoy Brick: www.mcavoybrick.com
 - k. Substitutions: See section Division 0; Supplemental Instructions to Bidders; Substitution Request During Bidding form.
- C. Facing Brick: ASTM C216, Type FBS, Grade SW.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 8000 psi.
 - 2. Initial rate of Absorption: Less than 20g/30 sq. in. per minute when tested per ASTM C 67.

3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. All bricks supplied are to be through the body color.
5. Nominal Size: Modular; Field Brick - 3 1/2 to 3 5/8 inches (89 to 92 mm) wide by 2 1/4 inches (57 mm) high by 7 1/2 to 7 5/8 inches (190 to 194 mm) long.

2.04 CLAY TILE UNITS

- A. Ceramic Glazed Structural Clay Facing Tile: ASTM C126; Grade S (Select); Type I (single-faced units).
 1. Color and texture to match Architect's sample.
 2. Size: 6T Series, thickness as indicated.
 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn without chipping to produce equivalent effect.
 4. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Elgin-Butler Brick Company; www.elginbutler.com

2.05 MORTAR AND GROUT MATERIALS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 1. Standard mortars:
 - a. The Quikrete Companies/Spec Mix Inc.: www.specmix.com
 - b. Cemex; Kosmos Cement: www.cemex.com
 - c. Heidelberg Cement Group; Lehigh Hanson/Essroc; Brixment:: www.lehighhanson.com
 2. Colored mortars:
 - a. Cemex; Kosmos Cement; Richcolor: www.cemex.com
 - b. Heidelberg Cement Group; Lehigh Hanson/Essroc; Flamingo Brixment: www.lehighhanson.com
 - c. The Quikrete Companies/Spec Mix Inc.; Color Mortar with Solomon Colors, Inc. Pigment : www.specmix.com
 3. Moisture-Resistant Admixture: Use for all exterior mortars listed above. Water repellent compound designed to reduce capillarity. Admixture for use in mortar at all exterior concrete masonry, brick facing units or any combination included in the project. Concrete masonry products containing integral water repellent by same and/or different manufacturer listed below is acceptable.
 - a. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) W.R. Grace & Co., Construction Products Division; Dry-Block: www.na.graceconstruction.com
 - 2) BASF Construction Chemicals; Rheopel Plus: www.masterbuilders.com
 - 3) RussTech Admixtures, Inc; Russtech Mortarpe-S: www.russtech.net
- B. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction.
 1. Not more than 0.60 percent alkali.
 2. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
- D. Ready-Mixed Mortar: Materials, water and aggregate complying with requirements specified in this article, combined with set controlling admixtures to produce a ready-mixed mortar complying with ASTM C 270.
- E. Mortar Colors: Type as required for mortar to match color selected.

1. Type as required for mortar to match color selected.
 2. Color : Gray
- F. Mortar Aggregate: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
1. Type as required for mortar to match color mortar selected.
- G. Water: Clean and potable.

2.06 GROUT MATERIALS

- A. Aggregate for Grout: ASTM C 404.
- B. Grout: ASTM C 476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
- C. Refer to structural sheets for additional grout information.

2.07 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
1. Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - a. Heckmann Building Products: www.heckmannbuildingprods.com
 - b. Hohmann & Barnard, Inc (including Dur-O-Wal and Blok-Lok companies): www.h-b.com.
 - c. WIRE-BOND www.wirebond.com/#sle.
- B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420) deformed billet bars; uncoated. Refer to structural drawings for sizes, spacing and placement.
- C. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - #220 Ladder Type.
 - b. Hohmann & Barnard - #120 Truss Type.
- D. Adjustable Multiple Wythe Joint Reinforcement: Truss type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
1. Vertical adjustment: Not less than 2 inches. Coordinate with total cavity wall thickness.
 2. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - #170 Lox-All Truss Adjustable Eye-Wire.
- E. Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in width, 0.105 in thick, lengths as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A 153/A 153M, Class B.
- F. Partition Anchors: Load Bearing to Load Bearing Wall Connection: Steel, ASTM A 366; ASTM A 36, 3/16 inch or greater, hot dip galvanized after fabrication to ASTM A 153/153M, Class B. Anchor to be 1/4 inch thickness, 1-1/2 inch width.

1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - #344 Rigid Partition Anchor.
- G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
 1. Concrete frame: Dovetail anchors of bent steel strap, nominal 1 inch width x 0.024 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 2. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - a. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.1875 inch diameter, hot dip galvanized steel wire.
 - b. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Hohmann & Barnard - #359-C Weld-on Tie and 301W Column Web Tie.
 - 2) Hohmann & Barnard - #359-FP Weld-on Tie and 301W Column Web Tie.
- H. Wall Ties: Non-Load Bearing to Non-Load Bearing and Non-Load Bearing to Load Bearing Wall Connection: Steel, ASTM A 366; ASTM A 36, 3/16 inch or greater, hot dip galvanized after fabrication to ASTM A 153/153M, Class B. Mesh to be 1/2 inch square x 16 gage..
 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - #MWT Mesh Wall Tie.
- I. Chase Wall Veneer Channel Anchor with Continuous Wire: Install at 4 inch CMU walls over 8 feet in height AFF: Steel, ASTM A 366; ASTM A 36, 3/16 inch or greater, hot dip galvanized after fabrication to ASTM A 153/153M, Class B. Anchor length - refer to wall type, 1-1/4 inch width, 9 gauge continuous wire, 12 gauge anchors and channels. Install at maximum 6 foot AFF increments and 24 inch on center horizontally, for length of wall.
 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - #360 Gripstay Channel and #364-SV Seismic-Notch Gripstay Anchor.
- J. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. Single screw veneer tie: Dual diameter barrels with EPDM washers to seal both the insulation face and air/vapor barrier and #12 screw, designed for fastening to structural backup through sheathing.
 2. Wire ties: Trapezoidal shape, 0.1875 inch thick.
 3. Vertical adjustment: Not less than 1 inches.
 4. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Hohmann & Barnard - 2 Seal Ties.
 - b. Heckman Building Products - Pos-I-Tie Brick Veneer Anchoring System
 - c. Wire-Bond - Sure Tie Anchoring System
- K. Joint Stabilizing Anchors: Dur-O-Wal DA2200 or equivalent.
- L. Grout Screen Stop: Dur-O-Wal grout screen stop or equivalent.
- M. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations: Headed Bolts.

2.08 FLASHINGS

- A. Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet; 40 mil minimum total thickness; with cross-linked polyethylene top and bottom surfaces, 18 inch wide roll minimum.
 - 1. For flashing not exposed to the exterior.
 - 2. Due to the UV sensitivity of flexible flashings all flashings, after installation, must be permanently covered within a reasonable amount of time, not to exceed 30 days.
 - a. Product is not to be installed where it would be exposed to sunlight.
 - 3. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - a. Grace Construction; Product - Perm-A-Barrier.
 - b. Hohmann & Barnard; Product - Textroflash.
 - c. Dayton Superior; Product - Dur-O-Wal.
 - d. IPCO Illinois Products Corporation; Product - Self-Adhesive Rubberized Asphalt Flashing: www.illinoisproducts.com
 - e. Mortar-Net USA: www.mortarnet.com
 - f. Advanced Building Products; Product - Strip-n- Flash: www.advancedflashing.com
 - g. DuPont: Product - Thru-Wall Flashing: www.Construction.Tyvek.com
 - h. BASF; Product - Enershield - TWF: www.enershield.basf.com
 - i. Wire Bond: Product - Aqua Flash 500: www.wirebond.com
 - j. York Flashings: www.yorkmfg.com
- B. Additional flashing system components:
 - 1. Primer, adhesives and seam tape: Provide materials as required by the manufacturer for proper adhesion on the cmu, bituminous dampproofing, fiberglass faced gypsum sheathing, or other substrate.
 - 2. Thru-Wall Flashing Support/Cavity Bridge: "L" shaped, type 304, 27 gauge stainless steel cavity bridge to provide positive support of self-adhered flexible thru-wall flashing across cavity openings. Size to specified cavity wall thickness. Secure to substrate with fasteners through pre-drilled holes.
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) IPCO Illinois Products Corporation; Product - Type "L" Cavity Bridge: www.illinoisproducts.com
- C. Flashing Bracket: Contractor's option to use flashing bracket system above openings at exterior metal stud and sheathing walls to receive sprayed-in-place thermal insulation.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Flash Track Systems, Inc.: Products - Flash Trac Wall Bracket, Retaining Rod, External & Internal Corner Returns, and Alignment Clips: www.flashtracsystems.com
 - 2. After exterior sheathing has been installed, install flashing brackets continuously along all horizontal locations to receive flashing, using self-tapping fasteners compatible with the sheathing/studs.
 - 3. Install flexible flashing after all sprayed-in-place thermal insulation has been applied.

2.09 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - a. Dur-O-Wal: www.dur-o-wal.com.
 - b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - c. MasonPro, Inc: www.masonpro.com
 - d. WIRE-BOND: www.wirebond.com/#sle.

- B. Compressible Filler: Cut to fit or premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, EPDM, or PVC.
 - 1. Install at tops of non-rated, non-load-bearing CMU walls running perpendicular or parallel to the metal deck. Place a bead of caulk 1/2 inch back from flute opening and on all sides of flute. Compress plug and slide into place.
 - a. Perpendicular to metal deck: Williams Products Inc. EVA 200G or 3000 Series Closure Flute Plugs or Strips: www.williamsproducts.net.
 - 1) Closed Cell plugs and strips per ASTM D-1171, ASTM D-925, ASTM D-412. Density: 12.8 lbs/ft
- C. Bond Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt felt.)
- D. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, thickness sized to fit the wall cavity air space, height to be minimum 10 inches, and design to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1) Advanced Building Products IncMortar Break: www.advancedflashing.com.
 - 2) Hohmann & Barnard, Inc: Mortar Trap : www.h-b.com
 - 3) IPCO Illinois Products Corporation; Product - Mortar Grab: www.illinoisproducts.com
 - 4) Keene Building Envelope Products: KeeneStone Cut: www.keenebuilding.com
 - 5) MasonPro, Inc; ProNet: www.masonpro.com
 - 6) Mortar Net USA, LtdWallDefender: www.mortarnet.com.
 - 7) Archovations, Inc; Cavclear Masonry Mat.
 - 8) Sandell Manufacturing/Hohmann & Barnard Company; Mortar Web: www.h-b.com
 - 9) Mason Pro; ProNet: www.masonpro.com
 - 10) Wire Bond: Cavity Net DT: www.wirebond.com
- E. Weeps: Polyethylene tubing. Contractors option to use either cotton rope or polyethylene tubing.
- F. Cavity Vents:
- G. Type: Molded PVC grilles, insect resistant.
 - 1. Provide polyester mesh or cellular, honeycomb polypropylene cavity vents.
 - a. Size: 3/8" x 2 1/2" x 3 5/8".
 - b. Vents to be impervious to water and resistant to UV degradation.
 - c. Color: Architect to select from manufacturers standard color choices. Minimum six colors.

2.10 MASONRY CLEANERS

- A. Cleaning Solution: Consult with brick manufacturer for recommended cleaning procedure and products. Masonry Contractor to match the cleaning method and cleaning solution to the type of brick and type of stain.
 - 1. Prepared solutions: Non-acidic, low odor, water-rinsable solution for use in the final clean up of new masonry.
 - a. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) Carlisle Coatings and Waterproofing: SimpleKleen Heavy Duty: www.carlisleccw.com

- 2) Diedrich Technologies: 202 New Masonry Detergent: www.diedrichtechnologies.com
- 3) EaCoChem; NMD 80: www.eacochem.com
- 4) Miracle Sealants Company: Liquid Poultice: www.miraclesealants.com
- 5) Price Research Limited: Price Non-Acidic Masonry Cleaner: www.priceresearchltd.com
- 6) Prosoco: Safety Klean: www.prosoco.com

2.11 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 1. Extended Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above at contractor's option.
 2. Limit cementitious materials in mortar to portland cement and lime.
 3. Loadbearing concrete masonry units below grade and in contact with earth: Type M.
 4. Loadbearing concrete masonry units above grade: Type S.
 5. Exterior, non-loadbearing masonry veneer units: Type N.
 6. Interior, loadbearing concrete masonry units: Type S.
 7. Interior, non-loadbearing concrete masonry units: Type N.
 8. Interior, non-loadbearing masonry veneer units: Type N.
- B. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 1. Bond: Running.
 2. Coursing: One unit and one mortar joint to equal 8 inches.
 3. Mortar Joints: Concave.
- D. Brick Units:
 1. Bond: Running.
 2. Coursing: Three units and three mortar joints to equal 8 inches.
 3. Mortar Joints: Concave.
- E. Cut joints flush for masonry walls to be concealed or to receive plaster or other direct applied finishes (other than paint), unless indicated otherwise.
- F. Walls to receive ceramic wall tile shall have flush struck joints. Any wall found to be unacceptable by the ceramic tile installer will be corrected to meet specified tolerances.

3.04 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.05 WEEPS AND CAVITY VENTS

- A. Install weeps in vertical head joints in exterior veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, at bottom of walls, and above windows, doors, louvers or any other horizontal obstruction of the cavity wall.
- B. Install cavity vents in vertical head joints in exterior veneer and cavity walls at 24 inches on center horizontally above and below shelf angles, above lintels, near tops of walls (coordinate top of wall location with coping/fascia or other roof edge covering) and above all openings with through-wall flashing. Also install at the bottom of any seat, screen and/or retaining walls without through-wall flashing.
- C. Weeps and cavity vents to be alternated at 24 inches on center.
- D. Depending on weep material used:
 - 1. Install cotton wicking through masonry veneer face and turn 8 to 10 inches up, into the cavity, above the height of any mortar droppings. Secure cotton wicking to substrate without penetrating any through wall flashing membrane. Trim cotton wicking material used in weep holes flush with outside face of wall after mortar has set.
 - 2. Install plastic tubes at an angle in the head joint mortar. Remove plastic tubes used in weep holes from wall after mortar has set.

3.06 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.
- D. Coat cavity face of backup wythe to comply with Division 7 Section "Bituminous Dampproofing".

3.07 CAVITY WALL INSULATION

- A. Sprayed-In-Place Insulation: Comply with Division 7 section "Building Insulation".

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, and CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.09 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing reinforcement: Refer to Division 5 sections for requirements.

3.10 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

3.11 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- F. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.12 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of openings.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.13 MASONRY THROUGH-WALL FLASHINGS

- A. Install through wall flashing above metal step flashings and reglets, shelf angles and lintels, at bottoms of walls, and above windows, doors, louvers or any other horizontal obstruction of the exterior cavity wall.
- B. Whether or not specifically indicated, install masonry through wall flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- C. Where sprayed-in-place thermal insulation will not be installed, secure through wall flashing to substrate with a continuous termination bar. Install continuous sealant at the intersection of the through wall flashing and termination bar.
- D. Extend flashing to the face of the masonry veneer.
- E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.14 LINTELS

- A. Refer to structural drawings for lintel sizes and additional requirements.
- B. Install loose steel lintels over openings.
- C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
- D. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block size units are shown without structural steel or other supporting lintels.
 - 1. Provide prefabricated or built-in place masonry lintels. Use specially formed bond beam units with reinforcing bars placed as indicated and filled with course grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- E. Provide minimum bearing of 8 inches at each jamb, unless indicated otherwise.

3.15 GROUTED COMPONENTS

- A. Refer to the structural specifications and drawings for additional requirements on grouted masonry.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.
- E. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - 1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.16 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Form expansion joint as detailed on drawings.

3.17 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.
- E. Install reglets and nailers for flashing and other related construction where they are shown to be built in to masonry.

3.18 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- H. Maximum Variation for exposed head joints thickness: 1/8 inch.
- I. Maximum Variation for vertical alignment of exposed head joints: 1/4 inch in 10 feet.
- J. Maximum Variation for exposed bed joints thickness: 1/8 inch.
- K. Maximum Variation for conspicuous horizontal lines: 1/4 inch in 20 feet.
- L. Maximum Variation for conspicuous vertical lines: 1/4 inch in 20 feet

3.19 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.20 REPAIRING AND POINTING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. prepare joints for sealant application.
- C. Damaged or chipped concrete masonry units that do not meet the requirements of ASTM C90 for the concrete masonry unit should not be installed. Repair chips, cracks, and other surface damage when visible as viewed in normal lighting conditions at 20 feet. If units incur damage during installation or by other trades, patching of the units shall be with materials compatible with the concrete mix provided in the concrete masonry unit. Provide a finished patch surface texture similar in texture to the concrete masonry unit face being repaired. Do not provide a smooth texture that will result in highlighting the patch when the final paint coats have cured. Patching and repair should be undetectable. Masonry patching by the general contractor, gypsum drywall, painting, or other subcontractor with an incompatible repair product will not be approved.

3.21 IN-PROGRESS CLEANING

- A. Remove excess mortar and mortar droppings. Clean masonry work as the work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Replace defective mortar. Match adjacent work.

3.22 FINAL CLEANING

- A. Comply with guidelines in Brick Industry Association - Technical Note #20 - Cleaning Brickwork.
- B. Remove excess mortar and mortar droppings.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations. Remove large mortar particles by hand with wooden paddles.
- F. Test cleaning methods on mock-up wall panel; leave one half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with final cleaning of masonry.
- G. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
- H. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
- I. Clean brick by bucket and brush hand cleaning method or by pressure sprayer using lowest possible pressure for effective cleaning, as described in BIA Technical Note #20.
- J. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces. Dry brush walls at the end of each day's work and after final pointing to remove mortar spots and droppings.

3.23 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 044200 - EXTERIOR STONE CLADDING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cut limestone sills at windows in masonry veneer walls; continuous band at exterior walls (typically between calcium silicate manufactured stone masonry base and brick); at exterior canopy column caps; and otherwise shown in the drawings.
- B. Joint sealing and Joint pointing.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Inserts in masonry to anchor stone.
- B. Section 079005 - Joint Sealers: Sealant for control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- F. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone; 2010.
- G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- J. ASTM C 880 - Standard Test Method for Flexural Strength of Dimension Stone.
- K. ASTM C 1242-10 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems.
- L. ILI (HB) - Indiana Limestone Handbook; 2007, 22nd Edition.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Design stone anchors, anchoring systems, and any required steel supports according to ASTM C 1242 and the Kentucky Building Code.
- B. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to 1/8 inch in 10 feet (3 mm in 3 m).
- C. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.05 SUBMITTALS

- A. Product Data: Provide data on each variety of stone, stone accessory, mortar products, and sealant products.
- B. Shop Drawings: Show details of fabrication and installation of dimension stone cladding system, including dimensions and profiles of stone units.
 - 1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
 - 2. Include details of mortar joints, sealant joints, and mortar joints pointed with sealant.
 - 3. Show locations and details of anchors and backup structure.
- C. Sealant Samples for Verification: For each type and color of joint sealant required.
- D. Samples: Submit two stone samples 12 x 12 inch in size, illustrating color range, grade and texture, markings, surface finish .
- E. Samples: Submit mortar color samples.
- F. Installation Instructions: Submit stone fabricator's installation instructions and field erection or setting drawings; indicate panel identifying marks and locations on setting drawings.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed dimension stone cladding systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Stone Fabricator: Company specializing in fabricating cut stone with minimum ten years of documented experience.
- C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
 - 1. Obtain each variety of stone from a single quarry.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.
- E. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.
- F. Perform work in accordance with ILI Indiana Limestone Handbook.

1.07 PREINSTALLATION MEETING

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.08 MOCK-UP

- A. Construct a masonry/stone wall as a mock-up panel size as provided in the drawings, mock-up to include mortar and accessories, structural backup, flashings, and wall insulation.
- B. Mock-up may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store stone panels vertically on edge, resting weight on panel edge.

- B. Protect stone from discoloration.
- C. Deliver sealants to project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multi-component materials.
- D. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- E. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- F. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.10 PROJECT CONDITIONS

- A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.
- B. Cold-Weather Construction: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions. When ambient temperature is within limits indicated, use the following procedures:
 - 1. At 40 deg F (4.4 deg C) and below, produce mortar temperatures between 40 and 120 deg F (4.4 and 49 deg C) by heating mixing water and, at temperatures of 32 deg F (0 deg C) and below, sand. In heating mortar materials, maintain mixing temperatures within 10 deg F (6 deg C); do not heat water to above 160 deg F (71 deg C). Maintain temperature of mortar on boards above freezing. Do not apply mortar to stone units or substrates below 32 deg F (0 deg C).
 - 2. At 25 to 20 deg F (minus 4 to minus 7 deg C), heat both sides of walls under construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph (25 km/h).
 - 3. At 20 deg F (minus 7 deg C) and below, provide enclosure and auxiliary heat to maintain air temperature above 32 deg F (0 deg C) within enclosure. Heat stone so it is above 40 deg F (4.4 deg C) at time of installation.
- C. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection:
 - 1. 40 to 25 Deg F (Plus 4.4 to Minus 4 Deg C): Cover dimension stone cladding with a weather-resistant membrane for 48 hours after construction.
 - 2. 25 to 20 Deg F (Minus 4 to Minus 7 Deg C): Cover dimension stone cladding with insulating blankets or provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure for 48 hours after construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph (25 km/h).
 - 3. 20 Deg F (Minus 7 Deg C) and below: Provide enclosure and heat to maintain air temperature above 32 deg F (0 deg C) within enclosure for 48 hours after construction.
- D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C) or when joint substrates are wet.

PART 2 PRODUCTS

2.01 STONE TYPES

- A. Limestone: Indiana Oolitic Limestone; complying with ASTM C568/C568M Classification II - Medium Density.
 - 1. Grade: ILI Standard.
 - 2. Color: Buff
 - 3. Surface Texture: Smooth.
 - 4. Variety and Sources: Limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
- B.

2.02 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Low-Alkali Cement: Portland cement for use with limestone shall contain not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
 - 1. For pigmented mortar, use a colored portland cement-lime mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of portland cement by weight.
- D. Aggregate: ASTM C 144; except for joints narrower than 1/4 inch (6 mm) and, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
 - 1. White Aggregates: Natural white sand or ground white stone.
 - 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.
- E. Water: Potable.
- F. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include:
 - 1. Colored Portland Cement-Lime Mix:
 - a. Essroc Italcementi Group: www.essroc.com
 - b. Glen-Gery Corporation: www.glengerybrick.com
 - c. Holnam, Inc., Holcim US: www.holnam.com
 - d. Heidelberg/Lehigh Cement Co.: www.lehighcement.com
 - e. LaFarge Cement: www.lafargenorthamerica.com

2.03 ANCHORS AND ACCESSORIES

- A. Anchors and Other Components in Contact with Stone: Stainless steel, ASTM A666, Type 304.
 - 1. Sizes and configurations: As required for vertical and horizontal support of stone and applicable loads.
 - 2. Wire ties are not permitted.
- B. Support Components not in Contact with Stone: Stainless steel, ASTM A240/A240M, Type 304.
- C. Setting Buttons and Shims: Plastic type.
- D. Flashings: Refer to Section 042000 - Unit Masonry.
- E. Joint Sealant: ASTM C920 silicone sealant with movement capability of at least plus/minus 25 percent and non-staining to stone when tested in accordance with ASTM C1248.

- F. Joint Backer Rod: ASTM C1330 open cell polyurethane of size 40 to 50 percent larger in diameter than joint width.
- G. Sealant: See type specified in Section 079005.
- H. Cleaning Solution: Type that will not harm stone, joint materials, or adjacent surfaces.

2.04 STONE ACCESSORIES

- A. Setting Buttons: Lead or resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting button.
- B. Setting Shims: Strips of resilient plastic or vulcanized neoprene, 50 to 70 Shore A durometer, nonstaining to stone, sized to suit joint thicknesses and depths of stone supports without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting shims.

2.05 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
 - 1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- B. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 - 1. Minimum Thickness: Provide stone units of not less than the following thickness, unless otherwise indicated:
 - a. Limestone Thickness/Size: 3 inch for quoins and panels. Refer to drawings for sizes of other units.
 - 2. Control depth of stone and back check to maintain minimum clearances indicated between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.
 - a. Minimum Clearance: 1 inch (25 mm).
 - 3. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated.
 - 4. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.
 - 5. Cut stone to produce joints of uniform width and in locations indicated.
 - a. Joint Width: 3/8 inch (10 mm).
 - 6. Clean backs of stone to remove rust stains, iron particles, and stone dust.
- D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- E. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
 - 1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
- F. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match approved samples and mockups.
- G. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
 - 1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

2. Arrange panels with veining to match existing.
- H. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
- I. Fabricate units for uniform coloration between adjacent units and over the full area of the installation.
- J. Cut drip slot in bottom surface of work projecting more than 1/2 inch over wall openings and at banding. Size slot not less than 3/8 inch wide and 1/4 inch deep; full width of projection.

2.06 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.
- B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:
 1. Set limestone with Type N mortar.
- C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
 1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
 2. Packaged Portland Cement-Lime Mix Mortar: Use portland cement-lime mix of selected color.
 3. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.
 4. Point limestone with Type N mortar.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this section.
- B. Verify that items built-in under other sections are properly located and sized.

3.02 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Clean stone surfaces that are dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- C. Clean stone prior to erection. Do not use wire brushes or implements that will mark or damage exposed surfaces.

3.03 SETTING DIMENSION STONE CLADDING WITH MORTAR

- A. Set stone in full bed of mortar with head joints slushed full, unless otherwise indicated.

1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint.
 2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
 3. Support and brace projecting stones until wall above is in place and mortar has set.
 4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes with mortar.
- B. Fill space between back of stone units and backup wall solidly with mortar or grout.
- C. Embed ends of sills in mortar; leave remainder of joint open until final pointing.
- D. Rake out joints for pointing with mortar to depths of not less than ½ inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.
- E. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than 3/8 inch (9 mm) until a uniform depth is formed; compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
- F. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch (9 mm).
- G. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.
- H. Rake out mortar from sealant-pointed joints to depths of not less than ½ inch (12 mm) nor less than that required to provide enough depth for sealant and sealant backing. Rake joints to uniform depths with square bottoms and clean sides.
- I. Set the following dimension stone cladding with unfilled head joints for installing joint sealants:
1. Cornices.
 2. Copings.
 3. Belt and other projecting courses.

3.04 JOINT SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 7 Section "Joint Sealants."

3.05 INSTALLATION

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joint minimum 6 inches and seal watertight.
- B. Erect stone in accordance with stone supplier's instructions and erection drawings.
- C. Set stone with a consistent joint width of 3/8 inch.
- D. Install anchors and place setting buttons to support stone and to establish joint dimensions.
- E. Joints in Exterior Work: Seal joints with joint sealant over backer rod, following sealant manufacturer's instructions; tool sealant surface to concave profile.
- F. Joints in Interior Work: Leave perimeter joints and expansion joints open for sealant; fill other joints with pointing mortar; pack and work into voids; tool surface to concave joint.

3.06 TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or ½ inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other

conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (9 mm in 12 m) or more.

- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).
- E. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.
- G. Positioning of Elements: Maximum 1/4 inch from true position.
- H. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet; 1/2 inch in 50 feet.
- I. Maximum Variation Between Face Plane of Adjacent Panels: 1/16 inch.
- J. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in any two stories.
- K. Maximum Variation from Level Coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch maximum.
- L. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.

3.07 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting any item not so indicated on drawings.
- B. Do not impair appearance or strength of stone work by cutting.

3.08 ADJUSTING AND CLEANING

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.
- B. Replace in a manner that results in dimension stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints.
- D. Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.
- E. Remove excess joint material upon completion of work.
- F. Clean soiled surfaces with cleaning solution.
- G. Use non-metallic tools in cleaning operations.

END OF SECTION

SECTION 047313 - CALCIUM SILICATE MANUFACTURED STONE MASONRY**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Calcium silicate masonry units

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Mortar, reinforcing and accessories.
- B. Section 051200 - Structural Steel Framing: loose steel lintels.
- C. Section 071113 - Bituminuous Dampproofing: at back and all joints (all sides except the face) of below-grade or partially below-grade courses to prevent wicking of moisture and staining.
- D. Section 072100 - Thermal Insulation: Insulation for cavity spaces.
- E. Section 079005 - Joint Sealants: Backing rod and sealant at control, and expansion joints.

1.03 REFERENCES

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2008.
- C. ASTM C73-[current edition]: Standard Specification for Calcium Silicate Face Brick.

1.04 FIELD REQUIREMENTS

- A. Protection of Masonry: During construction, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry is completed in advance of other wythes, secure cover a of 24 inches down face next to unobstructed wythe and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over wall surface.
 - 2. Protect sills, ledges and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and as specified in Section 042000.

1.05 SUBMITTALS

- A. Product Data: Provide data for masonry units.
- B. Samples: Submit two samples of each color and texture calcium silicate units to illustrate color, texture, and extremes of color range.

- C. Test Reports: test results prepared by an independent testing agency, indicating tested material characteristics as part of a source quality control program, current within the past five (5) years.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: manufacturer having sufficient plant facilities to produce the shapes, quantities and size of Products required in accordance with the project schedule.
- B. Installer: Company or person specializing in commercial masonry work with five years documented experience.
- C. Test compressive strength and absorption from specimens selected at random from plant production.

1.07 MOCK-UP

- A. Refer to section 042000 for mock-up requirements.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver calcium silicate masonry units in protective film. Prevent damage to units.
- B. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.
- C. Store units in a manner designed to prevent damage and staining of units.
- D. Stack units on timbers or platforms at least 3 inches above grade.
- E. Place polyethylene or other plastic film between wood and other finished surfaces of units when stored for extended periods of time.
- F. Cover stored units with protective enclosure if exposed to weather.
- G. Do not use salt or calcium-chloride to remove ice from masonry surfaces.

1.09 MASONRY PROJECT FORMAN/SUPERINTENDENT CERTIFICATION

- A. Both the Masonry Subcontractor Project Foremen and the General Contractor Superintendent shall provide a sworn notarized statement to the Owner and the Architect that the through wall flashing has been fully and installed following industry standards for a permanent watertight integrated system. All means, methods, and labor to perform this integration is fully part of this contract.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Arriscraft International: www.arriscraft.com
 - 2. Equivalent submitted to Architect for approval prior to issuance of the last addendum.
- B. Basis of Design: Design concept and the drawings indicate the size, profile, dimensional requirements, aesthetics, and formulations of the following:
 - 1. Arriscraft International - Renaissance Masonry Units: www.arriscraft.com.

2.02 MATERIALS

- A. Calcium Silicate Masonry Units: ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved; 3-5/8" bed depth; special shapes as indicated; and as follows:
 - 1. Sizes: 7-5/8 inch high x 23-5/8" long & 11 5/8" high x 23 5/8" long
 - 2. Textures: Type 1: Rocked finish; Type 2: Smooth finish
 - 3. Color: Driftwood

2.03 FABRICATION TOLERANCES

- A. Fabricate calcium silicate masonry units to the following tolerances:
 - 1. Unit Length: plus or minus 1/16".
 - 2. Unit Height: plus or minus 1/16".
 - 3. Deviation From Square: plus or minus 1/16", with measurement taken using the longest edge as the base.
 - 4. Bed Depth: plus or minus 1/8".
 - 5. Custom Unit Dimensions: plus or minus 1/8".

2.04 EXTERIOR CALCIUM SILICATE MASONRY VENEER UNITS - GENERAL

- A. General: Provide shapes indicated and as follows for each form of exterior calcium silicate masonry veneer unit required:
 - 1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished concrete masonry surfaces.
- B. Provide special shapes for applications requiring concrete masonry units of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, and turn-backs at window and door sills, jambs, heads and lintels.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
 - 3. Provide architectural quality calcium silicate masonry units with finished ends to match face at exposed exterior corners.
- C. Provide Bituminuous Dampproofing (Section 071113) at back and all joints (all sides except the face) of below-grade or partially below-grade courses to prevent wicking of moisture and staining.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify site conditions are ready to receive work.
- B. Inspect materials for fit and finish prior to installation. Do not set unacceptable units.
- C. Beginning of installation means acceptance of existing conditions.

3.02 CUTTING MASONRY UNITS

- A. Cut masonry units with wet-saw.
- B. Pre-soak units using clean water prior to cutting.
- C. Clean cut units using a stiff fibre brush and clean water. Allow units to surface dry prior to placement.
- D. Finish cut edges to match face when exposed in wall.

3.03 WETTING MASONRY UNITS

- A. Where the ambient air temperature exceeds 100°F or exceeds 90°F with a wind velocity greater than 8 mph, pre-wet masonry units.
- B. Lay wetted units when surface dry.

3.04 COURSING

- A. Place masonry to lines and levels indicated.

- B. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
- C. Lay masonry units in running bond.
- D. Course one masonry unit and one mortar joint to equal 8 or 12 inches.
- E. Maintain mortar joint thickness of 3/8 inch.
- F. Tool joints when thumbprint hard, to a concave finish.

3.05 PLACING AND BONDING

- A. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints, and deep or excessive furrowing of mortar joints and are not permitted.
- B. Fully bond intersections, and external corners.
- C. Do not adjust masonry units after laying. Where resetting of masonry is required, remove, clean units and reset in new mortar.
- D. Install loose steel lintels as scheduled.
- E. Install wall ties and anchorages as specified in Section 042000 Unit Masonry.
- F. Install flashings, vents, and masonry accessories as specified in Section 042000 Unit Masonry.
- G. Construct movement joints as specified in Section 042000 Unit Masonry.

3.06 SITE TOLERANCES

- A. Erect masonry within the tolerances described in ACI 530.1

3.07 FIELD QUALITY CONTROL

- A. Masonry will be inspected to be free of cracks or other blemishes on the finished face or front edges of the masonry units exceeding 3/8 inch or that can be seen from a distance of 10 feet.
- B. Units shall exhibit a texture approximately equal to the approved sample when viewed under diffused daylight illumination at a 20 foot distance.
- C. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under diffused daylight illumination from a 20 foot distance.

3.08 ADJUSTING AND CLEANING

- A. Repair chips on smooth finished units with patch kits furnished by manufacturer.
- B. Clean masonry units as specified in Section 042000 Unit Masonry.
- C. Clean one-half of mock-up panel as directed below and leave for one week. If no harmful effects appear, all objectionable stains have been removed and after mortar has set and cured, clean masonry as follows:
 - 1. Protect windows, sills, doors, trim and other work from damage.
 - 2. Remove large particles with stiff fiber brushes or wood paddles without damaging surface.
 - 3. Saturate masonry with clean water and flush off loose mortar and dirt.
 - 4. Dilute cleaning agent with clean water in controlled proportions.
 - 5. Apply solution to pre-soaked wall surface using soft-bristled brush or low pressure acid-resistant sprayer
 - 6. Thoroughly rinse cleaning solution and residue from wall surface.
 - a. Use alternative cleaning solutions and methods for difficult to clean masonry only after consultation with masonry unit manufacturer.

3.09 PROTECTION

- A. Protect units from damage resulting from subsequent construction operations.
 - 1. Use protection materials and methods which will not stain or damage units.
 - a. Remove protection materials upon Substantial Completion, or when risk of damage is no longer present.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 1 Sections
- B. Section 052100 – Steel Joist Framing.
- C. Section 053100 – Steel Decking.

1.02 REFERENCES

AISC – Steel Construction Manual, 14th Edition.

AISC 303 – Code of Standard Practice for Steel Buildings and Bridges.

AISC 341-10 – Seismic Provisions for Structural Steel Buildings dated June 22, 2010.

AISC 360-10 – Specification for Structural Steel Buildings.

AISC – Specification for Structural Joints Using ASTM A325 or A490 Bolts prepared by the Research Council on Structural Connections.

AWS D1.1 – Structural Welding Code.

AWS A5.1 – Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.

AWS A5.5 – Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.

AWS A5.17 – Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.

AWS A5.20 – Carbon Steel Electrodes for Flux Cored Arc Welding.

SSPC – Steel Structures Painting Manual.

ASTM A6 – Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

ASTM A36 – Standard Specification for Carbon Structural Steel.

ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A108 – Standard Specification for steel Bar, Carbon and Alloy, Cold-Finished.

ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength.

ASTM A490 – Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 KSI Minimum Tensile Strength.

ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

ASTM A563 – Standard Specification for Carbons and Alloy Steel Nuts

ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium Vanadium Structural Steel.

ASTM A673 – Standard Specification for Sampling Procedure for Impact Testing of Structural Steel

ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

ASTM A992 – Standard Specification for Structural Steel Shapes.

ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

ASTM F436 – Standard Specification for Hardened Steel Washers.

ASTM F844 – Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-Ksi Yield Strength.

ASTM F1852 – Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

ASTM F2280 – Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

1.03 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Shop Drawings:
 - 1. Contact Structural Engineer’s Construction Administrator prior to detailing structural steel shop drawings.
 - 2. Shop drawings shall be submitted on a 24” x 36” sheet minimum.
 - 3. Shop drawings shall clearly indicate the profiles, sizes, ASTM Grade, spacing and locations of structural steel members, including connections, attachments, anchorages, framed openings, sizes and types of fasteners, method of tightening fasteners, cambers, and the number, type and spacing of the stud shear connectors and headed studs.

4. Beam sizes shall be shown on the erection drawings (plans).
5. Submit shop drawings for review.
6. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.

- C. Maintain at construction office written welding procedures for each type of welded joint used in accordance with AWS D1.1.
- D. Submit certification that the fabricator meets the required qualifications and ultrasonic testing reports for complete penetration welds. If fabricator has an independent testing agency inspect fabrication as required by these specifications, submit the name and qualifications of the independent testing agency.
- E. Upon request, submit the erection sequence and procedures to be used by the steel erector.
- F. Submit certification that the erector meets the required qualifications.

1.04 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

1.05 STORAGE

- A. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials.

1.06 FABRICATOR'S QUALIFICATIONS

- A. Steel fabricator shall meet the requirements in the Structural Quality Assurance Plan in the Structural Drawings.

1.07 ERECTOR'S QUALIFICATIONS

- A. Steel fabricator shall meet the requirements in the Structural Quality Assurance Plan in the Structural Drawings
- B. Erector shall be experienced in erecting structural systems similar in complexity to this Project as evidenced by 10 completed projects.
- C. Erector shall have a minimum of 5 years experience in the erection of structural steel or is an AISC Certified Advanced Steel Erector.
- D. For qualification of welders, refer to the Structural Quality Assurance Plan in the Structural Drawings.

PART 2 PRODUCTS

2.01 ANCHOR RODS

- A. Anchor Rods: Headed rod or a threaded rod with a heavy hexagonal nut and plate washer welded to the bottom of the threaded rod conforming to ASTM F1554.
- B. Nuts and Washers: Two hexagonal nuts and two plate washers conforming to ASTM A36 for each anchor rod assembly.

2.02 ROLLED STEEL SHAPES, PLATES, AND BARS

- A. Rolled Steel Shapes, Plates, and Bars: ASTM A36; ASTM A572, Grade 50; or ASTM A992 as indicated by the Structural Drawings. ASTM A572, Grade 50 may be substituted for ASTM A992.

2.03 SQUARE, RECTANGULAR AND ROUND STEEL HOLLOW STRUCTURAL SECTIONS (HSS)

- A. Hollow structural sections:
 - 1. Rectangular and Square: ASTM A500 Grade B, 46 ksi minimum yield strength
 - 2. Round: ASTM A500 Grade B, 42 ksi minimum yield strength

2.04 PIPE STEEL STRUCTURAL SECTIONS

- A. Pipe Structural Sections: ASTM A53, Gr. B, 35 ksi minimum yield strength.

2.05 NON-HIGH-STRENGTH FASTENERS

- A. Non-High-Strength Bolts: ASTM A307, Grade A, 60 ksi minimum, where noted on the Structural Drawings.
- B. Hardened Steel Washers: ASTM F436.

2.06 HIGH-STRENGTH FASTENERS

- A. High-Strength Bolts: ASTM A325 or ASTM A490 as noted on the Structural Drawings. 3/4-inch minimum diameter.
- B. Hardened steel washers shall conform to ASTM F436.
- C. Spline-Type Tension Control Bolts: ASTM spline-type tension control bolts with plain hardened washers and suitable nuts are an acceptable alternate design bolt assembly.
- D. Do not use load indicating washers.

2.07 EXPANSION ANCHORS

- A. Expansion Anchors: See Structural Notes.

2.08 ADHESIVE ANCHORS

- A. Adhesive Anchors: See Structural Notes.

2.09 SCREW ANCHORS

- A. Screw Anchors: See Structural Notes.

2.10 HEADED STUDS

- A. Headed Studs: ASTM A108, comply with AWS D1.1. Provide studs with the diameter shown on the Structural Drawings.

2.11 STUD SHEAR CONNECTORS

- A. Stud Shear Connectors: ASTM A108, 3/4-inch diameter in compliance with AWS D1.1.

2.12 WELD ELECTRODES

- A. Weld Electrodes: AWS A5.1, A5.5, A5.17, or A5.20 E-70 series low hydrogen electrodes.
- B. Provide E-70 series, low hydrogen electrodes with a minimum Charpy V-Notch (CVN) toughness of 20 ft.-lb. at 0 degrees Fahrenheit and 40 ft.-lb. at 70 degrees Fahrenheit for demand critical welds. Refer to the Structural Drawings for locations of demand critical welds.
- C. Properly store electrodes to maintain flux quality.

2.13 PAINT

- A. Oxide Primer: AISC Specifications, Code of Standard Practice, and SSPC Steel Structure Painting Manual, unless indicated otherwise.
- B. Paint Primer: Free of lead and chromate and comply with State and Federal volatile organic compound (VOC) requirements.
- C. Paint Primer: Compatible with finish coating.

2.14 GALVANIZE

- A. Galvanized Coating: ASTM A123.
- B. Galvanize Bolts, Nuts, and Washers: ASTM A153 when used to connect steel members that are specified to be galvanized.
- C. Expansion Anchors, Adhesive Anchors, or Screw Anchors: Where specified to be galvanized, anchors shall be mechanically galvanized in accordance with ASTM B695, Class 65, Type I.

PART 3 EXECUTION**3.01 GENERAL**

- A. Fabricate and erect structural steel in accordance with AISC Specifications and Code of Standard Practice.
- B. Notify Architect/Structural Engineer and Structural Testing/Inspection Agency at least 48 hours prior to structural steel fabrication and erection.

3.02 ANCHOR ROD SETTING

- A. Provide templates for setting anchor rods. Position anchor rods by using templates with two nuts to secure in place prior to placement of concrete.
- B. Do not erect steel where anchor rod nuts will not have full threads.

3.03 CONNECTIONS

- A. Provide a minimum of two fasteners at each bolted connection.
- B. Ensure fasteners are lubricated prior to installation.
- C. Provide high-strength bolted connections in accordance with AISC Specifications for Structural Joints using ASTM A325 or A490 Bolts.

- D. Provide connections for expansion and contraction where steel beams connect to concrete walls or concrete columns and at expansion joints. Secure nuts on bolts against loosening. (Dent threads with a chisel.)

3.04 FASTENER INSTALLATION

- A. Bolts shall be installed in holes of the connection and brought to snug tight condition. Tighten connection progressing systematically from the most rigid part to the free edges of the connection to minimize relaxation of the bolts.
- B. High-strength bolts installed shall have a hardened washer under the element turned in tightening.
- C. Installation and tightening of bolts shall conform to the AISC Specifications for Structural Joints.

3.05 EXPANSION ANCHOR INSTALLATION

- A. Install in accordance with manufacturer's recommendation and the ICC ESR report for the particular anchor used.
- B. Minimum Embedment: See Structural Notes on Drawings.

3.06 ADHESIVE ANCHOR INSTALLATION

- A. Install in accordance with manufacturer's recommendation and the ICC ESR or IAPMO-UES report for the particular anchor used.
- B. Minimum Embedment: See Structural Notes on Drawings.

3.07 SCREW ANCHOR INSTALLATION

- A. Install in accordance with manufacturer's recommendation and the ICC ESR report for the particular anchor used.
- B. Minimum Embedment: See Structural Notes on Drawings.

3.08 HEADED STUDS

- A. Headed studs shall be installed in accordance with AWS D1.1 with the resulting in-place length after burn-off as shown on the Structural Drawings.
- B. Do not locate headed studs closer than 1-1/4 inches from the edge of embedded steel member to the centerline of the stud.
- C. Remove ceramic arc shields after welding studs.

3.09 STUD SHEAR CONNECTORS FOR COMPOSITE CONSTRUCTION

- A. Stud shear connectors shall be installed in accordance with AWS D1.1 with the resulting in-place length after burn-off as shown on the Structural Drawings.
- B. Stud shear connectors shall be placed as follows:
 1. Studs shall be uniformly spaced along beams.
 2. Locate studs directly over the web of beams with flanges less than 0.3 inches thick.
 3. Minimum spacing shall be 4½ inches along the longitudinal axis of the beam and 3 inches transverse to the longitudinal axis of the beam.

4. Where double rows of studs are required, begin double rows at each end of the beam. If possible, locate the studs at least 2 inches from the edge of the flange to the centerline of stud, but in no case locate the stud less than 1-1/4 inches from the edge of the flange to the centerline of stud.
5. Refer to the Structural Drawings for additional placement guidelines.

C. Remove ceramic arc shields after welding studs.

3.10 WELDING

- A. Comply with AWS D1.1. Use prequalified weld procedures.
- B. Provide end returns where fillet welds terminate at ends or sides. Returns shall be continuous for a distance of not less than two times the nominal size of the weld.
- C. Complete penetration joints shall be backgouged to sound metal before the second side is welded or have 1/4-inch root opening with 3/16 x 1 inch backing bar. Access holes are required. Filling access holes is not required.
- D. Remove all slag and weld splatter from deposited weld metal.

3.11 SPLICING

- A. Splice members only where indicated unless authorized in writing by Structural Engineer.
- B. Provide shim plates at bottom flange splice at continuous beam splices with different depths.

3.12 CUTTING

- A. Do not use flame cutting to correct errors unless authorized in writing.
- B. Re-entrant corners shall have a minimum radius of one inch and be free of notches. Notches and gouges resulting from flame cutting shall be finished to a smooth appearance.

3.13 MILL SCALE

- A. Remove loose mill scale.

3.14 BOLT HOLES

- A. Cut, drill, or punch holes perpendicular to metal surfaces. Do not enlarge holes by burning. Drill or punch holes in bearing plates. Remove burrs.

3.15 PAINTING

- A. Paint steel that is not encased in concrete, plaster, or sprayed fireproofing. Do not shop paint in areas to be field welded, contact surfaces of slip critical connections, or areas to receive special finishes.
- B. Field paint as required steel that has been welded or that is unpainted after connections have been tightened.

3.16 GALVANIZING

- A. Galvanize shelf angles that support the exterior building veneer, for example brick shelf angles.

- B. Galvanize environmentally exposed steel, for example mechanical equipment supports.
- C. Touch-up welds and abrasions in galvanized members in accordance with ASTM A780.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Section includes the design, manufacture, and erection of steel joists shown in the Structural Drawings.

1.02 RELATED SECTIONS

- A. Division 1 Sections
- B. Section 051200 – Structural Steel Framing.
- C. Section 053100 – Steel Decking.

1.03 REFERENCES

ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

AWS D1.1 – Structural Welding Code.

OSHA – Safety and Health Regulations for Construction, Steel Erection, Open Web Steel Joists, Part 1926.757.

SJI – Standard Specifications for Open Web Steel Joists, K-Series.

SJI – Standard Specifications for Open Web Steel Joists, H-Series.

SJI – Standard Specifications for Longspan Steel Joists, LH-Series, and Deep Longspan Steel Joists, DLH-Series.

SJI – Standard Specifications for Joist Girders.

SSPC – Paint 15 Steel Joist Shop Primer.

VULCRAFT – Specifications for Vulcraft Super Longspan Steel Joists, SLH-Series.

1.04 DESIGN REQUIREMENTS

- A. Steel joists and bridging shall be designed by a Structural Engineer licensed in the project state in accordance with the Steel Joist Institute (SJI) Standard Specifications.
- B. Refer to Structural Drawings for special design requirements, if any.

1.05 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Shop Drawings shall include the following:
 - 1. Plan of joist layout showing mark, number, type, location, bracing, and spacing of joists.
 - 2. Connection and seat details.
 - 3. Bridging requirements.

- C. Calculations shall be signed and sealed by an Engineer licensed in the Project state.
- D. Upon request, submit the erection sequence and procedures to be used by the steel erector.

1.06 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

1.07 QUALIFICATIONS

- A. Manufacturer shall be a member of the Steel Joist Institute.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle joists as recommended in SJI Standard Specifications.

PART 2 PRODUCTS

2.01 ROLLED STEEL PLATES, SHAPES, AND BARS

- A. Steel: Steel in accordance with SJI Standard Specifications.

2.02 UNFINISHED BOLTS, WASHERS, AND NUTS

- A. Unfinished Bolts: ASTM A307, Grade A, 60 ksi minimum tensile strength. Provide compatible hexagonal nuts and plain washers.

2.03 WELD ELECTRODES

- A. Weld Electrodes: E-70 series low hydrogen electrodes conforming to AWS A5.1 or A5.5, A5.17 or A5.20.
- B. Provide proper storage for electrodes to maintain flux quality.

2.04 PAINT

- A. Primer shall conform to Steel Structures Painting Council Specification SSPC – Paint 15.

PART 3 EXECUTION

3.01 MANUFACTURE AND ERECTION

- A. Manufacture and erect joists in accordance with SJI Standard Specifications and OSHA Steel Erection Standards.
- B. Members shall have parallel top and bottom chords unless otherwise indicated.
- C. Provide for connections of kickers and hangers to members.
- D. Provide bottom chord extensions at columns and as indicated by the Construction Drawings. Weld bottom chords to members after dead loads have been applied.
- E. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord (not suspended ceilings). Coordinate location with architectural drawings. Extend ends to within 1/2 inch of the finished wall surface unless otherwise indicated.

- F. Camber joists according to recommendations in the SJI Standard Specifications, unless noted otherwise on Structural Drawings. Negative camber and bent joists are unacceptable.
- G. Do not erect joists until supporting work is secured.
- H. Provide bridging complying with SJI Standard Specifications. Provide for connections where bridging terminates.
- I. Joists that support the load of hanging partitions shall comply with the maximum allowed deflection limits as required by the partition manufacturer.

3.02 CONCENTRATED LOADS ON JOISTS

- A. Do not place concentrated loads on the joists that are not shown in the Structural Drawings without receiving written consent from the steel joist manufacturer. Reinforcement required for concentrated loads applied to either the top or bottom chord shall be designed by joist manufacturer.

3.03 HEADER UNITS

- A. Provide header units to support openings in floor or roof system not framed with steel shapes.

3.04 SHOP PAINTING

- A. Remove loose scale, heavy rust, and other foreign materials from joists and accessories before application of shop paint.
- B. Apply one shop coat of steel joist primer paint to joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 1.0 mil.

3.05 BEARING

- A. Extend ends of steel joists not less than 4 inches over masonry and concrete supports. Extend ends of joists not less than 2½ inches over steel supports. Positive attachment to support shall be made by welding or bolting. In such cases where a shorter end bearing length must be used, such condition must be designed.
- B. Fabricate sloped bearing seats where indicated on Drawings or where slope of joist exceeds ¼ inch per foot.

3.06 WELDING

- A. Perform welding in accordance with AWS D1.1 "Structural Welding Code". Use AWS Certified Welders.
- B. Weld ends of joists resting on steel supports with the minimum weld specified by the SJI standard specifications, unless otherwise indicated in the Structural Drawings.
- C. Remove all slag and weld splatter from deposited weld material.

3.07 BRIDGING INSTALLATION

- A. Permanently fasten bridging before the application of loads. Secure to steel beams or CMU walls where possible; otherwise terminate bridging with X-bracing to joists top chord.
- B. In areas where joists will be exposed to view, align bridging in straight rows to create uniform appearance.

3.08 PROTECTION

- A. Provide means for adequate distribution of concentrated loads so that carrying capacity of joists is not exceeded during construction.
- B. Provide temporary bridging, bracing, connections, and anchors to ensure lateral stability during construction.
- C. Joists damaged during construction shall be replaced or repaired with procedures submitted by the joist manufacturer.

3.09 CUTTING

- A. Do not field cut or apply heat to joists unless authorized in writing.

3.10 REPAIRS OR MODIFICATIONS

- A. If a steel joist is damaged or its bearing condition must be modified, Contractor shall have the joist supplier provide a sketch showing the required repairs or modifications.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Division 1 Sections
- B. Section 051200 – Structural Steel Framing.
- C. Section 052100 – Steel Joist Framing.

1.02 REFERENCES

AISI – Specifications for the Design of Cold-Formed Steel Structural Members.

AWS D1.1 – Structural Welding Code.

AWS A5.5 – Specifications For Low Alloy Steel Covered Arc-Welding.

SDI 31 – Design Manual for Composite Decks, Form Decks, and Roof Decks

SDI RDCH1 – Roof Deck Construction Handbook

SDI DDMO3 – Diaphragm Design Manual, Third Edition

ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

ASTM C1513 – Standard Specification for Steel Tapping Screws for Cold-Formed Steel-Framing Connections.

1.03 SUBMITTALS

- A. Notify the Structural Engineer prior to detailing shop drawings.
- B. Submit detailed shop drawings showing layout and types of deck panels, weld sizes, weld patterns and conditions requiring closure panels, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories.
- C. Submit manufacturer's information including section properties, deck gage, material yield strength, etc. for each type of steel deck required. The submittal shall demonstrate that the deck complies with the minimum section and material properties indicated in the structural notes and this Specification.
- D. Submit supporting documentation and manufacturer's information for deck that does not comply with the minimum section and material properties specified. Deck shall be designed for the design criteria outlined herein and the submittal shall be stamped and signed by an Engineer licensed in the project state.
- E. Upon request, submit mill certification that the steel supplied meets these Specifications.

- F. Upon request, submit written welding procedures.
- G. Submit manufacturer's certification of compliance with supplementary framing, sump pans, cant strips, curb openings, special jointing and other accessories.

1.04 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.
- B. Welders shall be certified by AWS for the welding process involved.

1.05 STORAGE

- A. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide steel deck sheets of three spans minimum wherever possible.

2.02 DECK ATTACHMENT

- A. Use E-60 series electrodes conforming to AWS A5.5.
- B. Provide weld washers for material thinner than 22 gage.
- C. Provide screws conforming to ASTM C1513.

2.03 ROOF DECK

- A. Roof Deck: Steel sheets, minimum yield strength of 33,000 pounds per square inch, ASTM A653, Grade 33 or higher, deck types and gages as indicated on Drawings.
- B. Finish: Galvanized, G60 coating.
- C. End and Side Laps: 2-inch flush, nested unless otherwise indicated or specified.
- D. Vented deck: If required by lightweight insulating concrete system.

2.04 COMPOSITE DECK

- A. Composite Deck: Composite deck shall meet the properties noted in the Structural Drawings. Steel sheets having minimum yield strength of 33,000, 38,000, or 40,000 pounds per square inch shall comply with ASTM A1008 or A653.
- B. Contractor may submit an alternate design for the composite deck provided it meets the Design Criteria below and the submission is signed and sealed by an Engineer licensed in the Project State.
- C. Design Criteria
 - 1. Design Loads
 - a. Self-Weight: The sum of the weight of the theoretical volume of concrete (as determined by the design slab thickness and deck profile), the weight of an additional three-quarters inch (3/4") of

concrete to account for the deflection of the steel framing, and the weight of the steel deck. Fresh unit weight of normal weight concrete shall be assumed to be 145 pcf. Fresh unit weight of structural lightweight concrete shall be assumed to be 120 pcf.

- b. Construction Load: 20 psf uniform load or a 150 pound concentrated load and a one-foot width of deck.
 - c. Superimposed Live Load: 200 psf.
 - 2. Deflections
 - a. Unshored Form Deflection: Under self-weight and construction load, maximum $L/180$ or $3/4$ inch, whichever is smaller, relative to supporting members.
 - b. Superimposed Live Load Deflection: Maximum $L/360$ for the composite slab.
 - 3. Deck Design
 - a. Design of steel deck shall comply with AISI and SDI Specifications.
 - b. For design as a form, the bending stress in the steel deck shall not exceed 0.6 times the material yield strength under the combined loads of self-weight and construction load.
 - c. For design as a composite unit, allowable superimposed loads shall be based on either an elastic flexural analysis or an ultimate strength analysis.
 - 4. Bearing Lengths: Conform to AISI specification. A uniform load case consisting of the self-weight and construction load shall be used. Regardless of the calculated length, the minimum bearing length shall not be less than 2 inches.
- D. Finish: Phosphatized/painted on the exposed side of the deck. The side to be in contact with the concrete may be uncoated.
 - E. Closures: 20 gage minimum, galvanized, fit at columns, girders, where panels change direction, and end closures for panels not closed by bent plates or other means.

2.05 PERMANENT FORM DECK

- A. Permanent Form Deck: Steel sheets, minimum yield strength of 60,000 pounds per square inch, ASTM A653, gage as indicated on Drawings.
- B. Finish: Galvanized, G60 coating.

2.06 ROOF SUMP PANS

- A. Roof Sump Pans: Single piece of 14 gage galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, when required by Architect. Size to receive roof drains and with bearing flanges not less than 3 inches wide

PART 3 EXECUTION

3.01 GENERAL

- A. Installer must examine the areas and conditions under which metal decking is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Steel deck shall be installed in accordance with the approved shop drawings, requirements of the Steel Deck Institute, the manufacturer's recommendations, and any applicable regulatory, safety guidelines.

3.02 PLACEMENT

- A. Place steel deck units on supporting steel framework and adjust to final position before permanently fastening. Install deck units and accessories in accordance with manufacturer's recommendations and the Drawings, and as specified herein.

3.03 CUTTING

- A. Cut holes in deck indicated by the Drawings. Other holes required shall be supplied by those requiring them. Obtain written authorization for additional holes and cutting not indicated on erection drawings.

3.04 WELDING

- A. Perform welding in accordance with AWS Structural Welding Code.
- B. Install weld washers for deck thinner than 22 gage.

3.05 CONCENTRATED LOADS

- A. Concentrated loads suspended from the steel deck shall not exceed 50 pounds. No more than one suspended load shall be located in the sheet width in any span.

3.06 DECK SUPPORTS

- A. Fasten deck to steel framework at ends and at each intermediate support by welding according to manufacturer's specifications unless indicated otherwise on structural drawings or otherwise specified herein. Do not weld deck in place until all bolted and welded connections for the structural frame are complete. A minimum of one floor over the area to be decked is to be bolted and welded prior to welding deck in place.

3.07 ROOF DECK

- A. Place roof deck in straight alignment. Lap ends of sheets two inches.
- B. Attach side laps of roof deck with screws spaced as shown on the Drawings.
- C. Weld roof deck in place by welding with 5/8-inch puddle welds as shown on the Drawings.
- D. Where screws are required in the drawings, screw fasteners shall extend through the steel connection a minimum of three exposed threads.

3.08 COMPOSITE DECK

- A. Place steel floor units in straight alignment. Maintain a maximum space of ¼ inch between ends of abutting units. In no case shall the ridges of the composite deck be located over beams or girders running parallel to the span of the deck.
- B. Unless shown otherwise on the Drawings, weld panels in place with 3/4-inch puddle welds or shear connectors spaced at not more than twelve inches on center at each support. Fasten side laps with stitch welds 1½ inches long not exceeding a spacing of two feet on center. Where two panels butt, fasten each unit with separate welds. Lapping ends of panels is not acceptable. Side laps may be fastened by screws or button punching if approved by the Structural Engineer.

- C. Contractor may elect to shore deck to reduce deflection and overrun of concrete if approved by the Structural Engineer. Deck shoring shall be supported by adjacent steel beam/girder framing and shall not extend to floor below. Do not shore structural beams or girders unless authorized in writing by the Structural Engineer.
- D. Cut holes in deck after concrete is in place.
- E. Closures
 - 1. Place closures in straight alignment with structural steel beams or girders. Install closures to provide a minimum 1-inch bearing. Locate edge of closures a minimum 1-inch from beam or girder centerline.
 - 2. Weld deck closures with puddle welds spaced at 12 inches on center (maximum) unless noted otherwise on the Drawings. Puddle weld size shall match the weld size used for the deck attachment.

3.09 PERMANENT FORMS

- A. Place forms in straight alignment for the entire length of the run of the sheets. Lap ends of sheets two inches.
- B. Attach side laps of deck with screws spaced as shown on the Drawings.
- C. Weld deck in place with ½-inch puddle welds and weld washers with welds as shown on the Drawings.

3.10 ROOF SUMP PANS

- A. Recess pans not less than 1½ inches below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

END OF SECTION 053100

SECTION 054100 - COLD-FORMED EXTERIOR STEEL STUD FRAMING**PART 1 GENERAL****1.01 RELATED SECTIONS**

- A. Division 1 Sections.
- B. Section 054000 – Cold-Formed Steel Framing.

1.02 REFERENCES

AISI S100-07 – North American Specification for the Design of Cold-Form Steel Structural Members.

AISI S200-07 – North American Standard for Cold-formed Steel Framing – General Provisions.

ANSI Z49.1 – Safety in Welding, Cutting, and Allied Processes.

ASTM A653 – Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

AWS D1.3 – Structural Welding Code: Sheet Steel.

SSMA – Steel Stud Manufacturers Association Product Technical Information.

1.03 DESIGN REQUIREMENTS

- A. Design of the following is the sole responsibility of the Contractor:
 - 1. Cold-formed exterior steel studs including tracks, bridging, and window or door framing.
 - 2. Any required temporary and permanent restraint/bracing.
- B. Cold-formed exterior steel stud framing shall be designed by a Structural Engineer licensed in the Project state. Design criteria includes, but not limited to, the following:
 - 1. Deflection of steel studs shall not exceed L/360 Metal Panel and L/600 Masonry Veneer.
 - 2. Wind pressure for Components and Cladding as indicated in the Structural Drawings.
- C. Cold-formed steel design, fabrication and erection shall conform to AISI S100 and AISI S200.
- D. Stud depth, layout and configuration of cold-formed exterior steel studs shall be compatible with the plans, sections, and details of the Construction Documents.

1.04 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Shop Drawings
 - 1. Shall include but not necessarily be limited to the following:
 - a. Plans, cross-sections, or elevations as necessary to adequately depict component locations.
 - b. Framing details at wall openings including jamb members, headers, sills, and connections.

- c. Connection details showing screw types and locations, weld lengths or other fastener requirements.
 - d. Bracing locations and details. Any required bracing to the primary structure that is not shown in the Construction Documents shall be specifically identified.
- 2. Design loads.
- 3. Shall be sealed by an Engineer licensed in the Project state.
- C. Submit manufacturer's product information clearly describing quality, performance and finish for steel studs.
- D. Submit manufacturer and Installer qualifications.

1.05 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.
- B. Manufacturer shall have a minimum of three years documented experience in the manufacturing of products required by the Construction Documents.
- C. Installer shall have a minimum of three years documented experience.

1.06 MOCKUP

- A. Provide a minimum of one mockup of exterior wall framing sufficient in size to illustrate various construction conditions and as directed by the Architect. Construct mock-up to include, but not be limited to, the following components:
 - 1. Stud framing, including runners, bridging, outlet box framing and other farming accessories. Include interior and exterior corner conditions, and intersections with interior rated stud walls.
 - 2. Typical window frame, door frame and expansion joint.
 - 3. Insulation, sheathing and vapor retarder. Install sheathing with veneer anchors to receive subsequent veneer mock-up.
- B. The approved sample will serve as the standard of quality, as well as for coordination with related components.
- C. Leave approved mock-up ready to receive Exterior Finish mock-up.
- D. Do not place mock-up to remain as a part of the Work.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Studs and accessories which are 12, 14, or 16 gage shall meet the requirements of ASTM A446, Grade D with a minimum yield of 50,000 psi. Studs and accessories which are 18 or 20 gage shall meet the requirements of ASTM A446, Grade A with a minimum yield of 33,000 psi.
- B. Studs and accessories shall have a G60 galvanized coating meeting the requirements of ASTM A525.

2.02 ACCESSORIES

- A. Bridging: 1-1/2-inch deep by 16 gage minimum.
- B. Strap Bracing: Minimum of 1-1/2-inch wide by 18 gage unless noted otherwise.

- C. Tracks: Deep leg type, unpunched, same gage, size, and finish as studs with minimum 18 gage thickness.
- D. Compensation Tracks / Slip Tracks: Deep leg type with a flange width of 2½ inches. Track shall be same nominal depth as stud/track with allowance for slip of standard deep leg track. Minimum 14 gage.
- E. Plates, Gussets, Clip Angles: Minimum 14 gage. Clip angles shall be a minimum of 2 inches x 2 inches.
- F. Self-drilling, Self-tapping Screws: Hot-dip galvanized conforming to values given in the referenced SSMA document.
- G. Anchorage Devices:
 - 1. Powder Actuated Fasteners shall be manufactured from AISI 1062 or AISI 1065 steel austempered to a minimum core hardness of 50-54Rc and possess the following properties:
 - Tensile strength = 270,000 psi
 - Shear strength = 162,000 psi
 - All fasteners shall meet the requirements of ASTM B-633-78.
 - Fasteners shall be a minimum 9/64-inch diameter.
 - Fasteners shall be zinc plated.
 - Fastener minimum design values shall be in accordance with manufacturer's recommendations.
 - 2. Expansion anchors shall be stud type, and shall be zinc plated in accordance with ASTM B633, Type III Fe/Zn 5. Expansion anchors shall be a minimum of 3/8-inch diameter with 2-1/2-inch embedment into concrete unless noted otherwise in the Drawings.
- H. Welding: AWS D1.3-8 Structural Welding Code-Sheet Metal (field welding of material shall not be permitted for 20 gage material or thinner).
- I. Acoustical Sealant: USG, or approved equal.
- J. Sizes and thicknesses are minimum acceptable, regardless of load. Actual sizes shall be determined by Steel Stud manufacturer in accordance with loads given in the Structural Notes. Minimum listed size shall not be construed to be the actual designed component size.
- K. Primer for Synthetic Rubber Tape: HP-250, Carlisle Corporation.
- L. Synthetic Rubber Tape: Sure-Seal SecurTAPE, Carlisle Corporation.
 - 1. Width: 7 inches.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove dust and other foreign material from concrete slab edge by brooming and wiping to provide a clean surface to receive rubber tape and primer.

3.02 ERECTION

- A. General:
 - 1. Framing components shall be cut squarely for attachment to perpendicular members or, as required, for angular fit against abutting members.
 - 2. Erect framing plumb, level, and square.
 - 3. Studs shall be plumbed, aligned, and securely attached to the flanges or web of both the upper and lower tracks.

4. Fastening of components shall be with self-drilling screws or welds. Wire tying of components shall not be permitted. Touch-up field welds and scratched or damaged finish to studs with zinc rich paint.
 5. Splices in framing components shall not be permitted other than in runner tracks.
 6. Runner tracks shall be securely anchored to the supporting structure.
- B. Studs Spacing: Stud manufacturer shall determine stud spacing at interior and corner zones to resist Component and Cladding Loads given in the Structural Notes. Stud spacing shall not exceed 16 inches, center-to-center, regardless of design loads.
- C. Stud Tracks: Before installing stud tracks for exterior walls, apply primer and synthetic rubber tape longitudinally under stud tracks to seal runner to floor.
1. Anchor stud tracks to floor with powder-driven fasteners sized and spaced to resist the design loads. Spacing shall not exceed 16 inches, center-to-center.
 2. Attach flange of stud to track with screw(s) through each flange, as required to resist the design loads. Screws shall not be smaller than #8.
- D. Door Openings: Install multiple studs each side of door openings as shown on the approved Shop Drawings.
1. Install headers between door jambs at top of doors as shown on the approved Shop Drawings.
 2. On top of headers, install runners to receive bottom ends of studs over door openings.
- E. Window Openings: Install multiple studs each side of window openings as shown on the approved Shop Drawings.
1. Install headers and sills between window jambs shown on the approved Shop Drawings.
 2. On top of headers and bottom of sills, install runners to receive short studs.
 3. Where shown on the Architectural Drawings, attach wood blocking to stud framing with ½-inch diameter galvanized bolts 12 inches on-center. Coordinate attachment of window system to blocking/stud framing prior to erection of metal stud framing.
 4. Where indicated on the Structural Drawings (for example, at windows over 8 feet wide and at cantilevered parapets), attach studs / track to structural steel reinforcement with self-drilling screws.
- F. Corners: Construct using a minimum of three studs designed to resist the design loads.
- G. Between Studs: Install framing for attachment of electrical boxes, mechanical and for other items to be anchored to walls.
- H. At Butting Walls: Place studs not more than 2 inches from walls.
- I. Insulation: In all multiple jamb studs and multiple headers not accessible to insulation contractors, insulation equal to that specified elsewhere shall be provided.

END OF SECTION 054100

SECTION 054400 - COLD-FORMED STEEL TRUSSES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Section includes all work and supplementary items required to complete the proper design, fabrication and erection of the cold-formed steel trusses as shown in the Construction Documents and specified herein, including headers, outriggers, supplemental rafters and incidental framing for a complete assembly within the extent shown in the Construction Documents.
- B. Cold-formed steel trusses include planar structural units consisting of welded, screwed or bolted connected members which are fabricated, cut and assembled prior to delivery.

1.02 RELATED SECTIONS

- A. Division 1 Sections.
- B. Section 051200 – Structural Steel Framing.
- C. Section 053100 – Steel Decking.

1.03 REFERENCES

AISI S100-07 – North American Specification for the Design of Cold-Form Steel Structural Members.

AISI S200-07 – North American Standard for Cold-formed Steel Framing – General Provisions.

AISI S214-07 – North American Standard for Cold-formed Steel Framing – Truss Design, with Supplement 2, dated 2008.

ANSI Z49.1 – Safety in Welding, Cutting, and Allied Processes.

ASTM A653 – Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

AWS D1.3 – Structural Welding Code – Sheet Steel.

CFSBCSI – Guide to Good Practice for Handling, Installing, Restraining & Bracing of Cold-Formed Steel Trusses.

1.04 DESIGN REQUIREMENTS

- A. Design of the following is the sole responsibility of the Contractor:
 - 1. Cold-formed steel trusses.
 - 2. Header truss units at openings or change of framing.
 - 3. Temporary and permanent restraint/bracing for all cold-formed elements.
 - 4. Roof deck structural support at eave edge, valley, hip, and ridge transition planes.
- B. Cold-formed steel trusses shall be designed by a Structural Engineer licensed in the Project state for the loads shown in the Structural Drawings. Live load deflection shall not exceed 1/360 of the span, unless noted otherwise on the Structural Drawings.

- C. Cold-formed steel design, fabrication and erection shall conform to AISI S100 and AISI S200, except as modified by AISI S214.
- D. For trusses spanning 60 feet or greater, temporary installation restraint/bracing and permanent individual truss member restraint/bracing shall be designed by the cold-formed steel truss Engineer for the specific project conditions.

1.05 SUBMITTALS

- A. Refer to Structural Quality Assurance Plan in the Structural Drawings for additional submittal requirements.
- B. Shop Drawings:
 - 1. Shall include truss design drawings that show for each truss, as a minimum, the following:
 - a. Slope or depth, span and spacing.
 - b. Location of all joints and support locations.
 - c. Number of plies if greater than one.
 - d. Required bearing widths.
 - e. Design loads as applicable, including:
 - 1) Top chord dead and live load.
 - 2) Bottom chord dead and live load.
 - 3) Additional loads and locations.
 - 4) Environmental design criteria and loads (wind, rain, snow, seismic, etc.)
 - 5) Other lateral loads, including drag strut loads.
 - f. Maximum reaction force and direction, including maximum uplift reaction forces where applicable.
 - g. Location of all truss member connections.
 - h. Gusset plate locations, sizes, and material specifications.
 - i. Fastening type, size, quantities, and locations.
 - j. Shape and material specification for each truss member;
 - k. Maximum axial tension and compression forces in the truss members.
 - l. Truss-to-truss connections and truss field assembly requirements.
 - m. Calculated span-to-deflection ratio and maximum vertical and horizontal deflection for live and total load as applicable.
 - n. Required permanent individual truss member restraint location and the method and details of restraint/bracing.
 - o. Design and details for individual truss member reinforcement.
 - 2. Shall include truss placement drawings that identifies the proposed location for each individually designated truss and references the corresponding truss design drawing.
 - 3. Shall include instructions for erection.
 - 4. Shall be sealed by an Engineer licensed in the Project state.
- C. Submit erector's qualifications.

1.06 QUALITY ASSURANCE

- A. Refer to the Structural Quality Assurance Plan in the Structural Drawings.

1.07 FABRICATOR'S QUALIFICATIONS

- A. Truss fabricator shall meet the requirements in the Structural Quality Assurance Plan in the Structural Drawings.
- B. Trusses shall be designed, fabricated, and erected by a firm which has a minimum of five years of successfully designing, fabricating and erecting trussed assemblies similar to scope required .

1.08 ERECTOR'S QUALIFICATIONS

- A. Erector shall have a minimum of 5 years experience in the erection of trusses similar in complexity to this Project as evidenced by 10 completed projects.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store trusses with care and in accordance with manufacturer's instructions and CFSBCSI recommendations to avoid damage from bending, overturning or other cause for which trusses are not designed to resist or endure.

PART 2 PRODUCTS**2.01 TRUSS COMPONENTS**

- A. Truss components shall be manufactured from steel that conforms to the requirements of ASTM A653, Grade A (33 ksi min. yield) for 18 gage and lighter and ASTM A653, Grade D (50 ksi min. yield) for 16 gage and heavier. Galvanize with a zinc coating complying with G60 minimum.
 - 1. Top chord of cold-formed trusses shall be a minimum of 16 gage to receive roof deck attachments.

2.02 FASTENERS

- A. Framing components shall be shop fabricated and joined to one another by means of manufacturer recommended self-drilling, self-tapping screws with corrosion-resistant plated finish or welding complying with AWS D1.3. Welding in the field to cold-formed elements is strictly prohibited unless written permission is received from the truss Engineer.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Contractor shall prepare the structure to ensure proper and adequate structural support for the materials specified.

3.02 EXAMINATION

- A. Truss Erector shall visually examine and verify that receiving surfaces of the substructure have no apparent defects or errors which would result in substandard workmanship.
- B. Report any unsatisfactory conditions to the Architect.

3.03 FABRICATION

- A. Cold-formed steel trusses shall be constructed at the fabricator's shop. Job-site assembly is not permitted.
- B. Truss components shall be straight and true prior to fabrication. Flattening or straightening of components, when necessary, shall be accomplished in a manner so as to not damage the component.
- C. Truss components shall be cut neatly to fit snugly against adjacent members.
- D. No splices will be allowed in trusses except as shown in the approved shop drawings.
- E. Provide all clips, angles, henways and other miscellaneous pieces necessary to attach cold-formed steel trusses to the substructure or to attach other components within this section to one another.

- F. Completed trusses shall be free from twists, bends, or open joints with all members straight and true to line.
- G. If the truss components have been welded to one another then all welds must be thoroughly cleaned and wire brushed and primed and painted with a high zinc content paint capable of providing an equal or greater degree of protection than the original G-60 galvanized coating.

3.04 ERECTION

- A. Trusses shall be erected by approved methods using equipment of adequate capacity to safely perform the work. Lifting of trusses shall be done so as to not cause local distortion in any member.
- B. Trusses shall be erected true and plumb and properly bridged and braced in accordance with the approved shop drawings.
- C. Contractor is responsible for checking the dimensions and assuring the fit of all members and trusses before erection begins.
- D. Work shall be erected plumb and level and to dimensions and spacings indicated on the drawings.
- E. Components shall be of the size and spacing shown on the approved shop drawings.
- F. Provide web stiffeners and reinforcement at reaction points where required by analysis or to suit details.
- G. Anchor trusses securely at all bearing points to comply with methods and details indicated.
- H. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads, and comply with other indicated requirements.
- I. Do not cut, modify, damage, or remove truss components.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated and/or prefabricated steel, and aluminum items, including:
 - 1. loose steel lintels, elevator pit ladder, elevator sump pit cover, library chute, ships's ladder, walk-through ladder, fall protection anchors, safety chain, expandable gate, and trolley hoist, chute, and bookkeeper lock box.
 - 2. Steel framing and supports for: overhead doors, paired panel partitions, and mechanical and electrical equipment.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 042000 - UNIT MASONRY: Placement of metal fabrications in masonry.
- C. Section 055100 - Metal Stairs.
- D. Section 055213 - Pipe and Tube Railings.
- E. Section 099000 - Painting: Final paint finish system for all interior and exterior galvanized and/or prime painted items.

1.03 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions; 2015a.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- N. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 013300 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Submit painting and coating product data.
- E. Structural Design Data: Where installed metal fabrications are indicated or required to comply with certain design loadings, include structural computations, material properties, and other information needed for review of structural analysis. Computations and analysis shall be stamped by a structural engineer licensed to practice in Kentucky.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

PART 2 PRODUCTS**2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
 - 1. Additional acceptable materials: ZRC Worldwide - ZRC Galvilite: www.zrcworldwide.com

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.

- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 SHOP FABRICATED ITEMS

- A. General: Comply with requirements of ANSI A14.3 American National Standard for Ladder-fixed-safety 1992 and OSHA 29 CFR Standard 1910.27.
- B. Elevator Pit Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. Location: Elevator shaft.
 - a. Side Rails: 1/2 x 2-1/2 inches plate members spaced at minimum 16 inches.
 - 1) Side rails to extend 48 inches above the landing/finish floor to act as handrails.
 - b. Rungs: one inch diameter solid round bar spaced 12 inches on center.
 - 1) Space rungs a clear distance of not less than 4-1/2 inches from the centerline of the rungs to the nearest permanent object in back of the ladder.
 - 2) First rung 6 inches from top of ladder.
 - 3) Bottom rung 12 inches from floor surface.
 - c. Height: Verify pit depth/finish floor elevation with elevator manufacturer requirements.
 - d. Provide anchorage points, for fasteners, at floor and at ladder mid-point with tabs for anchorage to the wall and floor.
 - 1) Provide appropriate fastener for floor and wall substrate.
 - e. Locate pit ladder within 39 inches of the egress door.
 - f. Provide a metal ladder from each pit floor starting 12" above the pit floor and extending to 48" above the lowest landing floor level.
 - g. Locate the ladder at strike jamb side of hoistway when single panel or two speed doors are used.
 - h. Where center opening doors are used, locate the ladder on the nearest sidewall.
- C. Ship's Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. Refer to details on the drawings for sizes of components and requirements.
- D. Walk-Through Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. Location: Roof
 - 2. Refer to detail on the drawings for sizes of components and requirements.
- E. Bollards & Bollard Covers: Refer to Section 323136 - Security Gates and Barriers.
- F. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- G. Lintels: As detailed; hot dipped galvanized and prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.
- H. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish. Refer to Div 9 Painting specification section for final paint system requirements.

- I. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
- J. Elevator Sump Pit Cover: Refer to structural drawings for sump pit construction. Coordinate size with elevator manufacturer. Refer to Div 9 Painting specification section for final paint system requirements.
 - 1. McNichols, or equivalent, GW Series welded steel bar grating, hot-dipped galvanized 1-1/2 inch x 3/16 inch. Bearing bars 3/16 inch on center and cross bars at 4 inch on center.

2.05 PREFABRICATED ITEMS

- A. Aluminum Ladders: Contractors option in lieu of fabricated steel ladders to provide and install equivalent aluminum ladders.
 - 1. General: Comply with requirements of ANSI A14.3 American National Standard for Ladder-Fixed-Safety 1992 and OSHA 29 CFR Standard 1910.27.
 - a. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) Precision Ladders, LLC.: www.precisionladders.com
 - 2) ACL Industries, Inc.: www.aclindustries.com
 - 3) Cotterman Co.: www.cotterman.com
 - 4) Royalite Manufacturing, Inc. : www.royalite-mfg.com
 - 5) O'Keeffe's, Inc.: www.okeeffes.com
 - 6) FixFast USA: www.fixfastusa.com
 - 2. Materials:
 - a. Extruded Aluminum Profiles: ASTM B 221/B 221M, ASTM B 210, ASTM B 308/B 308M, Alloy 6061-T6; standard mill finish.
 - b. Aluminum Sheet and Plate: ASTM B 209/B 209M, Alloy 6061-T6; standard mill finish.
 - c. Fasteners: Aluminum solid aircraft rivets rated at 300 lbs (1335 N) shear strength.
 - d. Cast fittings, connectors and rung ends: Cast Aluminum alloy 356.
 - e. Finish: All components to have a mill finish.
 - 3. Ladders:
 - a. Elevator Pit Ladders: Extruded aluminum; Rungs shall withstand a 1,000 pound (454 kg) load without deformation or failure.
 - b. Ships Ladders: Extruded aluminum; Steps shall withstand a 1,000 pound load without deformation or failure.
 - c. Angled Walk-Through Ladders with Parapet Railings and Platform: Aluminum extrusions; extend railings not less than 42 inches (1,067 mm) above landing, 24 in (610 mm) between side rails at step through. Provide non-penetrating rubber base feet for roof systems.
 - 1) Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - (a) FixFast USA: KATTCLIMB RL22 Angled fixed ladder with parapet railings and platform.
- B. Chute: Through-wall chute installed in the Media Center. Refer to the A2 drawings for locations.
 - 1. Basis of design Kingsley Companies 10-8100 Ease Single Interior Through -Wall Chute. Fabricated of Type 304 stainless steel, 22 gauge. Straight chute with overall of 22- 1/2 inches wide x 20 1/2 inches high x 16 1/2 inches deep. Face plate wording to be vinyl lettering from manufacturers standard.
 - a. Face Plate Wording: Media Return
- C. Bookkeeper Lock Box
 - 1. Basis of Design: Locking Security Mailbox PSMDL170. Refer to drawings for location.
- D. Fall Protection Wall Anchors: Forged pad eye welded to 3" x 8" x 5/8" steel plate anchored to wall with minimum 4-5" bolts. Summit Anchor Co., 800-435-1164 or equivalent. Located at all three Mechanical Platforms.

- E. Fall Protection Ceiling Anchors: Roof Top Anchor, Inc: Four bolt overhead beam clamp anchor attached to the beam/bar joist. Located at all three Mechanical Platforms.
- F. Trolley Hoist: Provide a all steel, one-ton capacity, low profile trolley hoist. Trolley wheels to fit on a W-shape steel beam. Twenty foot lift with hand chain hoist. Chain to be Grade 100. Geared trolley wheels for movement. At all three mechanical platforms.
 - 1. Basis of Design: Harrington Hoists and Cranes - # SHB010 - SHB Ultra-Low Headroom Trolley Hoist: www.harringtonhoists.com
- G. Fall Protection Harness: Hy-Safe Technology #FS 5900: Classic full body harness with universal fit, 1 inch polyester webbing, three adjustable points, adjustable D-ring at shoulders, pass through chest buckle and leg straps.
 - 1. Provide one harness at each fall protection ceiling anchor.
- H. Fall Protection Lanyard: Hy-Safe Technology # FSL 1104: 4 foot length lanyard with shock-pack snap. Lanyard with 1 inch polyester webbing and two double locking snap hooks. www.hysafe.com
 - 1. Provide one lanyard at each fall protection ceiling anchor.
- I. Safety Chain: Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Coordinate with railing fabricator.
- J. Expandable Gate: Constructed of 3/4" x 3/8" channel riveted back to back, with brass washers between, not over 6" on center. Vertical end bars to be cold rolled box track section with ball bearing rollers and swivel rubber caster. Gate to be fixed to wall. Gate to be furnished with padlock lugs. Finish to be one coat shop enamel and final color as selected by Architect from manufacturers standard color selection.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Miller Wire Works, Inc.: No. 400 Single Lazy Tong Folding Gate: www.millerwireworks.com

2.06 FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.
- D. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.
- E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- F. All steel items to be installed on the exterior of the building are to be galvanized.
- G. Refer to Div 9 Painting specification section for final paint system requirements for all fabricated steel items.

2.07 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I natural anodized, AAMA 611 AA-M12C22A41 clear anodic coating not less than 0.7 mils thick.unless specified with item.
- B. Interior Aluminum Surfaces: Class I natural anodized, AAMA 611 AA-M12C22A41 clear anodic coating not less than 0.7 mils thick.unless specified with item.

2.08 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.

- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.
- D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 055100 - METAL STAIRS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Stairs with concrete filled pan treads with terrazzo tread overlay (Bid Alternate No. 2)
- B. Structural steel stair framing and supports.
- C. Pan treads to receive concrete fill, and landings.
- D. Gates and rails at Mechanical Platforms.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete fill in stair pans.
- B. Section 055000 - Metal Fabrications.
- C. Section 055213 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.
- D. Section 099000 - Painting: Paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- D. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- F. NAAMM AMP 510 - Metal Stairs Manual; 1992, Fifth Edition.
- G. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
- B. Structural Design Data: Where installed metal fabrications are indicated or required to comply with certain design loadings, include structural computations, material properties, and other information needed for review of structural analysis. Computations and analysis shall be stamped by a structural engineer licensed to practice in Kentucky.

PART 2 PRODUCTS**2.01 METAL STAIRS - GENERAL**

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
 2. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
 3. Dimensions: As indicated on drawings.
 4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
1. Concrete Depth: 1-1/2 inches, minimum.
 2. Tread Pan Material: Steel sheet.
 3. Tread Pan Thickness: As required by design; 12 gage, .109 inch minimum.
 4. Pan Anchorage to Stringers: Continuously welded, from top or bottom.
 5. Concrete Reinforcement: None.
 6. Concrete Finish: For resilient floor covering and/or precast terrazzo treads (bid alternate No. 2).
- D. Risers: Same material and thickness as tread pans.
1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
 2. Nosing Depth: Not more than 1 inch overhang.
 3. Nosing Return: Flush with top of concrete fill, not more than 1 inch wide.
- E. Stringers: Steel tubes.
1. Stringer Depth: As indicated on drawings.
- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Railings: Steel bar stock guard rails (see Section 055213).
- H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.03 MATERIALS

- A. Steel Sections: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, Grade B cold-formed structural tubing.

- C. Steel Plates: ASTM A 283.
- D. Ungalvanized Steel Sheet: ASTM A 1008/A 1008M, Designation SS, Grade 33, Type 1.
- E. Concrete Fill: Type specified in Section 033000.

2.04 FABRICATION - GENERAL

- A. Fit and shop assemble components in largest practical sections, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Fabricate components accurately for anchorage to each other and to building structure.

2.05 FABRICATION - PAN STAIRS AND LANDINGS

- A. Form treads and risers with minimum 12 gage sheet steel stock.
- B. Secure tread pans to stringers with clip angles; welded in place.
- C. Form stringers with rolled steel channels, 10 inches deep. Weld fascia plates to channels using 12 gage steel sheet across channel toes.
- D. Form landings with minimum 12 gage sheet stock. Reinforce underside with channels to attain design load requirements.
- E. Prime paint components.

2.06 FINISHING

- A. Prepare surfaces to be primed in accordance with SSPC-SP 2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Do not prime surfaces in direct contact with concrete or where field welding is required.
- D. Prime paint items with one coat.
- E. Joint Finish: Provide joints with finish #2, completely sanded joints, some underwitting and pinholes per NOMMA Technical Committee guidelines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 055213 - PIPE AND TUBE RAILINGS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior wall-mounted handrails in steel.
- B. Interior stair railings and guardrails in steel.
- C. Exterior handrail in aluminum.
- D. Interior garment racks storage.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 055100 - Metal Stairs: Attachment plates for handrails specified in this section.
- C. Section 092116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.
- D. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.
- E. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2010.
- F. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications; 2013.
- G. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013.
- H. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Submit painting and coating product data.
- D. Structural Design Data: Where installed metal fabrications are indicated or required to comply with certain design loadings, include structural computations, material properties, and other information needed for review of structural analysis. Computations and analysis shall be stamped by a structural engineer licensed to practice in Kentucky.

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

- B. Fabricator Qualifications:
 - 1. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

1.06 QUALITY ASSURANCE

- A. Aluminum Handrails and Railings:
 - 1. Manufacturer's Qualifications: Company specializing in manufacturing the aluminum non-welded pipe railing specified in this section with a minimum five years documented experience.
 - 2. Installer/Fabricator Qualifications: Company specializing in assembling and installing the manufactured aluminum non-welded pipe railing system specified in this section with a minimum five years documented experience.
 - a. Specified aluminum railing is to be provided as a railing system from one of the manufacturers listed, or approved substitution prior to bidding. Fabricated replication of the specified manufactured railing system will not be accepted.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver railing systems and related components in protective packaging.
 - 1. Upon delivery open cartons and inspect for damage.
 - 2. Maintain material in original packaging until installation.
 - 3. Store components to avoid damage from moisture, abrasion, and other construction activities.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum Handrails and Railings: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Superior Aluminum Products, Series 500 Aluminum Non-Welded Pipe Railing.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. C. R. Laurence Co., Inc: www.crlaurence.com.
 - b. Hollaender Railing: www.hollaender.com
 - c. Kane Sterling: www.kanescreens.com.
 - d. Superior Aluminum Products: www.superioraluminum.com
 - e. The Wagner Companies; ____: www.wagnercompanies.com/#sle.
- B. Garment Racks: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1. Kee Safety, Inc: www.keeklamp.com
 - 2. FS Industries: www.fsindustries.com

2.02 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
 - 1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:

- a. Concentrated load of 200 lbf (890 N) applied at any point and in any direction.
 - b. Uniform load of 50 lbf/ft. (730 N/m) applied horizontally and concurrently with uniform load of 100 lbf/ft. (1460 N/m) applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
- 2. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf (890 N) applied to 1 sq. ft. (0.09 sq. m) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights. Steel guardrails are to be constructed of 2" x 1/2" flat bar stock steel as shown in the drawings.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 - 2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
 - 3. For anchorage to stud walls, provide backing plates, for bolting anchors.
- G. Exterior Use Grout: Non-shrink Portland cement-based hydraulic grout mixed and applied in accordance with manufacturer's instructions. Gypsum based material is not acceptable.
 - 1. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating.

2.03 ALUMINUM MATERIALS

- A. Primary Horizontal and Support Aluminum Pipe: Schedule 40; ASTM B 429/B 429M, ASTM B 241/B 241M, or ASTM B 483/B 483M.
- B. Aluminum Tube for Rails and Posts: Aluminum extrusions; alloy and temper 6063-T4. Minimum wall thickness of 0.127 inch; ASTM B 429/B 429M, ASTM B 241/B 241M, or ASTM B 483/B 483M.
- C. Base Flanges, Anchors, and Railing Accessories: ASTM B 247. Manufacturer's standard 713 aluminum alloy cast bases or solid aluminum 6063 stock.
- D. Sleeves: ASTM A 120 or ASTM A 53 pipe.
- E. Fasteners: Provide concrete anchorage for fastening in aluminum or stainless steel.
- F. Exposed Fasteners: No exposed bolts or screws.

2.04 GARMENT RACKS

- A. Provide pipe, fittings, and accessories as indicated or required by drawings to match design indicated.
- B. Racks: ASTM A53/A 53M, Grade B, schedule 40, black finish, 1-1/4 inch inside diameter. seamed, steel pipe. Painted finish.
- C. Fittings, including elbows, crossovers, wall flanges, tees and couplings:
 - 1. Structural pipe fittings: Galvanized malleable cast iron, ASTM A447 with ASTM A153 galvanizing.
 - a. Basis of Design: Kee Klamp

2.05 FABRICATION - ALUMINUM RAIL

- A. Configuration: Size and space members in compliance with applicable codes. All posts shall be unspliced single pipe length. Lower rails shall be a single unspliced length between posts. All top rails shall be continuous.
 - 1. Vertical posts spacing not to exceed 6'-0" center-to-center.
 - 2. Open tube ends or sections are not allowed.
- B. All posts grouted in concrete to have one nominal 1/4 inch diameter weep hole, 1/2 inch nominal above post collar in the plane of the rail.
- C. Provide all posts with a minimum 19 inch hollow rod for internal reinforcing.
- D. Fit, shape and assemble components in largest practical sizes, for delivery to job site. Fabricate components with joints tightly fitted and secured.
 - 1. All pipe cuts shall be square and accurate for minimum joint-gap. Cuts shall be clean and free of chamfer, from deburring, nicks and burrs.
 - 2. Drill holes of proper size for a tight fit of rivets and screws.
- E. Expansion Joints: Provide expansion joints for continuous spans in excess of 40 feet. Construct joints by deleting structural adhesive from one end of the spliced joint so that it is free to move in or out of the pipe. If a joint is provided every 30 feet, the width of the gap should allow 1/8 inch expansion for each 40 degrees F of expected temperature rise.

2.06 ALUMINUM FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.
- B. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Sleeve Mounting:
 - 1. Arrange for casting of sleeves or core drill insitu concrete to provide holes for railing uprights.
 - 2. After setting, fill holes with hydraulic grout; brace members until grout is cured.

3.04 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 055800 - FORMED-METAL FABRICATIONS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Column covers.
 - 1. Aluminum, hook-on type, prefinished.
 - 2. Contractor option to provide aluminum or steel column covers.

1.02 SUBMITTALS

- A. Product Data: For the following:
 - 1. Column covers.
 - 2. Nonstructural anchors.
 - 3. Paint products.
- B. Shop Drawings: Detail fabrication and installation of the following formed-metal fabrications. Include plans, elevations, sections, and details of components and their connections. Show anchorage and accessory items.
 - 1. Column covers.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of formed-metal fabrication indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square samples of metal of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.03 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing formed-metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Source Limitations: Obtain formed-metal fabrications through one source from a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver formed-metal fabrications wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where formed-metal fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating formed-metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiled, dimensional requirements and aesthetics of the following:
 - a. SAF Series M-2000 metal reveal joint column cover, 12" diameter round for interior columns, as shown in drawings. Rectangular per the drawings at exterior custom canopy columns. Refer to drawings for reveal heights and locations.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. American Metal Forming Corp.; Pittcon Industries Div.
 - b. Atas International, Inc.
 - c. Industrial Louvers, Inc.
 - d. Una-Clad-Copper Sales, Inc.
 - e. Fry Reglet Corporation
 - f. MM Systems Corporations
 - g. Pac-Clad

2.02 SHEET METAL

- A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Sheet: Flat sheet complying with ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy 5005-H34 (anodized).
- C. Galvanized Steel: Flat sheet complying with ASTM A525, Coating Designation A-40 or A-60 with surfaces chemically treated for paint adhesion in accord with ASTM D2092.

2.03 MISCELLANEOUS MATERIALS

- A. Joint Sealants for Concealed Joints: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with ASTM C 1085 and formulated with minimum of 75 percent solids. Sealant is for exterior column cover vertical reveal joints. Architect to select matching color. For interior, use manufacturer's finished aluminum filler channel to cover vertical reveal joints.
- B. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1. Provide concealed fasteners for interconnecting formed-metal fabrications and for attaching
 - 2. them to other work, unless otherwise indicated.
- C. Nonstructural Anchors: For applications not indicated to comply with design loads, provide anchors of type, size, and material necessary for type of load and installation indicated, as recommended by the manufacturer from options listed below, unless otherwise indicated. Use nonferrous-metal or hot-dip galvanized anchors for exterior installations and elsewhere as needed for corrosion resistance.
 - 1. Powder-actuated fasteners.
 - 2. Metal expansion sleeve anchors.
 - 3. Metal impact expansion anchors.

2.04 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble formed-metal fabrications in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Coordinate dimensions and attachment methods of formed-metal fabrications with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.
- C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.
- D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness specified for stretcher-leveled sheet metal and sufficient strength for indicated use.
 - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
 - 2. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.
- E. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install formed-metal fabrications.
- F. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
 - 1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.
 - 2.

2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
 - 1. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.

2.06 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Finishes: Due to differences in manufacturer finishing standards provisions for clear and/or color anodized, painted and powder coated material is included. All finishes are acceptable and manufacturers are to provide their standard of ONE listed below.
 - 1. Class I, Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, coating 0.010 mm or thicker) complying with AAMA 612.
 - a. Color to be "Clear Anodized".
 - 2. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color to be selected from manufacturers standard color chart. Minimum twenty colors.

- 1) Color simulating clear anodized aluminum to be available in color choices.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate and place formed-metal fabrications level, plumb, and in alignment with adjacent construction.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Install concealed gaskets, joint fillers, and insulation, as the Work progresses, to make interior formed-metal fabrications soundproof or lightproof as applicable to the type of fabrication indicated.
- E. Corrosion Protection: Coat concealed surfaces of aluminum, zinc-coated, and nonferrous metals that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.02 ADJUSTING

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.03 PROTECTION

- A. Protect finishes of formed-metal fabrications from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Sheathing.
- B. Roof-mounted curbs.
- C. Roofing nailers.
- D. Preservative treated wood materials.
- E. Fire retardant treated wood materials.
- F. Miscellaneous framing and sheathing.
- G. Communications and electrical room mounting boards.
- H. Wood nailers and curbs for roofing and items installed on roof.
- I. Concealed wood blocking, nailers, and supports.
- J. Miscellaneous wood nailers, furring, and grounds.
- K. Installation of wood doors and hardware.

1.02 RELATED REQUIREMENTS

- A. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.
- B. Section 092116 - Gypsum Board Assemblies: Fiber -glass faced gypsum-based sheathing.

1.03 REFERENCE STANDARDS

- A. AF & PA - National Design Specification for Wood Construction. Include supplements.
- B. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- C. APA PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels (Form E445); 2001.
- D. ASTM D2559 - Standard Specification for Adhesives
- E. PS 1 - Structural Plywood; 2009.
- F. PS 20 - American Softwood Lumber Standard; 2010.
- G. SPIB (GR) - Grading Rules; 2014.

1.04 SUBMITTALS

- A. Product Data: Provide technical data on wood preservative materials and application instructions.
- B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
- B. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- C. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS**2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.
- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

2.02 DIMENSION LUMBER

- A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light framing size lumber of any species or board-size lumber as required. "Standard" grade boards per WPA rules or "No. 2 Boards" per SPIB rules.

2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacturer.
 - 1. Where rough carpentry is exposed to weather, in ground contact, in contact with preservative treated lumber, or humidity, provide fasteners with hot dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
 - 2. Nails, Wire, Brads, and Staples: FS FF-N-105.
 - 3. Power Driven Fasteners: National Evaluation Report NER-272.

4. Wood Screws: ANSI B18.6.1.
5. Screws to Cold-Formed Metal Framing: Corrosion-resistant coated, self drilling, self threading steel drill screws with low-profile head.
6. Lag Bolts: ANSI B18.2.1.
7. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.05 CONSTRUCTION PANELS

- A. Sheathing: Gypsum, complying with requirements of ASTM C 1396/C 1396M for gypsum sheathing, Type X fire-resistant, V-shaped long edges, 5/8 inch thick.
- B. Sheathing: Glass Mat Gypsum, ASTM C 1177/C 1177M, Type X fire resistant, square long edges, 5/8 inch thick.
- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.06 ACCESSORIES

- A. Fasteners and Anchors:
 1. For treated lumber, use hot-dip galvanized nails, screws, fasteners, and etc. with a minimum coating of G-185 (1.85 oz.) of zinc per square foot of surface area per ASTM A653. Contractor option to use stainless steel nails, screws, fasteners, and etc. in type 304 or 316. Do not use a mix of galvanized and stainless steel products.
 - a. Acceptable hot-dip galvanized products are:
 - 1) Simpson Zmax.
 - 2) USP Structural Connector Triple Zinc.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finishing work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.02 BLOCKING, NAILERS, AND SUPPORTS

- A. Install solid wood grounds, nailers, blocking, and sleepers as required for support of wall and ceiling mounted items.
 1. Plywood strips and/or metal strapping will not be accepted as suitable blocking material.
- B. Contractor option to use a flexible wood backing plate system in lieu of solid wood blocking as specified in this section.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include:
 - a. Clark Dietrich Building Systems - Danback Flexible Wood Backing Plate:
www.clarkdietrich.com
 - 1) Provide FSC certified wood.
 - b. Equivalent submitted to Architect prior to issuance of last addendum.
- C. In metal stud walls, provide continuous solid wood blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide solid wood blocking attached to studs as backing and support for wall-mounted items,
- E. Where ceiling-mounting is indicated, provide solid wood blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following non-structural framing and solid wood blocking, but not limited to the following locations:
 1. Cabinets, shelf, and countertop supports.
 2. Wall mounted cabinets.
 3. Wall brackets.
 4. Handrails and guardrails.
 5. Fire extinguisher cabinets, brackets, and valve cabinets.
 6. Grab bars.
 7. Toilet and bath accessories.
 8. Wall-mounted door hardware and stops.
 9. Chalkboards, tackboards, and marker boards.
 10. Wall paneling and trim.
 11. Joints of rigid wall coverings that occur between studs.
 12. Locker base and wall attachment.
 13. Interior and exterior wall openings to receive metal frame system; window, door, etc.
 14. Access panels.
 15. Framed openings.
 16. Plumbing fixtures.
 17. Ceiling mounted projection screens and projector mounts.
 18. Wall mounted projection screens and projector mounts.
 19. Wall and ceiling mounted items indicated as N.I.C. and/or Owner provided and Owner installed.

3.03 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- B. Coordinate curb installation with installation of decking and support of deck openings.

3.04 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.

3.05 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.

- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 064100 - ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Interior standing and running trim and custom self-edged casework
 - 2. Reception casework
 - 3. Custom Display Cases with light by MEP contractor
 - 4. Media Center Casework
 - 5. Corridor Bench
 - 6. Media center upholstered seats & bench backs.
 - 7. Concessions
 - 8. Solid surface windowsills
 - 9. Stainless steel countertops
 - 10. Solid surface countertops
 - 11. Plastic laminate countertops
 - 12. Cafeteria Seating
 - 13. Wood cap in Auditorium
- B. Related Sections include the following:
 - 1. Division 6 Section: "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Division 12 Section 123550 "Institutional Casework" (plastic laminate faced wood cabinets of stock design).
- C. Fabric Covered Tackable Surfaces
- D. Cabinet Hardware.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification sections, apply to this Section.
 - 1. Section 012300 - Alternates: Refer to section for additional information.
 - 2. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions
 - 3. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking
 - 4. Division 6 Section "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 5. Section 084313 Aluminum Framed Storefronts
 - 6. Section 088000 - Glazing: Glass for casework
 - 7. Section 090050 - Finish Legend
 - 8. Section 123550 - Institutional Casework (plastic laminate-faced wood cabinets of stock design)

1.03 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.
- B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. The bottom of wall cabinets are considered exposed and will receive **plastic laminate**.

- C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semiexposed.
- D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.04 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- G. ANSI A208.1 - American National Standard for Particleboard; 2009.
- H. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- I. AWI (QCP) - Quality Certification Program; current edition at www.awiqcp.org.
- J. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- K. AWMAC (GIS) - Guarantee and Inspection Services Program; current edition at www.awmac.com/gis.php.
- L. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- M. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.05 SUBMITTALS

- A. Samples for Verification: 6-inch- (150-mm-) square Samples for each type of finish, including top material and the following:
 - 1. Section of countertop showing top, front edge, and backsplash construction.
- B. Product Data: For each type of product indicated including cabinet hardware and accessories and finishing materials and processes.
- C. Product Data: For each type of product indicated.
- D. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- E. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminates.
 - 2. Thermoset decorative overlays.
- F. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.
- G. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Installer Qualifications: An authorized representative of institutional casework manufacturer for installation and maintenance of units required for this Project.
- D. Source Limitations: Obtain institutional casework through one source from a single manufacturer.
- E. Quality Standard: Build and install to AWI quality.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.09 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware Legend specified in Division 8 Section "Door Hardware (Keyed by Naming Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond
 - 2. Warping of components.
 - 3. Failure of operating hardware.
 - 4. Deterioration of finishes.
- B. Warranty Period: Five years from date of Substantial Completion.

1.12 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS**2.01 WOODWORK FABRICATORS**

- A. All manufacturing technic and components must comply with the contract specifications. The designer's selections will not be limited to those plastic laminate selections which are the standards of the casework manufacturer. The plastic laminate selections will be made from the laminate manufacturer(s) full range of colors, patterns and finishes.
- B. Multiple manufacturers of work of this section will not be accepted. Subject to compliance with requirements, interior architectural woodwork by one of the following include :
 - 1. Accents in Wood, Inc.
 - 2. Action Outfitters
 - 3. Advantage Millwork
 - 4. America's Finest Woodworking Team
 - 5. Cabinets & Countertops, Inc.
 - 6. Caseworks of Kentucky, Inc.
 - 7. Corman & Associates, Inc.
 - 8. Cowart & Company
 - 9. Cumberland Manufacturing
 - 10. Custom Creations, Inc.
 - 11. Euronique, Inc.
 - 12. Interior Wood Specialties
 - 13. Kentucky Caseworks
 - 14. Kentucky Mill & Casework
 - 15. Leininger Cabinets
 - 16. Louisville Lumber
 - 17. LSI Corporation, Inc.
 - 18. Morgan Smith Industries
 - 19. Reynolds & Doyle, Inc.
 - 20. Riverside Mill
 - 21. Smith's Laminating
 - 22. Southern Cabinetry, Inc.
 - 23. SSC Casework & Millwork
 - 24. Stevens Industries, Inc.
 - 25. Stidham Cabinets
 - 26. Tate Ornamental
 - 27. TMi/Trimline
 - 28. US Millwork
 - 29. Wood Concepts

30. Custom cabinetry companies whose products meet or exceed the project specifications as approved by written addendum.

C. Refer to the drawings for premium laminate and/or decorative metal laminate locations.

2.02 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: White birch, plain sawn or sliced.
- C. Wood Species for Opaque Finish: Any closed-grain hardwood.
- D. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.
 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 5. Hardwood Plywood and Face Veneers: HPVA HP-1.
 6. Exposed Plywood: Hardwood plywood, selected for compatible color and grain. Grade AA exposed faces at least 1/50 inch (0.5 mm) thick, and Grade J crossbands. Provide both faces of same species.
 7. Semiexposed Plywood: Hardwood plywood of same species as exposed plywood. Semiexposed backs of plywood with exposed faces shall be same species as faces. Grade B faces and Grade J crossbands.
- E. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a. Arborite
 - b. Formica Corporation
 - c. Nevamar
 - d. Wilsonart
- G. Exposed Cabinet Materials:
1. Plastic Laminate: Type VGS.
 - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
 - b. Provide plastic laminate for doors and drawer fronts and where indicated.
- H. Semiexposed Cabinet Materials:
1. Plastic Laminate: Type CLS.
 - a. Provide plastic laminate for interior faces of doors and drawer fronts [only/and] where indicated.
 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1.
 - a. Provide melamine-faced particleboard for semiexposed surfaces, unless otherwise indicated.
 3. Cabinets with glass doors: Provide plastic laminate within the cabinet to match the exterior of the cabinet unless shown otherwise on the drawings.
- I. Concealed Cabinet Materials:
1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.

2. Plywood: Hardwood plywood. Concealed backs of plywood with exposed or semiexposed faces shall be same species as faces.
 3. Plastic Laminate: Type BKL.
- J. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avonite; Avonite, Inc.
 - b. Corian; DuPont Polymers
 - c. Fountainhead; International Paper, Decorative Products Div.
 - d. Gibraltar
 - e. LG Surfaces
 - f. Surell; Formica Corporation
 2. Price Group: Based on selections from Corian provide the following price groups:
 - a. Restroom countertops -Price Group C
 - b. Remaining Countertops-Price Group D
 - c. Window Sills-Proce Group C
- K. Fabric-Covered Tackable Surfaces: Dimensionally stable 6-7 PCF glass fiberboard with resin hardened edge 3/4" thick with a fabric covering equivalent to Guilford of Maine.
- L. High Pressure Laminate-Reception Base and Wall Cabinets and Transaction Top (HPL5)
1. Manufacturer: Wilsonart or Formica
 2. Color: TBD
 3. No: TBD
 4. Finish: Linearity Texture
 5. Location: Refer to Drawings
- M. High Pressure Laminate-Art Room Display Shelving (HPL6)
1. Manufacturer: Wilsonart or Formica
 2. Color: TBD
 3. No: TBD
 4. Finish: Equal to Formica Microdot Finish
 5. Location: Refer to Drawings
- N. Stainless Steel Countertop (STL1)
1. Manufacturer: TBD
 2. Location: Refer to Drawings
- O. Solid-Surface Countertop & Display Bottom (SS1)
1. Manufacturer: TBD
 2. Color: Up to Price Group D
 3. Thickness: 1/2"
 4. Edge Profile: TBD
 5. Location: Refer to Drawings
- P. Solid-Surface Window Sills (SS2)
1. Manufacturer: TBD
 2. Color: Up to Price Group C
 3. Thickness: 1/2"
 4. Edge Profile: TBD
 5. Location: Refer to Drawings
- Q. Fabric-Media Center Bench Backs (F1)
1. Manufacturer: Momentum
 2. Style: 3D Grid
 3. Color: TBD
 4. Finish: Nanotex

- 5. Location: Media Center
- R. Fabric-Media Center Bench Seats (F2)
 - 1. Manufacturer: Momentum
 - 2. Style: Silica Etch
 - 3. Color: TBD
 - 4. Finish: TBD
 - 5. Location: Media Center
- S. Display Case Metal Shelving Standards: Provide metal shelving standards equal to KNAPE and
 - 1. VOGT 83 Series Heavy Duty with 182 Heavy Duty Brackets.
- T. Glass Shelves: Provide 1/4" thick tempered glass shelves

2.03 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware (Scheduled by Describing Products)." Refer to the drawings for additional hardware components.
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Hinges: Provide five knuckle, 2-3/4 inch, overlay type, hospital tip, 0.95 inch thick steel. Hinges shall have a minimum of eight (8) edge and leaf fastening. Doors 48 inches and over in height shall have three (3) hinges per door.
- D. Pulls: Pulls as standard shall be surface mounted solid aluminum.
- E. Catches: Roller catches, BHMA A156.9, B03071.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081 or BHMA A156.9, B04102; with shelf brackets, B04112. Shelf standards and supports shall be equal to Knappe and Vogt 182 decorative heavy duty bracket and standards.
- G. Shelf Rests: BHMA A156.9, B04013.
- H. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf (440 N)
 - 2. File Drawer Slides: 150 lbf (670 N)
 - 3. Pencil Drawer Slides: 45 lbf (200 N)
- I. File Drawer Frame System: Provide a metal file frame system in all file drawers equal to Rockler Woodworking & Hardware # 30976 with cut-to-size side rails, front & back rails, and side-to-side rail.
- J. Locks: Locks for drawers and hinged doors, where specified, shall be heavy-duty, cylinder type with five disc tumblers and shall be keyed and master-keyed as specified. Locate as indicated on the drawings.
- K. Grommets for Cable Passage through Countertops: 3-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color to be selected by Designer.
 - 1. Product: Subject to compliance with requirements, provide "XG series" by Doug Mockett and Co., Inc.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
- M. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- N. Countertop Support: Provide countertop supports equivalent to A & M Hardware, Inc. Workstation brackets, size brackets to suit installation.

- O. Display Case LED Puck Lights: Display case lights are in MEP package and are equal to Jesco Lighting MLX 2" fixture.

2.04 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.05 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide Custom grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- E. All wall and base cabinets over 3'-0" in width shall receive a vertical to prevent deflection.

2.06 PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Custom
- C. AWI Type of Cabinet Construction: Flush overlay
- D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: HGS
 - 2. Postformed Surfaces: HGP
 - 3. Vertical Surfaces: HGS
 - 4. Edges: Self edged plastic laminate
 - 5. Body Front Edging: HGS
- E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
- F. Box Drawers: ½" solid hardwood sides, dovetailed and glued. 1/4" five ply hardwood bottom, fitted into dado, glued and blocked into place. Equip with full extension drawer glides, including tops to prevent accidental removal.
- G. File Drawers: ½" solid hardwood sides, dovetailed and glued. ½" five ply hardwood bottom, fitted into dado, glued and blocked into place. Equip with full extension file drawer slides, 150 lb load capability, including stops to prevent accidental removal.

- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Solid colors
 - 2. Wood grains
 - 3. Patterns
- I. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- J. Wood grains and/or any laminate with a directional design shall all be applied to the cabinet face in one consistent direction.

2.07 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.
- B. Grade: Custom
- C. High-Pressure Decorative Laminate Grade: HGS
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Solid colors
 - 2. Wood grains
 - 3. Patterns
- E. Plastic Laminate Countertops: Plastic laminate countertops shall be minimum 1-1/2" thick with horizontal grade plastic laminate on all exposed sides, including edges, back and endsplashes, underside shall have laminate backer sheet, all countertops shall be continuous.
 - 1. Provide 4" back and side splashes at all junctures of countertop and any vertical surface.
- F. Core Material: Particleboard made with exterior glue
- G. Core Material at Sinks: Exterior-grade plywood

2.08 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Grade: Custom
- C. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm), unless shown otherwise on drawings
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
- E. Fabricate tops in one piece with field-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.09 STAINLESS STEEL COUNTERTOPS

- A. Stainless Steel Countertops: 304 stainless steel countertops 14 gauge with turned down aprons. Finish all exposed edges to be smooth and free of burs. Use exterior plywood or phenolic-resin-bonded particle board for substraight.

2.10 FINISH FOR WOOD CASEWORK

- A. Preparation: Sand lumber and plywood for casework construction before assembling. Sand edges of doors and drawer fronts and molded shapes with profile-edge sander. Sand casework after assembling

for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

- B. Wood Colors and Finishes: Match Architect's samples.
- C. Staining: Remove fibers and dust and apply wash-coat sealer and stain to exposed and semiexposed surfaces as required to provide uniform color and to match approved samples.
- D. Finishing Closed-Grain Woods: Apply manufacturer's standard two-coat, baked, clear finish consisting of a thermosetting catalyzed sealer and a thermosetting catalyzed conversion varnish. Sand and wipe clean between applications of sealer and topcoat. Topcoat may be omitted on concealed surfaces.

2.11 INTERIOR ORNAMENTAL WORK FOR TRANSPARENT OR STAIN FINISH

- A. Quality Standard: Comply with AWI Section 700
- B. Grade: Custom

2.12 INTERIOR ORNAMENTAL WORK FOR OPAQUE FINISH

- A. Quality Standard: Comply with AWI Section 700
- B. Quality Standard: Comply with WIC Section 11
- C. Wood Species: Any closed-grain hardwood

2.13 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.14 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. For opaque finishes, apply wood filler in exposed nail and screw indentations and sand smooth.
- C. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI/AWMA/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System 1 - Lacquer, Precatalyzed; System 2 - Lacquer, Postcatalyzed; System 3
 - b. Stain: As selected by Interior Designer

- c. Sheen: _____
- d. Products:
 - 1) Sherwin-Williams Sher-Wood F3 Kemvar Conversion Varnish, AWI Finishing System 5
 - 2) Sherwin-Williams Sayerlack Hydroplus Waterborne Clear, AF71 Series, ASI Finishing System 8
 - 3) Sherwin-Williams Ultra-Cure Waterborne UV Topcoat, Clear, AWI Finishing System 10

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

3.03 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Caulk space between backsplash and wall with clear silicone.
- H. Refer to Division 9 Sections for final finishing of installed architectural woodwork.
- I. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

- J. Use fixture attachments in concealed locations for wall mounted components.
- K. Use concealed joint fasteners to align and secure adjoining cabinet units.
- L. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- M. Secure cabinets to floor using appropriate angles and anchorages.
- N. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.04 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- D. Adjust installed work; test installed work for rigidity and ability to support loads.
- E. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 070810 - EXTERIOR BUILDING ENCLOSURE WEATHER BARRIER REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes administrative and procedural requirements for accomplishing a weather-tight building enclosure that controls infiltration or exfiltration of air, including but may not be limited to:
 - 1. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the exterior building enclosure shall be "the air barrier system."
 - 2. Coordinate between trades, schedule and sequence the Work, and provide preconstruction meetings, inspections, tests, and related actions.
 - 3. Reports performed by Contractor, independent agencies, and governing authorities.
 - 4. Construct the building enclosure with a continuous air barrier system to control air leakage into (infiltration) and out of (exfiltration) conditioned spaces. The air barrier system shall have the following characteristics:
 - a. Continuous, with all joints sealed.
 - b. Structurally supported to withstand positive and negative air pressures applied to the building enclosure.
 - c. Connections between:
 - 1) Foundation and walls.
 - 2) Walls and windows and doors.
 - 3) Different wall systems.
 - 4) Wall and roof.
 - 5) Walls, floors, and roofs across construction joints, control joints and expansion joints.
 - 6) Walls, floors and roofs to utility, pipe and duct penetrations.
 - 5. Make all penetrations of the air barrier membrane or system and paths of air infiltration / exfiltration air-tight.

1.02 RELATED REQUIREMENTS

- A. Section 070810.13 - Weather Barrier System Pre-Installation Conference Guide: Pre-Installation requirements.

1.03 RESPONSIBILITIES

- A. Contractor responsibilities:
 - 1. Coordinate affected trades and sequence construction to ensure continuity of the air barrier system, joints, junctures, and transitions between materials and assemblies of materials and products, from substructure to walls to roof.
 - a. Coordinate the sequence of activities to accommodate required services with a minimum of delay.
 - b. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 - 2. Provide quality assurance procedures, testing and verification as required.
 - a. Schedule times for inspections, tests, taking samples, and similar activities.
 - 3. Facilitate inspections, tests, and other quality-control services required.
 - a. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested.
 - b. Notify the agency sufficiently in advance of operations to permit assignment of personnel.
 - c. Services include, but are not limited to, the following:
 - 1) Provide access to the Work.
 - 2) Furnish incidental labor and facilities necessary to facilitate inspections and tests.

- 3) Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
- 4) Deliver samples to testing laboratories.
- 5) Provide security and protection of samples and test equipment at the Project Site.
4. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.
5. Provide mockup of exterior wall assembly as required.
6. Coordinate the Work and trades to provide an airtight building enclosure.
 - a. Continuity of the air barrier materials and products with joints to provide assemblies.
 - b. Continuity of all exterior enclosure assemblies with joints and transition materials to provide an exterior enclosure air barrier system.
 - c. Specific quality-control requirements for individual construction activities are also indicated in other applicable sections of the specifications. Ensure each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each such section.
 - d. Inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - e. Requirements to provide an airtight exterior building enclosure is not limited by quality-control services performed by Architect, Owner, or authorities having jurisdiction and are not limited by provisions of this section.

1.04 PERFORMANCE REQUIREMENTS

- A. Materials: Used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178.
- B. Assemblies of materials and components: Shall have an air permeance not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2357.
- C. Entire building: The air leakage of the entire building shall not exceed 0.25 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (2.0 L/s.m² @ 75 Pa) when tested according to ASTM E 779.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings" and adhere to the following specifics regarding masonry pre-installation conference guidelines.
 1. The General Contractor/Construction Manager should organize and hold a meeting with the Owner, Architect, General Contractor/Construction Manager, site superintendent, masonry foreman, testing and inspection agency representative, installers of cavity wall insulation, storefront, curtain wall, door and window, installers of steel, joist and deck, installers of mechanical, electrical and plumbing items, installers of other work in and around the masonry that must precede or follow masonry work.
 2. Review foreseeable methods and procedures related to masonry work, including but not necessarily limited to the following:
 - a. a)Sample and Mock-up Wall Sections:
 - 1) Size and Location
 - 2) Products and Detail required

- 3) Protection Methods of Sample and Mock-up Wall Sections
 - 4) Approval Authority and Notification
 - b. Site Inspection:
 - 1) Identity of Responsible Person
 - 2) Frequency of Inspection
 - c. Materials:
 - 1) Storage & Protection
 - 2) Delivery Process
 - d. Submittals:
 - 1) Product Certification
 - 2) Shop Drawing Requirements
 - 3) Time Expectation
 - 4) Testing and Inspection Requirements
 - e. Construction Means and Methods:
 - 1) Hot & Cold Weather Protection
 - 2) Protection of Work in Process
 - 3) Material Handling Process
 - 4) Cleaning Process
 - f. Schedule:
 - 1) Product Availability
 - 2) Review of Associated Trades Responsibility
 - g. Project Closeout:
 - 1) Punch List Procedure
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protect the Work, regardless of the assignment of responsibility for inspection, testing, or similar services.

3.02 TESTING AND INSPECTION

- A. The Owner will hire a testing and inspection agency to provide occasional observation and inspection during installation of the air barrier system; and written test reports of all tests performed, with copies to the Owner, Contractor and Architect The testing and inspection agency may provide the following listed services:
 - 1. Qualitative Testing and Inspection:
 - a. Continuity of the barrier system throughout building enclosure with no gaps, holes.
 - b. Materials used for compatibility.
 - c. Transitions at changes in direction, and structural support at gaps.
 - d. Connections between assemblies (membrane and sealants).
 - e. All penetrations sealed.

- f. Testing per ASTM E 1186 "Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems."
 - 1) Infrared scanning with pressurization/depressurization.
 - 2) Smoke pencil with pressurization/depressurization.
 - 3) Pressurization/depressurization with use of anemometer
- 2. Quantitative tests:
 - a. Provide written test reports of all tests performed, with copies to the Owner, Contractor and Architect.
 - b. Tracer gas testing, ASTM E741
 - c. Pressure test, ASTM E330

END OF SECTION

SECTION 070810 - EXTERIOR BUILDING ENCLOSURE WEATHER BARRIER REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes administrative and procedural requirements for accomplishing a weather-tight building enclosure that controls infiltration or exfiltration of air, including but may not be limited to:
 - 1. The airtight components of the building enclosure and the joints, junctures and transitions between materials, products, and assemblies forming the air-tightness of the exterior building enclosure shall be "the air barrier system."
 - 2. Coordinate between trades, schedule and sequence the Work, and provide preconstruction meetings, inspections, tests, and related actions.
 - 3. Reports performed by Contractor, independent agencies, and governing authorities.
 - 4. Construct the building enclosure with a continuous air barrier system to control air leakage into (infiltration) and out of (exfiltration) conditioned spaces. The air barrier system shall have the following characteristics:
 - a. Continuous, with all joints sealed.
 - b. Structurally supported to withstand positive and negative air pressures applied to the building enclosure.
 - c. Connections between:
 - 1) Foundation and walls.
 - 2) Walls and windows and doors.
 - 3) Different wall systems.
 - 4) Wall and roof.
 - 5) Walls, floors, and roofs across construction joints, control joints and expansion joints.
 - 6) Walls, floors and roofs to utility, pipe and duct penetrations.
 - 5. Make all penetrations of the air barrier membrane or system and paths of air infiltration / exfiltration air-tight.

1.02 RELATED REQUIREMENTS

- A. Section 070810.13 - Weather Barrier System Pre-Installation Conference Guide: Pre-Installation requirements.

1.03 RESPONSIBILITIES

- A. Contractor responsibilities:
 - 1. Coordinate affected trades and sequence construction to ensure continuity of the air barrier system, joints, junctures, and transitions between materials and assemblies of materials and products, from substructure to walls to roof.
 - a. Coordinate the sequence of activities to accommodate required services with a minimum of delay.
 - b. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 - 2. Provide quality assurance procedures, testing and verification as required.
 - a. Schedule times for inspections, tests, taking samples, and similar activities.
 - 3. Facilitate inspections, tests, and other quality-control services required.
 - a. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested.
 - b. Notify the agency sufficiently in advance of operations to permit assignment of personnel.
 - c. Services include, but are not limited to, the following:
 - 1) Provide access to the Work.
 - 2) Furnish incidental labor and facilities necessary to facilitate inspections and tests.

- 3) Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
- 4) Deliver samples to testing laboratories.
- 5) Provide security and protection of samples and test equipment at the Project Site.
4. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in the different sections, to be installed by the different trades.
5. Provide mockup of exterior wall assembly as required.
6. Coordinate the Work and trades to provide an airtight building enclosure.
 - a. Continuity of the air barrier materials and products with joints to provide assemblies.
 - b. Continuity of all exterior enclosure assemblies with joints and transition materials to provide an exterior enclosure air barrier system.
 - c. Specific quality-control requirements for individual construction activities are also indicated in other applicable sections of the specifications. Ensure each subcontractor is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each such section.
 - d. Inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - e. Requirements to provide an airtight exterior building enclosure is not limited by quality-control services performed by Architect, Owner, or authorities having jurisdiction and are not limited by provisions of this section.

1.04 PERFORMANCE REQUIREMENTS

- A. Materials: Used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178.
- B. Assemblies of materials and components: Shall have an air permeance not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2357.
- C. Entire building: The air leakage of the entire building shall not exceed 0.4 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (2.0 L/s.m² @ 75 Pa) when tested according to ASTM E 779.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings" and adhere to the following specifics regarding masonry pre-installation conference guidelines.
 1. The General Contractor/Construction Manager should organize and hold a meeting with the Owner, Architect, General Contractor/Construction Manager, site superintendent, masonry foreman, testing and inspection agency representative, installers of cavity wall insulation, storefront, curtain wall, door and window, installers of steel, joist and deck, installers of mechanical, electrical and plumbing items, installers of other work in and around the masonry that must precede or follow masonry work.
 2. Review foreseeable methods and procedures related to masonry work, including but not necessarily limited to the following:
 - a. Sample and Mock-up Wall Sections:
 - 1) Size and Location
 - 2) Products and Detail required

- 3) Protection Methods of Sample and Mock-up Wall Sections
 - 4) Approval Authority and Notification
 - b. Site Inspection:
 - 1) Identity of Responsible Person
 - 2) Frequency of Inspection
 - c. Materials:
 - 1) Storage & Protection
 - 2) Delivery Process
 - d. Submittals:
 - 1) Product Certification
 - 2) Shop Drawing Requirements
 - 3) Time Expectation
 - 4) Testing and Inspection Requirements
 - e. Construction Means and Methods:
 - 1) Hot & Cold Weather Protection
 - 2) Protection of Work in Process
 - 3) Material Handling Process
 - 4) Cleaning Process
 - f. Schedule:
 - 1) Product Availability
 - 2) Review of Associated Trades Responsibility
 - g. Project Closeout:
 - 1) Punch List Procedure
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protect the Work, regardless of the assignment of responsibility for inspection, testing, or similar services.

3.02 TESTING AND INSPECTION

- A. The Owner will hire a testing and inspection agency to provide occasional observation and inspection during installation of the air barrier system; and written test reports of all tests performed, with copies to the Owner, Contractor and Architect. The testing and inspection agency may provide the following listed services:
 - 1. Qualitative Testing and Inspection:
 - a. Continuity of the barrier system throughout building enclosure with no gaps, holes.
 - b. Materials used for compatibility.
 - c. Transitions at changes in direction, and structural support at gaps.
 - d. Connections between assemblies (membrane and sealants).
 - e. All penetrations sealed.

- f. Testing per ASTM E 1186 “Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Retarder Systems.”
 - 1) Infrared scanning with pressurization/depressurization.
 - 2) Smoke pencil with pressurization/depressurization.
 - 3) Pressurization/depressurization with use of anemometer
- 2. Quantitative tests:
 - a. Provide written test reports of all tests performed, with copies to the Owner, Contractor and Architect.
 - b. Tracer gas testing, ASTM E741
 - c. Pressure test, ASTM E330

END OF SECTION

SECTION 070810.13 - WEATHER BARRIER SYSTEM PRE-INSTALLATION CONFERENCE GUIDE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Few building construction components require the coordinated activities of more different trades on the construction, design, and management teams than the water, air, vapor and thermal barrier system. Once the water, air, vapor and thermal barrier has been covered, any remedies for problems with the components or installation can be costly and time-consuming.

1.02 PREINSTALLATION

- A. Contractor and subcontractors must have a working knowledge of the water, air, vapor and thermal barrier installation, proper sequencing, and must work toward a common goal. Through the use of the integrated mockup panel and this Pre-Installation Conference Guide, gaining such knowledge should be enhanced.
- B. Send a copy of this guide to the affected trades and/or attendees so they can attend the Conference prepared to discuss these topics and to fill in as much of this information as possible prior to the meeting, or be prepared to fill them in at the meeting.

1.03 TASK CHECKLIST

- A. Submit and/or complete the following prior to conducting the Pre-Installation Conference. Confirm any additional submittal requirements with the relevant specification sections. Check those items below that you have completed or received "Approved" submittals from the Architect.

Submittals**Approved**

Product data
 Shop drawings
 Product Certificates
 Product test reports
 Installer qualifications
 Samples
 Compatibility docs
 Integrated mockup
 Quality Assurance Program
 ABAA certifications
 Warranty Sample
 Air Barrier System Subcontractor reviewed
 submittals of other indicated/specified trade(s)

1.04 MANDATORY ATTENDEES

- A. Attendance by the following parties and affected trades is mandatory. Identify and ensure any other trades or parties involved or affected by the installation of the air barrier system components are also present. Check those below who actually attend the meeting.

Owner and/or Owner's representative

Architect
 Owner's Testing Agency (if hired to inspect ABS)

Contractor
 Air barrier installer / subcontractor

Air barrier manufacturer's technical representative

Masonry subcontractor
 Roofing subcontractor
 Window opening subcontractor
 Sheathing subcontractor
 Exterior Insulation subcontractor
 Concrete subcontractor
 Exterior Metal Panel subcontractor
 Cold Formed Metal Framing - Structural (CFMF-S)
 subcontractor
 Steel frame (hollow metal) subcontractor

Waterproofing subcontractor
 Underslab Vapor Barrier subcontractor

1.05 REVIEW OF RELEVANT PROJECT CONTRACT SPECIFICATION SECTIONS

- A. Review the Contract Specifications and identify and note any modifications that may be necessary, so all parties understand what is required of them. Submit any modifications via appropriate supplemental documents (FC or PCO).

Spec Section	Modifications (if any)
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042000 - Unit Masonry	
070810 - Exterior Building Enclosure Weather Barrier Requirements	
071300 - Underslab Sheet Waterproofing	
071326 - Waterproofing	
072100 - Thermal Insulation	
074113 - Metal Roof Panels	
081113 - Hollow Metal Doors and Frames	
084313 - Aluminum Framed Storefronts	
084413 - Glazed Aluminum Curtain Walls	
088000 - Glazing	

1.06 REVIEW OF RELEVANT PROJECT CONTRACT DRAWINGS

- A. Review the Contract Drawings and identify and note any modifications that may be necessary, so all parties understand what is required of them. Submit any modifications via appropriate supplemental documents (FC or PCO).

Project Contract Drawing or Detail Number	Modifications (if any)
--	-------------------------------

1.07 REVIEW OF RELEVANT PROJECT SHOP/SUBMITTAL DRAWINGS

- A. Review the submittals and identify and note any modifications that may be necessary, so all parties understand what is required of them. Resubmit those submittals that have not been approved by the Architect.

Project Submittal / Shop Drawing Reference	Modifications (if any)
---	-------------------------------

1.08 REVIEW OF PRODUCTS

- A. Review the type of air barrier system that will be provided on the Project and identify each component.

Component	Actual Product to be provided for Project
SPF insulation - field of wall	
SPF insulation (wall) - voids / cracks / shims	
Transition membrane / Ice and Water Shield - self-adhered	
Primer	
Mastic / Termination Sealant	
Underslab Sheet Waterproofing	
Thermoplastic Membrane Roofing	

1.09 CONSTRUCTION TIE-IN RESPONSIBILITY

- A. Air barrier systems are successful when a full building envelope/enclosure - without penetrations, voids, holes, gaps, and cracks - is complete. This is critical when numerous trades are involved in the tying-in of the air barrier system to all facets of the exterior building envelope. Utilize the table below to ensure everyone knows who is responsible for the indicated tie-in.

Tie-in Area	Subcontractor responsible for tie-in
Exterior footing to exterior foundation wall	
Exterior foundation to exterior wall	
Slab-on-grade to wall (exterior and interior)	
Slab-on-grade joints	
Slab-on-grade penetrations	

Exterior wall to steel frame/hollow metal (e.g., doors and windows)
 Exterior walls to aluminum frames (e.g., windows and louvers)
 Different exterior wall systems (e.g., masonry to metal)
 Exterior head-of-wall to sloping roof
 Parapet walls to roof
 Exterior wall joints
 Exterior shelf angles
 Exterior steel lintels
 Exterior wall penetrations (e.g., pipes, ducts)
 Roof penetrations
 Roof perimeter

1.10 COMPATIBILITY REVIEW

- A. Each trade/installer shall identify materials that may have potential compatibility issues. For example, some membranes may be subject to decomposing when placed in contact with other materials or components, especially sealants and primers; or may deteriorate if left exposed to the elements and are not protected.

Trade / Installer	Issues / Resolutions
Air barrier	
Window	
Steel frame (hollow metal)	
CFMF-S	
Exterior Metal Panels	
Waterproofing	
Masonry	
Roofing	
Sheathing	
Concrete	
Insulation	
Flexible Flashing	
Metal Flashing	
Structural steel	
Substrate primer considerations:	

1.11 SUBSTRATE PRIMER CONSIDERATIONS:

- A. Indicate whether the substrate for the air barrier material requires the use of a primer, and if so, identify the actual product to be used on the Project.

Substrate	Yes	No	Product
CMU			
Sheathing			
Concrete			
Precast			
Metal Panels			

Roof substrate board
 Flexible Flashing
 Metal Flashing
 Waterproofing
 Steel frame / hollow
 metal
 Structural steel
 Substrate preparation
 considerations:

1.12 SUBSTRATE PREPARATION CONSIDERATIONS:

- A. Indicate whether the substrate for the air barrier material requires special treatment or preparation (e.g., flush joints in CMU), and if so, identify the method to be used on the Project. Delete those that do not apply.

Substrate	Yes	No	Method / Procedure	Subcontractor responsible
CMU				
Sheathing				
Concrete				
Precast				
Metal Panels				
Roof substrate board				
Window frames				
Flexible Flashing				
Metal Flashing				
Waterproofing				
Steel frame / hollow metal				
Structural steel				
Joint considerations:				

1.13 JOINT CONSIDERATIONS:

- A. It is critical for all joints, gaps, voids, cracks, seams, etc. to be sealed/closed for the air barrier to function properly (based on air barrier manufacturer's instructions). If applicable, indicate the method to be used to close the joints and who is responsible. Delete those that do not apply.

Type of joint	Method used to close joint	Subcontractor responsible
CMU		
Sheathing		
Concrete		
Precast		
Metal Panels		
Roof substrate board		
Window frames		
Steel (hollow metal) frames		
Head-of-wall		

1.14 INSTALLATION TEMPERATURES:

- A. A major factor in contributing to a successful air barrier system installation is to monitor and install the components within the proper temperature ranges and weather conditions. Indicate below the proper temperature range for each component; the procedure for maintaining the proper temperature range; and the party responsible for maintaining the proper temperature range in accordance with the requirements.

Component	Proper temperature range	Procedure and Subcontractor responsible
SPF insulation - field of wall		
SPF insulation (wall) - voids / cracks / shims		
SPF insulation - field of roof		
Fluid-applied membrane - Permeable - wall		
Fluid-applied membrane - Impermeable -wall		
Self-adhered membrane - Permeable - wall		
Self-adhered membrane - Impermeable -wall		
Self-adhered membrane - Permeable - roof		
Self-adhered membrane - Impermeable -roof		
Transition membrane - self-adhered		
Primer		
Mastic / Termination sealant		

1.15 AIR BARRIER PROTECTION:

- A. The air barrier system shall be protected during construction. Indicate below how the components will be protected (method used), by whom, and when.

Component	Method used for protection	Subcontractor	When
SPF insulation - field of wall			
SPF insulation (wall) - voids / cracks / shims			
SPF insulation - field of roof			
Self-adhered membrane - Impermeable -wall			

Self-adhered membrane
 - Impermeable -roof
 Transition membrane -
 self-adhered
 Primer
 Mastic / Termination
 sealant
 Air barrier repair:

1.16 AIR BARRIER REPAIR:

- A. Discuss how any damage, including but not limited to, accidental holes in the air barrier system, will be repaired - and by whom. Indicate the actual product to be used to perform any repairs in the air barrier components.

Component	Product to be used for repair	Subcontractor responsible
SPF insulation - field of wall		
SPF insulation (wall) - voids / cracks / shims		
SPF insulation - field of roof		

Self-adhered membrane -
 Impermeable -wall

Self-adhered membrane -
 Impermeable -roof
 Transition membrane -
 self-adhered
 Primer
 Mastic / Termination sealant

1.17 INSULATION SECURED TO OR OVER AIR BARRIER MATERIAL

- A. Address any concerns or issues of installing insulation over the air barrier material (foundation, walls, and roof), such as preparation, securing, or fastening methods. Delete those that do not apply.

Insulation type	Method for securement	Concerns (if any)
SPF		
XPS		
Polyiso		
EPS		

1.18 COLD FORMED METAL FRAMING - STRUCTURAL (CFMF-S) LOCATIONS

- A. Where CFMF-S is a component in the exterior wall assembly, the air barrier installer may need to mark the material itself to indicate where the framing is located. The insulation subcontractor, in turn (when the insulation is not the air barrier), may need to transfer those marks onto the insulation. If any of the above is required, discuss and identify below.

Component
Sheathing
Air Barrier
Insulation

Subcontractor responsible for location marks, if necessary

END OF SECTION

SECTION 071113 - BITUMINOUS DAMPPROOFING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cold-applied asphalt emulsion dampproofing.
 - 1. Interior face of all CMU backup in masonry cavity wall construction in exterior screen walls.
 - 2. At back and all joints (all sides except the face) of below-grade or partially below-grade courses of calcium silicate manufactured stone masonry to prevent wicking of moisture and staining.

1.02 RELATED REQUIREMENTS

- A. Section 047313 - Calcium Silicate Manufactured Stone Masonry

1.03 REFERENCE STANDARDS

- A. ASTM D 1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective coatings for Metal.
- B. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013.

1.04 SUBMITTALS

- A. Product Data: Provide properties of primer, bitumen, and mastics.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. BASF; Sonneborn Building Products: www.buildingsystems.basf.com
 - 2. Euclid Chemical Co.: www.euclidchemical.com
 - 3. Karnak Corporation; ____: www.karnakcorp.com/#sle.
 - 4. Mar-Flex Systems, Inc; ____: www.mar-flex.com/#sle.
 - 5. W. R. Meadows, Inc; ____: www.wrmeadows.com/#sle.
 - 6. Premium Liquid Rubber: www.sprayrubber.com

2.02 COLD ASPHALTIC MATERIALS

- A. Bitumen: Emulsified asphalt, 1;with fiber reinforcement other than asbestos (Type II).

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.

- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 APPLICATION

- A. Apply bitumen by spray application or brush/roller application.
- B. Apply bitumen in one coat, continuous and uniform, at a rate of 1.5 to 2.5 gal/100 sq ft .
 - 1. Provide a uniform, dry film thickness of not less than 15 mills. Apply in two coats, if necessary, to obtain required thickness, allowing time for complete drying between coats.
- C. Seal items watertight with mastic, that project through dampproofing surface.

END OF SECTION

SECTION 071300 - UNDERSLAB SHEET WATERPROOFING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Underslab sheet membrane vapor barrier.
 - 1. Vapor barrier is to be installed beneath the entire interior area of first floor new concrete slab construction except in areas where underslab semi-rigid sheet waterproofing is required.
- B. Underslab semi-rigid sheet waterproofing.
 - 1. Semi-rigid waterproofing is to be installed beneath the entire gymnasium concrete floor slab scheduled to receive a wood flooring system.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 072100 - Thermal Insulation: Insulation used for protective cover.
- C. Section 079005 - Joint Sealers: Sealant for joints in substrates.
- D. Section 312323 - Fill.
- E. Section 334600 - Subdrainage.

1.03 REFERENCE STANDARDS

- A. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- B. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2014.
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
- D. ASTM D1709 - Standard Test Method for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- F. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).
- G. ASTM E 1643 - Standard Specification For Installation of Plastic Water Vapor Retarder Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- H. ASTM E 1745 - Standard Specification For Plastic Water Vapor Retarder Used in Contact with Soil or Granular Fill Under Concrete Slabs - Class A.
- I. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.04 SUBMITTALS

- A. Product Data: Provide data for vapor barrier and sheet waterproofing membranes, tape, sealants and other system components.
- B. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing and vapor barrier for compliance with requirements, based on testing of current waterproofing formulations.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.

- E. Samples: 4" x 4" square of vapor barrier and waterproofing sheet.
- F. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Roofing and Waterproofing Manual.
- B. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Source Limitations: Obtain products through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid and sheet material to Project site in original packages with seals unbroken, labeled with manufacturers name, product brand name and type, date of manufacture, and directions for storing and mixing other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by manufacturer.
- C. Remove and replace liquid materials that cannot be applied within thief stated shelf life.
- D. Store sheets and rolls according to manufacturers written instructions.
- E. Protect stored materials from direct sunlight.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.
- B. Do not apply to a damp or wet substrate.
- C. Do not apply in snow, rain, fog or mist.

1.08 WARRANTY

- A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by the Installer, covering work of this section, for warranty period of two years.

PART 2 PRODUCTS

2.01 MEMBRANE MATERIALS

- A. CLEAR, OR WHITE, POLYETHYLENE SHEET PLASTIC WILL NOT BE ACCEPTED UNDER ANY CIRCUMSTANCES.
- B. Manufacturers
 - 1. Underslab Vapor Barrier: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:

- 1) W.R. Meadows, Inc. - Perminator 15 mil - Class A.
 - b. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1) Floor Seal Technology, Inc. TruBarrier 15 mil: www.floorseal.com
 - 2) Insulation Solutions, Inc; Viper II 15 mil: www.insulationsolutions.com
 - 3) Inteplast Group: Barrier Bac IntePlus XF VB-350: www.barrierbac.com
 - 4) Raven Industries; VaporBlock 15 mil: www.ravenefd.com
 - 5) Stego Industries LLC; Stego Wrap 15 mil: www.stegoindustries.com
 - 6) Tex-Trude, LP: Xtreme 15 mil: www.tex-trude.com
 - 7) W.R. Meadows; Perminator 15 mil: www.wrmeadows.com
 2. Underslab Semi-Rigid Sheet Waterproofing Available Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) W.R. Meadows, Inc. - Sealtight Premoulded Membrane Vapor Seal with Plasmatic Core.
 - b. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1) Stego Industries, LLC: www.stegoindustries.com
 - 2) W.R. Meadows: www.wrmeadows.com
 - 3) Insulation Solutions, Inc: www.insulationsolutions.com
- C. Product Requirements
1. Vapor Barrier: 15 mil vapor retarder.
 - a. Vapor transmission rate: 0.018 or less.
 - b. Puncture resistance: ASTM D1709, Minimum 4000 grams.
 2. Semi-Rigid Sheet Waterproofing: 1/8" thick, semi-rigid sheet of fiberglass or mineral-reinforced asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.
 - a. Vapor transmission rate: 0.00
 - b. Puncture resistance: 40 lbf minimum, ASTM E154.
- D. Materials
1. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - a. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
 2. Joint Sealing Compounds: Low-viscosity, two component, asphalt-modified sealer. All protrusions (pipes, etc.) Shall have a premolded collar surround to be sealed in place.
 3. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items that penetrate surfaces to receive waterproofing are securely installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.
- E. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

3.03 INSTALLATION - VAPOR BARRIER

- A. Install vapor barrier in accordance with manufacturer's instructions.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Membrane to cover entire pour area.
- D. All vapor barrier joint/seams, both lateral and butt, are to be overlapped minimum 6 inches and taped using minimum 4 inch wide tape provided by the manufacturer.
 - 1. Tape area of adhesion to be free from dust, dirt and moisture to allow maximum adhesion of tape.
- E. Vapor barrier is to be turned up on all vertical foundation walls the full thickness of the concrete slab on grade. Adhere to the walls with an adhesive provided by the manufacturer of the waterproofing sheet.
- F. Per manufacturers requirements create collars, made from the vapor barrier material, to seal around all pipe, duct, rebar and conduit/wire penetrations. Tape collars completely.
- G. In the event that the vapor barrier is damaged during or after installation, repairs must be made. Cut a piece of vapor barrier material large enough to cover the damage by a minimum overlap of 6 inch in all directions. Clean all adhesive areas and tape.

3.04 INSTALLATION - SEMI-RIGID SHEET WATERPROOFING

- A. Install sheet waterproofing in accordance with manufacturer's instructions.
 - 1. Contractor option to install system per "Dutch Lap" or Butt-Joint" Method.
- B. Dutch Lap Method: Overlap edges and ends and seal by method recommended by manufacturer, minimum 6 inches. Seal permanently waterproof with bonding asphalt. Pressure roll all laps to assure complete adhesion.
- C. Butt-Joint Method: Sheets are to be tightly butted together and all butt-joints sealed with PMPC tape. PMPC tape is to be centered on the joints on the felt side and rolled down with pressure for a positive seal.
- D. Per manufacturers requirements provide a positive seal around all pipe, duct, rebar and conduit/wire penetrations and the sheet waterproofing. Place a collar of PMPC tape at least 12 inches larger than the protrusion around the protrusion. Seal in place with tape and point around the protrusion with mastic..
- E. Semi-rigid sheet waterproofing is to be turned up on all vertical foundation walls the full thickness of the concrete slab on grade, for either installation method. Adhere to the walls with an adhesive provided by the manufacturer of the waterproofing sheet.

3.05 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 071400 - FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
- B. Below-grade waterproofing accessories.
- C. The extent of fluid applied waterproofing includes the face of all below grade walls which have interior finished spaces on the other side of the wall and exterior retaining walls tied into interior walls. This work includes the elevator pit. Coordinate waterproofing installation with foundation drainage.

1.02 RELATED REQUIREMENTS

- A. Section 079005 - Joint Sealers: Sealant for joints in substrates.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. AATCC Test Method 30 - Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials; 2004.
- C. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2012.
- D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- E. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; Fifth Edition, with interim updates.

1.04 SUBMITTALS

- A. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, self stick insulation anchors.
- B. Shop Drawings: Show locations and extent of waterproofing. Indicate details for special joint, crack, penetrations, inside and outside corners, tie-ins with adjoining waterproofing or other termination conditions and conditions of interface with other materials.
- C. Samples:
 - 1. 4 inch x 4 inch square of waterproofing.
 - 2. 4 inch x 4 inch square of protection board.
 - 3. 4 inch x 4 inch square of drainage panel.
 - 4. Self-stick insulation anchor and safety cap.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
- F. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

- G. Product test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Waterproofing and Dampproofing Manual.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Mock-Up: Construct a mock-up consisting of 100 sq ft of vertical waterproofed panel, including internal and external corners, drainage panel, base flashings, control joints, expansion joints, and protective cover board similar to those that will be present in the finished work.
 - 1. Mock-up may remain as part of the work if found to be acceptable.
- E. Source Limitations: Obtain all components that make up the total waterproofing system; waterproofing membrane, protection board and drainage panel, through one source from a single manufacturer.

1.06 PRE-INSTALLATION CONFERENCE

- A. Pre-installation conference is to be conducted before the waterproofing system installation begins. The General Contractor/Construction Manager, waterproofing contractor, waterproofing system manufacturers representative and the Architect are to attend this meeting.
- B. After the pre-installation meeting, a mock-up wall with complete system installation shall be constructed for review. The mock-up wall shall be done in a "shingle" or stepped method so that each step of installation can be observed in its finished state.
- C. The waterproofing system installation is to be observed by the Architect at each of the following phases:
 - 1. After patching of the concrete wall and prior to the membrane installation
 - 2. After installation of the membrane and prior to the insulation/protection board installation
 - 3. After installation of the insulation/protection board and prior to and during the first run of drainage panel installation
 - 4. Prior to and during the installation of the drainage piping and initial backfill

1.07 PROJECT CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.08 WARRANTY

- A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include,
 - 1. Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:

- a. Waterproofing System based on W.R. Meadows: Mel-Rol LM Waterproofing Membrane, PC-2 Protection Course and Mel-Drain Drainage Panel.
2. Waterproofing system by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.: CCW-525, CCW MiraDrain 6000, CCW Protection Board-V: www.carlisle-ccw.com
 - b. W.R. Grace & Co.: www.na.graceconstruction.com
 - c. W. R. Meadows: www.wrmeadows.com
 - d. Mar-Flex Waterproofing & Building Products: www.mar-flex.com
 - e. Pecora Corporation.: www.pecora.com
 - f. Premium Liquid Rubber: www.sprayrubber.com
3. Self-stick insulation anchors are to be 12 gauge, galvanized, low carbon steel with safety cap. Length is to be sufficient for fastening of the insulation board, drainage panel and safety cap. Approved manufacturers/suppliers include:
 - a. Stud Welding Equipment and Accessories.
 - b. Continental Stud Welding, Ltd..
 - c. S.F. Products.
 - d. Sunbelt Stud Welding.
 - e. Midwest Fasteners, Inc..

2.02 SPRAY-ON WATERPROOFING

- A. Physical Properties: As follows, measure per standard test methods referenced:
 1. Single component, water based, polymer-modified, cold applied, waterproofing membrane
 2. Wet Mil Application Thickness: Coverage rate of 20-25 ft. 2/gallon providing a minimum thickness of 60 wet mils.
 3. Dry/Cured Thickness: Minimum 45 mils dry.
 4. Color: Brown to Black.
 5. Solids: 70%.
 6. Total Cure Time: 16-24 hours.
 7. Shore "00" Hardness, ASTM C836: Passes.
 8. Adhesion to Concrete, ASTM C836: Exceeds.
 9. Low Temperature Flex and Crack Bridging, ASTM C836: Passes.
 10. Stability, ASTM C836: Exceeds.
 11. Elongation, ASTM D412: + 1000% to 1500%.
 12. Water Absorption, ASTM D1970: 0.7%.
 13. Water Vapor Transmission, ASTM E96 (Method B): 0.01 to 0.03 perms/sq. ft.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid primer recommended for substrate by manufacturer of waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of waterproofing material.
- D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as waterproofing.
- E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

- F. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer for adhesion of the waterproofing, insulation/protection board and drainage panel system.
- G. Self-stick insulation anchors may be used in conjunction with the adhesive system above for securing the insulation/protection board and drainage panels to the wall system.
- H. Protection Courses: Due to differences in manufacturers protection course's the following types are acceptable in the fluid waterproofing total system:
 - 1. Protection Course: (W. R. Meadows system) Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - a. Thickness: 1/8 inch (3 mm), nominal.
 - b. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.
 - 2. Protection Course: (Carlisle system) Lightweight, high density, rigid, extruded polystyrene foam vertical protection board.
 - 3. Protection Course: Where waterproofing system is to be applied on a below grade wall that has inhabited/conditioned space on the opposite side, in lieu of the protection courses listed above provide 2 inch thick extruded polystyrene board insulation meeting ASTM C578 Type IV and specified in Section 072100.

2.04 MOLDED-SHEET DRAINAGE PANELS

- A. Description: Prefabricated, composite drainage panels, made with drainage core and filter fabric, for use as part of foundation drainage system.
- B. Drainage Core: 3-Dimensional, non-biodegradable, molded-plastic-sheet material designed to effectively conduct water to foundation drainage system under maximum soil pressures.
 - 1. Minimum Flow Rate: 15 gpm/foot (3.1 l/s/1000 mm) at one hydraulic gradient and 3600 psf (172 kPa) normal pressure when tested according to ASTM D 4716.
 - 2. Film Backing: Plastic, protective-film, backing sheet attached to surface building wall.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Ensure that all bug holes, honeycombing or other concrete imperfections have been repaired and prepared to receive the membrane primer and membrane.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.
- D. Seal cracks and joints with sealant using methods recommended by sealant manufacturer.
- E. Install cant strips at inside corners and at base of wall at the footing.

3.03 INSTALLATION

- A. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness. A two coat installation is preferred over a single coat installation.
 - 1. Back brush/back drag the coating if it begins to sag or drip.
- B. Conform to NRCA Waterproofing and Dampproofing Manual drawing details.
- C. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- D. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.
- E. At joints from 1/2 to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 and 1-3/4 inch. Extend sheet 6 inches on either side of expansion joint.
- F. Center joint cover sheet over joints. Roll sheet into 1/8 inch coating of waterproofing material. Apply second coat over sheet extending minimum of 6 inches beyond sheet edges.
- G. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness.
- H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- I. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- J. Extend waterproofing 12-inches across the top of the footing.
- K. Extend waterproofing across the brick ledge and up the face of wall to the elevation of the thru-wall flashing.
- L. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- M. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to ensure clamp ring seal, and coordinate with drain installation requirements specified in Section 221006.
- N. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL and PROTECTION BOARD

- A. After the membrane has cured, place insulation/protection board directly against membrane, butt joints tightly, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions. Prime membrane prior to insulation/protection board installation as recommended by the system manufacturer. Ensure that the primer will not adversely affect the insulation/protection board.
- B. Place drainage panel over and directly against the insulation/protection board. Butt vertical joints and adhere a 12-inch wide filter fabric patch centered over the vertical joint. Butt horizontal joints and ensure that there is a minimum of 6-inches of filter fabric overlap from the upper panel over the lower panel. The top section of drainage panel is to have the drainage core removed for 6-inches to create a 6-inch wide flap of filter fabric that can be wrapped over the top of the panel and tucked between the panel and the insulation/protection board. In lieu of cutting the drainage core, a 12-inch wide section of filter fabric can be adhered and wrapped similar to the vertical joints.
- C. Adhere insulation / protection board and drainage panel to substrate with compatible adhesive. Supplement the adhered system with self-stick insulation anchors as necessary to ensure that any part of the system will not pull loose from the wall.

3.05 PROTECTION

- A. Do not damage or permit traffic over unprotected or uncovered membrane.
- B. Backfill against drainage panel as soon as practical to prevent damage to the panel. Any damage to the system is to be repaired to new condition.

END OF SECTION

SECTION 072100 - THERMAL INSULATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Board insulation at perimeter foundation wall.
- B. Batt insulation in exterior wall construction.
- C. Sprayed-in-place thermal insulation (2 lb.) air barrier system at all exterior cavity wall construction.
- D. Sprayed-in-place thermal insulation (1/2 lb.) at all exterior cavity wall openings with metal stud box/beam constructed headers, jambs, and sills.

1.02 RELATED REQUIREMENTS

- A. Section 035216 - Lightweight Insulating Concrete: Roof insulation.
- B. Section 042000 - Unit Masonry: Supporting construction for insulation..
- C. Section 054100 - Cold-Formed Exterior Steel Stud Framing: Supporting construction for sprayed-in-place and batt insulation.
- D. Section 061000 - Rough Carpentry: Supporting construction for batt insulation.
- E. Section 072500 - Weather Barriers: Separate air barrier and vapor retarder materials.
- F. Section 074113 - Metal Roof Panels: Insulation specified as part of the roofing system.
- G. Section 075400 - Thermoplastic Membrane Roofing: Insulation specified as part of the roofing system.
- H. Section 078400 - Firestopping: Fire safing.
- I. Section 092116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.
- J. Sections 23 in regards to duct, equipment and pipe insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
- E. ASTM E2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
 - 1. Submit designation of the percentages of post-consumer and pre-consumer recycled-content in insulating materials.
- B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Sprayed-in-Place Thermal Insulation:

1. Provide data on product characteristics, product testing, product performance criteria, and product limitations.
 - a. Provide specific data that product is approved for direct application on cmu substrate as part of cmu/masonry veneer cavity wall and/or exterior sheathing as part of the metal stud/sheathing/masonry veneer cavity wall construction.
 - b. Provide product data on all auxiliary components; primer, seam tape and transition strip materials.
 - c. Provide specific data that product has been tested and is approved for use as an air barrier.
 - d. Provide hydrostatic water resistance pressure test results.
 - e. Shop Drawings: Indicate locations and extent of sprayed-in-place thermal insulation air barrier system assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in construction will be bridged, how inside and outside corners are negotiated, how materials that cover the insulation are secured, how air-tight conditions are maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed.
 2. Quality Assurance Program: Provide evidence of current accreditation of the subcontractor and certification of installers under the Air Barrier Association of America's (ABAA) Quality Assurance Program. Provide accreditation and certification information on the form included in the Form of Proposal.
- E. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed sprayed-in-place thermal insulation system confirming that the sprayed-in-place thermal insulation system installer is approved to install the proposed sprayed-in-place thermal insulation system.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.06 SEQUENCING

- A. Sequence work to ensure firestop materials are in place before beginning work of this section.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
1. Surface - Burning Characteristics: ASTM E 84.
 2. Fire - Resistance Ratings: ASTM E 119.
 3. Combustion Characteristics: ASTM E 136.
- C. Sprayed-In-Place Thermal Insulation: Current accreditation of the subcontractor and certification of installers in accordance with the Air Barrier Association of America's (ABAA) Quality Assurance Program.
1. Install in accordance with ABAA and training requirements outlined in ULC S705.2-05 Installation Standard.
- D. Sprayed-In-Place Thermal Insulation Field Quality Control:
1. ABAA Site Inspections: ABAA to verify conformance with the manufacturers instructions, the ULC S705.2 Installation Standard, the ABAA Quality Assurance Program and requirements of this specification.

- a. Inspections and testing shall be carried out at 5, 50 and 95 percent of sprayed-in-place thermal insulation completion. Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed.
- b. If the tests reveal any defects, promptly remove and replace defective work at no additional expense to the Owner.
 - 1) If the preliminary or final written inspection report indicates the system will not or has not passed then an additional ABAA inspection shall be conducted to ensure defects and deficiencies have been corrected and a passing ABAA report can be obtained.

1.08 PRE-INSTALLATION MEETING

- A. Preinstallation Meeting: Per Section 042000 - Unit Masonry the general contractor/construction manager will conduct a preinstallation conference prior to the masonry installation occurring. The sprayed-in-place thermal insulation installer is to attend this preinstallation conference too coordinate the installation of the sprayed-in-place insulation with the masonry subcontractor.
 - 1. Review foreseeable methods and procedures related to sprayed-in-place thermal insulation installation, including but not necessarily limited to the following:
 - a. Protection of through wall flashing.
 - b. Spray around horizontal reinforcing eyes.
 - c. Hot and cold weather protection.
 - d. Protection of work in process and installed.
 - e. Sequencing of work with masonry installation.
 - f. Review percentages of completion when ABAA testing will be conducted.
 - g. Has the project been registered with the ABAA for testing?
 - 1) If registered has the ABAA testing agent been notified?

1.09 MOCK-UP

- A. Sprayed-in-place thermal insulation to be included in the mock-up wall construction.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
 - 4. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 - 5. Board Thickness at Foundation Wall: 2 inches.
 - 6. Board Edges: Square.
 - 7. Thermal Conductivity (k factor) at 25 degrees F: 0.18.
 - 8. Thermal Resistance: R of 7.5 for 1-1/2 inch.
 - 9. Compressive Resistance: 25 psi.
 - 10. Board Density: 1.6 lb/cu ft.
 - 11. Water Absorption, Maximum: 0.3 percent, by volume.
 - 12. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - a. Certainteed Saint Gobain: www.certainteed.com
 - b. Dupont: www.dupont.com
 - c. Dow Chemical Company: www.dow.com.
 - d. Kingspan Insulation LLC; _____: www.trustgreenguard.com/#sle.
 - e. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

2.02 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less; smoke developed index of 450 or less, when tested in accordance with ASTM E 84.
 - 2. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 3. Formaldehyde Content: Zero.
 - 4. Thermal Resistance: R-value of 19.
 - 5. Thickness: 6 inch.
 - 6. Facing: Unfaced.
 - 7. Recycled Content: Give preference to products having recycled content.
 - 8. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - a. Johns Manville: www.jm.com.
 - b. Knauf Insulation GmbH: www.knaufinsulation.us.
 - c. Owens Corning Corp: www.owenscorning.com.

2.03 SPRAYED-IN-PLACE THERMAL INSULATION

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. NCFI Polyurethanes, Division of BMC: InsulBloc 2 lb. Spray Foam System 11-017.
 - b. NCFI Polyurethanes, Division of BMC: InsulStar Light 1/2 lb. Spray Foam System.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - a. NCFI Polyurethanes, Division of BMC: InsulBloc 2 lb. Spray Foam System 11-017: www.ncfi.com
 - b. BASF Polyurethane Foam Enterprises, LLC: Walltite 2 lb. Air Barrier System: www.basf-pfe.com
 - c. Carlisle Spray Foam Insulation: SealTite Pro Closed Cell: www.carlislefi.com
 - d. Huntsman Building Solutions/ formerly Demilec USA, LLC: Heatlok Soy 200 Plus: www.demilecusa.com
 - e. Gaco Western: Gaco WallFoam 183M 2 lb.: www.gaco.com
 - f. Henry Company: Permax 2.0: www.henry.com
 - g. Huntsman Building Solutions/ formerly Icynene-Lapolla Inc.: ProSeal MD-C-200 2 lb. Spray Foam Insulation: www.icynene.com
 - h. JohnsManville Insulation Systems: JM Corbond III 2 lb.: www.jm.com
 - i. SWD Urethane: Quik-Shield 112-XC: www.swdurethane.com
 - 3. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - a. NCFI Polyurethanes, Division of BMC: InsulStarLight 1/2 lb. Spray Foam System 11-017: www.ncfi.com
 - b. BASF Polyurethane Foam Enterprises, LLC: Enertite 1/2 lb. Air Barrier System: www.basf-pfe.com
 - c. Huntsman Building Solutions/ formerly Demilec APX 1.2: www.demilecusa.com
 - d. Gaco Western: Gaco WallFoam Open Cell Foam 052N 1/2 lb.: www.gacowallfoam.com
 - e. Huntsman Building Solutions/ formerly Icynene-Lapolla Inc.: LD-R-50 1/2 lb. Spray Foam Insulation: www.icynene.com

f. JohnsManville Insulation Systems: JM ocSPF 1/2 lb.: www.jm.com

- B. Spray applied closed cell, 2 lb. polyurethane foam insulation, air seal and water repellent treatment for CMU cavity wall and cold formed metal stud framed walls throughout the project.
1. Physical material properties shall be:
 2. Core Density 1.9-2.2 lb/ft per ASTM D-1622
 3. Water Vapor Transmission <1.0 @ 2" thick /perms per ASTM E-96
 4. R-Value 6.7 minimum at 1 inch thick per ASTM C-518
 5. R-Value Aged: 6.4 minimum at 1 inch thick per ASTM C-1029
 6. Compressive Strength 25 (min) psi per ASTM D-1621
 7. Flame Spread <25 per ASTM E-84
 8. Smoke Developed <450 per ASTM E-84
 9. Air Leakage - Infiltration: 0.00 @ 1.57 psf/cfm/ft² per ASTM E-283
 10. Air Leakage - Exfiltration: 0.00 @ 1.57 psf/cfm/ft² per ASTM E-283
 11. Air Barrier System Test: ASTM E 2357 and NFPA 285
 12. Tensile Bond Strength >45 for masonry psi per ASTM D-1623
 13. Hydrostatic Water Pressure Resistance Test: No failure at 56.5 feet head pressure per AATCC 127-1998.
- C. Spray applied open cell, 1/2 lb. polyurethane foam insulation, air seal and water repellent treatment for boxed/beam headers, jambs, and sills at openings in exterior metal stud framed walls throughout the project.
1. Physical material properties shall be:
 2. Core Density 0.5 lb/ft per ASTM D-1622
 3. Water Vapor Transmission 15 /perms at 1 inch per ASTM E-96
 4. R-Value 4.1 minimum at 1 inch thick per ASTM C-518
 5. Flame Spread <25 per ASTM E-84
 6. Smoke Developed <450 per ASTM E-84
 7. Air Leakage - Infiltration: 0.00 @ 1.57 psf/cfm/ft² per ASTM E-283
 8. Air Leakage - Exfiltration: 0.00 @ 1.57 psf/cfm/ft² per ASTM E-283
 9. Air Barrier System Test: ASTM E 2357 and NFPA 285
- D. Refer to the wall types on the A0.1 drawing sheet for thickness of spray polyurethane material required.
- E. Apply spray polyurethane foam directly to the masonry block or exterior sheathing in accordance with the manufacturers installation instructions. All surfaces to be sprayed with foam must be free of moisture and ice.
- F. Do not apply spray polyurethane foam during inclement weather or when ambient temperatures and humidity are outside the ranges prescribed by the manufacturer.
1. Optimum Adhesion: Sprayed-In-Place Thermal Insulation Installer to determine appropriate grade of adhesive material to be used on project based on; project type, substrate type, time of year of installation, average daily temperatures forecasted during installation, and other factors, as determined by the sprayed-in-place thermal insulation manufacturer to maintain the specified requirements. No additional compensation will be considered, or due, the sprayed-in-place thermal insulation contractor if the sprayed-in-place thermal insulation manufacturer requires a tack coat, or the type or grade of adhesive, originally bid, to be changed due to project type, environmental and/or temperature factors, to maintain the specified requirements and construction schedule.
- G. Materials:
1. Transition Strip and Seam Tape Primer:
 - a. Primer to facilitate adhesion of flashings to fiberglass faced sheathing, concrete and masonry substrates.

- 1) Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) Grace Construction Products: Perm-A-Barrier WB Primer
 - (b) W. R. Meadows, Inc.: Mel-Prime
 - (c) Product approved for use by sprayed-in-place thermal insulation manufacturer.
2. Seam Tape:
 - a. Self-adhered flashing with cross-laminated, high density polyethylene sheet backed with pressure-sensitive rubberized asphalt adhesive.
 - 1) Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) Grace Construction Products: Vycor Plus
 - (b) W. R. Meadows, Inc.: Air-Sheild 25 mil Flashing Tape
 - (c) Product approved for use by sprayed-in-place thermal insulation manufacturer.
3. Transition Strip Materials:
 - a. Contractor option to use self-adhered sheet product or fluid applied product for the transition strip materials.
 - b. Self-adhered Transition Strip Material: Minimum 1 mm self-adhered flashing sheet with cross-laminated, high density polyethylene sheet backed with pressure-sensitive rubberized asphalt adhesive. Install transition strip materials at all wall openings, transitions in substrate and connections to adjacent elements:
 - 1) Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) Carlisle Coatings and Waterproofing: CCW-705 TWF
 - (b) Grace Construction Products: Perm-A-Barrier Flashing
 - (c) Henry: Blueskin SA
 - (d) Protective Coatings Technology, Inc.: Poly-Wall Crack Guard
 - (e) Tremco, Inc.; ExoAir 110
 - (f) W. R. Meadows, Inc.: Air Shield
 - c. Fluid-applied Transition Strip Material System: One component rubberized air barrier material. Suitable for spray, roller or brush application direct to substrate. Install by roller/brush in two minimum 13 mil wet thickness applications, or one 26 mil wet thickness application by spray. Provide all additional auxiliary materials necessary to complete the entire system: Reinforced, nonwoven, polyester sheathing joint fabric with preformed corners, polyester-faced 30-mil thick, self-sealing, rubberized asphalt membrane, and water-based primer.
 - 1) Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) BASF: Enershield-1, Quick Corner 6, TF Membrane, WS Flashing Primer: www.enershield.basf.com
 - (b) Prosoco - R-Guard Fast Flash
 - (c) W. R. Meadows, Inc.: Air Shield LM

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
 - 1. Tape seal joints.
 - 2. Extend sheet full height of joint.
- B. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- E. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.

3.03 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 SPRAYED-IN-PLACE THERMAL INSULATION AIR BARRIER SYSTEM

- A. Equipment used to spray insulation shall comply with ABAA ULC S705.2 and the manufacturer's recommendations.
- B. Record equipment settings daily as required by the ABAA ULC S705.2 installation standard.
- C. Apply in consecutive passes as recommended by manufacturer and thickness indicated on drawings. Passes shall not be less than 1/2 inch and not greater than 2 inches.
- D. Install within manufacturer's tolerances, but not more than minus 1/4 inch or plus 1/2 inch.
 - 1. The total average thickness, tested and provided on the final ABAA Audit Report, for the sprayed insulation installed on the wall in the field shall be the minimum thickness indicated, for the various wall types, as shown on the drawings.
- E. Surface of foam insulation to be free of voids and embedded foreign objects.
- F. Remove masking materials and overspray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
- G. Trim as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
- H. Complete connections to other components and repair any gaps, holes or other damage using material which conforms to ABAA ULC S710.1 or ABAA ULC S711.1 and installed in accordance with ABAA ULC S710.2 or ABAA ULC S711.2 as applicable.
- I. Fill exterior metal stud boxed/beam headers, jambs, and sills at all openings completely with 0.5 lb. spray insulation.

- J. Transition Strip and/or Fluid-Applied Material Installation: Install transition strip/fluid-applied materials to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and the following:
1. Priming, seam tape/fluid-applied material, and transition strips are required by RossTarrant whether or not they are required by a manufacturer to meet the ABAA air leakage requirements of ASTM E2357.
 2. Apply primer for seam tape and transition strips. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
 3. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is required by manufacturer. Roll into place with roller.
 4. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches, unless greater overlap is required. Roll seams with roller.
 5. Seal around all penetrations with a transition strip or other procedure.
 6. At changes in substrate plane, provide transition material to make a smooth transition from one place to another.
 7. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to another. Membrane shall be continuously supported by substrate.
 8. At through-wall flashings, provide an additional 6 inch wide strip of membrane counterflashing to seal top of through-wall flashing to membrane. Seal exposed top edge of strip with bead of mastic.
 9. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
 10. At expansion and seismic joints provide transition to the joint assemblies.
 11. At the top of parapet walls, provide transition material over top of parapet to transition with roof membrane.
 12. Do not allow materials to come into contact with chemically incompatible materials.
 13. Do not expose transition membrane to sunlight longer than recommended by manufacturer.
 14. Inspect installation prior to enclosing assembly and repair damaged areas with sprayed-in-place thermal insulation air barrier system.

3.05 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072100.01 - SPRAYED-IN-PLACE THERMAL INSULATION (072100) INSTALLER'S CERTIFICATION

SPRAYED-IN-PLACE THERMAL INSULATION (072100) INSTALLER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal. Upon submittal of this form RossTarrant will verify from the ABAA website (www.airbarrier.org) the listed installers current and valid certification, at the time of bid, with the ABAA. Installers listed without current and valid ABAA certification will be rejected.

This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Sprayed-In-Place Thermal Insulation Installer:

I certify that _____ (Name of Sprayed-In-Place Thermal Insulation Installer) has achieved ABAA Accreditation for sprayed-in-place thermal insulation installation, and is a member with current and valid ABAA Certification.

ABAA Accreditation Number _____

I certify that _____ (Name of Sprayed-In-Place Thermal Insulation Subcontractor) installers have achieved ABAA Certification for sprayed-in-place thermal insulation installation, and is a member with current and valid ABAA Certification.

ABAA Certification Numbers _____

Signed: _____ Title: _____

SECTION 072129 - SPRAYED-ON ACOUSTICAL INSULATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cellulose insulation applied to underside of structure.
 - 1. Locations indicated in the drawings.

1.02 RELATED SECTIONS

- A. Section 099000 - Painting and Coating: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- B. ASTM C739 - Standard Specification for Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation; 2011.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- F. ASTM C-1149 Spray-applied Cellulose Insulation.
- G. ASTM C-423 - Sound Absorption and Sound Absorption Coefficients by the reverberation room method.

1.04 SUBMITTALS

- A. Product Data: Provide data on materials, describing insulation properties.
- B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- C. Manufacturer's Qualification Statement.
- D. Installer's Qualification Statement.
- E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- F. Manufacturer certification information for installer and persons to perform the work on job site.
- G. Samples: Samples of manufacturers standard color selection. Submit actual samples not photo reproductions.
- H. Independent laboratory test reports evidencing compliance with specified performance criteria.
- I. Manufacturer certificate, located in the FOP, to be submitted with the bid, for the proposed sprayed-on-acoustical system confirming that the sprayed-on acoustical system installer is approved to install the proposed PVC roof system.
- J. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed sprayed-on acoustical system confirming that the sprayed-on acoustical system installer is approved to install the proposed sprayed-on acoustical system.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Products Specified by Flammability Criteria: Listed and classified by ITS (DIR), UL (DIR), or authorities having jurisdiction (AHJ).
 - 1. Surface burning characteristic -ASTM E 84, Class I, Class A.
 - 2. Flame Spread: Maximum 15
 - 3. Smoke Developed: Maximum 0
- D. Product to comply with ASTM C-423 Sound Absorption and Sound Absorption Coefficients by the reverberation room method.
- E. Product to comply with ASTM C-1149 Spray-applied Cellulose Insulation.

1.06 FIELD CONDITIONS

- A. Do not install insulation, when ambient and surface temperatures are lower than 50 degrees F.
- B. Maintain acceptable ambient and substrate surface temperatures prior to, during, and after installation of primer and insulation materials and overcoat.

1.07 PROJECT CONDITIONS

- A. Apply insulation after hangers and supporting clips are installed but before subsequent construction is erected.
- B. Maintain required minimum building temperature as recommended by the manufacturer before, during and after application of sprayed insulation.

1.08 DELIVERY STORAGE AND HANDLING

- A. Deliver materials to the project in manufacturer's unopened packages, fully identified as to trade name, type and other identifying data.
- B. Store materials above ground, in a dry location, protected from the weather. Damaged packages found unsuitable for use should be rejected and removed from the job site.
- C. Protect liquids from freezing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cellulose Fiber: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the Work include:
 - 1. GreenFiber: www.greenfiber.com.
 - 2. International Cellulose Corp: www.spray-on.com.
 - 3. ThermoCon, Inc: www.thermocon.com.
 - 4. Isolatek International, Inc.: www.isolatek.com
- B. Basis of Design: The design concept and the specifications indicate the requirements and aesthetics of the K-13 ceiling system by International Cellulose Corp.

2.02 MATERIALS

- A. Cellulose Fiber Insulation: ASTM C739; treated cellulose fiber.
 - 1. Spray-on Acoustic Insulation to be asbestos free material composed of cellulose fibers, chemical treatment, and binding system designed to be spray-applied, permanently bonding to substrate. Material to have firm abrasion resistant surface that will not chip, shed, flake, dust or be subject to rot.
 - 2. Thermal Resistance (R-value): 3.9, at 1 inch thick when tested in accordance with ASTM C177 at 75 degrees F temperature

3. Density: 2 lb/cu ft, when tested in accordance with ASTM D1622/D1622M.
4. NRC: 0.80 for 1 inch average thickness per ASTM C-423.
5. Moisture Absorption: Maximum 15 percent by weight.
6. Flame Spread / Smoke Developed Index: 0-25 / 0-450, Class A, when tested in accordance with ASTM E84.
7. Combustibility: Passing ASTM E136.
8. Bond Strength: Greater than 900 psf according to ASTM E-736
9. Compression Strength: Greater than 600 psf according to ASTM E-761.
10. Color: Selected by Architect from manufacturers standard colors and Refer to Room Finish Schedule for painting notes.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are clean, dry, and free of matter that may inhibit adhesion.
- B. Verify other work on and within spaces to be insulated is complete prior to application.
- C. Coordinate installation with other trades whose work may be affected or have an effect on the insulating process. All work by other trades that will be concealed by insulation must be inspected and approved by those having jurisdiction before work may proceed.

3.02 PREPARATION

- A. Carefully examine all surfaces to receive spray-on insulation. Substrate shall be free of dirt, rust, grease, oil, loose material, frost or other matter which would affect bond of sprayed insulation.
- B. Mask and protect adjacent surfaces from overspray or damage.
- C. Apply sealer/primer in accordance with manufacturer's instructions to prevent migratory staining of the acoustical insulation.
- D. Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed by others prior to the application of sprayed insulation materials.

3.03 INSTALLATION

- A. Install sprayed insulation in accordance with manufacturer's instructions.
- B. Install sprayed insulation to a uniform monolithic density without voids.
- C. Install K-13 to a minimum cured thickness of 1 inch.
- D. Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
- E. The application of sprayed insulation to the underside of roof decks shall not commence until the roofing is completely installed and weathertight and after roof traffic has ceased.
- F. Provide masking, drop cloths or other suitable coverings to prevent insulation overspray from coming in contact with surfaces not intended to receive spray-applied insulation. Apply insulation on underside of roof/floor deck only. All other parts of the trusses, joists or the steel members are to be masked off to prevent over spray from coming in contact.. The following exception applies:
 1. Contractor option to spray the top chord of joists/trusses, top flange of steel members, or other steel members supporting the roof/floor deck with the same thickness of insulation material as specified for the roof/floor deck. All other parts of the trusses, joists or other steel members are to be masked off to prevent insulation over spray from coming in contact..
 2. Sprayed-on acoustical insulation subcontractor and painting subcontractor to coordinate the painting and insulation spraying sequence, and steel items to be either painted or insulated.

- G. Upon completion of application, remove any overspray, debris and waste from floors, walls, structure items, and adjacent areas. Leave the work area in a broom clean condition.
- H. Assure ventilation across the surface of the sprayed insulation during and after application to accelerate drying.

3.04 PROTECTION

- A. Do not permit subsequent construction work to disturb applied sprayed insulation.
- B. No activity shall be allowed on any roof deck surface on which the underside has been treated with sprayed-on insulation until the product is completely cured.

3.05 REPAIR AND CLEANING

- A. All patching and repair to sprayed insulation due to damage by other trades shall be performed under this section and paid for by the trade responsible for the damage.
- B. Upon completion of repair application, remove any overspray, debris and waste from floors, walls, structured items, and adjacent areas. Leave the work area in a broom clean condition.

END OF SECTION

SECTION 072129.01 - SPRAYED-ON ACOUSTICAL INSULATION MANUFACTURER'S CERTIFICATION**PART 1 GENERAL****1.01 SPRAYED-ON ACOUSTICAL INSULATION MANUFACTURER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

- A. This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Sprayed-On Acoustical Insulation Manufacturer:

Name & Address of Sprayed-On Acoustical Insulation Installer:

I certify that _____ (Name of Sprayed-On Acoustical Insulation Installer) is an approved applicator of our Sprayed-On Acoustical Insulation.

Signed: _____ Title: _____
(Sprayed-On Acoustical Insulation Manufacturer)

END OF SECTION

SECTION 074113 - METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Architectural roofing system of preformed steel panels.
 - 1. The specified architectural standing seam roof panels are to be factory fabricated in one piece. No mid-span lapped horizontal seaming will be accepted.
- B. Soffit Panels.
- C. Gutters and Downspouts.
- D. Thermal roof insulation.
- E. Attachment system.
- F. Factory Finishes.
- G. Accessories and miscellaneous components.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2012).
- D. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; 1995 (Reapproved 2011).
- E. ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems; 2011.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
- B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.
- C. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns. Submit actual samples not photo reproductions.
- D. Test Reports: Indicate compliance of metal roofing system to specified requirements.
- E. Warranty: Submit specified manufacturer's 20 year finish and 20 year weathertightness warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.
- F. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed metal roof panel system confirming that the metal roof panel system installer is approved to install the proposed metal roof panel system.

1.04 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

- B. Review preparation and installation procedures and coordinating and scheduling required with related work.
- C. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at project site. Meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and roof accessories, Architect, Owner, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers and test agencies. This meeting must be attended by the on-site Foreman overseeing the work.
 - 1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.
 - 2. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.
 - 3. Record discussion, including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
- D. Preapplication Roofing Conference: Approximately 2 weeks before scheduled commencement of standing seam roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, test agencies, and governing authorities.
 - 1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:
 - a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.
 - c. Review roofing system requirements (drawings, specifications, and other contract documents).
 - d. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - e. Review required submittals, both completed and yet to be completed.
 - f. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 - g. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - h. Review required inspection, testing, certifying, and material usage accounting procedures.
 - i. Review temporary protection requirements for roofing system during and after installation.

- j. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
- k. Review of roof observation and repair procedures after roofing installation.
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.05 COMPLETION MEETING

- A. A meeting shall be held at the completion of the project and attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the Manufacturer's representative. The Contractor shall complete all punch list items and acquire Manufacturer's warranty for final submittal to Architect.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of roofing systems similar to those required for this project, with not less than 5 years of documented experience.
- B. Installer Qualifications: Company trained and authorized by roofing system manufacturer, with minimum (5) five years of experience, in type of work specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing panels on site in protective packaging to prevent damage prior to installation.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Three executed copies of all warranties must be submitted to the Architect.
- C. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
 - 1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 - 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.
 - 3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- D. Manufacturer's "No Monetary Limit" Warranty: The entire installation from the deck up, including but not limited to insulation, hat channels, fasteners, metal roofing and edge metals shall be warranted against defects in material and workmanship as evidenced by leaks, as required to maintain roofing system in a watertight condition for the period stated below starting from the date of final acceptance by the Owner as herein before specified. Should leak occur, the manufacturer shall repair or replace the roof material as required to provide a watertight condition at its own expense, with no dollar limit or prorated amount. The warranty shall cover fully and completely the entire roofing system and the requirements as specified herein. This warranty shall be jointly signed by the Manufacturer of the primary roofing material and the authorized installer. The guarantee is for a complete system and shall not be limited by any previous work accomplished on the roof prior to this contract and elected to remain as a part of the system herein specified:
 - 1. Total Systems Warranty shall be for a period of twenty (20) years from the date of substantial completion.

2. Repairs and replacements required because of events beyond the Contractor's / Installer's / Manufacturer's control and beyond the limits specified herein shall be completed by the Contractor / Installer and paid for by the Owner.
3. Installer shall provide a typed certificate stating the following:
 - a. Type of roof.
 - b. Installer.
 - c. Installer's address and telephone number.
 - d. Manufacturer.
 - e. Manufacturer's address and telephone number.
 - f. Who to contact in case of roof failure.
 - g. Warranty period with beginning and ending dates. Certificate shall be framed and bolted (not hung) on the wall as directed by Architect. Copies of certificate shall be included with manufacturer's written warranty and submitted to Architect
 - h. Any representative who inspects the roof must copy all inspection reports to the office of Ross-Tarrant Architects, Inc. for the life of the roof.
- E. Structural Performance: Provide warranty by roof panel system manufacturer against perforation or structural failure of roof panels for period of twenty (20) years.
- F. All warranties shall commence on Date of Substantial Completion for building.
- G. Both the project Foreman and the Contractor shall provide a sworn notarized statement to the Owner and the Architects that the entire roofing system has been fully and completely integrated with the through-wall flashing system following industry standards for a permanent watertight integrated system. All means, methods, materials and labor to perform this integration is fully a part of this contract.
- H. Contractor's Warranty: Roofing contractor shall provide a written two year warranty for materials and workmanship commencing with the date of substantial completion. The warranty shall cover all labor and all material necessary to maintain complete water tightness, including that required to repair and all roof leaks and water infiltration through the roof, flashings, and wall copings in any configuration including standing water at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 1. DMI - Span Lock SL20 (2 inch rib height) Continuous mechanically seamed connections with concealed anchor clips. Exposed fasteners in the panel ends will NOT be accepted. Finish to be "Metallic Silver" premium color.
- C. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 1. ATAS International, Inc: www.atas.com.
 2. Berridge Manufacturing Company: www.berridge.com/#sle.
 3. Cornerstone Building Brands/Centria: www.centria.com
 4. DMI: www.dmimetals.com
 5. Englert, Inc: www.englertinc.com.
 6. Petersen Aluminum Corporation: www.pac-clad.com/#sle.
 7. Drexel Metals, Inc.: www.drexmet.com
 8. Fabral: www.fabral.com
 9. Innovative Metals Co.: www.imetco.com
 10. Cornerstone Building Brands/MBCI: www.mbc.com

11. McElroy: www.mcelroymetal.com
12. Metal Panel Systems, Inc.: www.metalpanelsystems.com
13. Metal Roofing Systems, Inc: www.metalroofingsystems.biz
14. Metal Sales Manufacturing: www.metalsales.us.com

2.02 PERFORMANCE REQUIREMENTS

- A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed $L/180$ of span length(L) when tested in accordance with ASTM E1592.
 2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
 3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.

2.03 ARCHITECTURAL METAL ROOF PANELS

- A. Architectural Metal Roofing: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
 - a. Steel Thickness: Minimum .030 inch (22 gauge).
 2. Texture: Smooth with striations.
 3. Length: Full length of roof slope, without lapped horizontal joints.
 4. Width: Maximum panel coverage of 16 to 18 inches.

2.04 SOFFIT PANELS

- A. Preformed Metal Soffit Panels: Pre-finished, galvanized 24 ga. to meet same requirements as the preformed metal roof panels along with the following:
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. DMI - FP1012
 2. Panels to have concealed fasteners.
 3. Profile to be flush, 12" wide.
 4. Panels to be non-vented.
 5. Color: "Metallic Silver" premium color.

2.05 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2, and with the following characteristics:
1. Compressive Strength: 20 psi
 2. Board Size: 48 x 48 or 48 x 96 inch. Maximum panel size listed shall be maintained. Provide insulation in longest practical lengths.
 3. Board Thickness: Top layer 2.6 inch and bottom layer 2.6 inch inch.
 4. Layers: Provide two layers.
 5. Thermal Resistance: Aged R-value of minimum 5.7 per inch. ASTM C518 aged "R" value at 75 degrees F (or RIC/TIMA Conditioning Procedure 281-1).
 6. Board Edges: Square.
 7. Joints: Joints in second layer shall not coincide with joints of the first layer. The course shall be staggered to ensure this.
 8. UL : Class A.

9. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Atlas Roofing Corporation: www.atlasroofing.com.
 - b. Dow Chemical Co: www.dow.com.
 - c. Hunter Panel: www.hpanels.com
 - d. Johns Manville: www.jm.com.
 - e. Firestone Building Products Company: www.firestonebpco.com
 - f. R-Max.: www.rmaxinc.com
 - g. Other manufacturers approved by metal roof panel manufacturer to meet full system warranty requirements.

2.06 VAPOR BARRIER

- A. 8-mil thick, reinforced three-ply polyethylene vapor barrier, coated both sides, with a .04 perm rating.
 1. Raven Industries: Dura-Skrim 8WB: www.ravenfd.com
- B. Provide and install if required by the roofing manufacturer for the requirements of the full system warranty.

2.07 SELF ADHERED WATERPROOF UNDERLAYMENT

- A. Install on entire roof surface and connect to air barrier of walls. Synthetic felt underlayment is not to be used as a replacement for self-adhered waterproof underlayment. Acceptable manufacturers offering the following products that may be incorporated into the work include:
 1. W.R. Grace-Ice and Water Shield.
 2. DMI DynaClad Ultra HT Wind and Water Seal.
 3. GAF-Ice and Water Shield.
 4. Firestone Clad-Gard SA.
 5. Mid-States Asphalt (MSA): Quik Stick HT: www.msarroof.com
 6. Polyglass USA, Inc: Polystick MTS High Temperature: www.polyglass.com
 7. Protecto Wrap Company: Jiffy Seal Ice and Water Guard HT: www.protectowrap.com
 8. Other manufacturers approved by the metal roof panel manufacturer to meet the full system warranty requirements.

2.08 GUTTERS AND DOWNSPOUTS

- A. Provide gutters and downspouts in shapes and sizes indicated, fabricated in longest continuous length possible. Include steel straps formed from at least 0.028-inch- (0.7-mm-) thick, galvanized steel sheet; hangers or other attachment devices; end plates; and trim and other accessories indicated or required for complete installation. Expansion joints are to be utilized so as to not have lapped gutter joints.
- B. Provide gutters and downspouts fabricated from the following metal:
 1. Prefinished formed-steel sheet in thickness indicated, but not less than the following:
 - a. Thickness: 22 ga. for gutters.
 - b. Thickness: 22 ga. for downspouts.
- C. Gutters and downspout sizes:
 1. Gutter to be profile and size as shown on the drawings.
 2. Downspouts: Refer to the drawings for size and location.
- D. Gutter and Downspout Anchors and Supports:
 1. Gutter Supports: Straps and Hangers. 1 inch wide, 0.050 inch thick internal aluminum strap at 30 inch on center at top of gutter. Alternate location with 1 inch wide 0.125 inch thick external hanger at bottom location 30 inch on center for support of gutter.
 2. Downspout Supports: Straps. Provide three anchor straps per 10 foot section.
- E. Color: Selected by Architect from same color choices as metal roof panel.
- F. Wire Ball Downspout Strainer: Provide a wire ball downspout strainer at every downspout location.

2.09 ATTACHMENT SYSTEM

- A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.10 FINISHES: PANEL, TRIM, GUTTER, DOWNSPOUT AND VISIBLE ACCESSORIES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 1. Minimum total dry film thickness of 0.9 mil; color and gloss as selected from manufacturer's standards, in a minimum of 20 colors. Minimum color selection to be equivalent to or greater than manufacturers list of standard colors for 24 gauge metal roof panel and (steel or aluminum) soffit panels with same material lead times and no minimum on square footage requirements. Must include a premium color equivalent to DMI "Metallic Silver."

2.11 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. High Temperature Pipes and Penetrations: Provide high-temp rated boots or sheet metal collars with clamping rings and sealant to separate pipes from roofing.
- D. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
- E. Snow Guards: Non-penetrating attachment system. Clamps to match standing seam profile and height. Brackets and cross members to be provided in color to match standing seam roof panel. Color as selected by Architect.
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. SnoGem, Inc.: 2" SnoGem iClad SnoCube Snow Retention System with 1 inch Blockade Plates.
 - 2. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Metal Roof Innovations Ltd.: SnoRail/SnoFence with SnoClips www.s-5.com
 - b. SnoBlox Snow Guards: Color Rail with IceStopper: www.snoblox.com
 - c. Sno-Gem, Inc.: www.snogem.com
- F. **MISCELLANEOUS WRAP AND TRIM**
 - 1. To match metal and finish of the roofing.
 - 2. Form pieces in longest possible lengths.
 - 3. Hem exposed edges on underside 1/2 inch; miter and seam corners.
 - 4. Provide double bead of butyl sealant/tape at all lapped joints.

2.12 FABRICATION

- A. Panels: Fabricate panels and accessory items at factory, using manufacturers standard processes as required to achieve specified appearance and performance requirements.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.
- B. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.
- C. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.
- B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
 - 1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.
 - 2. Provide sealant tape or other approved joint sealer at lapped panel joints.
 - 3. Install sealant or sealant tape, as recommended by panel manufacturer, at end laps and side joints.

3.04 CLEANING AND PROTECTION

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.
- B. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- C. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 074113.01 - METAL ROOFING SYSTEM MANUFACTURER'S CERTIFICATION**PART 1 GENERAL****1.01 METAL ROOFING SYSTEM MANUFACTURER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

- A. This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Roofing Systems Manufacturer:

Name & Address of Roofing Systems Installer:

I certify that _____ (Name of Roofing Installer) is an approved applicator of our roofing systems, and upon completion of this project, providing all terms and conditions for the manufacturer's guarantee are met, we will provide a no-dollar-limit 20-year manufacturer's guarantee for the roof.

Signed: _____ Title: _____

(Roofing Systems Manufacturer)

END OF SECTION

SECTION 074213 - METAL WALL PANELS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Manufactured metal panels for walls, with subgirts/z-furring, related flashings and accessory components.

1.02 RELATED REQUIREMENTS

- A. Section 072100 - Thermal Insulation.
- B. Section 074113 - Metal Roof Panels.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2010 (Reapproved 2015).

1.04 DESIGN REQUIREMENTS

- A. Maximum Allowable Deflection of Panel: 1/180 of span.
- B. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
- C. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
- D. Products: Provide continuity of thermal barrier at building enclosure elements .

1.05 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Summary of test results, indicating compliance with specified requirements.
 - 2. Storage and handling requirements and recommendations.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, _____, and methods of anchorage.
- C. Selection Samples: For each panel system specified, submit color chips representing manufacturer's full range of available colors and patterns. Submit actual samples not photo reproductions.
- D. Manufacturer's Qualification Statement.
- E. Warranty Information: Submit specified manufacturer's 20 year finish warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.

1.07 MOCK-UPS

- A. Locate as directed by Architect.

- B. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefabricated material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
- C. Installer's Warranty: Correct defective Work within a 5 year period after Substantial Completion, including defects in water tightness and integrity of seals.
- D. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
 - 1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 - 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.
 - 3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. Panel Type 1: DMI IL20. Finish to be "Metallic Silver" premium color. Smooth with striations. 16" rib spacing.
 - 2. Panel Type 2: DMI FP1511. Finish to be "Metallic Silver" premium color. Smooth, flush reveal.
- C. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1. ACI Building Systems; ACI Metal Roofing Systems: www.acibuildingsystems.com
 - 2. Architectural Building Components : www.archmetalroof.com.
 - 3. ATAS International, Inc : www.atas.com.
 - 4. Berridge: www.berridge.com
 - 5. Cornerstone Building Brands/Centria: www.centria.com
 - 6. DMI: www.dmimetals.com
 - 7. Drexel Metal Products, Inc./Met-Fab: www.drexmet.com/www.met-fab.com
 - 8. Englert: www.englertinc.com
 - 9. Firestone Metal Products: www.unaclad.com
 - 10. Innovative Metals Co. : www.imetco.com
 - 11. Cornerstone Building Brands/MBCI: www.mbeci.com
 - 12. McElroy: www.mcelroymetal.com
 - 13. Merchant & Evans: www.ziprib.com
 - 14. Metal Panel Systems, Inc.: www.metalpanelsystems.com
 - 15. Metal Roofing Systems: www.metalroofingsystems.biz

16. Metal Sales Manufacturing: www.metalsales.us.com
17. Morin Corporation: www.morincorp.com
18. Petersen Aluminum Corporation: www.pac-clad.com.

2.02 MANUFACTURED METAL PANELS

- A. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- B. Anchors: Galvanized steel.
- C. Metal panels shall be fabricated from zinc coated steel conforming to ASTM A 653 SQ, Grade 37, G90 coating. Steel panel shall be 22 gauge with smooth surface texture.
- D. All exterior flashing and trim shall be fabricated in the same material, gauge, finish and color as the exterior profile, unless otherwise indicated.
- E. Subgirts and/or Z-furring shall be fabricated from minimum 16 gauge zinc coated steel conforming to ASTM A 653 SQ, Grade 37, G90 coating. Depth as indicated on the drawings. On-center spacing per requirements of metal wall panel manufacturer.
 1. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include;
 - a. Metal Subgirts and Z-Furring:
 - 1) Flexospan Steel Buildings, Inc.: www.flexospan.com
 - 2) Johnson Brothers Metal Forming Co.: www.johnsonrollforming.com
 - 3) J. N. Linrose Manufacturing LLC: www.jnlinrose.com
 - 4) Telling Industries, LLC: www.tellingindustries.com.

2.03 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Fluoropolymer Coating System: Manufacturer's standard multi-coat thermocured coating system, including minimum 70 percent fluoropolymer color topcoat with minimum total dry film thickness of 0.9 mil; color and gloss as selected from manufacturer's standards, in a minimum of 20 colors. Finish to include an equal to DMI "Metallic Silver" premium color. Minimum color selection to be equal to or greater than manufacturers list of standard colors for 24 gauge metal wall panel and (steel or aluminum) soffit panel with same material lead times and no minimum on square footage requirements.
- C. Panel Back Coating: Panel manufacturer's standard polyester wash coat.

2.04 ACCESSORIES

- A. Sealants:
 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

2.05 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest practicable lengths.
- C. Form panels for standing seams.
- D. Fabricate corners in one continuous piece with minimum 16 inch returns.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that building framing members are ready to receive panels.

3.02 INSTALLATION

- A. Install panels on walls in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Locate joints over supports.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners unless otherwise approved by Architect.
- G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.03 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.04 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 075400 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fully adhered PVC membrane roofing system.
- B. Induction adhered PVC membrane roofing system.
- C. Insulation: flat.

1.02 RELATED REQUIREMENTS

- A. Section 035216 - Lightweight Insulating Concrete: Roof insulation.
- B. Section 061000 - Rough Carpentry: Roof blocking, parapet sheathing.
- C. Section 076200 - Sheet Metal Flashing and Trim: Misc. flashings.
- D. Section 077100 - Manufactured Roof Specialties: Fascia.
- E. Section 077123 - Manufactured Gutters and Downspouts: Scuppers.
- F. Section 092116 - Gypsum Board Assemblies: Parapet sheathing.

1.03 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.04 REFERENCE STANDARDS

- A. ASCE/SEI 7-10 - Minimum Design Loads for Buildings and Other Structures: Wind design.
- B. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2013.
- C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- E. ASTM D6630 - Standard Guide for Low Slope Insulated Roof Membrane Assembly; current edition.
- F. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim update
- G. UL (RMSD) - Roofing Materials and Systems Directory; Underwriters Laboratories Inc.; current edition.
- H. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- I. UL 580 - Tests for Uplift Resistance of Roof Assemblies ; current edition.
- J. UL 1897 - Uplift Tests for Roof Covering Systems; current edition.

1.05 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Lightweight Insulating Concrete: Roofing installer to coordinate lightweight insulating concrete manufacturer to ensure that a tested insulation/roof system can be provided between the two manufacturer's to meet the Special Project Full System Warranty as specified in the roofing section.

- C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- D. ASCE 7-10: Provide thermoplastic membrane, base flashings, and component materials that meet the wind design requirements as a part of a roofing system, as applicable.
 - 1. Refer to the structural drawings for wind speeds, building exposure, and building risk category.
- E. UL Listing: Provide thermoplastic sheet roofing system and component materials that have been tested for application and slopes indicated and are listed by Underwriters Laboratories, Inc. (UL) for Class A external fire exposure.
 - 1. Provide roof-covering materials bearing UL Classification Marking on bundle, package, or container indicating that materials have been produced under UL's Classification and Follow-up Service.
 - 2. Provide thermoplastic sheet roofing system that has been tested in accordance with UL 580 or UL 1897.
- F. Insulation Fire-Performance Characteristics: Provide insulation materials that are identical to materials whose fire-performance characteristics have been determined for the assemblies of which the insulation materials are a part, per test method listed below, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Surface Burning Characteristics: ASTM E 84.
 - 2. Fire Resistance Ratings: ASTM E 119.
- G. All material, the installation thereof shall meet or exceed the minimum criteria of the Kentucky State Building Code.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Base flashings and membrane terminations.
- C. Samples for Verification: For the following products:
 - 1. 3 by 3 inch (300 by 300 mm) square of sheet roofing, of color(s) specified, including T-shaped side and end lap seam.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing systems to maintain warranty.
 - 1. add a choice
- E. Qualification Data: For Installer and manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- G. Warranties: Special warranties specified in this Section.
- H. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.
- I. Wind Uplift Design: Provide wind uplift calculation that include wind uplift performance tested per ASCE 7-10 Envelope Procedure. Calculations to include:
 - 1. Minimum Design Wind-Resistance Loads: Include field of roof, perimeter, and corner uplift pressures for each applicable roof area.
 - 2. Fastener pattern, spacing, and/or enhanced adhesive requirements.

3. Additional wind uplift safety factors required by the building area, size or shape, and manufacturers requirements to meet the specified warranty requirements.
- J. Manufacturer certificate, located at the end of this Section, to be submitted with the bid, for the proposed PVC roof system confirming that the PVC roof system installer is approved to install the proposed PVC roof system.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Manufacturer Qualifications:
 1. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years of documented experience.
 2. Obtain primary products, including each type of roofing sheet, bitumen, membrane flashings, and vapor retarder (if any), from a single manufacturer. Provide secondary products as recommended by manufacturer of primary products for use with roofing system specified.
 3. Roof membrane manufacturer is to have an indemnity arrangement with the selected lightweight insulating concrete manufacturer to meet the special project full system roof warranty as specified.
- C. Installer Qualifications: Engage an experienced installer to perform Work of this Section who has specialized in installing roofing that is required for this Project; who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's products; and who is eligible to receive the project specific full system roofing manufacturer's warranty as specified. A minimum of five (5) years experience with the manufacturer and the specified system is required.
 1. Installer's Field Supervision: Require Installer to maintain a full-time supervisor/foreman on job site during times that PVC sheet roofing work is in progress and who is experienced in installation of roofing systems similar to type and scope required for this Project. A minimum of four (4) years experience with the manufacturer and the specified system is required.
- D. Source Limitations: Obtain components for membrane roofing system approved by roofing membrane manufacturer.
- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.
- F. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "General Requirements." Review methods and procedures related to roofing system including, but not limited to, the following:
 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 - a. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

- d. Manufacturer's technical representative to be on site during first day of installation.

1.08 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.
- B. Review preparation and installation procedures and coordinating and scheduling required with related work.
- C. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at project site. Meet with Installer (Roofer), installers of substrate construction (roof decks) and other work adjoining roof system including penetrating work and roof accessories, Architect, Owner, and representatives of other entities directly concerned with performance of roofing system including (as applicable) Owner's insurers and test agencies. This meeting must be attended by the on site Foreman overseeing the work.
 - 1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation facilities and establish preliminary installation schedule. Review requirements for inspections, testing, certifications, forecasted weather conditions, governing regulations, insurance requirements, and proposed installation procedures.
 - 2. Discuss roofing system protection requirements for construction period extending beyond roofing installation. Discuss possible need for temporary roofing.
 - 3. Record discussion, including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
- D. Preapplication Roofing Conference: Approximately 2 weeks before scheduled commencement of sheet roofing installation and associated work, meet at Project site with Installer, installer of each component of associated work, installers of roof drains, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing that must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, test agencies, and governing authorities.
 - 1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review foreseeable methods and procedures related to roofing work, including but not necessarily limited to the following:
 - a. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.
 - b. Review structural loading limitations of steel deck and inspect deck for loss of flatness and for required mechanical fastening.
 - c. Review roofing system requirements (drawings, specifications, and other contract documents).
 - d. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - e. Review required submittals, both completed and yet to be completed.
 - f. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
 - g. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - h. Review required inspection, testing, certifying, and material usage accounting procedures.

- i. Review temporary protection requirements for roofing system during and after installation.
- j. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not a mandatory requirement).
- k. Review of roof observation and repair procedures after roofing installation.
- 3. Record (Contractor) discussions of conference, including decisions and agreements (or disagreements) reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.09 COMPLETION MEETING

- A. A meeting shall be held at the completion of the project and attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the Manufacturer's representative. The Contractor shall complete all punch list items and acquire Manufacturer's warranty for final submittal to Architect.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.11 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

- A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Three executed copies of all warranties must be submitted to the Architect.
- B. Special Project Full System Warranty:
 - 1. The entire installation from the deck up, including but not limited to insulation, fasteners, roofing membranes, edge metals, counter flashing, base flashings and other components of the membrane roofing system, shall be warranted against defects in material and workmanship as evidenced by leaks, flashing membrane deterioration, blisters, splits, etc., as required to maintain roofing system in a watertight condition for the period stated below starting from the date of final acceptance by the Owner. Should leak occur, the Manufacturer shall repair or replace the roof materials as required, to provide a watertight condition, at its own expense, with no dollar limit (NDL) or prorated amount. The warranty shall cover fully and completely the entire roofing system and the requirements as specified herein. Particularly warranty shall not include language releasing manufacturer of responsibility if not installed by approved roofing Contractor or in accordance with manufacturer's specifications, or materials not specifically made by the manufacturer. It is the

manufacturer's responsibility to know by whom and how roofing was installed to eliminate this. The guarantee is for a complete system and shall not be limited by any previous work accomplished on the roof prior to this contract and elected to remain as a part of the system herein specified:

- a. Total Systems Warranty shall be for a period of twenty (20) years NDL from the date of substantial completion.
 - b. This warranty shall be jointly signed by the Manufacturer of the primary roofing material and the authorized installer.
 - c. Repairs and replacements required because of events beyond the Contractor's/Installer's/ Manufacturer's control and beyond the limits specified herein shall be completed by the Contractor/Installer and paid for by the Owner.
- C. Installer shall provide a typed certificate stating the following:
1. Type of roof.
 2. Installer.
 3. Installer's address and telephone number.
 4. Manufacturer
 5. Manufacturer's address and telephone number.
 6. Who to contact in case of roof failure.
 7. Warranty period with beginning and ending dates. Certificate shall be framed and bolted (not hung) on the wall as directed by Architect. Copies of certificate shall be included with manufacturer's written warranty and submitted to Architect.
 8. Any representative who inspects roof must copy all inspection reports to the office of RossTarrant Architects, Inc. for the life of the roof.
- D. Lightweight insulating concrete warranty to be provided within the Special Project Full System Roof Warranty as required under this Section. Lightweight insulating concrete warranty is not to be a separate pass-thru warranty attached to the roof warranty.
1. The roofing subcontractor shall not offer the LWIC/roofing warranty cost as a deduct to their bid price.
 2. The roofing and lightweight insulated concrete warranty is to be provided by the roofing contractor and is not to be obtained at a later date by the General Contractor/Construction Manager.
- E. Warranty Work: All warranty and/or maintenance work shall be documented by the individual performing the work with before and after pictures of the work and a detailed breakdown of cost. Submit to the Owner and the Architect. Time spent by the Architect for manufacturer warranty problems shall be billed to the manufacturer.
- F. Recommended Maintenance: In addition to the guarantee, the Contractor shall furnish to the Owner the Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.
1. Arrange for a meeting of the Owner, Architect, Manufacturer, and Installer to review procedure for general maintenance by the Owner that will not void warranty, as well as procedure for reporting roof problems, maintenance, and/or warranty problems to manufacturer.
 2. All warranty and/or maintenance work shall be documented by the individual performing the work with before and after pictures of the work and detailed breakdown of cost. Submit to Owner and Architect time spent by Architect for manufacturer's warranty problems shall be billed to the manufacturer.
- G. Contractor's Warranty: Roofing Contractor shall provide a written two (2) year warranty for materials and workmanship commencing with the date of substantial completion. The warranty shall cover all labor and all material necessary to maintain complete water tightness, including that required to repair and all roof leaks and water infiltration through the roof, flashings, and wall copings in any configuration including standing water at no additional cost to the Owner.

1.13 PROJECT FOREMAN/CONTRACTOR CERTIFICATION

- A. Both the project Foreman and the Contractor shall provide a sworn notarized statement to the Owner and the Architect that the entire roofing system has been fully and completely integrated with the through-wall flashing system following industry standards for a permanent watertight integrated system. All means, methods, materials and labor to perform this integration is fully a part of this contract.

PART 2 PRODUCTS**2.01 PVC SHEET ROOFING MEMBRANE**

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, aesthetics, and formulations of the following:
 - a. Roof Field: Sarnafil G410 EnergySmart fleeceback by Sika Sarnafil, Inc.: www.usa.sarnafil.sika.com
 - b. Flashings: Sarnafil G410 in conjunction with loose felt sheet.
 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect:
 - a. Carlisle Syn-Tec: Sure-Flex KEE HP 60 Mil MIN: www.carlisle-syntec.com
 - b. Johns-Manville: JM60 Mil/60 Mil MIN: www.jm.com
 - c. Sika Sarnafil, Inc.: www.usa.sarnafil.sika.com
 - d. Soprema: Sentinel P150: www.soprema.us.com
- B. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, aesthetics, and formulations of the following:
 - a. Roof Field: Sarnafil SikaPlan fleeceback by Sika Sarnafil, Inc.: www.usa.sarnafil.sika.com
 - b. Flashings: Sarnafil SikaPlan in conjunction with loose felt sheet.
 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect:
 - a. Carlisle Syn-Tec: Sure-Flex 60 Mil: www.carlisle-syntec.com
 - b. Johns-Manville: JM PVC SD Plus 60 Mil: www.jm.com
 - c. Sika Sarnafil, Inc.: www.usa.sarnafil.sika.com
 - d. Soprema: www.soprema.us.com
- C. Due to differences in roofing manufacturer standards for membrane reinforcement provisions for fiberglass and polyester are included. Reinforcements listed below are acceptable and manufacturers are to provide their standard of one listed below:
1. PVC sheet ASTM D 4434, Type II, Grade 1, fiberglass reinforced for fully adhered installation.
 2. PVC Sheet ASTM D4434, Type III, Grade 1, polyester fiber reinforced for fully adhered installation.
- D. Thickness: Specified thickness 60 mils MINIMUM thickness as required to meet the specified warranty period.
- E. Exposed Face Color for Field of Roof: White.
- F. Exposed Face Color for Vertical/Parapet Walls: White.

2.02 INSULATION

- A. General: Rigid roof insulation used for this project shall be UL and FM/ASCE approved. Each type of insulation used shall be approved in writing by the insulation manufacturer for intended use, and for use with the specified roof assembly.
- B. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2, and with the following characteristics:
 - 1. Compressive Strength: 20 psi
 - 2. Board Size: 48" x 48" inch.
 - 3. Board Thickness: 2.6 inch.
 - 4. Layers: Provide two layers.
 - 5. Thermal Resistance: Aged R-value of minimum 5.7 per inch. ASTM C518 aged "R" value at 75 degrees F (or RIC/TIMA Conditioning Procedure 281-1).
 - 6. Board Edges: Square.
 - 7. Joints: Joints in second layer shall not coincide with joints of the first layer. The course shall be staggered to ensure this.
 - 8. UL : Class A.
 - 9. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Atlas Roofing Corporation: www.atlasroofing.com.
 - b. Carlisle SynTec: www.carlislesyntec.com
 - c. Dow Chemical Co: www.dow.com.
 - d. GAF Materials Corporation: www.gaf.com.
 - e. Hunter Panels: www.hpanels.com
 - f. Johns Manville: www.jm.com.
 - g. Firestone Building Products Company: www.firestonebpco.com
 - h. R-Max.: www.rmaxinc.com
 - i. Sika Sarnafil, Inc.: www.usa.sarnafil.sika.com
 - j. Other manufacturers approved by roofing manufacturer to meet full system warranty requirements.
- C. Tapered Insulation Board: Roof insulation system of tapered panels composed of closed cell polyisocyanurate, which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The panels shall provide for a roof slope of one quarter (1/4) inch per foot.
- D. Tapered Pre-Cut Crickets: Roof insulation system of tapered panels composed of a foam core which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. . The panels shall provide for a roof slope of one quarter (1/4) inch per foot.
- E. Insulation Fasteners: Provide insulation fasteners and plates that are ASCE 7-10 approved and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for digging, etc. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products.
 - 1. Metal Decks: Provide insulation mechanical fasteners and metal plates for metal decks that have been factory coated for corrosion resistance, and when subjected to 30 Kesternich cycles, must show less than 100% red rust, conforming to ASCE 7-10. Acceptable insulation fasteners types for metal decks are listed below:
 - a. A single unit, precision formed, fluorocarbon coated screws type roofing fastener having a minimum of one hundred seventy-two thousandths (.172) inch diameter shank and a minimum two hundred-twenty-thousandths (.220) inch diameter thread.

All plates used with fastener shall be a metal type having a minimum three (3) inch diameter as supplied by the fastener manufacturer.

- 1) Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) ITW Buildex/OMG Inc. - Roofgrip with Buildex Metal Plates.
 - (b) Construction Fasteners, Inc. - Dekfast #12 with Dekfast Hexagonal Plates.
 - (c) Olympic Fasteners - #12 Standard Roofing fastener.
- F. Insulation Adhesive: Insulation installed over the mechanically fastened base/first layer of insulation board.
 1. Provide a ASCE7-10 approved and/or approved by the manufacturer of the primary roofing products insulation adhesive or low-rise foam adhesive. Low-rise bead/ribbon spacing to meet ASCE wind speed and warranty requirements as specified elsewhere in this section
- G. Insulation Adhesive: Insulation installed over structural concrete deck.
 1. Provide a ASCE7-10 approved and/or approved by the manufacturer of the primary roofing products insulation adhesive or low-rise foam adhesive. Low-rise bead/ribbon spacing to meet ASCE wind speed and warranty requirements as specified elsewhere in this section

2.03 ROOF COVER BOARD

- A. Roof Cover Board: Contractors option to use one of the following products to meet specified warranty requirements:
 1. Thickness of the roof cover board as required by the roofing membrane manufacturer to meet the warranty requirements. Deletion of the cover board is not allowed, even if manufacturers warranty requirements do not require a cover board.
 - a. Acceptable Products: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1) Georgia Pacific - DensDeck Prime Roof Board
 - 2) USG - Securock Gypsum-Fiber Roof Board
 - (a) Private label/distributed by Carlisle as Securock.
 - b. High-density polyisocyanurate bonded to mineral surfaced, fiber glass-reinforced facers. Tested per ASTM C1289, Type II, Class 4.
 - 1) Additional Acceptable Product: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - (a) Johns Manville - Invinsa Roof Board - 1/4 inch thick: www.jm.com
 - (b) Carlisle SecurShield HD Plus Polyiso - 1/2" inch thick.
- B. Roof Cover Board - Adhesive - Cover board installed over fully adhered insulation.
 1. Provide a ASCE7-10 approved and/or approved by the manufacturer of the primary roofing products insulation adhesive or low-rise foam adhesive. Low-rise bead/ribbon spacing to meet ASCE wind speed and warranty requirements as specified elsewhere in this section
- C. Roof Cover Board - Mechanically Fastened - For areas with metal decking mechanically fasten roof cover board to deck, through rigid board insulation, if any.
 1. Refer to the paragraph in this section on "Insulation Fasteners" for type.

2.04 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.
1. Sheet flashing membrane sheet is not required to have fleece backing unless required by manufacturer.
 2. Felt Sheet: Provide 9 oz. felt sheet to be fully adhered to parapet walls or other vertical surfaces.
 - a. Acceptable products:
 - 1) Sika Sarnafil - Sarnafelt
- C. Roof Membrane and Flashing Bonding Adhesive: Manufacturer's standard water or solvent-based bonding adhesive for field membrane, and solvent-based bonding adhesive for base flashings.
1. Solvent-Based Properties and Characteristics
 - a. High strength solvent based contact adhesive allowing bonding to porous and non-porous substrates.
 - b. Base: Synthetic rubber.
 - c. Solids: 24.2%
 - d. Flash Point: 16 degrees F closed cup
 - e. Brookfield Viscosity: 2700 Centipoises
 - 1) Acceptable products, compatible with manufacturers roof membrane and installation system:
 - (a) Carlisle - Sure-Flex PVC Bonding Adhesive
 - (b) JM - PVC Membrane Adhesive - Solvent Based
 - (c) Sika Sarnafil - Sarnacol 2170
 2. Water-Based Properties and Characteristics:
 - a. Acceptable products, compatible with manufacturers roof membrane and installation system:
 - 1) Sika Sarnafil - Sarnacol 2121
 - 2) JM - PVC Membrane Adhesive - Water Based
 3. RossTarrant Architects will not accept any membrane or field flashing adhesives other than the solvent-based or water-based adhesives described in this specification. Single or multi-component low-rise foams, urethanes, or any other type of single or multi-component adhesives will not be substituted or accepted.
- D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
1. Provide "Sarnastop," or equivalent, termination bar at areas where parapet walls occur.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470/ASCE 7-10, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.
- H. Tapered Polyisocyanurate Edge Strip: Provide tapered polyisocyanurate on top of blocking at parapets with fascia. Tapered panels composed of closed cell polyisocyanurate, which are bound with fiber glass reinforced facers on both sides. Provide panels that are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The panels shall provide for a slope of one quarter (1/4) inch per foot.
1. Atlas Roof Insulation: Gemini Tapered Edge Strip
- I. Tapered and Flat Polyisocyanurate Board at Roof Drain Sumps: Provide tapered and flat polyisocyanurate insulation in the roof drain sump. Tapered and flat panels composed of closed cell polyisocyanurate, which are bound with fiber glass reinforced facers on both sides. Provide panels that

are in full compliance with ASTM C 1289, Type II, Class 1, Grade 2, 20 psi. The tapered panels shall provide for a slope of one quarter (1/4) inch per foot.

- J. Roof Edge/Drip Edge Flashing: Manufacturers standard 24 gauge metal clad with 30 mil PVC coating for heat welding to meet warranty requirements.
 - 1. Color: White
- K. Scupper Opening Flashing: Manufacturers standard 24 gauge metal clad with 30 mil PVC coating for heat welding to meet warranty requirements.
 - 1. Color: White
- L. Walkway Pads: Provide walkway pads/roll in locations as shown on the drawings. Provide maximum 6 inch space between each pad/roll to allow for water drainage. Contractor's option to use pad or roll product.
 - 1. Pad/Roll: Minimum 30 inch x 30 inch, or minimum 30 inch x 4 foot, 60 mil, fiberglass reinforced material with non-slip surface pattern. Fully adhere center and heat weld entire perimeter of pad. Color to be Light Gray.
 - a. Basis of Design: Saranfil Saranpad.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify metal deck is clean and smooth, supported, secure, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system. Verify that flatness and fastening of metal roof decks comply with installation tolerances specified in Division 5 section "Steel Decking".
 - 4. Verify deck surfaces are dry and free of snow or ice.
 - 5. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips, nailing strips, and reglets are in place.
 - 6. Verify that nailers and blocking match thickness of the roof insulation.
- B. Bonding Adhesive Test: Roofing contractor to verify lightweight insulating concrete system moisture content prior to starting roof membrane installation. Moisture content to be below roof membrane manufacturers requirements prior to installation of bonding adhesive. Testing standards and procedures per roof membrane manufactures requirement to meet the specified warranty.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flash and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.03 FULLY ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

1. Install sheet according to ASTM D 5036.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesives: Roofing Installer and Roofing Membrane Manufacturer to determine appropriate adhesive material to be used on project based on; project type, substrate type, time of year of installation, average daily temperatures forecasted during installation, and other factors, as determined by the roof membrane manufacturer to maintain the specified warranty. No additional compensation will be considered, or due, the roofing contractor if the roof membrane manufacturer requires the type of bonding adhesive, originally bid, to be changed due to project type, environmental and/or temperature factors, to maintain the specified warranty. Either adhesive listed below is acceptable for use:
 1. Solvent-Based Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and/or roof membrane at rate required by the roof membrane manufacturer. Apply and allow first coat of solvent based bonding adhesive to dry. Apply second coat of solvent based adhesive and install roof membrane. Do not apply bonding adhesive to splice area of roofing membrane to be heat welded.
 2. Water-Based Bonding Adhesive: Apply water-based bonding adhesive to substrate at rate required by the roof membrane manufacturer. Apply single coat, or as required by roof membrane manufacturer, of water-based bonding adhesive and install roof membrane. Do not apply bonding adhesive to splice area of roofing membrane to be heat welded.
- D. RossTarrant Architects will not accept any membrane or field flashing adhesives other than the solvent-based or water-based adhesives described in this specification. Single or multi-component low-rise foams, urethanes, or any other type of single or multi-component adhesives will not be substituted or accepted.

3.04 BASE FLASHING INSTALLATION

- A. Install sheet flashing and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- D. Clean seam areas and overlap and firmly roll sheet flashing into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashes and mechanically anchor to substrate through termination bars.

3.05 CONCRETE DECK PREPARATION

- A. Fill surface honeycomb and variations with latex filler.
- B. Contractor to confirm dry deck by moisture meter with 12 percent moisture maximum.
- C. Verify that lightweight insulating concrete will pull a minimum of 40 pounds and is dry to the touch.
- D. Test concrete substrate for excessive moisture by pouring one pint of hot bitumen 2400 degrees F on EVT on deck at start of each days work and at start of each roof area or plane. Do not proceed with roofing work if test sample forms can be easily stripped after cooling then substrate is too wet.

3.06 METAL DECK PREPARATION

- A. Install deck sheathing on metal deck:
 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.

3.07 INSULATION INSTALLATION

- A. Roof Insulation - Metal Deck
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and ASCE .
 - 2. Adhere subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and ASCE requirements.
 - 3. Adhere cover board with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and ASCE requirements.
 - 4. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
 - 5. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
 - 6. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
 - 7. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
 - 8. Do not apply more insulation than can be covered with membrane in same day.
- B. Roof Insulation - Structural Concrete
 - 1. Fully adhere with adhesive first layer of insulation to deck in accordance with roofing manufacturer's instructions and ASCE.
 - 2. Adhere subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and ASCE requirements.
 - 3. Adhere cover board with joints staggered minimum 6 inch from joints of preceding layer in accordance with roofing manufacturer's instructions and ASCE requirements.
 - 4. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
 - 5. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
 - 6. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
 - 7. Do not apply more insulation than can be covered with membrane in same day.
- C. Roof Drain Sump Insulation:
 - 1. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.

3.08 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner seven days in advance of date and time of inspection.
- B. Final Roof Inspection Report: After final roof inspection is completed one copy of the final report (hardcopy or digital format) shall be provided to the General Contractor/Construction Manager, Architect, and Roofing Installer.
- C. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.09 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 075400.01 - THERMOPLASTIC MEMBRANE ROOFING SYSTEM MANUFACTURER'S CERTIFICATION**PART 1 GENERAL****1.01 THERMOPLASTIC MEMBRANE ROOFING SYSTEM MANUFACTURER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

- A. This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Roofing Systems Manufacturer:

Name & Address of Roofing Systems Installer:

I certify that _____ (Name of Roofing Installer) is an approved applicator of our roofing systems, and upon completion of this project, providing all terms and conditions for the manufacturer's guarantee are met, we will provide a no-dollar-limit 20-year manufacturer's guarantee for the roof.

Signed: _____ Title: _____

(Roofing Systems Manufacturer)

END OF SECTION

SECTION 077100 - MANUFACTURED ROOF SPECIALTIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Manufactured roof specialties, including: drip edge, reglet, counterflashing, fascia, and rake edge

1.02 RELATED REQUIREMENTS

- A. Section 075400 - Thermoplastic Membrane Roofing.
- B. Section 077123 - Manufactured Gutters and Downspouts: Gutter and downspout
- C. Section 079005 - Joint Sealers.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- C. NRCA (RM) - The NRCA Roofing Manual; 2017.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
- B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- C. Submit LEED data and forms on all products contained in system as specified herein.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) details.

1.06 WARRANTY

- A. Refer to roofing membrane section 075400 for Special Project Full System Warranty requirements for items to be included from this specification section.
- B. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
 - 1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 - 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.
 - 3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include::
 - 1. Copings, Fascia, and Other Roof Edge Metals:
 - a. Architectural Products Co; ____: www.archprod.com/#sle.
 - b. W. P. Hickman: www.wph.com

- c. Metal-Era Inc; _____: www.metalera.com/#sle.
- d. Johns Manville: www.jm.com
- e. MM Systems Corp: www.mmsystemscorp.com
- f. Sika Saranfil: www.sarnafilus.com
- g. Siplast: www.siplast.com

2.02 COMPONENTS

A. Fascia

1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1) Metal-Era; Anchor-Tite: www.metalera.com
 - 2) Metal-Era - Fascia Extender - Standard: www.metalera.com
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Architectural Products Co.: www.archprod.com.
 - 2) Dimensional Metal Inc. (DMI): www.dmimetals.com
 - 3) Firestone Building Products, Inc.: www.firestonebpco.com
 - 4) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 5) Metal-Era Inc: www.metalera.com.
 - 6) Johns Manville: www.jm.com
 - 7) Metal Roofing Systems: www.metalroofingsystems.biz
 - 8) MM Systems Corp: www.mmsystemscorp.com
 - 9) Sika Saranfil: www.sarnafilus.com
 - 10) Siplast: www.siplast.com
 - 11) Soprema: www.soprema.us
2. Provide fascia in shapes and sizes indicated, with shop-mitered and welded-corners. Include water dams formed from at least 0.028-inch- (0.7-mm-) thick, galvanized steel sheet; anchor plates; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.
3. High performance roof edge system shall be certified by the manufacturer to comply with ANSI/SPRI Standard ES-1-98. Roof edge shall meet performance design criteria according to the following test standards:
 - a. ANSI/SPRI ES-1-98 Test Method RE-1 Test for Roof Edge Termination of Single-Ply Roofing Membranes: The fascia system shall be tested to secure the membrane to minimum of 100 lbs/ft in accord with the ANSI/SPRI ES-1-98 Test Method RE-1. Use the current edition of ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
 - b. ANSI/SPRI ES-1-98 Test Method RE-2 Pull-Off Test for Fascia: The fascia system shall be tested in accord with the ANSI/SPRI ES-1-98 Test Method RE-2. Use the current edition of ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
4. The fascia product shall be approved for use in Miami-Dade County and has been designed to comply with Florida Building Code, including the High Velocity Hurricane Zone, Miami-Dade County NOA No. 03-0108.06 Expiration Date 12/11/08.
5. Performance Characteristics:
 - a. Extruded bar shall lock membrane, prevent wind pullback.
 - b. Injection molded EPDM splices to allow thermal expansion of extruded aluminum anchor bar.
 - c. Fascia shall freely thermal cycle on extruded bar, preventing periodic maintenance.
6. Fascia metal gauge: Contractor's option of .040" thick formed aluminum or 24 ga. galvanized steel.

7. Extruded bar: Shall be continuous 6063-T6 alloy aluminum at 12'-0" (3.65 m) standard lengths. All bar miters are welded.
8. Fasteners: #9 x 2" stainless steel fasteners provided with drivers. No exposed fasteners permitted.
9. All inside and outside corners to be manufactured corner pieces to eliminate seams.
10. Standard Face Height: Minimum 6 1/2", or manufacturers next larger size, unless noted otherwise on the drawings.
 - a. Extender: Factory-fabricated 24 gauge galvanized steel, minimum ____ inch face, or manufacturers next larger size, painted finish, concealed joint covers, and continuous, 22 gauge, galvanized anchor cleat. Provide factory-fabricated mitered corners.

B. Reglets and Counterflashing:

1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1) Fry Reglet: MA Masonry Reglet - Customized with flat flange
 - (a) MA-3 (3 inch customized horizontal flat flange for brick)
 - (b) MA-4 (4 inch customized horizontal flat flange for CMU)
 - 2) Fry Reglet: 90-Degree Inside and Outside Reglet Corners
 - 3) Fry Reglet: Spring Lock Flashing.
 - 4) Fry Reglet: Inside and Outside Spring Lock Flashing Corners.
 - 5) Fry Reglet: Spring Lock Flashing End Cap
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Fry Reglet: www.fryreglet.com
 - 2) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 3) Metal-Era Inc: www.metalera.com.
2. General: Provide two-piece reglets with counterflashing receiver of type, material, and profile indicated, compatible with counterflashing. Form to securely interlock with counterflashing.
3. Reglet - Masonry Type - MA: Provide with top flange for embedment in masonry mortar joint. Embedment flange into masonry to be flat and not have a turned up leg that creates a water dam for the flexible flashing.
 - a. Material: 24 gauge galvanized steel.
 - b. Provided by Roofing Contractor and installed by Masonry Contractor.
4. Reglet Finish: Manufacturers standard mill finish.
5. Counterflashing
 - a. Provide springlock counterflashing fabricated from the same metal as reglets and compatible with reglet system installed.
 - 1) Material: 24 gauge galvanized steel.
 - 2) Color to match reglet.
 - 3) Provided and installed by roofing contractor.
6. 90-Degree Inside and Outside Reglet and Spring Lock Flashing Corners
 - a. Material: 24 gauge galvanized steel
 - b. Color to match reglet and counterflashing.
 - c. Reglet: Provided by Roofing Contractor and installed by Masonry Contractor/Wall Panel Contractor.
 - d. Counterflashing: Provided and installed by roofing contractor.
 - e. Acute and Obtuse Intersections: Contractor to field verify and special order for corner angles less or more than 90-Degree.
7. Spring Lock Flashing System End Cap

- a. Factory provided 1 inch wide foam insert to close open end of the counterflashing. Insert to function as a backer for exterior sealant.
 - 1) Sealant color to match counterflashing.

C. Copings:

- 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, aesthetics, and formulations of the following :
 - 1) Metal-Era: Perma-Tite Coping System - Tapered Version: www.metalera.com
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Architectural Products Co.: www.archprod.com.
 - 2) Dimensional Metal Inc. (DMI): www.dmmetals.com
 - 3) Firestone Building Products, Inc.: www.firestonebpco.com
 - 4) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 5) Metal-Era Inc: www.metalera.com.
 - 6) Johns Manville: www.jm.com
 - 7) MM Systems Corp: www.mmsystemscorp.com
 - 8) Sika Saranfil: www.sarnafilus.com
 - 9) Siplast: www.siplast.com
 - 10) Soprema: www.soprema.us
- 2. Coping to have tapered top.
- 3. Coping to have minimum 6 inch outside cover face height, or manufacturers next larger size.
- 4. Coping to have minimum 6 inch inside cover face height, or manufacturers next larger size.
- 5. Coping with extruded aluminum anchor bar, 24 gauge coping cover, coping width to match wall thickness, including special supports. Include cover plates to conceal and weather seal joints and attachment flanges.

D. Drip Edge:

- 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1) Johns Manville - Presto Weld
 - b. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1) Architectural Products Co.: www.archprod.com.
 - 2) OMG Roofing Products/OMG Edge Systems formerly W. P. Hickman: www.omgroofing.com
 - 3) Metal-Era Inc: www.metalera.com.
 - 4) Johns Manville: www.jm.com
 - 5) MM Systems Corp: www.mmsystemscorp.com
 - 6) Sika Saranfil: www.sarnafilus.com
 - 7) Siplast: www.siplast.com
 - 8) Soprema: www.soprema.com
- 2. Drip Edge: Factory-fabricated 24 gauge PVC-coated steel, minimum 2 inch face, or manufacturers next larger size, painted finish, concealed joint covers, and continuous, galvanized anchor cleat.

2.03 ACCESSORIES

- A. Sealant: Type specified in Section 079005.
- B. Roof Cement: ASTM D4586/D4586M, Type I.
- C. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.
- D. Exposed Fasteners: Stainless steel, nonmagnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.
- E. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- G. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.
- H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- I. Foam-Rubber Seal: Manufacturer's standard foam.
- J. Adhesives: Type recommended by manufacturer for substrate and project conditions, and formulated to withstand minimum 60-lbf/sq. ft. (2.9-kPa) wind-uplift force.

2.04 FABRICATION

- A. Roofing Contractor/Local Fabricator shop or field fabricated/broken fascia will not be accepted.
- B. All roof edge components are to be designed and tested to meet ANSI/SPRI ES-1, and be fabricated in an ANSI/SPRI ES-1 approved fabrication facility.

2.05 FINISHES

- A. Finishes: Due to differences in manufacturer finishing standards, or base metal used, provisions for clear and/or color anodized, and painted material is included. All finishes are acceptable and manufacturers are to provide their standard of ONE listed below.
 - 1. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Finish to be Pearledize/Mica, consisting of 0.2 mil primer with 0.8 mil color coat containing mica pearlescent flakes to simulate the appearance of an anodized/metallic finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

- B. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- C. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
- D. Coordinate installation of flashing flanges into reglets.

END OF SECTION

SECTION 077123 - MANUFACTURED GUTTERS AND DOWNSPOUTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Manufactured, Pre-finished galvanized steel or aluminum:
 - 1. gutters, downspouts, collector box, and scupper
 - 2. Contractors option to provide either pre-finished aluminum, or pre-finished steel manufactured products.

1.02 RELATED REQUIREMENTS

- A. Section 077100 - Manufactured Roof Specialties: Fascia
- B. Section 334993 - Downspout Boots.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Product shall be listed in the current Factory Mutual Research Corporation Approval Guide approved for FM 1-90.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- B. Product Data: Provide data on prefabricated components.
- C. Selection Samples: For each item with a paint finish specified, submit color chips representing manufacturer's full range of available colors. Submit actual samples not photo reproductions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

1.07 WARRANTY

- A. Refer to roofing membrane section 075400 for Special Project Full System Warranty requirements for items to be included from this specification section.

- B. Finish Warranty: Manufacturer's 20-year finish warranty stating products to be free of corrosion, checking, crazing, chalking, discoloring, fading, oxidation, and that exposed finish surface will not peel, crack, chip, or spall.
1. Excessive color change/fading greater than 5 NBS (Hunter) units and passing 5000 hrs per ASTM D 2249-85, ASTM D 2244 and ASTM D 822-85 respectively.
 2. Chalking shall not be less than a rating of No. 8 per ASTM D 659 and ASTM D 4214.
 3. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, aesthetics, and formulations of the following:
 - a. Metal-Era, Inc: Seal-Tite Gutter System; Profile IG-2.
 - b. Metal-Era, Inc.: Seal-Tite Closed Face Industrial Downspout
 - c. Metal-Era, Inc.: Thru-Wall Scupper
 - d. Metal-Era, Inc.: Collector Box Welded Version, Style 3
 2. Prefinished Formed-Aluminum Gutters, Downspouts, Conductor Heads, Scuppers:
 - a. Architectural Products Co.: www.archprod.com
 - b. ATAS International, Inc.: www.atas.com
 - c. Berger Building Products: www.bergerbuildingproducts.com
 - d. DMI: www.dmimetals.com
 - e. Englert Inc.: www.englertinc.com
 - f. Gutter Supply, Div of Rain Trade Corporation: www.guttersupply.com
 - g. IMETCO/Innovative Metals Company, Inc:
 - h. W.P. Hickman Co.: www.wph.com
 - i. Metal-Era, Inc.: www.metalera.com
 - 1) Private labeled components manufactured by Metal-Era:
 - (a) Carlisle
 - (b) Johns Manville
 - (c) Siplast
 - (d) Firestone
 - (e) Soprema
 - j. Roof Drainage Components & Accessories, Inc.: www.rdcaa.com
 - k. Rutland Gutter Supply: www.rutlandguttersupply.com
 - l. Southern Aluminum Finishing Co.: www.saf.com

2.02 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A 653/A 653M, with G90/Z275 zinc coating gauge inch as indicated below:
1. Downspouts: 24 gauge.
 2. Gutters: 24 gauge.
 3. Scuppers: 24 gauge.
 4. Collector Boxes: 20 gauge.
- B. Pre-Finished Aluminum Sheet: ASTM B 209 (ASTM B 209M); gauge inch as indicated below:
1. Downspouts: 0.050 inch.
 2. Gutters: 0.050 inch.
 3. Scuppers: 0.050 inch.
 4. Collector Boxes: 0.063 inch.

2.03 COMPONENTS

- A. Gutters: SMACNA rectangular style profile.
 - 1. Manufacture in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories.
 - 2. Corners: Factory mitered and continuously welded.
- B. Downspouts: SMACNA Rectangular profile.
 - 1. Manufacture in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories.
 - 2. Provide with factory fabricated mitered elbows where spilling to grade, or into downspout boot.
- C. Gutter and Downspout Anchors and Supports:
 - 1. Gutter Supports: Straps and Hangers. 1 inch wide, 0.050 inch thick internal aluminum strap at 30 inch on center at top of gutter. Alternate location with 1 inch wide 0.125 inch thick external hanger at bottom location 30 inch on center for support of gutter.
 - a. Basis of Design: Metal-Era Seal-Tite IG-2 Industrial Gutter Support Bracket
 - 2. Downspout Supports: Straps. Provide three anchor straps per 10 foot section.
 - a. Basis of Design: Metal-Era Style 1 Downspout Wall Bracket.
- D. Gutter and Downspout Anchors and Supports:
 - 1. Anchoring Devices: In accordance with SMACNA requirements.
 - 2. Gutter Supports: #10 combo shank and circle hanger
 - 3. Downspout Supports: Brackets.
- E. Fasteners: Galvanized steel, with soft neoprene washers.
- F. Scuppers: Manufactured with closure flange trim to exterior, 4-inch wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.
 - 1. Factory mitered joints and continuously welded.
- G. Collector Boxes: Manufactured collector boxes, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.
 - 1. Factory mitered joints and continuously welded.

2.04 ACCESSORIES

- A. Wire Ball Downspout Strainer: Provide a wire ball downspout strainer at every downspout location.

2.05 FABRICATION

- A. Roofing Contractor/Local Fabricator shop or field fabricated/broken gutters and downspouts will not be accepted.
- B. Form gutters and downspouts of profiles and size indicated.
- C. Fabricate with required connection pieces.
- D. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- E. Hem exposed edges of metal.
- F. Fabricate gutter and downspout accessories; seal watertight.

2.06 FINISHES

- A. All exposed to view roof components specified above to have the following finish.
 - 1. All items to be the same color unless specifically noted.

- B. Finishes: Due to differences in manufacturer finishing standards, or base metal used, provisions for clear and/or color anodized, and painted material is included. All finishes are acceptable and manufacturers are to provide their standard of ONE listed below.
 - 1. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Finish to be Pearledize/Mica, consisting of 0.2 mil primer with 0.8 mil color coat containing mica pearlescent flakes to simulate the appearance of an anodized/metallic finish.
 - b. Color to be selected from manufacturers standard color chart. Minimum twenty colors.
 - 1) Color simulating clear anodized aluminum to be available in color choices.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.

3.02 PREPARATION

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Slope gutters 1/8 inch per foot, 1 percent minimum.
- C. Provide expansion joints for gutter runs exceeding 40 feet.
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Connect downspouts to downspout boots above grade. Grout connection watertight.
- F. Refer to Section 334993 for downspout boots and splashblocks.
- G. Refer to site drainage drawings for downspout boot and splashblock locations.

END OF SECTION

SECTION 078400 - FIRESTOPPING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
- C. Marking and identification of rated walls.
- D. The intent of the firestopping specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a completed certification form.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard acoustic insulation.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- C. FM (AG) - FM Approval Guide; current edition.
- D. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- E. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Installer Qualification: Submit qualification statements for installing mechanics.
- E. Submit LEED data and forms on all products contained in system as specified herein.
- F. Manufacturer certificate, located at the end of this section, to be submitted with the bid, for the proposed firestopping systems confirming that the firestopping installer is approved to install the proposed fireproofing systems.
 - 1. The intent of this specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a certification form.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991.
 - 2. OR meeting the following requirements:
 - a. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified tested and listed system requirements.
 - b. Installation personnel shall be trained by the approved firestop manufacturer.
 - c. Installation personnel to have minimum 3 years documented experience installing work of this type.
 - d. Verification of at least five satisfactorily completed projects of comparable size and type.
 - e. Approved by firestopping manufacturer.
 - 3. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a certification form.
- D. Installing Mechanic's Qualifications: Trained by firestopping manufacturer and able to provide evidence thereof.
- E. Source Limitations: Obtain each type of sprayed fire-resistive material from one source by a single manufacturer.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.07 FIELD QUALITY CONTROL

- A. The Owner will employ an independent agency qualified to perform the testing indicated to verify that the firestopping meets the required specification per Chapter 17 of the 2015 International Building Code with KY Amendments. The Owner will be responsible to pay for testing during normal hours of business operation or non-overtime hours. Any testing expense incurred due to overtime work will be paid for by the installing Contractor. The installing Contractor shall notify the testing agency at least 24 hours prior to beginning any work that requires testing. Copies of all reports shall be forwarded to the Owner and Architect.
 - 1. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports as documented according to ASTM E 2174 and ASTM E 2393 and as required by the Kentucky Building code, latest edition.
 - 2. Testing agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.
- C. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.08 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.
 - 1. Include coverage for firestopping to remain free from cracking, separation, and blistering.
 - 2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS**2.01 FIRESTOPPING SYSTEMS**

- A. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches or less: Any material meeting requirements.
- B. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches or less: Any material meeting requirements.
- C. Firestopping at Cable Tray Penetrations: Any material meeting requirements.
- D. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.
- E. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.
 - 1. Between Top of Fire-Rated Walls and Bottom of Slab Above: UL Design No. ____, F Rating 1-1/2 hour.

2.02 MATERIALS

- A. Manufacturers: Subject to compliance with requirements the following products may be included in the work;
 - 1. A/D Fire Protection Systems Inc: www.adfire.com.
 - 2. 3M Fire Protection Products: www.3m.com/firestop.
 - 3. Hilti, Inc: www.us.hilti.com.
 - 4. Specified Technologies, Inc: www.stifirestop.com
 - 5. RPM Company - TREM Fire Protection Systems Group: www.tremcofirestop.com
 - 6. Rectorseal - Metacaulk: www.rectorseal.com
- B. Fire Safing: ASTM C 665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch. or as required to meet UL system detailed on drawings.
 - 1. Owens Corning - Thermafiber SAFB: www.usg.com
 - 2. Roxul Inc. - Roxul AFB: www.roxul.com
- C. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than 250 g/L.
- D. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
- E. Foam Firestopping: Single component silicone foam compound; conforming to the following:
- F. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
- G. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
- H. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, intended to be installed after penetrating item has been installed; conforming to the following:
- I. Firestop Devices - Cast-In Type: Sleeve and sealing material, intended to be cast in concrete floor forms or in concrete on metal deck, not requiring any additional materials to achieve penetration seal.
- J. Intumescent Putty: Compound that expands on exposure to surface heat gain; conforming to the following:

- K. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.03 MARKING AND IDENTIFICATION

- A. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be permanently identified with signs or stencils.
- B. Locate identification in accessible floor, ceiling or attic spaces.
- C. Locate identification within 15 feet of the end of each wall and at intervals not exceeding 30 feet.
- D. Sign lettering to be not less than 3 inches in height with a minimum 3/8 inch stroke in a contrasting color Incorporating the wall name/rating wording.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install marking and identification required by code.

3.04 FIELD QUALITY CONTROL

- A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 PROTECTION

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 078400.01 - FIRESTOPPING MANUFACTURER'S CERTIFICATION**FIRESTOPPING MANUFACTURER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

The intent of the firestopping specification is for the entire project to have firestop products supplied by a single manufacturer, one firestop installing contractor and one firestop system warranty. If the CM/GC allows firestopping to be installed by individual contractors then every contractor installing firestopping is to have a certified firestopping mechanic and provide shop drawings and a warranty. Every installing contractor is to submit a completed certification form.

Date Submitted: _____

Name & Address of Firestopping Manufacturer:

Name & Address of Firestopping Installer:

I certify that _____ (Name of Firestopping Installer) is an approved applicator of our Firestopping.

Signed: _____ Title: _____

(Firestopping Manufacturer)

SECTION 079005 - JOINT SEALERS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping: Firestopping sealants.
- B. Section 088000 - Glazing: Glazing sealants and accessories.
- C. Section 093000 - Tiling: Sealant used as tile grout.
- D. Section 321373 - Pavement Joint Sealants: Exterior sealants for horizontal pavements and surfaces.

1.03 REFERENCE STANDARDS

- A. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.06 PROJECT CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.08 WARRANTY

- A. Correct defective work within a five year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Silicone, Polyurethane and Acrylic Sealants:
 - a. Dow Corning: www.dowcorning.com
 - b. Bostik Inc: www.bostik-us.com.
 - c. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - d. Pecora Corporation: www.pecora.com.
 - e. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - f. Tremco Global Sealants; Product : www.tremcosealants.com.
 - g. Sika Construction: www.sikaconstruction.com
 - h. Soudal Inc.: www.soudalusa.com
- B. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Preformed Compressible Foam Sealers:
 - a. EMSEAL Joint Systems, Ltd: www.emseal.com.
 - b. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 - c. Dayton Superior Corporation: www.daytonsuperior.com.
 - d. Tremco Global Sealants: www.tremcosealants.com.
 - e. Sika Construction: www.sikaconstruction.com
 - f. Soudal Inc.: www.soudalusa.com

2.02 SEALANTS

- A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than 250 g/L where applied within the waterproofing envelope.
- B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 - 1. Color: Standard colors matching finished surfaces.
 - 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- C. Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;
 - 1. Face color: Match exterior masonry veneer.
 - 2. Size as required to provide weathertight seal when installed.
 - 3. Provide product recommended by manufacturer for traffic-bearing use.
 - 4. Applications: Use for:
 - a. Exterior wall expansion joints.
- D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: Standard colors matching finished surfaces.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall and floor surfaces.
 - 1) Color at intersection of door frame bottom and resilient, sealed or coated flooring to match door frame color.
 - c. Other interior joints for which no other type of sealant is indicated.

- E. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 - 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.
- F. Acoustic Sealant/Sound Caulk: Permanently tacky non-hardening acrylic sealant.
 - 1. Minimum 1/4 inch, continuous, sealant bead, both sides, of top stud runner and structure and bottom stud track and floor.
 - 2. Minimum 1/4 inch, continuous, sealant bead, around all openings, penetrations, and partition intersections.
- G. Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C920, Grade P, Class 25, Uses T, M and A; single component.
 - 1. Approved by manufacturer for wide joints up to 1-1/2 inches.
 - 2. Color: Standard colors matching finished surfaces.
 - 3. Applications: Use for:
 - a. Expansion joints in floors.
- H. All masonry and stone movement joints, masonry to stone joints, and stone to stone joints.
 - 1. Basis of Design: Pecora 890 FTS TXTR
 - a. Contractor option to provide custom color to be selected by Architect, or provide caulk from manufacturers standard color selection and embed/coat with sand..

2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 - 2. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 3. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 - 4. Manufacturers:
 - a. ADFAST Corporation; ADSEAL BR-2600 (Backer Rod): www.adfastcorp.com/#sle.
 - b. Nomaco, Inc; HBR: www.nomaco.com/#sle.
- D. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.

- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
 - 1. Minimum 1/4 inch, continuous, sealant bead, both sides, of top stud runner and structure and bottom stud track and floor.
 - 2. Minimum 1/4 inch, continuous, sealant bead, around all openings, penetrations, and partition intersections.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.
- I. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- J. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

SECTION 079513 - EXPANSION JOINT COVER ASSEMBLIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Expansion joint assemblies for floor and wall surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Expansion and contraction joints in junction of concrete slab-on-grade.
- B. Section 042000 - UNIT MASONRY: Placement of joint cover assembly frames in masonry.
- C. Section 079005 - Joint Sealers: Expansion and control joint finishing utilizing a sealant and bond breaker.
- D. Section 092116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2010.
- D. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2010.

1.04 SUBMITTALS

- A. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and _____.
- B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and _____.
- C. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

1.05 QUALITY ASSURANCE

- A. Field Measurements: Verify compliance with manufacturer's requirements.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Expansion Joint Cover Assemblies: Subject to compliance with requirements provide products by one of the following, but not limited to the following:
 1. Architectural Art Mfg., Inc: www.archart.com.
 2. Balco, Inc.: www.balcousa.com
 3. C/S Group; C/S Construction Specialties, Inc: www.c-sgroup.com.
 4. Inpro: www.inprocorp.com.
 5. MM Systems Corp; _____: www.mmsystemscorp.com/#sle.
 6. BASF/Watson Bowman Acme Corp.: www.wbacorp.com

- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. Architectural Art Manufacturing Model #K-20-11-11 for interior floor to floor.
 - 2. InPro Corporation Model: 1200 Series Foam Seal for exterior vertical expansion joint in masonry veneer.

2.02 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
- C. Exterior Vertical Expansion Joint:
 - 1. Flexible profile manufactured from a monolithic piece of foam and factory applied elastomeric silicone or urethane membrane coating to provide moisture and water intrusion on vertical surfaces. Profile shall be capable of providing plus or minus 25% building movement and resist ultraviolet degradation. Profile shall be installed without the use of adhesives or anchor system.
 - a. Seal preformed and manufacturer from a polyether urethane foam per ASTM C864-98 with a factory applied silicone or urethane membrane on the exposed face.
 - b. Color to be selected by Architect from manufacturers standard color range.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
- B. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.04 FABRICATION

- A. Joint Covers: Aluminum cover plate, aluminum frame construction, designed to permit cover movement with full recovery, flush mounted.
- B. Provide joint components in single length wherever practical. Minimize site splicing.

2.05 FINISHES

- A. Floors: Mill finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 PREPARATION

- A. Install anchoring devices in conformance to templates.

3.03 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.

- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.04 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated steel frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Tornado-resistant hollow metal doors and frames.
- F. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Shims.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing: Glass for doors and borrowed lites.
- D. Section 099000 - Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- D. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
- K. ASTM A 1008/A 1008M - Standard Specification for Steel, sheet, Cold rolled, Carbon, High Strength Low-Alloy, High Strength Low Alloy with Improved Formability, Solution Hardened and Bake Hardenable.

- L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- N. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- O. FLA (PAD) - Florida Building Code Online - Product Approval Directory; database at www.floridabuilding.org.
- P. ICC 500 - ICC/NSSA Standard for the Design and Construction of Storm Shelters; National Storm Shelter Association; 2014.
- Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- R. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; 2000 (ANSI/DHI A115 Series).
- S. ITS (DIR) - Directory of Listed Products; current edition.
- T. Miami (APD) - Approved Products Directory; Miami-Dade County; database at www.miamidade.gov/development/product-control.asp.
- U. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- V. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- W. NAAMM HMMA 820 TN01 - Grouting Hollow Metal Frames
- X. NAAMM HMMA 820 TN03 - Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows.
- Y. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- Z. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.
- AA. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- AB. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- AC. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- AD. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
- AE. UL (BMD) - Building Materials Directory; current edition.
- AF. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- AG. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- AH. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
 - 1. Provide hollow metal frames from SDI Certified manufacturer.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Doors and Frames: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Steelcraft B-Series full flush, steel stiffened doors.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - b. Custom Metal Products: www.custommetalproductsnc.com
 - c. Mesker, dormakaba Group: www.meskeropeningsgroup.com/#sle.
 - d. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
 - e. Ceco Door Products an Assa Abloy Group company: www.cecodoor.com.
 - f. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - g. Metal Products Inc. (MPI): www.metalproductsinc.com
 - h. Pioneer Industries : www.pioneerindustries.com
- B. Tornado-Resistant/Storm Shelter Hollow Metal Doors and Frames:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Steelcraft Paladin PW Series Flush Doors and Frames.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Curries/Ceco Door Products an Assa Abloy Group Company - StormPro: www.cecodoor.com.
 - b. Krieger Specialty Products: www.kriegerproducts.com/#sle.
 - c. Republic Doors, an Allegion brand; DF Series: www.republicdoor.com/#sle.

2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 4. Door Edge Profile: Manufacturers standard for application indicated.
 5. Typical Door Face Sheets: Flush.
 6. Door Undercut: Manufacturer's standard, compatible with threshold configuration specified in section 087100.
 7. Interior Glazed Lights: Non-removable, square, stops on non-secure side. Size stops to accept 1/4 inch glass thickness. Refer to section 088000 - Glazing for glass requirements.
 8. Exterior Glazed Lights: Non-removable, square, stops on non-secure side. Glazing pocket to accept 7/8 inch total thickness insulated unit. Size stops in accordance with specified glass thickness. Refer to section 088000 - Glazing for glass requirements.
 9. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 10. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 1, full flush; 16 gage faces.
 2. Core: Vertical steel stiffeners, 22 gage, spaced not to exceed six inches apart, fill between stiffeners with manufacturers standard extruded polystyrene insulation or batt insulation
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Thickness: 1-3/4 inches.
 5. Exterior Doors - Top and Bottom Closures : Close top and bottom edges of doors flush as an integral part of the door construction or by the addition of 16 gage, metallic-coated steel channels with channel webs placed even with top and bottom edges.
 - a. Bottom closure is not required on doors with concealed automatic door bottoms. Provide manufacturers standard door bottom.
 6. Interior Doors - Top Closures : Close top edges of doors flush as an integral part of the door construction or by the addition of 16 gage, metallic-coated steel channels with channel webs placed even with top edges.
 7. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 8. Door Face Sheets: Flush.
 9. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363 .
 10. Weatherstripping: Refer to Section 087100.
- B. Interior Doors, Non-Fire Rated:
1. Grade: ANSI A250.8 Level 2, physical performance Level B, Model 1, full flush, 18 gage faces.

2. Core: Vertical steel stiffeners, 22 gage, spaced not to exceed six inches apart, filled with fiberglass batt insulation
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Texture: Smooth faces.
- C. Fire-Rated Doors:
1. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - c. Attach fire rating label to each fire rated unit.
 2. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Texture: Smooth faces.
- D. Interior Smoke and Draft Control Doors (Indicated as "S" on Drawings): Same fire rated construction as the fire-rated doors, and the following:
1. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 2. Gasketing: Separate, see section 087100.
 3. Label: UL "S" label.
- E. Tornado-Resistant Doors:
1. Design and size door and frame components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M.
 - a. Design Wind Loads: Comply with requirements of authorities having jurisdiction.
 - b. Wind-Borne Debris Resistance: Door and frame components shall have FLA (PAD) approval, Miami (APD) approval, or UL (DIR) approval for Large and Small Missile impact and pressure cycling at design wind loads.
 2. Tornado Shelter Application: Comply with ICC 500 standard.
 3. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. General:
1. Comply with the requirements of grade specified for corresponding door.
 - a. Frames for Exterior Hollow Metal Doors: Comply with frame requirements specified in ANSI A250.8 Level 3 Doors: 14 gage frames.
 - b. Frames for Interior Wood and Hollow Metal Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 16 gage.
 2. Finish: Same as for door.
 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
 5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

6. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- C. Exterior Door Frames: Face welded type.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Wall Attachment: Lock-in masonry "T". Minimum three anchors per jamb.
 3. Weatherstripping: Separate, see Section 087100.
- D. Interior Door Frames at CMU Walls, Non-Fire-Rated and Fire-Rated: Fully welded type, seamless with joints filled.
 1. Fire Rating: Same as door, labeled.
 2. Wall Attachment: Lock-in masonry "T". Minimum three anchors per jamb.
- E. Interior Door Frames at Gypsum Board/Metal Stud Partitions Non-Fire-Rated and fire-Rated: Knock-down type, slip-on with mitered or coped corners for field assembly.
 1. Fire Rating: Same as door, labeled.
 2. Wall Attachment: Metal stud anchor/flush steel stud anchor. Minimum three anchors per jamb.
 3. Floor Attachment: Fixed base.
- F. Tornado-Resistant Door Frames: With same tornado resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
 1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 2. Frame Finish: Factory primed and field finished.
- G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 087100.
- D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FINISHES

- A. Manufacturer Installed Primer: Rust-inhibiting, complying with ANSI A250.10 one coat, baked-on rust inhibiting prime paint.
- B. Frame installer provided material - Fibered Asphalt Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
 - 1. When temperature conditions necessitate the use of anti-freezing agents in the mortar, the inside of the frame shall be coated per manufacturer recommendations.
 - 2. Material to be installed at factory by frame manufacturer or field applied.
 - 3. Single component, waterborne, modified asphaltic emulsion, VOC and HAPS free. Certified for use in fire-rated frames.
 - a. Spray applied: 5 mils WFT.
 - b. Dip applied: 3 mils DFT.
 - c. Solids: 57-63%
 - d. VOC's: 0
 - e. Finish: Semi-gloss, non-tacky.
 - f. Odor: None.
 - g. Flash Point: None.
 - h. HAPS: 0
 - 1) Basis of Design:
 - (a) Royal Coatings, Inc.: Royal PC Asphaltic Paint
 - (b) Steelcraft Frame Back Coating
 - (c) Equivalent submitted to Architect prior to issuance of the last addendum.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Cold Weather Application: Frame installer to coat inside of frames that will be installed in masonry and filled with grout with anti-freeze additives prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.
- F. Comply with glazing installation requirements of Section 088000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.
- B. Factory glazing of doors.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Installation of wood doors and hardware.
- B. Section 081113 - Hollow Metal Doors and Frames.
- C. Section 087100 - Door Hardware.

1.03 REFERENCE STANDARDS

- A. ASTM E152 - Methods of Fire Tests of Door Assemblies.
- B. ICC (IBC) - International Building Code; 2012.
- C. ITS (DIR) - Directory of Listed Products; Intertek Testing Services/Warnock Hersey NA, Inc.; current edition.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- F. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- G. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- H. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; thickness, veneer species, type and characteristics, cut and matching requirements, factory machining and factory finishing criteria. Provide glass size, type, pattern and thickness for factory glazed doors..
- B. Specimen warranty.
- C. Test Reports: Show compliance with specified requirements for the following:
 - 1. Indicate compliance with specified fire rating (positive pressure or neutral pressure).
- D. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing
- E. Selection Samples: Submit samples representing manufacturer's full range of available colors. Submit actual samples not photo reproductions.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard and manufacturer's care and handling instructions.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.
 - 1. HVAC system should be operational prior to arrival of doors. Acceptable humidity shall be no less than 25% or greater than 55%.

1.07 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty for the following term:
 - 1. Interior Doors: Life of installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
- B. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Wood doors based on Masonite Architectural/Marshfield Door Systems.
 - 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Oshkosh Architectural Wood Doors: www.oshkoshdoor.com
 - b. VT Industries, Inc./Eggers Industries: www.vtindustries.com
 - c. Assa Abloy/Graham Wood Doors: www.grahamdoors.com.
 - d. Masonite Architectural dba Algoma Hardwoods Inc., and Marshfield Door Systems : www.masonitearchitectural.com.

2.02 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, "A" Grade Faces, Extra Heavy Duty performance, in accordance with WDMA I.S.1-A.
 - 2. Wood Veneer Faced Doors: 5-ply veneer and solid core unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL, or WH (ITS) labeled without any visible intumescent seals (Category A) when door is open.
 - 3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air

leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

4. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR CORES

- A. Non-Rated Solid Core, Smoke, 20 and 45 Minute Rated Doors: Type: particleboard core (PC).
 1. Door types: Flush (F), narrow view glass (NVG), narrow glass short (NGS), half-glass (HG) or other type indicated on the A6 drawings.
- B. Non-Rated Solid Core Doors: Type: structural composite lumber core (SCLC).
 1. Door Types: Full glass (FG1) or full glass with mid-rail (FG2).

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: White birch, veneer grade in accordance with quality standard indicated, rotary cut, with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
 1. Vertical Edges: Same species as face veneer.
 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 ACCESSORIES

- A. Glazing Stops: Non-fire-rated and 20 minute; Wood, of same species as door facing, mitered corners .
- B. Glazing Stops: Fire-rated doors 45 minute and above: Flush, wood veneer clad PVC or veneer wrapped rolled steel of same species as door facing. Provide glazing stops to match rating requirement of the door. Fire rated glazing to meet requirements of NFPA 80 to ensure all fire doors have a completed opening that meets all fire rating requirements.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Core Blocking:
 1. Non-Rated Doors - Flush (F), narrow view glass (NVG), narrow glass short (NGS), half-glass (HG) or other type indicated on the A6 drawings.
 - a. Provide solid blocks at lock edge, and top of door for closer for hardware reinforcement.
 - b. Provide solid blocking for other through-bolted hardware.
 2. Non-Rated Doors - Full glass (FG1) or full glass with mid-rail (FG2).
 - a. Solid blocking not required.
 3. Rated Doors: Flush (F), narrow view glass (NVG) or other type indicated on the A6 drawings.
 - a. Single door - Provide top blocking for closers, provide one mid-rail block or two lock blocks.
 - b. Pairs - Provide bottom lock block.
 4. All Doors with Closers:
 - a. Provide top lock blocking.
 - b. Particleboard is not acceptable as blocking material.
- C. Fit door edge trim to edge of stiles after applying veneer facing.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

- F. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY GLAZING - WOOD VENEER DOORS

- A. Glazing: Provided by wood door manufacturer as specified in Section 088000.
- B. Infill all nail holes, to match wood veneer color, both sides of glazing stops.

2.08 FACTORY FINISHING - WOOD VENEER DOORS

- A. Factory finish doors in accordance with approved sample for a transparent finish. Color to be selected by Architect.
- B. Finish Type: Water based stain with UV resistant cured polyurethane sealer to comply with EPA Title 5 guidelines for VOC emissions limitations or UV cured urethane per WDMA TR-8.
 - 1. Sheen: Satin Gloss.
 - 2. Testing: ANSI A161 1-1993 Section 9-3 Chemical Resistance.
 - a. Chemical Resistance: ANSI A161 1-1993 Section 9-3 Chemical Resistance.
 - b. Adhesion: ASTM D 3359 Method B to provide no loss of adhesion.
 - c. Water Resistance: Cellulose sponge containing 152 grams of water with no visible discoloration, staining, blistering or grain raise after 24 hours of exposure.

2.09 ACCESSORIES

- A. Glazing Stops: Non-fire-rated and 20 minute; Wood, of same species as door facing, mitered corners, flush beads/stops without reveal; prepared for countersink style nails or screws. Nail/screw holes to be filled with wood putty to match wood species. Sand filler smooth.
- B. Glazing Stops: Fire-rated doors 45 minute and above: Flush, wood veneer clad PVC or veneer wrapped rolled steel of same species as door facing. Provide glazing stops to match rating requirement of the door. Fire rated glazing to meet requirements of NFPA 80 to ensure all fire doors have a completed opening that meets all fire rating requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.02 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

SECTION 083100 - ACCESS DOORS AND PANELS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Access door and frame units, non-fire-rated, in wall and ceiling locations.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Provide framed openings in ceilings for access panels. Access door panels to receive gypsum board
- B. Section 099000 - Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- C. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Access Doors: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the Work include:
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements, and aesthetics of the following:
 - 1. Acudor Products, Inc: www.acudoor.com
 - a. Non-Fire Rated Walls - Acudor Products - DW-5040
 - b. Non-Fire Rated Ceilings - Acudor Products - DW-5015
- C. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect.
 - 1. Architectural Products Co.: www.archprod.com.
 - 2. Acudor Products Inc: www.acudor.com.
 - 3. Cendrex: www.cendrex.com
 - 4. Morris Group International/Elmdor Stoneman: www.elmdorstoneman.com
 - 5. Karp Associates, Inc: www.karpinc.com.
 - 6. Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 7. Morris Group International/Larsen's Manufacturing : www.larsenmfg.com
 - 8. Babcock Davis: www.babcockdavis.com
 - 9. J. L. Industries: www.jlindustries.com

2.02 ACCESS DOORS AND PANELS

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.

2.03 ACCESS DOOR UNITS

- A. Door and Frame Units: Formed steel.
 - 1. Frames and flanges: 0.058 inch (16 gage minimum) continuous welded steel.
 - a. Grind all welds smooth and flush with adjacent surfaces.
 - 2. Door panels: 0.070 inch (14 gage minimum) single thickness, continuous welded, steel sheet.
 - a. Grind all welds smooth and flush with adjacent surfaces.
 - 3. Trim in gypsum board partitions: Galvanized drywall bead.
 - 4. Sizes:
 - a. Walls: 16 x 16 inches in CMU toilet chases.
 - b. Ceilings: 24 inch x 24 inch in gypsum board.
 - 5. Hardware:
 - a. Hinges for Non-Fire-Rated Units: Concealed.
 - b. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - 6. Prime coat with alkyd primer.

2.04 FABRICATION

- A. Weld, fill, and grind joints to ensure flush and square unit.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 083313 - COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated coiling counter doors and operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Rough openings.
- B. Section 042000 - Unit Masonry: Openings

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish.
- B. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- C. Samples: Submit two slats, 4 inch long, illustrating shape, color and finish texture.
- D. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- E. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.
- F. Warranty: Provide two year manufacturer warranty against defects in material, finish and workmanship. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coiling Counter Doors: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Clopay/Cornell/Cookson - Coiling Counter Door #ESC10
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Clopay Corporation/Cornell/Cookson: www.clopaydoor.com.
 - b. McKeon Rolling Steel Door Co.: www.mckeondoors.com
 - c. Overhead Door Corporation: www.overheaddoor.com
 - d. Raynor Garage Doors: www.raynor.com
 - e. Wayne Dalton Corporation: www.wayne-dalton.com.

2.02 COILING COUNTER DOORS

- A. Coiling Counter Doors, Non-Fire-Rated: Galvanized steel slat curtain.
 - 1. Mounting: Interior face mounted.
 - 2. Nominal Slat Size: 1-1/4 inches wide.
 - 3. Slat Profile: Flat.
 - 4. Finish, Galvanized Steel: Factory baked enamel.

5. Color: As selected by Architect from manufacturer's standard range.
6. Guides: Formed track; same material and finish unless otherwise indicated.
7. Hood Enclosure: color to match door; galvanized steel.
8. Manual hand chain lift operation.
9. Locking Devices: Slide bolt on inside.

2.03 MATERIALS

- A. Curtain Construction: Interlocking, single thickness slats.
 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 2. Curtain Bottom: Fitted with tube to provide reinforcement and positive contact in closed position; vinyl astragal along bottom edge.
 3. Steel Slats: ASTM A653/A653M galvanized steel sheet, with minimum G90/Z275 coating; minimum thickness 16 gage, 0.06 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
- D. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
- E. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
- F. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 079005.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead coiling doors, operating hardware, exterior; manually or electrically operated.
- B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Openings
- B. Section 087100 - Door Hardware: Cylinder cores and keys.
- C. Section 262717 - Equipment Wiring: Power to disconnect.
- D. Section 260533.13 - Conduit for Electrical Systems: Conduit from electric circuit to operator and from operator to control station.
- E. Section 260583 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- C. NEMA MG 1 - Motors and Generators; 2014.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide general construction, electrical equipment, and component connections and details.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- C. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- D. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Cornell - Thermiser Max Insulated Rolling Door #ESD30

2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Clopay Building Products/Cornell/Cookson: www.clopaydoor.com/#sle.
 - b. McKeon Rolling Steel Door Company: www.mckeondoor.com
 - c. Raynor Garage Doors: www.raynor.com
 - d. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com.
 - e. Overhead Door Corporation: www.overheaddoor.com
 - f. Janus International: www.janusintl.com

2.02 COILING DOORS

- A. Exterior Coiling Doors: Steel slat curtain.
 1. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.
 2. Air Infiltration to comply with IECC 2012 requirements of less than 1.0 CFM/FT².
 3. Slats: Interior and exterior slats of 24/24 gauge, Grade 40 steel, ASTM A 653 galvanized steel zinc coating.
 - a. Sandwich slat construction with insulated core of minimum 7/8" foamed-in-place, closed cell urethane insulation.
 - b. Insulated slats to have a Flame Spread Index of 0 and Smoke Developed Index of 10 as tested per ASTM E84.
 - c. Minimum slat insulation R-value: 8.0
 - d. Minimum slat STC rating: 26
 4. Nominal Slat Size: 3 inches wide x 15/16" thick x required length.
 5. Bottom Bar: Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Interior and exterior face finish to be same as slats and match slat color.
 6. Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two 1/4" rivets. Provide windlocks as required to meet specified windloads.
 7. Interior and Exterior Slat, Guide, Bracket, Hood Finish: Factory coated, baked-on polyester powder coat, minimum 2.5 mils cured film thickness, ASTM D-3363 pencil hardness: H or better.
 - a. Color as selected by Architect from manufacturers standard minimum 32 powder coat colors.
 8. Guides: Angles; galvanized steel, minimum thickness 3/16". Top 16 1/2" of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service. Finish to be same as slats and match slat color.
 - a. Provide windlock bars of same material when required to meet specified wind load.
 9. Counterbalance Shaft Assembly:
 - a. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
 - b. Spring Balance: Oil-tempered, heat treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.
 10. Brackets: Steel plate; galvanized; minimum thickness 3/16". Finish to be same as slats and match slat color.
 11. Hood Enclosure: 24 gauge; galvanized steel. Finish to be same as slats and match slat color.
 - a. Provide neoprene/rayon baffle in hood to impede air flow above coil.
 12. Manual hand chain lift operation.
 - a. Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide.
 - b. Provide Padlockable chain keeper on guide.
 13. Electric operation.
 14. Mounting: Within framed opening.
 15. Weatherstripping:

- a. Bottom Bar: Replaceable, bulb style, compressible EPDM gasket extending into guides.

2.03 ELECTRIC OPERATION

- A. Electric Operators:
 - 1. Mounting: Side mounted.
 - 2. Motor Enclosure:
 - a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.
 - 3. Motor: Supply industrial duty motor operator - rated for a maximum of 20 cycles per hour, UL listed, Totally Enclosed Non Ventilated gear head operator rated hp as recommended by door manufacture for size and type of door, 120Volts, Single Phase. Provide complete with electric motor and factory pre-wired motor control terminals, maintenance free solenoid actuated brake, emergency manual chain hoist and control station. Motor shall be high starting torque, industrial type, protected against overload with an auto-reset thermal sensing device. Primary speed reduction shall be heavy-duty, lubricated gears with mechanical braking to hold the door in any position. Operator shall be equipped with an emergency manual chain hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual chain hoist. Operator drive and door driven sprockets shall be provided with #50 roller chain. Operator shall be capable of driving the door at a speed of 8 to 9 inches per second (20 to 23 cm/sec). Fully adjustable, driven linear screw type cam limit switch mechanism shall synchronize the operator with the door. The electrical contractor shall mount the control station and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.
 - 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA 250, Type 1.
 - 7. Opening Speed: 8 to 9 inches per second.
 - 8. Brake: Adjustable friction clutch type, activated by motor controller.
 - 9. Manual override in case of power failure.
- B. Control Station: Provide standard three button (Open-Close-Stop) continuous-constant control device for each operator conforming to UL 325.
 - 1. 24 volt circuit.
- C. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 260583.
- F. Complete wiring from disconnect to unit components.

- G. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 079005.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 083326 - OVERHEAD COILING GRILLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead coiling metal grilles and operating hardware; manually operated.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Openings
- B. Section 087100 - Door Hardware: Cylinder cores and keys.

1.03 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

1.04 SUBMITTALS

- A. Product Data: Provide general construction component connections and details.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- C. Manufacturer's Installation Instructions: Indicate installation sequences and procedures, adjustment and alignment procedures.
- D. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of experience.
- B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include::
 1. Alpine Overhead Doors, Inc: www.alpinedoors.com/#sle.
 2. Clopay/Cornell/Cookson: www.cornellcookson.com
 3. McKeon Rolling Steel Door Company: www.mckeondoors.com
 4. Raynor Garage Doors: www.raynor.com
 5. Wayne-Dalton, a Division of Overhead Door Corporation; ____ : www.waynedalton.com/#sle.
 6. Overhead Door Corporation: www.overheaddoor.com

2.02 GRILLES AND COMPONENTS

- A. Grille: Aluminum; horizontal bar curtain, coiling on overhead counterbalanced shaft.
 1. Finish: Anodized, ____.
 2. Lock Devices: Lock and latch handle on outside.
 3. Manual hand chain lift operation.

- 4. Mounting: Surface mounted.
- B. Curtain: Round horizontal bars connected with vertical links.
 - 1. Horizontal bars: 5/16 inch diameter.
 - 2. Bar spacing: 1-1/2 inch on center.
 - 3. Tube spacers: 1/2 inch diameter.
 - 4. Spacer spacing: 3-1/4 inch on center.
 - 5. Vertical links: 5/16 inch diameter.
 - 6. Link spacing: 6 inch on center.
 - 7. Bar Ends: Provide with nylon runners for quiet operation.
 - 8. Bottom Bar: Back-to-back angles with tubular resilient cushion.
- C. Guides: Extruded aluminum angles, of profile to retain grille in place with snap-on trim, mounting brackets of same metal.
- D. Hood Enclosure: Sheet metal same as grille; finish to match.
- E. Lock Hardware:
 - 1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 087100.
 - 2. Latch Handle: Manufacturer's standard.
- F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.03 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install grille unit assembly in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust grille, hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean grille and components.

B. Remove labels and visible markings.
END OF SECTION

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.
- D. Integral exterior sunshades.
- E. Perimeter sealant.
 - 1. Perimeter caulking at interior and exterior wall veneer/substrate.
 - 2. Perimeter expandable spray foam insulation to be installed between exterior veneer/substrate and wood storefront anchorage blocking at frame surround to prevent wall cavity air to infiltrate the back side of the storefront framing.
- F. Display case system.

1.02 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: Steel attachment members.
- B. Section 055000 - Metal Fabrications: Steel attachment devices.
- C. Section 079005 - Joint Sealers: Perimeter sealant and back-up materials.
- D. Section 087100 - Door Hardware: Hardware items other than specified in this section.
- E. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - 1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft.
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
- G. Integral Exterior Sunshade: Design and size components to interact with the structural performance and combined loading of the storefront framing system.

1.06 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details .
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Integral Exterior Sunshades: Shop drawings to include all anchors, supports, frame attachments, connections, fastening, sealing methods and integration with the storefront system.
 - 2. Zero Sightline Operable Vents: Shop drawings to include all anchors, supports, frame attachments, connections, fastening, sealing methods and integration with the storefront system.
- C. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
 - 1. Engineering calculations as described are required by Ross-Tarrant Architects, whether or not the listed manufacturers require engineered calculations.
 - 2. Include in the engineering calculations all storefront and integral exterior sunshade loads engineered in conjunction, and as part of, the storefront system.
 - 3. Engineering calculations documenting compliance are to be stamped by a registered professional engineer licensed in the State of Kentucky.
 - a. The storefront and integral sunshade calculations are to be performed together, by one registered P.E.

1.07 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- D. Source Limitations for Storefront System: Obtain all storefront, integral exterior sunshades and zero sightline operable vents and components through one source from a single manufacturer.
 - 1. Storefront manufacturers that do not manufacture sunshades or zero sightline operable vents are to provide proof of an arrangement with the selected sunshade and zero sightline operable vent manufacturer such that the sunshade or zero sightline operable vent can be included within any warranty requirements of the storefront system.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. General Contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront system installation. Correct defective Work within a one year period after Date of Substantial Completion.
 - 1. Includes: glass (including insulated glazing units) integral exterior sunshade and near-zero sightline operable vent device anchorage and setting system, sealing, flashing and etc, as it relates to air, water and structural adequacy.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, gloss reduction, chalking, or flaking.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Storefront: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Exterior Storefront: EFCO Series 403 Flush Glazed Thermal Screw Spline Storefront.
 - b. Interior Storefront: EFCO Series 402 Flush Glazed Non-Thermal Screw Spline Storefront with glazing adaptors.
 - c. Exterior Entrance Doors: EFCO Series D500 Wide Stile Entry Door.

- d. Interior Entrance Doors: EFCO Series D500 Wide Stile Entry Doors.
- e. Near-Zero Sight-Line Operable Vent: EFCO WV410.
- f. Integral Exterior Sunshades: Single-blade Vertical Sunshades - 9" minimum blade.
 - 1) If the exact dimensions, sizes, shapes, spacing of components, and etc. of the sunshade indicated on the drawings are not an exact match as manufactured by the listed manufacturers, then the manufacturer is to provide the next larger size of component nearest the dimensions provided on the drawings.
- 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Storefront:
 - 1) Apogee Enterprises, Inc./EFCO Corporation/Wausau Window and Wall Systems: www.efcocorp.com/www.wausauwindow.com
 - 2) Graham Architectural Products: www.grahamwindows.com
 - 3) Kawneer North America: www.kawneer.com.
 - 4) Manko Window Systems, Inc: www.mankowindows.com.
 - 5) Oldcastle Building Envelope/Vistawall Architectural Products/CRL(C. R. Laurence)/United States Aluminum: www.oldcastlebe.com.
 - 6) Peerless Products, Inc.: www.peerless-usa.com
 - 7) YKK AP America Inc: www.ykkap.com.
 - 8) Trulite Glass and Aluminum Solutions: www.trulite.com
 - 9) Apogee Enterprises/Tubelite, Inc.: www.tubeliteinc.com.
- 3. Sunshades: If the storefront manufacturers listed above do not single source sunshades then products by other manufacturers (listed below) may be considered, provided the warranty, deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. AGS Inc.: www.agsshade.com
 - b. Architectural Fabrication: www.archfab.com
 - c. CS Construction Specialties: www.c-sgroup.com
 - d. Mapes Canopies, LLC: www.mapescanopies.com
- 4. Near - Zero Sightline Operable Vents: If the storefront manufacturers listed above do not single source zero sightline operable vents then products by other manufacturers (listed below) may be considered, provided the warranty, deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Winco Window - 1150SF Series; 2 inch Heavy Commercial Near -Zero Sightline Thermally Improved Vent: www.wincowindow.com
 - b. DeSCo Architectural, Inc.: www.descoarch.com
- B. Display Case System: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. C.R.Laurence/Blumcraft Series 1301-SM
 - 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. DAMS Inc. Slimline Display Case: www.damsinc.com
 - b. Equivalent submitted to Architect prior to issuance of last Addendum.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Position: Centered (front to back).
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 - 3. Air Infiltration Test Pressure Differential: 1.57 psf.

4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
 3. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
 4. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 5. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.
- B. Doors: Glazed aluminum, wide stile.
1. Thickness: 1-3/4 inches.
 2. Top Rail: 5 inches wide, minimum.
 3. Vertical Stiles: 5 inches wide, minimum.
 4. Mid Rail: 6 inches wide, 5 inches minimum.
 5. Bottom Rail: 10 inches wide, minimum.
 6. Glazing Stops: Square.
 - a. Exterior Glazed Lights: Non-removable stops on non-secure side. Glazing pocket to accept a 7/8 inch total thickness insulated unit. Size stops in accordance with specified glass thickness. Refer to section 088000 - Glazing for glass requirements.
 - b. Interior Glazed Lights: Non-removable stops on non-secure side. Size stops and glazing pocket to accept 1/4 inch glass thickness. Refer to section 088000 - Glazing for glass requirements.

7. Finish: Same as storefront framing.
- C. Zero Sightline Operable Vent/Sash: Aluminum project-out awning; finished to match storefront; turn handle latch.
1. All aluminum components to be extrusions fabricated from aluminum alloy 6063-T6, manufactured within commercial tolerances and free from defects impairing strength and/or durability.
 2. All aluminum horizontal components shall be fabricated to have a minimum wall thickness of 0.063 inch to a maximum of 0.125 inch.
 3. Depth of main frame shall not be less than 2 inch.
 4. Depth of vent shall not be less than 3-1/4 inch.
 5. Each corner shall be mitered and assembly by means of double corner keys and hydraulically swedged. Seal all joints with sealant.
 6. Vent/Sash shall present a flush and zero to near-zero sightline condition on the exterior when closed.
 - a. Overlap sash or exposed framing is not acceptable.
 7. Operable Sash Weatherstripping: wool pile; permanently resilient, profiled to achieve effective weather seal.
- D. Sill Receptor, Sill Subframe and Sill Extension: Receptors, subframes and extensions are required for all exterior aluminum storefront system whether specifically shown/detailed on the architectural storefront details or required by the manufacturer to meet the aluminum storefront system warranty.
1. General: Receptors, extensions and subframes to be an extruded, thermally broken, aluminum, receiver type sill receptor or subframe with a minimum thickness of .063" as indicated on the drawings. Extensions to be extruded aluminum with a minimum thickness of .063" depth as indicated on the drawings. Assembly shall not require the use of exposed fasteners or rivets. All exposed to view edges shall be hemmed. Color and finish to match aluminum storefront frame.
 2. Sill Receptor: Set receptor in a continuous bed of sealant to insure watertight seal with exterior wall components. Sill receptor shall return up the back of the storefront sill in the interior of the room and be one continuous piece the full depth of the storefront sill. Outside edge of sill receptor to have built-in drip edge. Provide receptor in one continuous piece the full width of the storefront opening. If storefront opening width exceeds the limits for one continuous piece receptor then provide a splice joint sealed with 4" wide, self-adhering flashing tape and sealant to provide a watertight splice per manufacturers requirements. Provide receptor with mechanically attached, end dams/caps that have been sealed with a self-adhering sheet product or sealant to provide a watertight condition.
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Sill Receptor: EFCO Corporation: 2G90 thermally broken sill receptor: www.efcocorp.com.
 - 2) Self-Adhering Flashing Tape: W. R. Grace; Perma-Barrier Tape (EFCO Corporation; #WM01)
 3. Sill Extension: Slope for positive wash. Extension to attach to receptor without the need for exposed mechanical attachment or additional sealant. Extension to extend over the edge of the exterior veneer with a formed drip edge. Extension model number provided as the basis of design is for shape and basic design intent. Supplier/installer is to verify exact length of extension(s) required from the architectural storefront sill details. Distance of exterior face of storefront frame from the face of the exterior wall veneer may vary depending on exterior wall thickness and conditions.
 - a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Sill Extension: As shown in the drawings.
 4. Sill Subframe: Provide subframe, in addition to the sill receptor, at areas where the storefront is sitting on the interior concrete slab with flush exterior hard surface. Set subframe in a continuous bed of sealant to insure watertight seal with floor surface. Provide subframe in

one continuous piece the full width of the storefront opening. If storefront opening width exceeds the limits for one continuous piece subframe then provide a splice joint sealed with 4" wide, self-adhering flashing tape and sealant to provide a watertight splice per manufacturers requirements. Provide subframe with mechanically attached, end dams/caps that have been sealed with a self-adhering sheet product or sealant to provide a watertight condition.

- a. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1) Sill Subframe - EFCO: 1G64 thermally broken sill subframe:
www.efcocorp.com
 - 2) Self-Adhering Flashing Tape: W. R. Grace; Perma-Barrier Tape (EFCO Corporation; #WM01)
5. No field or shop fabricated brake metal sill receptors, subframes or extensions will be accepted.
- E. Integral Exterior Sunshades
 1. All aluminum components to be extrusions fabricated from aluminum alloy 6063-T6, manufactured within commercial tolerances and free from defects impairing strength and/or durability.
 2. All aluminum horizontal components (blades/air foils and fascia) shall be fabricated to have a minimum wall thickness of 0.063 inch to a maximum of 0.125 inch.
 3. Horizontal components (blades and fascia) shall be mechanically fastened by means of extruded aluminum screw splines.
 4. Sunshade "arms/outriggers" and mullion clips shall be extrusions, or cut from a single piece of aluminum plate, with a nominal wall thickness of 0.25 inch.
 5. Screws, bolts and other exposed fasteners shall be aluminum, color/finish to match system, or stainless steel.
 6. Refer to the drawings for locations, sizes and profiles of the integral exterior sunshades.

2.04 DISPLAY CASE SYSTEM

- A. Door Information:
 1. Glass: 3/8 inch thick, clear fully tempered glass.
 2. Top and bottom rails: 1-1/4 inch square solid aluminum.
 3. Vertical edges of glass doors: Polished edges.
 4. Top and bottom pivot: AP-150 and BP-150 concealed and applied to framing of display case.
 5. Key cylinder lock: #7150 lever cam type lock recessed in face of bottom door rail. Strike plate DT-150 to be included.
 6. Sidelites: Glass and rails matching doors.
 7. Roller Catch: #593 recessed at top of door as detailed.
 8. Finish: Clear Anodized.
- B. Construction and Testing: Doors shall be completely built in manufacturer's factory with top and bottom members bonded to the glass under controlled procedures.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum for Brake Metal: ASTM B209 (ASTM B209M). Minimum 0.040 gauge thickness. Prefinished sheet in color and gloss to match adjacent framing. Joints between brake metal and metal framing to be "hairline" in width. Provide "Z" clips to secure brake metal to metal framing. Provide sealant in all hairline joints, color to match adjacent framing color.
- C. Fasteners: Stainless steel.
- D. Perimeter Sealant: Type as specified in Section 079005.
- E. Glass: As specified in Section 088000.

- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.06 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
 - 1. Storefront framing, integral exterior sunshade and all other exposed system components to have same finish system.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 HARDWARE

- A. Other Door Hardware: As specified in Section 087100.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- D. Operable Vent Operator: Locking handles shall be cam type lever action handle, with US25D brushed finish, fitted to projecting 4-bar stainless steel sash arms.
- E. Operable Vent Limit Stops: Vandal resistant, manufacturer standard non-removable aluminum block limit stops with maximum outswing of 8" projection.
 - 1. Provide on all first floor and second floor windows.

2.08 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
 - 1. Install perimeter expandable spray foam insulation between exterior veneer/substrate and wood storefront anchorage blocking at frame surround to prevent wall cavity air from infiltrating the back side of the storefront framing.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Provide expandable foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install operating sash.
- K. Set thresholds in bed of sealant and secure.
- L. Install glass in accordance with Section 088000, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 079005.
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and glass infill panels.
- B. Integral exterior sunshades.
- C. Perimeter sealant.
 - 1. Perimeter caulking at interior and exterior wall veneer/substrate.
 - 2. Perimeter expandable spray foam insulation to be installed between exterior veneer/substrate and wood curtainwall anchorage blocking at frame surround to prevent wall cavity air to infiltrate the back side of the curtainwall framing.

1.02 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: Steel attachment members.
- B. Section 055000 - Metal Fabrications: Steel attachment devices.
- C. Section 079005 - Joint Sealers: Perimeter sealant and back-up materials.
- D. Section 084313 - Aluminum-Framed Storefronts: Entrance framing and doors.
- E. Section 088000 - Glazing.
- F. Section 092116 - Gypsum Board Assemblies: Metal stud and gypsum board wall at interior of curtain wall.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- G. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).
- H. SSPC-Paint 25BCS - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Blast Cleaned Steel; Society for Protective Coatings; 1997 (Ed. 2004).

1.04 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set:
 - 1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, and maximum of 3/4 inch, with full recovery of glazing materials.

- B. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - 1. Movement of curtain wall relative to perimeter framing.
 - 2. Deflection of structural support framing, under permanent and dynamic loads.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 2.86 lbf/sq ft.
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
- G. Design system to eliminate noises caused by wind and thermal movement, to prevent vibration harmonics, and to prevent "stack effect" in internal spaces.
- H. Integral Exterior Sunshade: Design and size components to interact with the structural performance and combined loading of the curtainwall system.

1.05 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, _____, and infill.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
 - 1. Integral Exterior Sunshades: Shop drawings to include all anchors, supports, frame attachments, connections, fastening, sealing methods and integration with the curtainwall system.
- C. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
 - 1. Engineering calculations as described are required by Ross-Tarrant Architects, whether or not the listed manufacturers require engineered calculations.
 - 2. Include in the engineering calculations all storefront and integral exterior sunshade loads engineered in conjunction, and as part of, the curtainwall system.
 - 3. Engineering calculations documenting compliance are to be stamped by a registered professional engineer licensed in the State of Kentucky.
 - a. The storefront and integral sunshade calculations are to be performed together, by one registered P.E.
- D. Structural Glazing Adhesive: Submit product data and calculations showing compliance with performance requirements.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- C. Source Limitations for Curtainwall System: Obtain all curtainwall, integral exterior sunshades and components through one source from a single manufacturer.
 - 1. Curtainwall manufacturers that do not manufacture sunshades are to provide proof of an arrangement with the selected sunshade manufacturer such that the sunshade can be included within any warranty requirements of the curtainwall system.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

- A. General Contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total curtainwall system installation. Correct defective Work within a one year period after Date of Substantial Completion.
 - 1. Includes; glass (including insulated glazing units), integral exterior sunshades device anchorage and setting system, sealing, flashing and etc, as it relates to air, water and structural adequacy.
- B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, gloss reduction, chalking, or flaking.
- C. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Apogee Enterprises, Inc./EFCO Corporation, Inc.: www.efcocorp.com.
 - 2. Graham Architectural Products: www.grahamwindows.com
 - 3. Kawneer North America; ____: www.kawneer.com/#sle.
 - 4. Apogee Enterprises, Inc./Tubelite, Inc: www.tubeliteinc.com.
 - 5. Trulite Glass and Aluminum Solutions/Arch Aluminum: www.trulite.com
 - 6. Apogee Enterprises/Tubelite, Inc: www.tubeliteinc.com.
 - 7. Oldcastle BuildingEnvelopeVistawall Architectural Products/ CRL(C. R. Laurence)/United States Aluminum: www.oldcastlebe.com.
 - 8. Apogee Enterprises/Wausau Window and Wall Systems: www.wausauwindow.com.

9. YKK AP America Inc.: www.ykkap.com
- B. Sunshades: If the curtainwall manufacturers listed above do not single source sunshades then products by other manufacturers (listed below) may be considered, provided the warranty, deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 1. AGS Inc.: www.agsshade.com
 2. CS Construction Specialties: www.c-sgroup.com
- C. Infill Panels: If the storefront manufacturers listed above do not single source infill panels then products by other manufacturers (listed below) may be considered, provided the warranty, deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 1. Mapes Panels, LLC - MapesSpan Panel : www.mapes.com

2.02 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Finish: Class I natural anodized.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 2. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 3. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 4. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 1. Design Wind Loads: Comply with loads listed on the structural drawings.
 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180 degrees F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
 1. Test Pressure Differential: 10 psf.
- D. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
- E. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
- F. Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 1. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Movement of curtain wall relative to perimeter framing.
 - b. Deflection of structural support framing, under permanent and dynamic loads.

2. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 2.86 lbf/sq ft.
3. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
4. Design system to eliminate noises caused by wind and thermal movement, to prevent vibration harmonics, and to prevent "stack effect" in internal spaces.

2.03 COMPONENTS

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Outside glazed, with pressure plate and mullion cover, where indicated.
 2. Finish: Class I natural anodized.
 3. Color: Clear.
- B. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
- C. Glazing: As specified in Section 088000.
- D. Integral Exterior Sunshades
 1. All aluminum components to be extrusions fabricated from aluminum alloy 6063-T6, manufactured within commercial tolerances and free from defects impairing strength and/or durability.
 2. All aluminum horizontal components (blades/airfoils and fascia) shall be fabricated to have a minimum wall thickness of 0.063 inch to a minimum of 0.125 inch.
 3. Horizontal components (blades and fascia) shall be mechanically fastened by means of extruded aluminum screw splines.
 4. Sunshade "arms/outriggers" and mullion clips shall be extrusions, or cut from a single piece of aluminum plate, with a nominal wall thickness of 0.25 inch.
 5. Screws, bolts and other exposed fasteners shall be aluminum, color/finish to match system, or stainless steel.
 6. Refer to the drawings for locations, sizes and profiles of the integral exterior sunshades.
 - a. If the exact dimensions, sizes, shapes, spacing of components, and etc. of the sunshade indicated on the drawings are not an exact match as manufactured by the listed manufacturers, then the manufacturer is to provide the next larger size of component nearest the dimensions provided on the drawings.
- E. Infill Panels
 1. Laminated, sealed, insulated, faced panels.
 2. Thickness: 1".
 3. Exterior Finish: Ceramic-coated, heat strengthened, spandrel glass.
 - a. Color as selected by Architect from manufacturers standard color selection.
 4. Interior Finish Substrate: Tempered hardboard.
 5. Interior Finish: Class II Clear Anodized Aluminum.
 6. Interior Finish texture: Smooth.
 7. Panel Core: 1.7 lb high density isocyanurate.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- C. Concealed Flashings: 0.018 inch thick galvanized steel.
- D. Perimeter Sealant: Type _____ specified in Section 079005.

- E. Glazing: As specified in Section 088000.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- G. Glazing Accessories: As specified in Section 088000.
- H. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.

2.05 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
 - 1. Curtainwall framing, integral exterior sunshade and all other exposed system components to have same finish system.

2.06 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce framing members for imposed loads.
- G. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

- A. Install curtain wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.

1. Install perimeter expandable spray foam insulation between exterior veneer/substrate and wood storefront anchorage blocking at frame surround to prevent wall cavity air from infiltrating the back side of the storefront framing.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 088000, using exterior dry glazing method.
- I. Install perimeter sealant in accordance with Section 079005.
- J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 ADJUSTING

- A. Adjust operating sash for smooth operation.

3.05 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION

SECTION 084500 - TRANSLUCENT WALL AND ROOF ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sandwich panels of translucent skins separated with an aluminum grid.
- B. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 079005 - Joint Sealers: System perimeter sealant and back-up materials.

1.03 REFERENCE STANDARDS

- A. AA DAF-45 - Designation System for Aluminum Finishes; 2003.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- I. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; 2000 (Reapproved 2009).
- J. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.04 PERFORMANCE REQUIREMENTS

- A. System Design: Design and size components to withstand dead loads and live loads caused by snow, hail, and positive and negative wind loads acting on plane of panel without damage or permanent set.
 - 1. Design Loads: Calculate in accordance with 2006 IBC.
 - 2. Measure performance in accordance with ASTM E330, using test load of 1.5 times the design wind pressure and 10 second duration of maximum load.
- B. Deflection: Limit mullion deflection to 3/4 inch with full recovery of glazing materials.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of sloped glazed area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E283.
- D. Water Leakage: None, when measured in accordance with ASTM E547 with a test pressure difference of 2.86 lbf/sq ft. Test shall include a minimum of 10 cycles, each lasting a minimum of 5 minutes.
- E. System Internal Drainage: Drain water entering joints, condensation occurring in framing system, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.05 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, internal drainage details.
- B. Design Data: Provide framing member structural and physical characteristics, dimensional limitations.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.
- D. Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with AAMA CW-DG-1.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle work of this section in accordance with AAMA CW-10.
- B. Protect prefinished aluminum surfaces with wrapping; do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
 - 1. Puncture wrappings at ends for ventilation.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and after installation of sealants.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Basis of Design: Kalwall; www.kalwall.com.
- B. Sandwich Panel Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include;
 - 1. Kalwall; ____: www.kalwall.com/#sle.
 - 2. Major Industries, Inc; ____: www.majorskylights.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.

2.03 COMPONENTS

- A. Translucent Wall and Roof System: Structurally reinforced translucent panels, with supplementary support framing, shop fabricated, factory prefinished, battens, cap strips, related flashings, anchorage and attachment devices.

- B. Panels: Bonded to both sides of structural extruded aluminum grid of pattern as indicated; exposed surfaces of exterior sheet chemically and permanently treated to protect against surface erosion and extreme weather conditions; exposed surface of interior sheets with fire retardant having flame spread index (FSI) of ____ and smoke developed index (SDI) of ____ in accordance with ASTM E84; polyvinyl fluoride film coated.
 - 1. Panel Thickness: 2-3/4 inches.
 - 2. Panel Exterior: .070" thermally broken.
 - 3. Panel Exterior Color: Equal to Kalwall - Super-weathering white.
 - 4. Panel Interior: .045" thermally broken.
 - 5. Panel Interior Color: Equal to Kalwall - S171 white.
 - 6. Panel U Factor: .23
- C. Wall System: Structurally reinforced translucent panels, with supplementary support framing, shop fabricated, factory prefinished, battens, cap strips, related flashings, anchorage.
- D. Battens, Cover Strips, Cover Plates, and Integral Flashings: Extruded aluminum, to suit location and application; sized to rigidly retain panels in place.
- E. Pattern: to match Kalwall "Shoji".
- F. Thermally broken aluminum perimeter framing system. Frame to have Kalwall CRF High Performance Architectural Coating or equal.
 - 1. Finish to match Kalwall color Aluminum #79.
- G. Weather Seals: To suit application; non-bleeding; non-staining.

2.04 SEALANT MATERIALS

- A. Sealant and Backing Materials: As specified in Section 079005.

2.05 FABRICATION

- A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, and ensure proper installation and dynamic movement of perimeter seals.
- B. Accurately fit and secure joints and corners. Make joints flush and hairline.
- C. Prepare components to receive fabricated anchor devices.
- D. Locate fasteners and attachments to ensure concealment from view.
- E. Reinforce framing members for external imposed loads.

2.06 FINISHES

- A. Finish Coatings: Conform to AAMA 611.
- B. Exterior Exposed Aluminum Surfaces:
 - 1. Exterior anodized to clear color, to 0.0007 inch thickness.
- C. Interior Exposed Aluminum Surfaces:
 - 1. Exterior anodized to clear color, to 0.0007 inch thickness.
- D. Shop and Touch-Up Primer for Steel Components: SSPC-Paint 25, zinc oxide, alkyd, linseed oil primer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.

- B. Verify wall openings and adjoining air barrier and vapor retarder materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install translucent panel system with cells vertical in accordance with manufacturer instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings.
- G. Coordinate installation of air stop at edge of construction.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install perimeter sealant, backing materials, and installation criteria in accordance with Section 079005.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Panel System Members and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths; remove dirt from corners and wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.05 PROTECTION

- A. Protect finished work from damage until Date of Substantial Completion.

END OF SECTION

SECTION 086223 - TUBULAR SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Roof curb installation.
- B. Section 075400 - Thermoplastic Membrane Roofing: Flashing-in of skylight base.
- C. Section 092116 - Gypsum Board Assemblies: Ceiling system.

1.03 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2011.
- B. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process; 2010.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- F. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
- G. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2014.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2011.
- J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).
- M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- N. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.
- O. ICBO/ICC AC-16 - Acceptance Criteria for Plastic Skylights; 2008.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
 3. Installation methods.
- B. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.
- C. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
1. Evidence of AAMA Certification.
 2. Evidence of WDMA Certification.
 3. Evidence of CSA Certification.
 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- D. Test Reports: Independent testing agency reports verifying compliance with specified performance requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engaged in manufacture of tubular skylights for minimum of 10 years.
- B. Single Source: All components of the tubular skylight to come from a single source manufacturer.
- C. Installer Qualifications: Company trained and authorized by the tubular skylight manufacturer, with minimum (2) two years of experience, in type of work specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

- A. Skylights: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with, manufacturers offering the following products that may be incorporated into the work include:
1. Solatube International, Inc; ____: www.solatube.com.
 2. Velux America, Inc; VELUX TCC - Curb Mounted SUN TUNNEL Skylight: www.veluxusa.com/#sle.
 3. Equivalent submitted to Architect prior to issuance of last addendum.
- B. Basis of Design: Design concept and drawings indicate the size, profiles, dimensional and aesthetics of:
1. Open Ceiling - Solatube International, Inc., SolaMaster Series Model S750 - DS-O - DAI - SK - FC - FI - EXX - R - L1 - I - Penetrating Ceiling, 21 inch Daylighting System.

2.02 TUBULAR SKYLIGHTS

- A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces.

1. Fabrication and assembly of components is by single manufacturer.
 2. Non-Metal Parts: Flammability less than the following.
 - a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
- B. Performance Requirements: Provide products that comply with the following:
1. Grade: 1 requirements for specific tubular skylight:
 - a. Product Type: Tubular Daylighting Device, Open Ceiling (TDDOC).
- C. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
1. Glazing: Acrylic plastic, 0.143 inch minimum thickness, Type DA, injection molded.
 2. Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
 3. Base Style: Curb mounted, with flashing 27 inches by 27 inches to cover curb constructed by others.
 4. Base Height: 4 inches.
 5. Base Pitch (Slope): Flat, no pitch.
 6. Flashing Insulator: Type F1, Thermal isolation material for use under flashing.
 7. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.
 8. Dome Seal: Polypropylene fiber pile weatherstrip 0.27 inch by 0.27 inch.
- D. Reflective Tube: ASTM B209 (ASTM B209M) aluminum sheet, thickness between 0.015 inch and 0.020 inch.
1. Interior Finish: Exposed interior surfaces of high reflectance specular finish; specular reflectance of 92, total reflectance 95 percent.
 2. Color a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
 3. Reflective Tube Transition: Provide reflective tube transition pieces in 30 degree adjustable tube increments, or in angles and increments as provided by the manufacturer, as necessary to provide a complete tube installation from the roof dome to the ceiling grid.
- E. Diffuser Assemblies for Tubes Penetrating Ceilings: Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration; 23.8 by 23.8 inches square frame to fit standard suspended ceiling grids or hard ceilings.
1. to square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch thick.
 2. Lens: Type L1 OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame. Visible Light Transmittance shall be >90 percent at 0.222 inch thick.
 3. Seal: Closed cell foam, 3 pounds per cubic foot.
 4. Secondary Diffuser: Type SS, acrylic plastic classified as CC2 material. Thickness shall not be less than 0.100 inches.

2.03 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Joint Sealant: As specified in Section 079005.
- C. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system.

2.04 TUBULAR SKYLIGHT CURBS

- A. Provide curb specifically manufactured for the tubular skylights specified. Provide curbs to the roofing contractor for flashing into the roofing system.
 - 1. Subject to compliance with, manufacturers offering the following products that may be incorporated into the work include:
 - a. Shaffner Heaney Associates, Inc. : www.shaffnerheaney.com (Solatube)
 - b. Thybar Corporation: www.thybar.com (Velux)
 - c. Equivalent submitted to Architect prior to issuance of last addendum.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Set roof assembly flashing in continuous bead of sealant.
- C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.
- D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 086223.01 - TUBULAR SKYLIGHT INSTALLER'S CERTIFICATION**PART 1 - GENERAL****1.01 TUBULAR SKYLIGHT INSTALLER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

- A. This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Tubular Skylight Installer:

I certify that _____ (Name of Tubular Skylight Installer) is an approved installer of our product, and upon completion of this project, providing all terms and conditions for the manufacturer's guarantee are met, we will provide a standard 10 year manufacturer's warranty.

Signed: _____ Title: _____

END OF SECTION 086223.01

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Commercial door hardware for the following swinging doors:
 - a. Aluminum.
 - b. Hollow metal.
 - c. Flush wood.
 2. Key cylinders for doors specified in other Sections.
 3. **Electrified access control door hardware. See Door Hardware Schedule and Door-Set Numbering Index (this Section) for Custom Switch Panel, details regarding the Emergency Lockdown System and hardware sets with lettered prefixes indicating required work and materials from the Electrical Contractor and the Access Control System Vendor. See electrical specifications for additional required electrical and access control system work and materials.**
 4. **Magnetic door holders:**
 - a. **Furnished by Contract Hardware Supplier.**
 - b. **Wall-portion installed by Contractor.**
 - c. **Door-portion installed by Hardware Installer.**
 - d. **Powered, controlled, wired and terminated by the Access Control System Vendor.**
 5. **Low-energy ADA automatic door operators requiring electrical work and materials, and installation by AAADM certified installer.**
 6. **Windstorm rated door and hardware assemblies: See Hardware Sets with the letter "W" in their prefix.**
- B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. ICC/IBC - International Building Code.
 3. NFPA 70 - National Electrical Code.
 4. NFPA 80 - Fire Doors and Other Opening Protectives.
 5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Smoke and Draft Control Door Assemblies.
 7. APPLICABLE STATE BUILDING CODE.
 8. UL 10C – Fire Tests of Door Assemblies
 9. UL 305 – Panic Hardware

1.2 ALTERNATE PRICING

- A. Provide alternate pricing (Alternate No. 9) to include the Owner's preferred hardware manufacturers and series as indicated below:
1. Key Cylinders: District standard Schlage Everest Primus keyway, 6-pin LFIC.
 2. Locksets: Schlage L and ND series, as specified.
 3. Exit Devices: Von Duprin 99 series.
 4. Closers: LCN 4040XP series.

1.3 SUBMITTALS

- A. **Number of Submittals:** All items listed in this section are to be included in one submittal prepared by one Supplier.
- B. **Product Data:** Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. **Samples for Initial Selection:** For each finish, color, and texture required for each type of door hardware as requested by Architect.
- D. **Samples for Verification:** For exposed door hardware of each type, in specified finish, full size, as requested by Architect. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets.
 - 1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- E. **Qualification Data:**
 - 1. **Finish Hardware Installers:** Company specializing in the installation of commercial door hardware with minimum of five years documented experience in commercial hardware installation.
 - 2. **Hardware Supplier**
 - a. Established contract hardware firm which maintains and operates an office, display, and stock in project area and which is a factory authorized distributor of the lock being furnished.
 - b. Hardware detailed, scheduled and furnished by or under direct supervision an Architectural Hardware Consultant.
 - c. All schedules submitted to the Architect for approval and job use must carry the signature and certified seal of this Architectural Hardware Consultant.
 - 3. **Architectural Hardware Consultant**
 - a. Currently certified by the Door and Hardware Institute.
 - b. Full-time employee of the Hardware Supplier or an individual having no contractual ties to any supplier/manufacturer entity.
 - c. Available at reasonable times to Architect, Owner, and Contractor during course of work.
 - 4. **Automatic Door Operator Supplier**
 - a. Established automatic operator distribution and installation firm which maintains and operates an office, display, and stock in project area and which is a factory authorized distributor of the automatic operator being furnished.
 - b. Currently certified by AAADM to install both high and low energy automatic door operators.
 - c. All schedules submitted to the Architect for approval and job use must include copies of the distributors factory authorization to distribute and install their operators and AAADM certification to install both high and low energy automatic door operators.
- F. **Maintenance Data Submittal:** For each type of door hardware. Include final hardware schedule, keying schedule, product data sheets for each item, manufacturers' published warranties, riser diagrams, and point-to-point wiring diagrams.
- G. **Warranty:** Special warranty specified in this Section.
- H. **Other Action Submittals:**

1. Door Hardware Sets: Prepared by or under the supervision of a DHI certified Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. **Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule"; other formats will be rejected without review. Double space entries, and number and date each page.**
 - b. **Provide index sorted by door number linking door numbers to hardware set numbers and hardware heading numbers.**
 - c. **Numerical Sequence of Sets and Headings: Submittal headings shall be in exact order as hardware sets in specification: one heading only per set. Submittal set numbers shall relate to specification set numbers, ie. if three headings are required for Set 12 due to door width differences, then the heading numbers should be 12.1, 12.2, and 12.3 or employing similar linking logic.**
 - d. **Door Numbers: Identical to those used in the contract documents.**
 - e. **Number of Copies: (5).**
 - f. **Content: Include the following information:**
 - 1) Identification number, location, hand, fire rating, and material of each door and frame.
 - 2) Type, style, function, size, quantity, and finish of each door hardware item.
 - 3) Complete designations of every item required for each door or opening including name and manufacturer.
 - 4) Degree of opening for closer and overhead stop and holder installation.
 - 5) Keying information.
 - 6) Fastenings and other pertinent information.
 - 7) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - 8) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 9) Mounting locations for door hardware.
 - 10) **Notes included with specification hardware sets transcribed verbatim into submittal hardware sets and headings.**
 - 11) Door and frame sizes and materials.
 - 12) Items referenced but not furnished.
 - 13) System function description for each hardware set with electrified hardware.
 - 14) List of related door devices specified in other Sections for each door and frame.
 - g. **Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.**
2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.4 QUALITY ASSURANCE

- A. **Furnish proper hardware types and quantities for proper door function, hardware mounting and clearances, aesthetics, and to meet applicable codes. Bring discrepancies to the attention of the Architect a minimum of (10) days prior to bid date so that an addendum may be issued and costs included in the bid. No additional compensation will be allowed after bidding for hardware changes**

required for proper function, hardware mounting or clearances, aesthetics or to meet codes. The specification is not a detail from which products should be ordered; detailing the project is the responsibility of the Contract Hardware Supplier.

- B. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- C. Source Limitations: **All items listed in hardware sets are to be furnished by one supplier.** Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 - 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 - 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Conference is to include representatives of the Owner, Architect, Contractor, CM if applicable, Hardware Supplier, and Manufacturer of Key Cylinders. Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- G. Access Control Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Conference is to include representatives of the Owner, Architect, Contractor, CM if applicable, and Access Control System Vendor. Access control conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future access control system expansion.
 3. Requirements for access control storage of credentials and software.
 4. Assignment and distribution of permanent access control credentials, badging equipment, and software.
 5. Access control privilege assignments including doors, time schedules, users, user groups, special credential functions, etc.
- H. Pre-Installation Conference: Prior to installation of door hardware, conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), Access Control System Vendor, and Contractor(s) to review proper methods and procedures for receiving, handling, and installing door and access control hardware to manufacturer's recommendations and according to specifications.
1. Arrange for manufacturers' representatives to hold a project specific training meeting on the proper installation and adjustment of their respective products; of highest priority would be electrified locks, panic/exit devices, door closers, and any atypical products used. Product training to be attended by the installers of standard and access control door hardware for the aluminum, hollow metal and wood door sections. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Verify door frames are plumb, level and square prior to the installation of doors and hardware.
 3. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 4. Review sequence of operation narratives for each unique access-controlled opening.
 5. Review and finalize construction schedule and verify availability of materials.
 6. Review the required inspecting, testing, commissioning, and demonstration procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Deliver hardware for aluminum doors to GC in timely manner so as not to delay fabrication of aluminum doors and frames. Balance of hardware may be delivered to GC at same time, packaged separately from aluminum door hardware, and may be billed as stored materials.**
- C. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- D. Deliver keys to Owner by registered mail or overnight package service. Obtain Owner's contact name and address from Architect.

1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Distribute templates in a timely manner so as not to delay suppliers. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, and security system.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for standard duty cylindrical (bored) locks and latches.
 - 3. Five years for panic/exit hardware.
 - 4. Twenty years for manual door closers.
 - 5. Five years for motorized electric latch retraction exit devices.
 - 6. One year for automatic door operators.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

1.9 EXTRA MATERIALS

- A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hardware:
 - a. (2) complete closers (heavy duty parallel arm)
 - b. (2) office function mortise locksets
 - c. (2) storeroom function mortise locksets
 - d. (2) classroom function mortise locksets
 - e. (5) rim key cylinders
 - f. (10) mortise key cylinders

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
- B. Designations: Requirements for design, grade, function, material, finish, size and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products listed by model number establish a basis of design for that product genre. Other products manufactured by available manufacturers listed in other Part 2 articles may be provided as long as they are equal in all aspects to the basis of design product listed for that particular product genre.
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Standards: In addition to other requirements in this section, provide products complying with or exceeding these standards and requirements for description, quality, and function.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electrified access control door hardware, in compliance with specifications, must be submitted in writing prior to the bid date and in accordance with the procedures and time frames outlined in Division 01 "Substitution Procedures". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
 - 1. Two Hinges: For doors with heights up to 60 inches (1524 mm).
 - 2. Three Hinges: For doors with heights 61 to 90 inches (1549 to 2286 mm).
 - 3. Four Hinges: For doors with heights 91 to 120 inches (2311 to 3048 mm).
 - 4. For doors with heights more than 120 inches (3048 mm), provide 4 hinges, plus 1 hinge for every 30 inches (750 mm) of door height greater than 120 inches (3048 mm).
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Height, Width, and Weight: Unless otherwise indicated, provide the following:
 - 1. Doors with panic/exit devices or 3'6" or more in width: 5" high, heavy-weight hinges.
 - 2. Doors less than 3'6" in width: 4-1/2" high, standard-weight hinges.
 - 3. Width: 4-1/2" heavy-weight, 4" standard-weight, unless proper clearance requires a different width.
 - 4. Doors with Closers: Antifriction-bearing hinges.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior and in-swinging restroom door hinges: Stainless steel, with stainless-steel pin.
 - 2. Balance of hinges: Steel, with steel pin.

- E. Hinge Options: Provide the following:
 - 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for reverse bevel lockable doors.
 - 2. Corners: Square.
 - 3. Number of knuckles: Five.
- F. Electrified Functions for Hinges: Comply with the following:
 - 1. Power Transfer: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle.
 - 2. Monitoring: Concealed electrical monitoring switch.
 - 3. Power Transfer and Monitoring: Concealed PTFE-jacketed wires, secured at each leaf and continuous through hinge knuckle, and with concealed electrical monitoring switch.
- G. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - 2. Wood Screws: For wood doors and frames.
 - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
 - 4. Screws: Phillips flat-head. Finish screw heads to match surface of hinges.
- H. Template Hinge Dimensions: BHMA A156.7.
- I. Available Manufacturers:
 - 1. Hager Companies (HAG).
 - 2. Ives (IVE).
 - 3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - 4. Stanley; Div. of DormaKaba (STA).
 - 5. PBB, Inc. (PBB)

2.3 CONTINUOUS HINGES

- A. Provide hinge of general series as indicated in hardware sets and of proper shape and model to suit door and frame configuration.
- B. Continuous, Pinless-Type Hinges: Extruded-aluminum, pinless, hinge leaves; with concealed, self-lubricating thrust bearings.
 - 1. Available Manufacturers:
 - a. Architectural Builders Hardware (ABH).
 - b. Hager Companies (HAG).
 - c. IVES Hardware; an Allegion Company (IVE).
 - d. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - e. National Guard Products (NGP).
 - f. Pemko Manufacturing Co. (PEM).
 - g. Select Products Limited (SEL).
 - h. Stanley; Div. of DormaKaba (STA).
 - i. Zero International (ZRO).

2.4 ELECTRONIC ACCESSORIES

- A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator or (2) LED indicators. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.
 - 1. Acceptable Manufacturers:
 - a. Security Door Controls (SDC).
 - b. Securitron Door Controls (SEC).
 - c. Architectural Control Systems (ACS).
 - d. Dortronics (DOR).
- B. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.
 - 1. Acceptable Manufacturers:
 - a. Security Door Controls (SDC).
 - b. Securitron Door Controls (SEC).
 - c. Architectural Control Systems (ACS).
 - d. Dortronics (DOR).
- C. Focused Motion Sensor: Request-to-Exit Sensors motion detectors specifically designed with field focusing feature equal to model specified. Include built-in timers (up to 60 second adjustable timing), door monitor with sounder alert, internal vertical pointability coverage, 12VDC or 24VDC power and selectable relay trigger with fail safe/fail secure modes.
 - 1. Acceptable Manufacturers:
 - a. BEA model R2E100
 - b. Equal approved prior to the bid.
- D. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. 3/4" or 1" pop-in design; DPDT contacts.
 - 1. Acceptable Manufacturers:
 - a. Flair Electronics; (FLR).
 - b. Interlogix (ILX).
 - c. GE Security.
- E. Electronic Power Transfers:
 - 1. Concealed: For new doors and frames, concealed when door is closed. All metal construction, cast housing with steel backboxes, two universal joints and rigid tubing. Acceptable Manufacturers:
 - a. Security Door Controls (SDC).
 - b. Securitron Door Controls (SEC).
 - c. Architectural Builders Hardware (ABH).
 - d. Hager (HAG).
 - e. Von Duprin (VON).

F. Sounders: 90dB@24VDC, single-gang, stainless steel cover plate.

1. Acceptable Manufacturers:

- a. Security Door Controls (SDC).
- b. Securitron Door Controls (SEC).
- c. Dortronics (DOR).
- d. Architectural Control Systems (ACS).

2.5 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Electrified Locking Devices: BHMA A156.25. Equal in all characteristics to model specified.

1. Available Manufacturers:

- a. Best; Div. of DormaKaba (BES).
- b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
- c. Schlage Commercial Lock Division; an Allegion Company (SCH).

D. Lock Trim:

- 1. Levers: Cast.
 - a. Schlage 17 model with full smooth return.
- 2. Roses: Forged.
 - a. Schlage A model.
- 3. Dummy Trim: Match lever lock trim and roses.
- 4. Lockset Designs: Provide design indicated in hardware sets, or, if sets are provided by another manufacturer, provide designs that match those designated.

E. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

- 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
- 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
- 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.

F. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

G. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended as needed to protect frame, finished to match door hardware set, and as follows:

1. Strikes for Bored Locks and Latches: BHMA A156.2.

2. Strikes for Mortise Locks and Latches: BHMA A156.13.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.

2.6 MECHANICAL LOCKS AND LATCHES

- A. Lock Types: Provide mortise or bored locks as indicated by model number in the Hardware Schedule.
- B. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
 1. Bored Locks: BHMA A156.2.
 2. Mortise Locks: BHMA A156.13.
- C. Bored Locks: BHMA A156.2 Grade 1.
 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
 - c. Schlage Commercial Lock Division; an Allegion Company (SCH).
- D. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13 Grade 1.
 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
 - c. Schlage Commercial Lock Division; an Allegion Company (SCH).
- E. Compatibility with Key Cylinders: fully warranted for use with key cylinder furnished.

2.7 AUXILIARY LOCKS AND LATCHES

- A. Auxiliary Locks: BHMA A156.5, Grade 1. Must be able to provide the specified public toilet (classroom double-cylinder) deadbolt function:
 1. Available Manufacturers:
 - a. Best; Div. of DormaKaba (BES).
 - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
 - c. Schlage Commercial Lock Division; an Allegion Company (SCH).
 - d. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).

2.8 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Mortise Flush Bolts: Minimum 3/4-inch (19-mm) throw.
- B. Manual Flush Bolts: BHMA A156.16, Grade 1; designed for mortising into door edge.

1. Available Manufacturers:
 - a. Door Controls International (DCI).
 - b. Glynn-Johnson; an Allegion Company (GLY).
 - c. Hager Companies (HAG).
 - d. IVES Hardware; an Allegion Company (IVE).
 - e. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 - f. Rockwood Manufacturing Company (ROC).
 - g. Trimco (TRI).

2.9 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1.
- B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- F. Removable Mullions
 1. BHMA A156.3.
 2. Key removable.
 3. Provide head cap spacers, angle brackets, and other mounting accessories as needed for proper mounting, and anchoring and support of screws, as needed for top jamb configuration.
 4. Provide mullion stabilizer sets for mullions at exterior openings.
- G. Outside Trim: As specified in hardware sets; material and finish to match locksets, unless otherwise indicated.
 1. Match design for locksets and latchsets, unless otherwise indicated.
- H. Fasteners. Manufacturer's standard, except furnish sex bolts for attachments to doors, unless doors have sufficient hardwood or other blocking to properly secure all required screws.
- I. Shims: Provide shims if needed for clearance.
- J. Available Manufacturers:

1. Precision Hardware; Div. of DormaKaba (PHI).
2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
3. Von Duprin; an Allegion Company (VON).

2.10 KEY CYLINDERS

- A. Cylinders: Provide cylinders for all devices requiring key cylinders to properly function: constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
 1. Number of Pins: Six.
 2. Keyway: Existing Everest Primus as directed by Owner.
 3. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
 4. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 5. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- B. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
 1. Large-format Removable Cores: Core insert, removable by use of a special key; for use only with core manufacturer's cylinder and door hardware.
- C. Construction Keying: Comply with the following:
 1. Construction Cores: Provide keyed brass construction cores that are replaceable by permanent cores for locking devices on exterior doors plus (10) extra. Provide 6 construction master keys.
 - a. Replace construction cores with permanent cores as directed by Owner.
- D. Supplemental Items: Provide cylinder spacers, collars, and correct cams as needed for proper function of locking devices.
- E. Available Manufacturers:
 1. Best; Div. of DormaKaba (BES).
 2. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (COR).
 3. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).
 4. Schlage Commercial Lock Division; an Allegion Company (SCH).

2.11 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference, and as follows:
 1. Existing System: Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 2. Quantity: Provide the following:

- a. Cylinder Change Keys: Three per cylinder.
- b. Master Keys: Six per master.
- c. Grand Master Keys: Six.
- d. Great-Grand Master Keys: Five.
- e. Control Keys: Two.
- f. Construction Control Keys: Two.
- g. Blanks: One hundred.

2.12 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5, Grade 1; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
 - 1. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
 - 2. Locate and mount per direction of Architect.
- B. Cross-Index System: Multiple-index system for recording key information. Include three receipt forms for each key-holding hook.
 - 1. Available Manufacturers:
 - a. Lund Equipment Co., Inc. (LUN).
 - b. MMF Industries (MMF).
 - c. Telkee; (TEL).

2.13 FIRE DEPARTMENT KEY BOX

- A. Provide (1) fully recessed hinged fire department key box.
 - 1. Basis of specification: Knox-Box Model 3200 x RMK x Aluminization x Black.
 - 2. Available Manufacturers:
 - a. Knox Company.
 - b. Approved equal.
- B. Locate in exterior wall as directed by Architect.

2.14 OPERATING TRIM

- A. Materials: Fabricate from stainless steel, unless otherwise indicated.
- B. Dimensions: All dimensions, shapes, fasteners, and other properties identical to models specified in hardware sets.
- C. Push Plates:
 - 1. 0.125" thick, Type 304 solid stainless steel, 4" or 8" wide as indicated by model number in hardware sets, 16" or 24" high (unless stile width requires different width), heavy bevel all (4) edges, 3/8"

radius rounded corners, factory prepped for key cylinders and thumb-turns as required, countersunk for flush bevel-headed screws.

2. Dimensions:
 - a. Top of plate to horizontal centerline of key cylinder: 5".
 - b. Horizontal centerline of key cylinder to horizontal centerline of thumb-turn: as required per dimension of lock model.
 - c. Lock-side edge of plate to vertical centerline of key cylinder: 2".

D. Pull Plates:

1. Plate: 0.050" thick, 4" wide x 16" high (unless stile width requires different width), bevel all (4) edges, 3/8" radius rounded corners, factory prepped for key cylinders and thumb-turns as required, countersunk for flush bevel-headed screws.
2. Grip: 1" wide, 8" CTC, Type 304 solid stainless steel, half-moon profile.
3. Dimensions:
 - a. Top of plate to horizontal centerline of key cylinder: 2".
 - b. Horizontal centerline of key cylinder to horizontal centerline of thumb-turn: as required per dimension of lock model.
 - c. Edge of plate to vertical centerline of key cylinder and grip: 2".
 - d. Top of plate to horizontal centerline of grip: 10".

E. Available Manufacturers:

1. Hager Companies (HAG).
2. Hiawatha (HIW).
3. Burns (BRN).
4. IVES Hardware; an Allegion Company (IVE).
5. Rockwood Manufacturing Company (ROC).
6. Trimco (TRI).

2.15 SURFACE CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- C. Fasteners: Manufacturer's standard for arms, shoes and brackets. Sex bolts for fastening closers to doors, unless doors have sufficient hardwood or other blocking to properly secure all required screws.
- D. Mounting Accessories: Provide shoes, brackets, drop plates, spacers, etc., as needed for proper mounting of closers and arms to door and frame.
- E. Spring Size of Units: Provide field-sizable closers, adjustable for spring sizes 1-6, plus 50% extra spring power at spring size 6, to meet field conditions and requirements for opening force.

- F. Cylinders: 1-1/2" minimum diameter; cast iron or high-silicon alloy aluminum.
- G. Mounting Configuration: Unless otherwise indicated by model number in the hardware sets:
 - 1. Do not furnish closers capable of being mounted on the corridor side of doors.
 - 2. If tri-pack closers are furnished for regular arm applications, remove parallel arm shoe from closer box before delivering to job.
 - 3. Parallel Arm closers are to be manufacturer's double forged rigid models.
- H. Available Manufacturers and Series for Rack and Pinion Surface Closers:
 - 1. LCN Closers; an Allegion Company (LCN): 4040XP series.
 - 2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR): 281 series.
 - 3. Corbin-Russwin (COR): DC8000 series.

2.16 AUTOMATIC DOOR OPERATORS

- A. **Standard: Set up operator to comply with Low Energy BHMA A156.19 standard. Operator shall also be capable of complying with High Energy BHMA A156.10 standard with no additional equipment required other than safety sensors.**
- B. Performance Requirements:
 - 1. Not more than 15 lbf (67 N applied) 1 inch (25 mm) from latch edge of door to prevent stopped door from opening or closing.
 - 2. If power fails, not more than 30 lbf (133 N applied) 1 inch (25 mm) from latch edge of door to manually set door in motion.
 - 3. **Warranted for use on out-swinging exterior doors with the use of a supplemental stop.**
- C. Operation: Power opening and spring closing; **power closing to get door latched when encountering resistance.** When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- D. Operating System: Electromechanical.
- E. Microprocessor Control Unit: Solid-state controls.
- F. Features:
 - 1. Adjustable opening and closing speed.
 - 2. Adjustable opening and closing force.
 - 3. Adjustable backcheck.
 - 4. Adjustable latch speed.
 - 5. Adjustable hold-open time of not less than 0 to 30 seconds.
 - 6. Adjustable time delay.
 - 7. Adjustable acceleration.
 - 8. Obstruction recycle.
 - 9. **Provide lock interface relay when not specified as part of locking device power supply.**
 - 10. **On/Off/HO switch on side, top or bottom of housing, as directed by Owner.**
- G. Mounting: Surface mounted to top jamb.
- H. Mounting Accessories: Provide shoes, brackets, drop plates, spacers, etc., as needed for proper mounting of operators and arms to door and frame.

I. Bollards:

1. Of material, size, configuration and shape indicated.
2. Material: Stainless steel.
3. Available Manufacturers for Bollards:
 - a. Wikk Industries (WIK).

J. Actuators:

1. Wall Push-Plate Switch: Semiflush, wall-mounted, door control switch; of material, size, and shape indicated; weather resistant for exterior applications; mounted in recessed junction box. Provide engraved message as indicated.
2. Wall Touchless Switch: Semiflush, wall-mounted, door control switch of material, size and shape indicated; mounted in recessed junction box. Provide engraved message as indicated.
3. Material: Stainless steel.
4. Message: International symbol of accessibility and "Push to Open."
5. Available Manufacturers for Actuators:
 - a. BEA (BEA).
 - b. Wikk Industries (WIK).

K. Automatic Door Operator Signage:

1. Comply with BHMA A156.19.
2. Consult Architect before applying signage to door.

L. Available manufacturers for Automatic Door Operators:

1. Besam SW200i series. (BSM).
2. LCN Closers; an Allegion Company (LCN); Senior Swing series.
3. Stanley Access Technologies (SAT); M-Force series.

2.17 PROTECTIVE TRIM UNITS

A. Size:

1. Width
 - a. Singles, and pairs with removable mullions or surface applied astragals: 2 inches (38 mm) less than door width on push side and 1 inch (13 mm) less than door width on pull side
 - b. Other pairs: 1 inch (13 mm) less than door width
2. Height: as specified in door hardware sets; or, if constrained by door bottom rail height, 1" less bottom rail height.

B. Fasteners: Manufacturer's machine or self-tapping countersunk screws.

C. Metal Protective Trim Units: BHMA A156.6; beveled 4 sides; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel.

D. Available Manufacturers:

1. Hager Companies (HAG).
2. IVES Hardware; an Allegion Company (IVE).
3. Hiawatha (HIW).
4. Burns (BRN).

5. Rockwood Manufacturing Company (ROC).
6. Trimco (TRI).

2.18 MECHANICAL WALL AND FLOOR STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
 1. Provide wall stops for doors unless floor, overhead, or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Provide floor stops (and spacers if needed) of proper height and configuration to accommodate floor condition. Where floor or wall stops are not appropriate, provide overhead holders.
 2. Properties. Cast construction with fastener suitable for wall or floor condition.
 3. Available Manufacturers:
 - a. Hager Companies (HAG).
 - b. IVES Hardware; an Allegion Company (IVE).
 - c. Hiawatha (HIW).
 - d. Burns (BRN).
 - e. Rockwood Manufacturing Company (ROC).
 - f. Trimco (TRI).
- B. Wall and Floor mounted Combination Door Stops and Holders: BHMA A156.16, Grade 1.
 1. Properties: Heavy cast with adjustable holding force, self-compensating for changes up to ¼" in vertical door position. **Provide 1" Z900.0 flush spacers finished to match adjoining substrates for clearance as needed.**
 2. Manufacturer and Model: Trimco 1283.

2.19 OVERHEAD STOPS AND HOLDERS

- A. BHMA A156.8, Grade 1. Template for maximum degree of opening before encountering obstruction.
- B. Available Manufacturers:
 1. Architectural Builders Hardware Mfg., Inc. (ABH).
 2. Glynn-Johnson; an Allegion Company (GLY).
 3. Hager (HAG).
 4. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
 5. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SAR).

2.20 ELECTROMAGNETIC DOOR HOLDERS

- A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button. **All metal covers.**
- B. **Accessories: Provide holders of proper configuration for wall and clearance conditions. Provide factory extension rods as required for proper clearance and engagement.**
- C. Available Manufacturers:

1. Architectural Builders Hardware Mfg., Inc. (ABH).
2. Hager (HAG).
3. Edwards (EDW).

2.21 SILENCERS

- A. Though not listed in the hardware sets, provide silencers for Hollow Metal and Wood Door Frames which do not have smoke, fire or weather seals: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame; three for single doors, two for paired openings.
- B. Available Manufacturers:
 1. Glynn-Johnson; an Allegion Company (GLY).
 2. Hager Companies (HAG).
 3. IVES Hardware; an Allegion Company (IVE).
 4. McKinney Products Company; an ASSA ABLOY Group company (MCK).
 5. Rockwood Manufacturing Company (ROC).
 6. Trimco (TRI).

2.22 DOOR GASKETING

- A. General: Provide continuous weather-strip gasketing on exterior hollow metal doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners as indicated by models in hardware sets.
 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. If hardware is to be attached to the frame and would interfere with the gasketing, then provide hardware compatible gasketing that does not need to be cut for the mounting of hardware.
 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 3. Mullion Gasketing: Fasten to mullions, forming seal when doors are closed.
 4. Sweeps: Apply to bottom of in-swinging exterior hollow metal doors, or as required for sound attenuation, forming seal with threshold or floor when door is closed.
 5. Seals integral to threshold at out-swinging exterior hollow metal doors.
- B. Requirements per type of rated door provided (these requirements supersede models indicated in hardware sets):
 1. Category A wood doors: provide models indicated in hardware sets.
 2. Category B wood doors: provide Category G&H seals at jambs and meeting edges. If Category H seals are indicated in hardware sets, provide Cat G seals in addition to the Category H seals.
 3. Category A and B hollow metal doors: provide models indicated in hardware sets.
- C. Air Leakage: Not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

- E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.
- F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- G. Mullion Gasketing: Sealing up to 1/4" gaps, 4 vanes, adhesive backed, collapsible to 1/32", black. Basis of Design: DHSI (DHS) Model MS-SA/75 x BK.
- H. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- I. Jamb Gasketing Materials:
 - 1. Adhesive Seals. As specified in hardware sets or approved equal.
 - 2. Intumescent: As required.
 - 3. Screwed-on weatherstrip and sweeps. Neoprene.
 - 4. Panic type thresholds. Neoprene.
- J. Available Manufacturers for Jamb Gaskets (provided they provide items with neoprene inserts):
 - 1. Hager Companies (HAG).
 - 2. National Guard Products (NGP).
 - 3. Pemko Manufacturing Co. (PEM).
 - 4. Reese Enterprises (REE).
 - 5. Zero International (ZER).

2.23 THRESHOLDS

- A. Standard: BHMA A156.21
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
- 1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.
- D. Fasteners: 1/4-20 machine screws and expansion anchors.
- E. Gasketing material: At panic-type thresholds: neoprene.
- F. Available Manufacturers (provided they provide items with neoprene inserts):
 - 1. Hager Companies (HAG).
 - 2. National Guard Products (NGP).
 - 3. Pemko Manufacturing Co. (PEM).
 - 4. Reese Enterprises (REE).

5. Zero International (ZRO).

2.24 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. **Fasteners: Manufacturer's standard, except as noted in product sections of this specification.**

2.25 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION PRIOR TO INSTALLATION OF DOORS AND HARDWARE

- A. Prior to installing doors, examine frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. **Verify frames are plumb, level, square and dimensioned properly for the installation of doors.**
- B. Prior to installing hardware other than hanging means, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction and other conditions affecting performance.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

3.3 INSTALLATION

- A. Low-energy Automatic Door Operators:
 - 1. **Installer is to have current AAADM certification to install automatic door operators and actuating systems.**
- B. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Pulls: locate pulls as directed by Architect.
 - 4. Push Plates: Top edge of plate: 53" AFF.
 - 5. Pull Plates: Top edge of plate: 50" AFF. Centerline of Grip: 40" AFF.
 - 6. Key Cylinders for Auxiliary Deadbolts: 48" AFF.
- C. Mounting Locations:
 - 1. Floor Stops and Holders: Locate at least 20" out from hinge edge of door for maximum degree of opening before door encounters obstruction.
 - 2. Wall Stops: Locate so that lockset spindle and wall stop share horizontal and vertical centerlines.
 - 3. Wall Stop/Holders: Locate 4" down and in from top lock-edge corner of door w/holder slot at bottom of unit.
 - 4. **Closers and Overhead Stop/Holders: Template and mount closers and overhead stops for maximum degree of opening before door encounters obstruction or so as to interface with specified wall stops and holders. When used with closers, template and locate overhead stops so that closer arm does not fully extend and bottom out. These functionality requirements override any degree of opening information in the specifications or submittals.**
- D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Hardware designed for mortised installation shall be mortised in flush with adjoining surfaces. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule. Document cross-indexing per manufacturer's instructions.

- F. **Weatherstrip and Gasketing with Metal Retainers: Fit up as needed for neat appearance with no gaps between retainers or bulbs. Mitre cut weatherstrip for flush fitup in corners.**
- G. **Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants." Position for complete seal with bottom of doors with no penetration of air or daylight.**

3.4 FIELD QUALITY CONTROL

- A. Provide Door and Door Hardware Inspection Services as indicated below.
- B. Door and Door Hardware Inspection Services
 - 1. Scope
 - a. Inspection of all swinging doors and door hardware immediately following completion of installation.
 - b. Inspector to furnish a Field Quality Report, itemized per each individual opening, to the Architect within 7 days of the inspection, including:
 - 1) deficiencies in workmanship and standard industry practices,
 - 2) use of allowable products,
 - 3) use of manufacturer recommended fasteners,
 - 4) compliance with the ADA,
 - 5) improper door/frame/hardware clearances,
 - 6) problems related to function, security, aesthetics or maintenance.
 - 2. Inspector Qualifications
 - 1) Architectural Hardware Consultant.
 - 2) Entirely independent of the supply side of the project, having no familial or financial relationship with any manufacturer, manufacturer's representative, distributor, installer or supplier used on this project.
 - 3) Approved by Architect. Go to <http://www.dhi.org/> for searchable list of local Architectural Hardware Consultants.
 - 4) Full member in good standing of Specification Consultants in Independent Practice (SCIP).
 - 5) Same Inspector for re-inspections as for the initial inspection.
 - 3. Payment for the inspection and subsequent re-inspections until work is complete and approved is to be made directly by the Hiring Entity to the Inspector within 30 days of receipt of report and invoice. The Hiring Entity responsible for contracting and paying this Inspector shall be that Entity responsible for the installation or sub-contracting of all of the hardware installation for all products specified in this Section. Re-inspections are required until all work is complete and approved.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Overhead Stops/Holders: Set adjustable stops for maximum degree of opening before door encounters obstruction. Adjust friction to control door.

- C. Wall and Floor Mounted Stop/Holders: Adjust holding force with spanner head wrench so that door is held securely yet is easy to pull out of hold open.
- D. Door Closers:
 - 1. Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
 - 2. Adjust latch period so that door does not slam nor injure fingers.
 - 3. Adjust spring power so that door properly latches. Per the ADA, 5 lbf is the maximum allowed on an interior non-rated door; 8.5 lbf is the maximum allowed on a non-rated exterior door. On smoke or fire rated doors, adjust the closer to the minimum spring power needed to reliably latch the door. If the Installer is having difficulty properly adjusting the closer due to improper door-frame clearances or air pressure differentials, they are to immediately notify the Contractor so that corrections may be quickly made.
 - 4. Adjust backcheck to not be noticeable when door is moving slowly, but to slow door down when accelerating due to human force or wind before hitting stop point so as to prevent damage to closer, arm, door, frame, and fasteners.
- E. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DOOR HARDWARE SCHEDULE (on following pages followed by Door-Set Index)

Woodford County High School Custom Switch Panel

(1) Dortonics Custom Switch Panel, Model 7205xL5x5T24x3P25xE5 with a Desktop Enclosure, Model 7605-ENCL. This Panel is listed in Hardware Set S01 and is furnished by the Hardware Supplier.

Panel has (5) stations factory labeled from left to right as follows:

Station 1	Exterior
Station 2:	Waiting
Station 3:	Corridor
Station 4:	Vestibule
Station 5:	After Hours

Switch Panel Station 1 – Exterior Doors VA-1, VA-1.1

(labeled “Exterior”); has a momentary pushbutton, a maintained toggle switch and a Red/Green LED.

Toggle Switch Up (Red LED lights):

Free egress by pushing on exit device touchbars at Doors VA-1 and VA-1.1. Doors VA-1 and VA-1.1 are normally locked against ingress. Mechanical ingress by key. Electrified ingress by card at VA-1. Electrified ingress at VA-1.1 by momentary remote release pushbutton on switch panel which retracts latches on both exit devices; doors relocks after time delay. Exterior operator actuator at Door VA-1.1 is normally disabled; during unlock period, it is enabled to signal operator to open LHRB door leaf; door closes after time delay. Green LED is lit during unlock period. Interior operator actuator is always enabled to retract latch on LHRB leaf of Door VA-1.1 and open door; door closes and relocks after time delay.

Toggle Switch Down (Green LED lights):

Doors VA-1 and VA-1.1 are electrically unlocked for free ingress.

Emergency Lockdown: No matter what state the Switch Panel is in, when an Emergency Lockdown Pushbutton is pushed Doors VA-1 and VA1.1 lock against ingress; ingress by key, or by card at Door VA-1. Free egress.

Switch Panel Station 2 – Waiting Door 177

(labeled “Waiting”); has a momentary pushbutton, a maintained toggle switch and a Red/Green LED.

Toggle Switch Up (Red LED lights):

Free egress by turning push-side electric mortise lockset lever. Door 177 is locked against ingress. Mechanical ingress by key. Electrified ingress by card or by momentary remote release pushbutton which unlocks pull-side lever on electric mortise lockset; door relocks after time delay. Green LED is lit during unlock period.

Toggle Switch Down (Green LED lights):

Door 177 is unlocked for free ingress.

Emergency Lockdown: No matter what state the Switch Panel is in, when an Emergency Lockdown Pushbutton is pushed this opening locks against ingress; ingress by key or by card.

Switch Panel Station 3 – Corridor Door 177.1

(labeled “Corridor”); has a momentary pushbutton, a maintained toggle switch and a Red/Green LED.

Toggle Switch Up (Red LED lights):

Door 177.1 is not a required exit in either direction. Door is electronically locked on both sides. Ingress from Corridor C101 to Waiting 177 by motion sensor, which releases electric mortise lockset; door relocks after time delay. Electronic ingress from Waiting 177 to Corridor C101 by card or by momentary remote release pushbutton which releases electric mortise lockset; door relocks after time delay. Mechanical ingress from Waiting 177 to Corridor C101 by key. Green LED is lit during unlock period.

Toggle Switch Down (Green LED lights):

Door 177.1 is electrically unlocked for free ingress in both directions.

Emergency Lockdown: No matter what state the Switch Panel is in, when an Emergency Lockdown Pushbutton is pushed this opening locks against ingress in both directions; ingress by key on both sides or by card on pull side.

Switch Panel Station 4 – Vestibule Doors VA-1.2, VA-1.3

(labeled “Vestibule”); has a maintained toggle switch and a Red/Green LED.

Toggle Switch Up (Red LED lights):

Free egress by pushing on exit device touchbars at Doors VA-1.2 and VA-1.3. Doors VA-1.2 and VA-1.3 are normally locked against ingress. Mechanical ingress by key. Electrified ingress by card at VA-1.2. Green LED is lit during unlock period.

Toggle Switch Down (Green LED lights):

Doors VA-1.2 and VA-1.3 are electrically unlocked for free ingress.

Emergency Lockdown: No matter what state the Switch Panel is in, when an Emergency Lockdown Pushbutton is pushed Doors VA-1.2 and VA1.3 lock against ingress; ingress by key, or by card at Door VA-1.2. Free egress.

Switch Panel Station 5 – After Hours (Corridor Door 177.1)

(labeled “After Hours”); has a maintained toggle switch and a Red/Green LED.

Toggle Switch Up (Red LED lights):

Motion Sensor on push side of Door 177.1 is disabled. Door 177.1 is locked against ingress in both directions. Electronic ingress from Waiting 177.1 to Corridor C101 by card. Mechanical ingress both directions by key. This function is used to lock up the Admin Suite after hours.

Toggle Switch Down (Green LED lights):

Motion Sensor on push side of Door 177.1 is enabled.

Emergency Lockdown: No matter what state the Switch Panel is in, when the Emergency Lockdown Pushbutton is pushed this opening locks against ingress and egress; ingress and egress by key. Electronic ingress from Waiting 177.1 to Corridor C101 by card.

Emergency Lockdown System

Emergency Lockdown System functions under two modes: 'normal' and 'emergency lockdown'. See Hardware Set L01 for emergency lockdown pushbuttons, emergency lockdown RF fobs, system peripherals, and System Function.

HARDWARE SET PREFIX KEY:

- A** Indicates an automatic door operator is involved.
- C** Indicates a card reader is involved.
- L** Indicates involvement with emergency lockdown system.
- M** Indicates security monitoring electronics but no other electronic function.
- S** Indicates involvement with custom switch panel.
- W** Indicates windstorm rated doors and hardware.

SOUNDER NOTE:

Sounders are listed in the hardware sets for each opening, but that quantity may be decreased by sharing with the following adjacent openings as indicated in the electrical drawings:

VA-1, VA-1.1

VA-1.2, VA-1.3

VA-2, VA-21

VA-3.4, VA-3.5

C102.2, C102.3

C103.1, C103.2

PROVISIONAL NOTE:

All items listed by model number below are furnished by the Hardware Supplier. Items not listed by model number are furnished per the Electrical Specifications.

Hardware Set A01***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (2) | Continuous Hinge | 112HD | 628 | IVE |
| (2) | Push/Pull Bar Set | 1731 | 630 | TRI |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |

Note: Provide closer drop plate(s) as required.

- (1) Lot: Provided by Aluminum Door and Frame Supplier: Jamb and door bottom and meeting edge seals.

Electrified Items:

- | | | | | |
|-----|-------------------------------|--------------------------|------|-----|
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Elect Automatic Door Operator | Senior Swing x 8310-806R | 628 | LCN |
- Note: Locate On/Off/HO switch on underside of operator housing. Mount operator on LHRB door leaf.
- | | | | | |
|-----|-----------------------------|------------|-----|-----|
| (2) | Actuator, Sng-gng, No Touch | CM-222/A42 | 630 | CDC |
|-----|-----------------------------|------------|-----|-----|
- (1) Lot: Conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress and ingress. Both operator actuators are always enabled to open LHRB door leaf; door closes and after time delay.

Hardware Set ACL01***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | 689 | VON |
| (1) | Rim Cylinder | 20-757 | 626 | SCH |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |

Note: Provide closer drop plate(s) as required.

- | | | | |
|-----|---|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | Black | DHSI |
|-----|---|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom seals, and ½" aluminum blocking for mounting of strike without cutting jamb seals; adjust panic device backset accordingly.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|------------------------------------|------|-----|
| (2) | Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electrified Panic Device, Rim, 03 | LX-RX-QEL-99NL x 697NL-R/V x RHRBA | 626 | VON |
| (1) | Electrified Panic Device, Rim, 02 | LX-RX-QEL-99DT x 697DT-R/V | 626 | VON |
| (1) | Elect Automatic Door Operator | Senior Swing x 8310-806R | 628 | LCN |
- Note: Locate On/Off/HO switch on underside of operator housing. Mount operator on LHRB door leaf.
- | | | | | |
|-----|-----------------------------|------------|------|-----|
| (2) | Actuator, Sng-gng, No Touch | CM-222/A42 | 630 | CDC |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. Doors are normally locked against ingress. Mechanical ingress by key. Electrified ingress by card which retracts latches on both exit devices; doors relocks after time delay. Exterior operator actuator is normally disabled; during unlock period, it is enabled to signal operator to open LHRB door leaf; door closes after time delay. Interior operator actuator is always enabled to retract latch on LHRB leaf and open door; door closes and relocks after time delay. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set ALS01***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | 689 | VON |
| (1) | Rim Cylinder | 20-757 | 626 | SCH |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (1) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
- Note: Provide closer drop plate(s) as required.
- | | | | | |
|-----|---|--|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | | Black | DHSI |
|-----|---|--|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom and meeting edge seals.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|------------------------------------|------|-----|
| (2) | Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electrified Panic Device, Rim, 03 | LX-RX-QEL-99NL x 697NL-R/V x RHRBA | 626 | VON |
| (1) | Electrified Panic Device, Rim, 02 | LX-RX-QEL-99DT x 697DT-R/V | 626 | VON |
| (1) | Elect Automatic Door Operator | Senior Swing x 8310-806R | 628 | LCN |
- Note: Locate On/Off/HO switch on underside of operator housing. Mount operator on LHRB door leaf.
- | | | | | |
|-----|--------------------------------|----------------------|------|-----|
| (1) | Actuator, Sng-gng, No Touch | CM-222/A42 | 630 | CDC |
| (1) | NS Actuator, Sng-gng, No Touch | CM-222/A42N x CM-23D | 630 | CDC |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Video-interior with stations at exterior and on casework in Reception 176, low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set C01***Non-electrified Items:***

- | | | | | |
|-----|------------------------|---------------------------|-----|-----|
| (3) | Butt Hinges | 5BB1 x 4.5 x 4.0 | 652 | IVE |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (1) | Closer, Regular Arm | 4040XP Reg | 689 | LCN |
| (1) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Universal Stop, 1-1/2" | 7280 | 630 | TRI |

Electrified Items:

- | | | | | |
|-----|-----------------------------|-----------------------------|------|-----|
| (1) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electric Mortise Lockset | L9092EU-17A x LS x RQE x DS | 626 | SCH |
- (1) Lot: Card reader (narrow jamb-mount), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. Ingress by card or key. Door is monitored for door position, REX of inside lever and latch position.

Hardware Set C01A***Non-electrified Items:***

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Parallel Arm	4040XP Reg/PA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Universal Stop, 1-1/2"	7280	630	TRI

Electrified Items:

(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electric Mortise Lockset	L9092EU-17A x LS x RQE x DS	626	SCH
(1)	Lot: Card reader (narrow jamb-mount), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Ingress by card or key. Door is monitored for door position, REX of inside lever and latch position.

Hardware Set CL01***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute	MS-SA/75	Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
	Note: Apply to top jamb only.			
(1)	Cat H Jamb Seal Set	135NA	628	NGP
	Note: Apply to side jambs only.			
(1)	Panic Threshold	896N x RCE	628	NGP
	Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.			

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	LX-RX-QEL-99NL x 697NL-R/V x RHRBA	626	VON
(1)	Electrified Panic Device, Rim, 02	LX-RX-QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Doors are normally locked against ingress; ingress by card or key. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL01A***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop/HO	4040XP SCUSH	689	LCN
(2)	Kick Plate	KO050 12 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute	MS-SA/75	Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
	Note: Apply to top jamb only.			
(1)	Cat H Jamb Seal Set	135NA	628	NGP
	Note: Apply to side jambs only.			
(1)	HD Panic Threshold	896HD-N x RCE	628	NGP
	Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.			

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	LX-RX-QEL-99NL x 697NL-R/V x RHRBA	626	VON
(1)	Electrified Panic Device, Rim, 01	LX-RX-99EO	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Doors are normally locked against ingress; ingress by card or key. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL01B***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop/HO	4040XP SHCUSH	689	LCN
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
	Note: Apply to top jamb only.			
(1)	Cat H Jamb Seal Set	135NA	628	NGP
	Note: Apply to side jambs only.			
(1)	¼" HD Saddle Threshold	513HD x RCE	628	NGP
	Note: Adjustable door bottom seals by FRP door supplier.			

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	LX-RX-QEL-99NL x 697NL-R/V x RHRBA	626	VON
(1)	Electrified Panic Device, Rim, 01	LX-RX-99EO	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Video-intercom system w/Door Chime, card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Doors are normally locked against ingress; ingress by card or key or by remote release pushbutton integral to two video intercom monitors. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL01C***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | 689 | VON |
| (1) | Rim Cylinder | 20-757 | 626 | SCH |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (2) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
- Note: Provide closer drop plate(s) as required.
- | | | | | |
|-----|---|--|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | | Black | DHSI |
|-----|---|--|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom seals and meeting edge seals.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|------------------------------------|------|-----|
| (2) | Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electrified Panic Device, Rim, 03 | LX-RX-QEL-99NL x 697NL-R/V x RHRBA | 626 | VON |
| (1) | Electrified Panic Device, Rim, 01 | LX-RX-99EO | 626 | VON |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. Doors are normally locked against ingress; ingress by card or key. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL02***Non-electrified Items:***

- | | | | |
|---|---------------------------|-------|-----|
| (1) Closer, w/Spring Stop | 4040XP SCUSH | 689 | LCN |
| (1) Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) Cat H Adhesive Jamb Seal Set | 2525B | Brown | NGP |
| Note: Apply to top jamb only. | | | |
| (1) Cat H Jamb Seal Set | 135NA | 628 | NGP |
| Note: Apply to side jambs only. | | | |
| (1) Panic Threshold | 896N x RCE | 628 | NGP |
| Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold. | | | |

Electrified Items:

- | | | | |
|---|----------------------------|------|-----|
| (1) Continuous Hinge | 224HD x EPT Prep | 628 | IVE |
| (1) Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) Electrified Panic Device, Rim, 02 | LX-RX-QEL-99DT x 697DT-R/V | 626 | VON |
| (1) Sounder (single-gang) | 400U-SN | 630 | SDC |
| (1) Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
| (1) Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications). | | | |

System Function:

Free egress. Door is normally locked against ingress; ingress by card. Door can be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL02A***Non-electrified Items:***

- | | | | |
|--|----------------------------------|-----|-----|
| (1) Rim Cylinder | 20-757 | 626 | SCH |
| (1) Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
| Note: Provide closer drop plate(s) as required. | | | |
| (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom seals, and 1/2" aluminum blocking for mounting of strike without cutting jamb seals; adjust panic device backset accordingly. | | | |

Electrified Items:

- | | | | |
|---|----------------------------|------|-----|
| (1) Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (1) Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) Electrified Panic Device, Rim, 03 | LX-RX-QEL-99NL x 697NL-R/V | 626 | VON |
| (1) Sounder (single-gang) | 400U-SN | 630 | SDC |
| (1) Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
| (1) Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications). | | | |

System Function:

Free egress. Door is normally locked against ingress; ingress by card. Door can be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CL03***Non-electrified Items:***

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA x 4040-61	689	LCN
Note: Provide closer drop plate(s) as required.				
(1)	Wall Stop, Convex	1270CX	626	TRI

Electrified Items:

(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electric Mortise Lockset	L9092EU-17A x LS x RQE x DS	626	SCH
(1)	Lot: Card reader (narrow jamb-mount), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Electrified ingress by card. Mechanical ingress by key. Door is monitored for door position, REX of inside lever and latch position.

Hardware Set CL04***Non-electrified Items:***

(1)	Continuous Hinge	224HD	628	IVE
(1)	Manual Flush Bolt	3917-36 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(2)	Closer, w/Spring Stop/HO	4040XP SHCUSH	689	LCN
(2)	Armor Plate	KA050-2 36 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
Note: Apply to top jamb only.				
(1)	Cat H Jamb Seal Set	135NA	628	NGP
Note: Apply to side jambs only.				
(1)	HD Panic Threshold	896HD-N x RCE	628	NGP
Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.				

Note 1: Welded steel overlapping astragal on push side of inactive leaf by door supplier.

Electrified Items:

(1)	Continuous Hinge	224HD x EPT Prep	628	IVE
(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Mortise	LX-RX-QEL-9975NL x 697NL (RHRBA)	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Door is normally locked against ingress; ingress by card. Door can be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CLS01***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154 x Angle Bracket	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN

Note: Provide closer drop plate(s) as required.

- | | | | |
|-----|---|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | Black | DHSI |
|-----|---|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier for Door VA-1: ADA threshold, jamb and door Bottom and meeting edge seals. Provided by Aluminum Door and Frame Supplier for Door VA-1.2: jamb and meeting edge seals.

Electrified Items:

(2)	Continuous Hinge	112HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	LX-RX-QEL-99NL x 697NL-R/V x LHRBA	626	VON
(1)	Electrified Panic Device, Rim, 02	LX-RX-QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set CLS02***Non-electrified Items:***

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI

Electrified Items:

(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electric Mortise Lockset	L9092EU-17A x LS x RQE x DS	626	SCH
(1)	Lot: Audio-intercom, card reader (narrow jamb-mount), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. See Hardware Set L01 for required emergency lockdown function. Door is monitored for door position, REX of inside lever and latch position.

Hardware Set CLS03***Non-electrified Items:***

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Electrified Items:

(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electric Mortise Lockset	L9095EU-17A	626	SCH
(1)	Focused Motion Sensor	R2E100	Black	BEA

Note: Locate sensor on push side on top jamb directly above lockset lever to detect a person's hand just as it reaches the lever.

- (1) Lot: Card reader (narrow jamb-mount on pull side of strike jamb), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. See Hardware Set L01 for required emergency lockdown function.

Hardware Set CLS04***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154 x Angle Bracket	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN

Note: Provide closer drop plate(s) as required.

- | | | | |
|-----|---|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | Black | DHSI |
|-----|---|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: jamb and meeting edge seals.

Electrified Items:

(2)	Continuous Hinge	112HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	QEL-99NL x 697NL-R/V x LHRBA	626	VON
(1)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. See Hardware Set L01 for required emergency lockdown function. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set L01***Electrified Items:***

- (3) Emergency Lockdown Pushbutton 5211-MP23PP/RxLxE6 630 DRT
 Note: Pushbutton engraved with "Emergency Lockdown". Locate (1) in casework in Reception 176, one on the wall in Principal's Office 174, and one on the wall in SRO 183: all as specifically located by Architect.
- (5) Emergency Lockdown RF Fobs, emergency lockdown system power and control electronics (see electrical specifications)

System Function:

Doors lock against ingress upon emergency lockdown signal from either of (3) emergency lockdown pushbuttons or any of the (5) emergency lockdown RF fobs, regardless of the state of the Custom Switch Panel or other access control system electronics. Emergency lockdown is initiated by pushing on either emergency lockdown pushbutton and is terminated by pulling pushbutton back into non-depressed position, or is initiated by pushing on any of the (5) emergency lockdown fobs and is terminated by pushing again on either of the (5) emergency lockdown fobs. Red LED's on emergency lockdown pushbuttons indicate system is in emergency lock down; Green LED's indicate the system if not in emergency lockdown. These pushbuttons and fobs initiate and terminate lockdown at all doors assigned to hardware sets prefixed with 'L' for emergency lockdown; this includes the following Doors and Hardware Sets:

Hardware Set L02

- | | | | |
|----------------------------------|----------------------------------|-------|-----|
| (6) Butt Hinges | 5BB1HW x 5.0 x 4.5 | 652 | IVE |
| (1) Fire Exit Device, SVR, 03 | 9927NL-F-LBR x 697NL-R/V x RHRBA | 626 | VON |
| (1) Fire Exit Device, SVR, 01 | 9927EO-F-LBR | 626 | VON |
| (1) Rim Cylinder | 20-757 | 626 | SCH |
| (2) Closer, HD Parallel Arm | 4040XP EDA | 689 | LCN |
| (2) Kick Plate | KO050 8 x 1LDW x CS x B4E | 630 | TRI |
| (1) Cat H Astragal Set | 115NA | 628 | NGP |
| (1) Cat H Adhesive Jamb Seal Set | 2525B | Brown | NGP |
| Note: Apply to top jamb only. | | | |
| (1) Cat H Jamb Seal Set | 135NA | 628 | NGP |
| Note: Apply to side jambs only. | | | |

Electrified Items:

- | | | | |
|---|--------------------|-----|-----|
| (2) Magnetic Holder | 2100 x Tri-voltage | 630 | ABH |
| Note: Provide factory extension pieces as needed for clearance. | | | |

Electrical Note 1: These magnetic holders part of the both the Fire Alarm System and the Emergency Lockdown System.

System Function:

Magnetic holders are normally enabled to hold doors open. Doors close, latch and lock against ingress upon fire alarm signal and/or emergency lockdown signal. When closed, ingress by key. Free egress.

Hardware Set L02A

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(2)	Fire Exit Device, SVR, 01	9927EO-F-LBR	626	VON
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
	Note: Apply to top jamb only.			
(1)	Cat H Jamb Seal Set	135NA	628	NGP
	Note: Apply to side jambs only.			

Electrified Items:

(2)	Magnetic Holder	2100 x Tri-voltage	630	ABH
	Note: Provide factory extension pieces as needed for clearance.			

Electrical Note 1: These magnetic holders part of the both the Fire Alarm System and the Emergency Lockdown System.

System Function:

Magnetic holders are normally enabled to hold doors open. Doors close, latch and lock against ingress upon fire alarm signal and/or emergency lockdown signal. When closed, no ingress. Free egress.

Hardware Set L03***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
	Note: Apply to top jamb only.			
(1)	Cat H Jamb Seal Set	135NA	628	NGP
	Note: Apply to side jambs only.			
(1)	Panic Threshold	896N x RCE	628	NGP
	Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.			

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Electrified Panic Device, Rim, 02	LX-RX-QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Card reader (single-gang), low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Doors are normally locked against ingress; no ingress. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set L03A***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | 689 | VON |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (2) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
- Note: Provide closer drop plate(s) as required.
- | | | | | |
|-----|---|--|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | | Black | DHSI |
|-----|---|--|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom and meeting edge seals.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|----------------------------|------|-----|
| (2) | Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (2) | Electrified Panic Device, Rim, 02 | LX-RX-QEL-99DT x 697DT-R/V | 626 | VON |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. Doors are normally locked against ingress; no ingress. Doors may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set L04***Non-electrified Items:***

- | | | | | |
|-----|---|---------------------------|-------|------|
| (1) | Key Removable Mullion | KR-4954 x 154 | 689 | VON |
| (1) | Rim Cylinder | 20-757 | 626 | SCH |
| (2) | Mortise Cylinder | 20-798 | 626 | SCH |
| (2) | Closer, w/Spring Stop | 4040XP SCUSH | 689 | LCN |
| (2) | Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | | Black | DHSI |

Electrified Items:

- | | | | | |
|-----|-----------------------------------|----------------------|------|-----|
| (2) | Continuous Hinge | 224HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electrified Panic Device, Rim, 03 | QEL-99NL x 697NL-R/V | 626 | VON |
| (1) | Electrified Panic Device, Rim, 02 | QEL-99DT x 697DT-R/V | 626 | VON |
| (1) | Keyswitch, single-gang | 5141-24xL x 500351 | 630 | DRT |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. Doors 154.2 and 154.3 are normally locked against ingress; ingress by key. Doors may be kept in an unlocked condition by maintained keyswitch located on wall inside Overhead Shutter 154.4; free ingress. Red LED on keyswitch indicates locked condition; Green indicates unlocked condition. See Hardware Set L01 for required emergency lockdown function.

Hardware Set L04A***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

See System Function for Hardware Set L04.

Hardware Set L05***Non-electrified Items:***

(1)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN
	Note: Provide closer drop plate(s) as required.			
(1)	Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom seals, and ½" aluminum blocking for mounting of strike without cutting jamb seals; adjust panic device backset accordingly.			

Electrified Items:

(1)	Continuous Hinge	112HD x EPT Prep	628	IVE
(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 02	LX-RX-QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(1)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Door is normally locked against ingress; no ingress. Door may be kept in an unlocked condition through the access control system; free ingress. See Hardware Set L01 for required emergency lockdown function. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set L06***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Closer Mounting Bracket	7ASL	689	NGP
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Adhesive Mullion Seal/Mute	MS-SA/75	Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS

Note 1: Do not cut top jamb sound seal for closer arm bracket. Lower the closers on the door and mount closer arm brackets to 7ASL closer mounting brackets.

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	QEL-99NL x 697NL-R/V	626	VON
(1)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Keyswitch, single-gang	5141-24xL x 500351	630	DRT
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Door is normally locked against ingress; ingress by key. Door may be kept in an unlocked condition by maintained keyswitch located on wall inside Control Room 158; free ingress. Red LED on keyswitch indicates locked condition; Green indicates unlocked condition. See Hardware Set L01 for required emergency lockdown function.

Hardware Set L06A***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Closer Mounting Bracket	7ASL	689	NGP
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS

Note 1: Do not cut top jamb sound seal for closer arm bracket. Lower the closers on the door and mount closer arm brackets to 7ASL closer mounting brackets.

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Keyswitch, single-gang	5141-24xL x 500351	630	DRT
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Door is normally locked against ingress; no ingress. Door may be kept in an unlocked condition by maintained keyswitch located on wall inside Control Room 158; free ingress. Red LED on keyswitch indicates locked condition; Green indicates unlocked condition. See Hardware Set L01 for required emergency lockdown function.

Hardware Set L07***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154 x Angle Bracket	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN

Note: Provide closer drop plate(s) as required.

(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75	Black	DHSI
(1)	Lot: Provided by Aluminum Door and Frame Supplier: jamb and meeting edge seals.		

Electrified Items:

(2)	Continuous Hinge	112HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	QEL-99NL x 697NL-R/V	626	VON
(1)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Keyswitch/PB Station, double-gang	D5141-15xP15xL x 500352	630	DRT
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. Door is normally locked against ingress; ingress by key or by momentary pushbutton integral to Keyswitch/PB Station located on Media Center casework. Door may be kept in an unlocked condition by maintained keyswitch integral to Keyswitch/PB Station; free ingress. Red LED on keyswitch indicates locked condition; Green indicates unlocked condition. See Hardware Set L01 for required emergency lockdown function.

Hardware Set L08***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(3)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Keyswitch, single-gang, MTN	5141-24xL x 500351	630	DRT
Note: Provide keyswitch factory printed with "Magnetic Holders"				
(1)	Keyswitch, single-gang, MTN	5141-24xL x 500351	630	DRT
Note: Provide keyswitch factory printed with "Exit Devices"				
(2)	Magnetic Holder	2100 x Tri-voltage	630	ABH
Note: Provide factory extension pieces as needed for clearance.				

Electrical Note 1: These magnetic holders are part of the Emergency Lockdown System but are not associated with the Fire Alarm System.

- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress at all times. Magnetic holders are normally enabled to hold doors open. Exit devices are normally locked against ingress. Keyswitch marked "Magnetic Holders" enables/disables magnetic holders at Doors 155.2, 155.3, 155.43, and 155.5; LED on board keyswitch indicates Green for enabled, Red for disabled. Keyswitch marked "Magnetic Holders" enables/disables electric dogging of exit devices at Doors 155.2, 155.3, 155.43, and 155.5; LED on board keyswitch indicates Green for enabled (free ingress), Red for disabled (doors locked against ingress). When doors are closed and locked against ingress, ingress by key through Doors 155.3 and 155.5. Doors close and lock against ingress upon emergency lockdown signal no matter what state the keyswitches are in. See Hardware Set L01 for required emergency lockdown function. Locate keyswitches on Commons/Café 155 wall within 24" of LHRB side jamb, south of Door 155.2.

Hardware Set L08A***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	QEL-99NL x 697NL-R/V	626	VON
(1)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(2)	Magnetic Holder	2100 x Tri-voltage	630	ABH

Note: Provide factory extension pieces as needed for clearance.

Electrical Note 1: These magnetic holders are part of the Emergency Lockdown System but are not associated with the Fire Alarm System.

- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

See System Function of Hardware Set L08.

Hardware Set L08B***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(2)	Magnetic Holder	2100 x Tri-voltage	630	ABH

Note: Provide factory extension pieces as needed for clearance.

Electrical Note 1: These magnetic holders are part of the Emergency Lockdown System but are not associated with the Fire Alarm System.

- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

See System Function of Hardware Set L08.

Hardware Set L09

(3)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Fire Exit Device, Rim, 03	99L-F x 996L-NL-R/V-17	626	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Jamb Seal Set Note: Apply to top jamb only.	2525B	Brown	NGP
(1)	Cat H Jamb Seal Set Note: Apply to side jambs only.	135NA	628	NGP

Electrified Items:

(1)	Magnetic Holder	2100 x Tri-voltage	630	ABH
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Note: Provide factory extension pieces as needed for clearance.

Electrical Note 1: These magnetic holders are part of the both the Fire Alarm System and the Emergency Lockdown System.

System Function:

Magnetic holder is normally enabled to hold door open. Door closes, latches and locks against ingress upon fire alarm signal and/or emergency lockdown signal. When closed, ingress by key. Free egress.

Hardware Set LS01***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154 x Angle Bracket	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN
Note: Provide closer drop plate(s) as required.				
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI
(1)	Lot: Provided by Aluminum Door and Frame Supplier: jamb and meeting edge seals.			

Electrified Items:

(2)	Continuous Hinge	112HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 03	QEL-99NL x 697NL-R/V x RHRBA	626	VON
(1)	Electrified Panic Device, Rim, 02	QEL-99DT x 697DT-R/V	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(2)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set LW01***Non-electrified Items***

(2)	Continuous Hinges	224HD	628	IVE
(2)	Fire Exit Device, SVR, 08	WS-9927L-F x 996L-R/V-06	626	VON
(2)	Rim Cylinder	20-757	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate/Latch Guard	LGO-3	630	VON
(1)	Cat H Astragal Set	8195	628	ZER
(1)	Cat H Jamb Seal Set	8803AA	628	ZER
(1)	¼" Saddle Threshold	546A x RCE	628	ZER

Note 1: ¾" maximum door undercut. Bottom strike for panic device must be mortised flush into the top of the threshold and grouted in (see Drawings).

Note 2: This hardware set includes products listed for use as part of a complete tested assembly using Allegion Steelcraft windstorm doors and frame. If using doors and frames by another manufacturer, then the hardware must be part of a complete tested assembly for use with those doors and frames.

Electrified Items

(2)	Magnetic Door Holder	SEM7800	689	LCN
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System Function: Free egress; outside lever trims can be left locked or unlocked against ingress. Free egress by pushing on either exit device touchbar. Magnetic holders are normally enabled to hold doors open; holders release upon fire alarm or power failure or emergency lockdown signal so that doors close and latch. Doors may also be manually pulled away from holders at which point they will automatically close and latch. See Hardware Set L01 for required emergency lockdown function.

Hardware Set M01***Non-electrified Items:***

(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
Note: Apply to top jamb only.				
(1)	Cat H Jamb Seal Set	135NA	628	NGP
Note: Apply to side jambs only.				
(1)	Panic Threshold	896N x RCE	628	NGP
Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.				

Electrified Items:

(1)	Continuous Hinge	224HD x EPT Prep	628	IVE
(1)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 01	LX-RX-99EO	626	VON
(1)	Sounder (single-gang)	400U-SN	630	SDC
(1)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Free egress. No ingress. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set M01A***Non-electrified Items:***

- | | | | |
|---------------------------|----------------------------------|-----|-----|
| (1) Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
|---------------------------|----------------------------------|-----|-----|
- Note: Provide closer drop plate(s) as required.
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom seals, and ½” aluminum blocking for mounting of strike without cutting jamb seals; adjust panic device backset accordingly.

Electrified Items:

- | | | | |
|---------------------------------------|------------------|------|-----|
| (1) Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (1) Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) Electrified Panic Device, Rim, 01 | LX-RX-99EO | 626 | VON |
| (1) Sounder (single-gang) | 400U-SN | 630 | SDC |
| (1) Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. No ingress. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set M02***Non-electrified Items:***

- | | | | |
|--------------------------------------|---------------------------|-------|------|
| (1) Key Removable Mullion | KR-4954 x 154 | 689 | VON |
| (1) Rim Cylinder | 20-757 | 626 | SCH |
| (1) Mortise Cylinder | 20-798 | 626 | SCH |
| (2) Closer, w/Spring Stop | 4040XP SCUSH | 689 | LCN |
| (2) Kick Plate | KO050 8 x 2LDW x CS x B4E | 630 | TRI |
| (1) Cat H Adhesive Mullion Seal/Mute | MS-SA/75 | Black | DHSI |
| (1) Cat H Astragal Set | 115NA | 628 | NGP |
| (1) Cat H Adhesive Jamb Seal Set | 2525B | Brown | NGP |
- Note: Apply to top jamb only.
- | | | | |
|-------------------------|-------|-----|-----|
| (1) Cat H Jamb Seal Set | 135NA | 628 | NGP |
|-------------------------|-------|-----|-----|
- Note: Apply to side jambs only.
- | | | | |
|---------------------|------------|-----|-----|
| (1) Panic Threshold | 896N x RCE | 628 | NGP |
|---------------------|------------|-----|-----|
- Note: 3/8” door undercut required for proper mating of door bottom with seal integral to threshold.

Electrified Items:

- | | | | |
|---------------------------------------|------------------|------|-----|
| (2) Continuous Hinge | 224HD x EPT Prep | 628 | IVE |
| (2) Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (2) Electrified Panic Device, Rim, 01 | LX-RX-99EO | 626 | VON |
| (1) Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. No ingress. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set M02A***Non-electrified Items:***

- | | | | | |
|-----|-----------------------|----------------------------------|-----|-----|
| (1) | Key Removable Mullion | KR-4954 x 154 x Angle Bracket | 689 | VON |
| (1) | Mortise Cylinder | 20-798 | 626 | SCH |
| (2) | Closer, w/Spring Stop | 4040XP SCUSH x 4040-30 x 4040-61 | 689 | LCN |
- Note: Provide closer drop plate(s) as required.
- | | | | | |
|-----|---|--|-------|------|
| (1) | Cat H Adhesive Mullion Seal/Mute MS-SA/75 | | Black | DHSI |
|-----|---|--|-------|------|
- (1) Lot: Provided by Aluminum Door and Frame Supplier: ADA threshold, jamb and door bottom and meeting edge seals.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|------------------|------|-----|
| (2) | Continuous Hinge | 112HD x EPT Prep | 628 | IVE |
| (2) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (2) | Electrified Panic Device, Rim, 01 | LX-RX-99EO | 626 | VON |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. No ingress. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set M03***Non-electrified Items:***

- | | | | | |
|-----|------------------------------|------------------------------|-------|-----|
| (1) | Continuous Hinge | 224HD | 628 | IVE |
| (1) | Manual Flush Bolt | 3917-36 (top) | 626 | TRI |
| (1) | Manual Flush Bolt | 3917-12 | 626 | TRI |
| (1) | Lock Guard, Mortise Lock | 5000T | 626 | TRI |
| (2) | Closer, w/Spring Stop/HO | 4040XP SHCUSH | 689 | LCN |
| (2) | Armor Plate | KA050-2 36 x 2LDW x CS x B4E | 630 | TRI |
| (1) | Cat H Adhesive Jamb Seal Set | 2525B | Brown | NGP |
- Note: Apply to top jamb only.
- | | | | | |
|-----|---------------------|-------|-----|-----|
| (1) | Cat H Jamb Seal Set | 135NA | 628 | NGP |
|-----|---------------------|-------|-----|-----|
- Note: Apply to side jambs only.
- | | | | | |
|-----|--------------------|---------------|-----|-----|
| (1) | HD Panic Threshold | 896HD-N x RCE | 628 | NGP |
|-----|--------------------|---------------|-----|-----|
- Note: 3/8" door undercut required for proper mating of door bottom with seal integral to threshold.

Note 1: Welded steel overlapping astragal on push side of inactive leaf by door supplier.

Electrified Items:

- | | | | | |
|-----|-----------------------------------|----------------------|------|-----|
| (1) | Continuous Hinge | 224HD x EPT Prep | 628 | IVE |
| (1) | Jamb-to-Door Power Transfer | EPT-10 | SP28 | VON |
| (1) | Electrified Panic Device, Mortise | LX-RX-9975EO (RHRBA) | 626 | VON |
| (1) | Sounder (single-gang) | 400U-SN | 630 | SDC |
| (2) | Door Contact, Pop-in, DPDT | 1076D-G | Grey | ILX |
- (1) Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).

System Function:

Free egress. No ingress. Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set M04***Non-electrified Items:***

(1)	Key Removable Mullion	KR-4954 x 154	689	VON
(1)	Rim Cylinder	20-757	626	SCH
(4)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Adhesive Mullion Seal/Mute MS-SA/75		Black	DHSI

Electrified Items:

(2)	Continuous Hinge	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(1)	Electrified Panic Device, Rim, 08	RX-ALK-99L x 697NL-R/V	626	VON
(1)	Electrified Panic Device, Rim, 01	RX-ALK-99EO	626	VON
(2)	Key Switch, Momentary	5141-25xL	630	DRT
(2)	Door Contact, Pop-in, DPDT	1076D-N	White	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Exit alarms on board exit devices are enabled/disabled by keyswitches integral to the exit devices.

Exit Alarms Enabled: This is to secure Corridors C106 in base bid and C104 in Alternate against ingress. Red LED's integral to exit devices and keyswitches are lit. Free egress with audible alarm; momentary keyswitches on either side of opening bypass alarm for ingress and egress. LED's on exit devices and keyswitches indicate Green during alarm bypass period.

Exit Alarms Disabled: Green LED's integral to exit devices and keyswitches are lit. Free egress with no alarm; for ingress, lever trim can be left in locked or unlocked condition by key. Doors are monitored for door position and request to exit signaling from the exit device touchbar(s) and for alarm indication from the exit devices.

Hardware Set M05***Non-electrified Items:***

Note 1: All non-electrified items by overhead door supplier.

Electrified Items:

(1)	Sounder (single-gang)	400U-SN	630	SDC
(1)	Door Contact, Exterior OHD	QS 911MA		QSW
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Local alarm sounds and access control system is notified if door is propped open for longer than the allowable time period requested by Owner. Door is monitored for door position.

Hardware Set M06***Non-electrified Items:***

(1)	Entrance Lock, Anti-vandal	ND92-SPA	626	SCH
(1)	Cylinder Core		626	SCH

Note 1: Balance of non-electrified items by greenhouse door supplier.

Note 2: Hardware Supplier to coordinate and provide spacers, lock with proper backset, etc. for proper fit-up with door.

Electrified Items:

(2)	Door Contact, Surface	MSS-1G	628	SEC
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Doors are monitored for door position.

Hardware Set M07***Non-electrified Items:***

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Communicating Lock	L9466-17A	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, w/Stop/HO	4040XP HCUSH	689	LCN
(1)	Cat H Jamb Seal Set	700UA	628	NGP

Note: Apply to all (4) jambs.

Electrified Items:

(1)	Door Contact, Pop-in, DPDT	1076D-G	Grey	ILX
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Door is monitored for door position.

Hardware Set MW01***Non-electrified Items***

(2)	Closer, w/Spring Stop/HO	4040XP SHCUSH	689	LCN
(2)	Kick Plate/Latch Guard	LGO-4	630	VON
(1)	Cat H Astragal Set	8195	628	ZER
(1)	Cat H Jamb Seal Set	8803AA	628	ZER
(2)	Door Sweep/Drip	8197	628	ZER
(1)	¼" Saddle Threshold	546A x RCE	628	ZER

Note 1: ¾" maximum door undercut. Bottom strike for panic device must be mortised flush into the top of the threshold and grouted in (see Drawings).

Note 2: This hardware set includes products listed for use as part of a complete tested assembly using Allegion Steelcraft windstorm doors and frame. If using doors and frames by another manufacturer, then the hardware must be part of a complete tested assembly for use with those doors and frames.

Electrified Items

(2)	Continuous Hinges	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Panic Device, SVR, 01	WS-LX-RX-9927EO	626	VON
(2)	Door Contact, Pop-in, DPDT	1076D-N	White	ILX
(1)	Lot: Control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Door is monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s).

Hardware Set MW02***Non-electrified Items***

(2)	Rim Cylinder	20-757	626	SCH
(3)	Mortise Cylinder	20-798	626	SCH
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate/Latch Guard	LGO-3	630	VON
(1)	Cat H Astragal Set	8195	628	ZER
(1)	Cat H Jamb Seal Set	8803AA	628	ZER
(2)	Door Sweep/Drip	8197	628	ZER
(1)	¼" Saddle Threshold	546A x RCE	628	ZER

Note 1: ¾" maximum door undercut. Bottom strike for panic device must be mortised flush into the top of the threshold and grouted in (see Drawings).

Note 2: This hardware set includes products listed for use as part of a complete tested assembly using Allegion Steelcraft windstorm doors and frame. If using doors and frames by another manufacturer, then the hardware must be part of a complete tested assembly for use with those doors and frames.

Electrified Items

(2)	Continuous Hinges	224HD x EPT Prep	628	IVE
(2)	Jamb-to-Door Power Transfer	EPT-10	SP28	VON
(2)	Panic Device, SVR, 08	WS-ALK-LX-RX-9927L x 996L-R/V-17	626	VON
(2)	Key Switch, Momentary	5141-25xL	630	DRT
(2)	Door Contact, Pop-in, DPDT	1076D-N	White	ILX
(2)	Magnetic Door Holder	SEM7800	689	LCN
(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).			

System Function:

Magnetic holders are normally powered to hold the doors open; doors close and latch upon fire alarm. Exit alarms on board exit devices are enabled/disabled by keyswitches integral to the exit devices.

Exit Alarms Enabled: This is to secure the Auditorium against ingress. Red LED's integral to exit devices and keyswitches are lit. Free egress with audible alarm; momentary keyswitches on either side of opening bypass alarm for ingress and egress. LED's on exit devices and keyswitches indicate Green during alarm bypass period.

Exit Alarms Disabled: Green LED's integral to exit devices and keyswitches are lit. Free egress with no alarm; for ingress, lever trims can be left in locked or unlocked condition by key. Doors are monitored for door position, latch position, and request to exit signaling from the exit device touchbar(s) and for alarm indication from the exit devices.

Hardware Set S01

(1)	Custom Switch Panel, Desktop	7205xL5x5T24x3P25xE5 x 7605-ENCL	Dortronics
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Note: Locate desktop panel on top of casework in Reception 176 as directed by Architect.

(1)	Lot: Low voltage power, control electronics, conduit, backboxes, cabling and terminations for fully functional system (see electrical specifications).		
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System Function:

See Woodford County High School Custom Switch Panel paragraph at beginning of Hardware Schedule for required System Function.

Hardware Set 01

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Wall Stop, Convex	1270CX	626	TRI

Hardware Set 01A

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Kick Plate	KO050 16 x 2LDW x CS x B4E	630	TRI
(1) Wall Stop, Convex	1270CX	626	TRI

Hardware Set 01B

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Overhead Stop, HD, Concealed	100S x ADJ	630	GLY

Hardware Set 01C

(1) Continuous Hinge	224HD	628	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Wall Stop, Convex	1270CX	626	TRI

Hardware Set 01D

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Closer, Regular Arm	4040XP Reg	689	LCN
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1) Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 01E

(3) Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1) Storeroom Lock	L9080-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Wall Stop, Convex	1270CX	626	TRI

Hardware Set 01F

(3)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 01G

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Universal Stop, 1-1/2"	7280	630	TRI

Hardware Set 01H

(3)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI
Note: Install in inverted U position with 6" of top lock corner of door.				

Hardware Set 01J

(6)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI
Note: Install in inverted U position with 6" of top lock corner of door.				

Hardware Set 01K

(6)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Storeroom Lock	L9080-17A x Less Outside Trim	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Flush Ring Pull	1068	626	TRI
Note: Supplier to detail flush ring pull for spindle thickness and orientation.				
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Overhead Holder, HD, Surface	900H	630	GLY

Hardware Set 01L

(6)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Overhead Holder, HD, Surface	900H	630	GLY

Hardware Set 01M

(3)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Overhead Holder, HD, Concealed	100H x ADJ	630	GLY

Hardware Set 01N

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI

Note: Install in inverted U position with 6" of top lock corner of door.

Hardware Set 01P

(6)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Storeroom Lock	L9080-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Overhead Holder, HD, Concealed	100H x ADJ	630	GLY

Hardware Set 02

(3)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Panic Device, Rim, 03, LD	LD99L x 996L-NL-R/V-17	626	VON
(1)	Rim Cylinder	Primus LFIC 6-pin	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				

Hardware Set 02A

(3)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Panic Device, Rim, 03, LD	LD99L x 996L-NL-R/V-17	626	VON
(1)	Rim Cylinder	Primus LFIC 6-pin	626	SCH
(1)	Closer, w/Spring Stop/HO	4040XP SHCUSH	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI

Hardware Set 02B

(3)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Fire Exit Device, Rim, 01	99EO-F	626	VON
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
Note: Apply to top jamb only.				
(1)	Cat H Jamb Seal Set	135NA	628	NGP
Note: Apply to side jambs only.				

Hardware Set 02C

(1)	Continuous Hinge	112HD	628	IVE
(1)	NS Panic Device, Rim, 01	LD99EO	626	VON
(1)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN
Note: Provide closer drop plate(s) as required.				
(1)	Lot: Provided by Aluminum Door and Frame Supplier: Jamb seals, and ½" aluminum blocking for mounting of strike without cutting jamb seal; adjust panic device backset accordingly.			

Hardware Set 02D

(3)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Fire Exit Device, Rim, 01	99EO-F	626	VON
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Cat H Adhesive Jamb Seal Set	2525B	Brown	NGP
Note: Apply to top jamb only.				
(1)	Cat H Jamb Seal Set	135NA	628	NGP
Note: Apply to side jambs only.				

Hardware Set 03

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Hotel Privacy Lock w/Indicators	L9485-17A x L283-722 x L283-711	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 04

(1)	Continuous Hinge	224HD	628	IVE
(1)	Privacy Set	ND40-SPA	626	SCH
(1)	Wall Stop, Concave	1270PV	626	TRI

Hardware Set 04A

(1)	Continuous Hinge	224HD	628	IVE
(1)	Privacy Set	ND40-SPA	626	SCH
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 04B

(1)	Continuous Hinge	224HD	628	IVE
(1)	Privacy Set	ND40-SPA	626	SCH
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN

Hardware Set 05

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Office Lock	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 05A

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Office Lock w/Indicators	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI

Note: Locate approx. 4" down and in from top lock corner of door.

Hardware Set 05B

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Office Lock	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 05C

(1)	Continuous Hinge	224HD	628	IVE
(1)	Office Lock	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Armor Plate	KA050-2 34 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				

Hardware Set 05D

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Office Lock	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 05E

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Office Lock	L9050-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 06

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 06A

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 06B

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY

Note 1: Door 130A is Right Hand.

Hardware Set 06C

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 06D

(6)	Butt Hinges	5BB1 x 4.5 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Classroom Lock	L9070-17A x Less Outside Trim	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Flush Ring Pull	1068	626	TRI
Note: Supplier to detail flush ring pull for spindle thickness and orientation.				
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI

Note: Install in inverted U position with 6" of top lock corner of door.

Hardware Set 06E

(1)	Continuous Hinge	224HD	628	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Armor Plate	KA050-2 34 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 06F

(1)	Continuous Hinge	224HD	628	IVE
(1)	Classroom Lock	L9070-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Armor Plate	KA050-2 34 x 2LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY

Hardware Set 06G

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Classroom Lock	L9070-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Overhead Stop, HD, Surface	900S	630	GLY

Note 1: Door 159.1 is Right Hand Reverse Bevel.

Hardware Set 06H

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Classroom Lock	L9070-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Overhead Stop, HD, Surface	900S	630	GLY

Hardware Set 06J

(3) Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1) Classroom Lock	L9070-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Cat H Adhesive Jamb Seal Set Note: Apply to top jamb only.	2525B	Brown	NGP
(1) Cat H Jamb Seal Set Note: Apply to side jambs only.	135NA	628	NGP

Hardware Set 07

(3) Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1) Privacy Lock w/Indicator	L9496-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Closer, Regular Arm	4040XP Reg	689	LCN
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1) Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1) Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 07A

(3) Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1) Privacy Lock w/Indicator	L9496-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Closer, Regular Arm	4040XP Reg	689	LCN
(1) Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1) Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1) Wall Stop, Convex	1270CX	626	TRI
(1) Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 07B

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Privacy Lock w/Indicator	L9496-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY

Hardware Set 07C

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Privacy Lock w/Indicator	L9496-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 07D

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Privacy Lock w/Indicator	L9496-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 07E

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Privacy Lock w/Indicator	L9496-17A	626	SCH
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 08

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Passage Set	L010-17A	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 08A

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Passage Set	L010-17A	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 08B

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Passage Set	L010-17A	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 08C

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Passage Set	L010-17A	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 08D

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Passage Set	L010-17A	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 09

(2)	Continuous Hinge	112HD	628	IVE
(2)	Push/Pull Bar Set	1731	630	TRI
(2)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN
Note: Provide closer drop plate(s) as required.				
(1)	Lot: Provided by Aluminum Door and Frame Supplier: Jamb and meeting edge seals.			

Hardware Set 09A

(1)	Continuous Hinge	112HD	628	IVE
(1)	Push/Pull Bar Set	1731	630	TRI
(1)	Closer, w/Spring Stop	4040XP SCUSH x 4040-30 x 4040-61	689	LCN
Note: Provide closer drop plate(s) as required.				
(1)	Lot: Provided by Aluminum Door and Frame Supplier: Jamb and meeting edge seals.			

Hardware Set 10

(1)	Entrance Lock, Anti-vandal	ND92-SPA	626	SCH
(1)	Cylinder Core	20-765	626	SCH

Note 1: Balance of items by greenhouse door supplier.

Note 2: Hardware Supplier to coordinate and provide spacers, lock with proper backset, etc. for proper fit-up with door.

Hardware Set 11

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Privacy Set	L040-17A	626	SCH
(1)	Closer, HD Parallel Arm	4040XP EDA	SRI-689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI

Hardware Set 11A

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1)	Privacy Set	L040-17A	626	SCH
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 12

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom Security Lock	L9071-17A	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI

Hardware Set 13

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom/Double Cyl Deadbolt	356 x Less Cylinders	626	YAL
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Push Plate	1809-4 x (Special 8 x 24) x RC x CFC	630	TRI
(1)	Pull Plate	1014-3B x RC x CFT x CFC	630	TRI
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI
Note: Install in inverted U position with 6" of top lock corner of door.				

Hardware Set 13A

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Classroom/Double Cyl Deadbolt	356 x Less Cylinders	626	YAL
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Push Plate	1809-4 x (Special 8 x 24) x RC x CFC	630	TRI
(1)	Push Plate	1809-4 x (Special 8 x 24) x RC	630	TRI
(1)	Pull Plate	1014-3B x RC x CFT x CFC	630	TRI
(1)	Pull Plate	1014-3B x RC	630	TRI
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(2)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI

Note: Install in inverted U position with 6" of top lock corner of door.

Hardware Set 13B

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Classroom/Double Cyl Deadbolt	356 x Less Cylinders	626	YAL
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Push Plate	1809-4 x (Special 8 x 24) x RC x CFC	630	TRI
(1)	Pull Plate	1014-3B x RC x CFT x CFC	630	TRI
(1)	Closer, Regular Arm	4040XP Reg	689	LCN
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder Shim	Z900.0 Shim for 1283-6S x 1"	628	TRI

Note: Install in inverted U position with 6" of top lock corner of door.

Hardware Set 14

(1)	Mortise Cylinder	20-798	626	SCH
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Note 1: Balance of hardware, including locking device compatible with key cylinder on this building's master key system by door supplier. Coordinate cylinder type and cam.

Hardware Set 14A

Note 1: All hardware, including non-keyed manual locking device(s) by door supplier.

Hardware Set 15

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(2)	Push/Pull Bar Set, 1"D, 12" Pull	1731	630	TRI
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Astragal Set	172NA	628	NGP
(1)	Cat H Jamb Seal Set	135NA	628	NGP

Hardware Set 15A

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(2)	Push/Pull Bar Set, 1"D, 12" Pull	1731	630	TRI
(2)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Closer Mounting Bracket	7ASL	689	NGP
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(2)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS

Note 1: Do not cut top jamb sound seal for closer arm brackets. Lower the closers on the door and mount closer arm brackets to 7ASL closer mounting brackets.

Hardware Set 15B

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(2)	Push/Pull Bar Set, 1"D, 12" Pull	1731	630	TRI
(1)	Closer, w/Spring Stop	4040XP SCUSH	689	LCN
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(2)	Closer Mounting Bracket	7ASL	689	NGP
(2)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				
(1)	Cat H Astragal Set	115NA	628	NGP
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS

Note 1: Do not cut top jamb sound seal for closer arm brackets. Lower the closers on the door and mount closer arm brackets to 7ASL closer mounting brackets.

Hardware Set 16

(2)	Continuous Hinges	224HD	628	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Panic Device, Mortise, 03	LD9975L x 996L-NL-M-17 x RHRBA	626	VON
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Closer Mounting Bracket	7ASL	689	NGP
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Kick Plate	KO050 8 x 3-5/8" LDW x CS x B4E	630	TRI
Note: Mount on inactive leaf.				
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Overlapping Astragal	109NA	628	NGP
Note: Locate on push side of inactive leaf with edge of metal retainer 1-5/8" back from strike edge of door.				
Butt kick plate to astragal.				
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS

Note 1: Do not cut top jamb sound seal for closer arm bracket. Lower the closer on the door and mount closer arm bracket to 7ASL closer mounting brackets.

Hardware Set 16A

(2)	Continuous Hinges	224HD	628	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Panic Device, Mortise, 01	LD9975EO x RHRBA	626	VON
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(1)	Closer, HD Parallel Arm	4040XP EDA	689	LCN
(1)	Closer Mounting Bracket	7ASL	689	NGP
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Kick Plate	KO050 8 x 3-5/8" LDW x CS x B4E	630	TRI
Note: Mount on inactive leaf.				
(1)	Wall Stop/Holder w/Shim	1283-6S x (1) Z900-35643.628 1" Shim	628	TRI
Note: Locate approx. 4" down and in from top lock corner of door.				
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Cat H Overlapping Astragal	109NA	628	NGP
Note: Locate on push side of inactive leaf with edge of metal retainer 1-5/8" back from strike edge of door.				
Butt kick plate to astragal.				
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(2)	Surface Sound Sweep	SSDB3	628	DHS
Note 1: Do not cut top jamb sound seal for closer arm bracket. Lower the closer on the door and mount closer arm bracket to 7ASL closer mounting brackets.				

Hardware Set 16B

(6)	Butt Hinges	5BB1HW x 5.0 x 4.5	652	IVE
(1)	Manual Flush Bolt	3917-24 (top)	626	TRI
(1)	Manual Flush Bolt	3917-12	626	TRI
(1)	Panic Device, Mortise, 03	LD9975L x 996L-NL-M-17 x RHRBA	626	VON
(1)	Mortise Cylinder	20-798	626	SCH
(1)	Lock Guard, Mortise Lock	5000T	626	TRI
(1)	Closer, w/Stop/HO	4040XP HCUSH	689	LCN
(2)	Kick Plate	KO050 8 x 1LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Surface	900S	630	GLY

Hardware Set 17

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Communicating Lock	L9466-17A	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Wall Stop, Convex	1270CX	626	TRI
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 17A

(3)	Butt Hinges	5BB1 x 4.5 x 4.0	652	IVE
(1)	Communicating Lock	L9466-17A	626	SCH
(2)	Mortise Cylinder	20-798	626	SCH
(1)	Kick Plate	KO050 8 x 2LDW x CS x B4E	630	TRI
(1)	Overhead Stop, HD, Concealed	100S x ADJ	630	GLY
(1)	Adjustable Jamb Seal Set	107NA	628	NGP
(1)	Surface Sound Sweep	SSDB3	628	DHS

Hardware Set 18

(3) Butt Hinges	5BB1 x 4.5 x 4.0	630	IVE
(1) Service	L9026-17A	626	SCH
(1) Mortise Cylinder	20-798	626	SCH
(1) Mop Plate	KM050 4 x 1LDW x CS x B4E	630	TRI
(1) Wall Stop, Convex	1270CX	626	TRI

3.8 DOOR - HARDWARE SET INDEX

Door	HW Set	119	02	135.2	M01	149C	05B
100	01	120	02A	135.3	M05	149F	01B
101	01	121	01	135.4	CL02	149G	14
101A	07	121.1	M01A	135A	01	149G.1	14
101A.1	07A	121A	06B	135B	01	149G.2	14
101B	08A	121A-1	06C	135C	01L	150	01L
101B.1	08	122.1	04A	136	01	151	01
101C	08C	122A	01A	137	01	151.1	14A
101C.1	08B	123.1	04	138	02A	152.1	04
102	01	123.2	04	139	02A	152.2	04
103	01	123.3	04	140	01	152.3	04
104	L09	123.4	04A	141	16B	152.4	04
104.1	02B	123A	03	142	01G	152.5	04A
104A	06H	124	M02A	142.1	CL04	152A	07A
105	01	124.1	CL01C	143.1	04A	153.1	04
106	01	125	02	143A	01A	153.2	04
107	L07	125.1	02	144.1	04	153.3	04A
107.1	02C	126	05B	144.2	04	153A	01A
107A	05B	127	05B	144.3	04	154	15
107B	05B	128	01	144.4	04A	154.1	15
108	01G	129	01	144A	03	154.2	L04
109	01	130	02	145	01F	154.3	L04A
110	01	130.1	02	146	01	154.4	14
111	01	130A	06B	147	01B	154A	13
112	01	130A.1	01	147A	06	154A-1	01H
113	01	131	01	147A.1	06	154A-2	13
114	01	132	01	148	01B	154A-2.1	04
115	01	133	01	148A	05B	154A-2.2	04
116	01	134	02	149	01M	154A-2.3	04A
117	01	134.1	02	149.1	05C	154B	13
118	01	135	17A	149A	11	154B-1	01H
		135.1	17	149B	08D	154B-2	13

154B-2.1	04	155.1	L02	172	05	VA-3.1	09A
154B-2.2	04A	156	15A	173	05	VA-3.2	09A
154C - BB	M02	156.1	15A	174	05	VA-3.3	09
154D	13A	156A	01E	175	05	VA-3.4	ACL01
154D-1	06D	156B	01E	176	CL03	VA-3.5	L05
154D.1	M01	157	M03	177	CLS02	VA-3.6	L05
154E	13B	158	05E	177.1	CLS03	VA-3.7	L03A
154E-1	05B	158A	C01A	177A	05	VA-4	L06A
154F	13A	159	15B	177A-1	07B	VA-5	L06
154F.1	M01	159.1	15A	178	05	VA-6	16
154G	01J	159A	05B	179	01D	VA-7	16A
154H	01J	159B	01C	180	11A	VA-8	16
154J	CL01A	159C	06A	181	11A	VA-9	16A
154K	13	159D	06A	182	05	200	01
154K-1	01	159E	06B	182A	C01A	201	01P
154K-2	13	159E.1	06G	183	05A	202	01
154K-2.1	04	160.1	04	C102	L02A	203	01
154K-2.2	04	160.2	04	C102.1	L02	204	01
154K-2.3	04	160.3	04	C102.2	M02A	205	01
154K-2.4	04	160.4	04A	C102.3	CL02A	206	01
154K-2.5	04B	161.1	04	C103	L02A	207	01G
154K-2.6	18	161.2	04A	C103.1	L02	208	01
154K-2.7	04	162	01A	C103.2	M02A	209	01
154K-2.8	04A	163	15A	C103.3	CL02A	210	01
154M	13	163.1	05A	C104	01N	211	01
154M-1	01	163A	06A	C104.1	CL01B	212	01
154M-2	13	163B	06F	C105	LW01	213	01
154M-2.1	04	163C	06E	C105.1	MW02	214	01
154M-2.2	04	163D	05B	C105.2	MW01	215	01
154M-2.3	04	163E	06F	C106	M04	216	01
154M-2.4	04	163F	06A	C106.1	M02	217	01
154M-2.5	04B	163G	06A	G-101	M06	218	02A
154M-2.6	04	164	12	G-101.1	10	219	02A
154M-2.7	04	165	05D	G-102	M06	220	01
154M-2.8	04A	166	05D	VA-1	CLS01	221	C01
154P	07C	167	05D	VA-1.1	ALS01	222.1	04A
154P-1	07C	168	05D	VA-1.2	CLS04	222A	01A
154P-1.1	07D	169	05	VA-1.3	LS01	223.1	04
154Q	05B	169.1	CL02	VA-2	CL01	223.2	04
154R	05B	170	05	VA-2.1	L03	223.3	04
155	L02A	171	05	VA-3	A01	223.4	04A

223A	02
224	02D
224.1	L09
224A	06J
225	01
225A	06G
225B	06A
226	01
227	01
228	01
229	01
230	01
231	01
232	01
233	01

234	01
235	01
236	01
237	01
238	01
239	01
240	02A
241	02A
242	01
243	01
244	01G
244A	C01A
245.1	04A
245A	01A
246.1	04

246.2	04
246.3	04
246.4	04A
246A	03
247	01F
248	02B
248.1	L09
248A.1	06C
248A.2	06C
248A-1	06
249	L09
249.1	02B
250A	C01
251A	C01
C202	L02A

C202.1	L02
C203	L02A
C203.1	L02
301	M07
302	M07

Alternate	
154C-ALT	M04
155.2	L08
155.3	L08A
155.4	L08B
155.5	L08A
155.6	CL01C

END OF SECTION

SECTION 087100.01 - FINISH HARDWARE SUPPLIER'S CERTIFICATION**FINISH HARDWARE SUPPLIER'S CERTIFICATION**

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

This certification must be completed and submitted within 24 hours after bids are received. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Finish Hardware Supplier:

I certify that _____ (print or type name of employee) is a current member of the Door and Hardware Institute (DHI), certified by DHI as an Architectural Hardware Consultant. I further certify that this person has fulfilled the educational experience requirements of the DHI's Continuing Education Program for Consultants and is authorized by DHI to use the Official Seal.

All hardware for this project shall be scheduled and furnished by or under direct supervision of the person listed above, who is also a full-time employee of the firm listed above.

DHI Membership Number _____

DHI Official Seal Valid Through _____ (Date)

Signed: _____ Title: _____

SECTION 088000 - GLAZING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Glass.
- B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 079005 - Joint Sealers: Sealant and back-up material.
- B. Section 081113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- C. Section 081416 - Flush Wood Doors: Factory glazed doors.
- D. Section 084313 - Aluminum-Framed Storefronts: Framing system.
- E. Section 084413 - Glazed Aluminum Curtain Walls: Framing system.
- F. Section 088300 - Mirrors.
- G. Section 102800 - Toilet, Bath, and Laundry Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- G. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- H. GANA (GM) - GANA Glazing Manual; 2009.
- I. GANA (SM) - GANA Sealant Manual; 2008.
- J. ICC (IBC) - International Building Code; 2015.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 - 2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- B. Select type and thickness of exterior glass to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with KBC code.
 - 1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
 - 2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
 - 3. Thicknesses listed are minimum.

1.05 SUBMITTALS

- A. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

1. Submit designation of the percentages of post-consumer and pre-consumer recycled-content in glass products.
- B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Product Data on Solar Control Coatings: Provide product data on all specified solar control coatings to be provided.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- C. Insulated Glass Fabricator Qualifications: Current, approved member of the Insulating Glass Certification Council (IGCC). Member warrants that its manufactured insulated glass units (IGU) will correspond in all material respects to the specification and will be free from defects in material and workmanship for ten (10) years from the date of substantial completion.

1.07 MOCK-UP

- A. Provide glazing for mockup. _____.
- B. Locate where directed by Architect.
- C. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

- A. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- B. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include;:
 1. Cardinal Glass Industries: www.cardinalcorp.com.
 2. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
 3. Guardian Industries Corp: www.sunguardglass.com.
 4. Pilkington North America Inc: www.pilkington.com/na.
 5. Vitro Glass + PPG Glass: www.ppgideascales.com.
 6. Trulite Glass and Aluminum Solutions: www.trulite.com
 7. Zeledyne: www.versaluxglass.com.
- C. Float Glass: Provide float glass based glazing unless noted otherwise.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.

2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 3. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.
- D. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
 2. Plastic Interlayer:
 - a. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.
 - 1) Color: Clear.
 3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.
- E. Clear Float Glass : Clear, annealed.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 2. Comply with ASTM C 1048.
- F. Safety Glass : Clear; fully tempered.
1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
 2. Comply with 16 CFR 1201 test requirements for Category II.
 3. 6 mm minimum thick.
 4. Provide this type of glazing in the locations indicated on the drawings.
- G. Laminated Glass at doors: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
 2. 1/4" total thickness, fully tempered with PVB interlayer.
 3. Outboard lite: 1/8 inch (6 mm) thick tempered, clear glass.
 4. Plastic Interlayer:
 - a. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.
 - 1) Color: Clear
 5. Inboard lite: 1/8 inch (6 mm) thick tempered, clear glass.
- H. Spandrel Glass: Fully Tempered.
1. Comply with ASTM C 1036 Type I, transparent flat, quality Q3.
 2. 6 mm minimum thickness.
 3. Coating to be one component, water base, flowable, silicone glass coating.
 - a. Durometer, Shore A Hardness: 40
 - b. Tensile PSI: 400
 - c. Elongation %: 400%
 - d. Color: Architect to select from manufacturers standard colors, minimum of 12 colors, including white.
 - 1) ICD High Performance Coatings: www.icdcoatings.com
 - 2) Oldcastle Building Envelope: www.oldcastlebe.com
 - (a) Basis of Design: ICD High Performance Coatings - Opaci-Coat 300.

2.02 SEALED INSULATING GLASS UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
1. Cardinal Glass Industries: www.cardinalcorp.com.
 2. Glenny Glass: www.glennygls.com
 3. Guardian Industries Corp: www.guardian.com.
 4. Louisville Plate Glass: www.louisvilleplateglass.com
 5. Oldcastle Building Envelope: www.oldcastlebe.com
 6. Trulite Glass and Aluminum Solutions: www.trulite.com
 7. Viracon, Apogee Enterprises, Inc: www.viracon.com.

- B. Sealed Insulating Glass Units: Types as indicated.
 - 1. Application: Exterior, except as otherwise indicated.
 - 2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 3. Edge Spacers: Aluminum, bent and soldered corners.
 - 4. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - 5. Purge interpane space with dry hermetic air.
- C. Insulated Glass Units : Double pane with glass to elastomer edge seal.
 - 1. Locations: Exterior metal storefront and/or curtainwall window systems.
 - 2. Locations: Base Bid & Alternate No. 1.
 - 3. Total unit thickness of 1 inch, minimum.
 - 4. Outer pane of 1/4" glass, inner pane of 1/4" glass.
 - 5. Place low E coating on No.2 surface within the unit.
 - 6. Low-E Coating: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - a. Basis of Design: Vitro+PPG - Solarban 70
 - b. AGC
 - c. Guardian
- D. Insulated Glass Units : Double pane with glass to elastomer edge seal.
 - 1. Locations: Exterior hollow metal, aluminum storefront and /or curtainwall doors.
 - 2. Locations: Base Bid & Alternate No. 1.
 - 3. Total unit thickness of 7/8 inch, minimum.
 - 4. Outer pane of 3/16 glass, inner pane of 3/16 glass.
 - 5. Place low E coating on No.2 surface within the unit.
 - 6. Low-E Coating: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - a. Basis of Design: Vitro+PPG - Solarban 70
 - b. ACG
 - c. Guardian

2.03 GLAZING COMPOUNDS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include,
- B. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 5. Substitutions: Refer to Section 016000 - Product Requirements.
- C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; standard color.

2.04 GLAZING ACCESSORIES

- A. Speak-Thru Device:
 - 1. Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. C. R. Laurence - CRLModel #834A Satin Anodized No-Draft Speak Thru, 5-5/16 inch diameter.
 - 2. Contractor to coordinate tempering and lamination of glass with indicated speak-thru locations.

- B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- D. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
 - 1. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Tremco Global Sealants: www.tremcosealants.com.
 - c. Substitutions: Refer to Section 016000 - Product Requirements.
- E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; standard color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.04 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.06 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 088300 - MIRRORS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Glass mirrors.
 - 1. Annealed float glass.

1.02 RELATED REQUIREMENTS

- A. Section 102800 - Toilet, Bath, and Laundry Accessories: Metal mirror frames.

1.03 REFERENCE STANDARDS

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. GANA (GM) - GANA Glazing Manual; 2009.
- F. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.04 SUBMITTALS

- A. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- B. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.06 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Mirrors: Subject to compliance with requirements provide products by one of the following but, not limited to the following:
 - 1. Trulite Glass and Aluminum Solutions: www.trulite.com.

2. Guardian Industries Corporation: www.guardian.com
3. Lenoir Mirror Co: www.lenormirror.com.
4. Pilkington North America, Inc. :www.pilkington.com

2.02 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings per ASTM C1503, and protective backcoating. .
 1. Thickness: 1/4 inch/6 mm.
 2. Edges: Arrised.
 3. Safety Backing: Adhesive backed polyethylene sheet applied to entire surface of glass.
 - a. Size: As noted on drawings.

2.03 ACCESSORIES

- A. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
- B. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

FINISH LEGEND - 95%				
November 2021		Woodford Co HS		RTA #1916
SPEC SECTION	KEY	FINISH		DESCRIPTION
055000		BOOK CHUTE	MFR.:	KINGSLEY
		MEDIA CENTER BOOK DROP	STYLE:	EASE INTERIOR THRUWALL SYSTEM 10-8100
055213		DISPLAY SHELVING	STYLE:	PIPE AND TUBE RAILING
		STEEL COMPONENT SHELVING	COMPONENTS:	EXTRA HEAVY DUTY FLANGES AND CONNECTORS AS REQUIRED
			COLOR:	TO RECEIVE STANDARD PAINT COLOR
			LOCATION:	ART ROOM
064100	HPL5	HIGH PRESSURE LAMINATE	MFR.:	WILSONART OR FORMICA
		RECEPTION BASE AND WALL	COLOR:	TBD
		CABINETS AND TRANSACTION TOP		
			NO:	TBD
			FINISH:	LINEARITY TEXTURE
			LOCATION:	REFER TO DRAWINGS
	HPL6	HIGH PRESSURE LAMINATE	MFR.:	FORMICA
		ART ROOM DISPLAY SHELVING	COLOR:	TBD
			NO:	TBD
			FINISH:	EQUAL TO MICRODOT FINISH
			LOCATION:	REFER TO DRAWINGS
	STL1	STAINLESS STEEL COUNTERTOP	MFR.:	TBD
			LOCATION:	REFER TO DRAWINGS
	SS1	SOLID-SURFACE	MFR.:	TBD
		Countertops & Display Bottom	COLOR:	UP TO PRICE GROUP D
			THICKNESS:	1/2"
			EDGE PROFILE:	TBD
			LOCATION:	REFER TO DRAWINGS
	SS2	SOLID-SURFACE	MFR.:	TBD
		Window Sills	COLOR:	UP TO PRICE GROUP C
			THICKNESS:	1/2"
			EDGE PROFILE:	TBD
			LOCATION:	REFER TO DRAWINGS
	F1	FABRIC	MFR.:	MOMENTUM
		Media Center Bench Backs	STYLE:	3D GRID
			COLOR:	TBD
			FINISH:	NANOTEX
			LOCATION:	MEDIA CENTER
	F2	FABRIC		
		Media Center Bench Seats	MFR.:	MOMENTUM
			STYLE:	SILICA ETCH
			COLOR:	TBD
			FINISH:	
			LOCATION:	MEDIA CENTER
092116	FRP1	Fiberglass Reinforced Panels	MFR.:	TBD
		TYPICAL	SURFACE:	PEBBLED
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
	FRP2	Fiberglass Reinforced Panels	MFR.:	TBD
		CULINARY	SURFACE:	SMOOTH
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
093000	CT1	CERAMIC OR PORCELAIN TILE	MFR.:	Louisville Tile
		FLOOR TILE & BASE	STYLE:	Ignite
			COLOR:	TBD
			SIZE:	12 X 24
			GROUT:	TBD
			GROUT MFR:	TBD
			GROUT COLOR:	MANUFACTURER'S STANDARD COLORS
			INSTALLATION:	1/3 OFFSET
			ACCESSORIES:	1 PROVIDE SCHLUTER-QUADEC Anodized Aluminum AE ON ALL OUTSIDE CORNERS.
			LOCATION:	RESTROOMS
	CT2	CERAMIC OR PORCELAIN TILE	MFR.:	Louisville Tile
		WALL TILE	STYLE:	Cosmopolitan Stripes
			COLOR:	TBD
			SIZE:	12 X 24
			GROUT:	TBD
			GROUT MFR:	TBD

SPEC SECTION	KEY	FINISH		DESCRIPTION
			GROUT COLOR:	TBD
			INSTALLATION:	STACK BOND
			ACCESSORIES:	1 PROVIDE SCHLUTER-QUADEC Anodized Aluminum AE ON ALL OUTSIDE CORNERS.
				2 PROVIDE SCHLUTER Anodized Aluminum AE COVE BASE PROFILE, -DILEX-FHK AT INTERSECTION OF FLOOR AND WALL TILE
			LOCATION:	REFER TO DRAWINGS
			NOTE:	WHERE WALL TILE OCCURS, THERE SHALL BE NO CT1 BASE, THE CT2 WALL TILE SHALL RUN ALL THE WAY TO THE FLOOR
	CT3	CERAMIC OR PORCELAIN TILE	MFR.:	Crossville
		ACCENT WALL TILE	STYLE:	Relax
			COLOR:	TBD
			SIZE:	6 x 36
			INSTALLATION:	1/3 offset, vertical install
			GROUT MFR:	TBD
			GROUT COLOR:	MANUFACTURER'S STANDARD COLORS
			LOCATION:	REFER TO DRAWINGS
	CT4	CERAMIC OR PORCELAIN TILE	MFR.:	American Olean
		Shower Floor Tile	STYLE:	Unglazed Mosaics
			COLOR:	TBD
			SIZE:	2 x 2 Mosaic
			INSTALLATION:	Mosaic
	CT5	CERAMIC OR PORCELAIN TILE	MFR.:	American Olean
		Shower Wall Tile	STYLE:	Bright and Matte
			COLOR:	TBD
			SIZE:	4x4
			INSTALLATION:	Tile
	QT1	UNGLAZED QUARRY TILE	MFR.:	American Olean
		FLOOR and TILE BASE	STYLE:	Quarry Naturals
		Kitchen and Culinary	COLOR:	TBD
			SIZE:	6x6
			INSTALLATION:	Tile
095113	APC1	ACOUSTICAL PANEL CEILING	MFR.:	ARMSTRONG
		TYPICAL SQUARE EDGE	STYLE:	SCHOOL ZONE FINE FISSURED
			NO.:	1713
			SIZE:	24 X 24 X 3/4"
			COLOR:	WHITE
			EDGE:	SQUARE
			GRID:	15/16" PRELUDE
			LOCATION:	REFER TO DRAWINGS
	APC2	ACOUSTICAL PANEL CEILING	MFR.:	ARMSTRONG
		REGULAR EDGE	STYLE:	SCHOOL ZONE FINE FISSURED
			NO.:	1717
			SIZE:	24 X 24 X 3/4"
			COLOR:	WHITE
			EDGE:	REGULAR
			GRID:	15/16" PRELUDE
			LOCATION:	REFER TO DRAWINGS
	APC3	ACOUSTICAL PANEL CEILING	MFR.:	ARMSTRONG
		WASHABLE FACE	STYLE:	KITCHEN ZONE
			NO.:	672
			SIZE:	24 X 24 X 3/4"
			COLOR:	WHITE
			EDGE:	SQUARE
			GRID:	15/16" PRELUDE
			LOCATION:	REFER TO DRAWINGS
	APC4	ACOUSTICAL PANEL CEILING	MFR.:	ARMSTRONG
		REGULAR EDGE	STYLE:	KITCHEN ZONE
			NO.:	1824
			SIZE:	24 X 48 X 3/4"
			COLOR:	WHITE
			EDGE:	REGULAR
			GRID:	15/16" PRELUDE
			INSTALLATION:	REFER TO DRAWINGS FOR TYPICAL AND OFFSET GRID LAYOUT LOCATIONS
			LOCATION:	REFER TO DRAWINGS
	AHP1	ACOUSTICAL HEX PANELS	MFR.:	ARMSTRONG
		MAIN LOBBY	STYLE:	SOUNDSCAPE HEX PANELS
			CONFIGURATION:	COMBINATION OF 7-GROUP HEXS AND SINGLE HEXS SPACED
			SIZE:	3'-4" NOMINAL
			COLOR:	MANUFACTURERS STANDARD
			EDGE:	STANDARD

SPEC SECTION	KEY	FINISH		DESCRIPTION
			LOCATION:	REFER TO DRAWINGS
096413	STG1	STAGE WOOD FLOORING - PINE STAGE FLOORING	MFR.:	ROBBINS INC
			SPECIES:	PINE
			COLOR:	BLACK PAINTED PINE
			CUT:	EDGE GRAIN
			WIDTH:	4"
			PLANK THICKNESS:	NOMINAL 3/4"
			LOCATION:	BEHIND STAGE CURTAIN
			NOTE:	GRADE C AND BETTER
	STG2	GYMNASIUM WOOD FLOORING - RED OAK STAGE FLOORING	MFR.:	ROBBINS INC
			SPECIES:	RED OAK
			COLOR:	CLEAR
			CUT:	EDGE GRAIN
			WIDTH:	4"
			PLANK THICKNESS:	NOMINAL 3/4"
			LOCATION:	FRONT OF STAGE CURTAIN
			NOTE:	GRADE C AND BETTER
096466	GWFI	GYMNASIUM WOOD FLOORING Gym Flooring	MFR.:	MARTIN FLOORING
			SPECIES:	MAPLE
			COLOR:	CLEAR
			FINISH:	AREA OF STAIN INSIDE THE THREE POINT CIRCLE
			WIDTH:	2 1/4"
			PLANK THICKNESS:	25/32"
			LOCATION:	REFER TO DRAWINGS
			NOTE:	INCLUDES PAINTED MASCOT AND COURT STRIPING AND ADDITIONAL GRAPHICS AND LETTERING
	VB1	RESILIENT BASE & ACCESSORIES VENTED BASE	MFR.:	MARTIN FLOORING
			STYLE:	VENTILATED BASE
			COLOR:	BLACK
			SIZE:	3" X 4"
			LOCATION:	REFER TO DRAWINGS
096500	VCT1	RESILIENT TILE FLOORING: VINYL COMPOSITION TILE	MFR.:	TARKETT
			STYLE:	STANDARD COLORS
			COLOR:	TBD
			SIZE:	12 X 12
			INSTALLATION:	MONOLITHIC
			LOCATION:	REFER TO DRAWINGS
096502	LVT1	RESILIENT TILE FLOORING: LUXURY VINYL TILE Admin Area	MFR.:	SHAW
			STYLE:	GRAIN
			COLOR:	TBD
			SIZE:	7 X 48
			INSTALLATION:	STANDARD OFFSET
			LOCATION:	REFER TO DRAWINGS
096513	RB1	RESILIENT BASE & ACCESSORIES RUBBER WALL BASE	MFR.:	NORA
			STYLE:	COVE
			COLOR:	MANUFACTURERS STANDARDS
			HEIGHT:	4"
			LOCATION:	REFER TO FINISH SCHEDULE
	RTR1	RESILIENT BASE & ACCESSORIES STAIR TREADS	MFR.:	NORA
			STYLE:	INTEGRAL TREAD AND RISER COMBINATION WITH SAFETY STRIP ON TREAD; NORA GRANO
			SAFETY STRIP:	SIGNAL STRIPE, INCLUDING PHOSPERESCENT
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
096566	RAF1	RESILIENT ATHLETIC FLOORING WRESTLING ROOM	MFR.:	GERFLOR
			STYLE:	MULTI-USE 6.2
			COLOR:	TBD
			TYPE:	CALENDARED AND VULCANIZED WITH A BASE OF NATURAL AND SYNTHETIC RUBBERS, STABILIZERS AGENTS AND PIGMENTATION
			THICKNESS:	6.2MM
			FINISH:	SMOOTH, MATTE
			LOCATION:	REFER TO DRAWINGS
	RAF2	RESILIENT ATHLETIC FLOORING WEIGHT ROOM	MFR.:	TARKETT
			STYLE:	REPLAY
			COLOR:	TBD - EQUAL TO RA1 MELLOWED
			TYPE:	TILE 24" X 24" SQAURE EDGE
			THICKNESS:	3/8"
			LOCATION:	REFER TO DRAWINGS
096623	T1 - T4	EPOXY-RESIN TERRAZZO Alternate for Corridor Flooring	MFR.:	TERRAZZO AND MARBLE SUPPLY
			EPOXY:	TO MATCH PAINT COLOR - TBD

SPEC SECTION	KEY	FINISH		DESCRIPTION
			CHIP FORMULA:	TBD -STANDARD CHIP SELECTION
			LOCATION:	REFER TO DRAWINGS
	T1	EPOXY-RESIN TERRAZZO	MFR.:	TERRAZZO AND MARBLE SUPPLY
		PRECAST TERRAZZO BASE	EPOXY:	TO MATCH PAINT COLOR - TBD
		Alternate for Corridor Flooring	CHIP FORMULA:	TBD -STANDARD CHIP SELECTION
			LOCATION:	REFER TO DRAWINGS
096813	CPT1 -	CARPET PLANK	MFR.:	SHAW
	CPT4	Media Center	COLLECTION:	LIVING SYSTEMS
			STYLE:	OBSERVE AND OBSERVE COLOR TILE
			COLOR:	TBD, UP TO FOUR COLORS
			SIZE:	9" X 36"
			FIBER:	ECO SOLUTION Q NYLON
			DYE METHOD:	100% SOLUTION DYED
			BACKING:	ECO WORX TILE
			INSTALLATION:	
			LOCATION:	REFER TO DRAWINGS
	CPT5	CARPET BROADLOOM	MFR.:	SHAW
		Auditorium	COLLECTION:	OFF THE GRID
			STYLE:	ESCAPE
			COLOR:	TBD
			SIZE:	12' BROADLOOM
			FIBER:	ECO SOLUTION Q NYLON
			DYE METHOD:	100% SOLUTION DYED
			BACKING:	ULTRALOC
			INSTALLATION:	
			LOCATION:	REFER TO DRAWINGS
097200	WLWC1	WOOD LOOK WALL COVERING	MFR.:	MOMENTUM
		changed from last spec	COLLECTION:	WALLCOVERING REESE 20 OZ.
			SIZE:	54" WIDE
			COLOR:	TBD - STANDARD
			INSTALLATION:	REFER TO DRAWINGS
097260		TACKABLE WALL COVERING	MFR.:	TACWALL
		ART ROOM	COLLECTION:	
			SIZE:	
			INSTALLATION:	REFER TO DRAWINGS
			ACCESSORIES:	FLUSH FASTENERS
098100	GOP1	GEL-COATED OVATION PANELS	MFR.:	KINETICS NOISE CONTROL
		AUDITORIUM	PRODUCT:	1/2" THICK PLYWOOD CORE OVATION PANELS
			SIZE:	REFER TO DRAWINGS
			INSTALLATION:	MANUFACTURERS STANDARD SUSPENSION
			COLOR:	MANUFACTURERS STANDARD GEL COAT COLORS WITH EDGES PAINTED TO MATCH
			LOCATION:	AUDITORIUM
098410	AWP1	ACOUSTICAL PANELS	MFR.:	KINETICS NOISE CONTROL
		SOUND ABSORPTION PANELS	PRODUCT:	HARDSIDE PANEL 2" TOTAL THICKNESS
			SIZE:	REFER TO DRAWINGS
			INSTALLATION:	IMPALING CLIPS
			COLOR:	UP TO TWO STANDARD COLORS OF GUILFORD OF MAINE FR701
			LOCATION:	REFER TO DRAWINGS
	AWP2	ACOUSTICAL PANEL	MFR.:	KINETICS NOISE CONTROL
		LOW FREQUENCY ABSORPTION PANEL	PRODUCT:	VERSATUNE PANEL 2 1/8" TOTAL THICKNESS
			INSTALLATION:	IMPALING CLIPS
			COLOR:	UP TO TWO STANDARD COLORS OF GUILFORD OF MAINE FR701
			SIZE:	REFER TO DRAWINGS
			LOCATION:	BAND AND VOCAL
	AWP3	ACOUSTICAL PANEL	MFR.:	KINETICS NOISE CONTROL
		WALL RADIUS DIFFUSER	PRODUCT:	Geometric Diffuser Sound-Diffusing Panel
			SIZE:	REFER TO DRAWINGS
			COLOR:	UP TO TWO STANDARD COLORS OF GUILFORD OF MAINE FR701
			SIZE:	REFER TO DRAWINGS
			INSTALLATION:	MANUFACTURERS STANDARD
			LOCATION:	BAND AND VOCAL
	APD1	ACOUSTICAL PANEL	MFR.:	KINETICS NOISE CONTROL
		CEILING PYRAMIDAL DIFFUSER	PRODUCT:	Geometric Diffuser Sound-Diffusing Panel
			SIZE:	REFER TO DRAWINGS
			COLOR:	MANUFACTURERS STANDARD POLYMER - WHITE
			INSTALLATION:	REFER TO DRAWINGS
			LOCATION:	BAND AND VOCAL
	AWP5	ACOUSTICAL PANEL	MFR.:	KINETICS NOISE CONTROL

SPEC SECTION	KEY	FINISH		DESCRIPTION
		ABUSE RESISTANT ABSORPTIVE PANEL	PRODUCT:	ABUSE RESISTANT HARDSIDE PANEL - 1 1/8" TOTAL THICKNESS
		GYMNASIUM	FABRIC:	STANDARD COLORS FROM GUILFORD OF MAINE FR 701 - 2100
			SIZE:	REFER TO DRAWINGS
			COLOR:	UP TO TWO COLORS
			INSTALLATION:	REFER TO DRAWINGS
			LOCATION:	GYMNASIUM
	AWP6	ACOUSTICAL PANEL	MFR.:	KINETICS NOISE CONTROL
		ABSORPTIVE PANEL	PRODUCT:	HARDSIDE PANEL 1" TOTAL THICKNESS
		COLAB, SOUND BOOTH AND AUDITORIUM	SIZE:	REFER TO DRAWINGS
			INSTALLATION:	IMPALING CLIPS
			COLOR:	ONE STANDARD COLOR OF GUILFORD OF MAINE FR701
			LOCATION:	REFER TO DRAWINGS
099000	P	PAINTING	MFR.:	TBD
		TYPICAL PAINT	COLOR:	TBD
			SHEEN:	1 FLAT AT CEILINGS
				2 EGGSHELL AT WALLS
	AP	PAINTING	MFR.:	TBD
		ACCENT PAINT	COLOR:	TBD
		Note: Up to 9 accent colors will be used	SHEEN:	1 FLAT AT CEILINGS
				2 EGGSHELL AT WALLS
	P	PAINTING	MFR.:	TBD
		HOLLOW METAL FRAMES	COLOR:	
			SHEEN:	SEMI-GLOSS AT HOLLOW METAL DOOR FRAMES
			LOCATION:	HOLLOW METAL DOOR FRAMES, TYPICAL
	SC1	SEALED CONCRETE	MFR.:	PPG
			PRODUCT:	PERMA-CRETE PLEX SEAL 4-6200 CLEAR SEALER
			LOCATION:	REFER TO DRAWINGS
	SC2	SEALED CONCRETE COATING WITH OIL SEALANT	MFR.:	PPG
			PRODUCT:	MEGASEAL SL
			LOCATION:	REFER TO DRAWINGS
	SC3	SEALED CONCRETE COATING WITH COLORANT	MFR.:	PPG
		AUDITORIUM FLOOR	PRODUCT:	PERMACRETE COLOR SEAL
			LOCATION:	REFER TO DRAWINGS
		SUPER GRAPHICS	MFR.:	TBD
		MEDIA CENTER AND CAFETERIA	PRODUCT:	SUPER GRAPHICS APPLIED WITH STENCIL
			APPLICATION:	METHODS AND DOUBLE TAPE AS NECESSARY FOR A SMOOTH INSTALLATION OF GRAPHICS OVER CMU WALLS
			LOCATION:	REFER TO DRAWINGS
101101		VISUAL DISPLAY BOARDS	MFR.:	CLARIDGE
		MARKERBOARD	SURFACE:	PORCELAIN ENAMEL MARKERBOARDS
			COLOR:	MANUFACTURER'S STANDARD COLORS, STAFF LINED AT MUSIC
			FINISH:	GLOSS
			CATALOG NUMBER:	TBD
			SIZE:	REFER TO FINISH LEGEND
			LOCATION:	REFER TO DRAWINGS
		VISUAL DISPLAY BOARDS	MFR.:	CLARIDGE
		MARKERBOARD - MATTE	SURFACE:	PORCELAIN ENAMEL MARKERBOARDS
			COLOR:	MANUFACTURER'S STANDARD COLORS
			FINISH:	MATTE
			CATALOG NUMBER:	TBD
			SIZE:	REFER TO FINISH LEGEND
			LOCATION:	REFER TO DRAWINGS
		VISUAL DISPLAY BOARDS	SURFACE:	VINYL FACED WASHABLE FABRIC
		TACKBOARD	COLOR:	MANUFACTURER'S STANDARD COLORS
			CATALOG NUMBER:	TBD
			SIZE:	REFER TO FINISH LEGEND
			LOCATION:	REFER TO DRAWINGS
		VISUAL DISPLAY BOARDS	SURFACE:	VINYL FACED WASHABLE FABRIC
		TACKBOARD - Mobile	COLOR:	MANUFACTURER'S STANDARD COLORS
			CATALOG NUMBER:	TBD
			SIZE:	8'-0" WIDE
			LOCATION:	ART ROOM
		COLLABORATIVE PANEL SYSTEM	MFR.:	POLYVISION
		MARKERBOARD - Break Out areas	SURFACE:	CERAMIC STEEL MOTIF

SPEC SECTION	KEY	FINISH		DESCRIPTION
			COLOR:	Equal to Honey Pattern CS
			FINISH:	STANDARD
			CATALOG NUMBER:	TBD
			SIZE:	4" H X 3'-6" W
			LOCATION:	REFER TO DRAWINGS, COORDINATE MOUNTING WITH ACCENT WALL STRIKE LINE. BOARD SHALL BE ALL ON ACCENT PAINT
101424		SIGNS	MFR:	FAST SIGNS
		ROOM SIGNAGE	BACKGROUND COLOR:	TBD
			COPY COLOR:	TBD
			SIZE:	8" x 8"
			LOCATION:	TYPICAL
		SIGNS	MFR:	FAST SIGNS
		DIMENSIONAL LETTERING	COLOR:	MANUFACTURERS STANDARDS
			SIZE:	REFER TO DRAWEINGS
			LOCATION:	REFER TO DRAWEINGS
		SIGNS	MFR:	FAST SIGNS
		PLAQUE	COLOR:	MANUFACTURERS STANDARDS
			SIZE:	REFER TO DRAWEINGS
			LOCATION:	REFER TO DRAWEINGS
	RS1	SIGNS	MFR:	FAST SIGNS
		RESINOUS SHEET	MATERIAL:	TO BE EQUAL TO 6MM LUMICORE IMPRESSIONS METRO WITH SUNFLOWER SPECTRUM ADD ON
			SIZE:	6MM THICKNESS, REFER TO DRAWINGS FOR CUT SIZES
			LOCATION:	REFER TO DRAWINGS
			NOTES:	SIZES ARE SHOWN ON DRAWINGS TO MAXIMIZE PANELS ON A STANDARD SHEET
	RSS1	SIGNS	MFR:	CR LAURENCE COMPANY
		RESINOUS SHEET STANDOFF	SIZE:	CRL 1" STANDOFF DISPLAY SYSTEM SPACER AND CAP
			SIZE:	REFER TO DRAWEINGS
			LOCATION:	REFER TO DRAWINGS
102123	CC1	CUBICLE CURTAIN	MFR.:	MOMENTUM TEXTILES
		Allied Health	STYLE:	ELON
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
102226	OPM1	OPERABLE PARTITION WITH MARKERBOARD	MFR.:	HUFCOR
		Some Classrooms	STYLE:	632 OPERABLE PARTITION
			DETAILS:	TOP SUPPORTED, CENTER STACKING, MANUALLY OPERATED, HINGED IN PAIRS, WITH SEALS AND TRIM, NO VERTICAL TRIM, INCLUDE ERASE POCKETS
			SURFACE:	STANDARD VINYL AND MARKERBOARD SURFACE
			CARRIER:	FOUR HIGH DENSITY POLYMER COVERED STEEL CALL BEARING WHEELS, TRACK 40 CLEAR ANODIZED EXTRUDED ALUMINUM
			LOCATION:	REFER TO DRAWINGS
102600	CG1	WALL & CORNER GUARDS	MFR.:	CONSTRUCTION SPECIALTIES
			PRODUCT:	SSM-20N SURFACE MOUNTED
			HEIGHT:	4'
			THICKNESS:	2" THICK
			COLOR:	MANUFACTURERS STANDARDS
			LOCATION:	GYPSUM CORNERS, REFER TO DRAWINGS
	CR1	WALL & CORNER GUARDS	MFR.:	CONSTRUCTION SPECIALTIES
		VINYL RUBRAIL	PRODUCT:	CRASH RAILS - RUBSTRIP
			HEIGHT:	6"
			THICKNESS:	.060"
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
	CMC1	WALL & CORNER GUARDS	MFR.:	KOFFLER SALES
		COLORED METAL GUARD	PRODUCT:	COLORED METAL CORNER GUARD
			SIZE:	1" X 1"
			HEIGHT:	AS NEEDED
			COLOR:	MANUFACTURERS STANDARDS
			LOCATION:	ALL GYPSUM CORNERS AT WOOD-LOOK WALL COVERING, REFER TO DRAWINGS
102601	WLW1	WOOD LOOK WALL TREATMENT	MFR.:	CS - ACROVYN
			STYLE:	INTERIOR WALL PANELS
			COLOR:	TBD
			SIZE:	TBD
			DETAILS:	WRAPPED EDGES - WOOD LOOK
			MOUNTING:	SURE-SNAP PANELS
			LOCATION:	REFER TO DRAWINGS

SPEC SECTION	KEY	FINISH		DESCRIPTION
	WPR1	WALL PROTECTION	MFR.:	CS - ACROVYN
			STYLE:	INTERIOR WALL PANELS
			COLOR:	TBD
			SIZE:	TBD
			DETAILS:	SINGLE STANDARD COLOR - NON WOOD
			MOUNTING:	DIRECT GLUE
			LOCATION:	REFER TO DRAWINGS
102800		TOILET AND BATH ACCESSORIES		REFER TO DRAWINGS
		SEE DRAWINGS AND SPECIFICATIONS FOR RESTROOM ACCESSORIES		
	MBS1	BOOKKEEPER LOCK BOX ADMINISTRATION	MFR.:	LOCKING SECURITY MAILBOX
			ITEM:	PSMDL170
			COLOR:	BEIGE POWDER COAT
			SIZE:	RECEPTACLE: 12"W X 16"H X 6"D
			DETAILS:	FITS IN WALLS 3 1/4" - 7 3/4" THICK
			LOCATION:	REFER TO DRAWINGS
105050	L1	METAL LOCKERS	MFR.:	LYON LOCKERS
		DOUBLE STACK	COLOR:	TBD - MANUFACTURERS STANDARD
		KITCHEN AND LAB	SIZE:	12 X 12 X 72 - DOUBLE STACK
			LOCATION:	REFER TO DRAWINGS
			NOTE:	1 MASONRY BASE & SLOPING TOP
				2 OWNER PROVIDED LOCKS
				3 REFER TO DRAWINGS FOR ADA LOCATIONS THAT INCLUDE STICKER, SHELF, DIGILOCK AND ACCESSORIES FOR ACCESSIBLE LOCKER
	L2	METAL LOCKERS	MFR.:	LYON LOCKERS
		ATHLETIC	COLOR:	TBD - MANUFACTURERS STANDARD
		ATHLETICS	SIZE:	24 X 24 X 72 MVP
			LOCATION:	REFER TO DRAWINGS
			NOTE:	1 MASONRY BASE & SLOPING TOP, DIAMOND VENTED
				2 OWNER PROVIDED LOCKS
				3 REFER TO DRAWINGS FOR ADA LOCATIONS THAT INCLUDE STICKER, SHELF, DIGILOCK AND ACCESSORIES FOR ACCESSIBLE LOCKER
	L3	METAL LOCKERS	MFR.:	LYON LOCKERS
		SINGLE TIER	COLOR:	TBD - MANUFACTURERS STANDARD
		CO LAB NEAR MEDIA CENTER	SIZE:	12 X 12 X 36
			LOCATION:	REFER TO DRAWINGS
			NOTE:	1 MASONRY BASE, FLAT TOP
				2 OWNER PROVIDED LOCKS
				3 REFER TO DRAWINGS FOR ADA LOCATIONS THAT INCLUDE STICKER, SHELF, DIGILOCK AND ACCESSORIES FOR ACCESSIBLE LOCKER
				4 UNDER SOLID SURFACE COUNTERTOP
	L4	METAL LOCKERS	MFR.:	LYON LOCKERS
		TRIPLE TIER	COLOR:	TBD - MANUFACTURERS STANDARD
		ATHLETICS	SIZE:	12 X 12 X 24
			LOCATION:	REFER TO DRAWINGS
			NOTE:	1 MASONRY BASE, SLOPE TOP, DIAMOND VENTED
				2 OWNER PROVIDED LOCKS
				3 REFER TO DRAWINGS FOR ADA LOCATIONS THAT INCLUDE STICKER, SHELF, DIGILOCK AND ACCESSORIES FOR ACCESSIBLE LOCKER
		LOCKER BENCH - TYPICAL	MFR.:	LYON LOCKERS
			COLOR:	WOOD
			SIZE:	48" LONG
			LOCATION:	REFER TO DRAWINGS
			NOTE:	1 FREESTANDING HEAVY DUTY, NOT BOLTED TO FLOOR
		LOCKER BENCH - ADA	MFR.:	LYON LOCKERS
			COLOR:	WOOD WITH ADA STICKER
			SIZE:	42" LONG X 24" DEEP, ATTACHED TO FLOOR OR WALL
			LOCATION:	REFER TO DRAWINGS
105723	CWS1	CLOSET WIRE SHELVING	MFR.:	TBD
			COLOR:	MANUFACTURERS STANDARD COLORS
			FINISH:	POLY COATED WIRE SHELVING
			LOCATION:	REFER TO DRAWINGS
110500		MEDIA CENTER EQUIPMENT SHELVING	MFR.:	WORDEN
			COLOR:	MANUFACTURERS STANDARD COLORS
			SPECIES:	OAK
			LOCATION:	REFER TO DRAWINGS
110510		MEDIA CENTER FURNITURE	MFR.:	TEKNION
		FURNITURE	LOCATION:	REFER TO DRAWINGS

SPEC SECTION	KEY	FINISH		DESCRIPTION
110620		TRAVERSING BACKDROP CURTAIN	MFR.:	BEST BLIND AND SHADE
		MEDIA CLASSROOM	STYLE:	13 OZ PLATEAU VELOUR
110625	STC1	STAGE CURTAIN	MFR.:	BEST BLIND AND SHADE
		AUDITORIUM	STYLE:	IFR POLYESTER VELOUR 23.5 - 24.5 OZ
			COMPONENTS:	VALANCE, FRONT CURTAIN, BORDERS, LEGS, REAR CURTAIN
116623	WP1 - WP2	WALL PADS	MFR.:	PORTER
			COLOR:	MANUFACTURERS STANDARD COLORS, COLOR 1-2
			LOCATION:	REFER TO DRAWINGS
			NOTE:	AREAS OF LETTER ART AND GRAPHIC WITH UP TO THREE COLORS IN GRAPHICS, REFER TO DRAWINGS AND ELEVATIONS
		ATHLETIC EQUIPMENT DIVIDER CURTAIN	MFR.:	PORTER
			COLOR:	TBD
			CONSTRUCTION:	TOP MESH / BOTTOM SOLID
			LOCATION:	REFER TO DRAWINGS
			NOTE:	MECHANICALLY OPERATED
116833		ATHLETIC EQUIPMENT VOLLEYBALL SLEEVES	MFR.:	TBD
			COLOR:	TBD
			LOCATION:	REFER TO DRAWINGS
			NOTE:	VOLLEYBALL SLEEVES IN WOOD FLOOR
122413	RWS1	MANUAL WINDOW SHADES	MFR.:	DRAPER
		ROLLER WINDOW SHADES	SHADE FABRIC:	SHEERWEAVE SW2400
		TYPICAL	OPENNESS FACTOR:	3%
			COLOR:	MANUFACTURER'S STANDARD
			FASCIA:	CLEAR ANODIZED
			LOCATION:	EXTERIOR WINDOWS EXCEPT AT CORRIDORS, STAIRS AND VESTIBULES, NOTED INTERIOR WINDOWS
	RWS2	MANUAL WINDOW SHADES	MFR.:	DRAPER
		ROLLER WINDOW SHADES - OPAQUE - Science Classroom Exterior & Typical Interior Window Locations	SHADE FABRIC:	LIGHT BLOCKING
			COLOR:	OPAQUE
			FASCIA:	CLEAR ANODIZED
			LOCATION:	SCIENCE CLASSROOMS AND NOTED AREAS ON DRAWINGS of CLASSROOM INTERIOR SIDE WINDOW
	RWS3	MANUAL WINDOW SHADES	MFR.:	DRAPER
		ROLLER WINDOW SHADES - BLACKOUT	SHADE FABRIC:	TRUE BLACKOUT WITH SIDE CHANNELS
			OPENNESS FACTOR:	OPAQUE
			COLOR:	MANUFACTURER'S STANDARD
			FASCIA:	CLEAR ANODIZED
			EDGES:	BLACKOUT SIDE CHANNELS
			LOCATION:	SCIENCE LABS AND NOTED AREAS ON DRAWINGS
	RDS1	ROLLER DOOR SHADES	MFR.:	BLACKOUT EZ.COM
			TYPE:	BLACK VINYL ROLLER SHADE WITH TIES
			SUPPLIER:	BEST BLIND AND SHADE
			COLOR:	BLACK
			SIZE :	REFER TO DRAWINGS
			LOCATION:	REFER TO DRAWINGS
123450	SWD1	SCIENCE WOOD CASEWORK	MFR.:	KEWAUNEE
			COLOR:	MANUFACTURERS STANDARD COLORS
			LOCATION:	REFER TO DRAWINGS
	SET1	SCIENCE EPOXY TOPS	MFR.:	KEWAUNEE
			COLOR:	BLACK
			LOCATION:	REFER TO DRAWINGS
	SET1	SCIENCE STUDENT TABLES	MFR.:	KEWAUNEE
			SIZE:	60" X 24"
			COLOR:	BLACK EPOXY TOPS WITH WOODEN LEGS, NO CASTERS
			LOCATION:	REFER TO DRAWINGS
124930	MWS1	MOTORIZED WINDOW SHADES	MFR.:	DRAPER
			FASCIA:	CLEAR ANODIZED
			OPENNESS FACTOR:	3%
			COLOR:	MANUFACTURER'S STANDARD
			LOCATION:	REFER TO DRAWINGS
123550	HPL1	HIGH PRESSURE LAMINATE BASE & WALL CABINETS	MFR.:	WILSONART OR FORMICA
			COLOR:	TBD
			NO:	TBD
			FINISH:	MANUFACTURERS STANDARD COLORS

SPEC SECTION	KEY	FINISH		DESCRIPTION
			LOCATION:	TYPICAL
	HPL2	HIGH PRESSURE LAMINATE	MFR.:	WILSONART OR FORMICA
		COUNTERTOPS	COLOR:	TBD
			NO:	TBD
			FINISH:	MANUFACTURERS STANDARD COLORS
			LOCATION:	TYPICAL
	HPL3	HIGH PRESSURE LAMINATE	MFR.:	WILSONART OR FORMICA
		BASE & WALL CABINETS	COLOR:	TBD
			NO:	TBD
			FINISH:	MANUFACTURERS STANDARD COLORS
			LOCATION:	COLAB SPACES
	HPL4	HIGH PRESSURE LAMINATE	MFR.:	WILSONART OR FORMICA
		COUNTERTOPS	COLOR:	TBD
			NO:	TBD
			FINISH:	MANUFACTURERS STANDARD COLORS
			LOCATION:	COLAB SPACES
		WENGER CABINETS	MFR.:	WENGER CABINETS
			COLOR:	TBD
			STYLE:	WIRE DOORS
			FINISH:	MANUFACTURERS STANDARD COLORS
			LOCATION:	BAND AND VOCAL
126100		FIXED AUDIENCE SEATING	MFR.:	HUSSEY
			STYLE:	QUATTRO CLASSIC SERIES
			MODEL:	S3L3A

SECTION 092116 - GYPSUM BOARD ASSEMBLIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Metal stud wall framing. non-loadbearing.
- B. Metal channel ceiling framing.
- C. Sound Attenuation Batts / Acoustic insulation.
- D. Gypsum sheathing.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Glass mat faced gypsum board.
- H. Joint treatment and accessories.
- I. Suspended gypsum board on track/grid.
- J. Products installed, but not furnished, under this Section include the following:
 - 1. Access panels to be furnished by, but not limited to the following; mechanical, electrical, plumbing, controls, communication/data contractors.

1.02 RELATED REQUIREMENTS

- A. Section 054000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
- B. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 072100 - Thermal Insulation: Thermal insulation.
- D. Section 074213 - Metal Wall Panels: Subgirts/z-furring for metal wall panels.
- E. Section 075400 - Thermoplastic Membrane Roofing: Gypsum based roof cover board for field of roof.
- F. Section 078400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- G. Section 079005 - Joint Sealers: Acoustic sealant/sound caulk.
- H. Section 083100 - Access Doors and Panels: Access panels in partitions and ceilings. Access door panels to receive gypsum board
- I. Section 102601 - Wall and Corner Guards: Standard corner guards.

1.03 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.

- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- M. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board; 2013.
- N. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2014.
- O. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- S. GA-214 - Recommended Levels of Finish for Gypsum Board, Glass Mat and Fiber-Reinforced Gypsum Panels; 2015
- T. GA-216 - Application and Finishing of Gypsum Board; 2013.
- U. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
- V. GA-253 - Recommended Specifications for the Application of Gypsum Sheathing; Gypsum Association; 1999.
- W. GA-600 - Fire Resistance Design Manual; 2015.
- X. GA-801 - Handling of Storage of Gypsum Panel Products; current edition.
- Y. ICC (IBC) - International Building Code; 2015.
- Z. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system, FRP panels, and corner guards.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

- C. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C840 and GA-214 and GA-216. Comply with requirements of GA-600 for fire-rated assemblies.
- B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packaging, containers or bundles bearing the manufacturers brand name and identification.
- B. Store materials inside and under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
- C. Stack panels flat to prevent sagging.
- D. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.
- E. In addition follow the guidelines found in GA-801.
- F. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 or GA-216 requirements, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet or moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840, GA-214 and GA-216.
 - 1. See PART 3 for finishing requirements.

2.02 METAL FRAMING MATERIALS

- A. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include;
 - 1. Metal Framing, Connectors, and Accessories:
 - a. Clark Dietrich Building Systems: www.dietrich.com
 - b. J. N. Linrose Manufacturing LLC: www.jnlinrose.com
 - c. Marino Ware: www.marinoware.com.
 - d. Mill Steel Framing: www.millsteelframing.com
 - e. Phillips Manufacturing Company: www.phillipsmfg.com.
 - f. Southeastern Stud and Components, Inc: www.sestud.com

- g. Telling Industries, LLC: www.tellingindustries.com.
- B. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include;
 - 1. Drywall Suspension Systems and Accessories: Contractor's option to use a drywall suspension system for the gypsum board ceilings in lieu of metal stud ceiling framing.
 - a. Armstrong Commercial Ceilings: www.armstrong.com
 - b. USG: www.usg.com
 - c. Chicago Metallic Corporation: www.chicago-metallic.com
- C. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Minimum recycled content of 30%. Preference shall be given for steel framing components containing locally recovered steel.
 - 2. All Framing and System Components: Minimum G40 zinc-coated hot dipped galvanized steel, per ASTM A 653 or coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) coating, roll-formed from steel meeting mechanical and chemical requirements of ASTM A 1003 with a zinc-based coating. Galvannealed products are not acceptable.
 - a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
 - b. Equivalent Gauge Thickness for Steel Studs and Runner: Members that can show certified third party testing with gypsum board in accordance with ICC ES AC86 (current edition) need not meet the minimum thickness limitation or minimum section properties set forth in ASTM C645. The submission of an evaluation report is acceptable to show conformance to this requirement.
 - 1) Clark Dietrich Building System - ProStud: www.clarkdietrich.com.
 - 2) Marino\Ware - Viper Stud: www.marinoware.com
 - 3. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 4. Runners: U shaped, sized to match studs.
 - 5. Ceiling Channels: C-shaped.
 - 6. Furring at Walls: Hat-shaped sections, minimum depth of 7/8 inch.
 - 7. Furring at Equipment/Mechanical Platform(s): Hat-shaped sections, minimum depth of 1-1/2 inch, 18 ga. top rail, 25 ga. remaining rails.
- D. Metal soffit panel support: Hat-shaped sections, minimum depth of 7/8 inch. Gauge to be 18 ga. or as determined and approved by the metal soffit panel manufacturer. On-center spacing to be determined by the metal soffit panel manufacturer.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Partition Head to Structure Connections: Contractor option to friction fit slip leg track or track with slotted holes as specified below:
 - 1. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
 - 2. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - a. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 - b. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.

- G. Drywall Grid System: Grid system meeting ASTM C 635 and ASTM C 645 Standard Specification for Rigid Furring Channels for Screw Applications of Gypsum Board.
1. Contractor option to use this system in lieu of framed construction.
 2. Intermediate-duty main beam, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height of 1-11/16" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 3. Cross-tees, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height 1-1/2" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 4. Wall moldings, galvanized steel, hemmed angle, nominal 1-1/4" x 1-1/4".
 5. Hanger wire, minimum 12 gauge and spaced along main beam not more than 4' on center to support load.
 6. Add vertical bracing as required to stabilize the frame.
 7. Product to have manufacturers 10-year limited warranty.
- H. Curved Drywall Grid System: Grid system meeting ASTM C 635 and ASTM C 645 Standard Specification for Rigid Furring Channels for Screw Applications of Gypsum Board.
1. Contractor option to use this system in lieu of framed construction.
 2. Intermediate-duty main beam, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height of 1-11/16" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 3. Cross-tees, G40 zinc-coated hot dipped galvanized steel, double-web construction, profile height 1-1/2" with peaked roof or rectangular top bulb and 1-1/2" knurled flange.
 4. Wall moldings, galvanized steel, hemmed angle, nominal 1-1/4" x 1-1/4".
 5. Radius clip to be installed at all main beam knockout locations to form curved installations.
 6. Hanger wire, minimum 12 gauge and spaced along main beam not more than 4' on center to support load.
 7. Add vertical bracing as required to stabilize the frame.
 8. Product to have manufacturers 10-year limited warranty.

2.03 BOARD MATERIALS

- A. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include;
- B. Manufacturers - Gypsum-Based Board:
1. Saint-Gobain BPB/Certainteed Inc: www.bpb-na.com.
 2. Georgia-Pacific Gypsum(acquired Temple Inland): www.gpgypsum.com.
 3. Continental Building Products: www.continental-bp.com.
 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 5. USG Corporation: www.usg.com/#sle.
- C. Cement Board/Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch.
 - b. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include;
 - 1) Custom Building Products: www.custombuildingproducts.com.
 - 2) National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com/#sle.
 - 3) Georgia Pacific; Denshield Tile Backer: www.buildgp.com
 - 4) USG Corporation; Durock Tile Backer Board: www.usg.com.

- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits, unless otherwise indicated.
 2. Thickness: 1/2 inch.
 3. Edges: Tapered.
 4. Products:
 - a. CertainTeed Corporation; Interior Ceiling Drywall: www.certainteed.com/#sle.
 - b. Continental Building Products; Sagcheck: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - d. National Gypsum Company; High Strength Brand Ceiling Board.
 - e. Temple-Inland Building Products by Georgia-Pacific, LLC; Span24 Ceiling Board.
 - f. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
- E. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
1. Regular Type:
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.
 - d. Application: Where required for fire-rated assemblies, unless otherwise indicated.
 2. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
 - a. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
 - b. Application: Where required for fire-rated assemblies, unless otherwise indicated.
 - c. Thickness: 5/8 inch.
 - d. Edges: Tapered.
- F. Abuse-Resistant Type: Gypsum wallboard especially formulated for increased impact resistance, with enhanced gypsum core and heavy duty face and back paper.
1. Application: High-traffic areas indicated.
 2. Core Type: Regular and Type X, as indicated.
 3. Thickness: 5/8 inch.
 4. Edges: Tapered.
 5. Recycled Content: Minimum 80% recycled gypsum and 95% recycled content face paper.
 6. Local Materials: Manufactured and of raw materials from within 500 miles of Project Site.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) CertainTeed/Saint Gobain - AirRenew Extreme Abuse
 - 2) Continental Building Products - Protecta HIR 300
 - 3) USG - FiberRock Abuse Resistant: www.usg.com
 - 4) National Gypsum - High Abuse XP: www.nationalgypsum.com
 - 5) GP/Temple-Inland - ComfortGuard AR: www.templeinland.com
- G. Mold-Moisture/Water-Resistant/Abuse Gypsum Backing Board: ASTM C 1396/C 1396M; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. Edges: Tapered.
 - a. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include, but are not limited to the following:
 - 1) CertainTeed/Saint Gobain - Extreme Abuse with M2 Technology
 - 2) Continental Building Products - Protecta HIR 300
 - 3) USG - FiberRock Aqua-Tough or Mold Tough Abuse Resistant: www.usg.com

- 4) National Gypsum - Gold Bond High Abuse XP:
www.nationalgypsum.com
 - 5) GP/Temple-Inland - ComfortGuard: www.templeinland.com
- H. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
 2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 3. Core Type: Regular.
 4. Regular Board Thickness: 5/8 inch.
 5. Edges: Square.
 6. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Exterior Sheathing.
 - b. Continental Building Products; Weather Defense Platinum Exterior Sheathing.
 - c. Saint Gobain Certainteed: GlasRoc.
 - d. Georgia-Pacific Gypsum; DensGlass Sheathing.
 - e. National Gypsum Company; Gold Bond eXP Sheathing.
 - f. Temple-Inland Building Products by Georgia-Pacific, LLC; GreenGlass Exterior Sheathing.
 - g. USG Corporation: Securock Glass-Mat Sheathing
- I. Exterior Roof Board: Sizes to minimize joints in place; ends square cut.
1. Application: Roof board at parapet walls, unless otherwise indicated.
 - a. Installer/supplier of roof board to coordinate with roofing manufacturer/installer to ensure that roof board selected (fiber-glass faced and/or unfaced/gypsum-fiber board or plywood sheathing per section 061000) meets the roof manufacturers warranty requirements as described in section 075400 Thermoplastic Membrane Roofing.
 2. Glass-Mat-Faced Board: Glass mat faced gypsum substrate as defined in ASTM C 1177/C 1177M.
 3. Unfaced/Gypsum-Fiber Board: Gypsum-fiber substrate as defined in ASTM C 1278.
 4. Core Type: Regular.
 5. Board Thickness: 5/8 inch.
 6. Edges: Square, for vertical application.
 7. Glass-Mat-Faced Roof Board Products:
 - a. Georgia-Pacific Gypsum LLC; DensDek Prime
 8. Unfaced/Gypsum-Fiber Roof Board Products:
 - a. United States Gypsum Co.; Securock Roof Board
- J. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
 2. Types: Regular and Type X, in locations indicated.
 3. Type X Thickness: 5/8 inch.
 4. Edges: Tapered.
 5. Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - a. Continental Building Products; Soffitboard Type C.
 - b. CertainTeed Corporation; ProRoc Brand Exterior Soffit Board.
 - c. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board.
 - d. Lafarge North America Inc; Soffitboard.
 - e. National Gypsum Company; Gold Bond Brand Exterior Soffit Board.
 - f. Temple-Inland Building Products by Georgia-Pacific, LLC; Exterior Gypsum Soffit Board.
 - g. USG Corporation; Sheetrock Exterior Gypsum Ceiling Board.

2.04 ACCESSORIES

- A. Sound Attenuation Batts/Blankets/Acoustic Insulation: ASTM C 665; 2.5 pcf nominal density, preformed mineral-fiber, friction fit type, unfaced. Fiber glass sound control batt insulation, unfaced, and must meet the performance requirements of ASTM C 665 "Standard Specification for Mineral Fiber Blanket, Thermal Insulation.
 - 1. Sound Attenuation Batts/Blankets/Acoustic Insulation: ASTM C 665; 2.5 pcf nominal density, preformed mineral-fiber, creased, friction fit type, unfaced. Creased batt width to be one inch wider than the on-center spacing of the studs. Refer to drawings for stud spacing.
 - a. Contractor option to provide creased batts/blankets or support batts/blankets with "tiger teeth, lightning rods, or wire stays" between studs or support batts with metal banding attached to the metal studs or metal wire threaded through the stud openings in a continuous manner.
 - 1) Acceptable Metal Banding Product:
 - (a) Insul-Hold Co., Inc. - Insul-Hold: www.insulhold.com
 - (1) Class D, ASTM 527-80, 24 gauge galvanized metal strapping with two-three inch long arrows to secure insulation.
 - 2. Contractor option to use one of the following products:
 - a. Mineral-Fiber Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1) Owens Corning - Thermafiber SAFB: www.thermafiber.com
 - 2) Roxul Inc. - Roxul AFB: www.roxul.com
 - b. Fiber Glass Manufacturers: Subject to compliance with requirements manufacturers offering the following products that may be incorporated into the work include:
 - 1) JM -Sound Control Batts: www.jm.com
 - 2) Owens Corning ProPink Sound Attenuation Batts: www.owenscorning.com
- B. Sound Attenuation Batts/Blanket Product Requirements:
 - 1. Sound Attenuation Batts/Blankets/Acoustic Insulation Thickness: Minimum thickness 3 inch at 3-5/8" metal stud walls.
 - 2. Sound Attenuation Batts/Blankets/Acoustic Insulation Thickness: Minimum thickness 6 inch at 6 inch metal stud walls.
 - 3. Sound Attenuation Batts/Blankets/ Acoustic Insulation Width: Minimum width to be the same as the on-center stud spacing indicated on the drawings.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Ready-mixed vinyl-based joint compound.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- G. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- H. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.

- I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- J. Compressible Filler: In lieu of coping gypsum board to deck profile and providing sound attenuation blanket material and acoustical sealant it is the contractor's option to provide and install cut to fit or premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, EPDM, or PVC.
 - 1. Install at tops of non-rated, non-load-bearing metal stud walls running perpendicular or parallel to the metal deck . Place a bead of caulk 1/2 inch back from flute opening and on all sides of flute. Compress plug and slide into place.
 - a. Perpendicular to metal deck: Williams Products Inc. EVA 200G or 3000 Series Closure Flute Plugs or Strips: www.williamsproducts.net.
 - 1) Closed Cell plugs and strips per ASTM D-1171, ASTM D-925, ASTM D-412. Density: 12.8 lbs/ft

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling and soffit system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
- C. Studs: Space studs as indicated on the drawings.
 - 1. Align and secure top and bottom runners at 24 inches on center.
 - 2. Install studs vertically.
 - 3. Align stud web openings horizontally.
 - 4. Stud splicing is not permissible.
 - 5. Extend partition framing to underside of floor or roof deck. Attach extended leg top runner to deck, maintain clearance between top of studs and runner, and brace both flanges of studs with continuous bridging.
 - 6. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track. Contractor option to use slotted track.
- D. Corners: Fabricate corners using a minimum of three studs.
- E. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- F. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- G. Brace stud framing system rigid.
- H. Access Panel Opening Framing: Coordinate with the following, but not limited to; mechanical, electrical, plumbing, communication/data contractors for access panel locations in walls and ceilings.
 - 1. If access panels are being furnished by other trades verify type of access panel being provided, and if gypsum board on the recess door panel is required.

- I. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
- J. Blocking: See Section 061000 for wood blocking. Install wood blocking for support of:
 - 1. Cabinets, shelf, and countertop supports.
 - 2. Wall mounted cabinets.
 - 3. Wall brackets.
 - 4. Handrails and guardrails.
 - 5. Fire extinguisher cabinets, brackets, and valve cabinets.
 - 6. Grab bars.
 - 7. Toilet and bath accessories.
 - 8. Toilet and urinal partitions.
 - 9. Wall-mounted door hardware and stops.
 - 10. Chalkboards, tackboards, and marker boards.
 - 11. Wall paneling and trim.
 - 12. Joints of rigid wall coverings that occur between studs.
 - 13. Locker base and wall attachment.
 - 14. Interior and exterior wall openings to receive metal frame system; window, door, etc.
 - 15. Access panels.
 - 16. Framed openings.
 - 17. Plumbing fixtures.
 - 18. Ceiling mounted projection screens and projector mounts.
 - 19. Wall mounted projection screens and projector mounts.
 - 20. Wall and ceiling mounted items indicated as N.I.C. and/or Owner provided and Owner installed.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Sound Attenuation Batts /Acoustic Insulation: Friction fit, by placing tightly within on-center stud spacing, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant/Sound Caulk: Install per requirements of 079005 - Joint Sealers

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
- C. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
- D. Glass Mat Faced Gypsum Board: Install in strict accordance with manufacturer's instructions.
- E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- F. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.

- B. Corner Beads: Install at external corners, using longest practical lengths.

3.06 LEVELS OF GYPSUM BOARD FINISH

- A. Paper Faced Gypsum Board: Use paper or fiberglass joint tape, bedded with powder-type or ready-mixed vinyl-based joint compound and finished with powder-type or ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in GA-214 and ASTM C 840, as follows:
1. Level 4: Walls, ceilings and soffits to receive flat, eggshell, semi-gloss or gloss paint.
 2. Level 2: Behind cabinetry, FRP panels in janitorial/custodial rooms and on backing board to receive tile finish.
 3. Level 1: Fire rated wall and non-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
 3. Taping, filling and sanding is not required at base layer of double layer applications.
- D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092116

SECTION 093000 - TILING**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. This Section includes the following:
 - 1. Porcelain paver tile and base (CT1, 2 & 3)
 - 2. Glazed ceramic wall tile (CT5) & unglazed floor tile in showers.
 - 3. Unglazed quarry tile and base (QT1) (including cooler and freezer locations)
 - 4. Setting and grouting materials
 - 5. Transition strips. Provide a cultured marble strip with bevels on both sides across the entry into the shower area. The intention of the strip is to contain the water within the shower to allow it to drain.
 - 6. Self-leveling system comprised of clips & wedges

1.02 RELATED REQUIREMENTS

- A. Section 012300 - Alternates: Refer to section for additional information.
- B. Section 013000 - Administrative Requirements - Submittal procedures
- C. Section 079005 - Joint Sealers: Acoustic sealant/sound caulk
- D. Section 090050 - Finish Legend
- E. Section 092116 - Gypsum Board Assemblies: Tile backer board
- F. Section 224000 - Plumbing Fixtures: Shower receptor

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- C. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- D. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation; 2014.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- J. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- K. ICC (IBC) - International Building Code; 2012, with Kentucky Amendments; current edition.
- L. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2015.

- M. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data: Provide manufacturer's data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
 - 1. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop drawings, and coordinate them with tile joint locations, in consultation with Architect.
- D. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection.
- E. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
 - 2. Full-size units of each type of trim and accessory for each color required.
- F. Master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile and tile setting and grouting products with requirements indicated.
- H. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.
- I. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 - Product Requirements, for additional information.

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings".
- E. Maintain one copy of ANSI A108/A118/A136.1 and TCNA (HB) on site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to the following:
 - 1. Glazed Wall Tile (Showers):
 - a. Basis of Design: American Olean Tile Co., Inc.
 - b. Crossville Ceramics
 - c. Dal-Tile Corp.
 - d. Florida Tile Industries, Inc.
 - 2. Unglazed Quarry Tile:
 - a. Basis of Design: American Olean Tile Co., Inc.
 - b. Dal-Tile Corp.
 - c. Summitville Tiles
 - 3. Porcelain Tile:
 - a. Basis of Design: Crossville, Inc.
 - b. American Olean Tile Co., Inc.

- c. Dal-Tile Corp.
- 4. Ceramic / Porcelain Tile (Showers):
 - a. Basis of Design: American Olean Tile Co., Inc.
 - b. Dal-Tile Corp.
 - c. Crossville, Inc.
 - d. Florida Tile Industries
- 5. Latex-Emulsion Based-Portland Cement Mortars:
 - a. Boiardi Products Corp.
 - b. Bostik Construction Products Div.
 - c. C-Cure Chemical Co.
 - d. Custom Building Products
 - e. Dal-Tile Corp.
 - f. DAP, Inc. Div.; USG Corp.
 - g. H.B. Fuller
 - h. Laticrete International, Inc.
 - i. L&M Mfg., Inc.
- 6. High Performance Grout:
 - a. TEC Power Grout 550

2.02 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide porcelain paver selections by interior designer as shown on the Finish Legend--090050.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile unless otherwise indicated.
 - 3. Provide glazed wall tile selections by interior designer.
 - 4. Provide quarry tile selections by interior designer.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.
- F. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.
- G. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.03 TILE PRODUCTS

- A. Ceramic or Porcelain Tile-Floor Tile & Base (CT1)
 - 1. Manufacturer: Louisville Tile
 - 2. Style: Ignite
 - 3. Color: TBD

4. Size: 12 x 24
 5. Grout: TBD
 6. Grout Manufacturer: TBD
 7. Grout Color: Manufacturer's standard colors
 8. Installation: 1/3 Offset
 9. Accessories: Provide Schluter-Quadec Anodized Aluminum AE ON ALL OUTSIDE CORNERS.
 10. Location: Restrooms
- B. Ceramic or Porcelain Tile-Wall Tile (CT2)
1. Manufacturer: Louisville Tile
 2. Style: Cosmopolitan Stripes
 3. Color: TBD
 4. Size: 12 x 24
 5. Grout: TBD
 6. Grout Manufacturer: TBD
 7. Grout Color: TBD
 8. Installation: Stack Bond
 9. Accessories:
 - a. Provide Schluter Anodized Aluminum AE ON ALL OUTSIDE CORNERS
 - b. Provide Schluter Anodized Aluminum AE COVE BASE PROFILE.-DILEX-EHK AT INTERSECTION OF FLOOR AND WALL TILE.
 10. Location: Refer to Drawings
 11. Note: Where wall tile occurs, there shall be no CT1 base, the CT2 wall tile shall run all the way to the floor.
- C. Ceramic or Porcelain Tile-Accent Wall Tile (CT3)
1. Manufacturer: Crossville
 2. Style: Relax
 3. Color: TBD
 4. Size: 6 x 36
 5. Installation: 1/3 offset, vertical install
 6. Grout Manufacturer: TBD
 7. Grout Color: Manufacturer's standard colors
 8. Location: Refer to drawings
- D. Ceramic or Porcelain Tile-Shower Floor Tile (CT4)
1. Manufacturer: American Olean
 2. Style: Unglazed Mosaics
 3. Color: TBD
 4. Size: 2 x 2 Mosaic
 5. Installation: Mosaic
- E. Ceramic or Porcelain Tile-Shower Wall Tile (CT5)
1. Manufacturer: American Olean
 2. Style: Bright and Matte
 3. Color: TBD
 4. Size: 4 x 4
 5. Installation: Tile
- F. Unglazed Quarry Tile Floor and Tile Base-Kitchen and Culinary (QT1)
1. Manufacturer: American Olean
 2. Style: Quarry Naturals
 3. Color: TBD
 4. Size: 6x6
 5. Installation: Tile

- G. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:
1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. External Corners for Thinset Installations: Surface bullnose unless otherwise noted.
 - b. Internal Corners: Field-butt square corners, except use coved base and cap angle pieces designed to member with stretcher shapes.

2.04 SETTING & GROUTING MATERIALS

- A. Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.
- B. Latex-Portland Cement Mortar: Provide product complying with ANSI A108.1 and the following requirement for composition:
1. Prepackaged dry mortar mix incorporating dry polymer additive in the form of a re-emulsifiable powder to which only water is added at the job site.
 2. Latex additive (water emulsion) of type described below, serving as a replacement for part or all of gauging water, added at job site to prepackaged dry mortar mix supplied or specified by latex manufacturer.
 - a. Latex Type: Manufacturer's standard.
- C. Grouting Materials:
1. Dry Set Grout: Provide product complying with ANSI A118.6 of color indicated.
 2. Prepackaged Dry Grout Mix incorporating dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 3. Grout Additive: Grout Boost Advanced Pro by H.B. Fuller Construction Products, Inc. Follow all manufacturer's instructions.
 4. Latex Additive (water emulsion) serving as a replacement for part or all of gauging water, added at job site to prepackaged dry grout mix, with type of latex and dry grout mix complying with requirements indicated below:
 - a. Latex Type: Manufacturer's Standard.
 - b. Grout Type: Dry-set grout specified or supplied by latex manufacturer. Use latex additive without a retarder with dry-set grout.
 - c. Application: Use to grout joints in floor and wall tile unless otherwise indicated.

Note: Grout joints shall be 1/8" wide and the epoxy grout shall fill the joint space and be no lower than 1/32" of an inch from the top face of the tile.

2.05 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.
- B. The quarry tile and unglazed mosaic tile shall be sealed before grouting with Aqua Mix Inc. penetrating sealer following manufacturer's application recommendations.
- C. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- D. Multipart Pourable Urethane Sealant for Use T: Type M; Grade P; Class 25; Uses T, M, A, and as applicable to joint substrates indicated, O.
- E. Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated into the Work include, but are not limited to, the following:
1. Multipart Pourable Urethane Sealant:
 - a. "Chem-Calk 550"; Bostik Construction Products Div.

- b. "Vulkem 245"; Mameco International, Inc.
- c. "Urexpan NR-200"; Pecora Corp.
- d. "THC-900"; Tremco Corp.

2.06 MISCELLANEOUS MATERIALS

- A. Transition Strips: Provide a metal stepless transition strip to match Schluter-Reno U or TK Series (or approved equivalent) at all exposed edges of tile installation.
- B. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout, is compatible with tile and mortar/grout products, and is easily removable after grouting is completed without damaging grout or tile.
 - 1. Petroleum paraffin wax, fully refined, tasteless, odorless, containing at least 0.5 percent oil with a melting point of 120 deg F (49 deg C) to 140 deg F (60 deg C) per ASTM D 87.
 - 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.
- C. Self-Leveling System: Provide two-part leveling clips and wedges (1/8") as manufactured by one of the following:
 - 1. Raimondi - Leveling Solutions
 - 2. Tuscan - Leveling System
 - 3. QEP - Lash System

2.07 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- B. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:
 - 1. Petroleum paraffin wax or grout release.
- C. Protect surrounding work from damage.
- D. Vacuum clean surfaces and damp clean.

- E. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- F. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- G. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealers."
- G. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113 or F116 (epoxy).
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122.
 - 2. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.
- B. Over wood substrates, install in accordance with TCNA (HB) Method F150.
- C. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS

- A. At tiled shower receptors install in accordance with TCNA(HB) Approved Method.

- B. At bathtub walls install in accordance with TCNA (HB) Method W202, thin-set over masonry.

3.06 INSTALLATION - WALL TILE

- A. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.07 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove latex-portland cement grout residue from tile as soon as possible.
 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
- D. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- E. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- F. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. This Section includes the following:
 - 1. Acoustical panels Type APC-1 (24" x 24")
 - 2. Acoustical panel Type APC-2 (24" x 24")
 - 3. Washable faced gypsum panel ceiling Type APC-3 (24" x 24")
 - 4. Acoustical Panel Type APC-4 (24" x 48")
 - 5. Acoustical Hex Panels (AHP1)
 - 6. Exposed suspension system (15/16")
- B. All acoustical panel ceiling components and installation methods shall comply with seismic zone requirements of the Kentucky Building Code. (Note required for renovations.)
- C. Refer to the Room Finish Schedule on Sheet A2.16 and the Ceiling Legend and Reflected Ceiling Plans for the locations of acoustical ceiling tile and grid types.

1.02 RELATED REQUIREMENTS

- A. Section 012300 - Alternates: Refer to section for additional information.
- B. Section 033000 - Cast-In-Place Concrete: Placement of special anchors or inserts for suspension system
- C. Section 053100 - Steel Decking: Placement of special anchors or inserts for suspension system
- D. Section 090050 - Finish Legend
- E. Section 211300 - Fire Suppression Sprinkler System: Sprinkler heads in ceiling system
- F. Section 233700 - Air Outlets and Inlets: Air diffusion devices in ceiling
- G. Section 265100 - Interior Lighting: Light fixtures in ceiling system
- H. Section 275116 - Public Address Systems: Speakers in ceiling system
- I. Section 284600 - Fire Detection and Alarm: Fire alarm components in ceiling system

1.03 DEFINITIONS

- A. CAC: Ceiling Attenuation Class.
- B. LR: Light Reflectance coefficient.
- C. NRC: Noise Reduction Coefficient.

1.04 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.

- E. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2005 (Reapproved 2012).
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- G. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at www.chps.net/.
- H. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at www.greenguard.org.
- I. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.
- J. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- K. UL (GGG) - GREENGUARD Gold Certified Products; current listings at <http://productguide.ulenvironment.com/QuickSearch.aspx>.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: One set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: One set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- E. Qualification Data: For testing agency.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- G. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor type.
- H. Maintenance Data: For finishes to include in maintenance manuals.
- I. NRC: Noise Reduction Coefficient.

1.06 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

- a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.
- 2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equivalent to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equivalent to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.01 WARRANTIES

- A. Panels shall not sag for 15 years. No limit to relative humidity, short of standing water and up to 120 degrees Fahrenheit.

2.02 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.03 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.04 MINERAL-BASE ACOUSTICAL PANELS

- A. Ceiling Type APC-1: (24" x 24" x 3/4")
 1. Products:
 - a. Armstrong's School Zone Fine Fissured No. 1713
 - b. USG: "Clima Plus" High NRC No. 22421
 - c. CertainTeed "Fine Fissured"
 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type III, Form 2
 - b. Pattern: CE (lightly textured)
 3. Color: White
 4. LR: Not less than 0.84
 5. NRC: Not less than 0.70, U.L. classified label on each carton
 6. CAC: Not less than 35, U.L. classified label on each carton
 7. Edge Detail: Square
 8. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 9. Panels shall exceed ASTM C367 ball hardness test to 210 lbs.

2.05 MINERAL-BASE ACOUSTICAL PANELS

- A. Ceiling Type APC-2: (24" x 24" x 3/4")
 1. Products:
 - a. Armstrong's School Zone "Fine Fissured" No. 1717
 - b. USG: "Clima Plus" High NRC No. 22350
 - c. CertainTeed "Fine Fissured"
 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type III, Form 2
 - b. Pattern: CE (lightly textured)
 3. Color: White
 4. LR: Not less than 0.70
 5. NRC: Not less than 0.40, U.L. classified label on each carton
 6. CAC: Not less than 40, U.L. classified label on each carton
 7. Edge Detail: Angled Tegular
 8. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 9. Panels shall exceed ASTM C367 ball hardness test to 210 lbs.

2.06 WASHABLE FACE PANEL CEILING

- A. Ceiling Type APC-3: (24" x 24" x 5/8")
 - 1. Products:
 - a. Armstrong's Kitchen Zone No. 672
 - b. Sheetrock Gypsum Ceiling Panel No. 3260
 - c. National Gypsum Gridstone No. GR5040
 - 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type IX, Form 2
 - b. Pattern: G
 - 3. Color: White
 - 4. LR: Not less than 0.89
 - 5. NRC: N/A
 - 6. CAC: Not less than 33, U.L. classified label on each carton
 - 7. Edge Detail: Square
 - 8. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 - 9. Panels shall exceed ASTM C 367 ball hardness test to 210 lbs.

2.07 MINERAL-BASE ACOUSTICAL PANELS

- A. Ceiling Type APC-4: (24" x 48" x 3/4")
 - 1. Products:
 - a. Armstrong's School Zone Fine Fissured No. 1824
 - b. USG: "Clima Plus" High NRC
 - c. CertainTeed "Fine Fissured"
 - 2. Classification: Provide Class A panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - a. Type and Form: Type III, Form 2
 - b. Pattern: CE (lightly textured)
 - c. Color: White
 - d. LR: Not less than 0.84
 - e. NRC: Not less than 0.70, U.L. classified label on each carton
 - f. CAC: Not less than 35, U.L. classified label on each carton
 - g. Edge Detail: Tegal
 - h. Paint Edges of tile where it is cut for light fixtures
 - i. Antimicrobial Treatment: Coating based to inhibit mold and mildew
 - j. Panels shall exceed ASTM C367 ball hardness test to 210 pounds.

2.08 ACOUSTICAL HEX PANELS IN MAIN LOBBY (AHP1)

- A. Manufacturer: Armstrong
- B. Style: Soundscape Hex Panels
- C. Configuration: Combination of 7-group hexs and single hexs spaced
- D. Size: 3'-4" Nominal
- E. Color: Manufacturer's Standard
- F. Edge: Standard
- G. Location: Refer to drawings

2.09 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
 - 3. Wire hangers shall be installed on two diagonal corners of each 2' x 4' ceiling grid opening, or equivalent. Refer to the electrical specifications for information concerning the suspension system for ceiling mounted equipment.

2.10 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

- A. Available Products:
 - 1. Armstrong Prelude XL
 - 2. USG DX/DXL 24 Series
 - 3. Chicago Metallic CMC 1200 Series
 - 4. Gordon, Inc.
- B. Wide-Face, Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished **15/16-inch- (24-mm-)** wide metal caps on flanges. Note: 146 and 147 Culinary, 148 Kitchen and 148E Dry Storage requires an aluminum cap faced grid system.
 - 1. Structural Classification: Intermediate-duty system
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type
 - 3. Face Design: Flat, flush
 - 4. Cap Material: Cold-rolled sheet
 - 5. Cap Finish: Painted white
 - 6. Width: 15/16"
 - 7. Corner trim: Pre-Manufactured

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION, GENERAL

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. Do not attach hangers to steel deck tabs.
 - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit. Where the unfinished/unpainted cut edge of a tile is exposed the edge shall be repainted to achieve a "finished" appearance.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Fit border trim neatly against abutting surfaces.
- B. Cutting Acoustical Units:

1. Cut to fit irregular grid and perimeter edge trim.
2. Make field cut edges of same profile as factory edges.
3. Double cut and field paint exposed reveal edges.

3.05 FIELD QUALITY CONTROL

- A. Remove and replace acoustical panel ceiling hangers where test results indicate that they do not comply with specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touch up of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096431 - WOOD STAGE FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division - 1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES

- A. Extent of wood flooring is indicated on drawings and in schedules.
- B. Types of wood flooring required include the following:
 - 1. Wood strip flooring nailed to wood subflooring on sleepers. Sleepers sit on 1/4" resilient rubber pads.
 - 2. Wood substrates including sleepers, ventilated base and plywood sub floor are specified herein.
 - 3. 1 1/2" thick rigid insulation between sleepers is specified herein.
 - 4. Maple apron at the face of the stage; Refer to the drawings for extent of maple and pine flooring.

1.03 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's detailed technical product data and installation instructions for each type of wood flooring. Include instructions for handling, storage, installation, finishing, protection and maintenance.
- B. Shop Drawings: Submit shop drawings indicating method of construction, relationships to surrounding construction, perimeter venting, base and trim details and other information and components not fully dimensioned or detailed in manufacturer's product data.
- C. Samples:

1. Submit sets of range samples for each type of wood flooring, including finish on 75% of each sample.
2. Submit sample of resilient pad.
3. Submit sample of APA-rated sheathing plywood.
4. Submit 12" sample of finish floor showing black stain and matt urethane finish for approval prior to installation.
5. Submit 12" x 12" x 3/4" plywood subfloor sample.
6. Special Project Warranty: Submit copies of 3-year warranty for finished wood flooring and associated work, agreeing to repair or replace flooring which shrinks, warps, cracks or otherwise deteriorates excessively, or which buckles, delaminates or breaks its anchorage or bond with substrate or fails otherwise to perform as required or as represented by manufacturer, due to failures of materials and workmanship and not due to unusual exposure to moisture or other abusive forces and elements not anticipated for application. Warranty shall be signed by Installer and by Contractor, who shall assume responsibility for obtaining adequate warranties on materials from manufacturers.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Firm specializing in installation of wood flooring, with not less than 3 three years successful experience in installation of the types of flooring required.
- B. Single Installer Responsibility: Entire wood floor system shall be installed by a single firm (herein called the installer), for undivided responsibility. Include moisture barrier, if any, anchorage system, sleepers (or channels), subflooring or underlayment (if any), adhesives or mastics, resilient mounts (if any), flooring, trim, expansion provisions, finish, markings and other accessory items as indicated.

1.07 PRE-INSTALLATION MEETING

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Protect wood flooring from excessive moisture in shipment, storage and handling. Deliver in unopened bundles and store in a dry place, with adequate air circulation. Do not deliver material to building until "wet work" such as concrete and plaster have been completed and cured to a condition of equilibrium.
- B. Moisture Content: At time of delivery to project, limit average moisture content to 12%; 14% maximum for any piece.

1.09 PROJECT CONDITIONS

- A. Conditioning: Do not proceed with delivery and installation of wood flooring until after spaces to receive flooring have been enclosed and are dry and maintained at approximately same humidity condition as planned for occupancy. Place wood flooring materials in spaces to be floored 7 days in advance of start of installation. Open packages of wood flooring which are sealed (if any) to permit natural adjustment of moisture content. Maintain ambient temperature in range of 65 deg.F (18 deg.C) to 90 deg.F (32 deg.C) prior to, during, and after installation of wood flooring.

1.10 WARRANTY

- A. Submit 1-year warranty signed by Manufacturer, Installer, and Contractor, agreeing to repair or replace wood flooring which shrinks, warps, cracks, or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials and/or workmanship and not due to unusual exposure to moisture or other abusive forces or elements not anticipated for application.

- B. Horner Flooring Company hereby warrants the BALANCED PERFORMANCE SYSTEM flooring materials to be free from manufacturing defects for a period of one year from the date of substantial completion of the floor.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide wood flooring system by one of the following, or equivalent:
1. Manufacturers of wood strip flooring include:
 - a. Aged Woods / First Capital Wood Products, Inc.
 - b. Anderson Hardwood Floors, Inc.
 - c. Applied Radiant Energy Corp.
 - d. Bingham Hardwood Floors.
 - e. Boen-Jiffy, Inc.
 - f. Bruce Hardwood Floors / Triangle Pacific Corp.
 - g. Chickasaw / Memphis Hardwood Flooring Co.
 - h. Harris-Tarkett, Inc.
 - i. Hartco / Tibbals Flooring Co.
 - j. Horner Flooring Co.
 - k. Kahrs / Wood Systems International, Inc.
 - l. Kentucky Wood Floors, Inc.
 - m. Permagrain Wood Floors, Inc.
 - n. Robbins, Inc.
 - o. White Lumber Co.

2.02 WOOD STRIP FLOORING

- A. Grade, Cut and Species: Comply with Maple Flooring Manufacturers Association grading rules for the following:
1. Areas Normally Exposed to View:
 - a. Grade: C and better.
 2. Cut: Edge-Grain.
 3. Southern Pine (STG1)-behind stage curtain
 4. Maple (STG2)-In front of stage curtain
 5. Lengths: Random, 4' minimum.
- B. Matching: Tongued and grooved and end matched; except for clip installation (if any), steel spline may replace tongues, at manufacturer's option.
- C. Back Channeling: Back channel each piece in accordance with manufacturer's standards, except when specifically recommended by manufacturer to be plain backed for application indicated.
- D. Thickness: Nominal 3/4".
- E. Face Width: Nominal 4".
- F. Seasoning: Kiln dried before milling.

2.03 ACCESSORY MATERIALS FOR WOOD FLOORING

- A. Wood Sleepers: Standard grade Hemlock, Fir, Pine or Spruce, pressure preservative treated in accordance with AWPB LP2, kiln dried to 15% maximum moisture content. Discard bowed and twisted pieces. Provide nominal 2" x 3" sleepers.
- B. Moisture Barrier: No. 15; unperforated organic felt complying with ASTM D 226, Type 1; 36 inches wide.

- C. Rigid Insulation: Extruded polystyrene complying with requirements of Division 7 "Building Insulation". Provide thickness equal to sleeper height.
- D. Underlayment: 3/4" C/D exterior grade plywood.
- E. Nails and Screws: Type and size recommended by manufacturer, but not less than recommended by manufacturer for each application.
- F. Cork Expansion Strip: Composition cork expansion strip; FS HH-C-576, Type I-B, Class 2.
- G. Stain: Manufacturer's standard penetrating stain which is compatible with floor finish, color as selected by Architect/Designer from manufacturer's full range of colors. The oak apron at the face of the stage shall receive a clear finish. Refer to the Specifications Section 099000 - Painting.
- H. Floor Sealer: Penetrating type, pliable, wood-hardening sealer and finish; as recommended by flooring manufacturer. Matt finish.
- I. Floor Finish: Epoxy resin or other synthetic resin type floor finish designed to minimize "rubber-burning" as recommended by flooring manufacturer.
- J. Floor Wax: Liquid, solvent-type, slip-resistant; FS P-Wp158, Type I. Class 2.
- K. Ventilated Base Trim: Vented, semi-rigid plastic angle; manufacturer's standard. All perimeter wall surface shall be provided with a 3" x 4" base.
- L. Reducer Strips: Wood reducer strip of same species and finish as wood flooring, minimum 4" wide by height and length required, tapered to provide transition between wood flooring and adjacent concrete flooring as required. Contractor to verify use of wood reducer strip or aluminum transition strip.
- M. Aluminum Transition Strip: Aluminum transition strip minimum 4" wide by length required to provide transition between wood flooring and adjacent concrete flooring as required. Contractor to verify use of wood reducer strip or aluminum transition strip.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with flooring manufacturer's instructions and recommendations for applications indicated, but not less than Wood & Synthetic Flooring Institute standards.
- B. Pattern Direction: Lay flooring lengthwise front to back of stage, as indicated.
- C. Tolerances: Level wood flooring system to a tolerance of 1/8" in 10'-0".
- D. Expansion Spaces: Provide space as indicated or required by instructions and standards, at walls and other obstructions, interruptions and terminations of flooring. Cover spaces with bases, trim, saddles and thresholds, except fill flush with cork expansion strip when indicated to be uncovered.
- E. Check for Dryness: Before proceeding with installation of wood flooring over concrete substrate, check for dryness. If not sufficiently dry, as determined by Installer, continue to dry substrate, or provide extra moisture protection for flooring.
- F. Treated Wood: When treated wood must be cut for installation, apply a heavy brush coat of 5% pentachlorophenol after cutting.

3.02 RESILIENTLY-MOUNTED WOOD SLEEPER SYSTEM

- A. Install moisture barrier, with joints lapped at least 4" and sealed.
- B. Install sleepers without anchorage over substrate, spaced 24" o.c., and running crosswise with long dimension of space. Install insulation continuous between sleepers.

- C. Install wood strip flooring perpendicular to sleepers by nailing to subfloor; nail each strip at each sleeper.

3.03 SANDING AND FINISHING

- A. Allow installed flooring to acclimate to ambient conditions for a minimum period of 10 days before sanding.
- B. Machine sand with coarse, medium and fine grades of sandpaper, followed by disc sanding with 000 sandpaper. Clean with power vacuum, and check to confirm that entire surface of each piece has been sanded, and that floor is level and smooth, without ridges or cups. Proceed immediately with finish.
- C. Penetrating Finish: Apply stain and wood sealer (2 coats) in accordance with manufacturer's instructions, including machine buffing with steel wool, in-the-wet when recommended by manufacturer.
- D. High-Built Finish: Apply floor finish in accordance with manufacturer's instructions, including a first coat of penetrating sealer of type recommended. Apply as many coats as needed to build a minimum dry film thickness of 3 mils. Follow manufacturer's recommendations for drying time between coats. Buff between each coat. Retain empty containers for confirmation of film thickness. Prevent traffic on finished floor for a minimum of 10 days.
- E. Wax and buff completed finish before permitting traffic.
- F. Install expansion base trim and other cover trim as indicated for expansion spaces at edges and interruptions of flooring.

3.04 EXTRA STOCK / REPLACEMENT MATERIAL

- A. After completion of work, deliver to project site not less than 1.0% of the quantity of wood flooring installed on the project; in average size, uncut pieces.

3.05 PROTECTION

- A. Protect completed wood flooring during remainder of construction period with heavy Kraft paper or other suitable covering, so that flooring and finish will be without damage or deterioration at time of acceptance.

END OF SECTION

SECTION 096466 - WOOD COMPETITION FLOORING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Extent of wood flooring is indicated on drawings and in schedules.
- B. Types of wood flooring required include the following:
 - 1. Wood strip flooring (GWF1), wood subflooring, vapor retarder, resilient underlayment, sanding, sealers, finishes, vented base and game line painting.
 - 2. Four color mascot design to be supplied by Owner, image to be supplied and installed by the flooring contractor, and areas of artwork and stain as shown on drawings.
 - 3. Provide at Owner's discretion, two complete practice basketball side courts paint striping.
 - 4. Metal flooring transition plates at all locations where wood flooring does not abut a wall surface.
 - 5. Volley Ball Sleeves

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.
- B. Section 090050 - Finish Legend.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's detailed technical product data and installation instructions for each type of wood flooring. Include instructions for handling, storage, installation, finishing, protection and maintenance.
- B. Samples:
 - 1. Submit sets of range samples for each type of wood flooring, including finish on 75% of each sample.
 - 2. Submit sample of resilient pad.
 - 3. Submit sample of APA-rated sheathing plywood.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Specialized wood flooring firm with not less than 3 years successful experience in installation of flooring types specified.
- B. General Standard: Comply with recommendations of "Hardwood Flooring Installation Manual" by National Oak Flooring Manufacturer's Association (NOFMA).
- C. Source Quality Control: All hard maple flooring shall be certified by the Maple Flooring Manufacturer's Association.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect wood flooring from excessive moisture in shipment, storage, and handling. Deliver in unopened cartons or bundles and store in a dry place, with adequate air circulation. Do not deliver material to building until "wet work" such as concrete and plaster have been completed and cured to a condition of equilibrium.

1.07 PROJECT CONDITIONS

- A. Conditioning: Do not proceed with installation of wood flooring until spaces have been enclosed and are at approximate humidity condition planned for occupancy. Condition wood for 5 days prior to start of installation by placing in spaces to receive flooring and maintaining ambient temperature between 65 deg. F and 70 deg. F (18 deg. C and 21 deg. C) before, during, and after installation. Open packages of wood flooring which are sealed (if any) to permit natural adjustment of moisture content.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. Submit 1-year warranty signed by Manufacturer, Installer, and Contractor, agreeing to repair or replace wood flooring which shrinks, warps, cracks, or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials and/or workmanship and not due to unusual exposure to moisture or other abusive forces or elements not anticipated for application.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Storefront: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Manufacturer - Basis of Design: Connor Laytite Maple
 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Designer/Architect:
 - a. Horner Flooring Co.
 - b. Robbins, Inc.
 - c. Action Floor Systems, Inc.

2.02 WOOD STRIP FLOORING

- A. Vapor Barrier - 6-mil polyethylene.
- B. Subfloor
 1. Alliance I - Factory assembled subfloor panels shall provide nominal 3/4" X 4" x 8' UL plywood nailers set at Alliance I spacing with 3/4" Rezill pads attached. Sleeper anchorage struts shall be nominal 1/2" X 4" UL grade plywood with pre-drilled anchor pockets.
- C. Flooring (Connor Laytite Maple)
 1. 25/32 X 2-1/4", Second & Better Grade, Northern Hard Maple Flooring, TGEM, MFMA
- D. Fasteners
 1. Flooring - 2" barbed cleats or coated staples
 2. Subfloor - 1" coated staples or nails and PL400 adhesive or equal
 3. Concrete - 2-1/2", collared, steel drive pins
- E. Ventilated Base: The entire floor perimeter shall be provided with a 3" x 4" ventilated rubber base, color as selected by Designer/Architect.
- F. Floor finish shall be a four coat system as follows:
 1. First Coat - Polyurethane sealer, Connorthane or equivalent.
 2. Second, Third and Fourth Coats - Oil based polyurethane varnish with high gloss finish.

3. Game line paint shall be as recommended by floor finish manufacturer and compatible with floor finish materials. Paint shall be equivalent to Sherwin Williams Industrial Enamel. Colors shall be indicated on the drawings and/or finish schedule.
- G. Manufacturer: Subject to compliance with requirements, provide wood strip flooring by one of the following:
1. Home Flooring Co.
 2. Robbins, Inc.
 3. Action Floor Systems, Inc.
 4. Connor Hardwood Courts.
- H. Volleyball sleeves for 3 1/2" dia. Post with 5" dia. Cover plaque equal to Porter No. G-872-200 with brass cover plate. Ensure that sleeves are designed for the wood floor system specified.

PART 3 EXECUTION

3.01 INSPECTION

- A. Installer must examine substrates on which wood flooring will be installed and conditions under which work will be performed and must notify Contractor in writing of conditions detrimental to proper completion and maintenance of wood flooring. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. Commencement of flooring installation indicates acceptance of substrate and job site condition.

3.02 INSTALLATION

- A. General: Comply with flooring manufacturer's instructions and recommendations, but not less than recommended by NOFMA in "Hardwood Flooring Installation Material" and by recommendations of American Parquet Flooring Association, Inc., as applicable to type flooring required.
- B. Expansion Space: Provide expansion space at walls and other obstructions and terminations of flooring, not less than 3/4" unless otherwise indicated on drawings.
- C. Wood Strip Flooring Installation:
1. Cover concrete with 6 mil polyethylene, sealing and lapping joints a minimum of 4".
 2. Install first layer of 15/32" x 4' x 8' sheathing grade plywood with 32 pads attached 12" o.c. with a 1/4" spacing between adjoining sheets and a 2" expansion void along perimeter and all vertical obstructions. Install perimeter rows of cushions with no more than 6" from edge of sheet to center of cushion. First layer shall be installed across the long dimension of the room at a 45o angle. Second layer of plywood shall be laid out along the opposite 45o angle to the long dimension, so that the two layers cross at a 90o angle, and securely fastened to bottom layer.
 3. Install finish flooring parallel with main plying court by power nailing or stapling approximately 12" o.c.
 - a. Space joints between flooring strips to allow for intermediate expansion, as designated by the installer and in accordance with humidity conditions in the region.
 - b. Provide 2" expansion voids at the perimeter and at all vertical obstructions.
 4. Moisture content of flooring shall not exceed 8% during installation. In regions with constant high humidity, a higher moisture content may be required, as determined by the flooring Contractor.

3.03 SANDING AND FINISHING

- A. Machine sand installed unfinished flooring to remove offsets and non-level conditions, ridges, cups, and sanding machine marks which would be visually noticeable after finishing. Use 3 grades of sandpaper, ending with 00 grade. Vacuum clean and immediately apply finish. Do not permit traffic on floor after sanding and until finish is completed. Cover sanded floor with building paper to provide access for application of first finish coats.
1. First coat shall be a penetrating polyurethane wood sealer.

2. Lightly sand or buff and vacuum or tack rag between all coats of finish.
3. After the floor is sealed, buffed and vacuumed, apply game lines accurately in accordance with the drawings and KHSAA rules. Lines shall be straight with sharp edges in colors selected by Designer/Architect.
4. Apply coats of polyurethane varnish finish, buffing and tack rag between coats.

3.04 PERIMETER MOULDING

- A. Install ventilated base anchored to walls with base cement. Use premolded outside corners and neatly mitered inside corners.

3.05 PROTECTION

- A. Cover installed wood flooring to protect it from damage or deterioration, before and after finishing, during remainder of construction period. Use heavy Kraft-paper or other suitable covering. Do not use plastic sheet or film that could cause condensation.
 1. Do not cover site-finished floors with Kraft paper, or any other material, until finish reaches full cure, but not less than seven days after applying the last coat.

END OF SECTION

SECTION 096500 - RESILIENT TILE FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Vinyl composition tile (VCT1).
 - 2. Vinyl composition tile pattern diagram. The flooring Contractor will be responsible for submitting a complete measured floor pattern diagram for all areas to receive a floor tile pattern. The diagram will locate all floor tile pattern locations for approval prior to beginning work.
 - 3. The elevator cab shall receive resilient tile flooring.
 - 4. Note: Where resilient floor tile abut terrazzo flooring the resilient installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.
 - 5. Provide resilient flooring between the wood gym floor's aluminum threshold and the exterior door thresholds.
- B. Floor Slab Preparation: The installer is required to prepare all areas of floor slabs by utilizing a self leveling material equivalent to Mapei M-20 with T-2 primer, Schonox XM or TEC Level Set 300, as required over the entire floor surface. Following the manufacturer's directions completely before installing tiles.

1.02 RELATED REQUIREMENTS

- A. Section 012300 - Alternates: Refer to section for additional information.
- B. Section 013000 - Administrative Requirements: Submittal procedures.
- C. Section 090050 - Finish Legend.
- D. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base, reducer strips and other accessories installed with resilient floor tile.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. Product data for each type of product specified.
- B. Samples for Initial Selection: For each type of resilient floor tile indicated.
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required.
- D. Maintenance Data: For resilient products to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.07 PROJECT CONDITIONS

- A. Substrate Conditions: Use the method described below to determine the dryness as required to ensure initial and long-term success.
 - 1. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In Situ Probes.
 - a. Three tests should be conducted for areas up to 1,000 square feet and one additional test should be conducted for each additional 1,000 square feet of flooring.
 - b. Results must not exceed 75% when tested to ASTM F 2170. A diagram of the area showing the location and results of each test shall be submitted to the Interior Designer/Architect. If the test results exceed the limitations, the installer must not proceed until the problem has been corrected.
- B. The flooring contractor shall verify in writing to the owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 - 1. Moisture: Initial emission rate, as tested with a calcium chloride test kit, per ASTM F 1869-89 requirements.
 - 2. Alkalinity: Maximum pH of 9.
- C. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- D. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- E. Close spaces to traffic during floor covering installation.
- F. Close spaces to traffic for 48 hours after floor covering installation.
- G. Install resilient products after other finishing operations, including painting, have been completed.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color and pattern of floor tile installed.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Tarkett
 - 2. Armstrong World Industries
- B. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 COLORS AND PATTERNS

- A. Colors and Patterns: As selected by Interior Designer from manufacturer's full range.

2.03 VINYL COMPOSITION TILE

- A. Products: Subject to compliance with requirements, provide one of the following Basis of Design selections: **Tarkett**

2.04 VINYL COMPOSITION TILE ADDITIONAL REQUIREMENTS

- A. Wearing Surface: Smooth
- B. Thickness: 1/8"
- C. Size: 12" by 12" (305 by 305 mm)
- D. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648

2.05 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale and foreign deposits that might interfere with adhesion of resilient products.
2. The flooring Contractor shall prepare floor slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM E 710.
 1. Where irregular slab conditions occur, utilize POZ patch self leveling material as required (or approved equivalent) to return the slab to a smooth, level surface.
 2. Verify that substrates are dry and free of curing compounds, sealers and hardeners.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes and depressions in substrates. Prepare all slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation and dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Where any concrete slab expansion material has been utilized adjacent to walls, columns, etc. and the thickness exceeds 1/4" out from the vertical surface. The flooring installer shall remove the expansion material and clean out the void in the floor surface. The installer shall then place a 1/4" thick removable spacer along the vertical surface and fill the remaining void with POZ self-leveling material (or approved equivalent). After the leveling material has cured, remove the 1/4" spacer and install tile per manufacturer's recommendations.

3.03 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles square with room axis unless otherwise indicated.
- C. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, including pipes, outlets, edgings, door frames, thresholds and nosings. Tiles shall be installed under cabinets and casework.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.

- F. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters..
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, and puckering at joints. Telegraphing of adhesive spreader marks and other surface imperfections.
- H. Maintain tile coursing, ensure that all tile coursing runs true and even, at no time shall coursing be allowed to “grow” or “shrink” causing uneven joints. Notify Designer/Architect of problems with the tile sizes.
- I. Where floor tile borders/patterns occur, the center "field" tiles shall be full size tiles and the border tiles along the wall shall be cut to center the field tiles.
- J. Provide color matching caulk at the inter-section of hollow metal frames and resilient flooring.

3.04 SEQUENCING AND SCHEDULING

- A. Install tiles and accessories per the work schedule set by the General Contractor.
- B. Do not install tiles over concrete slabs or areas of patching until all areas are sufficiently dry to bond with adhesive as determined by tile manufacturer’s recommended bond and moisture test.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
 - 1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.
 - a. Coordinate selection of floor polish with Owner’s maintenance service.
 - b. Provide two coats of floor polish. **[Verify number of coats]**
 - 2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - 3. Do not move heavy and sharp objects directly over surfaces. Place hard board or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 096502 - RESILIENT TILE FLOORING- LUXURY VINYL TILE**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. This Section includes the following:
 - 1. Luxury vinyl flooring (LVT-1)
 - 2. Note: If terrazzo alternate is accepted, where luxury resilient floor tile abuts terrazzo flooring, the resilient installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.
- B. Floor Slab Preparation: The installer is required to prepare all areas of floor slabs by utilizing a self leveling material equivalent to Mapei M-20 with T-2 primer and Schonox XM as required over the entire floor surface. Following the manufacturer's directions completely before installing tiles.
- C. Related sections include the following:
 - 1. Section 090050 - Finish Legend
 - 2. Section 096513 - Resilient Wall Base and Accessories, for resilient wall base, reducer strips and other accessories installed with resilient floor tile
 - 3. Section 012300 - Alternates: Refer to section for additional information.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures
- B. Section 090050 - Finish Legend

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Product data for each type of product specified
- B. Samples for Initial Selection: For each type of resilient floor tile indicated
- C. Samples for Verification: Full-size units of each color and pattern of resilient floor tile required
- D. Maintenance Data: For resilient products to include in maintenance manuals

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.07 PROJECT CONDITIONS

- A. Substrate Conditions: Use the method described below to determine the dryness as required to ensure initial and long-term success.
 - 1. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In Situ Probes
 - a. Three tests should be conducted for areas up to 1,000 square feet and one additional test should be conducted for each additional 1,000 square feet of flooring.
 - b. Results must not exceed 75% when tested to ASTM F 2170. A diagram of the area showing the location and results of each test shall be submitted to the Interior Designer/Architect. If the test results exceed the limitations, the installer must not proceed until the problem has been corrected.
- B. The flooring contractor shall verify in writing to the owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 - 1. Moisture: Initial emission rate, as tested with a calcium chloride test kit, per ASTM F 1869-89 requirements
 - 2. Alkalinity: Maximum pH of 9
- C. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation
 - 2. During installation
 - 3. 48 hours after installation
- D. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- E. Close spaces to traffic during floor covering installation.
- F. Close spaces to traffic for 48 hours after floor covering installation.
- G. Install resilient products after other finishing operations, including painting, have been completed.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color and pattern of floor tile installed.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 LUXURY VINYL TILE

- A. Luxury vinyl tile Manufacturer: Shaw
- B. Style: Grain
- C. Color: TBD
- D. Thickness: .100 inches
- E. Size: 7" x 48"
- F. Installation: Standard Offset
- G. Fire-Test-Response Characteristics:
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648
- H. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified, shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale and foreign deposits that might interfere with adhesion of resilient products.
 - 2. The flooring Contractor shall prepare floor slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

- B. Concrete Substrates: Prepare according to ASTM E 710.
 - 1. Where irregular slab conditions occur, utilize POZ patch self leveling material as required (or approved equivalent) to return the slab to a smooth, level surface.
 - 2. Verify that substrates are dry and free of curing compounds, sealers and hardeners.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes and depressions in substrates. Prepare all slabs to receive new floor covering to prevent telegraphing of irregular slab conditions per the floor covering manufacturer's recommendations.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles square with room axis unless otherwise indicated.
- C. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, including pipes, outlets, edgings, door frames, thresholds and nosings. Ties shall be installed under cabinets and casework.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- F. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, and puckering at joints. Telegraphing of adhesive spreader marks and other surface imperfections.
- H. Maintain tile coursing, ensure that all tile coursing runs true and even, at no time shall coursing be allowed to "grow" or "shrink" causing uneven joints. Notify Designer/Architect of problems with the tile sizes.

3.04 SEQUENCING AND SCHEDULING

- A. Install tiles and accessories per the work schedule set by the General Contractor.
- B. Do not install tiles over concrete slabs or areas of patching until all areas are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.
 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
1. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 2. Do not move heavy and sharp objects directly over surfaces. Place hard board or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Resilient wall base (RB1) - rolls only. Refer to the drawings and the room finish schedule for additional information.
 - 2. Resilient flooring accessories
 - 3. Resilient stair accessories (**RTR 1**)
 NOTE: The landing and second floor level shall receive a resilient stair tread as a visually impaired warning.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 012300 - Alternates, refer to section for additional information
 - 2. Section 090050 - Finish Legend
 - 3. Section 096502 - Resilient Tile Flooring

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for each type of product specified
 - 2. Samples for initial selection purposes of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility for Products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

- B. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
- D. Smoke Density: Less than 450 per ASTM E 662.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours in advance of installation.

1.07 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive products specified in this Section for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install products until they are at the same temperature as that of the space where they are to be installed.
- C. Close spaces to traffic during installation of products specified in this Section.

1.08 SEQUENCING AND SCHEDULING

- A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

1.09 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.
 - 1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color of resilient wall base installed, on a continuous roll. One roll per color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products specified in each Product Data Sheet at end of this Section.

2.02 RESILIENT WALL BASE

- A. Vinyl Wall Base: Products complying with FS SS-W-40, Type I, and requirements specified in the Rubber Wall Base Product Data Sheet at end of this Section.

2.03 RESILIENT ACCESSORIES

- A. Vinyl Accessories: Products complying with requirements specified in Vinyl Accessory Product Data Sheet at end of this Section.

2.04 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland- cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas where installation of products specified in this Section will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section.

3.02 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.
- B. Use trowelable leveling and patching compounds per manufacturers directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- D. Broom and vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.03 INSTALLATION

- A. General: Install products specified in this Section using methods indicated according to manufacturer's installation directions.
- B. All work required to put the wall and floor surface into acceptable condition to receive the specified products shall be the full responsibility of the installer. All surfaces shall be prepared to prevent the telegraphing of irregular substrate conditions onto/through the surface of the new wall base or other accessories.
- C. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install inside and exterior corners before installing straight pieces.
 - 3. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
 - 4. Form outside corners on job from straight pieces of maximum lengths possible by shaving back of base at point where bending will occur. Remove a strip perpendicular to length of base and only deep enough to produce a snug fit without bends whitening or removal of more than half the thickness of wall base.

5. Form radius corners for bullnose CMU as follows: The installer shall use a section of 2" diameter plastic pipe to aid in altering the shape of the wall base profile to ease the installation of the material. Simply drape the wall base profile over the pipe with the toe of the wall base facing up. Heat the wall base along the radius of the pipe with a hot air gun or torch until pliable. While holding the wall base section firmly in contact with the pipe, quench the heated wall base area with a water dampened cloth until the wall base is cool. (This process only takes a few seconds to perform). The wall base will maintain the shape of the pipe when removed. Cut the wall base to the desired length of the return and install with cove base adhesive. Use contact bond adhesive for extremely short returns. Roll with a 2" hand roller to ensure proper adhesion.
- D. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.
- E. Fill all rubber stair tread nosings with epoxy approved by the stair tread manufacturer to prevent any flexing of the tread's nosing. Provide cove stick flash base at all one piece tread riser locations.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.
 2. Sweep or vacuum floor thoroughly.
 3. Do not wash floor until after time period recommended by manufacturer.
 4. Damp-mop resilient accessories to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by manufacturer of resilient product involved.
 1. Apply protective floor polish to resilient accessories that are free from soil, visible adhesive, and surface blemishes.
 - a. Use commercially available metal, cross-linked, acrylic product acceptable to resilient accessory manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
- C. Clean products specified in this Section not more than 4 days prior to dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products using method recommended by manufacturer.
 1. Strip protective floor polish that was applied after completing installation, prior to cleaning.
 2. Reapply floor polish after cleaning.

3.05 VINYL WALL BASE PRODUCT DATA SHEET

Vinyl Wall Base Designation: VWB-1

Style: Cove with top-set toe

Minimum Nominal Thickness: 1/8"

Height: 4"

Lengths: Coils in lengths standard with manufacturer, but not less than 100 feet

Exterior Corners: Pre-molded or formed on job

Interior Corners: Pre-molded or formed on job

Ends: Pre-molded

Color and Pattern: As selected by Architect/Designer from manufacturer's full range of colors and patterns produced for vinyl wall base complying with requirements indicated. Provide up to two colors.

Available Products:

1. Basis of Design: Nora Cove
2. Roppe Corporation
3. Flexco Div., Textile Rubber Co.
4. Johnsonite

3.06 VINYL ACCESSORY PRODUCT DATA SHEET

Vinyl Accessory Designation: Resilient Edge Strips

Profile and Dimensions: 1/8" thick, homogeneous rubber composition, tapered or bullnose edge.

Color: As selected by Architect/Designer from manufacturer's full range of colors produced for rubber accessories complying with requirements indicated.

3.07 RUBBER STAIR ACCESSORY DATA SHEET

Rubber Accessory Designation: Stair Treads and Risers

Surface Texture: Hammered

Nosing Style: Square. The leading 2 inches (51mm) of the tread shall have visual contrast of dark-on-light or light-on-dark from the remainder of the tread. Inserts shall be phosphorescent

Nosing Height: As indicated

Thickness: 3/16 inch tapering to 1/8 inch at back edge

Size: Lengths and depths to fit each stair tread and riser in one piece

Rubber Treads and Risers: As selected by Designer from manufacturer's full range of colors and patterns produced for rubber stair accessories complying with requirements indicated. Provide one color.

Available Products:

1. Basis of Design: Nora Grano with signal stripe, including phosphorescent
2. Flexco Div., Textile Rubber Co.
3. Johnsonite
4. Roppe Corporation

END OF SECTION

SECTION 096566 - RESILIENT SHEET VINYL ATHLETIC FLOORING**PART 1 – GENERAL****1.01 SECTION INCLUDES**

- A. Products Supplied
 - 1. Resilient (sheet vinyl) athletic flooring (RAF 1)
 - 2. Recycled Resilient Flooring (RAF 2)
 - 3. Adhesive and accessories required for installation, maintenance and repair.
 - 4. Refer to the List of Alternates for additional information.
 - 5. Metal flooring transition plates at all locations where flooring does not abut a finished floor surface.

1.02 RELATED REQUIREMENTS

- A. Section 013000 – Administrative Requirements - Submittal procedures
- B. Section 022500 – Existing Material Assessment
- C. Section 030500 – Common Work Results for Concrete
- D. Section 060500 – Common Work Results for Wood, Plastics, and Composites
- E. Section 070500 – Common Work Results for Thermal and Moisture Protection
- F. Section 071000 – Dampproofing and Waterproofing
- G. Section 090050 – Finish Legend

1.03 REFERENCE STANDARDS

- A. American Society for Testing & Materials (ASTM)
 - 1. ASTM D2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as measured by the James Machine.
 - 2. ASTM D2240: Standard Test Method for Rubber Property (Durometer Hardness).
 - 3. ASTM D5116: Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 - 4. ASTM E648: Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - 5. ASTM E662: Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 6. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - 7. ASTM F970: Standard Test Method for Static Load Limit.
 - 8. ASTM F1869: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - 9. ASTM G21: Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - 10. ASTM F710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- B. National Fire Protection Association
 - 1. NFPA 101: Life Safety Code®.

1.04 INSTALLERS

- A. Installation shall be performed by an installer having satisfactory experience in the application of these or similar materials or with on-site consultation by a qualified field service representative of the product's manufacturer. Provide a letter of reference from the product's manufacturer stating the quality of the installer's past installation.

- B. Installer Qualifications:
 1. At least 5 years experience in the installation of resilient athletic flooring.
 2. Experience on at least five projects of similar size, type and complexity as this project.

1.05 PRE-INSTALLATION MEETING

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.06 SUBMITTALS

- A. Action Submittals
 1. Provide Manufacturer's current printed data sheets on specified products (flooring, adhesives, accessories, etc.).
 2. Provide shop drawings prepared for project illustrating layouts, details, dimensions and other data.
 3. Provide samples for verification of such characteristics as color, texture and finish.
- B. Informational Submittals
 1. Provide Manufacturer's current installation guidelines as published by the Manufacturer.
- C. Closeout Submittals
 1. Provide Manufacturer's current maintenance guidelines as published by the Manufacturer.
 2. Provide Manufacturer's current standard warranty as published by the Manufacturer.
- D. Maintenance Material Submittals
 1. Provide extra stock materials for use in facility operation and maintenance. Provide amount of approximately 2% of the total floor surface, of each type, color and dye lot.

1.07 QUALITY ASSURANCE

- A. Manufacturer must have experience in the manufacturing of prefabricated resilient athletic flooring.
- B. Installer must have performed installations of the same scale in the last three (3) years.
- C. Installer to be recognized and approved by the sheet athletic flooring Manufacturer.
- D. Installation of mock-up is required and must be deemed acceptable by Owner and Architect. Mock-up is to be installed following the same procedures and utilizing the same specified materials that will be used for the actual project. - Mock-up size: 20' x 20'.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Maintain a stable room and subfloor temperature for a period of 48 hours prior, during and 48 hours after installation. Recommended range: 65oF to 86oF (18oC to 30oC).
- B. Installation to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength).
- C. Moisture vapor emission content of the concrete slab must not exceed the tolerance of the adhesive used when tested using the anhydrous calcium chloride test as per ASTM F1869.
- D. Installation of resilient athletic flooring will not commence unless all other trades in the building are completed.

1.09 PROJECT CONDITIONS

- A. Maintain a stable room and subfloor temperature for a period of 48 hours prior, during and 48 hours after installation. Recommended range: 65oF to 86oF (18oC to 30oC).
- B. Installation to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength).

- C. Moisture vapor emission content of the concrete slab must not exceed the tolerance of the adhesive used when tested using the anhydrous calcium chloride test as per ASTM F1869.
- D. Installation of resilient flooring will not commence unless all other trades in the building are completed.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.
- B. Coordinate layout and installation of flooring with other gymnasium equipment.

1.11 WARRANTY

- A. Provide Manufacturer's current standard warranty.
- B. The resilient athletic flooring is warranted to be free from manufacturing defects for a period of three (3) years from the date of shipment from the Manufacturer.
- C. The resilient athletic flooring is warranted against excessive wear under normal usage for a period of ten (10) years from the date installation.

1.12 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Flooring: Equivalent to 5 percent of the total amount installed.

PART 2 – PRODUCT

2.01 MANUFACTURERS

- A. Resilient athletic flooring manufacturer: Subject to compliance with requirements, provide products including, but not limited to one of the following:
 - 1. Basis of Design: Gerflor
 - 2. Mondo America
 - 3. Spec Athletic
 - 4. Mats, Inc.
- B. Available Manufacturer's: Other manufacturers proposed which meet the specific standards specified, shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 MANUFACTURED PRODUCTS

- A. Sport Floor Product Description: Foam-backed sheet vinyl flooring for installation over vented slip-sheet (RAF 1).
 - 1. Overall Thickness: Not less than 0.24 inch (6.2 mm)
 - 2. Wear-Layer Thickness: Not less than 0.08 inch (2.1 mm)
 - 3. Foam Backing:
 - a. Very high density, two layer, dual-durometer, closed cell foam
 - b. Two (2) layers of fiberglass reinforcement for dimensional stability and indentation resistance. One layer of woven grid fiberglass and an additional layer of non-woven fiberglass.
 - c. Basis-of-Design Product: Multi-use 6.2
 - 4. Seaming Method: Heat welded.
 - 5. Adhesive Method:
 - a. Sport Flooring: Full-spread adhesive to completely adhere sport flooring to the top of the vented slip-sheet layer.
 - b. Vented Slip-Sheet: Loose-lay installation over substrate.

6. Traffic-Surface Texture: Wood visual shall have wood grain embossed texture for a genuine wood appearance and Solid colors to have "pebbled" embossed texture for an attractive appearance.
7. Bacteriostatic and Fungicidal Treatment: Manufacturer's factory-applied permanent treatment throughout the flooring material which can improve indoor air quality and reduce asthma and allergy risks associated with bacterial and mold growth.
 - a. Basis of Design Product: Gerflor Sanosol
8. Applied Finish: Manufacturer's, factory-applied, permanent and UV-cured
 - a. No-Wax finish: Published product literature identifying factory applied finish as, "No-Wax-Just clean and rinse"
 - b. Basis of Design Product: Gerflor ProtecSol
9. Field-Applied Finishes: None required and not allowed.
10. Roll Size:
 - a. Roll Width: Rolls to be a minimum width of 59 inches (1.5 m) wide.
 - b. Roll Length: Wood visual rolls to be a minimum length of 67 feet, 3 inches (20.5m).
11. Color Pattern:
 - a. As selected by Owner from manufacturer's standard colors and patterns.
 - b. Wood pattern shall accurately simulate the true visual appearance of natural athletic wood strip flooring.
 - 1) Pattern shall replicate random-length stock by simulating non-uniform board lengths ranging from 18 inches to 48 inches with a maximum board width of 2-1/2 inches.
 - 2) Wood pattern shall not include a dark line simulating edges or ends of individual boards.
 - 3) Surface texture shall simulate realistic wood grain and not be raised or "pebbled" embossing.
12. Performance Criteria:
 - a. ASTM F 2772-11 Indoor Sport Floor Standard:
 - 1) Provide certification of compliance for the four ASTM F2772 Indoor Sport Floor Standard Performance categories:
 - (a) Shock Absorption/Force Reduction: Class C2 (22% to 33%). Pass
 - (b) Ball Bounce: Minimum 90%: Pass
 - (c) Surface effect/Coefficient of Friction: Between 80-110: Pass
 - (d) Vertical Deformation: Maximum 3.5mm: Pass
13. Static Load Limit/Residual Indentation:
 - a. ASTM F1303; Pass, Static Load Resistance requirement of less than 0.005 inch of residual indentation as tested per ASTM F 970 at prescribed test load of 175 p.s.i.
 - 1) Less than 0.002 inch residual indentation when tested at 250 p.s.i
 - b. EN 1516; Pass, Less than or equal to 0.5mm
14. Resistance to Rolling Load: EN 1569; Pass.
15. Chemical Resistance: ASTM D 543; OK.
16. Impact Resistance: EN 1517; Pass.
17. Abrasion Resistance: EN ISO 5470; Pass

2.03 MANUFACTURED PRODUCTS

- A. Provide Tarkett Replay 24" X 24" tiles with colored granules as follows:
 1. Thickness: .375"
 2. Tile Size: 24" x 24"
 3. Color: TBD - equal to Speckled Black and Yellow
 4. Surface Type: Smooth
 5. Installation: Glue Down

2.04 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation provided by flooring manufacturer.
 - 1. Basis-of-Design Product: GerPatch, Gerflor's patching compound.
 - 2. Slab moisture tolerance: Same slab moisture tolerance as the adhesive.

2.05 ADHESIVES

- A. Water-resistant type recommended by athletic flooring manufacturer for substrate and conditions indicated.
 - 1. Basis-of-Design Product: Gerflor T-111 2 Part Urethane Adhesive.
 - a. Moisture Resistance Limit: 95% relative humidity (RH) when tested according to ASTM F 2170
 - b. Coverage Type: Full-spread application for 100% coverage.
- B. Heat Welding Rod: As supplied by indoor resilient flooring manufacturer. Color shall blend with resilient flooring color.
- C. Game-Line and Marker Paint: Complete system including primer, compatible with flooring and recommended by flooring and paint manufacturers.

PART 3 - EXECUTION**3.01 INSTALLERS**

- A. Refer to section 1.4 of this document for information on installers.

3.02 EXAMINATION

- A. The area in which the indoor resilient flooring will be installed is dry, weather-tight, and in compliance with specified requirements.
- B. Permanent heat, lighting, and ventilation systems are installed and operable.
- C. Other work, including overhead work, that could cause damage, dirt, dust or otherwise interrupt installation, has been completed or suspended.
- D. No foreign materials or objects are present on the substrate and that it is clean and ready for preparation and installation.
- E. Concrete or asphalt subfloors to be placed a minimum of twenty-eight (28) days prior to the installation of rubber athletic flooring.
- F. Concrete or asphalt subfloors on or below grade are installed over a suitable moisture retardant membrane. Water vapor membrane complies with specification in ASTM E1745.
- G. No concrete or asphalt sealers or curing compounds are applied or mixed with the subfloors (refer to Section 03 05 00 - Common Work Results for Concrete of Division 3).
- H. Moisture and alkalinity tests must be preformed. Moisture content must not exceed the capacity of the specified adhesive (verify using the anhydrous calcium chloride test as per ASTM F1869) and pH level should be in the range of 7 to 8.5. Testing according to ASTM F 710.
- I. Smooth, dense finish, highly compacted with a tolerance of 1/8" in a 10 ft radius (3.2 mm in 3.05 m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.

3.03 PREPARATION

- A. Prepare subfloor in accordance with Manufacturer's current printed Subfloor Preparation guidelines.

- B. Use Gerflor's GerPatch trowelable concrete based patching compound with the same moisture vapor tolerance as the adhesive to fill depressions, holes, cracks, grooves or other irregularities in substrate.
- C. Place flooring and installation materials into spaces where they will be installed at least 48 hours before installation. Install flooring materials only after they have reached the same temperature as space where they are to be installed.
- D. Sand the surface of the concrete slab.
- E. Sweep and then vacuum substrates immediately before installation. After cleaning, examine substrate for moisture, alkaline salts, grit, dust or other contamination. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 INSTALLATION

- A. Installation of Sheet Goods
 - 1. Install resilient athletic flooring in accordance with Manufacturer's current printed Installation Manual.
 - 2. Take necessary precautions to minimize noise, odors, dust and inconvenience during installation.
 - 3. Fit flooring neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
 - 4. 4. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- B. Lay out flooring as follows:
 - 1. Minimize number of seams and place them inconspicuous areas.
 - 2. Locate seams as shown on approved Shop Drawings
- C. Adhered Flooring: Attach products to substrates using Gerflor's full-spread adhesive applied to substrate to comply with adhesive and flooring manufacturer instructions.
- D. Vinyl Sheet Flooring Seams: Finish seams to produce surfaces flush with adjoining flooring surfaces. Comply with ASTM F 1516. Rout joints and use heat welding rod to permanently and seamlessly fuse sections together.

3.05 REPAIR

- A. Refer to section 1.13 for extra stock materials.
- B. Repair material must be from the same dye lot as material supplied for initial installation.
- C. Repairs are to be performed by qualified installers/technicians only.

3.06 CLEANING

- A. Initial cleaning should only be performed 72 hours after the rubber athletic surface has been completely installed.
- B. Maintain resilient athletic flooring according to Manufacturer's current maintenance instructions for specified product.

3.07 PROTECTION

- A. Resilient athletic flooring surface can be protected with Masonite during and after the installation, prior to acceptance by the Owner.

END OF SECTION

SECTION 096623 - EPOXY-RESIN TERRAZZO FLOORING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following types of terrazzo:
 - 1. Epoxy resin terrazzo (T1-T4) for new terrazzo installation. 3/8" thick.
 - 2. **number of colors to be used or reference drawing detail designation. Reference manufacturer's color designations."**
 - 3. Precast terrazzo stair treads with abrasive or aluminum inserts.
- B. Select finish required per the project requirements from the following:
 - 1. Finish required:
 - a. Provide a 800 grit polish surface **(add 3.25 per SF and inform Owner about added maintenance issues).**
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 3 Section "Concrete Work" for concrete substrate, including levelness tolerances.
 - 2. Division 7 Section "Joint Sealers" for furnishing and installing joint sealants.
 - 3. Division 15 Section "Drainage and Vent Systems" for furnishing and setting of floor drains.
 - 4. Section 012300 - Alternates: Refer to Section for additional information.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.
- B. Section 090050 - Finish Legend

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of terrazzo, accessory item, and component material specified.
- C. Shop Drawings: Showing layout of divider strips, control joint strips, and base and border strips.

- D. Samples: 6-inch-square samples of each different pattern, color, and type of terrazzo required. Provide minimum 6-inch-long samples of each type accessory item specified.
- E. Material Certification: Supplier's/manufacturer's written certification that terrazzo materials provided meet or exceed specified NTMA properties.
- F. Maintenance Instructions: Submit 2 copies of written instructions for recommended periodic maintenance of each type of terrazzo.
- G. Manufacturer Experience:
 - 1. Submit proof of Associate membership in NTMA.
 - 2. Submit a list of at least five (5) epoxy terrazzo projects using material being submitted for this project installed during the last five (5) years of the same scope, complexity and at least 50 percent of the square footage.
 - 3. Manufacturer shall provide history of providing primary materials for a minimum of ten (10) years.
- H. Qualification Data: For qualified installer.
 - 1. Submit proof of Contractor membership in NTMA.
 - 2. Furnish a list of at least five (5) epoxy terrazzo projects using material being submitted for this project installed during the last five (5) years of the same scope, complexity and at least 50 percent of the square footage.

1.05 QUALITY ASSURANCE

- A. NTMA Standards: Comply with specified provisions and recommendations of National Terrazzo and Mosaic Association, Inc. (NTMA) unless more stringent requirements are specified.
- B. Manufacturer Qualifications:
 - 1. Manufacturer shall be an associate member of NTMA.
 - 2. Engage an epoxy manufacturer with at least ten (10) years experience in the manufacture of epoxy flooring materials.
- C. Installer Qualifications:
 - 1. Installer shall be a contractor member of NTMA.
 - 2. Installer shall be certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
 - 3. Installer shall have at least five (5) years of satisfactory experience in installation of epoxy terrazzo. Installer shall demonstrate experience during last five (5) years by having completed at least five (5) projects of comparable scope and complexity of at least 50 percent of the total square footage of this project.
- D. Manufacturer's Instructions: In addition to specified requirements, comply with resin manufacturer's instructions and recommendations for substrate preparation, materials storage, mixing and application, finishing, and curing.
- E. Source Limitations for Marble: Obtain each color, grade, type, and variety of marble from one source with resources to provide materials of consistent quality in appearance and physical properties without delaying the Work.
- F. Mock-Ups: Before installing terrazzo, construct mock-ups for each type and color required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for completed Work.
 - 1. Locate mock-ups in the location and of the size indicated or, if not indicated, as directed by Designer/Architect.
 - 2. Notify Designer/Architect seven (7) days in advance of dates and times when mock-ups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Designer/Architect's approval of mock-ups before proceeding with terrazzo installation.
5. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - a. When directed, demolish and remove mock-ups from Project site.

1.06 PRE-INSTALLATION MEETING

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.08 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.11 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials that match products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.01 THIN-SET TERRAZZO MATERIALS

- A. Epoxy Resin Terrazzo Matrix: Thermosetting, amine-cured epoxy resin and hardener, mineral filler, and color pigment, complying with NTMA "Guide Specification for Epoxy Terrazzo" and as required to match Architect's sample.

- B. Acceptable manufacturers; subject to compliance with specified requirements:
1. Basis of design: Terrazzo & Marble Supply Companies, Terroxy® Systems Epoxy Matrix. (www.tmsupply.com <http://www.tmsupply.com>).
 2. Quadrant Chemical Companies.
 3. TEC Specialty Construction Brands, Inc., Tuff-Lite Epoxy Terrazzo Systems.

2.02 PERFORMANCE REQUIREMENTS

- A. Aggregates: Natural, sound, crushed marble chips, colors selected and graded to match Architect's samples, but with maximum size within limits of workability for terrazzo thickness indicated.
- B. Substrate Primer: Two-component resin or other compound, recommended by matrix manufacturer, to penetrate and seal substrate and provide maximum bond of terrazzo to substrate.
- C. Finishing Grout: Resin-based grout with filler and pigments as recommended by matrix manufacturer.
- D. Flexible Epoxy Isolation Membrane: Epoxy-Resin Matrix Manufacturer's 100 percent solids epoxy membrane and fiberglass mesh for crack penetration. (10% - 15% of project).

2.03 EPOXY MATRIC TERRAZZO APPLICATIONS

- A. Mix: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's product data for matrix and aggregate proportions and mixing.
1. Color and pattern schedule: Where the following designations are indicated, provide specified terrazzo matrices matching architect's samples:
 - a. TZ1: <Insert Terroxy® Resin System's sample number>
 - b. TZ__: <Insert Terroxy® Resin System's sample number>
 - c. TZ__: (Precast Tread/Riser) <Insert sample number>
 - d. TZ__: (Precast Base) <Insert sample number>

**** OR IF COLORS ARE UNDETERMINED ****

- A. Mix: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's product data for matrix and aggregate proportions and mixing.
1. Color and Pattern Schedule: Where the following designations are indicated, provide specified terrazzo matrices matching Interior Designer's samples:
 - a. All colors: **30% GA White, 30% Italian Botticino, 20% TM Post Consumer Ash Gray Glass, 10% ASG One Sided Mirror, 10% Fresh Water Mother of Pearl.**
 - b. Terrazzo filler shall be Clear Glass Fines.
 - c. Sample shall be approved by Architect.
 - d. Adjustments of proportions to individual colors may be necessary to obtain the intended appearance. No additional cost shall be charged to Owner if overall proportions for entire project remain within the proportions specified above.
- B. Floors:
1. Thickness: 3/8 inch, nominal.
 2. Color (s): Match NTMA Plate No. _____.
 3. Color (s): Match Architect's sample.
 4. Color (s): Match existing.
 5. Color (s): To be selected by Architect.
 6. Color (s): As indicated on drawings.
 7. Aggregate Type: Marble chips.
 8. Aggregate Size: No. 0-1.
- C. Wall Base:
1. Thickness: Same as floors.

2. Color (s): Same as adjacent floor.
 3. Color (s): As indicated on drawings.
 4. Aggregate Type and Size: Same as floors.
- D. Stair Treads and Landings:
1. Thickness: Same as floors.
 2. Thickness: 3/8 inch, minimum.
 3. Color (s): Same as adjacent floor.
 4. Color (s): As indicated on drawings.
 5. Aggregate Type and Size: Same as floors.
- E. Stair Risers and Stringers:
1. Thickness: Same as floors.
 2. Thickness: 1/4 inch, minimum.
 3. Color (s): Same as adjacent treads.
 4. Color (s): As indicated on drawings.
 5. Aggregate Type and Size: Same as floors.

2.04 TERRAZZO ACCESORIES

- A. Divider Strips: Depth and style required for terrazzo type and thickness. Width, material, and color as indicated. Angle or "T" -type for adhesive bonding to substrate.
1. Unless otherwise indicated, use divider strips with 1/8-inch-wide top, as follows:
 - a. White zinc alloy.
- B. Control Strips: Double or split units, 1/8 inch wide, of same material and color as divider strips with 1/8-inch-wide full-depth filler, laminated between strips.
1. Filler: Elastomeric sealant.
- C. Divider Strip Adhesive: Epoxy-Resin adhesive recommended by manufacturer for this use and acceptable to thin-set Terrazzo Resin manufacturer.
- D. Cleaner: Chemically neutral, liquid cleaner, with Ph factor between 7 and 10, of formulation recommended by sealer manufacturer for type of terrazzo used and complying with NTMA requirements.
- E. Interior Floor Sealer: Colorless, slip- and stain-resistant penetrating sealer with Ph factor between 7 and 10, that does not affect color or physical properties of terrazzo surface.
- F. Sealer: Slip and stain-resistant sealer that is chemically neutral with a pH factor between 7 and 10, that meets a standard coefficient of friction of 0.5 or higher, as measured by the James Machine (ASTM D-2047 Test Method), does not affect physical properties of terrazzo and complies with NTMA's "Terrazzo Specifications and Design Guide."
1. TRX Water Based 2-K Urethane / Acrylic Coating (premium) **DELETE TRX IF REQUIRING 800 - 1000 GRIT VITRIFIED HIGH POLISH.**
 2. WB Urethane
 3. WB Acrylic
- G. Thin-Set Terrazzo Primer: Two-component resin or other compound recommended by thin-set Terrazzo Resin manufacturer for priming substrate.
- H. Thin-Set Terrazzo Finishing Grout: Thin-Set Terrazzo Resin manufacturer's resin-based finishing grout.

2.05 PRECAST TERRAZZO

- A. Precast Terrazzo Units: Precast epoxy terrazzo [base] [stair tread] [threshold] [bench] [and] [planter] <Insert requirements> units.
1. Manufacturers: Subject to compliance with requirements, provided products acceptable to architect.

- a. Precast Terrazzo Enterprises
 - b. Wausau Tile Tectura
- B. Precast Terrazzo Base Units: 3/8" (6.4 mm) thick, cast in maximum lengths possible, but not less than 36" (900 mm).
 - 1. Type: Flat as indicated.
 - 2. Height: 4" as indicated.
 - 3. Outside Corner Units: With finished returned edges at outside corner.
 - 4. Color and Pattern: Match Architect's sample. Match adjacent poured-in-place terrazzo flooring.
- C. Precast Terrazzo Stair Treads: Thickness indicated with cast-in nosing.
 - 1. Tread/Riser: 1/2" (12.7 mm) thick epoxy, Type _____ with abrasive pattern _____.
 - 2. Color and Pattern: [Match architect's approved Terroxy® Resin Systems Sample].

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine concrete substrate to ensure that surface levelness tolerances are within tolerance ranges required by NTMA for type of terrazzo application specified.
 - 1. Notify Contractor of unsatisfactory levelness tolerances. Do not begin installation until unsatisfactory tolerances have been corrected and are ready to receive terrazzo.
 - 2. Verify that concrete substrates are visibly dry and free of moisture. Document the moisture level of concrete slab-on-grade surfaces prior to installation of terrazzo. Test moisture level with accord with ASTM F2170 (determining relative humidity in concrete slabs using in situ probes).
- B. Clean and prepare substrate to comply with NTMA specifications for type of terrazzo application indicated. Clean substrate of loose chips, foreign matter, oil, grease and curing compounds.

3.02 INSTALLATION, GENERAL

- A. For thin-set terrazzo, comply with resin manufacturer's recommendations for proportioning mixes, in-stalling strips, and placing, curing, grinding, and finishing.
- B. Provide terrazzo without interruptions of seams, except where divider strips, control joints, and expansion joints are indicated. Place and finish terrazzo around obstructions to achieve continuous color, pattern, and finish.
- C. Install divider and accessory strips in adhesive setting bed, in accordance with manufacturer's instructions, without voids below strips. Provide mechanical anchorage as required for adequate attachment of strips to substrate.
- D. Provide control joints at all expansion joints where indicated or specified by installing angle-type divider strips back-to-back with neoprene rubber filler cemented between strips, flush with finish floor.
- E. Flexible Epoxy Isolation Membrane: Prepare and prefill substrate cracks with membrane material and install flexible epoxy isolation membrane according to manufacturer's written instructions. Prepare epoxy membrane according to manufacturer's written instructions before applying substrate primer.
- F. Provide flexible epoxy isolation membrane with fiberglass mesh as recommended by the epoxy resin manufacturer at all areas of slab cracking. The base bid amount will include 10% isolation membrane of the total area of terrazzo. Additional areas determined to require epoxy isolation membrane with fiberglass mesh must be pre-approved by the Designer/Architect and/or the Construction Manager prior to proceeding with the work.
- G. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound when tapped. Cut out terrazzo areas in panels defined by strips and

replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

- H. Construction Tolerances: Limit terrazzo surfaces' variation from level to 1/4 inch in 10 feet (6.4 mm in 3 m).
- I. Where epoxy resin terrazzo terminates at floor covering changes, the installer shall utilize a Schluter Schiene Strip. Coordinate metal finish with Designer prior to installation.

3.03 THIN-SET TERRAZZO

- A. Comply with NTMA guide specifications previously referenced under "Thin-Set Terrazzo Materials" and with matrix manufacturer's directions for installing and finishing thin-set terrazzo. Match Architect's sample and provide total material thickness indicated.
- B. Exercise extreme care to ensure fluids from grinding operation do not react with divider or control strips to produce a stain on aggregate.
- C. Delay grinding and finishing until heavy trade work is completed and construction traffic through the area is restricted.

3.04 CLEANING & SEALING

- A. Clean terrazzo after installing and finishing operations are completed, complying with sealer manufacturer's instructions.
 - 1. Cleaner: Chemically neutral cleaner with pH factor between 7 and 12 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
 - 2. Sealer: Slip and stain-resistant, penetrating-type sealer that is chemically neutral with pH factor between 7 and 12, does not affect color or physical properties of terrazzo type indicated, is recommended by sealer manufacturer for this use, and complies with NTMA Guide Specification for terrazzo type indicated.
- B. Apply sealer to cleaned terrazzo surfaces to comply with sealer manufacturer's instructions.

3.05 FINAL CLEANING AND PROTECTION

- A. Clean terrazzo as recommended by manufacturer of sealer and machine buff if required when building is ready for occupancy.
- B. Protect terrazzo from damage and wear during construction operation.

END OF SECTION

SECTION 096813 - CARPET TILE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. This Section includes modular, tufted carpet tile and modular track off tile.
- B. Sections 09650 thru 09681 shall not be combined with any other bid packages. The installer must be CFI certified (C-2 level or higher). A certified person should be on the job at all times during the installation procedures. See Bid form of Proposal for line item to designate Installer's name and certification qualification.
- C. Note: Where carpeting abut terrazzo flooring the resilient and carpet installer shall provide a feathered underlayment to provide a smooth transition area. The area of floor level transition shall occur over a minimum of three feet distance.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.
- B. Section 090050 - Finish Legend
- C. Section 096513 - Resilient Wall Base and Accessories, for resilient wall base and accessories installed with carpet tile

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles
 - 2. Carpet tile type, color, and dye lot
 - 3. Pattern of installation

4. Pattern type, location, and direction
 5. Pile direction
 6. Type, color, and location of edge, transition, and other accessory strips
 7. Transition details to other flooring materials
- C. Samples: For each of the following products and for each color and texture required, label each sample with manufacturer's name, material description, color, pattern, and designation indicated on drawings and in schedules.
1. Carpet Tile: Full-size sample
 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long samples.
- D. Product Schedule: For carpet tile, use same designations indicated on drawings.
- E. Qualification Data: Installer must be CFI Certified (C-2 level or higher).
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals, include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile
- H. Warranty: Special warranty specified in this section.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 4, "Storage and Handling."

1.07 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Ambient Temperature and Humidity Suitable Substrates" and Section 7.3, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 1 Section "Product Requirements."
- B. Revise paragraph and subparagraphs below if manufacturers have separate warranties for various characteristics.

- C. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equivalent to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m)

PART 2 -PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Shaw
- B. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified, shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 CARPET TILE

- A. Products: Subject to compliance with requirements, provide one of the following Basis of Design selections:
 - 1. Carpet Plank-Media Center (CPT1-CPT4)
 - a. Manufacturer: Shaw
 - b. Collection: Living Systems
 - c. Style: Observe and Observe Color Tile
 - d. Color: TBD, Up to Four Colors
 - e. Size: 9" x 36"
 - f. Fiber: Eco Solution Q Nylon
 - g. Dye Method: 100% Solution Dyed
 - h. Backing: Eco Worx Tile
 - i. Installation:
 - j. Location: Refer to Drawings
 - 2. Carpet Broadloom-Auditorium (CPT5)
 - a. Manufacturer: Shaw
 - b. Collection: Off The Grid
 - c. Style: Escape
 - d. Color: TBD
 - e. Size: 12' Broadloom
 - f. Fiber: Eco Solution Q Nylon
 - g. Dye Method: 100% Solution Dyed
 - h. Backing: Ultraloc
 - i. Installation:
 - j. Location: Refer to Drawings

2.03 CARPET TILE ADDITIONAL REQUIREMENTS

- A. Applied Soil-Resistance Treatment: Manufacturer's standard material

- B. Antimicrobial Treatment: Manufacturer's standard material
- C. Performance Characteristics: As follows:
 - 1. Colorfastness to Light:
- D. Flammability, Methenamine Pill Test (DOC FF-1-70): Passes
- E. Flooring Radiant Panel (ASTM E-648): Class 1
- F. Smoke Density (ASTM E-662): Less than 450
- G. Wearability: Lifetime Commercial Wear Warranty
- H. Edge Ravel/Zippering: Lifetime Warranties
- I. Backing Integrity/Delamination: Lifetime Warranties
- J. Traffic Class: Heavy
- K. CRI Green Label:
- L. ADA Compliance: This product meets the guidelines as set forth in the Americans with Disabilities Act for minimum static coefficient of friction of 0.6 for accessible routes.

2.04 ACCESSORIES

- A. Carpet Edge Guard: Extruded aluminum carpet bar model No. MT-00-A as manufactured by Johnsonite (or approved equivalent). Extruded T-Moulding cap strip profile specifically made to transition between materials as manufactured by Johnsonite (or approved equivalent).
 - 1. Manufacturers: Subject to compliance to specifications, provide products as manufactured by one of the following:
 - a. Futura Home Products
 - b. William L. Bonnell Co., Inc.
 - c. Macklanburg - Duncan
 - d. Mercer Products Co., Inc.
 - e. Flexco Division, Textile Rubber Co.
 - f. Roppe
 - g. Johnsonite, Inc.
- B. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- C. Carpet Adhesive: Water resistant and non-staining as recommended by carpet manufacturer to comply with flammability requirements for installed carpet.

2.05 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Pressure Sensitive Adhesive System. CRI Green Label Plus certified and recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 7.0 "Site Conditions" and to Section 8.0 "Substrate Preparation" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with CRI 104, Section 10 "Carpet Tile" and with carpet tile manufacturer's written installation instructions.
- B. Installation method, layout: Monolithic. **[Edit Per Project Requirements]**
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 11, "Post Installation".
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 096813.01 - CARPET TILE INSTALLER'S CERTIFICATION

PART 1 GENERAL

1.01 CARPET TILE INSTALLER'S CERTIFICATION

This certification must be completed and submitted as outlined in the Supplemental Instructions to Bidders. Failure to submit this completed certification may be cause for rejection of the bidder's proposal.

Date Submitted: _____

Name & Address of Carpet Tile Installer:

I certify that _____ (Name of Carpet Tile Installer) has achieved CFI Certification for carpet installation.

CFI Number _____

Signed: _____ Title: _____

END OF SECTION

SECTION 097200 - WALL COVERINGS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Vinyl wall covering.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 9 Section "Painting" for priming wall surfaces.

1.03 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- C. Shop Drawings showing location and extent of each wall covering type. Indicate seams and termination points.
- D. Samples for initial selection in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available.
- E. Samples for verification in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

1. Wall Covering Material: Full-width sample, not less than 36 inches (914 mm) long, from dye lot used for the Work.
 - a. Show complete pattern repeat.
- F. Schedule of wall coverings using same room designations indicated on Drawings.
- G. Product certificates signed by manufacturers of wall coverings certifying that their products comply with specified requirements.
- H. Maintenance data for wall covering to include in the operation and maintenance manual specified in Division 1.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed 5 projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Provide wall coverings with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Flame Spread: 15 or less.
 2. Smoke Developed: 25 or less.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.08 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install wall covering until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
- B. Lighting: Do not install wall covering until a lighting level of not less than 15 foot-candles (160 lux) is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the wall covering manufacturer for full drying or curing.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 1. Rolls of Wall Covering Material: Full-size units equal to 5 percent of amount of each type installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, wall coverings that may be incorporated into the Work include, but are not limited to, the products specified in each wall covering Product Data sheet at end of this Section.

2.02 ADHESIVES

- A. General: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application, as recommended by wall covering manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for moisture content and other conditions affecting performance of Work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, and dirt.
- C. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Prime new gypsum board with primer recommended by wall covering manufacturer.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- E. Acclimatize wall covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.03 INSTALLATION, GENERAL

- A. General: Comply with wall coverings manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Cut wall covering panels in roll number sequence. Change run numbers at partition breaks and corners only.
- C. Install wall covering with no gaps or overlaps.
- D. Match pattern 72 inches (1830 mm) above finish floor.
- E. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside corners. No horizontal seams.
- F. Remove air bubbles, wrinkles, blisters, and other defects.
- G. Trim edges for color uniformity, pattern match, and tight closure at seams and edges. Butt seams.

3.04 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended by wall covering manufacturer.
- C. Replace strips that cannot be cleaned.

3.05 VINYL WALL COVERING PRODUCT DATA SHEET

Manufacturer: Momentum

Collection: Wall Covering Reese 20 oz.

Vinyl Wall Covering Designation: WLWC1.

Vinyl Wall Covering Standard: FS CCC-W-408A and CFFA-W-101-A, Type II, Medium Duty.

Total Weight: 20 oz. Total weight does not include performance coatings.

Width: 54" Wide.

Backing Material: 100% polyester Osnaburg.

Pattern Match: Reverse hang, random match

Available Products: Source One Reese, color TBD

END OF SECTION

SECTION 098100 - ACOUSTICAL SPACE UNITS SOUND DIFFUSERS AND REFLECTORS**PART 1 GENERAL****1.01 SUMMARY**

- A. Section Includes: Custom fabricated Sound Diffusers and Reflectors in the auditorium (GOP1)

1.02 RELATED DOCUMENTS

- A. Section 012300 - Alternates: Refer to section for additional information relating to the auditorium alternate.

1.03 REFERENCES

- A. ASTM International:
 - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method..
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.04 RELATED REQUIREMENTS

- A. Alternates: Refer to section for additional information.
- B. Administrative Requirements: Submittal procedures.

1.05 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Surface Burning Characteristics (ASTM E84): Suspended Model Ovation Reflectors (get coat finish) shall be Class C rated.

1.06 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division I Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors, and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
 - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of systems in lieu of retesting.

1.07 QUALITY ASSURANCE

- A. Regulatory Requirements and Approvals: All acoustical space unit sound diffusers and reflectors materials, hardware, and installation methods shall comply with the Kentucky Building Code.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division I Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.09 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install diffusers or reflectors until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 40% to 50%, respectively.

1.10 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by manufacturer agreeing to repair or replace components of acoustical wall panel system that fail in performance, materials, or workmanship within specified warranty period. Failure in performance includes, but is not limited to, acoustical performance. Failure in materials includes, but is not limited to, sagging or distortion of facing or warping of core.
- C. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 ACOUSTICAL DIFFUSERS AND REFLECTORS

- A. Manufacturer: Kinetics Noise Control.
 - 1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax (614)889-0075.
- B. Available Manufacturers: Other manufacturers proposed which meet the specific standards specified shall submit actual samples and specifications for review to the Designer/Architect not less than seven (7) days before the bid date.

2.02 MANUFACTURED UNITS

- A. Ovation Reflector Panels
 - 1. Core: Gel coat finish panels, 1/2" (13mm), 5-ply plywood core with resin coat layer on back of panel.
 - 2. Face: 15 mil smooth finished gel coat with color selected by architect, matte finish.
 - 3. Suspension and Flexing system: 1/8" (3mm) steel angle painted black and 1/4" (6mm) diameter zinc-plated tensioning rods mounted on the top (unexposed) side of the Reflector Panel. Gel coat faced panels shall have through bolt attachment of suspension/flexing angles with bolt heads color matched. Panels shall be flexed to the required radius before installation.
 - 4. Suspension System: 1/8" diameter, commercial grade aircraft cable with cable thimble and double crimp sleeves.
 - 5. Reflector properties:
 - a. Sound Reflectivity: Panels shall be highly acoustically reflective. The panels shall have less than .05 Sabines of absorption per sq. ft. of panel for all 1/3-octave band frequencies in the 200 Hz to 2000 Hz range tested per ASTM C423 with a Type J mounting.
 - b. Weight of reflector panel: No less than 2 psf and a maximum of 2.5 psf (9.75 - 12.20 kg/sq. m) excludes steel framing weight.
 - 6. Sizes: As shown on drawings.

2.03 FABRICATION

- A. Reflector Panel edges will be painted or stained to a finish similar to the exposed face.
- B. Reflector Panels will be fabricated to the sizes shown on the drawings as single units without visible joints or seams. Maximum size is 10 X 20 ft. (305 x 610 cm) for gel coat finish panels.

PART 3 - EXECUTION**3.01 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate or supporting structure, which has been previously installed under other sections, is acceptable for product installation in accordance with manufacturer's instructions.

3.03 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as-new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 098410 - ACOUSTICAL WALL PANELS AND INTERACTIVE ACOUSTICAL PANELS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

- A. This Section includes the following:
 1. Acoustical Panels (AWP1) Sound Absorption Panels
 2. Acoustical Panels (AWP2) low frequency absorption panels
 3. Acoustical Panels (AWP3) wall radius diffuser
 4. Acoustical Panels (APD1) Ceiling Pyramidal Diffuser
 5. Acoustical Panels (AWP5) abuse resistant absorptive panels
 6. Acoustical Panels (AWP6) absorptive panels
 7. Basis of Design for Panels: Kinetics Noise Control, Contact Parker Alboher at Ketchum and Walton Co, 317-985-2558

1.03 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures
- B. Section 090050 - Finish Legend

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available for facing materials for each type of acoustical wall panel indicated. Include samples of installation devices and accessories.

- D. Samples for Verification: 8-by-11-inch (200-by-280-mm) units of each type of acoustical wall panel indicated; in sets for each color, texture, and pattern specified for facing materials, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.
- E. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product Test Reports: From a qualified testing agency indicating acoustical wall panels comply with requirements, based on comprehensive testing of current products.
- H. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 1.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical wall panels similar to those indicated for this Project and with a record of successful in-service performance.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.
- D. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame Spread: 25 or less
 - 2. Smoke Developed: 450 or less

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical wall panels from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify wall surface dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.10 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by manufacturer agreeing to repair or replace components of acoustical wall panel system that fail in performance, materials, or workmanship within specified warranty period. Failure in performance includes, but is not limited to, acoustical performance. Failure in materials includes, but is not limited to, sagging or distortion of facing or warping of core.
- C. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, providers include, but are not limited to the following:
 - 1. Kinetic Noise Control
 - 2. Sound Seal
 - 3. Specialty Products and Insulation
 - 4. Real Acoutix
 - 5. Armstrong Wenger Corporation
 - 6. Acoustical Resources, Inc.
 - 7. Commercial Interior Supply

2.02 ACOUSTICAL PANELS, GENERAL

- A. Fabricate panels to sizes and configurations indicated; attach facing materials to cores to produce installed panels with visible surfaces fully covered and free from waves in fabric weave, wrinkles, sags, blisters, seams, adhesive, or other foreign matter.
 - 1. Fabricate back-mounted panels in factory to exact sizes required to fit wall surfaces, based on field measurements of completed substrates indicated to receive acoustical wall panels.
 - 2. Where square corners are indicated, tailor corners.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 - 1. Thickness
 - 2. Edge straightness
 - 3. Overall length and width
 - 4. Squareness from corner to corner
- C. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients indicated, as determined by testing per ASTM C 423 for mounting type specified under individual product requirements in the Acoustical Wall Panel Schedule at the end of Part 3.
- D. Panel Characteristics: Comply with requirements indicated in the Acoustical Wall Panel Schedule at the end of Part 3.
- E. Back-Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels, of type and size indicated, to substrates provided; and complying with the following requirements:
 - 1. Mechanically Mounted Edge-Reinforced Panels: Metal panel-clip and base-support bracket system consisting of two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to support panels laterally; and base-support brackets designed to support full weight of panels; with both designed to allow for panel removal.

2. Mechanically Mounted Edge-Reinforced Panels: Metal impaling clips designed to support weight of panels, mechanically attached to wall substrate according to panel manufacturer's standard pattern and adhesively bonded to back of panel, with base-support brackets where recommended by manufacturer for additional support of panels.
3. Mechanically Mounted Metal-Framed Panels: Metal panel-clip system designed to engage metal framing of panels and to allow for panel removal, with base-support brackets where recommended by manufacturer to support weight of panels.

2.03 ACOUSTICAL WALL PANEL (AWP1 and AWP6) (ABSORBER PANELS)

- A. Back-Mounted, Edge-Reinforced Acoustical Wall Panels AWP-1: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass fiber board core; with edges chemically hardened or impact resistant and resilient to reinforce panel perimeter against warpage and damage; and complying with the following requirements:
 1. Basis of Design: Kinetics Noise Control HardSide Panels
 - a. Facing Material: Manufacturer's standard woven polyester fabric from same dye lot; color and pattern as selected by Interior Designer from manufacturer's full color range
 - b. Nominal Core: Facing - 1/8", 18 PCF fiberglass and 6-7 PCF fiberglass backing
 - c. Nominal Overall Panel Thickness: 2" Note: AWP6 is same construction, only 1" total thickness
 - d. Panel Width: Refer to Drawings
 - e. Panel Height: Refer to Drawings
 - f. Edge Detail: Square
 - g. Corner Detail: Square
 - h. Color: Up to two standard colors of Guilford of Maine FR701 fabric color will be selected.
 - i. Quantity: Refer to Drawings. Coordinate exact mounting height with Designer prior to fabrication. Provide cut outs, etc. as required to accommodate other wall mounted items.

2.04 ACOUSTICAL WALL PANELS (AWP-2) LOW FREQUENCY ABSORPTION PANEL

- A. Back-mounted, edge-reinforced acoustical wall panels AWP-2: Manufacturer's standard panel constitution consisting of facing material laminated to front face, edge and back bonder of panel.
 1. Basis of Design: Kinetics Noise Controu Versatune Panel
 2. Thickness: 2 1/8" total thickness
 3. Installation: Impaling Clips
 4. Color: Up to two standard colors of Guilford of Maine FR701.
 5. Size: Refer to Drawings
 6. Location: Band & Vocal

2.05 ACOUSTICAL WALL PANEL (AWP3) (DIFFUSER PANELS)

- A. Back-mounted thermo-molded plastic diffuser panels with fabric covering.
 1. Facing Material: Manufacturer's standard woven polyester fabric from same dye lot, color and pattern as selected by Interior Designer from manufacturer's full color range
 2. Nominal Thickness: 0.125" (3mm)
 3. Panel Width: Refer to Drawings
 4. Panel Height: Refer to Drawings
 5. Color: Up to two standard colors of Guilford of Maine FR701 Fabric color(s) will be selected
 6. Quantity: Refer to Drawings
 7. Locations: Band & Vocal

2.06 OFFSET PYRAMID-SHAPED DIFFUSERS (APD1)

- A. Ceiling-mounted thermo-molded plastic diffuser with textured surface.
 - 1. Basis of Design: Kinetics Noise Control
 - 2. Product: Geometric Diffuser Sound Diffusing Panel
 - 3. Surface Texture: Manufacturer's standard "Lemon-Peel" finish
 - 4. Nominal Thickness: 0.125" (3mm)
 - 5. Diffuser Size:
 - 6. Quantity: Refer to Drawings
 - 7. Location: Band & Vocal

2.07 HIGH ABUSE ACOUSTICAL WALL PANEL (AWP5)

- A. Back-Mounted, High Abuse, High Impact Acoustical Wall Panels AWP-2: Manufacturer's high abuse, high impact panel construction consisting of facing material laminated to front face, edges, and back border of dimensionally stable, rigid glass fiber board core; with edges chemically hardened and high density fiberglass facing to reinforce panel against warpage and damage; and complying with the following requirements:
 - 1. Basis of Design: Kinetics Noise Control High Impact HardSide Acoustical Wall Panels
 - 2. Facing Material: Manufacturer's standard woven polyester fabric from same dye lot; color and pattern as selected by Interior Designer from manufacturer's full color range
 - 3. Nominal Core: Facing - 1/8", high density fiberglass facing
 - 4. Nominal Overall Panel Thickness and Noise Reduction Coefficient: 1-1/8" w/1.00 NRC
 - 5. Panel Width: Refer to drawings
 - 6. Panel Height: Refer to drawings
 - 7. Edge Detail: Square
 - 8. Corner Detail: Square
 - 9. Color: Selected from Manufacturer's Standards Colors from Guilford of Maine FR 701-2100.
 - 10. Quantity: Refer to Drawings
 - 11. Location: Gymnasium

PART 3 - EXECUTION**3.01 EXAMINATION**

- A. Examine substrates and blocking, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting acoustical wall panel performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
- B. Construction Tolerances: As follows:
 - 1. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm).
 - 2. Variation of Joints from Hairline: Not more than 1/16 inch (1.6 mm).

3.03 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

- C. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.04 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, in a manner approved by Designer/Architect, before time of Substantial Completion.

END OF SECTION

SECTION 099000 - PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 RELATED REQUIREMENTS

- A. Section 015721 - Indoor Air Quality Management
- B. Section 055000 - Metal Fabrications: Shop-primed items
- C. Section 055100 - Metal Stairs: Shop-primed items
- D. Section 090050 - Finish Legend
- E. Section 101100 - Visual Display Surfaces
- F. Section 220553 - Identification for Plumbing Piping and Equipment: Painted identification
- G. Section 260553 - Identification for Electrical Systems: Painted identification
- H. Section 321723.13: Pavement markings

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency
- B. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications
- C. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials
- D. GreenSeal GS-11 - Paints

1.04 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces including surface preparation and primer.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. VOC data: Submit Green Seal GS-11 and/or GC-03 compliance documents and description of the basis for compliance.
- C. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- D. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
 - 2. All exposed to view (from the ground) flashing are to be furnished prefinished where available. If items are not available prefinished, they are to be painted. Coordinate with Contractor on these items.
 - 3. Exposed copper piping shall receive a painting system.

4. **It shall be the full responsibility of the painter to verify all paint, types to determine if paint(s) system specified are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by painter/manufacturer based on testing and field experience. All existing painted surfaces shall be tested to ensure product compatibility and to ensure that the paint bonds will not fail.**
 5. Painting shall include field painting pre-finished grilles, registers and diffusers located on gypsum board ceilings and soffits, which are to receive an accent paint color.
 6. Painting shall include field painting of clips, wires, etc. used to suspend acoustical ceiling components, which are exposed after construction is complete.
 7. Painting shall include field painting exposed unfinished countertop and shelving brackets.
 8. Exterior items to receive a painting system include but are not limited to the following:
 - a. Fixed access ladders
 - b. Elevator pit ladders
 - c. Ships ladders
 - d. Walk-through ladders
 - e. Roof ladders
 - f. Ladder security guard
 - g. Bollards
 - h. Lintels
 - i. Door frames for overhead doors and wall openings
 - j. Elevator sump pit cover
 - k. Folding/disappearing stairway ie the door and frame
 9. Where the Room Finish Schedule calls for a new paint system (P#) New painting shall include all previously painted items including but not limited to door & window frames, doors, conduit, HVAC components, etc.
- E. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork
 - b. Elevator entrance doors and frames
 - c. Elevator equipment
 - d. Finished mechanical and electrical equipment
 - e. Light fixtures
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas
 - b. Ceiling plenums
 - c. Pipe spaces
 - d. Duct shafts
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum
 - b. Stainless steel
 - c. Chromium plate
 - d. Bronze and brass
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators
 - b. Linkages
 - c. Sensing devices
 - d. Motor and fan shafts
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.05 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures.
- D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- E. VOC Content: Determine VOC (Volatile Organic Compound) content of solvent borne and waterborne paints and related coatings in accordance with EPA Method 24 or ASTM D3960.
- F. Product Data: For each paint system indicated. Include primers.
 1. When proposing another manufacturers product other than product specified, a complete cross-reference list must be included with the submittal. Shop drawings will be automatically returned if the list is not included.
 2. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 3. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- G. Samples for Initial Selection: For each type of finish-coat material indicated.
 1. After color selection, Architect will furnish color chips for surfaces to be coated.
 2. The painter is required to submit drawdowns of each paint color for review of color and sheen match.

1.07 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 1. Product name or title of material
 2. Product description (generic classification or binder type)
 3. Manufacturer's stock number and date of manufacture
 4. Contents by volume, for pigment and vehicle constituents
 5. Thinning instructions
 6. Application instructions
 7. Color name and number
 8. VOC content

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.09 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- C. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 EXTRA MATERIALS

- A. See Section 016000 - Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles or approved equivalent as manufactured by one of the following manufacturers.
- C. Paint Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. ICI Paints & Devco High Performance Coatings (ICI)
 - 2. Sherwin-Williams Co. (Sherwin-Williams)
 - 3. Coronado Paint Company (Coronado)
 - 4. PPG Paints, Inc. (Pittsburgh & Porter Paints)
 - 5. Farrell Calhoun Paint
- D. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.
 - 1. Interior paint: Comply with GS-11
 - 2. Exterior paint: Comply with GS-11

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.03 PAINTS AND COATINGS - GENERAL

- A. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings applied on site shall comply with the following VOC content limits:
1. Interior paint: Comply with GS-11
 2. Exterior paint: Comply with GS-11
 3. Flat: 50 g/L
 4. Non-flat: 150 g/L
 5. Anti-corrosive & anti-rust: 250 g/L
 6. Floor Coatings: 100 g/L
- B. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- C. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- D. Chemical Content: The following compounds are prohibited:
1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings)
 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride

2.04 PAINT SYSTEMS - EXTERIOR

- A. Exterior Primers:
1. Exterior Concrete and Masonry Primer: Factory formulated alkali resistant acrylic latex primer for exterior application
 - a. Sherwin-Williams Loxon Concrete & Masonry Primer LX02W0050 VOC 99 g/l 3.2 mils. DFT
 - b. PPG Industries Perma-Crete Int/Ext Alkalie Resistant Primer 4-603 VOC < 100 g/l Farrell Calhoun 697 100% Acrylic Bonding Masonry Primer/Stain Killer
 - c. Benjamin Moore & Co. Products
 - 1) Concrete and Masonry, N068 Super Spec Masonry High Build Primer
 2. Exterior Ferrous Metal Primer: Factory formulated rust inhibitive metal primer for exterior application.
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic primer B66-310 series VOC less than 100 g/l 2.0-4.0 mils. DFT
Farrell Calhoun Tuff-Boy 5-56 100% Acrylic All Purpose Metal Primer/Finish Coat

- b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC <100 g/l
 - c. Benjamin Moore & Co. Products
 - 1) Ferrous Metal, P06 Alkyd Metal Primer
 - 3. Exterior Galvanized Metal Primer: Factory formulated galvanized metal primer for exterior application.
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic Primer B66-310 series VOC less than 100 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC <100 g/l
Farrell Calhoun Tuff-Boy 5-56 100% Acrylic All Purpose Metal Primer/Finish Coat
 - c. Benjamin Moore & Co. Products
 - 1) Galvanized Metal, P04 Acrylic Metal Primer
 - 4. Exterior Wood Primer: Factory formulated wood primer for exterior application.
 - a. Sherwin-Williams Exterior Latex Wood Primer, B42W08141 Series
 - b. Farrell Calhoun 235 Int/Ext 100% Acrylic Latex Undercoater
- B. Exterior Finish Coats:
 - 1. Exterior Semigloss Acrylic Enamel: Factory formulated semigloss waterborne acrylic latex enamel for exterior application.
 - a. Sherwin-Williams Exterior Super Paint Latex Satin A89 Series VOC 114 g/l 1.44 mils DFT
 - b. PPG Industries Speedhide Exterior 100% Acrylic Semi-Gloss 6-900XI series VOC < 50 g/l
 - c. Farrell Calhoun Durashield 3400 Line 100% Acrylic Exterior Semi-Gloss
 - d. Exterior Semigloss Acrylic Semigloss, N449 Ultra Spec Exterior Gloss Finish
 - e. Benjamin Moore & Co. Products
 - 1) Exterior Semigloss Acrylic Semigloss, N449 Ultra Spec Exterior Gloss Finish
- C. Exterior Finish Coats - Metal: Factory formulated water based alkyd urethane enamel:
 - 1. Sherwin Williams; Pro-Industrial Waterbased Alkyd Urethane B53-1050 series, gloss (B53-1150 semi-gloss, B53-1250 low sheen) VOC 50 g/l <0.42 lb/gal, wet mils 4.0 - 5.0, dry mils 1.4 - 1.7
 - 2. PPG Industries Speedhide Exterior 100% Acrylic Semi-Gloss 6-900XI series VOC < 50 g/l
 - 3. Farrell Calhoun Rust-Knox II DTM 2042 Line Int/Ext Satin Primer/Finish
- D. Exterior Finish Coats - Wood: Factory formulating latex semi-gloss for exterior application:
 - 1. Sherwin-Williams A-100 Exterior Latex **[Select flat, satin, low sheen, or gloss]**
 - 2. PPG Industries Sunproof 72-100 Series, VOC 50 g/l, 4.0 - 5.3 wet mils 1.6 - 2.2 dry mils
 - 3. Farrell Calhoun Durashield 3400 Line 100% Acrylic Exterior Semi-Gloss
- E. Exterior Treated Wood Siding shall receive two finish coats over a primer. Primer-PPG Porter Paint 17-921 Seal Grip Universal Primer. Top Coats-PPG Porter Speedhide Exterior 100% Acrylic semi-gloss or approved equal.
- F. Exterior Galvanized Metal shall receive two finish coats over a primer. Primer-PPG Porter Paint Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series or approved equal. Top Coats-PPG Porter Paint Speedhide Exterior 100% Acrylic semi-gloss 6-900XI Series or approval equal.

2.05 PAINT SYSTEMS - INTERIOR

- A. Interior Primers:
 - 1. Interior Concrete Primer: Factory formulated alkali resistant acrylic latex interior primer for interior application
 - a. Sherwin-Williams Pro Industrial Heavy Duty Block Filler
 - b. PPG Industries Speedhide Int/Ext Hi Fill Block Filler 6-15 VOC < 50 g/l

- c. Farrell Calhoun 697 100% Acrylic Bonding Masonry Primer/Stain Killer
 - d. Benjamin Moore & Co. Products
 - 1) Interior Concrete Primer, N068 Super Spec Masonry High Build Primer
 - 2. Interior Gypsum Board Primer: Factory formulated latex based primer for interior application
 - a. Sherwin-Williams Promar 200 Zero VOC Latex Primer B28W2600 VOC 2 G/L 1.5 DFT
 - b. PPG Industries Speedhide Zero Latex Primer 6-4900 Zero VOC
 - c. Farrell Calhoun 475 Perfik-Kote Int High Build Latex Primer/Sealer
 - d. Benjamin Moore & Co. Products
 - 1) Interior Gypsum Board Primer, N534 Ultra Spec 500 Interior Primer
 - 3. Interior Wood Primer for acrylic enamel and semigloss alkyd enamel finishes: Factory formulated alkyd or acrylic latex based interior wood primer
 - a. Sherwin-Williams Multi-Purpose Latex Primer B51W8020 VOC 96 G/L 1.4 mils DFT
 - b. PPG Industries Seal-Grip Int/Ext Universal Acrylic Primer 17-921XI VOC > 100 g/l
 - c. Farrell Calhoun 699 Waterborne 100% Acrylic Enamel Undercoater
 - d. Benjamin Moore & Co. Products
 - 1) Interior Wood Primer, 023 Fresh Start All Purpose Primer
 - 4. Interior Ferrous Metal Primer: Factory formulated quick drying rust inhibitive alkyd based metal primer
 - a. Sherwin-Williams Pro-Industrial Pro-Cryl Universal acrylic Primer B66-1310 series VOC 110 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC < 100 g/l
 - c. Farrell Calhoun Tuff-Boy 1069 Rust-Stop Primers
 - d. Benjamin Moore & Co. Products
 - 1) Interior Ferrous Metal Primer, P06 Alkyd Metal Primer
 - 5. Interior zinc-coated metal primer: Factory formulated galvanized metal primer
 - a. Sherwin-Williams Pro-Cryl Universal Water Based Primer B66-310 Series VOC 110 g/l 2.0-4.0 mils DFT
 - b. PPG Industries Pitt-Tech Plus Int/Ext DTM Industrial Primer 90-912 series VOC < 100 g/l
 - c. Farrell Calhoun Tuff-Boy 5-56 100% Acrylic All Purpose Metal Primer/Finish Coat
 - d. Benjamin Moore & Co. Products
 - 1) Interior Zinc-Coated Metal Primer, P04 Acrylic Metal Primer
- B. Interior Finish Coats:
- 1. Interior Finish Coats - Stair And Ramp Railings: Factory formulated high solids, single pack acrylic polysiloxane:
 - a. PPG Industries PSX One High Solids, high gloss. Two (2) coats are required to act as a self-primer.
 - b. Sherwin Williams Sher-Loxane 800, B58W00501. VOC < 100 g/l wet mils 5.0 - 7.0, dry mils 4.0 - 6.0. Two (2) coats are required to act as a self-primer.
 - c. Farrell Calhoun Rustoleum Sierra S60 Water-Based Epoxy Maintenance Coating
 - 2. Interior Finish Coats - Metal Excluding Stair and Ramp Railings: Factory formulated water based alkyd urethane enamel:
 - a. Sherwin Williams; Pro-Industrial, Waterbased Alkyd Urethane, number B53-1050 series, gloss (B53-1150 semi-gloss, B53-1250 low sheen) VOC 50 g/l <0.42 lb/gal, wet mils 4.0 - 5.0, dry mils 1.4 - 1.7
 - b. Benjamin Moore & Co. 79301 Advance waterborne interior alkyd semi-gloss
 - c. PPG Industries 1506-0110 Lifemaster Oil interior/exterior semi-gloss
 - d. Farrell Calhoun Rustoleum Sierra S60 Water-Based Epoxy Maintenance Coating
 - 3. Interior Flat Acrylic Paint: Factory formulated flat acrylic emulsion latex paint for interior application

- a. Sherwin-Williams Promar 200 Zero VOC Interior Latex Flat B30W2651 VOC 2 G/L 1.6 DFT
- b. PPG Industries Speedhide Zero Interior Latex Flat 6-4110 series Zero VOC
- c. Farrell Calhoun 300 Line Interior Premium Flat Latex Wall Paint
- d. Benjamin Moore & Co. Products
 - 1) Interior Flat Acrylic, N536 Ultra Spec 500 Interior Flat
- 4. Interior Semigloss Acrylic Enamel: Factory formulated semigloss acrylic latex enamel for interior application
 - a. Sherwin-Williams Promar 200 Zero VOC Interior Latex Semi-gloss B31W2600 Series 0 g/l 1.6 mils DFT. If using above product for trim areas, this is the more durable product.
 - b. PPG Industries Speedhide Zero Interior Latex Semi-Gloss 6-4510 series Zero VOC
 - c. Farrell Calhoun 600Line 100% Acrylic Interior Semi-Gloss Latex Enamel
 - d. Benjamin Moore & Co. Products
 - 1) Interior Semigloss Acrylic Enamel, N539 Ultra Spec 500 Interior Semigloss
- 5. Interior Eggshell Acrylic Paint: Factory formulated eggshell acrylic latex paint for interior application:
 - a. Sherwin Williams Promar 200 Zero VOC Interior Latex Eggshell B20W2600 applied as a dry film thickness
 - b. PPG Industries Speedhide Zero Interior Latex Eggshell 6-4310 series Zero VOC
 - c. Farrell Calhoun 370 Line Interior Premium Eggshell Latex Enamel
 - d. Benjamin Moore & Co. Products
 - 1) Interior Eggshell Acrylic Paint, N538 Ultra Spec 500 Interior Eggshell
- 6. Interior Concrete Floor Sealer (SC-1)
 - a. PPG Industries Perma-Crete 4-6200 Plex-Seal WB interior/exterior clear sealer
- 7. Interior Concrete Floor Coating (SC2)
 - a. Interior Concrete Floor Coating Primer -Megaseal HSPC 100% Solids Epoxy Primer/Sealer
 - b. PPG Industries Megaseal SL spreadable, self-leveling epoxy floor coating.
- 8. Interior Concrete Floor Coating (SC3)
 - a. Interior concrete coating with colorant: PPG Peracrete Color Seal
 - b. Location: Refer to Drawings
- C. All walls, Gypsum board ceilings, metal deck, structural elements, conduit, all unfinished surfaces exposed after construction is complete shall receive a paint system unless noted otherwise.
- D. All unfinished exterior surfaces including concrete block, steel lintels, etc. will receive a paint system. Refer to the specifications for additional information.

2.06 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler
- C. Fastener Head Cover Material: Latex filler

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, conform to procedures applicable when hazardous or contaminated materials are discovered.
- B. Substrate: Install formaldehyde-free MDF, particle board, or straw particle board.

- C. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- D. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
- E. Indoor Air Quality: Provide temporary ventilation during work of this section.
- F. Waste Management: As specified in Section 01351 - Waste Management and as follows:
 - 1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

3.02 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 2. **Required Surface Preparation:**
 - a. **Step 1 - Dust wall and other surfaces to receive paint by working down with a dust mop, static duster, or feather duster.**
 - b. **Step 2 - Clean surface with a mild detergent using a sponge or soft cloth. Avoid using cleaners containing alcohol on latex paint, as alcohol can dissolve and damage the paint film.**
 - c. **Step 3 - Wash surfaces from the bottom up to avoid water running down the wall over the dirt.**
 - d. **Step 4 - Rinse out the sponge in clean water until the cleaning solution is removed. Use the cleaned sponge to thoroughly rinse the washed area. Residual cleaner will interfere with adhesion of paint applied subsequently.**
 - e. **Step 5 - Use a soft cloth or towel to blot excess water off the paint film.**
 - f. **Refer to Item C below for additional requirements.**
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

- b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 - 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery. Revise first subparagraph and associated subparagraphs below to suit Project.
 - 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 - 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
- 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

- A. Paint Strippers: Compounds that do not contain methylene chloride tend to be slower-acting than conventional paint strippers and may take from one hour to overnight to work. Comply with manufacturer's recommendations for application.
- B. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- G. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 5. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- H. Electrical items to be painted include, but are not limited to, the following: List below contains electrical items that are usually field painted. Add other items to suit Project.

1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
 - J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
 - K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
 - L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Section 220553 and Section 260553 for schedule of color coding of equipment, duct work, piping, and conduit.
- B. Paint shop-primed equipment, where indicated.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Finish equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 INDOOR AIR QUALITY

- A. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.
- B. Maximize ventilation during application and drying.
- C. Isolate area of application from rest of building.
- D. Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms.

3.06 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.07 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.08 EXTERIOR PAINT SCHEDULE

- A. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a block filler
 - a. Block Filler: Concrete unit masonry block filler
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane
- B. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a rust-inhibitive primer
 - a. Primer: Exterior ferrous-metal primer
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane
- C. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Semigloss Alkyd Urethane Finish: Two finish coats over a galvanized metal primer
 - a. Primer: Exterior galvanized metal primer
 - b. Finish Coats (Minimum Two): Exterior semigloss alkyd urethane
- D. Wood: Provide the following finish systems over exterior wood:
 - 1. Primer: Exterior wood primer
 - 2. Finish Coats: (Minimum two): Exterior semi-gloss latex

3.09 INTERIOR PAINT SCHEDULE

- A. Concrete: Provide the following finish systems over interior concrete masonry:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior CMU Primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- B. Gypsum Board Ceilings & Soffits: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Flat Acrylic Finish: Two finish coats over a primer
 - a. Primer: Interior gypsum board primer
 - b. Finish Coats (Minimum Two): Interior flat acrylic paint
- C. Gypsum Board (Walls): Provide the following finish systems over interior gypsum board surfaces:
 - 1. Finish: Two finish coats.
 - a. Primer: Interior gypsum board primer
 - b. Finish Coats (Minimum Two): Interior Egg Shell Enamel
- D. Wood and Hardboard: Provide the following paint finish systems over new interior wood surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a wood undercoater
 - a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- E. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior ferrous-metal primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- F. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer
 - a. Primer: Interior zinc-coated metal primer
 - b. Finish Coats (Minimum Two): Interior semigloss acrylic enamel
- G. Interior Exposed Metal Decking and Bar Joists:
 - 1. First and Second Coats: Alkyd flat dry fall
 - 2. Subsequent coats only as required for complete, proper and full coverage

3.10 WASTE MANAGEMENT

- A. Separate waste in accordance with the Waste Management Plan. Set aside extra paint for future color matches, or reuse by Owner. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility.
- B. Close and tightly seal all partly used paint and finish containers and store protected in well-ventilated, fire-safe area at moderate temperature.
- C. Place empty containers of solvent-based paints in areas designated for hazardous materials.
- D. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.

END OF SECTION

SECTION 101101 - VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 090050 - Finish Legend.

1.02 SUMMARY

- A. This Section includes the following types of visual display boards:
 - 1. Porcelain enamel markerboards (for liquid chalk) with standard gloss and matte finishes.
 - 2. Vinyl-fabric-faced cork tackboards and tack strips
 - 3. Mobile Tackboard
 - 4. High Performance Collaborative Panel System
 - 5. Porcelain enamel chalkboard (Art Classroom)
 - 6. Music staff-lined markerboard (Music Classroom)
- B. Display board installation will utilize "Z" or "L" clip mounting bars top and mounting angles - bottom only. Adhesives used for mounting display boards will not be acceptable.
- C. Where visual display boards are too wide for the location indicated, the supplier shall notify the designer and modify the width accordingly.
- D. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 6 Section "Miscellaneous Carpentry" for wood blocking and grounds

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's data substantiating that products comply with requirements indicated.
- C. Shop Drawings: Provide shop drawings for each type of markerboard, and tackboard required. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
- D. Samples: Provide the following samples of each product for initial selection of colors, patterns, and textures, as required, and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color and pattern
 - a. Porcelain Enamel Markerboard: Manufacturer's color charts consisting of actual sections of porcelain enamel finish showing the full range of colors available for each type of markerboard required
 - b. Vinyl-fabric-faced Cork Tackboards: Manufacturer's color charts consisting of actual sections of vinyl fabric, showing the full range of colors, textures, and patterns available for each type of vinyl-fabric-faced cork tackboard indicated
- E. Certificates: In lieu of laboratory test reports, when permitted by the Designer/Architect, submit the manufacturer's certification that vinyl-fabric-faced cork tackboard materials furnished comply with requirements specified for flame spread ratings.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Furnish all markerboards, tackboards and tackstrips from a single manufacturer for the entire project.

- B. Fire Performance Characteristics: Provide vinyl-fabric-faced tackboards with surface burning characteristics indicated below, as determined by testing assembled materials composed of facings and backings identical to those required in this section, in accordance with ASTM E 84, by a testing organization acceptable to authorities having jurisdiction.
 - 1. Flame Spread: 25 or less
 - 2. Smoke Developed: 10 or less
- C. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of visual display boards. Other visual display boards having equivalent performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof of equality is on the proposer.

1.05 WARRANTY

- A. Porcelain Enamel Markerboard Warranty: Furnish the manufacturer's written warranty, agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking, provided the manufacturer's instructions with regard to handling, installation, protection, and maintenance have been followed.
 - 1. Warranty Period: 50 years

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Visual Display Board Manufacturer: Subject to compliance with requirements, provide products including, but are not limited to one of the following:
 - 1. Porcelain Enamel Markerboards:
 - a. American Display Products
 - b. American Visual Display
 - c. Best-Rite Chalkboard Company
 - d. Claridge
 - e. Ghent Manufacturing
 - f. Lemco Company
 - g. Marsh Company
 - h. Platinum Visual Systems
 - i. Polyvision
 - j. Weber Costello Company
 - k. Accobrand
 - 2. Tackboards and Tackstrips:
 - a. American Display Products
 - b. American Visual Display
 - c. Best-Rite Chalkboard Company
 - d. Claridge
 - e. Ghent Manufacturing
 - f. Marsh Company
 - g. Neil, Inc.
 - h. Platinum Visual Systems
 - i. Polyvision
 - j. Weber Costello Company
 - k. Accobrand
 - 3. Mobile Tackboards:
 - a. Claridge
 - b. Polyvision
 - 4. High Performance Collaborative Panel System
 - a. Polyvision
 - b. Claridge

2.02 MATERIALS

- A. Porcelain Enamel Markerboards: Provide balanced, high-pressure-laminated porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.
 - 1. Face Sheet: Provide face sheet of 24-gage enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat the exposed face and exposed edges with a 3-coat process consisting of primer, ground coat, and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at the manufacturer's standard firing temperatures, but not less than 1200 deg F (649 deg C).
 - 2. Markerboard Cover Coat: Provide the manufacturer's standard light-colored special writing surface with gloss finish intended for use with liquid felt-tipped markers.
 - a. Color shall be as selected by Designer/ Architect from full range of standard colors.
 - 3. Core: Provide the manufacturer's standard 3/8-inch-thick particleboard core material complying with the requirements of ANSI A208.1, Grade 1-M-1.
 - 4. Backing Sheet: Provide the manufacturer's standard 0.015-inch-thick aluminum sheet backing.
 - 5. Laminating Adhesive: Provide the manufacturer's standard moisture-resistant thermoplastic-type adhesive.
- B. Vinyl-Fabric-Faced Tackboards: Provide mildew-resistant, washable, vinyl fabric complying with FS CCC-W-408, Type II, weighing not less than 13 ounces per square yard, laminated to 1/4-inch-thick cork sheet. Provide fabric that has a flame spread rating of 25 or less when tested in accordance with ASTM E 84. Provide color and texture as scheduled or as selected from the manufacturer's standards.
 - 1. Backing: Make panels rigid by factory laminating cork face sheet under pressure to 1/4-inch-thick hardboard backing.
- C. Tackstrips: Provide Exhibit and Display Rail constructed of aluminum frame with cork insert. Provide only fabric that has a flame spread rating of 25 or less when tested in accordance with requirements of ASTM E84. Size shall be 2" wide x lengths as indicated on drawings. Provide color and texture as selected from the manufacturer's full range of standard colors.
- D. Music Staff Lined Markerboard: In the music classroom, provide 1/16" wide horizontal lines fused to the markerboard in standard music staff arrangement. Music staves shall be incorporated on one-half (1/2) of the total area of markerboards in this room. Locate as directed by the Designer/Architect. Color of lines to be selected from the manufacturer's standards. [Delete if not required]

2.03 ACCESSORIES

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. Where the size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify the trim as indicated or as selected by the Architect from the manufacturer's standard structural support accessories to suit the condition indicated.
 - 2. Tray: Furnish the manufacturer's standard continuous, solid extrusion-type aluminum tray with ribbed section and smoothly curved exposed ends, for each markerboard.
 - 3. Map Rail: Furnish map rail at the top of each unit, complete with the following accessories:
 - a. Display Rail: Provide continuous cork display rail approximately 1 or 2 inches wide, as indicated, integral with the map rail.
 - b. End Stops: Provide one end stop at each end of the map rail.
 - c. Map Hooks: Provide 2 map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.
 - d. Flag Holder: Provide one flag holder for each room.

2.04 FABRICATION

- A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- B. Assembly: Provide factory-assembled markerboard and tackboard units, except where field-assembled units are required.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Designer/Architect.
 - 2. Provide the manufacturer's standard vertical joint system between abutting sections of markerboard.
 - 3. Provide manufacturer's standard mullion trim at joints between markerboard and tackboard.

2.05 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Class II Clear Anodized Finish: AA-M12C22A31 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class II Architectural, clear film thicker than 0.4 mil).

2.06 VISUAL DISPLAY BOARDS-TACKBOARD-MOBILE

- A. Surface: Vinyl Faced Washable Fabric
- B. Color: Manufacturer's Standard Colors
- C. Catalog Number: TBD
- D. Size: 8'-0" Wide
- E. Location: Art Room

2.07 VISUAL DISPLAY BOARDS-MARKER BOARD (BREAKOUT AREAS)

- A. Manufacturer: Polyvision
- B. Surface: Ceramic Steel Motif
- C. Color: Equal to Honey Pattern CS
- D. Finish: Standard
- E. Catalog Number: TBD
- F. Size: 4" H x 3'-6" W
- G. Location: Refer to Drawings, coordinate mounting with accent wall strike line, board shall be all on accent paint.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible, to ensure proper fitting of the work. Allow for trimming and fitting wherever taking of field measurements before fabrications might delay work.

3.02 INSTALLATION

- A. Deliver factory-built markerboard and tackboard units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Designer/Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.
- B. Installer must examine the areas and conditions under which units are to be installed and notify the Designer/Architect in writing of conditions detrimental to the proper timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- C. Markerboards and tackboards shall be installed in strict accordance with manufacturer's recommendations, using concealed hangers at the top and wall angle at the bottom. Installation shall not require grounds.
- D. Provide blocking pads behind all boards at 16" o.c.
- E. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, brackets, anchors, trim and accessories necessary for a complete installation.
- F. Boards shall not be installed until the walls have been painted. Any damage to the painted walls shall be corrected.

3.03 ADJUST AND CLEAN

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 101424 - SIGNS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 9 Section 090050 - Finish Legend

1.02 SUMMARY

- A. This Section includes the furnishing of Specialty Signs. Extent of Specialty Signs is shown on the Drawings and in this section.
- B. Forms of Specialty Signs required include the following:
 - 1. Interior Panel signs (mechanical attachment)
 - 2. Cast metal plaques
 - 3. Fabricated letters (exterior) (interior)
 - 4. Resinous Sheet Graphics
 - 5. Standoff Hardware
- C. Work not included in this section:
 - 1. Illuminated exit signs are specified in Division 16.
 - 2. Handicapped parking signs are specified in Division 10 - Exterior Post & Panel Signs.
 - 3. Exterior post and panel signs are specified in Division 10 - Exterior Post and Panel Signs.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Furnish full-size rubbings for metal plaques.
 - 4. Furnish full-size spacing templates for individually mounted letters and numbers, and graphics.
 - 5. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - a. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:
 - 1) Panel Sign Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material indicated. Include a panel for each color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

- 2) Plastic Dimensional Letters: Provide full-size representative sample of letter type required, showing style, color and material finish and method of attachment.

1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
- C. ADA Regulations: All signage specified herein shall comply with the minimum sign requirements as outlined by the most current Americans with Disabilities Act (ADA).
 1. Manufacturer shall be responsible for complying with all applicable requirements of ADA whether specifically specified or not. Notify Architect of any discrepancies between ADA requirements and the contract documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 1. Manufacturers of Interior Panel Signs:
 - a. APCO Architectural Sign Systems
 - b. ASI Modulex
 - c. Best Manufacturing Co.
 - d. Contemporary Plastics, Inc.
 - e. Fastsigns of Louisville
 - f. Innerface Sign System
 - g. Inpro
 - h. J. Gemini, Inc.
 - i. Mohawk Signs
 - j. Nelson-Harkins
 - k. Serigraphics Sign Systems, Inc.
 - l. Signcraft
 2. Manufacturers of Cast Plaques:
 - a. American Graphics, Inc.
 - b. Andco Industries Corp.
 - c. A.R.K. Ramos Manufacturing Company, Inc.
 - d. ASI Modulex
 - e. Best Manufacturing Co.
 - f. Fastsigns of Louisville
 - g. Gemini, Inc.
 - h. Metal Arts, Division of L & H Manufacturing Co.
 - i. Mohawk Signs
 - j. Nelson Harkins
 - k. Signcraft
 - l. The Southwell Company
 3. Manufacturers of Dimensional Letters :
 - a. APCO Architectural Sign Systems
 - b. ASI Modulex
 - c. Best Manufacturing Co.
 - d. Contemporary Plastics, Inc.
 - e. Fastsigns of Louisville
 - f. Innerface Sign System

- g. Inpro
 - h. J. Gemini, Inc.
 - i. Mohawk Signs
 - j. Nelson-Harkins
 - k. Serigraphics Sign Systems, Inc.
 - l. Signcraft
4. Manufacturers of Fabricated Letters :
- a. APCO Architectural Sign Systems
 - b. ASI Modulex
 - c. Best Manufacturing Co.
 - d. Contemporary Plastics, Inc.
 - e. Fastsigns of Louisville
 - f. Innerface Sign System
 - g. Inpro
 - h. J. Gemini, Inc.
 - i. Mohawk Signs
 - j. Nelson-Harkins
 - k. Serigraphics Sign Systems, Inc.
 - l. Signcraft

2.02 MATERIALS

- A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested in accordance with ASTM D 790, a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:
- 1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.
 - 2. Aluminum Extrusions: Provide aluminum extrusions of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.
 - 3. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the aluminum producer and finisher for the casting process used and for the use and finish indicated.
 - 4. ABS Plastic: Provide high-impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.
 - 5. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
 - 6. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.03 PANEL SIGNS

- A. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- 1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.
 - 2. Material: Plastic
 - 3. Corner Condition: Square corners
 - 4. Panel Thickness: 1/8" minimum
 - 5. Attachments: Mechanical
 - 6. Size: 8" x 8"
 - 7. Copy: Final signage copy shall be provided on the shop drawings; for bidding purposes the bidder shall assume that the room name(s) and their three digit room numbers shall be listed.

8. Where panel signs are indicated to be mounted to window surfaces, the signage fabricator shall provide a matching blank backer panel.
- B. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
- C. Raised Copy: Provide sign plaque with raised copy (1/32") and grade 2 braille as an integral part of the plaque. Use photo etching process or reverse engraved process. Other methods to achieve raised and braille will require pre-approval. Sign surface color must be durable and scratch and vandal resistant. Applied copy and braille strips are not acceptable.
- D. Room Number and Title: Titles shall be 3/4" Sans Serif Typestyle, centered horizontally and vertically. Numbers shall be 2" Sans Serif Typestyle, centered horizontally and vertically.
- E. Changeable Message Inserts: Fabricate signs to allow insertion of 1" x 8" changeable messages in the form of transparent covers with paper inserts printed by Owner.
 1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Owner production of paper inserts.
- F. Special Symbols: Handicap symbol shall be 3" high. Men/Women symbols shall be 4" high. Locate as directed by Architect.
 1. Equivalent raised written description must be placed directly below symbol.
- G. See room finish schedule for sign locations and copy. Size shall be nominal 8" x 8" or as indicated. Manufacturer's standard sizes incorporating minor size variations will be accepted.
- H. Directory signage shall be 24" x 24" with 3" high copy.

2.04 CAST METAL PLAQUES

- A. Plaques: Castings shall be free from pits, scale, sand holes, or other defects. Comply with requirements specified for metal, border style, background texture, and finish and with requirements shown for thickness, size, shape, and copy. Hand-tool and buff borders and raised copy to produce the manufacturer's standards satin polished finish. Refer to "Finish" article for other finish requirements.
 1. Metal: Aluminum
 2. Border Style: As selected by Architect/ Designer
 3. Background Texture: Manufacturer's standard pebble texture
 4. Background Finish: Provide the manufacturer's standard baked enamel finish
 5. Layout: Refer to plaque layout sheet
 6. Size: Refer to Drawings

2.05 FABRICATED LETTERS (Base of Design: ASI Modulex LF Series)

- A. Fabricated Characters: Fabricate letters and numbers to required sizes and styles, using metals and thicknesses indicated. Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories. Comply with requirements indicated for finish, style and size.
 1. Aluminum Sheet: Face, not less than 0.090 inch (2.30 mm) thick, .063 returns, .063 welded loose fit backs
 2. Thickness: _____
 3. Character Height: _____
 4. Character Style: "Standard Block" _____
 5. Script: _____

2.06 FLAT CUT LETTERS

- A. Flat Cut Letters: Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Attach lugs onto back of characters

and tap to receive threading mounting studs. Comply with requirements indicated for finish, style and size.

1. Thickness: 1/4"
2. Mounting: Two part epoxy
3. Copy:
 - a. "CONCESSIONS" - 1 set, 6" high
 - b. "AUDITORIUM" - 2 sets, 6" high
 - c. "HOME" - 1 set, 12" high
 - d. "OF THE" - 1 set, 6" high
 - e. "YELLOW JACKETS" - 1 set, 14" high
 - f. "WOODFORD COUNTY" - 1 set, 4" high
4. Font: Times New Roman

2.07 RESINOUS SHEET-RS1 (Basis of Design: Lumicore)

- A. Thickness: 6mm
- B. Style: Lumicore Impressions Metro with Sunflower Spectrum Add-on
- C. Mounting: Standoffs (RSS1) equal to CR Laurence Company 1" Display System Spacer and Cap
- D. See drawings for panel layout, intention is to utilize smallest number of full panels

2.08 FABRICATION - GENERAL

- A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Design, fabricate, and install sign assemblies to prevent buckling, opening up of joints, and over-stressing of welds and fasteners.
- C. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
- D. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- E. Create signage to required sizes and layout. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.

2.09 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.
- B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.
 1. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
 2. Baked Enamel Finish: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other nondirectional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
 3. Organic Coating: Thermosetting modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.
 4. Color: As selected by the Architect from the manufacturer's standard colors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
- B. Wall Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
 - 1. Mounting: Use expansion bolt anchoring device as recommended by manufacturer to attach signs to concrete block walls. Provide minimum 4 fasteners for 8" x 8" signs.
 - 2. Mount interior signs with centerline one foot from latch side of door frames, and top of sign five feet above finish floor. Note: Lower signs as required to meet all ADA requirements.
 - 3. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches (76 mm) of signage without encountering protruding objects or standing within the swing of a door.
 - 4. Where a tactile sign is provided at a door, the sign shall be alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be to the right of the right-handed door. Where there is no wall space on the latch side of a single door, or to the right side of double doors, signs shall be on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor area 18 inches (455 mm) minimum by 18 inches (455 mm) minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
 - 5. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
- C. Dimensional Illuminated Letters:
 - 1. Install product in accordance with supplier's instructions.
 - 2. Install product in locations indicated using mounting methods recommended by sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.
 - 3. Install product level, plumb, and at heights indicated.
 - 4. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.
 - 5. Install signs within the following tolerances and in accordance with manufacturer's recommendations.
 - a. Interior Signs: Within 1/4 inch vertically and horizontally of intended location
 - b. Exterior Signs: Within 1 inch vertically and horizontally of intended location
 - 6. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.
- D. Cast Metal Plaques: Mount Plaques using the standard method recommended by the manufacturer for the type of wall surface indicated.
- E. Concealed Mounting: Mount plaques by inserting threaded studs into tapped lugs on the back of the plaque. Set in predrilled holes filled with quick-setting cement.
- F. Dimensional and/or Fabricated Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners. Locate as directed by Architect.
 - 1. Flush Mounting: Mount letters with backs in contact with the wall surface.

3.02 CLEANING AND PROTECTION

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

SECTION 101426 - EXTERIOR POST AND PANEL SIGNAGE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Non-illuminated single panel type post and panel exterior signs.

1.02 RELATED REQUIREMENTS

- A. Section 015000 - Temporary Facilities: Temporary project identification signs.
- B. Section 101424 - Signs: Exterior wall-mounted and interior signs.
- C. Section 101433 - Illuminated Panel Signage: Exterior changeable copy signage.
- D. Section 101453 - Traffic Signage: Single post and panel exterior signs.

1.03 SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required. Provide manufacturer's recommendations for maintenance and cleaning requirements for exterior sign surfaces.
- B. Shop Drawings: Include plans, elevations, and not less than 3/4-inch scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list, including not less than half-size details of wording and lettering layout. Include full-size details of special graphics.
- C. Samples: For each sign component provide the following samples showing finishes, colors, and surface texture.
 - 1. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
 - 2. Fiber-Reinforced Polyester (Fiberglass): Manufacturer's color charts showing the full range of colors available.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the sign manufacturer and has completed installation of exterior post and panel signs similar in material, design, and extent to those indicated for the Project and that has resulted in construction with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain exterior post and panel signs from one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.
- B. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's handling instructions for unloading components subject to damage.
 - 1. Inspect sign components for damage upon delivery. Do not install damaged sign components. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is acceptable to the Architect; otherwise remove and replace damaged sign components.

1.06 WARRANTY

- A. Fiberglass Sign Panel Warranty: Submit a written warranty signed by the manufacturer agreeing to repair or replace fiberglass panels that fail due to coating degradation, chalking, fading, or fiberglass delamination or cracking.
 - 1. Warranty Period: 5 years.
 - 2. The warranty submitted under this Section shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include::
 - 1. APCO Signs Inc.: www.apcosigns.com
 - 2. ASI Modulex Sign Systems, Inc.: www.asimodullex.com
 - 3. KMC Sign and Design, Inc.: www.kmc-sign.com
 - 4. Contemporary Plastics
 - 5. Poblocki & Sons: www.poblocki.com
- B. Basis of Design: The drawings indicate the size, profiles, and dimensional requirements of post and panel signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
 - 1. Add basis of design manufacturer, model number and etc here.

2.02 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design Criteria: Design, fabricate, and install exterior post and panel-type signs to withstand a wind pressure of 100 mph on the total sign area in all directions.

2.03 MATERIALS

- A. Aluminum Extrusions: Provide alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T5.
- B. Fiberglass: Provide molded seamless thermosetting glass fiber-reinforced polyester panels in sizes and thicknesses indicated, with a minimum tensile strength of 15,000 psi when tested in accordance with ASTM D 638 and a minimum flexural strength of 30,000 psi when tested in accordance with ASTM D 790.
- C. Concrete: Provide concrete for post holes consisting of Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and clean water. Mix the materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi. Use at least 4 sacks of cement per cubic yard, 1-inch maximum size aggregate, maximum 3-inch slump, and 2 to 4 percent entrained air.
- D. Fasteners: Unless otherwise indicated, use concealed fasteners fabricated from metals that are non-corrosive to either the sign material or the mounting surface.
- E. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete.
- F. Colored Coatings for Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors that are nonfading and are recommended by the manufacturers for optimum adherence to the type of surface used.

2.04 COMPONENTS

- A. Posts: Provide the manufacturer's standard 0.125-inch-thick structural aluminum tubing extruded from 6063-T5 alloy, with vertical slots to engage sign panels. Provide stop blocks in slots to hold panels in position. Include post caps, fillers, spacers, junction boxes, access panels, and related accessory items required for a complete installation. Comply with the following requirements for post shape, finish, and mounting method:
 - 1. Post Shape: 2" x 2" or 4" x 4" square to match panel thickness as indicated or as required by manufacturer.
 - 2. Finish: Class I, clear or color anodized as selected by the Architect / Designer.
 - 3. Post Mounting Method: Provide sign posts of length required for permanent installation by the direct-burial mounting method.
- B. Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.
 - 1. Panel Material: 0.125-inch-thick fiberglass sheet.
 - a. Finish: Manufacturer's standard semigloss finish with ultraviolet inhibitors.
 - b. Corner Condition: Square corners.
 - 2. Composite Fiberglass Box-Type Panels: Provide composite box sign message panels with molded fiberglass outer shell bonded to internal reinforcing. Comply with the following requirements:
 - a. Panel Face: Seamless 0.125-inch-thick molded fiberglass.
 - b. Finish: Manufacturer's standard semigloss finish with ultraviolet inhibitors.
 - c. Internal Panel Structure: Impact-resistant polyurethane or polyester core.
 - 1) Corner Condition: Square corners.
- C. Graphic Content and Style: Provide sign copy to comply with the requirements indicated for sizes, styles, spacing, content, positions, materials, finishes, and colors of letters, numbers, symbols, and other graphic devices.
 - 1. Copy Embedded in Fiberglass Panels: Apply computer-generated adhesive graphics to panel as a masking material. Apply acrylic polyurethane background color flood coats, 0.015-inch minimum thickness. Include ultraviolet inhibitors. Remove masking material.

2.05 FABRICATION

- A. General: Provide the manufacturer's standard double post, single-panel-type post, and panel signs. The completed sign assembly shall consist of a message panel supported between two posts. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
 - 1. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 deg F (55.5 deg C). Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing welds and fasteners.
 - a. Base design on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - 2. Welded Connections: Comply with AWS for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of the exposed side. Clean exposed welded surfaces of welding flux and dress on all exposed and contact surfaces.
 - 3. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
 - 4. Preassemble post and panel signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
 - 5. Conceal fasteners where possible; otherwise locate fasteners where they will be inconspicuous.

- B. Posts: Fabricate posts to lengths required for mounting method indicated.
 - 1. Direct Burial: For permanent sign installation, provide posts 36 inches longer than height of sign indicated to permit direct embedment in concrete foundations.
- C. Panels: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
 - 1. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.

2.06 FINISHES

- A. Colors and Textures: For exposed sign material that requires selection of materials with integral or applied colors, textures, or other characteristics related to appearance, provide color matches as selected by the Architect from the manufacturer's standards.
- B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.
- C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
 - 1. Architectural Class I Clear Anodized Finish: AA-M12C22A41 (Mechanical finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 607.1.
 - a. Color: As selected by the Architect from within standard industry colors and color density range.
 - 2. Architectural Class I Color Anodized Finish: AA-M21C22A42/44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural, film thicker than 0.7 mil with integral color or electrolytically deposited color) complying with AAMA 606.1 or 608.1.
 - a. Color: As selected by the Architect from within standard industry colors and color density range.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
- B. Excavation: In firm undisturbed or compacted soil, drill or (using a post-hole digger) hand-excavate holes for each post to the minimum diameter recommended by the sign manufacturer, but not less than 4 times the largest post cross-section.
 - 1. Excavate hole depths approximately 3 inches lower than the required post bottom, with bottom of posts set not less than 36 inches below finished grade surface.
- C. Setting Posts: Center and align posts in holes 3 inches above bottom of the excavation.
 - 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position until concrete has achieved its initial set.
- D. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

3.02 CLEANING

- A. At completion of the installation, clean soiled surfaces of sign units in accordance with the manufacturer's instructions.

3.03 PROTECTION

- A. Protect installed sign units from damage until acceptance by the Owner.

END OF SECTION

SECTION 101453 - TRAFFIC SIGNAGE**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Single post type exterior signs.

1.02 RELATED REQUIREMENTS

- A. Section 015000 - Temporary Facilities: Temporary project identification signs.

1.03 SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required. Provide manufacturer's recommendations for maintenance and cleaning requirements for exterior sign surfaces.
- B. Shop Drawings: Include plans, elevations, and not less than 3/4-inch scale sections of typical members and other components. Show anchors, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list, including not less than half-size details of wording and lettering layout. Include full-size details of special graphics.
- C. Samples: For each sign component provide the following samples showing finishes, colors, and surface texture.
 - 1. Aluminum: Samples of each finish type and color, on not less than 4-inch squares of sheet or plate.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the sign manufacturer and has completed installation of exterior post and panel signs similar in material, design, and extent to those indicated for the Project and that has resulted in construction with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain exterior post and panel signs from one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Provide protective covering or crating as recommended by the manufacturer to protect sign components and surfaces against damage during transportation and delivery.
- B. Handle signs carefully to prevent breakage, surface abrasion, denting, soiling, and other defects. Comply with the manufacturer's handling instructions for unloading components subject to damage.
 - 1. Inspect sign components for damage upon delivery. Do not install damaged sign components. Repair minor damage to signs, provided the finished repair is equal in all respects to the original work and is acceptable to the Architect; otherwise remove and replace damaged sign components.

1.06 WARRANTY

- A. Aluminum Sign Panel Warranty: Submit a written warranty signed by the manufacturer agreeing to repair or replace signs that fail due to coating degradation or fading.
 - 1. Warranty Period: 5 years.
 - 2. The warranty submitted under this Section shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: The drawings indicate the size, profiles, and dimensional requirements of single post signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

2.02 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design Criteria: Design, fabricate, and install exterior single post signs to withstand a wind pressure of 100 mph on the total sign area in all directions.

2.03 MATERIALS

- A. Sheet Aluminum: Provide alloy 6061-T6, 5052-H36, 5052-H38 or recycled aluminum meeting alloy 3105, as specified in ASTM B 209. All sheet aluminum receive chromate conversion coating conforming to ASTM B 449, Class 2. Protect all panels at all times from contact or exposure to oils, grease, dirt, dust or other contaminants.
- B. Concrete: Provide concrete for post holes consisting of Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and clean water. Mix the materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least 4 sacks of cement per cubic yard, 1-inch maximum size aggregate, maximum 3-inch slump, and 4 to 6 percent entrained air.
- C. Fasteners: Unless otherwise indicated, use fasteners fabricated from stainless steel that are non-corrosive to either the sign material or the mounting surface.
- D. Retroreflective Sheeting: Use "Premium Grade" reflective sheeting for all backgrounds. If borders, symbols and lettering are to be sheeting products, they shall also adhere to the above requirements. Approved products include:

2.04 COMPONENTS

- A. Posts: Provide the manufacturer's standard 0.125-inch-thick structural aluminum tubing extruded from 6063-T5 alloy. Include post caps, fillers, spacers, and related accessory items required for a complete installation. Comply with the following requirements for post shape, finish, and mounting method:
 - 1. Post Shape: 2 1/4" Diameter.
 - 2. Finish: Galvanized or as selected by the Architect / Designer.
 - 3. Post Mounting Method: Provide sign posts of length required for permanent installation by the direct-burial mounting method.
- B. Aluminum Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions.
 - 1. Panel Material: Sheet thickness to be 0.080 for sign up to 18-inches wide and 0.125 for signs over 18-inches wide.
 - 2. Corner Condition: Rounded corners.
- C. Fasteners: All components to be stainless steel. Bolts and/or screws to be tamper resistant with lock nuts.

2.05 FABRICATION

- A. General: Provide the manufacturer's standard double post, single-panel-type post, and panel signs. The completed sign assembly shall consist of a message panel supported between two posts. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 deg F (55.5 deg C). Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing welds and fasteners.
 - a. Base design on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 2. Welded Connections: Comply with AWS for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of the exposed side. Clean exposed welded surfaces of welding flux and dress on all exposed and contact surfaces.
 3. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
 4. Preassemble post and panel signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
 5. Conceal fasteners where possible; otherwise locate fasteners where they will be inconspicuous.
- B. Posts: Fabricate posts to lengths required for mounting method and height indicated.
1. Direct Burial: For permanent sign installation, provide posts 36 inches longer than height of sign indicated to permit direct embedment in concrete foundations. Perforated tube posts are to be sleeved.
- C. Panels: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
1. Background: Reflective sheeting to be applied to properly prepared base panel with mechanical equipment.
- D. Colors: Colors to be as required below:
1. Stop Sign - Red background with White border and text.
 2. Visitor Parking - White background with Green border and text.
 3. Do Not Enter - White background with Red symbol and White text.
 4. Accessible Parking - White background with Blue border, text and symbol.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
- B. Excavation: In firm undisturbed or compacted soil, drill or (using a post-hole digger) hand-excavate holes for each post to the minimum diameter recommended by the sign manufacturer, but not less than 12-inches in diameter.
1. Excavate hole depths approximately 3 inches lower than the required post bottom, with bottom of posts set not less than 36 inches below finished grade surface.
- C. Setting Posts: Center and align posts in holes 3 inches above bottom of the excavation.
1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position until concrete has achieved its initial set.
- D. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

3.02 CLEANING

- A. At completion of the installation, clean soiled surfaces of sign units in accordance with the manufacturer's instructions.

3.03 PROTECTION

- A. Protect installed sign units from damage until acceptance by the Owner.

END OF SECTION

SECTION 102123 - CUBICLES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Curtains (CC1)

1.02 RELATED SECTIONS

- A. Section 090050 - Finish Legend
- B. Section 095100 - Acoustical Ceilings: Suspended ceiling system to support track

1.03 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- B. NFPA 701 - Standard Methods of Fire Tests for Flame-Resistant Textiles and Films; National Fire Protection Association

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics and Hardware.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 x 12 inch sample patch of curtain cloth with representative hem stitch detail, heading with reinforcement, and carrier attachment to curtain header.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

1.06 EXTRA MATERIALS

- A. See Section 016000 - Product Requirements, for additional provisions.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Cubicle Curtains:
 1. A. R. Nelson Co; Product : www.arnelson.com
 2. General Cubicle Co., Inc; Product : www.generalcubicle.com
 3. Imperial Fastener Co., Inc; Product : www.imperialfastener.com
 4. Inpro
 5. Substitutions: See Section 016000 - Product Requirements

2.02 TRACKS AND TRACK COMPONENTS

- A. Track: Extruded aluminum sections; one piece per cubicle track run; I-beam profile.
 1. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers
 2. Escutcheons to Suspension Rods: Aluminum
 3. Finish on Exposed Surfaces: Clear anodized finish

- B. Curtain Carriers: Nylon slider to accurately fit track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.

2.03 CURTAINS

- A. All Curtain Materials:
 - 1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E 84
- B. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, same color as curtain
- C. Curtain Fabrication:
 - 1. Include open mesh cloth at top 18 inches of curtain for room air circulation
- D. Curtain Fabric: Momentum Textiles
- E. Style: Elon
- F. Color: TBD

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

3.02 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. Install end cap and stop device.
- C. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 102260 - OPERABLE PANEL PARTITIONS**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 9 Section 090050 Finish Legend

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Manually operated, paired panel partitions with marker boards. (OPM 1) markerboard surfaces shall occur on both sides of the panels.
 - 2. Top Supported, Center Stacking, manually operated, hinged in pairs, with seals, no vertical trim

1.03 DEFINITIONS

- A. NIC: Noise isolation class.
- B. NRC: Noise reduction coefficient.
- C. NVLAP: National Voluntary Laboratory Accreditation Program.
- D. STC: Sound transmission class.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound Transmission Requirements: Operable panel partition assembly tested in a full-scale opening, 14 by 9 feet (4267 by 2743 mm), for laboratory sound transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

1.05 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified. Include data on acoustical performance, surface-burning characteristics, and durability.
- B. Shop Drawings: Show location and extent of operable panel partitions. Include plans, elevations, sections, details, numbered panel installation sequence, attachments to other construction, and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel. Show blocking to be provided by others. Include the following:
 - 1. Calculations: Calculate requirements for supporting operable panel partitions and verify capacity of carriers and track components to support loads; indicate deflection limits for partition and adjacent construction.
- C. Setting Drawings: For embedded items and cutouts required in other work, including support beam punching template.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
 - 1. Include similar Samples of accessories involving color selection.

- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color pattern and texture variations, include sample sets showing the full range of variations expected.
 - 1. Panel Face Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
 - 2. Panel Edge Material: Not less than full width by 3 inches (75 mm) long.
- F. Product Certificates: Signed by manufacturers of operable panel partitions certifying that products furnished comply with requirements.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- H. Product Test Reports: From a qualified testing agency indicating that each operable panel partition complies with requirements, based on comprehensive testing of current products.
- I. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:
 - 1. Panel face finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - 2. Seals, hardware, track, carriers, and other operating components.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable panel partition manufacturer as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Fire-Test-Response Characteristics: Provide operable panel partitions with the following fire-test-response characteristics, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.
 - c. Fire Growth Contribution: Textile wall coverings complying with the acceptance criteria of the Kentucky Building Code.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening and storage dimensions and proceed with fabricating operable panel partitions without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

1.09 WARRANTY

- A. Furnish the manufacturer's written warranty agreeing to replace panel partitions that are defective in materials or workmanship.
 - 1. Warranty Period: Two years.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel-Face Finish Material: Furnish full-width in quantity to cover both sides of two panels when installed of each type of finish material.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following including, but are not limited to:
 - 1. Basis of Design: Hufcor 632 Operable Partition
 - 2. Advanced Equipment Corp.
 - 3. Industrial Acoustics Co.
 - 4. Moderco Inc.
 - 5. Modernfold, Inc.
 - 6. National Folding Wall Corp.
 - 7. Panelfold, Inc.

2.02 MATERIALS

- A. Steel Frame: Steel sheet.
- B. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.
 - 1. Frame Reinforcing: Manufacturer's standard steel or aluminum.
- C. Steel Face/Liner Sheets: Tension-leveled steel sheet.
- D. Gypsum Board: ASTM C 36.
- E. Plywood: DOC PS 1.
- F. Particleboard: ANSI A208.1.
- G. Medium-Density Fiberboard: ANSI A208.2.

2.03 OPERABLE PANEL PARTITIONS

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- B. Dimensions: Fabricate operable panel partitions, from manufacturer's standard sizes, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
- C. Cap-Trimmed Edges: Protective aluminum perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing.
- D. Operable Panel Partition Characteristics: Comply with requirements indicated in the Operable Panel Partition Schedule at the end of Part 3.
- E. Trim: Manufacturer's standard aluminum trim, finished as follows:
 - 1. Clear anodized or color anodized, as selected by Architect from manufacturer's standard colors.

- F. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.04 SEALS

- A. General: Provide types of acoustical seals indicated that produce operable panel partitions complying with acoustical performance requirements and the following:
 - 1. Seals made from materials and profiles that minimize sound leakage.
 - 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
- E. Mechanically Operated: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than the 1-1/2-inch (38-mm) operating clearance between retracted seal and floor finish.

2.05 FINISH FACING

- A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
- B. Apply one-piece, seamless facings free from air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
- C. Match facing pattern 72 inches (1830 mm) above finished floor.
- D. Vinyl Covering: Manufacturer's standard.
- E. Markerboard Surface: Color to be selected from manufacturer's standard colors.
- F. No vertical trim, includes erase pockets

2.06 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.5 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
 - 1. Center carrier stop.

- 2. Four High Density Polymer Covered Steel Ball Bearing Wheels, Track 40 Clear Anodized Extruded Aluminum
- C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish, unless otherwise indicated.
- D. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Comply with ASTM E 557, operable panel partition manufacturer's written installation instructions, Drawings, and approved Shop Drawings.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed.
- C. Match operable panel partitions for color and pattern by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.03 ADJUSTING

- A. Adjust operable panel partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.04 CLEANING AND PROTECTION

- A. Clean soiled surfaces, fabric facing, metal surfaces, and vacuum carpet facing on completing installation of operable panel partitions, to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.
- C. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.
 - 1. Test and adjust seals, hardware, carriers, tracks, and other operable components. Replace damaged or malfunctioning operable components.
 - 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 5. Schedule training with Owner through Architect with at least seven days' advance notice.

3.06 OPERABLE PANEL PARTITION SCHEDULE

- A. Operable Panel Partition OP-1: Comply with the following:
1. Product: Classic 632, manufactured by Hufcor.
 2. Partition Operation and Configuration: Manually operated, paired panels
 3. Panel Construction: Manufacturer's standard panel construction complying with requirements indicated.
 4. Panel Weight: 5.7-10.2 lbs. maximum.
 5. Panel Thickness: Not less than 3 inches (100 mm).
 6. Edges: Cap trimmed.
 7. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
 8. Final Closure: Constant-force, lever-operated, mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
 9. Finish Facing: Wall carpet covering and markerboard.
 - a. Total Weight: Not less than 23 oz./linear yd. (713 g/linear m)
 - b. Color/Pattern: As selected by Interior Designer from manufacturer's full range.
 10. STC: Not less than 50.

END OF SECTION

SECTION 102601 - WALL SURFACE PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wall Protection Systems:
 - a. Corner Guards (CG1)
 - b. Semi-Rigid Protective Sheet (WLW and WPR1)
 - c. Vinyl Rubrail (CR1)
 - d. Colored Metal Guard (CMC1)
- B. Related Sections/Items
 - 1. Steel angle and bent plate corner guard, refer to Section 05 50 00.
 - 2. Wood blocking and grounds, refer to Section 06 10 00.
 - 3. Division 9 Section 090050 Finish Legend

1.02 SUBMITTALS

- A. Comply with Section 01 33 00.
- B. Product data indicating compliance with specified requirements.
- C. Shop drawings showing methods of attachment to substrate and product locations/layout.
- D. Samples: For selection of color, pattern, and surface texture.
 - 1. 12 inch (300 mm) long samples of each type of wall and corner guard required. Include examples of joinery, corners, and field splices.
 - 2. 7 x 9 inch (175 x 225 mm) samples of each semi-rigid sheet

1.03 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Comply with ASTM E 84 for the fire performance characteristics indicated below. Identify components with markings from testing and inspection organization.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.
- B. Single Source Responsibility: Obtain wall surface protection system components from a single source.
- C. Deliver materials in original factory wrappings and containers, clearly labeled with manufacturer and brand name.
- D. Store materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within the storage area between 60° F (16° C) and 80° F (27° C) during the period plastic materials are stored. Keep materials out of direct sunlight to avoid excessive surface temperatures.
 - 2. Store rigid plastic corner guard, wall guard, and handrail covers in a horizontal position for a minimum of 72 hours, or until the plastic material attains the ambient room installation temperature of between 65° F (18° C) and 75° F (24° C).

1.04 PROJECT CONDITIONS

- A. Maintain ambient temperature within building at not less than 65° F (18° C) or greater than 75° F (24° C) for a minimum 72 hours prior to beginning of installation.
- B. Do not install wall surface protection system components until the space is enclosed, weatherproof and climate controlled.
- C. Do not install semi-rigid wall protection systems until temperature is stable and permanent lighting is in place.

1.05 MAINTENANCE

- A. Maintenance Instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.
- B. Replacement Materials: Minimum 2% of each type, color, and pattern of wall surface protection materials and components. Include accessory components as required. Replacement materials shall be from the same production run as installed materials. Package with protective coverings and appropriate labels.

1.06 MOCK-UPS

- A. Mock-ups: Before installing the wall protection system, construct mock-ups to demonstrate aesthetic effects and qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for completed work.
 - 1. Locate mock-ups in the location directed by Designer/Architect. The mock-up shall be a minimum of 9'-0" to include one outside corner.
 - 2. Notify Designer/Architect seven (7) days in advance of dates and times when mock-ups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Designer/Architect's approval of mock-ups before proceeding with installation.
 - 5. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - 6. Preinstallation Conference: Conduct conference at project to comply with requirements of Division 1 Section "Project Meetings".

PART 2 - PRODUCTS**2.01 MANUFACTURER**

- A. CS Acrovyn. Contact: Carlos Cruzado with Engineered Systems, 440.665.0685, c-sgroup.com
- B. Drawings and specifications are based on manufacturer's literature from CS Acrovyn unless otherwise indicated.
- C. InPro Corporation and Koroseal Wall Protection-shall be considered an approved manufacturer pending compliance with specifications.

2.02 MATERIALS

- A. Plastic Sheet Wallcovering Material: Textured, chemical-and stain-resistant, high-impact, acrylic modified vinyl plastic sheets, thickness as indicated. Comply with specified requirements of ASTM D 256 for impact resistance and ASTM E 84 for flame spread and smoke developed characteristics.
- B. Rigid Plastic Material: Extruded, textured, chemical-and stain-resistant, high-impact, acrylic modified vinyl plastic, thickness as indicated. Comply with specified requirements of ASTM D 256 for impact resistance and ASTM E 84 for flame spread and smoke developed characteristics. Color: As selected by Architect from the manufacturer's full range of standard colors, for corner guard and from Woodgrains for areas as noted.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M) for 6063-T5.
- D. Fasteners: Use non-corrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theft-proof fasteners where exposed to view.

2.03 WALL SURFACE PROTECTION

- A. Wall and Corner Guards (CG1)
 - 1. Manufacturer: Construction Specialties

2. Product: SSM-20N Surface Mounted
 3. Height: 4"
 4. Thickness: 2" Thick
 5. Color: Manufacturer's Standards
 6. Location: Gypsum corners, Refer to Drawings
- B. Wall and Corner Guards-Vinyl Rubrail (CR1)
1. Manufacturer: Construction Specialties
 2. Product: Crash Rails-Rubstrip
 3. Height: 6"
 4. Thickness: .060"
 5. Color: TBD
 6. Location: Refer to Drawings
- C. Wall and Corner Guards-Colored Metal Guard
1. Manufacturer: Koffler Sales
 2. Product: Colored Metal Corner Guard
 3. Size: 1" x 1"
 4. Height: as needed, in longest strips possible
 5. Color: Manufacturer's standards
 6. Location: All gypsum corners at Wood-Look wall covering in Media Center, refer to drawings
- D. Wood Look Wall Treatment (WLW1)
1. Manufacturer: CS-Acrovyn
 2. Style: Interior Wall Panels
 3. CS Acrovyn Wood Grains
 4. Size: TBD
 5. Details: Wrapped Edges-Wood Look
 6. Sure Snap Installation as shown on drawings
 7. Direct Glue as shown on drawings
 8. Location: Refer to drawings

2.04 FABRICATION

- A. Comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thicknesses of components.
- B. Shop-assemble components to the greatest extent possible. Disassemble only as necessary for shipping and handling.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions in which wall surface protection components and wall protection systems will be installed.
- B. Complete finishing operations, including painting, before beginning installation of wall surface protection system materials.
- C. Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.
- D. Do not proceed with installations until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Properly prepare substrate and clean to remove dust, debris, and loose particles.

3.03 INSTALLATION

- A. Install wall surface protection units plumb, level, and true to line without distortions.
- B. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished work.
- C. Install aluminum retainers, mounting brackets, and other accessories in strict accordance with the manufacturer's instructions.
- D. Where splices occur in horizontal runs of over 20 feet (6 m), splice aluminum retainer and plastic cover at same locations along the run.

3.04 CLEANING

- A. Clean plastic covers and accessories using a standard non-ammonia based household cleaning agent.
- B. Clean metal components in accordance with the manufacturer's recommendations.
- C. Remove excess adhesive in manner recommended by manufacturer.

END OF SECTION

SECTION 102800 - TOILET AND BATH ACCESSORIES**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following toilet accessory items:
 - 1. Automatic roll paper towel dispenser
 - 2. Grab bars (toilets and showers)
 - 3. Electric hand dryer with anti-microbial wall guards
 - 4. Mirrors - stainless steel frame
 - 5. Mop and broom holder (located at each mop sink)
 - 6. Shower curtain, hooks and rod
 - 7. Folding shower seat
 - 8. Diaper changing station
 - 9. Sanitary napkin disposal unit (surface-mounted)
 - 10. Underlavatory guard
 - 11. Soap dish
 - 12. Robe hook
 - 13. Coat rack
 - 14. Hat and coat hook

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.
- C. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

1.04 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.
- B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.
- C. ADA Compliance: Provide products which comply with applicable provisions of the Americans with Disabilities Act.

1.05 PROJECT CONDITIONS

- A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.06 WARRANTY

- A. Special Project Warranty: Provide manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors that develop visible defects within warranty period.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide toilet accessories excluding the electric hand dryer by one of the following including, but not limited to:
1. A & J Washroom Accessories
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation
 5. General Accessory Manufacturing Co.
 6. Royce Rolls Ringer Co.
 7. Columbia Accessories
 8. Saniflow
 9. Gamco
 10. Searchrome

2.02 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gage (.034-inch) minimum thickness, unless otherwise indicated.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16, Castings, ASTM B-30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gage (.040-inch) minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 527, G60.
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
- F. Mirror Glass: Nominal 6.0 mm (0.23 inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.
- G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.
- I. Keys: Unless otherwise indicated, provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six (6) keys to Owner's representative and obtain receipt.

2.03 AUTOMATIC ROLL PAPER TOWEL DISPENSER

- A. Paper Towel Dispenser: Where this designation is indicated, provide automatic paper towel dispenser units complying with the following:
1. Products: Available products include the following:
 - a. Bobrick Washroom Equipment, Inc. No. B-72974 or approved equivalent.
 - 1) Materials: High impact resin. Door is translucent with keyed lock at top.
 - 2) Operation: Electronic sensor dispenses towel when hands are placed under towel opening. Dispenses universal, 1-1/2" to 2" diameter core up to 8" diameter, 8" wide, non-perforated, non-proprietary rolls. Towel length can be set to 9", 12", or 15". Dispenser includes a 3-1/2" diameter stub roll. When the stub roll is depleted, main roll automatically starts dispensing without need to open the dispenser.
 - 3) Batteries: LED light on dispenser blinks when battery needs to be changed. Battery pack holds 4 "D" sized alkaline batteries.

2.04 GRAB BARS

- A. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 gage (.050 inch) and as follows:
 - 1. Mounting: Concealed, manufacturer's standard anchorages
 - 2. Clearance: 1-1/2 inches clearance between wall surface and inside face of bar
 - 3. Gripping Surfaces: Smooth, satin finish
 - 4. Heavy-Duty Size: Outside diameter of 1-1/2 inches
 - 5. Anchorage: Grab bar and anchorages shall have capacity to withstand minimum 250 lb. pull in any direction of aluminum duration of 5 minutes.
 - 6. Product: Bobrick B-6806 or approved equivalent
 - 7. Refer to drawings for sizes and quantities.
- B. Grab Bars at Showers: Provide grab bars with wall thickness not less than 18 gage and as follows:
 - 1. Mounting: Concealed, manufacturer's standard flanges and anchorages
 - 2. Clearance: 1-1/2 inches clearance between wall surface and inside face of bar
 - 3. Gripping Surfaces: Smooth, satin finish
 - 4. Heavy-Duty Size: Outside diameter of 1-1/2 inches
 - 5. Anchorage: Grab bar and anchorages shall have capacity to withstand minimum 250 lb. pull in any direction of aluminum duration of 5 minutes.
 - 6. Product: Bobrick B-5861 or as required for shower size and configuration to meet ADA Guidelines.

2.05 MISCELLANEOUS ACCESSORIES

- A. Mop and Broom Holder: 18-gage (.050-inch) Type 304 stainless steel "hat" channel with spring-loaded rubber cam-type mop/broom holders that grips handles 7/8" to 1-1/4" diameter. Provide 24" long unit with 3 holders.
 - 1. Product: Bobrick B-223 or approved equivalent

2.06 MIRROR UNITS

- A. Stainless Steel Framed Mirror Units: [Type 430 Stainless Steel 1/2" x 1/2" x 3/8" channel with 1/4" return at rear with bright polish finish. Provide locking devices to secure mirror to concealed wall hanger. Utilize concealed philips-head locking screws to securely fasten mirror to wall hanger.]
 - 1. Size:
 - a. 18" w x 24" h
 - b. 18" w x 30" h
 - c. 18" w x 36" h
 - d. 24" w x 30" h
 - e. 24" w x 36" h
 - f. 24" w x 48" h
 - g. 24" w x 60" h
 - h. 36" w x 36" h
 - i. 48" w x 36" h
 - j. 60" w x 36" h
 - 2. Product: Bobrick No. B-165 or approved equivalent

2.07 ELECTRIC HAND DRYER

- A. Base of Design: Excel Dryer XLERATOR Hand Dryer Model XL-W
- B. Hand Dryer: High speed, energy efficient, electric hand dryer; surface mounted; entire dryer internally grounded
 - 1. Saniflow Machflow M09A with ADA Recessed Kit
- C. Warranty Period: 5 years; limited warranty

- D. Manufacturing: MADE IN USA Certified, verify certification number.
- E. Sound Level: Operational sound level less than 80 dB
- F. Noise Reduction Nozzle: 1.1 inch radius noise reduction nozzle lowers usage decibel level by 9 dB and reduces air deflection noise.
- G. Motor and Blower: 5/8 HP, 20,000 RPM. Air flow rate: 19,000 linear feet per minute.
- H. Heater: 900 watts mounted inside blower housing to be vandal proof with Air Temperature of 135 degrees F measured at average hand position of 4 inches below air outlet.
- I. Controls: Completely sealed control board and optics, automatic operation, activated by infrared optical sensor.
- J. Size: 11-3/4" wide by 12-11/16" high by 6-11/16" deep.
- K. Cover: One piece, heavy duty, rust resistant, rib-reinforced, die-cast zinc alloy.
- L. Finish: Electrostatically applied, chip resistant, white paint.
- M. Green: GreenSpec Listed, Qualifies for LEED Credits.
- N. Recess Kit: ADA compliant recess kit is fabricated at 22 GA 18-8 type 304 stainless steel with #4 satin finish with 16 GA 18-8 type 304 stainless steel dryer mounting plate. All welded construction. 16-3/8 inches (416 mm) wide by 26 inches (660 mm) high by 3-3/8 inches (86 mm) deep.
- O. Anti-Microbial Wall Guards: Provide one white wall guard at each handdryer location.

2.08 SHOWER ACCESSORIES

- A. Vinyl Shower Curtain: (Width of opening + 12") x 72" high by minimum 8 mils thick, opaque matte vinyl material with hemmed edges and corrosion-resistant grommets at minimum 6 inches on center through top hem. Furnish in white color unless otherwise indicated.
 - 1. Product: Bobrick No. 204.3 or approved equivalent.
- B. Shower Curtain Hooks: Chrome plated or stainless steel spring wire curtain hooks with snap fasteners, sized to accommodate curtain rod size provided with shower. Provide one hook per grommet.
 - 1. Product: Bobrick No. 204.1 or approved equivalent.
- C. Shower Curtain Rod, Heavy Duty: 1 inch o.d., 20-gage (.040 inch) stainless steel, satin finish; furnish with 1-5/8 inch o.d., chrome plated brass flanges, polished finish; designed for concealed fasteners.
 - 1. Product: Bobrick B-207 or equivalent.
- D. Folding Shower Seat: One piece, 1/2" thick, solidly fused plastic laminate with matte finish melamine surface which cannot delaminate. Frame: 18-85, Type 304 stainless steel with satin finish. 16-gauge, 1-1/4" square tubing and 18 gauge 1" diameter seamless tubing.
 - 1. Product: Bobrick B-5191 or equivalent.

2.09 SANITARY NAPKIN DISPOSAL UNIT (SURFACE-MOUNTED)

- A. Sanitary Napkin Disposal Unit: Where this designation is indicated, provide stainless steel sanitary napkin disposal unit complying with the following:
 - 1. Products: Available products include the following:
 - a. American Specialties, Inc., No. 0852 or approved equivalent.

2.10 UNDERLAVATORY GUARD

- A. Underlavatory Guard: Handicapped sink locations will receive underlavatory guard complying with the following:
 - 1. Products: Available products include the following:

- a. Insulating Piping Coverings: White, anti-microbial, molded-vinyl covering for supply and drain piping assemblies intended to use at accessible lavatories to prevent direct contact with burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

2.11 SOAP DISH

- A. Vandal-resistant surface mounted soap dish equivalent to GAMCO MSA-5 or approved equivalent.
- B. Supply one soap dish at each shower location.

2.12 ROBE HOOK

- A. Heavy duty robe hook with concealed mounting equivalent to Bobrick B-2116 or approved equivalent.

2.13 COAT RACK

- A. A multi-hook coat rack equivalent to Bradley Model 9948 with accent series - color laminate back plate or approved equivalent.
 - 1. Model 9948 - 24" w, 3 hooks

2.14 HAT AND COAT HOOK

- A. Satin-finished stainless steel hat and coat hook with concealed, 19 gauge stainless steel mounting bracket. All welded construction. Secured to wall plate with a stainless steel set screw. Hat and coat hook shall be equivalent to Gamco Model Number 76827 or equivalent.

2.15 FABRICATION

- A. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.
- D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamper proof glass installation and prevent accumulation of moisture, as follows:
 - 1. Provide galvanized steel backing sheet, not less than 22 gage (.034 inch) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- E. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamper proof, and theft-proof installation, as follows:
 - 1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

- B. Secure mirrors to walls in concealed, tamper proof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

3.02 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION

SECTION 104400 - FIRE PROTECTION SPECIALTIES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Fire extinguisher brackets.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 092116 - Gypsum Board Assemblies: Roughed-in wall openings.

1.03 REFERENCE STANDARDS

- A. International Building Code; 2015 with Kentucky Amendments; current edition.
- B. IFC - International Fire Code; 2012.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 PERFORMANCE REQUIREMENTS

- A. Conform to International Fire code.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, locations of individual fire extinguishers, mounting measurements for wall bracket, and accessories required for complete installation.
- B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Fire Extinguishers, Cabinets, Brackets and Accessories: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. F.E. Cabinet - J. L. Industries; Academy 1027W10.
 - b. Bracket - J. L. Industries; Bracket 10 lb; MB 846.
 - c. Bracket - J. L. Industries; Bracket 15 lb; MB 810.

- d. Fire Extinguisher - J. L. Industries; Cosmic 10E (Class A, B, C).
- e. Fire Extinguisher - J. L. Industries; Saturn 15 (Class K).
- f. Fire Extinguisher - J. L. Industries; Sentinel 15 (Class B, C)
- 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions, profiles, and formulations are minor and do not change the design concept as judged by the Architect:
 - a. Activar Inc.; JL Industries, Inc: www.activarcpg.com/jl-industries
 - b. Larsen's Manufacturing Co: www.larsensmfg.com.
 - c. Morris Group International/Potter-Roemer: www.potterroemer.com.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Heavy-duty steel tank, with pressure gage.
 - 1. Class A, B, C.Multi-purpose
 - 2. Size 10 pound.
 - 3. Tank Finish: Corrosion and impact resistant powder coat.
 - 4. Tank Color: Red.
 - 5. Location: All areas of building.
 - 6. Mounting Type: Refer to drawings for cabinet mount or bracket mount symbol.
- C. Wet Chemical Type Fire Extinguisher: Stainless steel tank, with pressure gage.
 - 1. Class K
 - 2. Size: 25 pound
 - 3. Location(s): Install at all kitchens/concessions/food service preparation areas within 30 feet of any hood located above cooking equipment or any cooking equipment involving solid fuels, vegetable or animal oils and fats whether or not located under a hood.
 - 4. Mounting Type: Bracket

2.03 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed aluminum; #180 gauge minimum thickness.
- B. Cabinet Configuration: Semi-recessed type.
 - 1. Trim: Returned to wall surface, 2-7/8" to 3" projection from wall, rolled edge, 3 inch wide face trim.
- C. Door: 0.036 inch thick, with pull handle and emergency opening cam lock to secure door.
 - 1. Cam Locks; J. L. Industries; Saf-T-Lok or equivalent.
 - 2. Cam locks to be keyed alike for all cabinets.
- D. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- E. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- F. Finish of Cabinet Interior: White powder-coat.

2.04 BRACKETS AND ACCESSORIES

- A. Extinguisher Bracket: Formed steel, powder-coat paint finish.
 - 1. Color: Red
- B. Graphic Identification: FIRE EXTINGUISHER.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings.
- C. Install cabinets so the centerline of the cabinet handle is not more than 4 feet above the finished floor, and the top of the fire extinguisher is not more than 5 feet above the finished floor.
- D. Install brackets so the top of the fire extinguisher is not more than 4 feet above the finished floor.
- E. Secure cabinets and brackets rigidly in place.
- F. Place extinguishers in cabinets.
- G. All fire extinguishers to arrive at the job site fully charged.
 - 1. Some fire extinguisher manufacturers will not ship Class K fire extinguishers to the job site fully charged. If required, Class K fire extinguishers are to be charged at the job site by a qualified fire extinguishing professional.

3.03 SCHEDULES

- A. FE-1 Fire extinguisher and bracket.
- B. FE-2 Fire extinguisher and cabinet.
- C. FE-3 Fire extinguisher and bracket near range hood in kitchen.

END OF SECTION

SECTION 105050 - METAL LOCKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 9 Section 090050 - Finish Legend

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Metal Lockers:
 - a. New Lockers: Double Tier Lockers (L1)
 - 1) Lockers with Owner-provided locks and sloping top, knocked-down construction
 - b. ADA Single or Double Tier Lockers (L1)
 - 1) Provide ADA compliant lockers with Digilocks.
 - c. New Lockers: Single Tier Lockers (L3)
 - 1) Single tier lockers with Owner-provided locks, and knocked-down construction. Manufacturer's standard colors.
 - d. New Athletic Lockers: Triple Tier (L4)
 - 1) Athletic lockers with built-in combination locks or Owner-provided locks and sloping tops and knocked-down construction. Manufacturer's standard colors.
 - e. New Athletic Lockers (L2) equivalent to Republic's complete "MVP" lockers.
 - 1) Athletic lockers with owner-provided combination locks and knocked-down construction
 - f. Locker Room Benches Not Bolted to Floor
 - g. Locker Room Benches (ADA)
- B. Related Sections include the following:
 - 1. Division 6 Section "Miscellaneous Carpentry" for wood furring and grounds

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Show sloping tops, locker fillers, trim, base and accessories. Include locker-numbering sequence in student and kitchen staff lockers.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.
 - 1. Lockers
 - 2. Locker Room Benches
- E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain locker units and accessories through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.
- B. Protect lockers from damage during delivery, handling, storage, and installation.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following including, but not limited to:
 - 1. Art Metal Products
 - 2. DeBourgh
 - 3. List industries
 - 4. Lyon Metal Products, Inc.
 - 5. Penco Products, Inc.; Subsidiary of Vesper Corporation
 - 6. Republic Storage Systems Co., Inc.
 - 7. Lockers MFG
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Metal Locker Schedule at the end of Part 3.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 366/A 366M, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.
- B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.03 WARDROBE LOCKERS (L1 & L3)

- A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners. Comply with the following:
 - 1. Supply HDC - Heavy-duty Corridor Lockers with 14 gauge doors, 16 gauge top, bottom and shelves and 24 gauge sides and back.
- B. Frames: Form channel frames from minimum 0.0598-inch- (1.50-mm-) thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.
 - 1. Latch Hooks: Form from minimum 0.1046-inch- (2.70-mm-) thick steel; welded or riveted to door frames.
 - 2. Cross Frames: Form intermediate channel cross frames between tiers from minimum 0.0598-inch- (1.50-mm-) thick steel sheet. Weld to vertical frame members.
 - 3. Frame Vents: Fabricate vertical face frames with vents.
- C. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:
 - 1. Reinforcement: Brace or reinforce inner face of doors more than 15 inches (381 mm) wide.
 - 2. Reinforcing and Sound-Dampening Panels: Brace or reinforce inner face of doors with manufacturer's standard reinforcing angles, channels, or stiffener panels.

3. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
 4. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen door surface and reduce sound levels when door is slammed, of die-formed metal with full perimeter flange and sound-dampening material. Spot weld panel to inside of door.
 5. Louvered Vents: Stamped, louvered vents in door face, as follows:
- D. Shelves: Provide hat shelf in single-tier units; fabricated from minimum 16 gauge thick, formed steel sheet; flanged on all edges.
- E. Continuous Hinges: Manufacturer's standard, steel continuous hinge mounted to door and frame.
- F. Recessed Handle and Latch: Manufacturer's standard housing, formed from 0.0359-inch- (0.90-mm-) thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows:
1. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.
 2. Provide single-point gravity or spring-actuated latch with padlock lug.

2.04 ATHLETIC LOCKERS (L4)

- A. Body: Form tops and bottoms from minimum 0.0598-inch- (1.50-mm-) thick steel sheet.
1. Solid Backs: Form from minimum 0.0478-inch- (1.20-mm-) thick, solid steel sheet; flanged for double thickness at back vertical corners.
 2. Perforated Sides and Intermediate Partitions: Form from minimum 0.0598-inch- (1.50-mm-) thick steel sheet, with manufacturer's standard perforations, as follows:
 - a. Perforation Shape: Diamond Perf
- B. Frames: Form welded frames from minimum 0.0598-inch- (1.50-mm-) thick, steel sheet channels or minimum 0.1046-inch- (2.70-mm-) thick steel angles.
1. Latch Hooks: Form from minimum 0.1046-inch- (2.70-mm-) thick steel; welded or riveted to door frames.
 2. Cross Frames: Form intermediate channel cross frames between tiers from minimum 0.0598-inch- (1.50-mm-) thick steel sheet. Weld to vertical frame members.
- C. Perforated Steel Doors: Form doors from one-piece perforated steel sheet with flanged edges, complying with the following:
1. Sheet Thickness: 0.0747 inch (1.90 mm) minimum
 2. Reinforcement: Brace or reinforce inner face of doors more than 15 inches (381 mm) wide.
 3. Perforations: Provide manufacturer's standard perforations, as follows:
 - a. Perforation Shape: Diamond Perf
- D. Shelves: Provide hat shelf in single-tier units, fabricated from minimum 0.0598-inch- (1.50-mm-) thick formed-steel sheet; flanged on all edges.
- E. Continuous Hinges: Manufacturer's standard, steel continuous hinge, side or top mounted to door and frame.
- F. Recessed Handle and Latch: Manufacturer's standard housing, formed from 0.0359-inch- (0.90-mm-) stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows:
1. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.

2.05 ATHLETIC LOCKERS (L2)

- A. Door Frames: Frames shall be 16 gauge steel formed into 1" wide face channel shapes with continuous stiffening members on both sides of the locker opening. Channel-shaped 16 gauge top and bottom cross frame members shall be securely welded to vertical framing members.
- B. Doors: 16 gauge components made of cold rolled steel formed for strength and rigidity with tight joints and perforated with diamond shaped openings 3/4" wide x 1 1/2" high.
- C. Interior Equipment: One full width shelf located 12 3/4" down from the top of the locker and having a 13 3/4" depth. Provide four single-prong clothes hooks, one mounted on each side and two mounted on the lower back. Provide full width coat rod.
- D. Foot Locker: Provide full width foot locker with hinged lid that serves as a seat.
- E. Locked compartments: Provide 16 gauge vertical partition extending from 13 3/4" deep, full width shelf to locker top forming a security box. The door latch shall be a protruding padlock hasp with stainless steel strike plate with integral handle.
- F. Number plates: Provide a polished aluminum number plate with black numbers not less than 1/2" high.

2.06 LOCKS

- A. Fabricate lockers to receive the following locking devices, installed on lockers using security-type fasteners:
 - 1. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key. Comply with the following:
 - a. Bolt Operation: Manually locking dead bolt or automatically locking spring bolt, as standard with manufacturer.
 - 2. Owner Provided Combination Locks:
 - a. Bolt Operation: Manually locking dead bolt or automatically locking spring bolt, as standard with manufacturer.
 - 3. ADA compliant lockers shall receive Digilock range lock, kyless co., or approved equivalent.

2.07 LOCKER ACCESSORIES

- A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
 - 1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks. Attach hooks with at least two fasteners.
- B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
- C. Recess Trim: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet, minimum 2-1/2-inch (64-mm) face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.
- D. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet in an unequal leg angle shape, and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.
- E. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch- (0.60-mm-) thick steel sheet, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers.

- F. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359 - inch- (.90 mm) thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and closures, as follows:
 - 1. Closures: Vertical-end type
 - 2. Sloped top corner fillers, mitered

2.08 FABRICATION

- A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.
- B. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.
- C. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.

2.09 FINISHES, GENERAL

- A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
- B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.
- C. Powder-Coated Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer finish consisting of a thermosetting powder topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1 mil.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine concrete bases for suitable conditions where metal lockers are to be installed. **[Delete if not required]**
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.

- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.
- C. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.
- D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
- E. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed lockers.
- F. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed lockers.

3.03 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous-metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

3.04 METAL LOCKER SCHEDULE

- A. Metal Wardrobe Locker (L1): Where metal lockers of this designation are indicated, provide products complying with the following:
 - 1. Style: Double Tier
 - 2. Material: Cold-rolled steel sheet
 - 3. Back Material Thickness: 24 gauge
 - 4. Side Material Thickness: 24 gauge
 - 5. Door Material Thickness: 14 gauge
 - 6. Locker Arrangement: Double tier, refer to plans for locations and quantities.
 - 7. Backs: Solid
 - 8. Sides: Solid
 - 9. Door Style: Louvered vents
 - 10. Shelves: Solid
 - 11. Hinges: Side mounted continuous
 - 12. Handles/Latches: Recessed
 - 13. Locks: Owner-provided padlock
 - 14. Color: Selected from manufacturer's standards
 - 15. Size: 12" x 12" x 72" H
 - 16. Base: Masonry
 - 17. Provide ADA compliant lockers at all (L1) designations.
- B. Metal Wardrobe Locker (L3): Where metal lockers of this designation are indicated, provide products complying with the following:
 - 1. Style: Single Tier
 - 2. Material: Cold-rolled steel sheet
 - 3. Back Material Thickness: 0.0598 inch (1.50 mm)
 - 4. Side Material Thickness: 0.0598 inch (1.50 mm)
 - 5. Door Material Thickness: 0.0747 inch (1.90 mm)
 - 6. Locker Arrangement: Single, refer to plans for locations and quantities
 - 7. Backs: Solid

8. Sides: Solid
 9. Door Style: Louvered vents
 10. Shelves: Solid
 11. Hinges: Side mounted continuous
 12. Handles/Latches: Recessed
 13. Locks: Owner-provided padlock
 14. Color: As selected by Architect from manufacturer's full range
 15. Size: 12" x 12" x 36" H
 16. Base: Masonry
 17. Provide ADA compliant lockers at all (L3) designations.
- C. Metal Athletic Locker (L4): Where metal lockers of this designation are indicated, provide products complying with the following:
1. Style: Triple Tier. Basis of design is Republic's Single Point II
 2. Material: Cold-rolled steel sheet
 3. Back Material Thickness: 0.0598 inch (1.50 mm)
 4. Side Material Thickness: 0.0598 inch (1.50 mm)
 5. Door Material Thickness: 0.0747 inch (1.90 mm)
 6. Locker Arrangement: Double tier, refer to plans for locations and quantities
 7. Backs: Solid
 8. Sides: Solid
 9. Door Style: Large diamond perforations
 10. Hinges: Side mounted continuous
 11. Handles/Latches: Recessed
 12. Locks: Owner-provided padlock
 13. Accessories:
 - a. Sloping tops: Continuous
 - b. Recess trim: Required
 - c. End panels: Finished
 14. Color: As selected by Architect from manufacturer's full range
 15. Size: 12" x 12" x 24" H
 16. Base: Masonry
- D. Metal Athletic Locker (L2): Where metal lockers of this designation are indicated, provide products complying with the following:
1. Style: Basis of design is Republic's MVP (complete).
 2. Material: Cold-rolled steel sheet
 3. Back Material Thickness: 18GA
 4. Side Material Thickness: 16GA
 5. Locker Arrangement: Refer to plans for locations and quantities.
 6. Backs: Solid
 7. Sides: Perforated
 8. Base: Masonry
 9. Hinges: Heavy-duty hinge
 10. Locks: Owner-provided padlock
 11. Accessories:
 - a. Recess Trim: Required
 - b. End Panels: Perforated
 - c. Corner Enclosure Panels: Provide corner enclosure panels on top of lockers where lockers are on perpendicular walls.
 12. Color: As selected by Architect from manufacturer's full range
 13. Size: 24" x 24" x 72" H
 14. Top" Sloping

3.05 LOCKER ROOM BENCHES

- A. 1-1/4 diameter tubing with 10 gauge steel flanges welded to each end. Bench shall have 9-1/2" w x 1 1/4" full finished thickness laminated maple.
- B. ADA compliant locker room benches with wall-mounted bracket equal to global industrial.
 - 1. Size: 24" deep x 48" wide with minimum of two brackets

END OF SECTION

SECTION 105723 - CLOSET AND UTILITY SHELVING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall mounted wire closet shelving.
- B. Laminated shelves associated with wire shelving.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking in walls for attachment of shelving.
- B. Section 092116 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.
- C. Division 9 Section 090050 Finish Legend

1.03 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, with installation instructions.
- C. Shop Drawings: Provide drawings prepared specifically for this project; show dimensions of shelving and attachment to substrates.
- D. Selection Samples: For each color selection required, submit color chips representing manufacturer's full range of available colors and finish.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.
- C. Store flat to prevent warpage and bending.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Wire Storage Shelving:
 - 1. ClosetMaid Corporation : www.closetmaid.com/#sle.
 - 2. RubberMaid Closet and Organization Products : www.rubbermaidcloset.com/#sle.
 - 3. _____.
 - 4. _____.
 - 5. _____.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.02 SHELVING APPLICATIONS

- A. Shelf Depth: 12 inches, unless otherwise indicated.

- B. Master Bedroom Closets:
 - 1. Not less than 24 feet of shelving equipped with free sliding hanger rod; up to 12 feet may be arranged double height.
 - 2. Not less than 12 feet of shoe shelf.
- C. Other Bedroom Closets:
 - 1. Wall-to-wall shelf with free sliding hanger rod.
 - 2. Not less than 4 feet of shoe shelf.
- D. Coat Closets:
 - 1. Wall-to-wall shelf with integral hanger rod.
- E. Linen Closets:
 - 1. Wall-to-wall shelves spaced at 13 inch vertically, not less than 16 inch deep.
- F. Storage Closets:
 - 1. Wall-to-wall storage shelves, close-mesh cross wire spacing, stacked at 13 inch vertically, not less than 12 inch deep.

2.03 MATERIALS

- A. Wire Shelving: Factory-assembled coated wire mesh shelf assemblies for wall-mounting, with all components and connections required to produce a rigid structure that is free of buckling and warping.
 - 1. Construction: Cold-drawn steel wire with average tensile strength of 100,000 psi resistance welded into uniform mesh units, square, rigid, flat, and free of dents or other distortions, with wires trimmed smooth.
 - 2. Coating: PVC or epoxy, applied after fabrication, covering all surfaces.
 - 3. PVC Coating: 9 to 11 mils thick.
 - 4. Epoxy Coating: Non-toxic epoxy-polyester powder coating baked-on finish, 3 to 5 mils thick.
 - 5. Standard Mesh Shelves: Cross deck wires spaced at 1 inch.
 - 6. Close-Mesh Shelves: Cross deck wires spaced at 1/2 inch.
 - 7. Shelf and Rod Units: Integral hanging rod at front edge of shelf.
 - 8. Free-Sliding Hanging Rod: Integral hanging rod that permits uninterrupted sliding of hangers the full width of the shelf.
- B. Laminated Shelves: Particleboard with thermal-fused melamine surface on top and bottom.
 - 1. Edge Finish: Hot-melt PVC edge banding, matching color.
 - 2. Substrate Thickness: 3/4 inch, nominal.
 - 3. Laminate: NEMA LD 3 Type HGL.
 - 4. Color: White.
 - 5. Color: As selected by Architect from shelving manufacturer's full line.
- C. Hanging Rod: Tubular steel, 1 inch diameter, with end caps on open ends.
 - 1. Finish: Epoxy powder coat.
 - 2. Wall Thickness: 20 gage, 0.035 inch.
 - 3. Provide corner hanging rods and hanging rod connectors where required.
- D. Wall-Mounted Standards: Vertically slotted channel standards with double-tab cantilever brackets to suit shelving; factory finished to match shelving.
- E. Mounting Hardware: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.
- F. Fasteners: As recommended by manufacturer for mounting substrates.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Inspect areas to receive shelving, to verify that spaces are properly prepared to receive shelf units, and are of dimensions indicated on shop drawings.
- B. Verify appropriate fastening hardware.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, with shelf surfaces level.
- B. Cap exposed ends of cut wires.
- C. Install back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.
- D. Mounting Heights:
 - 1. Single Hanging Rod Units: Install shelf at 68 inches above floor.
 - 2. Double Hanging Rod Units: Install shelves at 42 inches and 84 inches above floor.
 - 3. Other Shelves: See drawings.

3.04 CLEANING

- A. Clean soiled surfaces after installation.

3.05 PROTECTION

- A. Protect installed work from damage.
- B. Touch-up, repair, or replace damaged products before Substantial Completion in a manner that eliminates evidence of replacement.

END OF SECTION

SECTION 107300 - ALUMINUM CANOPY**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Wall supported manufactured aluminum canopy.
 - 1. Downspouts will be connected to the storm drainage system.
- B. Column supported manufactured aluminum canopy.
 - 1. Column/downspouts will be connected to the storm drainage system.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-In-Place Concrete
- B. Section 042000 - Unit Masonry
- C. Section 079000 - Joint Sealants

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum.
- B. AAMA 2604 - Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- C. AAMA 2605 - Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- D. ASTM B 209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B 221 - Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles and Tubes.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Wall supported canopy, canopy attachment to wall, metal deck, beams, and fascia.
 - 2. Column supported canopy, columns, column embedment, metal deck, beams and fascia.
- B. Shop Drawings: Detail fabrication and installation of all formed metal fabrications. Include dimensioned plans, elevations, sections, and details of components and their connections. Show anchorage and accessory items.
 - 1. Show downspout attachment to storm drainage system.
 - 2. Show column/downspout foundation attachment.
 - 3. Manufacturer to field verify project conditions for wall bracket attachments to ensure proper attachment is indicated in the shop drawings.
- C. Field Measurements: Where formed metal canopies are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Design Data: Submit design calculations bearing the seal of a Registered Professional Engineer, licensed in Kentucky. Design calculations shall state that the canopy system design complies with the wind uplift requirements of ASCE 7, the stability criteria of the 2015 IBC with Kentucky Amendments, and all other governing criteria.
- E. Selection Samples: Submit color chips representing manufacturer's full range of available colors and patterns. Submit actual samples not photo reproductions.

1.05 KENTUCKY DEPARTMENT OF HOUSING, BUILDINGS AND CONSTRUCTION (HBC) SUBMITTALS

- A. In addition to the shop drawings submitted to the Architect for review the pre-engineered metal canopy manufacturer shall also submit shop drawings to the pre-engineered canopy installer for shop drawings submittal to HBC for approval as a requirement of the building permit.
- B. Shop Drawings: Each sheet shall be identified with the project name and bear the seal and signature of a Kentucky licensed design professional. Section 107.1 2015 IBC with KY Amendments, current edition.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of canopy system, as specified, with minimum ten years of documented experience.
- B. Installer Qualifications: Canopies to be installed by the manufacturer. Third party installation is not acceptable, unless installer is certified through the manufacturer, or installs manufacturers canopies exclusively.
- C. Source Limitations: Obtain canopies through one source from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver formed metal canopies wrapped in protective coverings and strapped together in suitable packs or in heavy duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

1.08 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, gloss reduction, chalking, or flaking.
 - 1. Provide if manufacturers standard finish is anodized or powder-coated.
- C. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
 - 1. Provide if manufacturers standard finish is painted.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
- B. Basis of Design: design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. Superior Mason Products, LLC.
- C. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1. Architectural Fabrication, Inc.: www.arch-fab.com
 - 2. Childers Carports and Structures: www.childersonline.com
 - 3. Mapes Industries: www.mapes.com
 - 4. MASA Corporation: www.architecturalcanopies.com
 - 5. Mitchell Metals, LLC: www.mitchellmetals.net

6. Peachtree Protective Covers: www.peachtreecovers.com
7. Superior Mason Products, LLC: www.superiormetalproducts.com
8. Tennessee Valley Metals: www.tvmetals.com
9. Rusco Custom Canopies: www.ruscocanopies.com

2.02 MATERIALS

- A. General: Provide materials without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Members: Extruded aluminum, ASTM B 221, 6063 alloy, T6 temper.
- C. Deck Panels: Extruded .062 inch aluminum flush deck
 1. Panel Profile: Flat
 - a. Deck must be continuously flat across the entire canopy. Deck profile or deck attachment to not create any open spaces to allow bird nesting/roosting.
- D. Intermediate Gutters/Drain Beam: Extruded .125 inch aluminum with one end closed at the factory and be provided with top cap that is removable for cleaning.
 1. Intermediate Gutter Size: Manufacturers standard size or nominal, 0.188 inch thick, 3 inch wide x 6 inch deep.
- E. Fascia/Gutter: Full perimeter extruded .094 inch aluminum fascia/gutter.
 1. Fascia Size: Manufacturers standard size or nominal, 0.070 inch thick, 3 inch wide x 7 inch deep to interlock with decking and gutters.
- F. Downspouts that are not a supporting column: Fully welded, extruded aluminum tubing, minimum wall thickness of 0.125 inch. Minimum size 3 inch by 3 inch or size as indicated on the drawings.
- G. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 1. Provide concealed fasteners for interconnecting formed metal fabrications and for attaching them to other work, unless otherwise indicated.
 2. Fasteners to be provided in same finish and color as canopy components.
- H. Structural Anchors and Rods: All ferrous fasteners and hanging accessories shall be heavily galvanized or cadmium plated and finished in same finish and color as other canopy components.
- I. Columns: Extruded aluminum tubing, with radiused corners, to be ASTM A500 Grade B with a minimum yield stress of 46,000 ksi.
 1. Column Size: Manufacturer to provide standard size nominal 6 inch x 6 inch at 0.188 inch thick.
 2. Provide clear acrylic or bituminous paint protection between the aluminum column and the concrete footer.
 3. Tombstone shaped water outlet holes are to be cut at the bottom of all draining columns with deflector plates installed inside, unless underground drainage is indicated. Circular drain holes are not allowed.
- J. Column Base Plates: ASTM A 36 - 1 inch structural steel plate with a minimum yield stress of 36,000 ksi. Plate to be minimum 3/4 inch A572 Grade 50 thick with welded gussets. Shop fabricate with pre-punched or pre-drilled bolt holes.
- K. Column Anchor Bolts: ASTM A 572 or A 490 Grade 50 threaded round stock with a minimum yield stress of 50,000 psi. Provide double nuts and washers for leveling.
- L. Column Top Plates: ASTM A 36 structural steel plate with a minimum yield stress of 36,000 ksi. Plate to be a minimum 3/4 inch thick with welded gussets. Shop fabricate with pre-punched or pre-drilled bolt holes.

- M. Flashing: Flashing shall be made of aluminum sheet in same finish and color as the other canopy components. Minimum flashing thickness to be 0.040 inch thick. Coordinate installation of flashing with masonry and/or roofing subcontractor to integrate flashing into throughwall flashing and reglets.
- N. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.03 ACCESSORIES

- A. Wire Ball Downspout Strainer: Install wire ball downspout strainer at each downspout location.

2.04 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble formed metal canopies in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of formed metal canopies with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.
- C. Welding: In accordance with ANSI/AWS D1.2.
- D. Bent Construction: Factory weld beams to columns with neatly mitered corners to form one piece rigid bents. Make welds smooth and uniform using an inert gas shielded arc. perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjacent structure to allow for flush connection. Field welding is not permitted.
- E. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. fasten interlocking joints at on center spacing creating a monolithic structural unit capable of developing the full strength of the sections. Fastening to have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.
- F. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2 inch (12 mm) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.
- G. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed metal units as needed to attach and support other construction.
- H. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install formed metal fabrications.

2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.

2.06 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
- C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- D. Canopy finishes: Due to differences in canopy manufacturer finishing standards provisions for clear and/or color anodized, painted and powder coated material is included. All finishes are acceptable and manufacturers are to provide their standard of ONE listed below.
 - 1. High-Performance Organic Finish (2-coat Fluoropolymer): AA-C12C40R1X (Chemical Finish): cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Finish to be Pearledize/Mica, consisting of 0.2 mil primer with 0.8 mil color coat containing mica pearlescent flakes to simulate the appearance of an anodized/metallic finish.
 - b. Color to be selected from manufacturers standard color chart. Minimum twenty colors.
 - 1) Color simulating clear anodized aluminum to be available in color choices.
 - c. All canopy components to be painted; fascia, deck, columns, wall hangers, accessories, and drain beam.
 - d. Extruded deck to be painted the same color on the topside and underside.
 - 2. Powder Coated Finish: AAMA 2604 thermosetting resin of, 1.20 mils minimum, modified polyesters electrostatically applied to the aluminum profile. Profile to be baked in an oven where the powder particles are melted to a liquid state, fusing together to form a homogenous film.
 - a. Color to be selected from manufacturers standard color chart. Minimum sixteen colors.
 - 1) Color simulating clear anodized aluminum to be available in color choices.
 - b. All canopy components to be painted; fascia, deck, columns, wall hangers, accessories, and drain beam.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate and place formed metal fabrications level, plumb, and in alignment with adjacent construction.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Coat concealed surfaces of aluminum, zinc coated, and nonferrous metals that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- E. Entire unit shall be erected straight and true.

- F. Hanger rods shall be anchored using through bolt type anchors to support dead and live loads, as recommended by the manufacturer.

3.02 ADJUSTING

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.03 PROTECTION

- A. Protect finishes of formed metal canopies from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 107300

SECTION 107500 - FLAGPOLES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

- A. Section 033000: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2014.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.
- E. Flagpole With Flag Flying: Resistant without permanent deformation to 115 wind velocity; nonsafety design factor of 2.5.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Flagpoles:
 1. American Flagpole; ____: www.americanflagpole.com/#sle.
 2. Concord Industries, Inc; ____: www.concordindustries.com/#sle.
 3. Eder Flag Manufacturing Co., Inc. & Baartol Company: www.ederflag.com
 4. Morgan-Francis Flagpoles & Accessories; ____: www.morgan-francis.com
 5. Poletech; [____]: www.poletech.com
 6. Substitutions: See Section 016000 - Product Requirements.

2.02 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001.
 1. Material: Aluminum.

2. Design: Straight shaft.
 3. Mounting: Ground mounted type.
 4. Nominal Wall Thickness: Sized for length and diameter of poles indicated.
 5. Nominal Height: 50 foot; measured from nominal ground elevation.
 6. Mounting: Ground mounted type.
 7. Halyard: Interior type .
- B. Performance Requirements:
1. Flagpole With Flag Flying: Resistant without permanent deformation to 95 miles/hr wind velocity; non-resonant, safety design factor of 2.5.

2.03 POLE MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

2.04 ACCESSORIES

- A. Finial Ball: Stainless steel, 6 inch diameter.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Base Collar: Spun Aluminum.
- D. Flag: American design, (10' x 15' for 50' pole), polyester fabric, brass grommets, hemmed edges.
- E. Cleats: 9 inch size, aluminum with galvanized steel fastenings, two per halyard.
- F. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.
- G. Halyard: 3/8 inch diameter stainless steel aircraft cable.

2.05 OPERATORS

- A. Winch: Stainless steel direct drive internal winch with removable hand crank and cast bronze internal brakes, lockable in any position. Size to fit pole diameter and winch opening.

2.06 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36M, corrugated 16 gage steel, galvanized, depth of as required for length of pole above grade., .

2.07 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Concealed Steel Surfaces: Prime painted.
- C. Aluminum: Mill finish.
- D. Finial: Spun finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

- A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- B. Electrically ground flagpole installation.
- C. Fill foundation tube sleeve with concrete specified in Section 033000.
- D. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

3.06 SCHEDULES

END OF SECTION

SECTION 110500 - LIBRARY EQUIPMENT**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this Section.

1.02 SECTION INCLUDES

- A. Extent of library equipment is indicated on drawings.
- B. Types of library equipment required herein include:
 - 1. Adjustable bookshelf units.
 - 2. Library furnishings (tables, chairs, lounge and seating).
 - 3. Circulation Desk.
- C. Installation is included as part of this section.

1.03 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of library equipment.
- B. Samples: Submit 6" x 6" samples of each exposed finish required.
- C. Shop Drawings: Submit shop drawings for each type of library equipment, showing details, dimensions, and layout of installation.

1.06 RECYCLED CONTENT

- A. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

- B. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
- C. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
- D. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

1.07 LOCAL/REGIONAL MATERIALS

- A. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
- B. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
- C. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
- D. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

1.08 VOC DATA

- A. Adhesives:
 - 1. Submit manufacturer's product data for adhesives used on site. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
 - 2. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this section.

1.09 QUALITY ASSURANCE

- A. Manufacturer: Provide each type of library equipment by one manufacturer for entire project.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. [_____]

1.11 PROJECT CONDITIONS

- A. Deliver units only after wet operations in building are completed.
- B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene.

1.12 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.13 WARRANTY

- A. Submit 1-year warranty signed by Manufacturer, Installer, and Contractor, agreeing [_____]

PART 2 PRODUCTS

2.01 GENERAL

- A. Brodart products are specified hereunder only to illustrate the quality required and not to exclude other, equivalent manufacturers.

- B. Approved equivalent Manufacturers: Manufacturers other than those listed below must be approved by written addendum. Materials from non-approved manufacturers will not be accepted. Requests for approval must be made in writing to the Designer/Architect no less than ten (10) days prior to the bid date.

2.02 ACCEPTABLE MANUFACTURERS

- A. Library Equipment: Subject to compliance with the requirements, provide library equipment by one of the following:
1. Brodart Company: Epoch series with maple species wood and specified features.
 2. Worden Company: Product to be modified to meet specifications.

2.03 MATERIALS

- A. Lumber: All woods used in the construction of this equipment shall be selected from thoroughly air seasoned stock, free from imperfections and kiln dried to have a moisture content at time of assembly, of from 5% to 7%. All exposed solid woods shall be select Northern Grown Hard Maple. Woods used in the unexposed parts shall be suitable hardwoods, sound throughout, but unselective as to color.
- B. Wood Species: All exposed or show wood shall be selected Northern Hard Maple, free from all defects and selected for uniform grain and color. All unexposed wood shall be sound hardwoods.
- C. Plywood: Plywood shall be constructed with an odd number of plies to resist warping. All inner plies shall be sound and cross-banded. Face veneers shall be selected for uniformity of grain and color on one or both sides as required.
- D. Lumber Core: Lumber core shall be 5 ply of the best grade with tight glue joints and controlled strip width to minimize warping.
- E. High Pressure Laminate: (Work or Top Surfaces) shall be .050 thick and used with an appropriate backing sheet not to be less than .020 thickness. Plastic laminate to be of maximum hardness being resistant to scratches, marring, fading, straining, etc., and shall comply with performance standards set by the National Electrical Manufacturers Association (NEMA LDA 1980). Vertical surfaces shall be .028" thick laminate.
- F. Hardware: Material to be aluminum or steel, finish as selected by Designer/Architect from manufacturer's full range. Glides, drawer pulls, label holders, rods, ferrules, bolts, screws, hinges, locks, drawer slides, etc., shall be furnished as required.
- G. Framing: Shall be of solid hardwood, kiln dried to above specifications and selected for clearness and quality. Stock shall be a minimum of 3/4" in thickness.
- H. Joinery: All joints shall be securely glued, pinned and/or screwed together.
- I. Desk Drawers: Drawers shall operate on mechanical side mounted guides having ball bearing rollers. Drawer sides are 7/16" thick solid oak, bottoms are 1/4" maple as specified.
- J. Wood Finishing Operations:
1. Procedure:
 - a. Prior to the finishing operation all furniture shall be hand sanded, cleaned, and inspected for imperfections. The furniture shall be treated with a pre-stain conditioner to promote surface penetration of special-formulated stains designed for maximum penetration and adhesion. Selected stain shall be applied on all visible surfaces in a uniform manner and allowed to dry.
 - b. Catalyzed conversion sealer shall then be applied, allowed to dry, and is then sanded. Furniture is inspected for imperfections prior to application of top coat. A top coat of catalyzed conversion varnish shall then be applied.
 2. ANSI: American National Standard Institute.
 3. ASTM: American Society of Testing Materials.

4. C.D.G.: Coating Development Group, Inc.
 5. NEMA: National Electrical Manufacturers Association.
- K. UL Listed: Brodart furniture is listed under UL standard QAWZ for office furnishings and has earned a UL listed label. Included in this listing are tables, access furniture, carrels and circulation desks, as well as the power-entry and power-distribution assemblies that are required to electrify them. UL listed furniture has been tested by Underwriters Laboratories and found to be in compliance with applicable UL Standards for Safety. UL has examined the materials and construction methods and has conducted flammability and stability tests to reach this determination.

2.04 FABRICATION

- A. Shelving: Shelving construction shall be modular type and shelving units shall be designed with the starter and adder concept and shall measure 36" +/- from center to center of the uprights.
1. End Panels: Oak end panels shall be 9-ply, plywood. All exposed vertical edges and 42", 48", and 60 1/2" high top edges shall be banded with matching solid hardwood. Edges will be square, but eased. Vertical rows of holes will be drilled near the front and the rear of each panel for shelf adjustment on 32 mm centers. Panels will be drilled at front and rear, top and bottom for embedding internally and externally threaded bushings. Tops and bases will be attached to end panels with 5/16" - 18 x 6" hex-head bolts, nuts and washers.
 2. Intermediate Uprights: Intermediate uprights shall be 3/4" thick,
 3. Cornice Tops: Cornice tops shall have 3/4" 3-ply particle board of specified depth with wood veneer on all exposed surfaces. Provide continuous plastic laminate top surface on 42" high units as specified below:
 - a. Tops: Tops shall be 1-1/4" thick three-ply particle board, including plastic laminate top surface and backing sheet. Top shall be wood edged on all exposed sides and shall receive an edge treatment to match the table edge of the series ordered. Tops will be continuous over as many units as possible. Tops shall be joined with tight joint fasteners and splines.
 4. Base: The base front shall be 5-ply lumber core hardwood finish to match. Bases shall be made so that the base shelf rests on the bolting cleats and sets behind and flush with the top of the base front.
 5. Shelves: Shelves shall be 3/4" thick solid glued-up oak and/or maple hardwood. Random widths no more than 4" or less than 1" shall be used. The 2" wide nosing strip shall be select oak to match case construction. The shelves shall be grooved the length of the shelf and fit over the shelf pins to prevent accidental removal.
 6. Attachment: Furnish and install concealed anchors and other accessories as recommended by the manufacturer and as may be required for complete, secure installation.
- B. Display Furniture:
1. Accent Strip: A solid hardwood accent strip shall be fitted between the legs. Bottom edge and ends shall be radiused.
 2. Legs: Legs shall be glued-up solid hardwood with radiused vertical edges. Each leg shall be equipped with an adjustable glide. Legs shall attach to aprons by means of a steel corner bracket and hanger bolts.
 3. Dictionary Stand: Dictionary stand shall have sloped top, 1-1/4" thick with a .050" high pressure plastic laminate face. The front edge has an extruded black aluminum retaining strip & the back is self-edged. The back panel is 3/4" thick, 3-ply particle board construction with select grade "A" oak veneers on both faces. The bottom edge is banded with 1/8" solid oak. Provide one adjustable shelf, 3/4" thick, with oak veneer face and 1/8" oak edge band.
- C. Tables:
1. Table Tops: Standard table tops shall be 1-1/4" thick, particle board core wrapped in HPL backer sheet, including a plastic laminate top surface and backing sheet. Edges shall be external banded solid hardwood in beveled or semi-bullnose design.
 2. Legs: Legs shall be glued up solid hardwood with radiused vertical edges. Each leg shall have an adjustable glide mounted in a recessed tee-nut. Legs shall attach to table tops by

means of a square steel plate. The plate shall be attached to the leg by two 5/16" x 2-1/2" machine bolt engaging a barrel nut inserted into the leg. The steel plate shall be attached to the table top by 5/16" x 1" machine bolts engaging threaded bronze bushings in the underside of the table top.

3. Table Top Support: Rectangular tables 60" or more long shall receive a vee-shaped steel keel (14 ga. minimum) securely fastened to the underside of the table top. Tables 48" wide and more than 60" long shall receive two steel keels parallel to the length of the table.

2.05 FABRICATED PRODUCTS

PART 3 EXECUTION

3.01 INSTALLATION

- A. Bookstack Units:
 1. Install units at locations shown, in continuous ranges made up of number of units shown, complying with manufacturer's instructions. Set units plumb and level, using adjustable leveling devices.
 2. Anchor single-faced ranges to wall construction, using manufacturer's recommended method.
 3. Install end panels and tops with concealed fasteners.
 4. Install shelves at equal spacing in each unit.
 5. Install accessory items and filler in locations indicated or as required, complying with manufacturer's instructions. Provide fillers at all tops of shelves and at all voids and gaps.
 6. Where shelving units meet at a 90 degree corner, the shelving tops shall be filled to eliminate openings. Filler strips are required at the end of all shelving units and inside corners.
- B. Installation of Tops:
 1. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surface.
 2. Fastenings: Use concealed clamping devices for field joints. Tighten in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints. Secure tops to cabinets with "Z"-type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.
 3. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices. At stone-type material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths not more than 1/16" wide at any location, completely filled and flush with abutting edges.
 - a. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8" and plug hold flush with material equal in chemical resistance, color, hardness, and texture to top surface.
 - b. After installation carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.
 - c. Provide holes and cutouts as required for mechanical and electrical service fixtures.
 - d. Provide scribe moldings for closures at junctures of top with walls as recommended by manufacturer for materials involved. Use chemical resistant, permanently elastic sealing compound where recommended by manufacturer.

3.02 ADJUST AND CLEAN

- A. Verify that moving parts are operating freely. Clean exposed surfaces and touch-up marred finishes or replace components as necessary to eliminate evidence of damage or deterioration.

END OF SECTION

SECTION 110510 - LIBRARY FURNITURE**PART 1- GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this Section.

1.02 SUMMARY

- A. Extent of library furniture is indicated on drawings.
- B. Types of library furniture required herein include:
 - 1. Library furnishings (tables, chairs, lounge and seating).
- C. Installation is included as part of this section.
- D. Library furniture is a part of the Base Bid.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for each type of library equipment.
- B. Samples: Submit 6"x 6" samples of each exposed finish required.
- C. Shop Drawings: Submit shop drawings for each type of library furniture piece, showing details, dimensions, and layout of installation.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Provide each type of library equipment by one manufacturer for entire project.

1.05 PRODUCT HANDLING

- A. Deliver furniture only after wet operations in building are completed.
- B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene.

PART 2- PRODUCTS**2.01 GENERAL**

- A. Steel case products are specified hereunder only to illustrate the quality required and not to exclude other, equivalent manufacturers.
- B. Approved Equivalent Manufacturers: Manufacturers other than those listed below must be approved via written addendum. Materials from non-approved manufacturers will not be accepted. Requests for approval must be made in writing to the Designer/ Architect no less than (10) days prior to the bid date.

2.02 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturer's: Products by other manufacturer's (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - 1.

2.03 FURNITURE PRODUCTS

PART 3 - EXECUTION

3.01 ADJUST AND CLEAN

- A. Verify that moving parts are operating freely. Clean exposed surfaces and touch-up marred finishes or replace components as necessary to eliminate evidence of damage or deterioration.

END OF SECTION

SECTION 110620 - BACKGROUND CURTAIN**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. The provisions of the General Conditions, Supplementary Conditions and the Sections included under Division 1, General Requirements, are included as a part of this Section as though bound herein.

1.02 DESCRIPTION OF WORK

- A. Provide all labor, materials and equipment necessary for the complete installation of the production room background curtain indicated on the Drawings and as specified herein.
 - 1. Traversing back drop curtain in Second Level, Media Classroom. Refer to Item PP on the Equipment Legend.
- B. Work under this Section includes, but is not limited to, the following components:
 - 1. Background Curtain (Traversing).
 - 2. Curtain tracks (Contract).

1.03 RELATED REQUIREMENTS

- A. Section 01300 - Administrative Requirements - Submittal procedures.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.05 SUBMITTALS

- A. Shop drawings shall indicate dimensioned layouts, plans and sections showing assembly and the installation of components.
- B. Individual components shall be detailed as required to illustrate materials, thickness, sizes and methods of assembly or attachment to adjoining components.
- C. Maintenance Data: Submit instructions and precautions for cleaning and maintenance, operating hardware.
- D. Selection Samples:
 - 1. Fabric: Submit two (2) sets of samples, representing manufacturer's standard range of options for fabric.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Engaged in manufacturing of products of similar type to that specified, with a minimum of 10 years successful experience.
- B. Installer Qualifications: Minimum two (2) years successful experience installing similar products.
- C. All equipment and installation shall be the responsibility of a single installer/manufacture.
- D. Workmanship: All workmanship and finish must be first-class in every particular and strictly in accordance with the best practice. All work shall be made in accordance with the approved shop drawings. All work made in sections shall be properly laid out and spaced between terminals.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site protected from damage.
- B. Storage: Store materials in clean, dry area indoors in manufacturer's unopened packaging until ready for installation and in accordance with manufacturer's instructions. Store in a clean, dry area, laid flat to prevent sagging and twisting of packaging.

1.08 PROJECT CONDITIONS

- A. This Contractor shall take all measurements he may require at the building. He shall consult with the various other Contractors whose work adjoins his work and he shall be responsible for the proper coordination of all details.
- B. This Contractor shall do all drilling and fitting and work of similar character required in the fitting and setting of the materials in place, and he shall do all cutting and fitting required in connection with the fitting of his materials to the adjoining work of other Contractors.
- C. He shall provide all connecting members needed for properly supporting and securing this work to the masonry, joints, walls, structural members, or other parts of the building as may be best suited for each case.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.10 WARRANTY

- A. Warranty:
 - 1. Provide limited lifetime warranty on all Bali®, Graber®, and SWFcontract™ products sold by SWF or by an authorized dealer, other than the products listed below, which have the limited warranty periods as indicated.
 - 2. Drapery hardware: Three years.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Acceptable manufacturers/installers:
 - 1. Best Blind & Shade.
 - 2. Beck Studios Inc., Milford, Ohio.
 - 3. Tiffin Scenic Studio, Tiffin, Ohio.
 - 4. Pelfrey & Associates, Lexington Kentucky.
 - 5. Secoa Inc., Champlin, MN.
 - 6. Dixie Lite-Trol Co.
 - 7. Spindletop Draperies, Inc.
 - 8. Or approved equivalent.

2.02 DRAPERY HARDWARE

- A. Drapery Hardware: Contrack Graber Drapery Hardware Track Systems as manufactured by SWFcontract.
 - 1. Track Systems: Series 9-8191.
 - a. Control Type: Baton.
 - b. Pleat Style: Pinch.

2.03 BACKGROUND CURTAINS

- A. Flame Retardant Requirements: All fabrics shall be completely immersed, squeezed under pressure and dried in a tenter frame. The fabric shall be processed in conformance with the laws of the State of California, NFPA 701 Small and Large Scale, Boston Fire Department, New York Port Authority, and Commonwealth of Massachusetts. Spray method of flame retardant treatment will not be considered equivalent. Any material indicating the surface precipitation inherent with this procedure will not be accepted and will be replaced at the Contractor's expense with the proper material as specified.
- B. All curtains are to have sewed-in pleats to 50 percent fullness reinforced as required. All salvage edges are to be turned under. Webbing is to be sewed to the curtain with three continuous runs of stitching. All curtains are to have 5 inch bottom hems.
- C. Fabrics:
 - 1. Where flame retardant velour is specified it shall be Plateau Velour.
 - a. Fibert Content: 100% FR Polyester, inherently flame retardant.
 - b. Width: 54".
 - c. Weight: 13 oz.
 - d. Or approved equivalent.

2.04 CURTAIN SIZES

- A. Size: 12' Wide x 9'-8" High.
- B. All dimensions are provided for bidding purposes only and must be field verified.

2.05 EXECUTION

- A. Fabricate and install items in conformity with all applicable trade practices and manufacturer's recommendations, unless specifically excepted by specifications or drawings.
- B. Carry out shop welding in full conformity with applicable AISC and ASA standards.
- C. Comply with local codes. In absence of local codes, comply with AISC, NEC, and ASA standards as applicable.

2.06 INSTALLATION

- A. Consult and coordinate work with trades doing adjoining work.
- B. Do all cutting and drilling necessary to properly install work.
- C. Position items accurately as indicated on drawings and true to plumb line and level.
- D. Curtains are to be installed on their proper tracks and battens and trimmed to the floor in the best manner known to the profession.
- E. Provide completed installation, ready for satisfactory operation, prior to tests and inspection. Advise the Architects in writing that the installation is completed and ready for acceptance tests and inspection.

END OF SECTION

SECTION 110625 - STAGE EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions and the Sections included under Division 1, General Requirements, are included as a part of this Section as though bound herein.

1.02 DESCRIPTION OF WORK

- A. Provide all labor, materials and equipment necessary for the complete installation of the platform equipment indicated on the Drawings and as specified herein.
 - 1. Valance, Front Curtain, borders, legs, rear and cyclorama curtain. **[Edit per project requirements]**
- B. Work under this Section includes, but is not limited to, the following components:
 - 1. Curtain tracks, carriers and hangers.
 - 2. Fabricated stage curtains.
 - 3. Pipe battens and all required miscellaneous hangers, chain, fittings and hardware for a complete installation.
 - 4. Valance to receive "000" letters, centered on curtain. **[Verify with Owner]**

1.03 SECTION INCLUDES

- A. [_____].

1.04 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.
- B. Section 013510 - LEED Green Building Summary, Requirements and Goals.

1.05 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.06 SUBMITTALS

- A. Shop drawings shall indicate dimensioned layouts, plans and sections showing assembly and the installation of components.

- B. Individual components shall be detailed as required to illustrate materials, thickness, sizes and methods of assembly or attachment to adjoining components.

1.07 RECYCLED CONTENT

- A. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
- B. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
- C. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
- D. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

1.08 LOCAL/REGIONAL MATERIALS

- A. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
- B. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
- C. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
- D. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

1.09 VOC DATA

- A. Adhesives:
 - 1. Submit manufacturer's product data for adhesives used on site. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
 - 2. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this section.

1.10 QUALITY ASSURANCE

- A. All equipment and installation shall be the responsibility of a single rigging installer/manufacture who shall be certified by the Entertainment Technical Certified Program (ETCP).
- B. Workmanship: All workmanship and finish must be first-class in every particular and strictly in accordance with the best practice. All work shall be made in accordance with the approved shop drawings. All work made in sections shall be properly laid out and spaced between terminals.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Protect wood flooring from excessive moisture in shipment, storage, and handling. Deliver in unopened cartons or bundles and store in a dry place, with adequate air circulation. Do not deliver material to building until "wet work" such as concrete and plaster have been completed and cured to a condition of equilibrium.

1.12 PROJECT CONDITIONS

- A. This Contractor shall take all measurements he may require at the building. He shall consult with the various other Contractors whose work adjoins his work and he shall be responsible for the proper coordination of all details.

- B. This Contractor shall do all drilling and fitting and work of similar character required in the fitting and setting of the materials in place, and he shall do all cutting and fitting required in connection with the fitting of his materials to the adjoining work of other Contractors.
- C. He shall provide all connecting members needed for properly supporting and securing this work to the masonry, joints, walls, structural members, or other parts of the building as may be best suited for each case.

1.13 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.14 WARRANTY

- A. Submit 1-year warranty signed by Manufacturer, Installer, and Contractor, agreeing to repair or replace wood flooring which shrinks, warps, cracks, or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials and/or workmanship and not due to unusual exposure to moisture or other abusive forces or elements not anticipated for application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers/installers:
 1. Peter Albrecht Corp., Milwaukee, WI
 2. Beck Studios Inc., Milford, Ohio
 3. Hoffend & Sons Inc., Honeoye, NY
 4. I. Weiss & Sons, Long Island, NY
 5. Tiffin Scenic Studio, Tiffin, Ohio NY
 6. Pelfrey & Associates, Lexington Kentucky NY
 7. Secoa Inc., Champlin, MN
 8. Dixie Lite-Trol Co.
 9. Janson Industries
 10. Spindletop Draperies
 11. Best Blind & Shade Co.

2.02 STAGE CURTAIN TRACKS

- A. Front Curtain Track
 1. Provide Model 280 Tracks as manufactured Automatic Devices Company, Allentown, PA.
 - a. Other Acceptable Track Manufacturers: Pook, Diemont & Ohl, Bronx, NY or Tiffin Scenic Studios, Tiffin, Ohio.
 2. Track: Shall be of 14 gauge galvanized, steel construction entirely enclosed except for slot in bottom, each half to be in one continuous piece except where splicing clamps are required. Aluminum track is not acceptable.
 3. Each curtain carrier shall be spaced on 12 inch centers and shall be of plated steel construction supported from a ball-bearing by two polyethylene wheels held to ball-bearing by rust-proof nickel-plated rivet, such wheels rolling on two separate parallel treads.
 4. Each curtain carrier shall consist of a free-moving plated swivel and sufficient trim chain to accommodate curtain "S" hook.
 5. End pulley blocks shall be adjustable and shall be equipped with sleeve-bearing adequately guarded.
 6. A rubber bumper shall be attached to each curtain carrier to function as noise reducer.
 7. The manufacturer shall furnish two end-stops for placement at each track end and a tension floor pulley for increasing or decreasing cord tension.
 8. Stretch-resistant operating cord shall have fiberglass center and shall be of 3/8" diameter, extra-quality yarn.

- B. Rear Curtain Track
 - 1. Provide Model 422 Tracks as manufactured by Automatic Devices Company, Allentown, PA.
 - 2. Tracks: Shall be of BLACK ANODIZED 7 gauge extruded Aluminum, I-beam construction.
 - 3. Each curtain carrier shall be spaced on 12 inch centers and shall be of steel construction to include two nylon-tired ball-bearing wheels rolling on two separate parallel treads.
 - 4. Each curtain carrier shall consist of a free-moving plated swivel and sufficient trim chain to accommodate curtain "S" hook.
 - 5. The manufacturer shall furnish two end-stops for placement at each track end.
- C. Leg Pivotal Fixtures
 - 1. Provide Model 6a pivotal fixtures as manufactured by Automatic Devices Corporation, Allentown, PA.
 - 2. Fixture brackets shall be formed of 11 ga. steel for hanging pipe from the pipe with U-bolts.
 - 3. Pivot legs to have stops at each end.
- D. Border, Valance and Leg Curtains
 - 1. These curtains shall be dead hung on pipe battens. Refer to Paragraph 2.5 of this section for pipe batten and chain information.

2.03 STAGE CURTAINS

- A. Flame Retardant Requirements: All fabrics shall be completely immersed, squeezed under pressure and dried in a tented frame. The fabric shall be processed in conformance with the laws of the State of California, NFPA 701 Small and Large Scale, Boston Fire Department, New York Port Authority, and Commonwealth of Massachusetts. Spray method of flame retardant treatment will not be considered equivalent. Any material indicating the surface precipitation inherent with this procedure will not be accepted and will be replaced at the Contractor's expense with the proper material as specified.
- B. All stage curtains are to have sewed-in pleats to 50 percent fullness reinforced at the top on heavy 3 inch flame-proofed polypropylene webbing with #3 brass grommets and #9 "S" hooks 12 inch on center for attaching curtains to track. Front curtains are to have one-half width turnback on all leading edges and 12 inch side hems on all off-stage edges. All salvage edges are to be turned under. Webbing is to be sewed to the curtain with three continuous runs of stitching. All curtains are to have 5 inch bottom hems with zinc-plated #8 jack chain weight encased in the muslin pocket and sewed inside the bottom hem in such a manner as to hold the chain weight approximately 2 inches above the bottom fold of the curtain.
- C. Border, Valance & Leg Curtains are to have 6 inch side hems an the other cyclorama curtains are to have 2 inch side hems and all are to have the bottom hems as described above. The overhead border curtains are to have the chain weight omitted.
- D. Fabrics:
 - 1. Where flame retardant velour is specified it shall be IFR Polyester Velour (23.5-24.5oz.) Charisma. It is to be as manufactured by:
 - a. K & M Fabrics, Inc. of Greenville, SC
 - b. J.L. deBall America Inc., New York, NY
 - c. I. Weiss & Sons, Long Island, New York
 - d. Frankel Associates, Ridgewood, New York
 - e. Or approved equivalent.

2.04 STAGE CURTAIN SIZES

- A. The following curtains shall be made of IFR POLYESTER VELOUR or approved equivalent. Curtain sizes are based on opening sizes and do not include material needed for pleats, gathers or stacking.
 - 1. Main Curtain - 2 pcs. ea. ____ w x ____ h.
 - 2. Valance - 1 pc. ____ w x ____ h
 - 3. Border Curtains - ____ w x ____ h

4. Rear Curtain - 1 pc. ea. ____ w x ____ h
 5. Side Legs: ____ w x ____ h
- B. All dimensions are provided for bidding purposes only and must be field verified.
- C. The following curtain shall be made of 13 oz IFR POLYESTER VELOUR.
1. Cyclorama ____ w x ____ h.

2.05 PIPE BATTENS AND TRACK SUPPORTS

- A. All dead-hung tracks are to supported with #2/0 weldless coil chain with spacing of support chain not to exceed 5'0" o.c.
- B. Borders and Valance are to be fastened to 1-1/2" i.d. Schedule 40 steel pipe. pipes are to be supported with #2/0 weldless coil chain with spacing of support chain not exceed 5 feet on center.
- C. Any additional steel needed to properly support the tracks or battens shall be supplied by the Stage Equipment Contractor.

2.06 BATTENS SHALL BE FABRICATED AS FOLLOWS:

- A. Pipe battens shall be jointed with 18 inch internal sleeves which shall have snug fit and center 3/8" wide space at joint shall be welded.

2.07 EXECUTION

- A. Fabricate and install items in conformity with all applicable trade practices and manufacturer's recommendations, unless specifically excepted by specifications or drawings.
- B. Carry out shop welding in full conformity with applicable AISC and ASA standards.
- C. Comply with local codes. In absence of local codes, comply with AISC, NEC, and ASA standards as applicable.

2.08 INSTALLATION

- A. Consult and coordinate work with trades doing adjoining work.
- B. Use only qualified riggers for installation of lines and trimming and adjustment.
- C. Do all cutting, drilling, tapping, and welding necessary to properly install work.
- D. Use fittings and clips conforming with cable manufacture's recommendations as to size, number, and method of installation. Form rope and cable eyes over properly sized thimbles at requisite connection points.
- E. Position items accurately as indicated on drawings and true to plumb line and level.
- F. Curtains are to be installed on their proper tracks and battens and trimmed to the floor in the best manner known to the profession.
- G. Provide completed installation, ready for satisfactory operation, prior to tests and inspection. Advise the Architects in writing that the installation is completed and ready for acceptance tests and inspection.

END OF SECTION

SECTION 11 40 00 - FOOD SERVICE EQUIPMENT**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. General Provisions and Drawings including General and Supplemental conditions and Division I Specification Sections apply to this Section.

1.02 SUMMARY

- A. Questions concerning Drawings or Specifications shall be asked of the Architect in writing.
- B. Drawings and specifications assign work (labor and/or materials) to be provided by the General Contractor, Plumbing, Fire Suppression, HVAC, and Electrical Contractor. Understanding that the contractors for Division 11 are sub-contractors to the General Contractor such assignments are not intended to restrict the General Contractor in assignment of work among the Sub-Contractors to accommodate trade agreements and practices or the normal conduct of the construction work.
- C. Equipment of standard manufacture shall be of latest model (cooking equipment shall be of same manufacturer where possible). Custom fabricated equipment must be fabricated in the same shop. All work and materials, where possible, shall be listed by Underwriter Laboratories, Inc., National Sanitation Foundation, Inc., and conform to local and state ordinances, State Fire Marshall, National Fire Protection Assoc. codes, and other prevailing regulations, and codes of this area.
- D. Bids are to be presented as lump sum price including any and all applicable city, state, occupational, or government taxes. All cost of permits and licenses shall be included. If requested by Owner, Consultant, Architect, or Construction Manager suppliers are required to submit an itemized list of equipment manufacturers and prices by item. See form at end of this section. The owner reserves the right to omit any items or increase the quantities in order to bring the project into budget. Partial bids will not be accepted.
- E. Request for substitutions on specified equipment and/or materials must be submitted in writing to Architect no later than ten days prior to bid date.
- F. The Kitchen Equipment Contractor shall examine structural, mechanical, plumbing, and electrical drawings. Charges incurred due the selection of alternate items or substitutions that require changes to building structure or, mechanical, plumbing, and electrical systems as shown on original bid documentation shall be the responsibility of the Kitchen Equipment Contractor.

1.03 SCOPE

- A. Work Included by Kitchen Equipment Contractor
 - 1. Provide equipment, supervision, and labor required for delivering, uncrating, setting in place, leveling, and caulking all specified food service equipment with all related items necessary for the completion of work shown on the Contract Drawings and/or required by these specifications, exclusive of utility connections unless covered by Sub Paragraph 19 of 1.03, A, or/unless covered by line item description.
 - 2. Cutting of holes and ferrules in the equipment provided for running of piping, drains, electrical outlets, conduit, etc., required for the installation of work by other contractors.
 - 3. Verifying that all electrical equipment is correct type current for electrical supply at job site.
 - 4. Furnishing to Plumbing Contractor for installation, chrome plated faucets and drains with tailpieces as called for in specifications.
 - 5. Furnishing to Plumbing Contractor for installation, floor troughs as called for in specifications, as well as providing Plumbing Contractor with necessary documentation and supervision for proper installation of this piece of equipment. Floor troughs should be installed flush with the finished floor. If dispute arises with the installing plumber or the local Plumbing Inspector over the level at which the floor trough is installed the Kitchen Equipment Contractor is required to notify the Design Team immediately.
 - 6. When notified by Construction Manager, General Trades Contractor, Plumbing Contractor, or

Electrical Contractor, Kitchen Equipment Contractor shall field measure structural, mechanical, plumbing, and electrical rough-ins to verify compliance with Kitchen Equipment Contractors rough-in drawings. Relocation of rough-ins due to Kitchen Equipment Contractors failure to verify rough-ins, errors in verification of rough-in locations, or errors in Kitchen Equipment Contractor's drawings and brochures, shall be at the Kitchen Equipment Contractors expense.

7. Within 30 calendar days after awarding of the contract, the Kitchen Equipment Contractor must submit rough-in drawings, (minimum scale no less than 1/4" = 1'), showing the exact location of convenience outlets, mechanical and electrical services for each piece of equipment provided by Kitchen Equipment Contractor, Owner, and Vendors. Mechanical and electrical rough-ins must be on separate sheets. Equipment should be shown in a lighter line weight than Rough-ins, dimensions, and notations. With drawings provide an equipment brochure booklet containing manufacturers' spec sheets with electrical and mechanical requirements for each piece of equipment to be supplied. PDF files of all drawing pages and buy-out book pages are acceptable.
8. Within 30 calendar days after awarding of the contract, the Kitchen Equipment Contractor must submit complete shop drawings of all fabricated equipment. Scale must be 3/4" = 1' for plan view and elevations, and 1-1/2" = 1' for cross sections. Also include layouts with dimensions for any recesses required.
9. Kitchen Equipment Contractors rough-in and shop drawings shall be supplied in the following manner:
 - a. Provide submittal drawings as called for in General Conditions for this project for review, correction and approval.
 - b. Brochures on "buy-out" items shall contain manufactures specification sheets on each item preceded by type written page indicating quantity required, model number, mechanical requirements, and list of accessories required by the specifications.
10. Upon Kitchen Equipment Consultant's approval of drawings and brochure booklets Kitchen Equipment Contractor shall submit copies to the Construction Manager for distribution. PDF files are also acceptable.
11. Any proposed substitution of materials or items must be submitted to the Architect for approval in writing.
12. Fabrication of custom equipment shall not begin until final approval has been received from Architect and until field measurements have been taken.
13. All equipment items shall be made to fit in the spaces provided.
14. At substantial completion of this project Kitchen Equipment Contractor shall deliver to Architect for Owner; a collection of documents that make up the Food Service Operation & Maintenance Manual. These shall be provided as a quantity of three (3) hard copy binders or one digital file. Verify media requirements with C.M. or G.C.
 - a. If O&M is provided as three (3) hard copy binders, include with each copy a USB flash drive containing digital files of all documents included in hard copy binder. Spine of hard copy binder is to be labelled with "O&M Manual" and project name.
 - b. Each O&M manual shall contain the following documents for all items provided by the K.E.C. for this contract:
 1. Service contact list pages containing names and telephone numbers of applicable service agencies. These pages are to be acetate protected if hard copies are submitted.
 2. Manufacturer's Operation, Maintenance, and Parts manuals (when available).
 - a. Before each manufacturer's manual place a cover sheet noting the item number, quantity, and item description.
 - b. Order of Manufacturer O&M manuals is to be alphabetical by name of manufacturer.
 3. Manufacture's warranty certificates.
 - a. This includes: Shelving, dunnage racks, and all custom fabrication.
 - b. Include at front of O&M Manual a letter from each manufacturer that does not furnish as a standard, the warranties required by these specifications. This letter must include the serial number for each piece of equipment covered by the manufacturer's "optional" warranties.
15. All debris accumulated by Kitchen Equipment Contractor in connection with the installation of their equipment shall be removed daily. The Kitchen Equipment Contractor shall clean, and turn

- over to Owner all equipment ready for use.
16. At owner's convenience, Kitchen Equipment Contractor shall schedule and provide live demonstrations and training for all equipment. Cooking demonstrations will be required for all cooking and holding equipment. Demonstrations and training to be performed by manufacturer's representatives. K.E.C. is responsible for coordinating demonstrations with the owner and G.C. Manufacturer's Representative shall be allotted adequate time frame to comprehensively demonstrate equipment. K.E.C. to verify that all equipment is fully operational and ready for demonstration.
 17. If State or local codes require boiler inspections, the Kitchen Equipment Contractor shall provide a licensed boiler installer who shall apply for all permits, reviews, and inspections by the Boiler Inspector for kitchen steam equipment specified as part of this contract. All fees incurred in providing these services shall be the responsibility of the Kitchen Equipment Contractor.
 18. If required, Provide revit drawings of hood system and all components for coordination purposes.
 19. Kitchen Equipment Contractor shall hire an Electrical Contractor and Plumbing Contractor to make all final connections between cooking equipment, including owner's supplied items, and E.D.S.
 20. Kitchen Equipment Contractor must complete all punch list items no later than 14 days after receipt of punch list. Kitchen Equipment Contractor to notify, in writing, Joby Smith & Associates when all items are completed and that the kitchen is ready for the follow-up punch list. Items not completed on the original punch list will have to be inspected again by Joby Smith & Associates at Kitchen Equipment Contractor's expense.
 21. When selecting equipment, unless otherwise called for in line-item description:
 - a. All steam equipment and tilt-skillets to be provided by same manufacturer.
 - b. When possible, all reach-in and under-counter refrigeration to be provided by same manufacturer.
 - c. When possible, all reach-in and under-counter refrigeration to be provided by same manufacturer.
 - d. All disposers to be provided by same manufacturer.
 - e. All heated cabinets to be provided by same manufacturer.
 22. Kitchen Equipment Contractor to move existing equipment that is being re-used to storage in an owner designated location within the school district. When site is ready for equipment installation, relocate existing equipment and set in place per Food Service Equipment Floor Plan drawings. K.E.C. shall coordinate with owner and dispose of existing equipment that owner does not want to re-use or sell.
- B. Work Included by General Trades Contractor, Construction Manager.
1. Provide all holes and recesses including wall openings required for condensate lines, refrigeration lines, floor drains, ducts, equipment, access to coolers, etc.
 2. In area specified for walk-in cooler/freezer provide 10" recess in concrete floor. Kitchen Equipment Contractor shall be responsible to provide vapor retarder, vertical conduction barrier, and insulation for walk-in cooler/freezer floor. General Trades Contractor is then to fill remainder of recess with reinforced concrete and finish to match adjacent finish floor.
 3. Provide base molding at exterior and interior perimeter of all walk-in walls. Base molding at exterior only required on exterior walls exposed to kitchen. Base molding material is to match material used for finished floor.
 4. Provide all roof penetrations, curbs, and flashing required for gas piping, refrigeration lines, compressors, exhaust fans, etc. unless otherwise provided for in Item description.
 5. Provide work as noted in Section 114000 specifications and on Hood Drawings for Items 4, 32, 71, 91, and 111 under the heading "EXHAUST SYSTEM WORK BY OTHER TRADES".
 6. Construction Manager shall notify Kitchen Equipment Contractor when rough-ins are ready for verification.
- C. Work Included by Plumbing Contractor
1. Unless otherwise specified by Item description and Drawings; make all plumbing connections required between kitchen equipment components.

2. Unless otherwise specified by Item description and Drawings provide all hot and cold water piping with shutoffs between point of rough in and connections on equipment. Install pressure reducers supplied by the Kitchen Equipment Contractor for kitchen equipment.
 3. Install all faucets, drains with tailpiece, and waste, incorporated in sinks, tables, etc., furnished by Kitchen Equipment Contractor.
 4. Install all floor troughs furnished by Kitchen Equipment Contractor. The Plumbing Contractor shall coordinate with the Kitchen Equipment Contractor the proper installation of the floor trough. Per code, floor troughs can be installed flush with the finished floor. If dispute arises with Plumbing Inspector and these specifications over the level at which the floor trough is to be installed the installing Plumbing Contractor is required to notify the Construction Manager, Kitchen Equipment Contractor, and Design Team of the disagreement before the floor trough is set. Failure to do so will result in the Plumbing Contractor incurring the cost of relocating the floor trough to meet code.
 5. Except where specifically included in Kitchen Equipment Contractors responsibility by Item Specifications and Drawings; Provide all traps, stops and waste piping. Extend waste piping from sinks, disposers, and steam equipment to waste or floor sinks. All waste piping shall be hard copper except when specified otherwise.
 6. Provide all floor drains, and floor sinks shown on plumbing and kitchen drawings.
 7. Provide work as noted in Section 114000 specifications and on Hood Drawings for Items 4, 32, 71, 91, and 111 under the heading "EXHAUST SYSTEM WORK BY OTHER TRADES".
 8. Plumbing Contractor shall notify Construction Manager when rough-ins are ready for Kitchen Equipment Contractor verification.
 9. Verify with Kitchen Equipment Contractor proper procedure for mounting of mixing valves for hose reels. See detail drawing on plan sheets.
 10. Plumbing contractor to disconnect all existing kitchen equipment for relocation, sale, or disposal. Any loose parts to be reused or sold shall be placed in a clear plastic bag and secured to the piece of equipment.
- D. Work Included by HVAC Contractor
1. Unless otherwise specified by Item description and Drawings make all mechanical connections required between kitchen equipment components.
 2. Provide work as noted in Section 114000 specifications and on Hood Drawings for Items 4, 32, 71, 91, and 111 under the heading "EXHAUST SYSTEM WORK BY OTHER TRADES".
 3. H.V.A.C. shall notify Construction Manager when rough-ins are ready for Kitchen Equipment Contractor verification.
- E. Work Included by Electrical Contractor
1. Unless otherwise specified by Item description and Drawings make all electrical connections required between kitchen equipment components.
 2. Provide rough-in of all electric services, conduit, wall receptacle, safety cut-off, starters, motor control panels, disconnects, wiring, etc., except where specifically included in Kitchen Equipment Contractors responsibility by Item Specifications and Drawings. Connections to equipment shall be made in accordance with National Electric Code.
 3. Provide electrical work as noted in Section 114000 specifications and on Hood Drawings for Items 4, 32, 71, 91, and 111 under the heading "EXHAUST SYSTEM WORK BY OTHER TRADES".
 4. Electrical Contractor shall notify Construction Manager when rough-ins are ready for Kitchen Equipment Contractor verification.
 5. Electrical contractor to disconnect all existing kitchen equipment for relocation, sale, or disposal. Any loose parts to be reused or sold shall be placed in a clear plastic bag and secured to the piece of equipment.

1.04 SERVICE AND GUARANTEES

- A. All refrigeration equipment shall be installed in an approved manner meeting all State and Local codes. All compressors to be given a "Manufacturers" five-year minimum warranty and one year minimum service warranty. Dealer warranties are not acceptable when a Manufacturer's warranty is available.
- B. All equipment is to be given a "Manufacturer's" one-year minimum free service and parts warranty. Date

of warranties to begin with final acceptance of project. Kitchen Equipment Contractor shall replace free of charge any equipment, work, parts, materials and/or workmanship which becomes defective (except that which becomes defective due to abuse) during this time period. Dealer warranties are not acceptable when a Manufacturer's warranty is available.

1.05 QUALITY ASSURANCE

- A. Manufacture and install equipment with strict compliance to all State and Local codes. If applicable, equipment must bear the seal of UL, NFPA, ANSI, OSHA, AGA, ASMA, NSF and NEMA.
- B. Approval of contractor's drawings and other data does not relieve Kitchen Equipment Contractor from responsibility of complying with codes and regulations.

PART 2 - PRODUCTS

2.01 PLUMBING

- A. Work specified by this section shall include, but not be limited to the following.
 - 1. Faucets to be chrome plated, and provided with check valves, swing spouts, soft flow aerators (T&S B-0199-01F-20), and union coupling inlets. Faucets and components are to be as follows:
 - a. Pre Rinse - Splash Mount:
T&S B-2278-01-CR with B-0109 aerator or Chicago Faucet, Fisher Faucet, equal
 - b. Pre Rinse with Filler Faucet – Deck Mount:
T&S B-0179-01-CR MOD or Chicago Faucet, Fisher Faucet, equal
 - c. Faucets - Deck mount:
T&S B-0300-CR with aerator or Chicago Faucet, Fisher Faucet, equal.
 - d. Faucet - Splash Mount:
T&S B-0231-CR with aerator or Chicago Faucet, Fisher Faucet, equal.
 - e. Quick Disconnect and Hose Assemblies:
T&S - Caddy - Avtec – Captive Aire – Dormont – Krowne Metal
 - f. Drain Valve Assemblies:
Klein 1750-1020-1000 or Fisher, Chicago Faucet equal
 - 2. Wastes to be chrome plated. Twist handles to be stainless steel. Overflows when specified shall be chrome plated. Overflows and components are to be as follows:
 - a. Lever Waste:
Standard Keil 1720-1620-1000 or Chicago Faucet, Fisher Faucet equal
 - b. Crumb Cup Waste:
Standard Keil 1840-1012-3251 or Chicago Faucet, Fisher Faucet equal
 - c. Open Waste:
Standard Keil 1836-1010-1000 or 1818-1410-168 or Chicago Faucet, Fisher Faucet equal
 - 3. Chrome plated vacuum breakers shall be on all fixtures where water inlets are placed below the water level. Vacuum breakers and components are to be as follows:
 - a. 1/2" Vacuum breakers on a flat surface:
T&S B-0456 vacuum breaker assembly or Chicago Faucet, Fisher Faucet equal.
 - b. 1/2" Vacuum breakers on a sloped surface:
T&S B-0455 vacuum breaker assembly or Chicago Faucet, Fisher Faucet equal.
 - c. 3/4" Vacuum breakers on sloped surface:
T&S B-0457 vacuum breaker assembly or Chicago Faucet, Fisher Faucet equal.
 - 4. All piping extending through table and sink surfaces shall be chrome plated with chrome plated angle flanges, deck flanges, or wall flanges at penetration points.
 - 5. Back flow preventers are to be on pre-rinse units.
 - 6. All faucets, vacuum breakers, and hose reels to be of the same manufacturer.

2.02 ELECTRICAL

- A. Work specified by this section shall include, but not be limited to the following:
 - 1. All electrical equipment shall be of voltage specified by Item Description, Drawings, and Equipment Schedule. The Architect shall be notified of any discrepancies between Contract specifications and electrical characteristics at job site before equipment is ordered.

2. Wiring in fabricated items must be in a raceway or conduit.
3. Wiring in damp areas, (walk-in cooler interiors, under dish tables, etc.) must be in Sealtite type conduit and waterproof boxes.

2.03 FABRICATION

- A. Unless otherwise specified in item description all stainless steel is to be U.S. Standard Type 19-8 composition, Type 302 or 304 with #4 mil finish.
- B. Galvanized steel used shall be processed by hot dip method and be free of runs, blisters, spelter, hard spots and other surface defects. Any exposed galvanized surfaces shall be painted hammertone gray.
- C. Welding rods will be of same material being joined. Welds shall cover joint completely and be ground smooth and polished. Discoloration, warping, pitting, and depressions will not be acceptable.
- D. All equipment secured to or firmly secured against wall shall be sealed with clear silicone.
- E. Field joints should be used only if necessary and must be tight fitting.
- F. Depressions or discoloration at stud bolt locations will not be accepted.
- G. Stainless steel sink bowls, drainboards, and tops will be 14-gauge.
- H. All shelves to be 16-gauge stainless steel.
- I. Cabinet bodies and doors to be 16-gauge stainless steel.
- J. Unless otherwise stated in item description all tops are to be 14-gauge stainless steel. All work surfaces with exposed edges shall be turned down 1-1/2" and under 1/2" at a 45° angle. Corners shall be welded and polished to smooth finish. Splashes shall be turned up with 3/4" radius and back at 45° angle and down 1/2" minimum. Tops and work surfaces to have 12-gauge stainless steel channel under bracing for strength and to prevent warping. Tops to be sound deadened.
- K. Sinks and dish tables to have coved 3/4" radius at all horizontal and vertical corners. Sinks backs, bottoms and front shall be formed from one continuous piece. Sink bottoms to have slopping depression to drain outlet. Drainboards to slope 1/2" to sinks. Drainboards to be sound deadened.
- L. Chases, where mounted to table tops and rear splashes, shall have integral risers with coved 3/4" radius at table top. Top of riser to turn in 1/2" at 90° on all four sides with threaded studs centered on top of turn in. Bottom of chase should turn in 1/2" at 90° on all four sides with holes punched in center of turn in to accept riser studs.
- M. Legs under open base tables and sinks shall be constructed of 1-5/8" o.d. 16-gauge stainless steel tubing and cross braced with 1-1/4" o.d. stainless steel tubing welded to legs. Legs to be fitted with adjustable stainless steel feet at bottom and stainless steel gusset at top. Gusset to be welded to 12-gauge stainless steel channels where secured to table.
- N. Drawer assemblies, unless otherwise specified by item description, shall have 16 gauge double walled stainless steel faces with integral hand pulls and cylinder locks, stainless steel channel slides, 5" deep vinyl inserts, and full 18-gauge stainless steel enclosures. Rollers are to be stainless steel ball bearing type. All drawer slides are to have manual releases to remove drawers from housing. Drawer assembly must be mounted so that face of drawer is no less than 3/4" back from edge of table top.
- O. Removable undershelves to be 16-gauge with rolled edges contoured to fit pipe base. Undershelf sections to be no more than 24" wide and are to be turned down 1" on all edges between pipe rails where shelf sections butt.
- P. Stationary 16-gauge stainless steel shelving on open base tables and drainboards shall be turned down and under on all sides in the same manner as table tops. Shelves to be notched to fit tangent points on legs and welded into place. Shelves to be reinforced in same manner as tabletops.

- Q. Undershelves on tables that butt against walls will be turned up 2" on a 3/4" radius, on the sides adjoining the walls.
- R. Wall mounted shelves are to be 16-gauge with rear turned up 2". All exposed edges are to be constructed in same manner as tabletops.
- S. Custom manufactured equipment shall be of one of the following shops:
 1. DBS Stainless Fabrication, Hamilton Oh.
 2. Commercial Stainless, Bloomsburg, Pa.
 3. Low Temp Industries, Jonesboro, Ga.
 4. EMI Industries, Boonton, NJ
 5. IMC Teddy, Amityville, NY

PART 3 - EXECUTION

3.01 EQUIPMENT FOR KITCHEN – ROOM 148

ITEM 1 SOILED DISH TABLE W/ CHASE & PRE RINSE SINK -- ONE (1) REQUIRED.

Provide custom soiled dish table with pre-rinse sink, undershelf, and pipe base. Top to be 14-gauge stainless steel with stainless steel channel reinforcing, stainless steel leg gussets, 10" high rear splash and sound deadening. Rear splash to be turned up on 3/4" radius, turned back at the top 2" on a 45° angle, and down 1" at rear. Front rail to be 3" high, rolled on a 1-1/2" radius with front edge of roll to be turned down no less than 1". Table top, splash, rail, sinks, and pass through to be of integral construction 14-gauge stainless steel with all inside corners being coved and all welds ground and polished to a smooth surface. Top to be rigidly reinforced with 12-gauge stainless steel channel under bracing. Channels to have stainless steel leg gussets welded in place for securing of leg sets.

Pre-rinse section of table to have one 20" x 20" x 5" deep scrap sink with 8-1/4" disposer adaptor collar welded into bottom, removable stainless steel rack slide, and (2) holes punched in sink walls for water swirl nozzles. Splash behind sink to be punched on 6" centers for vacuum breaker supplied with garbage disposer. In rear splash where shown, punch holes for installation of B-1458-MOD 30 ft. hose reel mixing valve. Under right side of pre-rinse sink bowl secure bracket for mounting control box for disposer.

Drain board at dishwasher end to be configured for machine specified in this contract.

At left edge of sink bowl provide rear splash with 2" deep x 12" wide integral stainless steel riser. Provide riser with 12" wide x 5" deep 18-gauge stainless steel water and vent pipe chase that extends from top of backsplash to 4" above ceiling. Chase should be constructed in one piece. and secured to wall with 14-gauge stainless steel angles and stainless steel screws. Set in place where shown on drawing. Secure a 2" stainless steel collar where chase extends through ceiling.

Entire unit to be mounted on stainless steel legs with 16-gauge stainless steel undershelf notched at corners and fully welded to legs, stainless steel tubular cross bracing, and adjustable stainless steel bullet feet. Undershelf to have 2" turn up at rear. Outside corner legs to be provided with flanged feet.

See drawings for further details. Set in place as shown on drawing and secure flanged feet to floor with stainless steel bolts.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 2 DISPOSER -- ONE (1) REQUIRED.

Provide 2 hp offset disposer unit with 8" rotor/turntable, and three adjustable legs. Provide with 8-1/4" stainless steel sink adaptor to be welded into bottom of pre-rinse sink, (1) swirl nozzle, and solenoid. Control panel to be provided with automatic reversing magnetic contactors, overload protection, alternator, automatic delay timer for motor and water run time, low voltage protection, emergency disconnect switch, and push button operation. Install swirl nozzles in sink walls. 208/60/3

Provide with the following option: (1) extra swirl nozzle.

Furnish with the following option: T&S B-0455 vacuum breaker assembly.

K.E.C. to install disposer to adaptor and lag to floor with stainless steel bolts, control panel on mounting bracket provided under landing area and wire to solenoid and disposer.

All disposers must be from the same manufacturer.

MANUFACTURER & MODEL: MASTER C2-O-SK-RAC2

INSINGER and RED GOAT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 3 HOSE REEL – 30 FT. -- ONE (1) REQUIRED.

Provide stainless steel enclosed wall mount hose reel with 30 Ft. of 3/8" I.D. heavy duty hose with adjustable hose bumper, 3/8" NPT female inlet, B-0107 spray valve, wall mount mixing faucet with 8" centers and control valve in riser, B-0963 vacuum breaker, fixed wall bracket, and retractable hose reel.

Furnish with the following options: ceramic cartridges, (2) B-CVV-1/2" vertical check valves, and 004R finger hook.

Plumbing Contractor to mount mixing valve to back splash per manufacturers' specification, then notify Kitchen Equipment Contractor that mixing valve is installed and ready for completion of hose reel assembly installation. Kitchen Equipment Contractor to install balance of piping to mixing valve and mount hose reel with fixed mounting bracket to wall using stainless steel bolts. See hose reel detail drawing of this item for installation details.

See detail drawing for center line of mixing valve and top point of hose reel mounting dimensions. If additional chrome piping is needed to place vacuum breaker at height as shown on drawing, then Kitchen Equipment Contractor shall provide additional length of piping.

K.E.C. to adjust hose stop so that nozzle height is to kitchen manager's preference.

Hose reel to be of the same manufacturer as all other faucets.

MANUFACTURER & MODEL: T&S B-1458-CR-MOD

CHICAGO FAUCET, FISHER, and SANIGUARD will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 4 CONDENSATE HOOD -- ONE (1) REQUIRED.

Furnish and install complete condensate exhaust system as shown on drawings. Complete system to include: condensate exhaust fan, hood, connecting duct, start up/air balance/service. System to meet all requirements of U.L., Kentucky Mechanical Code, and bear the NSF seal #908. Hood Manufacturer must assume responsibility for installation of hood, ductwork, fan and all support equipment specified in this Item description except where noted "WORK BY OTHER TRADES".

EXHAUST FAN: Furnish one (1) roof exhaust blower of the down blast spun aluminum type. U.L. 705 listed use for general ventilation. Fan chosen must include a 13" wheel and not exceed 11.0 sones. Rated at 1,200 CFM at .75" sp., 1/2 hp, 120/60/1. Fan to include disconnect switch.

ROOF CURB: Provide (1) roof curb consistent with other curbs furnished for this project. Curb material to be 18-gauge, all welded galvanized construction. Curb to be internally insulated with rigid fiberglass with foil backing.

HOOD: Provide one (1) 6'-0" long x 3'-6" wide x 30" high Type II condensate exhaust hood, as shown on hood system drawings. Constructed of 18-gauge, type 304 stainless steel with #4 finish, solid welded and polish to face, no exposed joints. Interior baffle panels to be constructed of 18-gauge stainless steel material. Provide bulkhead between top of hood and ceiling on all exposed sides, constructed of same material as hood body.

DUCTWORK: Provide light gauge sealed aluminum condensate duct work to extend from top of condensate exhaust hood to condensate fan on the building roof.

INSTALLATION: By this contractor to include hanging hood, setting exhaust fan, locating roof curb on shop drawings to be provided, and fabricating and installing connecting ductwork.

EXHAUST SYSTEM WORK BY OTHER TRADES:

KITCHEN EQUIPMENT CONTRACTOR: To coordinate with General, Electrical, and Mechanical contracts.

ROOFING CONTRACTOR: Provide roof opening. Set in place and flash (with cant if required) roof curb provided by the hood system manufacturer.

STRUCTURAL CONTRACTOR: Frame roof opening as required. Coordinate joist or structural member installation to provide required clearances for ductwork.

ELECTRICAL CONTRACTOR: Provide single phase power as required to condensate exhaust fan, as indicated on hood system drawings. Interwire fan contacts on dishmachine through condensate exhaust fan circuit for fan actuation.

MECHANICAL CONTRACTOR: Provide net room air demand as indicated on the hood system drawings. This air volume is required only when the condensate exhaust hood system is in operation.

Hood manufacturer shall file for all state and local permits.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER & MODEL: MASTER AIR

HALTON and AVTEC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 5 DISHWASHER -- ONE (1) REQUIRED.

Provide electric tank heat opti-rinse dishwasher with flow configuration for this operation. Unit to be configured for high temperature final rinse. Tank and chamber to be constructed of 16-gauge stainless steel. Machine power wash motor to be 2 HP with stainless steel self-draining pump, and impeller. Conveyor to be driven by 1/6 HP motor. Tank heat to be provided by factory inter-wired 15 kW electric immersion heaters. Standard equipment to include: insulated hinged double doors, solid state controls; automatic fill with low water protection; top mounted dial thermometers; overload protection with manual resets for motors; rinse agent dispenser injector, and electrical interface points; auto-timer; door safety interlocks on all doors; stainless steel upper, and lower wash arms with debossed anti-clog nozzles; stainless steel front panel; stainless steel frame, feet, and legs. Machine to have a minimum capacity of 202 racks per hour. 480/60/3

Provide with the following options: single point electrical connection; higher than standard chamber, stainless steel splash shield on clean end, drain water tempering kit (cool down kit must be able to cool drain water down to 140°F or lower), DDU38 direct drive unloader (unloader must be installed by manufacturer), and table limit switch.

Kitchen Equipment Contractor to install drain water tempering kit and hang control panel on wall where shown on drawing. Kitchen Equipment Contractor shall also be responsible for running the drain line to the floor sink ready for the Electrical and Plumbing Contractors to make all final electrical and cold water connections to the tempering kit.

Provide the following Vollrath ware washing racks: (2 ea.) 52664, (2 ea.) 52669, (2 ea.) 52671, and (2 ea.) 52672.

METRO and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

Install table limit switch at rolled edge on end of clean dish table and wire to control box.

K.E.C. to provide copper drain line from unloader to floor sink.

MANUFACTURER & MODEL: HOBART CL-44eN

STERO and ELECTROLUX will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 6 BOOSTER HEATER -- ONE (1) REQUIRED.

Provide compact booster heater with on/off switch, temperature/pressure relief valve, pressure reducing valve, temperature/pressure gauges for water inlet, and outlet, high temperature limit control, pilot indicator light, and low water cutoff. Unit to be rated at 30 kW. 480/60/3

Provide with the following options: slide brackets, back pressure relief valve "QSBPRV", and shock absorber.

Install slide brackets to clean dishtable as shown on drawings and hang booster heater. Piping and mounting of related components are not in Kitchen Equipment Contractor's Contract.

Booster Heater specification is based on hot water requirements, at 70° rise, for primary Dishwasher Manufacture. If Kitchen Equipment Contractor elects to use an alternate manufacturer, Kitchen Equipment Contractor must provide booster heater sized to meet hot water demand of that manufacturer. If alternate Manufacturer is used, any expenses incurred due to changes in electrical service are the responsibility of the Kitchen Equipment Contractor.

MANUFACTURER & MODEL: HATCO C-30

A.O. SMITH, HUBBELL, and LOCHINVAR will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 7 CLEAN DISHTABLE W/POT & PAN SINK -- ONE (1) REQUIRED.

Provide custom "L" shaped 14-gauge stainless steel clean dish table with pot & pan sink. Top to be 14-gauge stainless steel with stainless steel channel, stainless steel leg gussets, 10" rear splash and sound deadening. Rear splash to be turned up on 3/4" radius, turned back at the top 2" on a 45° angle, and down 1" at rear. Front rail to be 3" high, rolled on a 1-1/2" radius with front edge of roll to be turned down no less than 1". Table top, splash, rail, and sinks to be of integral construction 14-gauge stainless steel with all inside corners being coved and all welds ground and polished to a smooth surface. Top to be rigidly reinforced with 12-gauge stainless steel channel under bracing. Channels to have stainless steel leg gussets welded in place for securing of leg sets. Drainboard at dishwasher end to be configured for machine specified in this contract.

Pot sink section to have three 20" wide x 28 1/2" long x 14" deep cove cornered sinks with lever waste and overflows, stainless steel fully welded undershelf with 2" turn up at rear, and 42" drainboard at soiled end. Drain board is to have 1" drop to sink for drainage. In rear splash over sink dividers punch holes for mounting T&S B-0231 faucets.

Entire unit to be secured on stainless steel leg set with 16-gauge stainless steel undershelf notched at corners and fully welded to legs. Provide front legs with adjustable stainless steel bullet feet and rear legs with adjustable flanged feet.

Provide with (2) T&S B-0231-CR splash mount faucets with ceramic cartridges and B-0199-01 aerators.

Provide clean area of table as shown on drawings, a stainless steel 5'-0" x 12" cantilevered shelf on stainless steel post extended through the rear splash to stainless steel support bracket.

Provide on wall above sink secure 8'-0" long x 16" deep x 14" high, two-tier pot rack. Construction to be of 14-gauge stainless steel support brackets welded to 2" x 1/4" stainless steel slide bars with double sided sliding hooks mounted on 8" centers.

Stud mount slides for Hatco booster heater to underside of table as shown on drawings.

See drawings for further details. Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 8 DRYING RACK -- ONE (1) REQUIRED.

Provide 24" deep X 45 5/8" wide x 74 5/8" height three tier mobile drying rack. Unit to include four (4) posts, rear pan stops for each tier, one (1) adjustable height top shelf, two (2) adjustable height center shelves, and one (1) bottom shelf with four (4) pre-tapped caster plates welded in place that include 5" diameter heavy-duty swivel casters (two (2) with brakes). Posts to be constructed of heavy duty extruded aluminum pipe with a wall thickness of .15, and an outside diameter of 1 5/16". Each post to be marked in 2" increments and fitted with a plastic cap in each end. Shelves to be fully welded constructed of 1 1/2" aluminum tubing with a wall thickness of .070. Each shelf is to have welded pan slides spaced at 1-1/2" on center and heavy duty aluminum collars, at all four corners, with stainless steel set screws.

Top two tiers to accommodate twenty-eight (28) 12" x 20" x 2-1/2" pans with long end of pans inserted horizontally. Bottom tier to accommodate twenty-eight (28) 18" x 26" full size sheet pans per shelf with long end of pan inserted vertically into tier.

MANUFACTURER & MODEL: NEW AGE 51353

ITEM 9 HAND SINK -- FOUR (4) REQUIRED.

Not in K.E.C. contract. To be provided by Plumbing Contractor.

ITEM 10 SHELVING - POT & PAN -- FOUR (4) REQUIRED.

Provide standard antimicrobial polymer, open grid, shelving on 63" post with non-marking casters (two w/locking brakes). Size per drawing. Bottom shelf to be 12" off floor.

Shelving to be of the same manufacturer as items 13.

MANUFACTURER & MODEL: METRO METROMAX

CAMBRO "CAMSHELVING" and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 11 OPEN NUMBER.

ITEM 12 WALK-IN COOLER/FREEZER – ONE (1) REQUIRED.

Provide pre-fabricated combination walk-in cooler/freezer without floor as described in this specification and as shown on Food Service Equipment drawings.

DIMENSIONS

- Overall: 33'-6" long by 20'-0" wide by 8'-2 5/8" high.
- Cooler Interior: 32'-10" long by 9'-6" wide.
- Freezer interior to be 32'-10" long by 9'-6" wide.
- Nominal dimensions will not be accepted.

PANEL CONSTRUCTION

Ceiling, wall, and door panels to be 4" thick 100% foamed-in-place CFC and HCFC free polyurethane insulation, bonded by adhesive, to the interior and exterior metal pan skins, and heat cured. Edges of panels to be "Tongue and Groove" with cam locking assemblies foamed-in-place at time of panel fabrication and include NSF approved gaskets integrally locked to interior and exterior of skins as continuous pieces. Bottom of wall panels to have female bottom rail that fits over sealer guide. Sealer guide to be fastened to wood vertical conduction barriers.

PANEL FINISHES

- Ceiling panel exterior: 26-gauge smooth galvanized steel.
- Ceiling and wall panel interior: .040-gauge embossed white mill finish aluminum.
- Wall panel exterior (not exposed to kitchen): 26-gauge embossed galvanized steel with aluminum coating.
- Wall panel exterior (exposed to kitchen): 22-gauge smooth stainless steel.
- Trim caps: 22-gauge smooth stainless steel installed at walls, and matching finish enclosure panels at ceiling. Enclosure panels at ceiling are to provide access to walk-in roof for servicing, and shall be removable without the use of tools.

PANEL R-VALUE REQUIREMENTS

COOLER

- Walls/Ceilings = R-25 or greater
- Doors = R-25 or greater

FREEZER

- Walls/Ceilings = R-32 or greater
- Doors = R-32 or greater

FLOORS

- R-28 or greater

PANEL FIRE RATINGS

- Must conform to State and Local code requirements.
- Upon request, walk-in manufacturer shall provide requested engineering documents showing proof of conformance.

DOOR PANEL FINISHES

- Door frame panel exterior and interior: 22-gauge smooth stainless steel.
- Door panel exterior and interior: 18-gauge smooth stainless steel.

ENTRY DOOR CONSTRUCTION

- Doors to be flush mount design in 48" wide panels with 36" x 78" high opening and have double sweep gasket.
- Doorjamb construction to be fully coved extruded structural anodized aluminum. Doorjamb to be heated and include: magnetic perimeter gasket.
- Door threshold construction to be extruded aluminum. Threshold to be heated. Secure to floor with stainless steel screws and caulk perimeter with clear all-weather silicone.
- Set of clear vinyl curtain strip doors with spring hinges. If curtain is shipped loose the walk-in manufacturer must pre-drill holes in door frame for curtain hanger brackets.

DOOR HARDWARE (TO BE INCLUDED WITH EACH DOOR)

- Three (3) cam lift hinges. One (1) hinge to have spring assist.
- Door closer.
- Deadbolt handle latch that can be locked with cylinder lock, padlock, or both. Handle latch to have glow in the dark, or lighted, inside release knob.

DOOR OPTIONS (TO BE INCLUDED WITH EACH DOOR)

- 14" x 24" tempered three pane glass observation window with heated frames and heated glass.
- Door open sensor. Door open sensors to be foamed into door jambs. Do not mount externally. K.E.C. is to wire sensor to Enviro-Control. Wiring to be routed from door frame across exterior of ceiling.

CONTROL PANEL (TO BE INCLUDED WITH EACH COMPARTMENT)

- Flush mounted LED display thermometer with illuminated on/off light switch, and battery back-up, on exterior of door frame panel.
- Flush mounted audible alarm wired, by K.E.C., from Enviro Controllers.

LIGHTING FIXTURES (TO BE INCLUDED WITH EACH COMPARTMENT)

- Globe style vapor proof all temperature LED light fixture, one centered over each door. Fixtures to include: Passive infrared sensor that detects motion and turns lights on. Motion detector to include timer that is capable of being set in the field with a range of 15 seconds to 30 minutes to shut lights off when no motion is detected in the walk-in compartment after set amount of time.
- 48" length LED vapor proof ceiling mount light fixtures. Fixtures to be located over aisle(s) and in such a quantity, and manner, as to provide no less than 20 foot candles average of light when measured 40" above floor. Tube style light fixtures to be oriented perpendicular to low profile evaporator unit cooler. Lights to be controlled with same switch as door light. Conduit for all lights to be on exterior of ceiling.

AIR PRESSURE RELIEF PORT (TO BE INCLUDED WITH EACH COMPARTMENT)

- Freezer pressure relief port must be heated.

WALK-IN PANEL INSTALLATION NOTES

- Panels to be installed per manufacturer's instruction.
- Walls to be erected in a manner to prevent lateral movement.
- If finished floors are to be quarry tile; then panels should be erected to sit flush on concrete floor and anchored to thermal break with stainless steel screws prior to installation of tile.
- If finished floors are epoxy type; then panels should be erected to sit flush on concrete floor and anchored to thermal break with stainless steel screws prior to installation of flooring material.

WALK-IN FLOOR TO BE INSULATED SLAB TYPE

General Trades Contractor to provide 10" deep smooth and transit leveled depression in concrete slab and the following:

- Second pour of concrete on top of urethane insulation and concrete fill between slab and vertical conduction barriers. Second pour to be smooth and transit leveled.

K.E.C. is to provide and install the following in slab depression:

- 15 mil. polyethylene sheet vapor retarder.
- Two (2) layers of 3" sheets of urethane insulation. Three (3) layers of 2" sheets are also acceptable. Install each layer so that the seams do not run parallel with previous layer.
- Vertical Conduction Barriers for all walk-in compartments are to be Polyiso Ridgid Foam Insulation Board with aluminum foil backing.
- 3/4" x 3"x 3" steel angle brackets to secure vertical conduction barrier to floor. Provide quantity to accommodate angle bracket spacing of every 6'-0" O.C.
- Reference "Walk-in Floor Detail @ Floor" drawings on Foodservice Equipment drawings for slab depression details.

WALK-IN FLOOR INSTALLATION NOTES

- Slab depression vapor barrier, vertical conduction barriers, and insulation installation must be performed or supervised by a manufacturer's representative.
- Upon request; K.E.C. must provide step-by-step photos of walk-in floor installation before final pour of concrete.
- General Trades Contractor is responsible for provision and installation of base molding at exterior and interior perimeter of all walk-in walls. Base molding at exterior only required on exterior walls exposed to kitchen. Base molding material finish is to match material used for finished floor.
- Reference 'Walk-In Floor Detail' on Food Service Equipment drawing sheets for more details.

OPTIONS (TO BE PROVIDED WITH WALK-IN)

- One (1) alarm phone dialer to serve both compartments. K.E.C. to Locate at front center of walk-in roof and wire to enviro controllers.
- Ceiling panel support system as recommended by manufacturer.

REFRIGERATION SYSTEMS

Complete refrigeration systems, as specified hereafter shall be supplied as part of this contract. If an accepted equal manufacturer listed below is used, it is that manufacturer's responsibility to size the refrigeration systems according to standards they deem appropriate for proper operation of this size walk-in in this application. Changes in type of condensing units will not be accepted.

- K.E.C. shall be responsible for any added costs associated with changes in condensing unit sizes due to selecting manufacturer other than the basis of design.
- K.E.C. shall be responsible for provision and installation of refrigeration systems and all components required for proper operation
- Refrigeration systems are to be supplied by same manufacturer as walk-in box

MANUFACTURER & MODEL: NORLAKE FINELINE SERIES

THERMO KOOL and CHRYSLER KOPPIN will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 12A EVAPORATOR – COOLER – TWO (2) REQUIRED.

Provide low-profile type evaporator unit sized for 35°F operation of Cooler compartment's complete pre-assembled and pre-piped refrigeration system; as calculated by walk-in manufacturer for walk-in freezer compartment represented on Food Service Equipment drawings and in these written specifications. All components of this refrigeration system are to be provided and paired by manufacturer of Walk-In.

UNIT CONSTRUCTION TO INCLUDE

- 208-230/60/1 Electric connection (K.E.C. to inter-wire electric supply from single point connection at condensing unit)
- R-448A/449A refrigerant
- 6,440 BTU's evaporator capacity
- Aluminum housing
- Condensate drain pan with removable drain fitting
- Off cycle defrost
- THX and solenoid
- High throw fan blade guards
- UL listing
- KE2 controlled environment kit with female CAT5 RJ45 ethernet port.

EVAPORATOR INSTALLATION NOTES FOR K.E.C.

- Condensing unit and evaporator are to be installed per manufacturer specification.
- Provide all electric and control inter-wiring between evaporator and condensing unit.
- Supply and install all controls and components, per manufacturer's instructions, for proper operation of system.
- Provide and Install 3/4" copper condensation drain piping with "P" trap at exterior of box. Run piping from evaporator's condensate drain pan, along wall, to floor drain as shown on drawings. Drain piping should be held out 1" from walls and exit cooler approximately 11" above floor. When cooler drain piping is manifolded to freezer drain piping, a "P" trap must be installed in cooler compartment before entering through to freezer. Run line from coil along wall to drain as shown on drawings. PVC piping will not be accepted.
- Fees for any required inspections or test are to be part of this contract.
- Upon request, a pressure piping permit must be provided, if required.
- Coordinate location with bid document Food Service Equipment drawings

PROVIDE WITH THE FOLLOWING OPTIONS

- EC type fan motors

MANUFACTURER & MODEL: NORLAKE E1MD0065B-ME*

THERMO KOOL and MASTER BILT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 12B CONDENSING UNIT - COOLER - ONE (1) REQUIRED.

Provide rack mounted remote, air-cooled condensing unit, for outdoor use, sized for 35°F operation of Cooler compartment's complete pre-assembled and pre-piped refrigeration system; as calculated by walk-in manufacturer for walk-in freezer compartment represented on Food Service Equipment drawings and in these written specifications. All components of this refrigeration system are to be provided and paired by manufacturer of Walk-In.

UNIT CONSTRUCTION TO INCLUDE

- 208-230/60/1 single point connection (K.E.C. to inter-wire electric supply from single point connection at condensing unit to evaporator)
- Scroll compressor
- R-448A/449A refrigerant
- Minimum system available capacity of no less than 9,125 BTU's per hour at 100°F ambient temperature
- Initial oil charge
- Suction service valves
- Discharge service valves
- High and low pressure controls
- Liquid line received with fusible plug, liquid shutoff valve, and charging port
- Aluminum fins
- EC fans
- Pre-piped remote refrigeration system that includes: Liquid line filter drier, Site glass, and hand valves
- Mounted on welded galvanized steel rack
- Pre-wired remote refrigeration system with factory pre-wired controls mounted in control box on rack.
- 0°F to -20°F Ambient control kit that includes head pressure control and crankcase heater with thermostat
- Electric heat defrost
- Starter
- Suction accumulator
- Pump down receiver tank
- Flip up All weather hood constructed of painted galvanized steel. Must be UL listed
- UL listing

PROVIDE WITH FOLLOWING ACCESSORIES

- 18-gauge galvanized steel equipment support rails. Support rail height to be 12" above finished roof. Rails to be equal to Pate ES-2 style. Equipment support rail lengths to be based on Walk-in Manufacturer's compressor size.
- Insulated heavy gauge galvanized steel pipe curb assembly with integral base plate and all components to make a weather tight piping and control line roof penetration.
- "ACR" type hard copper refrigeration piping that is nitrogen charged to prevent oxidation and scale formation.
- Liquid line dehydrator and sight glass with moisture indicator.
- Conduit required for inter-wiring of condensing unit and evaporator.
- Seamless rubber tubular pipe insulation for suction line piping.
- UV resistant reflective foil tape

CONDENSING UNIT INSTALLATION NOTES FOR K.E.C.

- Condensing unit and evaporator, all controls and components are to be installed per manufacturer requirements for proper operation of this system.
- Coordinate location of condensing unit with bid document Food Service Equipment drawings, C.M. and other associated trades.
- Supply to Roofing Contractor for installation, 18-gauge galvanized steel equipment support rails for compressor, insulated heavy gauge galvanized steel pipe curb assembly with integral base plate and all components to make a weather tight piping and control line roof penetration. Before ordering Equipment Support Rails and Pipe Curb, K.E.C. is to coordinate heights required for roof type.
- Provide all electric and control inter-wiring between evaporator and condensing unit.

- Install all suction and liquid line piping between condensing unit and evaporator, as required for proper operation of complete refrigeration system. Piping to be "ACR" type hard copper with brazed silver solder joints.
- All line piping to be purged, charged, tested, and insulated in accordance with state and local codes.
- Install liquid line dehydrator and sight glass with moisture indicator at condensing unit end of line.
- Seamlessly wrap all suction line piping with rubber tubular pipe insulation.
- Wrap any line piping insulation, exposed to the outdoors, with UV resistant foil tape.
- Provide pressure piping permit, if required or requested.
- Fees for any required inspections or test are to be part of this contract.

CONDENSING UNIT INSTALLATION NOTES FOR OTHER TRADES

- E.C. to provide and install electrical service to single point connection on condensing unit to supply combined power load for the condensing unit and evaporator as represented on the Food Service Drawings.
- Roofing Contractor to coordinate with K.E.C.; the locations for condensing unit support rails and pipe curb, and roof opening dimensions.
- Roofing contractor to obtain support rails and pipe curb from K.E.C., secure and flash to roof at locations agreed to with K.E.C. and G.C. or C.M.

MANUFACTURER & MODEL: NORLAKE MSMD012MB*

THERMO KOOL and MASTER BILT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 12C EVAPORATOR – FREEZER – TWO (2) REQUIRED.

Provide low-profile type evaporator unit sized for 0°F operation of Freezer compartment's complete pre-assembled and pre-piped refrigeration system; as calculated by walk-in manufacturer for walk-in freezer compartment represented on Food Service Equipment drawings and in these written specifications. All components of this refrigeration system are to be provided and paired by manufacturer of Walk-In.

UNIT CONSTRUCTION TO INCLUDE

- 208-230/60/1 Electric connection (K.E.C. to inter-wire electric supply from single point connection at condensing unit)
- R-448A/449A refrigerant
- 5,084 BTU's evaporator capacity
- Aluminum housing
- Heated condensate drain pan with removable drain fitting
- Electric heat defrost
- Termination/fan delay controls
- Thermostat
- Fan delay thermostat
- Room thermostat
- Expansion valve
- THX and solenoid
- High throw fan blade guards
- UL listing
- Enviro Control kit with female CAT5 RJ45 ethernet port.

PROVIDE WITH THE FOLLOWING OPTIONS

- EC type fan motors

PROVIDE WITH THE FOLLOWING ACCESSORIES

- Heat tape, plug set, and seamless rubber pipe insulation sized for entire length of drain piping in freezer compartment

EVAPORATOR INSTALLATION NOTES FOR K.E.C.

- Condensing unit and evaporator are to be installed per manufacturer specification.

- Provide all electric and control inter-wiring between evaporator and condensing unit.
- Supply and install all controls and components, per manufacturer's instructions, for proper operation of system.
- Provide and Install 3/4" copper condensation drain piping with "P" traps at exterior of box. Run piping from evaporator's condensate drain pan, along wall, to floor drain as shown on drawings. Drain piping should be held out 1" from walls and exit cooler approximately 11" above floor. If freezer line does not manifold to cooler condensate line, install condensate "P" trap at exterior of box. Run line from coil along wall to drain as shown on drawings. Drain line should be held out 1" from walls and exit cooler approximately 11" above floor. PVC piping will not be accepted.
- If freezer drain piping does not manifold to cooler condensate drain piping, install condensate "P" trap at exterior of box. Run piping from coil along wall to drain as shown on drawings. Drain line should be held out 1" from walls and exit cooler approximately 11" above finished floor.
- Provide and install, on evaporator's condensate drain piping, heat tape and seamless rubber pipe insulation.
- Fees for any required inspections or test are to be part of this contract.
- Upon request, a pressure piping permit must be provided, if required.
- Coordinate location with bid document Food Service Equipment drawings

EVAPORATOR INSTALLATION NOTES FOR OTHER TRADES

- E.C. to provide and install 120/60/1 outlet on walk-in wall, behind evaporator, for heat tape; as shown on Food Service Equipment drawings.

MANUFACTURER & MODEL: NORLAKE EILD0049B-ME*

THERMO KOOL and MASTER BILT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 12D CONDENSING UNIT - FREEZER - ONE (1) REQUIRED.

Provide rack mounted remote, air-cooled condensing unit, for outdoor use, sized for 0°F operation of Freezer compartment's complete pre-assembled and pre-piped refrigeration system; as calculated by walk-in manufacturer for walk-in freezer compartment represented on Food Service Equipment drawings and in these written specifications. All components of this refrigeration system are to be provided and paired by manufacturer of Walk-In.

UNIT CONSTRUCTION TO INCLUDE

- 208-230/60/1 single point connection (K.E.C. to inter-wire electric supply from single point connection at condensing unit to evaporator)
- Scroll compressor
- R-448A/449A refrigerant
- Minimum system available capacity of no less than 9,326 BTU's per hour at 100°F ambient temperature
- Initial oil charge
- Suction service valves
- Discharge service valves
- Crank case heater
- High and low pressure controls
- Liquid line received with fusible plug, liquid shutoff valve, and charging port
- Aluminum fins
- EC fans
- Pre-piped remote refrigeration system that includes: Liquid line filter drier, Site glass, and hand valves
- Mounted on welded galvanized steel rack
- Pre-wired remote refrigeration system with factory pre-wired controls mounted in control box on rack.
- 0°F to -20°F Ambient control kit that includes head pressure control and crankcase heater with thermostat
- Electric heat defrost
- Starter
- Suction accumulator
- Pump down receiver tank
- Flip up All weather hood constructed of painted galvanized steel. Must be UL listed

- UL listing

PROVIDE WITH FOLLOWING ACCESSORIES

- 18-gauge galvanized steel equipment support rails. Support rail height to be 12" above finished roof. Rails to be equal to Pate ES-2 style. Equipment support rail lengths to be based on Walk-in Manufacturer's compressor size.
- Insulated heavy gauge galvanized steel pipe curb assembly with integral base plate and all components to make a weather tight piping and control line roof penetration.
- "ACR" type hard copper refrigeration piping that is nitrogen charged to prevent oxidation and scale formation.
- Liquid line dehydrator and sight glass with moisture indicator.
- Conduit required for inter-wiring of condensing unit and evaporator.
- Rubber tubular pipe insulation for suction line piping.
- UV resistant reflective foil tape

CONDENSING UNIT INSTALLATION NOTES FOR K.E.C.

- Condensing unit and evaporator, all controls and components are to be installed per manufacturer requirements for proper operation of this system.
- Coordinate location of condensing unit with bid document Food Service Equipment drawings, C.M. and other associated trades.
- Supply to Roofing Contractor for installation, 18-gauge galvanized steel equipment support rails for compressor, insulated heavy gauge galvanized steel pipe curb assembly with integral base plate and all components to make a weather tight piping and control line roof penetration. Before ordering Equipment Support Rails and Pipe Curb, K.E.C. is to coordinate heights required for roof type.
- Provide all electric and control inter-wiring between evaporator and condensing unit.
- Install all suction and liquid line piping between condensing unit and evaporator, as required for proper operation of complete refrigeration system. Piping to be "ACR" type hard copper with brazed silver solder joints.
- All line piping to be purged, charged, tested, and insulated in accordance with state and local codes.
- Install liquid line dehydrator and sight glass with moisture indicator at condensing unit end of line.
- Seamlessly wrap all suction line piping with rubber tubular pipe insulation.
- Wrap any line piping insulation, exposed to the outdoors, with UV resistant foil tape.
- Provide pressure piping permit, if required or requested.
- Fees for any required inspections or test are to be part of this contract.

CONDENSING UNIT INSTALLATION NOTES FOR OTHER TRADES

- E.C. to provide and install electrical service to single point connection on condensing unit to supply combined power load for the condensing unit and evaporator as represented on the Food Service Drawings.
- Roofing Contractor to coordinate with K.E.C.; the locations for condensing unit support rails and pipe curb, and roof opening dimensions.
- Roofing contractor to obtain support rails and pipe curb from K.E.C., secure and flash to roof at locations agreed to with K.E.C. and C.M.

MANUFACTURER & MODEL: NORLAKE MSLD025MB*

THERMO KOOL and MASTER BILT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 13 SHELVING - COOLER/FREEZER -- ONE (1 LOT) REQUIRED.

Provide four tier standard antimicrobial polymer, open grid, shelving on 86" polymer posts. "S" clips must be used at corner shelving units. All other shelving sections to have four (4) posts. Size per drawing. Bottom shelf to be 12" off floor.

Shelving to be of the same manufacturer as item 10.

MANUFACTURER & MODEL: METRO METROMAX Q

CAMBRO "CAMSHELVING" and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 14 DUNNAGE RACK – COOLER/FREEZER -- ONE (1) REQUIRED.

Provide heavy duty dunnage rack constructed of type 6063-T5 extruded aluminum tubing 1-1/2" x 1-3/4" x .070 wall, with all joints heli-arc welded, and feet completely sealed. 2,000 Lb. minimum weight capacity. Platform level to be 12" above floor. See drawing for sizes and location.

Dunnage racks to be of the same manufacturer as item 17.

MANUFACTURER & MODEL: NEW AGE

KELMAX, WINHOLT, and CHANNEL will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 15 OPEN NUMBER.

ITEM 16 SHELVING - DRY STORAGE -- ONE (1 LOT) REQUIRED.

Provide four tier steel chrome plated wire shelving on 86" chrome plated posts. "S" clips must be used at corner shelving units only. All other shelving sections to have four (4) posts. Size per drawing. Bottom shelf to be 12" off floor.

Shelving to be of the same manufacturer as item 106.

MANUFACTURER & MODEL: METRO SUPER ERECTA BRITE

EAGLE and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 17 DUNNAGE RACK – DRY STORAGE -- ONE (1 LOT) REQUIRED

Provide heavy duty dunnage rack constructed of type 6063-T5 extruded aluminum tubing 1-1/2" x 1-3/4" x .070 wall, with all joints heli-arc welded, and feet completely sealed. 2,000 Lb. minimum weight capacity. Platform level to be 12" above floor. See drawing for sizes and location.

Dunnage racks to be of the same manufacturer as item 14.

MANUFACTURER & MODEL: NEW AGE

KELMAX, WINHOLT, and CHANNEL will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 18 BUN PAN RACK -- SIX (6) REQUIRED.

Provide all welded aluminum rack with capacity for (20) 18" x 26" pans on 3" centers, and 5" swivel casters.

Provide with the following options: solid bottom, brakes on two of the casters, rear vertical pan stop, and wrap around bumper.

MANUFACTURER & MODEL: NEW AGE 93024PSPBCL

CARTER HOFFMANN "HEAVY DUTY", CRES-COR "207-1820", WINHOLT ALUN-1820/HD SB-PEB-VB, and CHANNEL "AXD1820-JS" will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 19 UTILITY CART -- THREE (3) REQUIRED.

Provide 1000 lb. capacity stainless steel carts. Cart shelf to be 14-gauge stainless steel reinforced front and back with 16-gauge angles. Legs are to be 1/8" thick stainless steel angle. Wheels to be (2) 5" swivel and (2) 8" fixed with polyurethane tires. Provide with bumpers on legs and handle.

MANUFACTURER & MODEL: LAKESIDE (1) 943, (2) 944

STERIL-SIL and SAMMONS EQUIPMENT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 20 OPEN NUMBER.ITEM 21 ICE MACHINE W/BIN -- ONE (1) REQUIRED.

Provide air-cooled, individual crescent cube, ice machine with 393 lb. production capacity in a 24 hr. period installed on a 300 lb. capacity ice storage bin. Ice machine to have stainless steel exterior. Storage bin to have stainless steel exterior with polyethylene interior liner. 115/60/1

Provide with the following option: stainless steel legs.

As part of this unit, provide the manufacturer's recommended water filtering system with standard components. Size filtering system for this machine. Along with components shipped with base system, furnish (1) additional cartridge. Secure filter system on wall as shown on drawing ready for P.C. to make final connections. P.C. to make final connection to water source and interconnect to ice machine.

K.E.C. to set in place. Plumbing Contractor to provide all plumbing connections. Electrical Contractor to provide all electrical connections.

MANUFACTURER & MODEL: HOSHIZAKI KM-350MAJ/B-300SF

MANITOWOC and ICE-O-MATIC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 22 SLICER -- ONE (1) REQUIRED.

Provide gravity feed slicer with 13" removable knife. Slicer is to operate in either manual or automatic mode. Slicer motor to be 1/2 HP with a start capacitor and electronic start switch. Base, support arm, product tray, gage plate, and knife ring guard shall be anodized aluminum with no cracks or crevices. The knife and knife cover shall be constructed of stainless steel. The product tray is to be angled at 45° for gravity feed of product. Product tray drive is to have four fixed speeds and three stroke lengths. The knife shall be 300 series formed stainless steel base material with stellite edge machined and ground into finished form. A knife removal tool is to be supplied with the slicer to allow for quick, easy removal and re-installation of the knife for cleaning. The removal tool will securely hold the knife and will cover the sharp edge while the knife is removed from the slicer. Provide slicer with the following interlock system: product tray must be in home position to start, when gage plate is closed the knife will be turned off, a no volt release, gauge plate must be closed and product tray must be in home position before product tray can be removed, (when product tray is removed, gauge plate can not be opened) and if slicer is not used within 30 seconds, the slicer will automatically shut off. Slicer to be provided with a top mounted stone type sharpener located behind knife. Sharpener to be removable without tools. The knife is guarded when sharpener is removed. Slicer to be provided with lift mechanism to facilitate raising, and tilting the slicer for easy cleaning underneath machine, adjustable product fence, and 6' cord, and plug. 120/60/1

Provide with the following options: dish washer safe knife removal tool, low fence, and tubular chute including plunger.

MANUFACTURER & MODEL: HOBART HS-9

BIZERBA "GSPHD" and GLOBE "SG13A" (with removable knife and carriage option) will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 23 MOBILE OUTRIGGER TABLE – ONE (1) REQUIRED.

Provide 20 1/2" wide x 26" deep x 33" high heavy duty mobile outrigger table. Table construction to include all welded 304 stainless steel, 16 gauge polished stainless steel work top with marine edge on all four sides and under shelf with turned down edges, welded stainless steel tubular base, 10 gauge stainless steel reinforcing stress plates at corners for casters, 12 gauge stainless steel uprights, fifteen (15) tray slides with rounded corners, wing channels on left and right side of table for supporting various sizes trays, and 5" diameter heavy duty swivel casters w/dual locking brakes (locking both swivels and wheels). Dual locks to be on all four casters.

MANUFACTURER & MODEL: FWE OTR-15-MSWT

CUSTOM (must use same manufacturer as for rest of project) will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 24 FOOD PROCESSOR - ONE (1) REQUIRED

Provide food processor with 1/3 HP, 420 RPM motor with overload protection, planetary gear driven drive system, anodized aluminum housing and top cover, continuous feeding chute, pusher handle, off/on switch with lid safety interlock, aluminum slicer plates with removable stainless steel cutting knives, 8 foot power cord and plug, and UL and NSF listing. 120/60/1

Provide with the following options: 6-pack plates which include 1/16", 5/32", 7/32", 3/8" slicer plates, 3/16" shredder plate, 3/8" dicer plate, and two wall racks.

MANUFACTURER & MODEL: HOBART FP-100

BERKEL and GLOBE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 25 PREP SINK -- ONE (1) REQUIRED.

Provide custom 12'-0" long x 30" wide 14-gauge stainless steel table with 34" working height, marine edge at all worktop edges, knockouts in table top on 6" centers for vacuum breaker (supplied with garbage disposer), rigidly reinforced top, two (2) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts and cylinder locks keyed the same as other tables, stainless steel disposer control mounting bracket, sound deadening, stainless steel channel under bracing, stainless steel gussets, stainless steel legs with adjustable stainless steel bullet feet, two (2) stainless steel adjustable flanged feet on outside rear legs, welded stainless steel cross bracing under sink area, and 16-gauge stainless steel fully welded undershelves.

In top, as shown on drawings, provide two (2) integral 18" x 22" cove cornered sinks. Sink with disposer to be 10" deep. Other sink to be 12" deep with crumb cup waste. Both sinks to have bottoms creased to opening for waste.

In table top behind sink provide a 36" long x 4" wide x 4" high integral stainless steel riser. Provide riser with a 36" long x 4" wide chase to extend from top of riser to 4" above ceiling level. Chase is to be 18-gauge all welded stainless steel with removable rear access panel to allow for installation of faucet and necessary plumbing connections. Panel to be removable without the use of tools. Secure chase to riser with screws and secure a 2" stainless steel collar where chase extends through ceiling. Provide on chase a splash mounted T&S B-2278-01-CR-MOD pre-rinse with B-0970-FE vacuum breaker, ceramic cartridges, B-0230-K Splash Mount installation kit, B-CVV1-2 check valves, B-1420 squeeze valve w/quick connect socket, B-1421 quick connect spray and B-1428 quick connect fan jet spray heads, B-0044-H2A hose, 060X 8" swing nozzle and B-0199-01 aerator, and B-0109 wall bracket.

See drawings for further details.

Set in place as shown on drawings and secure to floor with stainless steel bolts.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 26 DISPOSER -- ONE (1) REQUIRED.

Provide 1-1/4 hp adaptor mounted disposer with 6" reversible adjustable rotor/turntable, Series F sink assembly, splash guard, solenoid, flow control, sink stopper, and control panel with automatic reversing magnetic contactors, overload protection, alternator, automatic delay timer for motor and water run time, low voltage protection, emergency disconnect switch, and push button operation. 208/60/3

Furnish with the following option: B-0456 (deck mount) vacuum breaker assembly.

K.E.C. to install disposer to sink adaptor, control panel on mounting brackets below drain board, and wire to solenoid and disposer.

All disposers must be from the same manufacturer.

MANUFACTURER & MODEL: MASTER F114-L-SK-RAC2

INSINGER and RED GOAT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 27 OPEN NUMBER.

ITEM 28 WORK TABLE W/OVERSHELF -- FOUR (4) REQUIRED.

Provide custom 6'-0" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, two (2) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks with all locks to be keyed the same.

Provide 6'-0" long x 10" wide 16-gauge stainless steel over shelf. Front, ends and back to be turned down 1" and under 1/2". Weld and polish intersections. Mount shelves on 1" 16-gauge stainless steel legs and attach to table top with concealed fasteners.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 29 WORK TABLE W/OVERSHELF -- ONE (1) REQUIRED.

Provide custom 6'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, two (2) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks with all locks to be keyed the same.

Provide 6'-6" long x 10" wide 16-gauge stainless steel over shelf. Front, ends and back to be turned down 1" and under 1/2". Weld and polish intersections. Mount shelves on 1" 16-gauge stainless steel legs and attach to table top with concealed fasteners.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 30 WORK TABLE W/SINK, CHASE, AND OVER SHELF-- ONE (1) REQUIRED.

Provide custom 6'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, stainless steel channel underbracing, two (2) 20" X 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks with all locks to be keyed the same, sound deadened, stainless steel gussets, stainless steel legs, welded stainless steel cross bracing under sink area, 16-gauge fully welded undershelf under balance of table, and adjustable stainless steel bullet feet - two outside rear feet to be flanged.

Provide 4'-6" long x 10" wide 16-gauge stainless steel overshelf. Front, ends and back to be turned down 1" and under 1/2". Weld and polish intersections. Mount shelves on 1" 16-gauge stainless steel legs and attach to table top with concealed fasteners.

In top, as shown on drawings, provide integral 16" x 20" x 10" deep cove cornered sink with bottom creased to crumb cup waste.

In table top behind sink provide a 4" deep x 16" wide x 4" high integral stainless steel riser. Provide riser with a 4" x 16" chase to extend from top of riser to 4" above ceiling level. Chase is to be 18-gauge all welded stainless steel with removable access panel to allow for installation of faucet and necessary plumbing connections. Panel to be removable with out the use of tools. Secure riser to curb with screws and provide a T&S B-0231-CR faucet with ceramic cartridges, B-0199-01 aerator to face of chase 6" above tabletop. Secure a 2" stainless steel collar where chase extends through ceiling.

Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

See drawings for further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 31 OPEN NUMBER.ITEM 32 HOOD SYSTEM – ONE (1) REQUIRED.

Provide exhaust/tempered make up air system as shown on the drawings. Complete system to include: exhaust and make up air fans, make up air heater, hood, connecting duct, start up/air balance/service. System to meet all requirements of NFPA Code 96, Kentucky Mechanical Code, U.L., and bear the NSF seal #908. Hood manufacturer must assume responsibility for installation of hoods, ductwork, fans, and all support equipment specified in this item description except where noted "WORK BY OTHER TRADES".

EXHAUST FAN: Provide one (1) roof exhaust blower of the upblast centrifugal, spun aluminum, belt-driven type. Fan to be U.L. 705 listed for general ventilation use. Rated at 6,260 CFM at 1.125" sp., 3.0 hp, 480/60/3. Fan must include a 30" wheel and not exceed 15.1 sonex. Fan to include disconnect switch.

SUPPLY FAN: Provide one (1) supply air fan of the centrifugal belt-driven, side inlet type, rated at 5,008 CFM at 1.5" sp., 5.0 hp, 480/60/3. Fan chosen must include a 15" wheel and not exceed 21.0 sonex. Cabinet to be constructed of 18-gauge galvanized steel with painted enamel exterior finish. Blower inside case to be heavy gauge, rigid steel die stamped housing. Blower to be mounted for downblast discharge, Preslok wheel to have sealed sleeve bearings. Drive sheave and motor base plate to be adjustable. Motor to be open drip-proof with ball bearings. Motor plate and bearings to be mounted on vibration isolators. Factory-wired three-phase disconnect switch in unit cabinet to be included. Provide motor starters for exhaust and supply fans in supply fan cabinet. An auxiliary contact will be provided on the starter contactor for the hood exhaust fan. Connection to the Building Management System will be by Control Contractor. Outside air intake shroud to include four (4) washable aluminum outside air filters. Motorized backdraft damper to be mounted in unit make-up air outlet. Damper to close when unit is turned off to prevent outside air infiltrating the building.

DIRECT-FIRED GAS FURNACE: Provide one (1) furnace to be direct-fired, gas type, provided as a modular attachment to the supply fan, rated at 370,100 BTUH. Unit set for 7" WC minimum pressure at rated flow, 14" WC maximum, 1" gas supply connection. Burner box to be all galvanized steel material. Baffle plates to be installed in

burner box to provide proper air flow across burner for ordered CFM. Control box to be all galvanized steel material. Cabinet door to be lift-out type for easy access to controls. Burner to have cast iron supports and stainless-steel perforated air foils, with 30 to 1 turndown ratio for optimal energy efficiency. Spark ignition to be on all control systems. Controls include 50 to 90 degrees operating range. System to be ETL listed per ANSI 283.4-1999 and 283.4a-2001 standards. All components are to be factory-mounted in the furnace. Control voltage to be 120/60/1. Burner control to be electronic control system. Controls on-off so that standing pilot is not required. Wiring harness is included to provide control voltage from supply fan to furnace.

ROOF CURBS: Provide two (2) roof curbs consistent with other curbs furnished for this project. Curb material to be 18-gauge, all-welded galvanized construction. Curbs to be internally insulated with rigid fiberglass with foil backing. Provide one (1) equipment support rail, to be same construction and material as curb, with adjustable cap for leveling in the field.

HOOD: Provide island-style Type II canopy exhaust hood for condensate removal, sized at 12'-6" long x 11'-0" wide x 24" high. Hood to be fabricated in two (2) sections. Factory to supply all fasteners required for assembly in the field. Hood body to be constructed of 18-gauge, type 304 stainless steel, solid welded and polish to face, no exposed joints. Provide integral bottom support frame for baffle panels. Provide (12) stainless steel interior baffle panels, constructed of same material as hood body and removable without use of tools. Hood lights: provide (6) 36" UL listed, recessed LED fixtures, constructed for use in canopy exhaust hoods. Factory to wire fixtures to junction box on top of the hood. Provide bulkhead between top of hood and ceiling on all exposed sides, constructed of same material as hood body.

DUCTWORK: Exhaust duct to be light gauge lock-formed galvanized material. All seams to be sealed liquid tight. Duct work to extend from top of condensate exhaust hood to exhaust fan on the building roof. Make-up air duct to be 24-gauge steel and fabricated per SMACNA low pressure standards. Provide make-up air plenums at ceiling for supply air, constructed of steel with white-clad finish. Provide stainless steel perforated face diffuser.

INSTALLATION: By this contractor to include hanging hoods, setting exhaust fan and supply fan/furnace on building roof, locating roof curbs and equipment rail on shop drawings to be provided, fabricating and installing connecting ductwork, fabricating and installing make-up air plenum.

WORK BY OTHER TRADES:

NOTE: Control switches for hood lights and exhaust/supply fans to be mounted on Energy Distribution System. Switches to be provided by E.D.S. manufacturer (see E.D.S. drawings).

KITCHEN EQUIPMENT CONTRACTOR: To coordinate with General, Electrical, HVAC and Plumbing contracts.

ROOFING CONTRACTOR: Provide roof openings as required. Set in place and flash (with cant if required) roof curbs and equipment support rail provided by the hood system manufacturer.

STRUCTURAL CONTRACTOR: Frame roof openings as required. Coordinate joist or structural member installation to provide required clearances for ductwork and rated assemblies.

ELECTRICAL CONTRACTOR: (Hood System Requirements) Provide 120/60/1 20-amp circuit for hood lights and controls to junction box on top of hood. Provide 3-phase circuit (for fan motors) to disconnect switch mounted on exterior of supply fan cabinet. Extend power wiring from motor starter panel (mounted on exterior of supply fan) to connection point on exhaust fan. Provide conduit and four wires from switches mounted on E.D.S. unit to terminal block on supply fan motor starter panel. This work must be in accordance with the N.E.C.

MECHANICAL CONTRACTOR: Provide net room air demand as indicated on the hood system drawings. This air volume is required only when hood system is in operation. Provide normal heating and cooling of the kitchen area. Provide and install gas service to furnace, regulated between 7" and 14" WC, on building roof.

Hood manufacturer shall file for all state and local permits.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER & MODEL: MASTER AIR

HALTON and AVTEC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 33 ENERGY DISTRIBUTION SYSTEM -- ONE (1) REQUIRED.

Provide energy distribution and management system, which shall be island mounted, pre-wired and pre-plumbed to one final connection point for electric, and hot and cold water service to support the equipment items as shown on drawing. Additional connections shall be required of respective trades for connection of hood and fire suppression system components.

Compliance:

System to be Underwriters' Laboratories (UL) listed utility distribution system as a complete system manufactured according to the latest edition of NEC, NFPA Pamphlet No. 96 and No. 54, ANSI, ASME, Uniform Plumbing Code, NEMA, and OSHA, using only UL tested, Bureau of Mines rated, I. A. P. M. O. certified components. System will meet N. S. F. standards and local building codes.

Construction:

The EDS system will be 11'-6" long x 12" wide, completely modular with riser and pedestal sections. End caps and exterior panels will be constructed of 16-gauge type 304 stainless steel #4 finish, and all removable riser and pedestal panels will be constructed of 18-gauge stainless steel. The pedestal will be secured to the floor with unexposed stainless steel angle interior reinforcing flanges. The plumbing compartment will be isolated and weatherproof sealed from the electrical compartment by a 16-gauge stainless steel divider. Doors and field joints will be fully sealed or gasketed, all electrical compartments will be NEMA type 4 or NEMA type 12 enclosures, and all receptacles, switches, and circuit breakers will be provided with a weatherproof cover compatible with and covering the accessible portion of the receptacle face, switch actuator, and circuit breaker actuator.

Provide a 14-gauge stainless steel mounting plate to the EDS system. Secure bracket directly behind control panel of item 39 for mounting of the T&S B-0104D wall hose hanger hook provided by the Kitchen Equipment Contractor.

Provide and install water filter system sized to service all steam cooking equipment. Unit to be hard connected at factory to feed filtered water line within EDS. Along with components shipped with base system, furnish (2) additional pre-filter cartridges and (4) multi-purpose media cartridges. Kitchen Equipment Contractor to make final connection from filtered water line to each piece of steam equipment with quick disconnect water hoses provided by the EDS Manufacturer.

Kitchen Equipment Contractor to make final connection from filtered water line to each piece of steam equipment with quick disconnect water hoses provided by the EDS Manufacturer.

P.C. to make final connections to water source and interconnect equipment water supply line. K.E.C. is responsible for making sure P.C. connects system to equipment line only.

Island mounted system will be provided with neoprene bumper strips and a 6" peaked top.

Electrical:

Main electrical feeders in system will be four conductor solid copper bus bars having balanced loads and phases with branch circuit locations directly behind each connection plate. Bus bars will be of capacity for a full load the entire length of system, mounted on non-conductive insulators spaced 14" to 24" centers, provided with solid copper connection lugs for main service and system equipment ground. Field joints will be connected by securing bolts in each bus bar through pre drilled holes. Branch circuit wiring for each electrical connection will be phase identified

and sized according to the circuit breaker rated ampacity.

Safety and Control:

Provide a 16-gauge stainless steel gasketed connection plate for each electrical connection, provided with a point-of-use circuit breaker with knob-type watertight actuator and dual-color (green-on, red-off) 24-volt LED type status indicator lights. On each connection plate provide a UL tested adjustable trip, 24-volt power sensitive ground fault sensor and relay, which can be adjusted by maintenance personnel to eliminate any nuisance tripping should it ever occur. Regardless of voltage, amperage or phase, the equipment connected to the EDS system that might develop an internal current leakage to ground or power supply, not detectable by the circuit breaker, will be automatically disconnected from its power source without affecting the operation of any other connected equipment. A ground fault test button will be provided on each plate to check for proper operation of this device. Connection plate will be individually grounded to system main frame and will be provided with a grounding type receptacle having a specific NEMA polarized configuration. Each connection plate assembly will bear the UL label as having met UL branch circuit requirements for voltages up to and including 480 volts.

Furnish fire fuel shut off for the main Circuit breakers cutting off power to the electric service for individual pieces of equipment per NFPA No. 96. Shut off system will be pre-wired in Caddy system, needing only one final connection by electrical contractor from 120-volt power source in fire extinguishing system relay or micro switch. Caddy to furnish manual resets for each individual electric connection, using no external solenoid valves, contactors, relays or shunt trips.

Plates will be spaced on 10" centers and have a quick connect and quick disconnect means of separating each ground fault device, fire fuel shut off and all control wiring from the EDS system to simplify changing of connection plates for future additions, deletions or changes of equipment. Provide UL tested matching special purpose power supply cord and plug set for each connection plate; 125 volt and 250-volt cord sets more than 60 amps and all 480-volt cord sets will be shielded and non-arcing type. All cords will be provided with strain relief grips at the equipment connecting end.

Provide a recessed control panel mounted in an end cap of if island mounted system of which will include a duplex convenience outlet with circuit breaker and equipment status indicator lights numerically coded to indicator lights on each connection plate to show "power". The control panel will also house the following controls: a warning light and solid-state whistle, ventilator light switch with a circuit breaker; and an exhaust fan breaker.

Provide a system disconnect switch that will shut down the electrical power to all the equipment on line without the need for getting to the main circuit breaker panel that is remote from the EDS system.

No live electrical parts or wiring in panels will be accessible unless panels are removed requiring the use of security keys or tools. Permanently lettered metallic labels showing operational procedures and markings according to UL, must be provided as part of this system.

Plumbing:

Provide direct reading combination pressure temperature gauges for incoming services for hot water and a pressure gauge for the cold water. Provide quarter turn ball type shut off valves for water main incoming services. To permit easy cleaning a non-combustible, glass smooth, color coded plastic coating is to be applied to each water hose supplied with the EDS system. All piping and disconnects will be color coded.

Hot and cold water piping will be hard temper type "1" copper tubing with copper sweat type solder fittings, wrapped with 1/8" thermal closed cell pipe insulation. Each branch outlet will be provided with a safe tested, fully adjustable connector assembly consisting of a stainless steel braided restraining chain, complete with a solid brass two way quick disconnect device for instant removal.

Submittal Requirements:

At the time of submittal, to receive approval, the manufacturer must supply a copy of their UL test Report and UL listing Card to show compliance with the electric and plumbing services as required in this project, besides UL Cards for Ground Fault Sensing and Relaying Equipment, Panelboard Accessories (connection plate assembly), and Cord Sets and Power Supply Cords.

The manufacturer must submit samples, drawings and diagrams of the following system assemblies for evaluation and approval before the equipment contractor preparing his submittal: U. L. tested interchangeable connection plate assembly complete with circuit breaker and knob type watertight actuator, adjustable trip 24-volt ground fault sensor and relay, 24-volt fire fuel shut off mechanism, NEMA configuration outlet, 24-volt dual colored LED status indicator light, and test button.

Provide twist lock plugs on all electric Combi Ovens with long enough cords for servicing.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER AND MODEL: CADDY CA-ID-EW-012

AVTEC, and HALTON will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 34 FLOOR TROUGH -- ONE (1) REQUIRED.

Provide floor trough 72" x 12" x 4" deep constructed of 14-gauge stainless steel type 304, completely welded and coved. All welds are to be ground and polished smooth. The four top edges are to be 1" wide and formed down 1" on the outside, integrally formed 1" wide x 1" deep interior ledges on long sides to support drain trough grate. The bottom is pitched to a central cup style waste drain fitted with removable stainless steel scrap basket. Drain pipe to be 4" outside diameter. Stainless steel tabs are to be included for securing the trough to the floor.

Furnish with three (3) equal length sections of subway style all welded grate constructed of 3/16" x 1" stainless steel bars set in a vertical position. Three 1/2" stainless steel rod supports, two (2) set in 3" from each edge, one (1) centered, shall pass through holes in the treads. Treads are then welded to the rods on 11/16" centers.

Top of floor trough to be mounted flush with finished floor (No Exceptions). If a dispute arises with the installing plumber or the local Plumbing Inspector over the level at which the floor trough is installed, the Kitchen Equipment Contractor is required to notify the Design Team. Kitchen Equipment Contractor to deliver floor trough to Plumbing Contractor for installation. Kitchen Equipment Contractor to furnish Plumbing Contractor with necessary documentation and supervision for proper installation of this piece of equipment.

All floor troughs shall be of the same manufacturer.

MANUFACTURER & MODEL: IMC TEDDY FT/SG

MADE-TO-DRAIN, GATES, and CUSTOM (must use same Manufacturer as chosen for rest of this project) will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 35 CONVECTION OVEN – DBL. STACK - ONE (1) EXISTING.

Existing equipment supplied by owner. K.E.C. to relocate and set in place per drawings.

S/N: N/A (2) 480/60/3

MANUFACTURER & MODEL: BLODGETT ZEPHAIRE-100-E-DOUBLE

ITEM 36 CONVECTION OVEN – DBL. STACK - ONE (1) EXISTING.

Existing equipment supplied by owner. K.E.C. to relocate and set in place per drawings.

S/N: N/A (2) 480/60/3

MANUFACTURER & MODEL: VULCAN VC55E

ITEM 37 COMBI OVEN – ROLL-IN -- ONE (1) REQUIRED.

Provide roll-in model electric CombiMaster PLUS Combi Oven. Oven to have 304 stainless steel interior and exterior, and include: right-hinged door with rear-ventilated double-glass, plug-in type door gasket, integral sealing mechanism for cooking cabinet, magnetic door switch with automatic shut-off when opened and restart when closed, seamless hygienic cooking cabinet with coved corners and splash guard, halogen illuminated cooking cabinet, Care Control system with automatic cleaning and descaling of steam generator, 7 cleaning stages for unsupervised overnight cleaning and care, reversing programmable 5 speed fan, integral fan impeller brake, safety temperature limiter, high-performance fresh steam generator, automatic active rinsing and drainage of steam generator by pump, CombiMaster PLUS control panel, individual programming of 100 cooking programs with up to 6 steps each, diagnostic system with automatic service notices, mode and alarm displays, HACCP data output and software update via integral USB Interface, manual cleaning program, integral maintenance free grease extraction system, cool down system, automatic adaptation to the installation location (elevation, climate, etc), swiveling service door for service and monitoring, retractable hand shower with automatic rewind, separate solenoid valves for fresh or soft water, menu-guided descaling program, demand related power supply by means of modulating, low-noise high-performance blower burner system, integral core temperature probe, and mobile rack with ten (10) grid shelves and 5" casters. Mobile rack configured for twenty (20) 18"x26" sheet pans and to have handle mount for mobile oven rack. Oven to be microprocessor controlled. 480/60/3

CombiMaster PLUS control panel to include: power on/off dial with pictograms for operation modes, cool down control, programming/program start button, humidity setting controls, LED illuminated clear display with dial for cooking cabinet temperature setting, fan speed control, LED illuminated clear display with dial and buttons to set and view cooking time (selection 0-24 hours with continuous run settings) and core temperature.

Provide with the following options: one (1) extra mobile oven rack, ten (10 ea) grid shelves, twenty (20 ea) 12"x20" Combi Fry Baskets, automatic drain cool down kit (cool down kit must be able to cool drain water down to a minimum of 140°), installation kit, container of 56.00.210A oven cleaner tablets, container of Rational rinse tablets 56.00.211, and certified Rational installation.

E.D.S. manufacturer to provide steam equipment manufacturer approved water filter, filtered water line, and filtered water connections.

MANUFACTURER & MODEL: RATIONAL CMP 202 E

CONVOTHERM and HENNY PENNY will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 38 OPEN NUMBER.ITEM 39 KETTLE 40 GALLON - TILTING -- ONE (1) REQUIRED.

Provide low profile electric, self contained, manual tilting, 40 gallon, full steam jacketed kettle. Kettle and supports to be type 304 stainless steel. Steam jacket to have 50-psi rating and be factory filled with treated distilled water and fitted with a high capacity pouring lip. Venting and/or refilling not required. Temperature and low water safety feature to be solid state controlled mounted in a plug-in control module. Pressure/vacuum gauge to be recessed and safety valve to be mounted under kettle. Tilt mechanism to be roller bearing and case hardened self-locking worm and segment gear. Unit to be mounted on 1-5/8" tri-leg supports with adjustable flanged feet. 480/60/3

Provide with the following options: high wattage, spring assisted hinged cover, pan carrier, 2" draw-off valve with strainer, custom stainless steel faucet mounting bracket, measuring strip (Note: If measuring strip is not available, then provide etched markings), food strainer, T&S #B-0179-01-CR modified with base faucet and ceramic cartridges, T&S #B-0179-01-CR modified with base faucet and ceramic cartridges (right side kettle), B-1420 squeeze valve w/quick connect socket, B-1421 spray quick connect and B-1428 quick connect fan jet, custom faucet mounting bracket (see detail drawing), T&S HG-4D-48SK quick disconnect swivel gas hose kit, and (2) T&S HW-4C-48 quick disconnect water hoses.

Set in place as shown on drawings and secure to floor with stainless steel bolts. Install custom bracket with faucet to

control housing, and hanger hook to wall or hanger hook to bracket located on EDS.

Fees for any required inspections or test are to be part of this contract.

All steam cooking equipment shall be from the same manufacturer.

MANUFACTURER & MODEL: CLEVELAND RANGE KEL-40-TSH

GROEN and BLODGETT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 40 FLOOR TROUGH -- ONE (1) REQUIRED.

Provide anti spill floor trough 30" x 36" x 6" deep constructed of 14-gauge stainless steel type 304, 18-8, completely welded and coved. All welds are to be ground and polished smooth. The four top edges are to be 1- 1/2" wide and formed down 1" on the outside, the two long sides have integrally formed 1" wide x 1" deep interior ledges to support drain trough grate. The sides are to be coved in such a manner as to prevent liquids from splashing out of the pan area. The bottom is pitched to a central cup style waste drain fitted with removable stainless steel scrap basket. Drain pipe to be 3.3" in diameter. Stainless steel tabs are to be included for securing the trough to the floor. Furnish with subway style all welded grate constructed of 3/16" x 1" stainless steel bars set in a vertical position. Three 1/2" stainless steel rod supports, two (2) set in 3" from each edge, one (1) centered, shall pass through holes in the treads. Treads are then welded to the rods on 13/16" centers.

Top of floor trough to be mounted flush with finished floor (No Exceptions). If a dispute arises with the installing plumber or the local Plumbing Inspector over the level at which the floor trough is installed, the Kitchen Equipment Contractor is required to notify the Design Team. Kitchen Equipment Contractor to deliver floor trough to Plumbing Contractor for installation. Kitchen Equipment Contractor to furnish Plumbing Contractor with necessary documentation and supervision for proper installation of this piece of equipment.

All floor troughs shall be of the same manufacturer.

MANUFACTURER & MODEL: IMC TEDDY ASFT-3036/SG

MADE-TO-DRAIN, GATES, and CUSTOM (must use same Manufacturer as chosen for rest of this project) will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 41 CONVECTION STEAMER -- TWO (2) REQUIRED.

Provide two compartment 10-pan pressureless convection steamer with electric twin independently operated 32 kW atmospheric steam generators, automatic water level float, automatic water fill, automatic blow-down, manual by pass, compensating thermostat, and mechanical timer. Each cooking compartment to have capacity for five full size hotel pans 2-1/2" deep. 480/60/3

Provide with the following options: rear water connections, Dissolve six (6) one-gallon liquid descaling solution, automatic drain cooling kit (cool down kit must be able to cool drain water down to a minimum of 140°F), and compartment door steam shut-off switch. Fees for any required inspections or test are to be part of this contract.

Provide the following Vollrath stainless steel pans: (1 ea.) 30022, 30023, 30042, 30043, and 30442. POLAR WARE and CARLISLE will be accepted as an equal.

E.D.S. manufacturer to provide steam equipment manufacturer approved water filter, filtered water line, and filtered water connections.

Kitchen Equipment Contractor to set steamer in place as shown on drawing, provide drain line to floor sink per manufacturer's specification and install drain water tempering kit. Electrical Contractor and Plumbing Contractor shall be responsible for making electrical and cold water connections to the drain water cool down

kit.

All steam cooking equipment to be of the same manufacturer.

MANUFACTURER & MODEL: CLEVELAND RANGE 24-CEA-10

GROEN and BLODGETT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 42 OPEN NUMBER.

ITEM 43 WORK TABLE W/SINK & POT RACK -- ONE (1) REQUIRED.

Provide custom 6'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, sound deaden, stainless steel channel underbracing, stainless steel gussets, stainless steel legs with adjustable stainless steel bullet feet - two outside front feet to be flanged, 16-gauge fully welded stainless steel undershelf, 20" x 20" fully enclosed stainless steel drawer housing with vinyl insert located as shown and cylinder locks keyed the same as other tables, and welded stainless steel cross bracing under sink area.

In top, as shown on drawings, provide integral 16" x 20" x 10" deep cove cornered sink with bottom creased to crumb cup waste.

Provide table with a 4'-4" long stainless steel floor mount-three bar pot rack with over shelf installed on 1 5/8" O.D. 16- gauge stainless steel uprights that extend through die stamped openings in table top through rear legs. Rack is to be constructed of 2" x 1/4" stainless steel slide bars with the outside bars having rounded ends and the lower bar centered 10" below the outer bars. Provide with stainless steel double point sliding hooks installed on 8" centers.

Over shelf to be 4'-7" x 12" long 16-gauge stainless steel with edges turned down 1 1/2" and under 1/2' on a 45° angle with all corners welded and polished. Shelf to be mounted to table by extending pot rack legs through die stamped openings in shelf and locked in place with set screws. Shelf height to be adjustable.

In table top behind sink provide a 16" long x 4" wide x 4" high integral stainless steel riser. Provide riser with a 16" x 4" chase to extend from top of riser to 4" above ceiling level. Chase is to be 18-gauge all welded stainless steel with rear removable access panel to allow for installation of faucet and necessary plumbing connections. Panel to be removable with out the use of tools. Secure riser to curb with screws and provide a T&S B-0231-CR faucet with ceramic cartridges and B-0199-01 aerator to face of chase 6" above tabletop. Secure a 2" stainless steel collar where chase extends through ceiling.

Set in place as shown on drawings and secure flanged feet to floor with stainless steel screws. See drawings for further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 44 WORK TABLE -- ONE (1) REQUIRED.

Provide custom 6'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, two (2) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks keyed the same as other table drawers.

Provide notch in table top to accommodate building column. Field verify required dimensions.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 45 OPEN NUMBER.ITEM 46 BAKERS TABLE -- ONE (1) REQUIRED.

Provide custom 7'-0" long x 30" wide 14-gauge stainless steel top with 5" high double walled fully enclosed splash on rear, and both sides. Top to be 34" working height, and of integral construction, rigidly reinforced, stainless steel channel underbracing, and sound deadened.

Top to be secured at one end of table on an 18-gauge stainless steel enclosed cabinet with a tier of three (3) 20" x 20" drawers with 5" deep vinyl inserts. Cabinet to rest on four (4) 6" stainless steel legs with adjustable stainless steel bullet feet.

Balance of table to be mounted to welded open front stainless steel pipe base with one end of rear cross rail attached to cabinet base by use of stainless steel flange. Legs to be fitted with adjustable stainless steel bullet feet.

Over table, provide a 7'-0" long by 12" wide 16-gauge stainless steel shelf. Front to be turned down 1", and under 1/2". Rear, and ends to be turned up 2", then hemmed down 3", and under 1/2". Weld, and polish intersections. Mount on four 1" O.D. stainless steel legs secured to splash with expandable type mounting bolts.

Provide as part of this item three PIPER PRODUCTS 47-75 stainless steel portable bins and sliding lids. Custom manufactured bins will be accepted as an alternative provided they conform to the dimensions, construction, design, capacity, and function of the specified Manufacturer and are by the same custom fabricator providing the bakers table.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 47 MIXER 30 QT. -- ONE (1) REQUIRED.

Provide floor mounted 30-quart mixer with 3/4-hp motor. Provide with standard accessories consisting of bowl guard, 30-quart stainless steel bowl, "B" flat beater, and stainless steel D" whip. 208/60/1

Provide with the following options: (1) extra 30 qt. stainless steel bowl and (2) bowl dollies.

MANUFACTURER & MODEL: HOBART HL-300

DOYON and VARIMIXER will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 48 HOT WATER DISPENSER -- ONE (1) REQUIRED.

Provide counter top hot water dispenser which shall have a 12 gallon stainless steel tank with the capacity of dispensing 8 gallons of continuous hot water. Provide unit with the capability of dispensing 2, 3, or 4 quarts of hot water at a temperature ranging from 75°-200°F and shall have a manual dispensing button to allow for other water volume options. Unit shall be provided with electronic temperature controller, on-off switch, high temperature limit and a low water cut-off, and digital temperature read out. Water dispensing spout to be no more than 55" above finished floor. 208/60/1

Kitchen Equipment Contractor shall remove plastic legs and provide 4" high stainless steel or polished nickel legs with (2) adjustable flange feet installed diagonally.

Provide as part of this item a six-foot food safe rubber hot water drain hose, Rubbermaid FG321700 (2 quart) and FG321800 (4 quart) heat resistant polycarbonate pitcher. CAMBRO and CONTINENTAL will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

Set in place as shown on drawings and secure flange feet to table with stainless steel bolts and calibrate water flow to match preset dispensing buttons.

MANUFACTURER & MODEL: HATCO AWD-12

BUNN-O-MATIC H10X-80 and BLOOMFIELD will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 49 WORK TABLE -- ONE (1) REQUIRED.

Provide custom 2'-0" long x 30" wide 14-gauge stainless steel table with 34" working height (If Bunn Hot Water Dispenser is used table working height to be 22"), marine edge on front, ends and rear, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs with adjustable stainless steel bullet feet - two feet to be flanged on diagonal corners or 5" diameter casters (all w/brakes that lock both the swivel and the wheels), and 16-gauge fully welded stainless steel undershelf.

If Bunn Hot Water Dispenser is selected this table is to have a working top height of 24".

Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 50 PASS-THRU FREEZER -- ONE (1) REQUIRED.

Provide single section pass-thru freezer with full length doors, (3) wire shelves per door section. Finish to be stainless steel interior and exterior. See drawing for door swing. Hinged front shroud condenser, V-Temp Controller to include an on/off switch, manual defrost, interior light switch, LED temperature indicator in °C or °F, a hi/lo audio/visual temperature alarm, power supply interruption, door ajar and "clean condenser" alarms. A manager's "lock-out" feature is provided to safeguard pre-determined control settings. A HACCP event indicator/memory feature announces and records up to nine (9) alarm events. Unit includes super cool down feature and the cabinet automatically reverts to the energy saving mode when there are no door openings for four hours. Provide unit with cord & plug. Refrigerant to be R-290. 115/60/1

Provide with the following options: 5" diameter swivel casters (2 w/locking brakes), (1) extra shelf per door section and two year parts/labor warranty.

Pass-Thru Freezer to be of the same manufacturer as Items 52 & 56.

MANUFACTURER & MODEL VICTORY FS-1D-S1-PT-HC

TRAULSEN "R" SERIES and UTILITY will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 51 PASS-THRU HEAT-N-HOLD OVEN -- THREE (3) REQUIRED.

Provide pass-thru rethermalization oven with AquaTemp features. Unit to have solid state electronic control with digital readout and eighteen (18) programmable retherm and hold cycles. Each program must have capability to store time, temperature and humidity percentage. Unit to have the capability to cook at full power with six (6) blower fans or reduced power with four (4) blower fans. Cabinet to be 22-gauge stainless steel with 18-gauge stainless steel internal framework. Cabinet to have fully welded frame. Doors to be field reversible, 22-gauge stainless steel dutch doors with fully welded inner framework. Each door to have anti-microbial pull handle. Doors to be hinged as shown on drawing. Cooking compartment to be 22-gauge stainless steel, insulated and cove cornered for easy cleaning. Provide with eighteen (18) sets of stainless steel universal pan slides on 1-1/2" centers, capacity for thirty-six (36) 12 x 20 x 2-1/2" hotel pans or eighteen (18) full size sheet pans. Unit to be provided with 1-1/2" cooking probe with probe cooking capability. Unit to have separate 2000 watt heater with separate humidity control. Unit to come standard with automatic fill system that can be used with or without incoming water line. Unit to have LED and water heater shut off when water level becomes critically low. Unit to have 2" of fiberglass insulation in sides and 1-1/2" in doors, top and base. Cooking range of 140°-350° F, holding range of 75°-250° F. Unit must be

12,000 watts. Oven to be mounted on 5" diameter swivel rubber casters (2 w/locking brakes). Place controls so they are facing the kitchen. 208/60/3

Provide with the following options: 6" food temperature probe, perimeter bumper, 0840-068 cord and twist-lock plug set with matching receptacle (cord set to exit top of cabinet), four sided top shroud that matches adjacent refrigerator height, and extended 5 year parts warranty.

Pass-Thru Heat-N-Hold Oven to be of the same manufacturer as item 55.

MANUFACTURER & MODEL: CRES COR RO-151-FPW-UA-18DX-2083

ALTO SHAAM and WINSTON "CA8522PT" will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified manufacturer.

ITEM 52 PASS-THRU REFRIGERATOR -- ONE (1) REQUIRED.

Provide two-section pass-thru refrigerator with full length doors. Finish to be stainless steel interior and exterior. See drawing for door swing. Hinged front shroud condenser, V-Temp Controller to include an on/off switch, manual defrost, interior light switch, LED temperature indicator in °C or °F, a hi/lo audio/visual temperature alarm, power supply interruption, door ajar and "clean condenser" alarms. A manager's "lock-out" feature is provided to safeguard pre-determined control settings. A HACCP event indicator/memory feature announces and records up to nine (9) alarm events. Unit includes super cool down feature and the cabinet automatically reverts to the energy saving mode when there are no door openings for four hours. Provide unit with cord & plug. Set in place as shown on drawing, with temperature display digital thermometer facing kitchen. Refrigerant must be R-290. 115/60/1

Provide with the following options: 5" diameter swivel casters (2 w/locking brakes), (18) sets Type "A/C" Universal Pan Slides per section, (3) total shelves (18" x 26") for Type "A/C" Universal Pan Slides and two year parts/labor warranty.

Pass-Thru Refrigerator to be of the same manufacturer as Item 50 & 56.

MANUFACTURER & MODEL: VICTORY RS-2D-S1-PT-HC

TRAULSEN "R" SERIES and UTILITY will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 53 OPEN NUMBER.

ITEM 54 HOSE REEL – 50 FT. -- ONE (1) REQUIRED.

Provide stainless steel enclosed wall mount hose reel with 50 Ft. of 3/8" I.D. heavy duty hose with adjustable hose bumper, 3/8" NPT female inlet, B-0107 spray valve, wall mount mixing faucet with 8" centers and control valve in riser, B-0963 vacuum breaker, supply hose or for parallel mounting bracket application use: HW-4B-48 (4 Ft.) connector hose, and retractable hose reel.

Furnish with the following options: ceramic cartridges, (2) B-CVV-1/2" vertical check valves, #004R finger hook and #G019430-45 stainless steel swing mounting bracket.

Plumbing Contractor to mount mixing valve to wall per manufacturers' specification, then notify Kitchen Equipment Contractor that mixing valve is installed and ready for completion of hose reel assembly installation. Kitchen Equipment Contractor to install balance of piping to mixing valve and mount hose reel with parallel mounting bracket to wall using stainless steel bolts. See hose reel detail drawing of this item for installation details.

See detail drawing for center line of mixing valve and top point of hose reel mounting dimensions. If additional chrome piping is needed to place vacuum breaker at height as shown on drawing, then Kitchen Equipment Contractor shall provide additional length of piping.

K.E.C. to adjust hose stop so that nozzle height is to kitchen manager's preference.

Hose reel to be of the same manufacturer as all other faucets.

MANUFACTURER & MODEL: T&S B-1444-CV-CR-MOD

CHICAGO FAUCET, FISHER, and SANIGUARD will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 55 REACH-IN HEAT-N-HOLD OVEN -- FOUR (4) REQUIRED.

Provide reach in rethermalization oven with AquaTemp features. Unit shall have solid state electronic control with digital readout and 18 programmable retherm and hold cycles. Each program must have capability to store time, temperature and humidity percentage. Unit to have the capability to cook at full power with 6 blower fans or reduced power with 4 blower fans. Cabinet to be 22-gauge stainless steel with 18-gauge stainless steel internal framework. Cabinet to have fully welded frame. Doors to be field reversible, 22-gauge stainless steel dutch doors with fully welded inner framework. Each door shall have anti-microbial pull handle. Cooking compartment to be 22-gauge stainless steel, insulated and cove cornered for easy cleaning. Provide with (18) sets of stainless steel universal pan slides on 1-1/2" centers, capacity for (36) 12 x 20 x 2 1/2" hotel pans or (18) full size sheet pans. Unit to be provided with 1-1/2" cooking probe with probe cooking capability. Unit to have separate 2000 watt heater with separate humidity control. Unit to come standard with automatic fill system that can be used with or without incoming water line. Unit to have LED and water heater shut off when water level becomes critically low. Unit to have 2" of fiberglass insulation in sides and 1-1/2" in doors, top and base. Cooking range of 140°-350° degrees F, holding range of 75°-250° degrees F. Unit must be 12,000 watts. Unit to be mounted on 5" diameter swivel rubber casters (2 w/locking brakes). Place controls so they are facing the kitchen. 208/60/3

Provide with the following options: 6" food probe, perimeter bumper, four-sided top shroud that matches adjacent refrigerator height, and extended 5-year parts warranty.

Reach-in Heat-N-Hold Oven to be of the same manufacturer as item 51.

Manufacturer and Model: CRES COR RO-151-FW-UA-18DX-2083

ALTO SHAM and WINSTON "CA8522" will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 56 REACH-IN REFRIGERATOR -- TWO (2) REQUIRED.

Provide single section reach-in refrigerator with full length door. Finish to be stainless steel interior and exterior. See drawing for door swing. Hinged front shroud condenser, V-Temp Controller to include an on/off switch, manual defrost, interior light switch, LED temperature indicator in °C or °F, a hi/lo audio/visual temperature alarm, power supply interruption, door ajar and "clean condenser" alarms. A manager's "lock-out" feature is provided to safeguard pre-determined control settings. A HACCP event indicator/memory feature announces and records up to nine (9) alarm events. Unit includes super cool down Feature and the cabinet automatically reverts to the energy saving mode when there are no door openings for four hours. Provide unit with cord & plug. Refrigerant to be R-290. 115/60/1

Provide with the following options: 5" diameter swivel casters (2 w/locking brakes), (18) sets Type "A/C" Universal Pan Slides per section, (3) total shelves (18" x 26") for Type "A/C" Universal Pan Slides and two year parts/labor warranty.

Reach-in Refrigerator to be of the same manufacturer as Item 50 & 52.

MANUFACTURER & MODEL: VICTORY RS-1D-S1-HC

TRAULSEN "R" SERIES and UTILITY will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 57 OPEN NUMBER.

ITEM 58 REFRIGERATED GLASS DOOR MERCHANDISER – TWO (2) REQUIRED.

Equipment provided and set in place by vendor. 115/60/1

Manufacturer & model represented on drawings: TRUE GDM-45-HC-LD
E.C. must verify utility requirements with vendor.

ITEM 59 REFRIGERATED OPEN FRONT DISPLAY -- ONE (1) REQUIRED.

Provide 60" length, refrigerated, self-serve, 78" height, high profile specialty merchandiser with four tier adjustable shelving. Merchandiser construction to include: welded powder coated frame, moisture resistant end panel with field replaceable tempered thermo-pane glass, high density urethane foam insulation, front air intake with front and rear air discharge, energy savings night curtain, self-contained refrigeration, condenser air filter, electronic temperature control with on demand defrost, condensate heater, LED top light, and thermometer. Unit must maintain temperature range of 38°-40°F and operate with R44a refrigerant. 208/60/1

Provide with the following options: white interior and shelving finish, white roll down locking security door, special laminate color to match other service equipment, LED lights below shelves, rear access solid swing doors with locks, lockable roll-up security door, 4" casters (2-locking), condensate pan, casters, and cord and plug.

MANUFACTURER & MODEL: FEDERAL RSSM-578SC

HUSSMANN and STRUCTURAL CONCEPTS will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 60 SOLID TOP TABLE -- TWO (2) REQUIRED.

Provide 28" long solid top table with 36" working height, solid "V" ridge tray slide, line up locks, and 5" diameter swivel casters (all w/locking brakes). **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide open base understorage compartment lined with 18-gauge stainless steel and secure to liner a stainless steel intermediate shelf with the rear and ends turned up. Liner to have coved vertical and horizontal corners.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides, and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends, and sides to be turned down square with all corners, fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Line up locks to be barrel bolt and key slot design with cam locking action. Locks to be placed on opposing corners for maximum versatility.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

MANUFACTURER & MODEL: COLORPOINT 28-ST-F

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 61 SOLID TOP TABLE -- THREE (3) REQUIRED.

Provide 60" long solid top table with 36" working height, solid "V" ridge tray slide, full length undershelf, open storage base with removable intermediate shelf, and 5" diameter swivel casters (all w/locking brakes). **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide open base understorage compartment lined with 18-gauge stainless steel and secure to liner a stainless steel intermediate shelf with the rear and ends turned up. Liner to have coved vertical and horizontal corners.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides, and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish. In counter top, intermediate shelf, and base where shown on drawing, punch a knockout sized large enough to accept the plug provided with the equipment mounted on top of the table. Place a rubber grommet into each hole to protect electrical cord for items 62 & 64.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends, and sides to be turned down square with all corners, fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

MANUFACTURER & MODEL: COLORPOINT 60-ST-F

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 62 HEATED DISPLAY CASE - PIZZA -- ONE (1) REQUIRED.

Provide Glo-Ray 58-1/2" Heated Display Case with dual shelves, sliding doors on front and back and 4" high legs. 120/208/60/1

Provide with the following options: double sided opening with sliding doors on front and back, and wire trivets.

Pizza Display Warmer to be of the same manufacturer as Item 64.

MANUFACTURER & MODEL: HATCO GRHD-4PD

MERCO and ALTO SHAAM will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 63 CUSTOM S/S COUNTER TOP -- FOUR (4) REQUIRED

Provide counter top as shown on drawing. Top shall be constructed of 14-gauge stainless steel with all sides turned down 2-1/2" and under 1/2" at 45°. Corners to be fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish to match other service line equipment.

G.C. to provide 3/4" plywood sub top for securing stainless steel counter top.

Item to be provided by same manufacturer as serving line tables.

K.E.C. to field verify dimensions before placing order for tops. Refer to Kitchen Equipment Floor Plan for Bidding purposes.

MANUFACTURER & MODEL: COLOR POINT CUSTOM-ST

MULTI-TERIA USA and RANDELL will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 64 HEATED DISPLAY CASE SANDWICH & FRIES -- TWO (2) REQUIRED.

Provide Glo-Ray 60" Sandwich Display Case with dual slanted shelves and 4" high legs. 120/208/60/1

Heated Sandwich Display Case to be of the same manufacturer as Item 62.

Provide with the following option: breath protector for top and bottom shelves (front side only for food court jobs) and for both sides.

MANUFACTURER & MODEL: HATCO GRSDS-60D

MERCO and ALTO SHAAM will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 65 OPEN NUMBER.

ITEM 66 REFRIGERATED COLD FOOD TABLE -- ONE (1) REQUIRED.

Provide 66" forced air refrigerated cold food table with 36" working height, solid "V" ridge tray slide, stainless steel cutting board, two-tier display shelf, open storage base with removable intermediate shelf, drain, line up locks, 5" diameter swivel casters (all w/locking brakes), one year service warranty, and five year compressor warranty. **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide an intermediate shelf with the rear ends turned up, and secured to the interior liner.

Top to be 30" wide, and fabricated from 14-gauge stainless steel with square turn down on all sides, and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

The fully urethane insulated 18-gauge stainless steel mechanically cooled cold pan shall be 9" deep with continuous refrigeration coil bonded to underside and concealed in mastic. The pan shall be fitted with 1" open brass drain extended to shut off ball valve below base. A full perimeter Formica breaker strip shall separate pan from tabletop. 120/60/1

Condensing unit to be sized to the evaporator load, have necessary controls for proper operation, and be housed in cross flow ventilated compartment with stainless steel louvers, and slide out channels to accommodate servicing.

Two-tier 64" long display to have sloped front stand, uprights constructed of 1-1/4" square stainless steel tubing with stainless steel cap and base. Shelves to be 1/4" tempered glass resting on a horizontal stainless steel framework

welded to the uprights. The display stand is to be enclosed on the ends with 1/4" tempered glass with sloped tempered glass front. Front sneeze guard to be mounted on adjustable stainless steel brackets.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends and sides to be turned down square with all corners, fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Cutting board to be 14-gauge stainless steel, 8" wide with edges turned down square and all corners fully welded, ground and polished. Support brackets to be stainless steel fold down type.

Line up locks to be barrel bolt and key slot design with cam locking action.

Verify fiberglass color with Architect before ordering. The Architect can select colors from Colorpoint base colors or any plastic laminate manufacturers' standard solid color chart. All service line equipment to be of same color.

Set in place and provide copper drain line from shut off valves to floor drain.

MANUFACTURER & MODEL: COLORPOINT 66-CFMA

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 67 HOT FOOD TABLE -- ONE (1) REQUIRED.

Provide five well, 74" hot food table with 36" working height, manifold drains, ball valve, solid "V" ridge tray slide, stainless steel cutting board, convertible/adjustable sloped front food protector, heat strip with lights, open storage base with removable intermediate undershelf, line up locks, twist lock plug and matching receptacle, and 5" diameter swivel casters (all w/locking brakes). **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide open base understorage compartment lined with 18-gauge stainless steel and secure to liner a stainless steel intermediate shelf with the rear and ends turned up. Liner to have coved vertical and horizontal corners.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

Hot food wells to be dry/moist electric hot food wells with drains, manifold, and ball valve. Wells are to be secured from the bottom and have 12" x 20" opening with 1/4" raised beaded edge. All food wells to be centered on the top. Each hot food well shall be provided with 1000-watt heating element wired to a double pole thermostat for temperature control. All wells are wired to a circuit breaker mounted in the control panel for current overload protection. Drop in wells will not be accepted. 120/208/60/1

Food protector to be convertible/adjustable type. Protector to have a full height sloped front with 18-gauge stainless steel top serving shelf with all edges turned down square and all corners fully welded, ground, and polished. Edges to have #7 mirror hi-lite finish. Ends and front glass to be 1/4" tempered glass having an air space at top and bottom. Glass to be bound in stainless steel channel to prevent chipping. Front glass to pivot for full or self-service configurations. Food protector to have adjustable height. Height and pivoting glass to be adjustable without the use of tools. Under the stainless steel top install heat strip with lights and wire to a circuit breaker mounted in the control panel for current overload protection.

Food protectors for all tables to be by same manufacturer.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends and sides to be turned down square with all corners fully welded, ground and polished. Support brackets to be stainless steel fold down type.

Cutting board to be 14-gauge stainless steel, 8" wide with edges turned down square and all corners fully welded, ground and polished. Support brackets to be stainless steel fold down type.

Line up locks to be barrel bolt and key slot design with cam locking action. Locks to be placed on opposing corners for maximum versatility.

In place of standard plug, manufacturer shall provide a twist lock plug with matching receptacle.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

Set in place as shown on drawings and provide copper drain line from control valve to floor drain.

MANUFACTURER & MODEL: COLORPOINT 5E5-CPA-F

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 68 HOT FOOD TABLE -- ONE (1) REQUIRED.

Provide four well, 60" hot food table with 36" working height, manifold drains, ball valve, solid "V" ridge tray slide stainless steel cutting board, convertible/adjustable sloped front food protector, heat strip with lights, full length undershelf, open storage base with removable intermediate shelf, line up locks, twist lock plug and matching receptacle, and 5" diameter swivel casters (all w/locking brakes). **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide open base understorage compartment lined with 18-gauge stainless steel and secure to liner a stainless steel intermediate shelf with the rear and ends turned up. Liner to have coved vertical and horizontal corners.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

Hot food wells to be dry/moist electric hot food wells with drains, manifold, and ball valve. Wells are to be secured from the bottom and have 12" x 20" opening with 1/4" raised beaded edge. All food wells to be centered on the top. Each hot food well shall be provided with 1000-watt heating element wired to a double pole thermostat for temperature control. All wells are wired to a circuit breaker mounted in the control panel for current overload protection. Drop in wells will not be accepted. 120/208/60/1

Food protector to be convertible/adjustable type. Protector to have a full height sloped front with 18-gauge stainless steel top serving shelf with all edges turned down square and all corners fully welded, ground, and polished. Edges to have #7 mirror hi-lite finish. Ends and front glass to be 1/4" tempered glass having an air space at top and bottom. Glass to be bound in stainless steel channel to prevent chipping. Front glass to pivot for full or self-service configurations. Food protector to have adjustable height. Height and pivoting glass to be adjustable without the use of tools. Under the stainless steel top install heat strip with lights and wire to circuit breaker mounted in table's control panel for current overload protection.

Food protectors for all tables to be by same manufacturer.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends and sides to be turned down square with all corners fully welded, ground and polished. Support brackets to be stainless steel fold down type.

Cutting board to be 14-gauge stainless steel, 8" wide with edges turned down square and all corners fully welded, ground and polished. Support brackets to be stainless steel fold down type.

Line up locks to be barrel bolt and key slot design with cam locking action.

In place of standard plug, manufacturer shall provide a twist lock plug with matching receptacle.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

Set in place as shown on drawings and provide copper drain line from control valve to floor drain.

MANUFACTURER & MODEL: COLORPOINT 5E3-CPA-F MOD

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 69 HOT/COLD/FROZEN FOOD TABLE -- ONE (1) REQUIRED.

Provide four well, 66" hot/cold/freeze food table with 36" working height, individual drains that are manifold into a single drain, ball valve, solid "V" ridge tray slide, stainless steel cutting board, convertible/adjustable sloped front food protector, open storage base with removable intermediate shelf, hinged door with louvered vents covering refrigeration, line up locks, twist lock plug and matching receptacle, 5" diameter swivel casters (all w/locking brakes), two year service warranty and five year compressor warranty. **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide an intermediate shelf with the rear ends turned up, and secured to the interior liner. Provide removable louvers on front for ventilation.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

Doors to be mounted on one side and shall be double pan construction with 18-gauge stainless steel interior liner and 20-gauge stainless steel exterior. All corners to be fully welded, ground, and polished. Doors to be vented, mounted with semi-concealed hinges, and fitted with hand pulls, positive catches, and cylinder locks.

Hot/cold/freeze food well to be dry/moist electric that can be switched over from hot to cold to frozen food temperatures. Wells to be 18-gauge stainless steel fully welded, ground, polished, and fully insulated with a 3/4" open drain in each pan. Manifold individual drains into one extending, with copper pipe, to shut off ball valve below base. Wells are to be mounted from the bottom and have 12" x 20" opening with 1/4" raised beaded edge. Drop in wells will not be accepted. All wells to be centered on table top. Each well shall be provided with 500 watt heating element wired to a digital control panel for temperature control. When switched over to cold temperatures, wells will operate with compressor that will be hermetically sealed and R-507 refrigerant. 120/208/60/1

Food protector to be Convertible/Adjustable type with sloped front. Protector to have a full height sloped front with 18-gauge stainless steel top serving shelf with all edges turned down square and all corners fully welded, ground,

and polished. Edges to have #7 mirror hi-lite finish. Ends and front glass to be 1/4" tempered glass having an air space at top and bottom. Glass to be bound in stainless steel channel to prevent chipping. Front glass to pivot for full or self-service configurations. Food protector to have adjustable height. Height and pivoting glass to be adjustable without the use of tools.

Food protectors for all tables to be by same manufacturer.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends, and sides to be turned down square with all corners fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Cutting board to be 14-gauge stainless steel, 8" wide with edges turned down square, and all corners fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Line up locks to be barrel bolt and key slot design with cam locking action. Locks to be placed on opposing corners for maximum versatility.

In place of standard plug, manufacturer shall provide a twist lock plug with matching receptacle.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

Set in place as shown on drawing and provide copper drain line from ball valve to floor drain.

MANUFACTURER & MODEL: COLORPOINT QSCHP-4-F

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 70 OPEN NUMBER.

ITEM 71 HOOD SYSTEM – ONE (1) REQUIRED.

Provide exhaust/tempered make up air system as shown on the drawings. Complete system to include: exhaust fan, hood, connecting duct, start up/air balance/service. System to meet all requirements of NFPA Code 96, Kentucky Mechanical Code, U.L., and bear the NSF seal #908. Hood manufacturer must assume responsibility for installation of hoods, ductwork, fans, and all support equipment specified in this item description except where noted "WORK BY OTHER TRADES".

EXHAUST FAN: Provide one (1) roof exhaust blower of the upblast centrifugal, spun aluminum, belt-driven type. Fan to be U.L. 705 listed for general ventilation use. Rated at 1,500 CFM at 0.75" sp., 3/4 hp, 120/60/1. Fan must include a 14" wheel and not exceed 11.3 sones. Fan to include disconnect switch.

ROOF CURBS: Provide one (1) roof curb consistent with other curbs furnished for this project. Curb material to be 18-gauge, all-welded galvanized construction. Curb to be internally insulated with rigid fiberglass with foil backing.

HOOD: Provide wall-style Type II canopy exhaust hood for condensate removal, sized at 5'-0" long x 5'-0" wide x 24" high. Hood to be fabricated in one (1) section. Hood body to be constructed of 18-gauge, type 304 stainless steel, solid welded and polish to face, no exposed joints. Provide integral bottom support frame for baffle panels. Provide (2) stainless steel interior baffle panels, constructed of same material as hood body and removable without use of tools. Hood lights: provide (1) 36" UL listed, recessed LED fixtures, constructed for use in canopy exhaust hoods. Factory to wire fixtures to junction box on top of the hood. Provide vertical stainless steel wireway mounted on centerline of hood face. Provide oil tight switches for hood light and fan on wireway cover. Provide bulkhead between top of hood and ceiling on all exposed sides, constructed of same material as hood body.

DUCTWORK: Exhaust duct to be light gauge lock-formed galvanized material. All seams to be sealed liquid tight. Duct work to extend from top of condensate exhaust hood to exhaust fan on the building roof.

INSTALLATION: By this contractor to include hanging hood, setting exhaust fan on building roof, locating roof curb on shop drawings to be provided, and fabricating and installing connecting ductwork.

WORK BY OTHER TRADES:

KITCHEN EQUIPMENT CONTRACTOR: To coordinate with General, Electrical, HVAC and Plumbing contracts.

ROOFING CONTRACTOR: Provide roof opening. Set in place and flash (with cant if required) roof curb provided by the hood system manufacturer.

STRUCTURAL CONTRACTOR: Frame roof opening as required. Coordinate joist or structural member installation to provide required clearances for ductwork.

ELECTRICAL CONTRACTOR: (Hood System Requirements) Provide 120/60/1 20-amp circuit for hood lights, and controls to junction box on top of hood. Provide single-phase circuit (for fan motor) to disconnect switch mounted on exterior of motor starter box (mounted on top of hood). Extend power wiring from motor starter box panel to connection point on exhaust fan. This work must be in accordance with the N.E.C.

MECHANICAL CONTRACTOR: Provide net room air demand as indicated on the hood system drawings. This air volume is required only when hood system is in operation. Provide normal heating and cooling of the kitchen area.

Hood manufacturer shall file for all state and local permits.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER & MODEL: MASTER AIR

HALTON and AVTEC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 42 CONVECTION OVEN – DBL. STACK -- ONE (1) REQUIRED.

Provide double deck electric convection ovens with insulated stainless steel construction, vertically split doors that both open by pulling a single handle, porcelainized 16-gauge steel interior, adjustable door gaskets, moisture vent, snap action electric switch-type thermostat, interior lighting, automatic fan cut off when doors are opened, and heating element shut off when door is open, separate rocker switch for oven cool-down mode, fan on/off switch, and standard finish. Oven compartment to be rated at no less than 15.15 KW. 480/60/3

Provide with the following options: Snap action controls, casters (2 with locking brakes), and 11-position rack guides

MANUFACTURER & MODEL: MONTAGUE 2EK15A

LANG "ECOD-AP2" and GARLAND "MCO-ED-20-S" W/PULSE PLUS FAN will be accepted as alternative manufacturers provided the product conforms to the dimensions, construction, design, capacity, and function of the specified manufacturer.

ITEM 73 WORK TABLE W/ OVERSHELF -- ONE (1) REQUIRED.

Provide custom 4'-8" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, 8" high rear splash, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, and wall mount over shelf.

On wall over table secure one (1) 4'-8" long by 12" wide 16-gauge stainless steel shelf and stainless steel mounting brackets. Front and ends of shelf to be turned down 1" and under 1/2". Rear & left side to be turned up 3". Weld and polish intersections. Secure to wall with stainless steel bolts.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 74 WORKTABLE W/SINK & OVERSHELF -- ONE (1) REQUIRED.

Provide custom 5'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, 8" high rear splash, rigidly reinforced top, stainless steel channel underbracing, one (1) 20" x 20" fully enclosed stainless steel drawer housing with vinyl insert located as shown and cylinder locks with all locks keyed the same as all other tables, sound deadened, stainless steel gussets, stainless steel legs, welded stainless steel cross bracing under sink area, 16-gauge fully welded undershelf under balance of table with 2" turn up on rear, wall mount overshelf, and adjustable stainless steel bullet feet - two outside rear feet to be flanged.

In top, as shown on drawings, provide integral 16" x 20" x 10" deep cove cornered sink with bottom creased to crumb cup waste. Provide a B-0300 Deck Mount faucet with ceramic cartridges and B-0199-02 aerator.

On wall over table secure one (1) 7'-0" long by 12" wide 16-gauge stainless steel shelf and stainless steel mounting brackets. Front and ends of shelf to be turned down 1" and under 1/2". Rear to be turned up 3". Weld and polish intersections. Secure to wall with stainless steel bolts.

Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

See drawings for further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 75 WORK TABLE W/ OVERSHELF -- ONE (1) REQUIRED.

Provide custom 4'-6" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, 8" high rear splash, sound deadened, galvanized channel underbracing, one (1) 20" x 20" fully enclosed stainless steel drawer housing with vinyl insert located as shown and cylinder locks with all locks keyed the same as all other tables, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, and wall mount over shelf.

On wall over table secure one (1) 4'-6" long by 12" wide 16-gauge stainless steel shelf and stainless steel mounting brackets. Front and ends of shelf to be turned down 1" and under 1/2". Rear to be turned up 3". Weld and polish intersections. Secure to wall with stainless steel bolts.

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 76 OPEN NUMBER.

ITEM 77 REFRIGERATED OPEN FRONT DISPLAY -- ONE (1) REQUIRED.

Provide 60" length, refrigerated, self-serve, 78" height, high profile specialty merchandiser with four tier adjustable shelving. Merchandiser construction to include: welded powder coated frame, moisture resistant end panel with

field replaceable tempered thermo-pane glass, high density urethane foam insulation, front air intake with front and rear air discharge, energy savings night curtain, self-contained refrigeration, condenser air filter, electronic temperature control with on demand defrost, condensate heater, LED top light, and thermometer. Unit must maintain temperature range of 38°-40°F and operate with R44a refrigerant. 208/60/1

Provide with the following options: white interior and shelving finish, white roll down locking security door, special laminate color to match other service equipment, LED lights below shelves, lockable roll-up security door, 4" casters (2-locking), condensate pan, casters, and cord and plug.

MANUFACTURER & MODEL: FEDERAL RSSM-578SC

HUSSMANN and STRUCTURAL CONCEPTS will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 78 TRAY & FLATWARE CART – TWO (2) REQUIRED.

Provide 36" x 24" tray & silverware transport/dispensing cart that is all welded 304 stainless steel construction cabinet with laminate panels on back and sides, on stainless steel base with bumpers and casters.

Cabinet to be constructed of 18-gauge stainless steel with front open for tray storage and dispensing. Exterior sides and back of cabinet to have laminate panels that match the color pattern selected for the serving line tables (verify w/architect).

Base to be 16-gauge stainless steel and include four (4) corner bumpers and four (4) 5" height non-marking swiveling casters with brakes.

Top of cabinet to include integral 18-gauge stainless steel silverware dispenser unit with canted top. Top of silverware dispenser to include opening that accommodates three stainless steel E1 System inserts.

Provide with the following accessories: 16-gauge stainless steel removable intermediate shelf (inside cabinet), Two (2) E1-BS6OE-RP E1 System stainless steel drop-in silverware baskets with six (6) plastic silverware cylinders in each basket, and one (1) E1-2NS-1VH dual napkin dispenser.

Verify color of the plastic silverware cylinders with owner. Cart laminate color to match serving line table bases.

Provide the following option: Removable 18-gauge stainless steel intermediate shelf.

MANUFACTURER & MODEL: STERIL-SIL E1-CRT36-3V-MOD

LAKESIDE and CUSTOM FABRICATOR will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 79 ICE CREAM DISPLAY FREEZER -- ONE (1) REQUIRED.

Provide 52" slide top ice cream display freezer on 2" heavy-duty casters (2 w/locking brakes). Top to be an aluminum extrusion frame with sliding safety glass lids. Sliding door to be secured with a lock and key. Exterior to be painted steel. Walls to have 2-3/8" and bottom to have 2" of insulation with an R-factor of 17.24 minimum. Interior to be white powder coat with a drain in the bottom. Provide interior with LED lighting and on/off switch. Cabinet shall have (4) wire baskets. Compressor to be 1/3 h.p. with R-290 refrigerant and maintain a temperature range of 10° F to -18° F. Provide with six foot cord and plug. 115/60/1

Provide with the following option: custom cabinet color matching other service equipment.

MANUFACTURER & MODEL: MASTER-BILT MSF-52A

TRUE and METALFRIO SOLUTIONS, INC. will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 80 MILK COOLER -- TWO (2) REQUIRED.

Provide single access 58" milk cooler with stainless steel exterior finish, aluminum finished back, 300 series stainless steel interior floor, oversized forced-air refrigeration system, epoxy coated evaporator, slide out compressor, heavy duty floor rack, exterior mounted digital temperature monitor, cylinder lock, interior clean out drain, and 4" diameter swivel casters (2 w/locking brakes). Refrigerant to be R-290. Provide with three-year parts and labor warranty and five year compressor warranty. 115/60/1

Provide with the following options: corner bumper guards, stainless steel interior

MANUFACTURER & MODEL: TRUE TMC-58-S-HC

BEVERAGE-AIR and TRAULSEN will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 81 OPEN NUMBER.

ITEM 82 SOLID TOP TABLE – CONDIMENT STATION -- ONE (1) REQUIRED.

Provide 60" long solid top with 36" working height, solid "V" ridge tray slide located on both sides, open storage base with removable intermediate shelf, hinged doors covering open base, and 5" diameter swivel casters (all w/locking brakes). **Tray slide height to be 34" AFF.**

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters. Where possible, provide open base understorage compartment lined with 18-gauge stainless steel and secure to liner a stainless steel intermediate shelf with the rear and ends turned up. Liner to have coved vertical and horizontal corners.

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides, and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish.

Doors to be double pan construction with 18-gauge stainless steel interior liner and 20-gauge stainless steel exterior. All corners to be fully welded, ground, and polished. Doors to be mounted with semi-concealed hinges and fitted with hand pulls, positive catches, and cylinder locks.

Solid tray slides to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends, and sides to be turned down square with all corners, fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

MANUFACTURER & MODEL: COLORPOINT 60-ST-F

MULTITERIA USA and DUKE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 83 CASHIER STATION -- FOUR (4) REQUIRED.

Provide portable 60" solid top with solid "V" tray slide on one side as shown on drawing, 36" working height, full

length undershelf, louvered hinged doors with cylinder lock and 5" diameter swivel casters (2 w/locking brakes). Locking cash drawer to be provided in one end. Opposite end to have 4" chase for data cable, cord wrap hook, and guarded exhaust fan outlet. Exhaust fan to be rated at 105 CFM. Top to have 3" knock out for data and power cords. Interior to have convenience outlet for computer and cash register. See detail drawing for further information. **Tray slide height to be 34" AFF. 120/60/1**

Top to be 30" wide and fabricated from 14-gauge stainless steel with square turn down on all sides and corners fully welded, ground, and polished. Top to have #4 satin finish and all edges having a #7 mirror hi-lite finish. In top punch 3" knockout for data and power cords.

Body to be a seamless molded fiberglass with smooth exterior surfaces, and rounded corners. Fiberglass to be flame retardant per specification ASTM E-162 having flame spread of 25 or less. On the interior of the body, provide 12-gauge galvanized channels extending from top, and running the full length of front, across the bottom, and up the full length of the back. Channels to be welded at the corners to form rigid structural framework supporting the fiberglass eliminating stress. On the outside bottom, provide 12-gauge stainless channels supporting the casters.

Body interior, except open area below cashier, to be full length under storage lined with 18-gauge stainless steel with coved vertical and horizontal corners.

Interior of cabinet where cashier sits to be lined with 18-gauge stainless steel with coved vertical and horizontal corners. A one inch diameter 18-gauge stainless steel foot rest shall be secured to interior walls. Provide 14-gauge stainless steel removable, adjustable height, computer undershelf with 1½" turndown on rear & sides and down on front 1½" and under ½". Notch side turndowns to fit over footrest. Provide on inside walls of knee area a stainless steel bracket on rear & sides to support undershelf. On back wall of cabinet storage compartment provide flush mount convenience outlet for computer. Provide 3" chase from inside knee wall area to inside of cabinet storage base for running of computer cables.

Doors to be double pan construction with 18-gauge stainless steel interior liner and 20-gauge stainless steel exterior. All corners to be fully welded, ground, and polished. Doors to be mounted with semi-concealed hinges and fitted with hand pulls, positive catches, and cylinder locks. One door is to have integral full width vents cut into three-quarters of its height.

Cashier drawer to have 18-gauge stainless steel drawer face with cylinder locks, keys, and removable 3" deep ABS drawer liner mounted on stainless steel roller bearing slides.

Solid tray slide to be 14-gauge stainless steel with three inverted "V" ridges on surface. Ends, and sides to be turned down square with all corners fully welded, ground, and polished. Support brackets to be stainless steel fold down type.

Verify fiberglass color with Architect before ordering. Architect to select color from Colorpoint, Formica, or Wilson Art standard solid color charts. All service line equipment to be of same color.

See drawings for further details.

MANUFACTURER & MODEL: COLORPOINT 60-ST-F MOD

MULTITERIA USA and RANDELL will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of specified Manufacturer.

ITEM 84 P.O.S. SYSTEM -- FOUR (4) REQUIRED.

Not in K.E.C. contract. To be provided by Owner.

ITEM 85 OPEN NUMBER.

ITEM 86 LOCKERS - EMPLOYEE -- ONE (1 LOT) REQUIRED.

Not in K.E.C. Contract. To be provided by Others.

ITEM 87 CLOTHES WASHER AND DRYER -- ONE (1 SET) REQUIRED.

Not in Kitchen Equipment Contractor's Contract. To be provided by Others.

ITEM 88 MOP SINK -- ONE (1) REQUIRED.

Not in Kitchen Equipment Contractor's Contract. To be provided by Others.

ITEM 89 STORAGE CABINET - CHEMICAL -- ONE (1) REQUIRED.

Provide 18-gauge type 304 stainless steel storage cabinet with sloped top, hinged doors with , 6" stainless steel legs with adjustable bullet feet, and (5) adjustable shelves. Hinge doors as shown on drawing.

MANUFACTURER & MODEL: IMC TEDDY SC-1824HS MODIFIED

COMMERCIAL STAINLESS and CUSTOM FABRICATION will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

3.02 EQUIPMENT FOR CULINARY CLASS ROOMS – ROOMS 146, 146A, & 147**ITEM 90 HAND SINK -- THREE (3) REQUIRED.**

Not in K.E.C. contract. To be provided by Plumbing Contractor.

ITEM 91 HOOD SYSTEM – ONE (1) REQUIRED.

Provide exhaust/tempered make up air system as shown on the drawings. Complete system to include: exhaust fan, hood, fire protection system, connecting duct, start up/air balance/service. System to meet all requirements of NFPA Code 96, Kentucky Mechanical Code, U.L., and bear the NSF seal #908. Hood manufacturer must assume responsibility for installation of hoods, ductwork, fans, and all support equipment specified in this item description except where noted "WORK BY OTHER TRADES".

EXHAUST FAN: Provide one (1) roof exhaust blower of the upblast centrifugal, spun aluminum, belt driven type. Fan to be U.L. 762 listed for use with kitchen exhaust vapors. Rated at 1,500 CFM at 1.0" sp., 3/4 hp, 120/60/1. Fan must include a 14" wheel and not exceed 11.3 sones. Fan to include disconnect switch, tilting base, and grease catch trough.

ROOF CURB: Provide (1) roof curb consistent with other curbs furnished for this project. Curb material to be 18-gauge, all welded galvanized construction. Curbs to be internally insulated with rigid fiberglass with foil backing.

HOOD: Provide wall style, Type I canopy exhaust hood, sized at 4'-6" long x 4'-6" wide x 30" high. Hood to be fabricated in one (1) section. Hood body to be constructed of 18-gauge, type 304 stainless steel. U.L. Listed construction without exhaust dampers. Grease filter frames to be stainless steel. Integral bottom grease filter frame forms a pitched drip guard draining to a stainless-steel drip pan. Provide (2) 25"x20"x2" UL Classified, stainless steel grease filters with stainless steel blank-off panels, as required. Hood lights: provide (1) 36" UL listed, recessed LED fixture, constructed for use in grease laden environments. Factory to wire fixture to junction box on top of the hood. Provide bulkhead between top of hood and ceiling on all exposed sides, constructed of same material as hood body. Provide vertical wireway cover, constructed of same material as hood body, centered on face of hood with oiltight switches for hood light and exhaust fan mounted on wireway cover.

FIRE PROTECTION SYSTEM: Provide one (1) U.L. 300 Listed, liquid agent type. System to provide hood, duct, plenum and required surface protection. Exposed piping to be chrome sleeved or stainless steel. Fire system to be mounted in cabinet on adjacent wall. Provide dual microswitch and remote manual pull station with system.

EXHAUST WRAP SYSTEM FOR GREASE EXHAUST DUCTS: Exhaust ducts serving type I hoods shall be installed with a duct wrap system meeting ASTM E2336 Standards from the point of ceiling penetration (or duct connection) at the hood, to the termination of the duct at the exhaust fan (or exit of the duct from the building). The duct wrap system shall be installed in strict accordance with the system's listing and the manufacturer's instructions for 2 hour rated system 0" clearance to combustible and grease duct installation. System provides two layers of 1.5" uncompressed insulation. Insulation to be banded to the duct with steel banding straps. Penetration of rated walls and floors shall be fire-stopped in accordance with the system manufacturer's installation instructions.

SYSTEM ACTUATION CONTROL and APPLIANCE INTERLOCK: Hood to include an "Auto-Start" control system as required by the International Mechanical Code, as adopted by state and local agencies. Control to monitor the differential between room ambient and hood interface temperature, activating the hood system fans if the temperature should exceed a preset limit. Hood system will turn off 30 minutes after hood temperature has cooled below the preset limit. Solid state control to monitor up to eight hood locations with all set point and time during adjustment made at a single point.

INSTALLATION: By this contractor to include hanging hood, setting exhaust fan on building roof, locating roof curb on shop drawings to be provided, and fabricating and installing connecting ducts. Exhaust duct to be 16-gauge steel material. All seams to have continuous liquid-tight external welds. Provide clean-outs at every 10'-0" or at any change of direction for grease exhaust ducts.

WORK BY OTHER TRADES:

KITCHEN EQUIPMENT CONTRACTOR: To coordinate with General, Electrical, HVAC and Plumbing contract documents.

GENERAL CONTRACTOR: Provide fire-rated exhaust duct shaft or fire-rated exhaust duct wrap where required by code. General Contractor to provide rated access doors in the shaft to allow access to exhaust duct cleanout panels.

ROOFING CONTRACTOR: Provide roof deck openings as required. Set in place and flash (with cant if required) roof curbs and equipment support rail provided by the hood system manufacturer.

STRUCTURAL CONTRACTOR: Frame roof openings as required. Cutout and frame deck openings as required. Coordinate joist or structural member installation to provide required clearances for ductwork and rated assemblies.

ELECTRICAL CONTRACTOR: (Hood System Requirements) Provide 120/60/1 20-amp circuit for hood lights and controls to junction box on top of hood. Provide single-phase circuit (for fan motor) to disconnect switch mounted on exterior of motor starter box (mounted on top of hood). Extend power wiring from motor starter box panel to connection point on exhaust fan. This work must be in accordance with the N.E.C.

ELECTRICAL CONTRACTOR: (Fire Protection System Requirements) Provide conduit and three wires to microswitch of fire protection system. Interlock wiring of the supply fan motor control device through the fire system microswitch, shutting off supply air in the event of fire system actuation. Furnish and install a 4" octagonal box for the fire system pull station, mounting the centerline of the box at 48" above the finished floor. Run 1/2" only conduit (with no bends) from the top of the box to 6" above the ceiling. If installed in a wall the area around the 1/2" conduit should be notched or set back to allow the pulley elbow fitting for the pull station to be installed. Connections for the fire system wiring must be made in a junction box on the outside of the fire system cabinet. Furnish and install automatic power shut off devices (shunt trip breakers, or definite purpose contactors) with interlock to fire system microswitch, shutting off all power below the hood (including control voltage) in the event of fire system actuation. This work must be in accordance with N.F.P.A. 17A, and the N.E.C.

MECHANICAL CONTRACTOR: Provide net room air demand as indicated on the hood system drawings. This air volume is required only when hood system is in operation. Provide normal heating and cooling of the kitchen area. Install fire protection system gas valve (provided with fire suppression system) in the main supply line serving the cooking equipment to shut off gas service to the cooking equipment in the event of fire system actuation.

Hood manufacturer shall file for all state and local permits.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER & MODEL: MASTER AIR

HALTON and AVTEC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 92 6-BURNER RANGE W/OVEN -- TWO (2) REQUIRED.

Provide restaurant series four burner 36" wide natural gas range with oven base. Unit to be constructed of stainless steel front and sides, stainless steel front landing edge, and stainless steel backguard with plate shelf. Provide range with porcelain interior oven base capable of accepting standard sheet pans, manual gas control with standard pilot light for each burner, cast iron top grates and pressure regulator. Each burner rated at no less than 38,000 BTU per hour.

Provide with the following options: 5" Casters (two to be locking), low profile back guard stainless steel front and sides.

MANUFACTURER & MODEL: GARLAND G36-6R

MONTAGUE and ROYAL RANGE will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 93 WORK TABLE - MOBILE -- TWO (2) REQUIRED.

Provide custom 3'-0" long x 30" wide 14-gauge stainless steel table with 34" working height, 5" high fully enclosed rear splash, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, one (1) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks keyed the same as other table drawers. Provide with 5" diameter casters (all w/brakes that lock both the swivel and the wheels).

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 94 PREP SINK -- TWO (2) REQUIRED.

Provide custom 3'-4" long x 30" wide 14-gauge stainless steel prep sink with one (1) 16"L x 20"W x 14"D sink bowl, 18" drainboard at right side, 34" working height, 3" high rolled edge at front and sides, 11" high rear splash, reinforced top, sound deadened, stainless steel channel underbracing, stainless steel gussets, stainless steel legs, welded crossbracing at sides, stainless steel adjustable bullet feet, and flanged feet at rear legs.

Provide the following options: Crumb cup waste and tailpiece, and T&S B-0231-CR splash mount faucet with ceramic cartridges and B-0199-01 aerator.

See drawings for dimensions and further details.

Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

MANUFACTURER & MODEL: ADVANCE TABCO 94-1-24-18R

CUSTOM FABRICATOR will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 95 OPEN NUMBER.ITEM 96 REFRIGERATOR -- SIX (6) REQUIRED.

Not in K.E.C. contract. To be provided by Owner.

ITEM 97 BUN PAN RACK -- FOUR (4) REQUIRED.

Provide all welded aluminum rack with capacity for (20) 18" x 26" pans on 3" centers, and 5" swivel casters.

Provide with the following options: solid bottom, brakes on two of the casters, rear vertical pan stop, and wrap around bumper.

MANUFACTURER & MODEL: NEW AGE 93024PSPBCL

CARTER HOFFMANN "HEAVY DUTY", CRES-COR "207-1820", WINHOLT ALUN-1820/HD SB-PEB-VB, and CHANNEL "AXD1820-JS" will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 98 COUNTER & CABINETRY W/ PREP SINKS -- FOUR (4) REQUIRED.

Not in K.E.C. contract. To be provided by Others.

ITEM 99 OPEN NUMBER.ITEM 100 HOOD SYSTEM -- NINE (9) REQUIRED.

Not in K.E.C. contract. To be provided by Others.

ITEM 101 4-BURNER RANGE -- NINE (9) REQUIRED.

Not in K.E.C. contract. To be provided by Others.

ITEM 102 WORK TABLE - MOBILE -- TWO (2) REQUIRED.

Provide custom 5'-0" long x 30" wide 14-gauge stainless steel table with 34" working height, 5" high fully enclosed rear splash, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, two (2) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks keyed the same as other table drawers. Provide with 5" diameter casters (all w/brakes that lock both the swivel and the wheels).

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 103 WORK TABLE - MOBILE -- TWO (2) REQUIRED.

Provide custom 4'-0" long x 30" wide 14-gauge stainless steel table with 34" working height, rigidly reinforced top, sound deadened, galvanized channel underbracing, stainless steel gussets, stainless steel legs, 16-gauge fully welded stainless steel undershelf, one (1) 20" x 20" fully enclosed stainless steel drawer housings with vinyl inserts located as shown and cylinder locks keyed the same as other table drawers. Provide with 5" diameter casters (all w/brakes that lock both the swivel and the wheels).

See drawings for dimensions and further details.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 104 POT & PAN SINK -- TWO (2) REQUIRED.

Provide custom 8'-0" long x 30" wide 14-gauge stainless steel prep sink with three (3) 18"L x 24"W x 14"D sink bowls, 18" drainboards at each side, 34" working height, 3" high rolled edge at front and sides, 11" high rear splash, reinforced top, sound deadened, stainless steel channel underbracing, stainless steel gussets, stainless steel legs, welded crossbracing at sides, stainless steel adjustable bullet feet, and flanged feet at rear legs.

Provide the following options: Two (2) T&S B-0231-CR splash mount faucets with ceramic cartridges and B-0199-01 aerators, and three (3) lever wastes with overflows.

See drawings for dimensions and further details.

Set in place as shown on drawings and secure flanged feet to floor with stainless steel bolts.

MANUFACTURER & MODEL: ADVANCE TABCO 94-63-54-18RL

CUSTOM FABRICATOR will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 104A 16"x4" S/S UTILITY CHASE – ONE (1) REQUIRED.

Provide 16" x 4", 16-gauge stainless steel plumbing chase with 14-gauge stainless steel angles, and 2" stainless steel ceiling trim collar. Chase to be constructed in one piece and extend from 1" below top of table backsplash, to 4" above ceiling. Fasten angles to wall with stainless steel bolts. Fasten chase to angles with stainless steel screws. Secure 2" stainless steel collar where chase extends through ceiling. Chase to be located in Culinary Classroom 147 as shown on Foodservice Equipment Culinary Floor Plan.

See chase detail on drawings for further details.

MANUFACTURER & MODEL: CUSTOM FABRICATOR

ITEM 105 STORAGE CABINET - CHEMICAL -- ONE (1) REQUIRED.

Provide 18-gauge type 304 stainless steel storage cabinet with sloped top, locking hinged doors, 6" stainless steel legs with adjustable bullet feet, and (5) adjustable shelves. Hinge doors as shown on drawing.

MANUFACTURER & MODEL: IMC TEDDY SC-1830HS MODIFIED

COMMERCIAL STAINLESS and CUSTOM FABRICATION will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 106 SHELVEING W/ SECURITY CAGE - MOBILE -- FOUR (4) REQUIRED.

Provide mobile 50"L x 28"W x 68"H heavy duty, Super Erecta model security unit constructed of heavy-gauge steel chrome plated wire. Construction of unit to include; Four (4) posts, two (2) chrome plated wire doors that each open 270°, 1/4-turn door handle, four (4) aluminum dolly with wrap around bumper and 5" dia. Casters (two locking on same side as unit's doors), and chrome plated finish strips.

Provide with the following option: Two (2) Super adjustable Super Erecta intermediate shelves

Shelving to be of the same manufacturer as item 16.

MANUFACTURER & MODEL: METRO SEC55LC

EAGLE and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 107 UNDER COUNTER DISH MACHINE -- TWO (2) REQUIRED.

Provide undercounter rack type dishwasher. Machine to have a capacity of up to 30 racks per hour. Dishwasher shall be provided with: top mounted controls with digital cycle/temperature display, dirty water indicator, automatic delime cycle, low chemical alert, service diagnostics, energy saving mode, anti-clogging upper and lower wash arms, lower and upper rinse arms, stainless steel interior tank, top, and door construction, removable stainless steel strainer, self-draining pump, detergent and rinse aid pump, delime pump, 1.8 kW electric immersion heating element for tank heat, built-in 70° rise booster heater, automatic fill, and manufacturer supplied 72" hose with female garden hose connection. Microcomputer controls to be placed within a water protected enclosure located on front top panel. 208/60/3

Provide with the following options: power cord kit, ½" pressure regulator and drain water tempering kit (cool down kit must be able to cool drain water down to a minimum of 140°F).

Provide the following Vollrath ware washing racks: (2 ea.) 52672, (2 ea.) 52669, and (2 ea.) 52671. METRO and AMCO will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

MANUFACTURER & MODEL: HOBART LXeR

STERO and ELECTROLUX will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 108 DISPOSER SINK W/ OVERSHELF -- ONE (1) REQUIRED.

Provide custom 12'-0" long x 32" wide 14-gauge stainless steel disposer sink work table with one sink bowl, 27" drainboard and 8'-3" drainboard both sloping 1" to sink basin, 34" working height, 11" high rear splash. Rear splash to be turned up 11" on 3/4" radius, turned back at the top 2" on a 45° angle, and down 1" at rear. Provide 1-1/2" rolled edge on front and each end, knockouts in top of splash on 6" centers for vacuum breaker supplied with garbage disposer, rigidly reinforced top, disposer control mounting bracket under left drainboard, sound deadening, stainless steel channel under bracing, stainless steel gussets, stainless steel legs with adjustable stainless steel bullet feet, (2) two stainless steel adjustable flanged feet on outside rear legs, and welded stainless steel cross bracing under front, both ends, and between front and back legs at area of dishwashers.

In top, as shown on drawings, provide one (1) integral 18" x 24" cove cornered sink. Sink to be 5" deep. Sink to have bottom creased to disposer waste. Provide on splash a T&S B-0133-01-CR pre-rinse with ceramic cartridges, B-1100-K installation kit, B-0044-H 44" flexible hose, B-CVV1-2 check valves, B-1420 squeeze valve w/quick connect socket, B-1421 spray quick connect and B-1428 quick connect fan jet, B-0155LN add-on-faucet without nozzle but w/B-060X 8" nozzle, B-0199-01F-20 aerator, B-0044-V9 hose w/back flow preventer, and B-0109 wall bracket.

On wall over table drainboards secure two (2) 8'-0" long by 12" wide 16-gauge stainless steel shelves and stainless steel mounting brackets. Front and ends of shelves to be turned down 1" and under 1/2". Rear to be turned up 3". Weld and polish intersections. Secure to wall with stainless steel bolts.

See drawings for further details.

Set in place as shown on drawings and secure to floor with stainless steel bolts.

MANUFACTURER & MODEL: CUSTOM FABRICATED

ITEM 109 DISPOSER -- ONE (1) REQUIRED.

Provide 2 hp offset disposer unit with 8" rotor/turntable, and three adjustable legs. Provide with 8-1/4" stainless steel sink adaptor to be welded into bottom of pre-rinse sink, (1) swirl nozzle, and solenoid. Control panel to be provided with automatic reversing magnetic contactors, overload protection, alternator, automatic delay timer for motor and water run time, low voltage protection, emergency disconnect switch, and push button operation. Install swirl nozzles in sink walls. 208/60/3

Provide with the following option: (1) extra swirl nozzle.

Furnish with the following option: T&S B-0455 vacuum breaker assembly.

K.E.C. to install disposer to adaptor and lag to floor with stainless steel bolts, control panel on mounting bracket provided under landing area and wire to solenoid and disposer.

All disposers must be from the same manufacturer.

MANUFACTURER & MODEL: MASTER C2-O-SK-RAC2

INSINGER and RED GOAT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 110 UTILITY CART -- FOUR (4) REQUIRED.

Provide 1000 lb. capacity stainless steel carts. Cart shelf to be 14-gauge stainless steel reinforced front and back with 16-gauge angles. Legs are to be 1/8" thick stainless steel angle. Wheels to be (2) 5" swivel and (2) 8" fixed with polyurethane tires. Provide with bumpers on legs and handle.

MANUFACTURER & MODEL: LAKESIDE (4) 943

STERIL-SIL and SAMMONS EQUIPMENT will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 111 HOOD SYSTEM – ONE (1) REQUIRED.

Provide exhaust/tempered make up air system as shown on the drawings. Complete system to include: exhaust fan, hood, fire protection system, connecting duct, start up/air balance/service. System to meet all requirements of NFPA Code 96, Kentucky Mechanical Code, U.L., and bear the NSF seal #908. Hood manufacturer must assume responsibility for installation of hoods, ductwork, fans, and all support equipment specified in this item description except where noted "WORK BY OTHER TRADES".

EXHAUST FAN: Provide one (1) roof exhaust blower of the upblast centrifugal, spun aluminum, belt driven type. Fan to be U.L. 762 listed for use with kitchen exhaust vapors. Rated at 1,500 CFM at 1.0" sp., 3/4 hp, 120/60/1. Fan must include a 14" wheel and not exceed 11.3 sonos. Fan to include disconnect switch, tilting base, and grease catch trough.

ROOF CURB: Provide (1) roof curb consistent with other curbs furnished for this project. Curb material to be 18-gauge, all welded galvanized construction. Curbs to be internally insulated with rigid fiberglass with foil backing.

HOOD: Provide wall style, Type I canopy exhaust hood, sized at 4'-6" long x 4'-6" wide x 30" high. Hood to be fabricated in one (1) section. Hood body to be constructed of 18-gauge, type 304 stainless steel. U.L. Listed construction without exhaust dampers. Grease filter frames to be stainless steel. Integral bottom grease filter frame forms a pitched drip guard draining to a stainless-steel drip pan. Provide (2) 25"x20"x2" UL Classified, stainless steel grease filters with stainless steel blank-off panels, as required. Hood lights: provide (1) 36" UL listed, recessed LED fixture, constructed for use in grease laden environments. Factory to wire fixture to junction box on top of the hood. Provide bulkhead between top of hood and ceiling on all exposed sides, constructed of same material as hood body. Provide vertical wireway cover, constructed of same material as hood body, centered on face of hood with oiltight switches for hood light and exhaust fan mounted on wireway cover.

FIRE PROTECTION SYSTEM: Provide one (1) U.L. 300 Listed, liquid agent type. System to provide hood, duct, plenum and required surface protection. Exposed piping to be chrome sleeved or stainless steel. Fire system to be mounted in cabinet on adjacent wall. Provide dual microswitch and remote manual pull station with system.

EXHAUST WRAP SYSTEM FOR GREASE EXHAUST DUCTS: Exhaust ducts serving type I hoods shall be installed with a duct wrap system meeting ASTM E2336 Standards from the point of ceiling penetration (or duct connection) at the hood, to the termination of the duct at the exhaust fan (or exit of the duct from the building). The duct wrap system shall be installed in strict accordance with the system's listing and the manufacturer's instructions for 2 hour rated system 0" clearance to combustible and grease duct installation. System provides two layers of 1.5" uncompressed insulation. Insulation to be banded to the duct with steel banding straps. Penetration of rated walls and floors shall be fire-stopped in accordance with the system manufacturer's installation instructions.

SYSTEM ACTUATION CONTROL and APPLIANCE INTERLOCK: Hood to include an "Auto-Start" control system as required by the International Mechanical Code, as adopted by state and local agencies. Control to monitor the differential between room ambient and hood interface temperature, activating the hood system fans if the temperature should exceed a preset limit. Hood system will turn off 30 minutes after hood temperature has cooled below the preset limit. Solid state control to monitor up to eight hood locations with all set point and time during adjustment made at a single point.

INSTALLATION: By this contractor to include hanging hood, setting exhaust fan on building roof, locating roof curb on shop drawings to be provided, and fabricating and installing connecting ducts. Exhaust duct to be 16-gauge steel material. All seams to have continuous liquid-tight external welds. Provide clean-outs at every 10'-0" or at any change of direction for grease exhaust ducts.

WORK BY OTHER TRADES:

KITCHEN EQUIPMENT CONTRACTOR: To coordinate with General, Electrical, HVAC and Plumbing contract documents.

GENERAL CONTRACTOR: Provide fire-rated exhaust duct shaft or fire-rated exhaust duct wrap where required by code. General Contractor to provide rated access doors in the shaft to allow access to exhaust duct cleanout panels.

ROOFING CONTRACTOR: Provide roof deck openings as required. Set in place and flash (with cant if required) roof curbs and equipment support rail provided by the hood system manufacturer.

STRUCTURAL CONTRACTOR: Frame roof openings as required. Cutout and frame deck openings as required. Coordinate joist or structural member installation to provide required clearances for ductwork and rated assemblies.

ELECTRICAL CONTRACTOR: (Hood System Requirements) Provide 120/60/1 20-amp circuit for hood lights and controls to junction box on top of hood. Provide single-phase circuit (for fan motor) to disconnect switch mounted on exterior of motor starter box (mounted on top of hood). Extend power wiring from motor starter box panel to connection point on exhaust fan. This work must be in accordance with the N.E.C.

ELECTRICAL CONTRACTOR: (Fire Protection System Requirements) Provide conduit and three wires to microswitch of fire protection system. Interlock wiring of the supply fan motor control device through the fire system microswitch, shutting off supply air in the event of fire system actuation. Furnish and install a 4" octagonal box for the fire system pull station, mounting the centerline of the box at 48" above the finished floor. Run 1/2" only conduit (with no bends) from the top of the box to 6" above the ceiling. If installed in a wall the area around the 1/2" conduit should be notched or set back to allow the pulley elbow fitting for the pull station to be installed. Connections for the fire system wiring must be made in a junction box on the outside of the fire system cabinet. Furnish and install automatic power shut off devices (shunt trip breakers, or definite purpose contactors) with interlock to fire system microswitch, shutting off all power below the hood (including control voltage) in the event of fire system actuation. This work must be in accordance with N.F.P.A. 17A, and the N.E.C.

MECHANICAL CONTRACTOR: Provide net room air demand as indicated on the hood system drawings. This air volume is required only when hood system is in operation. Provide normal heating and cooling of the kitchen area. Install fire protection system gas valve (provided with fire suppression system) in the main supply line serving the cooking equipment to shut off gas service to the cooking equipment in the event of fire system actuation.

Hood manufacturer shall file for all state and local permits.

Specific product names used in this specification are based on primary manufacturer's assembly of their system, but in no way restricts the alternate manufacturers from using other suppliers with equal components for construction of their systems.

MANUFACTURER & MODEL: MASTER AIR

HALTON and AVTEC will be accepted as an alternative manufacturer provided the product conforms to the dimensions, construction, design, capacity, and function of the specified Manufacturer.

ITEM 112 CLOTHES WASHER & DRYER -- TWO (2 SETS) REQUIRED.

Not in Kitchen Equipment Contractor's Contract. To be provided by Others.

END OF SPECIFICATIONS

SECTION 116623 - GYMNASIUM EQUIPMENT**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Basketball backboards, goals, and support framing.
- B. Wall mounted protection pads.
- C. Fold-up divider curtain.
- D. Scoreboards.
- E. Floor Sleeves for net and goal posts

1.02 RELATED REQUIREMENTS

- A. Section 099000 - Painting: Field painting of any required athletic equipment wood blocking or non-prefinished steel ceiling supports.
- B. Section 260583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
 - 1. Electrical characteristics and connection locations.
 - 2. Fire rating certifications.
 - 3. Structural steel welder certifications.
 - 4. Manufacturer's installation instructions.
- B. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gage of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.
- C. Wall Pads: Submit samples of wall pad coverings in manufacturer's available range of standard colors.
- D. Divider Curtain: Submit samples of divider curtain solid and net material in manufacturers available range of standard colors.
- E. Operating and maintenance data, for each operating equipment item.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
- B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
- C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.07 PROJECT CONDITIONS

- A. Coordinate size of access and route to place of installation.
- B. Coordinate equipment installation with size, location, and installation of service utilities.

1.08 WARRANTY

- A. Provide 5 year manufacturer warranty for scoreboard electronic parts and radios.
- B. Provide 1 year manufacturer warranty, from date of substantial completion, for the wall pads.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers of individual gymnasium equipment are listed in each items respective section below.

2.02 GENERAL REQUIREMENTS

- A. See A2 drawings for sizes and locations.
- B. Where mounting dimensions or sizes are not indicated, comply with applicable requirements of the following:
 - 1. National Federation of State High School Associations (NFHS) sports rules.
- C. Provide mounting plates, brackets, wood blocking, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of contract documents.
- D. Hardware: Heavy duty steel hardware, as recommended by manufacturer.
- E. Electrical Wiring and Components: Comply with NFPA 70; provide UL-listed equipment.
- F. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M, using certified welders.

2.03 BASKETBALL

- A. Gymnasium Equipment: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Basketball Goals:
 - 1) Main Court: Draper EZ Fold TF-20- B Ceiling Suspended, Forward Folding, Front Braced over 28 feet in height.

- 2) Side/Cross Courts: Draper EZ Fold TF-20- B Ceiling Suspended, Forward Folding, Front Braced over 28 feet in height.
2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. AALCO Manufacturing: www.aalcomfg.com
 - b. AL Inc. Division of ADP Lemco, Inc.
 - c. Draper, Inc: www.draperinc.com.
 - d. IPI by Bison: www.ipibybison.com
 - e. Medart
 - f. Performance Sports Systems: www.perfsports.com.
 - g. Porter Athletic Equipment Company: www.porterathletic.com.
 - h. Spalding Equipment Company: www.spaldingequipment.com
- B. Wall-Mounted Backstop Assemblies: Wall-mounted steel frame assembly capable of mounting both rectangular and fan-shaped backboards.
 1. Framing: Stationary framing.
 2. Blocking: Provide wood blocking as necessary for support of the backstop assembly.
 3. Height Adjuster: Raises or lowers assembly by 2 feet to adjust goal height.
 4. Height Control System: Manual winch.
 5. Framing Color: As selected from manufacturer's standard selection of minimum 8 colors.
 6. Framing Finish: Manufacturers standard powder-coat finish.
- C. Ceiling-Suspended Backstop Assemblies: Capable of mounting both rectangular and fan-shaped backboards.
 1. Framing: Center strut; forward folding framing.
 2. Folding Control System: Electric hoist that folds backstop with 115 volt actuator, integral limit switches that provide automatic shut-off in both positions, and safety catch with automatic reset.
 - a. Controls: Provide key lock, 3 position, momentary contact wall control switch to lower, raise and stop backstop.
 - 1) Provide two keys, one controlling up direction and second controlling down direction.
 - 2) Provide with stainless steel cover plate.
 3. Height Adjuster: Raises or lowers assembly by 2 feet to adjust goal height.
 4. Height Control System: Manual winch.
 5. Framing Color: As selected from manufacturer's standard selection of minimum 8 colors.
 6. Framing Finish: Manufacturers standard powder-coat finish.
 7. Accessories: Provide each ceiling-suspended backstop assembly with safety strap locking system. Basis of Design: Draper - Posilok Safety Belt or Spaulding Aut-O-Loc Safety Belt or equivalent.
 8. Overhead Structure: Manufacturer to verify existing/new building structure and determine, and supply, any additional steel structural members to support the equipment. Attachment to structure by athletic equipment installer.
- D. Backboards: Tempered glass, rectangular shaped.
 1. Frame: Brushed aluminum edge, steel mounting.
 2. Dimensions: 42 inches high by 72 inches wide
 3. Thickness: 1/2 inches.
 4. Markings: Painted.
 5. Provide safety padding for bottom edge of backboard.
 - a. Padding shall be bolted to backboard. Tape or glue attachment systems will not be accepted.
 - b. Padding shall protect bottom and 15" up each side of backboard.
 - c. Padding shall provide a full 2" thickness from the bottom and sides of the backboard frame. Front and back surfaces of the backboard frame shall be further protected by a 1" thick lip extending 3/4" up from the bottom and sides of backboard.

- d. Molded pad material to have integral padding color. Color to be selected by architect from manufacturer's standard color selection of minimum 8 colors.
- 6. Color: As selected from manufacturer's standard selection.
- E. Goals: Steel rim, mounted to backboard, with attached nylon net; complete with mounting hardware.
 - 1. Net Attachment Device: Tube-tie.
 - 2. Rim flexible when load of 160 to 230 pounds is applied.
 - 3. Breakaway mechanism, adjustable.
 - 4. Finish: Powder coat orange.

2.04 WALL PADDING

- A. Gymnasium Equipment: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Wall Padding: Draper EcoVision Class A Flame Retardant Wall Padding
 - 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. AALCO Manufacturing: www.aalcomfg.com
 - b. AL Inc. Division of ADP Lemco, Inc.
 - c. Arizona Courtlines, Inc.; www.arizonacourtlines.com
 - d. Draper, Inc: www.draperinc.com.
 - e. Institutional Products, Inc: www.instprod.com
 - f. Medart
 - g. Performance Sports Systems: www.perfsports.com.
 - h. Porter Athletic Equipment Company: www.porterathletic.com.
 - i. Spalding Equipment Company: www.spaldingequipment.com
- B. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
 - 1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84 as a complete panel.
 - 2. Flammability: Comply with NFPA 286.
 - 3. Covering: Vinyl-coated polyester fabric, fire-retardant, mildew and rot resistant; stapled to back of board. Tear strength of 100 psi.
 - a. Color: As selected from manufacturer's standard range by Architect.
 - 1) Maximum of two colors to alternate, or be placed on either side of the graphic image to provide contrast.
 - b. Texture: Embossed leather-look.
 - c. Graphics: Digitally printed on wall pad material. Silk screened or adhesive vinyl graphics will not be accepted.
 - 1) Graphics: Custom graphics shall be provided on four pads on either side of court beyond goals, and in Wrestling Room as shown on drawings, at each end of gym. Vector artwork will be provided, by the Architect or Owner, to the manufacturer.
 - d. Fabric Weight: 14 oz/sq yd. minimum.
 - 4. Foam: Flame-retardant, open cell polychloroprene (Neoprene) 5.5 pcf nominal density.
 - 5. Foam Thickness: 2 inches, minimum
 - 6. Backing Board: Plywood or OSB.
 - a. Thickness: 3/8 inch minimum.
 - b. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84.

7. Panel Dimensions: 24 inches wide by 70 to 72 inches wide, no nailing margins, x overall length as indicated on the A2 sheets .
8. Mounting: Removable; Z-clips fixed to wall and to padding.
9. Cutouts: Provide molded wall pad cutouts for electrical outlets, electrical switches, or other wall mounted device within the wall pad area.

2.05 FOLD UP DIVIDER CURTAINS

- A. Gymnasium Equipment: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Draper, Inc.: Fold-Up Divider Curtain, motorized.
 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. AALCO Manufacturing: www.aalcomfg.com
 - b. AL Inc. Division of ADP Lemco, Inc.
 - c. Arizona Courtlines, Inc.; www.arizonacourtlines.com
 - d. Draper, Inc: www.draperinc.com.
 - e. Institutional Products, Inc: www.instprod.com
 - f. Medart
 - g. Performance Sports Systems: www.perfsports.com.
 - h. Porter Athletic Equipment Company: www.porterathletic.com.
 - i. Spalding Equipment Company: www.spaldingequipment.com
- B. Overhead superstructure: The gym curtain shall be supported from the roof structure from 3 1/2" OD structural tubing (ASTM A513) supplied by curtain supplier. All tubing shall be first run steel only, second run steel will not be approved as equivalent. Bridge pipe will be required when truss spans exceed 14'-0". Superstructure shall be furnished with standard black finish.
- C. Material: The lower 8 feet shall be solid 18 oz. polyester reinforced, fire retardant and mildew resistant vinyl fabric. Seams shall be electronically welded with a full contact weld. A padded pocket shall be formed in the bottom edge of the curtain to accommodate a 1-7/8" OD bottom support pipe. Upper portion of curtain shall be a 6 oz. vinyl coated polyester mesh. A pocket shall be formed in the top edge of accommodate a 1-7/8" OD top support pipe. Curtain shall stop 2" above the finish floor.
- D. Drive/Support Structure: The curtains shall be operated by a 3/4 horsepower, 115 volt, 60 cycle, single phase, reversible, capacitor start motor with thermal overload protection. This motor shall drive a continual drive shaft of 2-3/8" OD. The curtains shall be lifted by means of 1/8" galvanized aircraft cable. Lift cables shall be spaced at no greater than 12'0" center to center. The cable shall pass through grommets in the vinyl fabric spaced 24" center to center and be taken up on individual reels located on the drive shaft. The drive shaft shall be supported by a carrier assembly spaced no greater than 12'0" center to center. The carrier shall consist of a formed bracket with two rubber tire wheels on which the drive shall rotate.
- E. Electric Hoist: Electric hoist shall be equipped with a 3/4 horsepower, 115 volt, 60 hertz, single phase motor with thermal overload protection. The hoist has both V-Belt and a 60 to 1 worm gear reduction. The worm gear design shall lock and hold the curtain in any position in the event of power failure. Gear box shall be filled with oil and completely sealed at the factory.
- F. The electric hoist shall be controlled from a 24 volt switch to reduce the hazard of electrical shock, hoists not having low voltage 24V switch will not be acceptable. The hoist not having low voltage 24V switch will not be acceptable. The hoist shall come with a three position momentary contact key switch and rotary counting limit switches to control the raising and lowering of the backstop. Hoist shall be prewired and come to complete with twist lock plug and receptacle. Maximum load rate is 750 lbs.

2.06 SCOREBOARDS

- A. Scoreboards: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Daktronics: BB-2155 single-sided, LED, basketball scoreboard that can score volleyball and wrestling.
 2. Products by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Daktronics: www.daktronics.com
 - b. Electro-Mech: www.electro-mech.com
 - c. Fair Play: www.fair-play.com
 - d. Nevco: www.nevco.com
 - e. Sportable Scoreboards: www.sportablescoreboards.com
- B. General Information:
1. General: Single-sided basketball scoreboard that can score volleyball and wrestling
 2. Scoring: Scores HOME and GUEST to 199, PERIOD to nine, team FOULS to 99, PLR (player number) to 99, play FOUL to 9, T.O.L (time outs left) to 9, indicates possession and bonus, displays period time to 59:59 and during the last minute of the period, it displays time to 1/10 of a second.
 3. Dimensions: 4'-0" (1219 mm) high, 10'-0" (3048 mm) wide, 0'-6" (152 mm) deep.
 4. Weight: 150 lb (68 kg).
 5. Power requirement: 200 W.
 6. Color: Architect to select from manufacturers standard color selection.
- C. Construction:
1. All-aluminum construction.
 2. Scoreboard face and perimeter: 0.063" thick.
 3. Scoreboard back: 0.050" thick.
 4. Digit faceplates: 0.063" thick.
 5. Cabinet withstands high-velocity impact from indoor sports balls without the need for protective screens.
- D. Digits:
1. AS AlInGap LED digits.
 2. Seven bar segments per digit.
 3. LED digit technology: LED digits protrude through the digit faceplates for wide angle viewing. Maximum viewing angle of 140 degrees.
 4. Clock and score digits: 10" (254 mm) high.
 5. Time outs left digit: 7" (178 mm) high.
 6. All other digits: 10" (254 mm) high.
 7. Clock, PLAYER, FOUL, PERIOD digits and bonus indicators: amber LEDs.
 8. All other digits: Red LEDs.
- E. Captions:
1. HOME and GUEST captions: 6" (152 mm) high.
 2. All other captions: 3" (76 mm) high.
 3. All captions: White vinyl applied directly to scoreboard face.
- F. Horn:
1. Vibrating horn: Mounts behind scoreboard face.
 2. Sounds automatically when period clock counts down to zero.
 3. Sounds manually as directed by operator.
- G. Power:

1. Scoreboard to be hardwired per MEP specs and drawings.
 2. Scoreboard to have hardwired power to console location.
 3. Scoreboard to have wireless/radio frequency transmitters for console control.
- H. Scoring Console:
1. Console Basis of Design: All Sport 5100 controller.
 2. Capable of scoring basketball, volleyball, and wrestling through the use of keyboard inserts.
 3. Capable of controlling other All Sport controlled scoreboards.
 4. Console has a maximum power requirement of 5 watts.
 5. Console recalls clock, score, and period information if power is lost.
- I. Console includes:
1. Aluminum enclosure to house electronics.
 2. Sealed membrane water-resistant keyboard.
 3. 32-character liquid crystal prompting display to verify entries and recall information currently displayed.
 4. 6' (1829 mm) power cord to plug into a standard grounded 120 V AC outlet.
 5. 20' (6096 mm) control cable to connect to the control receptacle junction box at Scorers Table location.
 6. Console to have radio frequency/wireless connection to the scoreboard.
- J. Practice timer mode:
1. Can sound the horn at the end of each segment.
 2. Has 99 programmable segments.
 3. Displays the segment number and segment length.
 4. Has a programmable interval time.

2.07 FLOOR-MOUNTED EQUIPMENT

- A. A. Floor Sleeves for Posts: Metal sleeve, with latch cover, cast into concrete subfloor to hold poles for nets and goals; installed flush with finish floor surface.
1. Latch Cover: Brass, round; tamper resistant with key.
 2. Sleeve: Aluminum
 3. Round Pole Diameter: 3" inches. Verify with Construction Manager and Owner.
 4. Depth of Sleeve: 9 inches from floor surface to bottom, including latch cover.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.
- B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.
- C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
- D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION

- A. Install in accordance with contract documents and manufacturer's instructions.
- B. Install equipment rigid, straight, plumb, and level.
- C. Secure equipment with manufacturer's recommended anchoring devices.
- D. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.

- E. Separate dissimilar metals to prevent electrolytic corrosion.

3.03 ADJUSTING

- A. Verify proper placement of equipment.
- B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.
- C. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.

3.04 CLEANING

- A. Remove masking or protective covering from finished surfaces.
- B. Clean equipment in accordance with manufacturer's recommendations.

3.05 PROTECTION

- A. Remove masking or protective covering from finished surfaces.
- B. Clean equipment in accordance with manufacturer's recommendations.
- C. Protect installed products until Date of Substantial Completion.
- D. Replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 122413 - MANUALLY OPERATED WINDOW SHADES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Section includes: Manually operated, roll-up fabric window shades including mounting and operating hardware.
 - 1. Shade types:
 - a. RWS1 – Typical roller shades at exterior windows, 3% openness
 - b. RWS2 – Opaque roller shades at Science Classroom Exterior Windows, and noted Interior window locations
 - c. RWS3 – Roller Blackout Shades with Blackout Side Channels – Science Labs and noted areas on drawings
 - d. RDS1 – Roller Door Shades – Equal to BlackoutEZ.com, Black vinyl roller shade with ties, located on drawings
 - 2.

1.02 RELATED REQUIREMENTS

- A. Division 1 Specifications Sections for Submittal Procedures.
- B. Section 012300 - Alternates: Refer to Section for additional information.
- C. Section 079005 - Joint Sealers: Acoustic sealant/sound caulk.
- D. Section 090050 - Finish Legend.
- E. Section 092116 - Gypsum Board Assemblies: Suspended gypsum board ceiling recessed window shade pockets.
- F. Section 095113 - Acoustical Panel Ceilings: Suspended acoustical panel ceilings to contain recessed window shade pockets.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.04 SUBMITTALS

- A. Submit in accordance with Division 1 Specifications Sections for Submittal Procedures:

1. List of proposed products and product data
2. Shop drawings showing window openings, dimensions, and attachment method
3. Samples for selection by Interior Designer:
 - a. Fabrics: Sheerweave SW 2400-3% openness and opaque fabrics.
4. Window Shade Schedule listing rooms, field verified window dimensions, quantities, type of shade, fabric, and color
5. Manufacturer's installation and maintenance instructions

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. NFPA Flame-Test: Passed NFPA 701. Materials tested shall be identical to products proposed for use.
- C. Store products in manufacturer's unopened packaging until ready for installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.

1.07 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity, and ventilation conditions are maintained at levels recommended for project upon completion.
- B. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruptions of construction progress.
- C. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. Provide under provisions of Division 1 Specifications Sections for Contract Closeout: 5 years warranty against defects in materials and workmanship for clutch operating mechanism.

PARTS 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Draper, Inc., 411 South Pearl Street, Spiceland, Indiana 47385-0425; 765-987-7999
- B. Springs Window Fashions Division, Inc.
- C. Hunter Douglas Window Fashions
- D. Lutron
- E. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.

2.02 MANUALLY OPERATED WINDOW SHADES

- A. Type: Manually operated, vertical roll-up, fabric window shade with bead chain and clutch operating mechanism, mounting brackets, fasteners, and other components necessary for complete installation; Equal to FlexShade as manufactured by Draper, Inc.
- B. Method of installation: Mounted inside of window opening and extending from head to sill and jamb to jamb.
- C. Operation: Bead chain and clutch operating mechanism allowing shade to stop when chain is released. Designed never to need adjustment or lubrication. Provide preset limit stops to prevent shade from being raised or lowered too far.
 - 1. Clutch mechanism: Fabricated from high carbon steel and molded fiberglass reinforced polyester or injected molded nylon
 - 2. Control loop: Stainless steel bead chain hanging at side of window
 - 3. Chain location: Right hand side when facing window from interior

2.03 WINDOW SHADE TYPES

- A. Manual Window Shades-Roller Window Shades Typical (RWS1)
 - 1. Manufacturer: Draper
 - 2. Shade Fabric: Sheerweave SW2400
 - 3. Openness Factor: 3%
 - 4. Color: Manufacturer's standard
 - 5. Fascia: Clear Anodized
 - 6. Location: Exterior Windows except at corridors, stairs and vestibules, noted interior windows
- B. Manual Window Shades-Roller Window Shades -Opaque-Science (RWS2)
 - 1. Manufacturer: Draper
 - 2. Shade Fabric: Light Blocking
 - 3. Color: Opaque
 - 4. Fascia: Clear Anodized
 - 5. Location: Science Classrooms and noted areas on drawings
- C. Manual Window Shades-Roller Window Shades-Blackout (RWS3)
 - 1. Manufacturer: Draper
 - 2. Shade Fabric: True Blackout with Side Channels
 - 3. Openness Factor: Opaque
 - 4. Color: Manufacturer's Standard
 - 5. Fascia: Clear Anodized
 - 6. Edges: Blackout Side Channels
 - 7. Location: Science labs and noted areas on drawings

2.04 HARDWARE

- A. Mounting Brackets: 1018 plated steel stamping. Sizes 1 5/8" and 2 1/4". Mount to face, ceiling or jamb. Brackets do not require additional adapters.
- B. Fascia: L-shaped cover of extruded aluminum, .060 wall. Snap-lock assembly to end caps without exposed fasteners. Anodized Aluminum (standard) finish or black, white, ivory or bronze powder coat finish.

2.05 FABRIC

- A. Material: Manufacturer's standard 3% open light filtering fabric equal to SheerWeave 2400 and opaque fabrics.

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Field verify window dimensions prior to fabrication.
- B. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

3.02 INSTALLATION

- A. Install window shades at locations indicated on drawings and approved Window Shade Schedule.
- B. Comply with shade manufacturer's written instructions and approved shop drawings.
- C. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.
- D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
 - 1. Fascias
 - 2. Closure panels
 - 3. Endcaps
- E. Position shades level, plumb, and at proper height relative to adjacent construction. Secure with fasteners recommended by manufacturer.

3.03 ADJUSTING AND CLEANING

- A. Operate shade through complete cycle of lowering, stopping, and raising to ensure proper operation. Adjust as required for smooth operation.
- B. Clean shade assemblies and protect from damage from construction operations. If damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 123450 - LABORATORY CASEWORK**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. This Section includes stock laboratory casework units (SWD1), complete with laboratory countertops, integral sinks, accessories, and mechanical and electrical service fittings mounted on epoxy countertop (SET1).
 - 1. In some instances casework model numbers based on specific manufacturers are shown as a further clarification only and are not intended to preclude other approved manufacturers from being accepted as equivalents.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Service fittings are specified in this Section. Installation of service fittings is specified under mechanical work of Division 15 and electrical work of Division 16.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures
- B. Section 090050 - Finish Legend

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of laboratory furniture unit specified.
 - 1. Include independent laboratory certification that applied finish complies with specified chemical and physical resistance requirements.
- C. Shop drawings for laboratory casework and fittings showing plan layout, elevations, ends, cross-sections, service run spaces, location and type of service fittings, together with associated service supply connection required.
 - 1. Include details and location of anchorages and fitting to floors, walls, and base, including required blocking or back-blocking.

2. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
 3. Coordinate shop drawings with other work involved.
 4. Include manufacturer's recommendations for blocking and securing of laboratory casework units and fittings.
- D. Samples for verification purposes of each type of specified finish, including top material. Provide in minimum 6-inch by 6-inch sizes. Samples will be reviewed by Designer/Architect for color, texture, and pattern only. Compliance with other specified requirements is exclusive responsibility of Contractor.
1. One minimum 6-inch by 6-inch sample of each type of countertop specified.
- E. Product test reports from and based on tests performed by a qualified independent testing laboratory evidencing compliance of laboratory casework finishes with requirements specified for chemical and physical resistance.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide laboratory casework with tops, sinks, and service fittings, manufactured or furnished by same laboratory furniture company for single responsibility.
- B. Catalog Standards: Manufacturer's catalog numbers may be shown on drawings for convenience in identifying certain laboratory cabinet work. Unless modified by notation on drawings or otherwise specified, catalog description for indicated number constitutes requirements for each such cabinet.
1. The use of catalog numbers and specific requirements set forth in drawings and specifications are not intended to preclude the use of any other acceptable manufacturer's product or procedures which may be equivalent, but are given for purpose of establishing standard of design and quality for materials, construction, and workmanship.
- C. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver laboratory casework only after wet operations in building are completed.
- B. Store completed laboratory casework in a ventilated place, protected from the weather, with relative humidity of 50 percent or less at 70 deg F (22 deg C).
- C. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.07 PROJECT CONDITIONS

- A. Conditioning: Do not proceed with installation of wood flooring until spaces have been enclosed and are at approximate humidity condition planned for occupancy. Condition wood for 5 days prior to start of installation by placing in spaces to receive flooring and maintaining ambient temperature between 65 deg. F and 70 deg. F (18 deg. C and 21 deg. C) before, during, and after installation. Open packages of wood flooring which are sealed (if any) to permit natural adjustment of moisture content.

1.08 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 1. Delamination of components or other failures of glue bond
 2. Warping of components
 3. Failure of operating hardware
 4. Deterioration of finishes
 5. Warranty Period: Five years from date of substantial completion

1.10 EXTRA MATERIALS

- A. Furnish complete touch-up kit for each type and color of laboratory casework provided. Kit to include touch-up paint and other materials necessary to perform permanent spot repairs to damaged casework finish.

PART 2 PRODUCTS**2.01 WOOD LABORATORY CASEWORK**

- A. General: Provide wood laboratory casework that complies with requirements specified in this article.
- B. Definitions: The following definitions apply to wood laboratory casework units:
 1. Exposed portions of casework include surfaces visible when doors and drawers are closed. Bottoms of cases more than 4'-0" above floor shall be considered as exposed. Visible members in open cases or behind glass doors also shall be considered as exposed portions.
 2. Semiexposed portions of casework includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of cases 6'-6" or more above floor shall be considered semiexposed.
 3. Concealed portions of casework include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- C. Exposed Materials: Do not use exposed faces of lighter-than-average color joined with exposed faces of darker-than-average color. Do not use two adjacent faces which are noticeably dissimilar in grain, figure, and natural character markings.
 1. Solid Lumber: Clear, dry, premium-grade red oak, free from defects and selected for compatible grain and color.
 2. Plywood Face Veneer: Same species as exposed solid lumber, clear, selected for grain and color compatible with exposed solid lumber, no defects. Provide solid crossbandings without voids. Edgeband exposed edges with minimum 1/8-inch-thick, solid wood edging of same species as face veneer.
- D. Semiexposed Materials: Comply with the following:
 1. Solid Lumber: Dry, sound, selected to eliminate appearance defects. Any species of hardwood or softwood of similar color and grain to exposed portions.
 2. Plywood: Hardwood, ANSI/HPMA HP, Good Grade (1) or softwood, PS-1, Group 1, A-A, INT of species to match color and grain of exposed members.
- E. Concealed Members: Comply with the following:
 1. Solid Lumber or Plywood: Any species, with no defects affecting strength or utility.
 2. Particleboard: ANSI A208.1, minimum 40 lb./cu. ft. density, Grade 1-M-2 or better.
 3. Hardboard: ANSI/AHA A135.4, Class 1, tempered.
- F. Manufacturers: Subject to compliance with requirements, provide wood laboratory casework products by one of the following:
 1. Campbell Rhea/Mohon International, Inc.

2. Kewaunee Scientific Equipment Corp.
 3. Taylor/Div. American Desk.
 4. Leonard Peterson Company
 5. Southern Cabinetry, Inc.
 6. Diversified Woodcrafts, Inc.
 7. Mott Manufacturing.
 8. Advanced Lab Concepts.
 9. Sheldon Labs.
- G. Acid Storage Cabinet Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Campbellrhea Wood Casework by Mohon International, Inc. Model No. 6781-A equipped with one adjustable shelf; one built in top tray; swinging doors open to 180 deg; doors have a three-point latching and locking handle.
 2. Companies whose products meet or exceed the project specifications as approved by written addendum.
- H. Safety Glasses/Goggles Monitor: Subject to compliance with requirement, provide safety glasses/goggle sanitizer cabinets produced by the following or approved equivalent:
1. Campbellrhea, Mohon International, Inc.
 - a. Safety Glasses/Goggle Sanitizer No.6784.
 2. Companies who products meet or exceed the project specifications as approved by written addendum.
- I. Flammable Storage Cabinet Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Campbellrhea, Mohon International, Inc., Model No. 6778-A
 2. Companies whose products meet of exceed the project specifications as approved by written addendum.
- J. First Aid Kit: Subject to compliance with requirements, provide first aid kits produced by the following or approved equivalent:
1. Campbellrhea, Mohon International, Inc.
 - a. First Aid Kit, 9962
- K. Fire Blanket: Subject to compliance with requirements, provide fire blankets produced by the following or approved equivalent:
1. Campbellrhea, Mohon International, Inc.
 - a. Fire blanket 9960 with metal case. Cabinet size, 19 1/2" H x 17" W x 12" D.
- L. Scienc Student Tables:
1. Manufacturer: Kewaunee
 2. Size: 60" x 24"
 3. Type: Black Epoxy tops with wooden legs, no casters

2.02 CHEMICAL AND PHYSICAL RESISTANCE OF LABORATORY CASEWORK FINISHES

- A. General: Provide laboratory casework with a factory-applied finish that is capable of withstanding the tests specified in this article with no permanent change in gloss, color, film hardness, adhesion, or film protection.
- B. Acids: Not less than 10 drops (0.50 cc) of the following reagents applied to finish surface, covered with watch glass, convex side down, for 60 minutes, then washed and dried.
1. Hydrochloric acid (37 percent), sulfuric acid (85 percent), nitric acid (25 percent), phosphoric acid (75 percent), acetic acid (98 percent).
- C. Solvent: Not less than 10 drops (0.5 cc) of the following reagents applied to finish surface, covered with watch glass, convex side up, for 60 minutes, then washed and dried.

1. Ethyl alcohol, butyl alcohol, methyl alcohol, toluene, acetone, benzene, carbon tetrachloride, formaldehyde (37 percent), gasoline, ethyl acetate, ethyl ether, methyl ethyl ketone, naphtha, kerosene, xylene, glycerin, furfural.
- D. Bases and Salts: Not less than 5 drops (0.25 cc) of the following reagents applied to finish surface, covered with watch glass, convex side up, for 60 minutes, then washed and dried.
 1. Sodium hydroxide (25 percent), ammonium hydroxide (28 percent), potassium hydroxide (40 percent), saturated zinc chloride, saturated sodium chloride, saturated sodium sulphide, saturated sodium carbonate, poultice of "Tide" laundry detergent and water.
- E. Moisture Resistance: No visible effect when finish surface exposed to the following:
 1. Hot water at a temperature of 190 deg F (91 deg C) to 205 deg F (96 deg C), trickled down surface at 45-degree angle for 5 minutes.
 2. Constant Moisture using a 2-inch by 3-inch by 1-inch cellulose sponge, soaked with water, in contact with surface for 100 hours.

2.03 FINISH FOR WOOD LABORATORY CASEWORK

- A. General: Provide exposed portions of wood laboratory casework with a clear factory finish that complies with chemical and physical resistance requirements specified.
- B. Preparation: Sand exposed and semiexposed components, using machine and hand methods. Machine marks, cross-sanding, tool marks, or other surface blemishes are not acceptable.
- C. Exposed Portions: Carefully sand finishes after each surface treatment. Apply finishes as follows:
 1. Sealer coat, if required.
 2. Stain to match color selected, if required.
 3. Mineral filler for open-grained wood, if required.
 4. Multiple coats of highly chemical-resistant finish, heat-dried and sanded between each coat to produce a smooth, satin luster free of imperfections.
- D. Semiexposed Portions: Apply sealer coat, colored to match exposed portions, and follow with heavy application of clear, water-repellant finish coat to provide a smooth, washable surface.
- E. Concealed Portions: One heavy coat of water-repellant finish.

2.04 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Provide manufacturer's standard satin finish, commercial quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Hinges: Institutional 5-knuckle, 2-3/4 inch., overlay type, hospital tip, 0.95 inch thick steel. Provide one pair for doors less than 4 feet high and 1-1/2 pair for doors over 4 feet high. Hinges shall have a minimum of eight (8) edge and leaf fastening.
- C. Pulls: Solid metal for drawers and swing doors, mounted with 2 screws fastened from back. Provide 2 wire pulls, 4" wide for drawers over 24 inches wide.
- D. Door Catches: Catches for doors on wall and base cabinets shall be double action, springs tension nylon roller catches, or magnetic catches with a minimum ten (10) pound pull, attached with screws and slotted for adjustment.
- E. Drawer Guides: Provide nylon-tired, ball-bearing rollers with metal guide channels and integral stops to eliminate accidental removal of drawer. Provide guides designed to provide self-closing of drawer and to prevent rebounding action when drawers are closed. Guides shall have a 100 lb. load rating at 3/4 extension. Guides shall have a life time warranty as offered by the Slide Manufacturer.
- F. Drawer Stops: Designed to permit easy removal, and yet prevent inadvertent drawer removal. Provide on all drawers, located on the inside.

- G. Filler Strips: Provide where required for closing space between cabinets and walls and ceilings, of same material and finish as cabinets.
- H. Drawer and Cupboard Locks: Half-mortise type, 5-pin tumbler and dead bolt, round cylinder only exposed, brass with plated finish. Locks shall be keyed and master-keyed as specified.
- I. Cabinet Base Molding: Extruded vinyl 4 inches high. Provide on exposed sides and fronts of floor-mounted cabinets.
- J. Adjustable Shelf Supports: Wrought steel, mortise-mounted.
- K. Countertop/Shelf Support: Provide countertop/shelf supports equivalent to A & M Hardware, Inc. workstation brackets, size brackets to suit installation.

2.05 TOPS, SINKS, AND ACCESSORIES

- A. Tops, Box Curbs, Splash Rim: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Make exposed edges and corners uniformly rounded.
- B. Epoxy Resin Top Thickness: 1-inch thickness, with tolerance not exceeding plus or minus 1/32 inch. Provide front and end overhang of 1 inch over base cabinets, formed with continuous drip groove on under surface 1/2 inch from edge.
- C. Modified Epoxy Resin Tops: Tops and curbs shall be molded from a silica filled epoxy-resin that has been especially compounded and cured to provide optimum physical and chemical resistance required for laboratory working surfaces. Tops and curbs shall be a uniform mixture throughout and shall not depend on a surface coating which can be readily removed by chemical or physical abuse. Tops and curbs are molded to counter top configurations and then finished off by cutting sink cut outs, hole drillings and other field conditions.
 - 1. Tops and curbs shall be non-glaring matte finish and black in color.
 - 2. Tops shall be 1" thickness as required with a drip groove provided on underside, where noted only. All edges shall have a slight radius.
 - 3. Curbs shall be 3/4" thickness as required, bonded to the surface on the top to form a square water tight joint. All joints in tops to be bonded with an approved epoxy cement and shall be smooth and water tight.
 - 4. Counters with a marine edge to have 1" wide by 1/4" high raised edge, front and exposed ends, and a drip groove on the countertops underside. Fume hood counters are specified to have marine edge on four (4) sides.
 - 5. Fabricate counter top from longest lengths possible, 8' minimum length typical. Submit shop drawings showing seaming diagram for approval prior to fabrication and installation.
 - a. Physical Properties: Comply with the following minimum requirements:
 - 1) Flexural strength:15,000 psi.
 - 2) Compressive strength:35,000 psi.
 - 3) Hardness (Rockwell M):100.
 - 4) Water absorption (24 hrs): 0.02 percent (maximum).
 - 5) Heat distortion point:350 deg F (176 deg C).
 - 6) Thermal shock resistance: Highly resistant.
 - b. Chemical Resistance: Spot test with the following reagents in standard laboratory concentrations, in contact with finished top for 24 hours; top shall be entirely unaffected or show only slight dulling of finish:
 - 1) Glacial acetic acid, nitric acid, sulfuric acid, ammonium hydroxide, sodium hydroxide, amyl acetate, benzene, ethyl acetate, ethyl ether, hydrogen peroxide, methyl ethyl ketone, phenol, trichloroethylene, zinc chloride, hydrochloric acid, phosphoric acid, chromic acid, calcium hypochlorite, acetone, aqua regia, butyl alcohol, ethyl alcohol, formaldehyde, methyl alcohol, kerosene, silver nitrate, xylene.

- c. Workmanship: Cast surfaces very smooth, with factory cutouts for sinks and drip grooves. Fabricate plain butt-type joints assembled with epoxy adhesive and prefitted, concealed metal spline.

2.06 SINKS, CUP SINKS, TROUGHS

- A. Sizes: As indicated or manufacturer's closest stock size of equal or greater volume, as acceptable to Architect.
- B. Cast Epoxy Resin Sinks: Nonspecular black, molded in one piece with surfaces smooth, corners coved to 1½" radius and bottom sloped to outlet. Minimum physical properties and chemical resistance as specified for cast epoxy resin tops; 1/2-inch minimum thickness.
 - 1. Refer to the epoxy sink legend on the architectural drawings for sink sizes.
- C. Epoxy Resin Countertops Associated Fixtures: Subject to compliance with requirements, provide faucets and gas cocks produced by the following or approved equivalent:
 - 1. Chicago Faucet Company
 - 2. Sprakman Inc.
 - 3. T&S Brass Inc.
 - a. Chicago Faucet Co. Water Fitting No.930
 - 1) GN2BVB 6" Vacuum Breaker Spout.
 - 2) E7 Serrated Nozzle Outlet.
 - 3) 204 Handles.
 - 4) Chicago Faucet Co. Turret No.981
 - (a) Two outlets, 180 deg.
 - 5) Chicago Faucet Co. Flange No.907

2.07 MECHANICAL SERVICE FITTINGS

- A. Service Fittings: Provide units complete with washers, locknuts, unions, nipples and other accessories for positive mounting to supporting laboratory units. Include wall and deck flanges, escutcheons, handle extension rods, remote valves, and similar items required. Fabricate units to withstand test pressure of 100 psig.
- B. Material and Finish: Fabricate service fittings from cast or forged red brass containing a minimum of 85 percent copper. Provide exposed surfaces, including fittings, escutcheons, and trim, with a polished chrome-plated finish.
 - 1. For fittings inside fume hoods, coat with acid- and solvent-resistant baked-on plastic coating in manufacturer's standard metallic brown, aluminum, or other color as acceptable to Architect.

PART 3 EXECUTION

3.01 CASEWORK INSTALLATION

- A. Install plumb, level, true and aligned with no distortions. Shim as required, using concealed shims. Where laboratory casework abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.
- B. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16 inch of a single plane. Fasten each individual cabinet to floor at toe space with fasteners spaced 24 inches on center. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor where they do not adjoin other cabinets.
 - 1. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- C. Install hardware uniformly and precisely after final finishing is complete. Set hinges snug and flat in mortises unless otherwise indicated. Turn screws to flat seat. Adjust and align hardware so that

moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.

- D. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.02 INSTALLATION OF TOPS

- A. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory-prepared so there is no jobsite processing of top and edge surfaces.
- B. Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices. At stone-type material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths not more than 1/16 inch wide at any location, completely filled and flush with abutting edges.
- C. Provide holes and cutouts as required for mechanical and electrical service fittings.
- D. Carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.
- E. Provide scribe moldings for closures at junctures of top, curb, and splash with walls as recommended by manufacturer for materials involved. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

3.03 INSTALLATION OF SINKS

- A. Underside Installation: Use manufacturer's recommended adjustable support system for table-type and cabinet-type installations.
- B. Set top edge of sink unit in manufacturer's recommended chemical-resistant sealing compound and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement.
- C. Semiflush Installation: Use stainless steel sink frame, complete with clamping lugs and pads. Before setting, apply a full coat of manufacturer's recommended sealant under rim lip and along top. Omit sink frame if sink fabricated with integral rim seal.

3.04 INSTALLATION OF ACCESSORIES

- A. Install accessories in accordance with approved location drawings and manufacturer's installation recommendations. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely and smoothly without binding.

3.05 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed upon completion of installation.
- B. Clean factory- and shop-finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as acceptable to Designer/Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at minimum of 4 feet on center. Advise Contractor of procedures and precautions for subsequent protection of installed laboratory casework and fittings from damage by work of other trades.

END OF SECTION

SECTION 123550 - INSTITUTIONAL CASEWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Plastic laminate faced wood cabinets of stock design
 - 2. Plastic laminate countertops
 - 3. Band room casework - design based on Wenger Corporation Casework Ultrastor storage cabinets
- B. In some instances specific manufacturer's model numbers have been used to more clearly define the casework design and are not provided to preclude other acceptable manufacturer's from supplying equal products.
- C. Related Sections include the following: List below only products and construction that the reader might expect to find in this Section but are specified elsewhere.
 - 1. Division 6 Section "Miscellaneous Carpentry" for wood blocking for anchoring institutional casework
 - 2. Division 6 Section "Interior Architectural Woodwork" (Custom Millwork)
 - 3. Division 9 Section "Gypsum Drywall" for reinforcements in gypsum board partitions for anchoring institutional casework
 - 4. Division 9 Section "Resilient Wall Base and Accessories" for resilient base applied to institutional casework

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures
- B. Section 090050 - Finish Legend

1.03 DEFINITIONS

- A. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets. The bottom of wall cabinets are considered exposed and will receive plastic laminate.
- B. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

1.04 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014

- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated
- B. Shop Drawings: Show fabrication and installation details for institutional casework. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated
- D. Samples for Verification: 6-inch- (150-mm-) square Samples for each type of finish, including top material and the following:
 - 1. Section of countertop showing top, front edge, and backsplash construction

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of institutional casework manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain institutional casework through one source from a single manufacturer.
- C. Quality Standard: Build and install to AWI quality standards.
- D. Product Designations: Drawings indicate sizes, configurations, and finish material of institutional casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver institutional casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install institutional casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify all dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating institutional casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.09 COORDINATION

- A. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of institutional casework.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional casework that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 1. Delamination of components or other failures of glue bond
 2. Warping of components
 3. Failure of operating hardware
 4. Deterioration of finishes
 5. Warranty Period: Five years from date of substantial completion

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: The design for institutional casework is based on TMI Systems Design Corp. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
- C. Plastic Laminate Faced Institutional Casework:
 1. Action Outfitters
 2. Advanced Cabinet Systems
 3. Advantage Millwork
 4. America's Finest Woodworking Team
 5. Architectural Cabinet Systems; Division of Windham Millwork, Inc.
 6. Case Systems, Inc.
 7. Caseworks of Kentucky
 8. Creative Cabinets
 9. Cumberland Manufacturing
 10. Custom Casework
 11. Custom Creations
 12. Diversified Woodworking
 13. Euronique, Inc.
 14. Fisher Hamilton Inc.
 15. Hamilton Sorter
 16. Hausmann Industries, Inc.
 17. Interior Wood Specialties, Inc.
 18. Kentucky Mill & Casework
 19. Leininger Cabinets
 20. Louisville Lumber
 21. LSI Corporation of America, Inc.
 22. Morgan Smith Industries
 23. Norlab, Inc.
 24. Polyvision Corporation
 25. Procace Countertops
 26. Riverside Mill
 27. Smith's Laminating
 28. Southern Cabinetry, Inc.
 29. Stevens Industries, Inc.
 30. Tate Ornamental
 31. Techline

32. Terrill Manufacturing Company
 33. TMI Systems Design Corp.
 34. Top Service
 35. U.S. Millwork
 36. Wenger Co.
 37. Westmark Commercial Casework
- D. Plastic Laminate Material:
1. Arborite
 2. Formica Corporation
 3. Nevamar
 4. Wilsonart International; Div. of Premark International, Inc.
- E. Rigid PVC Extrusions (3mm & 1mm):
1. Wood Tape

2.02 MATERIALS

- A. General:
1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood
 2. Hardwood Plywood: HPVA HP-1, either veneer core or particle core, unless otherwise indicated
 3. Softwood Plywood: DOC PS 1
 4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue
 5. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue
 6. Hardboard: AHA A135.4, Class 1 Tempered
 7. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3
 8. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere
- B. Exposed Cabinet Materials:
1. Plastic Laminate: Type VGS.
 - a. Unless otherwise indicated, provide plastic laminate for exposed surfaces.
 - b. Provide plastic laminate for doors and drawer fronts and where indicated.
- C. Semiexposed Cabinet Materials:
1. Plastic Laminate: Type CLS
 - a. Provide plastic laminate for interior faces of doors and drawer fronts [only/and] where indicated.
 2. Melamine-Faced Particleboard: Particleboard with decorative surface of thermally fused, melamine-impregnated web and complying with LMA SAT-1
 - a. Provide melamine-faced particleboard for semiexposed surfaces, unless otherwise indicated.
 3. Cabinets with glass doors: provide plastic laminate to match the exterior of the cabinet unless shown otherwise on the drawings.
- D. Concealed Cabinet Materials:
1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility
 2. Plywood: Hardwood plywood. Concealed backs of plywood with exposed or semiexposed faces shall be same species as faces.
 3. Plastic Laminate: Type BKL

2.03 DESIGN, COLOR, AND FINISH

- A. Design: Provide institutional casework of the following design:
1. Flush overlay with wire pulls

- B. Melamine-Faced Particleboard Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.
- C. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from plastic-laminate manufacturer's full range.
- D. Rigid PVC Extrusions (3mm & 1mm). As selected by Architect/Designer from PVC edging manufacture selections - provide a minimum of 65 color/pattern selection(s).

2.04 CABINET FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction:
 - 1. Bottoms and Ends of Cabinets, Shelves, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semiexposed surfaces. The bottom of wall cabinets is considered exposed and will receive plastic laminate. The front exposed edges of the cabinet shall receive plastic laminate.
 - 2. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced on exposed surfaces, melamine faced on semiexposed surfaces.
 - 3. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced on both sides.
 - 4. Drawer Sides and Backs: 1/2-inch (12.7-mm) solid wood or plywood or particle board, with glued dovetail or multiple-dowel joints.
 - 5. Drawer Bottoms: 1/4-inch (6.4-mm) plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
 - 6. Doors: 3/4-inch (19-mm) particleboard or medium-density fiberboard, plastic-laminate faced on both sides.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
- C. All wall and base cabinets over 3'-0" in width shall receive a vertical to prevent deflection.

2.05 CASEWORK HARDWARE

- A. Hardware, General: Provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware complying with requirements indicated.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. 5-Knuckle Hinges: Chrome-plated or Powder-coated, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches (1220 mm) high and 3 hinges for doors more than 48 inches (1220 mm) high.
- C. Pulls: Pulls as standard shall be surface mounted solid aluminum. Provide 2 pulls for drawers more than 24 inches (600 mm) wide. Wire pulls shall be 4" wide.
- D. Door Catches: Powder-coated, nylon-roller spring catch. Provide 2 catches on doors more than 48 inches (1220 mm) high.
- E. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings. Type B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf (440 N)
 - 2. File Drawer Slides: 150 lbf (670 N)
 - 3. Pencil Drawer Slides: 45 lbf (200 N)
 - 4. Keyboard Slide: 75 lbf (330 N)
- F. Drawer and Cupboard Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, complying with BHMA A156.11, Grade 1.
 - 1. Provide a minimum of two keys per lock and six master keys.
 - 2. Provide locks where indicated.

- G. Grommets for Cable Passage Through Countertops: 3 OD, Molded-plastic grommets and matching caps with slot for wire passage. Color to be selected by designer.
- H. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013
- I. Countertop / Shelf Support: Provide countertop/shelf supports equivalent to A & M Hardware, Inc., workstation brackets, size brackets to suit installation.

2.06 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.

Note: Countertops for 3 mm edge banding & radius corners.

- B. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded with waterproof glue to both sides of 1" to 1-1/4" (29-mm) plywood or particleboard. Sand surfaces to which plastic laminate is to be bonded. Plastic laminate below is standard general-purpose grade.
 - 1. Plastic-Laminate Type for Flat Tops: HGS
 - 2. Plastic-Laminate Type for Backing: BKL
 - 3. Provide PVC edgings on front edge of top, and on ends of tops.
 - 4. Use exterior plywood or phenolic-resin-bonded particleboard for countertops containing sinks.
- C. Provide grommets at all KS locations per owner's direction.

2.07 INSTRUMENT STORAGE CABINETS

- A. Refer to the instrument storage cabinet legend for additional requirements.
- B. Shelves are blow-molded polyethylene mounted with ventilation ridges and self-lock shelf supports including the bottom opening. High wear polyethylene is acceptable.
- C. All cabinet and door edging shall be 3mm beveled PVC.
- D. Provide bolt-through construction. Doweled construction is acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of institutional casework.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CASEWORK INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where institutional casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).
 - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches (600 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
 - 1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm) o.c.
- D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF TOPS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- B. Secure tops to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and walls with adhesive.
- E. Seal junctures of top, splash, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.04 INSTALLATION OF SHELVING

- A. Securely fasten adjustable shelving supports to partition framing, wood blocking, or reinforcements in partitions.
- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

3.05 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 124930 - MOTORIZED WINDOW SHADES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Section includes: Electrically operated, roll-up opaque window shades (MWS1) for complete blackout of window opening including motor operator, controls, mounting hardware, side and bottom channels, headbox, and opacity plates. Mount top treatment in side window jamb.
- B. Related Sections:
 - 1. Section 09260 "Gypsum Board Assemblies." Suspended gypsum board ceilings to contain recessed window shade pockets.
 - 2. Section 09510 "Acoustical Ceilings." Suspended acoustical panel ceilings to contain recessed window shade pockets.
 - 3. Section 26. Electrical supply, conduit, and wiring for motorized window shades.
 - 4. Section 079005 - Joint Sealers: Sealants for perimeter of shade system.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements - Submittal procedures.
- B. Division 9 Section 090050 Finish Legend.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. Submit in accordance with Section 013300 "Submittal Procedures."
 - 1. List of proposed products and product data.
 - 2. Shop drawings showing window openings, dimensions, attachment method, and electrical and control wiring.
 - 3. Samples for selection by Interior Designer.
 - a. Fabrics. (Opaque) Manufacturer's standards and black vinyl roller shades.
 - b. Window Shade Schedule listing rooms, field verified window dimensions, quantities, type of shade, controls, fabric, and color.
 - c. Manufacturer's installation and maintenance instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate the work with all sections referencing this section.

1.07 WARRANTY

- A. Submit 1-year warranty signed by Manufacturer, Installer, agreeing to replace and install new shades to replace broken and defective shades.

PART 2 - PRODUCTS**2.01 ACCEPTABLE MANUFACTURERS**

- A. Draper, Inc.
- B. Lutron - Shading Solutions by Vimco.
- C. Mecho.
- D. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 "Product Substitution Procedures."

2.02 MOTORIZED OPAQUE WINDOW SHADES

- A. Type: Electrically operated, motorized vertical roll-up, fabric, window shade with motors, controls, mounting brackets, housings, fasteners, and other components necessary for complete installation.
- B. Method of installation: Inside window jamb.
- C. Electric operator:
 - 1. Mounted inside roller on right or left side when facing window from interior. Coordinate location with Electrical Contractor.
 - 2. Motor: 110 VAC, single-phase, 60 HZ, instantly reversible, lifetime lubricated, and equipped with internal thermal overload protector, electric brake, and pre-set accessible limit switches.
- D. Shade size: Verify sizes in field.
- E. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller.
- F. Brackets: Plated stamped steel with suitable for mounting to wall. Provide size compatible with roller size and with fasteners appropriate for installation conditions.
- G. Shade slat: Minimum 1/8 by 1 inch (3 mm by 25 mm) aluminum slat encased in heat seamed hem.
- H. Individual shade control: 3-position toggle switch with cover plate, accepting 110 V current. Provide one switch for each shade.
- I. Headbox: Fabrication from 0.06 inch (1.59 mm) thick extruded aluminum sections with endcaps and opacity plates.
 - 1. Size: [4-1/8 inches high by 3-1/2 inches wide] [105 mm high by 89 mm wide] by length required for shade being provided.
 - 2. L-shaped removable front face and bottom cover and L-shaped back and top.

- J. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall and jamb. Provide size compatible with roller size and fasteners appropriate for installation conditions.
- K. Side Channels: Double chamber fabricated from [0.06 inch] [1.59 mm] thick extruded aluminum sections. One chamber accepts fabric and contains groove for fabric retainer. Other chamber accepts fabric guide and channel locator.
- L. Sill channel: [0.06 inch] [1.59 mm] thick extruded aluminum channel to receive slat bar and prevent light leakage.
- M. Slat bar: Extruded aluminum bar attached to bottom of shade. Bar does not retract into headbox.
- N. Channel Locator: Injected molded nylon insert to align side and sill channels with headbox.
- O. Fabric guide: Plated steel transition for fabric rolling into side channel.
- P. Fabric retainer: System designed to prevent disengagement of fabric from side channels due to normal variations of air pressure caused by doors opening, HVAC systems, and temperature differences between room and window well. System consists of horizontal steel stays installed in shade, covered with fabric, and spaced at regular intervals. Grommets installed through stays are held within groove of side channel chamber.
- Q. Opacity plates: Steel plates with rubber O rings installed on endcaps to eliminate light leakage.
- R. Exposed aluminum finish: To be selected from manufacturer's full product line.

2.03 FABRIC

- A. Roc-Rol.
- B. Top treatment: Aluminum or wood housing painted to match the wall color. Paint color to be specified by the Architect. Paint to be supplied and applied by the shade installer.
- C. Shade fabric material: Vinyl coated polyester yarn woven into basketweave pattern. Designer to select from available colors in 10%, 5%, 3% and zero open fabrics. Acceptable fabrics include SheerWeave Series 2400/2900/2600 by Phifer and XL by Hexcel.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Field verify window dimensions prior to fabrication.
- B. Coordinate requirements for blocking construction of shade pockets and structural supports to ensure adequate means for installation of window shades.
- C. Coordinate requirements for power supply, conduit, and wiring required for window shade motors and controls.
- D. Coordinate location of wall switch.
- E. Prior to installation, verify type and location of power supply.

3.02 INSTALLATION

- A. Install window shades at locations indicated on drawings and approved Window Shade Schedule.
- B. Comply with shade manufacturer's written instructions and approved shop drawings.

3.03 TESTING AND DEMONSTRATION

- A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

- B. Demonstrate operation of shades to Owner's designated representatives.

3.04 PROTECTING

- A. Clean shade assemblies and protect from damage from construction operations. If damage occurs, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

SECTION 126100 - FIXED AUDIENCE SEATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fixed, upholstered theater chairs.
- B. Fixed, non-upholstered theater chairs.
- C. Support standards.
- D. Chair accessories.

1.02 RELATED REQUIREMENTS

- A. Section _____ - Stadium and Arena Seating.
- B. Section 126613 - Telescoping Bleachers.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- D. Section 260533.23 - Surface Raceways for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- D. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- E. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2012.
- F. ASTM D3597 - Standard Specification for Woven Upholstery Fabrics--Plain, Tufted, or Flocked; 2002 (Reapproved 2013).
- G. ASTM E1352 - Standard Test Method for Cigarette Ignition Resistance of Mock-Up Upholstered Furniture Assemblies; 2008a.
- H. ASTM E1537 - Standard Test Method for Fire Testing of Upholstered Furniture; 2013.
- I. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.
- J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- K. NFPA 261 - Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes; National Fire Protection Association; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination with Electrical Work: Coordinate installation of wiring to ensure that floor-mounted junction boxes are completely beneath seats and free of aisle spaces.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, chair layouts and dimensions and seat numbering scheme.

1. Field Measurements: Verify seating layout by field measurements and record field dimensions on shop drawings.
- D. Selection Samples: Manufacturer's color charts and swatches for fabric upholstery, indicating full range of materials, colors, and patterns available.
- E. Verification Samples: Full-size two-seat fabricated sample of each type of chair specified, including all accessories and one end panel, illustrating all finishes and workmanship to be expected in the finished Work; approved sample may be incorporated into the Work.
- F. Maintenance Materials:
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Seats: Quantity equal to 5 percent of total installed, but not less than one of each type and width of seat, furnished from same production run as that installed.
 3. Extra Fabric: Quantity sufficient for reupholstering 5 percent of installed seating.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer certified in writing by the seating manufacturer to be qualified for installation of specified seating.
- B. Fire Retardance of Upholstered Seating: Self-extinguishing when mock-up is exposed to smoldering cigarettes in accordance with ASTM E1352 or NFPA 261.
- C. Fire Retardance of Fixed Theater Seating: Maximum instantaneous net peak rate of heat release of 250 kW or less, and total energy released during first 5 minutes of 40 mJ or less, when tested in accordance with ASTM E1537.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver seats to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.
- B. Store seating units in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.08 MOCK-UP

- A. See Section 014000 - Quality Requirements, for additional mock-up requirements.
- B. Construct mock-up with at least 2 seats in each of 2 rows at location indicated. Approved mock-up will serve as quality standard for completed installation. Approved mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fixed Theater Seating:
 1. Hussey Seating Company; _____: www.husseyseating.com/#sle.
 2. SERIES Seating, LLC; _____: www.seriesseating.com/#sle.
 3. _____.
 4. Track Seating, a division of Track Corp.; Product _____: www.trackseating.com.
- B. Substitutions: See Section 016000 - Product Requirements.
- C. Provide all theater seating by one manufacturer.

2.02 MATERIALS

- A. Cast Iron: ASTM A48/A48M, Class 25A minimum, free of air holes and casting imperfections, all edges ground smooth.

- B. Sheet Steel: ASTM A879/A879M, Commercial Steel (CS) or Drawing Steel (DS) electrogalvanized sheet, 04Z (12G) coating class on both surfaces; chemically treated for baked enamel finish.
 - C. Steel Plates, Bars, and Tubes: ASTM A36/A36M.
 - D. Exposed Hardwood: Solid lumber selected for absence of visible defects; birch, northern hard maple, white oak, or species standard with manufacturer.
 - E. Hardwood Plywood: HPVA HP-1; face veneers for exposed surfaces Grade A birch, hard maple, walnut, or as standard with manufacturer, with no visible defects; concealed surface veneers of sound grade hardwood.
 - F. Laminated Plastic: NEMA LD 3, Type 1, Grade GP 50, nominal thickness 0.050 in; colors and patterns as selected from manufacturer's standards.
 - G. Fiberglass: Molded plastic material with not less than 30 percent glass fiber reinforcement and integral color pigments.
 - H. Polypropylene Sheet: Molded high density plastic with minimum tensile strength of 3300 psi, integral color pigments, and textured, scuff-resistant surface finish.
 - I. Polyurethane Foam: Density not less than 1.8 lb/cu ft, fire retardant, non-hardening and non-oxidizing, with high resistance to alkalis, oils, moisture, and mildew.
 - J. Upholstery Fabric: ASTM D3597 heavy-duty plain woven nylon fabric, treated to resist cigarette ignition and staining; color and pattern as selected from manufacturer's standards.
 - K. Upholstery Fabric: As supplied by Owner.
 - L. Upholstery Fabric: Manufacturer _____; fabric designation _____; color and pattern _____.
1. Above fabric designation is intended to establish fabric material; weight, weave, surface texture, pattern, and color required. Products by other manufacturers that match the specified product in all essential respects may be substituted, with Architect's prior approval.

2.03 UPHOLSTERED CHAIRS

- A. Fixed seating system designed to permit radial installation using common middle support standards in each row and aisle standards aligned as indicated on drawings. Width of seats not less than 22 inches, except exit seat locations may be reduced to 20 inches to complete specific row dimensions.
- B. Backs: Fixed type; two-panel construction with fabric covering over padding and protective back panel, with installed height not less than 32 inches above finished floor.
 1. Structural Support: Molded hardwood plywood, not less than 5 ply and 3/8 in thick.
 2. Structural Support: One-piece die-formed steel sheet.
 3. Padding: Polyurethane foam not less than 1 in thick bonded to structural support.
 4. Covering: Fabric bonded to padding and fastened by upholstery technique that facilitates replacement.
 5. Rear Panel: One-piece die-formed steel sheet.
 6. Rear Panel: One-piece injection molded high-impact plastic, with scuff-resistant textured surface.
 7. Rear Panel: One-piece molded plywood, not less than 1/4 in thick, with exposed back surface of plastic laminate.
- C. Seats: Hinged type, constructed to permit reupholstering without removing seat from chair.
 1. Steel Seat Construction: One-piece sheet steel pan construction, reinforced at stress points; supporting not fewer than 16 coil springs or five non-sag serpentine springs. Separate padding from springs with burlap sheeting cemented to polyurethane foam padding formed with minimum thickness of 1-3/4 in. Upholster with fabric sewn into box construction

without welts and securely fastened to supporting frame to provide smooth, wrinkle-free surface.

- a. For serpentine spring construction, provide not less than 3 in thick foam padding at front edge of seat.
 - b. Perforate steel seat pan and provide interior acoustic baffle for sound absorption when seat is in raised position.
2. Plywood Seat Construction: Molded one-piece hardwood plywood shell of minimum 3/4 in thickness with threaded inserts for fastening to hinges; polyurethane foam padding of minimum 3-1/2 in thickness glued to plywood support; bottom seat surface of fabric matching seat upholstery over glued polyurethane foam. Upholster with fabric sewn into box construction without welts and securely fastened with concealed clips to provide smooth, wrinkle-free surface.
- D. Hinges: Self-lubricating, noiseless steel hinges with brass alloy bearings or nylon bushings, equipped with spring mechanism that causes unoccupied seat to rise automatically to uniform 3/4 fold, with 100 percent fold when additional pressure is applied.
1. Provide push-back hinge mechanism that allows additional aisle space while seat is in an open position.
- E. Arm Rests: Locate at aisles and between chairs; mount to support standard with concealed fasteners; exposed surfaces of solid hardwood lumber with smoothed edges.
1. Provide arm rests with cup holder opening sized to accommodate cups up to 40 ounces.
- F. End Panels: One piece panels fastened securely to aisle standards with concealed fasteners, configured as follows:
1. Shape: Rectangular.
 2. Finish: Solid hardwood.

2.04 NON-UPHOLSTERED CHAIRS

- A. Fixed seating system designed to permit radial installation using common middle support standards in each row and aisle standards aligned as indicated on drawings. Width of seats not less than 21 inches, except exit seat locations may be reduced to 20 inches to complete specific row dimensions.
- B. One-Piece Chairs: Contoured, shell-type construction with rolled edges, fabricated from molded fiberglass or injection-molded high-impact polypropylene.
1. Provide embedded provisions for fastening to welded bracket for connection to steel support standards.
- C. Two-Piece Chairs:
1. Construction: Contoured seat and back construction with rolled edges, fabricated from molded fiberglass or injection-molded high-impact polypropylene.
 2. Construction: Contoured seat and back fabricated from hardwood plywood with rounded edges, not less than 5 ply, 3/8 thick, with exposed surfaces of hardwood face veneers, and riveted to steel mounting brackets.
 3. Seats: Equip seat with noiseless, self-lubricating hinges and spring-operated mechanism that will raise seat to vertical or near-vertical position when seat is unoccupied.
- D. Arm Rests: Locate at aisles and between chairs; mount to support standard with concealed fasteners; exposed surfaces of solid hardwood lumber with smoothed edges.
- E. End Panels: One piece panels fastened securely to aisle standards with concealed fasteners, configured as follows:
1. Shape: Rectangular.
 2. Finish: Hardwood plywood veneer.

2.05 STANDARDS

- A. Support Standards: One-piece cast iron, with integral mounting points for backs, seats, and arm rests, and integral floor anchoring points.
- B. Support Standards: Tubular steel with welded mounting points for backs, seats, and arm rests, and welded floor anchor plates.

2.06 ACCESSORIES

- A. Folding Tablet Arms: At standard to right side of each seat, provide manufacturer's standard fold-away tablet arm assembly, with hinge and swivel mechanism securely fastened to underside of writing surface and designed to provide solid support in the open position and semi-automatic return to stowed position beneath right arm rest and parallel to right standard.
 - 1. Finish: Plastic laminate both sides, with smooth, rounded edges.
 - 2. Size: Writing surface not less than 100 sq inches.
- B. Aisle Lights: Manufacturer's standard UL-approved concealed lamp assemblies, with louvers to conceal lamp and direct light toward floor, mounted beneath aisle arm rest; wiring route concealed to floor connection.
- C. Seat and Aisle Numbers: Manufacturer's standard seat numbers securely fastened to front edge of folding seats and row numbers securely fastened to aisle arm rests; anodized aluminum finish, with letters and numbers countersunk and filled with black paint.
- D. Audio Response System: Locate control box below arm rest panel at locations indicated; route wiring through concealed casing to floor connection box.
- E. Power and Data System: Provide raceways and terminals for power and data connections at each chair.
- F. Book Holders: Manufacturer's standard book holder in finish compatible with chairs, designed for concealed attachment to chair backs and to underside of seats in front rows.

2.07 FINISHES

- A. Ferrous Metals: Manufacturer's standard two-coat baked enamel finish, applied over conversion coating appropriate to base metal.
 - 1. Color and Gloss: Match Architect's sample.
 - 2. Color and Gloss: As selected from manufacturer's standard choices.
- B. Hardwood: Manufacturer's standard clear low-gloss finish.
- C. Hardwood Plywood: Manufacturer's standard clear low-gloss finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of fixed theater seating. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's installation instructions and approved shop drawings.
- B. Anchor support standards securely to substrate with at least two anchoring devices recommended by manufacturer.
 - 1. Place standards in each row laterally so the standards at the aisle will be in alignment.
 - 2. Vary width of seats and backs as required to optimize sightlines, and comply with the ADA Standards for row and aisle widths.
 - 3. In curved rows, install standards to form smooth radius, without breaks or angled chords

4. Attach components to standards with sufficient flexibility to compensate for convergence of seats toward the center.

3.03 ADJUSTING

- A. Adjust seat mechanisms to ensure that seats in each row are aligned when unoccupied.
- B. Repair minor abrasions and imperfections in painted finishes with a coating that matches factory-applied finish; replace units that cannot be repaired to unblemished appearance.
- C. Replace upholstery fabric damaged or soiled during installation.

END OF SECTION

SECTION 126613 - TELESCOPING BLEACHERS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Telescoping bleachers.
- B. Electric motor operators, controls, and internal wiring.

1.02 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Connection of electric motors and controls.

1.03 REFERENCE STANDARDS

- A. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; National Fire Protection Association; 2015.
- B. PS 1 - Structural Plywood; 2009.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2008.
- E. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; National Fire Protection Association; 2015.
- F. PS 1 - Structural Plywood; 2009.
- G. ICC/ANSI 300-2012 Bleachers, Folding and Telescopic Seating and Grandstands.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage handling and requirements.
 - 3. Installation methods.
- B. Shop Drawings: Complete layout with dimensions, seat heights, row spacing and rise, aisle widths and locations, points of connection to substrate, assembly dimensions, and material types and finishes.
 - 1. Provide drawings customized to this project.
 - 2. Include Professional Engineer's seal on each sheet licensed in Kentucky.
 - 3. Wiring Diagrams: Show locations of motors, electrical wiring, and rough-in connections.
 - 4. Graphics Layout Drawings: Indicate pattern of contrasting seat colors.
- C. Selection Samples: For each material for which color selection is required, submit samples, 2 by 2 inches in size, illustrating colors and finishes available.
- D. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions, including annual inspection and maintenance and bi-annual inspection by a Professional Engineer or manufacturer factory service personnel.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Kentucky Department of Housing, Building and Construction, Division of Building Codes Enforcement (HBC) Submittal: The telescoping bleacher manufacturer, supplier and/or installer is responsible to provide and submit all required shop drawings necessary to obtain all approvals, permits and pay any fees required by HBC per ICC/ANSI 300-2012 for the project.

1. All drawings to be marked "FOR CONSTRUCTION" and bear the required seal and signature of the professional engineer in responsible charge of the shop drawing preparation for the manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Manufacturer's installation crew.
- C. Welder Qualifications: Certified by AWS for the process employed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store, in original packaging, under cover and elevated above grade.

1.07 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion. Replace parts that fail under normal use at no extra charge to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Telescoping Bleachers
 1. Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - a. Interkal LLC: www.interkal.com.
 - b. Irwin Telescopic Seating Company: www.irwintelescopicseating.com.
 - c. Hussey Seating Company: www.husseyseating.com.
 - d. Kodiak Industries Ltd.: www.kodiakgym.com

2.02 TELESCOPING BLEACHERS

- A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
 1. Provide a design certified by a licensed Professional Engineer licensed in the State in which the Project is located.
 2. Provide a design that has been in use for at least 5 years; submit documentation.
 3. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
 4. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
 5. Standard Extension: Top row fixed to floor, adjacent to wall under overhang, forward extension (away from wall); attachment to wall acceptable.
 6. Wheelchair Spaces: Provide manufacturers standard recoverable handicap notchouts located as shown on architectural drawings.
 - a. Notchouts to be 36 inch wide.
 - b. Notchouts to be one row deep.
 7. Operation: Motor operated.
- B. Design Loads: Design to withstand the following loading conditions:
 1. Live Load on Structural Supports: 100 psf, minimum, of gross horizontal projection.
 2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.

3. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot of seat plank.
 4. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot of seat plank.
- C. Dimensions:
1. See drawings for overall dimensions.
 2. Rise Per Row: 10 inches.
 3. Row Depth: 22 inches.
 4. Seat Height Above Tread: 6 inches.
- D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
1. Design so that each row carriage so that it will individually support the design loads and is self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
 2. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
 3. Bolting: Use lock-washers or locknuts.
 4. Wheels: Minimum 5 inch diameter by 1-1/8 inch wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
 5. Finish: Manufacturer's standard enamel or powder coating.
 6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
 7. Unlocking: Automatically unlock all rows before engaging retraction mechanism.
- E. Motor Operation: Manufacturer's standard drive mechanism, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
 2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
 3. Control Station: Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
 4. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
 5. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
 6. Electrical Characteristics: 120V, single phase, 60 Hz.
 7. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches wide is acceptable.

2.03 SEAT AND PLATFORM COMPONENTS

- A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum 1 inch thick, textured finish, homogeneous color throughout, color as selected from manufacturer's standard selection; approximately 18 inch long sections independently removable with tongue-and-groove or rabbeted interlock at end joints.
1. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than 3 inches; no openings to trap debris.
 2. Provide end caps of same material and finish on each exposed end.
 3. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.
 4. Colors: Up to two standard colors will be selected by the architect for seat color and school initial color in contrast to show when bleachers are in the open or closed position.
 - a. Maximum four letters will be provided; "WCHS".
- B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear with side joints tongue-and-grooved.

1. Plywood: PS 1, 5-ply southern pine or polyethylene-overlaid douglas fir or southern pine, Grade A-C.
2. Plywood Thickness: 5/8 inch, minimum.
3. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
4. Provide end caps of same material and finish on each exposed end.
5. Finish: High gloss clear urethane, both sides, unless polyethylene finished.
6. Nosings: Extruded aluminum; clear anodized finish.
7. At aisles provide permanently attached intermediate steps of same construction and finish.
8. At bottom of aisles provide step in front of first riser, hinged to first platform to fold for storage.

2.04 HANDRAILS AND RAILINGS

- A. Provide the following railings:
 1. Aisle Handrails: Single post folding railing segment mounted in center of aisle at every other row beginning at row 2.
 2. End of Row Guardrails: Self-storing, at open ends of sections beginning at row 2.
 3. Height: 42 inches above adjacent platform or tread.
- B. Design handrails and railings to withstand the following loads:
 1. Concentrated Load on Handrails: 200 pounds in any direction.
 2. Concentrated Load on Guardrails: 200 pounds in any direction along top rail.
 3. Live Load on Handrails: 50 pounds per linear foot, applied in any direction.
 4. Live Load on Guardrails:
 - a. Horizontal: 50 pounds per linear foot, applied at the guardrail height.
 - b. Vertical: 100 pounds per linear foot, applied vertically to top of guardrail.
- C. Railing Construction: Round steel or aluminum pipe or tube, with formed elbows at corners and caps at ends of straight runs.
 1. Aluminum: 1.66 inches minimum outside diameter; natural anodized finish.
 2. Steel: 1-1/2 inch minimum outside diameter, with 11 gage, 0.12 inch minimum wall thickness; textured powder coat epoxy finish.

2.05 ACCESSORIES

- A. Fillers and Closures:
 1. Ends of Retracted Units: Plywood panels, finished to match platforms.
 2. Top Row: Provide seat level rear filler panels to close openings between top row seat and wall; finish to match platforms.
 3. Sides of Extended Units: Vinyl curtains.
 4. Vinyl Curtains: 18 ounce vinyl with grommets; color as selected from manufacturer's standard palette.
- B. Motion Monitor: Strobe light and warning horn rated at 150 dB, both of which operate continuously during movement of any section of bleachers; mount strobe light where it is clearly visible to entire bleacher installation.
- C. Scorer's Table: 8 feet wide by 15 inches deep; relocatable to any row of any section without mounting brackets.
- D. Fasteners: Provide hardware and fasteners in accordance with manufacturer's recommendations.
- E. Anchorage: As indicated on drawings; provide hardware in accordance with manufacturer's recommendations.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field measurements are consistent with those on the shop drawings.
- B. Verify that electrical rough-ins have been installed and are accessible.
- C. Do not begin installation until substrates have been properly prepared and area has been cleared of obstructions.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Do not field cut or alter seats, fascia, or structural members without approval.
- C. Provide manufacturer's field representative to inspect completed installation.

3.04 OWNER PERSONNEL DEMONSTRATION AND TRAINING

- A. Demonstration and Training: Provide manufacturer's field representative to demonstrate to and train Owner's operating personnel in proper operation of equipment.
 - 1. Location: On site using installed equipment.
 - 2. Time: As agreed between Owner and Contractor.

3.05 ADJUSTING

- A. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.06 CLEANING

- A. Clean exposed and semi-exposed assembly surfaces.
- B. Touch up finishes on damaged or soiled areas.

3.07 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 126613

SECTION 133413 - GREENHOUSE AND RELATED EQUIPMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Engineered, clear span greenhouse including; structure, exterior panels, doors and greenhouse equipment as noted on the drawings.
 - 1. House size: 30' x 96'
 - 2. Headhouse size: 24' X 30'
 - 3. Sidewall height: 8' minimum

1.02 WORK NOT INCLUDED

- A. This specification does not include the following work, and is conditioned on the proper performance of such work by the General Contractor or other Subcontractors.
 - 1. Site preparation.
 - 2. Footings, foundation and slabs.
 - 3. Utility installation and utility connections to equipment furnished by the greenhouse manufacturer.

1.03 RELATED REQUIREMENTS

- A. Section 033000 - Cast-In-Place Concrete: Concrete foundations and slabs.
- B. Section 334111 - Site Storm Utility Drainage Piping: Greenhouse trench drain.
- C. Divisions 22 through 26 for all mechanical, electrical and plumbing items.

1.04 QUALITY ASSURANCE

- A. A qualified greenhouse specialty contractor approved by the greenhouse manufacturer shall erect the greenhouse.
- B. The greenhouse contractor shall have at least 5 year's experience in constructing greenhouses of the type specified.

1.05 SUBMITTALS

- A. Submit shop drawings and product data for engineered structure. Include support post piers and anchoring requirements, complete dimensions, door locations and flashing details. The plans shall bear the seal of an architect or engineer registered in the State of Kentucky.
- B. Submit product data for mechanical systems provided under this section.
- C. Provide copies of polycarbonate panel manufacturers 10 year limited warranty, five (5) year hail breakage warranty and longevity claims with the greenhouse shop drawings. Provide plastic panels that comply with flammability restrictions of BOCA, Standard Building Code, and other applicable codes.
- D. Kentucky Department of Housing, Building and Construction, Division of Building Codes Enforcement (HBC) Submittal: The greenhouse manufacturer, supplier and/or installer is responsible to provide and submit all required shop drawings necessary to obtain all approvals, permits and pay any fees required by HBC for the project.
 - 1. All drawings to be marked "FOR CONSTRUCTION" and bear the required seal and signature of the professional engineer in responsible charge of the shop drawing preparation for the manufacturer.
 - 2. Shop drawing submittal to contain the anchor bolt layout and indicate that the anchor bolts meet the embedment depth as required by the 2015 IBC with Kentucky Amendments Section 2308.6.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
 - 3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
 - 7. Storage of materials at the site shall be confined to areas within the Contract Limits, and the Contractors designated parking area if necessary, where designated by the Architect.

1.07 WARRANTY

- A. Greenhouse shall have a warranty period of one year for defect of structural members and glazing. Equipment in the greenhouse will carry the manufacturer's standard warranty for parts.
- B. Polycarbonate panels to carry minimum warranty of 10 years against yellowing.

PART 2 - PRODUCTS**2.01 MANUFACTURERS PLASTIC PANEL GLAZED STRUCTURE**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Winandy Greenhouse Co., Inc.: www.winandygreenhouse.com
 - 2. Rough Brothers, Inc.: www.roughbros.com
 - 3. Florian Greenhouses, Inc.: www.floriangreenhouse.com
 - 4. Stuppy, Inc.: www.stuppy.com
 - 5. Nexus Greenhouse Systems: www.nexuscorp.com
 - 6. The Greenhouse Company of South Carolina, LLC (formerly Jaderloon Co, Inc.)
www.jaderloon.com
 - 7. Solar Innovations: www.solarinnovations.com
 - 8. United Greenhouse Systems: www.unitedgreenhouse.com
- B. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - 1. United Greenhouse Systems: Ambassador Crown.

2.02 GLAZED STRUCTURES

- A. General Description: The greenhouse shall be steel or aluminum framed and clear span, with attachments to support plastic panel skin. Greenhouse to be the product of a single manufacturer. Structure shall be a standard module of the manufacturer and total area shall not be less than 95% of area shown on bid documents.
- B. Standard Design Conditions:

1. Design Members to carry the following loads:
 - a. Dead Load.
 - b. Live Load-20 lbs. Psf on horizontally projected area.
 - c. Wind Load-70 mph, exposure B per Kentucky Building Code.
 2. In designing for the above loads, the loads may be considered to act in any of the following combinations:
 - a. Dead Load plus Live Load.
 - b. Dead Load plus Wind Load plus Live Load.
 - c. Dead Load plus Wind Load.
 3. Expansion Control: Suitable expansion joint shall be provided in all longitudinal members to take care of the longitudinal expansion in the framing members. No longitudinal members shall exceed 24'-0". All members shall be so joined as to require each joint to handle the expansion in the individual member and to prevent an accumulation of expansion in several members in one direction.
- C. Framing Materials:
1. Primary supporting posts, trusses and purlins to be steel, hot dip zinc galvanized, of 55-60,000 psi yield, or extruded aluminum 6061-T6 or 6005-T5 with a rating of 35,000 PSI yield.
 - a. If members are galvanized prior to fabrication touch up all welds and connections to provide complete galvanized coverage.
 2. Provide all other structural members, bracing, clips, lugs and fasteners not mentioned above but required to complete the framework of the greenhouse.
 3. Endwalls to be framed with minimum 3 inch by 2 inch 15 gauge steel tubing with minimum yield strength of 50,000 psi.
 4. Columns to be fabricated from 2.875" O. D. 13-gauge high strength alloy steel with minimum yield strength of 60,000 psi.
 5. Truss top cords to be fabricated from 1.90" O. D. steel with minimum yield strength of 50,000 psi
 6. Truss bottom cords to be fabricated from 1.66" O.D. steel with minimum yield strength of 50,000 psi.
 7. Truss webbing to be fabricated from minimum 1.315 inch steel with minimum yield of 50,000 psi. Truss webbing to be attached to top and bottom cords with aluminum connections to enhance corrosion resistance.
 8. Truss to column connections to be hot-dipped galvanized.
 9. Roof purlins to be minimum 2 inch by 2 inch steel members. Purlins to have bolted connection to trusses.
 10. No wood members are required or allowed to complete the structure.
- D. Fasteners:
1. Roofs: Extruded aluminum cap and self-threading screw cap system to secure polycarbonate double walled plastic panel roof skin. All plastic panels to be weather sealed with EPDM rubber seals and/or manufacturers standard methods to provide a watertight seal when complete.
- E. Polycarbonate Sheet Glazing Materials:
1. Glazing panels for roofs, walls and ends shall be 8MM, double walled polycarbonate panels to be secured by full-length extruded aluminum caps and self-threading screws. Panels weather sealed with EPDM seals.
 - a. Clear lexan for all sides, ends, and greenhouse roof.
 - b. White lexan for head house roof only with 50% shade.
 - c. Acceptable manufacturers are:
 - 1) General Electric - LEXAN (R)
 - 2) CO-EX Corporation - 8MM Double Wall.
 - 3) Gallina, USA - 8MM

- 4) Polygal North America - 8MM
 - 5) Sable Innovative Plastics Products - Lexan Thermaclear Plus
- F. Gutters: and Downspouts
1. ASTM B221 extruded aluminum of hot-dipped galvanized steel, sized in accordance with SMACNA Chapter 1 using the 100-year storm information.
 2. Refer to site drawings for downspout boot details.
- G. Door Frames and Doors:
1. Greenhouse manufacturer to provide 42" x 6'-8" steel insulated man door, frame and trim at locations shown on plans.
 2. Greenhouse manufacturer to provide 8' x 8' overhead roll up door, frame and trim as locations as shown on the plans.
 3. Doors to comply with ANSI A250.B, Level 3.
 4. Door glazing to be tempered.
 5. Doors to be installed by greenhouse contractor.
 6. Refer to hardware specifications for door hardware sets and requirements..
- H. Ventilation/Cooling System:
1. Provide 48" rigid vent, cooling unit with fans included and the following:
 - a. Inlet Air Entrance: 48" x 28' rigid vent and one shutter.
 - b. Air Circulation: (4) Four HAF horizontal air flow fans in the greenhouse, ACME 20", (1) 3 speed HAF fan in the headhouse with pull cord for speed control.
 - c. Evaporative Pad Cooling System: 48" x 28' system
 - 1) Evaporative pad system will consist of pads made of cross-fluted cellulose paper; aluminum distribution and return system complete with pump and return tank.
 - (a) Pads: 4"
 - (b) Pump: #20 Little Giant
 - (c) Sump Tank: 95 gallon tank
 - d. Exhaust Fans: (2) 42", 1/2 HP to be installed in the greenhouse and (1) 36" in the head house.
 - 1) One exhaust fan to be 2-speed.
 - 2) Fans to have automatic shutters, inlet/outlet guards, and belt tighteners.
 - 3) Exhaust fans are to have aluminum blades . Steel blades are not acceptable.
 - 4) Ventilation equipment to be properly sized to meet the required CFM amounts.
 - 5) Acceptable manufacturers for exhaust fans and horizontal air flow fans:
 - (a) Acme Engineering
 - (b) Coolair
 - (c) Equivalent product submitted to Architect for review prior to issuance of last addenda.
 - e. Motorized Inlet Shutter
 - 1) Shutter to be installed in upper gable of structure.
 - 2) Motor and linkage to operate shutter to be included.
 - 3) Shutter size to be 40" x 40"
 - f. Inlet Vents and Vent Operators
 - 1) Single run of vents shall be made up of a top rail and bottom rail of extruded aluminum and bolted together in accordance with manufacturer instructions. All vents shall have provisions made at the hinge point to prevent creeping of the vents.
 - 2) Vent size to be 48" x 28"
 - 3) Vent opener to be included.
 - 4) No tube motors are allowed.

I. Heating Equipment

1. Greenhouse manufacturer to provide heating system composed of heaters, hanger kits, vent piping, vent caps, and accessories as required for project site.
2. Provide (2) Modine HD125S for the greenhouse.
3. Provide (1) Modine HD60SS for the headhouse.
4. Fuel Type: propane
5. Differential: 60 degrees at zero outside.
6. Percent: 115%
7. Total heat loss: 207,819
8. Heater Hangers: Included
9. Heater Stacking: Twin wall stacking included to meet code.
10. Provide heaters with stainless steel heat exchangers and burners and intermittent pilot and power ventors. Heaters with aluminum exchangers are not acceptable.
11. Head house heater will use a thermostat control and the greenhouse heaters will be tied into the control system.

J. Controls

1. Automatic control system capable with minimum two stages of heating, set point, and four stages of cooling. Controller to be equipped with decondensate controller. Controller is to be complete with contractor panel and wiring diagram.
2. Provide controls by Wadsworth Step Up Controller or equal.
 - a. Controller to have 4 stages of cooling and two stages of heating, Dif control and humidity control.
3. Thermostat control is not acceptable, except in the head house.
4. Greenhouse manufacturer to provide Owner training on the programming and use of the control system.

K. Irrigation

1. Provide Dosmatic Advantage A30 2.5% fertilizer injector, or equal.
2. Provide Dosmatic SuperDos 30 fertilizer injector, or equal.
 - a. Provide minimum (8) zone controller, (5) solenoid valves, overhead minicompact sprinkler heads (60 liter/hour), hanging basket drippers, PE 0.6 ID supply tubing, pressure regulator, plastic filter, etc. required for complete system installation. Overhead mini-compact sprinklers to be spaced 4' on center and suspended overhead. hanging basket drippers to be spaced 2' on center.

L. Shade Cloth

1. Provide 50-60% LS shade cloth sized to cover the entire greenhouse roof.
2. Provide LS Svensson FLS White 50% shade cloth (or equal) sized to cover the entire greenhouse roof (40' x 72').
3. Cord and attachment package to be included. All edges to have reinforcing tape with grommets installed 3 feet on center. Shade cloth to be attached to the framework using nylon cord and eye bolts secured to framework.
4. System to be equal to Wadsworth Power Pull Shade/Heat retention system for the greenhouse only.
5. Provide motorized system operated with a time clock.

M. Benches/Training Tables

1. Provide 6' x 8' bench. Refer to drawings for quantities.
2. Provide 6' x 12' bench. Refer to drawings for quantities.
3. Provide 4' x 12' bench. Refer to drawings for quantities.
4. Benches/Training Tables to be mix of stationary and roller tables. Roller tables to be Stuppy MOR-SPACE Rolling Bench System or equal.
 - a. Roller benches to have anti-tip bracket at the ends of the bench top.

- 5. Benches/Training Tables to be provided, assembled and installed by the greenhouse supplier.
- N. Growing Accessories
 - 1. Hanging Basket Rails
 - a. Provide (4) suspended rails for placement of hanging baskets.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Approved representative of the greenhouse manufacturer is to visit the job site a minimum of three times, at appropriate times, during construction to meet with the General Contractor and the Greenhouse Installation Contractor.
- B. Greenhouse Installation Contractor to verify that field conditions are acceptable and ready to receive the greenhouse.
- C. Foundation/concrete supports installed by Greenhouse Installation Contractor.
- D. Greenhouse to be installed by Greenhouse Installation Contractor.
- E. Ventilation equipment to be installed by Greenhouse Installation Contractor. General Contractor to make utility connections.
- F. Heating equipment to be installed by Greenhouse Installation Contractor. General Contractor to make utility connections.

END OF SECTION 133413

SECTION 142010 - PASSENGER ELEVATORS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Complete commercial, standard pre-engineered hydraulic passenger elevator systems.
- B. Excavating for hydraulic cylinder casing for below grade jack.
- C. Above ground jack, holeless.
- D. Elevator maintenance.

1.02 WORK NOT INCLUDED

- A. This specification does not include the following work, and is conditioned on the proper performance of such work by the General Contractor or other Subcontractors.
 - 1. A legal hoistway, properly framed and enclosed, and including a pit of proper depth provided with a ladder, sump pump, lights, access doors, and waterproofing, as required. Legal machine room, adequate for the elevator equipment, including floors, access doors, gratings, foundations, lighting, ventilation and heat to maintain the room at an ambient temperature of 50 degrees F. minimum to 100 degrees F maximum.
 - 2. Adequate supports and foundations to carry the loads of all equipment, including supports for guide rail brackets.
 - 3. Cutting of walls, floors, etc., and removal of such obstruction as may be necessary for proper installation of the elevator. Setting of anchors and sleeves. Pockets or blockouts or signal fixtures.
 - 4. The grouting of door sills. Finish walls after hoistway frames are installed.
 - 5. Provide and maintain temporary enclosures or other protection from open hoistways during the time the elevator is being installed.
 - 6. Proper trenching and backfilling of any underground piping or conduit.
 - 7. Guide rail bracket inserts provided by Elevator Contractor and installed by Masonry Contractor.
 - 8. Guide rail bracket inserts provided by Elevator Contractor and installed by Steel Erector.
 - 9. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator machine room will be furnished by the electrical contractor. This means shall not be self resetting.
 - 10. Removal of all dirt and debris accumulated during excavation of the jack hole to be done by the General Contractor.
 - 11. Suitable connections from the power mains to each controller or motor generator set starter, signal equipment feeders as required, including necessary circuit breakers and fused mainline disconnect switches. Auxiliary contact set for use in conjunction with emergency battery lowering is to be included.
 - 12. Wiring to controller for car lighting and ventilation. Electric power without charge, for construction, testing and adjusting, of the same characteristics as the permanent supply.
 - 13. Wiring and conduit from life safety panel or any other monitor station to elevator machine room.
 - 14. Telephone connection to elevator controller.
 - 15. Any governmentally required safety provisions not directly involved in the elevator installation.
 - 16. All painting, except as otherwise specified.
 - 17. Temporary elevator service prior to completion and acceptance of complete installation.
 - 18. Furnishing, installing and maintaining the required fire rating of elevator hoistway walls, including the penetration of fire wall by elevator fixture boxes, is not the responsibility of the elevator contractor.

19. Heat and smoke sensing devices at elevator lobbies on each floor, in the machine room, and at the top and bottom of the hoistway with electrical conductors terminating at a properly marked panel in the elevator machine room.

1.03 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Includes elevator machine foundation.
- B. Section 042000 - UNIT MASONRY: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
- C. Section 051200 - Structural Steel Framing: Includes hoistway framing.
- D. Section 055000 - Metal Fabrications: Includes pit ladder, sill supports, divider beams, overhead hoist beams, and sump pit cover.
- E. Section 071400-Fluid-Applied Waterproofing: Waterproofing of elevator pit walls and floor.
- F. Section 092116 - Gypsum Board Assemblies: Gypsum shaft walls.
- G. Section 096510 - Resilient Flooring: Floor finish in cab.
- H. Section 223000 - Plumbing Equipment: Pit drain.
- I. Section 260533.13 - Conduit for Electrical Systems:
- J. Section 260583 - Wiring Connections:
 1. Electrical characteristics and wiring connections.
 2. Electrical service to main disconnect in elevator machine room.
 3. Emergency power transfer cabinet.
 4. Electrical power for elevator installation and testing.
 5. Electrical disconnecting device to elevator equipment prior to activation of sprinkler system.
 6. Electrical service for machine room.
 7. Lighting in elevator pit.
 8. Empty conduit for telephone service .
- K. Section 312316 - Excavation: Excavation for cylinder casing and hydraulic lines between cylinder and remote machine room.

1.04 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2010.
- B. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.
- C. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks; 2014.
- D. ASME A17.4 - Guide for Emergency Personnel; The American Society of Mechanical Engineers; 1999.
- E. ASME A17.5 - Elevator and Escalator Electrical Equipment; The American Society of Mechanical Engineers; 2004.
- F. ASME A17.6 - Standard for Elevator Suspension, Compensations and Governor Systems; The American Society of Mechanical Engineers; 2010.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

- J. UL (BMD) - Building Materials Directory; current edition.
- K. UL (ECMD) - Electrical Construction Materials Directory; current edition.

1.05 SUBMITTALS

- A. Shop Drawings: Indicate the following information:
 - 1. Locations of Machine Room Equipment: Driving machines, controllers, governors and other components.
 - 2. Hoistway Components: Car, counterweight, sheaves, machine and sheave beams, guide rails, buffers, ropes, and other components.
 - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
 - 4. Individual weight of principal components; load reaction at points of support.
 - 5. Loads on hoisting beams .
 - 6. Clearances and over-travel of car and counterweight.
 - 7. Locations in hoistway and machine room of traveling cables and connections for car light and telephone.
 - 8. Location and sizes of access doors, doors, and frames.
 - 9. Standard color charts of exposed materials for color selection by the Architect.
 - 10. Expected heat dissipation of elevator equipment in machine room.
 - 11. Interface with building security system.
 - 12. Electrical characteristics and connection requirements.
- B. Product Data: Provide data on the following items:
 - 1. Signal and operating fixtures, operating panels, indicators.
 - 2. Cab design, dimensions, layout, and components.
 - 3. Cab and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.
- C. Operation and Maintenance Data: Include:
 - 1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
 - 2. Technical information for servicing operating equipment.
 - 3. Legible schematic of hydraulic piping and wiring diagrams of installed electrical equipment and changes made in the Work. List symbols corresponding to identity or markings on machine room and hoistway apparatus.
- D. Certificates: Inspection and acceptance certificates of elevator system installation. Provide certificates signed by the elevator manufacturer certifying that the hoistway, pit and machine room layout and dimensions and electrical service as shown and specified are adequate for the elevator system being provided.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable code and as supplemented in this section.
- B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360, Specification for Structural Steel Buildings. Perform seismic design in accordance with applicable code.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Fabricate and install door and frame assemblies in accordance with NFPA 80.

- F. Perform electrical work in accordance with NFPA 70.
- G. Maintain one copy of each quality standard document on site.
- H. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- I. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.
- J. Products Requiring Fire Resistance Rating: Listed and classified by UL.
- K. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver elevator materials, components and equipment in manufacturer's protective packaging.
- B. Store materials in a dry protected area provided by others. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage, soiling, or deterioration.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits, entrance subsills and electrical service, electrical outlets, lights and switches in pits and machine rooms.
- D. Use of the Elevator: Elevator shall not be used for any purpose during the construction period before Substantial Completion.

1.08 WARRANTY

- A. Provide one year manufacturer warranty for elevator operating equipment, devices and to repair, restore, or replace defects in elevator work, materials, and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering the following hydraulic elevator products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. ThyssenKrupp Elevator - Endura 2500: www.thyssenkruppelevator.com.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - a. Otis Elevator Co: www.otis.com.
 - b. Schindler Elevator Corp: www.schindler.com.
 - c. Canton Elevators: www.cantonelevator.com
 - d. Global-Tardiff Elevator Manufacturing Group, Inc.: www.globaltardiff.com
 - e. ThyssenKrupp Elevators: www.thyssenkruppelevator.com
 - 3. The following Elevator Companies may supply and install elevator equipment purchased from third party manufacturers but must meet the requirements of this specification. Include:
 - a. DC Elevator
 - 1) 709 Miles Point Way, Lexington, KY 40510
 - 2) PH. (859) 254-8224
 - 3) www.dcelevatorco.com

2.02 ELEVATORS

- A. Elevator No.1: Passenger, holeless hydraulic type with cylinder in hoistway.
1. Operation and Controls: Two-stop automatic.
 2. Hoistway Doors and Frames: Stainless steel.
 3. Cab Height: 8' foot nominal.
 4. Cab Enclosure:
 - a. Walls: Cab type DLP, wood core panels finished on both sides with high pressure plastic laminate.
 - 1) Provide moving pad buttons.
 - b. Canopy: Reinforced 14 gauge cold rolled steel with hinged exit. Finished with two coats factory applied reflective baked enamel.
 - c. Ceiling: Downlight type metal pans with suspended LED downlights at 7' -4".
 - d. Cab Columns, Front and Transom: Stainless steel ASTM A 167, Type 304 stainless steel panel, No. 4 satin finish.
 - e. Handrail: Cylindrical, 1.5" dia. stainless steel No. 4. Provide at rear and side walls.
 - f. Car Top Inspection: Provide a car top inspection station with an "emergency stop" switch and constant pressure "up-down" direction buttons to make normal operating devices inoperative and give the inspector complete control of the elevator. Mount the car top inspection station into the door operator assembly.
 5. Hoistway and Cab Entrance Frame Opening Size: 7'-0" high x 3'-0" wide.
 - a. Formed construction of stainless steel ASTM A 167, type 304 formed stainless steel sheet, No. 4 satin finish.
 6. Interlocks: Equip each hoistway entrance with an Underwriter's "B" label; approved type interlock tested as required by code. Interlock shall be designed to prevent operation of the car away from the landing until the doors are locked in the closed position as defined by code and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing.
 7. Door Type: Horizontal Single slide, one speed. Doors reinforced with steel for rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic shoes sliding in a smooth threshold groove.
 - a. Door Finish: Stainless steel, ASTM A 167, Type 304 stainless steel panels, No. 4 satin finish, flush construction.
 - b. Manufacturers standard entrance design, bearing Underwriter's Laboratories "B" labels, and consisting of 14 gauge frames with 2 inch profile, 16 gauge door hangers, hanger supports, hanger covers, fascia plates, sight guards and necessary hardware.
 - c. Elevator wall interface with hoistway entrance assembly shall comply with elevator manufacturers requirements.
- B. Elevator Requirements
1. Cab Sills: Extended, with grooved surface, 1/4" thick. Aluminum ASTM B 221 mill finish.
 2. Door Operation: Side opening, automatic, direct current powered.
 3. Rated Net Capacity: 2500 pounds.
 4. Rated Speed: 100 ft./min..
 5. Clear Net Platform Size: 5'-8" wide x 4'-3 1/2" deep.
 6. Travel Distance: As indicated on drawings.
 7. Number of Openings: 2 Front; 0 Rear.
 8. Power Characteristics: 208 volts, 3 Phase, 60 Hz.
 9. Ventilation: Two speed exhaust fan mounted on the car top.
 10. Special Features:
 - a. Hall signal fixtures to be vandal resistant.
 - b. Car signal fixtures to be vandal resistant.

11. Elevator Motor: 20 HP.
12. Pads: Provide pad buttons on cab front and walls.

2.03 MOVING PADS

- A. Moving Pads: Provide padded, quilted, fire-retardant canvas moving pads to cover all sides. Provide bound edge cutouts for control panels. Provide pads with metal grommets sized to fit pad buttons. Architect to select from manufacturers standard canvas color choices.

2.04 HOISTWAY EQUIPMENT

- A. Platform: Fabricate frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed.
- B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building with steel brackets.
- D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.
- E. Guide Rail Lubricators: Provide a leakproof reservoir on top of upper guide shoes. Wool felt wiper shall apply an even, uniform flow of lubricant which shall thoroughly cover face of guide rail.
- F. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- G. Jack: Jack unit shall be of sufficient size to lift the gross load to the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Jack unit shall consist of the following components:
 1. Heavy seamless steel tubing plunger accurately turned and polished.
 2. Stop ring shall be electrically welded to the plunger to prevent plunger leaving the cylinder.
 3. Internal guide bearing.
 4. Packing or seal of suitable design and quality.
 5. Drip ring around cylinder top.
 6. Cylinder made of steel pipe and provided with a pipe connection and air bleeder.
 7. Weld brackets to the jack cylinder for supporting the elevator on pit channels. An auxiliary safety bulkhead shall be provided in the lower end of the cylinder.
- H. Automatic Terminal Limits: Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cutoff the electric current and stop the car if it runs beyond either terminal landing.
- I. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- J. Failure Protection: Design electrical control circuit so if a malfunction occurs, due to motor starter failure, oil becoming low in the system, or the car failing to reach a landing in the up or down direction within a predetermined time, the elevator car will automatically descend to the lowest terminal landing. If power operated doors are used, the doors will automatically open when the car reaches that landing to allow passengers to depart. The doors will then automatically close and all control buttons, except the "door open" button in the car station, shall be made inoperative.
- K. Wiring and Piping: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary pipe and fittings shall connect the power unit to the jack unit.

- L. Hydraulic Fluid/Oil: Provide necessary hydraulic fluid to power elevator as recommended and approved by the manufacturer.
 - 1. Provide biodegradable synthetic oil as recommended and approved by the elevator manufacturer.
- M. Emergency Terminal Stopping Device: Provide emergency terminal stopping devices for speeds over 100FPM. The emergency terminal stopping device shall operate independently of the normal terminal stopping device if it fails to slow down the car at the terminal as intended. Stopping devices shall not be prevented from functioning by a single short circuit caused by a combination of grounds or by other conditions.
 - 1. Normal and emergency terminal stopping devices shall not control the same controller switches unless two or more separate and independent switches are furnished, two of which shall be closed in either direction of travel to complete the circuit to the control valve solenoids in the down direction and to complete the circuit to the pump motor for the up direction of travel.

2.05 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following:
 - 1. Oil reservoir with tank cover and controller compartment with cover.
 - 2. Oil hydraulic pump.
 - 3. Electric motor.
 - 4. Oil control unit with the following components built into a single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and magnetic controller.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Drive: Drive shall be by direct coupling with the pump and motor submerged in the oil reservoir or by multiple V-belts and sheaves of number and size to insure maximum factor of safety. Drive type shall be determined based primarily on the load on the car, travel, and speed.
- D. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall comply with specified speeds and loads.
- E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
 - 1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure by more than 10 percent above that required to barely open the valve.
 - 2. Up start and stop valve shall be externally adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 - 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 - 4. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed, and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slowdown is initiated.

- F. Power controller shall contain electrical contractor, electro-mechanical switches and thermal overload relays. Mount components in a NEMA 1 enclosure. Logic control system shall be microprocessor based and protected from environmental extremes and excessive vibrations.
- G. Reduced Voltage Starting: Provide a solid state starter to limit current inrush during starting and to provide gradual acceleration of the motor. Motor starting shall not be initiated by mechanical contacts. Starter shall include a current limit adjustment range of 200 percent to 450 percent of the overload adjustment range. Provide an integral fault detection and diagnostic system.

2.06 DOOR OPERATION

- A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Direct drive geared operators, AC controlled units with oil checks, or other deviations are not acceptable.
 - 1. No Unnecessary Door Operation: Car door shall open only if the car is stopping or a car or hall call, answering a car or hall call at the present position or selected and the next car up.
 - 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 - 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
 - 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door movement is obstructed for a field programmable time, a buzzer will sound and the doors will close at reduced speed. If the infra-red door protection system detects a person or object while closing, the doors will stop and resume closing after the obstruction has been removed.
 - 5. Limited Door Reversal: If the doors are closing and an infra-red beam is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
 - 6. Door Open Sentinel: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then open six times to try and correct the fault.
 - 7. Door Close Sentinel: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then close six times to try and correct the fault.
 - 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
 - 9. Door Protection Devices: Provide a door protection system using 40 microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. A mechanical reopening device is not acceptable.
 - 10. Door Lock: Door to be opened from hallway side of each floor with a spring-loaded/momentary keyed entry. Door to stay in locked position when not in use. Key to open door also operates elevator.

2.07 CAR OPERATING STATION

- A. General: The main car control in each car shall contain the devices required for specific operation mounted in stainless steel No. 4 integral swing return panel requiring no applied faceplate. The

panel shall consist of a series of modules, inclined 20 degrees from vertical for optimum viewing and accessibility.

1. The lowest module shall contain the “door open,” “door close,” and “alarm” buttons and a keyed “emergency stop” switch.
 2. Intermediate modules shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located immediately adjacent to the floor buttons and be fully integrated in the module design. No applied symbols or floor indications or symbols on the buttons shall be permitted.
 3. The top module shall contain Phase II firefighters emergency in-car operation service key switch, with instructions, and shall be incorporated into the car operating station.
 4. Car station button shall be vandal resistant.
- B. Position Indicator: An electronic dot matrix position indicator inclined 20 degrees from vertical and mounted in a module matching the control panel for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped or passing.
- C. Emergency Light: An emergency light and capacity plate shall be integrated into a module inclined 20 degrees from vertical. Emergency light shall illuminate automatically upon loss of the building’s normal power supply.
- D. Emergency Communications System: Provide an emergency communications device mounted in the swing return. Emergency communications device shall comply with ANSI A117.1/Americans with Disabilities Act (ADA) requirements.
1. Emergency phone/device to be programmable.
 2. Phone number to be programmed must be staffed 24/7/365. Example: Local 911, or other equivalent service provided by the local municipality.
- E. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- F. Special Accessories:
1. Independent service switch.
 2. Inspection switch.
 3. Two speed fan/light switch.
 4. Telephone jack: Telephone will be provided and installed by the Owner.
 5. Certificate frame.

2.08 CONTROLS

- A. Controller: The elevator control system shall be microprocessor based and software oriented and be linked together for purposes of communication by a serial communications link. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by ‘up-down’ push buttons at each intermediate landing and ‘call’ push buttons at terminal landings.
1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or “up” hall buttons have been pressed. The car shall not stop at floors where “down” buttons have been pressed, unless the stop for the floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed.

Pressing the “up” button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
- B. Microprocessor: Locate the main microprocessor and car controller behind the elevator swing return panel.
1. Microprocessor door operator shall reside in the door operator and control all functions of the elevator door(s).
 2. Microprocessor selector shall reside on the car top and contain hall effect transducers that detect magnetic fields. Locate the magnetic fields on a perforated metal tape that runs the length of the hoistway.
- C. Group Operation: Not required.
- D. Provide a key operated switch in the elevator for the purpose of removing the car from normal operation. When the switch is in the “independent service” position, the elevator will bypass all landing calls and answer only car calls. The operator will have complete control over the operation of the car.

2.09 HALL STATIONS

- A. General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction. Faceplates shall be stainless steel No. 4. Provide one set of risers.
1. Each terminal station shall contain one illuminating push button.
 2. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.
 3. Phase I firefighters emergency recall operation service key switch, with instructions, shall be incorporated into the hall station at the designated level.
 4. Power Supply Indicator Light: Provide a jewel light indicator with engraved wording "GENERATOR POWER" when the elevator is not operating on normal power.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Hall Position Indicator: Not required.

2.10 HALL SIGNAGE

- A. Provide the international symbol for emergency medical services (star of life). The symbol shall not be less than 3 inches high and shall be placed inside on both sides of the hoistway door frame.

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. Silencer shall contain pulsation absorbing material inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line. Rubber hose without blowout proof features will not be acceptable.
- B. Vibration Pads: Mount vibration pads under the power unit assembly to isolate the unit from the building structure.
- C. Sound Insulating Panels: When pump and motor are not submerged, provide panels manufactured of reinforced 14 gauge steel with 1 inch (25 mm) thick 1-1/2 pound fiberglass core attached to interior and mounted on all four open sides of the power unit frame.

- D. Sound Isolating Couplings: When pump and motor are not submerged, install a minimum of two couplings in the oil line in the machine room between pump and jack. Verify with manufacturers.
- E. Identification of Equipment: Provide device serial number in minimum 1 inch lettering on the crosshead of the each elevator and on the motor of the each machine.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of the correct characteristics.

3.02 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components.
- B. Excavate for hydraulic cylinder casing and hydraulic lines between plunger and remote machine room in accordance with Section 312316.

3.03 INSTALLATION

- A. Install system components. Connect equipment to building utilities.
- B. Provide conduit, boxes, wiring, and accessories.
- C. Mount motors on vibration and acoustic isolators, on bed plate and concrete pad. Place on structural supports and bearing plates. Securely fasten to building supports. Prevent lateral displacement.
- D. Accommodate equipment in space indicated.
- E. Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.
- F. Accurately machine and align guide rails. Form smooth joints with machined splice plates.
- G. Coordinate installation of hoistway wall construction.
- H. Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.
- I. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- J. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- K. Adjust equipment for smooth and quiet operation.

3.04 ERECTION TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 .
- B. Cab Movement on Aligned Guide Rails: Smooth movement, with no objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

- A. Testing and inspection by regulatory agencies will be performed at their discretion.
 - 1. Schedule tests with agencies and notify Owner and Architect.
 - 2. Obtain permits required to perform tests.
 - 3. Document regulatory agency tests and inspections in accordance with the requirements of Section 014000.
 - 4. Perform tests required by regulatory agencies.
 - 5. Furnish test and approval certificates issued by authorities having jurisdiction.
- B. Perform operational tests in the presence of Owner and Architect.
- C. Operational Tests:
 - 1. Test single elevator system by transporting at least five persons up from main floor during a five minute period.

3.06 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- B. Adjust automatic floor leveling feature at each floor to achieve 1/4 inch from flush.

3.07 CLEANING

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components ready for inspection.

3.08 PROTECTION

- A. Do not permit construction traffic within cab after cleaning.
- B. Protect installed products until project completion.
- C. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

3.09 MAINTENANCE

- A. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the elevator manufacturer or original installer.
- B. Elevator Manufacturer/Installer to provide, to the Owner, service and maintenance of the elevator system and components for one year from Date of Substantial Completion.
 - 1. Examine system components monthly. Clean, adjust, and lubricate equipment.
 - 2. Include systematic examination, adjustment, and lubrication of elevator equipment. Maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment.
- C. Perform work without removing cars during peak traffic periods.

3.10 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failure or malfunctions.
- B. Make a final check of each elevator operation with Owner's personnel present, immediately before Date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 142010

SECTION 200100 - GENERAL PROVISIONS - MECHANICAL**1. GENERAL**

- A. The Advertisement for Bids, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub-Contractor's work. All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals to any part if for work, services, materials or equipment to be used on or applied to this project are hereby directed to familiarize themselves with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- B. Each Proposer shall also be governed by any unit prices and Addenda insofar as they may affect his part of the work or services.
- C. The work included in this division consists of the furnishing of all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Mechanical System(s) indicated or specified in the Contract Documents.
- D. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Mechanical Systems in a substantial manner, in compliance with the requirements stated, implied or intended in the drawings and/or specifications, shall be included as part of this Contract.
- E. It is not the intent of this section of the specifications to make any Contractor, other than the Construction Manager, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect (if applicable), then to the Engineer. Also, this section of the specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.
- F. It is the intent of this Contract to deliver to the Owners a "like new" project once work is complete. Although plans and specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials required for the complete installation without additional cost to the Owner.
- G. In general, and to the extent possible, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owners at least two weeks prior to the interruption of any services or utilities. The Owners shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.
- H. Definitions and Abbreviations
 - (1) Contractor - Any Contractor whether proposing or working independently or under the supervision of a General Contractor and/or Construction Manager and who installs any type of mechanical work (Controls, Plumbing, HVAC, Sprinkler, Gas Systems, etc.) or, the General Contractor.
 - (2) Engineer - The Consulting Mechanical-Electrical Engineers either consulting to the Owners, Architect, other Engineers, etc. In this case: CMTA, Inc., Consulting Engineers.
 - (3) Architect - The Architect of Record for the project.

- (4) Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.
- (5) Provide - Furnish and install complete, tested and ready for operation.
- (6) Install - Receive and place in satisfactory operation.
- (7) Indicated - Listed in the Specifications, shown on the Drawings or Addenda thereto.
- (8) Typical - Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- (9) Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owners, etc.
- (10) Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.
- (11) OSHA - Office of Safety and Health Administration.
- (12) KBC - Kentucky Building Code.
- (13) The Project - All of the work required under this Contract.
- (14) NEC - National Electrical Code.
- (15) NFPA - National Fire Protection Association.
- (16) ASME - American Society of Mechanical Engineers.
- (17) AGA - American Gas Association.
- (18) SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
- (19) ANSI - American National Standards Institute.
- (20) ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.
- (21) NEMA - National Electrical Manufacturers Association.
- (22) UL - Underwriters Laboratories.
- (23) ADA - Americans with Disabilities Act.
- (24) IMC - International Mechanical Code.
- (25) IECC - International Energy Conservation Code.
- (26) IFGC - International Fuel Gas Code.

I. Required Notices:

- (1) Ten days prior to the submission of a proposal, each proposer shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, Proposers signify that they have included the cost of all required items in the proposal and that the Proposer will be responsible for the safe and satisfactory operation of the entire system.

2. INTENT

- A. It is the intention of the Contract Documents to call for finished work, tested and ready for operation.
- B. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.

3. DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The drawings are not intended to show every item which may be necessary to complete the systems. All proposers shall anticipate that additional items may be required and submit their bid accordingly.
- B. The drawings and specifications are intended to supplement each other. No Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Proposer shall request a clarification not less than twelve days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.
- C. The drawings and specifications shall be considered to be cooperative and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. He shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- E. The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.
- F. Should conflict or overlap (duplication) of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
- G. Unless dimensioned, the mechanical drawings only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to ensure no conflict with other work.
- H. Each Proposer shall review all drawings including Architectural, Mechanical, Electrical, Fire Protection, Landscaping, Structural, Surveys, etc., to ensure that the work he intends to provide does not encroach a conflict with or affect the work of others in any way. Where such effect does occur, it shall be the Proposer's responsibility to satisfactorily eliminate any such encroachment conflict or effect prior to the submission of his

proposal. Each Proposer shall in particular ensure that there is adequate space to install his equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to ensure adequate spaces.

- I. Where on the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
- J. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- K. Where on the Drawings or Addenda the word typical is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.
- L. Special Note: Always check ceiling heights indicated on Architectural Drawings and Schedules and ensure that they may be maintained after all mechanical and electrical equipment is installed. Do not install equipment in the affected area until the conflict is resolved.

4. EXAMINATION OF SITE AND CONDITIONS

- A. Each Proposer shall inform himself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, above and below grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. Each Proposer shall also fully acquaint himself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. His proposal shall cover all expenses or disbursements in connection with such matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after bids are accepted.

5. EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS

- A. When any Contractor requests approval of materials and/or equipment of different physical size, capacity, function, color, access, it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, electrical services, etc., from that indicated. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall remunerate them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineers does not in any way absolve the Contractor of this responsibility.
- B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of Paragraph (A) immediately preceding are met. Requested substitutions shall be submitted to the Engineer a minimum of twelve days prior to bids.
- C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineers.

- D. Each Proposer shall furnish along with his proposal a list of specified equipment and materials which he is to provide. Where several makes are mentioned in the specifications and the Contractor fails to state which he proposes to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not ensure that the Engineers will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings is satisfactorily comparable to the items specified and/or indicated.

6. SUPERVISION OF WORK

- A. The Contractor shall personally supervise the work for which he is responsible or have a competent superintendent, approved by the Engineers, on the work at all times during progress with full authority to act for him.

7. CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, water and/or sewer system development charge, etc. in connection with his work. He shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. He shall hire an independent Registered Engineer to witness installations and provide necessary certifications where required by utility companies, municipal agencies or others that have review authority. He shall also obtain all required certificates of inspection for his work and deliver same to the Engineers before request for acceptance and final payment for the work. Ignorance of Codes, Rules, Regulations, Laws, etc. shall not render the Contractor irresponsible for compliance. The Contractor shall also be versed in all Codes, Rules and Regulations pertinent to his part of the work prior to submission of a proposal.
- B. The Contractor shall include in his work, without extra cost, any labor, materials, services, apparatus and drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.
- C. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.
- D. All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable. Where required by the Code and/or the Authority Having Jurisdiction, provide the services of a field labeling agency to provide a UL label for the entire system in the field under evaluation.
- E. All plumbing work is to be constructed and installed in accordance with plans and specifications which have been approved in their entirety and/or reflect any changes requested by the State Department of Health. Plumbing work shall not commence until such plans are in the hands of the Contractor.
- F. All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Kentucky Building Code (KBC) and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association. Contractor shall secure a permit from the Division of HVAC. Final inspection certificate shall be provided by Contractor and a copy included in Operation and Maintenance Manuals.
- G. All pressure vessel installations shall comply with the State, and/or Federal Code applicable. A Certificate of Final Boiler Inspection shall be required.

- H. The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.
- I. Where minimum code requirements are exceeded in the Design, the Design shall govern.
- J. The Contractor shall ensure that his work is accomplished in accord with the OSHA Standards and that he conducts his work and the work of his personnel in accord with same.
- K. Work in elevators, elevator shafts and elevator equipment rooms shall comply with the Elevator Code enforced by the Commonwealth of Kentucky.
- L. All work relating to the handicapped shall be in accord with regulations currently enforced by the Department of Housing, Buildings and Construction, Commonwealth of Kentucky and the American Disabilities Act.
- M. All work in conjunction with a natural gas installation shall, in addition to all other Codes, Rules, Regulations, Standards, etc., comply with the requirements of the local gas supplier and/or standards and recommendations of the American Gas Association.
- N. All work in relation to domestic water systems shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the requirements of the local water utility company and the adopted edition of the 10 States Standards.
- O. All work in relation to the installation of sanitary or storm sewers shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the local agency governing such installations and the adopted edition of the 10 States Standards.
- P. All work relating to the handicapped shall be in accord with regulations currently enforced by the Department of Housing, Buildings, and Construction, Commonwealth of Kentucky and the American Disabilities Act.

8. EQUIPMENT AND PIPING SUPPORT

- A. Each piece of equipment, apparatus, piping, or conduit suspended from the structure or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded by such equipment. Provide any required additional bracing, cross members, angles, support, etc., as indicated or required by the Structural Engineer. This, in some instances, will require the Contractor to add an angle to a joist to transfer the load to a panel point. If in doubt, contact the Structural Engineer.

9. DUCT AND PIPE MOUNTING HEIGHTS

- A. All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure.

10. COST BREAKDOWNS (SCHEDULE OF VALUES)

- A. Within thirty days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.

11. CORRECTION PERIOD

- A. All equipment, apparatus, materials, and workmanship shall be the best of its respective kind. The Contractor shall replace all parts at his own expense, which are proven defective as described in the General Conditions. The effective date of completion of the work shall be the date of the Architect's or Engineer's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period, due to negligence of his operator or other employees. Refer to other sections for any special or extra warranty requirements.
- B. It is further clarified that all required and specified warranties shall begin on the date of Substantial Completion, not at the time of equipment start-up.
- C. All gas fired heat exchangers shall have 20-year warranty.
- D. All compressors shall have five-year warranty.

12. COMPUTER-BASED SYSTEM SOFTWARE

- A. For all equipment, controls, hardware, computer-based systems, programmable logic controllers, and other materials provided as a part of the work, software that is installed shall be certified in writing to the Engineer and Owner by the manufacturer and/or writer to be free of programming errors that might affect the functionality of the intended use.

13. CHANGES IN MECHANICAL WORK

REFER TO GENERAL AND SPECIAL CONDITIONS.

14. CLAIMS FOR EXTRA COST

REFER TO GENERAL AND SPECIAL CONDITIONS.

15. SURVEY, MEASUREMENTS AND GRADE

- A. The Contractor shall lay out his work and be responsible for all necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the contract documents, he shall promptly notify the Engineer and shall not proceed with this work until he has received instructions from the Engineer on the disposition of the work.

16. TEMPORARY USE OF EQUIPMENT

DESIGNER NOTE: REVIEW TEMPORARY UTILITIES WITH ARCHITECT & OWNER.

- A. The permanent heating and plumbing equipment, when installed, may be used for temporary services, with

the consent of the Engineers. Should the permanent systems be used for this purpose the Contractors shall make all temporary connections required at their expense. They shall also make any replacement required due to damage wear and tear, etc., leaving the same in "as new" condition.

- B. Permission to use the permanent equipment does not relieve the Contractors from the responsibility for any damages to the building construction and/or equipment which might result because of its use.
- C. A pre-start-up conference shall be held with the Architect, Owner, General Contractor and the Mechanical Contractor. Equipment shall not be started until after this meeting.
- D. During all phases of construction:

(2) Heat Pump Units:

- a. At a minimum, four complete sets of filter media are required for each unit. In each unit, install two sets of filter media during construction (more shall be required if construction activities dictate more frequent changes). In each unit, install one set of filter media at substantial completion. Leave one set of filter media in boxes in appropriate mechanical room as a spare set for the Owner. All other filters shall be used by the Contractor during construction. Dispose of all construction filter media.
- b. On the outside of all return air openings install a minimum of two sets of fiberglass filter media, such as cheesecloth, to be utilized as pre-filters for the "construction" filters. Install first set upon start-up and then install second set when first set is dirty. Dispose of all dirty construction filters. Change filters as often as necessary to keep units from becoming dirty at no additional cost.
- c. At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.

(3) Outside Air Units:

- a. These units shall not be used for temporary heating and cooling by the Contractor. They shall, however, be made operational, tested, etc. as specified during construction by the Contractor. Three complete sets of filters are required for each unit. In each unit, install one set of filters during construction. In each unit, install one set of filters at substantial completion. For each unit, leave third set of filters in boxes in appropriate mechanical room as a spare set for the Owner. Dispose of all construction filters.
- b. At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.

17. TEMPORARY SERVICES

- A. The Contractor shall arrange any temporary water, electrical and other services which he may require to accomplish his work. Refer also to General and Special Conditions.

18. RECORD DRAWINGS

- A. The Contractor shall ensure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. Deliver these record drawings electronically in AutoCAD

2007 format along with the hand marked field set to the Engineer. Electronic bid drawings will be furnished to the Contractor for his use.

19. MATERIALS AND WORKMANSHIP

- A. All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Proposer shall determine that the materials and/or equipment he proposes to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be necessary to remove and replace walls, floors and/or ceilings and this work shall be the responsibility of the Contractor. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Ensure, through coordination, that no other Contractor seals off access to space required for equipment, materials, etc.
- B. Materials and equipment, where applicable, shall bear Underwriters' Laboratories label where such a standard has been established.
- C. Use extreme care in the selection of equipment and its installation to ensure that noise and vibration are kept at a minimum. The Engineer's determination shall be final and corrections to such discrepancies shall be made at the cost of the Contractor.
- D. Each length of pipe, fitting, trap, fixture and device used in the plumbing or drainage systems shall be stamped or indelibly marked with the weight or quality thereof and with the manufacturer's mark or name.
- E. All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a data plate indicating required horsepower, voltage, phase and ampacity.

20. COOPERATION AND COORDINATION WITH OTHER TRADES

- A. The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'-0", clearly indicating how his work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. He shall make the necessary changes in his work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

21. QUALIFICATIONS OF WORKMEN

- A. All mechanical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workman shall refrain from work in areas not satisfactory to him. Requests for relief of a workman shall be made through the normal channels of Architect, Contractor, etc.

- B. All plumbing work shall be accomplished by Journeymen Plumbers under the direct supervision of a Master Plumber as defined and clarified under Kentucky State Plumbing Law Regulations and Code. Proof and Certification may be requested by the Engineer.
- C. All sheet metal, insulation and pipe fitting work shall be installed by workmen normally engaged or employed in these respective trades, except where only small amounts of such work are required and are within the competency of workmen directly employed by the Contractor involved.
- D. All automatic control systems shall be installed by workmen normally engaged or employed in this type work, except in the case of minor control requirements (residential type furnaces, packaged HVAC equipment with integral controls, etc.) in which case, if a competent workman is the employee of this Contractor, he may be utilized subject to review of his qualifications by the Engineer and after written approval from same.
- E. All special systems (Automatic Sprinkler Equipment, etc.) shall be installed only by workmen normally engaged in such services. Exception to this specification may only be made in writing by the Engineer.
- F. All electrical work shall be installed only by competent workmen under direct supervision of a fully qualified Electrician.

22. CONDUCT OF WORKMEN

- A. The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workman to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or debilitating drugs on the job site is strictly forbidden.

23. PROTECTION OF MATERIALS AND EQUIPMENT

- A. The Contractor shall be entirely responsible for all material and equipment furnished by him in connection with his work and special care shall be taken to properly protect all parts thereof from physical, sun, and weather damage during the construction period. Such protection shall be by a means acceptable to the manufacturer and Engineer. All rough-in soil, waste, vent and storm piping, ductwork, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at his own expense.

24. SCAFFOLDING, RIGGING AND HOISTING

- A. The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

25. BROKEN LINES AND PROTECTION AGAINST FREEZING

- A. No conduits, piping, troughs, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. If in doubt, contact the Engineer. Do not install piping across or near openings to the outside whether they are carrying static or moving fluids or not. Special Note: Insulation on piping does not necessarily ensure that freezing will not occur.

26. CLEANING

- A. The Contractor shall, at all times, keep the area of his work presentable to the public and clean of rubbish and debris caused by his operations; and at the completion of the work, shall remove all rubbish, debris, all of his tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.
- B. After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.

27. CONCRETE WORK

- A. The Contractor shall be finally responsible for the provisions of all concrete work required for the installation of any of his systems or equipment. He may, at his option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of his responsibilities relative to dimensions, quality of workmanship, locations, etc. In the absence of other concrete specifications, all concrete related to Mechanical work shall be 3000 psi minimum compression strength at 28 days curing and shall conform to the standards of the American Concrete Institute Publication ACI-318. Heavy equipment shall not be set on pads for at least seven (7) days after pour. Insert 6-inch steel dowel rods into floors to anchor pads.
- B. All mechanical equipment (tanks, heaters, chillers, boilers, pumps, air handling units, etc.) shall be set on a minimum of 4" tall concrete pads. Pads shall be taller where required for condensate traps. All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18" in width shall be reinforced with ½" round bars on 6" centers both ways. Bars shall be approximately 3" above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all square edges one-half inch.
- C. In general, concrete pads for equipment shall extend four (4) inches beyond the equipment's base dimensions. Where necessary, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space.
- D. Exterior concrete pads shall be four (4) inches minimum above grade and four (4) inches below grade on a tamped four (4) inch dense grade rock base unless otherwise indicated or specified. Surfaces of all foundations and bases shall have a smooth finish with one-half (1/2) inch chamfer on exposed edges.
- E. All exterior below grade concrete structures (utility vaults, grease traps, manholes, etc.) shall be provided with exterior waterproofing. Waterproofing shall be hot-fluid applied rubberized-asphalt waterproofing membrane with elastomeric sheets at edges, corners, and terminations of membrane for continuous watertight construction. Apply in layers and reinforce as required to provide uniform seamless membrane minimum 4mm thickness. Also, seal penetrations into and out of the structure watertight. Provide Link-Seal modular seal or equal.

28. NOISE, VIBRATION OR OSCILLATION

- A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at his expense.

- B. All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means. Unitary equipment, such as small room heating units, small exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.
- C. The Contractor shall provide supports for all equipment furnished by him. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineers.

29. ACCESSIBILITY

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and hung ceilings for the proper installation of his work. He shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.
- B. The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, etc.
- C. The Contractor shall provide access panels for each concealed valve, control damper or other device requiring service as shown on engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work.

30. RESTORATION OF NEW OR EXISTING SHRUBS, PAVING, SURFACES, ETC.

- A. The Contractor shall at his expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Architect and/or Engineer.

31. MAINTENANCE OF EXISTING UTILITIES AND LINES

- A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily.
- B. Utilities and lines, where known, are indicated on the drawings. Locations and sizes are approximate. Prior to any excavation being performed, the Contractor shall ascertain that no utilities or lines are endangered by new excavation. Exercise extreme caution in all excavation work.
- C. If utilities or lines occur in the earth within the construction site, the Contractor shall probe and locate the lines prior to machine excavation or blasting in the respective area. Electromagnetic utility locators and acoustic pipe locators shall be utilized to determine where metallic and non-metallic piping is buried prior to any excavation.

- D. Cutting into existing utilities and services where required shall be done in coordination with and only at times designated by the Owner of the utility.
- E. The Contractor shall repair to the satisfaction of the Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- F. Machine excavation shall not be permitted with ten feet of electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only.
- G. Protect all new or existing lines from damage by traffic, etc. during construction. Repairs or replacement of such damage shall be at the sole expense of the party responsible.

32. SMOKE AND FIRE PROOFING

- A. The Contractor shall fire and smoke stop all openings made in fire or smoke rated walls, chases, ceilings and floors in accord with the KBC. Patch all openings around ductwork and piping with appropriate type material to stop smoke at smoke walls and provide commensurate fire rating at fire walls, floors, ceilings, roofs, etc. Back boxes in rated walls shall be a minimum distance apart as allowed by code to maintain the rating. If closer provide rated box or fireproofing in code approved manner.

33. MOTORS

- A. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of A.S.A. C50, conforming to this and all applicable standards for insulation resistance and dielectric strength.
- B. Each motor shall be provided by the equipment supplier, installer or manufacturer with conduit terminal box, and N.E.C. required disconnecting means as specified or required. Three-phase motors shall be provided with external thermal overload protection in their starter units. Single-phase motors shall be provided with thermal overload protection, integral to their windings or external, in control unit. All motors shall be installed with NEMA-rated starters as specified and shall be connected per the National Electrical Code.
- C. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least of the horsepower indicated or specified. Each motor shall be selected for quiet operation, maximum efficiency and lowest starting KVA per horsepower. Motors producing excessive noise or vibration shall be replaced by the responsible contractor. See Division 26 of Specifications for further requirements related to installation of motors.

34. CUTTING AND PATCHING

- A. The Contractor shall provide his own cutting and patching necessary to install his work. Patching shall match adjacent surfaces and shall be to the satisfaction of the Architect and Engineer.
- B. No structural members shall be cut without the approval of the Engineer and all such cutting shall be done in a manner directed by him.
- C. When installing conduit, pipe, or any other work in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore, all new work shall NOT be installed in concrete center of wall. All mechanical and electrical installations shall be on the interior side of the concrete.

35. CURBS, PLATES, ESCUTCHEONS & AIR TIGHT PENETRATIONS

- A. In all areas where ducts are exposed and ducts pass thru floors, the opening shall be surrounded by a 4-inch-high by 3-inch-wide concrete curb.
- B. Escutcheon plates shall be provided for all pipes and conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.
- C. Seal all duct, pipe, conduit, etc., penetrations through walls and floors air tight. If wall or floor assembly is rated then use similarly rated sealing method.

36. WEATHERPROOFING

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.

37. OPERATING INSTRUCTIONS, MAINTENANCE MANUALS AND PARTS LISTS

- A. Upon completion of all work tests, the Contractor shall instruct the Owner or his representative(s) fully in the operations, adjustment and maintenance of all equipment furnished. The time and a list of representatives required to be present will be as directed by the Engineer. Turn over all special wrenches, keys, etc., to the owner at this time.
- B. The Contractor shall furnish three (3) complete bound sets for delivery to the Engineer of typewritten and/or blueprinted instructions for operating and maintaining all systems and equipment included in this contract prior to substantial completion. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs alone will not be acceptable for operating and maintenance instructions.
- C. The Contractor, in the instructions, shall include a preventive maintenance schedule for the principal items of equipment furnished under this contract and a detailed, parts list and the name and address of the nearest source of supply.
- D. The Contractor shall frame under Lexan in the main mechanical room all temperature control diagrams and all piping diagrams.

38. PAINTING

- A. In general, all finish painting shall be accomplished under the Painting Section of the specifications by the Contractor; however, unless otherwise specified under other sections of these specifications, the following items shall be painted:
 - (1) All exposed piping, valve bodies and fittings (bare and insulated), including hangers, platforms, etc.
 - (2) All mechanical equipment not factory finished. Aluminum and stainless-steel equipment, motors, identification plates, tags, etc. shall not be painted. All rust and foreign matter shall be thoroughly removed from surfaces prior to painting. All baked enamel factory finish of equipment which may have been scratched or chipped shall be touched up with the proper paint as recommended and supplied by the manufacturer.

- (3) All ductwork exposed in finished areas (bare and insulated), all grilles, diffusers, etc. not factory finished. Paint the inside surfaces of all interior duct surfaces visible from any register, grille or diffuser opening on all jobs; surfaces shall receive one (1) prime coat of Rustoleum 1225 red "galvinoleum" or other approved equivalent primer and rust inhibitor and one (1) coat of Rustoleum 1579 jet black "Speedy Dry" enamel or approved equivalent applied in accordance with the manufacturer's recommendations.
- (4) All insulated piping, ductwork and equipment shall be properly prepared for painting by the Contractor where mechanical items are to be painted. In the case of externally insulated duct and pipe, the Contractor shall provide 6 oz. canvas jacket with fire retardant lagging. The jacket shall be allowed to dry properly before applying paint to avoid shrinking after painting and exposing unpainted surfaces. The Contractor, at his option, may provide double wall ductwork in lieu of externally insulated ductwork with canvas jacket and lagging.

39. ELECTRICAL CONNECTIONS

- A. The Contractor shall furnish and install all (1) temperature control wiring; (2) equipment control wiring and (3) interlock wiring. The Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring thru starters, and shall furnish and install all required starters not factory mounted on equipment.
- B. The Contractor shall, regardless of voltage, furnish and install all temperature control wiring and all associated interlock wiring, all equipment control wiring and conduit for the equipment that the Contractor furnishes. He may, at his option, employ at his own expense, the Electrical Contractor to accomplish this work.
- C. After all circuits are energized and completed, the Contractor shall be responsible for all power wiring, and all control wiring shall be the responsibility of the Contractor. Motors and equipment shall be provided for current characteristics as shown on the drawings.
- D. The Contractor shall furnish motor starters of the type and size required by the manufacturer for all equipment provided by him, where such starters are necessary. Starters shall have overloads for each phase.

40. FINAL CONNECTIONS TO EQUIPMENT

- A. The Contractor shall finally connect to mechanical services, any terminal equipment, appliances, etc., provided under this and other divisions of the work. Such connections shall be made in strict accord with current codes, safety regulations and the equipment manufacturer's recommendations. If in doubt, contact the Engineers prior to installation.

41. REQUIRED CLEARANCE FOR ELECTRICAL EQUIPMENT

- A. The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost.

42. INDEMNIFICATION

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

43. HAZARDOUS MATERIALS

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of his work, ensure that his workers are aware of this potential and what they are to do in the event of suspicion. He shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall ensure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- B. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- C. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise him immediately.
- D. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

44. ABOVE-CEILING AND FINAL PUNCH LISTS

- A. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least two stages of the project:
 - (1) For review of above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - (2) For review of all other work as the project nears substantial completion.
- B. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.
- C. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor at a rate of \$140.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.



Phone: 859 253-0892

The following is CMTA's guide for Division 20-25 required information relative to the Schedule of Values. Please utilize all items that pertain to this project and add any specialized system as required. A thorough and detailed schedule of values will allow for fair and equitable Pay Application approval and minimize any discrepancies as to the status of the job.

<u>DIVISION 20-25 – MECHANICAL</u> Field Representative: _____ Project Engineer: _____			
Description of Work	Scheduled Value	Labor	Material
Shop Drawings			
Mobilization/Permits			
Demolition			
Geothermal Horizontal Piping and Vault			
Geothermal Wells, Vertical pipe and grout			
Plumbing Underslab			
Sanitary Above Slab Rough-in			
Plumbing Fixtures			
Plumbing Inspections			
Sprinkler Plan Submittals			
Fire Protection Exterior			
Fire Protection Vault			
Fire Protection Interior			
Storm Piping Exterior			
Storm Piping Interior			
Plumbing Shop Drawings			
Mechanical Shop Drawings			

Domestic Water Piping			
Domestic Water Insulation			
Hydronic Piping			
Gas Piping Exterior			
Gas Piping Interior			
Steam Piping			
HVAC Sheet Metal			
Heat Pumps			
Boiler			
Chiller			
Cooling Tower			
Pumps & Assoc. Equipment			
Grilles & Diffusers			
Insulation			
Controls			
Air Balance			
Water Balance			
Chemical Treatment			
Boiler Inspection			
Factory Start-Up Reports			
Owner Training			
Record Drawings			
O & M Manuals			
Punchlist/Closeout			
Controls Check-out			

END OF SECTION 200100

SECTION 200200- SCOPE OF THE MECHANICAL WORK**1. GENERAL**

- A. The Mechanical work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not necessarily limited to the following:
- (1) Complete exterior domestic water service finally connected to the local domestic water system.
 - (2) Complete exterior sanitary sewer system connected to the local system.
 - (3) Complete exterior storm drainage system.
 - (4) Complete exterior fire protection system.
 - (5) Interior domestic hot, cold and recirculating hot water system.
 - (6) Interior soil, waste and vent systems.
 - (7) Roof drainage system.
 - (8) All plumbing equipment, fixtures and fittings.
 - (9) 100% automatic sprinkler system.
 - (10) All mechanical exhaust systems.
 - (11) All insulation associated with mechanical systems.
 - (12) Condensate drainage systems.
 - (13) Complete heating, ventilation and air conditioning systems.
 - (14) Final connection of all mechanical equipment furnished by others (e.g., kitchen equipment).
 - (15) Complete balancing of air and water systems.
 - (16) Complete natural gas piping systems.
 - (17) All applicable services and work specified in Section 200100; General Provisions - Mechanical.
 - (18) All specified or required control work.
 - (19) Provide all required motor starters, etc. not provided under the electrical sections.
 - (20) One year guarantee of all mechanical equipment, materials and workmanship.
 - (21) Thorough instruction of the owner's maintenance personnel in the operation and maintenance of all mechanical equipment.

- (22) Thorough coordination of the installation of all piping, equipment and any other material with other trades to ensure that no conflict in installation.
- (23) Approved supervision of the mechanical work.
- (24) Excavation, backfilling, cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.
- (25) Prior to submitting a bid, the Contractor shall contact all serving utility companies to determine exactly what each utility company will provide and exactly what is required of the Contractor and shall include such requirements in his base bid.
- (26) Procurement of all required permits and inspections, including fees for all permits and inspection services and submission of final certificates of inspection to the Engineers (Plumbing, Boiler, HVAC, etc.).
- (27) All necessary coordination with gas, water, and sewer utility companies, etc., to ensure that work, connections, etc., that they are to provide is accomplished.
- (28) Factory start-up of all major equipment (including terminal HVAC equipment) and submission of associated factory start-up reports to the Engineer.

END OF SECTION 200200

SECTION 200300 - SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS & TOOLS**1. GENERAL**

- A. The Contractor's attention is directed also to the General and Special Conditions and Section 200100 - General Provisions - Mechanical as well as to all other Contract Documents as they may apply to his work.
- B. The Contractor shall prepare and submit to the Engineer, through the General Contractor and the Architect (where applicable) within thirty (30) days after the date of the Contract, a minimum of seven (7) copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter.
- OR**
- C. The Contractor shall prepare and submit to the Engineer, through the General Contractor and the Architect (where applicable) within thirty (30) days after the date of the Contract, all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter through eComm. In addition to the electronic submittal, hard copies of the Fire Protection drawings shall be submitted. **(UK ONLY)**
- D. Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.
- E. All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the General Contractor and the Architect (if applicable) to show that the drawings have been reviewed by the Contractor. Any drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.
- F. It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- G. The Engineers review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for: adaptability of the item to the project; compliance with applicable codes, rules, regulations and information that pertains to fabrication and installation; dimensions and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project. Any items that differ from the Drawings or Specifications shall be flagged by the Contractor so the Engineer will be sure to see the item. Do not rely on the Engineer to "catch" items that do not comply with the Drawings or Specifications. The Contractor is responsible for meeting the Drawings and Specification requirements, regardless of whether or not something does not get caught by the Contractor or Engineer during shop drawing reviews.
- H. Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.

- I. If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the drawings; and the Contractor shall be required to furnish all materials in accordance with this list.
- J. Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors. Color samples shall be furnished with the shop drawing submission for such equipment.
- K. Shop Drawing Submittals
 - (1) All submittals for HVAC equipment shall include all information specified. This shall include air and water pressure drops, RPM, noise data, face velocities, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.
 - (2) All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule.
 - (3) All items submitted shall be designated with the same identifying tag as specified on each sheet.
 - (4) Any submittals received in an unorganized manner without options listed and with incomplete data will be returned for resubmittal.

2. SHOP DRAWINGS

Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

- | | |
|---|--------------------|
| Duct Insulation (Internal and External) | Heat Pumps |
| Condensing units | Air handling units |
| Pipe Insulation | Controls |
| Water Heaters | |
| Hydronic Specialties | |
| (2) Chemical Treatment System | |
| (1) Pumps and Circulators (HVAC) | |

SPECIAL NOTES:

- 1) Upon substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item marked (1) above. These documents shall include at least:
 - a. Detailed operating instructions
 - b. Detailed maintenance instructions including preventive maintenance schedules.
 - c. Addresses and phone numbers indicating where parts may be purchased.
- 2) Shop drawings for the Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system.
- 3) Shop drawings for the Building Fire Protection System shall be prepared and stamped by a Certified Contractor and shall meet the criteria of the Department of Housing, Buildings and Construction and submitted to the Engineer. After the Engineer's review, they shall be submitted by the Contractor to the proper state authorities along with the required State review fee.

- 4) The Contractor shall submit to the Boiler Inspector's Office the required documentation and review fees for a boiler permit. The boiler permit shall be submitted to the Engineer along with the Boiler Shop Drawings.
- 5) The Contractor shall submit shop drawings for the kitchen hood system(s) along with all required supporting documentation and review fees to the Department of Housing, Buildings and Construction and receive approval prior to submittal to the Engineers.
- 6) The Contractor shall submit Material Safety Data sheets for all chemical treatment and anti-freeze solutions.

3. SPECIAL WRENCHES, TOOLS, ETC.

- (1) The Contractor shall furnish, along with equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed under the Contract. Wrenches shall include necessary keys, handles and operators for valves, cocks, hydrants, etc. A reasonable number of each shall be furnished.

4. BALANCE REPORTS

- A. Upon substantial completion of the project, the Contractor shall submit to the Engineers four (4) bound copies of the Certified Air and Hydronic Balance Report.

END OF SECTION 200300

SECTION 200400 - DEMOLITION AND SALVAGE**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

2. DEMOLITION**A. INTENT**

It is the intent of this section to completely remove all components of any existing mechanical system no longer in use that will be open to view in, or will interfere with the operations of the completed building, or which will, in any way, interfere with project construction. Components of the existing mechanical systems which do not meet the above criteria, may be abandoned in place in a safe, workmanlike, code approved manner.

B. PLUMBING

- (1) All existing piping not to be reused, shall be removed when located in accessible chases, accessible ceiling spaces, crawl spaces, mechanical rooms, exposed, etc.
- (2) Unless otherwise indicated, the Contractor shall be responsible for patching and repairing all holes, etc. in the ceilings, walls, and floors where plumbing piping is removed.
- (3) All lines abandoned in place shall be made safe in compliance with the Kentucky Plumbing Code.

C. HVAC

- (1) Remove from the project area all piping not to be reused and hangers, specialties, etc. that are accessible or that become accessible during construction and/or interfere in any way with any part of the construction or would be exposed in the completed building.
- (2) Remove all temperature controls and related items that are accessible or become accessible during construction.
- (3) Remove all existing heating and ventilating equipment not indicated to be reused from the building.
- (4) The Contractor shall be responsible for the removal and/or relocation of any HVAC piping, equipment, fittings, valves, etc. which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Structural, Mechanical or Electrical Systems at no increase in the contract price.
- (5) Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing of all holes, etc. in the ceiling, wall and floors where HVAC equipment is removed.
- (6) Unless otherwise noted, when removing equipment sitting on a concrete pad, also remove the concrete pad and patch and repair floor to match adjacent surfaces.

D. REFRIGERANT RECOVERY

- (1) The Contractor shall have a licensed refrigerant recovery technician evacuate all refrigerants from all refrigeration equipment being removed in accordance with EPA guidelines and regulations. The Contractor shall take all necessary precautions to not accidentally vent refrigerants to the atmosphere. The recovered refrigerant shall be offered to the Owner. If the Owner refuses it then it becomes the property of the Contractor.

E. THERMOSTAT, THERMOMETER, AND MERCURY BEARING DEVICE DISPOSAL

- (1) The Contractor shall dispose of all mercury bearing materials in accordance with state and federal guidelines. The Contractor shall take all necessary precautions to not accidentally allow mercury to be released from the device during demolition.

3. SALVAGE

- A. It is the intent of this section to deliver to the owner all components of any mechanical system which may be economically reused by him. The Contractor shall make every effort to remove reusable components without damage and deliver them to a location designated by the Owner.
- B. Components to be delivered to the owner shall be specifically identified by the owner's representative prior to beginning the demolition. These components shall include, but are not limited to the following:
 - (1) Control air compressor and air dryer.
 - (2) Hydronic pumps.
 - (3) Exhaust Fans.
 - (4) Fire Protection Hose Stations.
 - (5) Water Coolers.
 - (6) Unit Ventilators.
- C. Other items become the property of the Contractor and are to be removed from the site.

END OF SECTION 200400

SECTION 200500 - COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERS**1. COORDINATION**

- A. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural and Structural drawings, to the end that complete coordination between trades will be affected. Special attention shall be given to the points where ducts or piping must cross other ducts or piping, where lighting fixtures must be recessed in ceilings, and where ducts, piping and conduit must fit into walls, soffits, columns, etc. It shall be the responsibility of the Contractor to leave the necessary room for other trades. No extra compensation will be allowed to cover the cost of removing piping, conduit, ducts, etc., or equipment found encroaching on space required by others.
- B. The Contractor shall be responsible for coordination with the Electrical trade to ensure that he has made provision for connections, operational switches, disconnect switches, fused disconnects, etc. for electrically operated equipment provided under this division of the specifications, or called for on the plans.
- C. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other Contracts, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of piping, ductwork, conduit, and equipment not installed in accordance with the above instructions, and which interfered with work and equipment of other trades.
- D. In all areas where air diffusers and lighting fixtures are to be installed, the Contractor shall coordinate their respective construction and installations so as to provide combined symmetrical arrangements.

2. INTERFACING

The Contractor shall ensure that coordination is affected relative to interfacing of systems. Some interface points are (but not necessarily all):

- A. Connection of Domestic Water System to water service mains.
- B. Connection of Natural Gas System to natural gas service.
- C. Connection of Fire Protection System to domestic water service.
- D. Connection of Sanitary sewer house line to municipal service.
- E. Connection of Storm Drainage System to municipal system.
- F. Connection of fuel oil piping to emergency generator.
- G. Connection of Domestic Water System to Hydronic System.
- H. Connection of all controls to equipment.
- I. Electrical power connections to electrically operated (or controlled) equipment.
- J. Connection of Emergency Engine Exhaust System.

3. CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. The Contractor shall make all connections to equipment furnished by others, or relocated from the existing structure, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.
- B. Supervision to assure proper functioning and operation shall be provided by the Contractor.
- C. Items indicated on the drawings as rough-in only (RIO) will be connected by others. The Contractor shall be responsible for rough-in provisions only.
- D. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.
- E. The Contractor shall be responsible for coordinating to determine any and all final connections that he is to make to equipment furnished by others.

4. COORDINATION DRAWINGS AND RECORD DRAWINGS

A. COORDINATION as follows:

- (1) Detailed electronic coordination drawings shall be required for this project and shall be led by the Mechanical Contractor. A specific line-item shall be included on the schedule of values by each Trade for "preparation of coordination drawings". **This line-item value shall be approved by the Engineer. Minimum that shall be included is \$20,000 for this effort.** The Engineer and the Engineer's Field Inspector shall closely monitor progress and quality of the preparation of the electronic coordination drawings and may withhold pay requests as deemed appropriate.
- (2) Coordination Drawings shall be provided on this project by each Trade (Mechanical, Fire Protection, Electrical). Drawings shall be 30 x 42 sheet size and shall be at 1/4" scale and shall match the drawing setup as included in the Architectural Drawings. The Architect and Engineer will supply electronic drawings files of the Contract Documents upon the Contractor's request and release.
- (3) The basis for the Coordination Drawings shall be the sheet metal ductwork fabrication shop drawings and shall be prepared by the Mechanical Contractor. The Coordination Drawings shall indicate (1) systems above ceilings in finished areas, (2) systems supported from the structure in finished areas without ceilings, (3) systems in the mechanical rooms, and (4) all wall, roof, floor penetrations. **These drawings shall be 3-D drawings and shall be able to be reviewed with a 3-D software system such as Revit or Navisworks.**
- (4) The sheet metal fabrication shop drawings shall be completed in a timely manner so as not to conflict with construction schedule and phasing plan. At the General Contractor's discretion, these drawings shall be completed in phases to correspond with the project construction work sequencing. The Mechanical Contractor shall furnish an electronic copy of these ductwork shop drawings to all other Trades, specifically the Fire Protection and Electrical and other Contractors as requested by the General Contractor for the purpose of including other trades work on the Coordination Drawings.
- (5) Pre-Coordination Meetings with all necessary trades shall occur. During these meetings, the Contractors shall discuss locations/elevations where piping, conduits, cable trays, etc will be installed with respect to the sheet metal fabrication drawings and other trades. The sheetmetal ductwork and gravity piping systems shall be given the first priority. Within 30 days of the meeting, each Trade shall provide the Mechanical Contractor electronic drawings of all of their systems (with elevation noted), coordinated with the ductwork and other trades for them to incorporate into the Coordination Drawings. Coordination Meetings shall then occur so that all

conflicts can be resolved between Trades. All conflicts shall be resolved between all Trades at these Coordination Meetings and the Mechanical Contractor shall then amend the Drawings to include the Final Coordinated Work.

- (6) It is realized that not all systems can be completely detailed. The coordination drawings shall include the following at a minimum:
 - a. All ductwork including and all above ceiling equipment i.e. VAV boxes indicating appropriate maintenance access routed as indicated on the drawings. The drawings shall indicate a 3 ft. clearance zone that is unobstructed and allows access from a 2x2 ceiling tile.
 - b. All hydronic, plumbing, and sprinkler piping. Indicate all valves and ensure that appropriate access is provided for all valves.
 - c. Provide all conduits (existing or new) 2" and above. Multiple smaller conduits hung on a common trapeze hanger that is larger than 6" wide
 - d. All cable tray and enclosed wireway shall be indicated and shall indicate all required access.
 - e. All wall, roof, floor penetrations.
- (7) After completion of the Final Coordination Drawings, a Final Review with the all Trades shall occur to provide any final comments and approval by all Trades. Other interim coordination meeting will be required to ensure successful coordination drawings. Any additional coordination items will be updated by the Mechanical Contractor. The Final Approved Coordination Drawings shall distributed electronically (on CD) to each Trade by the Mechanical Contractor. The Mechanical Contractor shall also furnish a complete 30x42 paper set of drawings to the jobsite main office and shall utilize them for updates of field conditions/deviations that occur during construction. Final Approved Coordination Drawings shall also be distributed to the General Contractor, Owner, Architect and Engineer for their Records. This process shall be completed prior to starting any work.
- (8) RECORD DRAWINGS - Each Contractor shall ensure that any deviations from the Coordination Drawings are recorded as they occur, in red erasable pencil on Coordination Drawings kept at the jobsite. Upon completion of a particular phase, the Mechanical Contractor shall incorporate all field deviations into the Coordination Drawings to be utilized as Record Drawings. The Engineer shall review the Record Documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. The Record Drawings shall be distributed electronically (on CD) to the Construction Manager, Owner, Architect and Engineer for their Records.

END OF SECTION 200500

SECTION 201100 - SLEEVING, CUTTING, PATCHING AND REPAIRING

1. GENERAL

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. The Contractor shall be responsible for all openings, sleeves, trenches, etc., that he may require in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.
- C. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to go through; however, when this is not done, the Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Engineer. Any damage caused to the buildings by the workmen of the responsible Contractor must be corrected or rectified by him at his own expense.
- D. The Contractor shall notify other trades in due time where he will require openings or chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.
- E. The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly made good to the satisfaction of the Engineer.
- F. All work improperly done or not done at all as required by the Mechanical Trades in this section, will be performed by the Contractor at the direction of the trade whose work is affected.

2. SLEEVES, PLATES AND ESCUTCHEONS

- A. The Contractor shall provide and locate all sleeves and inserts required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for pipes where sleeves and inserts were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves. Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the pipe or conduit and the sleeves shall be made completely and permanently water tight.
- B. Pipe that penetrates fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.
- C. At all other locations either pipe sleeves or core drilled openings are acceptable.
- D. Where thermal expansion does not occur, the wall may be sealed tight to the pipe or insulation.
- E. Insulation, that requires a vapor barrier (i.e., cold water or refrigerant piping, etc.), must be continuous through the sleeve/cored hole. For other piping, insulation may stop on either side of the sleeve.

- F. Sleeves shall be constructed of 24-gauge galvanized sheet steel with lock seam joints or Schedule 40 pipe. Sleeves in floors shall extend 1" above finished floor level.
- G. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- H. In all areas where ducts are exposed and ducts pass thru floors, the opening shall be surrounded by a 4-inch-high by 3-inch-wide concrete curb.
- I. Escutcheon plates shall be provided for all pipes and conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

3. CUTTING

- A. All rectangular or special shaped openings in plaster, stucco or similar materials, including gypsum board, shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirement is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for grilles, diffusers, lighting fixtures, etc.
- B. Mechanical, plumbing, and fire protection contractors shall coordinate all openings in new and existing masonry walls with the General Contractor; and, unless otherwise indicated on the Architectural drawings, provide lintels for all openings required for the work (Louvers, wall boxes, exhaust fans, etc.). Lintels shall be sized as follows:
 - (1) New Openings under 48" in width: Provide one 3-1/2"x3-1/2"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on either side.
 - (2) New Openings 48" to 96" in width: Provide one 3-1/2"x6"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on either side.
 - (3) New Openings over 96" in width: Consult the Project Structural Engineer.
- C. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- D. Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- E. Openings in metal building walls shall be made in strict accord with building suppliers recommendations.

4. PATCHING AND REPAIRING

- A. Patching and repairing made necessary by work performed under this division shall be included as a part of the work and shall be done by skilled mechanics of the trade or trades for work cut or damaged, in strict accordance with the provisions herein before specified for work of like type to match adjacent surfaces and in a manner acceptable to the Engineer.
- B. Where portions of existing lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced to the satisfaction of the Engineer.

- C. Where the installation of conduit, ducts, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material satisfactory to maintain the rating integrity of the wall, floor or ceilings affected.
- D. Where ducts penetrate fire rated assemblies, fire dampers shall be provided with an appropriate access door.
- E. Piping passing through floors, ceilings and walls in finished areas, unless otherwise specified, shall be fitted with chrome plated brass escutcheons of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe around which it is installed.
- F. Stainless steel collars shall be provided around all ducts, large pipes, etc., at all wall penetrations; both sides.
- G. Where ducts, pipes, and conduits pass through interior or exterior walls, the wall openings shall be sealed air tight. This shall include sealing on both sides of the wall to ensure air does not enter or exit the wall cavity. This is especially critical on exterior walls where the wall cavity may be vented to the exterior.
- H. When installing conduit, pipe, or any other work in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore, all new work shall NOT be installed in concrete center of wall. All mechanical and electrical installations shall be on the interior side of the concrete.

END OF SECTION 201100

SECTION 201200 - EXCAVATION, TRENCHING, BACKFILLING AND GRADING**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. The Contractor shall include all excavating, filling, grading, and related items required to complete his work as shown on the drawings and specified herein or as required to complete, connect and place all mechanical systems in satisfactory operation.
- C. Unless otherwise shown or required, provide separate trenches for sewers, water lines and other underground raceways, with a minimum of 10 feet measured from outside diameter between pipes. In locations, such as close to buildings where separate trenches for sewers and water lines are impractical, lay the water pipe on a solid shelf at least 2'-0" above the top of the sewer and 2'-0" to the side. Electric and fuel lines shall always be placed in a separate trench. All exterior lines shall have a minimum earth cover of thirty (30) inches to top of pipe, unless otherwise indicated.
- D. Water lines crossing under sewer lines, or crossing less than 2 feet above sewer lines, must be encased for a distance not less than 5 feet on either side of the point of crossover.

2. SUBSURFACE DATA

- A. Materials to be excavated shall be unclassified, and shall include earth, rock, or any other material encountered in the excavating to the depth and extent indicated on the drawings and specified herein. No adjustment in the Contract sum will be made on account of the presence or absence of rock, shale, or other materials encountered in the excavating. This paragraph is written to include the removal of all rock with no extras, whether rock is indicated or not.

3. BENCH MARKS AND MONUMENTS

- A. Maintain carefully all bench marks, monuments and other reference points. If disturbed or destroyed, replace as directed.

4. EXCAVATION

- A. Excavate trenches of sufficient width for proper installation of the work. When the depth of backfill over sewer pipe exceeds 10 feet, keep the trench at the level of the top of the pipe as narrow as practicable. Trench excavation for piping eight inches and smaller shall not exceed thirty-inch width for exterior lines and twenty-four-inch width for interior lines.
- B. Sheet and brace trenches as necessary to protect workmen and adjacent structures. Comply with local regulations or, in the absence thereof, with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc., and current OSHA Standards. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and prevent injurious caving. Where removal of sheeting and/or bracing is hazardous, leave in place. Cut off such sheeting not to be removed at least 3 feet below finished grade.
- C. Rules and regulations governing the respective utilities shall be observed in executing all work under this heading. Active utilities discovered in the course of excavation shall be protected or relocated in accordance with written instructions from the Engineer. Inactive and abandoned utilities encountered in

trenching operations shall be removed and abandoned with ends plugged or capped in accord with current codes and safe practice. If in doubt, contact Engineers. Machine excavation shall not be allowed within ten (10) feet of existing electric lines or lines carrying combustible materials. Use only hand tools.

- D. The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted unless authorized in writing by the Engineer. Any damage to existing structures, exterior services, or rock intended for bearing, shall be corrected at the Contractor's expense.
- E. Perform final grading of trench bottoms by hand tools; carry machine excavation only to such depth that soil bearing for pipes and raceways will not be disturbed. Grade the bottom of trenches evenly to ensure uniform bearing for all piping and raceways. Cut bell holes as necessary for joints and jointmaking. Except as hereinafter specified, bottom of trenches for bell and spigot pipe, flanged pipe, etc. shall be shaped to the lower quadrant of pipe with additional excavation for bell or flange. Piping installed where it rests on bell, or flange and/or is supported with blocks or wedges will not be accepted.
- F. Keep trenches free from water while construction therein is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper jointing of pipe. Any water pumping from this Contractor's trenches which is required during construction, shall be included in this Contract.
- G. In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, utility lines, large trees to remain, etc. The Contractors shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage or any other damage incurred in the course of excavation shall be borne by the responsible Contractor.
- H. Use surveyor's level to establish elevations and grades.
- I. The Contractor shall accept the site as he finds it and remove all trash, rubbish and material from the site prior to starting excavation of his work.
- J. The Contractor shall provide and maintain barricades and temporary bridges around excavations as required for safety. Temporary bridges shall be provided where excavations cross paved areas and walks. The Contractor shall maintain these bridges in a safe and passable condition for all traffic until removal. Refer to OSHA Standards for such installations and comply with same in all details.
- K. Pay particular attention to existing utilities and lines to avoid damage. The locations of existing lines which are indicated on the plans were taken unconfirmed from drawings prepared for previous construction and locations are approximate only. Also, certain water, gas, electric, storm and sanitary sewer lines and other underground appurtenances, active or abandoned, may not appear on the drawings. It shall be each Mechanical Contractor's responsibility to ascertain the location of all lines and excavate with caution in their area.

5. BACKFILL AND SURFACE REPAIR

- A. Backfilling for mechanical work shall include all trenches, manhole pits, storage tank pits, and/or any other earth and/or rock openings which are excavated under this Contract. Backfilling shall be carefully performed and the surface restored to its original level to receive new finish. Wherever trenches and earth openings have not been properly filled and/or settlement occurs, they shall be re-excavated, re-filled and properly compacted, smoothed off and finally made to conform to the level of the original ground surface.
- B. Unless otherwise indicated or specified, all piping shall be bedded on four (4) inches minimum of compacted naturally or artificially graded mixture of crushed gravel, crushed stone, or crushed sand with

100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve on undisturbed soil excavated as described hereinbefore. Install tracer wire above pipe. Cover the pipe with twelve (12) inches of compacted backfill to prevent settlement above and around the new pipe. The backfill shall be naturally or artificially graded mixture of crushed gravel, crushed stone, or crushed sand with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve. Prior to placing this second level of backfill, apply all required coatings and coverings to pipe, apply required tests and check the grading of the pipe to ensure that it is correct and that the pipe is free of swags, bows or bends. Also check lines for leaks at this point and repair as required. Once all of the preceding is accomplished, continue backfill with clean, debris and rock free earth tamped at six (6) inch intervals. Finish the backfill as specified following. Note: Water settling of backfill will be permitted only as an aid to mechanical compacting.

- (1) When installing any type of pipe below building footing, parallel or perpendicular to the footing, the area underneath the footing and in the zone of influence shall be backfilled with cementitious flowable fill. The zone of influence is the area within a 45-degree angle projecting down from the bottom edge of footers on all sides of the footing. Piping within flowable fill shall be isolated from the fill by a layer of heavy duty felt paper. Piping installed in trenches backfilled with flowable fill shall be anchored to the soil below prior to backfilling.

- C. Backfill beneath areas to be seeded or sodded within six (6) inches of finished grade. The remaining six (6) inches shall be backfilled with clean top soil.
- D. Backfill beneath paved areas, walks, etc. shall be brought to proper grade to receive the sub-base and paving. No paving shall be placed on uncompacted fill or unstable soil.

*** REVIEW E, F, AND G BELOW FOR APPLICABILITY TO PROJECT.**

- E. Backfill for natural gas lines shall be in strict accordance with the utility company or local municipalities requirements. If in doubt, contact the utility company or local municipality and/or the Engineer.
- F. Backfill for lines carrying hazardous or combustible materials shall be in accordance with current codes, rules, regulations and safe practices. If in doubt, contact the Engineers.
- G. Backfill for underground tanks shall be in accord with the tank manufacturer's recommendations. If in doubt, contact the Engineers.
- H. Wherever, in the opinion of the Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting piping, special support shall be provided as directed by the Engineer.
- I. Unsuitable material and surplus excavated material not required for backfill shall be removed from the site. The location of dump and length of haul shall be the affected Contractor's responsibility.
- J. Provide and place any additional fill material from off the site as may be required for backfill. Fill obtained from off site shall be of kind and quality as specified for backfill and the source approved by the Engineer and shall be brought to the site by the Contractor requiring the fill.
- K. In the absence (if not specified or indicated elsewhere in the drawings or specifications to be done by others) of such work by others, the Contractor shall lay new sod over his excavation work. Level, compress and water in accord with sound sodding practice.
- L. When running any type of piping below a footer or in the zone of influence the piping shall be backfilled with cementitious flowable fill. The zone of influence is the area under the footer within a 45-degree angle projecting down from the bottom edge of the footer on all sides of the footer. Additionally, grease traps,

manholes, vaults, and other underground structures shall be held away from building walls far enough to be outside of the zone of influence.

M. Warning Tape and Tracer Wire

Provide a yellow and black plastic tape in all trenches 6" above the buried utility that identifies the utility about to be encountered. For non-metallic pipe a #12 copper wire shall also be laid in the trench to aid in future location of the piping. A foil faced warning tape may be used in lieu of the plastic tape and wire.

- N. All manholes, vaults, and similar underground structures shall have the top elevation set flush with finished grade unless specifically noted otherwise.

6. MINIMUM DEPTHS OF BURY (TO TOP OF PIPE)

In the absence of other indication, the following shall be the minimum depth of bury of exterior utility lines. (Check drawings for variations).

- A. Domestic Water Lines36 inches.
- B. Fire Protection Lines42 inches.
- C. Geothermal Lines42 inches.
- D. Storm Lines20 inches.
- E. Sanitary Lines (Exterior).....36 inches.
- F. Natural Gas Lines.....36 inches.
- G. Fuel Oil Lines.....36 inches.
- H. Other lines carrying combustible and/or hazardous materials.....36 inches.

END OF SECTION 201200

SECTION 201300 - PIPE, PIPE FITTINGS AND PIPE SUPPORT**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. When a pipe size is not indicated, the Contractor shall request the pipe size from the Engineers. All piping shall be installed straight and true, parallel or perpendicular to the building construction. Piping shall be installed so as to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. Where a section of piping is not indicated but is obviously required for completion of the system, the Contractor shall provide same at no additional cost to the project. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers and other building openings.
- C. All pipe shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted. Spacing of pipe supports shall not exceed eight feet for pipes up to 1-1/4 inches and ten feet on all other piping. Small vertical pipes (1 inch and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants. Insulated piping shall be supported on a rigid insulation block at each hanger so as to prevent crushing of insulation by hangers. Hangers shall pass completely around the insulation jacket and a steel protective saddle shall be applied to prevent compression of the insulation. (Refer to Specifications Section entitled INSULATION-MECHANICAL).
- D. Where piping rests directly on a hanger, clip, bracket or other means of support, the support element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe to rest on ferrous structural members, equipment, etc. without electrolytic isolation.
- E. In general, piping shall be installed concealed except in Mechanical, Janitor Rooms, etc. unless otherwise indicated, and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceilings shall be held as high as possible and shall run so as to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur, they shall be kept as close to walls as possible.
- F. Installation of pipe shall be in such a manner as to provide complete drainage of the system toward the source. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be 1/2" size gate type with 3/4" hose thread end and vacuum breaker. Label each drain valve.
- G. All hot and cold-water piping shall be kept a sufficient distance apart so as to prevent heat transfer between them. Cold water piping shall also be kept apart from refrigerant hot gas lines.
- H. Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing; if in doubt, consult Engineer.
- I. Piping for all drainage systems shall be installed to permit flow, trapping, and venting in accord with current codes and sound practice.

- J. All cast iron soil pipe and fittings shall be coated inside and out with coal tar varnish.
- K. Non-metallic piping shall be installed in strict accordance with the manufacturer's instructions. If no such instructions are available, consult Engineers.
- L. Nipples shall be of the same material, composition and weight classification as pipe with which installed.
- M. Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineers prior to submission of a bid proposal.
- N. Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If necessary, contact Engineers.
- O. Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case, shall be accomplished without use of insulating unions and permission of the Engineers.
- P. Apply approved pipe dope (for service intended) to all male threaded joints. Pay particular attention to dope for fuel gas lines. The dope shall be listed for such use.
- Q. High points of closed loop hot water heating systems shall have manual or automatic air vents as indicated or required unless automatic air vents are specifically indicated. Pipe to suitable drainage point.
- R. All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.
- S. The entire domestic hot, cold and recirculating hot water piping system shall be sterilized in strict accord with requirements of the Department of Health Codes, Rules and Regulations for the State which the work is being accomplished in.
- T. Provide expansion joints where shown on the plans and where required by good practice. Expansion joints shall be guided and anchored in accordance with the recommendations of the Expansion Joint Manufacturer's Association.
- U. Where plastic pipe penetrates a fire rated assembly, it shall be replaced with a metal threaded adapter and a metal pipe per code.
- V. Foam Core PVC is not permitted
- W. Where piping penetrates interior or exterior walls, the wall shall be sealed air tight. Refer to the sleeving, cutting, patching and repairing section of the specifications for additional requirements.
- X. Provide thrust blocks on all storm, sanitary, water, steam, hot, chilled, condenser, etc., and any other piping subject to hammering. Thrust blocks shall be provided at all turns.
- Y. All piping to hydronic coils shall be full size all the way to the coil connection on the unit. If control valve is smaller than pipe size indicated, transition immediately before and after control valve. Also, if coil connection at unit is a different size than the branch pipe size indicated, provide transition at coil connection to unit. On 3-way valve applications, the coil bypass pipe shall be full size.
- Z. Provide check valves on individual hot and cold-water supplies to each mixing valve (including each sensor style faucet, safety shower, mop sink, etc.) and each showerhead with a diverter valve (including all ADA showers). This requirement shall not be satisfied by mixing valves or fixtures with internal check valves. Independent external check valves are required.

2. UNIONS AND FLANGES AND WELDED TEES

- A. Screwed unions, soldered unions or bolted flanges shall be provided as required to permit removal of equipment, valves and piping accessories from the piping system. Keep adequate clearances for coil removal, rodding, tube replacement, motor lubrication, filter replacement, etc. Flanged joints shall be assembled with appropriate flanges, gaskets and bolting. Gaskets for steam piping systems shall be flexitalic spiral wound type. The clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system.
- B. Dielectric insulating unions or couplings shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.
- C. Tee connections for welded pipe shall be made up with welding fittings. Where the size of the side outlet is such that a different connection technique than on the run is required, a weldolet, sockolet, or threadolet type fitting may be used for the branch in place of reducing tees only where the branch is 2/3 the run size or smaller.
- D. **KDMC Projects Only** – All piping 2½” and larger shall use flanged joints in mechanical rooms.

3. SPECIFICATIONS STANDARDS

All piping and material shall be new, made in the United States and shall conform to the following minimum applicable standards:

- A. Steel pipe; ASTM A-120, A-53 Grade A, A-53 Grade B.
- B. Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.
- C. Cast iron soil pipe; ASA A-40.1 and CS 188-59.
- D. Cast iron drainage fittings; ASA B16.12.
- E. Cast iron screwed fittings; ASA B16.4.
- F. Welding fittings; ASA B16.9.
- G. Cast brass and wrought copper fittings; ASA B16.18.
- H. Cast brass drainage fittings; ASA B16.23.
- I. Reinforced concrete pipe; ASTM-C-76-64T.
- J. Solder; Handy and Harmon, United Wire and Supply; Air Reduction Co. or equivalent.
- K. CPVC Plastic pipe; ASTM D2846.
- L. PVC plastic pipe; ASTM D1785.
- M. ABS plastic pipe; ASTM D1788-73.
- N. Cross-linked polyethylene (PEX) pipe; ASTM F876 and ASTM F877.
- O. Cross-linked polyethylene (PEX) fittings; ASTM F1960

4. PITCH OF PIPING

All piping systems shall be installed so as to drain to a low point. Certain minimum pitches shall be required for this drainage. For proper flow and/or for proper operation, the following pitches shall be required:

A. Interior Soil, Waste and Vent Piping:

1/4 inch per foot in direction of flow where possible but in no case less than 1/8" per foot.

B. Exterior Sanitary Lines:

Not less than one (1) percent fall in direction of flow and no greater than indicated.

C. Roof Leaders:

1/8 inch per foot where possible.

D. Condensate Drain Lines from Cooling Equipment:

Not less than 1/4 inch per foot in direction of flow.

E. Exterior Storm Lines:

Not less than 1 percent grade in direction of flow.

F. All Other Lines:

Provide ample pitch to a low point to allow 100 percent drainage of the system.

5. APPLICATIONS

A. General Notes

- (1) Where plastic piping penetrates a fire rated assembly, it shall be replaced with a threaded metal adapter and metal pipe or whatever means necessary to maintain the separation rating in accordance with local plumbing and fire codes.
- (2) Plastic piping or any materials with a flame and smoke spread rating not approved for plenum use shall not be permitted in supply, return, relief or exhaust plenums.
- (3) PVC, CPVC, or plastic piping shall not be used under paving, roads or areas where vehicular traffic is expected.
- (4) PVC or plastic piping whether specifically listed or not may not be used in high rise buildings or anywhere else prohibited by code.

B. Sanitary Sewer – Exterior

- (1) SDR 35 PVC pipe extruded from Type 1, Grade 1 polyvinyl chloride material. PVC pipe shall have a bell type fitting on one end. All joints shall be solvent cement type, made in accordance with the Kentucky Plumbing Code.

C. Natural Gas Piping - Exterior

Exterior natural gas piping shall be thermoplastic gas pressure pipe with fittings complying with ASTM D 2513. All gas piping shall be installed per NFPA 54.

Columbia Gas of Kentucky requires, in compliance with Sections 192.283 and 192.285 of Title 49 of the Code of Federal Regulations, that Contractors installing plastic pipe be qualified in the procedures for joining plastic pipe. Contractors not previously qualified by Columbia should contact the local Columbia Gas office for information on the necessary procedures for qualifying under this requirement.

D. Domestic Water Piping - Exterior

- (1) Class 200 PVC. Piping shall meet AWWA C900 requirements, be UL listed, Factory Mutual approved and NSF approved. Joints shall have spigot pipe ends with a flexible elastomeric ring seated in a groove to provide water tight seal. Minimum burst pressure to be 900 psi when tested in accordance with ASTM D1599.

E. Fire Protection - Exterior and Interior

Refer to the Fire Protection System section of these specifications.

F. Hydronic Piping - Underground

G. Soil Waste and Vent Piping - General Requirements

- (1) Water closet floor flanges and ells shall be cast iron regardless whether PVC piping is allowed or not.
- (2) Soil and waste piping serving mechanical rooms, laundries and kitchens shall be cast iron regardless whether PVC piping is allowed or not. Cast iron will also be required at any other location where waste water temperature can exceed 120°F. Cast iron shall extend a minimum of 35' past last waste inlet.

H. Soil, Waste and Vent Piping (Below Slab)

- (1) Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints made in accordance with the Kentucky Plumbing Code. **Foam core piping is not permitted.**

DELETE BELOW IF NO SODA DESPENSING EQUIPMENT

- (2) Waste piping serving Soda Machine drains, (floor sinks or floor drains) shall be: Service weight cast iron epoxy coated no-hub cast iron pipe and fittings, as manufactured by Newage Casting or approved equal. Certified to conform to ASTM A888 & CISPI 301. The two-part epoxy spray on coating shall have a 2.5 mil. Minimum exterior thickness and a 5 mil. Minimum interior thickness for adhesion and chemical resistance. Two-part epoxy is to be tested to be non- reactive from 2pH-12pH. Install piping in accordance to manufacturer's instructions. This branch piping shall run as this material until connected to the main.

I. Soil, Waste and Vent Piping (Above Slab)

- (1) Type DWV copper drainage piping with cast bronze drainage pattern fittings with solder joints.

- (2) Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints made in accordance with the Kentucky Plumbing code.

J. Roof Leaders/Interior Storm Sewer Piping

- (1) Schedule 40 PVC pipe with drainage pattern fittings and solvent cement joints.

K. Sump Pump Discharge

- (1) Type "M" copper with solder joints.
- (2) Schedule 40 PVC where piping is not installed in a plenum. All piping exposed on the exterior must be copper.

L. Natural Gas Piping – Interior

- (1) Schedule 40 black steel pipe with malleable iron threaded fittings for pipe sizes 2" and smaller.
- (2) Schedule 40 black steel pipe with wrought steel butt welded fittings for pipe sizes 2-1/2" and larger.
- (3) Where gas pressure is 5 psi or greater, piping shall be schedule 40 black steel pipe with wrought steel butt welded fittings.
- (4) Gas piping on the roof shall have expansion loops on all piping runs 75 feet or greater.

NOTES:

- (1) All gas piping shall be installed per NFPA 54.
- (2) Unions or valves shall not be installed in an air plenum.
- (3) Piping below slab must be sleeved and vented.
- (4) Piping installed in concealed locations shall not have mechanical joints.

M. Domestic Cold, Hot and Recirculating Hot Water Piping (Above Slab)

- (1) Type "L" hard copper tubing with wrought copper fittings with lead free solder equivalent in performance to 95/5. (Maximum lead content of solder and flux is 2%).
- (2) Victaulic 607 or engineer approved equivalent mechanical grooved pipe couplings and fittings may be used in lieu of solder. For potable water, product shall utilize grade "P" EPDM gasket rated from +0°F to +180°F for improved resistance to chlorine, chloramine and other typical potable water disinfectants. Victaulic 608N may be utilized with copper groove system.

(3) PEX PIPING

- a. Installer Qualifications: Installer shall have successfully completed the Manufacturer's Commercial Piping Systems Training Course (formerly Uponor AquaPEX Certification) and is able to provide proof/verification. Course shall be conducted by the manufacturer or a manufacturer's representative.
- b. DELIVERY, STORAGE, AND HANDLING
 - 1) Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

- 2) Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 3) Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 - 4) Store PEX tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
 - 5) Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight
- c. WARRANTY
- 1) Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
 - 2) Manufacturer's Warranty: PEX-a manufacturer system warranty shall cover piping and fittings for a duration of 25 years from the date of installation. Piping system warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.
- d. PEX PIPE AND FITTINGS
- 1) PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5) by Uponor or equal.
 - 2) PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - 3) UNS No. C69300 Lead-free (LF) Brass.
 - 4) UNS No. C27453 Lead-free (LF) Brass.
 - 5) 20% glass-filled polysulfone as specified in ASTM D 6394.
 - 6) Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.
 - 7) Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.
 - 8) Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.
 - 9) Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".
 - 10) Pre-Sleeved Piping (1/2 inch (16mm) through 3/4 inch (20mm) nominal pipe size): PEX-a piping, with a high-density polyethylene (HDPE) corrugated sleeve.
 - 11) Pre-Insulated Piping (1/2 inch (16mm) through 2 inch (50mm) nominal pipe size): PEX-a piping, with a closed-cell polyethylene foam insulation.
 - 12) Multi-Port Tees: Multiple-outlet fitting complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 inlets and outlets.
 - 13) Engineered polymer branch multi-port tee.
 - 14) Engineered polymer flow-through multi-port tee.
 - 15) Engineered polymer commercial branch multi-port tee.
 - 16) Engineered polymer commercial branch multi-port elbow.
 - 17) Engineered polymer commercial flow-through multi-port tee.
 - 18) Manifolds: Multiple-outlet assembly complying with ASTM F 877 (CAN/CSA B137.5); with ASTM F 1960 outlets.
 - 19) Engineered polymer valved manifold.
 - 20) Engineered polymer valveless manifold.
 - 21) Lead - free copper branch manifold.
 - 22) Lead-free copper valved manifold.
- e. TRANSITION FITTINGS
- 1) PEX-to-Metal Transition Fittings:
 - 2) Manufacturers: Provide fittings from the same manufacturer of the piping.
 - 3) PEX-a to Thread Transition: One-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - 4) PEX-a to Copper Sweat Transition: One-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.

- 5) PEX-a to Copper Press Transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - 6) PEX-a to Flange Transition: Two-piece fitting with one steel flange conforming to ASME B16.5 and one lead free (LF) brass adapter conforming to ASTM F 1960.
 - 7) PEX-a to Groove Transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - 8) PEX-a to Water Meter Transition: Two-piece fitting with one NPSM union thread and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - 9) PEX-to-Thermoplastic Transition Fittings:
 - 10) PEX-a to CPVC Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- f. VALVES
- 1) PEX-to-PEX, Lead Free (LF) Brass Ball Valves (1/2 inch (16 mm) through 2 inch (50 mm) nominal pipe size)
 - 2) Manufacturers: Provide ball valve(s) from the same manufacturer as the piping system.
 - 3) Full-port ball valve: two-piece, ASTM F1960 cold-expansion ends, with PEX-a reinforcing cold-expansion ring.
 - 4) LF brass valve with a positive stop shoulder manufactured from C69300 brass.
 - 5) In compliance with: 250 CWP, ANSI/NSF 359, ANSI/NSF 14/61, cNSF-us-pw_G lead free 0.25% Lead max., ASTM F1960, ASTM F 877 (CAN/CSA B137.5).
- g. EXECUTION
- 1) EXAMINATION
 - (a) Site Verification of Conditions: Verify that site conditions are acceptable for installation of the domestic water piping. Do not proceed with installation until unacceptable conditions are corrected.
 - 2) INSTALLATION
 - (a) Install plumbing system according to approved shop drawings and coordination drawings.
 - (b) Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
 - (c) Piping Installation:
 - (d) Install piping system in compliance with the Uponor Piping Pocket Guide (2017).
 - (e) PEX shall not be installed in areas within five feet of UV light.
 - (f) Hangers and Supports:
 - (g) Horizontal PEX-a Piping Hangers: Install CTS hangers suitable for PEX-a piping in compliance with the Uponor Piping Pocket Guide (2017) and local codes, with the following maximum spacing:
 - (h) National Plumbing Code of Canada (NPCC): 3 inch (75mm) and below: Maximum span, 32 inches (0.81 m).
 - (i) International Plumbing Code (IPC) & Uniform Plumbing Code (UPC): 1 inch (25 mm) and below: Maximum span, 32 inches (0.81 m).
 - (j) IPC & UPC: 1-1/4 inch (31 mm) and above: Maximum span, 48 inches (1.2 m).
 - (k) Note: The above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.
 - (l) Horizontal PEX-a Piping with PEX-a Pipe Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
 - (m) 3/4 inch (20 mm) and below: Maximum span, 6 feet (1.8 m).
 - (n) 1 inch (25 mm) and above: Maximum span, 8 feet (2.4 m).
 - (o) Vertical PEX-a Piping: Support PEX-a piping with maximum spacing of 5 feet (1.5 m).

- (p) PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor for domestic hot-water systems. Install mid-story guides between each floor. Install CTS riser clamps at the base of each floor and at the top of every fourth floor for domestic cold-water systems. Install mid-story guides.
- (q) Piping Schedule:
- (r) Underground / under-building slab, domestic water piping (3 inch and below) shall be the following:
- (s) 1/2 inch (16 mm) through 3 inch (75 mm) - PEX-a piping with engineered polymer (EP) or lead-free brass F1960 cold-expansion fittings. Insulate in compliance with Section - 9 "Plumbing Piping Insulation." Use the fewest possible joints and install per manufacturer's recommendations.
- (t) 1/2 inch (16 mm) through 2 inch (50 mm) - Pre-insulated PEX-a piping with PEX-foam insulation with engineered polymer (EP) or lead-free brass ASTM F 1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
- (u) 3/4 inch (20 mm) through 2 inch (50 mm) - Pre-insulated PEX-a piping with multi-layer, closed-closed cell PEX-foam insulation and a corrugated HDPE jacket with engineered polymer (EP) or lead-free brass ASTM F 1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
- (v) In-slab, domestic water piping (3 inch (75mm) and below) shall be the following: Bare PEX-a piping, pre-sleeved PEX-a piping, or pre-insulated PEX-a piping with engineered polymer (EP) or lead-free brass F1960 cold-expansion fittings. Use the fewest possible joints and install per manufacturer's recommendations.
- (w) Aboveground domestic water piping (3 inch (75mm) and below) shall be the following: PEX-a piping, with engineered polymer (EP) or lead-free brass F1960 cold-expansion fittings.
- (x) Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.
- (y) Field Quality Control: Do not expose PEX piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

N. Trap Prime Piping

- (1) Above slab: It shall match domestic water piping requirements.
- (2) Underslab: It shall match domestic water piping requirements with a protective wrap or cross-linked polyethylene (PEX) piping.

O. Domestic Cold, Hot and Recirculating Hot Water Piping (Below Slab)

Type "K" hard or soft copper tubing with wrought copper fittings and brazed joints. There shall be no joints beneath slabs.

P. Hydronic Piping (Hot, Chilled, Heat Pump Systems)

- (1) If Base-Bid is accepted, All piping within 100 ft of boiler must conform to the following:
 - a. Schedule 40 black steel pipe with 125# welded or flanged joints. Weldolets may be used for branch line connections to pipe mains. Type "L" hard copper piping with wrought copper fittings and 95/5 solder may be installed.

- b. Victaulic 607 or engineer approved equivalent mechanical grooved pipe couplings and fittings may be used in lieu of solder. Gaskets shall be grade "EHP" EDPM designed for operating temperatures from -30°F to +250°F. Mechanical grooved piping may not be used if system water temperature exceeds 250°F.
 - c. Schedule 40 Victaulic 107/W07 or engineer approved equivalent mechanical grooved pipe couplings and fittings with 125# rating minimum may be used. Install gaskets as recommended by the manufacturer. Piping system shall be rated for minimum of 250°F water temperature. Mechanical grooved piping may not be used if system water temperature exceeds 250°F.
 - 1) Roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions, which may or may not include torque settings, torque wrenches, extreme lubricant and specified gaps. Engineer reserves the right to inspect any and all installation of product. Factory trained representative must periodically visit the job site and provide on-site training. Grooved pipe shall be produced using approved method by fitting manufacturer. Confirm all grooved pipe critical dimensions fall into the required tolerance range as listed by the tool manufacturer.
- (2) If Geothermal alternate is accepted, all piping mains other than runout piping to heat pumps shall conform to the following requirements. If base bid is accepted, after downstream of boiler greater than 100 ft, the following solution is to be used throughout:
- a. Mains and branches – Piping shall be virgin polyethylene with a PE 3408 piping formulation and 345464C or greater cell classification. Pipe shall be SDR 15.5, minimum pressure rating of 110 psi at 73.4°F.
 - b. Branches - Type "L" hard copper tubing with wrought copper fittings and 95/5 solder.
 - c. Transitions from polyethylene to copper – refer to detail on drawings. **Factory manufactured transition required** with brass threads. No metal threads shall be inserted into polyethylene piping, and no polyethylene threads shall be inserted into metal piping.
 - d. Pipe shall be butt or socket fused in accordance with pipe manufacturer's procedures. Installers shall have heat fusion school certification per geothermal specifications. Provide copy of heat fusion card to Engineer for review. Alternatively, Victaulic HDPE piping system may be used in lieu of heat fusion joints. Contractor shall utilize Victaulic Style 905 HDPE Couplings. Style 907 Transition Couplings may be used in conjunction with Vic-300/W761 butterfly valves and 380/381 Catalog Drops. Product shall be rated to pressures and temperatures exceeding the pipe.
 - e. Within the main pump room, Schedule 40 Victaulic or approved equivalent mechanical grooved pipe couplings and fittings with 125# rating minimum may be used. Install gaskets as recommended by the manufacturer. Piping system shall be rated for minimum of 220°F water temperature. Mechanical grooved piping may not be used if system water temperature exceeds 220°F.
 - f. Special Notes:

- 1) Takeoffs and branch piping to individual coils or heat pumps shall not be connected to the bottom of hydronic mains. Connection to mains shall be at the side of the main. Also refer to details on the drawings.

(3) Special Notes:

- a. Dielectric unions shall be provided at all connections of dissimilar materials.
- b. Copper and steel piping shall not be mixed in the mechanical room.
- c. Piping shall meet all State Boiler Code requirements. Pay particular attention to welded pipe requirements for hot water systems.
- d. Takeoffs and branch piping to individual coils or heat pumps shall not be connected to the bottom of hydronic mains. Connection to mains shall be at the side of the main. Also refer to details on the drawings.

Q. Air Vent Discharge Lines

Type "L" soft copper; wrought copper fittings, 95/5 solder.

R. Refrigerant Piping

Interior Piping for Variable Refrigerant Flow Systems 1/8" to 1-3/8" shall be ACR soft copper tube with long radius bends of soft copper tube. Provide ACR hard copper tube in all sizes for systems other than Variable Refrigerant Flow. Interior lines larger than 1-3/8" shall be ACR hard copper tube. All exterior lines shall be ACR hard copper tube. Fitting shall be wrought or forged copper with silver solder joints and minimum 15% silver content.

(1) General Installation Notes:

- a. Contact Engineer 24 hours prior to installation of refrigerant lines or evacuation of refrigerant system.
- b. Refrigerant lines installation must meet HVAC equipment manufacturer's recommendations.
- c. While installing or soldering refrigerant lines, system must continuously be purged with nitrogen.
- d. After system is installed, the refrigerant system must be evacuated to 25 microns for eight hours.

S. Condensate Drain Lines

(1) Type "DWV" copper, wrought copper, lead free solder.

(2) Schedule 40 PVC with solvent welded fittings.

T. Water Heater Relief Line

Type "M" copper tubing with sweat fittings and 95/5 solder.

U. Acid Waste and Vent Piping - (Below Slab and Grade or Above Slab)

- (1) Below slab: Schedule 40 non-flame retardant polypropylene pipe conforming to ASTM D4101 with joints made in accordance with the Kentucky Plumbing Code. Below grade piping shall be installed with fusion joint fittings.
- (2) Above slab, pipe in non-plenum area: Schedule 40 flame retardant polypropylene pipe conforming to ASTM D4101 with joints made in accordance with the Kentucky Plumbing Code. Piping shall be installed with fusion joints within concealed spaces and with mechanical joints in accessible areas. All mechanical couplings below casework or exposed shall have the clamp edges smoothed or covered to keep sharp edges from cutting people
- (3) Above slab, pipe in plenum: Schedule 40 PVDF per ASTM F1673 with mechanical joint fittings meeting ASTM E84 for flame spread and smoke generation (less than 25 and 50 respectively).
- (4) Piping shall be protected from sunlight in accordance with the manufacturer's recommendations.
- (5) Acceptable manufacturers of acid waste and vent piping materials: Enfield (Iplex), Orion, or G.F. Sloane.

END OF SECTION 201300

SECTION 201310 - WELDING

1. GENERAL

- A. All welding accomplished by the Contractor shall comply with provision of the latest revision of applicable codes, whether ASME Boiler and Pressure Vessel Code for pressure piping or such State and Local requirements as may supersede these codes.
- B. Welds shall be of sound metal thoroughly fused to the base metal at all points, free from cracks and reasonably free from oxidation blow holes and non-metallic inclusions. No fins or weld metal shall project within the pipe and should they occur they shall be removed. All pipe beveling shall be done by machine. The surface of all parts to be welded shall be thoroughly cleaned free from paints, oil, rust or scale at the time of welding, except that a light coat of oil may be used to preserve the beveled surfaces from rust.
- C. Pipe and fittings shall be carefully aligned with adjacent parts and this alignment must be preserved in a rigid manner during the process of welding.
- D. Each Contractor shall be responsible for quality of welding done by his organization and shall repair or replace any work not done in accordance with specifications. If required by the Architect/Engineer, the Contractor shall cut out at least three (3) welds during the job for X-raying and testing. These welds shall be selected at random by the Resident Inspector and shall be tested as a part of the Contractor's Contract. Certifications of these tests and X-rays shall be submitted, in triplicate to the Engineer. In case a faulty weld is discovered, the Contractor shall be required to furnish additional tests.

2. WELDING QUALIFICATIONS

- A. It is required that all welding of piping covered by this specification, regardless of conditions of service, be installed as follows:
 - (1) Pipe welding shall comply with the provisions of the latest revision of the applicable codes, whether ASME Boiler and Pressure Vessel Code, ASA Code for Pressure Piping, or such state or local requirements as may supercede codes mentioned above.
 - (2) Before any pipe welding is performed, submit to the Owner or his authorized representative, a copy of the welding procedure specifications, together with proof of its qualification as outlined and required by the most recent issue of the code having jurisdiction.
 - (3) Before any welder shall perform any pipe welding, submit to the Owner or his authorized agent the operator's qualification record in conformance with the provisions of the code having jurisdiction, showing that the operator was tested under the proven procedure specifications submitted.
 - (4) Standard Procedure Specifications and Welders qualified by the National Certified Pipe Welding Bureau shall be considered as conforming to the requirements of these specifications.
 - (5) "R" Stamp: Any welder performing modifications, repairs, etc. to boilers, pressure vessels, or other pressure retaining items shall have a current R stamp issued by the National Board of Boiler and Pressure Vessel Inspectors.
 - (6) "PP" Stamp: Any welder working with steam systems exceeding 15 PSIG shall have a current PP stamp issued by ASME. This shall apply up to the first stop valve for single boiler installations and up to the second stop valve for multiple boiler installations.

B. MATERIALS

- (1) Welding fittings shall conform to ASA B16.9; of the same materials, thickness, etc., as the pipe being jointed; see ASA B36.10.

END OF SECTION 201310

SECTION 201320 - GEOTHERMAL (EARTH COUPLED) LOOP PIPING SYSTEM

1. GENERAL

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

2. INSTALLATION PERSONNEL AND TRAINING REQUIRED

- A. The loop installer must have a current International Ground Source Heat Pump Association (IGSHPA) certification, having completed an IGSHPA training course in the fundamentals of design, installation, and operation of ground source systems, and having passed the IGSHPA certification examination.
- B. Ground heat exchanger fabricators must have completed a heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of a IGSHPA Certified Heat Fusion Technician. The Fusion Technician must be thoroughly familiar with heat fusion procedures, and have had formal training at a heat fusion school under direct supervision of an IGSHPA certified instructor.
- C. Local and state laws, ordinances, and regulations as they pertain to buried pipe systems shall be strictly followed.

3. GROUND HEAT EXCHANGER MATERIALS

- A. Piping shall be virgin polyethylene with a PE 4710 piping formulation and cell classification of 445576C or E per ASTM D 3350. Pressure ratings are at 73.4° F.
- B. 2" and smaller shall be SDR 9. Pressure rating of 255 PSI
- C. 3" and larger shall be SDR 15.5 or Schedule 40. Pressure rating of 135 PSI.
- D. Markings
 - (1) Sufficient information shall be permanently marked on the length of the pipe as defined by the appropriate ASTM pipe standard.
 - (2) Piping shall also have permanent factory length markings.
- E. Certification
 - (1) Manufacturer shall supply a notarized document confirming compliance with the above standards.
- F. Manufacturers
 - (1) Centennial Plastics, Charter Plastics, Flying W Plastics, Lamson Vylon Plastics, Chevron Phillips, or Polypipe
- G. Warranty
 - (1) Manufacturer shall supply a written warranty of 25 years or greater, specifying material replacement and labor allowance. This applies to all pipe, fittings, transitions, valves, etc.

4. PIPE JOINING METHODS

- A. The only acceptable method for joining buried pipe systems is by a heat fusion process.

- B. Polyethylene pipe shall be butt or socket fused in accordance with pipe manufacturer's procedures.
- C. Factory installed "U" bends shall be used at the bottom well bend.

5. CASING

- A. Casing shall be steel. PVC casing is not acceptable.
- B. The Contractor shall include in the bid an allowance for 20 feet of permanent left-in-place steel casing per each new geothermal well indicated on the drawings (excluding the previously installed test wells). The actual amount of casing used per hole shall be tracked with a casing log and wellfield schematic. Schematic shall depict geothermal wells and provide labels for each. Log shall state the bore hole number (as depicted on the schematic), date and time casing was installed, and linear feet of casing left in place for **each** bore hole. For example:

Bore hole # 1	8/1/09	2 P.M.	30 feet of casing installed
Bore hole # 2	8/2/09	9 A.M.	10 feet of casing installed

This log shall be kept current at all times and be **signed daily during drilling** by the well field installer, mechanical contractor, General Contractor and Owner's representative.

- C. Contractor shall submit a unit price for steel casing left in place on the Bid Form. In no case will a unit price greater than \$19 / linear foot be accepted. Bids not complying with this requirement may be rejected.
- D. The casing log and the submitted casing unit price will be used to reconcile the Contract Amount with the actual amount of casing installed. The Contractor will only be paid the full unit price for casing left in place. Push and pull casing (temporary casing) will be paid at half the rate for casing left in place.

6. GEOTHERMAL VAULT

- A. General

This specification designates the requirements for the geothermal vault including internal pipe, fittings, and valves.

- B. External Shell

Shall be constructed of a high-density polyethylene flat stock having a cell classification of 345444 with a UV stabilizer of C. All materials used shall have a minimum thickness of 1". Internal and external seams are heat welded using high density polyethylene welding rods having a cell classification of 345444C. Provide with a 30" manhole. The manhole lid is connected with 8-3/8" stainless steel counter sunk bolts. Lid to have 5000-pound load bearing capacity.

- C. Internal Bracing

Shall be spaced at a maximum of 30" and constructed of a minimum of 1" thick high-density polyethylene flat stock heat welded to the external shell with high density polyethylene welding rods.

- D. Internal Piping

Shall be constructed of Drisoplex 5300 Climate Guard High Density Polyethylene SDR 15.5 pipe having a cell classification of 345444 with a UV stabilizer of C. This internal pipe is constructed in an offset, over and under, model for supply and return lines. All joints to be heat fused. The entire piping system shall be tested using 150 psi nitrogen. The main supply and return pipe to be shipped with cap butt welded to pipe. All pipe penetrating the vault walls shall be SDR9 and heat welded to external shell.

E. Fittings

P/T Plugs: Shall be constructed of solid brass and have a dual seal core of Nordel, good up to 350°F for water. Plugs shall be rated zero leakage from vacuum to 1000 psig and are capable of receiving a pressure or temperature probe. Each HPS & R pipe to the well field shall have a P & T port.

Butterfly Valve: Shall be constructed of a cast iron body, 416 stainless steel stem with a lever shut off system.

90° Elbows: Shall be molded out of high density polyethylene resins in accordance with the requirements of ASTM 3261.

Branch and Service Saddles: Shall be molded out of high density polyethylene resins in accordance with the requirements of ASTM 3261.

Valving: Each row of 10 wells shall have HPS & R shut off valve and each return line shall have a Bell & Gossett circuit setter (or equal) for balancing.

Drain: Provide a 4" floor drain in each vault.

F. Installation

The vault shall be lowered into a pit with a 6" bed of #57 gravel. Once the vault is in its place, concrete is poured as recommended by the manufacturer in and around the vault to balance buoyancy pressure and allow for anchoring. The manhole shall be flush with finished grade.

7. FLUSHING, PURGING, PRESSURE AND FLOW TESTING

A. General

- (1) Coordinate this section with the cleaning and flushing listed in Section 230200 - HVAC Equipment.
- (2) All fusion joints and loop lengths shall be checked to verify that no leaks have occurred due to fusion joining or shipping damage.

B. Pressure Testing

- (1) Vertical loops shall be pressure tested before installation. All horizontal components of the ground heat exchanger will be flushed, pressure and flow tested prior to backfilling. Pipes must contain fluid under pressure during backfilling.
- (2) Heat exchangers shall be tested hydrostatically at 150% of the pipe design rating or 300% of the system operating pressure if this value is the smaller of the two. No leaks shall occur within a 48-hour period. Engineer shall be notified when system is to be placed under pressure test.

C. Flushing and Purging

- (1) Notify the Engineer a minimum of 2 weeks in advance of system flushing. The Engineer, Mechanical Contractor, Heat Pump Supplier, Test and Balance Contractor, and Well Field Installer shall all be present to observe system flushing and purging. Schedule the system flushing to occur the same day as a regularly scheduled progress meeting. The Engineer MUST BE PRESENT. Failure to notify the Engineer in advance will result in the Contractor having to flush the system a second time.
- (2) Flow rates shall be compared to calculated values to assure that there is no blockage or kinking of any pipe. Submit this in writing to the Engineer. Balance Contractor to verify.

- (3) A minimum velocity of 3 ft/sec in each piping section must be maintained until all air is removed. Piping 8" and larger shall be purged at 4 ft/s minimum. The system shall also be forward and reverse flushed to remove all debris. The building shall be flushed in sections as required to maintain high velocities. Building mains shall be flushed separate from branches to maintain high velocity when flushing the mains.
- (4) Final purging of air from the entire building and loop field shall be performed by the Well Field Installer so that air in building piping will not be transferred to the well field.
- (5) The Balance Contractor must witness and confirm all pressure tests and flushing velocities along with confirm pressure drop for each geothermal well zone.
- (6) Contractor shall provide full size connection ports and valves as required to purge wellfield and building separately.
- (7) After the heat pump bypasses are flushed and the piping network is determined to be clean and free of air, the heat pumps themselves shall be flushed.
- (8) The system flushing device shall be equal to a Purge Pro Max distributed by Geothermal Supply Company. The flushing pump shall provide performance equal to or exceeding the following values: 550 GPM at 117 PSI, 500 GPM at 115 PSI, 300 GPM at 125 PSI, dead head pressure of 128 PSI. SUBMIT PUMP CURVE to Engineer for review and approval prior to system flush. The flushing device shall provide means to release entrained air to the atmosphere and shall filter the water. Filter shall be 50 micron. Water shall be circulated and filters shall be changed until debris is no longer visible on filter. Contractor shall provide filter media as required.

8. HORIZONTAL PIPING SYSTEMS

- A. Sharp bending of pipe around trench and bore hole corners must be prevented by using a shovel to round corners. Manufacturer's procedures must be followed.
- B. Backfilling procedure will include prevention of any sharp-edged rocks from coming into contact with the pipe by removal of the rocks before backfilling, backfilling through a coarse screen for a 6-inch cover, or use of a 6-inch cover of rock-free soil. Clods resulting from use of a backhoe must be broken up so as not to form air pockets around the pipe which will reduce heat conduction between the earth and the pipe. The flow of backfill soil must be controlled to prevent bridging and the formation of air pockets. Several slow passes with an angled backfill blade are required. Flooding is required to assure removal of air pockets. Since most of the horizontal piping is below the parking lot, the backfill shall support the expected bus traffic. Backfill load bearing capacity shall meet the Architect's specification.
- C. Horizontal return bends must be backfilled by hand to properly support the pipes and prevent kinking.
- D. All horizontal piping shall be a minimum of 42 inches below finished grade.

9. BORE HOLE

- A. The Contractor shall bore wells of a sufficient diameter to allow installation of the piping and U-bend, but shall be no less than 4-1/2".
- B. The entire bore shall be grouted as recommended by IGSHPA with a thermally enhanced grout mixture with a thermal conductivity of 1.00 Btu/hr-ft-°F. Grout shall be GeoPro Thermal Grout Lite 100 bentonite mixture or approved equal. Mixture shall be field mixed in strict accordance with manufacturer's recommendations. Grout mixture shall be mechanically pumped with a positive displacement pump into bore hole from bottom to top utilizing a tremie tube. Through the course of the project, three sample grout specimens shall be taken of the mixed grouting material by this contractor. An analysis shall be performed by the grout manufacturer to verify proper thermal performance and grout mixture. This contractor shall submit these reports to the Owner, Architect and Engineer to verify compliance with the installation specifications.

- C. If large water seams are encountered, bridging across water seams with #7 or #9 rock, or GeoPro Black Hills 3/8-inch Bentonite Plug, is acceptable. The maximum height of the rock or bentonite bridge shall not exceed 8 feet. The remainder of the vertical bore hole shall be grouted per the above specification. Bore holes with water seams shall be monitored for settling of grout. After a period of one week, all holes shall be topped off with grout as needed. The Contractor shall continue to monitor holes that experience grout settling and continue to top off with grout throughout the warranty period. Bore holes that are unable to hold grout shall be replaced with new bore holes at no cost.
- D. The Contractor shall accept the site as-is and is responsible for any and all required casings. If an area of voids is encountered, the Contractor shall either fill or re-drill wells in an approved area and extend piping to them.
- E. No night drilling will be allowed.

10. DUST CONTROL

- A. The Contractor is responsible for and shall provide dust control. Dust shall not be allowed to leave the construction site boundaries, and furthermore, shall not be allowed to enter the building or accumulate on the building exterior. When needed to meet these requirements, the Contractor shall provide and operate a mechanical dust collection system to control dust at the source. Mechanical dust collection system shall consist of collection hood at the source ducted to a dust collector which separates dust from the airstream. Dust shall be collected into sealed containers for disposal by the Contractor.
- B. Water spraying may be used but shall not be considered a substitute for mechanical dust collection at the source when required.

11. SURFACE WATER / MUD / SLURRY CONTROL

- A. The Contractor is responsible for and shall provide control of all ground flowing fluids resulting from drilling operations. The Contractor shall erect silt fences or other structures as required to contain drill cuttings, mud, slurry, etc. within the construction site boundaries. In the event this requirement is not met, the Contractor shall provide all remediation measures as required by all authorities having jurisdiction over such events.

12. WARRANTY

- A. The entire ground loop system and backfill from a point 5 feet inside the building shall be warranted for **five (5) years** from date of substantial completion against any leakage or failure. Warranty service for a pipe leak shall include recharging system with heat transfer fluid as originally specified, including glycol or ethyl alcohol if originally specified, as well as corrosion inhibitors.

13. BALANCE

The Contractor shall assist the Balance Contractor in balancing the geothermal well zones to obtain the specified flows.

14. SUBMITTALS

- A. Submit manufacturer's specification sheets and installation instruction for each component of the system, showing manufacturer, pipe or tube weight, pressure rating, fitting type and joint type for each piping system.
- B. Submit manufacturer's mechanical data for valves.
- C. Submit a drawing indicating the system layout and pipe sizes.
- D. Provide a copy of the technician's certification, and International Ground Source Heat Pump Association Certification.

15. TEST BORES

- A. Typical test bore is provided on the plans.
- B. The Contractor may visit the site prior to bid and perform their own test boring if additional information is required. This shall be coordinated with the Owner.

END OF SECTION 201320

SECTION 202100 - VALVES AND COCKS**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.
- B. The Contractor shall provide all valves required to control, maintain and direct flow of all fluid systems indicated or specified. This shall include, but may not be limited to all valves of all types including balancing cocks, air cocks, lubricated plug cocks, packed plug cocks, special valves for special systems, etc., for all Mechanical Systems.
- C. All valves shall be designed and rated for the service to which they are applied.
- D. The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.
- E. Ball valves with temperature and pressure ports are not an acceptable alternative to the balancing valves specified herein. Valves that do not comply with these specifications shall be removed and replaced by the Contractor with no increase in contract price.
- F. Each type of valve shall be of one manufacturer, i.e., gate valves, one manufacturer, globe valves, one manufacturer, silent check valves, one manufacturer, etc. The following valve manufacturers shall be acceptable: Lunkenheimer, Tour & Anderssen, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Victaulic, Bell & Gossett, Flow Design, Watts, Victaulic.
- G. All valves shall comply with current Federal, State and Local Codes.
- H. All valves shall be new and of first quality.
- I. All valves shall be full line size. Valves and hydronic specialties shall not be reduced to coil or equipment connection size. Size reductions shall be made at the connection to the equipment.
- J. Angle stops for plumbing fixtures shall be quarter turn ball type.
- K. All valves for use in potable water systems shall comply with federal lead-free requirements that the lead content of wetted surfaces cannot exceed 0.25% by weight.

2. LOCATION OF MAINTENANCE VALVES

Maintenance valves and unions, installed so as to isolate equipment from the system shall be installed at the following locations:

- A. At each plumbing fixture.
- B. At each air handling unit, and make-up air unit.
- C. At each unit heater.
- D. At each heating or cooling coil.

- E. At all other locations indicated on the drawings.

3. WORKMANSHIP AND DESIGN

- A. Handwheels for valves shall be of a suitable diameter to allow tight closure by hand with the application of reasonable force without additional leverage and without damage to stem, seat and disc. Seating surfaces shall be machined and finished to ensure tightness against leakage for service specified and shall seat freely. All screwed valves shall be so designed that when the screwed connection is properly made, no interference with, nor damage to the working parts of the valve shall occur. The same shall be true for sweat valves when solder or brazing is applied.

4. TYPES AND APPLICATION

A. GATE VALVES

Gate Valves shall be of the wedge disc type, permit straight line flow, complete shut-off and designed so that when the valve is wide open, it can be packed under pressure. Valves 1-1/2 inches and smaller shall be bronze, with ends to suit piping and non-rising stem. The valve shall have a deep stuffing box for long contact with the stem, packing gland and filled with high quality packing. Valves 2 inches thru 4 inches shall be iron body bronze mounted with flanged ends and non-rising stem. Boiler stop valves and valves larger than 4 inches shall be iron body bronze mounted flanged ends with outside screw and yoke with rising stem. Working pressure for bronze valves shall be 150 pounds and iron valves 125 pounds when installed in piping with system pressures up to 100 pounds per square inch and 250 pounds for 100 pounds per square inch and over. 2" and under NIBCO T133, greater than 2" NIBCO F619. All gate valves 2" and smaller for use in potable water systems shall meet federal requirement to be lead free containing less than 0.25% lead by weight of wetted area. NIBCO F768B.

B. GLOBE VALVES

Globe Valves shall permit control of flow rate from full flow to complete shut-off and designed that when the valve is wide open it can be repacked under pressure, and have a deep stuffing box with gland and filled with high quality packing. Valves 1-1/2 inches and smaller shall be bronze with ends to suit piping union bonnet, and with stainless steel plug type disc and seat of not less than 500 Brinnell hardness. Valves 2 inches and larger shall be iron body bronze mounted with flanged ends, yoke bonnet, and disc guide. Working pressure for bronze valves shall be 150 pounds and iron valves 125 pounds when installed in piping with system pressures up to 100 pounds per square inch and 250 pounds for 100 pounds per square inch and over. 1-1/2" and under NIBCO T256AP, greater than 1-1/2" NIBCO F768B.

C. CHECK VALVES

Check Valves shall be horizontal swing type with two-piece hinges, disc construction seats to be bronze and bronze discs or with composition face depending on service and provide silent operation. Valves 1-1/2 inches and smaller shall be bronze with ends to suit piping, have full area "Y" pattern body and integral seats. Valves 2 inches and larger shall be iron body brass mounted and with flanged ends. Working pressure for bronze valves shall be 150 psi and iron valves 125 psi when installed in piping with system pressures up to 100 psi and 250 psi for 100 psi and over. 3" and under NIBCO T433Y, greater than 3" NIBCO F918B (for less than 100 psi systems) greater than 3" NIBCO F968B (for 100 psi or greater systems). Victaulic 716/779 check valves allowed with grooved piping system.

D. BALL VALVES (NON-POTABLE)

Ball Valves shall have removable lever handle with vinyl grip, adjustable stem gland screw, reinforced Teflon stuffing box ring, blow out proof stem, bronze body, reinforced Teflon seats, chrome plated steel ball as

manufactured by Consolidated Valve Industries, Inc., Lunkenheimer, Apollo, Jenkins, Nibco or equivalent. Provide a stem extension so that the base of the handle is 1/4" above the insulation similar to Nibseal. NIBCO T5800-70.

E. BALL VALVES (POTABLE WATER)

All valves for use in potable water systems 2" and smaller contain less than 0.25% lead by weight and comply with federal lead free potable water requirements. Ball valves shall have a removable lever handle with vinyl grip, adjustable stem gland screw, reinforced Teflon stuffing box ring, blowout proof stem, stainless steel or bronze body, reinforced Teflon seats, stainless steel or chrome plate steel ball as manufactured by Apollo, Aslo, Nibco, Milwaukee, or equivalent. Provide a stem extension so that they bas of the handle is 1/4" above the insulation similar to Nibseal. NIBCO S-585-66-LF.

F. BUTTERFLY VALVES

Butterfly valves shall be line sized cast iron body, lug style, 200 PSI rating (bubble tight) EPT or Viton seat, cartridge type; high strength stem. Disc to have ground and polished seating surface. Operator shall be locking lever style. Quality equivalent to Crane Monarch series. 3" and under NIBCO LD3222-3, greater than 3" NIBCO LD322-5. Valves 6" and over shall have gear driven operators. 3" and under Victaulic 608N, greater than 3" Vic-300 butterfly valves allowed with grooved piping system. **DESIGNER: DELETE AUTOMATIC FLOW CONTROL VALVE REFERENCE TO 15P BELOW IF NOT ALLOWED.**

G. BALANCING VALVES

Bell & Gossett, Model CB circuit setter balancing valve or approved equivalent. Calibrated balancing valve shall have flanged connections suitable for 125# working pressure at 250°F. 4" and up shall be rated at 175# at 250°F working pressure. Provide with brass readout valves fitted with an integral EPT insert and check valve. Each balance valve shall have a calibrated nameplate to assure specific valve settings and be constructed with internal seals to prevent leakage. **Note: Refer to Specification Section 230200-HVAC Equipment for automatic flow control balancing valves on terminal equipment.**

H. AIR COCKS

Straight nose; Lunkenheimer Fig. 476; bronze; tee handle; bent nose; Lunkenheimer Fig. 478, 125#; bronze; tee handle.

I. GAUGE COCKS

Straight, Lunkenheimer, Fig. 1178; 125#; bronze; tee handle. FIP.

J. LUBRICATED PLUG COCKS

2" and under; Homestead Fig. 601; 150#; semi-steel; screwed; 2-1/2" and over; Homestead Fig. 602; ±50#; semi-steel; flanged.

K. PACKED PLUG COCKS

2" and under; DeZurik Fig. 425-S; 175#; semi-steel; screwed. 2-1/2" and over; DeZurik Fig. 425-F; 175#; semi-steel; flanged.

END OF SECTION 202100

SECTION 202110 - ACCESS TO VALVES, EQUIPMENT, FILTERS, ETC.**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Requirements-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.
- B. All mechanical equipment shall be installed in a manner which allows ready access to all components requiring service, adjustments, shutoff, etc.
- C. Filters shall be accessible, removable and replaceable without disconnecting mounting brackets, piping, wiring, etc.
- D. All oil cups, grease cups, grease fittings, etc. shall be accessible without disassembly of equipment, piping, ductwork, etc. (Extended oilers or grease fittings may be required).
- E. Provide access doors or panels for all equipment, valves, dampers, filters, fire dampers, etc. in concealed spaces not otherwise provided with suitable access. (Lay-in ceilings shall be considered acceptable access; splined or drywall ceilings shall not).
- F. All valves, unions, strainers, cleanouts, volume dampers, and test points shall be accessible.
- G. Access panels in lay-in ceilings shall be labeled with a lamacoid plate to indicate location of equipment, filters, valves, etc.
- H. Access panels in fire rated walls shall bear the same rating as the wall.
- I. Each fire damper shall be provided access through the duct to allow reset of the damper. This may be either a gasketed sheet metal panel over a suitable opening or a factory-built access panel. The panel shall be at least one and one-half (1 1/2) inch larger than the opening all around and shall be held in place with sheet metal screws sufficiently to ensure that it is air tight. Manually check the size and location of each of these openings to ensure that the fire damper may be manually reset by use of hand only.
- J. Contractor shall coordinate the finish of all access doors and panels installed in finished areas with Architect.

2. ACCESS DOORS

Refer to Sheet Metal and Flexible Duct section of the specifications.

END OF SECTION 202110

SECTION 202200 - INSULATION - MECHANICAL**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.
- B. Work under this section shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for all mechanical systems specified herein and/or as indicated.
- C. Application of insulation materials shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use. Insulation shall be applied by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineers shall be removed and properly installed at the expense of the Contractor.

2. MANUFACTURERS

- A. Insulation shall be as manufactured by Manville, Knauf, CertainTeed, Owens-Corning, Armacell or approved equivalent. Insulation sundries, adhesives, and jackets/covers shall be as made by Benjamin Foster, Zeston, Speedline, Proto, Childers, Vimasco or approved equivalent.

3. FIRE RATINGS AND STANDARDS

- A. Insulations, jackets and facings shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255 and UL 723 procedures not exceeding Flame Spread 25, Smoke Developed 50.
- B. Adhesives, mastics, tapes and fitting materials shall have component ratings as listed above.
- C. All products and their packaging shall bear a label indicating above requirements are not exceeded.
- D. Duct linings shall meet the Erosion Test Method in compliance with UL Publication No. 181.

4. GENERAL APPLICATION REQUIREMENTS

- A. Insulation shall be applied on clean, dry surfaces in a neat and workmanlike manner reflecting the best current practices in the trade. Insulation shall not be applied to piping, ductwork or equipment until tested, inspected and released for insulation.
- B. All insulation shall be continuous through walls, ceiling openings and sleeves. However, insulation shall be broken through fire walls. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. If necessary, extra fittings and pipe are to be used. No noticeable deformation of insulation or discontinuity of vapor seal, where required, will be accepted.
- C. "Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, mechanical platform, mezzanine, penthouses, storage areas, unfinished rooms, etc. is to be considered as "exposed".
- D. Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced as directed by the Engineer.

- E. Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples thru the jacket. NO EXCEPTIONS!
- F. All insulation shall be installed with joints butted firmly together.
- G. The Contractor shall ensure that all insulation (piping, ductwork, equipment, etc.) is completely continuous along all conduits, equipment, connection routes, etc. carrying cold fluids (air, water, other) and that condensation can, in no way, collect in or on the insulation, equipment, conduits, etc. Any such occurrence of condensation collection and/or damage therefrom shall be repaired solely at the expense of the Contractor.

5. PIPING SYSTEMS

A. GENERAL

- (1) Bevel insulation and jacket at all points where insulation terminates at unions, flanges, valves and equipment. Note: Applies to hot water lines only; cold water lines require continuous insulation.
- (2) Geothermal pumps shall be insulated continuously like a chilled water system. This requirement extends to all components in the system (pump impeller housing, unions, flanges, valves, air separators, side stream filters, hydronic specialties, etc.).
- (3) Pipe insulation shall extend around valve bodies to above drain pans in hydronic equipment over pumps, etc. to ensure no condensation drip or collection.
- (4) Factory molded fittings may be installed in lieu of built-up fittings. Jackets to be the same as adjoining insulation. Insulated fittings must have same or better K factors than adjoining straight run insulation.
- (5) Valves, flanges and unions shall only be insulated when installed on piping whose surface temperature will be at or below the dew point temperature of the ambient air.
- (6) Insulation shall not extend through fire and smoke walls. A UL-listed penetration system shall be used for each fire or smoke wall penetration in accordance with KBC. Materials used such as caulk, sleeves, etc. shall be manufactured by 3M, Hilti, or equal.

B. INSULATION SHIELDS

- (1) Metal insulation shields are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180-degree arc. Insulation shields shall be the following size:

PIPE SIZE	SHIELD GAUGE	SHIELD LENGTH
2" AND LESS	20	12"
2 1/2" TO 4"	18	12"
5" TO 10"	16	18"
12" AND GREATER	14	24"

C. INSULATION MATERIAL (FOR THE FOLLOWING SYSTEMS)

Insulation shall be Owens-Corning Model 25ASJ/SSL, or approved equivalent fiberglass pipe insulation with an all service jacket. The insulation shall be a heavy density, pipe insulation with a K factor .23 at 75°F mean temperature. The insulation shall be wrapped with a vapor barrier jacket. Approved manufacturers are listed in

Section 2 – Manufacturers. The jacket shall have an inside foil surface with self sealing lap and a water vapor permeability of .02 perm/inch. All circumferential joints shall be vapor sealed with butt strips. All insulation shall be installed in strict accordance with the manufacturers' recommendations. The following pipes shall be insulated with the thickness of insulation as noted.

(1) Domestic Cold Water

- a. Piping 3'' or less – use 1/2" thick insulation. Provide an additional 1/2" layer of insulation 3" above and 3" below vertical pipe supports.
- b. Piping 4'' or greater – use 1'' thick insulation.

(2) Hydronic System Fill Lines from Domestic Cold Water - 1/2" thick.

(3) Domestic 110°F Hot Water and 110°F Recirculating Hot Water. (If heat traced, see below)

- a. Piping 1 1/2'' or less – use 1 1/2'' thick insulation.
- b. Piping 2'' or greater – use 2'' thick insulation.

(4) Domestic 140°F Hot Water and 140°F Recirculating Hot Water. (If heat traced, see below)

- a. Piping 1 1/2'' or less – use 1 1/2'' thick insulation.
- b. Piping 2'' or greater – use 2'' thick insulation.

(5) Domestic Hot Water with Heat Tape for Heat Maintenance - Insulation thicknesses as required by the manufacturer to maintain water temperature.

(6) Geothermal Heat Pump Piping (These requirements apply to all metal piping installed but do not apply to polyethylene mains installed within building)

- a. Piping 1 1/2'' or less – use 1/2'' thick insulation.
- b. Piping 2'' and greater – use 1'' thick insulation.

(7) Hydronic Water – Hot and Chilled

- a. Piping 1 1/2'' or less – use 1 1/2'' thick insulation.
- b. Piping 2'' and larger - use 2" thick insulation.

(8) Horizontal Roof Leaders.

- a. Piping 3'' or less – use 1/2" thick insulation
- b. Piping 4'' or greater – use 1'' thick insulation

(9) Sanitary Sewer and plumbing fixture P-traps to waste stack – see schedule below. Insulate horizontal runs which receive air conditioning condensate and which are not located below slab or grade.

- a. Piping 3'' or less – use 1/2" thick insulation
- b. Piping 4'' or greater – use 1'' thick insulation

(10) Condensate Drain Lines.

- a. Piping 1 ½" or less – use 1/2" thick insulation
- b. Piping 2" or greater – use 1" thick insulation

(11) Refrigerant Liquid and Suction Lines - Interior & Exterior

IMCOA, Nomaco, or Armacell closed cell polyethylene, 1.5 Lbs/Ft³ density, 0.24 BTU-Hr.-Ft³-°F/in at 75°F thermal conductivity, zero vapor permeance, 25/50 flame and smoke spread per NFPA 90 requirements. Elastomeric closed cell insulations that meet the above requirements are also allowed. Install insulation per the manufacturer's requirements. Provide UV protective coating for all exterior refrigerant lines.

- a. All pipe sizes: 1 ½" thick

D. JACKETS

(1) Exposed (Mechanical Rooms, Interior Finished Rooms and Storage Rooms)

All insulated piping installed in the above areas shall have a canvas or PVC jacket where below 6 ft in a mechanical room:

- a. 6 oz. canvas jacket with fire retardant lagging. Apply to the insulation specified for the piping.
- b. For all systems except steam, plenum rated PVC jacket equal to LoSmoke PVC jacket with flame/smoke rating of 25/50, ASTM-E84 test method. Minimum thickness 0.04 inches. Steam systems shall utilize plenum rated CPVC jacket with minimum thickness of 0.04 inches. Jackets shall be applied over top of specified pipe insulation. Approved equal manufacturers are Zeston and Speedline. Approved equal manufacturers are Zeston and Speedline.

(2) Exposed (Exterior)

In addition to the insulation specified for the exterior pipe, provide .016" aluminum jacket or PVC jacket 0.05" thick. The jackets shall be installed as recommended by the manufacturer to maintain water tight seal. All longitudinal and transverse seams to be sealed water tight. PVC jacket shall be Ceel-Co, Proto, or Zeston.

6. DUCTWORK SYSTEMS

A. GENERAL

- (1) Duct sizes indicated are the net free area inside clear dimensions; where ducts are internally lined, overall dimensions shall be increased accordingly.
- (2) Duct insulation shall extend completely to all registers, grilles, diffusers, and louver outlets, etc., to ensure no condensation drip or collection. The backs of all supply diffusers, plenums, grilles, etc. shall be insulated only if indicated by details on the drawings.
- (3) All flexible duct connections on insulated ductwork shall be externally insulated.
- (4) All duct outside of building envelope, including rooftop duct, duct in unconditioned attic spaces above the insulation, etc. shall have two layers of specified insulation. This shall apply to supply air, exhaust air where air is run through energy recovery unit, outside air, return air, and combustion air intake ducts.

B. EXTERNAL INSULATION

- (1) Supply Air
- (2) Outside Air (only Intake upstream of ERU-1)
- (3) Exhaust Air (Only Outlet downstream of ERU-1 to Gravity hood)
- (4) Boiler Combustion Air
- (5) Flexible Duct Connections on Internally Lined Ducts

Owens/Corning "Faced Duct Wrap - Type 100", or approved equal, 2" thick fiberglass duct wrap, **1.0 pcf** density factory laminated to a reinforced foil kraft vapor barrier facing (FRK) with a 2" stapling flange at one edge. Flame spread 24, smoke developed 50, vapor barrier performance 0.02 perms per inch. K factor shall not exceed .26 at 75°F. mean temperature. Minimum R-value of the 2" thick insulation shall be 7.4 out of package and 6.0 installed.

Special Notes:

- a. Do not provide externally insulated duct per the above specification for any duct that is to be painted. Insulated duct that is to be painted shall be dual wall ductwork per specification Section 231200, Sheet Metal and Flexible Duct.
- b. Where supply, return, and outside air ductwork is routed through an unconditioned attic or any other space outside of the building thermal envelope, the ductwork shall be provided with a minimum of 2 layers of duct wrap for a minimum R value of 11.0. Additionally, this shall apply to exhaust ductwork on entering side of energy recovery type air handling units.

C. EXPOSED EXTERNALLY INSULATED DUCT

- (1) Round. 1 ½" semi-rigid fiberglass tank and pipe wrap with kraft aluminum foil all service jacket vapor barrier or PSK facing. K=.27 @ 75°F. Minimum R-value shall be OK. Provide 6 oz. canvas jacket with fire retardant lagging.
- (2) Rectangular. 1" rigid fiberglass industrial board with foil scrim kraft vapor barrier facing or PSK facing, 6.0 PCF density, K=.22 @ 75°F. Owens/Corning type 705. Provide 6 oz. canvas jacket with fire retardant lagging.

D. EXTERNALLY INSULATED DUCT – OUTDOORS

- (1) 2" semi-rigid fiberglass industrial board with foil scrim kraft vapor barrier facing or PSK Facing, 3.0 PCF density, K=.23 @ 75°F. Minimum R-value of 8.7. Owens/Corning, or approved equivalent industrial installation type 703. Weather proofing shall be ductmastic adhesive and sealer rated for outdoor use, Harcast Flex-Grip 550, or approved equivalent.
- (2) As an alternative to duct mastic adhesive and sealer, Contractor may provide a field applied aluminum jacket meeting the following specification:

Aluminum Jacket Material: Smooth finished sheets manufactured from 0.024-inch-thick aluminum alloy complying with ASTM B209 and having an integrally bonded 10mil thick, heat-bonded polyethylene and kraft paper moisture barrier over entire surface in contact with insulation.

Aluminum Jacket Applications: Apply aluminum jacketing to all external ductwork that is externally insulated. Cover all fittings and specialties with aluminum jacketing. Provide a 2-inch overlap at longitudinal seams and end joints. Secure jacket with stainless-steel sheet metal screws 6 inches o.c. and at end joints. Overlap longitudinal seams arranged to shed water and seal end joints with weatherproof mastic.

E. INTERNALLY INSULATED DUCT – OUTDOORS

- (1) In addition to the specified internal insulation, weatherproof ductwork with ductmastic adhesive and sealer, Cadoprene 725 as manufactured by Epolux Manufacturing Corp., or approved equivalent.

7. MECHANICAL EQUIPMENT

A. ROOF DRAIN SUMPS

- (1) Owens-Corning Model 475-FR or approved equivalent rigid board insulation with exterior vapor barrier jacket formed to bottom of sump basin. Insulation shall have a K factor of .22 at 75°F. mean temperature. Insulation shall be 1" thick. Insulation shall be formed to roof drain sump. Vapor barrier shall remain continuous.

B. FLOOR DRAIN SUMPS (Applies to all Floor Drains which Receive Air Conditioning Condensate and which are Installed in Locations **Other Than** Slab on Grade)

- (1) Owens-Corning Model 475-FR or approved equivalent rigid board insulation with exterior vapor barrier jacket formed to bottom of sump basin. Insulation shall have a K factor of .22 at 75°F. mean temperature. Insulation shall be 1" thick. Insulation shall be formed to roof drain sump. Vapor barrier shall remain continuous.

C. EXPANSION TANK, COMPRESSION TANK, AIR SEPARATOR, HEAT EXCHANGER, SIDESTREAM/LOOP FILTERS, AND HOT WATER STORAGE TANKS

- (1) Owens-Corning "Tank Wrap I" or approved equivalent. Insulation shall be constructed of non-combustible, flexible wool. Insulation shall be 2" thick. K factor shall be .29 at 100°F. mean temperature. Insulation shall be attached in strict accordance with the manufacturer's recommendations. All insulation shall be jacketed with 6 oz. canvas with fire retardant lagging. Coordinate with mechanical contractor to extend all piping connections, blowdown ports, etc. outside of the insulation. Additionally, for loop filters and other equipment requiring periodic service, provide removable insulated covers.

END OF SECTION 202200

SECTION 202300 - THERMOMETERS & OTHERS, MONITORING INSTRUMENTS**1. GENERAL**

- A. The Contractor shall include all thermometers, pressure gauges and/or compound gauges at the locations indicated.

2. THERMOMETERS AND PRESSURE GAUGES

- A. All thermometers and gauges shall be readable from a standing position on the floor.
 - B. Thermometers shall be linear, alcohol filled, graduated in 1°F. Or less and shall have adequate range for service intended.
 - C. Pressure gauges shall be Bourdon Type, circular, 3" face, black letters on white face graduated in 2 PSI or less and shall have adequate range and shall be manufactured for service intended. Provide with pig tail connectors and gauge cocks.
 - D. Pressure gauges and thermometers subject to vibration shall be mounted remotely away from vibrating pipe surface, etc., with flexible tubing.
 - E. Mount thermometers in approved wells and install with thermal grease. Do not make direct contact of base with fluid in pipe.
 - F. Gauges and thermometers shall be Marsh, Marshalltown, Weksler or equivalent.
- 3. Provide, when indicated on the plans, on the inlet and outlet of each terminal unit, a "Pete's Plug" or equivalent pressure/temperature test station. Furnish two (2) matching thermometers and pressure gauges to the owner upon project completion.

END OF SECTION 202300

SECTION 202400 – IDENTIFICATIONS, TAGS, CHARTS, ETC.**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.

2. VALVE TAGS AND CHARTS

- A. Provide and install on each valve in the Mechanical Systems a 1-1/2" diameter circular brass tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with letter and number identifiers as to system and purpose respectively. Letter identifiers shall be as follows:

H	Heating
C	Cooling
HC	Combination Heating/Cooling
DCW	Domestic Cold Water
DHW	Domestic Hot Water
RHW	Recirculating Hot Water
HPS	High Pressure Steam
MPS	Medium Pressure Steam
LPS	Low Pressure Steam
HPC	High Pressure Steam Condensate
MPC	Medium Pressure Steam Condensate
LPC	Low Pressure Steam Condensate
FP	Fire Protection
FOS	Fuel Oil Supply
FOR	Fuel Oil Return
NG	Natural Gas

Number identifiers shall be determined by the Contractor sequentially. For example, valve No. HC-1 may be maintenance stops for fan coil units. HC-2 maintenance stops for air heaters, etc.

- B. Provide three (3) copies of typewritten valve charts indicating each valve identifier, the valves purpose and its location. For example: "HC-1 Fan Coil Maintenance Stop-one valve at supply and return of each fan coil unit." One (1) copy of this chart shall be mounted in suitable wood frame(s) with clear plastic or glass covers in a conspicuous location in the Mechanical Room. Two other copies shall be turned over to the Engineers.
- C. Where more than one major Mechanical room is indicated for the project, install mounted valve schedule in each major Mechanical Room, and repeat only main valves which are to be operated in conjunction with operations of more than single Mechanical Room.

OR

- D. All valves must have labels, both a tag on the valve and on the ceiling grid. All labels for valves must be on ceiling grid (see UK's standard for lettering below). **(UK ONLY)**
- E. UK's Standard for Standard Lettering:
Attach Seton-Ply Discs to ceiling grid under equipment or to access doors in non-accessible ceiling. **(UK ONLY)**

EQUIPMENT: COLOR:	ENGRAVES:
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Valve Yellow	V.
Fire Damper Black	F.D.
Smoke Damper Black	SM.D.
Volume Damper Black	V.D.
Terminal Unit Red	T.
Variable Volume Unit Red	V.V.
Heating Coil Blue	H.C.
Cabinet Unit Heater Red	C.H.

3. PIPING IDENTIFICATION

A. GENERAL

- (1) Provide stenciled markers and arrows indicating direction of flow on all piping installed under this Contract. Markers and arrows shall be painted on the piping using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking. The following table describes the size of the color field and size of the identification letter which shall be used for pipes of different outside pipe diameters.

OUTSIDE DIAMETER OF PIPE OR COVERING	LENGTH OF COLOR FIELD	SIZE OF LETTERS
INCHES	INCHES	INCHES
3/4 TO 1-1/4	8	1/2
1-1/2 TO 2	8	3/4
2-1/2 TO 6	12	1-1/4
8 TO 10	24	2-1/2
OVER 10	32	3-1/2

- (2) "Concealed", where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. "Exposed" shall mean that piping or equipment is not "concealed" as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered as "exposed".
- (3) All piping shall be marked not less than every 15 linear feet above a ceiling system, every 10 feet in a mechanical room, and at all points where lines pass through walls or floors.

- (4) Provide pipe marker colors as indicated in the following table where manufactured marking systems are used:

<u>PIPE+</u>	<u>MARKER COLOR+</u>	<u>ABBREVIATION</u>
Chilled Water Supply*	Green with Black Letters	C.W.S.
Chilled Water Return	Green with Black Letters	C.W.R.
Hot Water Supply*	Yellow with Black Letters	H.W.S.
Hot Water Return	Yellow with Black Letters	H.W.R.
Chilled/Hot Water Supply*	Green with Black Letters	C.H.W.S.
Chilled/Hot Water Return	Green with Black Letters	C.H.W.R.
Steam (Low, Medium & High Pressure)	Yellow with Black Letters	LPS, MPS, HPS
Condensate (Low, Medium & High Pressure)	Yellow with Black Letters	LPC, MPC, HPC
Domestic Cold Water	Green with Black Letters	D.C.W.
Domestic Hot Water	Yellow with Black Letters	D.H.W.
Recirculated Hot Water	Green with Black Letters	R.H.W.
Compressed Air	Blue with White Letters	C.A.
Natural Gas	Yellow with Black Letters	NAT. GAS
Propane Gas	Yellow with Black Letters	PROP. GAS
Fuel Oil (Supply, Return, Fill & Vent)	Yellow with Black Letters	FOS, FOR, FOF, FOV
Sanitary Sewer Piping	Green with Black Letters	SAN.
Sanitary Vent Piping	Green with Black Letters	VENT
Storm Sewer Piping	Green with Black Letters	STORM
Fire Protection Water	Red with White Letters	F.P.

OR (UK ONLY)

University of Kentucky Standard Color Coding for Mechanical Piping Markers			
PIPE	ABBREVIATION	MARKER COLOR	NO.*
High Pressure steam and return (over 76 psig)	H.P.S. & H. P. R.	Safety Red	SW4081
Medium pressure steam and return (21 psig to 75 psig)	M.P.S. & M. P. R.	International Orange	SW4082
Low pressure steam and return (0 psig to 20 psig)	L.P.S. & L. P. R.	Safety Orange	SW4083
Domestic cold water	D.C.W.	Safety Green	SW4085
Domestic hot water	D.H.W.	Green Byte	SW4076
Medium temperature hot water & return (300F or less)	M.T.H.W. & M.T.H.W.R.	Safety Yellow	SW4084
Reheat supply & return	R.S. & R.R.	Junction Yellow	SW4033
Chilled water supply & return	C.W.S. & C. W. R.	Safety Blue	SW4086
Condenser water supply & return	C.D.W.S. & C.D.W.R	Slate Gray	SW4026
Natural gas	GAS	Deck Red	SW4040

Safety valve vents	S.V.V.	Galvano	SW4027
Cast iron soil & waste vents	W. & V.	Vacuum Black	SW4032
Chilled hot water	C.H.W.	Galvano	SW4027
Air (steel pipe)	AIR	Galvano	SW4027
Air (copper pipe)	AIR	None	--
Vacuum (copper pipe)	VAC	None	--
Vacuum (steel pipe)	VAC	Galvano	SW4027
Roof leaders	R. L.	Galvano	SW4027
Soft water	S.W.	Pillar White	SW4029
De-mineralized water	D.W.	None	--
Distilled water	DIST. W.	None	--
Diesel fuel	D. FUEL	Galvano	SW4027
Nitrogen	NITROGEN	Galvano	SW4027
Elevator oil lines	E.O.L.	Galvano	SW4027
Muriatic acid	MUR. ACID	Galvano	SW4027
Sulfuric acid	SUL. ACID	Galvano	SW4027
Chromate or cooling tower additives	C.T.A.	Galvano	SW4027
Boiler treatment	B.T.	Galvano	SW4027
Gasoline	GASOLINE	Galvano	SW4027
Nitrous oxide (copper)	N. OXIDE	None	--
Caustic soda	C. SODA	Galvano	SW4027
Condensate pump discharge	COND. P. D.	Galvano	SW4027
Sump pump discharge	S. PUMP DIS.	Galvano	SW4027
Oxygen	OXYGEN	None	--
Fire suppression/sprinkler system	FIRE	Safety Red	SW4081
Ammonia	AMMONIA	Bolt Brown	SW4001
Glycol solutions	GLYCOL	Rotor Turquoise	SW4066
Freon – R500	FREON R-500	Junction Yellow	SW4033
Freon – R502	FREON R-502	Recycled Red	SW4073

Notes: *Color and number are from the Sherwin Williams System 4000 color selection guide dated 1999.

- A. Piping, whether exposed or concealed, shall be marked not less than every 15 linear feet and at the points where the piping passes through wall or floors.
- B. In mechanical rooms, piping shall be labeled every 10 feet. **(UK ONLY)**

4. PIPE PAINTING (REFER ALSO TO ARCHITECTURAL SECTION ON PAINTING)

A. GENERAL

- (1) All exposed piping installed shall be painted according to the color coding chart hereinafter specified.
- (2) “Concealed”, where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. “Exposed” shall mean that piping or equipment is not “concealed” as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered as “exposed”.

- (3) Paint all equipment and metal surfaces which are not factory finished (and all damaged or rusted surfaces) in high grade rust proofing machinery enamel. Pay particular attention to flanges, valves, unions, etc., where condensation may collect.
- (4) Paint exposed pipe (whether insulated or bare) and exposed surfaces (tanks, etc.).
- (5) All piping shall be painted in accordance with the following color coding chart.

PIPE ⁺	PIPE COLOR CODE ⁺	ABBREVIATION
Chilled Water Supply*	Green with Black Letters	C.W.S.
Chilled Water Return	Green with Black Letters	C.W.R.
Hot Water Supply*	Yellow with Black Letters	H.W.S.
Hot Water Return	Yellow with Black Letters	H.W.R.
Chilled/Hot Water Supply*	Green with Black Letters	C.H.W.S.
Chilled/Hot Water Return	Green with Black Letters	C.H.W.R.
Steam (Low, Medium & High Pressure)	Yellow with Black Letters	LPS, MPS, HPS
Condensate (Low, Medium & High Pressure)	Yellow with Black Letters	LPC, MPC, HPC
Domestic Cold Water	Green with Black Letters	D.C.W.
Domestic Hot Water	Yellow with Black Letters	D.H.W.
Recirculated Hot Water	Green with Black Letters	R.H.W.
Compressed Air	Blue with White Letters	C.A.
Natural Gas	Yellow with Black Letters	NAT. GAS
Propane Gas	Yellow with Black Letters	PROP. GAS
Fuel Oil (Supply, Return, Fill & Vent)	Yellow with Black Letters	FOS, FOR, FOF, FOV
Sanitary Sewer Piping	Green with Black Letters	SAN.
Sanitary Vent Piping	Green with Black Letters	VENT
Storm Sewer Piping	Green with Black Letters	STORM
Fire Protection Water	Red with White Letters	F.P.

* Includes pumps, air separator, valves, compression tanks, etc.

+ Where a pipe is not specifically identified in this table, painting and marking shall be in accordance with the most recent ANSI Standards.

- B. Water heaters, storage tanks, heat exchangers, etc., shall be painted light gray.
- C. All piping shall be marked. Piping shall be marked not less than every 15 linear feet above a ceiling system, every 10 feet in a mechanical room, and at all points where the piping passes through wall or floors.

OR

- (1) **Piping: (UK ONLY)**
All plumbing and mechanical piping must be color coded and labeled, including sprinkler lines, every 15 feet above a ceiling system and every 10 feet in an open mechanical room.

University of Kentucky Standard Color Coding for Mechanical Piping			
TYPE OF SERVICE	MARKINGS	COLOR	NO.*
High Pressure steam and	H.P.S. & H. P. R.	Safety Red	SW4081

return (over 76 psig)			
Medium pressure steam and return (21 psig to 75 psig)	M.P.S. & M. P. R.	International Orange	SW4082
Low pressure steam and return (0 psig to 20 psig)	L.P.S. & L. P. R.	Safety Orange	SW4083
Domestic cold water	D.C.W.	Safety Green	SW4085
Domestic hot water	D.H.W.	Green Byte	SW4076
Medium temperature hot water & return (300F or less)	M.T.H.W. & M.T.H.W.R.	Safety Yellow	SW4084
Reheat supply & return	R.S. & R.R.	Junction Yellow	SW4033
Chilled water supply & return	C.W.S. & C. W. R.	Safety Blue	SW4086
Condenser water supply & return	C.D.W.S. & C.D.W.R	Slate Gray	SW4026
Natural gas	GAS	Deck Red	SW4040
Safety valve vents	S.V.V.	Galvano	SW4027
Cast iron soil & waste vents	W. & V.	Vacuum Black	SW4032
Chilled hot water	C.H.W.	Galvano	SW4027
Air (steel pipe)	AIR	Galvano	SW4027
Air (copper pipe)	AIR	None	--
Vacuum (copper pipe)	VAC	None	--
Vacuum (steel pipe)	VAC	Galvano	SW4027
Roof leaders	R. L.	Galvano	SW4027
Soft water	S.W.	Pillar White	SW4029
De-mineralized water	D.W.	None	--
Distilled water	DIST. W.	None	--
Diesel fuel	D. FUEL	Galvano	SW4027
Nitrogen	NITROGEN	Galvano	SW4027
Elevator oil lines	E.O.L.	Galvano	SW4027
Muriatic acid	MUR. ACID	Galvano	SW4027
Sulfuric acid	SUL. ACID	Galvano	SW4027
Chromate or cooling tower additives	C.T.A.	Galvano	SW4027
Boiler treatment	B.T.	Galvano	SW4027
Gasoline	GASOLINE	Galvano	SW4027
Nitrous oxide (copper)	N. OXIDE	None	--
Caustic soda	C. SODA	Galvano	SW4027
Condensate pump discharge	COND. P. D.	Galvano	SW4027
Sump pump discharge	S. PUMP DIS.	Galvano	SW4027
Oxygen	OXYGEN	None	--
Fire suppression/sprinkler system	FIRE	Safety Red	SW4081
Ammonia	AMMONIA	Bolt Brown	SW4001
Glycol solutions	GLYCOL	Rotor Turquoise	SW4066
Freon – R500	FREON R-500	Junction Yellow	SW4033
Freon – R502	FREON R-502	Recycled Red	SW4073

Notes: *Color and number are from the Sherwin Williams System 4000 color selection guide dated 1999.

- A. Water heaters, storage tanks, heat exchangers, etc., shall be painted light gray.
- B. Piping, whether exposed or concealed, shall be marked not less than every 15 linear feet and at the points where the piping passes through wall or floors.
- C. In mechanical rooms, piping shall be labeled every 10 feet. **(UK ONLY)**

5. EQUIPMENT IDENTIFICATION

- A. All equipment, except in finished rooms, shall be identified by stenciling the title of the equipment as taken from the plans in a position that is clearly visible from the floor. The letters shall be made with black paint and shall be not less than two inches high. The titles shall be short and concise and abbreviations may be used as long as the meaning is clear. Lamacoid plates are also acceptable. In finished rooms or outdoors, equipment shall be identified by engraved nameplates.

6. DUCTWORK IDENTIFICATION

- A. All ductwork shall be identified as to the service of the duct and direction of flow. The letters shall be at least two inches high and the flow arrow shall be at least six inches long. The letters and flow arrow shall be made by precut stencils and black oil base paint with aerosol can. Concealed ducts need not be identified.

7. ACCESS THROUGH LAY-IN CEILINGS

- A. Mark the ceiling T-bar nearest the ceiling panel access to equipment, valves, damper, filter, duct heaters, etc., with a small red lamacoid plate with name of item above ceiling.

END OF SECTION 202400

SECTION 202500 - HANGERS, CLAMPS, ATTACHMENTS, ETC.**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Provisions - Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. Each Contractor's attention is also directed to Section 201300, Pipe, Pipe Fittings and Pipe Support.
- C. This section includes, but is not limited to, furnishing and installing dampers, supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work.
- D. Power driven anchors and expansion anchors shall be permitted only when permission is granted in writing by the Architect and Engineer.

2. MATERIALS AND EQUIPMENT

- A. Hangers, Clamps, Attachments, Etc.:

	SIZE	SPECIFICATION
1. Pipe Rings	2" pipe and smaller	Adjustable swivel split ring or split pipe ring, Grinnell Figures 104 and 108, Elcen, Fee & Mason, or approved equivalent.
2. Pipe Clevis	2-1/2" pipe and larger	Adjustable wrought Clevis type, Grinnell Figure 260, Elcen, Fee & Mason, or approved equivalent.
3. Pipe Clevis	All	Steel Clevis for insulated pipe, Elcen Figure 12A, Grinnell, Fee & Mason or approved equivalent.
4. Rise Clamps	All	Extension pipe or riser clamp, Grinnell Figure 261, Elcen, Fee & Mason or approved equivalent.
5. Beam Clamps and Attachments	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason, or approved equivalent. Malleable beam clamp with extension piece figure 229; I-beam clamp figure 131; C-clamp figures 83, 84, 85, 86, 87, and 88.
6. Brackets	All	Welded steel brackets medium weight, Grinnell Figure 195, Elcen, Fee & Mason or approved equivalent.

7. Concrete Inserts	All	Grinnell Figure numbers listed or, Elcen, Fee & Mason or approved equivalent. Wrought steel insert Figure 280 and wedge type insert Figure 281.
8. Concrete Fasteners	All	Self-drilling concrete inserts, Phillips, Grinnell, Elcen or approved equivalent.
9. Ceiling	All	Grinnell Figure numbers listed or Elcen, Fee & Mason, or approved equivalent. Pipe hanger flange Figure 153, adjustable swinging hanger flange Figure 155, ceiling flanges Figures 128 and 128R, and adjustable ceiling flange Figure 116.
10. Rod Attachments	All	Grinnell Figure numbers listed or Elcen, Fee & Mason, or approved equivalent. Extension piece Figure 157, rod coupling Figure 136, and forged steel turnbuckle Figure 230.
11. U-Bolts	All	Standard, U-bolt, Grinnell Figure 137, Elcen, Fee & Mason, or approved equivalent.
12. Welded Pipe Saddles	All	Pipe covering protection saddle sized for thickness of insulation, Grinnell Figure 186, Elcen, Fee & Mason or approved equivalent.
13. Pipe Roll	All	Adjustable swivel pipe roll, Grinnell Figure 174, Elcen, Fee & Mason, or approved equivalent.
14. Protection Saddle	All	18-gauge sheet metal pipe protection saddle, Elcen Figure 219, Fee & Mason, Power Strut, or approved equivalent.
15. Hanger Rods	All	Steel, diameter of the hanger threading, ASTM A-107.
16. Miscellaneous Steel	All	Steel angles, rods, bars, channels, etc., used in framing for supports and fabricated brackets, anchors, etc., shall conform to ASTM-A-7.
17. Concrete Channel Inserts	All	Continuous slot inserts, Unistrut, or approved equivalent. Heavy duty Series P-3200 or Light Duty Series P-3300 as required.
18. Adjustable Spot Insert	All	Adjustable spot insert Unistrut, or approved equivalent, P-3245. Design load 1000 lbs.

3. INSTALLATION

- A. Unless otherwise specifically indicated or hereinafter specified in the specifications, all supporting, hanging and anchoring of piping, ductwork, equipment, etc., shall be done by each trade as is necessary for completion of the work and shall be as directed in the following paragraphs:
- (1) Supporting and hanging shall be done so that excessive load will not be placed on any one hangers so as to allow for proper pitch and expansion of piping. Hangers and supports shall be placed as near as possible to joints, turns and branches.
 - (2) For concrete construction, utilize adjustable concrete inserts for fasteners. Expansion anchors and power-driven devices may be used when approved in writing by the Architect/Engineer. Utilize beam clamps for fastening to steel joists and beams and expansion anchors in masonry construction. When piping is run in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger.
 - (3) Trapeze hangers shall be supported by steel rods of sufficient diameter to support piping from joists or concrete construction. Where desired or required, piping may be double mounted on trapeze hangers. Where conditions permit, trapeze hangers may be surface mounted on exposed joists by means of approved beam clamps, or to concrete construction by means of approved adjustable inserts or expansion anchors.
 - (4) Install all miscellaneous steel other than designed building structural members as required to provide means of securing hangers, supports, etc., where piping does not pass directly below or cross steel joists.
 - (5) Piping shall not be supported by the equipment to which it is connected. Support all piping so as to remove any load or stress from the equipment.
 - (6) Where piping, etc., is run vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum and an approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.
 - (7) Where piping is run along walls, knee braced angle frames or pipe brackets with saddles, clamps, and rollers (where required) mounted on structural brackets fastened to walls or columns shall be used.
 - (8) Support all ceiling hung equipment, with approved vibration isolators.
 - (9) Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.
 - (10) Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.
 - (11) All insulated piping shall be supported with clevis type and/or pipe roll hangers. Hangers shall be sized to allow the pipe insulation to pass through the hangers. Install insulation protection saddles at all hanger locations. Welded pipe saddles shall be installed at all hangers on piping 5" and larger. The pipe saddles shall be sized for the thickness of insulation used. Hangers shall fit snugly around outside of insulation saddles.
 - (12) Under no conditions will perforated band iron or steel wire driven hangers be permitted.
 - (13) In general, support piping at the following spacing:

- a. Steel and copper piping - 5 feet intervals for piping $\frac{3}{4}$ " and smaller. 6 feet intervals for $1\frac{1}{4}$ " and 1" pipe. 8-foot intervals for piping $1\frac{1}{2}$ " to 3". 10-foot intervals piping $3\frac{1}{2}$ " and larger.
- b. Polyethylene piping – 4-foot intervals for piping 2" and smaller. 5-foot intervals for 3" pipe. 6-foot intervals for 4", 6", and 8" pipe. 7-foot intervals for 10" and larger pipe.
- c. PVC piping – 4-foot intervals for piping $1\frac{1}{2}$ " and smaller. 5-foot intervals for 2 and $2\frac{1}{2}$ " piping. 6-foot intervals for 3" pipe and larger.
- d. Where the manufacturer of the pipe has more strict guidelines, the manufacturer's recommendations shall be followed.

END OF SECTION 202500

SECTION 203100 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS**1. GENERAL**

- A. The General Conditions, Instructions to Bidders, Section 200100, and other Contract Documents are a part of this specification and shall be binding on all Mechanical Contractors. It shall be each Contractor's responsibility to apprise himself of all information pertinent to his work prior to submitting his proposal. No adjustments will be made in this Contract which is a result of failure to comply with this requirement.
- B. The Engineer, or his authorized representative, shall be notified by the Contractor twenty-four (24) hours in advance of any tests called for in these specifications or required by others. Any leaks or imperfections found shall be corrected and a new test run to the satisfaction of the Engineer or his authorized representative. Upon completion of a test, a written approval of that part of the work will be given to the Contractor. Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow his work to be furred-in. This written approval, however, does not relieve the Contractor of the responsibilities for any failure during the guarantee period. The expense of all tests shall be borne by the Contractor, along with all temporary equipment, materials, gauges, etc. required for tests.

2. PLUMBING

- A. Piping shall be tested before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory.
- B. Water piping systems shall be subjected to a hydrostatic test of one hundred fifty pounds. The system shall be proven tight after a twenty-four (24) hour test.
- C. The house drain line, interior storm sewers, interior rain water conductors, and all soil, waste and vent piping shall be subjected to a hydrostatic test of not less than a 10-foot head or an air test of not less than 5 lbs. per sq. inch using a mercury column gauge and shall hold for 15 minutes.
- D. Exterior sewer lines to the termination point outside the building shall be subject to a ten-foot hydrostatic test or an approved smoke test. These lines shall be subjected to a second test after 2 feet of backfill has been properly installed.
- E. After fixtures have been installed, the entire plumbing system, exclusive of the house sewer, shall be subjected to an air pressure test equivalent to one-inch water column and proven tight. The Contractor responsible shall furnish and install all of the test tees required, including those for isolating any portion of the system for tests.
- F. Thermometers and gauges shall be checked for accuracy. If instruments prove defective, they shall be replaced.
- G. The Contractor shall perform all additional tests that may be required by the Kentucky Department of Health or other governing agency.
- H. Set temperature control on water heaters and adjust tempering valves as required.
- I. Balance the water flow rate of each domestic hot water recirculating pump. Set the flow rate for each balancing valve in the recirculating hot water system. If flow rates are not indicated, contact the engineer for each balance valve GPM.
- J. Any leaks or imperfections found shall be corrected and a new test run until satisfactory results are obtained. The cost of repair or restoration of surfaces damaged by leaks in any system shall be borne by the Contractor.
- K. The compressed air system shall be tested for leaks for eight (8) hours at 250 PSI.

- L. The natural gas piping shall be tested in accordance with requirements and/or recommendations of the local gas company.
- M. Fuel oil piping shall be static tested at 250 PSI for eight (8) hours.

3. HEATING, VENTILATING AND AIR CONDITIONING
(Designer – If this is a state project, use the State's spec.)

- A. The test and balance of this system shall be by a contractor who employs only the services of a certified AABC or independent NEBB firm whose sole business is to perform test and balance services. The test and balance contractor shall report all deficiencies to the engineer.
- B. The Mechanical Contractor shall test all piping before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory. Water piping systems shall be subjected to a hydrostatic test of not less than one hundred pounds and shall be proven tight after a twenty-four (24) hour test.
- C. All motors, bearings, etc. shall be checked and lubricated as required during start-up procedures. All automatic, pressure regulating and control valves shall be adjusted. Excessive noise or vibration shall be eliminated. Provide all start-up documents to Designer prior to any test and balance services.
- D. System balancing, where required, shall be performed only by persons skilled in this work. The system shall be balanced as often as necessary to obtain desired system operation and results.
- E. All fan belts shall be adjusted for proper operation of fans.
- F. All deficiencies observed by the Test and Balance Contractor shall be reported immediately to the Engineer and Mechanical Contractor.
- G. For the purpose of placing the heating, ventilating and air conditioning system in operation according to design conditions and certifying same, final testing and balancing shall be performed in complete accordance with AABC Standards for Total System Balance, Volume Six (2002), for air and hydronic systems as published by the Associated Air Balance Council. The following systems shall be test and balance: **(Designer - Do you want an AABC contractor? Also edit below well.)**
 - (1) The supply, return and outside air duct systems associated with **(AHU-X Designer to edit accordingly)**. Provide static pressure profiles thru each system. Static pressure profiles shall include all sections from the return duct inlet and supply duct outlet of the air handling unit. Show accurate representation of return, relief, outdoor and economizer damper locations. On units equipped with return air fans; show location and profile of the return fan.
 - (2) Verify that the temperature control systems supply and return air flow stations on AHU-1 and AHU-2 air calibrated corrected. Test at 25%, 50%, 75% and 100% flow rated. **(Designer, not very often done, except VAV systems.)**
 - (3) AHU-1 and AHU-2 supply and return duct air leakage testing per Section 15130. **(Designer, only if you required leakage testing in 15130.)**
 - (4) Verify calibrations of the duct static pressure sensors for AHU-1 and AHU-2. **(Designer, not very often done, except VAV systems.)**
 - (5) The chilled water pumps and chilled water coils.
 - (6) The hot water pumps and hot water coils.

- (7) Set the minimum and maximum air flow rates for each VAV and CAV box.
 - (8) Balance all supply, return and exhaust air grille to within 10% of design air flow rate.
 - (9) Balance all supply, return and exhaust air grilles to within 5% for critical rooms such as operating rooms, ICU, L&D, Isolation, Nursery and Trauma.
 - (10) Balance all exhaust air fans and record inlet static pressure.
 - (11) Balance the kitchen range hood supply/exhaust air system.
 - (12) Balance domestic hot water return system including all balance valves and record settings and flows.
DELETE BELOW IF NO DUCT PRESSURE TESTING REQUIRED
 - (13) Pressure test ductwork if required by sheet metal specification section 231200.
 - (14) Provide pre-construction test information on the following systems (_____). Information required is existing AHU air flow rate and static pressure profiles. Determine CFM of each diffuser in project renovation area. Provide 15 duct static pressure measurements where requested by engineer. **(Designer – you need to determine when this paragraph is applicable and edit/make specific this paragraph as required.)**
 - (15) Adjust all adjustable diffusers to minimize air drafts and eliminate suspended light fixture sway. Furthermore, adjustable diffusers in spaces with ceilings taller than 9 feet shall be adjusted to eliminate air stratification during heating season.
- H. Provide a preliminary test report to the mechanical engineer immediately after the system is air balanced, or any initial phases are balanced. This report may be hand written. Anticipate visiting the site again after the engineer has reviewed the report. The engineer may request up to 15 additional static pressure measurements for any air handling system to help resolve any balancing deficiencies. Include five additional static pressure measurements for each exhaust air system. **(Note to designer, edit above as required.)**
 - I. The Test and Balance agency shall provide lifts, scaffolding, etc. as required to balance devices in areas with high ceilings such as gymnasiums, auditoriums, atriums, cupolas, etc. The Test and Balance agency may coordinate with the General Contractor or Mechanical Contractor to arrange for these items to be provided to access high devices, however, it is emphasized the Contractor is finally responsible for providing the means required to balance all devices.
 - J. Instruments used for testing and balancing of air and hydronic systems shall have been calibrated within a period of six months prior to balancing. All final test analysis reports shall include a letter of certification listing instrumentation used and last date of calibration.
 - K. Test and Balance agency is to provide sizing of fan or motor sheaves required for proper balance. The Mechanical Contractor will purchase and install all sheaves and belts as required. This includes new and existing equipment.
 - L. Four (4) copies of the complete test reports shall be submitted to the Consulting Engineer prior to final acceptance of the project. Preliminary test reports shall be submitted when requested.
 - M. The Contractor shall provide and coordinate their work in the following manner:
 - (1) Provide sufficient time before final completion date so that tests and balancing can be accomplished.
 - (2) Provide immediate labor and tools to make corrections when required without undue delay.

- N. The Contractor shall put all heating, ventilating and air conditioning systems and equipment and range hood system into full operation and shall continue the operation of same during each working day of testing and balancing.
- O. The test and balance contractor shall be present during the Engineer's final inspection of the building, or a separate project review date. The Engineer may request confirmation of the air balance report by asking for new measurements to be taken at that time. Any information in the test and balance report may be asked to be reconfirmed. **(Note to Designer - delete if not appropriate.)**
- P. Balance all water and air systems. Be sure to include:
 - (1) Domestic Hot Water Recirculating System.
- Q. Geothermal Balance
 - (1) Confirm flushing velocities (forward and backward) in geothermal well field.
 - (2) Confirm pressure drop values for each well field zone.
 - (3) Set flow rate for each well field zone.
 - (4) Submit report confirming above geothermal information to the Engineer prior to submission of final balance report.
- R. Automatic Flow Control Balance Valves
 - (1) Verify that each installed automatic flow control device matches the GPM indicated on the drawings.
 - (2) Verify that the actual pressure at each automatic flow control device is within the pressure limits specified by the valve manufacturer.

DESIGNER NOTE: FACILITIES COMMISSIONING GROUP CAN DO THE BUILDING PRESSURE TEST. BE SURE TO HAVE THE ARCHITECT/DD NOTES TO THEIR DRAWINGS INDICATING A BUILDING PRESSURE TEST IS REQUIRED. IF THERE IS A COMMISSIONING SPECIFICATION IT IS BETTER FOR THE AIR PRESSURE TEST TO BE IN THAT SECTION.

4. BUILDING AIR TIGHTNESS TEST

- A. The fan pressurization test to determine final compliance with the air tightness requirement shall be conducted when all components of the air barrier system have been installed and inspected, and have passed any intermediate testing procedures as detailed in the construction drawings and specifications. The test may be conducted before finishes that are not part of the air barrier system have been installed. For example, if suspended ceiling tile, interior gypsum board, or cladding systems are not part of the air barrier system, the test may be conducted before they are installed.
- B. Test Requirements
 - (1) The air leakage test must be performed in accordance with ASTM E 779 with the following additions and exceptions:
 - (2) The test consists of measuring the flow rates required to establish a minimum of 12 positive and 12 negative building pressures. The lowest test pressure shall be 0.1 in wg; the highest test pressure shall be 0.3 in wg; and there must be at least 0.1 in wg difference between the lowest and highest test pressures.

- (3) The test pressure must be measured in a representative location such that pressures in the extremities of the enclosure can be shown to not exceed 10% of the measured test pressure. At least 12 bias pressure readings must be taken across the envelope and averaged over at least 20 seconds each before and after the flow rate measurements. None of the bias pressure readings must exceed 30% of the minimum test pressure when testing in both directions.
- (4) Where it can be shown that it is impossible to test in both directions, then the building may be tested in the positive direction only, provided the bias pressure does not exceed 10% of the minimum test pressure.
- (5) The mean value of the air leakage flow rate calculated from measured data at 0.3 in wg must not exceed 0.25 CFM per square foot of envelope area. Measurements must be referenced at standard conditions of 14.696 PSI and 68F.
- (6) The test shall be conducted with ventilation fans and exhaust fans turned off and the outdoor air inlets and exhaust outlets sealed (by dampers or masking). The contractor must provide a responsible HVAC technician with the authority to place the HVAC system in the correct mode for the pressure test. The test technician must have unhindered access to mechanical rooms, air handlers, exhaust fans, and outdoor air and exhaust dampers.
- (7) The contractor must ensure that all windows in the enclosure are kept closed. Entry and exit through doors in the test enclosure must be prohibited during the test. Data collected while the pressures and flows are affected by a door opening and closing shall be discarded.
- (8) The testing agency is required to perform a diagnostic evaluation in accordance with ASTM E 1186, whether the building achieves the air tightness requirement or not. The diagnostic evaluation will assist the contractor and responsible parties in identifying and eliminating air leakage so the building meets the requirement upon retesting. The testing results will also be expressed in terms of the Equivalent Leakage Area (EqLA) at 0.3 in wg. The EqLA is the equivalent area of a flat plate that leaks the same amount as the building envelope at 0.3 in wg.
- (9) A report shall be provided to Engineer and Architect after the first Air Tightness Test and the first diagnostic evaluation. After corrective measures are taken by the appropriate subcontractors, a second and final test Air Tightness Test shall be provided by the testing agency. A diagnostic evaluation shall again be provided after the second Air Tightness Test, should the second Air Tightness test reveal the building still does not meet air tightness requirements.
- (10) Any subsequent testing and evaluation after the second Air Tightness Test and second diagnostic evaluation shall be considered additional scope, and the cost of which shall be paid by the responsible party.

5. FIRE PROTECTION SYSTEM

- A. Test in accord with local Fire Marshall requirements and/or requirements or recommendations of NFPA Regulations.

END OF SECTION 203100

SECTION 210100 - FIRE PROTECTION SYSTEM**1. GENERAL**

- A. The General Conditions, Instructions to Bidders, Section 200100, 1. A, and other Contract Documents are a part of this specification and shall be binding on the Contractor. It shall be the Contractor's responsibility to apprise himself of all information pertinent to his work prior to submitting his proposal. No adjustments will be made in this Contract which is a result of failure to comply with this requirement.
- B. No Contractor, other than those regularly engaged in the installation of approved and franchised automatic sprinkler systems, will be considered or approved for the work under this section of the specifications. Bidders must have had not less than five (5) years experience in the fabrication and erection of such systems: wet, dry and rack storage types, and shall have completed installations similar and equivalent in scope to this system under approval by one or more of the recognized Underwriting Associations in the Insurance Field.
- C. Before submitting bid, examine all Mechanical, Architectural, and Structural Drawings, visit the site and become acquainted with all conditions that may, in any way whatsoever, affect the execution of this work. Also, the Contractor shall coordinate with the rating bureau and insuring agency to verify adequacy of water supply for the proposed sprinkler system extension.
- D. The Contractor shall take his own measurements and be responsible for exact size and location of all openings required for installation of this work. Figured dimensions where indicated are reasonably accurate and should govern in setting out work. Detailed method of installation is not indicated. Where variations exist between described work and approved practice, the Engineer shall be consulted for directive.
- E. It is the intent of the Plans and Specifications to provide a general layout only and locate major equipment, piping, etc. Variations in head locations, pipe routing, etc., may be anticipated by the Contractor and shall be coordinated with all other trades and indicated on the drawings and descriptive literature called for hereinafter. It shall be the express responsibility of the Contractor to provide all required materials and equipment and perform all work required to install a complete and approved installation.
- F. All materials and methods shall be in accordance with applicable codes, regulations and/or ordinances and meet approval of local inspection authority and the State Fire Marshal. Also, all work shall comply with the latest editions of the National Board of Fire Underwriters, National Fire Protection Association, OSHA Regulations, the National Building Code, the Life Safety Code, IMC Code and the Southern Building Code (Where applicable). The local insuring agency shall review plans prepared and submitted by the Contractor but shall have no authority to make changes once work has begun.
- G. All work performed under this section shall be accomplished in close harmony with all other trades. All work not so coordinated shall be removed and reinstalled at the expense of the Contractor.
- H. The Contractor shall submit a proposed layout to the Engineer prior to submittal to the Fire Marshal's Office.

2. SCOPE OF WORK

- A. Furnish all material, labor, tools, equipment and supervision required for installation of a complete fire protection and stand pipe system as indicated on the project drawings. Include all necessary piping, sprinkler heads, test connections, valves, drains, cabinets, siamese connections, fire hydrants, fire pump, etc.
- B. The Contractor shall provide flushing and sterilization of all water lines in accordance with current Kentucky Plumbing Codes, Rules and Regulations and shall make connection to domestic water mains in accord with current rules and regulations of the State Department of Sanitary Engineering and Division of Water.

- C. Provide stand pipes with fire hose cabinets or fire valves as indicated or as required to meet the requirements of NFPA and the local fire authority.
- D. Provide sprinklers in attics, overhangs, awnings, cooler/freezers, in accessible spaces and all other areas required by NFPA and the local fire authority.
- E. Provide dry pipe systems or freeze proof heads as required to provide continuous coverage without freezing.

NOTE TO DESIGNER: DELETE SEISMIC REFERENCE IF NOT REQUIRED.

- F. Provide seismic restraints in accordance with the Seismic Restraint specification section 202600.

3. WATER SUPPLIES AND SYSTEM LAYOUT CRITERIA

- A. Where flow and pressure data are available, they are indicated on the project drawings. The Contractor shall independently verify all such information and notify the engineer of any discrepancies discovered prior to beginning the work. Where no flow information is indicated on the project drawings, the Contractor shall obtain it and indicate it on the shop drawing submittal. Piping systems shall be hydraulically sized based on the most conservative flow information obtained. No adjustments in the contract amount will be allowed for failure of the Contractor to obtain adequate flow information.

4. DRAWINGS AND DESCRIPTIVE LITERATURE

- A. The Contractor shall prepare and submit to the Engineers, seven (7) copies of detailed drawings indicating his proposed Automatic Sprinkler System. These drawings shall indicate minimally the following components when they are used in the system.
 - (1) Name and address of Owner, Architect and Engineers.
 - (2) Make and type of sprinkler heads (Catalog cuts).
 - (3) Make and type of fire department connection (Catalog cuts).
 - (4) Make and type of post indicator valve (Catalog cuts).
 - (5) Make and type of detector check valve (Catalog cuts).
 - (6) Make and type of electric alarm bell (Catalog cuts).
 - (7) Make and type of retard chamber (Catalog cuts).
 - (8) Make and type of dry pipe alarm valve (Catalog cuts).
 - (9) Make and type of flanged check valve (Catalog cuts).
 - (10) Make and type of flanged gate valve (Catalog cuts).
 - (11) Make and type of automatic drains (Catalog cuts).
 - (12) Make and type of pipe hangers (1 catalog cut of each make and/or type).
 - (13) Make, type and electrical characteristics of:
 - a. The pressure sensing switch*.
 - b. The post indicator supervisory switch*.
 - c. The main gate valve supervisory switch*.
 - d. The flow switch*.
 - e. Air compressor.
 - (14) Make and type of fire pump (Catalog cuts).
 - (15) Make and type of jockey pump (Catalog cuts).
 - (16) Make and type of supervised O.S & Y valve.
 - (17) Make and type of indicating butterfly valve.
 - (18) Make and type of fire hose cabinets.

- (19) Make and type of reduced pressure backflow preventer.

Note: All layouts and drawings are to be closely coordinated with the work of all other trades. The Engineers will, upon request, provide a complete set of Architectural, Structural, Mechanical and Electrical Plans and Specifications to aid the Contractor in this work.

*SPECIAL NOTE: 1) The items (indicated by asterisk) must be clearly coordinated with the Fire Alarm System supplier. 2) Supervisory switches located in wet locations (i.e., fire protection vault) shall be provided with NEMA 6 enclosures.

- (20) On a set of drawings to the same scale as the drawings accompanying these specifications, indicate:
- a. Each head location coordinated with lights, diffusers and other ceiling mounted device.
 - b. Location of all risers, mains, runout lines, etc.
 - c. Size of all risers, mains, runout lines, etc.
 - d. Location and type of pipe hangers.
 - e. All other information required by the Kentucky Department of Housing, Buildings and Construction.

The Contractor shall submit these drawings to the Engineer through the General Contractor/Construction Manager and Architect where applicable. The Contractor shall submit reviewed drawings to the Kentucky Department of Housing, Buildings and Construction for their review and approval. No work shall be done until drawings are approved by the Kentucky Department of HBC.

5. SYSTEM DRAINAGE

- A. The entire Standpipe and Sprinkler System (except that part which is below grade and will not freeze) shall be installed so as to allow 100% drainage.
- B. All sprinkler branch piping shall be installed so as to drain back to the main riser.
- C. Approved 2" drawoff piping shall be provided on sprinkler risers with discharge piping running to nearest floor drain or open air.
- D. Where sprinkler piping is trapped, an approved auxiliary draw-off shall be provided and neatly installed.
- E. All draw-offs shall have a metal tag labeled "Sprinkler Drain."

6. INSPECTIONS AND TESTS

- A. Furnish all labor, equipment and conduct all required tests in the presence of the Owner and Engineer or designated representative.
- B. All piping and devices comprising the fire protection system shall be tested under hydrostatic pressure of not less than 200 PSI and maintained for not less than two (2) hours.
- C. Upon completion of his work, the Contractor shall submit a written and signed certificate to the Engineers indicating that he performed the above prescribed tests and rectified all malfunctions arising there from.

7. PERMITS

- A. The Contractor shall obtain and pay for all necessary state, municipal, county, city and other permits and fees and pay all State taxes which are applicable.

8. GUARANTEE

- A. All workmanship, equipment and material shall be guaranteed in writing against defects from any cause, other than misuse, for a period of one year after date of final acceptance.

9. ACCEPTANCE CERTIFICATE

- A. Upon completion, the Contractor shall submit to the Engineers, a properly filled out "Sprinkler Contractor's Certificate Covering Materials and Tests." (4 copies).

10. CLEANING

- A. Upon completion of this work all debris, material, and equipment shall be removed from the building and premises; all piping shall be cleaned ready for finish painting. Note: Do not remove rust inhibitive primer specified hereinafter.

11. PAINTING

- A. All fire protection piping, fittings, etc., shall have one factory or shop coat of rust inhibitive primer. The Contractor shall thoroughly clean all such items in areas where the piping will be exposed so as to readily receive the finish coat specified in the Architectural Division of Painting. Colors shall be as specified in Identification Section of these specifications.

12. PIPE LAYING

- A. Bell holes shall be excavated accurately to size and barrel of pipe shall bear firmly on bottom of trench throughout its length. All foreign matter and dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying. At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe. Cutting of pipe, where necessary, shall be done in a neat and workmanlike manner, without damage to pipe. Refer also to Excavation.

13. EQUIPMENT AND MATERIALS

- A. Signs

Appropriate code approved and required signs shall be installed on all control valves, drains, inspector's test, etc., indicating the function, installation, etc. Signs shall be neatly affixed with rust inhibitive screws, rivets or where hung from piping; with stainless steel No. 14 AWG wire.

- B. Finish

All exposed materials such as valves, fire department connections, sprinkler heads, fire pump test headers, etc., shall be brass or chrome-plated brass.

- C. Check Valves

- (1) 2-1/2" and over; listed and approved by UL and FM; marked SV-FM; 175# working pressure; 1 BBM; flanged; equivalent to Mueller, Scott or Lunkenheimer.
- (2) 2" and under; 150# working pressure; bronze; screwed; equivalent to Jenkins, Scott or Lunkenheimer.

D. Pipe & Fittings

- (1) Nipples and fittings shall be of same material, composition, and weight classification as pipe in which installed.
- (2) Up to 2" (Interior) Schedule 40 ASTM A-53 black steel; 125# cast iron screwed fittings or Schedule 10, ASTM A-135 black steel with victaulic or similar type approved fittings.
- (3) 2-1/2" and larger (Interior) Schedule 40 black steel with flanged, welded or victaulic (or similar) type approved fittings or Schedule 10, ASTM A-135 black steel with victaulic or similar type approved fittings.
- (4) Blazemaster or approved equivalent CPVC SDR 13.5 pipe UL listed for fire protection use. CPVC is not allowed for dry pipe systems and is only allowed in light hazard occupancies. Piping must be installed in accordance with the manufacturer's recommendation and all governing bodies having jurisdiction.
- (5) Exterior: Class 200 PVC piping for exterior fire protection piping. Piping shall meet AWWA C900 requirements, be UL listed, Factory Mutual approved and NSF approved. Joints shall have spigot pipe ends with a flexible elastomeric ring seated in a groove to provide water tight seal. Minimum burst pressure to be 900 psi when tested in accordance with ASTM D1599. No. 8 copper wire (tracer wire) shall parallel all exterior PVC pipe.
- (6) Dry Pipe System Piping: Same as standard system except Schedule 10 piping is not acceptable.

E. Clamps and Anchors

- (1) Furnish and install approved clamps, as required, at all (45 degree) 1/8 bends, (90 degree) 1/4 bends and flange and spigot pieces to the straight pipe to ensure permanent anchorage of all fire lines. Clamps, clamp rods, nuts, washers, and glands shall be coated with a quick drying coal tar bituminous paint after installation.

F. Hangers

- (1) All piping shall be adequately and permanently supported in an approved manner on approved hangers (Submit with drawings).

G. Sleeves and Escutcheon Plates

- (1) Furnish and install sleeves for pipes where piping penetrates masonry walls; exterior wall sleeves to be watertight. Fire and smoke stop all penetrations through fire and smoke walls and coordinate with General Contractor for locations.
- (2) Furnish and install cast brass chrome plated split ring type escutcheons where piping penetrates walls, ceilings and floors, whether in finished areas or not.

H. Electric Wiring

- (1) All electric wiring for the system which may be required shall be installed in accordance with the National Board of Fire Underwriters, and National Electric Code. The cost of this electric wiring shall be included under this Contract. All electrical wiring and conduit installed in fire protection pits shall be sealed watertight.

I. Inspection Test Connections & Pressure Gauges

- (1) A 1" inspection test connection as required by the Kentucky Building Code. Discharge shall run to open air.
- (2) Control valve for test connection shall be installed not over 7' above the floor.
- (3) A pressure gauge at the inspection. Test connection at each location indicated on the Plans. Pressure gauges shall be 2-1/2" diameter and readable from the floor.

J. Gate Valves

- (1) 2-1/2" and over; listed and approved by UL and FM; marked SV-FM; 175# working pressure; 1 BBM; OS&Y; flanged; cast iron discs; bronze seat rings; four-point wedging mechanism; equivalent to Mueller, Scott or Lunkenheimer.
- (2) 2" and under; 150# working pressure; bronze; rising stem; screwed; bronze discs; bronze seat rings; two-point wedging mechanism; equivalent to Jenkins, Scott or Lunkenheimer.

K. Sprinkler Head Cabinet

- (1) Furnish and install a cabinet, clearly labeled, with four (4) sprinklers of each type complete with required wrenches. Locate as directed by Engineer. Label "Sprinkler Heads."

L. Fire Department Connection

- (1) Furnish and install a fire department connection with threads as approved by the local fire department; cast brass polished and chromium plated; with connection sizes and lettering as directed by the local authority having jurisdiction.

M. Fire Department Connection **(FOR FAYETTE COUNTY ONLY)**

- (1) Furnish and install a fire department connection with threads as approved by the local fire department; cast brass polished and chromium plated; with connection sizes and lettering as directed by the local authority having jurisdiction; Units shall be Acron Brass or equal single 4" nozzle, clapper, etc.

N. Fire Valve Cabinets

- (1) Manufacturer. The products specified hereunder shall be Crocker or equivalent by Larsen's Mfg. Co., J.L. Industries, Kidde, or other nationally recognized manufacturer of cabinets conforming closely to specification requirements.
- (2) Valve cabinets for recessed installation at all locations where shown shall be similar to Crocker Model No. 2700 with flat trim and clear glazed full glass door. Provide 18-gauge steel tub, 20-gauge steel door, 16-gauge steel frame, and white enamel finish interior with all exposed exterior portions painted with color selected by Architect.

- (3) Each cabinet shall be equipped with one 2-1/2" (or as required by the local authority) Fire Department valve with cap and chain. All connections and threads shall be as required by the local authority.

O. Fire Hose Valve

- (1) Manufacturer. The products specified hereunder shall be Crocker or equivalent by Elkhart, Central Sprinkler, Kidde, or other nationally recognized manufacturer of hose valves conforming closely to specification requirements. Valve shall be with cap and chain. All connections shall be 2½" or as required by the local authority.

P. Siamese Hose Connection (Delete "on roof" if not required)

- (1) Furnish and install on the fire protection pit and on the roof where required by the local authority a siamese hose connections with threads as approved by the local Fire Department. Unit shall be similar to Larsen's No. 15 sidewalk siamese, size: 2-1/2" x 2-1/2" x 6". Coordinate threads type with local Fire Department.

Q. Post Indicator Valve

- (1) Furnish and install a post indicator valve as required by the local authority. It shall be listed and approved by Underwriters Laboratories and Associated Factory Mutual Laboratories; Marked SV-FM; vertical; non-adjustable; with electric supervisory switch, handle, view window, brass padlock with (2) keys; gate valve to meet gate valve specifications, except to have non-rising stem and mechanical joint ends; equivalent to Mueller, Scott or Lunkenheimer.

R. Detector Check Valve

- (1) Furnish and install detector check valve as required by the local authority. It shall be listed and approved by Underwriter Laboratories and Associated Factory Mutual Laboratories; 175# working pressure; IBBM; flanged; with tapped bosses each side for by-pass meter trimming; equivalent to Viking, Badger or Grinnell.
- (2) The Contractor shall contact the servicing water company and ascertain their policy pertaining to the by-pass water meter; if not furnished by water company. The Contractor shall furnish and install the by-pass meter and trimming as detailed on the drawings.

S. Sprinkler Heads

Gem, Grinnell, Star, Viking, Reliable, Central or approved equivalent as follows:

- (1) Where piping is exposed: "Standard up right."
- (2) Where piping is concealed above finished ceilings, provide two pieces, semi recessed, white plated sprinkler heads with removable escutcheon.
- (3) Install sprinkler head guards where heads are subject to physical abuse. Heads located below seven (7) feet above floor, etc.

**EDIT BELOW IF FLEXIBLE SPRINKLER BRANCH PIPING IS NOT ALLOWED.
UK AND NKU DO NOT ALLOW THIS.**

- (4) Flexible Fire Protection Head Drops may be installed. Install in accordance with NFPA and manufacturer's requirements.

- (5) Sprinkler head degree ratings shall be determined by the area serviced in accord with current Codes and Standard Practices. Indicate degree ratings on submitted Shop Drawings.
- (6) The Contractor shall submit to the Engineer for inspection, one (1) sample of each type of sprinkler head, proposed to be used on the project.
- (7) Where heads are installed in a tile ceiling, they shall be installed in the middle of the tiles, at half or quarter points along the length of the tiles. Install sprinkler heads at quarter points of center scoured 2' X 4' ceiling tiles.
- (8) Provide high temperature heads around range hoods, kitchen equipment, kilns, boilers, water heaters and other heat producing equipment.
- (9) **KDMC Hospital and light hazard occupancies only** – Install quick response heads.

T. Air Compressor

- (1) Furnish and install an air compressor. Locate adjacent to the sprinkler entrance. Riser and air compressor sized as required for the proposed installation. Contractor shall submit sizing data for approval. Unit shall be ____V/ ____Ø/60. Mount on vibration isolation springs similar to and of equal quality as Mason Industries Type SLF spring mounts.

U. Water Motor Gong

- (1) Furnish and install a water motor gong.
Grinnell, Viking, Mueller or equivalent.

V. Retard Chamber

- (1) Same as water motor gong.

W. Flow Indicator Switches

- (1) Furnish and install flow indicator switches as required by NFPA 13. All flow indicator switches shall be UL approved. Coordinate with Fire Alarm System supplier/installer. Provide a set of dry contacts on each flow switch for interface to the Control System if this control point is specified in the Controls Section.

X. Tamper Switches for Water Shut-Off Valves

- (1) Furnish and install tamper switches where required by NFPA 13. All tamper switches shall be UL approved. Coordinate with fire alarm system supplier/installer. All tamper switches located in fire protection pits shall be waterproof, capable of operating beneath water similar to Potter PTS Series and be NFPA approved.

Y. Fire Hydrant

- (1) Furnish and install fire hydrants as approved by local Fire Department.

Z. Reduced Pressure Backflow Preventer

- (1) Refer to plumbing specialties section of these specifications.

AA. Preaction System

- (1) Provide a Single Interlocked Preaction cabinet with electric release containing all hydraulic and electrical components required for the control of a preaction system. The cabinet shall include the following:
- a. Self-contained unit (with control panel) in sturdy free-standing 14-gauge steel cabinet, measuring:
 - 1) 71"x36"x20" (180x91x51cm) for 1 ½", 2" & 3" systems
 - 2) 71"x46"x24" (180x117x61cm) for 4" & 6" systems
 - b. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base.
 - c. Two locked access doors to reduce front area required for opening, easily removable without tools to allow easy installation & servicing.
 - d. Individual access doors for the hydraulic and electrical sections and the emergency release (unlocked) with a neoprene gasket to avoid vibrations.
 - e. Deluge Valve, complete with Schedule 40 galvanized steel trim rated at 250 psi.
 - f. Integrated control panel, with emergency batteries in a top enclosure including a sprinklers storage rack.
 - g. Field wiring terminal strips integrated with the cabinet for connection of field wiring for detection system, audible devices, auxiliary contacts and power supply for air compressor.
 - h. Pressure gauges to indicate water supply pressure, priming water pressure and air pressure of the system.
 - i. Release trim with solenoid valve and each supervisory device required.
 - j. Schedule 40 steel pipe header with grooved ends to be connected to supply water.
 - k. Schedule 40 steel pipe drain manifold of 2" diameter for drain connections. Open drain cups in the cabinet and multiple drain manifolds will not be accepted.
- (2) The cabinet assembly must be pre-assembled, pre-wired and factory tested under ISO-9001 conditions. It shall also be c-UL-us Listed, FM and MEA Approved as an assembled unit.
- (3) Complete and functioning system shall meet all applicable codes, as listed below:
- a. NFPA 13 (Installation of Sprinkler Systems)
 - b. NFPA 25 (Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems)
 - c. NFPA 72 (Standard for the Installation, Maintenance, and Use of Protective Signaling Systems)

- d. NFPA 72E (Standard on Automatic Fire Detectors)
 - e. KBC (Kentucky Building Code)
 - f. National Building Code
 - g. National Fire Code
 - h. National Electrical Code
- (4) Provide a complete electrical detection system including: system tubing, wiring, smoke detectors, signaling devices and connections to auxiliary functions. Provide detection and alarm indicating devices (24 Vdc bell, horn or strobe) to be compatible with the release control panel. A bell or a horn should be provided near the cabinet.
- (5) Provide an internal air compressor as required for supervisory air. The air supply must be regulated and of the proper size in order to be able to restore normal system air pressure within 30 minutes. Size compressor as required for specific project. 120VAC, 60Hz. Air compressor and supervisory trim shall be factory installed inside the cabinet and adjusted for the required configuration.
- (6) Sprinkler heads for the preaction system shall be as allowed by NFPA 13 for preaction systems and as specified in these specifications.
- (7) The installation of the Preaction system must meet all established standards and be according to all applicable laws, regulations and codes. The proper operation and coordination for the system's installation, including the automatic sprinkler system, detection system, signaling system and initial start-ups are all under the responsibility of the contractor.
- (8) The contractor must plan and organize a training session of at least two hours for the building maintenance staff, in the presence of building owner or his representative. The training session must include the normal operation, emergency procedures and system maintenance.
- (9) Testing and Verifications of the system shall be as follows:
- a. Hydrostatic tests must be performed on the entire sprinkler piping system, as required by NFPA 13.
 - b. In addition to the standard hydrostatic test, an air pressure leakage test at 40 psi (2.8 bars) shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1 1/2 psi (0.1 bar) during the 24 hours shall be corrected.
 - c. A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to make sure that no back pressure in drain piping exists, which could affect the proper operation of the preaction system.
 - d. An air supply test must be performed, to confirm that normal air pressure can be restored within 30 minutes.
 - e. The verification of the fire alarm system must be done in accordance with the NFPA 72.
- (10) An inspection report and a certificate must be supplied to the engineer at the completion of the project. All tests results shall be registered in a booklet to be included with the inspection report.

(11) Acceptable Manufacturers: Reliable, Viking or Fire Flex.

14. GUARANTEE

- A. All workmanship, equipment and material shall be guaranteed in writing against defects from any cause, other than misuse, or vandalism, for a period of one year after date of final acceptance.

END OF SECTION 210100

SECTION 220100 - PLUMBING SPECIALTIES**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work specified in this section.
- B. The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the Kentucky Building Code.
- C. The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of his rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- D. Prior to final inspection, test by operation at least twice, all equipment.
- E. Prior to final inspection, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.
- F. All equipment and specialties shall be installed as recommended by the manufacturer in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost.
- G. All pipes, valves, fittings, fixtures, etc. for use in potable water systems 2" and below shall comply with federal lead-free requirements that the lead content of wetted surfaces cannot exceed 0.25% by weight.

EDIT BELOW (ALSO NOTE THIS ON PLAN)

- H. The Contractor shall raise or lower existing floor drains and/or clean outs to be flush with new floor surface.

2. DRAINAGE SPECIALTIES**A. GENERAL**

- (1) Provide all drainage specialties indicated, specified and/or required to provide complete and acceptable removal of all storm, sanitary, waste, laboratory waste, etc. from the building and into approved receptors.
- (2) Drainage specialties shall be on non-electrolytic conduction to the material to which they are connected.
- (3) Drainage specialties shall be installed in a manner so as to ensure no leakage of toxic or odorous gases or liquids and shall have traps and/or backflow preventers where required. Nor shall they allow backflow into other or existing systems.

B. CLEANOUTS - INTERIOR (CO)

- (1) In addition to cleanouts indicated, provide cleanouts in soil and waste piping and storm drainage at the following minimum locations:
 - a. At base of each stack.
 - b. At fifty (50) foot maximum intervals in horizontal lines.
 - c. At each change of direction of a horizontal line.
 - d. As required by current KBC.

- e. As required to permit rodding of entire system. (If in doubt, contact Engineers.)
- (2) Water closets, slop sinks and other fixtures with fixed traps shall not be accepted as cleanouts.
- (3) Cleanouts and/or test tees concealed in inaccessible pipe spaces, walls and other locations shall have an eight (8) inch by eight (8) inch (minimum) access panel or cover plates shall be set flush with finished floors and walls and shall be key or screw driver operable.
- (4) Access panels for cleanouts shall be of the Zurn, 1460 series or equivalent by Josam or Watts. They may, at the Contractor's option, be Perma-Coated steel, prepared to receive finish. The Contractor shall coordinate the finish of all access panels installed in finished areas with Architect.
- (5) Cleanouts and access panels shall be sized so as to permit the entry of a full sized rodding head capable of one hundred percent circumferential coverage of the line served.
- (6) Provide a non-hardening mixture of graphite and grease on threads of all screwed cleanouts during installation.
- (7) Do not install cleanouts against walls, partitions, etc. where rodding will be difficult or impossible. Extend past the obstruction.
- (8) In finished walls, floors, etc., ensure that cleanouts are installed flush with finished surfaces and, where required, grout or otherwise finish in a neat and workmanlike manner.
- (9) Cleanouts shall be as manufactured by Zurn, Josam, Jay R. Smith, Watts, MIFAB, Ancon or equivalent, similar to the following:
 - a. Zurn, Z-1440 cleanouts or Z-1445 cleanout tee at base of exposed stack and at change in direction of exposed lines.
 - b. Zurn, Z-1440 cleanout or Z-1445-1 cleanout tee where stacks are concealed in finished walls
 - c. Zurn, ZN-1400-T cleanout with square scoriated top in finished concrete and masonry tile floors.
 - d. Zurn, ZN-1400-Tx cleanout with square recessed top for tile in vinyl and linoleum finished floors.
 - e. Zurn, ZN-1400-Z cleanout with round recessed top for terrazzo floors.
 - f. Zurn, Z-1400-HD cleanout with tractor cover for exterior locations. Provide concrete supporting pad crowned to shed water. Refer to drawings for pad size.
 - g. Mueller, No. D-731 or D-714, Nibco, Flage or equivalent for cleanouts in copper waste with cover plates and/or access panels listed for other cleanouts.
 - h. Threaded hex head type cleanouts of same materials as pipe for piping 2" and smaller.
 - i. Zurn, cleanout with round top with adjustable retainer for carpet area. Install flush with carpet.

C. FLOOR DRAINS

- (1) Provide floor drains at locations indicated and/or as required by Kentucky Building Code. Install in a neat and workmanlike manner. Coordinate locations with appropriate persons or party to ensure floor pitch to drain where required.

- (2) Install floor drains in strict accordance with manufacturer's recommendations and the KBC unless otherwise indicated.
- (3) Each floor drain located on floors above the lowest floor shall be provided complete with a three (3) foot by three (3) foot, four (4) pound sheet lead flashing and clamping collar or chlorinated polyethylene shower pan liner of 30 mil. Lead pans shall be given a heavy coat of asphaltum on bottom and sides before installation and a heavy coat on exposed surfaces (if any). After installation, provide one ply of fifteen (15) pound roofing felt beneath each pan.
- (4) Ensure by coordination with the appropriate persons or party that spaces served by a floor drain(s) has a water seal extending at least three (3) inches from the floor of the space served on all floors above the lowest level.
- (5) The floor drains shall be Zurn, Josam, Watts, Jay R. Smith, MIFAB, Sioux Chief or equivalent, similar to the following:
 - a. FD-1 - Zurn, Z-415 with 6" X 6" top, Type "S" strainer. Provide with trap primer connection.
 - b. FD-2 - Zurn, ZN-610 with 12" X 12" locking grate, secondary strainer, sediment bucket, and galvanized cast iron construction with trap primer connection.
 - c. FD-3 - Zurn, Z415 with Type "E" strainer with 4" diameter funnel. Provide with trap primer connection.

D. TRAP PRIMERS

Provide trap primers for all floor drains and open receptacle. Acceptable Trap Primer Manufacturers included Zurn, Precision Plumbing Products and Sioux Chief. Trap Primer selection shall be as follows:

(1) Trap Primer Type-1 (TP-1)

Precision Plumbing Products Prime-Time or equal electronic trap priming manifold, with atmospheric vacuum breaker, pre-set 24-hour clock, manual override switch, 120-volt solenoid valve with 120v/3wire connection. Provide in 12" x 12" x 4" surface mounted metal cabinet. Provide with 10-opening manifold, un-used manifold opening shall be capped. Install unit as required by manufacturer.

(2) Trap Primer Type-2 (TP-2)

Precision plumbing products Prime-Rite or equal trap primer shall be installed on a cold-water line, with distribution unit(s) to serve 1 to 8 drains. Install per manufacturer's recommendations.

(3) Trap Primer Type-3 (TP-3)

Zurn Z-1022 or equal trap primer shall be installed in cold water supply line of nearest plumbing fixture. One trap primer per floor drain, one trap primer per fixture. Pipe to waste inlet per manufacturer's recommendations.

E. CLEANOUTS (EXTERIOR) (ECO)

Provide exterior cleanouts at each location indicated and in the manner indicated. Permanently set all exterior cleanouts centered in a 30" X 30" X 6" deep concrete pad. The top of the concrete pad shall be flush with finished grade. The top of the cleanout box shall be flush with the top of the pad and shall be stamped "CO."

F. ROOF DRAINS

- (1) Each drain shall be provided complete with a three (3) foot by three (3) foot, four (4) pound sheet lead flashing and clamping collar. Roof drains shall be installed in strict accordance with the drain manufacturers and roofing manufacturer's instructions. Provide all accessories required for a complete installation.
- (2) RD-1, Zurn, Z-100 15", or equivalent, diameter roof drain, dura-coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette cast iron dome. Provide with any accessories needed for installation in roof specified by Architect and as recommended by the roofing manufacturer.
- (3) RD-2 (Overflow Roof Drain with external water dam) Zurn, Z-100-89, or equivalent, 15" diameter roof drain, dura-coated cast iron body with 2" high combination membrane flashing clamp/gravel guard and low silhouette cast iron dome. Provide with any accessories for installation in roof specified by the Architect and as recommended by the roofing manufacturer.

G. HEADWALLS (HW)

Provide at the locations indicated and/or as required by Federal, State and/or local codes, rules, regulations, standards and/or requirements, headwalls of the type required or indicated. Install as prescribed by local authority or as indicated, whichever is superior.

H. VARMINT GUARDS

Provide at each live discharge and/or culvert discharge (where culvert exceeds 30 linear feet in length) and where the line has a surface opening greater than one-half (2) square feet, a three (3) inch mesh steel varmint guard made up with frame and 3/8-inch minimum steel rods welded together and affixed tightly into the end of the open pipe.

3. WATER SUPPLY SPECIALTIES**A. GENERAL**

- (1) Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in a neat and workmanlike manner in accordance with the manufacturer's recommendations and the KBC.
- (2) Where required by the KBC, install code approved vacuum breakers in each water supply specialty.

B. FREEZEPROOF WALL HYDRANTS (FPWH)

- (1) Provide code approved wall hydrants at each location indicated in a neat and workmanlike manner. Affix tight to walls and ensure that the feed piping is on the heated side of the building insulation blanket.
- (2) Where hydrants are of handwheel type, remove handwheels and turn over to owners in an envelope labeled "Wall Hydrants" exterior upon completion of the project.
- (3) Where hydrants have key operators, turn over at least two (2) keys in an envelope labeled "Wall Hydrants" to owners upon completion of the project.
- (4) Where hydrants have lockable boxes, turn over at least two (2) keys in an envelope labeled "Wall Hydrants, Exterior" to owners upon completion of project.

- (5) Mount all wall hydrants at least twenty (20) inches above finished exterior grade. Where this is not possible or practical, contact Engineers.
- (6) Wall hydrants shall be as follows or equivalent:
 - a. Zurn 1300 or equivalent, 3/4", encased, flush, non-freeze wall hydrant with key lock and combination backflow preventer/vacuum breaker.

C. HOSE BIBBS (HB)

- (1) Provide code approved hose bibbs with vacuum breakers and male threaded spouts at each location indicated and as follows:
- (2) Do not install hose bibbs spaces which do not have existing planned or installed floor drains even if sill cocks are indicated for these areas.
- (3) Hose bibbs shall be mounted at eighteen (18) inches above finished floor served.
- (4) The hose bibb shall be Zurn or equivalent similar to the following:
 - a. Zurn Z1350-VB Model. Encased moderate climate wall hydrant for narrow wall installation. Complete with bronze body, all bronze interior parts, replaceable seat washer, screwdriver operated stop valve in supply, key operated control valve, and 3/4 [19] IP female inlet and 3/4 [19] male hose connection standard. Adjustable stainless-steel box furnished with hinged cover, cylinder lock and "WATER" stamped on cover. Provide with 3/4 adapter vacuum breaker.

D. BOILER DRAINS (BD)

Install 3/4-inch bronze body boiler drains, similar and equivalent to Nibco, No. 72 or 73, as indicated and at the following locations:

- (1) At the low point of the plumbing system.
- (2) On boiler low point.
- (3) In each hot water heater and/or storage tank.
- (4) At the low point of each hydronic system.
- (5) On the water refrigeration machine (100 percent drainage).
- (6) On each water storage tank.
- (7) At each pump suction.
- (8) At the low point of each isolatable section of any system carrying water.

NOTE: Install a code approved vacuum breaker where installation on to domestic water system.

- E. WATER HAMMER ARRESTORS (WHA): Provide water hammer arrestors at each location indicated and/or as required to eliminate hydrostatic on the domestic water system. Provide at least one water hammer arrestor at all quick acting valve locations including:

Automatic Clothes Washers – Type “A”

Commercial Dishwashers – Type “B”

Sterilizers – Type “B”

Mop Basins (downstream of check valve) – Type “A”

Flush valve fixtures - Type “B” (Each toilet room with 1-3 flush valve fixtures shall have its own Type “B” water hammer arrestor.)

- (1) Multiple Fixtures – Branch Line Less Than 20’ Long: The preferred location for a Zurn Shoktrol is at the end of the branch line between the last two fixtures when the branch lines do not exceed 20’ in length, from the start of the horizontal branch line to the last fixture supply on this line.
- (2) Multiple Fixtures – Branch Line More Than 20’ Long: On branch lines over 20’ in length, use two Shoktrols whose capacities total the requirement of the branch. Locate one unit between the last and next to last fixture and the other unit approximately midway between the fixtures.
- (3) Water hammer arrestors shall be Zurn, Z-1700, Shoktrol, Smith, Josam, Wade, or equivalent. Water hammer arrestors shall be stainless steel, bellows type. Field fabricated capped cylinders shall not be acceptable.
- (4) Note: Provide insulation unions where arrestors are of dissimilar material from the piping served (unless piping is non-conducting, such as ABS or PVC).

MARK	MANUFACTURER & MODEL	SIZE	P.D.I. SIZE
TYPE "A"	ZURN, Z-1700 # 100	1-11	A
TYPE "B"	ZURN, Z-1700 # 200	12-32	B
TYPE "C"	ZURN, Z-1700 # 300	33-60	C
TYPE "D"	ZURN, Z-1700 # 400	61-113	D

F. PRESSURE REDUCING VALVES (PRV)

Install at each location indicated and/or as required to reduce domestic building water service to a maximum of eighty (80) PSIG code approved pressure reducing stations with by-pass. Install in a manner indicated or as required. Provide unions and stops for removal of station. PRV shall be adjustable from thirty (30) percent above or below reduced pressure. Where this cannot be attained with single stage, provide multi-staged reduction.

G. REDUCED PRESSURE BACKFLOW PREVENTERS (RPBP)

Watts #909 or equivalent reduced pressure backflow preventer. Provide with gate valves for isolation, FDA food grade strainer and air gap fitting. RPBP shall be UL listed.

H. DOUBLE CHECK VALVE ASSEMBLY

Watts #709, Watts #757, or equivalent double check valve assembly. Provide with FDA approved food grade strainer and gate valves for isolation. Assembly shall be UL listed.

Designer Note: Designer to review use of Watts #757 with local utility.

I. DOMESTIC HOT WATER HEAT TRACE

(1) General

Furnish and install a U.L. listed system of electric self-regulating heating cable and components for maintaining the water temperature in the domestic hot water lines as indicated on drawings. Domestic hot water temperature maintenance system shall be a Raychem Hwat-Plus system, Thermon, Nelson or Bylin. Contractor shall provide power connection kits, splice connection kits, tee connection kits, end seal kits, glass tape, electric traced labels, cables, ground fault protection device, junction boxes and all other electrical and mechanical components required to install a complete and working system that shall maintain the domestic water temperature as listed on the drawings. Install the system per manufacturer's installation recommendations. The Contractor furnishing and installing the system shall coordinate with the Electrical Contractor to ensure of all electrical requirements have been identified and shall have the electrician provide power to all circuits of the heat trace system. System shall be tested by vendor by a 2500-volt Meggar test with a minimum of 20 megaohms prior to insulation. The Contractor shall inform the Engineer 7 days prior to this test. Provide insulation and insulation size per manufacturer's recommendations.

(2) Cable

Heating cable shall have a polyolefin color coded outer jacket, tinned copper braid, polymer coated aluminum wrap, radiation cross-linked polyolefin coated insulating jacket, bus wires, radiation cross-linked, self-regulating conductive core.

(3) Over-site & Warrantee

The cable shall have a 10-year product defect warrantee. The complete installation shall have a 2 years parts and labor warrantee. The heat trace manufacturer shall inspect the heat trace application on site prior to insulation installation.

(4) Insulation

The cable manufacturer shall oversee the insulation of the heat traced piping to ensure the correct thickness of insulation is installed. The supplier shall specify the insulation thicknesses.

(5) Performance

The entire heat traced hot water system shall maintain the temperatures indicated plus or minus 5°F.

(6) Labels

Provide permanent markers on the heat traced piping as indicated elsewhere in the specifications to identify the piping as "Heat Traced."

(7) Power

V/1Ø. Provide 30mA ground fault protection or as required by the manufacturer.

(8) Extent of Tracing

Heat trace all piping to the point where the piping drops in the wall to the fixture or to a point that hot water is available at the fixture within 5 seconds.

(9) Factory Installation

All heating cable, fittings and accessories shall be installed with a factory representative's assistance.

4. GENERAL SPECIALTIES

A. VACUUM BREAKERS AND BACK FLOW PREVENTERS

Where required by the KBC, whether indicated or not, provide approved vacuum breakers or backflow preventers at the following locations.

- (1) Where domestic water system connects to fire protection system.
- (2) Where domestic water system connects to hydronic system.
- (3) At any hose (threaded) tap on the domestic water system.

B. ROOF FLASHINGS

All plumbing vents or other plumbing passing thru the roof shall be flashed as approved by the KBC and as recommended by the roofing manufacturer and/or Contractor.

C. GAS PRESSURE REGULATORS

Provide gas pressure regulators for all gas fired equipment that requires a lower pressure than what is delivered to the appliance. Regulators shall be installed in accordance with the requirements of NFPA 54 and/or International Fuel Gas Code, whichever is more stringent.

END OF SECTION 220100

SECTION 220200 - PLUMBING FIXTURES, FITTINGS AND TRIM**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. The Contractor shall provide all fixtures complete with trim required and connect in a manner conforming to the State Plumbing Code.
- C. The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of his rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- D. All exposed piping or in casework below sinks, stops, traps, tailpieces, etc., shall be code approved chrome plated brass unless otherwise indicated or specified. Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws.
- E. All fittings, fixtures and trim shall be new unless otherwise indicated or specified. They shall also be of equivalent quality, dimensions, material, etc. as those specified. All faucets, shower heads, drains, levers, trim, etc. shall be constructed of metal and not plastic.
- F. Handicapped fixtures shall be mounted as recommended by the KBC and ADA.
- G. All fixtures shall be mounted as recommended by the manufacturer. Fixtures shall be rigidly mounted to walls and floors. Pay particular attention to flush valves and bracket concealed portion to building structure during rough-in. Loose, shaky flush valves, lavatories, etc. shall not be acceptable.
- H. Prior to final inspection open all faucets and allow to run for fifteen (15) minutes, then remove all faucet aerators and thoroughly clean until smooth flow is obtained.
- I. Prior to final inspection, test by operation at least twice:
 - (1) (Where applicable) adequate flow of hot and/or cold water at;
 - a. Shower Heads
 - b. All Faucets
 - c. Flush Valves and Tanks
 - d. Tub Drains
 - e. Hose Bibbs
 - f. Sill Cocks
 - g. All Other Valved Hot and/or Cold-Water Openings in the Plumbing System
 - (2) All toilet seats
 - (3) All flush tank overflows
- J. Prior to final inspection, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from plumbing fixtures and thoroughly clean same.

- K. All sink and lavatory traps shall have screw in plugs in the bottom for ease of cleaning and have mechanical fittings for ease of removal.
- L. All fixtures shall be set level and true and shall be grouted into finished walls, floors, etc. in a neat and workmanlike manner with an approved waterproof non-yellowing grout for such service.
- M. Special Note for Handicap Grab Rails: Coordinate top of shower valves, flush valves, flush tank, etc., with location of grab rails as shown on the architectural plans. The Contractor shall install all items to allow for installation, removal and service without removal of the grab bar.
- N. All exposed drain pipes and domestic water piping under handicap accessible sinks and lavatories shall be insulated in accordance with ADA requirements and shall have a vinyl plastic covering over all insulation.
- O. The Contractor shall obtain a copy of the casework shop drawings and confirm sinks, faucets, gas turrets, etc., will fit in the space provided. Additionally, in ADA applications with handicap sink base cabinets, the Contractor shall limit the total distance from the bottom of the sink to the bottom of the P-trap and coordinate waste pipe rough-in height to ensure the proper installation of the handicap sink base cabinet front closure panel. The Contractor shall not order sinks until he confirms no conflicts occur and shall adjust sink sizes if required. If the Contractor orders sinks, faucets, etc., that do not fit in the casework supplied, he shall replace them at no additional cost.
- P. All lavatories, sinks, etc. shall be supplied with center rear drain outlets where necessary to avoid conflict with casework, handicapped kneeboards, etc. If the Contractor orders sinks that do not fit in the casework supplied, he shall replace them at no additional cost.
- Q. All single supply faucets shall be provided with mechanical mixing valves unless otherwise noted. Mechanical mixing valves shall have hot and cold-water inlet connections, common outlet, in-line check valves, and adjustable temperature setting. Mixing valves shall be Moen model 104424 or equal. Provide one mixing valve per single supply faucet unless otherwise noted. Contractor shall provide all required connections and set mixing valve to required temperature.
- R. All gooseneck faucets shall have rigid spouts, unless swing spouts are specified. If swing spouts are specified, the spout shall have a maximum swing of 140 degrees from side to side.
- S. All plumbing fixtures shall comply with federal lead-free requirements that the lead content of wetted surfaces cannot exceed 0.25% by weight.
- T. All water closet handles on ADA water closets shall be located on the approach side of the fixture.

2. FIXTURES AND TRIM

Available Manufacturers: Subject to compliance with requirements of manufacturers offering plumbing fixtures and trim. Plumbing fixtures and trim, which may be incorporated in the work include, but are not limited to, the following:

- A. Plumbing Fixtures - Water Closet, Lavatory, Urinal, Bathtubs, Clinical Sink and Scrub Sink

American Standard, U.S. Plumbing Products
 Eljer Plumbingware Div., Wallace-Murray Corp.
 Kohler Co.
 Crane Plumbing
 Universal-Rundle
 Toto

- Zurn Co.
- Sloan Fixtures

- B. Plumbing Trim
 - American Standard, U.S. Plumbing Products
 - Chicago Faucet Co.
 - Kohler Co.
 - Delta Co.
 - T&S Brass & Bronze Work Co. (Commercial)
 - Zurn Co.
 - Just Co.
 - Speakman Co.
 - Moen Commercial

- C. Flush Valves
 - Delany Co.
 - Sloan Valve Co.
 - Zurn Co.
 - American Standard

- D. Fixture Seats
 - Bemis Mfg. Co.
 - Church Seat Co.
 - Olsonite Corp., Olsonite Seats

- E. Water Coolers
 - Elkay Mfg. Co.
 - Halsey Taylor Div., King-Sealey Thermos Co.
 - Haws Drinking Faucet Co.
 - Western Drinking Fountains, Div. of Sunroc Corp.
 - Oasis Co.
 - Acorn AQUA

* Acceptable wall hung water coolers shall be equal to Oasis P8AM, Elkay EZS8 or Halsey Taylor HAC8FS. All other wall hung water coolers shall be subject to review of the Engineer.

- F. Service Sinks and Mop Basins
 - American Standard, U.S. Plumbing Products
 - Eljer Plumbingware Div., Wallace-Murray Corp.
 - Fiat Products
 - Kohler Co.
 - Stern-Williams Co., Inc.
 - Florestone

- G. Stainless Steel Sink
 - Elkay Mfg. Co.
 - Just Mfg. Co.

- Moen, Div. of Stanadyne/Western
Sterling Co.
- H. Fixture Carriers
- Josam Mfg. Co.
Jay R. Smith
Tyler Pipe
Zurn Industries
Watts
- I. Shower
- Bradley Co.
Zurn Co.
Symmons Industries, Inc.
Chicago Faucets
Speakman Company
Powers
Acorn Co.
Moen Commercial
- J. Shower Stalls
- Clarion
Universal-Rundle
Aqua Bath
Aquarius
Aqua Glass
Acryline
Lasco Bathware
- K. Canwash
- Zurn Industries
Murdock
Woodford
Watts
- L. Washer/Dryer Connection Box
- Guy Gray Co.
Wolverine Brass, Inc.
- M. Wash Fountain
- Bradley Co.
Acorn Co.
Intersan
Willoughby
- N. Shampoo Sink

- Belvedere
- O. Care Ware - Swingette, Swivette
- Bradley Co.
Acorn Co.
White Hall Co.
- P. Penal Ware
- Bradley Co.
Acorn Co.
Willoughby
- Q. Emergency Fixtures - Eyewash, Showers
- Bradley Co.
Speakman Co.
Guardian Co.
- R. P-Trap Insulation Kit (Trap Wrap)
- Truebro
Brocar
Plumberex

Note: Kitchen, Lab, Science Room Fixtures, Special Equipment, Etc.

Contractor to provide final plumbing connections to all of the equipment furnished by Owner including, but not limited to: chrome supplies, stops, continuous drains, drain tailpiece, Kentucky Code "P" traps and escutcheons.

3. FIXTURE SELECTION

- A. Refer to drawings for fixture schedule.

END OF SECTION 220200

SECTION 220300 - PLUMBING EQUIPMENT**1. GENERAL**

- A. All plumbing equipment shall comply with the latest provisions of KBC.
- B. Provide magnesium anodes for water heaters and storage tanks.

2. WATER HEATER

- A. Lochinvar ETA120KK, A.O. Smith or equivalent electric water heater; 120-gallon storage; copper sheathed tin coated elements (75 watt/sq. in. maximum density); glass lined tank; foam insulation; magnesium anode rod; automatic over-heat control; enameled steel jacket; (2) 4.5 KW elements wired for non-simultaneous operation; upper and lower thermostat; 240/1/60; with ASME temperature and pressure relief valve; set temperature at 105°F.

3. EXPANSION TANK (DOMESTIC WATER)

- A. Amtrol Therm-X-Trol ST-25V expansion tank, 10.3-gallon tank volume, pre-charged air chamber, stainless steel connection and heavy-duty butyl diaphragm.

4. SUMP PUMPS

- A. Weil, Zoeller, or approved equivalent 1-1/4" submersible sump pump, 5 GPM at 24 ft. TDH, 1750 RPM, 1/3 HP, 115-volt single phase. Furnish with mercury switch level control. Provide with light duty iron grate to cover sump pit opening, completely.

5. RECIRCULATING DOMESTIC HOT WATER PUMPS

- A. Thrush, Armstrong, Bell and Gossett or approved equivalent all bronze in-line centrifugal circulating pump with mechanical seals, drip proof motor and all required overloads, starters and disconnects.

END OF SECTION 220300

SECTION 220500 - COMPRESSED AIR SYSTEM**1. GENERAL**

- A. The Contractor shall provide and install in strict compliance with all applicable codes and regulations and with manufacturer's recommendations, all components for complete and functional compressed air systems as shown on the drawings or as specified, herein, including, but not necessarily limited to the following:
- (1) Air Compressors, receivers, after cooler and all required appurtenances, connections, etc.
 - (2) Filters, regulators, valves and quick disconnects.
 - (3) Compressed air piping.
 - (4) Test systems and perform initial equipment starts.
 - (5) Flexible pipe connections and vibration isolators.

2. EQUIPMENT**A. AIR COMPRESSOR AC/1**

- (1) Provide a packaged compressed air system as manufactured by Ingersoll-Rand, Quincy, Gardner-Denver, Kellogg-American or approved equivalent. Basic system shall consist of a two-stage, packaged air-cooled compressor with motor, storage tank, air dryer, controls and filters. The intent of this specification is to provide a complete compressed air system, either factory or field assembled, ready for connection to power and air piping.
- (2) System shall be equivalent to an Ingersoll-Rand, Model No. T-30. Compressor motor shall be 5 HP, 208V/3Ø/60 HZ. ASME approved receiver shall be designed for 150 PSIG and 80-gallon size.
- (3) Compressor shall be two-stage and deliver 19.7 CFM at 150 PSIG. Controls shall be automatic start-stop.
- (4) Accessories shall be compatible with the compressor as specified above and shall include:
 - a. A dry type filter silencer.
 - b. An automatic condensate drain valve mounted on the receiver.
 - c. An air-cooled after cooler.
 - d. A totally enclosed belt guard.
 - e. Compressor mounted magnetic motor starting switches.
 - f. Provide on the discharge side of the receiver, an Ingersoll-Rand, Filter and an automatic drain valve.
 - g. Air Pressure Gauge
- (5) Provide on the discharge side of the filter, line size flexible metallic hoses.
- (6) Mount compressor on floating inertia base filled with concrete. Base shall be equal in quality to type BMK manufactured by Mason Industries. Base shall be mounted on vibration isolation springs similar to type SLF manufactured by Mason Industries.

B. COMPRESSED AIR PIPING

Schedule 40 black steel with screwed fittings. See Section, Pipe, Pipe Fittings and Pipe Support for additional requirements.

C. COMPRESSED AIR FILTERS - REGULATORS

Near the bottom of all compressed air drops, provide a filter-regulator.

D. COMPRESSED AIR REGULATORS

Regulators shall be DeVilbis, Type HLG, Binks, Schrader, Ingersoll-Rand or approved equivalent. Provide a pressure gauge downstream of each regulator.

E. QUICK DISCONNECTS

Quick disconnects shall be provided on the bottom of all 1/2" compressed air drops designated on the drawings. Disconnects shall be coordinated with Owner to match Owner's requirements.

F. SHUT-OFF COCKS

Provide shut-off cocks for each compressed air drops.

G. FLEXIBLE CONNECTORS

Provide flexible connectors in line with the quick disconnects. Flexible connectors shall be Ingersoll-Rand, Model No. MTHSS050-12, stainless steel "vibraflexor" Mason or approved equivalent. Flexible connectors shall be 1/2" I.P.T. and 12" long.

END OF SECTION 220500

SECTION 230100 - PUMPS

1. GENERAL

- A. The Contractor's attention is directed to the General and Special Conditions, General Provisions - Mechanical and to all other contract Documents as they apply to this branch of the work. Attention is also directed to other sections of the specifications which affect the work of this section and which are hereby made a part of the work specified herein.
- B. All required motor starters shall be furnished with the respective pump.
- C. Electric motors shall be furnished with the pumps and shall be of the size and type scheduled or otherwise specified. All motors shall be UL labeled and shall comply with applicable NEMA standard.
- D. Shop drawings shall be submitted as required by Section 200300 and shall include complete pump specifications, installation and start-up instructions, current and accurate pump performance curves with the selection points clearly indicated, maintenance data and spare parts lists.
- E. Pumps shall be factory tested, cleaned and painted prior to shipment. Size, type, capacity and electrical characteristics are listed in the pump schedule.
- F. Insofar as possible, all pumps shall be by the same manufacturer.
- G. Pump shall have data plate indicating horsepower, voltage, phase, ampacity, pressure head, and flow rate.
- H. Special notes for pumps controlled by variable frequency drives:
 - (1) Supplier shall provide the largest non-overloading impeller size for the specified pump motor horsepower, regardless of the specified pump head given on the pump schedule(s).
 - (2) Pumps less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.
 - (3) Pumps greater than 100 HP to 1000 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. Provide shaft grounding ring on drive end and non-drive end of motor per manufacturer's instructions. Additionally, provide insulated bearing journals to further reduce risk of current dissipation through bearings. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

2. MATERIAL

A. BASE MOUNTED PUMPS

- (1) Type: Horizontal, base mounted, end suction, single stage, flexible coupled, 175 PSI working pressure.
- (2) Pump Body: Cast iron, flanged gauge and drain tappings, bronze fitted.
- (3) Shaft: Stainless steel. Refer to special notes for pumps controlled by VFD's above for shaft grounding kit specification.

- (4) Bearing: Re-lubricatable ball bearing. Provide insulated bearing journals for pumps greater than 100 HP.
- (5) Seal: Mechanical, carbon ring with ceramic seal.
- (6) Motor: open, drip proof, re-lubricatable ball bearing. Minimum efficiency per NEMA Premium Induction Motor Efficiency.
- (7) Impeller: Enclosed, balanced.
- (8) Base: Structural steel.
- (9) Coupling: Flexible with coupling guard.
- (10) Manufacturers: Subject to compliance with the specified and scheduled requirements. Pumps by the following manufacturers will be considered:

Amtrol/Thrush
 Armstrong/Aurora
 Bell and Gossett
 Federal Pump
 Patterson
 Sigmund
 Worthington Pump
 Weinman
 Taco
 FloFab

(11) SELECTIONS:

Refer to the schedule on the plans for base-mounted pump selections.

END OF SECTION 230100

SECTION 230200 - HVAC EQUIPMENT AND HYDRONIC SPECIALTIES**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.
- B. The Contractor shall provide in complete working order the following heating, ventilation and air conditioning equipment located as indicated and installed, connected and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.
- C. Each subcontractor shall be responsible for their own completion of System Verification Checklists/Manufacturer's Checklist.
- D. Factory startup is required for all HVAC equipment. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include air handling units, boilers, chillers, cooling towers, VFDs, etc.
- E. All HVAC equipment shall comply with the latest provisions of ASHRAE Standard 90 and/or International Energy Conservation Code 2012, whichever is more stringent.
- F. Installation of all heating, ventilating and air conditioning systems shall be performed by a master HVAC contractor licensed in the state the work will be performed.
- G. Note to Suppliers and Manufacturers Representative furnishing proposals for equipment for the project:
 - (1) Review the Controls Section of these Specifications (if applicable) to determine controls to be furnished by the equipment manufacturer, if any. The Contractor shall provide all controls with equipment unless specifically listed otherwise.
 - (2) Review the section of these specifications entitle: SHOP DRAWINGS, DESCRIPTIVE LITERATURE, MAINTENANCE MANUALS, PARTS LISTS, SPECIAL KEYS, TOOLS, ETC., and provide all documents called for therein.
 - (3) Ensure that the equipment which you propose to furnish may be installed, connected, placed in operation and easily maintained at the location and in the space allocated for it.
 - (4) Determine from the Bid Documents the date of completion of this project and ensure that equipment delivery schedules can be met so as to allow this completion date to be met.
 - (5) Where manufacturers' temperature controls are specified, they shall be in full compliance with International Mechanical Code Section 606 including automatic smoke shut down provisions.
 - (6) Provide factory start-up on site by a factory representative (not a third-party contractor) for all HVAC equipment, including pumps, VFDS, boilers, chillers, cooling towers, heat pumps, rooftop units, etc. Submit factory start-up reports to the Engineer.
 - (7) Provide training to the Owner by a factory representative for each type of equipment. Training shall be a minimum of eight (8) hours on site and the Engineer shall be notified one (1) week in advance of the

training. Training shall only occur when the systems are complete and 100% functional. All training shall be video taped.

- (8) Review the Section on Motor Starters and Electrical Requirements for Mechanical Equipment.

DESIGNER: Coordinate notes below on vfd motors, exhaust hoods, energy recovery wheels, condensate overflow switches, air tight filter doors, etc. with inserted equipment specifications.

- (9) Requirements for motors controlled by variable frequency drives:
- a. All motors shall be inverter duty rated.
 - b. Motors less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.
 - c. Motors greater than 100 HP to 1000 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. Provide shaft grounding ring on drive end and non-drive end of motor per manufacturer's instructions. Additionally, provide insulated bearing journals to further reduce risk of current dissipation through bearings. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.
- (10) Type 1 kitchen exhaust hoods shall be provided with a heat sensor per IMC 2006, section 507.2.1.1, to enable the exhaust and make-up air system automatically upon detection of heat.
- (11) Equipment incorporating energy recovery wheels shall be provided with an aluminum wheel with molecular sieve desiccant, 4 angstrom maximum sieve size. Wheels shall be certified in accordance with ASHRAE 84 or ARI 1060 standards.
- (12) All condensate producing equipment shall be provided with a condensate trap as recommended by the equipment manufacturer and a condensate overflow switch.
- (13) Provide low ambient and all required controls and accessories on all HVAC equipment to ensure they can provide cooling during the winter season.
- (14) All outdoor HVAC equipment shall be provided with hail guards.
- (15) Provide a complete air tight enclosure with opening door that seals air tight for all filters on air moving equipment.
- (16) All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.

2. EQUIPMENT

A. BOILER B-1A & B

I. NATURAL DRAFT CAST IRON SECTIONAL HOT WATER BOILER

- (1) The boilers shall be constructed in accordance with the provisions of Section IV of the ASME Boiler and Pressure Vessel Code and shall be stamped with the required official ASME symbol. Each boiler section shall be hydrostatically pressure tested at the factory for 50 PSIG ASME working pressure.
- (2) The boiler shall be rated in accordance with the provision of the American Gas Association and shall have A.G.A. design certified input and steady-state gross output ratings. The boiler shall have an A.G.A. output/input efficiency ratio of at least 81% for maximum energy savings.
- (3) The boiler shall be tested in accordance with the requirements of the Institute of Boiler and Radiation Manufactures.
- (4) The boiler and piping shall be installed and assembled in accordance with manufacturer's specific erecting instructions, and all work shall be completed in a neat workmanlike manner.
- (5) Any deviations or changes from these specifications will be the responsibility of the contractor and will not relieve the contractor from his responsibility for the installation and operation and compliance with the intent, detail, and scope of these specifications.
- (6) The boiler shall be complete with jacket, burners, controls, and trim mounted and wired. The boiler shall be shipped to the job location in a heavy-duty shipping crate with plastic covering. Lifting brackets shall be secured to the boiler end sections to facilitate lifting and positioning the boiler.
- (7) The boiler shall be assembled with individual draw rods that distribute tension evenly on all boiler sections. All boiler sections are to be sealed with high temperature sealing rope in accommodating sealing grooves to provide a permanent gas tight seal. Asbestos material shall not be used for the sealing rope.
- (8) The boiler shall be assembled with a flexible elastomer sealing ring for each port opening to assure a permanent water-tight seal between the boiler sections. Each section shall be provided with aligning lugs to assure positive alignment with the adjoining section.
- (9) The boiler shall be provided with built-in air elimination system to assure positive separation of air from circulating water. The water boiler shall be constructed to provide balanced water flow through the entire section assembly. The boiler shall incorporate top port openings between sections to provide optimum circulation for even heating.
- (10) The boiler shall be furnished with a heavy gauge aluminized steel base with aluminized steel curtain walls. The end, front, and back base panels shall be protected against high temperatures with high temperature insulation board panels. The boiler base shall be field constructed. The burner manifold, main burners, base panels, and insulation board panels shall be installed in each base section, and each section shall be packaged in a protective shipping crate.
- (11) The boiler shall be furnished with a flue collector hood and horizontal to vertical draft hood constructed of heavy gauge aluminized steel. The flue collector hood shall be securely bolted to the top of the boiler sections at time of installation. A gas-tight seal shall be maintained between the flue collector hood and the top of the boiler sections.
- (12) The boiler shall be provided with an insulated heavy gauge steel jacket with durable baked enamel finish. The jacket shall be insulated with fiberglass on the left end, right end, top, back and interior panels. The jacket shall be designed to permit installation after connecting the supply and return piping.
- (13) The boiler shall be provided with aluminized steel main burners of one-piece construction. The burners shall feature high flame temperature, quiet ignition and extinction, and excellent flame retention qualities. Air inlet shall be set by factory-design so the proper amount of primary combustion air will be drawn into

- the burner throat over a wide range of burner manifold gas pressures. Adjustment for primary combustion air control at the main burners will not be required and air inlet adjustment shutters will not be necessary.
- (14) The gas control used for each base section will be preassembled and piped at the factory. A manual main shut-off gas valve, safety gas valve, combination gas pressure regulation valve and operating gas valve shall be furnished for each base section. Standard gas control assembly shall be located inside the boiler jacket. A union shall be used to connect gas control assembly to gas manifold.
 - a. The safety gas valve shall be equipped with a pilot take-off tapping to provide for gas supply to the intermittent burning safety pilot located in each base section.
 - b. Combination gas pressure regulating valve and operating gas valve shall be equipped with separate low-fire and high-fire operators to always assure low fire at the main burners before progression to high fire.
 - (15) All electrical safety boiler trim controls are to be of accepted quality manufacturer bearing U.L. listing.
 - (16) The gas train shall meet the requirements of I.R.I.
 - (17) Water Boiler Standard Controls:
 - a. The boiler shall be furnished with low limit operating and high limit temperature control. The low limit control shall be set according to the design requirements of the heating system. The high limit control should be set at least 20°F higher than the low limit control setting.
 - b. The boiler shall be furnished with a combination pressure-temperature-altitude gauge to indicate boiler water temperature, system pressure, and feet of altitude. The combination gauges shall be of rugged guarded type construction and the gauge dials shall be clearly marked and easy to read.
 - c. The boiler shall be furnished with an ASME certified pressure relief valve set to relieve at the rated boiler ASME working pressure or as directed by the boiler inspector. The relief valve shall be of the side outlet discharge type. The relief valve outlet shall be piped to a floor drain. The relief valve outlet must not be piped to any area where freezing temperatures could occur.
 - (18) The boiler shall be furnished with a factory-constructed wiring harness to facilitate wiring the electrical safety controls into the limit control circuits. Also provide boiler with factory-approved counter-balanced barometric damper if required.
 - (19) Provide cross-capped cleanout tee in water return line to boiler.
 - (20) Selection - Burnham, Peerless or Weil-McLain. Refer to the schedule on the plans for additional data.
 - (21) Kentucky Boiler Note: Since mechanical grooved pipe couplings are allowed, the Kentucky Boiler Code requires multiple high limits controls and some of which require manual reset. The Contractor shall supply all controls specified and any additional controls required by the Kentucky Boiler Code.

II. NATURAL DRAFT WATER TUBE HOT WATER BOILER

- (1) The Contractor may provide a water tube boiler as specified below in lieu of a cast iron sectional as an equal. The boiler shall be a Bryan CL Series or Parker flexible water tube boiler, with capacities and characteristics indicated in the cast iron sectional boiler specification.

- (2) Boilers shall be manufactured in strict accordance with the ASME heating Boiler Code, Section IV, and shall bear the ASME standard for maximum working pressure of 60 psig at 250°F temperature.
- (3) Boiler shell shall be constructed of welded steel boiler plate. Boiler shall be constructed with adequately sized upper drums, water legs and tube headers, providing proper thermal internal water circulation, not requiring an external circulation source. Water tubes are to be 1" O.D., 13 gauge steel, six pass, flexible serpentine bend design, not subject to thermal shock damage. Individual water tubes shall be easily removable and replaceable without requiring either welding or rolling. The boiler shall be furnished with an adequate number of tapings and inspection openings to facilitate internal boiler inspection and cleaning. The entire tube area shall be easily accessible for fireside cleaning.
- (4) The boiler shall be complete with an insulated metal jacket, consisting of not less than 1-1/2" fiberglass insulation and a heavy gauge, rust-resistant, zinc coated steel casing, painted with a suitable heat resisting primer and lacquer. Complete jacket and insulation shall be easily removable and re-installed, if necessary.
- (5) The boiler shall be warranted for 20 years against thermal shock on a non-pro-rated basis.
- (6) Appropriate controls, where possible, shall be mounted in enclosed panel on boiler front, and shall include control circuit fuse, indicating light and on-off switch.
- (7) Gas burner assembly shall be an integral part of boiler. Burners shall be tubular alloy steel atmospheric type for operation with natural draft, requiring no motor or blower.
- (8) The following trim and controls shall be furnished as standard equipment:
 - a. Combination thermometer and pressure gauge.
 - b. Water temperature control operator.
 - c. High limit safety control.
 - d. Low water cutoff.
 - e. ASME safety relief valve.
 - f. Electronic pilot safety control.
 - g. Motorized valve operator.
 - h. Auxiliary safety shutoff valve.
 - i. Pilot and main pressure regulators.
 - j. Main manual shutoff valve.
 - k. Pilot cock.
 - l. 100% pilot safety shutoff.
 - m. Barometric draft control.
 - n. IRI insurance requirements.
 - o. Electric pilot ignition.
 - p. Counter-balanced barometric draft damper if required.
- (9) Provide cross-capped cleanout tee in water return line to boiler.
- (10) Kentucky Boiler Note: Since mechanical grooved pipe couplings are allowed, the Kentucky Boiler Code requires multiple high limits controls and some of which require manual reset. The Contractor shall supply all controls specified and any additional controls required by the Kentucky Boiler Code.

B. CLOSED CIRCUIT COOLING TOWER (CC-1)

(1) General

- a. Furnish a factory assembled closed circuit industrial cooler of sectional counterflow blow-thru design. The industrial cooler shall have centrifugal blower assemblies built into the pan, with all moving parts factory mounted, aligned and dynamically balanced. The industrial cooler shall be internally baffled, and blowers arranged to permit operation of the individual coil section blower assemblies. Unit construction shall be all galvanized steel and additionally protected with aluminum primer/top coat to provide corrosion protection.

(2) Pan-Blower Section

- a. The combination pan section shall consist of heavy gauge hot-dip galvanized steel angle framework hot-dip galvanized self-cleaning pan and centrifugal blowers mounted beneath the sloping underside of the pan shelf.
- b. Standard accessories shall include circular access doors, large area lift-out hot-dip galvanized steel strainer of anti-cavitating design; waste water bleed line valve, and brass make up valve with large diameter industrial quality float arranged for easy adjustment.
- c. Interior of pan-blower section shall be coated with aluminum primer/top coat for increased leak protection and corrosion resistance.
- d. Blower housings shall have removable, curved inlet rings and shall have discharge cowls within the pan for increased efficiency and to prevent water from entering blowers. Non-overloading, forwardly curved centrifugal blowers shall be mounted on four-inch tubular steel shaft with necked down bearing journals at each end supported by heavy-duty pillow block bearings. Entire shaft and blows assembly shall be dynamically balanced on the unit. Bearings shall be self-aligning grease-packed ball bearings mounted in a cast iron body with locking collar and grease fitting extended to outside the pan blower protective screens.
- e. The basins shall be linked so that the fill is in one basin and the bleed/drain is in the other. Both basins shall be fully drainable.

(3) Water Distribution System

- a. The water distribution system shall consist of a PVC pipe supply header with wide orifice, non-clogging, PVC spray nozzles. Water distribution system shall be factory adjusted for complete coil wetting.

(4) Blower Motor Drive

- a. 1800 RPM drip-proof ball bearing fan motors with 1.15 service factor shall be furnished. Motors shall be suitable for outdoor service. Each motor shall be mounted on an easily adjusted heavy duty motor base located so the drive and motor are in a protective enclosure beneath the pan side.
- b. The V-belt fan drive shall be designed for not less than 115% of motor nameplate horsepower. The drive and all moving parts shall be completely enclosed by removable hot-dip galvanized steel screens.

(5) Coil Section

- a. The heat transfer section of the industrial cooler shall be encased entirely with hot-dip galvanized panels and the section shall be removable from the pan section.

- b. The cooling coil shall be all prime surface steel, square wave welded tubing with steel headers, tested to 350 psig air pressure under water and hot-dip galvanized after fabrication. The coils shall have sloping tubes to permit free drainage of the fluid. A vent connection shall be provided at each coil inlet for installation of an air vent.
- (6) Spray Water Recirculating Pump
 - a. A close-coupled centrifugal pump equipped with a mechanical seal, shall be mounted on the pan and completely piped to the suction strainer and water distribution system. It shall be installed so that it will drain freely when the pan is drained.
- (7) Eliminators
 - a. Eliminators shall be constructed of not-dip galvanized steel and be removable in easily handled sections. They have a minimum of three breaks with hook leaving edge and shall direct discharge air vertically.
- (8) Accessories
 - a. Positive closure dampers with hood and operator.
 - b. An electric immersion heater with thermostat, stainless steel element, and low water cut-off.
 - c. Two (2) speed fans.
- (9) Selection
 - a. Acceptable manufacturers shall be BAC, Marley and Frick. Refer to the schedule on the drawings.
- C. ROTARY SCREW AIR COOLED CHILLER (CH-1)

(1) General

- a. Units shall be leak and pressure tested at 450 psig high side, 300 psig low side, then evacuated and charged. Chiller shall be factory tested to confirm operation prior to shipment. Ship units with a full operating charge of oil and refrigerant.
- b. Unit panels, structural elements and control boxes shall be constructed of 12 gage galvanized steel and mounted on a welded structural steel base. Unit panels and control boxes shall be finished with a baked-on powder paint, and the structural base with an air-dry paint.

(2) Evaporator

- a. The evaporator shall be tube-in-shell heat exchanger design with internally finned copper tubes roller expanded into the tube sheet. The evaporator shall be designed, tested and stamped in accordance with ASME for a refrigerant side working pressure of 300 psig. The evaporator shall be designed for a water side working pressure of 215 psig.
- b. Each shell shall include a vent, a drain and fittings for temperature control sensors and be insulated with 3/4" Armaflex II or equal insulation (K=0.26). Internal heat tape with thermostat shall be provided to protect the evaporator from freezing at ambient temperatures down to -20°F.

(3) Condenser and Fan

- a. Air cooled condenser coils shall have aluminum fins mechanically bonded to internally finned seamless copper tubing. The condenser coil shall have an integral sub-cooling circuit and also provide oil cooling for the compressor bearing and injection oil. Condensers shall be factory proof and leak tested at 500 psig.
- b. Direct drive vertical discharge condenser fans shall be dynamically balanced. Provide condenser fan motors with permanently lubricated ball bearings and internal thermal overload protection. Unit shall start and operate down to 40°F. ambient.

(4) Compressor and Lube Oil System

- a. The rotary screw compressor shall be semi-hermetic, direct drive, 3600 rpm, with capacity control slide valve, rolling element bearings, differential refrigerant pressure oil pump and oil heater. The motor shall be suction gas cooled, hermetically sealed, two pole squirrel cage induction motor.
- b. Oil separator and filtration devices shall be provided separate from the compressor. Provide check valves in the compressor discharge and lube oil system. Also provide a solenoid valve in the lube system.

(5) Refrigeration Circuits

- a. Each unit shall have two independent refrigerant circuits, with one rotary screw compressor per circuit. Each refrigerant circuit shall include a compressor discharge service valve, liquid line shutoff valve, removable core filter drier, liquid line sight glass with moisture indicator, charging port and an electronic expansion valve. Provide fully modulating compressors and electronic expansion valves to allow variable capacity modulation over the entire operating range.

(6) Unit Controls

- a. All unit controls shall be housed in a weather tight enclosure with removable plates to allow for connection of power wiring and remote interlocks. All controls, including sensors, shall be factory mounted and tested prior to shipment. All cataloged units shall be UL listed.
- b. Microcomputer controls shall provide all control functions including start-up and shut down, leaving chilled water temperature control, compressor and electronic expansion valve modulation, fan sequencing, anti-recycle logic, automatic lead/lag compressor starting and load limiting.
- c. The unit control module shall automatically take action to avoid unit shutdown due to abnormal operating conditions associated with low refrigerant temperature, high condensing temperature and motor current overload. Should the abnormal operating condition continue until a protective limit is violated, the unit shall shut down.
- d. Unit protective functions shall include loss of chilled water flow, evaporator freezing, loss of refrigerant, low refrigerant pressure, high refrigerant pressure, reverse rotation compressor starting and running over current, phase loss, phase imbalance, phase reversal, high motor winding temperature, high refrigerant discharge temperature and loss of oil flow.
- e. A menu driven digital display shall indicate over 20 operating data points including chilled water set point, current limit set point, leaving chilled water temperature, evaporator and condenser refrigerant pressures and temperatures. Over 60 diagnostic checks shall be made and displayed when a problem is detected.

(7) Accessories

- a. Deluxe Control Package - Provide digital cycle counter and hour meter for each compressor, under/over voltage protection, remote alarm and compressor run indication contacts and a % volts display.
- b. Provide Control Power Transformer to eliminate the need to run separate 115-volt control power to the unit. A control power transformer shall be factory installed and wired.
- c. Provide chiller with integral disconnect and provide fuses per manufacturer's recommendations.

(8) Selection

- a. Trane, McQuay, York or Carrier. See schedule on the plans.

D. AIR HANDLING UNIT

(1) Casing

Construct casing of 18 ga. minimum mill galvanized or phosphatized steel, dual wall construction, designed to withstand specific operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts. All welds and drilled holes must be coated.

- (2) Provide single zone unit consisting of draw-thru fan section, hot/chilled water coil section, filter-mixing box, air blender, reheat coil, adjustable fan motor mounting, drain pan, filter frames, and face and by-pass dampers, variable frequency drivers, return and discharge plenums with perforated liners as specified and detailed.
- (3) All fan, filter and access sections shall have airtight hinged and gasketed full size access doors.
- (4) Provide reinforced points of support for either setting or hanging units.
- (5) Provide stainless steel drain pan located under entire coil section extensive enough to catch condensate leaving coil and moisture carry over at the unit operating velocities. Provide drain connection on side of unit. The pan shall be pitched in two planes to ensure complete drainage.
- (6) Cover casing and frame with protective finish on all sides.

(7) Water Coils

- a. Provide heating/cooling and reheat coils of scheduled capacity, mounted in unit in manner permitting removal.
- b. Construct coils with copper tubing primary surface and aluminum secondary surface mechanically bonded to tubes by method approved by specified manufacturer.

(8) Fan Section

Provide fans specifically designed and suitable for class or service indicated. Provide adjustable motor base, adjusted with mounting bolts or provide variation in center distance. Provide locking nuts or similar devices to secure base in proper position. Provide belt driven fans with adjustable pitch pulley permitting

- fan speed to be varied. Select pulley for mid-point of adjustable range. Design fan shafts so as not to pass through first critical speed when unit comes up to rated RPM. Provide grease lubricated fan bearings with remote externally accessible fittings for lubrication. Statically and dynamically balanced fan assemblies in fan housing after final assembly. Provide flexible connection between fan housing and unit casing.
- (9) Fan motors shall be provided with code approved motor starters. Motor starter shall contain an adjustable time delay relay, adjustable 0-60 seconds.
- (10) Insulation
- Insulate unit casing from air entrance to fan section, to air outlet from unit. Insulate framing angles exposed to air stream. Securely attach 2" thick, 3# density insulation minimum or of sufficient thickness and density to prevent condensation from forming on unit casing. Protect insulation against deterioration from air currents. Provide insulation with fire-retarding characteristics, complying with ANSI/NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.
- (11) Combination Filter/Mixing Box
- Disposable 2" deep extended area filters. Filter media shall have an average efficiency of 25-30% on ASHRAE Test Standard 52-76. Provide air foil, low leak dampers similar to Ruskin CD60.
- (12) Vibration Isolators
- Provide high efficiency housed spring type vibration isolators to isolate the fan and motor section from the unit casing.
- (13) Internal or External Face & By-Pass Dampers
- Single section for attachment to unit intake. Provide Ruskin CD-60 opposed blade-type for dampers with nylon bushings for noiseless operation. The contractor shall supply the by-pass duct as required by the manufacturer.
- (14) Air Blender
- Provide air blender section between filter/mixing box and coil to prevent air stratification entering coil.
- (15) Internal Sealing
- Seal top of heating/cooling coil and mating surface of F&B damper air tight to prohibit uncontrolled by-pass of air.
- (16) Air handling unit shall be Trane, McQuay, York or Carrier.
- (17) Selection
- Refer to the schedule on the plans.

E. WATER TO AIR HEAT PUMPS

- (1) General

- a. The Contractor shall furnish and install Trane, McQuay, Mammoth, Command Aire, WaterFurnace or Climate Master heat pumps. Each unit shall be ARI rated and ETL or UL listed. Each unit shall be fully run tested at the factory.

(2) Casing and Cabinet

- a. The cabinet shall be fabricated from heavy-gauge galvanized steel and finished with baked-on enamel. The interior shall be insulated with 1/2" thick coated glass fiber. Panels shall provide access to the fan compartment and the compressor/control box compartment. Unit shall have a drain pan with positive slope and a drain connecting extending through the unit casing. Cabinet shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be copper FPT fittings and shall protrude through the cabinet for connection to a flexible hose. Unit shall be supplied with heavy metal brackets, rubber isolators, fasteners and washers to suspend and isolate the unit from the building structure.

(3) Refrigerant Circuit

- a. Each unit shall have a sealed refrigerant circuit including a hermetic compressor, expansion valve, finned tube heat exchanger, reversing valve, water to refrigerant coaxial heat exchanger and safety controls. Compressor shall have external vibration isolator mounts and thermal overload protection. The finned tube coil shall be constructed of aluminum fins bonded to copper inner tube and a steel outer tube and be UL listed. The heat exchanger shall be rated for 400 PSIG on the water side and 450 PSIG on the refrigerant side.
- b. Safety controls shall include a low suction temperature (freezestat) switch and a high refrigerant pressure switch to lock out the compressor from operation. Units four tons and above shall have a low refrigerant pressure switch for loss of charge protection. A low-pressure switch shall not be permitted to replace a low suction temperature switch for freeze protection. Unit shall be able to reset from the BAS. Unit shall be capable of starting in an ambient of 40°F with entering water at 70°F with both air and water flow rates at the ARI rating conditions.

(4) Electrical

- a. A control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have transformer and a terminal block for low voltage field wiring connections. Unit shall be nameplated to accept time delay fuses for branch overcurrent protection of the power source.
- b. Unit control system shall provide heating or cooling as required by the setpoints of the wall thermostat. The unit control scheme shall provide for fan operation simultaneous with compressor operation (fan interlock) regardless of the thermostat type.

(5) Fan and Motor Assembly

- a. Unit shall have a direct drive centrifugal fan. The fan housing shall have a removable orifice ring to facilitate fan motor and fan wheel removal. The fan housing shall protrude through the cabinet to facilitate field duct connection. The fan motor shall be multi-speed, PSC type with integral mounting brackets isolated from the fan housing and thermal overload protection. Units above one ton shall have a terminal strip mounted on the fan motor to facilitate motor speed change.
- b. Unit shall have a straight-through or right-angle or opposite-hand discharge air arrangement as indicated on the plans and shall be able to be field converted from one or the other without the use of additional parts.

(6) Control System

- a. Unit shall be supplied with a condensate overflow switch mounted on the drain pan to suspend compressor operation if the pan fills with water. Refer to controls for additional requirements.
- b. Provide drain pan high limit shut off switch.

(7) Flexible Hose

- a. Each unit shall be supplied with three flexible hoses.
- b. Hoses shall be of adequate length for connection to the unit and field piping. Provide hose end adapters for system flushing.

See "STARTUP AND FLUSHING" instructions in this section.

- c. Also refer to "Hose Kit" section of these specifications.

(8) Duct Collar

- a. Provide with duct flange.

(9) Warranty

- a. The unit shall have one (1) year warranty on all parts and labor and a five (5) year parts only warranty on the compressors.

(10) Selection

Refer to the schedule on the plans.

F. HOSE KITS

NOTE TO DESIGNER: Delete below as required if automatic flow control valves are not to be allowed.

(1) HOSE KIT SIZES SHALL BE AS SCHEDULED ON THE DRAWINGS.

- a. Provide a factory-assembled, one-piece hose kit/piping package for supply and return connections for each heat pump.
- b. Contractor shall provide and install Hays Hose Kit Piping Packages or Nexus Hose Kit Piping packages with integral automatic balance valve. Each kit shall be sized for 2.0 to 7.0 feet per second. Valves may be mounted in any altitude and do not require straight sections of pipe either upstream or down stream for proper operation. Griswold is not an acceptable manufacturer.
- c. Each return side hose kit/piping package shall include the following:
 - 1) Single piece Y - valve body for sizes ½" – 1-1/2", shall be constructed of hot forged brass with threaded inlets and outlets. 2" – 3" shall be constructed of bronze. 4" and larger shall be constructed of carbon steel with flanged inlets and outlets. All valve bodies are suitable for a minimum of 400 PSIG working pressure.

- 2) Automatic flow control valves shall be factory set to rated flow and shall automatically control the flow to within 10% of the rated value subject to the operating parameters of; 2 to 80 PSID, fluid freezing to 225° F, 2.0 to 7.0 FPS.
 - 3) Valve internal control mechanism shall be of a quiet, clog resistant design with reverse flow capabilities and consist of precision orifice that is field changeable within the listed flow rate.
 - 4) Single pressure/temperature test ports for verifying the pressure differential and system temperature, full flow design ball valve with blow out proof stems for shut off.
 - 5) Manufacturer shall provide certified independent laboratory tests verifying accuracy of performance.
 - 6) All valves shall be labeled with controlled flow direction, flow rate, PSID control range, manufacturer and model number, unit tagging.
- d. Each supply side hose kit/piping package shall include the following:
- 1) Single piece Y - valve body for sizes ½” – 1-1/2”, shall be constructed of hot forged brass with threaded inlets and outlets. 2-3” shall be constructed of bronze. 4” and larger shall be constructed of carbon steel with flanged inlets and outlets. All valve bodies are suitable for a minimum of 400 PSIG working pressure.
 - 2) Single pressure/temperature test ports for verifying the pressure differential and system temperature, full flow design ball valve with blow out stems for shut off.
 - 3) Strainer shall be Y-type configuration furnished with hose connector blow down valve. Strainer screen shall be stainless steel mesh and easily accessible for cleaning without disconnecting hoses.
 - 4) All valves shall be labeled with flow direction, manufacturer and model number, unit tagging.
- e. Stainless Steel Braided Supply and Return Hoses: All hoses shall be equipped with end connections at terminal unit. All end connections shall be either permanently crimped swivel ends or butt welded to carbon steel end fittings to meet stated pressure ratings. Operational temperature shall be rated from fluid freezing to 200 degrees F. Minimum burst pressure shall be four times the working pressure. Furnish with field flushing connection fitting. ½” to 1-1/4” shall be reinforced, fire retardant EPDM rubber, bonded to the inside wall of braiding. 1 ½” and larger shall be a corrugated type 321 stainless steel tube.
- f. Flushing Bypass: Provide with means at each heat pump to flush system completely while allowing no fluid flow through heat pump. Also see “Start-up and Flushing” instructions in this section.
- g. Condensate Hose Kits: Contractors Option: Manufactured ¾” tubing x 54” long clear flexible plastic hose, with molded P-trap, fittings, couplings and clamps. All condensate drains larger than ¾” shall be field fabricated by contractor to allow for flexible movement. All sizes shall match sizes indicated on drawings.
- h. Warrantee: Automatic Flow Control Valves containing orifice and diaphragm shall be warranted for the life of the HVAC system in which it was originally installed. Manufacturer shall warrant all other components, for no less than five (5) years from date of purchase. Manufacturer shall warrant steel braided hose for no less than three (3) years from date of substantial completion.

G. VENTILATING FANS

- (1) Ventilating fans shall be of the type, capacity, size, etc. here-in-after scheduled. Catalog numbers are listed as design criteria only. Alternate selections will be accepted provided quality, function, etc. are equivalent. All fans shall be UL listed, complete with all required disconnects and starters and shall be AMCA rated and certified. Model numbers listed are Greenheck, acceptable alternates are Penn, Carnes, Acme, Shipman, Jenn-Aire and Loren-Cook. The Architect shall select the color for all exposed fans.
- (2) Selection

Refer to the schedule on the plans.

H. AUTOMATIC FIRE VENTS (FV-1)

- (1) Furnish and install automatic Fire Vent Type DSH 6' x 4' as manufactured by The Bilco Company or approved equivalent. Covers shall be 14-gauge paint bond galvanized steel with 3" beaded flange neatly welded. Insulation shall be of glass fiber 1" in thickness, fully covered and protected by a 22-gauge paint bond galvanized steel cover liner. Curb shall be of 14-gauge galvanized paint bond steel 12" in height on hinge sides with a 5N pitch to the fixed center channel. Curb shall be formed with a 3-1/2" flange with holes for securing to the roof deck and with an integral metal capflashing of the same gauge and material as the curb, fully welded for weathertightness. Insulation on the exterior of the curb shall be rigid fiberboard 1" in thickness. Curb shall be 12" tall, special to match the metal building roof type, with metal insulation liner of same material as the curb. All hardware shall be zinc plated and chromate sealed. Factory finish shall be red oxide primer on steel.
- (2) Vent shall be completely assembled with a positive hold/release mechanism, heavy pintle hinges, compression spring operators, thermoplastic rubber gasket, heavy duty shock absorbers and pull handles for inside and outside operation. It shall open automatically when heat breaks the 165° fusible link and shall be labeled as being FM Approved or UL Listed. Installation shall be in accordance with manufacturer's instructions. Manufacturer shall guarantee against defects in material or workmanship for a period of five years. Contractor shall test for proper operation after installation by fusing the link, and a replacement fusible link shall be furnished with the vent.

I. COMBINATION VARIABLE FREQUENCY DRIVE / DISCONNECT (VFD) FOR MOTORS 50 HP AND LESS

- (1) Manufacturers
 - a. Danfoss Graham VLT 6000 Series, Reliance, Yaskawa, Emerson, ABB, or approved equal.
- (2) General
 - a. Furnish complete variable frequency VFDs as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD shall be housed in a metal NEMA enclosure of type according to the installation and operating conditions at the job site. The VFD's UL listing shall allow mounting in plenum or other air handling compartments. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer must supply a NEMA 12 rated VFD.
 - b. The VFD shall have integral disconnecting means to disconnect power to device in accordance with NEC.

- c. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.
- d. With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.
- e. The VFD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.
- f. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VFD and option panel, in the case where these are not contained in one panel. When these VFDs are to be located in Canada, CSA or C-UL certifications shall apply. Both VFD and option panel shall be manufactured in ISO 9001 certified facilities.
- g. The VFD shall have a dual 5% DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the drive from power line transients. The reactor shall be non-saturating (linear) to provide full harmonic filtering throughout the entire load range. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.
- h. The VFD's full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.
- i. The VFD shall be able to provide full torque at any selected frequency from 29 Hz to base speed to allow driving direct drive fans without derating.
- j. An automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.
- k. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.
- l. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.
- m. Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFDs not including either

galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

- n. VFD shall minimize the audible motor noise through the used of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.
- o. VFD supplier shall coordinate with motor supplier to ensure that all motors 20 horsepower and greater are provided with grounding bushings.

(3) Protective Features

- a. A minimum of Class 20 I^2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
- b. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VFD overtemperature and motor overtemperature. The VFD shall display all faults in plain English. Codes are not acceptable.
- c. Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output with an input voltage as low as 164 V AC for 208/230-volt units, 313 V AC for 460-volt units, and 394 volts for 600 volts units.
- d. The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
- e. VFD package shall include semi-conductor rated input fuses to protect power components.
- f. To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Otherwise the VFD manufacturer must ensure that inverter rated motors are supplied.
- g. VFD shall include a “signal loss detection” circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
- h. VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
- i. VFD shall catch a rotating motor operating forward or reverse up to full speed.
- j. VFD shall be rated for 100,000 amp interrupting capacity (AIC).
- k. VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- l. VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230-volt units, 539 V AC on 460-volt units, and 690 volts on 600-volt units.

(4) Interface Features

- a. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.
- b. The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

- c. The VFD shall provide digital manual speed control. Potentiometers are not acceptable.
- d. Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
- e. The keypads for all sizes of VFDs shall be identical and interchangeable.
- f. To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD's keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
- g. Display shall be programmable to display in 9 languages including English, Spanish and French.
- h. The display shall have four lines, with a minimum of 20 characters on three lines and a minimum of eight large characters on one line.
- i. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- j. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.
- k. As a minimum, the following points shall be controlled and/or accessible:
 - 1) VFD Start/Stop
 - 2) Speed reference
 - 3) Fault diagnostics
 - 4) Meter points
 - (a) Motor power in HP
 - (b) Motor power in kW
 - (c) Motor kW-hr
 - (d) Motor current
 - (e) Motor voltage
 - (f) Hours run
 - (g) Feedback signal #1
 - (h) Feedback signal #2
 - (i) DC link voltage
 - (j) Thermal load on motor
 - (k) Thermal load on VFD
 - (l) Heatsink temperature
- l. Four additional Form C 230-volt programmable relays shall be available for factory or field installation within the VFD.
- m. Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
- n. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
- o. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFDs unable to show these four displays simultaneously shall provide panel meters.

- p. Sleep mode shall be provided to automatically stop the VFD when its speed drops below set “sleep” level for a specified time. The VFD shall automatically restart when the speed command exceeds the set “wake” level.
- q. The sleep mode shall be functional in both follower mode and PID mode.
- r. Run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
- s. The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
- t. The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (⁰F) for a cooling tower application.
- u. VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
- v. If the temperature of the VFD’s heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD’s heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.
- w. The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.
- x. The VFD shall store in memory the last 10 faults and related operational data.
- y. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
- z. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.
- aa. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltages (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
- bb. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
- cc. Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.
- dd. On motors connected to variable frequency drives, 20hp or greater in size. Provide grounding bushings to prevent arcing.

(5) Interface with Building Automation System/Direct Digital Control System

- a. VFD manufacturer shall provide an interface to the BAS/DDC system. Manufacturer shall coordinate as required with the Controls Contractor. Provide Bacnet, Lonworks, FLN, Modbus, or any other interface required for a complete and operational system.
 - b. Provide mode of operation to BAS/DDC system (hand, off, auto, etc.). BAS/DDC graphic shall highlight or produce pop-up graphic when VFD is in hand or off. Also, provide all points to BAS/DDC identified in section (4).K of this Specification.
- (6) Adjustments
- a. VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.
 - b. Sixteen preset speeds shall be provided.
 - c. Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
 - d. Four current limit settings shall be provided.
 - e. If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under voltage, overvoltage, current limit and inverter overload.
 - f. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
 - g. An automatic "on delay" may be selected from 0 to 120 seconds.
- (7) Service Conditions
- a. Ambient temperature, -10 to 40°C (14 to 104°F), without derating.
 - b. 0 to 95% relative humidity, non-condensing.
 - c. Elevation to 3,300 feet without derating.
 - d. AC line voltage variation, -10 to +10% of nominal with full output.
 - e. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.
- (8) Quality Assurance
- a. To ensure quality and minimize infantile failures at the jobsite, the complete VFD shall be tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.
 - b. All optional features shall be functionally tested at the factory for proper operation.
- (9) Submittals
- a. Submit manufacturer's performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalog information.

The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

- b. Harmonic filtering. The seller shall, with the aid of the buyer's electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will meet the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

(10) Start-Up Service

- a. The manufacturer shall provide on-site start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Provide start-up report to Engineer.

(11) Warranty

- a. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

(12) Examination

- a. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
- b. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

J. KITCHEN RANGE HOOD SYSTEM

(1) General

- a. Furnish and install a complete kitchen range hood system. Hoods shall be a full capture, canopy type Greenheck "Circu-Vent," CW, Captive Aire, Aerolator, Grease Master, Duo-Aire, or Master Air.
- b. Make-up supply air shall be introduced into room at front of hood through opposed blade, aluminum balancing dampers and registers. Provide with bird screen.
- c. Hoods shall be furnished and installed where indicated on the drawings and shall comply with NFPA-96, IMC and local/state regulating governing same. Complete unit shall be UL listed or ETL approved.

- d. One manufacturer shall furnish the kitchen hoods and fan package system and all controls.
- e. Type 1 hoods shall be provided with a heat sensor per IMC 2006, section 507.2.1.1, to enable the exhaust and make-up air system automatically upon detection of heat.

(2) Rangehood

- a. Hood shall be constructed of 18-gauge, Type 304 stainless steel, number 3 finish. Grind and polish all exposed welds. Joints other than welded will not be accepted. All joints shall be internally welded.
- b. Hood shall be capable of providing 100% of the required make-up air tempered through discharge grilles in the face of the hood.
- c. Hood shall be equipped with listed UL high velocity centrifugal grease extractor type filters the entire length of the cooking equipment battery. Adjust height of filters to suite equipment. A grease through with removable grease collection cups shall run the full hood length.
- d. Hood shall be furnished complete with all required concentric, ductwork, plenums, cups and hood/fan package wiring, harness and vaporproof light fixtures and 130-volt rough service lamps, etc.
- e. A remote recessed control panel shall be located on the wall. This panel shall have a single switch to control the supply fan, exhaust fan and make-up air heater. The panel installation shall have a stainless-steel bezel plate with integral etched switch and lamp function descriptions. If a location is not indicated on the plan, contact the Engineer for a location prior to installation.
- f. Provide a stainless-steel enclosure to extend from the top of the hood to above the ceiling.

(3) Fan Packaged System FP-1

- a. Greenheck fan packaged roof top systems or approved equivalent, complete with make-up air unit, exhaust fan, duct heater and extended length sound absorbing roof curb, support, curb rail, motorized two position supply damper and intake hood. Package shall be sized for single point electrical connection. Provide with 1" disposable filters on the make-up air. The controls wiring at the unit shall be wired to a terminal strip identical to the control panel. The Contractor shall provide all field wiring to the control panel, gas valves, shunt trip breakers or panels, fire control system and all other points to provide a complete control system. The exhaust and make-up air fans shall be interlocked so that any time the exhaust fan runs the supply fan also runs.

(4) Duct Heater

- a. Greenheck fan package, direct gas fired heater. Unit to be complete with accessible duct mounted thermostat aluminized steel weatherproof cabinet and modulating gas valve for discharge temperature control and electronic ignition. Provide all required safety controls.

(5) Balancing

- a. Hood supply and exhaust fans shall have the final air balance supervised by factory authorized personnel to obtain maximum performance. Air balancing may be done by providing blank panels in lieu of filters in the hood or as recommended by the hood manufacturer. Submit air balance report to Engineer stating CFM of exhaust and supply fan.

(6) Fire Control System

- a. Furnish and install for the hood a fire control system. It shall be specifically UL listed for the hazard involved and installed in accordance with National Fire Protection Association Standard No. 96 (latest revision), "Standard for the Installation of Equipment for the Removal of Smoke and Grease Laden Vapors for Commercial Cooling Equipment" and conform to all local and/or state codes and standards.
- b. The design of the system shall provide for protection of duct systems, grease removal devices and hoods. Cooking equipment such as fat fryers, ranges, griddles and boilers, which may be a source of ignition of grease in the hood or duct shall also be protected.
- c. The system shall be capable of automatic (connected to all suitable listed system of detector and actuation) and manual mechanical operation. Install manual operator 4'-6" above floor. Provide four sets of auxiliary contacts.
- d. All components, including the pressure container and the remote emergency fire station, shall be furnished and installed by the Contractor.
- e. The system shall shut off the electrical power and gas input to all equipment under the hood.
- f. Hood Generated Noise

The hood with supply and exhaust fans ON shall generate less than 60 dBA when measured at 5'-0" above the floor at a distance 5' away from the hood at all points around its perimeter.

- g. Selection

Refer to the schedule on the drawings.

K. HEAT-TRACING SYSTEM (HEAT TAPE)

Chemelex, "Auto-Trace, Self-Limiting Heating" Model 8BTV-CT or approved equivalent. The heat tape shall have a cross-linked polymer core with copper bus wire so that the heater output increases as the jacket temperature drops. Heat output shall be 8.0 watts per foot at 50 degrees F. surface temperature. The heat tape shall be installed as recommended by the manufacturer along the entire length of all exterior piping subject to freezing and where indicated on the drawings. All valves shall be wrapped additionally 2 foot of heat tape. Provide two tracings on each pipe, and each of the two fed from a different circuit. Heat tape electrical characteristics shall be as indicated on the electrical plans. Provide with power connection kits and end caps. Heat tape shall be placed in operation at the electrical circuit breaker. Normally power shall remain active to the heat tape.

L. HYDRONIC SPECIALTIES

DESIGNER EDIT OUT REFERENCES TO VICTAULIC IF OWNER DOES NOT WANT VIC IN MECHANICAL ROOM

(1) Manufacturers

Subject to compliance with the specified and scheduled requirements the following manufacturers will be considered, but not limited to:

Hoffman
Amtrol/Thrush

Armstrong/Aurora
 Bell & Gossett
 Patterson
 Taco
 Victaulic
 Wheatley

(2) Air Release Tank

The air release tank shall be of the in-the-pipe-line type with flanged tangential openings for inlet and outlet connections. The inside shall be specifically designed to create a low velocity vortex for the separation of free air from the water stream. The tank shell shall be rated at 125 PSI working pressure and shall be constructed with the ASME code for unfired pressure vessels and shall be so certified and stamped. The tank shall be equipped with a bottom drain connection and expansion tank/vent connection. Tank shall be line sized. Tank shall not have a strainer.

(3) Expansion Tank

The tank shall be constructed in accordance with the ASME Code for unfired pressure vessels and shall be suitable for 125 PSI water working pressure and 340°F maximum water temperature. The tank shall be a pre-charged, heavy duty butyl rubber diaphragm-type pressure vessel complete with standard tire charging valve. Refer to the plans for mounting orientation. Capacities shall be as scheduled on the drawings.

(4) Factory-Assembled Drops

Contractor has the option to utilize pump drop assemblies in lieu of traditional method consisting of flexible connectors and flanged components. Pump Drops shall consist of orange enamel coated assembly, consisting of a Class 150 flange for pump connection, Standard of Acceptance: Victaulic Series 380/381/385/26.

Suction Vibration Isolation Pump Drop: Factory assembled grooved end vibration pump suction drop for pipe sizes 3" through 12". Consisting of a suction diffuser with stainless steel basket and diffuser, Vic-300 butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and/or pressure ports. Assembly is installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300-psig.

Discharge Vibration Isolation Pump Drop: Factory assembled grooved end vibration pump discharge drop for pipe sizes 3" through 12". Consisting of tri-service valve assembly, which includes a 779 spring-actuated check valve and Vic-300 butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and pressure ports. Assembly is installation ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure is 300-psig.

(5) Suction Diffusers

Provide at the inlet of each base mounted pump, a suction diffuser as manufactured by Bell and Gossett, Victaulic, Thrush, or approved equivalent. Each suction diffuser shall be equipped with a disposable fine mesh start-up strainer and an adjustable support foot to carry weight of inlet piping. Victaulic Series 731 G, W731G, Bell and Gossett Suction Diffuser, or equal.

(6) Triple Duty Valves

Provide at the discharge of each base mounted pump and where shown on the plans, a triple duty valve as manufactured by Bell & Gossett, Thrush or Engineer approved equivalent. Each valve shall perform check, shut-off and throttling functions and shall be line sized.

Alternatively, in lieu of a triple duty valve, a Victaulic grooved end "Tri-Service" valve assembly may be used in applicable piping systems. The assembly shall consist of a Victaulic Vic-300 MasterSeal™ butterfly valve with memory stop feature for shut-off and balancing, and a 779 Venturi-Check for backflow prevention and flow measurement.

(7) Flexible Connections

Provide at the inlet and discharge side of each base mounted pump, at each connection to major equipment requiring vibration isolation and where shown on plans, a flexible connector, Metraflex Metrasphere or Engineer approved equal. Flexible connectors shall be of the flexible neoprene and nylon or EPDM and suitable for 225 PSI working pressure and 230°F temperature. Couplings shall be installed per the manufacturer's recommendations, in close proximity to the source of the vibration.

Alternatively, in lieu of a flexible connector, three (3) Victaulic Style 77 flexible couplings may be used on suction side and discharge side of base mounted pumps (six Victaulic flexible couplings per pump).

(8) Pressure Reducing Valve

Provide at the point of connection of the domestic water line to the hydronic system and where shown on the plans, a pressure reducing valve by Thrush, Bell and Gossett, or Engineer approved equivalent. Such pressure reducing shall be provided with an inlet strainer and shall be set to maintain a pressure of 4 PSI in excess of that at the highest point in the hydronic system. Each pressure reducing valves shall be line sized.

(9) Vacuum Breaker

Provide, where shown on the plans, a vacuum breaker as manufactured by Huffman, Jackson or Engineer approved equivalent.

(10) Manual Air Vents

Provide, where shown on the plans, at each rise in piping and where required a manual air vent.

(11) Automatic Air Vents

Provide, where shown on the plans, automatic air vents.

(12) Expansion Loops

Expansion loops shall be Metaflex Metra loops or Engineer approved equivalent. Install with pipe guides and anchors as recommended by the manufacturer in all piping runs 75 feet long or greater and also where indicated on the plans.

Alternatively, in water piping systems, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and as required for the elimination of expansion loops. (In accordance with Victaulic recommendations and as approved by the Engineer). Where expansion loops are required in Victaulic piping systems, use Victaulic flexible couplings on the loop(s).

2. FACTORY START-UP REPORTS

- A. Provide factory start-up on site by a factory representative (not a third-party contractor) for all HVAC equipment, including pumps, VFD's, boilers, chillers, cooling towers, heat pumps, rooftop units, etc. Submit factory start-up reports to the Engineer. The Mechanical Contractor and the Controls Contractor shall have a representative on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action taken shall be submitted to Engineer.
- B. At a minimum, the report submitted to the Engineer shall include the following data:

(1) Water Source Heat Pumps

- a. High voltage power supply is correct and accordance with the unit nameplate.
- b. The phasing of the unit is correct per the compressor rotation.
- c. The field wiring and circuit protection is the correct size.
- d. The low voltage control circuit wiring is correct per the unit wiring diagram.
- e. The piping system is clean and complete.
- f. Verify water flow is established and circulating through all units.
- g. The condensate line is properly sized, run, trapped and pitched.
- h. The indoor blower turns freely without rubbing.

Start-up checklist and log: Upon unit start-up, the following items shall be checked and logged for each water source heat pump. Note, the items listed below must be verified/checked before the system is put into full operation:

- i. Entering fluid temperature (heat and cool mode)
- j. Leaving fluid temperature (heat and cool mode)
- k. Temperature differential (heat and cool mode)
- l. Return air temperature (heat and cool mode)
- m. Supply air temperature (heat and cool mode)
- n. Water coil heat exchanger (water pressure "in" – psig) (heat and cool mode)
- o. Water coil heat exchanger (water pressure "out" – psig) (heat and cool mode)
- p. Pressure differential (psig) (heat and cool mode)
- q. Compressor amps
- r. Compressor volts
- s. Compressor discharge line temperature (after 10 minutes)
- t. Refrigerant charge (oz.)
- u. Test drain pan operation
- v. Check and note strainer condition.
- w. Check and note filter condition.

(2) Outside Air Units/Energy Recovery Units

- a. Fan rotation
- b. Recovery wheel rotation
- c. Confirm all wiring connections are correct
- d. Confirm all field wiring is correct
- e. Adjust belt tensions and alignments
- f. Confirm pipe connections are correct
- g. Confirm sequence of operation is correct
- h. Confirm damper operation

(3) Water-to-Water Heat Pumps

- a. High voltage power supply is correct and accordance with the unit nameplate.
- b. The phasing of the unit is correct per the compressor rotation.
- c. The field wiring and circuit protection is the correct size.
- d. The low voltage control circuit wiring is correct per the unit wiring diagram.
- e. The piping system is clean and complete.
- f. Verify water flow is established and circulating through all units.

Start-up checklist and log: Upon unit start-up, the following items shall be checked and logged for each water source heat pump. Note: The items listed below must be verified/checked before the system is put into full operation.

- g. Source entering fluid temperature (heat and cool mode)
- h. Source leaving fluid temperature (heat and cool mode)
- i. Load entering fluid temperature (heat and cool mode)
- j. Load leaving fluid temperature (heat and cool mode)
- k. Temperature differential (heat and cool mode)
- l. Water coil heat exchanger (water pressure “in” –psig) (heat and cool mode)
- m. Water coil heat exchanger (water pressure “out” – psig) (heat and cool mode)
- n. Pressure differential (psig) (heat and cool mode)
- o. Compressor amps
- p. Compressor volts
- q. Compressor discharge line temperature (after 10 minutes)
- r. Refrigerant charge (oz.)
- s. Check and note strainer condition.

(4) Boiler Over Draft Damper System

- a. Test the operation of the Modulating Over-Draft Damper System and:
 - 1) Increase and decrease draft setting.
 - 2) Increase and decrease firing rate.
- b. Test safety control by firing boiler and:
 - 1) Shut off power to the actuator.
 - 2) Shut off power to the control.
 - 3) Increase boiler outlet pressure to exceed +0.25°WC.
- c. Supervision installation of damper actuator and draft controls.
- d. Test individual controls for proper operation.
- e. Set draft for specified operation.
- f. Test safety system.

(5) Boiler

- a. Control circuit Component Operational Test is required.
Test the following:
 - 1) Primary LWCO
 - 2) Secondary LWCO
 - 3) High Pressure gas switch (if gas fired boiler)
 - 4) Low Pressure gas switch (if gas fired boiler)
 - 5) High Limit Setting

- 6) Operating Control Setting
 - 7) Oil pressure switch (if oil fired boiler)
 - 8) Air Flow Switch
 - 9) Firing rate control
 - 10) Low fire start switch
 - 11) High fire purge switch
 - b. Running Motor Amps and Volts vs. Nameplate amps and volts.
 - c. Measuring the following and verify measurements within manufacturer's recommendations:
 - 1) Firing Rate
 - 2) CO₂
 - 3) O₂
 - 4) Smoke or CO
 - 5) Stack Temperature Net °F
 - 6) Room Temperature
 - 7) Over fire draft (in. W.C.)
 - 8) Breeching Draft (in. W.C.)
 - 9) Inlet/Outlet Water Temp °F/Steam outlet pressure
 - 10) Air inlet shutter % Open
 - 11) Flame Signal Pilot
 - 12) Flame Signal Main
 - 13) Oil pressure/Gas pressure
 - 14) Bypass oil pressure
 - 15) Atomizing Air Pressure
 - 16) Combustion Efficiency
- (6) Dryer Venting System
- a. Test the operation of the Mechanical Venting Dryer System and:
 - 1) Increase and decrease pressure setting.
 - 2) Increase and decrease firing rate.
 - b. Test safety control by firing dryer and:
 - 1) Shut off the ventilator.
 - 2) Shut off the control.
 - c. Additionally, factory agent shall
 - 1) Supervise installation of ventilator and controls
 - 2) Start-up and adjust control.
 - 3) Test individual controls for proper operation.
 - 4) Set pressure for specified operation
 - 5) Test safety system. Confirm that safety and operating controls have been properly installed.
- (7) Cooling Tower/Closed Circuit Coolers
- a. Inspect the following and verify all are clean of any debris, silt, or foreign materials.
 - 1) Air Inlet Screens
 - 2) Fans and Housing
 - 3) Drift Eliminators
 - 4) Strainer Screens
 - 5) Coil Section
 - 6) Pan Section
 - b. Inspect the following:
 - 1) Check locking collars and set screws on fan bearings.
Note if lubrication is necessary.
 - 2) Fan Rotation

- 3) Belt tension
- 4) Pump rotation/operation.
- 5) Belt alignment.
- 6) Float for freedom of movement
- 7) Make-up valve
- 8) Drain valve and sump overflow
- 9) Bleed rate
- 10) Spray Distribution System and spray pattern (for even water pattern)
- c. Note and set levels if necessary
 - 1) Low Water Level
 - 2) Operating Water Level
 - 3) Overflow Water Level
- d. Check and note voltage and amp draw, note nameplate amps
 - 1) Fan(s)
 - 2) Pump
- e. Energize at full speed and check for excessive vibration.

(8) Base-Mounted Pumps

- a. With power off, note the following:
 - 1) pump properly secured, level, and grouted
 - 2) pipe installed so as not to transmit stress to pump
 - 3) coupler between pump and water shaft aligned
 - 4) pump and motor lubricated
- b. With power on, note the following:
 - 1) impeller rotation
 - 2) Actual amps/volts vs. nameplate amps/volts.
 - 3) Inlet and outlet pressure

(9) Air Handling Units

- a. Verify economizer operation
- b. Verify operating per sequence of control
- c. Discharge air temperature sensor calibration
- d. Discharge static pressure
- e. Dirty filter differential pressure switch function
- f. Outside air temperature sensors calibration
- g. Return air temperature sensor calibration
- h. Airflow monitoring station calibration
- i. VFD response to pressure sensors or other DDC input
- j. Smoke detection shut down
- k. Freeze protection sequence
- l. Fan bearings lubrication
- m. Fan not vibrating
- n. Fan motor volts / amps
- o. Check drive belt tension
- p. Check sheave alignment
- q. Coils clean
- r. Dampers operating properly
- s. Filters clean
- t. Fan rotation direction

(10) Air Cooled Reciprocating Chiller or Large Split DX Systems

- a. Volts – Comp. 1 and Comp. 2
- b. Control Voltage
- c. Comp. Amps #1 – Comp. Amps #2
- d. Condenser Fan Amps
- e. Condenser Performance
- f. Ambient Temperature
- g. Leaving Air Temp
- h. Liquid Press.
- i. Sub-cooling
- j. Evaporator Performance
 - (1) Evap. Air/Water Temp. IN
 - (2) Evap. Air/Water Temp. OUT
 - (3) Evap. ΔT or ΔP
 - (4) Suction Pressure
 - (5) Superheat
 - (6) Suction Temp
 - (7) Evap. Water Press. IN
 - (8) Evap. Water Press. OUT
- k. Lubrication System
 - Oil Pressure
 - Oil Level
 - Acidity Test Per Contract
 - Crank Case Heater OK
- l. General Check
 - Unusual noise or vibration
 - Visual Leak Check
 - Comp. Loading, Unloading
 - Pump down Control – Cutout PSI – Cutout PSI
 - Low Ambient Dampers
 - Condenser Fan Belt
 - Condenser Coil Cleanliness
 - Evap. Coil Cleanliness
 - Moisture Indicator

(11) Blower Coil and Fan Coil Units

- a. Fan bearings lubrication
- b. Fan not vibrating
- c. Fan motor volts / amps
- d. Fan belt tension, if applicable
- e. Sheave alignment, if applicable
- f. Coils clean
- g. Filters clean
- h. Fan rotation direction

3. WATER TREATMENT**A. SCOPE**

Provide a one-year water treatment program for the HCS and HPS water loop systems. The one-year period shall start from the date of substantial completion. The program shall minimize corrosion, scaling, and prevent biological fouling of the piping system.

B. QUALIFICATIONS

Chemicals, service, and equipment shall be supplied by a single water treatment company for undivided responsibility. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of commercial/industrial water treatment for at least 5 years, whose major business is in the field of industrial water treatment. The water treatment company shall have regional water analysis laboratories, service department, and full-time representatives located within the trading area of the job site or facility.

Water treatment company shall be Bluegrass Kesco, Nalco, American Water Treatment, or approved equal.

C. SERVICE

Provide quarterly field service and Owner consultation. System water or fluid shall be tested for proper chemical parameters, clarity, and biological activity. If needed, provide chemical addition. Provide any laboratory and technical assistance required to achieve a successful program.

D. CHEMICALS

Provide one year's supply of the recommended chemical for scale and corrosion protection of the closed loop recirculating system. If needed, provide separate chemical to control microbiological growth in the system. Formulations shall not contain any ingredients which are harmful to system materials of construction.

E. PHASED PROJECTS

Provide multiple trips, testing, treatment, chemicals, etc. as required to accommodate phased projects. Systems that will be constructed and brought on-line in phases shall be treated at the completion of each phase. Under no circumstance shall any portion of the system operate with untreated heat transfer fluid.

F. EQUIPMENT

(1) Bypass Feeder

Provide one 5-gallon bypass chemical feeder for each system. Neptune DBF-5HP or approved equivalent.

(2) HPS Loop Filter LF-1

Harmsco HIF or WB series fluid filter. Refer to schedule on the drawings for selection. Provide with a total of three sets of filter cartridges.

(3) Packaged Hydronic System Feeder (Heat Transfer Fluid Reservoir and Pump Assembly)

-NOTE TO DESIGNER: EDIT ALL ITEMS IN BOLD PRINT BELOW-

The contractor shall supply and install, as indicated on the plans and in the specifications, a prefabricated automatic and autonomous fluid make-up package for the **(geothermal heat pump loop, water source heat pump loop, and the chilled/hot water loop generated by water to water heat pump)**.

The package shall be designed to occupy a minimum amount of floorspace (no more than 30 inches in diameter), to operate on a standard 120 Volt, 60 Hz electrical circuit, and to maintain a fill pressure in

the system it serves of **X psi (pressure range is 10-70 psi)**. The pumping assembly shall be mounted in a sturdy steel frame with legs to keep it off the floor.

Use this paragraph only for single loop: It shall include a 1.7 GPM at 70 psi pump, a ½ horsepower motor, a magnetic starter, a pressure tank with pressure control, a priming valve, a pressure reducing valve, a shut-off valve, and a pressure gauge. It shall be connected to the system with a ½" NTP connection. It shall feature a cut-off and alarm arrangement, which will stop the pump in case of excessive pressure, or a low fluid level in the reservoir, and activate an audible (which can be silenced) and a visual alarm. A 120 Volt dry contact shall also be available for a remote alarm or connection to a building management system.

Use this paragraph only for two loops: The system shall include two independent pressurization modules for two glycol/water applications. Each module shall include a 1.7 GPM at 70 psi pump, a ½ horsepower motor, a magnetic starter, a pressure tank with pressure control, a priming valve, a pressure reducing valve, a shut-off valve, and a pressure gauge. It shall be connected to the system with a ½" NTP connection. It shall feature a cut-off and alarm arrangement, which will stop the pump in case of excessive pressure, or a low fluid level in the reservoir, and activate an audible (which can be silenced) and a visual alarm. A 120 Volt dry contact shall also be available for a remote alarm or connection to a building management system.

A translucent polyethylene **(50 or 100)** gallon reservoir, complete with lid, shall be mounted on the pumping assembly and shall include a strainer and shut-off valve. A one-inch heat transfer fluid recovery line shall be piped in from the system relief valve outlet to the solution container, through the lid in such a way that the lid can be removed for filling and mixing.

The make-up package shall be **(Wessels GMP Glycol/Water Make-up System, Wessels Duplex GMP Glycol/Water Make-up System)**, Pulsafeeder DGF, or pre-approved equal. **(choose duplex only for systems where you have two loops. i.e. heat pump loop and hot/chilled water).**

G. REPORTS

A summary of water or fluid quality and treatment shall be provided in writing to the Owner and Engineer after each quarterly site visit. Results of quarterly biological activity tests shall also be provided to the Owner and Engineer.

H. CONDENSATE WATER SYSTEM (CLOSED CIRCUIT COOLER)

- (1) Provide two (2) chemical feed pumps, electronic water meter, bleed-off flow control valve and conductivity controller. Conductivity controller shall be similar to Morr Control "T-209A" or approved equivalent. The conductivity controller shall activate the bleed-off solenoid valve as required to maintain the total dissolve solids (TDS) level within acceptable ranges. The conductivity controller shall have an integral seven (7) days, 24-hour timer for the biocide feed pump control. When the biocide feed pump is activated, the bleed-off solenoid valve shall be locked out. The conductivity controller shall also keep track of the amount of make-up water being supplied into the system and activate the scale inhibitor feed pump as required to maintain acceptable levels.
- (2) The chemical feed pumps (scale inhibitor pump and iodide pump) shall be similar to LMI or approved equivalent. The pumps shall be an adjustable metering type. The pumps shall be fully grounded. The pumps shall be controlled by the conductivity controller. The pumps shall be provided with all required tubing for system interconnection. The electrical characteristics shall be 120V/1Ø/60 HZ.
- (3) Provide a one-year treatment program, from the date of substantial completion, for the open recirculating tower system. Furnish one-year supply of chemicals for control of scale and corrosion. Field service and reports for the open recirculating tower system shall be as stated above for the closed loop system, except field service shall occur and reports shall be submitted on a monthly basis in lieu of quarterly.

I. WHITE RUST PASSIVATION FOR COOLING TOWER OR CLOSED-CIRCUIT COOLER

- (1) The following specification is applicable to evaporative coolers such as closed-circuit coolers, closed fluid coolers, cooling towers, open cooling towers, etc., and any reference herein shall apply to all. Provide chemical passivation to prevent white rust zinc oxidation before any water is added to the cooling tower or closed-circuit cooler. The contractor shall submit a detailed plan for chemical passivation of galvanized metal and continued water treatment after passivation for engineering review. Under no circumstances can the cooling tower or closed-circuit cooler be started without implementing the passivation plan as described in the following specifications.
- (2) The cooling tower or closed circuit cooler surfaces shall be thoroughly cleaned of dirt, dust, grease, debris, etc., prior to commencing the passivation process. It is critical to protect the zinc coating on galvanized metal. Abrasive scrubbing and abrasive cleaning agents are not allowed. Accordingly, acid or alkaline cleaners should not be used. Phosphate and silicate cleaners are recommended.
- (3) The passivation plan shall be specific for the quality of domestic water at the site and identify critical circulation water parameters to be maintained during the passivation process as follows:

PARAMETER	PASSIVATION VALUE
pH	7.0-8.0
Conductivity	<2,400
Calcium Hardness	>50 PPM
Chlorides	<250 PPM
Sulfates	<250 PPM
Alkalinity	<300 PPM
Chlorine (Biocide)	<0.5 PPM

NOTE: These passivation values are a guide for preparing the proposed passivation plan. Actual values shall be adjusted in the passivation plan based on the closed circuit cooler manufacturer's requirements.

- (4) Conductivity and pH control of the circulating water is required. The circulating water quality shall be tested and recorded twice daily on four consecutive days. The initial passivation phase shall be continued for 96 hours with no heating load. Following 96 hours of initial passivation, the closed-circuit cooler should be shut down and interior components observed for white rust. Photographs to document appearance of galvanized metal at this stage of passivation shall be included in the final report noted below. Any observed white precipitate shall be collected and lab analyzed for zinc oxide and calcium carbonate. Zinc oxide, if present, shall be removed and the galvanized metal inspected by the closed circuit cooler manufacturer to determine the integrity of the zinc coating. Damaged zinc coatings shall be repaired by approved method and approved contractor with repairs observed and accepted by the closed circuit cooler manufacturer. The Owner reserves the right to obtain the services of a Metallurgist, at the contractor's expense, to observe the zinc coating where white rust has been found and any zinc coating repairs to provide a final determination whether zinc coatings and zinc coating repairs are acceptable. The passivation plan shall be restarted at the beginning following removal of white rust and acceptance of the original or repaired zinc coating. When the initial passivation phase (96 hours) is completed and no white rust is present, heating load can gradually be added provided the circulating water passivation values are maintained. pH control is critical. It generally takes four to twelve weeks for complete passivation of the galvanized metal.
- (5) Acceptance of passivation shall be provided in writing by the closed circuit cooler manufacturer and included in a final passivation report to be submitted by the contractor for engineering review. This report shall include pre-passivation, initial passivation and post-passivation photographs to document the appearance of galvanized steel inside the closed-circuit cooler before and after passivation. The

report shall document the circulating water passivation values throughout the passivation process, and the dates of passivation commencement, initial phase completion (without heat load), initiation heat load (with water passivation values), and final completion.

DESIGNER: IF THIS PROJECT IS A FLUID COOLER REPLACEMENT IT IS LIKELY THE OWNER HAS A CURRENT SERVICE CONTRACT WITH A CHEMICAL TREATMENT SERVICE PROVIDER. IF SO, YOU SHOULD CONFIRM THE OWNER'S SATISFICATION WITH THIS SERVICE. ULTIMATELY, THE CHEMICAL TREATMENT AND PASSIVATION SPECIFICATION WILL HAVE TO BE EDITED ACCORDINGLY.

4. HEATING/COOLING SYSTEM CLEANING

Should be used for heat pump system, can be used for 2 or 4 pipe, but not required.

A. GENERAL

The heating/cooling system for this contract is a hydronic heat pump system and there are several precautions which must be observed during its installation. The Contractor is advised to read all of the manufacturer's instructions prior to commencing the installation.

B. SYSTEM START-UP

The Contractor shall include as a part of his work a factory system fill and start-up by an authorized Factory Representative of the unit manufacturer.

C. CLEANING AND FLUSHING HYDRONIC HEAT PUMP PIPING SYSTEMS

- (1) During construction, extreme care shall be exercised to prevent all dirt and other foreign matter from entering the pipe or other parts of the system. Pipe stored on the project shall have the open ends capped and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting or valve shall be visually examined and all dirt removed.
- (2) After the system is complete it shall be thoroughly cleaned before placing in operation to rid the system of dirt, biological contamination, piping compound, loose mill scale, oil and any and all other material foreign to the water.
- (3) Before chemical cleaning and sterilization of the entire system, the loop field shall be flushed and purged until free of dirt, debris, and air. During the chemical cleaning and sterilization process the supply and return run-outs shall be temporarily connected together at each heat pump location.
- (4) After purging of the field loop the Contractor shall add an approved system cleaning solution at the recommended concentration to the entire system. Circulate the system with cleaner for the time recommended by the chemical manufacturer. After prescribed circulation time, flush the system until cleaner is removed.
- (5) After chemical cleaning, the entire system shall be sterilized. Introduce a solution of sodium hypochlorite to achieve a chlorine residual of 25 to 50 ppm. Maintain this chlorine level for 12 to 24 hours. Flush out system until chlorine residual in system equals that of the makeup water.
- (6) After the system has been completely cleaned and sterilized as specified herein, the individual heat pumps shall be connected permanently to the supply and return runouts and the system filled for operation under normal closed loop conditions. Within 48 hours of the completion of the sterilization implement a water treatment program to passivate all metal surfaces.

5. HVAC SYSTEM START-UP PROCEDURE

A. GENERAL

- (1) The goal of this procedure is for a few units to run as much as possible with the coils as cold as possible to "wring out" the water and allow it to drain away in the condensate drain pans. Allowing all units to cycle on and off, running for short periods of time, does not dehumidify the air in the building. Starting the system without following the steps outlined will raise the relative humidity in the building and most likely cause condensation on some of the building surfaces and HVAC system that the Contractor will be responsible to correct.
- (2) The high humidity and condensation occurs in school buildings at start up primarily because the building is only partly occupied (or not occupied) when the HVAC system is started. Most people believe that the answer to this problem is to turn the thermostats down very low. The assumption is that cold air will not hold moisture. That is not true. What happens is that the thermostats are quickly satisfied thermally because there is very little cooling load on the building and the cooling equipment. The terminal units then only have to run for a very short period of time to keep the thermostats satisfied and the relative humidity of the air is in fact raising. The goal is to cause the moist air to pass over coils which are cooling it and drying it without allowing more moist air to be introduced into the building.
- (3) To reduce the always present high humidity start-up problem, we have devised this start-up procedure that will minimize the adverse effects of the start-up. As the building sits at start-up, all of the walls, floor, and ceilings are saturated with moisture from the air and also moisture is being released from the drying paint and curing concrete and mortar.
- (4) The following procedure will slowly bring down the temperature and humidity in the lightly loaded building. It will also allow the HVAC equipment to more closely match the actual building load without students and equipment in use.

To reach these goals we require the following:

- (1) Set 1/3 of the units (approximately every third unit) on 74°F (no lower). Set the other thermostats for a cooling setpoint of 90°F so the units will not cool. Override the controls so that the fans in all units will circulate air.
- (2) Leave all of the interior doors open to allow the air to mix throughout the building.
- (3) Close all exterior windows and doors.
- (4) Turn off all exhaust fans and outside air units. Outside air unit exhaust and outside air dampers shall be closed.
- (5) Leave all of the lights on in the building to provide a cooling load.
- (6) Provide portable electric heaters or dehumidifiers in any room that shows signs of condensation.

Here is a list of things you should not do:

- (1) Do not prop the exterior doors open during construction or while moving in furnishings.
- (2) Do not start all of the units until students are starting school. When students start school the normal setpoints, schedules, and fan cycling shall begin.

END OF SECTION 230200

SECTION 230300 - CONDENSATE DRAINAGE SYSTEM (FOR COOLING EQUIPMENT)**1. GENERAL**

- A. The Contractor's attention is directed to the General and Special Conditions, General Conditions-Mechanical and to all other Contract Documents as they apply to this section of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- B. The Contractor shall provide a complete condensate drainage system to carry all condensate discharge from all cooling equipment from the building. Condensate system shall be installed in accordance with IMC. Provide condensate overflow switch for all condensate producing equipment.
- C. Pipe installation and fabrication shall be in accordance with the section of these specifications entitled PIPE, PIPE FITTINGS AND PIPE SUPPORT and as hereinafter specified.
- D. All piping shall be installed concealed, unless specifically noted otherwise and shall be installed under slabs or underground only when specifically indicated.
- E. Lines installed in ceiling spaces shall be held at the maximum possible elevation and shall be coordinated with all other trades to avoid conflicts.
- F. Condensate drain lines shall be pitched 1/4 inch per foot and installed with cleanout plugs at each change in direction and/or at thirty (30) foot intervals. Where this minimum pitch cannot be attained, contact Engineers.
- G. Horizontal runs of condensate drain lines shall be supported at six (6) foot intervals maximum, or more frequently where required to prevent sags and low spots.
- H. Lengths of horizontal lines shall be held at a minimum due to potential lint collection.
- I. Provide condensate traps in accordance with the manufacturer's recommendations.

2. MATERIAL

- A. Refer to Section of these Specifications entitled: PIPE, PIPE FITTINGS AND SUPPORT.

3. INSULATION

- A. Refer to Section of these Specifications entitled: INSULATION - MECHANICAL.

END OF SECTION 230300

SECTION 230800 – FUNDAMENTAL COMMISSIONING OF HVAC

To be bid under separate contract. Commissioning Agent will work directly with Woodford County Schools. The Contractor shall coordinate with the Owner's commissioning agent as specified herein. The bid date and deadline to submit bids shall be concurrent with project. Bidding Commissioning contractor to provide bid pricing for test and balance work separately to Matt Wade, CMTA, mwade@cmtaegrs.com prior to bid date and time for commissioning work specified herein. Do not turn in with bid or include in total submitted bid amount

1. GENERAL

1.1. DESCRIPTION

- A. General provisions and other mechanical systems are specified in other Sections of Division 23.
- B. Commissioning is an ongoing process and shall be performed throughout construction. Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. Division 23 shall be familiar with the commissioning plan issued by the Commissioning Agent (CA) as it applies to the work of Division 23 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- C. Commissioning shall conclude with the completion of all required deferred testing, training and system documentation as specified and required to ensure the proper operation of the mechanical equipment and systems provided by this Division.
- D. This Section covers mechanical systems commissioning, as required to demonstrate that the equipment and systems of Division 23 are ready for safe and satisfactory operation, as defined by project documents. Commissioning shall include, but shall not be limited to, identification of piping and equipment, cleaning, lubrication, start-up, check-out, and testing, adjusting, and balancing of systems, preparation of equipment and systems documentation and of maintenance and operation manuals, Owner training, and preparation of record drawings.
- E. The bidding contractor shall review the Architect's list of alternates. Provide alternate pricing for both the Kitchen and Arena Alternates.

1.2. QUALITY ASSURANCE

- A. The mechanical contractor shall identify a mechanical commissioning supervisor. The mechanical commissioning supervisor should have a minimum of ten years experience in mechanical contracting. The mechanical commissioning supervisor shall become familiar with the design intent and the requirements of the commissioning process as defined in this Section. The mechanical commissioning supervisor shall attend all commissioning meetings and coordinate the commissioning schedule as outline by the commissioning agent. The mechanical commissioning supervisor shall assist the CA in coordinating and executing the required commissioning activities.

1.3. MECHANICAL CONTRACTOR RESPONSIBILITIES

- A. The mechanical commissioning supervisor shall be responsible for scheduling, supervising, and coordinating the startup, testing and commissioning activities as specified herein with the CA. Specific requirements of the mechanical contractor and associated subcontractors are identified in this Section and in other Sections of this Division.
- B. Mechanical commissioning shall take place in three phases. Commissioning requirements for each phase are as follows:
 - 1. Construction Phase

- a. Contractor shall attend a Commissioning Scoping meeting and additional commissioning meetings as required throughout the commissioning process. These commissioning meetings will be monthly during early construction and may increase in frequency to weekly during the start-up, prefunctional and functional testing phases. Contractor shall assure that all subcontractors who have commissioning responsibilities attend the Commissioning Scoping meeting and other commissioning meetings, as appropriate, during the construction process.
- b. Contractor shall report in writing to the CA at least as often as commissioning meetings are scheduled concerning the status of his activities as they affect the commissioning process, the status of each discrepancy identified, the prefunctional and functional testing process, explanations of any disagreements with the identified deficiencies, and proposed resolution and schedule.
- c. Contractor shall provide the CA with normal cut sheets and shop drawing submittals of equipment that is to be commissioned.
- d. Contractor shall provide documentation to the CA for development of pre-functional and functional performance testing procedures, prior to normal O&M manual submittals. This documentation shall include detailed manufacturer installation, start-up, operating, troubleshooting and maintenance procedures; full details of any owner-contracted tests; fan and pump curves; full factory testing reports, if any; and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent. The Commissioning Agent may request further documentation necessary for the development of functional performance testing and the commissioning process. This data request may be made prior to normal submittals.
- e. Contractor shall develop and submit to CA, for review prior to equipment or system startup, a complete startup and initial checkout plan using manufacturer's start-up procedures. The commissioning agent shall conduct their own pre-functional testing check in parallel with the contractors.
- f. Contractor shall review the commissioning agent's pre-functional checksheets and sign-off on the appropriate areas when contractor and sub-contractors are complete. The prefunctional test sheets will be developed by the commissioning agent. Only when each portion of the pre-functional test sheet is signed off will the contractor be able to move onto the next phase of the start-up and check-out.
- g. Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CA for review.
- h. Contractor shall assist in clarifying the proposed operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
- i. CA shall prepare the specific functional test procedures as specified herein. The contractors shall review the CA's proposed functional performance test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
- j. Commissioning agent shall prepare a preliminary schedule for Division 23 commissioning activities, to include pipe and duct system testing, flushing and cleaning,

equipment start-up, and TAB start and completion, for use by the CA and shall update the schedule as appropriate. The contractor shall update the commissioning activities and notify any delays in the progress meetings. Contractor shall notify the CA during the commissioning meetings when commissioning activities not yet performed or not yet scheduled will delay construction.

- k. Mechanical equipment start-up shall not be initiated until the complete sign-off of the pre-functional check-sheets as developed by the commissioning agent as specified in other Sections of Division 23.
 - l. Contractor shall provide startup testing for all HVAC equipment, including the building automation control system and shall execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment during the startup and initial checkout process. The commissioning agent shall conduct an independent start-up once the contractor is complete with their requirements.
 - m. Contractor shall perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.
 - n. Contractor shall correct current A/E punch list and CA deficiency items before functional performance testing can begin. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air or water related systems.
 - o. The commissioning agent shall generate the functional testing procedure and provide record to the mechanical contractor. The mechanical contractor shall review and provide support to the functional testing process. Contractor shall operate Energy Recovery Units, VRF Units, and if chiller alternate is accepted, pumps, and chiller, etc and systems in accordance with the CA requirements, open and close disconnects and switch normal and emergency power requirements as directed by the commissioning agent and the functional testing procedures.
 - p. Contractor shall report in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each outstanding discrepancy identified during commissioning, prefunctional and functional performance testing. Report shall include description of the identified discrepancy, explanations of any disagreements, and proposals and schedule for correction of the discrepancy.
2. Acceptance Phase. Contractor shall assist and cooperate with the CA in the commissioning process by:
- a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of the test and balance and commissioning effort, as required.
 - b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the mechanical system and associated controls completed and approved by the CA prior to beginning the test and balance process.
 - c. Provide a qualified technician to operate the controls as required to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
 - d. Provide a TAB representative to assist the CA on conducting a random 10% check of the air distribution requirements.

- e. Including cost of sheaves and belts that may be required to obtain required equipment performance, as measured by the test and balance effort.
 - f. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
 - g. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 - h. Installing a P/T plug at each water sensor that is an input point to the Control System.
 - i. Providing skilled technicians to execute starting and operation of equipment.
 - j. The commissioning agent will conduct functional performance testing. The contractor may be required to have a skilled technician present during functional testing although it is suggested that one be available to make adjustments or assist in problem-solving.
 - k. The commissioning will require full and part load performance verifications as well as seasonal and simulated testing requirements. The contractor shall be prepared to operate different components of various systems (example, chilled/hot water and geothermal systems to generate loading strategies) during the functional testing.
 - l. Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and A/E.
 - m. Prepare O&M manuals according to the Contractor Documents, including clarifying and updating the original sequence of operation to as-built conditions.
 - n. Maintain on site redline as built drawings and produce final "As-built" drawings for all project drawings and contractor-generated coordination drawings. List and clearly identify on the as-built drawings the locations of all airflow stations and sensor installations that are not equipment mounted.
 - o. Provide specified training of the Owner's operating personnel in accordance with the commissioning agent's overview and outline.
 - p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 - q. Provide updated diagrammatical logic for all TAB adjustments to the system.
3. Warranty Period. During the warranty period, the contractor shall:
- a. Be available during seasonal or deferred functional performance testing conducted by the CA, according to the specifications.
 - b. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.4. TAB CONTRACTOR RESPONSIBILITIES

- 1. Six weeks prior to the starting of the T&B, submit to the commissioning agent, the qualifications of the site technician(s) for the project, including three (3) names of contractors and facility managers of recent projects on which the personnel were in charge. The Owner and CA will approve the site technician for this job.

2. Three months prior to the start of the TAB, the TAB Contractor shall submit a plan and approach for each system. The plan shall be reviewed by the CA for review and approval. The submitted plan shall include:
 - a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system
 - b. An explanation of the intended use of the building control system.
 - c. All field check-out sheets and logs to be used that lists each piece of equipment to be tested adjusted and balanced with the data cells to be gathered for each.
 - d. Final test report forms to be used during this process
 - e. Detailed step by step procedures for TAB work for each system and issue: terminal flow calibration, diffuser proportioning, branch and submain proportioning, total flow calculations, rechecking diversity issues.
 - f. List all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of each of the test procedures, parameters and formulas to be used.
 - g. Details of how total flow will be determined (Air: sum of terminal flows via BMS calibrated readings or via hood, pitot tube or flow stations. Water: pump curves, circuit setters, flow station, ultrasonic, etc,
 - h. The identification and types of measurement instruments to be used and their most recent calibration date.
 - i. Specific procedures that will ensure that both air and watersides will be operating at there lowest possible pressure at the point where the system will operate.
 - j. Confirmation that the TAB contractor understands the outside air ventilation criteria under all conditions and how this will be measured during normal, economizer and unoccupied conditions.
 - k. Details of how building static, room static and exhaust fan capacity will be checked.
 - l. Proposed selection points for traverse measurement locations on the as-built documents. Review the placement of the HVAC measurement devices for proper straight runs and accuracy.
 - m. Plan for formal progress reports including scope and frequency
 - n. Plan for formal deficiency reports including scope and frequency.
3. TAB contractor shall attend commissioning meetings as directed by the commissioning agent and the GC.
4. TAB contractor shall communicate in writing to the controls contractor and the commissioning agent all setpoint and parameter changes made or problems and discrepancies identified during the TAB process that would affect the control loop system set-up and operation.
5. Submit written report of discrepancies, deficit or uncompleted work by others, contract interpretation requests and list of completed tests to the CA at least once per week.
6. After the TAB plan is accepted and two-weeks prior to TAB work, the commissioning agent shall conduct a pre-balancing conference. Prior to the prebalancing conference, the TAB contractor shall inspect the system readiness for testing and balancing. The TAB contractor shall prepare a list of deficiencies and uncompleted work that will affect the TAB process. This list shall be submitted to the commissioning agent and the GC.
7. If applicable, the TAB contractor shall coordinate testing of the fume hood systems with the CA and the owner's environmental health and safety organization.

8. The TAB contractor shall review the projected schedule and provide, in writing, to the CA and GC any delays in the schedule and what items will require completion prior to the TAB work.
9. The CA agent shall conduct independent verification of 10% of air and water end-devices for acceptance after the TAB contractor states in writing that they are complete with Testing & Balancing. The TAB contractor shall provide a mechanic to assist the CA in this verification and shall include this in the scope and price of the Work.
10. The TAB agent shall submit the TAB report to the commissioning agent for his review and comment. All data contained shall be re-verified in the field by the commissioning agent. A minimum of ten percent of the airflow readings shall be verified by the commissioning agent using his own equipment. All selection points shall be random. Total airflow shall be verified on all mains in the supply and the exhaust ducts.

2. PRODUCTS

2.1. SYSTEMS TO BE COMMISSIONED

- A. The following are systems to be commissioned.
 1. Building Automation System
 2. Outside Air Energy Recovery Unit
 3. Heat Pumps
 4. Building Pumps
 5. Boilers (Base Bid)
 6. Cooling Tower (Base Bid)
 7. Geothermal Loop Pumps (Alternate)
 8. Exhaust Fans
 9. Split System Units (Indoor/Outdoor)
 10. Domestic Hot Water Systems
 11. Commissioning of electrical systems as outlined in division 26. Refer to 260800 for additional commissioning requirements.
 12. Building air tightness test as documented below. Pressure test shall exclude temporary connector to existing high school.

2.2. TEST EQUIPMENT

- A. All standard testing equipment required to the mechanical portion startup, initial checkout shall be provided by the contractor responsible for the equipment or system being tested. This includes TAB and controls verification.
- B. The commissioning agent shall perform their own system verification and performance check-out. The commissioning agent shall provide their own calibrated equipment as required for this testing.
- C. All testing equipment associated with functional performance verification and point-to-point required by the commissioning agent shall be the responsibility of the commissioning agent.
- D. Special equipment, tools and instruments (only available from vendor or specific to a piece of equipment) required for the functional testing of that equipment, according to the requirements of the contract documents and the functional test procedures shall be provided to the CA by the installing contractor and shall become the property of the Owner at project completion as indicated in the specification.

- E. Proprietary test equipment and software required by any manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide test equipment, demonstrate its use and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon successful completion of the commissioning process as required in the specifications.

2.3. BUILDING AIR TIGHTNESS TEST

- A. The fan pressurization test to determine final compliance with the air tightness requirement shall be conducted when all components of the air barrier system have been installed and inspected, and have passed any intermediate testing procedures as detailed in the construction drawings and specifications. The test may be conducted before finishes that are not part of the air barrier system have been installed. For example, if suspended ceiling tile, interior gypsum board, or cladding systems are not part of the air barrier system, the test may be conducted before they are installed.
- B. Test Requirements
 - 1. The air leakage test must be performed in accordance with ASTM E 779 with the following additions and exceptions:
 - 2. The test consists of measuring the flow rates required to establish a minimum of 12 positive and 12 negative building pressures. The lowest test pressure shall be 0.1 in wg; the highest test pressure shall be 0.3 in wg; and there must be at least 0.1 in wg difference between the lowest and highest test pressures.
 - 3. The test pressure must be measured in a representative location such that pressures in the extremities of the enclosure can be shown to not exceed 10% of the measured test pressure. At least 12 bias pressure readings must be taken across the envelope and averaged over at least 20 seconds each before and after the flow rate measurements. None of the bias pressure readings must exceed 30% of the minimum test pressure when testing in both directions.
 - 4. Where it can be shown that it is impossible to test in both directions, then the building may be tested in the positive direction only, provided the bias pressure does not exceed 10% of the minimum test pressure.
 - 5. The mean value of the air leakage flow rate calculated from measured data at 0.3 in wg must not exceed 0.25 CFM per square foot of envelope area. Measurements must be referenced at standard conditions of 14.696 PSI and 68F.
 - 6. The test shall be conducted with ventilation fans and exhaust fans turned off and the outdoor air inlets and exhaust outlets sealed (by dampers or masking). The contractor must provide a responsible HVAC technician with the authority to place the HVAC system in the correct mode for the pressure test. The test technician must have unhindered access to mechanical rooms, air handlers, exhaust fans, and outdoor air and exhaust dampers.
 - 7. The contractor must ensure that all windows in the enclosure are kept closed. Entry and exit through doors in the test enclosure must be prohibited during the test. Data collected while the pressures and flows are affected by a door opening and closing shall be discarded.
 - 8. The testing agency is required to perform a diagnostic evaluation in accordance with ASTM E 1186, whether the building achieves the air tightness requirement or not. The diagnostic evaluation will assist the contractor and responsible parties in identifying and eliminating air leakage so the building meets the requirement upon retesting. The testing results will also be expressed in terms of the Equivalent Leakage Area (EqLA) at 0.3 in wg. The EqLA is the equivalent area of a flat plate that leaks the same amount as the building envelope at 0.3 in wg.
 - 9. A report shall be provided to Engineer and Architect after the first Air Tightness Test and the first diagnostic evaluation. After corrective measures are taken by the appropriate subcontractors, a second and final test Air Tightness Test shall be provided by the testing agency. A diagnostic evaluation shall again be provided after the second Air Tightness Test, should the second Air Tightness test reveal the building still does not meet air tightness requirements.

10. Any subsequent testing and evaluation after the second Air Tightness Test and second diagnostic evaluation shall be considered additional scope, and the cost of which shall be paid by the responsible party.

3. EXECUTION

3.1. SUBMITTALS

- A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1.

3.2. STARTUP PLAN AND PREFUNCTIONAL TESTING

- A. The mechanical contractor and associated subcontractors shall be responsible for the installation of complete systems and sub-systems, fully functional, meeting the design objectives of the Contract Documents. Contractor shall follow the approved start-up, initial checkout, and prefunctional testing procedures. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility to the commissioning agent or Owner.
- B. Prefunctional testing as directed and performed by the commissioning agent shall be required for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation so that functional performance testing may proceed without delays. Sampling strategies shall not be used for prefunctional testing. The prefunctional testing for all equipment and subsystems of a given system shall be successfully completed and documented prior to functional performance testing of the system. The mechanical contractor and sub-contractors shall sign off on the CA's pre-functional test sheets that they are complete and the system is ready. The commissioning agent will verify and conduct their own independent verification and start-up in parallel to the contractor's verification. Any deficiencies identified during this process shall be noted and reviewed by the contractors. Start-up and functional testing shall not proceed until all the deficiencies are corrected and verified by the commissioning agent.
- C. The following procedures shall apply to all equipment and systems to be commissioned.
 1. Start-up and Initial Checkout Plan. The Commissioning Agent shall develop the detailed start-up and prefunctional testing plans for all scheduled equipment. The primary role of the CA in this process shall be to review the installation for construction completeness and ensure that all components have been installed as per the design documents. Only when pre-functional testing is complete and signed off by all contractors, shall the equipment be start-up by the contractor. Equipment and systems to be commissioned are identified in this Section Part 2.
 2. The start-up and initial checkout plan shall consist of the following as a minimum:
 - a. The manufacturer's standard written start-up and checkout procedures copied from the installation manuals and manufacturer's normally used field checkout sheets. The plan shall include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - b. First-run checklist for equipment, to include:
 - 1) Equipment properly set.
 - 2) Alignment of shafts and couplings.
 - 3) Adjustment of vibration isolators.

- 4) Piping and equipment properly connected.
 - 5) Completion of initial lubrication procedures.
 - 6) Clean filters in place, as appropriate.
 - 7) Wiring properly connected.
 - 8) Electrical overload relays appropriate for load.
 - 9) Electrical accessories properly installed and adjusted.
 - 10) Controls, safeties, and time switches properly calibrated and set-up
 - 11) Verification of direction of motor rotation after final electrical connections by jogging motor.
 - 12) Measurements of ampere draw of electric motors and comparison with nameplate rating and with overload heater ratings.
3. The Commissioning Agent shall determine which trade is responsible for executing and documenting each of the line item tasks and note that trade on the form. Each form may have more than one trade responsible for its execution.
 4. The Contractor shall submit the startup reports to the CA for review.
- D. The CA shall review and approve the procedures and the format for documenting them, noting any procedures that need to be added.
 - E. Two weeks prior to startup, the contractor shall schedule startup and checkout with the Owner and CA. The execution of the startup and checkout shall be directed and performed by the contractor, in accordance with manufacturer's published procedures and with the approved procedures. The CA shall be present for the contractor's required startup and checkout of all systems and equipment to be commissioned.
 - F. Sensor Calibration. Calibration of all sensors shall be included as part of the prefunctional testing and listed on the appropriate test checklists and reports, according to the specified procedures and accuracies for the devices and systems being tested.
 - G. All contractor responsible start-up, checkout forms shall be completed and submitted to the CA for review.

3.3. FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Verification (FPV) is the dynamic testing of systems (rather than just individual components) under full, part and seasonal requirements. Systems are tested under various loads and control sequences, such as low cooling and heating loads, component failures, unoccupied modes, fire alarm, etc. The systems are run through all the control sequences of operation and components are verified to be responding as the design intent and documents. Functional performance verification shall include; testing all sequences of operations, verification of system capacity, generating simulated signals to simulate sensor values, conducting simulated conditions to tests all loads and verify system performance during all conditions of operation and verifying design intent. In addition, each system shall be tested through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part and full load). Proper responses such as power failures,

freeze conditions, low-oil pressures, equipment failures, etc. shall also be tested. The commissioning authority develops the functional test sheets and procedures in sequential written form, coordinates the testing, conducts the testing and documents the testing. Each contractor is required to supply personnel to assist during the functional performance testing where applicable.

- B. No system, equipment or component thereof shall be tested until the contractor and the GC has certified, in writing, that the system, equipment and / or components are complete, have been tested, adjusted and balanced and are ready for validating and performance testing. Functional Performance Verification is scheduled by the commissioning agent after the pre-functional testing requirements are complete and signed-off by the GC and the CA. Functional Performance Verification will not be conducted until a written notice of completion by the GC confirming that the system is ready for FPV. The air balancing and water balancing must be complete and the controls must be debugged prior to the performance verification.
- C. Functional testing shall be conducted by the commissioning agent. Functional testing may not proceed until the systems have been properly installed, started-up and all deficiencies have been corrected.
- D. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and GC. Beginning system testing before full completion shall not relieve the Contractor from fully completing the system, including all prefunctional checklists.
- E. The contractor shall provide personnel to operate the systems while functional performance testing is commencing. This shall include but not be limited to; starting and stopping of systems, opening and closing valves to create false loads on the system (with the capabilities of the existing system) and allowing the commissioning agent to manipulate the building automation systems to modulate the system requirements.
- F. The contractor shall review the commissioning functional performance testing procedure supplied by the commissioning agent. After functional testing commences, the contractor and the commissioning agent shall sign the functional test record and provide the owner and the GC a copy to review. All deficiencies either corrected in the field or outstanding shall be documented on the functional test forms for review by all parties.
- G. All Functional Testing must be completed and approved by the commissioning agent and the owner before the project will be considered substantially complete.

3.4. DEFERRED TESTING

- A. Deferred Testing. The contractor shall be available to assist in seasonal testing (Summer, Winter and Intermediate), tests delayed until weather or other conditions building construction is completed, required building occupancy or loading, or other conditions are suitable for the demonstration of equipment or system's performance, as specified. These deferred tests shall be conducted in the same manner as the seasonal tests as soon as possible. Deferred testing shall be executed, documented and deficiencies corrected as specified herein for functional performance testing. Any adjustments or corrections to the O&M manuals and "As built" documents required by the results of the testing shall be made before the seasonal testing process is considered complete.

3.5. TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. The commissioning agent shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the testing form or on an attached sheet. The testing form and any outstanding deficiencies shall be provided to the GC / Owner within two days of test completion. The CA shall review the contractor's startup testing reports and shall submit either a non-compliance report or an approval form to the contractor. The CA shall work with the contractor and others as necessary, to correct and retest deficiencies or

uncompleted items. The contractor shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report with a Statement of Correction on the original non-compliance report. When all requirements are satisfactorily completed, the CA shall recommend approval of the startup and prefunctional testing of each system and schedule the functional testing of the equipment or system.

- B. As functional performance testing progresses and a deficiency is identified, the CA shall discuss the issue with the executing contractor and the commissioning team.
 - 1. When there is no dispute of the deficiency and the contractor accepts responsibility for correcting it, the CA shall document the deficiency and the contractor's response and intentions and the testing shall proceed, if possible. Corrections of minor deficiencies identified may be made by the contractor during the functional performance testing, at the discretion of the CA. Every effort shall be made or expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the commissioning effort.
 - 2. When the identified deficiency is corrected, the contractor shall sign the statement of correction at the bottom of the non-compliance form, certifying that the equipment is ready to be retested, and return the form to the CA. The CA shall schedule the retest of the equipment or system involved.
 - 3. If there is a dispute about an identified deficiency, the CA shall document the deficiency and the contractor's response, and provide a copy to the contractor. Every attempt shall be made to resolve the dispute at the lowest management level possible. When the dispute resolution has been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and returns the form to the CA. The CA shall schedule the retest of the equipment or system involved. Final interpretive authority shall be the A/E. Final acceptance authority shall be the Owner.
- C. During the functional performance testing of multiple units of similar equipment, the CA will test all of the installed equipment and components identified. If, under such a testing procedure, three or more, identical pieces of equipment (size alone does not constitute difference) fail to perform to the requirements of the Contract Documents (mechanically or substantively) due to manufacturing defects not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CA. In such case, the contractor shall provide the CA with the following:
 - 1. Within one week of notification from the CA, the contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CA within two weeks of the original notice.
 - 2. Within two weeks of the original notification, the contractor shall provide the CA and the A/E a signed and dated, written explanation of the problem, cause of failures, etc. and proposed solution, including full equipment submittals for corrective or replacement equipment, if appropriate. The proposed solution shall not be for less than the specification requirements of the original installation.
 - 3. When approved, two examples of the proposed solution shall be installed by the contractor and the CA shall schedule and conduct functional testing of the proposed solution. Upon completion of the functional testing of the proposed solution, the CA shall recommend the acceptance or disapproval of the proposed solution to the Owner.
 - 4. Upon acceptance of the proposed solution by the Owner, the contractor shall replace or repair all identical items, at their expenses and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week of approval of the proposed solution.

D. Cost of Retesting

1. The cost for CA and/or Owner personnel to conduct the retesting of a functional performance testing requirements necessitated because a specific prefunctional or startup test item, reported to have been successfully completed, but found to be incomplete or faulty, shall be the responsibility of the contractor.
2. For a deficiency identified during the functional testing, not related to any prefunctional checklist or start-up fault, the CA and Owner shall direct the retesting of the equipment once at "no charge" for their time. However, all costs for any subsequent retesting shall be the responsibility of the contractor.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party.

3.6. EMERGENCY POWER / UNINTERRUPTIBLE POWER / LIFE SAFETY SYSTEMS

A. Parties Responsible to Execute or Participate in Functional Test including Blackout Testing:

1. Controls contractor: operate the controls.
2. Electrical contractor: assist in testing sequences and debugging.
3. Fire Alarm Contractor: Assist in the testing & debugging
4. Mechanical contractor: assist in testing sequences and debugging of mechanical equipment.
5. Owner staff at regional monitoring site: report communication response.
6. Facility representatives: assist in testing sequences and debugging.
7. Commissioning agent: conduct and coordinate testing.

B. Integral Components or Related Equipment Being Tested:

1. Automatic transfer switch
2. Emergency Generator
3. Building Automation System, HVAC and lighting, Fire Alarm and Fire Protection

3.7. OPERATION AND MAINTENANCE (O&M) MANUALS

- A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
- B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals, according to this section and prior to the training of owner personnel.
- C. The CA shall receive a copy of the O&M manuals for review.
- D. Operation and maintenance documentation, in hardback 3-ring loose-leaf binders except full size drawings and diskettes, shall cover all mechanical systems. Documentation shall include the following: operations and maintenance documentation directory; emergency information; operating manual; emergency information; maintenance manual; test reports; and construction documents.

- E. The operation and maintenance documentation package shall be submitted as one comprehensive package to the Owner and CA before systems start-up and commissioning, and shall be updated, revised and completed during, and at completion of, commissioning.

3.8. TRAINING OF OWNER PERSONNEL

- A. The mechanical commissioning supervisor shall be responsible for training coordination and scheduling of required training and for ensuring that all required training is completed. The CA shall oversee the content and adequacy of the training of Owner personnel.
- B. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading. Obtain direction from the Owner on which operating personnel shall be instructed in each system. Proposed training schedules, materials, and lesson plans shall be submitted to the CA for review of the content and adequacy of the training of Owner personnel for commissioned equipment or systems.
- C. Mechanical Contractor – the mechanical contractor shall have the following training responsibilities:
 1. Provide the CA with training plan one week before the planned training.
 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of equipment.
 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment.
 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the startup technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
 6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

3.9. WRITTEN WORK PRODUCTS

- A. Written work products of Contractors shall consist of the start-up and initial checkout plan and the filled out start-up, initial checkout and prefunctional checklists.

END OF SECTION

SECTION 231100 - REGISTERS, GRILLES, DIFFUSERS & LOUVERS**1. REGISTERS, GRILLES AND DIFFUSERS****A. GENERAL**

Alternate R, G & D selections, other than manufacturers and models listed below, will be accepted, provided quality, function and characteristics are equivalent. Acceptable alternates are Price, Titus, Metalaire, Carnes, Anemostat, Kruegar, and Tuttle & Bailey. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes shall be selected by the Architect. If Architect elects not to select color, all colors shall be off-white. Factory color samples shall be submitted with shop drawings.

B. SELECTION

Refer to the Selections Scheduled on the Drawings.

2. DIFFUSERS FOR RAISED FLOOR AND ACCESSIBLE FLOOR SYSTEMS

- A. Provide floor mounted supply diffusers as required to distribute supply air CFM of air handling equipment scheduled to serve raised/accessible floor areas. Coordinate placement of diffusers in the room with manufacturer of equipment to be set in the room. Diffusers shall be manufactured specifically for raised floor applications and shall support foot traffic and equipment. At the Contractor's option, diffusers may be supplied by the accessible floor system manufacturer; it is emphasized, however, that the Contractor is finally responsible for providing a finished air distribution system for the raised/accessible floor system.

3. LOUVERS**A. GENERAL**

Alternate louver selections, other than manufacturer and model listed below, will be accepted, provided quality, function and characteristics are equivalent. Acceptable alternates are Ruskin, Air Balance, Airline, Airstream, Louvers and Dampers and Penn. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes shall be selected by the Architect unless scheduled otherwise.

B. LINTELS

Provide lintels above all louvers as required. Refer to the lintel schedule in Specification Section 201100.

C. SELECTION

Refer to the Selections Scheduled on the Drawings.

END OF SECTION 231100

SECTION 231200 - SHEET METAL AND FLEXIBLE DUCT

1. GENERAL

- A. The Contractor's attention is directed to the General and Special Conditions, General Requirements-Mechanical and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified herein.
- B. This branch of the work includes all materials, labor and accessories for the fabrication and installation of all sheet metal work as shown on the drawings and/or as specified herein. Where construction methods for various items are not indicated on the drawings or specified herein, all such work shall be fabricated and installed in accordance with the recommended methods outlined in the latest edition of SMACNA's HVAC Duct Construction Standards, Metal and Flexible, and its subsequent addenda. HVAC duct systems shall be fabricated and installed in accordance with the SMACNA duct construction standards (SMACNA-HVAC and SMACNA-Seismic) including Appendix B of the Seismic Restraint Manual Guidelines for Mechanical Systems. These references and plate numbers shall be used by the Engineer for required sheet metal thicknesses and final acceptance of methods of fabrication, hanging, accessories, etc. All equipment furnished by manufacturers shall be installed in strict accord with their recommended methods.
- C. Ductwork shall be constructed and installed per the latest edition of the International Mechanical Code.
- D. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic to prohibit dust and dirt from entering the installed ductwork, air handling unit, terminal devices, etc. Provide temporary filters on all return grilles and duct openings if the units are running prior to the building being satisfactorily cleaned. Do not install the ductwork if the building is not "dried-in". If this is required, the open ends of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

Prior to purchase and fabrication of ductwork (shop fabricated or manufactured), the Contractor shall coordinate installations with new and existing conditions. Notify the Engineer if there are any discrepancies for resolution.
- E. Provide a SMACNA duct cleanliness level "C" per the latest SMACNA standards. [Refer to LEED / Healthcare Requirements]
- F. If separate filter grilles are specified for an HVAC unit the Contractors shall remove any unit mounted filters and blank off the unused filter access opening with sheet metal and seal air tight.
- G. Wall Penetrations: Where ducts penetrate interior or exterior walls, the walls shall be sealed air tight. Refer to the sleeving, cutting, patching, and repairing section of the specifications for additional requirements.
- H. Duct dimensions indicated are required inside clear dimensions. Plan duct layouts for adequate insulation and fitting clearance.
- I. Prior to purchase/shipment of the ductwork, manufacturer shall provide as part of the submittal process scaled, field coordinated AutoCAD drawings of the complete system to be furnished. Drawings will indicate all system components including fittings, ductwork and manifolds. Drawings shall be available in an electronic format.

2. LOW PRESSURE DUCTWORK

- A. General (Low Pressure)

- (1) Double turning vanes shall be installed in all square turns and in any other locations indicated.
- (2) Provide a "high efficiency" type take-off with round damper (Flexmaster STOD-B03 or approved equal) for all round duct branches from a rectangular main to a GRD. Refer to the detail on the drawings for all installation requirements.
- (3) Cross-break all ducts where any duct section dimension or length is 18" or larger.
- (4) Air volume dampers shall be installed in each duct branch takeoffs and/or where indicated, whichever is more stringent. All such dampers shall be accessible without damage to finishes or insulation and shall be provided where required for proper system balance.
- (5) Splitter dampers shall be provided in all rectangular supply air duct tees. Damper blade operator shall extend a minimum two inches thru the insulation.
- (6) Unless otherwise dimensioned on the drawings, all diffusers, registers and grilles shall be located aesthetically and symmetrically with respect to lighting, ceiling patterns, doors, masonry bond, etc. Locate all supply, return and exhaust diffusers and grilles in the locations shown on the architectural reflected ceiling plan.
- (7) Ducts shall be hung by angles, rods, 18 ga. minimum straps, trapezes, etc., in accordance with SMACNA's recommended practices. Duct supports shall not exceed 12 ft intervals. There shall be no less than one set of hangers for each section of ductwork. Where ductwork contains filter sections, coils, fans or other equipment or items, such equipment or items shall be hung independently of ductwork with rods or angles. Do not suspend ducts from purlins or other weak structural members where no additional weight may be applied. If in doubt, consult the structural engineer.
- (8) Provide approved flexible connectors at inlet and outlet of each item of heating and cooling equipment whether indicated or not. Install so as to facilitate removal of equipment as well as for vibration and noise control.
- (9) All ductwork connections, fittings, joints, etc., including longitudinal and transverse joints, seams and connections shall be sealed. Seal with medium pressure, smooth-textured, water based duct sealant. Sealant shall be UL 181B-M listed, UL 723 classified, NFPA 90A & 90B compliant, permanently flexible, nonflammable, and rated to 15" wg. Apply per manufacturer's recommendations. Contractors shall ensure no exposed sharp edges or burrs on ductwork.
- (10) All angular turns shall be made with the radius of the center line of the duct equivalent to 1.5 times the width of the duct.
- (11) Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA and/or as indicated. Test openings shall be placed at the inlet and discharge of all centrifugal fans, coils, VAV boxes, fan sections of air handling units, at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.
- (12) Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panel at each fire damper located and sized so as to allow hand reset of each fire dampers. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to Architectural Plans for locations of fire rated walls. All access doors shall be 16"x16" or as high as ductwork permits and 16" in length.

- (13) The Contractor who installs the sheet metal shall furnish to the Air Balancing Contractor, a qualified person to assist in testing and balancing the system.
- (14) All fans and other vibrating equipment shall be suspended by independent vibration isolators.
- (15) The interior surface of the ductwork connecting to return/exhaust air grilles shall be painted flat black. The ductwork shall be painted a minimum of 24" starting from the grille.

B. Materials (Low Pressure Single Wall)

- (1) Ductwork, plenums and other appurtenances shall be constructed of the following:
 - a. Steel sheets, zinc coated, Federal Specification 00-S-775, Type I, Class E & ASTM A93-59T with G-90 zinc coating or aluminum alloy sheets 3003, Federal Specification AA-A-359, Temper H-14. Utilize Aluminum in MRI Scan Rooms or NMR Room applications.
 - b. Exposed ductwork in finished spaces requiring insulation such as gymnasiums, etc., shall be dual wall ductwork.
- (2) Ductwork, plenums and other appurtenances shall be constructed of the materials of the minimum weights or gauges as required by the latest SMACNA 2" W.G. Standard or the below table, whichever is more stringent. When gauge thickness differs, the heavier gauge shall be selected. The below table shall serve as a minimum:

ROUND DUCT		RECTANGULAR DUCT	
DIA., INCHES	GAUGE	WIDTH, INCHES	GAUGE
3 TO 12	26	UP TO 12	26
12 TO 18	24	13 TO 30	24
19 TO 28	22	31 TO 54	22
29 TO 36	20	55 TO 84	20
37 TO 52	18	85 AND ABOVE	18

C. Materials (Low Pressure Double Wall Ductwork)

(Designer Edit locations below to match project requirements)

- (1) Install Double Wall Ductwork in the following areas:
 - a. Gymnasium
 - b. Lobbies (where exposed)
 - c. Above areas with partial ceilings or clouds.
 - d. Anywhere supply ductwork is installed exposed to view in spaces (other than mechanical rooms)
 - e. At all other locations indicated on drawings.

- (2) Furnish and install where indicated double wall duct. The double wall duct shall be Eastern Sheet Metal, United McGill, Semco or approved equivalent. The duct shall have an inner shell, a 1-inch layer of fiberglass insulation and an outer pressure shell.
- (3) Ductwork outer shell shall be spiral, lock-seam construction fabricated from galvanized steel meeting ASTM-527 standard. Any ductwork exposed to view shall be constructed of G90 galvanized steel, 20 gauge, and shall be supported as required with aircraft cables and self-tightening locks. Ductwork shall be constructed as specified in LOW PRESSURE DUCTWORK.

(Designer Edit below (5) or (6) to match job requirements. Solid steel inner shell required for jobs where insulation exposed to airstream is disallowed, perforated inner liner for better sound control.)

- (4) Inner shell for spiral pipe shall be a perforated inner liner. The inner liner shall have 3/32" perforation with an overall open area of 23%.
- (5) Inner shell for spiral pipe shall be solid galvanized steel and constructed of the minimum gauge specified with 3 intermediate reinforcing ribs.
- (6) Inner shell for fittings shall be galvanized steel. All fittings shall be manufactured by the same manufacturer as the spiral pipe. Fittings shall be constructed a minimum of 22 Ga.
- (7) The fiberglass liner shall have a maximum thermal conductivity (k) factor of 0.27 btu per hour per square foot per degree Fahrenheit per inch thickness at 75-degree F ambient temperature.
- (8) All double wall ductwork will be furnished with factory installed flanges equal to Eastern Sheet Metal Flange which shall consist of a 1.5 outer flange and an inner secondary flange which shall keep the inner flange concentric and eliminate inner wall connections. Flanges requiring inner couplings will not be allowed, no insulation shall be exposed to the airstream at the connections.
- (9) All grille and register taps shall be factory manifolded. Field installed taps will not be allowed. Manifolded taps may be tack welded and caulked for appearance. Only taps for grilles and registers may be provided this way. All other fittings shall be full body welded.

D. Miscellaneous (Low Pressure)

(1) Un-insulated Flexible ductwork (Use Only Where Indicated)

- a. Un-insulated flexible ductwork shall be corrugated aluminum. No sections shall be greater than five feet in length. Ductwork shall be UL rated and in accordance with IMC.
- b. Flexible ductwork installed in a return or exhaust or other negative static pressure application shall be rated for installation in negative pressure systems.

(2) Insulated Flexible Duct (Use Only Where Indicated)

- a. Owens/Corning or equivalent, 1 ½" inch thick fiberglass insulation; flexible liner; with aluminum pigment vinyl vapor barrier facing. Insulated flexible duct shall meet Fire Hazards Standards of NFPA 90A and IMC, flame spread not to exceed 25, smoke develop and fuel contributed not to exceed 50 when tested in accordance with ASTM-E84. Minimum R-value of 6.0, tested in accordance with ASTM C177.71. Flexible duct may be used only for runouts and no sections shall be more than five feet in length.

- b. When flexible duct is located in areas where it will be visible because the ceiling allows views to the ductwork above, the flexible duct shall be black. The black color shall be factory coloring and not field applied.
 - c. Flexible duct shall not be used in areas where there is no ceiling.
 - d. Flexible ductwork installed in a return or exhaust or other negative static pressure application shall be rated for installation in negative pressure systems
- (3) Insulated Flexible Duct – Steel or Aluminum (Use Only Where Indicated) **[UK Requirement]**
- a. Flexible duct shall be a factory-fabricated assembly consisting of an all steel or aluminum material. Plastic with spiral wire flexible duct is not permitted.
 - b. All supply flexible duct shall be insulated with 1 ½ inch blanket of glass wool with an outer moisture barrier. The insulation assembly shall have a flame spread of not more than 25 and a smoke development rate of not over 50.
 - c. Flexible duct shall be rated for 10 inches W.G. static pressure.
 - d. A single length of flexible duct shall not exceed 4'0".
 - e. The minimum bend radius shall be 1 ½ times the duct diameter. The radius shall be measured to the inside edge of the flexible duct.
 - f. Total offset in any run of flexible duct shall not exceed 90 degrees.
 - g. Provide a minimum of one hanger of each run of flexible duct. The hanger must be strapped around the flexible duct and secured to the structure above. Hangers shall not be attached to other mechanical or electrical objects. Hangers may be attached to an approved trapeze. Ceiling grid shall not be used to fabricate a trapeze. Support hangers shall be installed horizontal. Screws shall not be used to penetrate the flexible duct to attach the hanger.
 - h. Flexible duct shall be secured to the rigid duct and appliance with a nylon adjustable, self-locking, strap and a minimum of three sheet metal screws. The flexible duct shall be sealed airtight at each connection with self-adhesive aluminum tape. Fiber or cloth duct tape is not permitted to seal rigid or flexible duct.
 - i. All flexible duct shall be pressure tested by a testing and balancing agency to ensure the installation is airtight.
- (4) Flexible Connectors: Duro-Dyne, Ventfabrics, Inc., U.S. Rubber or equivalent; conforming to NFPA Pamphlet No. 90-A; neoprene coated glass fabric; 20 oz. for low pressure ducts secured with snap lock.
- (5) Turning Vanes: Duro-Dyne or equivalent fabricated as recommended by SMACNA: noiseless when in place without mounting projections in ducts. All turning vanes shall be double blade type.
- (6) Splitter Damper: Splitter damper shall be constructed of 16-gauge galvanized steel. Provide with operating hardware by Ventfabrics, Inc. to include damper blade bracket, ball joint bracket and operator shaft. Operator shall extend two inches from duct to allow for external insulation, where required. Regulator shall seal operator shaft air tight. Install hardware as recommended by manufacturer.

- (7) Access Doors; In Ductwork: Flexmaster TBSM, Air Balance, Vent Products or equal. Access doors for rectangular ducts shall be 16"x16" where possible. Otherwise install as large an access door as height permits by 16" in length. Door shall be 1" thick double-wall insulated with continuous hinge and cam lock. Provide in ducts where indicated or where required for servicing equipment whether indicated or not. Provide a hinged access door in duct adjacent to all fire, smoke and control dampers for the purpose of determining position. Access doors shall also be provided on each side of duct coils (water, electric, steam, etc.) and downstream side of VAV boxes and CAV boxes.
- (8) Architectural Access Doors in Ceilings or Walls: Provide where required to access equipment, dampers, valves, filters, etc. Provide Kees D Panel, Cesco, Milcor or equal. Panels shall be 24"x24" in size and constructed with 16 gauge galvanized steel for door and frame. In finished areas, provide with primed steel with 1" border to accept architectural specified finish. In Mechanical, Electrical, or service spaces, provide brushed satin finish with 1" border. Door shall include three (3) screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- (9) Security Architectural Access Doors in Walls: Provide where required to access equipment, dampers, valves, filters, etc. Provide Kees SSAP Panel, Cesco, Milcor or equal. Panels shall be 24"x24" in size and constructed with 12-gauge steel for door and frame. In finished areas, provide with primed steel with 1" border to accept architectural specified finish. In Mechanical, Electrical, or service spaces, provide brushed satin finish with 1" border. Door shall include key-operated cylinder dead bolt lock (coordinate cylinders and keys with Owner to match facility standards) and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors and straps. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- (10) Volume Dampers (Rectangular): Ruskin, Model MD35 or Empco, Air Balance; Louvers and Dampers, Titus, Carnes, Cesco/Advanced Air, Creative Metals, United Air, Pottorff rectangular volume dampers. Frames shall be 4" x 1 "x 16-gauge galvanized steel. Blades shall be opposed blade 16-gauge galvanized steel with triple crimped blades on 6" centers. Linkage shall be concealed in jamb. Bearings shall be 1/2" nylon. Maximum single section size shall be 48" wide and 72" high. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.
- (11) Volume Dampers (Round): Ruskin, Model MDRS25 or, Empco, Air Balance; Louvers and Dampers, Titus, Carnes, Cesco/Advanced Air, Creative Metals, United Air, Pottorff round volume dampers. Dampers shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20-gauge steel, 6" long. Damper blades shall be 20-gauge galvanized steel. Axle shall be 3/8"x6" square plated steel. Bearing shall be 3/8" nylon. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.
- (12) Fire Dampers: Fire dampers shall comply with IMC and shall be constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1-1/2 or 3-hour fire protection rating as required by fire wall. Damper shall have a 165°F fusible link, and shall include a UL label in accordance with established UL labeling procedures. Fire damper shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing 16-gauge minimum steel sleeves, angles, other materials, practices required to provide an installation equipment to that utilized by the manufacturer when dampers were tested at UL. Installation

- shall be in accordance with the damper manufacturer's instructions. **All fire dampers shall be dynamic. Static fire dampers are not allowed.** Provide velocity level and pressure level as required for application (if in doubt, contact Engineer). Fire dampers shall be Ruskin Type DIBD for 1-1/2-hour rating or Ruskin Type DIBD 23 for a 3-hour rating. Other acceptable manufacturers are Air Balance, Prefco, Greenheck, Nailor, or Safe Air. Provide an access door for fire damper reset at all fire damper locations.
- (13) Motor Driven Smoke Dampers – Air Foil Blade: Provide Ruskin SD60 smoke damper where required by the locations of smoke partitions or as shown on the plans, whichever is more stringent. Other acceptable manufacturers are Air Balance or Pottorff. All smoke dampers shall be three inches larger than HVAC duct in each direction. Frame shall be a minimum of 18-gauge galvanized steel formed into a structural hat channel shaper with tabbed corners for reinforcement. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, on 6" maximum centers. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Jamb seal shall be stainless steel flexible metal compression type. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close under HVAC system operating conditions) with pressures of at least the maximum possible of the HVAC system in the closed position, and the system maximum duct air velocity in the open position. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Appropriate electric actuators shall be installed by the damper manufacturer. Refer to building fire alarm and controls for exact type. Actuator to be mounted outside of air stream. The pressure drop shall not be greater than .16" wg @ 2500 FPM when tested by an independent laboratory. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements.
- (14) Motor Driven Fire/Smoke Dampers – Air Foil Blade: Fire damper shall be constructed and tested in accordance with UL Safety Standard 555. The damper shall be Ruskin FSD60. Other acceptable manufacturers are Air Balance or Pottorff. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, on 6" maximum centers. Frame is to be a minimum of 16-gauge galvanized steel, rollformed into a structural hat shape channel. Frame seals shall consist of flexible, compression type stainless steel. The damper and actuator electric shall be rated to an elevated temperature or 250 degrees F or 350 degrees F. In addition, the damper must be factory supplied with actuator and sleeve to comply with the requirements of UL 555S. These dampers shall have been constructed and tested in compliance with U.L. Standard 555 and U.L. Standard 555S, current editions. The pressure drop shall not be greater than .25 in.wg. At 2500 fpm when tested by an independent laboratory. Each damper shall bear an approved U.L. label identifying its classification as a Dynamic Rated Fire Damper (Static Rated dampers are not acceptable), and shall further be classified by U.L. as a Leakage Rated Damper for use in Smoke Control Systems. Each damper shall have a 1-1/2-hour fire protection rating, 212EF U.L. Listed fusible link and a leakage class I. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Appropriate electric actuators shall be installed by the damper manufacturer. Refer to building fire alarm and controls for exact type. Provide factory supplied caulked sleeve, 20 gauge on dampers through 84" wide and 18 gauge above 84" wide. Actuator to be mounted outside of air stream. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements.
- (15) Motor Driven Control Dampers – Provide Ruskin Model CD50 air foil damper as shown on the plans. Frame shall be a minimum of 16-gauge galvanized steel formed into a structural hat channel shaper with tabbed corners for reinforcement. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, 6 inches wide. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Jamb seal shall be stainless steel flexible metal compression type. Blade seals shall be equal to Ruskinprene. Leakage Rating shall be Pressure/Class 1.

3. MEDIUM PRESSURE DUCTWORK

A. General (Medium Pressure)

- (1) All ductwork connections, fittings, joints, etc., shall be sealed. Seal with high velocity, smooth-textured, water based duct sealant. Sealant shall be UL 181B-M listed, UL 723 classified, NFPA 90A & 90B compliant, permanently flexible, non-flammable, and rated to 15" wg. Apply per manufacturer's recommendations.
- (2) Ductwork shall be installed per SMACNA Medium or High-Pressure Manual, whichever is applicable. (Latest Edition shall apply.)
- (3) All hanger straps shall be 18 ga. minimum with reinforcement angles installed in strict accordance with SMACNA. Flat oval ducts shall be installed with 2"x2"x1/4" angles on top and bottom ducts 18" wide and larger. Use 1"x1"x3/16" angles on ducts under 18" wide.
- (4) Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA or the duct manufacturer, and/or as indicated. Test openings shall be placed at the discharge of all air handling units and at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.
- (5) Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panels at each fire damper located and sized so as to allow hand reset of each fire damper. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to Architectural Plans for locations of fire rated walls. Where access doors are installed in insulated ductwork, the access door shall be the insulated type.

B. Materials (Medium Pressure Single Wall)

- (1) All round, rectangular, and oval medium pressure ductwork for systems above 1.5" W.G. shall be Eastern Sheet Metal, United McGill or Semco or equal with construction as required by the latest SMACNA Standard (Refer to required pressure rating of the duct system as outlined in the Duct Schedule of this spec section).
- (2) Any ductwork exposed to view shall be double wall and constructed of galvanized steel. Galvanized metal shall be prepped and clean prior to painting. Coordinate with General Contractor.

Ductwork shall be spiral, lock-seam construction fabricated from galvanized steel meeting ASTM-527 standard. Ductwork shall be constructed of materials of the minimum weights or gauges as required by the latest SMACNA Standard (Refer to required pressure rating of the duct system as outlined in the Duct Schedule of this spec section) or the below table. When gauge thickness differs, the heavier gauge shall be selected. The below table shall serve as a minimum:

ROUND DUCT (or Equivalent Round Diameter for Oval Ducts)		RECTANGULAR DUCT	
DIA., INCHES	GAUGE	WIDTH, INCHES	GAUGE
3 TO 14	26	UP TO 12	26
15 TO 26	24	13 TO 30	24
27 TO 36	22	31 TO 54	22
37 TO 50	20	55 TO 84	20
52 TO 60	18	85 AND ABOVE	18

- (3) All medium pressure duct fittings shall be fabricated by the same manufacturer as the spiral pipe. Contractor or field fabricated fittings shall not be accepted. Duct fittings shall be constructed per the latest SMACNA standard (Refer to required pressure rating of the duct system as outlined in the Duct Schedule of this spec section) with continuous welds. Take-off fittings shall be combination type tees (Eastern Sheet Metal Model "CB" or equal). Straight or angle tees are not acceptable. Fittings shall be constructed of the following minimum gauges:

ROUND DUCT (or Equivalent Round Diameter for Oval Ducts)		RECTANGULAR DUCT	
DIA., INCHES	GAUGE	WIDTH, INCHES	GAUGE
3 TO 50	20	UP TO 36	20
51 TO 60	18	37 TO 60	18
61 TO 84	16	61 AND ABOVE	16

- (4) All single wall ductwork will be furnished with factory installed flanges equal to Eastern Sheet Metal Flange on all ductwork greater than 24 inches in size.

C. Materials (Medium pressure Double Wall)

- (1) Furnish and install where indicated by drawings or specifications medium pressure double wall duct. The double wall duct shall be United McGill Acoustic K27, SEMCO, Dixie or approved equivalent. The duct shall have a **[perforated inner liner. The inner liner shall have 3/32" perforation with an overall open area of 23%.]** **[solid galvanized steel inner liner]**, an intermediate layer of fiberglass insulation minimum 1" thick and an outer pressure shell. Duct shall be of spiral lock seam construction fabricated from galvanized steel meeting ASTM-A527 standard. The duct insulation shall have minimum R-value of 6.0. Medium pressure double wall fittings shall have the same construction features as the double wall duct.

Duct shall be constructed of G90 Galvanized steel. Outer shell of ductwork shall be constructed of the minimum gauges specified above for single wall medium pressure ductwork.

- (2) All double wall ductwork will be furnished with factory installed flanges equal to Eastern Sheet Metal Flange which shall consist of a 1.5 outer flange and an inner secondary flange which shall keep the inner flange concentric and eliminate inner wall connections. Flanges requiring inner couplings will not be allowed, no insulation shall be exposed to the airstream at the connections.

D. Miscellaneous (Medium pressure)

- (1) Flexible Connectors: Duro-Dyne, Ventfabrics, U.S. Rubber or equivalent; conforming to NFPA Pamphlet No. 90-A or IMC, whichever is more stringent; neoprene coated glass fabric; 30 oz. for medium pressure ducts secured with bolted angles. Provide flexible connectors at inlet and outlet of air handling equipment to accommodate a minimum of three times the operating pressure of the system.
- (2) Architectural Access Doors In Ceilings or Walls: Provide where required to access equipment, dampers, valves, filters, etc. Provide Kees D Panel, CESCO, Milcor or equal. Panels shall be 24"x24" in size and constructed with 16 gauge galvanized steel for door and frame. In finished areas, provide with primed steel with 1" border to accept architectural specified finish. In Mechanical, Electrical, or service spaces, provide brushed satin finish with 1" border. Door shall include three (3) screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- (3) Security Architectural Access Doors in Walls: Provide where required to access equipment, dampers, valves, filters, etc. Provide Kees SSAP Panel, CESCO, Milcor or equal. Panels shall be 24"x24" in size and constructed with 12-gauge steel for door and frame. In finished areas, provide with primed steel with 1" border to accept architectural specified finish. In Mechanical, Electrical, or service spaces, provide brushed satin finish with 1" border. Door shall include key-operated cylinder dead bolt lock (coordinate cylinders and keys with Owner to match facility standards) and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors and straps. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- (4) Fire Dampers: Fire dampers shall comply with IMC and shall be constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1-1/2 or 3-hour fire protection rating as required by fire wall. Damper shall have a 165°F fusible link, and shall include a UL label in accordance with established UL labeling procedures. Fire damper shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing 16-gauge minimum steel sleeves, angles, other materials, practices required to provide an installation equipment to that utilized by the manufacturer when dampers were tested at UL. Installation shall be in accordance with the damper manufacturer's instructions. **All fire dampers shall be dynamic. Static fire dampers are not allowed.** Provide velocity level and pressure level as required for application (if in doubt, contact Engineer). Fire dampers shall be Ruskin Type DIBD for 1-1/2-hour rating or Ruskin Type DIBD 23 for a 3-hour rating. Other acceptable manufacturers are Air Balance, Prefco, Greenheck, Nailor, or Safe Air. Provide an access door for fire damper reset at all fire damper locations.
- (5) Motor Driven Smoke Dampers – Air Foil Blade: Provide Ruskin SD60 smoke damper where required by the locations of smoke partitions or as shown on the plans, whichever is more stringent. Other acceptable manufacturers are Air Balance or Pottorff. Frame shall be a minimum of 18-gauge galvanized steel formed

- into a structural hat channel shaper with tabbed corners for reinforcement. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, on 6" maximum centers. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Jamb seal shall be stainless steel flexible metal compression type. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close under HVAC system operating conditions) with pressures of at least the maximum possible of the HVAC system in the closed position, and the system maximum duct air velocity in the open position. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Appropriate electric actuators shall be installed by the damper manufacturer. Refer to building fire alarm and controls for exact type. Actuator to be mounted outside of air stream. The pressure drop shall not be greater than .16" wg @ 2500 FPM when tested by an independent laboratory. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements.
- (6) Motor Driven Fire/Smoke Dampers – Air Foil Blade: Fire damper shall be constructed and tested in accordance with UL Safety Standard 555. The damper shall be Ruskin FSD60. Other acceptable manufacturers are Air Balance or Pottorff. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, on 6" maximum centers. Frame is to be a minimum of 16-gauge galvanized steel, rollformed into a structural hat shape channel. Frame seals shall consist of flexible, compression type stainless steel. The damper and actuator electric shall be rated to an elevated temperature of 250 degrees F or 350 degrees F. In addition, the damper must be factory supplied with actuator and sleeve to comply with the requirements of UL 555S. These dampers shall have been constructed and tested in compliance with U.L. Standard 555 and U.L. Standard 555S, current editions. The pressure drop shall not be greater than .25 in.wg. At 2500 fpm when tested by an independent laboratory. Each damper shall bear an approved U.L. label identifying its classification as a Dynamic Rated Fire Damper (Static Rated dampers are not acceptable), and shall further be classified by U.L. as a Leakage Rated Damper for use in Smoke Control Systems. Each damper shall have a 1-1/2-hour fire protection rating, 212EF U.L. Listed fusible link and a leakage class I. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. Appropriate electric actuators shall be installed by the damper manufacturer. Refer to building fire alarm and controls for exact type. Provide factory supplied caulked sleeve, 20 gauge on dampers through 84" wide and 18 gauge above 84" wide. Actuator to be mounted outside of air stream. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements
- (7) Motor Driven Control Dampers – Provide Ruskin Model CD60 air foil damper as shown on the plans. Frame shall be a minimum of 16-gauge galvanized steel formed into a structural hat channel shaper with tabbed corners for reinforcement. The blade shall be airfoil shaped, constructed of a dual skinned galvanized steel, 14-gauge equivalent thickness, 6 inches wide. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Jamb seal shall be stainless steel flexible metal compression type. Blade seals shall be equal to Ruskinprene. Leakage Rating shall be Pressure/Class 1.
- (8) Access Doors; In Rectangular Medium Pressure Ductwork: Flexmaster TBSM, Air Balance, Vent Products or equal. Access doors for rectangular ducts shall be 16"x16" where possible. Otherwise install as large an access door as height permits by 16" in length. Door shall be 1" thick double-wall insulated with continuous hinge and cam lock. Provide in ducts where indicated or where required for servicing equipment whether indicated or not. Provide a hinged access door in duct adjacent to all fire, smoke and control dampers for the purpose of determining position.
- (9) Access Doors; In Round or Oval Medium Pressure Ductwork: All access doors in round or oval medium pressure ductwork shall be screw and gasketed type. Screws shall be maximum 4 inches on centers. Access door sizes shall be as follows:

DUCT DIAMETER	OPENING SIZE
3-4 inches	4" x 10"
5-6 inches	6" x 10"
7-24 inches	10" x 16"
26-36 inches	16" x 16"
Over 36 inches	16" x 22"

- (10) Pressure Relief Doors: **[Designer edit if required]** Provide a pressure relief vent in the supply air ductwork at each air handling unit. It shall be located between the fan outlet and the first manual or automatic (i.e., fire, fire smoke, or any motorized) damper or closure device. It shall be sized to relieve the duct air pressure below the rated pressure construction of the ductwork and above the working pressure of the fan. The supply air relief door shall be Ruskin PRD18 or equal. Provide a vacuum relief vent in the return and/or outside air ductwork at each air handling unit. It shall be located between the air handling unit casing and the first manual or automatic damper or closure device. It shall be sized to relieve the duct vacuum below the rated construction of the ductwork and above the working negative pressure of the fan. The return air relief door shall be Ruskin NRD18 or equal. Automatic fan shutdown upon damper closure shall not be an acceptable protection for either overpressure or vacuum conditions. All duct pressure relief doors shall be of the automatic resetting type unless otherwise noted.

4. TYPE 1 KITCHEN RANGE HOOD EXHAUST DUCT

- A. Ducts shall be constructed of 18-gauge stainless steel with liquid tight continuous external weld of all seams and joints where exposed. Where ducts are concealed, they shall be constructed of 16-gauge black steel with liquid-tight continuous weld of all seams and joints. Inside laps on duct joints shall project in a direction against the air flow.
- B. Ducts shall be so constructed and sloped as to provide suitable drainage of grease to a collection point or to hood. At the base of each vertical riser or low point in ductwork, a residue trap shall be provided with provisions for cleanout per IMC. Ducts shall slope a minimum of 1/4" per foot. Horizontal ducts exceeding 75 ft in length must slope a minimum of 1" per foot.
- C. Hand holes for inspection and cleaning purposes, equipped with tight fitting sliding or swinging doors and latches, shall be provided in horizontal and vertical sections of exhaust ducts. Such openings shall be at the sides of the horizontal run in order to prevent dripping of residue. Spacing of such openings shall not exceed 20 feet and shall be located at all offsets and grease collection points. Openings shall have a minimum dimension of 20" in width with a height equivalent to the duct height minus one inch.
- D. No turning vanes or dampers shall be installed in type 1 grease duct.
- E. The Contractor shall install the kitchen range hood exhaust duct systems and maintain the minimum code required clearances to combustibles. The use of UL listed and approved enclosure system of fire wraps/blankets installed per the manufacturer's instructions are acceptable when required to achieve the clearance to combustibles requirements.
- F. At the Contractor's option and where noted on the plans, a UL2221 Pre-manufactured Duct System equal to Metal Fab 3G shall be acceptable. Duct shall have a stainless steel inner liner, aluminized outer liner and one or three-inch liner as required to comply with requirements of clearance to combustibles.
- G. Shop drawings of the kitchen range hood exhaust ductwork shall be made and submitted to the appropriate reviewing agency. Any fees associated with this submittal shall be borne by this Contractor.

5. TYPE 2 KITCHEN RANGE HOOD EXHAUST DUCT

- A. All type 2 kitchen range hood exhaust duct connected to hoods designated as foodservice item #'s [edit fs item #'s] is to be installed as required by dishwasher exhaust duct requirements.
- B. All type 2 kitchen range hood exhaust duct connected to hoods designated as foodservice item #'s [edit fs item #'s] is to be installed as required by low pressure ductwork requirements.

6. DISHWASHER EXHAUST DUCT

- A. All exposed exhaust duct shall be 22-gauge stainless steel duct with liquid tight continuous external weld of all seams and joints. All concealed exhaust duct shall be 24-gauge aluminum with liquid tight joints. Provide dielectric connection between steel and aluminum ductwork. All ductwork shall be sloped a minimum of 1/8" per foot so as to drain back toward the dishwasher.

7. DRYER VENT

- A. All dryer ducting shall be a minimum of 4" in diameter. Refer to the drawings for exact duct sizing.
- B. Dryer vent ductwork shall be rigid metal 20-gauge aluminum duct. Duct joints shall be installed so that the male end of the duct points in the direction of the airflow. Joints shall be secured with metal tape (not duct tape). Do not use rivets or screws in the joints or anywhere else in the duct as these will incur lint collection
- C. Length of concealed rigid metal ducting shall not exceed the allowable length of 35 feet. Deduct 5 feet from the allowable length for every 4" 90-degree elbow and 4" 2.5 feet for every 45-degree fitting. lengths may vary per local codes and dryer manufacturer's recommendations. Install per 2012 IMC Section 504 Clothes Dryer Exhaust. Provide a complete, working in-line booster fan system, including power, if the maximum allowable duct length is exceeded.
- D. Flexible transition hose connection at the dryer shall be the aluminum flexible duct type. Do not use the plastic or vinyl.
- E. Termination of dryer venting shall be to the exterior with a proper hood or roof jack equipped with a backdraft damper. Hood/jack shall be painted with suitable exterior grade paint and color per the Owner's direction. Small orifice metal screening shall not be part of the hood or roof jack as this will trap lint and block the opening. The hood opening shall point down and maintain a minimum of 12 inches of clearance between the bottom of the hood and the ground or other obstruction.

8. UNDERGROUND OR UNDERSLAB LOW PRESSURE SUPPLY AND RETURN AIR DUCTWORK

- A. Eastern Sheet Metal and United McGill, 4 mil PVC clad, interior and exterior steel corrugated duct installed in strict accordance with the manufacturer's recommendations.

Designer note: review this detail. Also indicate how ducts are to be drained in needed.

- B. Underground ductwork indicated on the plans shall also be installed in strict accordance with SMACNA HVAC Duct Construction Standards, Section 3.9 – Underground Duct Construction Standards and Reference Figure 3-11. Provide drain connections and piping as required.

9. WATER HEATER AND BOILER FLUE STACKS

- A. Location

- (1) All flues shall be offset to provide, whether indicated or not, a minimum of 10' horizontal separation to any air intake. This distance shall be a 25' minimum on healthcare facilities.
- B. Natural Draft, Gas-Fired Water Heaters and Boilers (Maximum Flue Temperature 300°F., Maximum Size 8 Inches Diameter)
- (1) Metal Fab Type M, or approved equivalent Type "B" gas vent system. Gas Vent shall be double wall construction, with inner wall constructed of aluminum and outer wall constructed of galvanized steel. Gas vent system shall be UL listed and installed in strict accordance with the manufacturers recommendations. Provide with factory fittings such as elbows, tees, increasers, draft hood connections, tall cone flashing, storm collar, wall thimble, metal cap, etc., as required for a complete project. Minimum UL listed clearance to combustibles shall be one inch.
- C. Natural Draft, Gas-Fired Water Heaters and Boilers (Maximum Flue Temperature 400°F; 10 Inch Diameter and Greater in Size)
- (1) Metal Fab Type M, or approved equivalent Type "B" gas vent system. Gas vent shall be double wall construction. Inner wall shall be aluminum and outer wall galvanized steel. One-half inch insulating air space shall be provided between the walls. Gas vent system shall be UL listed and installed in strict accordance with the manufacturer's recommendations. Provide with factory fittings such as elbows, tees, tee cap, cap, tall cone flashing, support plate increaser etc., as required for a complete project. Shop drawings shall be submitted for Engineer's review. Minimum UL listed clearance to combustibles shall be one inch.
- D. Gas-Fired Water Heaters and Boilers with Barometric Damper or Number 2 Fuel Oil-Fired Water Heaters and Boilers (Maximum Flue Temperature 1000°F)
- (1) AMPCO Model "NPS", or approved equivalent double wall negative pressure system. Vent shall be double wall construction. Inner wall shall be Type 304 stainless steel. Outer wall shall be aluminum coated steel. One-half inch insulating air space shall be provided between walls. Minimum UL listed clearance to combustibles shall be twelve inches. Provide vent spaces as required, vent system shall be UL listed in strict accordance with the manufacturer's recommendations. Provide with factory fittings such as elbows, tees, tee cap, cap, tall cone flashing, support plate, increaser, etc., as required for a complete project. Shop drawings shall be submitted for Engineer's review.
- E. Positive Pressure vent systems for Water Heaters and Boilers, Gas-Fired or Oil-Fired (Maximum Flue Temperature 1000°F)
- (1) Metal Fan PIC or approved equivalent double wall positive pressure system. Vent shall be double wall construction. Inner wall shall be 20-gauge, Type 304 stainless steel. Outer wall shall be 24-gauge aluminum coated steel. One-inch insulating air space shall be provided between walls. Minimum UL listed clearance to combustibles shall be ten inches. Provide vent spacers as required. Vent system shall be UL listed in strict accordance with the manufacturer's recommendations. Provide with factory fittings such as elbows, tees, tee cap, cap, tall cone flashing, support plate, increaser, etc., as required for a complete project. Shop drawings shall be submitted for Engineer's review.
- F. Category II and Category IV Appliances (Positive and Negative Pressure Condensing Appliances)
- (1) Metal-Fab Corr/Guard, Heat-Fab Saf-T Vent or other approved equal meeting the specification below:

The vent shall be of the double wall, factory-built type for use on condensing appliances or pressurized venting systems serving Category II, III, or IV appliances or as specified by the equipment manufacturer.

Maximum temperature shall not exceed 550°F.

Vent shall be listed for an internal static pressure of 6" w.g. and tested to 15" w.g.

Vent shall be constructed on an inner and outer wall with a 1" annular insulating air space.

The inner wall (vent) shall be constructed of AL29-4C superferritic stainless steel, .015 thickness for 6"-12" diameters and .024 thickness for 14"-24" diameters.

The outer wall (casing) shall be constructed of type 304 stainless steel. .018 thickness for 6"-12" diameters and .024 thickness for 14"-24" diameters.

Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.

Product shall carry the appropriate UL listing mark or label.

6" to 12" diameter vent shall have 1" clearance to combustibles at 550°F. 14" to 24" diameter vent shall have 5" clearance to combustibles at 550°F.

10. FLUE CAPS

- A. Provide a flue cap on all flues. It shall be similar to the Breident positive downdraft eliminator style.

11. DUCT SCHEDULE

A. Supply Ducts:

- (1) Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, downstream of Terminal Units <Insert equipment>:
 - a. Pressure Class: Positive 2-inch wg Refer to Low Pressure requirements as outlined in section 2 of this spec.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- (2) Ducts Connected to Constant-Volume Air-Handling Units <Insert equipment>:
 - a. Pressure Class: Positive [2] [4, 6, or 10]-inch wg Refer to [Low Pressure requirements as outlined in section 2 of this spec] [Medium Pressure requirements as outlined in section 3 of this spec].
 - b. Minimum SMACNA Seal Class: [C] [A].
 - c. SMACNA Leakage Class for Rectangular: [24] [6].
 - d. SMACNA Leakage Class for Round and Flat Oval: [12] [3].
- (3) Ducts Connected to Variable-Air Volume Air-Handling Units <Insert equipment>:
 - a. Pressure Class: Positive [4, 6, or 10]-inch wg Refer to medium pressure standards as outlined in section 3 of this spec.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.

B. Return Ducts:

- (1) Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, downstream of Terminal Units <Insert equipment>:
 - a. Pressure Class: Negative 2-inch wg Refer to Low Pressure requirements as outlined in section 2 of this spec.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- (2) Ducts Connected to Air-Handling Units <Insert equipment>:
 - a. Pressure Class: Negative [2][4, 6, or 10]-inch wg Refer to [Low Pressure requirements as outlined in section 2 of this spec] [Medium Pressure requirements as outlined in section 3 of this spec].
 - b. Minimum SMACNA Seal Class: [C] [A].
 - c. SMACNA Leakage Class for Rectangular: [24] [6].
 - d. SMACNA Leakage Class for Round and Flat Oval: [12] [3]

C. Exhaust/Relief Ducts:

- (1) Ducts Connected to Exhaust Fans <Insert equipment>:
 - a. Pressure Class: Negative [2][4, 6, or 10]-inch wg Refer to [Low Pressure requirements as outlined in section 2 of this spec] [Medium Pressure requirements as outlined in section 3 of this spec].
 - b. Minimum SMACNA Seal Class: [C] [A].
 - c. SMACNA Leakage Class for Rectangular: [24] [6].
 - d. SMACNA Leakage Class for Round and Flat Oval: [12] [3]
- (2) Ducts Connected to Air-Handling Units <Insert equipment>:
 - a. Pressure Class: Positive or Negative [2][4, 6, or 10]-inch wg Refer to [Low Pressure requirements as outlined in section 2 of this spec] [Medium Pressure requirements as outlined in section 3 of this spec].
 - b. Minimum SMACNA Seal Class: [C] [A].
 - c. SMACNA Leakage Class for Rectangular: [24] [6].
 - d. SMACNA Leakage Class for Round and Flat Oval: [12] [3].
- (3) Ducts Connected to Laboratory Exhaust Fans <Insert equipment>:
 - a. Pressure Class: Negative [4, 6, or 10]-inch wg Refer to Medium Pressure requirements as outlined in section 3 as well as requirements outlined in the Hazardous Exhaust duct section of this spec.
 - b. Minimum SMACNA Seal Class: [A] [Welded seams, joints, and penetrations].
 - c. SMACNA Leakage Class: 3.

D. Outdoor Air Ducts:

- (1) Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, downstream of Terminal Units <Insert equipment>:
 - a. Pressure Class: Positive 2-inch wg Refer to Low Pressure requirements as outlined in section 2 of this spec.
 - b. Minimum SMACNA Seal Class: C.

- c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- (2) Ducts Connected to Air-Handling Units <Insert equipment>:
- a. Pressure Class: Positive or Negative [2][4, 6, or 10]-inch wg Refer to [Low Pressure requirements as outlined in section 2 of this spec] [Medium Pressure requirements as outlined in section 3 of this spec].
 - b. Minimum SMACNA Seal Class: [C] [A].
 - c. SMACNA Leakage Class for Rectangular: [24] [6].
 - d. SMACNA Leakage Class for Round and Flat Oval: [12] [3].

12. Air Leakage Testing of the Ductwork Systems

- A. It is the intent of this section to ensure the ductwork installed has minimal air leakage.
- B. Air leakage testing shall be accomplished by an AABC or NEBB certified company. Refer to the Test & Balance specifications.
- C. It is the intent to test all ductwork. The duct systems which will require testing are as follows: (Note to Designer to edit.)
 - (1) All supply air duct systems
 - (2) All return air duct systems.
 - (3) All exhaust air duct systems.
 - (4) All make-up air duct systems.
- D. Do not insulate the supply air systems prior to testing.
- E. The maximum allowable air leakage rate for each system tested must conform to SMACNA required leakage class rating as specified in section 11, DUCT SCHEDULE, of this spec.
- F. The entire supply air ductwork system shall be tested with some exceptions. On VAV systems, the medium pressure ductwork upstream of the VAV boxes shall only be tested. Cap the duct at the inlet to the VAV box. On low pressure reheat system, all ductwork upstream of the hot water reheat coil shall be tested. The air volume damper and access door upstream of the reheat coil shall be included in the tested system. (Designer, edit above paragraph as required.)
- G. All return and exhaust air sheet metal ductwork associated with the system shall be tested. Flexible ductwork shall not be tested. Cap the main duct prior to the central equipment fan connection. Also cap the branch ducts which serve the diffusers, after the round branch air volume with sheet metal caps. Seal caps well to damper to avoid air loss at this location. This air loss, from the caps, is included in the noted leakage rate.
- H. The noted allowable leakage rate is the total allowable. It shall include leakage associated with the following: (Note to Designer to edit.)
 - (1) All ductwork as described in above paragraphs.
 - (2) Access doors
 - (3) Volume dampers

- (4) Relief air doors
 - (5) Smoke dampers
 - (6) Fire dampers
 - (7) Fire smoke dampers
 - (8) End caps used to seal ducts
- I. If any duct system fails a test, the contractor shall reseal the system. It shall then be retested until the duct system meets the leakage allowable at no additional cost to the owner.
- J. Carefully select the ductwork construction requirements and the type of duct sealant to be used as required to meet the leakage allowances. The sheet metal duct pressure classification is a minimum only. The contractor shall select the appropriate sheet metal pressure classification, duct sealant class and duct sealant materials to meet the project air leakage allowances.
- (Edit Below if not required)**
- K. A duct pre-installation conference shall be held prior to the installation of the ductwork. Present should be the owner's representative, engineer, Test & Balance Contractor, General Contractor, Mechanical Contractor, Sheet Metal Contractor, Insulation Contractor and the manufacturer's representative of the duct sealant to be used. At this meeting, the contractor shall advise all of the duct materials and sealant materials to be used to meet the air leakage allowances.
- L. Whenever the systems are being leak tested by the Test & Balance Contractor, a representative from the Mechanical Contractor shall be present to assist.

END OF SECTION 231200

SECTION 250100 - MOTOR STARTERS AND OTHER ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**1. MOTOR STARTERS-GENERAL**

- A. Where motor starters are required for mechanical equipment they are to be the responsibility of the Contractor furnishing the equipment as outlined herein.
- B. Motor starters shall be furnished by the Equipment Supplier with his equipment. Coordinate all requirements for starters with equipment suppliers and other trades.
- C. Motor starters shall be NEMA style. I.E.C.-style starters are not to be provided. Their sizing and installation shall be coordinated with the equipment manufacturer's requirements and in accordance with the National Electrical Code.
- D. Unless otherwise noted, provide combination starter/disconnects for all equipment requiring a starter.

2. ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. All mechanical equipment shall be provided for single point electrical connection unless specifically noted to the contrary. Refer to schedules and other sections of these specifications for further requirements. It is the responsibility of the Contractor to coordinate the electrical characteristics of all equipment with the electrical provisions indicated on the Contract Documents. The Contractor shall notify the Engineer in writing ten calendar days prior to bid of any discrepancy so a written clarification by Addendum may be made. If such notice is not given, the Contractor shall be responsible for any and all costs or delays associated with any changes required. Specification of equipment characteristics made during review of shop drawings shall not relieve the Contractor of this responsibility.
- B. The equipment manufacturer shall provide internally mounted fuses with his equipment, as required, to comply with the U.L. listing on the equipment name plate. (i.e., hermetically sealed compressors or equipment with name plate data that recommends or requires fuse protection.) See also, National Electrical Code, Article 440, and other applicable sections of the N.E.C.
- C. It is the Contractor's responsibility to furnish and install fusible or non-fusible disconnect switches or circuit breakers for disconnecting means as required by the Code for all electrically powered equipment. All power wiring from source, thru disconnecting means and motor starters to motor terminals or equipment junction box is to be furnished and installed by the Contractor. Each separate contractor engaged for the project shall coordinate with all other trades to ensure all necessary equipment and labor is included for fully functioning mechanical systems, installed per code requirements. Unless otherwise notes, provide combination starter/disconnects for all equipment requiring a starter.
- D. Final electrical connection of equipment shall be verified for proper voltage requirements in conjunction with the motor nameplate patch and actual wiring configuration. Any costs associated with damage to appliances motors, equipment, etc., connected to incorrect supply voltage shall be borne by the Contractor.
- E. Refrigeration condensing units with internal compressors shall be furnished with integral starter. The Contractor is to furnish and install a fusible disconnecting means with fuses sized to motor nameplate requirements. Coordinate wiring, mounting and style of disconnect switch at unit in field.
- F. All interlock or other control wiring, unless specifically noted otherwise, is the responsibility of the Contractor.

- G. All equipment shall be suitably enclosed. All enclosures for equipment shall be rated and approved for the environment in which it operates. (i.e., NEMA 1, NEMA 3R, NEMA 7, NEMA 12, etc.) Verify the requirement with the installation condition if not indicated on the plans.
- H. Observe the following standards for manufacturers of equipment and selection of components.
 - (1) Starters, control devices and assemblies: NEMA, U.L. - (I.E.C. style not acceptable)
 - (2) Enclosures for electrical equipment: NEMA, U.L.
 - (3) Enclosed switches: NEMA, U.L.
 - (4) All electrical work, generally: National Electrical Code
 - (5) All electrical work in industrial occupancies: J.I.C. standards
 - (6) All electrical components and materials: U.L. listing required.
- I. Where required, the Contractor is to provide mounting rails or channels to install starters with code-required clearances. Framing shall be solidly anchored by welding expansion shields in masonry or other approved anchorage. Frames are to be constructed of steel angles or pre-manufactured channel systems such as Unistrut, Kindorf or B-Line Company. Framing material shall be pre-finished with corrosion-resistant material or painted with two coats corrosion-resistant oil-based enamel.

3. REQUIREMENTS FOR MECHANICAL EQUIPMENT, 1/2 H.P OR LESS

- A. This section describes requirements for small mechanical equipment such as (but not limited to) package terminal heating/cooling units, (water source heat pumps, etc.) VAV boxes, unit heaters, vertical and horizontal unit ventilators, exhaust fans, in-line fans, fan coil units, cabinet heaters and the like.
- B. Small equipment with motor(s) of 1/2 H.P., single phase or less are generally not required to be furnished with NEMA-style starter(s), unless otherwise noted.
- C. For such equipment, provide integral contactor or horsepower-rated relay where controlled by thermostat or other type of switch. Contactors or relays shall be as recommended by the manufacturer of the equipment, suitable for the service duty.
- D. Provide transformer within unit as required to derive low voltage A.C. for thermostat control or derive from temperature controls panel, if available.
- E. Provide internal fusing for unit motor and other loads in fuse block or in-line fuseholder. See also Article 2-B, this Section.
- F. Where externally-mounted disconnecting means is required and would be impractical, unsightly or inappropriate in the judgment of the Engineer, disconnects shall be located within the unit. These disconnects may be fusible H.P.-rated snap switches or manual starters with overload elements, as required. Locate this and other electrical equipment within enclosure where easily accessible behind access panel or door on unit, and as acceptable to the electrical inspector or local authority having jurisdiction. Refer to mechanical equipment schedules for further information.
- G. Where fractional horsepower duplex pumps such as water circulators, sump pumps, etc. are provided, they shall be provided with alternators, cordsets, etc., as required for a complete installation.

4. REQUIREMENTS FOR MECHANICAL EQUIPMENT, 3/4 H.P. OR LARGER

- A. This section describes requirements for mechanical equipment such as (but not limited to) exhaust fans, larger air handling units, cooling tower fans, water source heat pumps, chilled or hot water pumps, D.X. roof-top units, air compressors and the like.
- B. Provide premium efficiency motors.
- C. Equipment provided with motor(s) of 3/4 H.P. and larger, single or three-phase are required to be furnished with starters suitable for the load(s) specified. It is recommended that starters be furnished integrally with or mounted on equipment for field wiring by the Contractor. Where starters are furnished separate from equipment, furnish templates or rough-in diagrams to the appropriate contractor for his use in installation.
- D. All starters shall be size 0 minimum. They shall be constructed and tested in accord with latest edition of NEMA standards. All starters shall be across-the-line magnetic type, unless indicated otherwise. On motors of 20 H.P. or greater rating, the supplier shall provide starters capable of limiting inrush currents. These shall be of the wye-delta, reduced voltage open-transition type, or electronic controlled, as required. Do not utilize closed transition starters unless specifically indicated.
- E. Magnetic starters shall be furnished with the following characteristics and accessories as a minimum. See other sections of these specifications and mechanical schedules for further requirements.
 - (1) Contacts shall be silver-alloy, double-break type. Contacts shall be replaceable without removal of wiring or removal of starter from enclosure. Number of contacts shall be as required for service indicated. Contacts shall be gravity dropout type, positive operation.
 - (2) Coil voltage shall be 120 volts, A.C., 60 HZ or less, as required to suit control systems available voltages. Coils shall be of molded construction, rated for continuous duty. Provide coil clearing contact as required.
 - (3) Provide control transformer of adequate K.V.A. as required on all starters with line-to-line voltages higher than 120 volts A.C. Provide fuse block and slow-blow fuse to protect control transformer per NEMA, N.E.C. and U.L.
 - (4) Provide hand-off-auto selector switch in face of starter, wired into hand and off switch positions. Auto position (if needed) to be field wired as indicated on plans or schedules for automatic control. Provide a green run pilot light.
 - (5) Provide NEMA Class 20 resettable overload relays, accurately sized to the motor nameplate rating of the motor served and the temperature differential between motor and controller. Overloads shall be easily replaceable, and resettable without opening enclosure, via a push button or similar means. Class 10 or Class 30 overloads may be used, depending on the type of anticipated service.
 - (6) Provide at least one N.O. and one N.C. auxiliary contact (field-convertible to opposite operation) with each starter. Refer to mechanical details or schedules for additional requirements, if any. All starters shall have space for two additional single-pole contacts.
 - (7) All starters shall be thru-wiring type.
 - (8) Provide phase failure sensing relay to open starter coil circuit (on loss of one or more phases) on all three-phase starters controlling motors of 15 H.P. or larger.

- (9) Provide power factor correction capacitors on motors of 15 H.P. or larger where predicted power factor based on manufacturer's data will fall below 0.90%. Capacitors shall be of the unit-cell type, in single enclosure with discharge resistors and tank overpressure circuit interrupter for safety.

5. REQUIREMENTS FOR WIRING

- A. All wiring, including controls, interlock, miscellaneous power, sensors, thermostats, etc., shall be installed in metallic raceway systems that are in compliance with all Division 26 requirements of these Specifications, unless specifically noted otherwise. Open cabling systems will only be permitted where specifically permitted within the Division 26 Specifications and if less than 50 volts A.C. peak-to-peak or 50 volts maximum D.C.
- B. Where open cabling is permitted, it shall be installed with proper support as specified in the Division 26 Specifications.
- C. Where open cabling is permitted, and installed in environmental air plenum (return, relief, supply, etc.), the materials installed shall be in compliance with N.E.C. Articles 700, 725, 770 (for fiber optic), 780 and 800.
- D. Where open cabling is permitted, it shall only be installed open in accessible spaces. Where concealed in walls, it shall be routed through raceways to outlet box(es) for the terminal device.

6. INVERTER DUTY MOTORS

- A. Motors which are controlled by variable frequency drive shall be:
 - (1) NEMA MG-1 Part 31 rated for Inverter Duty.
 - (2) Furnished with shaft grounding kit for all motors:
 - a. Motors less than 100 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. One shaft grounding ring and related hardware shall be provided on drive end or non-drive end of motor per manufacturer's instructions. These shall be factory mounted and installed on the exterior of the motor to allow for visual inspection. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.
 - b. Motors Pumps greater than 100 HP to 1000 HP in size shall be furnished with shaft grounding kit, Aegis SGR Bearing Protection Ring or equal. Provide shaft grounding ring on drive end and non-drive end of motor per manufacturer's instructions. Additionally, provide insulated bearing journals to further reduce risk of current dissipation through bearings. Ground motor frame per manufacturer's instructions. Install kit in strict accordance with manufacturer's instructions.

END OF SECTION 250100

SECTION 250200 - CONTROLS – DIRECT DIGITAL**1. GENERAL**

- A. The Contractor shall furnish all labor, materials, equipment and services required to provide a complete temperature control system as specified and as shown on the plans.
- B. Prior to the installation of or payment for any work, the Contractor shall prepare submittals which shall be reviewed by the Architect and Engineer. These submittals shall include a complete control diagram and sequence of operation of the entire system, plus engineering data on all devices used.
- C. The Contractor shall be a licensed installer of HVAC temperature controls by a national temperature controls manufacturer. Acceptable manufacturers are Trane, Siemens, Johnson, Honeywell, Andover, TAC, Invensys, Alerton or Automated Logic. The installer shall have 5 years experience and installed a minimum of 8 systems of similar size. Their offices shall be within 150 miles of the project site.
- D. The system herein specified shall be free from defects in workmanship and material under normal use and service if, within twelve (12) months from the date of acceptance by the Engineer, any of the equipment herein described is proved to be defective in workmanship or material, it will be adjusted, repaired, or replaced free of charge by the Contractor.
- E. All equipment, unless specified to the contrary, shall be fully proportioning and adjustable. The Control System shall consist of all room thermostats, air stream thermostats, valves, damper operators, relays, freeze protection equipment, dampers, panels, and other accessory equipment not provided with the equipment to fill the intent of the specifications and drawings.
- F. Complete freeze protection equipment shall be provided at all required locations. Freeze protection thermostats shall have twenty-foot elements and be capable of de-energizing the circuit when any point along the element reaches the set point of the thermostat. Freezestat elements shall be placed on the leaving side of each heating coil, so that every square foot on the heating coil is protected. On heating coils larger than eighteen (18) square feet, provide multiple freezestats wired in series. The Contractor shall ensure that all freeze protection devices and equipment has been fully tested prior to the heating season and shall so certify in writing to the Engineers. The cost of replacement of equipment damaged by freeze-up caused by improper freeze protection or faulty control equipment shall be borne by the Contractor.
- G. All units, controls, equipment, heat pumps, etc., and controls shall reset automatically when power is restored after an outage.
- H. All control wiring concealed in walls and exposed in mechanical rooms, closets, etc., shall be in conduit. Provide plenum rated wiring where cable is concealed above ceilings. Do not paint wiring. The Contractor is responsible for protecting wiring from paint. Any painted cabling shall be replaced.
- I. All dampers shall be capable of operating properly with the system pressures encountered. This shall include modulating and shut-off functions.
- J. The Contractor shall also refer to the mechanical maintenance, HVAC equipment, and all other sections of the specifications for additional control requirements.
- K. Provide smoke detectors and shut down control for all air handling units and combined air systems as required by the KBC and IMC Section 606.
- L. All DDC controllers or control modules shall have covers to protect the circuit boards. All wiring shall be anchored securely within 6" of the controller.

- M. Provide all control dampers, etc. not supplied with the equipment or required to accomplish the sequences specified.
- N. The Contractor shall provide all refrigeration control and interlock wiring as recommended by the equipment manufacturer.
- O. Wiring and required conduit in connection with the control system(s), including power wiring of any voltage, shall be installed by the Contractor. The Contractor may, at his option, engage the Electrical Contractor to accomplish this work. It is emphasized however, that the Contractor is finally responsible for all such work.
- P. Electric power for the control panels, modules, unit controller, damper motors, etc., shall be derived from the building electric system. Power shall not be derived from the HVAC equipment power source or equipment low voltage transformers (internal or integral).
- Q. The electrical work required for the installation of the control system(s), shall be provided by the Contractor in accordance with all National and Local Electrical Codes. All wiring shall be concealed except in Mechanical Rooms. All electrical work specified under this division of the specifications shall also comply with Division 26 of these specifications.
- R. All exterior electrical work, equipment, etc. shall be waterproofed.
- S. Controls system and all related components shall comply with ASHRAE Standard 135 (BACnet protocol).

2. OWNER'S TRAINING

- A. The Contractor shall provide full instructions to designated personnel in the operation, maintenance, and programming of the system. The training shall be specifically oriented to the system and interfacing equipment installed. Four hours of Owner Training shall be provided at substantial completion, again after 6 months and again 1 year after substantial completion. The Owner Training shall include an overview of the entire HVAC system operation, temperature sensor setpoint manipulation, critical alarm training and graphics display overview. Subcontractors shall be present during Owner training sessions.
- B. The Contractor shall provide a Sign-in Sheet and Meeting Minutes of the training. The Contractor shall also video record the initial training sessions. Complete Operations and Maintenance Manuals shall be reviewed by the Contractor during training.

3. CONTROL SYSTEM CHECKOUT AND TESTING – BY CONTROLS CONTRACTOR PRIOR TO DEMONSTRATION AND ACCEPTANCE

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any of all startup testing.
 - (1) Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 250200.
 - (2) Verify that control wiring is properly connected and free of shorts and ground faults.
 - (3) Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 - (4) Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

- (5) Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
- (6) Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated. Submit log to Engineer for review.
- (7) Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
- (8) Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

DELETE BELOW IF CMTA WILL NOT BE COMMISSIONING THE CONTROLS SYSTEM. EDIT ON-SITE TIME REQUIREMENT.

4. CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Control System Checkout and Testing. Provide Engineer with log documenting completion of startup tests. Submission of log is required before Demonstration and Acceptance may begin.
 - (1) Engineer will be present to observe and review system demonstration. Schedule with Engineer at least 14 days before system demonstration begins. Systems balancing shall be complete prior to demonstration, coordinate scheduling with TAB agency accordingly.
 - (2) Demonstrate actual field operation of each sequence of operation as specified in these specifications. Provide at least two persons for two days each (32 man-hours) to demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation. Specified on site time does NOT include time necessary to correct deficiencies.
 - (3) Demonstrate complete operation of operator interface.
 - (4) Demonstrate all alarms, including external alarms to Owner selected pagers, phones, e-mail accounts, etc. Also demonstrate fire alarm system interface.
 - (5) Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
 - (6) Provide all required tools to perform system demonstration and point calibration (drills, duct plugs, thermometers, hygrometers, hand-held carbon dioxide sensors, aerosol test smoke, 2-way radios, water probes, DP sensors for water and air, etc.)
- B. Acceptance
 - (1) After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
 - (2) System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in these specifications. Warrantee will not start until acceptance by Owner and Engineer.

DELETE OPTIMIZATION PERIOD BELOW IF CMTA WILL NOT BE MONITORING THE BUILDING PERFORMANCE AFTER CONSTRUCTION.

5. ONE YEAR OPTIMIZATION PERIOD

- A. The controls contractor shall provide assistance to the Engineer for a period of one year from date of system acceptance for the purposes of optimizing the systems for energy efficiency and occupant comfort. The assistance shall consist of the following:

- (1) Assist the Engineer in accessing the controls system remotely.
- (2) Input schedules and setpoints for all zones and equipment as requested by Engineer and Owner.
- (3) Trend points as requested by Engineer.
- (4) Modify controls sequences as requested by Engineer. No additional points will be added by the Engineer.
- (5) Modify setpoints and schedules as requested by Engineer and Owner.

Additionally, during the optimization period, include 2 site visits (6 hours on-site each) for system modifications that cannot be accomplished remotely.

6. EQUIPMENT

A. CONTROL PANEL(S)

- (1) Each system shall be provided with a local panel for mounting of all relays, switches, controllers, and thermometers associated with that system. Where one cabinet will not accommodate all the equipment necessary for one system, a second cabinet shall be mounted and bolted adjacent to it. Cabinets shall be provided with a 2/3's door. All devices shall be provided with lamacoid plastic nameplates for identification.

B. THERMOSTATS

(1) General

- a. All thermostats shall have a "warmer-cooler" knob. This control shall allow the space occupants to reset the temperature up or down a predetermined amount. This amount, or no amount at all, shall be settable thru the BAS.
- b. The thermostat shall have an unoccupied override button and an integral communications port.
- c. The thermostat shall have no integral thermometer.
- d. All thermostats provided for the project shall be similar in size and appearance.
- e. Provide tamper-proof guards for all wall mounted thermostats selected by Owner.
- f. All thermostats shall be mounted on a plastic base or other insulating material to prevent wall coupling effect.
- g. Thermostats shall be mounted with the top at a maximum of 48" A.F.F. and shall be mounted to comply with A.D.A.
- h. Thermostats shall provide temperature dead band of 5° F as required by IECC 2012.
- i. Thermostat, or any other DDC sensor back box in rated walls shall be a minimum distance apart as allowed by code to maintain the rating. If closer, provide rated box or fireproofing in code approved manner.

C. DAMPERS

- (1) Several louvers of practical widths shall be provided for larger dampers. Modulating dampers shall have opposed blades. Dampers shall have edge and end seals. Dampers shall be Ruskin CD-60 or better. Maximum leakage rate shall be 2 CFM per square foot at 1" W.G. pressure differential for dampers greater than 12" wide. Leak rate for dampers 12" and less shall be 3 CFM per square foot. NOTE: Do not mount outside air dampers so close to water coils, piping, etc., that freeze-up may occur due to a leaky damper.

D. RELAYS AND SWITCHES

- (1) Relays and switches shall be of the positive and gradual acting type and shall be furnished and installed as required for the successful operation of the system. All switches shall have suitable indicating plates.

E. VALVES

- (1) All valves shall be of the fully modulating and silent type unless otherwise specified. They shall provide accurate control of the heating or cooling medium under all load conditions. All valves 2-inches or smaller shall have brass or bronze bodies with screwed ends. Valves 2-1/2 inches and larger shall have iron bodies, brass or bronze trimming with flange ends. Valves shall be normally open or normally closed as required. Valves shall be installed with the stem in the upright position or as recommended by the valve manufacturer.

7. DEMONSTRATION

- A. A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall demonstrate on -site with the Owner and Engineer that all points and sequences operate as designed.

The warranty does not start until all controls, graphics, points, etc. are functioning.

All controls functioning on _____ Date

Witnessed by _____

8. SEQUENCE OF CONTROL**A. Control Zones:**

- (1) All control zones shall be provided with occupied/unoccupied scheduling, holiday scheduling and timed override. All areas served by outside air handling unit OA-1 is one control zone including gang toilets and associated ventilation fans. Cafeteria 103, Storage 102 and Mechanical 102A is the second control zone. Console heat pumps CHP-12 in Lobby 101 shall be included in both control zones. Provide night setback control.

B. Control Zone #1:

- (1) Occupied: Outside air handler OA-1 starts and runs continuously under its' own control. Exhaust fans EF-1, 2, 3 run continuously. Heat pump fans run continuously and their compressors cycle to maintain room setpoint.

END OF SECTION 250200

SECTION 260501 - GENERAL PROVISIONS - ELECTRICAL**1. GENERAL**

- A. The Instructions to Bidders, General and Special Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub Contractor's work. Each Contractor is directed to familiarize himself in detail with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- B. The Contractor shall be governed by any alternates, unit prices and Addenda or other contract documents insofar as they may affect his part of the work.
- C. The work included in this division consists of the furnishing of all labor, equipment, transportation, supplies, material and appurtenances and performing all operations necessary for the satisfactory installation of complete and operating electrical systems indicated on the drawings and/or specified herein.
- D. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the electrical systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the drawings and specifications, shall be included as part of this Contract. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting his bid, it shall be understood that the Contractor has included the cost of all required items in his bid, and that he will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- E. It is not the intent of this section of the specifications (or the remainder of the contract documents) to make any specific Contractor, other than the Contractor holding the prime contract, responsible to the Owner, Architect and Engineer. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be done through the Contractor to the Architect (if applicable), then to the Engineer.
- F. This section of the Specifications or the arrangement of the contract documents shall not be construed as an attempt to arbitrarily assign responsibility for work, material, equipment or services to a particular trade Contractor or Sub-Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.
- G. It is the intent of this Contract to deliver to the Owner a "like new" project once work is complete. Although plans and specifications are complete to the extent possible, it shall be responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials to be installed by other trades without additional cost to the Owner.
- H. The Contractor shall provide interim life safety and fire detection measures as required by the Authority Having Jurisdiction, Division 1 specifications, NFPA, and applicable Codes. This includes temporary relocations of heat/smoke detection, exit signage, and egress lighting in existing buildings as applicable.
- I. In general, and to the extent possible, all work shall be accomplished without interruption of the existing facilities' operations. Each Contractor shall advise the Architect, Owner and Engineer (as applicable) in writing at least one week prior to the deliberate interruption of any services. The Owner shall be advised of the exact time that interruption will occur and the length of time the interruption will occur. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed.

- J. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of his own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without request for extra compensation to the Owner, except where otherwise provided for in the contract document.
- K. The Contractor shall be responsible for maintaining existing fire alarm, paging, access control, intrusion detection, CCTV, nurse call systems, etc., in occupied spaces in renovation and addition projects. The Contractor shall be required to disconnect and remove all existing devices in renovated areas (where directed as such) without affecting system operations. All costs associated with said work shall be borne by the Contractor.

L. Definitions:

- (1) Prime Contractor - The Contractor who has been engaged by the Owner in a contractual relationship to accomplish the work.
- (2) Electrical Contractor - Any Contractor whether bidding or working independently or under the supervision of a General Contractor, that is: the one holding the Prime Contract and who installs any type of Electrical work, such as: power, lighting, television, telecommunications, data, fiber optic, intercom, fire detection and alarm, security, video, underground or overhead electrical, etc.

Note: Any reference within these specifications to a specific entity, i.e., "Electrical Contractor" is not to be construed as an attempt to limit or define the scope of work for that entity or assign work to a specific trade or contracting entity. Such assignments of responsibility are the responsibility of the Contractor or Construction Manager holding the prime contract, unless otherwise provided herein.

- (3) Electrical Sub-Contractor - Each or any Contractor contracted to, or employed by, the Electrical Contractor for any work required by the Electrical Contractor.
- (4) Engineer - The Consulting Mechanical-Electrical Engineers, either consulting to the Owner, Architect, other Engineers, etc.
- (5) Architect - The Architect of Record for the project, if any.
- (6) Furnish - Deliver to the site in good condition.
- (7) Provide - Furnish and install in complete working order.
- (8) Install - Install equipment furnished by others in complete working order.
- (9) Contract Documents - All documents pertinent to the quality and quantity of all work to be performed on the project. Includes, but not limited to: Plans, Specifications, Addenda, Instructions to Bidders, (both General and Sub-Contractors), Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Construction Manager's Assignments, Architect's Supplemental Instructions, Periodical Payment Requests, etc.

2. INTENT

- A. It is the intent of these specifications and all associated drawings that the Contractor provide finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."

- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

3. ELECTRICAL DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed insofar as possible. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Engineer for review before proceeding with the work. The Contract Drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Contractors shall, however, anticipate that additional offsets may be required and submit their bid accordingly.
- B. The drawings and specifications are intended to supplement each other. No Contractor or supplier shall take advantage of conflict between them, or between parts of either, but should this condition exist, the Contractor or supplier shall request a clarification of the condition at least ten days prior to the submission of bids so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be the determining factor. In all instances, unless modified in writing and agreed upon by all parties thereto, the Contract to accomplish the work shall be binding on the affected Contractor.
- C. The drawings and specifications shall be considered to be cooperative and complimentary and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. The Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. He shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- E. The Engineer shall reserve the right to make minor adjustments in location of conduit, fixtures, outlets, switches, etc., where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance.
- F. The Contractor shall evaluate ceiling heights called for on Architectural Plans. Where the location of Electrical equipment may interfere with ceiling heights, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work on the part of the Contractor or unduly delay the work.
- G. Special Note: Always check ceiling heights indicated on Drawings and Schedules and insure that these heights may be maintained after all mechanical and electrical equipment is installed. If a conflict is apparent, notify the Engineer in writing for instructions.
- H. Should overlap of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
- I. The drawings are intended to show the approximate location of equipment, materials, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions whether given in figures or scaled shall be verified in the field. In case of conflict between small and large scale drawings, the larger scale drawings shall take precedence.
- J. The Contractor and his Sub Contractors shall review all drawings in detail as they may relate to his work (structural, architectural, site survey, mechanical, etc.). Review all drawings for general coordination of

work, responsibilities, ceiling clearances, wall penetration points, chase access, fixture elevations, etc. Make any pertinent coordination or apparent conflict comments to the Engineers at least ten days prior to bids, for issuance of clarification by written addendum.

- K. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.

4. EXAMINATION OF SITE AND CONDITIONS

- A. The Contractor shall inform himself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. All Contractors or suppliers shall carefully examine all Drawings and Specifications and contract documents to determine the kind and type of materials to be used throughout the project and which may, in any way, affect the execution of his work.
- B. The Contractor shall fully acquaint himself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of temporary or permanent utilities, etc. The Contractor shall include in his work all expenses or disbursements in connection with such matters and conditions. The Contractor shall verify all work shown on the drawings and conditions at the site, and shall report in writing to the Engineer ten days prior to bid, any apparent omissions or discrepancies in order that clarifications may be issued by written addendum. No allowance is to be made for lack of knowledge concerning such conditions after bids are accepted.

5. EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS

- A. When any Contractor requests review of substitute materials and/or equipment, and when under an approved formal alternate proposal, it shall be understood and agreed that such substitution, if approved, will be made without additional cost regardless of changes in connections, spacing, service, mounting, etc. In all cases where substitutions affect other trades, the Contractor offering such substitutions shall advise all such Contractors of the change and shall reimburse them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Special Note: Review of Shop Drawings by the Engineer does not absolve the Contractor of this responsibility
- B. References in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Each Contractor, in such cases, may, at his option, use any article, device, product, material, fixture, form, or type of construction which in the judgment of the Engineer is equivalent to that specified, provided the provisions of paragraph (A) immediately preceding are met. Substitutions shall be submitted to the Engineer a minimum of ten days prior to bid date for approval to bid in written form thru addenda or other method selected by the Engineer. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the engineers.
- D. The Contractor shall furnish along with his proposal a list of specified equipment and materials which he proposes to provide. Where several makes are mentioned in the Specifications and the Contractor fails to

state which he proposes to furnish, the Engineer shall have the right to choose any of the makes mentioned without change in price.

- E. The Contractor shall review the contract documents and if a material substitution form is required for each proposed substitution, it shall be submitted per requirements.

6. SUPERVISION OF WORK

- A. Each Contractor and Sub-Contractors shall personally supervise the work or have a competent superintendent on the project site at all times during progress of the work, with full authority to act for him in matters related to the project.

7. CODES, RULES, PERMITS, FEES, REGULATIONS, ETC.

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, and other costs including utility connections or extensions, in connection with his work. As necessary, he shall file all required plans, utility easement requests and drawings, survey information on line locations, load calculations, etc., prepare all documents and obtain all necessary approvals of all utility and governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in the work, without extra cost, any labor, materials, services, apparatus or drawings required in order to comply with all applicable laws, ordinances rules and regulations, whether or not shown on drawings and/or specified.
- D. All materials furnished and all work installed shall comply with the current edition of the National Electrical Codes, National Fire Codes of the National Fire Protection Association, the requirements of local utility companies, and with the requirements of all governmental agencies or departments having jurisdiction.
- E. All material and equipment for the electrical systems shall bear the approval label, or shall be listed by the Underwriters' Laboratories, Incorporated. Listings by other testing agencies may be acceptable with written approval by the Engineer.
- F. All electrical work is to be constructed and installed in accordance with plans and specifications which have been approved in their entirety and/or reflect any changes requested by the State Fire Marshal, as applicable or required. Electrical work shall not commence until such plans are in the hands of the Electrical Contractor.
- G. The Contractor shall insure that his work is accomplished in accord with OSHA Standards and any other applicable government requirements.
- H. Where conflict arises between any code and the plans and/or specifications, the code shall apply except in the instance where the plans and specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten working days prior to bid date, otherwise the Contractor shall make the required changes at his own expense. The provisions of the codes constitute minimum standards for wiring methods, materials, equipment and construction and compliance therewith will be required for all electrical work, except where the drawings and specifications require better materials, equipment, and construction than these minimum standards, in which case the drawings and specifications shall be the minimum standards.

8. COST BREAKDOWNS/SCHEDULE OF VALUES

- A. Within thirty days after acceptance of the Contract, the Contractor is required to furnish to the Engineer one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made on forms provided or approved by the Engineer or Architect. Payments will not be made until satisfactory cost breakdowns are submitted. Refer to the end of this section for a sample of expected level and breakout being required.

9. CORRECTION PERIOD

- A. All equipment, apparatus, materials, etc., shall be the best of its respective kind. The Contractor shall replace all materials at his own expense, which fail or are deemed defective as described in the General Conditions. The effective date of completion of the work shall be the date each or any portion of the work is accepted by the Architect or Engineer as being substantially complete.
- B. Items of equipment which have longer guarantees, as called for in these specifications or as otherwise offered by the manufacturer, such as generators, engines, batteries, transformers, etc., shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall in no way invalidate the guarantee except that Owner shall be liable for any damage to equipment during this period due to negligence of his operator or other employee.

10. INSPECTION, APPROVALS AND TESTS

- A. Before requesting a final review of the installation from the Architect and/or Engineer, the Contractor shall thoroughly inspect his installation to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineers for unnecessary and undue work on their part.
- B. The Contractor shall provide as part of this contract electrical inspection by a competent Electrical Inspection Agency, licensed to provide such services in the Commonwealth of Kentucky. The name of this agency shall be included in the list of materials of the Form of Proposal by the Contractor. All costs incidental to the provision of electrical inspections shall be borne by the Electrical Contractor.
- C. The Contractor shall advise each Inspection Agency in writing (with an information copy of the correspondence to the Architect and/or Engineer) when he anticipates commencing work. Failure of the Inspection Agency to inspect the work in the stage following and submit the related reports may result in the Contractor's having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- D. Inspections shall be scheduled for rough as well as finished work. The rough inspections shall be divided into as many inspections as may be necessary to cover all roughing-in without fail. Report of each such inspection visit shall be submitted to the Architect, Engineer and the Contractor within three days of the inspection.
- E. Approval by an Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these plans and specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.

- F. Before final acceptance, the Contractor shall furnish three copies of the certificates of final approval by the Electrical Inspector (as well as all other inspection certificates) to the Engineer with one copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.
- G. The Contractor shall test all wiring and connections for cross connects, continuity and grounds before equipment and fixtures are connected, and when indicated or required, demonstrate by continuity/load/voltage test and Megger Test the installation of any circuit or group of circuits. Where such tests indicate the possibility of faulty insulation, locate the point of such fault, replacing same with new and demonstrate by further test the elimination of such defect. The secondary service entrance conductors from the utility (source) transformer to the main service disconnecting means shall be megger tested. The results of this test shall be turned over to the engineer for review and approval. Any conductor failing the test shall be replaced and any costs associated shall be borne by the contractor.

11. COMPUTER-BASED SYSTEM SOFTWARE

- A. For all equipment, controls, hardware, computer-based systems, programmable logic controllers, and other materials provided as a part of the work, software that is installed shall be certified in writing to the Engineer and Owner by the manufacturer and/or writer to be free of programming errors that might affect the functionality of the intended use.

12. CHANGES IN ELECTRICAL WORK

REFER TO GENERAL AND SPECIAL CONDITIONS.

13. CLAIMS FOR EXTRA COST

REFER TO GENERAL AND SPECIAL CONDITIONS.

14. SURVEYS, MEASUREMENTS AND GRADES

- A. The Contractor shall lay out his work and be responsible for all necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so.
- B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
- C. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the Engineer thru normal channels of job communication and shall not proceed with his work until he has received instructions from the Engineer.

15. TEMPORARY USE OF EQUIPMENT

- A. The permanent electrical equipment, when installed, may be used for temporary services, subject to an agreement among the Contractors involved, the Owner, and with the consent of the Engineer. Should the permanent systems be used for this purpose, each Contractor shall pay for all temporary connections required and any replacements required due to damage without cost, leaving the equipment and installation in "as new" condition. The Contractor may be required to bear utility costs, user fees, etc.

- B. Permission to use the permanent equipment does not relieve the Contractors who utilize this equipment from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

16. TEMPORARY SERVICES

- A. The Contractor shall arrange for temporary electrical and other services which he may require to accomplish his work. In the absence of other provisions in the contract, the Contractor shall provide for his own temporary services of all types, including the cost of connections, utility company fees, construction, removal, etc., in his bid.

17. RECORD DRAWINGS

- A. The Contractor shall insure that any deviations from the design are being recorded daily or as necessary on record drawings being maintained by the Contractor. Dimensions from fixed, visible permanent lines or landmarks shown in vertical and horizontal ways shall be utilized. Compliance shall be a requirement for final payment. Pay particular attention to the location of underfloor or underground exterior in-contract or utility-owned or leased service lines, main switches and other appurtenances important to the maintenance and safety of the Electrical System. Keep information in a set of drawings set aside at the job site especially for this purpose. Deliver these record drawings electronically to the Engineer in AutoCad 2000 format (or more recent version) along with the hand marked field set. Electronic bid drawings will be furnished to the Contractor for his use at the completion of the work.

18. MATERIALS AND WORKMANSHIP

- A. All electrical equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. All workmanship shall be first-class and shall be performed by electricians skilled and regularly employed in their respective trades. The Contractor shall determine that the equipment he proposes to furnish can be brought into the building(s) and installed within the space available. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s).
- B. All conduit and/or conductors shall be concealed in or below walls, floors or above ceilings unless otherwise noted. All fixtures, devices and wiring required shall be installed to make up complete systems as indicated on the drawings and specified herein.
- C. All materials, where applicable, shall bear Underwriters' Laboratories label or that of another Engineer-approved testing agency, where such a standard has been established.
- D. Each length of conduit, wireway, duct, conductor, cable, fitting, fixture and device used in the electrical systems shall be stamped or indelibly marked with the makers mark or name.
- E. All electrical equipment shall bear the manufacturer's name and address and shall indicate its electrical capacity and characteristics.
- F. All electrical materials, equipment and appliances shall conform to the latest standards of the National Electric Manufacturers Association (NEMA) and the National Board of Fire Underwriters (NBFU) and shall be approved by the Owner's insuring agency if so required.

19. QUALIFICATIONS OF WORKMEN

- A. All electrical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen as evidenced by their workmanship shall be relieved of their responsibilities in those areas. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workmen shall refrain from work in areas not satisfactory to him. Requests for relief of a workman shall be made through the normal channels of responsibility established by the Architect or the contract document provisions.
- B. All electrical work shall be accomplished by Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.
- C. Special electrical systems, such as Fire Detection and Alarm Systems, Intercom or Sound Reinforcement Systems, Telecommunications or Data Systems, Lightning Protection Systems, Video Systems, Special Electronic Systems, Control Systems, etc., shall be installed by workmen normally engaged or employed in these respective trades. As an exception to this, where small amounts of such work are required and are, in the opinion of the Engineer, within the competency of workmen directly employed by the Contractor involved, they may be provided by this Contractor.

20. CONDUCT OF WORKMEN

- A. The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workmen to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption or influence of alcoholic beverages, narcotics or illegally used controlled substances on the jobsite is strictly forbidden.

21. COOPERATION AND COORDINATION BETWEEN TRADES

- A. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural, Mechanical, Structural and other pertinent Drawings, to the end that complete coordination between trades will be affected.
- B. Refer to Coordination Among Trades, Systems Interfacing and Connection of Equipment Furnished by Others section of these Specifications for further coordination requirements.

22. PROTECTION OF EQUIPMENT

- A. The Contractor shall be entirely responsible for all material and equipment furnished by him in connection with his work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All rough-in conduit shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged while stored on site either before or after installation shall be repaired or replaced (as determined by the Engineer) by the responsible Contractor.

23. CONCRETE WORK

- A. The Contractor shall be responsible for the provision of all concrete work required for the installation of any of his systems or equipment. If this work is provided by another trade, it will not relieve the Electrical Contractor of his responsibilities relative to dimensions, quality of workmanship, locations, etc. In the absence of other concrete specifications, all concrete related to Electrical work shall be 3000 PSI minimum compression strength at 28 days curing and shall conform to the standards of the American Concrete Institute Publication ACI-318. Heavy equipment shall not be set on pads for at least seven days after pour.

- B. All concrete pads shall be complete with all pipe sleeves, embeds, anchor bolts, reinforcing steel, concrete, etc., as required. Pads larger than 18" in width shall be reinforced with minimum #4 round bars on 6" centers both ways. All reinforcing steel shall be per ASTM requirements, tied properly, lapped 18 bar diameters and supported appropriately up off form, slab or underlayment. Bars shall be approximately 3" above the bottom of the pad with a minimum 2" cover. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms properly adhered repairs shall be made. If structural integrity is violated, the concrete shall be replaced. All surfaces shall be rubbed to a smooth finish.

Special Note: All pads and concrete lighting standard bases shall be crowned slightly so as to avoid water ponding beneath equipment.

- C. In general, concrete pads for small equipment shall extend 6" beyond the equipment's base dimensions. For large equipment with service access panels, extend pads 18" beyond base or overall dimensions to allow walking and servicing space at locations requiring service access.
- D. Exterior concrete pads shall be 4" minimum above grade and 4" below grade on a tamped 4" dense grade rock base unless otherwise noted or required by utility company. Surfaces of all foundations and bases shall have a smooth finish with three-quarter inch radius or chamfer on exposed edges, trowelled or rubbed smooth. All exterior pads shall be crowned approximately 1/8" per foot, sloping from center for drainage.

24. RESTORATION OF NEW OR EXISTING SHRUBS, PAVING, ETC.

- A. The Contractor shall restore to their original condition all paving, curbing surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item to be replaced. All repairs shall be to the satisfaction of the Engineer, and in accord with the Architect's standards for such work, as applicable.

25. MAINTENANCE OF EXISTING UTILITIES AND LINES

- A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that come within the contract construction site, shall be subject to continuous uninterrupted maintenance with no exception unless the Owner of the utilities grants permission to interrupt same temporarily, if need be. Provide one week's written notice to Engineer, Architect and Owner prior to interrupting any utility service or line. Also see Article 1. - General, this section.
- B. Known utilities and lines as available to the Engineer are shown on the drawings. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain that no utilities or lines, known or unknown, are endangered by the excavation.
- C. If the above mentioned utilities or lines occur in the earth within the construction site, the Contractor shall first probe and make every effort to locate the lines prior to excavating in the respective area. Electromagnetic utility locators and acoustic pipe locators shall be utilized to determine where metallic and non-metallic piping is buried prior to any excavation.
- D. Cutting into existing utilities and services shall be done in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or

accidental interruption, providing premium time and materials as needed without extra claim to the Owner.

- E. The Contractor shall repair to the satisfaction of the Engineer any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- F. Machine excavation shall not be permitted within ten feet of existing gas or fuel lines. Hand excavate only in these areas, in accord with utility company, agency or other applicable laws, standards or regulations.
- G. Protect all new or existing lines from damage by traffic, etc. during construction.
- H. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.

26. SMOKE AND FIRE PROOFING

- A. The Contractor shall not penetrate rated fire walls, ceilings or floors with conduit, cable, bus duct, wireway or other raceway system unless all penetrations are protected in a code compliant manner which maintains the rating of the assembly. Smoke and fire stop all openings made in walls, chases, ceiling and floors. Patch all openings around conduit, wireway, bus duct, etc., with appropriate type material to smoke stop walls and provide needed fire rating at fire walls, ceilings and floors. Smoke and fire proofing materials and method of application shall be approved by the local authority having jurisdiction.

27. QUIET OPERATION, SUPPORTS, VIBRATION AND OSCILLATION

- A. All work shall operate under all conditions of load without any objectionable sound or vibration, the performance of which shall be determined by the Engineer. Noise from moving machinery or vibration noticeable outside of room in which it is installed, or annoyingly noticeable noise or vibration inside such room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor (or Contractors responsible) at his expense.
- B. All equipment subject to vibration and/or oscillation shall be mounted on vibration supports suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc., by means of flexible connectors, vibration absorbers or other approved means. Surface mounted equipment such as panels, switches, etc., shall be affixed tightly to their mounting surface.
- C. The Contractor shall provide supports for all equipment furnished by him using an approved vibration isolating type as needed. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. No work shall depend on the supports or work of unrelated trades unless specifically authorized in writing by the Architect or Engineer.

28. FINAL CONNECTIONS TO EQUIPMENT

- A. The roughing-in and final connections to all electrically operated equipment furnished under this and all other sections of the contract documents or by others, shall be included in the Contract and shall consist of furnishing all labor and materials for connection. The Contractor shall carefully coordinate with

equipment suppliers, manufacturers representatives, the vendor or other trades to provide complete electrical and dimensional interface to all such equipment (kitchen, hoods, mechanical equipment, panels, refrigeration equipment, etc.).

29. WELDING

- A. The Contractor shall be responsible for quality of welding done by his organization and shall repair or replace any work not done in accordance with the Architect's or structural Engineer's specifications for such work. If required by the Engineer, the responsible Contractor shall cut at least three welds during the job for X-raying and testing. These welds are to be selected at random and shall be tested as a part of the responsible Contractor's work. Certification of these tests and X-rays shall be submitted, in triplicate, to the Engineer. In case a faulty weld is discovered, the Contractor shall be required to furnish additional tests and corrective measures until satisfactory results are obtained.

30. ACCESSIBILITY

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in partitions and above suspended ceilings for the proper installation of his work. He shall cooperate with the General Contractor (or Construction Manager) and all other Contractors whose work is in the same space, and shall advise each Contractor of his requirements. Such spaces and clearances shall be kept to the minimum size required to ensure adequate clearance and access.
- B. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to junction boxes, pull boxes, contactors, panels, disconnects, controllers, switchgear, etc. Minor deviations from drawings may be made to allow for better accessibility, and any change shall be approved where the equipment is concealed.
- C. Each Contractor shall provide (or arrange for the provision by other trades) the access panels for each concealed junction box, pull box, fixtures or electrical device requiring access or service as shown on Engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. All access panels shall be installed in accord with the Architect's standards for such work.
- D. Access Doors; in Ceilings or Walls:
 - (1) In mechanical, electrical, or service spaces:
 - 14 gauge aluminum brushed satin finish, 1" border.
 - (2) In finished areas:
 - 14 gauge primed steel with 1" border to accept the architectural finishes specified for the space. Confirm these provisions with the Architect prior to obtaining materials or installing any such work.
 - (3) In fire or smoke rated partitions, access doors shall be provided that equal or exceed the required rating of the construction they are mounted in.

31. ELECTRICAL CONNECTIONS

- A. The Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring through starters. The Contractor shall install all starters

not factory mounted on equipment. Unless otherwise noted, the supplier of equipment shall furnish starters with the equipment. Also refer to Divisions 11, 14, 20, 21, 22, 23 and 25 of the Specifications, shop drawings and equipment schedules for additional information.

- B. All control, interlock, sensor, thermocouple and other wiring required for equipment operation shall be provided by the Contractor. All such installations shall be fully compliant with all requirements of Division 26 and 27 regardless of which trade actually installs such wiring. Motors and equipment shall be provided for current and voltage characteristics as indicated or required. All wiring shall be enclosed in raceways unless otherwise noted.
- C. Each Contractor or sub-contractor, prior to bidding the work, shall coordinate power, control, sensor, interlock and all other wiring requirements for equipment or motors with all other contractors or sub-contractors, to ensure all needed wiring is provided in the Contract. Failure to make such coordination shall not be justification for claims of extra cost or a time extension to the Contract.

32. MOTORS

- A. Each motor shall be provided by the equipment supplier, installer or manufacturer with conduit terminal box and N.E.C. required disconnecting means as indicated or required. Three-phase motors shall be provided with external thermal overload protection in their starter units. Single-phase motors shall be provided with thermal overload protection, integral to their windings or external, in control unit. All motors shall be installed with NEMA-rated starters as specified and shall be connected per the National Electrical Code.
- B. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least of the horsepower indicated or specified. Each motor shall be selected for quiet operation, maximum efficiency and lowest starting KVA per horsepower as applicable. Motors producing excessive noise or vibration shall be replaced by the responsible contractor. See Division 20, 22 and 23 of the Specifications for further requirements and scheduled sizes.
- C. All three-phase motors shall be tested for proper rotation. Correct wiring if needed and retest. Document testing and corrective action in operations and maintenance manual.

33. CUTTING AND PATCHING

- A. Unless otherwise indicated or specified, the Contractor shall provide cutting and patching necessary to install the work specified in this Division. Patching shall match adjacent surfaces to the satisfaction of the Engineer and shall be in accord with the Architect's standards for such work, as applicable.
- B. No structural members shall be cut without the approval of the Structural Engineer and all such cutting shall be done in a manner directed by him.
- C. When installing conduit, pipe, or any other work in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore all new work shall NOT be installed in concrete center of wall. All mechanical and electrical installations shall be on the interior side of the concrete.

34. ANCHORS

- A. Each Contractor shall provide and locate all inserts required for his work before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where inserts were not

installed, or where incorrectly located. Each Contractor shall do all drilling required for the installation of his hangers. Drilling of anchor holes may be prohibited in post-tensioned concrete construction, in which case the Contractor shall request approved methods from the Architect and shall carefully coordinate setting of inserts, etc., with the Structural Engineer and/or Architect.

35. WEATHERPROOFING

- A. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect and/or Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.
- B. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

36. OPERATING INSTRUCTIONS

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating his systems and equipment for a period of three days of eight hours each, or as otherwise specified. During this period, instruct the Owner or his representative fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least one week's written notice to the Owner, Architect and Engineer in advance of this period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.
- B. Each Contractor shall furnish three complete bound sets for approval to the Engineer of typewritten and/or blueprinted instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- C. Each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.
- D. Formatting & content shall follow the guidelines outlined in the latest version of ASHRAE Applications Handbook, Guideline 4. As a minimum, the following shall be included:
 - The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
 - Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 - The operating manual should contain the following information:
 - I. General Information
 - a. Building function
 - b. Building description
 - c. Operating standards and logs
 - II. Technical Information
 - a. System description
 - b. Operating routines and procedures
 - c. Seasonal start-up and shutdown
 - d. Special procedures

e. Basic troubleshooting

- The maintenance manual should contain the following information:
 - I. Equipment data sheets
 - a. Operating and nameplate data
 - b. Warranty
 - II. Maintenance program information
 - a. Manufacturer's installation, operation, and maintenance instructions
 - b. Spare parts information
 - c. Preventive maintenance actions
 - d. Schedule of actions
 - e. Action description
 - f. History
- Test reports document observed performance during start-up and commissioning.

37. SCAFFOLDING, RIGGING AND HOISTING

- A. The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

38. CLEANING

- A. The Contractor shall, at all times, keep the area of his work presentable to the public and clean of rubbish caused by his operations; and at the completion of the work, shall remove all rubbish, all of his tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the work clean and ready for use. If the Contractor does not attend to such cleaning immediately upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the responsible Contractor. Each Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.
- B. After completion of all work and before final acceptance of the work, each Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of materials, equipment and all associated fabrication. Pay particular attention to finished area surfaces such as lighting fixture lenses, lamps, reflectors, panels, etc.

39. PAINTING

- A. Each fixture device, panel, junction box, etc., that is located in a finished area shall be provided with finish of color and type as selected or approved by the Architect or Engineer. If custom color is required, it shall be provided at no additional cost to the Owner. All other equipment, fixtures or devices located in finished or unfinished areas, that are not required to have or are provided with finish color or coating shall be provided in a prime painted condition, ready to receive finish paint or coating. All galvanized metal in finished areas shall be properly prepared with special processes to receive finish paint as directed and approved by the Architect.

40. INDEMNIFICATION

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to

any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

41. HAZARDOUS MATERIALS

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of his work, insure that his workers are aware of this potential and what they are to do in the event of suspicion. He shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- B. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- C. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise him immediately.
- D. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

42. ABOVE-CEILING AND FINAL PUNCH LISTS

- A. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least two stages of the project:
 - (1) For review of above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - (2) For review of all other work as the project nears substantial completion.
- B. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.
- C. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$140.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.



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The following is CMTA's guide for required electrical information relative to the Schedule of Values. Please utilize all items that pertain to this project and add any specialized system as required. A thorough and detailed schedule of values will allow for fair and equitable Pay Application approval and minimize any discrepancies as to the status of the job.

Electrical

Description of Work	Scheduled Value	Labor	Material
Shop Drawings			
Mobilization/Permits			
Temporary Utilities			
Demolition			
Site Utilities			
Switchgear			
Branch Panels			
Feeder Conduit			
Branch Conduit			
Feeder Wire			
Branch Wiring			
Emergency Generator			
Fire Alarm Conduit & Wiring			
Fire Alarm Devices			
Cabletray & Accessories			
Light Fixture Interior			
Light Fixture Exterior			
Lighting Control System			
Wiring Devices			

Surge Suppression			
Chemical Grounding System			
Intercom/Paging Conduit			
Intercom/Paging Wiring			
Intercom/Paging Devices			
CCTV System Conduit			
CCTV System Wiring			
CCTV System Devices			
Intrusion Detection Conduit			
Intrusion Detection Wiring			
Intrusion Detection Controller & Devices			
Voice/Data System Conduit			
Voice/Data System Wiring			
Voice/Data System Devices & Termination			
Audio/Video System Conduit			
Audio/Video System Wiring			
Audio/Video System Devices & Termination			
Electrical Inspection			
Owner Training			
Record Drawings			
O & M Manuals			
Punch List / Closeout			

END OF SECTION 260501

SECTION 260502 - SCOPE OF THE ELECTRICAL WORK**1. GENERAL**

Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

2. SCOPE OF THE ELECTRICAL WORK

The Electrical work for this project includes all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, verify place in service and deliver to the Owner complete electrical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not limited to the following:

- A. All conduits, conductors, outlet boxes, fittings, etc.
- B. All switchgear, panels, disconnect switches, fuses, transformers, contactors, starters, etc.
- C. Fault Current Coordination Study.
- D. All wiring devices and device plates.
- E. All light fixtures and lamps.
- F. Emergency generator.
- G. Electrical connection to all electrically operated equipment furnished and/or installed by others, including powered casework, kitchen equipment, etc.
- H. Digital video surveillance system.
- I. Security intrusion detection system.
- J. Lightning protection system.
- K. Voice/Data wiring system.
- L. CATV wiring and distribution system.
- M. Paging/Intercom distribution system.
- N. Master clock distribution system.
- O. Gym/Cafeteria/Auditorium Sound reinforcement system.
- P. Fire alarm system.
- Q. Wireless sound enhancement system.
- R. Nurse call system.
- S. Physiological monitoring system.

- T. Theatrical lighting/dimming system.
- U. All necessary coordination with electric utility company, telephone company, cable television company, etc. to ensure that work, connections, etc., that they are to provide is accomplished and that service to this facility is delivered complete prior to occupancy.
- V. Paying all necessary fees and cost for permits, inspections, work by utility companies (power, telephone, CATV, etc). The Contractor shall contact the utility companies prior to submitting a bid to determine exactly these charges will be.
- W. Prior to submitting a bid, the Contractor shall contact all serving utility companies to determine exactly what each utility company will provide and exactly what is required of the Contractor and the Contractor shall include all such requirements in his base bid.

END OF SECTION 260502

SECTION 260503 - SHOP DRAWINGS, LITERATURE, MANUALS, PARTS LISTS, AND SPECIAL TOOLS

1. SHOP DRAWINGS

- A. Each Contractor shall submit to the Architect and/or Engineer, within thirty days after the date of the Contract, seven sets of shop drawings and/or manufacturer's descriptive literature on all equipment required for the fulfillment of his contract. Each shop drawing and/or manufacturer's descriptive literature shall have proper notation indicated on it and shall be clearly referenced so the specifications, schedules, light fixture numbers, panel names and numbers, etc., so that the Architect and/or Engineer may readily determine the particular item the Contractor proposes to furnish. All data and information scheduled, noted or specified by hand shall be noted in color red on the submittals. The Contractor shall make any corrections or changes required and shall resubmit for final review as requested. Review of such drawings, descriptive literature and/or schedules shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless they have, in writing, directed the reviewer's attention to such deviations at the time of submission of drawings, literature and manuals; nor shall it relieve them from responsibility for errors or omissions of any nature in shop drawings, literature and manuals. The term "as specified" will not be accepted.
- B. If the Contractor fails to comply with the requirements set forth above, the Architect and/or Engineer shall have the option of selecting any or all items listed in the specifications or on the drawings, and the Contractor will be required to provide all materials in accordance with this list.
- C. Review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- D. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.
- E. No cutting, fitting, rough-in, connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractors concerned. It shall be each Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. Each Contractor shall coordinate with all the other Contractors having any connections, roughing-in, etc., to the equipment, to make certain proper fit, space coordination, voltage and phase relationships are accomplished.
- F. In accord with the provisions specified hereinbefore, shop drawings, descriptive literature and schedules shall be submitted on each of the following indicated items as well as any equipment or systems deemed necessary by the Engineer:

Power Equipment

- Fault current coordination study (submit along with switchgear & panelboards).
- Switchgear and panelboards.
- Circuit breakers or fusible switches, per each type.
- Dry-type transformers.
- Liquid-filled pad-mount transformers and their accessories.

- Power and lighting contactors.
- Disconnect switches.
- Fuses, per each type required.
- Magnetic starters, if not submitted with unit equipment by supplier.
- Control components (relays, timers, selector switches, pilots, etc.)
- Primary cable (over 600 volts) and each style of termination fitting for primary cable.
- Building service grounding electrode components.
- Metering devices.
- Bus duct and each type of fitting for bus duct.
- Emergency generator, engine fuel system and transfer switch, with all required generator system accessories, such as battery charger, batteries, exhaust system and its insulation, fuel pumps, day tanks, etc.
- Lightning protection system.
- Transient voltage surge suppression system.
- Grounding system.

Raceways

- Cable tray and each type of cable tray fitting.
- Wireways and each type of wireway fitting.
- Surface-mounted metal or plastic raceways, with each type of fitting.
- J-hook or Bridle ring assemblies.

Devices

- Each type of wiring device and their coverplates.
- Floor boxes, each by type, with required accessories.
- Data/voice/video wallplates, each by type.
- Any special items not listed above.

Lighting

- Light fixtures, each by type, marked to indicate all required accessories and lamp selection. Also provide original color selection chart to allow Architect and/or Engineer to indicate color selection.
- Lamps, each by type.
- Ballast, each by type.
- Lighting standards or poles.
- Photocells, time clocks or other lighting accessories.
- Lighting control system schematic, functional & programming data, along with building specific floor plan drawings indicating each device, master controller, input device locations and specific interconnect/wiring requirements for each device.

Systems

Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Include system specific wiring schematics showing each device and its specific interconnect/wiring requirements. For rack mounted equipment, provide a scalable elevation drawing with proposed component locations & specific interconnect wiring requirements for each component/panel. Also provide scale building specific layout drawings that indicate device placement, wiring, etc. Refer to the specific system's specification for additional submittal requirements where required.

- Fire alarm system.
- Closed circuit television security system.

- Intrusion detection system.
- Building paging/intercom audio system.
- Clock/program system.
- Telephone system.
- Video system.
- Data network.
- Sound reinforcement system(s).
- Wireless intercom system.

Miscellaneous

- Control panel assemblies.
- Non-standard junction/pullboxes.
- Manholes, hand holes, and all outdoor electrical equipment and fittings.

2. SPECIAL WRENCHES, TOOLS AND KEYS

- A. Each Contractor shall provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed by him. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc. At least two of any such special wrench, keys, etc. shall be turned over to the Architect prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Engineer.

3. FIRE ALARM SHOP DRAWINGS

- A. The Contractor and equipment supplier shall submit to the Architect and/or Engineer, fire alarm system shop drawings complete with catalog cuts, descriptive literature and complete system wiring diagrams for their review prior to the Contractor's submittal to the Commonwealth's Department of Housing, Buildings and Construction or other governing authority for their review. No work shall be done until drawings are approved by the Kentucky Department of Housing, Buildings and Construction.

4. MAINTENANCE AND OPERATION MANUALS

- A. Prior to substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three complete copies of operation and maintenance instructions and parts lists for all equipment provided. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline 4. As a minimum, the following shall be included:
 - The **operation and maintenance document directory** should provide easy access and be well organized and clearly identified.
 - **Emergency information** should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 - **The operating manual** should contain the following information:
 - I. General Information
 - a. Building function
 - b. Building description
 - c. Operating standards and logs
 - II. Technical Information
 - a. System description
 - b. Operating routines and procedures
 - c. Seasonal start-up and shutdown

- d. Special procedures
- e. Basic troubleshooting
- **The maintenance manual** should contain the following information:
 - I. Equipment data sheets
 - a. Operating and nameplate data
 - b. Warranty
 - II. Maintenance program information
 - a. Manufacturer's installation, operation, and maintenance instructions
 - b. Spare parts information
 - c. Preventive maintenance actions
 - d. Schedule of actions
 - e. Action description
 - f. History
- **Test reports** document observed performance during start-up and commissioning.

END OF SECTION 260503

SECTION 260504 - SLEEVING, CUTTING, PATCHING AND REPAIRING**1. GENERAL**

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc. that he may require in floors, roofs, ceilings, walls, etc. and shall coordinate all such work with the General Contractor and all other trades. He shall determine and coordinate any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the responsible Contractor.
- B. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for conduit, buss duct, conductors, wireways, etc. to go through; however, when this is not done, this Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Architect. Any damage caused to the building by the workmen of the responsible Contractor must be corrected or rectified by him at his own expense.
- C. The Contractor shall cut holes in casework, equipment panels, etc. (if any), as required to pass pipes in and out.
- D. The Contractor shall notify other trades in due time where he will require openings of chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.
- E. Openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- F. Cast iron sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking with lead and oakum between pipe and sleeve for waterproofing.
- G. In all cases, sleeves shall be at least two inches larger than nominal pipe diameter.
- H. Sleeves passing through roof or exterior wall or where there is a possibility of water leakage and damage shall be caulked water tight for horizontal sleeves and flashed and counter-flashed with lead (4 lb.) or copper and soldered to the piping, lapped over sleeve and properly weather sealed. Any roof penetration shall not void or lessen the warranty in any way.
- I. All rectangular or special shaped openings in plaster, stucco or similar materials including gypsum board shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirements is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for lighting fixtures, panels, etc. Lintels shall be provided where indicated over all openings in bearing walls, etc.
- J. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Architect.
- K. The Contractor shall be responsible for properly shoring, bracing, supporting, etc. any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Architect.

- L. All work improperly done or not done at all as required by the Contractor will be performed by others. The cost of this work shall be paid for by the Contractor who is in non-compliance with the Contract.

2. SLEEVES, PLATES AND ESCUTCHEONS

- A. The Contractor shall provide and locate all sleeves required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for conduits where sleeves were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves. Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the conduit and the sleeves shall be made completely and permanently water tight.
- B. Conduits that penetrates fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.
- C. At all other locations either pipe sleeves or core drilled openings are acceptable.
- D. Where thermal expansion does not occur, the wall may be sealed tight to the conduit.
- E. Sleeves shall be constructed of rigid steel conduit. Sleeves in floors shall extend 6" above finished floor level.
- F. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- G. In all areas where ducts are exposed and ducts pass thru floors, the opening shall be surrounded by a 4 inch high by 3 inch wide concrete curb.
- H. Escutcheon plates shall be provided for all conduit passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the sleeves.
- I. When installing conduit, pipe, or any other work in insulated concrete form (ICF) walls, the responsible subcontractor for the work shall provide spray foam insulation to patch the rigid insulation to maintain full integrity of the insulating value of the wall after the mechanical and electrical work is complete. Furthermore all new work shall NOT be installed in concrete center of wall. All mechanical and electrical installations shall be on the interior side of the concrete.

END OF SECTION 260504

SECTION 260506 - LIGHTNING PROTECTION SYSTEM**1. GENERAL**

- A. Each Electrical Contractor's attention is directed to Section 260000, General Provisions - Electrical and all other contract documents as they may apply to his work.

2. SCOPE OF THE WORK

- A. The Electrical Contractor shall provide the necessary labor, materials, services necessary to provide the complete lightning protection system as specified herein. This work shall include, but is not necessarily limited to:

- Conductors
- Air Terminals
- Connectors
- Splicers
- Ground Rods
- Rod Clamps
- Ground Plates
- Bonding Plates
- Surge Arrestors

3. QUALITY ASSURANCE

- A. Manufacturers: First regularly engaged in manufacturer of lightning protection equipment, of types, sizes and ratings required, whose products have been satisfactorily used in similar service for not less than 5 years. The firm shall be a member of and certified by the Lightning Protection Institute of America.
- B. Installer: A firm with at least 3 years of success installation experience on projects with lightning protection work similar to that required for project.
- C. ANSI/NFPA Compliance: Comply with NEC and NFPA No. 780, "Standard for the Installation of Lightning Protection Systems", as applicable to materials and installation of lightning protection components and wiring.
- D. ANSI Compliance: Comply with applicable portions of ANSI C2 and C62.2 pertaining to lightning (surge) arrestors.
- E. UL Compliance: Comply with UL 96, "The Standard for Lightning Protection Components" and UL96A, "Installation Requirements for Lightning Protection Systems" pertaining to design, materials and sizing of lightning protection components. Provide components which are UL listed and labeled.

4. SUBMITTALS

- A. Product Data: Submit manufacturer's data on lightning protection systems and components.
- B. Shop Drawings: Submit dimensioned layout drawings of lightning protection system equipment and components including conductor routing and connections.
- C. Maintenance Data: Submit maintenance instructions for lightning protection system. Include this data in maintenance manuals.

- D. UL Certificate: Provide Owner with UL Master "C" Label for new buildings overall system which is suitable for fastening to building for display. Comply with UL 96A. "Master Labeled Lightning Protection Systems".

5. MATERIALS

A. Acceptable Manufacturers

Available Manufacturers: Subject to compliance with requirements, manufacturers offering lightning protection components which may be incorporated in the work include, but are not limited to, the following:

Conductors and Air Terminals:

Independent Protection Co., Inc.
Thompson Lightning Protection, Inc.
A/C Lightning Protection Co., Inc.

Protective Devices (Surge Arrestors):

General Electric Co.
TII Industries, Inc.
Atlantic Scientific Corp.

6. LIGHTNING PROTECTION SYSTEM COMPONENTS

A. General

- (1) Provide lightning protection system components of types, sizes, ratings for class of service indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information and as required for a complete installation. Where more than one type of component meets requirements, selection is Installer's option. Where type or material is not otherwise indicated comply with NFPA 780 and UL 96 standards.

B. Conductors

Class 1 Installations:

- (1) Main Conductors: Aluminum cable; strand dia. 0.064"; 0.095#/ft.; 98,600 circular mils.
- (2) Secondary Conductors: Aluminum cable; strand dia. 0.064"; 10 strands.
- (3) Air Terminals: Aluminum for concealed installation; 10" point, 1/2" x 12" long solid aluminum stem, lead washer, support bracket and adjustable clamp type cable connector.
- (4) Connector: Aluminum right-angle thru-roof cable connector; bronze and lead seal flashing washer, 1/2" x 8" threaded stem, to fit 6" roof thickness.
- (5) Connector: 4" aluminum parallel bonding clamp for connecting 1/0 or 2/0 cables.
- (6) Splicer: Aluminum straight cable splicer for splicing No. 4 and No. 6 cables.
- (7) Splicer: Aluminum pressure type "T" cable splicer for clamping standard cables through 2/0 with hex bolts and washers.

- (8) Splicer: Bimetal straight splicer of cast aluminum and bronze for 2/0 cable with moisture tight sealing capability.
- (9) Ground Rod: Solid copper, 5/8" dia. x 10'.
- (10) Rod Clamp: 4" bronze ground rod clamp for connecting cable, up to and including 2/0 and 5/8" or 3/4" ground rod.
- (11) Ground Plate: Sheet copper plate, 36" x 36" x 20-gauge, with 2 cable attachments.
- (12) Bonding Plate: 8 sq. in. steel plate with 1" dia. bolt-hole for bonding cable to structural steel, with vice-grip type cable connector with 2" of cable contact.
- (13) Surge Arrestor: Electrical service arrestor, solid state, 277/480V/30/4W for exterior mounting.

7. EXECUTION - Installation of Lightning Protection Systems

- A. Install lightning protection systems as indicated in accordance with equipment manufacturer's written instructions, in compliance with applicable requirements of NFPA No. 70 and 780 and with UL's lightning protection standards to ensure that lightning protection systems comply with requirements.
- B. Coordinate with other work, including electrical wiring and roofing work as necessary to interface installation of lightning protection system with other work.
- C. Install conductors with direct paths from air terminals to ground connections avoiding sharp bends and narrow loops.
- D. Install arrestors as close as practical to equipment they are protecting. Install appropriate unit at main electrical service entrance equipment.

8. TESTING

- A. Upon completion of installation of lightning protection system, test resistance-to-ground with resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, by driving additional ground rods. Provide to the Owner and the Engineer a certificate of compliance upon completion of testing.

END OF SECTION 260506

SECTION 260508 - COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERS**1. COORDINATION**

- A. The Contractor is expressly directed to read the General Conditions and all sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural, Plumbing, Fire Protection, Mechanical and Structural drawings, to the end that complete coordination between trades will be affected. Each Contractor shall make known to all other contractors the intended positioning of materials, raceways, supports, equipment and the intended order of his work. Coordinate all work with other trades and proceed with the installation in a manner that will not create delays for other trades or affect the Owner's operations.
- B. Special attention to coordination shall be given to points where raceways, fixtures, etc., must cross other ducts or conduit, where lighting fixtures must be recessed in ceilings, and where fixtures, conduit and devices must recess into walls, soffits, columns, etc. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- C. The Contractor shall be responsible for coordination with all trades to insure that they have made provision for connections, operational switches, disconnect switches, fused disconnects, etc., for electrically operated equipment provided under this or any other division of the specifications, or as called for on the drawings. Any connection, circuiting, disconnects, fuses, etc., that are required for equipment operation shall be provided as a part of this contract.
- D. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other trade's work, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of fixtures, devices, conduit, and equipment not installed or connected in accordance with the above instructions.
- E. In all areas where air diffusers, devices, lighting fixtures and other ceiling-mounted devices are to be installed, the Mechanical Trade(s) and the Electrical Trade and the General Trades shall coordinate their respective construction and installations so as to provide a combined symmetrical arrangement that is acceptable to the Architect and Engineer. Where applicable, refer to reflected ceiling plans. Request layouts from the Architect or Engineer where in doubt about the potential acceptability of an installation.

2. INTERFACING

Each Electrical Trade, Specialty Controls Trade, Mechanical Trade and the General Trades, etc., shall insure that coordination is affected relative to interfacing of all systems. Some typical interface points are (but not necessarily all):

- A. Connection of Telecommunications (voice, video, data) lines to Owner's existing or new services.
- B. Connection of Power lines to Owner's existing or new services.
- C. Connection of fuel oil and exhaust piping to emergency generator and furnishing of fuel for testing unit. Provide a full tank at final acceptance.
- D. Connection of all controls to equipment.
- E. Electrical power connections to electrically operated (or controlled) equipment.

F. Electrical provisions for all equipment provided by other trades or suppliers within this contract.

3. CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Each Contractor shall make all connections to equipment furnished by others, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.
- B. All drawings are complementary, one trade of the other. It is the Contractor's responsibility to examine all drawings and specifications to determine the full scope of his work. The project Engineers have arranged the specifications and drawings in their given order solely as a convenience in organizing the project, and in no way shall they imply the assignment of work to specific trades, contractors, subcontractors or suppliers.
- C. Supervision to assure proper installation, functioning and operation shall be provided by the Contractor furnishing the equipment or apparatus to be connected.
- D. Items indicated on the drawings as rough-in only (RIO) will be connected by the equipment supplier or Owner, as indicated. The Contractor shall be responsible for rough-in provisions only as indicated. These rough-ins shall be in accord with the manufacturer's or supplier's requirements.
- E. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.
- F. The Contractor shall be responsible for coordinating with the General and all other trades, as necessary, to determine any and all final connections that he is to make to equipment furnished by others.

END OF SECTION 260508

SECTION 260519 - CONDUCTORS, IDENTIFICATION, SPLICING DEVICES & CONNECTORS**1. GENERAL**

- A. This section of the Specifications covers all of the electrical power, lighting, and control power (line voltage) conductors, but does not include communications, data or signal system conductors, which are specified separately in these specifications.
- B. All conduits installed without conductors shall have a 200 lb. test nylon string installed for future use, tied off securely at each end.
- C. **No more than 40% conduit fill is permitted for any conduit system, including video, intercom, data, power or other signal circuits unless specifically indicated otherwise on the plans.**
- D. Lighting circuits: No more than five conductors shall be installed in conduit except for switch legs and travelers in multi-point switching arrangements.
- E. Receptacle circuits: If multiple circuits are pulled in a single homerun, a dedicated neutral shall be provided for each phase conductor. In these cases, a maximum of seven conductors are permitted in a single conduit. Conductors shall be derated per N.E.C.
- F. Intentional or unintentional painting of exposed low voltage or line voltage cabling is prohibited. The contractor shall ensure that exposed cabling is adequately protected from direct painting or overspray whether painting is required within the electrical specifications or required by other disciplines/trades. The contractor shall review the painting requirements for all disciplines and shall provide cabling protection as required. Where exposed cabling is being installed in exposed ceiling or wall spaces that are required to be painted, the contractor shall provide alternate options for cable colors and shall provide submittals for such cabling to engineer for approval.

2. MATERIALS**A. CONDUCTORS**

- (1) All conductors shall be 98% conductive annealed copper unless otherwise noted, UL listed and labeled.
- (2) Lighting and receptacle branch circuits shall be not less than No. 12 copper wire or of the sizes shown on the drawings with Type THW, THHN or THWN insulation. All feeder circuits shall be Type THW or THWN of the size as shown on the Contract Drawings. THHN wiring shall only be installed in overhead, dry or damp locations. THWN or THW wiring shall be used for all circuits pulled in underground or other wet locations.
- (3) Conductors No. 10 and smaller sizes of wire shall be solid. Conductors No. 8 and larger sizes shall be stranded.
- (4) Conductors for fire alarm wiring shall be stranded and in full compliance with N.E.C. 760. All fire alarm conductors shall be installed within conduit and enclosed junction boxes.
- (5) All wire on the project shall be new, in good condition, and shall be delivered in standard coils or reels.
- (6) The color of the wire shall be selected to conform with Section 210-5 of the latest edition of the National Electrical Code. Refer also to 260519-4, Color Coding.

- (7) All equipment grounding conductors shall have green color insulation or if larger than #8, shall be taped for two inches, green color at every termination and pullbox access point.
- (8) Conductors used for motor connections and connections to vibrating or oscillating equipment shall be extra flexible.
- (9) Conductors for main ground from neutral bus, equipment grounding bus, building steel, grounding grid and main cold water pipe connection shall be bare copper.
- (10) All conductors shall be identified by color code and by means of labels placed on conductors in all junction boxes and at each terminal point with Brady, Ideal, T & B or approved equivalent labels indicating source, circuit No. or terminal No.
- (11) Branch wiring and feeder conductors that are greater than 100' in length shall be increased at least one size to compensate for voltage drop. All circuits shall be installed and sized for a maximum 2% voltage drop. As calculated using 80% of the supply breaker rating as the load. Adjust conductors and conduit size accordingly for actual field installed conditions.

B. SPLICING DEVICES & CONNECTORS

- (1) Splicing devices for use on No. 14 to No. 10 AWG conductors shall be pressure type such as T & B "STA-KON", Burndy, Reliable or approved equivalent.
- (2) Wire nuts shall be spring pressure type, insulation 600V, 105°C insulation, up to #8 size. Greater than #6 Cu shall be a compression type connection, 600V insulation, cold shrink tubing, taped to restore full insulation value of the wire being spliced.
- (3) Pressure crimp-applied ring type (or fork with upturned ends) terminations shall be employed on motor and equipment terminals where such terminals are provided on motor and equipment leads or on all stranded wire terminations using No. 10 AWG or smaller conductors.
- (4) Splices, where necessary, shall be made with hydraulically-set "Hy-press" or equivalent crimped connectors. All splices shall be insulated to the full value of the wiring insulation using a cold-shrink kit or the equivalent in built-up materials.
- (5) Large connectors (lugs) at terminals shall be mechanical type, hex-head socket or crimp-on style, installed per the manufacturer's recommendations.
- (6) Exterior underground connections made between bare ground wires or to ground rods shall be exothermically welded, "Cadweld" or equivalent.
- (7) The use of split-bolt clamps will be permitted in wireways at service entrance only. Torque to 55 foot-pounds or as recommended by manufacturer.
- (8) No aluminum conductors shall be used.

3. INSTALLATION

- A. The pulling of all wires and cable on this project shall be performed in strict compliance with applicable sections of the National Electrical Code. No conductor entering or leaving a cabinet or box shall be deflected in such a manner as to cause excess pressure on the conductor insulation. Conductors shall only be installed after insulating bushings are in place.

- B. The radius of bending of conductors shall be not less than eighteen times the outside diameter of the conductor insulation or more, if recommended by the manufacturer.
- C. Conductors installed within environmental air plenums shall be per N.E.C. Article 800 and other applicable codes, with FEP-type insulation or an approved equivalent. Also provide plenum-rated tie-wraps where plastic straps or other supports, etc., are installed in plenum areas.
- D. Where indicated, communications conductors that are installed exposed shall not be routed across ceilings or ductwork. They shall be held up against building structure or against permanent support members. They shall be installed in such a manner that they do not interfere with the access to or operation of equipment or removal of ceiling tiles. Tie-wraps shall be installed in such a manner so as to bundle conductors neatly, allowing runouts of single conductors or groups to drop down to equipment served. Install grommeting where dropping out of trays or into panels or service columns. Install sleeves with bushings where penetrating partitions. Firestop sleeves with approved material. Do not penetrate firewalls if so indicated on plans. Refer to the drawings for support requirements and details on routing exposed communications conductors.
- E. Conductors for isolated power systems shall be installed in as short a run of conduit as practicable. No pulling soap shall be used on conductors in isolated power systems.
- F. Where conductors are installed in industrial facilities, they shall be per J.I.C. standards.
- G. Maximum permissible pulling tensions, as recommended by the manufacturer for any given type of cable or wire installed shall not be exceeded. Utilize special remote readout equipment as required to ensure compliance. Use particular caution when installing twisted pair data cable or fiber optic cables -- forces permitted for pulling in are typically very low for these cable types.
- H. All cables and wiring, regardless of voltage, installed in manholes or cable vaults shall be routed in such a manner to provide a minimum of 6 feet of slack cable for future splicing. Install cables along walls by utilizing the longer route from entry to exit. If both routes are symmetrical, provide a loop of cable secured to wall. All cables shall be tied to insulated cable supports on wall-mounted racks, spaced a maximum of three feet apart.
- I. Where multiwire branch circuits are allowed, the phases and neutral shall be wire-tied together in the panelboard and in all pull boxes.

4. COLOR CODING DISTRIBUTION VOLTAGE CONDUCTORS, 600 VOLT OR LESS

- A. Conductors to be color coded as follows:
 - (1) 120/208 Volt Conductors
 - Phase A - Black
 - Phase B - Red
 - Phase C - Blue
 - Neutral - Solid White or White with tracer stripe to match phase conductor
 - (2) 277/480 Volt Conductors
 - Phase A - Brown
 - Phase B - Orange
 - Phase C - Yellow
 - Neutral – Solid Gray or White with tracer stripe to match phase conductor
 - (3) Isolated Power Conductors (Type XLP or XHHN)

Phase A – Brown with colored stripe other than white, green or grey

Phase B Device or Neutral- Orange with colored stripe other than white, green or grey

Phase C - Yellow with colored stripe other than white, green or grey

Neutral on Three-Phase Systems- Solid White or White with tracer stripe to match phase conductor

Note: Further identify isolated power conductors with 2" wide purple tape at all terminations and junctions.

(4) Control Wiring - Red, or as indicated.

(5) Conductors within enclosures that may be energized when enclosure disconnect is off - yellow, or taped with 1/2" yellow tape every 6" of length, inside enclosure. Provide lamacoid plate warning sign on front of enclosure where this condition occurs.

(6) D.C. Wiring - Positive - Light Blue
Negative - Dark Blue

5. COMMUNICATIONS CONDUCTORS

- A. Communications conductors shall be of type suitable for the service, installed in accordance with the manufacturer's recommendations for pulling tensions, support, terminations, proximity to high power fields, etc. Types not indicated on this schedule but indicated on plans shall be as noted or required for the service. If in doubt, contact the Engineer for clarification.
- B. Plenum-rated conductors (per N.E.C.) shall be installed where required by codes. If installation is thru an approved raceway system that excludes the wiring from the plenum, non-plenum type may be used.
- C. All communications cables shall be furnished and installed in compliance with U.L. 444, U.L. 13, N.E.C. 800, 725, 760 and all applicable codes and standards, for premises or riser installations.
- D. Riser cables shall be provided in accord with current edition of the N.E. Code.
- E. Schedule of Wiring Types - Plenum-Rated

Data Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P. Plenum-Rated	Anixter #CMP-00424 FAS-5B Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
Voice Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P. Plenum-Rated	Anixter #CMP-00424 FAS-5B Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
Voice Circuits	24 AWG, 4 Pair Category Five U.T.P. Plenum-Rated	Anixter #CMP-00422 HAH-3 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
Video Drops	RG-6/U Coaxial,	Belden #89120

	18 AWG Solid Conductor, Plenum-Rated	Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
Video Trunks	RG-11/U Coaxial, 14 AWG Solid Conductor, Plenum-Rated	Belden #89292 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
T-1 Premises Extension Cable	T-1, 4 Pair 22 AWG, Plenum-Rated Pairs Individually Shielded	Anixter #CMP-00422T1-3 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
6-Strand Fiber (or # of Strands as Noted)	Multimode 50/125 Micron, Plenum-Rated	Anixter #370-COROM2-TBD-06 Superior Essex TE Connectivity Siecor Equivalent Berk-Tek Equivalent
Speaker Cable	22 AWG. 1 Pair Shielded	Belden #88761 Superior Essex TE Connectivity W.P.W. Equivalent Anixter Equivalent
Speaker Cable, with Call-In Unshielded Pair	22 AWG. 1 Pair Shielded, 1 Pair 22 AWG. Unshielded	Belden #88723 Superior Essex TE Connectivity W.P.W. Equivalent Anixter Equivalent
100 Pair Telephone Cable	24 AWG. 100 Pairs, Non-Plenum Exchange Cable, Wet Location Rated, Gel-Filled Certified Category Three	Anixter #E-010024DFC Superior Essex TE Connectivity Belden Equivalent A.T.&T. Equivalent

- OR -

F. Schedule of Wiring Types - Non-Plenum Rated

Data Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P.	Anixter #CM-00423PND-6A-06 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent

Voice Circuits	24 AWG, 4 Pair Certified Category Six augmented U.T.P.	Anixter #CM-00423PND-6A-06 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
Voice Circuits	24 AWG, 4 Pair Category Three U.T.P.	Anixter #CM-00422 BAG-3 Superior Essex Belden Equivalent W.P.W. Equivalent
Video Drops	RG-6/U Coaxial 18 AWG Solid Conductor	Belden #9060 Superior Essex Anixter Equivalent W.P.W. Equivalent
Video Trunks	RG-11/U Coaxial, 14 AWG Solid Conductor	Belden #1523A Superior Essex E Connectivity Anixter Equivalent W.P.W. Equivalent
T-1 Premises Extension Cable	T-1, 4 Pair 22 AWG, Pairs Individually Shielded	Anixter #CM-00422 MIGT-3 Superior Essex TE Connectivity Belden Equivalent Berk-Tek Equivalent
6-Strand Fiber (or # of Strands as Noted)	Multimode 50/125 Micron	Anixter #370-947-SMODE-12 Superior Essex TE Connectivity Siecor Equivalent Berk-Tek Equivalent
12-Strand Fiber (or # of Strands as Noted)	Singlemode 8.3/125 Micron	Superior Essex TE Connectivity Siecor Equivalent Berk-Tek Equivalent
Speaker Cable	22 AWG. 1 Pair Shielded, Plenum-Rated, Stranded	Belden #9414 Superior Essex TE Connectivity Equivalent W.P.W. or Anixter
Speaker Cable with Call-In Pair	22 AWG. 1 Pair Shielded, 1 Pair 22 AWG. Unshielded for Call- In, Plenum-Rated	Belden #8730 Superior Essex TE Connectivity W.P.W. Equivalent Anixter Equivalent
100 Pair Telephone Cable	24 AWG. 100 Pairs, Non-Plenum Exchange Cable, Wet Location Rated, Gel-Filled, Certified Category Three, Installed in Metal Conduit	Anixter #E-010024DFC Superior Essex TE Connectivity Belden Equivalent A.T.&T. Equivalent

6. HIGH VOLTAGE PRIMARY CABLE

- A. High voltage primary cable shall be rated for aerial, direct burial, open tray, wet location and submersible underground service. Cable shall be I.P.C.E.A. - listed and UL listed for the use indicated.
- B. Cable shall be rated 15 K.V., nominal. Insulation shall be XLP, XLPE or approved equivalent with a nominal 133% value.
- C. Cable shall be shielded, grounded, with extruded 8 mil. semiconducting layer bonded to the insulation. Provide with copper drain wires served over semiconducting layer.
- D. Cable shall be installed in accordance with manufacturer's recommendations, with particular attention to termination, handling, bending radii and pull tension recommendations.
- E. The conductor shall be copper with Class "B" stranding per ASTM B-8.
- F. Cable shall be as manufactured by G.E., Anaconda, Phelps-Dodge, Okonite, or approved equivalent.
- G. Cable shall be manufactured per the following standards: UL 1072 and ICEA for medium voltage cable.
- H.
 - (1) Cable shall be terminated at pad-mount transformer or as indicated with pre-manufactured load-break, dead-front elbows and fittings compatible with cable and rated for the purpose. Pre-manufactured elbows and other types of fittings indicated shall be as manufactured by Elastimold Co., Blackburn-ITT, R.T.E. Corporation, S & C Company or other approved equivalent.
 - (2) Cable terminators for 15 K.V., 200 ampere connection shall be ANSI Standard 386-1877 200 amp hot-stick operable load break elbow with voltage test point. The elbow shall be furnished with the necessary cable adapter for terminating the copper cable used.
 - (3) Electrical ratings shall be as follows:

Voltage	15 KV class
Continuous and Load Break Current.....	200 amps, rms
BIL	95 KV
Withstand Voltage (AC).....	34 KV, 60 HZ, 1 minute
Short-Time Current	10,000 amps, rms, sym., 17 seconds.
 - (4) Cable terminators for 15 K.V., 600 ampere connection shall be ANSI Standard 368-1977 premolded dead break unit for terminating 15 KV shielded cable. The connector shall be fully shielded, of dead front operation and shall be fully submersible. The connector shall be furnished with proper adapters for terminating the copper cable used.
 - (5) The connectors shall have the following ratings:

Voltage	15 KV Class
Continuous Current	600 amps, rms
BIL	95 KV
8 Hour Overload.....	900 amps, rms
Withstand Voltage (AC).....	35 KV, 60 Hz, 1 minute
Momentary	25,000 amps, rms, sym, .17 seconds
- I. Cable shall be color coded at all terminations and junctions as follows:

Phase A - Black
 Phase B - Red
 Phase C - Blue

Follow the above color coding unless otherwise indicated or required by system user.

- J. Cable grounding at all terminations shall be in accord with the manufacturer's recommendations and applicable codes.
- K. A full size (matching phase conductors) copper 600 volt insulated ground is to be provided with each primary circuit.
- L. Installation, termination and testing of primary power cables shall be accomplished by Journeymen Electricians with at least three years experience with such work.
- M. In lieu of using pre-manufactured elbows and other fittings, installer may substitute field-build and taped stress cones or other type of termination, subject to written prior approval of the engineer. In requesting such approval, submit complete data on materials proposed to be used and tools to be used in cutting and stripping cable.
- N. All new primary cable shall be high-potential tested in accord with criteria outlined herein. Where taps, splices or terminations to existing primary cables are indicated on the plans, the Engineer reserves the right to request high-potential testing of the existing cable or systems to determine their suitability and safety, if not so indicated on the plans.
- O. Always field verify exact primary power voltage potentials with the supplying utility and report any discrepancy from that indicated on the plans to the Engineer prior to placing any primary cable in service.

7. TESTING OF PRIMARY CABLE

- A. All new primary cable shall be tested prior to energization in accord with the following criteria, or other approved method.
 - (1) Use equipment made by one of the following (or approved equivalent) and abide by their operation rules for their respective equipment:
 - a. Associated Research, Inc.
 - b. J.G. Biddle Company
 - c. Hipotronics, Inc.
 - d. Von Corporation
 - (2) Clear cable of all equipment, switchgear, etc. for elbows, install insulation plugs. On cable end, insulate by high voltage taping, insulating jar or plastic. All terminations and splices shall be completely and properly grounded. All adjacent equipment shall be grounded, where danger of flashover exists.
 - (3) A sphere gap in parallel with the 100,000 volt D.C. "Hipot" tester shall be calibrated for sparkover at 70 KV D.C.
 - (4) The direct current test voltage shall be applied in increments of 5 KV and shall be left at the step for 1 minute. Saturate cable for 15 minutes at test voltage as in (5) below.

(5) Test: (as appropriate)

- a. 15 KV cables with open terminations at 55 KV D.C.
- b. 15 KV cables with elbow termination at 45 KV D.C., or to the limit of the elbow or splice. Verify with manufacturer.

SPECIAL NOTE: It is suggested that tests be performed when relative humidity is 50 to 60% or less in clear, dry weather for greater safety.

(6) Record the leakage current at each step and at end of saturation time.

(7) Acceptance: The above procedure with less than 100 microamperes of current registered.

(8) Proof test on existing cable at 35 KV for 5a and 35 KV for 5b above.

(9) After test (in order listed):

- a. Turn tester power off.
- b. Discharge tester and cable thru a resistive discharge device (8 MEGOHM discharge stick).
- c. Ground cable thru a grounding means (#12 AWG THW wire to ground).
- d. Disconnect tester.

(10) For Safety:

- a. Wear high voltage gloves at all times.
- b. Treat cable and tester as high voltage at all times.
- c. Remember, D.C. static charges can be very harmful.

(11) All tests must be made in the presence of the Engineer and shall be recorded on a form sheet signed by the person performing the test and dated. Three (3) copies shall be submitted to the Engineer. Provide 48 hour advance written notice to Engineer.

END OF SECTION 260519

SECTION 260526 - GROUNDING**1. GENERAL**

- A. All metallic conduit, raceways, cable trays, wireways, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code, as shown on the Contract Drawings and in accord with the requirements of the local authority having jurisdiction, as applicable.
- B. The size of the equipment grounding conductors, grounding electrode conductors and service grounding conductors shall be not less than that given in Article No. 250 of the National Electrical Code, and/or as shown on the Contract Drawings. Where ungrounded conductor sizes are increased to minimize voltage drop, grounded conductor sizes shall be increased in the proper proportion.
- C. Grounding bus and non-current carrying metallic parts of all equipment and raceway systems shall be securely grounded by connection to common ground.
- D. The service entrance main ground bus shall also be connected to the main cold metallic water pipe within three feet of where it enters the building, on both the house and street sides of the main shut-off valve with a properly sized bonding jumper. A properly sized bonding jumper shall also be provided to the frame of any steel structure utilized in the construction. The steel frame of the building (if any) shall be made electrically continuous.

2. MATERIALS

- A. Ground wires and cables shall be of the AWG sizes shown on the Contract Drawings or shall be sized in accord with the prevailing codes. All ground wires and cables shall be copper.
- B. All grounding fittings shall be heavy cast bronze or copper of the mechanical type except for underground installations or interconnection of grounding grid to cable, columns and ground electrodes, which shall be thermically welded type as manufactured by Cadweld, Burndy Co., Therm-O-Weld, or approved equivalent. Other bonding clamps or fittings in above ground locations shall be as manufactured by O.A. Co., T & B, Burndy, or approved equivalent.
- C. Ground electrode pipe systems shall be solid copper construction. Ground rods shall be 5/8" minimum diameter, eight feet long, copperweld steel. All ground electrode systems shall be installed in accord with manufacturer's recommendations, U.L. listings, National Electrical and National Electrical Safety Codes.

3. INSTALLATION

- A. All grounding conductors shall be protected from mechanical injury and shall be rigidly supported. Where ground conductors are run through flexible conduit and through panelboard switchboard or motor control center feeders, they shall be securely bonded to such conduit thru the use of grounding bushings at the entrance and exit. All connection of equipment shall be made with an approved type of solderless connection and same shall be bolted or clamped to equipment or conduit.
- B. All equipment grounding conductors to lighting fixtures, devices, receptacles, electric heaters, furnace and other equipment not exceeding No. 8 AWG in size shall be green colored Type "THWN".
- C. Equipment ground connections to GFI circuit breakers shall be carried and bonded to each outlet on the circuit. Provide a separate equipment grounding conductor with green color insulation.
- D. Resistance to the grounding at the service entrance equipment shall be in accordance with the N.E.C. for style of construction and shall not exceed ten ohms as measured by the described testing method.

- E. All circuits shall have a separate grounding conductor, except as otherwise noted.
- F. When grounding systems are completely installed and all grading in the area of the service grounding electrode has been completed up to finish elevations, perform a fall-of-potential or other approved test to determine actual system resistance to earth. Report results to the Engineer in writing. Refer to testing provisions in this section of specifications.
- G. Where separately-derived systems are utilized as part of the power distribution network, the neutral leg of the secondary side of generators, transformers, etc., shall be connected to a grounding electrode in accordance with the manufacturer's recommendations.
- H. The Contractor shall ensure that the ground return path thru building structural steel or other means is electrically continuous back to the service grounding electrode and is of adequate capacity and impedance to carry the maximum expected fault or other current. Where no electrically continuous steel building frame is available, the Contractor shall provide a properly sized ground bar and ground conductor routed back to the main facility ground bus.
- I. Where a building's steel frame is made electrically discontinuous by masonry breaks (as at firewalls, etc.), the Contractor shall provide an accessible thermally welded bonding jumper of #500MCM copper to bond the building steel frame sections together, making the entire steel frame electrically continuous. The installation of these bonding jumpers shall be reviewed by the Engineer prior to their being covered by construction.
- J. Where lightning protection systems are utilized on the work, their electrodes and conductors shall be electrically segregated from the building service ground, except where connections to structural elements are required for the proper installation of these systems. Lightning protection grounds shall only be utilized for lightning grounding applications, in accord with U.L. and manufacturer's recommendations.
- K. Grounding connections shall **never** be made to fire protection, natural gas, flammable gas or liquid fuel piping, except where specifically indicated on the plans.
- L. Where dielectric fittings are utilized in piping systems, the piping system shall **not** be utilized as a ground path. Bonding jumpers shall not be utilized to bridge over such fittings. Piping systems shall **not** be utilized as ground paths except where specifically required by codes in the case of water piping.

4. GROUNDING ELECTRODE SYSTEM

- A. The ground electrode system shall be as specified herein. The system shall not require maintenance throughout the expected life span of the materials.
- B. Ground system shall be an electrolytic rod type, as manufactured by Lyncole XIT Grounding, Superior Grounding Systems, L.E.C., Inc. (Chem-Rod), or approved equivalent. Electrode(s) shall be placed as shown on the plans, installed exactly per manufacturer's recommendations. Electrodes shall be installed vertically, 12 feet of overall length (or length as indicated), set in a drilled hole and backfilled per manufacturer's instructions with a special clay slurry surrounding the rod. Provide a concrete protection box with cast iron grate for the top of the rod termination. Ground system shall be per the following:
 - (1) Manufacturer: Lyncole XIT Grounding (or approved equivalent).
 - (2) Source: Lyncole XIT Grounding, 22412 S. Normandie Ave., Torrance, CA 90502 1-800-962-2610
 - (3) Shaft Configuration: Straight.
 - (4) Shaft Length: 12 feet (or as otherwise indicated).
 - (5) Listings: U.L.-467J, ANSI 633.8.
 - (6) Material: Type K Copper.

- (7) Construction: Hollow tube, 2.125" O.D., chemical filled with non-hazardous metallic salts.
- (8) Weight 3.5 lbs. per foot of length, nominal.
- (9) Ground Wire Termination: Exothermic ("Cadweld" by Contractor) connection to 4/0 conductor, with U-bolt with pressure plate provided as test point.
- (10) Average Life Expectancy: 25 Years.
- (11) Model Number: K2-(length)CS.
- (12) Provide grounding system with the following components: protective box, backfill material. Box to be concrete with cast iron, tamper-resistant lid, backfill to be "Bentonite" clay.

C. Installation of Pipe Ground System

- (1) **Pipe ground systems shall be installed exactly as required by the system manufacturer. The Contractor shall be diligent to observe the excavation, sealing tape removal, slurry backfill and all other critical requirements.**

- (2) **Note: NEVER USE SAND OR ORDINARY EARTH AS A BACKFILL MATERIAL**

- D. Pipe grounding system shall be warranted unconditionally by the Contractor for a period of one year from the date of substantial completion.

5. GROUND TESTING PROCEDURE

- A. The actual resistance to earth of the service grounding electrode shall be measured by the Contractor via the fall-of-potential method. This testing shall be accomplished after the grounding electrode has been completely installed and the finished grade is achieved.
- B. The results of the testing shall be summarized in a written report by the Contractor, which shall be forwarded to the Engineer for review. The report shall also be included with the operation and maintenance manuals for the Owner's information and future reference. This report is to also contain a detailed description and illustrations of the testing procedure, along with the name and model number of the testing instrument(s).
- C. For the actual testing, the Contractor shall follow the procedures outlined below. A self-contained instrument such as a "Megger" or "Ground OHMMETER" shall be used that is designed to eliminate the influence of stray current effects on the accuracy of the measurements.
 - (1) Connect one side of the instrument to the grounding electrode conductor where it connects to the facility main ground bus (point C1). Disconnect and isolate the grounding electrode conductor for the test.
 - (2) Drive a copperweld reference electrode probe (point C2) into earth between 300 and 500 feet away from C1 and connect to measurement instrument.
 - (3) Drive the movable grounding probe (C3) into earth at ten equally spaced intervals, in a straight line between C1 and C2 points and note the $E/I=R$ resistance readings on a graph at each point.
 - (4) The resistance measurements in OHMS taken from the flat part of the curve shall be averaged to determine the true grounding electrode resistance to earth.
 - (5) At completion of testing, remove reference electrode C2 and all temporary wiring and connections.
 - (6) If actual measurements of grounding electrode indicate a resistance greater than five OHMS, contact the Engineer for instructions. If deemed necessary by the Engineer, additional electrodes shall be placed and the measurement process repeated until the desired ground potential achieved.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of [five] <Insert number> times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings:[**Signed and sealed by a qualified professional engineer.**] Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - h. <Insert manufacturer's name>.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with **9/16-inch- (14-mm-)** diameter holes at a maximum of **8 inches (200 mm)** o.c., in at least 1 surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - e. **<Insert manufacturer's name>**.
 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 4. Fitting and Accessory Materials: Same as channels and angles[, **except metal items may be stainless steel**].
 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: **[Steel] [Steel and malleable-iron]** hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

- 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 5) **<Insert manufacturer's name>**.
2. Mechanical-Expansion Anchors: Insert-wedge-type, **[zinc-coated]** **[stainless]** steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) **<Insert manufacturer's name>**.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as **[required by]** **[scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in]** NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted **[or other]** support system, sized so capacity can be increased by at least **[25]** **<Insert number>** percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with **[two-bolt conduit clamps]** **[single-bolt conduit clamps]** **[single-bolt conduit clamps using spring friction action for retention in support channel]**.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, **[EMT]** **[IMC]** **[RMC]** **[EMT, IMC, and RMC]** may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inches (100 mm)** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches (100 mm)** thick.
 6. To Steel: **[Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts]** **[Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69]** **[Spring-tension clamps]**.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate **[by means that meet seismic-restraint strength and anchorage requirements]**.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than **4 inches (100 mm)** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use [**3000-psi (20.7-MPa)**] **<Insert value>**, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "[**Cast-in-Place Concrete**]" [**Miscellaneous Cast-in-Place Concrete**]."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Touchup: Comply with requirements in Division 09 [**painting Sections**] [**Section "High-Performance Coatings"**] for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260531 - CABINETS, OUTLET BOXES AND PULL BOXES**1. GENERAL**

- A. This section of the specifications covers all electrical cabinets, outlet boxes and pull boxes.
- B. Continuous runs of conduit shall have properly sized pull boxes at least each eighty-five feet of run, or as near as possible to that limit.

2. MATERIALS & INSTALLATION

A. Cabinets, Outlet and Pull Boxes:

- (1) Cabinets for lighting and power, telephone, pull boxes, outlet boxes, or any other purposes specified or shown on the Contract Drawings, shall be constructed of code gauge, galvanized steel with sides formed and corner seams riveted or welded before galvanizing. Boxes assembled with sheet metal screws will not be accepted. Pull boxes shall include all boxes used to reduce the run of conduit to the required number of feet or bends, supports, taps, troughs, and similar applications and shall also be constructed as specified above.
- (2) All cabinets and boxes for NEMA 1 and 1A application shall be provided with knockouts, as necessary, or shall be cut in the field by approved cutting tools which will provide a clean, symmetrically cut opening. All boxes, except panelboards, shall be provided with code gauge fronts with hex head or pan head screw fasteners. Outdoor cabinets shall be hinged cover with pad locking provisions. Fronts for panelboards shall be as specified for panelboards.
- (3) Ceiling outlet boxes shall be galvanized steel, 4" octagonal, not less than 2 1/8" deep, with lugs or ears to secure covers. Those for use with ceiling lighting fixtures shall be fitted with 3/8" fixture studs fastened to the back of the boxes, where applicable. Provide adequate support with at least a 2 x safety factor for the anticipated fixture weight.
- (4) Special size concealed outlet boxes for clocks, speakers, alarms, panels, etc., shall be provided by the manufacturer of the equipment.
- (5) Floor outlet boxes shall be as specified in Section 262726, fully adjustable unless noted or specified otherwise.
- (6) Unless otherwise noted on the drawings or in the specifications, outlet boxes shall be installed at the following heights to centerline of box:

Wall Switches, Control Stations.....	3'-10"
Convenience Outlets	1'-6"
Convenience Outlets - Above Counters	Bottom at 2" above top of backsplash
T.V. Outlets.....	1'-6"
T.V. Outlets - At Wall Brackets	7'-2"
Desk Telephones.....	1'-6"
Wall-Mounted Telephone	4'-6"
Weatherproof Outlets.....	2'-2"
Disconnects, Branch Panelboards	5'-0" max. to centerline
Fire Alarm Manual Stations	3'-10"
Fire Alarm Audio and/or Visual Units.....	80" AFF to bottom of device or 6" below ceiling, whichever is lower.

- (7) The location of outlets, as shown on the drawings, shall be considered as approximate only. It shall be incumbent upon this Contractor to study the general building drawings, with relation to spaces surrounding each outlet, in order to make his work fit the work of others and in order that when the devices or fixtures are installed, they will be symmetrically located and will not interfere with any other work or equipment. Any change in fixture or layout shall be coordinated with and approved by the Engineer before this change is made. Regardless of the orientation shown on the drawings, all devices shall be easily accessible when installed.
- (8) Boxes installed in fire rated assemblies shall not compromise the rating of the assembly. The Contractor is responsible for identifying assembly ratings and construction requirements prior to rough-in.
 - a. Listed single and double gang metallic outlet and switch boxes with metallic or nonmetallic cover plates may be used in bearing and nonbearing wood stud and steel stud walls with rating not exceeding 2 h. The boxes shall be fastened to the studs with the openings in the wallboard facing cut so that the clearance between the boxes and the wallboard do not exceed 1/8 in. The boxes shall be installed so that the surface area of individual boxes do not exceed 16 sq in, and the aggregate surface area of the boxes do not exceed 100 sq in per 100 sq ft of wall surface unless approved alternate protection materials are used.
 - b. Boxes located on opposite sides of walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between the boxes may be reduced when listed Wall Opening Protective Materials are installed according to the requirements of their Classification.
 - c. Boxes installed on opposite sides of walls or partitions of staggered stud construction shall have listed Wall Opening Protective Materials installed with the boxes in accordance with Classification requirements for the protective materials.
 - d. All installation shall be done in accordance with AHJ requirements.
- (9) All outlets, pull boxes, junction boxes, cabinets, etc., shall be sized per the current edition of the National Electrical Code.
- B. Cabinets, outlet boxes and junction or pull boxes shall be threaded for rigid-threaded conduit, dust-tight, vapor-tight or weatherproof as required for areas other than for NEMA 1 or 1A application. These shall be as manufactured by Crouse-Hinds, Appleton, Killark, or approved equivalent.
 - (1) NEMA 1 or 1A cabinets, outlet boxes or pull or junction boxes shall be as manufactured by Appleton, Steel City, T & B, or approved equivalent.
 - (2) Outlet boxes for switches, receptacles, telephone, etc., concealed in walls shall be galvanized steel, 2" X 4" X 2" with plaster cover for the number of devices as required. Where outlet boxes are installed in walls of glazed tile, brick, concrete block, or other masonry which will not be covered with plaster or in walls covered by wood wainscot or paneling, deep sectional masonry boxes shall be used and they shall be completely covered with the plates or lighting fixtures. This Contractor shall cooperate with the brick layers, block layers and carpenters to insure that the outlet boxes are installed straight and snugly in the walls. Receptacles shall be set vertically in walls, unless noted otherwise.
 - (3) Outlet boxes mounted in glazed tile, brick, concrete block or other types of masonry walls shall be mounted above or below the mortar joint. Do Not Split The Mortar Joint.
 - (4) Boxes for more than two devices shall be for the number of devices required and shall be one piece. No ganging of single switch boxes will be allowed.

- (5) Outlets provided shall have only the holes necessary to accommodate the conduit at the point of installation and shall be rigidly secure in position. Boxes with knockouts removed and openings not used shall be replaced or be provided with a listed knockout closure.
- (6) Openings for conduit entrance in cabinets and boxes shall be prefabricated, punched, drilled and/or reamed. The use of a cutting torch for this purpose is prohibited.

END OF SECTION 260531

SECTION 260533 - RACEWAYS & FITTINGS**1. GENERAL**

- A. This section is intended to specify the raceways, conduit, conduit fittings, hangers, junction boxes, splice boxes, specialties and related items necessary to complete the work as shown on the drawings and specified herein.
- B. This section specifies basic materials and methods and is a part of each Division 26, 27 and 28 that implies or refers to electrical raceways specified therein.
- C. The types of raceways specified in this section include the following:
 - (1) Steel electrical metallic tubing. (E.M.T.)
 - (2) Rigid galvanized steel conduit. (G.R.S.)
 - (3) Intermediate metal conduit (I.M.C.).
 - (4) Rigid aluminum conduit.
 - (5) Flexible metal conduit (aluminum or steel)
 - (6) Liquid - tight flexible metal conduit.
 - (7) Rigid nonmetallic conduit.
 - (8) Surface metal raceways.
 - (9) Wireways, wall ducts and trench ducts.
 - (10) Cable tray or cable trough.
 - (11) Duct banks, and their construction.
- D. All raceways, as listed in 1C. above and otherwise specified herein shall be provided in compliance with latest editions of all applicable U.L., NEMA, N.E.C. and A.N.S.I. standards. All conduit, raceways and fittings shall be Underwriters Laboratories listed and labeled, or bear the listing of an agency acceptable to the local authority having jurisdiction.
- E. Conduit and raceways, as well as supporting inserts in contact with or enclosed in concrete shall comply with the latest edition of all A.C.I. standards and the equipment manufacturer's recommendations for such work.
- F. P.V.C. or other non-metallic conduit shall be rated for the maximum operating temperature that could be developed by the conductors it encloses, while in normal operation.
- G. The decision of the Engineer shall be final and binding in any case where a question or inquiry arises regarding the suitability of a particular installation or application of raceways, supports or materials, if other than outlined herein.
- H. Minimum size of conduit shall be 3/4" trade size. All conduit and raceways shall be sized for the number of conductors contained, in accord with the latest edition of the National Electrical Code or any other applicable standards.
- I. The installer of raceway systems shall avoid the use of dissimilar metals within raceway installations that would result in galvanic-action corrosion.

2. MATERIALS**A. STEEL ELECTRICAL METALLIC TUBING**

- (1) Electrical metallic tubing, (E.M.T.) of corrosion-resistant steel construction shall be permitted for concealed installation in dry interior locations. Electrical metallic tubing shall not be installed in concrete slabs or where exposed to physical damage. Electrical metallic tubing shall be permitted for exposed work

in mechanical and electrical rooms and other exposed structure areas where not subjected to physical damage, as determined by the Engineer.

B. RIGID GALVANIZED STEEL CONDUIT

- (1) Rigid galvanized steel conduit shall be used where subject to physical damage for exposed work in mechanical spaces, within factory or other industrial work areas, for exposed fit-up work on machinery, for exposed exterior damp or wet location work, in hazardous atmospheres, in exterior underground locations where installed beneath roadways, where ells occur in underground P.V.C. conduits, or where turning out of concrete encased duct banks, and at other locations as specifically called out on the drawings.
- (2) Rigid galvanized steel conduit shall be used for all building interior power wiring or cables of over 600 Volts.

C. INTERMEDIATE METAL CONDUIT

- (1) Unless otherwise indicated on the drawings, intermediate metal conduit (I.M.C.) may be used in any location in place of rigid galvanized steel conduit, as permitted by codes, and as approved by the Engineer.

D. RIGID ALUMINUM CONDUIT

- (1) Rigid aluminum conduit, shall be permitted for installation indoors in dry locations only. Under no conditions shall it be cast into concrete slabs or pass thru construction where prolonged contact will degrade the aluminum. All ells used in rigid aluminum conduit systems shall be rigid galvanized steel. Rigid aluminum conduit shall always be used for power wiring greater than 5 KVA and higher than 60 Hz frequency.

E. FLEXIBLE METAL CONDUIT

- (1) Flexible conduit shall be used where permitted by NEC. It may be constructed of aluminum or steel. It shall be installed with connectors designed for the purpose. All flexible metal conduit shall be installed as a single piece. No joints shall be installed. Flexible conduit shall not be used in wet or dusty locations or where exposed to oil, water or other damaging environments. An equipment grounding conductor or bonding jumper shall be used at all flexible conduit installations. Maximum permitted length of flexible metal conduit shall be 72", as for light fixture whips unless approved in writing by Engineer.

F. LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- (1) Weatherproof flexible metal conduit shall be wound from a single strip of steel, neoprene covered, equivalent to "Liquatite" or "Sealtite" Type "UA". It shall be installed in such a manner that it will not tend to pull away from the connectors. Provide strain relief fittings equivalent to "Kellems" as required where subject to vibration. Flexible connections to motors in dusty areas shall be dust-tight, in areas exposed to the weather - weatherproof.

G. RIGID NON-METALLIC CONDUIT

- (1) Rigid non metallic conduit shall be constructed of P.V.C, nominally schedule 40 weight, except where encased in concrete, where it may be "EB" type. If installation will enclose utility company provided conductors, verify exact type required and install in accord with their standards, if more stringent than this specification.
- (2) Rigid non-metallic conduit may be used in exterior wet or damp locations where installed underslab or underground. It shall not be run in interior locations, except with special permission from the Engineer for

use in corrosive environments, and then only if protected from physical damage. No rigid nonmetallic conduit may be installed in environmental air plenums or cast into above-grade concrete slabs. No rigid nonmetallic conduit may be installed in locations where the ambient temperature might exceed the rating of the raceway.

- (3) Where rigid non metallic conduit is placed underground, as for feeder circuits, secondaries or branch circuit runs and where ell is made upward thru a slab on grade, transition the turning ell and the riser to rigid steel conduit to a height of 6" above the concrete slab. Transition may then be made to E.M.T or other approved conduit for remainder of run.
- (4) Flexible nonmetallic conduit shall not be used, except by special permission, obtained in writing from the Engineer.
- (5) Provide equipment grounding conductors of copper, sized as required by codes, in all circuits installed in rigid nonmetallic raceways.

H. SURFACE METAL RACEWAYS

- (1) Surface metal raceways shall be constructed of code gauge corrosion-resistant galvanized steel or aluminum extrusions, and finished in an ivory, buff or grey color as selected by the Architect. Finishes shall be suitable for field painting, prepared by the installing contractor as necessary.
- (2) Surface metal raceways, where used as raceways only, shall be sized for the conductors indicated. Nominal minimum size of such raceways shall be equivalent to Wiremold Co. Series #700, or equivalent by Isotrol or other approved manufacturer.
- (3) Surface metal raceways to be furnished with integral receptacles shall have Simplex Nema 5-20R outlets spaced on centers as indicated on plans. These shall be Wiremold Co. #2200 Series or equivalent Isotrol or other approved manufacturer.
- (4) Surface metal raceways and all components and fittings shall be furnished by a single manufacturer, wherever practical. All trim and cover fittings, flush feed boxes, splices, outlet fittings, etc, necessary for a complete installation shall be provided by the installing contractor. These raceways shall be rigidly mounted with approved fasteners on not to exceed 24" centers in a run, or 6" from ends and on either side of a corner. Refer to plans for notations on exact types of these raceways and outlet configurations.

I. WIREWAYS, WALL DUCT, FLUSH FLOOR TRENCH DUCT

(1) WIREWAYS

- a. Wireways of painted steel construction shall be corrosion-resistant, moisture and oil resistant where indicated or necessary. Wireways shall be furnished in nominal sizes of 2 1/2" X 2 1/2", 4" X 4", 6" X 6", 8" X 8" or 12" X 12", as indicated on plans. Furnish with hinged covers on all runs and removable covers on all fittings, to allow a continuous unobstructed path for conductor installation. Provide knockouts on all runs, unless otherwise indicated or prohibited by codes.
- b. Provide wireways with hangers of same manufacturer, installed so as to allow unobstructed access to wireway interior. Install at not to exceed 8'-0" centers, closer as needed at fittings and turns. Use 1/4" rod hangers minimum for up to 4"X4", 3/8" rod minimum up to 8"X8", 1/2" rod minimum for 12" X 12".
- c. Wireways shall be equivalent to Square "D" Co. "LD" series, as a minimum standard of construction and quality.

(2) WALL DUCTS

- a. Where wall duct type raceways are indicated to be installed flush, they shall be a minimum 3 1/2" deep by 10" wide (or 18" width, as indicated), furnished with screw covers to overlap flange 1" on each side. Covers shall be furnished in nominal 3'-0" lengths. Provide fully grommated openings or bushed nipples as needed in coverplates to pass cables thru. Where indicated or required, provide transition fittings between horizontal runs of wireway and wall ducts to properly interface each raceway system.
- b. Where wall ducts are installed flush either vertically or horizontally as a collector duct, provide proper blocking and support in stud walls, adding a layer of studs as needed to prevent undercutting major structural elements of walls. Trim flange shall be set tight to wall surface with 1/16" tolerance each way.
- c. Wall ducts, if indicated to be surface mounted, shall be furnished with flangeless coverplates.
- d. All completed systems shall be provided with a factory prime painted finish, suitable for field finish painting.
- e. Wall ducts shall be equivalent to Square D Company "RWT" Series, as a standard of construction and quality.

(3) TRENCH DUCTS

- a. Trench duct is to be installed flush with finished concrete floor slab with a vertical tolerance to adjacent surfaces of 1/16" plus or minus. Nominal depth of trench duct shall be adjustable from 2 3/8" to 3 1/2", minimum 12" width unless otherwise noted on plans.
- b. Trench duct shall be constructed of code-gauge steel, 14 gauge minimum, with corrosion resistant finish. Surfaces of duct or fittings in contact with concrete shall be painted with two coats of "Asphaltum" or receive equivalent coating or taping prior to placement of concrete.
- c. Furnish trench duct with flat turns, riser transition fittings to wall duct or panelboard as shown, concrete tight couplings, internal barriers as required to separate services, reducers, end closers, tees and all other fittings as indicated or required.
- d. Furnish coverplates of aluminum, 1/4" thickness minimum, with flush fasteners in nominal 24" lengths. Furnish grommated openings or nipples with insulated bushings as required. Coverplates shall not deflect more than .085" with application of a 200 pound concentrated load. Any compartment over 16" in width shall have additional coverplate support, to meet the deflection criteria above.
- e. Provide (as standard) an aluminum tile trim flange (verify and coordinate with floor finishes). Refer to architectural drawings, where applicable.
- f. Trench duct and coverplates shall be equivalent to Square "D" Company RSV/RCP-AL series, as a standard of quality and construction.

J. CABLE TRAY OR CABLE TROUGH

- (1) Cable tray shall be furnished in all-aluminum construction or galvanized steel construction, as noted and sized on the drawings.

- (2) Galvanized finishes on tray shall be hot-dipped after fabrication for all trays in exterior locations. Mill finished galvanizing may be used where tray is installed indoors in dry locations.
- (3) The installing contractor shall carefully follow the manufacturer's recommendations for hanger sizing and hanger support spacing. The weight per linear foot of tray, fully loaded with a 200% safety factor shall be accounted for in sizing hangers. Refer to manufacturer's instructions and/or the drawings, as applicable for hangers and supports. In no case shall supports be spaced further than 8'-0" apart.
- (4) Cable tray shall be of the ladder type with rungs spaced 12" apart. Side rails shall be of I-Beam or C-Channel construction with welded rungs, depth and width as indicated on the drawings.
- (5) Cable trough shall be similar to cable tray, except bottom shall be a ribbed solid piece, depth and width as indicated on the drawings.
- (6) Cable tray or trough shall be provided with all required fittings for a complete installation. Fittings shall include, but not be limited to: Horizontal and vertical elbows and tees, smooth dropout fittings, end closure plates, fixed (or adjustable) splices as needed for field offsets, reducers, barriers or box connector flanges.
- (7) Cable tray and trough shall be equivalent to Square "D" Company Series CLA/CLG (ladder tray) or CTA/CTG (trough) as a standard of quality and construction.

K. OPEN WIRE MESH CABLETRAY

- (1) Section includes continuous, rigid, welded steel wire mesh cable management system.
- (2) References
 - a. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. ASTM A 510 - General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
 - c. ASTM B 633 - Electrodeposited Coatings of Zinc on Iron and Steel.
- (3) Design Requirements
 - a. Maximum Deflection Between Supports: $L/240$.
- (4) Submittals
 - a. Product Data: Submit manufacturer's product data, including UL classification.
 - b. Shop Drawings: Submit shop drawings indicating materials, finish, dimensions, and accessories. Show layout, support, and installation details.
 - c. Manufacturer Qualifications: Submit manufacturer's certification indicating ISO 9002 quality certified.
- (5) Delivery, Storage and Handling
 - a. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- b. Storage: Store materials in a dry area indoors, protected from damage, and in accordance with manufacturer's instructions.
 - c. Handling: Protect materials and finishes during handling and installation to prevent damage.
- (6) Manufacturer
- a. Cablofil, Inc., 8319 State Route 4, Mascoutah, IL, 62258. Phone (618) 566-3230. Toll Free (800) 658-4641. Fax (618) 566-3250. www.cablofil.com, or approved equivalent. Part numbers included in this section are not meant to restrict truly equivalent manufacturers.

(7) Open Wire Mesh Cabletray System

- a. Description: Continuous, rigid, welded steel wire mesh cable management system.
 - 1) Mesh System: Permitting continuous ventilation of cables and maximum dissipation of heat.
 - 2) Safety Edge: Continuous safety edge T-welded wire lip.
 - 3) Wire Mesh: Welded at all intersections.
- b. UL Classification: Straight sections 4" x 8", 12", and 18 inches.
- c. Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
- d. Finish for Carbon Steel Wire: Finish applied after welding and bending of mesh.
 - 1) Hot-Dip Galvanizing: ASTM A 123. (Only in exterior, wet or corrosive locations)
 - 2) Flat Black: Powder painted surface treatment using ASA 61 black polyester coating. (In indoor dry locations)
- e. Nominal Dimensions:
 - 1) Nominal Mesh: 2 x 4 inches.
 - 2) Nominal Straight Section Lengths: 80 inches and 118 inches.
 - 3) Width: [6 inches] [8 inches] [12 inches] [18 inches] [24 inches].
 - 4) Depth: Four inches in depth for all but 6" wide, which shall be 2" depth.
 - 5) Wire Diameter: Nominal .177 inch, minimum.
- f. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections.
- g. Support System: Standard.
 - 1) Wall Installation: CS Bracket. Maximum tray width of 12 inches (300 mm).
 - 2) Trapeze Mounting to Ceilings: CS Profile. Maximum tray width of 18 inches (450 mm).

- 3) Ceiling Installation: CSC Bracket. Maximum tray width of 12 inches (300 mm).
- 4) Fasteners: As required by tray widths. To be furnished by manufacturer.

- h. Hardware: Hardware, including splice connectors, grounding fittings and support components to be furnished by the manufacturer.
 - i. Grounding: GTA-2-2 grounding lugs for attachment on tray of continuous ground conductor fixing system.
- (8) Examination
- a. Examine areas to receive cable management system. Notify the Engineer of conditions that would adversely affect the installation or subsequent utilization of the system. Do not proceed with installation until unsatisfactory conditions are corrected.

(9) Installation

- a. Install open wire mesh cabletray system at locations indicated on the drawings and in accordance with manufacturer's instructions.
- b. Load Span Criteria: Install open wire mesh cabletray system in accordance with span load criteria of $L/240$.
- c. Cutting:
 - 1) Cut wires in accordance with manufacturer's instructions.
 - 2) Cut wires with side action bolt cutters to ensure integrity of galvanic protective layer.
 - 3) Cut each wire with 1 clean cut to eliminate grinding or touch-up.
- d. Install open wire mesh cabletray system using hardware, splice connectors, support components, and accessories furnished by manufacturer.
- e. Coordinate with other trades to provide as straight and accessible runs as possible. Not all offsets are shown on drawings, but Contractor shall make accessible offsets as required around ductwork, structure, piping or other interferences as required.

L. DUCT BANKS

- (1) Duct banks are defined as a raceway or raceways installed in underground locations, enclosed in a steel-reinforced concrete envelope. They shall be installed where indicated on the drawings or otherwise required.
- (2) All concrete used in duct bank construction shall be 3000 PSI minimum 28 day compressive strength unless otherwise noted, in accord with latest A.C.I. standards. Testing of concrete shall be the responsibility of the Contractor, as directed by the engineer. Place concrete against undisturbed earth, or provide forming as needed.
- (3) Duct bank raceways shall receive a minimum of 3" concrete cover all sides. Minimum size of any duct bank shall be 12" x 12" square, in cross section. In all cases, local and national codes shall apply to duct bank construction where they exceed the requirements of this specification.

- (4) Each corner of duct bank shall receive a minimum No. 4 steel reinforcing bar with 2" minimum concrete cover on all sides. Lap bars fifteen diameters at all splices. Provide stirrup bars bury 60" on center to tie bars together. Stirrups may be #3 bar. Reinforcing steel shall be rigidly supported during pour and vibration, and shall be constructed to ASTM standards.
- (5) Support for encased raceways shall be as recommended by raceway manufacturer, spaced 8'-0" maximum on centers, rigidly fastened to prevent floating of ducts during concrete pours. Supports shall be of a material compatible with the raceway, and shall be of the interlocking type, forming a rigidly braced installation. Provide base type and intermediate type spacers to suit conduit configurations and sizes.
- (6) Where rigid nonmetallic raceways leave concrete duct banks, a transition to rigid steel conduit shall be made 18" inside the concrete envelope. Under no circumstances shall PVC, EB or similar ducts exit concrete envelope, except where duct bank ties into a manhole wall. Provide bell ends at such terminations and dowel duct bank rebars 4" into manhole wall with non-shrink grout. Refer to details on drawings, as applicable. Slope all raceways within duct bank systems such that they shall drain into manholes or pull boxes. Provide proper drainage at manholes or pull boxes to prevent water accumulation.
- (7) Where ducts transition thru manholes, pull boxes or at terminating end, each duct shall be specifically identified. A nomenclature as shown on the drawings or as agreed upon by the installer and engineer shall be utilized to identify each individual duct. A permanent means of identifying each duct, such as engraved lamacoid plates or stamped metal tags shall be used.

M. RACEWAY FITTINGS

- (1) Raceway fittings (or condulets) shall be of gray iron, malleable iron or heavy copper-free cast aluminum. They shall be furnished in proper configurations, avoiding excessive plugged openings. Any openings that are left shall be properly plugged. All coverplates shall be gasketed with neoprene or similar approved materials, rated for the environment.
- (2) Where required, raceway fittings shall be provided in explosion-proof configurations rated for the atmosphere. Place conduit seal off fittings at each device in accord with applicable codes. Seal off fittings shall be packed with wadding, and poured with an approved non-shrink sealing compound.
- (3) Where conduit transitions in a run from a cold to a warm environment, (such as at a freezer, refrigerator or exterior wall) sealoff fittings shall be placed on the warm side immediately at the boundary to prevent migration of condensation within raceway systems.
- (4) Expansion fittings shall be provided at all locations where conduits or other raceways cross over expansion joints. Provide copper ground bonding jumpers across expansion fittings.
- (5) Conduit bodies, junction boxes and fittings shall be dust tight and threaded for dusty areas, weatherproof for exterior locations and vapor tight for damp areas. Conduit fittings shall be as manufactured by Crouse Hinds, Appleton, Killark or approved equivalent. All surface mounted conduit fittings as with "FS", "FD", "GUB" Types etc., shall be provided with mounting hubs.
- (6) Where lighting fixtures, appliances or wiring devices are to be suspended from ceiling outlet boxes, they shall be provided with 3/4" rigid conduit pendants. Outlet boxes shall be malleable iron, provided with self-aligning covers with swivel ball joint and No. 14 gauge steel locking ring. Provide safety chain between building structure and ballast housing of light fixtures for all fixtures, appliances or devices greater than 10 lbs weight. Fixtures shall be installed plumb and level.

- (7) Fittings for threaded raceways shall be tapered thread with all burrs removed, reamed ends and cutting oil wiped clean.
- (8) Fittings for E.M.T. conduit shall be of the compression type. Conduit stops shall be formed in center of couplings. All EMT connectors and couplings shall be of formed steel construction.
- (9) Indentation or die-cast fittings shall not be permitted in any raceway system.
- (10) All conduit fittings shall be securely tightened. All threaded fittings shall be engaged seven full threads. Fasteners shall be properly torqued to manufacturer's recommendations.

N. SUPPORTS AND HANGERS

- (1) Supports and hangers shall be installed in accord with all applicable codes and standards. They shall be corrosion - resistant, galvanized or furnished with an equivalent protective coating. All electrical raceways shall be hung independently from the building structure with U.L. listed and approved materials. Hangers and supports depending on the support systems of other trades' work shall not be permitted, except with specific approval in writing from the Engineer. The use of tie wire for support or fastening of any raceway system is prohibited. Perforated metal tape shall not be used for raceway support.
- (2) No raceway shall be installed on acoustic tile ceiling tees, or in any location that will impair the functioning, access or code-required clearances for any equipment or system.
- (3) Supports for raceways shall be of materials compatible with the raceway, of malleable iron, spring steel, stamped steel or other approved material. Die-cast fittings are not permitted for supports.
- (4) The installing contractor shall provide all necessary supports and braces for raceways, in a rigid and safe installation, complying with all applicable codes.
- (5) Individual conduits run on building walls or equipment shall be secured by one hole galvanized malleable iron or stamped steel pipe strap or "minerallac" 2-piece straps. The straps are to be anchored by an approved means such as expansion anchors, toggle bolts, through bolts, etc. Where required by codes or other standards, provide spacers behind mounting clamps to space conduits off walls.
- (6) Individual conduits run on building steel shall be secured by means of clamp supports similar and equal to those manufactured by the C.C. Korn Company, Elcen Co., B-Line or approved equivalent. Provide korn clamps, bulb tee clamps, flange clamps, beam clamps, "minerallacs", etc.
- (7) Where feasible, vertical and/or horizontal runs of conduit shall be grouped in common hangers on "trapezes" of channel stock as manufactured by "Unistrut" or equivalent, 1-5/8" minimum depth, 12 gauge. Utilize conduit clamps appropriate to the channel.
- (8) Channel strut systems for supporting electrical equipment or raceways in outdoor wet or corrosive locations shall be constructed of 12 gauge minimum hot dip galvanized steel with 9/16" diameter holes on 8" centers, with finish coat of paint as manufactured by Unistrut, B-Line, Kindorf, or approved equivalent. In indoor dry locations, factory finish paint will be acceptable.
- (9) The minimum diameter of round all-thread steel rods used for hangers and supports shall be 1/4", 20 threads per inch. All-thread rod shall be furnished with a corrosion-resistant finish.
- (10) Welding directly on conduit or fittings is not permitted.

- (11) Provide riser support clamps for vertical conduit runs. Riser support clamps shall be of heavy gauge steel construction. Install riser support clamps at each floor level penetration, or as otherwise required.
- (12) Provide conduit cable support clamps for vertical conductor runs as required or indicated on plans. Clamps to be insulating wedging plug, with malleable iron support ring. Install within properly sized and anchored junction box.
- (13) Spring steel clips and fittings such as those manufactured by HITT-Thomas, Caddy-Erico, or approved equivalent, with black oxide finish are permitted in any indoor dry location for concealed work, where acceptable to the local authority having jurisdiction.

3. INSTALLATION

- A. This Contractor shall lay out and install all conduit systems so as to avoid any other service or systems, the proximity of which may prove injurious to the conduit, or conductors which it confines. All conduit systems, except those otherwise specifically shown to the contrary, shall be concealed in the building construction or run above ceilings. Size of all conduit shall as a minimum conform to the National Electrical Code, unless larger size is indicated on the Contract Drawings.
- B. No conduit larger shall be installed in poured concrete slabs except with permission of the structural engineer. All other shall be held below slab. Conduit shall be held at least 6" from flues or hot water pipes.
- C. All exposed conduit shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of cast metal fittings or symmetrical bends unless otherwise shown. All conduit shall have supports spaced not more than eight feet apart.
- D. Conduit shall be installed in such a manner so as to insure against collection of trapped condensation. All runs of conduit shall be arranged so as to be devoid of traps. Trapped conduit runs shall be provided with explosion proof drains at low points. Runs of conduit between junctions shall not have more than the equivalent of three 90° bends.
- E. Junction boxes shall be installed so that conduit runs will not exceed 85', as shown on the Contract Drawings.
- F. Underground electric, cable TV, telephone service or other rigid steel conduit and underfloor rigid steel conduit below the concrete floor slab shall be painted with two coats of bitumastic paint, such as "Asphaltum".
- G. All underground or underfloor conduits shall be swabbed free of all moisture and debris before conductors are pulled.
- H. At least two 1 inch and four 3/4 inch conduits shall be stubbed from flush-mounted panelboards into the nearest accessible area for future use. Provide suitable closures for these stubs. Identify each stub with a suitable hang tag.
- I. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of latest edition of the N.E.C., and NECA "Standard of Installation", complying with recognized industry practices.
- J. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- K. Level and square raceway runs, and install at proper elevations and required heights. Hold tight to structure or route through joists webbing wherever possible, to maximize available space and not restrict other trades.

- L. Complete installation of electrical raceways before starting installation of cables or wires within raceways.
- M. All underground conduits shall be buried to minimum depth of 24" from the top of the concrete encasement or raceway to finished grade, unless otherwise noted on plans. Observe minimum burial requirements of local utility company where their standards or regulations apply. Conduits containing primary power conductors, (higher than 600 volts to ground) shall be 42" to top below finished grade, unless otherwise noted on plans.
- N. All raceways shall be installed to maintain a minimum of 4" clearance below roof decking.

4. SPECIALTIES

- A. All EMT terminations at junction boxes, panels, etc. shall be made with case hardened locknuts and appropriate fittings, with insulated throat liners. Insulating terminations shall be manufactured as a single unit. The use of split sleeve insulators is not permitted.
- B. All rigid conduit, except main and branch feeders, shall have heavy fiber insulating bushings reinforced with double locknuts. All branch and main feeders shall have insulated bushings with grounding lugs and shall be bonded to enclosures with appropriately sized copper jumpers, except at pad mounted transformers. Bonding jumpers shall be installed as required by the N.E.C. and other applicable codes.
- C. All conduit stubbed through floor during construction shall have openings protected with plastic caps approved for this purpose. Connections on both ends of all flexible conduit shall be equivalent to Thomas and Betts, Ideal, Appleton, Efcor, or approved equivalent, rated for the environment.
- D. All pulling lines left in open conduit systems shall be non-metallic, left securely tied off at each end.
- E. Where spare raceways terminate in switchboards or motor control centers a fishtape barrier shall be provided.

END OF SECTION 260533

SECTION 260544 - EXCAVATION, TRENCHING, BACKFILLING AND GRADING**1. GENERAL**

- A. Each Contractor's attention is directed to Section 260501, General Provisions, Electrical and all other contract documents as they may apply to his work.
- B. Each Contractor shall include all excavating, filling, grading and related items required to complete his work as shown on the drawings and specified herein.
- C. Electrical distribution lines and underground telephone or TV cables shall, in no case, be placed in the same trench with sanitary, storm, domestic or fire protection water lines. Phone cable may, at the Contractor's option, and if acceptable to both utility companies, be placed in a common trench with power lines as long as 8" of earth separation is maintained. T.V. cable shall, in all cases, be placed in a separate trench with two feet separation from electrical power lines.
- D. Depths of bury shall be as indicated on the drawings.

2. SUBSURFACE DATA

- A. Subsurface investigations have been made and the results shown on the drawings. The information was obtained primarily for use in preparing foundation design. Each Contractor may draw his own conclusions therefrom. No responsibility is assumed by the Owner for subsoil quality or conditions other than at the locations and at the time investigations were made. No claim for extra compensation, or for extension of time, will be allowed on account of subsurface conditions inconsistent with the data shown.
- B. Materials to be excavated shall be unclassified, and shall include earth, rock, or any other material encountered in the excavation to the depth and extent indicated on the drawings and specified herein. No adjustment in the Contract sum will be made on account of the presence or absence of rock, shale, or other materials encountered in the excavating.

3. BENCH MARKS AND MONUMENTS

- A. Maintain carefully all bench marks, monuments and other referenced points. If disturbed or destroyed, replace as directed.

4. EXCAVATION

- A. Each Contractor shall accept the site as he finds it and remove all trash, rubbish and material from the site prior to starting excavation for his work.
- B. Excavate trenches to sufficient width and depth for proper installation of the work and where required, smooth the bottom on the trench with hand tools.
- C. The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted unless authorized in writing by the Architect. Any damage to existing structures, exterior services or rock intended for bearing, shall be corrected at the responsible Contractor's expense.
- D. Keep trenches free from water while construction therein is in progress. Under no circumstances lay conduit or cable in water. Pumping or bailing water from this Contractor's trenches, which is required during construction shall be accomplished at his expense.

- E. In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, etc. Each Contractor shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage, or any other damage incurred in the course of excavation, shall be borne by the responsible Contractor.

5. BACKFILL

- A. Backfill shall be accomplished with clean debris free earth and the new earth tamped at 12" intervals so as to avoid earth sinks along the trench. The responsible Contractor will be required to return to the project and fill any sunken areas along the route of his work.
- B. Backfill trenches only after conduit and cable have been inspected, tested, and locations of pipe lines have been recorded on "as-built" drawings.
- C. The backfill below paved areas shall be brought to proper grade to receive the sub-base and paving. No paving shall be placed on uncompacted fill.
- D. The backfill below sodded or seeded areas shall be brought to within six inches of finished grade. The remaining six inches shall be backfilled with clean soil.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATIONS**1. GENERAL**

- A. Equipment, disconnect switches, motor starters, pushbutton stations, special device plates, and similar materials shall be clearly marked as to their function and use. Markings shall be applied neatly and conspicuously to the front of each item of equipment with 1/2" white lamacoid plate (or equivalent) with black letters 1/4" high.
- B. The Contractor shall provide clearly legible typewritten directories in each electrical panel indicating the area, item of equipment, etc., controlled by each switch, breaker, fuse, etc. These directories are to be inserted into plastic card holders in each panel. The Contractor shall be required to demonstrate the accuracy of the panel directory for a random sampling of circuits in each panelboard as directed in the field by the Engineer with corrections made immediately so it is imperative that care be taken during installation to insure 100% accurate directories.
- C. All circuit breakers and disconnects serving fire alarm equipment shall be painted red and clearly labeled as Fire Alarm Circuits.
- D. Branch circuit panelboards and switch gear shall be provided with a white lamacoid plastic plate with 1/2" black letters for panel designation and 1/4" black letters showing voltage and feeder information. Branch circuit switches shall be designated as to function. Panelboard and switchgear labels shall indicate the source they are fed from, and the circuit number at that source. Panelboards shall also indicate color coding of the branch circuit phase conductors supplied. Clearly indicate the exact label legend to be furnished with each panelboard and switchgear on the shop drawings for each item of equipment prior to submission of shop drawings.

EXAMPLE:

<p style="text-align: center;"> PANEL "XYZ" FED FROM "MDP – 2" 120/ 208/ 3PH/ 4W – 225A BLACK-RED-BLUE CONDUCTORS </p>
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- E. Where branch circuit panelboards and switchgear are connected to an emergency source, the lamacoid plate shall be red, and the word "emergency" shall be incorporated into the legend. In healthcare applications, the NEC – designated branch (life safety, critical or equipment branch) shall also be incorporated into the legend, all in 1/4" letters. Also provide similar plates and legends for automatic transfer switches, and equipment disconnects 100 amps and larger.
- F. Lamacoid plates shall be located at center of top of trim for branch circuit panels, switch gear, and centered at side for branch circuit switches. Fasten with self-tapping stainless steel screws or other approved method.
- G. The building service disconnect(s) shall be marked with the maximum available fault current available at that location in accordance with NEC Article 110. If a fault current study is not required by this contract, the Contractor shall obtain fault current availability data from the utility company. This requirement applies to both new and existing services if any distribution equipment is changed.

END OF SECTION 260553

SECTION 260573 - ELECTRICAL STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All services, materials and installation shall comply with the owners' construction standards. Special attention shall be given to Divisions 02, 16 and 17. In the event of a conflict between these standards and the Contract Documents the most stringent requirement shall be met.
- C. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- D. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This Section includes computer-based, fault-current, arc flash and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
- B. Electrical Studies shall be performed by the Low-Voltage Switchboard manufacturer. All Electrical Studies required by this specification shall be completed within five (5) weeks from award of project. The Electrical Contractor shall provide all required data to Low-Voltage Switchboard manufacturer within one (1) week and the manufacturer will have four (4) weeks to complete the studies.
- C. A licensed professional engineer employee of the Low-Voltage Switchboard manufacturer shall provide electrical power system studies for the project using the latest version of one of the approved software packages. The software model files shall be submitted with the report. The analysis shall follow the latest IEEE 1584 guidelines. An example report will be provided by the university upon request.
- D. Studies specified herein must be submitted and approved prior to release of any affected equipment. Revisions to equipment or devices necessary to meet study recommendations shall be at the Manufacturer's expense.
- E. All adjustments and settings recommended by these studies shall be made prior to any testing.
- F. The analysis shall be submitted to the engineer of record prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.
- E. Owners Record Copy: The as-built software model and all electronic files are to be provided to the owner at project closeout. Electronic files are to be compatible with the latest version of SKM software. The

owner shall receive rights to use and/or modify the electronic files and data for operations planning, maintenance and modification of their electrical system.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

1.5 Commissioning

- A. This section specifies a system or a component of a system being commissioned as defined in Section 019113 Commissioning. Testing of these systems is required, in cooperation with the Owner and the Commissioning Authority. Refer to Section 019113 Commissioning for detailed commissioning requirements.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Software utilized shall be capable of converting all data to SKM formatting. Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated, including arc-reduction features where applicable.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
- B. Data shall be obtained for the power sources (utility system and generators), impedance components (transformers, cables and busway), overcurrent protective devices (fuses, circuit breakers and relays) and other relevant equipment such as automatic transfer switches. Cable data (length, quantity per phase, size and type) shall be provided by the electrical contractor. Assumptions should only be used when the actual data is not available and the assumptions should be clearly listed in the report. Assumptions shall be kept to a minimum.
- C. A one-line diagram shall be provided as part of the analysis and shall clearly identify individual equipment buses, bus numbers used in the analysis, cable information (length, quantity per phase, size and type), overcurrent device information (manufacturer, type and size), transformers, motors, transfer switches, generators, etc.
- D. The one line and analysis shall use a numbering scheme where each bus begins with a three digit number followed by a description (e.g., 102 MDPA or 103 ELEV DISC) and each connected circuit breaker or fuse shall have a corresponding designation (e.g., 102-1 MAIN CB, 102-2 ELEVATOR FDR or 103-1 ELEV DISC CB).

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus
 - 2. Medium-voltage switch and transformers
 - 3. Distribution panelboards
 - 4. Branch circuit panelboards
 - 5. Variable Frequency Drives
 - 6. Motor Control Centers
 - 7. Company switches
 - 8. Fused and non-fused disconnects
 - 9. Low-voltage transformers
 - 10. Individual circuit breakers
 - 11. Automatic transfer switches
 - 12. Generator
 - 13. Combination starter/disconnects
- B. Study electrical distribution system from normal and alternate emergency power sources throughout electrical distribution system for Project, using approved computer software program. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10
 - b. ANSI C57.12.22
 - c. ANSI C57.12.40
 - d. IEEE C57.12.00
 - e. IEEE C57.96
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.
 - 4. Circuit Breakers: IEEE C37.13.
- E. Study Report: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
 - 1. For overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 - 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- G. A table shall be included which lists the calculated short-circuit currents (rms symmetrical three phase), equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment at each bus.
- H. Any inadequacies shall be called to the attention of the engineer of record and recommendations made for improvements as soon as they are identified.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.
- H. A table shall be included which lists the recommended settings of each circuit breaker and relay.
- I. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
- J. Deficiencies in protection and/or coordination shall be called to the attention of the engineer of record and recommendations made for improvements as soon as they are identified.

- K. The electrical engineer that performed the study shall be responsible to set the circuit breakers according to the analysis once the report has been approved by the engineer of record.

3.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The analysis shall consider multiple possible utility scenarios as well as multiple system configurations where appropriate such as normal and emergency transfer switch positions and different main-tie-main configurations. Where manually activated arc energy reduction means are utilized, the analysis shall calculate energy available downstream for normal operation and for maintenance mode operation.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system. This includes all switchboards, switchgear, motor-control centers, panelboards, busway and splitters.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- L. Incident energy and flash protection boundary calculations
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time

3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendation for arc flash energy reduction

- M. The Arc Flash Hazard Analysis shall include recommendations for reducing Arc Flash Incident Energy (AFIE) levels and enhancing worker safety.
- N. Results of the Arc Flash Hazard Analysis shall be submitted in tabular form and shall include the following information for each bus location: bus name, protective device name, bus voltage, bolted fault, arcing fault, trip/delay time, equipment type, working distance, arc flash boundary, incident energy and protective clothing category.

3.6 ARC FLASH WARNING LABELS

- A. Arc flash labels shall be furnished and installed by the contractor of the Arc Flash Hazard Analysis.
- B. The labels shall be 4 inches high by 6 inches wide and printed on a Brady THTL-25-483-1-WA label type or similar. The arc flash label shall be as required by NFPA 70E or as required by the owner's standards.
- C. After labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

3.7 Labels shall be machine printed, with no field markings.

3.8 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. Provide one arc flash label for all electrical equipment including:

- A. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
- B. For each 480 and applicable 208 volt distribution panelboard, one arc flash label shall be provided.
- C. For each motor control center, one arc flash label shall be provided.
- D. For each low-voltage switchboard, one arc flash label shall be provided.
- E. For each switchgear, one flash label shall be provided.
- F. For medium voltage switches and transformers, one arc flash label shall be provided.
- G. For each fused or non-fused disconnect switch, one arc flash label shall be provided.
- H. For each generator and automatic transfer switches, one arc flash label shall be provided.
- I. For each variable frequency drives, one arc flash label shall be provided.
- J. For each combination starter/disconnects, one arc flash label shall be provided.
- K. For each fused or non-fused disconnect switch and individual circuit breakers, one arc flash label shall be provided.
- L. For each low-voltage transformer, one arc flash label shall be provided.
- M. For each company switch, one arc flash label shall be provided.

END OF SECTION 260573

SECTION 262400 - ELECTRICAL DISTRIBUTION EQUIPMENT**1. GENERAL**

- A. All electrical distribution equipment shall be dead front UL listed for the purpose and application. All equipment shall meet or exceed all applicable requirements of the National Electrical Code (N.E.C.). Any device or component, i.e., switchboard, panel, breaker, switch, etc., used as service entrance equipment, shall be listed for use at 100% of the rated capacity.

NOTE TO DESIGNER, REMOVE IF NOT APPLICABLE*2. UL RE-CERTIFICATION OF EXISTING EQUIPMENT**

- A. *Where existing switchboards, panelboards, motor control centers, and similar are modified in a manner that changes how the original equipment was shipped from the factory the contractor shall obtain a UL Field Evaluation and the equipment shall be provided with new UL certifications and UL Field Evaluation Marking. Modifications include but are not limited to tapping of bussing, dismantling and rebuilding of gear, or the installation of aftermarket breakers, components, etc. UL re-certification shall not be required for the following conditions:*

- (1) *If a new breaker listed or classified by the manufacturer for installation in the gear is provided in an existing prepared space. Contractor must submit documentation of this classification if the breaker type is not specifically noted on the panelboard product data.*
- (2) *Removal of existing breakers*
- (3) *Removal of conductors to/from gear*
- (4) *Addition of conductors to/from gear*

The contractor shall carry all costs associated with the evaluation and re-certification. The contractor shall submit the service agreement with the UL certified for review by the engineer prior to execution. All work shall be approved by the Authority Having Jurisdiction.

3. MAIN SWITCHBOARD - FUSIBLE SWITCH STYLE

- A. Switchboard shall be dead front, totally enclosed, free standing type consisting of sections housing the equipment as indicated. The structure height shall be nominally 92" high, including the base channels. The structure shall be constructed of formed steel channels and angles (12 gauge minimum) to support cover plates, bussing, distribution equipment and other devices to be installed therein. Neutral and ground shall be separate busses. Removable cover plates shall be provided on all sides and top with opening for conduit in bottom. Cover plates and trim shall have formed edges so that no sheared surfaces are exposed. Housing shall be given a rust inhibiting treatment inside and out and finished in light gray baked enamel, per ANSI #49. Connection will be made by entering the switchboard as indicated on the drawings. Provide concrete housekeeping pad, 3" high, with #4 rebar on 6" X 6" centers, per A.C.I. standards. Chamfer edges of pad 1/2".
- B. All bussing shall be 100% annealed copper. The temperature rise above ambient of the bus bars shall not exceed 50NC. Heat rise test shall be conducted in accordance with U.L. Standard UL-67. All joints are to be rigidly bolted to insure maximum conductivity. All bus bars shall extend full length of equipment to permit future additions.
- C. Neutral bussing shall be of the same ampacity as the phase bussing and shall be insulated from the enclosure. Ground bussing shall be sized and shall be bonded to the enclosure per N.E.C. current edition. Service grounding electrode connection shall be made between ground and neutral busses. Provide ground bushings and equipment ground conductor connection on each feeder conduit leaving the switchboard and at the terminal end for each continuous metallic feeder conduit.

- D. The main bus shall be adequately braced to withstand short circuits of 100,000 asymmetric RMS amperes. The line side of branch units shall be bussed with copper connectors unless otherwise indicated or required.
- E. Main switches indicated for service entrance duty of more than 601 ampere rating shall have a bolted pressure contact fusible load break switch. All current carrying parts of the switch shall be silver plated. Fuse compartment shall have a hinged door interlocked with the handle so door cannot be opened with switch in the "ON" position and switch cannot be closed with the door open. Provisions for padlocking switch in the "ON" or "OFF" position shall be provided. Fuses of 601 or greater rating shall be the bolted-on type.
 - (1) Main switches on 277/480 volt systems rated for 1000 amps or above shall have ground fault protection equipment and comply with Article 230-95 of the National Electrical Code.
- F. Distribution section(s) shall consist of the number of quick-make, quick-break fusible switches of sizes as indicated. Units shall be mounted in group type construction and supplied as indicated. Each switch shall be enclosed in a steel enclosure having a hinged cover with an interlock to prevent opening the cover when the switch is in the "ON" position.
- G. Provide an arc energy reducing maintenance switch with local status indicator for all fused switches or equipment rated 1,200 Amps or greater. Provide a local status indicator light for all fuses equipped with maintenance switches. Maintenance switch and indicator shall be mounted to the fuse compartment door or immediately adjacent to the compartment in the switchboard enclosure. Maintenance switch shall have permanently mounted lockout/tagout provisions. Provide labelling to indicate operation instructions for maintenance switch at each switch.
- H. Arc Flash Hazard warning labels shall be affixed to all switchboards in accordance with Article 110.16 of the National Electrical Code. All components protected by a manually-operated arc energy reduction means shall have an additional label affixed that describes the location of the energy reduction means.
- I. Switchboard shall be Square "D", G.E., Siemens, Eaton/Cutler-Hammer or approved equivalent.
- J. Lockable breakers shall be provided for all breakers serving all HVAC equipment, Plumbing equipment, and kitchen appliances.

OR

4. MAIN SWITCHBOARD - CIRCUIT BREAKER STYLE

- A. Switchboard shall be dead front, totally enclosed, free standing or wall mounted, as required or herein specified, housing the equipment as indicated. The switchboard shall meet Underwriters' Laboratories enclosure requirements, and be furnished with an Underwriters' Laboratories label. The entire switchboard is to be Square D I-Line or equivalent construction, G.E., Siemens, Eaton / Cutler - Hammer or approved equivalent. Where switchboards are floor-mounted, provide concrete housekeeping pad, 3" high, with #4 rebar on 6" X 6" centers, per A.C.I. standards. Chamfer edges of pad 1/2".
- B. The switchboard shall be dead-front with front accessibility. The switchboard framework shall consist of steel channels bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. The framework is to be formed of code gauge steel, rigidly welded together to support all cover plate, bussing and component devices. All unused positions shall have closures.
- C. Each switchboard section shall have an open bottom (closed for wall-mounted style) and a top plate for installation and termination of conduit. Top and bottom conduit areas are to be clearly shown and dimensioned on the shop drawings. The wireway front covers shall be secured by screws and hinged, to permit access to the branch circuit breaker load side terminals. The paint finish shall be medium light gray, per ANSI #49, applied

by the electro-deposition process over an iron phosphate pre-treatment. Enclosure shall be NEMA 1, with drip shield on top. Provide top covers without knockouts. All conduit entries to be field cut. At top conduit entries, provide weatherproof sealing lock nuts on terminator.

- D. The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 on temperature rise. Main and/or through busses shall be 100% annealed copper. The through bus shall have an ampacity in amperes as indicated on the drawings and shall be braced to have a short circuit current rating of 100,000 RMS symmetrical amperes unless otherwise indicated. (Where through bus is provided, it shall have provisions for the addition of future sections on the branch or distribution side.) The through bus supports, connections and joints are to be bolted with hex head bolts and belleville washers to minimize maintenance requirements.
- E. Neutral bussing shall be of the same ampacity bussing and insulated from the enclosure. Ground bussing shall be sized and shall be bonded to the enclosure per N.E.C., current edition. Service grounding electrode connection shall be made between ground and neutral busses. Provide ground bushings and equipment ground conductor connection on each feeder conduit leaving switchboard and at the terminal end for each continuous metallic feeder conduit.
- F. Each switchboard, as a complete unit, shall be given a single short circuit current rating by the manufacturer. Such a rating shall be established by actual tests by the manufacturer, in accordance with UL specifications, on equipment constructed similarly to the subject switchboard.
- G. The service disconnect device(s) shall be thermal-magnetic molded case circuit breaker(s) installed totally front accessible and front connectable. Line side of branch circuit breaker connections are to be jaw type plug-on. Ground fault protection shall be provided as required by N.E.C. Article 230-95, where switchboard is rated for 277/480 volts and circuit breaker frame sizes are 1000 amperes or greater, regardless of trip setting.
- H. Group mounted molded case circuit breakers for branch distribution are to be totally front accessible. These circuit breakers are to be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. All line and load side connections are to be individual to each circuit breaker. Common mounting brackets or electrical bus connectors will not be acceptable. Line side circuit breaker connections are to be jaw type plug-on, arranged to withstand the anticipated fault currents.
- I. Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate as well as exercise the circuit breaker operating mechanisms.
- J. Include kw, kwh, voltage, amperage metering per phase along with appropriate digital output to interface with campus DDC control system for remote monitoring of power system. Coordinate with controls supplier for a 100% complete installation.
- K. Provide an arc energy reducing maintenance switch with local status indicator for all breakers or equipment rated or adjustable to 1,200 Amps or greater. Provide a local status indicator light for all breakers equipped with maintenance switches. Maintenance switch and indicator shall be mounted to the breaker face or immediately adjacent to the breaker in the switchboard enclosure. Maintenance switch shall have permanently mounted lockout/tagout provisions. Provide labelling to indicate operation instructions for maintenance switch at each switch.
- L. All circuit breakers shall have a minimum ISCA rating of 65,000 amps, A.I.C., unless otherwise noted on the One-Line Diagram.
- M. Arc Flash Hazard warning labels shall be affixed to all switchboards in accordance with Article 110.16 of the National Electrical Code. All components protected by a manually-operated arc energy reduction means shall have an additional label affixed that describes the location of the energy reduction means.

- N. Switchboard shall be Square "D", G.E., Siemens, Eaton/Cutler–Hammer or approved equivalent.
- O. Lockable breakers shall be provided for all breakers serving all HVAC equipment, Plumbing equipment, and kitchen appliances.

5. DISTRIBUTION PANELBOARDS (600 AMPERE OR GREATER)

- A. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Cabinets to be equipped with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge steel, with gray baked enamel finish electrodeposited over cleaned, phosphatized steel.
- B. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers. Bus structure shall be full height of panel.
- C. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50°C. rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All panelboards unless otherwise noted shall have space to accept forty-two 20 amp one pole circuit breakers.
- D. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF." Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. All panelboards shall be capable of accepting 225 amp 3 pole branch breakers as a minimum unless otherwise noted.
- E. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on schedules on the plans or as determined by verification with local utility company. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard overcurrent devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.
- F. Arc Flash Hazard warning labels shall be affixed to all panelboards in accordance with Article 110.16 of the National Electrical Code. All components protected by a manually-operated arc energy reduction means shall have an additional label affixed that describes the location of the energy reduction means.
- G. Provide energy reducing maintenance switch with local status indicator for any breaker or equipment rated or adjustable to 1,200 Amps or greater.
- H. Distribution panelboards shall be Square "D", G.E., Siemens, Eaton/Cutler–Hammer or approved equivalent.

- I. Lockable breakers shall be provided for all breakers serving all HVAC equipment, Plumbing equipment, and kitchen appliances.

6. BRANCH PANELBOARDS

- A. This section covers lighting and power panelboards (refer to schedules, notes on Drawings and the Electrical One-Line Diagram, of the Contract Drawings).
- B. All panelboards shall be of the circuit breaker type, and shall be of one manufacturer.
- C. Branch panelboards shall be as indicated on the drawings and as specified herein. The lighting panelboards shall be of the dead-front, quick-make, quick-break, plug-in circuit breaker type, with trip indicating and trip free handles. All circuits shall be clearly and properly numbered and shall be provided with thermal magnetic protection. The panelboards shall be enclosed in code gauge, galvanized steel cabinets with smooth finished hinged doors without visible external fasteners and heavy chrome locks. Locks shall all be keyed alike. Each door shall have a directory card inside, covered with a plastic shield, filled in with black india ink or typewritten with circuit numbers and description indicated. Room numbers shall be coordinated with final room numbers as selected by Owner -- not numbers on Contract Documents.

Special Note: The room numbers used to fill out the panel directories shall match the actual final name and numbering scheme selected by the Owner. They shall not be filled out per the construction drawing numbering scheme, unless the Contractor is directed to do so by the Architect or Engineer.

- D. Branch panelboards shall be surface or flush mounted as indicated on the Contract Drawings.
- E. Circuit breakers for 120/208 volt systems shall be of 10,000 A.I.C. RMS symmetrical rating unless otherwise indicated on the Contract Drawings. For 277/480 volt systems, provide circuit breakers with 14,000 A.I.C. ratings unless otherwise indicated.
- F. All main bus and connections thereto in branch panelboards shall be copper. All bus bars shall extend full length of panelboards.
- G. All circuit breakers used to switch lights shall be SWD (switching duty) rated and U.L. listed for the purpose.
- H. Where required by the National Electrical Code, provide branch arc-fault circuit interrupters (A.F.C.I.'s) in branch panelboards, whether indicated on the panel schedule or not. They shall be U.L. listed, latest edition.
- I. Where branch circuit breakers feed hermetically, sealed compressor for cooling or refrigeration equipment, provide U.L. listed H.A.C.R.-style circuit breakers.
- J. Where branch circuit breakers are indicated or required to be ground-fault circuit-interrupting type (G.F.C.I.), they shall have test and reset buttons and be U.L. listed, latest edition. Do not share neutrals with other circuits.
- K. Where branch circuit breakers are feeding H.I.D. (high-intensity-discharge) loads, they shall be rated and listed for such loads. Provide proper circuit breaker whether indicated on panel schedules or not.
- L. Arc Flash Hazard warning labels shall be affixed to all panelboards in accordance with Article 110.16 of the National Electrical Code. All components protected by a manually-operated arc energy reduction means shall have an additional label affixed that describes the location of the energy reduction means.
- M. Panels shall be Square "D", G.E., Siemens, Eaton/Cutler-Hammer or approved equivalent.

- N. Lockable breakers shall be provided for all breakers serving all HVAC equipment, Plumbing equipment, and kitchen appliances.

7. INSTALLATION INSTRUCTIONS

- A. Panelboards with circuit breakers installed before the building has been finished and cleaned shall be masked.
- B. All dust and debris shall be removed from the panels before they are energized and placed in service.
- C. All panelboard fronts shall be omitted until final punch list inspection is made. Directories for each panelboard shall be completed and available for review by the Engineer at that time.
- D. All service equipment shall be marked with the maximum available fault current and the date of the calculation. This information shall be obtained in writing from the serving utility. Provide label adjacent to the service disconnecting means. Document action of the fault current shall be included in the operation and maintenance manual. This labeling shall be provided for all new service installations, service upgrades, and any project that adds or replaces distribution panels or branch panel boards.
- E. Where applicable - Provide a warning sign on the service entrance equipment indicating type and location of all on-site emergency power sources in accordance with the NEC.
- F. Where applicable – Provide warning sign(s) for alternative power devices (photovoltaic, wind, fuel cell, etc.) on all equipment in accordance with the NEC.
- G. All emergency system switchgear, distribution panels and branch panelboards shall be provided with surge protection devices in accordance with the NEC. Refer to Section 264313 Surge Suppression Systems.

8. SAFETY SWITCHES

- A. Provide heavy duty safety switches as a final disconnecting means as required by NEC and/or as indicated on the Contract Drawings.
- B. All safety switches shall be NEMA Type 1, NEMA 3R, NEMA 4 stainless steel, NEMA 12, or as required by the operating environment, Heavy Duty Type HD, UL listed.
- C. All safety switches shall have switch blades that are fully visible in the "OFF" (open) position with the door open.
- D. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.
- E. Switch mechanism shall be quick-make, quick-break, load break rated, such that during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing and opening action of the contacts has started. The handle and mechanism shall be an integral part of the box (not cover) with facilities for pad locking in the open or closed position with up to three padlocks. Switch doors shall be interlocked with switch handle so that the door can only be opened when the switch is in the "OFF" (open) position.
- F. Arc Flash Hazard warning labels shall be affixed to all switches in accordance with Article 110.16 of the National Electrical Code. All components protected by a manually-operated arc energy reduction means shall have an additional label affixed that describes the location of the energy reduction means.
- G. Switches shall be as manufactured by Square D., G.E., Siemens, Eaton/Cutler-Hammer or approved equivalent.

9. FUSES

- A. Upon completion of the building, the Contractor shall provide the owner with spare fuses as shown below. All fuses shall be Bussmann, Shawmut, Gould or Reliance.
 - (1) 10% (minimum of 3) of each type and rating of installed fuses shall be supplied as spares:
 - (2) Bussmann spare fuse cabinets - Catalog No. SFC - shall be provided to store the above spares.
- B. No fuses shall be installed in the equipment until the installation is complete, including tests and inspections required prior to being energized. All fuses shall be of the same manufacturer to insure retention of selective coordination, as designed.
- C. Circuits 601 to 6000 amperes shall be protected by current limiting BUSSMANN HI-CAP TIME DELAY FUSES KRP-C. Fuses shall employ "O" rings as positive seals between the end bells and the fuse barrel. Fuses shall be a time-delay type and must hold 500% of rated current for a minimum of 5 seconds, clear 20 times rated current in .01 seconds or less and be listed by Underwriter's Laboratories, Inc., with an interrupting rating of 200,000 amperes R.M.S. symmetrical. The fuses shall be UL Class L.
- D. Circuits 0 to 600 amperes shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses, LPN-RK (250 volts) or LPS-RK (600 volts). All dual element fuses shall have separate overload and short circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284°F melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse shall hold 500% of rated current for a minimum of 10 seconds and be listed by Underwriters Laboratories, Inc. with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class RK1.
- E. Motor Circuits - All individual motor circuits rated 480 amperes or less shall be protected by BUSSMANN LOW PEAK DUAL-ELEMENT FUSES LPN-RK (250 volts) or LPS-RK (600 volts). The fuses for 1.15 service factor motors shall be installed in rating approximately 125% of motor full load current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the Type KRP-C HI-CAP Time Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) installed in rating approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 or L.
- F. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual Element fuses LPN-RK (250 volts) or LPS-RK (600 volts) as shown on the drawings. The fuses shall be UL Class RK1.

10. DISTRIBUTION TRANSFORMERS

- A. The Contractor shall provide dry-type transformers as manufactured by Square "D", G.E., Siemens, Eaton/Cutler-Hammer or equivalent. KVA ratings shall be as indicated on the electrical plans and shall have copper windings.
- B. Three phase transformers are to have 480 volt Delta primary and 120/208V/30/4W secondary. 30 KVA transformers and larger are to be supplied with 2-22% full capacity taps above and (4) 2-1/2% full capacity taps below primary voltage. Exceptions to the above will be shown on the electrical plans.
- C. Transformers 30 KVA and above shall be Class H, 115°C. and shall have the ability to carry a continuous 15% overload without exceeding a 115°C rise above 40° ambient.

- D. Transformer coils shall be vacuum impregnated with non-hygroscopic, thermosetting varnish. Each layer shall have end fillers or tie downs to provide maximum mechanical strength. Insulation systems and their construction techniques shall be listed by Underwriters Laboratories.
- E. Transformer coils shall have a final wrap of electrical insulating material designed to prevent injury to the coil wire. Transformers having coils with magnet wire visible will not be acceptable.
- F. All cores to be manufactured from a high grade, non-aging, silicon steel with high magnetic permeabilities, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10% over voltage excitation. The cores shall be clamped with structural angles (formed angles not acceptable) and bolted to the enclosure to prevent damage during shipment or rough handling.
- G. The core and coil unit shall be completely isolated from the enclosure by means of a vibration isolating system and shall be so designed as to provide for continual securement of the core and coil unit to the enclosure. Sound isolating systems requiring the removal of all tie down facilities will not be acceptable.
- H. Transformers 15 KVA thru 45 KVA shall be provided with interchangeable mounting for floor or wall.
- I. The maximum top of case temperature shall not exceed 35°C above ambient.
- J. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed and finished with baked enamel.
- K. The core and coils shall be visibly grounded to the frame of the transformer cubicle by means of a flexible grounding strap of adequate size.
- L. Sound levels shall be guaranteed by the manufacturer and substantiated by certified tests on each unit furnished. The sound levels are not to exceed the following values: 10 to 45 KVA, 42 D.B. to 150 KVA; 45 D.B., 225 to 300 KVA; 50 D.B. and 500 KVA, 54 D.B.
- M. If a particular "K" rating is specified for a dry-type transformer, that rating shall be provided.
- N. Transformers shall be as manufactured by Square D, G.E., Eaton/Cutler-Hammer, Siemens, Niagara or approved equivalent.

11. CONTACTORS

A. General

- (1) Contactors shall be continuously rated at the specified amperes per pole for all types of ballast and tungsten lighting, resistance and motor load. Contactors shall have totally enclosed, double-break silver-cadmium-oxide power contacts. Auxiliary arcing contacts will not be acceptable. Contact inspection and replacement shall be possible without disturbing line or load wiring. Contactors shall have straight-through wiring with all terminals clearly marked. Contactors shall have a gasketed NEMA Type 1 (NEMA 12 for electrically-held) enclosure, unless otherwise noted or required.
- (2) Contactors shall be approved per UL 508 and/or CSA, and be designed in accordance with NEMA Standards. They shall be industrial-duty rated for applications to 600 volts maximum. I.E.C.-style contactors are not acceptable.
- (3) Contactors shall have provisions for factory or field addition of:
 - a. Four N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.

- b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
 - c. Control-circuit fuse holder, one or two fuses.
 - d. 0.2-60 second adjustable interval timer attachment, if so indicated on plans.
 - e. Transient-suppression module for coil control circuit. Coil control to be 120 volts. Provide circuit or step-down transformer.
- B. Electrically Held Lighting Contactors
- (1) Contactor coils shall be continuously rated and encapsulated, 120 volt rated. Enclosures shall be NEMA 12, to minimize noise transmission.
- C. Mechanically Held Lighting Contactors
- (1) Coil-clearing contacts shall be supplied so that the contactor coils shall be energized only during the instance of operation. Both latch and unlatch coils shall be encapsulated. Coils shall be rated for 120 volt operation.
 - (2) Lighting contactors shall be Square D Class 8903 or equivalent by G.E., Siemens, Eaton/Cutler-Hammer or Allen-Bradley.

12. LIQUID-FILLED PAD-MOUNT TRANSFORMERS

- A. General
- (1) Pad-mount transformer shall be liquid filled, concrete pad mounted and completely enclosed with high voltage switching and removable oil fusing. They shall be dead-front type with bushing wells and inserts. Transformer placement shall conform to the requirements of the local authority having jurisdiction for distance from the building. Verify these clearances and restrictions prior to pouring concrete pads and roughing in any work. Provide all containment pads in accordance with the N.E.C.
- B. Performance Requirements
- (1) Built to ANSI Standard C57.12.00 - 1968. ANSI short circuit test (Sample Unit) data, ANSI impulse test - full and chopped wave (Sample Unit) data and certified test data (ANSI) (Sample Unit).
 - (2) KVA size - As noted on the drawings.
 - (3) Primary voltage - As noted on the drawings. Note: Prior to submission of shop drawings, the Contractor shall confirm the primary circuit voltage with the serving utility and indicate this on shop drawings.
 - (4) Secondary voltage - As noted on the drawings. Note: An insulated neutral bushing shall be provided where 4-wire service is specified.
 - (5) 60 Hertz frequency.
 - (6) Temperature Rise above ambient shall not exceed 65°C.
 - (7) High conductivity copper coils.
 - (8) Dead-front construction.

- (9) Provide minimum of two sets of + or - 2 1/2% taps with external tap changer switch handle for de-energized operation. On dual-winding transformers provide a non load-break voltage switch, with + or - taps located on the highest voltage side.
- (10) Impedance - not less than 2% and not more than 6.5%.
- (11) Noise level - not to exceed NEMA Standard levels.
- (12) Bolted connections will be acceptable only from lead to bushing. All other connections shall be welded or adequately crimped, per NEMA and ANSI standards.
- (13) Provide with dead-front distribution class MOV lightning arrestors, arranged to suit the provided voltage and bushings on the primary side.
- (14) Transformers shall be liquid filled with a bolted tank cover. Liquid shall be U.L. listed mineral oil, non-P.C.B. bearing. Transformers shall be manufactured, equipped, and installed to conform to the U.L. classification of the liquid.
- (15) Pad-mounted transformer shall be protected by three "bay-o-net" oil-immersed expulsion fuses, load-break with fault sensing elements in parallel with partial range oil-immersed current limiting fuses, primary current sized for the full secondary load amperes times 125% for overload capacity, as the manufacturer recommends.
- (16) Pad-mounted transformers shall be furnished with a hotstick operable three-phase, load-break primary voltage oil-immersed, 200 ampere 2-position switch to disconnect loop circuit where specified for loop feed.
- (17) Provide test: Completely assembled tank with all accessories in place (except for pressure relief valve) must withstand a test pressure of 5 PSI.
- (18) Transformers shall be loop feed-thru type with six two piece bushing wells with 200 (or 600) amp inserts, arranged to include M.O.V. type lightning arrestors for the specified voltage.

OR

- (19) Shall be radial-feed type, with 200 amp bushing wells with 200 (or 600) amp inserts, including M.O.V. type lightning arrestors for the specified voltage.
- (20) Internal leads shall be of sufficient length to permit field replacement of bushing without opening the tank.
- (21) Transformer paint color shall be Munsell Green, or custom color if required elsewhere in these documents.
- (22) Accessories:
 - a. Liquid level gauge
 - b. Vacuum pressure gauge and valve
 - c. Drain valve with a built-in sampling device
 - d. Upper filling plug
 - e. Pressure-relief valve
 - f. Welded steel tank
 - g. Lifting lugs, skiddable in all directions
 - h. Dial type temperature gauge

- i. Threaded grounding lug
- j. Warranty period - 2 year, unconditional from date of installation acceptance by the Engineer or Owner
- k. Permanent nameplate, with data submitted for approval before shipment to site.

END OF SECTION 262400

SECTION 262450 - ELECTRICAL DISTRIBUTION TRANSFORMERS**1. GENERAL**

- A. All electrical distribution transformers shall be dead front UL listed for the purpose and application. All equipment shall meet or exceed all applicable requirements of the National Electrical Code (N.E.C.).

2. QUALITY ASSURANCE

- A. Manufacturer shall be ISO 9001 certified.
- B. Transformers shall be CSA certified and UL listed [CE certified outside North America],
- C. Transformers shall be factory tested to CSA C9,
- D. Transformers shall meet all relevant CSA, EPA, IEEE, NEMA, NFPA, and UL standards.

3. SHOP DRAWING SUBMITTALS

- A. Submit shop drawings, in accordance with Section 260503 – Submittals, that includes:
 - (1) Enclosure dimensions,
 - (2) Mounting devices,
 - (3) Terminals,
 - (4) Taps,
 - (5) Internal and external component layout,
 - (6) Amperage (neutral),
 - (7) kVA rating,
 - (8) Voltage,
 - (9) Frequency,
 - (10) BIL,
 - (11) Insulation class.

4. INSTALLATION INSTRUCTIONS

- A. All Transformers shall be installed within 10 linear wire feet of the secondary means of disconnect, or a N.E.C. compliant means of disconnect shall be provided.
- B. A minimum of six (6") inch air gap shall be provided between transformer and wall if located adjacent to wall.
- C. Provide a 4" concrete house keeping pad for all floor mounted transformers in accordance with A.C.I. standards.
- D. Provide 4" x 4" x 3/4" nominal thick vibration isolation pads, four per transformer. Pads shall be Korfund Co. or equal. Transformer is to be anchored in a manner that minimizes transmission of vibration.

5. TYPE "D" DISTRIBUTION TRANSFORMERS

- A. The Contractor shall provide dry-type transformers as manufactured by Power Smith, Power Quality International, Square "D" or equivalent. KVA ratings shall be as indicated on the electrical plans, transformers shall have copper windings.
- B. Three phase transformers are to have 480 volt Delta primary and 120/208V/30/4W secondary. 30 KVA transformers and larger are to be supplied with 2-1/2% full capacity taps above and (4) 2-1/2% full capacity taps below primary voltage. Exceptions to the above will be shown on the electrical plans.

- C. Transformer coils shall be vacuum impregnated with non-hygroscopic, thermosetting varnish. Each layer shall have end fillers or tie downs to provide maximum mechanical strength. Insulation systems and their construction techniques shall be listed by Underwriters Laboratories.
- D. Transformer coils shall have a final wrap of electrical insulating material designed to prevent injury to the coil wire. Transformers having coils with magnet wire visible will not be acceptable.
- E. All cores to be manufactured from high grade, non-aging, silicon steel with high magnetic permeabilities, low hysteresis and eddy current losses. Magnetic flux densities are to be designed below saturation as required to allow for a minimum of 10% over voltage excitation. The cores shall be clamped with structural angles (formed angles not acceptable) and bolted to the enclosure to prevent damage during shipment or rough handling.
- F. The core and coil unit shall be completely isolated from the enclosure by means of a vibration isolating system and shall be so designed as to provide for continual securement of the core and coil unit to the enclosure. Sound isolating systems requiring the removal of all tie down facilities will not be acceptable.
- G. Primary winding configuration must be 'Delta'.
- H. Secondary winding configuration must provide a zero-sequence reactance of $<0.2\%$ at 60Hz at any primary to secondary phase shift.
- I. Secondary winding configuration must provide a zero-sequence impedance of $<0.9\%$ at 60Hz at any primary to secondary phase shift.
- J. Transformers 15 KVA thru 45 KVA shall be provided with interchangeable mounting for floor or wall.
- K. The maximum top of case temperature shall not exceed 35°C above ambient.
- L. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed and finished with baked enamel.
- M. The core and coils shall be visibly grounded to the frame of the transformer cubicle by means of a flexible grounding strap of adequate size.
- N. Sound levels shall be guaranteed by the manufacturer and substantiated by certified tests on each unit furnished. The sound levels are not to exceed the following values: 10 to 45 KVA, 42 D.B. to 150 KVA; 45 D.B., 225 to 300 KVA; 50 D.B. and 500 KVA, 54 D.B.
- O. If a particular "K" rating is specified for a dry-type transformer, that rating shall be provided.
- P. Insulation Class: R (220°C) and shall have the ability to carry a continuous 15% overload without exceeding a 220°C rise above 40° ambient.
- Q. Magnetic field at 1.5 feet: max. 0.1 Gauss
- R. Transformer shall provide an ultra-low zero-sequence impedance path in its secondary three-phase, four-wire subsystem for all zero-sequence currents, including 3rd, 9th, 15th, 21st harmonics, ---.
- S. Transformer shall provide a primary-secondary phase-shift of 0 degree in order to achieve cancellation of 5th, 7th, 11th, 13th, 17th, 19th, 23rd, 25th, --- positive- and negative-sequence harmonic currents on the units' primary bus, equal to the lesser source of each individual harmonic current through each model, thereby treating all of the foregoing harmonic currents.

- T. NEMA TP1 linear-load efficiency at 35% full load must be verified by NEMA TP2 test method. In addition, non-linear efficiency at 35% full load must be verified by Voltage & Current Difference Measurement Method.
- U. Anti-vibration pads shall be used between the core and the enclosure.
- V. e-Rated® Efficiency: US DOE-CSL3 efficiency requirements.
- W. TVSS (parallel) – 160,000 Amps per Phase (L-N, L-L, N-G all at 80,000 Amps each)
- X. Linear Load Efficiency: The transformer shall meet the efficiency requirements of NEMA TP1-2002, EPA Energy Star® and CSA C802.2-00, which are linear load efficiency requirements. Proof of compliance Type Tests, for each transformer type and rating, must be based on NEMA TP2-1998 – ‘Standard Test Method for Measuring the Energy Consumption of Distribution Transformers’. Type Test are required with each submission
- Y. Non-Linear Load Efficiency: The transformer shall meet the efficiency requirements of NEMA TP1-2002 under non-linear loading, which has 100% THDI and a harmonic profile that is based on IEEE Std. 519-1992, Table 4.3 – ‘Spectrum of Typical Switch Mode Power Supplies’. Proof of compliance Type Tests, for each transformer type and rating, must be based on the Voltage and Current Difference Measurement Method, with a minimum accuracy of 0.033%. Type Tests are required with each submission. The Power In – Power Out Measurements Method is not acceptable.
- Z. Linear and non-linear losses and efficiencies, which are based on the Sections Y and Z, between 25% full load and 100% full load, must be plotted for each type and kVA rating.

6. REQUIREMENTS & CERTIFICATIONS

- A. Evidence of significant relevant application experience.
- B. Quantitative performance data including before/after effect on voltage distortion at load panels that demonstrates the capability to achieve the harmonic mitigation called for in this specification.
- C. Manufacturer shall be ISO 9001 certified.
- D. Device shall be UL Listed, CSA certified and CE Listed.

7. WARRANTY

- A. Manufacturer shall guarantee that the product will perform as described in Section 2.2 of this specification.
- B. Manufacturer shall warrant the product against defective materials and workmanship.
- C. Minimum terms and conditions: 10 year pro-rated, with standard limited liability clauses.

END OF SECTION 262450

SECTION 262713 - ADVANCED ENERGY METERING**PART 1.0 - GENERAL****1.1 DOCUMENTS**

1. Please note: that this section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts listed by the appropriate parties below.
2. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
3. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SYSTEM DESCRIPTION

1. The products specified herein are intended to provide a complete sub-metering solution. This solution shall be utilized to measure and monitor various meters and monitors throughout the building as shown on the drawings or required herein. System will also allow for compliance with national and local energy codes and provide equipment needed to meet specific energy monitoring objectives.

1.2.1 SECTION INCLUDES

1. Electrical sub-metering equipment, data collection systems, and data management software systems including:
 - a. Multi-point electrical sub-meters
 - b. Data collection hubs
 - c. Open protocol data communication network
 - d. Wireless communication devices
 - e. Energy monitoring software

1.3 STANDARDS

1. Provide equipment of this Section in full compliance with the following applicable portions of the latest revisions of the following standards:
 - a. ANSI C12.1 & C12.20 at 0.5 Accuracy Class
 - b. UL Certified to IEC/EN/UL/CSA 61010-1 2nd Edition.
 - c. UL916:
 - i. These requirements cover energy management equipment and associated sensing devices rated 600 volts or less and intended for installation in accordance with the National Electrical Code, NFPA 70.
 - d. NEMA -ESM-1

1.4 SHOP DRAWINGS

1. Installation and Shop Drawings to include the following:
 - a. Manufacturer's literature and specification
 - b. Component connection wiring diagrams
 - c. Communications system specification

1.5 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

1. Submit installation, operation, and maintenance manuals for the electrical sub-metering components.

1.6 TECHNICAL PERFORMANCE

1. Minimum measured technical performance of each piece of installed equipment shall meet the specifications published by the manufacturer.
2. Optimize technical performance of all systems to produce the highest achievable technical performance to the satisfaction of consultant and/or client.
3. Any deficiencies in the system, particularly information communication errors or operational deficiencies, shall be cause for rejection. All CT readings shall be field verified in the presence of the engineer. The attached form shall be utilized to field verify the system components. Rectify any such deficiencies prior to calling for substantial completion review.

1.7 WARRANTY

1. Manufacturer shall provide a comprehensive warranty for all products.
2. All electrical sub-meters included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.
3. All data collection system components included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.

PART 2.0 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Acceptable Manufacturers: Leviton Manufacturing Co. Inc, Obvius Acquisuite Ally, Dent PowerScout 48 HD
2. Basis of Design: Obvius Acquisuite Ally
3. Substitutions Not Permitted:
 - a. Provide Manufacturer's reference list.
 - b. Clearly delineate all propose substitutions as such and submit in writing for approval by the engineer a minimum of 10 working days prior to the bid date
 - c. Prior to rough-in, provide complete engineered shop drawings, including power wiring, with deviations for the original design highlighted in an alternate color, to the engineer for review and approval.
 - d. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

2.2 METERS AND CURRENT TRANSFORMERS

1. Multipoint metering devices: Obvius AMC48-MD
2. Solid or split core current transformers with full scale output 0.333v
3. Rogowski coil current transformers.
4. Solid Core current transformers available for 100-400A and split core current transformers available from 50A -.800A
5. Current transformer secondary conductor wires can be extended:
 - a. 300' for 0.333V CT's
 - b. 20' for Rogowski Coil CT's

2.3 SYSTEM DESCRIPTION – SINGLE POINT METERING DEVICES

1. Provide single point metering devices capable of metering 1PH/2W, 2PH/3W, 3PH/3W, and/or 3PH/4W loads.
2. Meters must be capable of directly metering North American 120/208/240v, 277/480V and 347/600V.
3. Metering units must be capable of metering loads between 50A and 4000A. Provide meters specific to each project as indicated on construction drawings.
4. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on stated accuracy class.
5. The system shall be as described below:
 - a. To consist of electronic meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full scale output of 333v and secondary voltage clamps for safety purposes.
 - b. Meters to be used for Energy Monitoring applications
 - c. The meters will be capable of remote communication from each metering device.
 - d. Advanced meters shall transmit data via one of the following communication protocols:
 - i. BACNet IP
 - ii. BACNet MS/TP
 - e. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system
6. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification purposes. The system shall incorporate complete metering, communications, reporting functions; energy monitoring and threshold limit capabilities.

2.4 SYSTEM DESCRIPTION – MULTIPPOINT METERING DEVICES

1. The system shall be as described below:
 - a. To consist of electronic multiple point meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full-scale output of 333v A/C outputs and secondary voltage clamps for safety purposes.
 - b. Meters to be used for Energy Monitoring applications
 - c. Meters shall be capable of external mounting in a NEMA 1 enclosure or internal mounting in electrical panels or switchgear.
 - d. The meters will be capable of remote communication from each metering device. Each device shall have IP sockets and RS-485 terminals to accommodate data transmission via BACNet MS/TP, BACNet IP and standard Ethernet. Data shall be transmitted by one or a combination of the following:
 - i. Standard Ethernet interface
 - ii. Ethernet connection to PC or laptop via crossover cable.
 - iii. RS-485 Network-Modbus BACNet MS/TP
 - e. Systems to have backup storage power to key components so no data is lost during power outages. The system shall continue to function after resumption of power.

- f. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system.
- 2. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification. The system shall incorporate the following:
 - a. Complete metering
 - b. Communications
 - c. Reporting functions
 - d. Energy monitoring
 - e. Threshold limits capabilities.
- 3. Meters must be capable of directly metering on board, North American 120/208/240V, 277/480V and 347/600V.
- 4. Meters may be capable of two distinct and independent reference voltage inputs to allow for monitoring two separate electrical systems. Meter must allow any CT input to be referenced against either input voltage channel.
- 5. Metering Units may also be configured with individual input channels for CT's secondary wires.
- 6. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on accuracy class.
- 7. Large Metering unit (s) must be configurable to meter 48 single pole circuits, 16 two pole circuits or 16 three-pole circuits.
- 10. Small Metering unit (s) must be configurable to meter 12 single pole circuits, 4 two-pole circuits or 4 three-pole circuits.

2.5 SYSTEM MEASUREMENTS – MULTIPPOINT METERING DEVICES

- 1. Meters to be complete with a Liquid Crystal Display (LCD) to access energy measurements and phase diagnostics when needed.
- 2. Energy Parameters:
 - a. kWh real energy consumption
 - b. kW instantaneous power
 - c. kVAh apparent consumption
 - d. kVA apparent power
 - e. kVARh reactive consumption
 - f. kVAR reactive power
- 3. Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
 - a. Voltage Phase to neutral or phase to phase
 - b. Amps Instantaneous amperage for each phase
 - c. kW Instantaneous power
 - d. PF Power factor
 - e. PA Phase angle
 - f. kVA Instantaneous apparent energy
 - g. kVAR Instantaneous reactive energy

- h. THD Total Harmonic Distortion-Theta

2.6 METER DATA COLLECTION AND COMMUNICATION

1. Data acquisition sever: Obvius Acquisuite A8810

2.7 SYSTEM DESCRIPTION - METER COMMUNICATIONS AND DATA COLLECTION

1. The system shall be as described below:
 - a. To consist of energy management hubs (data acquisition server), pulse modules, and software used to transmit, collect, and display data provided by sub-metering equipment used to capture measurements from utilities that include, but are not limited to, electrical, gas, water, and steam.
 - b. System to allow all data collected to be connected to IP based applications including Third Party Billing Companies/Software, Enterprise Energy Management Software, Demand Response, and Smart Grid Collection for use in power measurement and tenant billing.
 - c. Data collection system shall be all non-proprietary and compatible with industry standard M&V software applications. Open protocols such as Modbus, pulse outputs, analog, resistive inputs, etc. shall be utilized. No proprietary or manufacturer specific protocols between meter and data collectors shall be accepted.

2.8 PRODUCT REQUIREMENTS - DATA AQUISITION SERVER

Provide data acquisition servers that measure and verify data from electrical meters

1. Server shall comply with the following codes and standards:
 - a. FCC CFR 47 Part 15, Class A
 - b. EN 610000
 - c. EN 61326
 - d. CE
2. Server shall be equipped with an ARM7 embedded CPU, an ARM7 I/O co-processor, 32MB of onboard RAM, 16MB of NOR flash memory, and a USB expansion port. Provide and install 1GB USB storage expansion.
3. Server shall operate under the following conditions:
 - a. 32°F to 122°F (0°C to 50°C), 0-90% RH, non-condensing
 - b. 41°F to 104°F (5°C to 40°C), 0-90% RH, non-condensing
4. Server shall have the capability to collect and log information at intervals from one (1) to sixty (60) minutes.
5. Server shall timestamp all acquired data and store it in a non-volatile memory.
6. Server shall use modem and/or Ethernet connections for internet access allowing either static IP (internet protocol) or DHCP (Dynamic Host Control Protocol) addressing.
7. Server shall communicate with metering data points via wired connections over the following protocols:
 - a. Wired communications:
 - i. Pulse
 - ii. Ethernet-Modbus TCP/IP
 - iii. RS-485-Modbus RTU
- a. Modbus devices to be connected via Belden 1120A or equivalent 18g twisted shielded pair.
8. Server shall communicate with external devices via -wired over the following protocols:
 - a. Wired communications:

- i. Ethernet LAN (Local Area Network) or WAN (Wide Area Network)
 - ii. TCP/IP
 - iii. PPP
 - iv. HTTP/HTML
 - v. FTP
 - vi. NTP
 - vii. XML
 - viii. SNMP
 - ix. BACnet-Optional Downloaded Module
- c. Server shall upload data at user selectable scheduled intervals via HTTP or FTP and download data in XML or custom formats.
- 9. Server shall generate alarms for data points including SNMP (Simple Network Management Protocol) traps.
 - 10. Server shall have the following input and output connections:
 - a. Input:
 - i. RS485 Modbus serial input capable of supporting 32 external devices. Input to be expandable at owner's option.
 - ii. Eight (8) Flex I/O inputs configurable for the following modes:
 - iii. 0-10VDC
 - iv. 4-20mA
 - v. Resistive
 - vi. Standard KYZ pulse modes for A or C dry contact relay outputs
 - vii. Status
 - b. Output:
 - i. Two (2) opto-FET dry contact relays rated at 30VDC and 150mA maximum

PART 3.0 – EXECUTION

- 3.1 Wiring and connections
 - 1. All wiring must meet and or exceed local electrical code.
 - 2. Metering points show on submitted drawings only to be connected or installed
 - 3. Install all wiring in conduit.
 - 4. Provide a non-dedicated or Ethernet drop for remote meter reading and diagnostics of the system
 - 5. Perform all necessary system calibration, testing, commissioning, and demonstrations as required. Utilize attached form to submit testing/calibration information. Verification shall be performed with Engineer present.
 - 6. Prepare and submit record drawings and installation, operation and maintenance manuals for the energy metering system as required.
- 3.2 TESTING AND COMMISSIONING (ECO)

1. Perform final testing, adjustment, and commissioning of the systems, report results to the Architect/Engineer, and include the results in the installation, operation, and maintenance manuals. Provide qualified technicians for testing and commissioning.
2. Perform sufficient technical and operational tests to ensure the technical performance of the system meets the intent of the Contract Documents. Typical testing to include but not be limited to:
 - a. Verification of meter readings and proper installation of meter equipment (utilize attached form for recording system verification) shall be in the presence of the project engineer.
 - b. Communication system connectivity
3. Provide functional testing including end to end verification that all meters are operating properly.
4. Demonstrate the operation of the system to the Owner at a time suitable to them.

3.3 FIELD VERIFICATION, ACCEPTANCE, AND TRAINING

1. Provide all "AS BUILT" DRAWINGS and data showing each meter, serial number, IP address, MAC address, cross reference, load and CT ratio prior to field verification.
2. Manufacturer's representative shall verify, adjust and test the system. Verification of the energy monitoring system is to be carried out with the assistance of an electrical contractor at all times and in the presence of the project engineer. Upon completion, the manufacturer shall issue a "Commissioning Report" to the owner, electrical consultant, contractor and client.
3. Manufacturer's representative shall demonstrate operation of the system as follows:
 - a. Local and remote meter readings
 - b. Phase diagnostics
 - c. Provide manual of the installed system
 - d. Ensure system is connected to the cloud as required to communicate with software servers.

3.4 FIELD QUALITY CONTROL

1. Submit a detailed testing and commissioning procedure to the Consultant and Client for review and approval prior to undertaking this Work. The procedure shall indicate all test equipment required and acceptance criteria.
2. Upon completion of all testing and commissioning, submit a copy of the test results and certify the system as acceptable for revenue metering purposes.
3. Undertake the testing and commissioning Work with the manufacturer's factory representative(s) and project engineer.

END OF SECTION 262713

Meter Commissioning Verification

Channel A (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel B (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel C (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel D (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel E (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel F (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel G (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
Channel H (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel I (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel J (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel K (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel L (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel M (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel N (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							
Channel O (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

Channel P (Load name)	CT Type Design	CT Type Installed	Install Location Design	Install Location Field	Phase Design	Phase Installed	CT Size Designed	CT Size Installed	Clamp Reading	DS6000 Value	Reference V Design	Reference V Installed
CT 1					L1-N							
CT 2					L2-N							
CT 3					L3-N							

END OF SECTION 262713.01

SECTION 262726 - WIRING DEVICES AND PLATES**1. GENERAL**

- A. This section of the specifications includes wiring devices, cover plates, weatherproof and dust-tight closures, communications devices and floor outlets.
- B. Wiring devices are listed by manufacturer and catalog numbers to establish the quality and type required. Equivalent devices of other manufacturers will be acceptable with prior approval of the Engineer. Submit cutsheets and/or samples of each type ten days prior to bid date for review and written approval to bid. Insofar as possible, standard application or special application devices shall be by one manufacturer.

2. MATERIALS

TYPE	RATING	CONFIGURATION	COLOR	VENDOR - CAT. #
RECEPTACLE - DUPLEX COMMERCIAL GRADE	125V, 20A	NEMA 5-20R	!	HUBBELL CR5362* GE 5362*
	125V, 15A	NEMA 5-15R	!	LEVITON 5362* HUBBELL CR5262** GE 5262** LEVITON 5262**
	* USE WHEN ON DEDICATED 20A CKT., OR CALLED OUT ** USE WHEN ON DEDICATED 15A CKT., OR WHEN MORE THAN ONE RECEPTACLE ON A CIRCUIT			
RECEPTACLE - DUPLEX PREMIUM GRADE	125V, 20A	NEMA 5-20R	!	HUBBELL 5352* LEVITON 5362*
	125V, 15A	NEMA 5-15R	!	GE 5362,* HUBBELL 5252** LEVITON 5262** GE 5262**
	* USE WHERE ON DEDICATED 20A CKT., OR CALLED OUT ** USE WHERE ON DEDICATED 15A CKT., OR WHERE MORE THAN ONE RECEPTACLE ON A CIRCUIT			
RECEPTACLE - DUPLEX G.F.I. (SHALL MEET U.L. 943 STANDARD)	125V, 20A	NEMA 5-20R	!	HUBBELL GFR5352A
RECEPTACLE - SIMPLEX	125V, 20A	NEMA 5-20R	!	HUBBELL 5361
RECEPTACLE - DUPLEX, SAFETY TYPE (WITH TAMPER- RESISTANT SCREWS)	125V, 20A	NEMA 5-20R	!	HUBBELL HBL-8300- SG
RECEPTACLE - DUPLEX, SAFETY TYPE (WITH TAMPER-	125V, 15A	NEMA 5-15R	!	HUBBELL HBL-8200- SG

RESISTANT SCREWS)				
RECEPTACLE, DUPLEX NEON PILOT FACE-RED	125V, 15A	NEMA 5-15R	!	HUBBELL 5262-LHR GE 5362-LHR LEVITON 5362-LHR
RECEPTACLE, SIMPLEX WITH CLOCK HANGER TAB, STAINLESS STEEL PLATE	125V, 15A	NEMA 5-15R	METAL	HUBBELL 5235 LEVITON 658-BR ARROW-HART 5760
RECEPTACLE, DUPLEX ISOLATED GROUND (WITH ORANGE LEGEND PLATE)	125V, 20A	NEMA 5-20R	ORANGE	HUBBELL IG-5362 GE 5362-IG LEVITON 5362-IG
RECEPTACLE, DUPLEX HOSPITAL GRADE (TO BE USED IN ALL PATIENT CARE AREAS, PER N.E.C., ART. 517)	125V, 20A	NEMA 5-15R NEMA 5-20R	!	HUBBELL 8200H GE 8200 LEVITON 8200 HUBBELL 8200H GE 8300 LEVITON 8300
RECEPTACLE, DUPLEX RED COLOR NYLON FACE (FOR EMERGENCY POWER OUTLETS)	125V, 20A	NEMA 5-20R	RED	HUBBELL 5352-RDB GE 5362-RDB LEVITON 5362-RDB
RECEPTACLE, DUPLEX ISOLATED GROUND WITH SURGE SUPPRESSION, INCLUDING INDICATOR LIGHT	125V, 15A	NEMA 5-15R	BLUE DEVICE	HUBBELL 5250S LEVITON 5380 ARROW-HART 5362
RECEPTACLE, SINGLE	250V, 20A	NEMA 10-20R	BLACK	HUBBELL 6810 GE 4124 LEVITON 5032
RECEPTACLE, SINGLE	250V, 30A	NEMA 6-30R	BLACK	HUBBELL 9330 GE 4139 LEVITON 5372
RECEPTACLE, SINGLE	250V, 50A	NEMA 6-50R	BLACK	HUBBELL 9367 GE 4141 LEVITON 5374
SWITCH, SINGLE POLE	120/277V, 20A	SPST	!	HUBBELL HBL-1221 GE 5951 LEVITON 1221
SWITCH, SINGLE POLE - RED TOGGLE (WITH RED COVER PLATE, FOR EMERGENCY	120/277V, 20A	SPST	RED	HUBBELL HBL-1221- RDB GE 5951-RDB LEVITON 1221-RDB

LIGHTING CONTROL)				
SWITCH, THREE-WAY	120/277V, 20A	3-WAY	!	HUBBELL HBL-1223 GE 5953 LEVITON 5953
SWITCH, FOUR-WAY	120/277V, 20A	4-WAY	!	HUBBELL HBL-1224 GE 5954 LEVITON 5954
SWITCH, KEYED	120/277V, 20A	SPST	N/A	HUBBELL HBL-1221- L GE 5951-L LEVITON 1221-L
SWITCH, KEYED	120/277V, 20A	3-WAY	N/A	HUBBELL HBL-1223- L GE 5953-L LEVITON 1223-L
SWITCH, KEYED	120/277V, 20A	4-WAY	N/A	HUBBELL HBL-1224- L GE 5954-L LEVITON 1224-L

NOTE:

SWITCH, KEYED TO EACH BE FURNISHED WITH ONE HUBBELL #1209 KEY. TURN OVER TO OWNER AT CLOSE OF PROJECT AND OBTAIN RECEIPT FOR VERIFICATION THAT KEYS HAVE BEEN DELIVERED.

SWITCH, MOMENTARY, 3-POSITION, CENTER OFF SWITCH, PILOT (TOGGLE LIT IN OFF POSITION)	120/277V, 20A (VERIFY VOLTAGE USED)	SPDT	!	HUBBELL HBL SERIES GE EQUIVALENT LEVITON EQUIVALENT
SWITCH, PILOT (TOGGLE LIT IN OFF POSITION)	120/277V, 20A (VERIFY VOLTAGE USED)	SPDT OR AS NOTED	CLEAR "LEXAN"	HUBBELL HBL SERIES GE EQUIVALENT LEVITON EQUIVALENT
SWITCH, PILOT (TOGGLE LIT IN ON POSITION)	120/277V, 20A (VERIFY VOLTAGE USED)	SPST OR AS NOTED	CLEAR "LEXAN"	HUBBELL HBL-PL7 SERIES GE EQUIVALENT LEVITON EQUIVALENT
TIMER SWITCH	120V	SPST, 15 MINUTE	!	NUTONE VS63 GE EQUIVALENT LEVITON EQUIVALENT

NOTES:

1. PROVIDE MATCHING CAP (PLUG) FOR ALL RECEPTACLES 30 AMP RATED AND ABOVE AS REQUIRED FOR EQUIPMENT.
 2. ALL RECEPTACLES SHALL BE BACK OR SIDE-WIRED, CLAMPING TYPE
 3. FOR DRYERS AND RANGES, PROVIDE 3-POLE GROUNDING TYPE AS REQUIRED BY DEVICE. LOCATE DEVICE SO THAT DRYER OR RANGE CAN BE PUSHED TIGHTLY AGAINST WALL.
 4. RECEPTACLES SHALL BE TAMPER RESISTANT AND WEATHER RESISTANT AND MARKED ACCORDINGLY AS REQUIRED BY N.E.C.
 5. ALL RECEPTACLES INSTALLED IN DAMP OR WET LOCATIONS SHALL BE UL LISTED WEATHER RESISTANT TYPE.
- ! SEE ARTICLE 3, COLOR.

A. Small Motor Control Switches:

- (1) For small line-to-neutral motor loads of 3/4 HP or less, single phase, rated at 120 or 277 volts, provide snap-type, H.P. rated motor starter switch with thermal overloads. Overload heaters sized to match the

motor nameplate amperes and the ambient temperature shall be provided. Provide with NEMA 1, NEMA 3R or other enclosure suitable for the location and atmosphere. All manual starters in finished areas shall be in flush-mounted enclosures.

3. COLOR

- A. Color of devices shall be as selected by the architect. Samples (devices, plates or both) may be required to be submitted with other architectural color items by the Contractor. The Contractor shall coordinate any such submission required with other trades, the Prime Contractor or as needed.
- B. Where devices are controlling or supplying emergency power from a standby source, the device color shall be red, as with switch toggles or receptacle fronts. Plate color shall match others on normal power in the building unless otherwise noted.
- C. Where surface finishes next to the devices vary in color or shade throughout the project, the Contractor may be required to provide lighter or darker plates and devices to more closely match wall finishes. These variations are considered to be included in the original contract for construction.

4. MANUAL DIMMERS

- A. Manual dimmers for incandescent, MR-lamp incandescent or fluorescent loads shall be matched to the type load intended to be controlled.
- B. Power rating shall be verified by examining the plans and suitable for the load, but in no case less than circuit load. Furnish dimmers in nominal power ranges of 600W, 1000W, 1500 watts, etc.
- C. Manual dimmers shall be provided with all solid state components, complete with choke coil and/or other R.F.I. suppression devices.
- D. Manual dimmers shall be suitable for mounting in single gang outlet box, ganging together in multi-section boxes where indicated, without derating being necessary.
- E. Manual dimmers shall be of the sliding-type, with detent stop at off position, full range control 0-100%. Lutron Company "Nova" Series or equivalent Lithonia, Lightolier.
- F. Manual dimmers for fluorescent lighting or low voltage transformer-fed incandescent fixtures shall be matched to suit the characteristics of the particular manufacturer's electronic ballast or transformer used in the dimming - type fixture. Submit shop drawings of dimmer in the same submittal as the lighting fixtures.

5. PLATES AND COVERS

- A. All faceplates shall be bright finish 302 stainless steel.
- B. Cover plates shall be of one manufacturer insofar as possible.
- C. Weatherproof plates for G.F.C.I. receptacles shall be cast aluminum, self-closing, gasketed, suitable for standard box mounting, U.L. listed for wet location use, cover closed. Vertical mounting - Hubbell WP26M, horizontal mounting - Hubbell WP26MH (die-cast zinc) or equivalent Leviton or G.E.
- D. Weatherproof switch plates for toggle-handle switches shall be clear silicone rubber, for standard outlet boxes. Hubbell 1795 or equivalent G.E. or Leviton.

- E. Cover plates for computer, telephone or other system outlets shall be as required to meet supplier or the owner's requirements, as applicable. Color to match other plates on project. Furnish telephone plates with wall-mounting studs if mounted at 48" or higher. See devices schedule below.

6. COMMUNICATIONS DEVICES AND PLATES

- A. Communications devices and wall plates furnished for this project shall all be standard products, of the same manufacturer. They shall consist of a wall plate bezel, capable of holding snap-in devices as indicated.
- B. Communications wall plates shall be stainless steel, matching switch, receptacles, etc. Verify all color selections with the Architect.
- C. The color of communications wall plate snap-in inserts shall match the system color legend and be as noted herein, or shall be per the owner's standards, if applicable. Verify color requirements prior to ordering any materials.
- D. Provide securely-fastened permanent labels in the faceplate of communications wall plates that clearly and legibly indicate the address or unique identifier for an individual jack.
- E. All communications wall plates shall be provided with a bezel capable of holding a minimum of four separate device inserts, unless otherwise noted. Provide blank inserts to close any unused positions, of a color to match the plate.
- F. Communications wall plates and devices shall be as manufactured by Panduit, Lucent Technologies, Leviton, AMP or approved equivalent.

DEVICE INSERT SCHEDULE	
Multimode Fiber Optic (Always Install in Pairs)	FDDI - Compatible 62.5/125μ, ST-Style Grey Color, Female (2 fibers terminated)
Ethernet Network Data	Category 5 - Enhanced or Category 6, 8 Pos/4 Pair Blue Color RJ-45, EIA/TIA 568AB (4 pairs terminated)
Voice Circuits 4 Pair	Category 5 - Enhanced or Category 6, 8 Pos/4 Pair White Color RJ-45, EIA/TIA 568B (4 pairs terminated)
Fiber Optic 2 Strands	"SC"-Style Connectors Mounted in Adjacent Pairs - Black Color
Voice Circuits 2 Pair	Category 3, 4 Pos/2 Pair Green Color RJ-11 (2 Pairs Terminated)
Video Circuits	"F" Connector Bulkhead Style White Color (RG-6 coax termination)
Blank Cover	Color to Match Wall plate
Wall Plate (4-Port/1 Gang)	Color to Match Wiring Devices Used in Adjacent Areas
Special Comm. Port for T-1 and Special Communication Circuits	Orange Color RJ-31X, 8 Pos/4 Pairs Terminated

7. STANDARD SINGLE-SERVICE FLOOR BOXES

- A. In general, floor boxes to be used flush in concrete floors shall be of single-gang stamped steel construction, round, deep style, fully adjustable Hubbell B-2537 Series, Type 1 or equivalent.
- B. Where multiple gangs are indicated on the plans (or elsewhere), multi-gang (up to 3 yokes maximum) stamped steel, rectangular, deep style units shall be used. They shall be fully adjustable, Hubbell B-2432 Series, Type 1, or equivalent. Multiple-gang boxes shall be provided with removable partitions between each section in accord with N.E.C., where power and non-power circuits enter the same box.
- C. In general, all cover plates for floor boxes shall be flush, solid brass. Provide typical plates as listed:

Duplex Outlet	- Round, Duplex Flap - Hubbell S-3925 - Rectangular, Duplex Flap - Hubbell S-3825
Telephone or Data	- Round, Combination 1" or 2 1/8" - Hubbell S-2725 - Rectangular, Combination 1" or 2 1/8" - Hubbell S-2625
- D. Furnish floor boxes with threaded hubs as required to suit conduit routings, 3/4" minimum.

- E. Furnish carpet flanges for all boxes installed in carpeted areas. Flanges to be clear polycarbonate plastic, round - Hubbell S-3079 or rectangular, for gangs indicated - Hubbell S-308 Series or equivalent.
- F. Floor outlet boxes shall be installed dead level flush with wood, VCT, concrete or other hard surface type floor. Furnish special stop trims for terrazzo where required.
- G. Outlets within floor boxes shall be as specified elsewhere in these specifications.

8. SPECIAL MULTI-SERVICE FLOOR BOXES

- A. In general, floor boxes that are to contain multiple services such as power, data, voice, video, etc., shall be constructed of stamped steel and heavy thermoplastic with barriers or compartments to separate power from signal services per National Electrical Code.
- B. Provide multi-service floor boxes with proper trim for carpet, wood, terrazzo, tile or concrete floors, wiring slots, dust covers and proper device plates to hold outlets, jacks, etc. They shall be fully adjustable. Conduit rough-in shall be as required. All tops shall be capable of receiving an insert of the surrounding floor material.
- C. Outlets for multi-service floor boxes shall be as specified elsewhere in these specifications.
- D. Set boxes dead level with flooring and provide proper support by thickening concrete slab, welding angle iron across joists below or other approved means.
- E. Multi-service floor boxes shall be capable of containing a minimum of two duplex receptacles and two 4-position single gang modular plates for voice, video or data jacks and shall be as manufactured by Hubbell #HBLCFB401 base with #HBLTCGNT cover, with all required accessories or equivalent Walker "RFS" Series or Lew. If not installed on carpeted floors, provide flush brass trim.

9. INSTALLATION

- A. All wiring devices in dusty areas, exposed to weather and moisture shall be installed in Type "FS" or similar conduit fittings having mounting hubs, with appropriate cover plates.
- B. Devices that have been installed before painting shall be masked. No plates or covers shall be installed until all finishing and cleaning has been completed.
- C. Provide G.F.C.I. duplex feed-thru style receptacles in accordance with new U.L. Standard 943 where indicated or required by the National Electrical Code, whether specifically called out or not. When a G.F.C.I. receptacle is on a circuit with other non-G.F.C.I. receptacles, it shall always be placed at the homerun point of the circuit and shall be wired to ground-fault interrupt protect the downstream outlets on that circuit unless specifically indicated to the contrary. Provide a "G.F.C.I. protected" label on each downstream outlet.
- D. GFCI devices shall be installed in a "readily accessible" location per NEC requirements. GFCI protected outlets required by plans or code shall be fed by a GFCI breaker or upstream GFCI device if they are not readily accessible.
- E. Where surge suppression outlets are provided, they shall be ANSI Category "A" style. They shall be installed as dedicated-circuit outlets or where indicated with multiple outlets on a circuit, they shall be placed at the homerun point of that circuit and feed-thru wired to protect the downstream outlets on that circuit.
- F. All receptacles shall be installed with ground prong at **top** position.

- G. All outlets not provided with wiring devices shall be closed with a blank plate matching other plates in the area.

END OF SECTION 262726

SECTION 263300 – STORM SHELTER INVERTER SYSTEM**PART 1 GENERAL****1.1 SUMMARY**

- A. This Power Lynx 1 UPS specification describes a single phase, on-line, double conversion, solid state Uninterruptible Power System utilizing Patented ECM Technology here after referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide high quality power conditioning, back-up power protection and distribution for Lighting loads and other critical loads. The system shall consist of a solid- state inverter, a temperature compensated rectifier/battery charger, a 100% rated for continuous duty static switch, an internal maintenance bypass switch, battery plant, status/control panel, and synchronizing circuitry as described herein.

1.2 STANDARDS

- A. The UPS shall meet the requirements of the following standards:
 - 1. IEEE 587-1980/ANSI C62.41 1980 Standards for Surge Withstand Ability
 - 2. FCC rules and regulations of Part 15, Subpart J, Class A
 - 3. Listed under UL 924, Standards for Lighting Inverter Equipment
 - 4. NEMA PE 1 (National Electrical Manufacturers Association) - Uninterruptible Power Systems
 - 5. NEMA 250 (National Electrical Manufacturers Association) – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 6. NFPA 70 – National Electrical Code 7.
 - ISO 1001
 - 8. Occupational Safety & Health Administration (OSHA)

1.3 SUBMITTALS

- A. Submittals for engineering approval shall contain the following documentation:
 - 1. Installation Drawings: Indicate electrical characteristics and connection requirements. Provide cabinet dimensions; battery type, size, dimensions, weight and location of conduit entry and exit; single-line diagram, control, and external wiring requirements; heat rejection and air flow requirements.
 - 2. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.
- B. Upon delivery of the UPS system the following submittals shall be included:
 - 1. An operator's and user's manual showing safe and correct operation of all UPS functions.

1.4 QUALIFICATIONS & QUALITY ASSURANCE

- A. **Manufacturers Certification:** The manufacturer shall specialize in manufacturing of on-line, double conversion, single phase UPS modules specified in this document with a minimum of twenty years documented experience, and with a nationwide service organization. The manufacturer will use only patented ECM technology. The manufacturer shall comply with ISO 1001 and shall be designed to internationally accepted standards.
- B. **Factory Testing:** Prior to shipment the manufacturer shall complete a documented test procedure to test all functions of the UPS module and batteries (via a discharge test) and guarantee compliance with the specification. The manufacturer shall provide a copy of the test report upon request.
- C. **Materials and Assemblies:** All materials and parts comprising the UPS shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. All active electronic devices shall be solid state and not exceed the manufacturers recommended tolerances for temperature or current to ensure maximum reliability. All semiconductor devices shall be sealed. All relays shall be provided with dust covers. The manufacturer shall conduct inspections on incoming parts, modular assemblies and final products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All products shall be packaged in a manner to prevent penetration by debris and to allow safe delivery by all modes of ground transportation and air transportation where specified.
- B. Prior to shipping all products shall be inspected at the factory for damage.
- C. Equipment shall be protected against extreme temperature and humidity and shall be stored in a conditioned or protected environment.
- D. Equipment containing batteries shall not be stored for a period exceeding three months without powering up the equipment for a period of eight hours to recharge the batteries.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. The UPS shall operate under the following environmental conditions:
 - 1. Temperature:
 - a. UPS Module
 - (1). Operating: 0° to 40°C (32°F to 104°F)
 - (2). Non-Operating: -20°C to +60°C (-4°F to 140°F)
 - b. Batteries: 25°C (77°F)
 - 2. Relative humidity (operating and storage): 5 to 95% non-condensing
 - 3. Barometric Pressure:
 - a. Up to 1000 meters above sea level
 - b. Up to 2000 meters with ambient temperature less than 28°C
 - c. Up to 12,000 meters above sea level non operating

4. Audible Noise: 45 DBA at 3 feet

1.7 WARRANTY

- A. UPS Module: The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of twelve (12) months from date of installation or acceptance by customer or eighteen (18) months from date of shipment from the manufacturer, whichever occurs first.
- B. Battery: The battery manufacturer's warranty shall be passed through to the final customer and shall have a minimum period of one year, with 9 years prorated.

1.8 SERVICE AND SPARES PARTS

- A. The manufacturer shall upon request provide spare parts kits for the UPS module in a timely manner as well as provide access to qualified factory trained service personnel to provide preventative maintenance and service on the UPS module when required.

1.9 MAINTENANCE, ACCESSIBILITY AND SELF DIAGNOSTICS

- A. All UPS subassemblies, as well as the battery, shall be accessible from the front only. UPS design shall provide maximum reliability and minimum MTTR (mean time to repair). To that end, the UPS shall be equipped with a self-test function to verify correct system operation. The electronic UPS control and monitoring assembly shall therefore be fully microprocessor based.
 1. Auto-compensation of component drift;
 2. Self-adjustment of replaced subassemblies;
 3. Extensive acquisition of information vital for computer-aided diagnostics (local or remote);

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. DSPM Power Lynx 1 Emergency Lighting System
- B. Engineer permits substitutions, subject to meeting all the requirements of this specification and having written approval no less than 10 days prior to bid closing.

2.2 PRODUCT SPECIFICATION

- A. UPS Design Requirements
 1. Output Power Continuous Rating: The continuous output power rating of the UPS shall be 12.6kW (18kVA).
 2. Input Voltage: 208VAC – 15% / +10%, single phase, 2-wire plus ground.
 3. Output voltage(s): 120VAC single phase, 2 wire plus ground.
 4. Battery Autonomy: The UPS shall be capable of operating at full load for 120 minutes (2 hours) at unity PF output at a temperature of 25°C on battery power.

5. Battery Type: Valve regulated, sealed, Lead Calcium (AGM).

B. AC Input Characteristics

1. Input Frequency: 60 Hz
2. Power walk-in: 0 to 100% over a 10-second period.
3. Magnetizing Inrush Current: Less than nominal input current for less than one cycle.
4. Input Surge Protection: The UPS is equipped with standard input filter assembly will withstand surges per IEEE 587-1980/ANSI C62.41

C. AC Output Characteristics

1. Voltage Regulation: + 3% for no-load to full load and full 10 minute battery discharge mode.
2. Frequency: 60 Hz (+ 0.1Hz when free running).
3. Voltage Distortion: Maximum 5% total (THD) @ 100% linear loads.
4. Voltage Transient (Step Load) Response:
 - a. + 5% for 50% step load change
 - b. + 8% for 100% step load change
 - c. + 3% for loss or return of AC input power or manual transfer at full load.
5. Voltage Recovery Time: Return to within 3% of nominal value within 50 milliseconds.
6. Non-Linear Load Capability: Output voltage total harmonic distortion shall be less than 8% when connected to a 100% non-linear load with a crest factor not to exceed 2.5%.
7. Slew Rate: 1 Hz/second maximum
8. Power Factor: Unity power factor.
9. Inverter Overload Capability:
 - a. 125% of rated load for 1 minute
 - b. 145% of rated load for 10 seconds
10. Bypass Overload Capability: > 200% for one cycle; > 150% for 30 seconds
11. (LED Monitor) Every 30 days a self testing / self-diagnostics will be activated. The system will log (store in memory) any alarms and make available through the front panel LED all information.

D. DC Bus

1. DC Bus Voltage: 2.3 VDC/cell nominal Float level. The battery charger will compensate

for temperature changes in accordance with the battery manufacturer's requirements. UPS will utilize our watch-dog interface software to control DC voltage; this control will extend life of batteries by 50%.

2.3 MODES OF OPERATION

- A. The UPS module shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.
1. Normal: The inverter shall continuously supply power to the critical load. The rectifier/battery charger shall derive power from the utility AC source, supply DC power to the inverter and simultaneously float charging the battery.
 2. Emergency: Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any switching, shall obtain its power from the battery.
 3. Recharge: Upon restoration of the utility AC power source (prior to complete battery discharge), the rectifier/battery charger shall power the inverter and simultaneously recharge the battery.
 4. Bypass Mode: The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.
 5. Manual Bypass Switch: A manual make before break internal bypass switch shall be provided to isolate the UPS inverter output and static bypass and connect the load directly to the utility until service personnel can arrive to repair unit.

2.4 COMPONENT DESCRIPTION

- A. Rectifier / Battery Charger: Incoming AC power shall be converted to a regulated DC output voltage. The rectifier / battery charger shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:
1. Input Current Limiting: The UPS shall be equipped with a system designed to limit the battery recharge current to conform to UL924 standard.
 2. Modular Assembly: The rectifier/battery charger assembly shall be constructed of modular design to facilitate rapid maintenance.
 3. Charging Levels: The battery charging circuitry shall be capable of being set for automatic battery recharge operation, float service and equalizing operation.
 4. Temperature Compensated Charging: The battery charger shall enable temperature compensated charging and adjust the battery float voltage to compensate for the ambient temperature using a negative temperature coefficient of 3 mV per cell per degree Celsius at a nominal temperature of 25°C.
 5. Capacity: The rectifier/battery charger shall have sufficient capacity to support a fully loaded inverter and fully recharge the battery to full capacity in accordance with UL 924 specifications.
- B. Inverter: The UPS output shall be derived from a Pulse Width Modulated (PWM) IGBT inverter design. The inverter shall be capable of providing precise output power while operating over the battery voltage range. The inverter assembly shall be constructed as a

modular assembly to facilitate rapid maintenance.

- C. Static Bypass: The static bypass transfer switch shall be solid-state, rated for continuous 100% duty and shall operate under the following conditions:
 - 1. Uninterrupted Transfer: The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
 - 2. Inverter overload exceeds unit's rating
 - 3. Inverter failure
 - 4. Automatic Uninterrupted Forward Transfer: The static bypass transfer switch shall automatically forward transfer power from the bypass to the rectifier / inverter, without interruption, after the UPS inverter is turned "ON", after an instantaneous overload-induced reverse transfer has occurred and the load current returns the UPS's nominal rating or less.
- D. Microprocessor Controlled Logic: The full UPS operation shall be provided through the use of microprocessor controlled logic. All operation and parameters are firmware controlled. The logic shall include a self-test and diagnostic circuitry such that a fault can be isolated down to the printed circuit assembly or plug-in power assembly level.
- E. Standard Communication Panel: The UPS will include a standard easy to use communication panel. Included will be a LED display. The UPS communication panel will include pushbuttons that will permit the user to safely command the UPS.

2.5 SYSTEM CONTROLS AND INDICATORS

- A. Front Panel LED Display: The UPS control panel shall provide a LED display. The indication of UPS status, metering, battery status, alarm event log and advanced operational features will be available. The display provides access to:
- B. System Parameters Monitored (data displayed): The visual display will display the following system parameters based on true RMS metering:
 - 1. Measurements
 - a. Input voltage indicator
 - b. UPS output voltage indicator
 - c. UPS output current indicators
 - d. DC voltage indicators
 - 2. Status indications and events
 - e. Load on battery
 - f. Load on UPS
 - g. Load on automatic bypass

- h. Low-battery warning
 - i. General alarm
 - j. Additional indications shall provide maintenance assistance
2. Time-stamped historical events: This function shall time-stamp and store all important status changes, anomalies and faults and make this information available for automatic or user-requested consultation; it shall interpret the events and indicate remedial measures if applicable.
 3. Dry Contacts: The UPS shall be capable of providing optional relay contacts. The contacts will be a form "C" contact and will change state to indicate the operating status. The contacts will be rated at 2.0 A (125 VAC / 30 VDC). Contacts shall be programmed as:
 - a. UPS on Line
 - b. Load on Bypass
 - c. UPS on Battery

2.6 MECHANICAL DESIGN AND VENTILATION

- A. Enclosure: The UPS shall be housed in a freestanding enclosure. The mechanical structure of the UPS shall be sufficiently strong and rigid to withstand handling and installation operations without risk. Access to UPS subassemblies shall be through the front only. The sheet-metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, powder coating, epoxy paint or an equivalent.
- B. Cable Access: The standard UPS available shall accommodate side, top and bottom entry cables.
- C. Ventilation and Heat Rejection: The UPS shall be designed for forced air- cooling. Air inlets shall be provided from the front bottom of the UPS enclosure. Air exhaust shall be from the top or side portions of the unit.

2.7 BATTERY

- A. The UPS module shall use a valve regulated sealed Lead Calcium heavy- duty industrial battery, designed for auxiliary power service in a UPS application. The primary battery shall be furnished with battery with impact resistant plastic case and housed in matching battery cabinet (18 KW or greater only).
 1. Protection against Deep Discharge and Self-Discharge: The UPS shall be equipped with a device designed to protect the battery against deep discharge depending on discharge conditions, with isolation of the battery by a circuit breaker. In particular, a monitoring device shall adjust the battery shutdown voltage as a function of a discharge coefficient to avoid excessive discharge.
 2. Battery Self-Tests: The battery monitoring system shall be to perform the following automatic functions:
 - a. Battery circuit check

- 2.8 External Maintenance Bypass (Optional): The maintenance bypass provides a wrap around bypass

configuration for total UPS isolation during maintenance. Maintenance bypass transfers shall be without interruption and shall have mechanical interlocks to protect the UPS from damage in the event of an out of sequence transfers.

PART 3 EXECUTION

3.1 SITE TESTING START-UP

- A. The UPS system will be checked, start-up and tested by a manufacturer's qualified field service engineer.

3.2 MAINTENANCE TRAINING

- A. The manufacturer shall make available to the customer various levels of training ranging from basic UPS operation to UPS maintenance.

END OF SECTION 263300

SECTION 264313 - SURGE SUPPRESSION SYSTEMS**1. GENERAL**

- A. Each Contractor's attention is directed to Section 260501, General Provisions - Electrical and all other contract documents as they may apply to his work.
- B. Each Surge Suppression Unit (transient voltage surge suppressor, or T.V.S.S.) furnished shall meet or exceed U.L. 1449, Second Edition *Revision* (February 2007), with capacity for each basic Category A, B and C, surge rise time of ten microseconds and a surge duration of at least one thousand microseconds.
- C. SPECIAL NOTE: When using a "Meggar" or similar instrument to test conductors in a panelboard or switchboard, disconnect any T.V.S.S. device connected to any combination of those conductors. Failure to do so may damage or destroy the T.V.S.S. device. If any damage occurs as a result of testing to a T.V.S.S. device, the Contractor shall replace the device.

2. SCOPE OF THE WORK

- A. The Contractor shall provide the necessary labor, materials, wiring and services necessary to provide the complete electrical surge protection systems as specified herein. This work shall include, but is not necessarily limited to:
 - (1) Provision of Surge Suppression Units at certain points in the power distribution network, on telephone, satellite dish leads and cable television service lines as indicated herein or on the drawings.
 - (2) Proper installation of surge suppression unit(s), in accord with shop drawings. Wiring routing, grounding, raceways and all connections shall be in exact accord with manufacturer's recommendations, the National Electrical Code, and any other applicable regulations, local or national, or international.

3. QUALITY ASSURANCE

- A. The manufacturer shall be regularly engaged in production of surge protection equipment, of types, sizes and ratings required, whose products have been satisfactorily used in similar service for not less than three years.
- B. Comply with NEC and NFPA requirements, as applicable to materials and installation of surge protection components and wiring. Surge protection equipment shall be UL listed and labeled for its intended use. TVSS shall be labeled with 200kA Short Circuit Current Rating (SCCR). Where applicable, equipment shall comply with ANSI standards for such equipment.
- C. SPECIAL NOTE: The physical routing, length and connections of the unit's phase, neutral and ground conductors are critical to the performance of surge suppression units. The Contractor shall carefully observe and comply with the manufacturer's installation requirements.

4. SUBMITTALS

- A. Product Data: Submit manufacturer's data on surge protection systems and components as part of shop drawing submissions. Indicate all capacity ratings, clamp times, maximum capacities, EMI/RFI attenuation data, withstand capabilities, physical construction and listing agency approvals.
- B. Maintenance Data: Submit maintenance instructions for surge suppression system. Include this data in Operation and Maintenance manuals.

5. MATERIALS

A. ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers offering surge protection components which may be incorporated in the work includes, but are not limited to, the ones listed below. Other manufacturers will be considered if their proposed products are in full compliance with these specification requirements.

Surge Protective Devices:

Liebert Corporation, Inc
General Electric Corporation
Transtector, Inc.
Advanced Protection Technologies, Inc.
Square D. Inc.

6. T.V.S.S. MINIMUM REQUIREMENTS

T.V.S.S. minimum requirements shall meet or exceed the following criteria:

A. Minimum surge current capability (single pulse rated) per phase shall be:

- | | |
|------------------------------------|---------------------------------|
| (1) Service entrance applications: | 200 kA per phase (Category "C") |
| (2) Distribution applications: | 120 kA per phase (Category "B") |
| (3) Non-receptacle applications: | 40 kA per phase (Category "A") |
| (4) Receptacle applications: | 12 kA per phase (Category "A") |

B. UL 1449 Listed Suppression Voltage Ratings for service entrance shall not exceed the following: (Category "C")

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>	<u>MCOV</u>
208Y/120V	400	400	400	150V
240Delta/120V	400	400	400	150V
480Y/277V	800	800	800	320V

(With internal disconnect switch 400V and 800V respectively).

C. UL 1149 Listed Suppression Voltage Ratings for distribution shall not exceed the following: (Category "A" & "B")

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>	<u>MCOV</u>
208Y/120V	400	400	400	150V
240Delta/120V	400	400	400	150V
480Y/277V	800	800	800	320V

(With internal disconnect switch 400V and 800V respectively)

(L-N = Line to neutral)

(L-G = Line to ground)

(N-G = Neutral to ground)

(MCOV = Maximum continuous operating voltage)

7. BUILDING ELECTRICAL SERVICE SURGE PROTECTION SYSTEM COMPONENTS

A. GENERAL

- (1) Provide UL 1449 Second Edition *Revision* (February 2007) listed and labeled lightning and transient surge protection devices, installed where shown on the drawings and in accord with the manufacturer's recommendations.
- (2) The surge protection devices shall be shunt type and polyphase, with the ability to conduct high energy transients from line to ground, line to neutral and neutral to ground. Provide in a NEMA 12 enclosure with hinged or screw cover front panel. Provide internal fusing in modules to protect unit.
- (3) Provide units with EMI/RFI noise attenuation, using 50 ohm insertion loss test: -50 dB at 100 khz, UL 1283 listed, with an insertion ratio of 50:1 using M.I.L. STD 220-A.
- (4) For each surge suppression unit, categories A, B & C, provide unit function status indicators. These indicators shall be mounted in the face of the equipment panel. Provide green L.E.D., illuminated for normal operation, red L.E.D. for trouble/fault or reduction of surge suppression capacity. Provide an audible alarm with silence switch to alarm at unit on malfunction for category "C" units only. Provide a resettable surge counter for each category "C" unit to indicate each suppression operation of the unit.
- (5) Enclosures shall be surface-mounted where panels protected are surface-mounted, flush-mounted for all units in finished areas. Where panels protected are flush-mounted, place surge suppression device above or below panel, aligned and square with panel trim.
- (6) Provide disconnecting means for each surge protection device per the following:

Category "C" Device at Main Service:

40 to 60 Ampere, 3 Pole, 600V, S/N, NEMA 1 disconnect, built into the unit and furnished by the supplier as an integral part of the equipment. Disconnecting means shall be capable of withstanding the available fault currents. Verify fault current with the Contractor.

Category "B" Devices, at Panels:

30 Ampere, 3 Pole Circuit Breaker in Protected Panel

Category "A" Devices, at Panels:

30 Ampere, 3 Pole Circuit Breaker in Protected Panel

- (7) Internal Device Overcurrent Protection (Fusing)
 - a. All protection modes (including Neutral to Ground) of each surge suppression device shall be internally fused at the component level with fuse I²t capability allowing the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. Every suppression component of every mode (including Neutral to Ground) shall also be protected by thermal overtemperature controls. If the rated I²t characteristic of the fusing is exceeded, the fusing shall be capable of opening in less than one millisecond and clear both high and low impedance fault conditions. The fusing shall be capable of interrupting up to 200 KA symmetrical fault current with 600 VAC applied. This overcurrent protection circuit shall be monitored, to provide indication of suppression failure. Conductor level fuses or circuit breakers internal or external to the surge suppression units are not acceptable as meeting this requirement.

B. MAIN SERVICE SURGE SUPPRESSION - CATEGORY "C" UNITS

- (1) Category "C" units shall be installed on the service entrance or building entrance equipment. Units shall be rated 277 volts/480 volts (or 120/208 volts as needed), 3 phase, 4 wire, minimum 200,000 amp (total amps per phase) surge capacity, with less than 5 nanosecond reaction time. Category "C" units installed to protect a switchboard may be built into the switchboard construction if U.L listed for such applications.
- (2) Category "C" withstand capabilities: 5,000 A.N.S.I. Category C3 surges with less than 10% change in clamping voltage.

C. PANELBOARD SURGE SUPPRESSION - CATEGORY "B" UNITS

- (1) Units shall be installed as indicated herein or on the contract drawings, set beside or above the distribution panel indicated, and connected as recommended by the equipment manufacturer.
- (2) All emergency system switchgear, distribution panels and branch panelboards shall be provided with surge protection devices in accordance with the NEC.
- (3) Category "B" units shall be rated for 277-480 volts (or 120/208 volts, as indicated), 3-4 Wire Wye service. Units shall be minimum 120,000 ampere rated per phase, with less than 5 nanosecond reaction time. Provide fusing and fault indicator pilot lights as in (A) - General above.
- (4) Category "B" withstand capabilities: 5,000 A.N.S.I. Category C3 surges with less than 10% change in clamping voltage.

D. BRANCH PANELBOARD SURGE SUPPRESSION - CATEGORY "A" UNITS (NON-RECEPTACLE APPLICATIONS)

- (1) Units shall be installed as indicated herein or on the contract drawings, set beside or above the panelboard indicated, and connected as recommended by the equipment manufacturer.
- (2) All emergency system switchgear, distribution panels and branch panelboards shall be provided with surge protection devices in accordance with the NEC.
- (3) Units shall be installed flush in finished areas. Units may be surface-mounted if in unfinished mechanical spaces and the panel protected is also surface-mounted.
- (4) Category "A" units shall be rated for 277/480 volts or 120/208 volts, three phase, 4 wire wye service as indicated on the drawings. Units shall be rated 40,000 amperes surge current, less than one nanosecond response time. Units shall be fused in accord with (A) - General noted above.
- (5) Furnish unit with red and green indicator lights to signify normal operation and component or suppression capability failure.

E. TELEPHONE AND TELEVISION SURGE SUPPRESSION

- (1) As a part of this section of work, the Contractor shall provide or arrange for the installation of U.L. listed lightning and surge arrestors on the incoming telephone and television service lines, as well as on AM-FM-antenna downloads and the coaxial cables coming into the building from satellite dish antennas and all other types of exterior antennas installed by the Contractor or Owner, where the Contractor installs the coaxial cable for the antenna.
- (2) Arrestors shall be U.L. listed, properly grounded per N.E.C., and shall be located at the service entrance points for each cable installed by a utility company or at the point of building entry for Contractor-installed

cables leading in from antennas. Also provide surge arrestors of the proper type for any copper cables that are installed between buildings by the Contractor, if such a condition occurs within the project.

- (3) The Contractor shall arrange for the telephone company to install M-O-V, gas-type or other U.L. listed lightning arrestors on each of their incoming telephone circuits that are terminated for building use.
- (4) Arrestors for coaxial lines shall be rated 25 to 250 MHZ on cable T.V. lines, and 250 MHZ to 1GHZ on satellite dish lead-ins with BNC jacks in/out or as required by antenna connectors.
- (5) Devices as manufactured by Lucent Technologies, Winegard or Liebert Corporation will be acceptable.
- (6) Provide a ground lug for individual surge suppression unit installations, with the recommended ground wire size routed back to the building main electrical ground or ground bar in wiring closet.
- (7) Where multiple surge suppression units are installed, as at service entrance locations, provide a ground bar, copper, with multiple tapped holes and a properly sized ground lead routed back to the building main electrical ground.

8. EXECUTION

A. Installation of Surge Protection Systems:

- (1) Install surge protection systems as indicated and in accordance with equipment manufacturer's written instructions, in compliance with applicable requirements of NFPA, local prevailing codes and with UL lightning and power surge protection standards to ensure that surge suppression systems comply with requirements.
- (2) Coordinate with other work, including electrical wiring work as necessary to interface installation of units.
- (3) Install conductors with direct, shortest possible phase, neutral and ground paths from all in/out connections, avoiding sharp bends and narrow loops.
- (4) Install surge suppression units as close as practical to equipment they are protecting. Install appropriate units at main electrical service entrance equipment and secondary branch panelboards as indicated.
- (5) Refer to the drawings for installation of individual surge suppression devices to protect branch circuits. Also see Section 262726 for (receptacle type) device requirements. All receptacle type surge suppression units shall be wired as feed-thru type, to protect all downstream outlets on that branch circuit unless otherwise indicated.

9. WARRANTIES

- A. All surge suppression equipment shall be unconditionally warrantied by the Contractor for a period of one year from the date of project substantial completion. Where longer manufacturer's warranties are offered, they shall be made available to the Owner. Note these extended warranties in the Operations and Maintenance Manuals.
- B. Category "C" devices to carry 5 year parts and on site labor unconditional warranty.
- C. Category "B" and "A" devices to carry 5 year unconditional replacement warranty.

END OF SECTION 264313

SECTION 265113 – LED LIGHTING FIXTURES AND LIGHTING EQUIPMENT

1. GENERAL

- A. Furnish and install all lighting fixtures, as herein specified, complete with accessories for safe and effective operation. All fixtures shall be installed and left in an operable condition with no broken, damaged or soiled parts.
- B. All items furnished shall comply with the latest standards applicable such as U.L., NEMA, etc., and shall bear labels accordingly. All fixtures shall be the color specified or as selected by the Architect. Wherever fixtures have evident damage, they shall be restored to new condition or shall be replaced. Likewise, fixtures showing dirt, dust or fingerprints shall be restored to new condition or shall be replaced.
- C. Eight copies of light fixture factory shop drawings and cuts, showing fixture dimensions, photometric data, installation data and, if applicable, air handling data, shall be submitted to the Engineer for written approval 30 days after bid date. (Verify shop drawing quantities with the Architect.)
- D. Locate pendant, surface mounted or chain-hung industrial fixtures in mechanical rooms and similar spaces to avoid ductwork and piping. Locate around and between equipment to maximize the available light. Request a layout from the Engineer if uncertain about an installation.
- E. Alternate fixtures may be substituted for types specified by name or catalog number. Proposed substitutions must be submitted to the Engineer **ten working days prior to bid** date for written approval to bid. This written approval will only be issued in addendum form.
- F. Where emergency battery packs are provided with fixtures (if any), they shall be connected to an unswitched power line and wired in accord with the manufacturer's recommendations.
- G. All reflecting surfaces, glass or plastic lenses, downlighting Alzak cones and specular reflectors shall be handled with care during installation to avoid fingerprints or dirt deposits. It is preferred that louvers be shipped and installed with clear plastic bags to protect louvers. At close of project, and after construction air filters are changed, remove bags. Any louver or cone showing dirt or fingerprints shall be cleaned with solvent recommended by the manufacturer to a like-new condition, or replaced as necessary in order to turn over to the Owner new fixtures at beneficial occupancy.
- H. Refer to architectural details as applicable for recessed soffit fixtures or wherever fixture installations depend upon work of other trades. Coordinate all installations with other trades. Verify dimensions of spaces for fixtures, and if necessary, adjust lengths to assure proper fit and illumination of diffuser and/or area below.
- I. Warranty shall start at Final Project Completion.

2. VOLTAGE

- A. All lighting fixtures will be rated 120, 277 or 480 volts, single phase as indicated or required.

3. LED FIXTURES

LED SOURCES

- A. LED's shall be manufactured by a manufacturer who has produced commercial LEDs for a minimum of five (5) years.
- B. Lumen Output – minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-360 degree zone - as measured by IESNA Standard LM-

79-08 in an accredited lab. Exact tested lumen output shall be clearly noted on the shop drawings.

- C. Lumen output shall not decrease by more than 20% over the minimum operational life of 50,000 hours at the rated ambient operating temperature.
- D. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
- E. LED Boards shall be suitable for field maintenance and have with plug-in connectors. LED boards shall be upgradable
- F. Light Color/Quality:
 - a) Correlated Color temperature (CCT) range as per specification, between 3000K, 3500K and 4000K shall be correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart.
 - b) Color shift over 6,000 hours shall be <0.007 change in u' v' as demonstrated in IES LM80 report.
 - c) The color rendition index (CRI) shall be 80 or greater
 - d) LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.

LED DRIVERS

- A. Driver: Acceptable manufacturer: eldoLED, Sylvania, or Philips that meet or exceed the criteria herein.
- B. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
- C. Driver should be UL Recognized under the component program and shall be modular for simple field replacement.
- D. Electrical characteristics: 120 – 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
- E. Dimming: Driver shall be suitable for full-range dimming. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 percent to 0.1 percent of rated lumen output with a smooth shut off function.
- F. Dimming shall be controlled by a 0-10V signal, or if require “DMX”.
- G. Driver shall include ability to provide no light output when the control signal drops below 0.5 V, and shall consume 0.5 watts or less in this standby.
- H. Driver shall be capable of configuring a linear or logarithmic dimming curve.
- I. Drivers shall track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range regardless of the controller type
- J. Flicker: Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have: Less than 1 percent flicker index at frequencies below 120 Hz and less than 12 percent flicker index at 120 Hz, and shall not increase at greater than 0.1 percent per Hz to a maximum of 80 percent flicker index at 800Hz
- K. Driver disconnect shall be provided where required to comply with codes.

LED ELECTRICAL

- A. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage and meet ANSI C82.11 maximum allowable THD requirements.
- B. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference. Withstand up to a 1,000 volt surge without impairment of

performance as defined by ANSI C62.41 Category A. To reduce false circuit breaker tripping due to turn on inrush, the following statement ensures that electronic dimming driver will meet NEMA inrush recommendations.

- C. Rush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps² – seconds.
- D. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions
- E. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance.
- F. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

4. LIGHT FIXTURE GENERAL REQUIREMENTS

A. LED Recessed Lighting Fixtures - General Requirements

- (1) The following are minimum requirements for recessed LED fixtures for lay-in grid, gypsum board, plaster and concealed spline ceilings. Surface-mounted LED fixture requirements shall be similar.
- (2) Housings shall be a minimum of 4" depth, premium grade, constructed of a minimum 22 gauge die embossed or stiffened cold rolled pre-treated rust-resistant steel. Troffers shall be equivalent to Hubbell "Versaline," Daybrite "Designer," Lightolier equivalent or Lithonia "2SPG" series.
- (3) All parts shall be finished with polyester powder or white baked enamel (85% minimum reflectance) painted after fabrication. All wiring shall be type TFN, or THWN and shall be covered by the steel driver cover or wiring channel. Exposed wiring is not acceptable. Connection wiring shall be accessible thru a hinged access plate above driver channel in top of unit.
- (4) The complete light fixture unit shall be UL listed and labeled. Other agency listings may be acceptable with written approval from the Engineer.
- (5) Fixture lens doors shall be reversible, hinged, painted after fabrication, with spring-loaded or other mechanically stable positive action latches.
- (6) Lens shall be as specified for each fixture type. If a specific manufacturer and series number of lens is listed, the substitute shall be of the exact specification (thickness, prism configurations, transparency, efficiency, photometric distribution, hardness, vandal-resistance, etc.). Minimum average thickness of any prismatic lens shall be .125".
- (7) Fixture trim and/or flanges shall conform with ceiling constructions as required. Verify all types prior to submission of shop drawings and indicate any special types on submittals. Fixtures installed in drywall or plaster ceilings to be provided with flange, screed and swing gate anchoring system.
- (8) All fixtures shall be furnished with hold down clips to meet applicable seismic codes, four clips per fixture minimum or the equivalent thereof in the installation trim. Verify thickness of drywall or plaster ceilings prior to submission of shop drawings, to allow for proper trim adjustment.
- (9) Support fixtures with one hanger wire at each end. Hanger wires shall be installed within 15° of plumb, maximum or additional support shall be provided. Wires shall be attached to the fixture body and to the building structure - not to the supports of other work or equipment.

- (10) Each type of lay-in fixture shall be furnished with the proper housing flange or lip to suit the type of lay-in grid(s) being utilized on the project. The Contractor is to verify if narrow or standard grid members are being furnished and provide the proper type of light fixture trim. Indicate any special trims on shop drawing submittals.

B. Industrial and Striplight LED Fixtures - General Requirements

- (1) Units shall have die-formed heavy gauge cold rolled steel channels and die-embossed reflectors.
- (2) Finishes to be coated with a gloss powder paint or baked enamel finish with a minimum 85% reflectance.
- (3) Units to have aligner clips where required for a continuous row appearance. Where continuous rows exceed twelve feet in length, provide a "unistrut" channel or similarly adequate mounting to stiffen and align row.
- (4) Units to have captive latches for all covers and wire guards where specified. Wire guards shall be heavy-duty #14 wire gauge minimum with corrosion-resistant plated or vinyl finish.
- (5) Units to be UL listed.
- (6) Mounting brackets and hanging mechanisms shall be as specified in fixture descriptions, or as required. Allow a generous safety margin with all support systems, as recommended by the manufacturer.

C. Recessed Ellipsoidal or Parabolic Cone Downlight - General Requirements

- (1) Fixture to have an extruded or die-cast aluminum housing. Retaining mechanism shall provide easy access to LED array and driver box.
- (2) Unit to have a corrosion-resistant steel junction box with hinged access covers and thermal protector.
- (3) Mounting/plaster frame to be heavy gauge steel with finishing trim friction support springs, for the required ceiling thickness. Trim to be of color as selected by the Architect.
- (4) Optical system to consist of a specular clear Alzak upper ellipsoidal (or parabolic, as noted) reflector with specular Alzak cone or microgroove matte black baffle as noted in schedule. Where other than clear Alzak cone/reflector color is noted on the schedule, it shall be furnished as specified.
- (5) Provide telescoping channel bar hangers that adjust vertically and horizontally.
- (6) Fixtures to be UL listed for thru-branch circuit wiring, recessed, and damp locations. Where installed in plaster or drywall or other inaccessible ceiling type, they shall be U.L. listed for bottom access.

D. Exit Lights - General Requirements

- (1) Housings and canopies shall be die-cast aluminum or corrosion resistant steel. Mountings shall be wall or ceiling, universal type, to suit the installation conditions.
- (2) Provide with stencil face, lettering color red, of sizes in accord with code, or as otherwise specified.
- (3) Provide single or double face as scheduled, indicated on plans or as required by the local authority having jurisdiction. Adjust installation position if required for clear visibility, in accord with applicable codes.

- (4) Complete unit to be finished in color as selected by the Architect. Provide directional arrows as indicated on plans, as scheduled to suit the means of egress or as required by the local authority having jurisdiction.
- (5) All exit signs shall be long life LED type.
- (6) Where emergency backup battery packs are provided with exit lights, they shall have capacities for continuous operation per applicable codes. They shall have reserve battery capacity to operate remote lamps where indicated.

5. LIGHTING FIXTURE SCHEDULE

- A. Refer to the contract drawings for Lighting Fixture Schedule

6. PHOTOCELLS

- A. Provide 120, 277 or 480 volt (rated as needed), 1000 or 2000 watt photocells as needed for control of certain circuits or fixtures as indicated on plans. They shall be as manufactured by Tork, Paragon, AMF or approved equivalent.
- B. Mount photocells in locations concealed from sight lines standing on ground unless otherwise noted, in which case the final position shall be as directed by the Architect. Group together (if indicated at one location) and mount on back of parapet wall or otherwise properly support with mounting bracket. Coordinate with roofing installer to ensure that roof penetrations are properly made without violating or reducing the roof warranty in any way. Photocells may be mounted in other locations if it is not practical to install them on roofs or parapets, in which case the Contractor shall request direction for their mounting locations from the Engineer or Architect. Photocells shall always be mounted in a weatherproof, inconspicuous manner.

7. TIMECLOCKS

- A. Provide digital astronomic timeclock(s) to control the indicated loads. The number of poles, their ampacity and voltage withstand shall be to suit the load, but in no case less than 30 amps, 277 volts.
- B. Timeclock coil and motor power shall be 120 volts AC, backed up with seven day memory which is automatically replenished in normal operation. Provide a 120 volt control circuit from the nearest available panelboard.
- C. Order unit for the proper geographical latitude for the project site. Also provide day light savings time option and calibrate for April-October dates. Provide instruction to the Owner's representative in proper setting and operation of each type of timeclock provided.
- D. Enclosures for timeclocks shall be surface type, NEMA 1 or NEMA 3R as needed. Where exposed in finished areas, provide flush-style NEMA 1 enclosures.

8. LIGHTING MEANS AND METHODS

- A. THE FOLLOWING WIRING MEAN AND METHODS WILL BE APPROVED ON THIS PROJECT:

- (1) A 23.75" LONG 23.75" WIDE 4.77" HIGH 20 GAUGE CRS WHITE POWDER COATED GRID MOUNTED ENCLOSURE WITH HTC CLIPS AND SUSPENSION ILETS ON EACH CORNER. THE ENCLOSURE IS TO HAVE A 20 GAUGE HINGED AND LATCHED DOOR WITH FACTORY PREWIRED OCCUPANCY SENSOR, PHOTOSENSOR AND/OR EMERGENCY BYPASS RELAY REFERRED TO IN NEC 700.2 AS AUTOMATIC LOAD CONTROL MOUNTED ON DOOR WITH LOW VOLTAGE CAT 5 CABLE INTERCONNECTING SENSOR TO

CONTROL POWER DEVICES. EMERGENCY BYPASS RELAY IS TO BE PREWIRED THRU DRIVER CHANNEL TO EMERGENCY DRIVER. LIGHTING CONTROL DEVICES (POWER PACK, RELAY, BRIDGES, ETC.) ARE TO BE MOUNTED IN LOW VOLTAGE SECTION OF ENCLOSURE AND PREWIRED TO UP TO SIX (6) CAT 6 CONNECTORS IN TOP OF ENCLOSURE. THE CAT 6 CONNECTORS ARE TO ALL THE CONTROL DEVICE TO NETWORK THE LIGHTING CONTROL AND CONNECT REMOTE DEVICES TO CONTROL HARDWARE INSIDE OF ENCLOSURE (SWITCHES, SENSORS).

- (2) LINE VOLTAGE UP TO TWELVE (12) LIGHT EMITTING DIODE (LED) DRIVER ARE TO BE MOUNTED TO THE FOUR (4) SIDES OF THE ENCLOSURE AND FACTORY PREWIRED TO THE INCOMING NORMAL AND/OR EMERGENCY ELECTRICAL SERVICE 3/8" DIAMETER 72" LONG FLEXIBLE GALVANIZED STEEL CONDUIT WITH 3 NO. 18 THHN 600 VOLT INSULATED AND GROUND COPPER CONDUCTORS ENTERING INTO DRIVER AND 600 VOLT WIRING CHANNEL. THE DRIVER (AS SPECIFIED HEREIN) ARE SCREWED TO THE FOUR SIDES OF THE CHANNEL, LINE VOLTAGE WIRING AND LOW VOLTAGE LOAD SIDE WIRING IS PREWIRED AT THE FACTORY. LOW VOLTAGE ON THE LOAD SIDE OF THE DRIVER IS TO CONNECT TO A TWO WIRE PIN AND SLEEVE CONNECTOR IN TOP OF ENCLOSURE ABOVE EACH DRIVER. THE LINE VOLTAGE AND LOW VOLTAGE SECTION OF THE ENCLOSURE ARE TO BE SEPARATED BY FOUR (4) TABBED AND SCREWED 20 GAUGE CRS WHITE CHANNEL COVERS. ENCLOSURE WITH DRIVERS AND LIGHTING CONTROL DEVICES ARE TO BE UL LIST AS A UNIT. COMPONENT LISTING ONLY WILL NOT BE ACCEPTED.
- (3) LOW VOLTAGE UL LISTED LED LIGHTING FIXTURE ARE TO BE CONNECTED TO ENCLOSURE WITH 2 NO. 18 600 VOLT RATED CLASS II STRANDED PLENUM RATED CABLE THAT EXTENDS FROM TWO PIN AND SLEEVE FEMALE CONNECTOR IN TOP OF ENCLOSURE TO TWO PIN AND SLEEVE FEMALE CONNECTOR IN LED FIXTURE WITH TWO PIN MALE CONNECTOR IN EACH END OF CLASS II CONNECTOR CABLE. CABLE TO BE FACTORY MANUFACTURED AND FURNISHED WITH FIXTURES AS A COMPLETE UL LISTED ASSEMBLY.

ASSEMBLY EQUAL TO NINE 24 PTP SYSTEM

END OF SECTION 265113

SECTION 265116 – NETWORK LIGHTING SYSTEMS**1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (occupancy), and manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- C. The system architecture shall provide stand-alone groups (rooms) of devices to function in a default capacity even if network connectivity to the greater system is lost. The network shall allow for remote troubleshooting and reporting as well as some higher level functionality.
- D. The system shall not require any centrally hardwired switching equipment.
- E. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.
- F. Graphical floor plan software shall be provided allowing the owner to see devices in specific rooms and by clicking on the symbol with a mouse shall be able to see status, make device adjustments, modify schedules, over-ride, and/or disable devices. The software shall also provide a reporting tool that indicates what savings have been accomplished by use of each technology used in a space over a specified time (Occupancy sensing, daylight harvesting, time of day, etc.)

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - A. Specification Conformance Document: Indicate whether the submitted equipment:
 - A. Meets specification exactly as stated.
 - B. Meets specification via an alternate means and indicate the specific methodology used.
 - B. Shop Drawings; include:
 - A. Schematic (one-line diagram) of system.
 - B. Mounting dimension requirements for each product and mounting condition.
 - C. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.
 - D. Sequence of Operation to describe how each area operates and how any building wide functionality is described.
 - E. Sequence of Operation to describe how each area operates and how any building wide functionality is described.
 - F. Provide coordination drawings showing interconnecting control wiring and interface devices.

G. Quality Control Submittals:

- A. Test Reports: Indicating compliance with specified fabric properties.
- B. Certification: Morton International Laboratory Report for PVC coated fabrics and bacterial and mildew resistance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

- A. Retain "Testing Agency Qualifications" Paragraph below if Contractor selects testing agency or if Contractor is required to provide services of a qualified testing agency in "Field Quality Control" Article. Qualification requirements are in addition to those specified in Section 01 40 00 "Quality Requirements," which also defines "NRTL" (nationally recognized testing laboratory).
- B. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- C. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- D. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- E. All applicable products must be UL/CUL Listed or other acceptable national testing organization.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation according to NECA 407.

1.8 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.9 WARRANTY

- A. All devices in lighting control system shall have a 5 year warranty. Warranty shall start at Final Project Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. This specification is based on the nLight Network Control System from Sensor Switch, by Watt Stopper or Cooper Controls

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section)
- D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5E low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

- M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.
- N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.
- O. WiFi-enabled devices shall be capable of current monitoring
- P. WiFi-enabled devices shall utilize WPA2 AES encryption
- Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks
- R. WiFi-enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi- enabled system devices
- S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
- T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- U. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.
- V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
- W. A taskbar style desktop application shall be available for personal lighting control.
- X. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- Y. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- Z. Control software shall enable integration with a BMS via BACnet IP.
- AA. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)

- 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
- 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.

3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
4. Device shall automatically detect all devices downstream of it.
5. Device shall have a standard and astronomical internal time clock.
6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
7. Device shall have a USB port
8. Each control gateway device shall be capable of linking 1500 devices to the management software.
9. Device shall be capable of using a dedicated or DHCP assigned IP address.

B. Networked System Occupancy Sensors

1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray). Wall plates shall be brushed stainless steel
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
20. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
21. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
22. Embedded sensors shall have an optional photocell
23. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
24. Fixture mount sensors shall be capable of powering themselves via a line power feed.
25. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
26. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
27. System shall have WiFi enabled fixture mountable sensors available.

28. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output

C. Networked System Daylight (Photocell and or Dimming) Sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.
9. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.

D. Networked System Metering Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system and come capable of metering connected load.
3. All devices shall have two RJ-45 ports.

4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
 5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
 6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
 7. Power Packs and Power Supplies shall be available that are WiFi enabled.
 8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
 9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
 10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
 11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
 12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
 13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
 14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
 15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
 16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
 17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
 18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
- E. Networked System Relay & Dimming Panels
1. Panel shall incorporate up to 4 normally closed latching relays capable of switching

120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.

2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection

F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
7. Specific I/O devices shall sense state of low voltage outdoor photocells
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense .

G. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device
2. Networked LED luminaire shall have two RJ-45 ports
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
4. Networked LED luminaire shall provide low voltage power to other networked control devices

5. System shall be able to turn on/off LED luminaire without using a relay
6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

H. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

I. Networked System Graphic Wall Station

1. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box
5. Device shall have a micro-USB style connector for local computer connectivity.

6. Device shall have two RJ-45 ports for communication

J. Networked System Scene Controllers

1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Device shall recess into single-gang switch box and fit a standard GFI opening.
3. Devices shall provide LED user feedback.
4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
5. All sensors shall have two RJ-45 ports.
6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
7. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
8. Device shall have LEDs indicating current selection.

K. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.4 LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

- D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6 BMS COMPATIBILITY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
- B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
- C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.7 SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An "Energy Scorecard" shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- D. All system devices shall be capable of being given user defined names.

- E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- H. Install equipment in accordance with manufacturer's installation instructions.
- I. Provide complete installation of system in accordance with Contract Documents.
- J. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- K. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- L. Season lamps at full intensity according to lamp manufacturer's recommendation.
- M. Install equipment in accordance with manufacturer's installation instructions.
- N. Provide complete installation of system in accordance with Contract Documents.
- O. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- P. Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
- Q. Season lamps at full intensity according to lamp manufacturer's recommendation.
- R. Install plenum cable in environmental air spaces, including plenum ceilings.
- S. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- T. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- U. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Acceptance Testing Preparation:
 - 1. Test continuity of each circuit.
- D. Lighting control panel will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time- of-day schedules, and input override assignments.
- B. Required factory-trained personnel site visits:
 - 1. Pre-installation: The system shall be provided with visits from factory trained technician(s) for a pre-installation visit with the contractor prior to system installation.
 - 2. Commissioning and Programming: A second visit shall be included for commissioning and programming of the system including testing of switches and sensors.

3. Owner Training: A third visit shall be provided for owner training after the owner has occupied the building. Minimum four hour training to be video recorded.
4. Owner Re-Training and System Adjustment: A fourth visit 6 months after the owner has occupied the building shall be provided to tweak the system for occupant preferences and for additional training.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 SEQUENCE OF OPERATION

A. Classrooms With Daylight:

1. The classrooms with daylighting shall be provided with a control station at the entry door to turn on and dim the zones of lighting in four (4) presets. The first preset shall be labeled "green" and shall turn all lighting on to 30 footcandles and shall provide a contact closure to the HVAC system to adjust the set point. The second preset shall be labeled "AV" and shall turn the lighting closest to the smart board on to 10% output with the rest of the lighting at 30% output. The third preset shall be labeled "Full" with all lighting at 100% output. The fourth preset shall be labeled "Low" and shall be all lighting at 10% output. A vacancy sensor shall be provided to turn lights off when no occupancy has been detected for 30 minutes. It shall include auxillary relay contacts to provide occupancy status to the temperature control system. A photosensor shall be provided to dim the lighting in daylighting zones independently from the rest of the room from the selected preset level. See typical classroom layout.

B. Offices With Daylighting

1. The offices with daylighting shall be provided with a dimmer at the entry door to turn on and dim all lighting in one zone. A vacancy sensor shall be provided to turn lights off when no occupancy has been detected for 30 minutes. A photosensor shall be provided to dim the lighting in daylighting zones independently from the rest of the room where size dictates.

C. Corridor/Lobbies/Vestibules:

1. The common areas shall be controlled via time of day scheduling. These areas shall be placed in occupied mode at 4:00AM and unoccupied mode at 6:30PM. At 6:30 the lighting will be swept off after a blink warning to provide occupants time to hit the switch and receive 90 minutes of additional lighting. Switches shall be placed in locations indicated on drawings to provide 90 minute over-ride to on when necessary. During school hours the switches will be programmed as on only.

D. Restrooms:

1. The restrooms shall be controlled via occupancy sensors. The system shall be programmed to remain on during normal school hours for security. After hours the occupancy sensor shall control the lighting. Switches in restrooms will be used for over-ride to on only.

E. Storage Rooms:

1. The storage rooms shall be provided with a low voltage switch at the entry door allowing the occupant to turn lighting on if needed. The vacancy sensor shall turn the lighting off when no occupancy has been detected for 5 minutes.

F. Gym:

1. The lighting shall be controlled via low voltage switches at entry doors and a master controller next to the stage. Time of day scheduling will put the Gym into occupied mode at 4:00AM and into unoccupied mode at 10:00PM. The occupant will be required to turn the lighting on when they enter the space. If the lighting is not switched off then the time of day scheduling will sweep it off after a blink warning.

G. Media Center:

1. The media center shall be provided with a switch at the entry door to turn on all lighting in one zone. A master control station shall be provided at the media desk to switch and dim four (4) separate zones. Photosensors shall be provided to dim the lighting in daylighting zones independently from the rest of the room. Time of day scheduling shall place the room into occupied mode at 5:30AM and shall sweep lighting off after a blink warning at 6:30PM.

H. Cafeteria:

1. The cafeteria shall be provided with a switch at the entry door to turn on all lighting in one zone. A three zone control station shall be provided at one entry door to dim three (3) separate zones. Photosensors shall be provided to dim the lighting in daylighting zones independently from the rest of the room. Time of day scheduling shall place the room into occupied mode at 5:30AM and shall sweep lighting off after a blink warning at 6:30PM.

I. Kitchen:

1. The kitchen shall be controlled via time of day scheduling. It shall be placed in occupied mode at 4:00AM and unoccupied mode at 6:30PM. At 6:30 the lighting will be swept off after a blink warning to provide occupants time to hit the switch and receive 90 minutes of additional lighting. Switches shall be placed in locations indicated on drawings to provide 90 minute over-ride to on when necessary. During school hours the switches will be programmed as on only.

3.9 SERVICE AND SUPPORT

- A. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters
 - a. Qualifications for factory certified field service engineer:
 - 1) Minimum experience of 2 years training in the electrical/electronic field.
 - 2) Certified by the equipment manufacturer on the system installed.
 - b. Make first visit prior to installation of wiring. Contractor must schedule meeting Electrical Engineer and Manufacturer representative to review system and functionality prior to installation of wire and equipment.
 - c. Make second visit upon completion of installation of Network Lighting Control System for system start up. Schedule start up with owner and engineer with 2 weeks prior notice.
 - d. A total two (2) Owner training session with the electrical contractor, the lighting controls contractor, the factory authorized representative, engineer of record, and the owner (and staff) shall be conducted at the project site. The training session shall be scheduled a minimum of 2 weeks prior. The training session shall not be conducted until the lighting controls system has been programmed and is fully operational.

- e. A total of two (2) walk thrus shall be conducted after completion of construction to assure that the system is fully operational. The walk thrus shall be schedule a minimum of 2 weeks prior and shall be conducted at the request of the owner or engineer of record. In lieu of a formal request from the owner or engineer of record the walk thrus shall be conducted 3 months and 9 months after completion of construction. Reports shall be issued at each walk-thru.

END OF SECTION 265116

SECTION 265561 - THEATRICAL LIGHTING SYSTEMS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications section, apply to work of this section.
- B. Division 26 Basic Materials and Methods sections apply to work of this section.

1.2 INTENT

- A. The intent of this specification is to provide for furnishing all necessary equipment, as detailed on drawings and/or schedules, for a complete lighting and control system.

1.3 QUALITY CONTROL

- A. Equipment specified herein shall be the sole responsibility of a single theatrical systems integrator.
- B. The manufacturer of all dimming and control equipment shall have been producing lighting control equipment for at least ten consecutive years.

1.4 APPROVALS

- A. Prior approval is required for alternate proposals.
- B. Complete catalog data, specifications, and technical information on alternate equipment must be furnished to the Architect and Owner at least ten business days in advance of the bid date.

1.5 SCOPE

- A. The work included under this specification shall cover all labor, materials, and equipment to furnish the lighting control system herein specified.
- B. It shall also include the services of a qualified engineer regularly employed by the manufacturer of the system that shall check the installation and ensure its proper operation.
- C. No part of the system shall be energized before being so checked and the installation approved. Failure to observe this provision shall automatically relieve the manufacturer of any responsibility concerning the proper operation of the system or any part thereof and the replacement of parts that may have been damaged by the premature energizing.

1.6 SUBMITTALS

- A. The manufacturer shall provide twelve (1) complete sets of electronic submittal drawings for approval, prior to manufacture of any of the components.

- B. On the dimming system, bidders submitting other equipment shall include all pertinent information showing in what respect the system will function in accordance with the specifications. In the case of substitution of the control system, the bidder shall submit the name of the manufacturer and a list of three or more operating systems (with names and telephone numbers of contacts).
- C. All fixtures supplied shall meet or exceed the mechanical, electrical, optical, and performance data published for the equipment listed herein.
- D. If required by the Architect or Engineer, the bidder shall provide at his expense, samples of proposed units for testing by an independent testing laboratory. All costs for these tests shall be the responsibility of the bidder.
- E. It shall be understood that any additions or revisions of wiring required by the use of substitute equipment shall be the responsibility of the bidder making the substitution.
- F. Field commissioning and instructional checkout shall be provided within 21 days of written request by the electrical contractor.
- G. If the installation is not sufficiently complete to perform the checkout upon arrival of the factory certified field service technician, all costs for the additional trips shall be paid by the contractor.

1.7 SHOP DRAWING REVIEW AND APPROVAL

- A. Shop drawings shall be furnished for approval prior to fabrication of the equipment. A set of drawings shall be returned, appropriately marked, as the approval document.
- B. When the installation is complete, the owner shall be supplied with "as built" drawings which shall be incorporated as part of the Operation and Maintenance Manual. Maintenance information shall be provided on all major units and principal components of the system.

1.8 WARRANTY

- A. The manufacturer shall warrant his equipment to be free from defects in material and workmanship for a period of twenty-four (24) months after the manufacturer's checkout of the installation.

1.9 STANDARDS

- A. All lighting instruments and control system components, where applicable standards have been established shall follow the recommendations of a National Registered Testing Laboratories and the National Electrical Code, and must bear appropriate labels.
- B. Manufacturers
 - 1. Provide products by the manufacturers indicated on the drawings and specifications. This apparatus is fully catalogued and described with complete technical data available from the manufacturers.
 - 2. The theatrical lighting and control equipment basis of design is as specified in these documents.
 - 3. The listing of a manufacturer as "equivalent systems" does not imply automatic approval. It is the responsibility of the Electrical Contractor to ensure that any price quotation and products meets or exceed the specifications herein.

PART 2 - PRODUCTS

2.1 THEATRICAL RELAY PANELS

A. Materials and Components

1. NEMA rated enclosure with screw cover or hinged door. Rain tight or oil tight and other NEMA rated versions available.
2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
3. LCP input power shall be capable of accepting 120v or 277v without rewiring
4. Control electronics in the low voltage section shall be capable of driving 2 to 48 relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control Normally Open (NO) or Normally Closed (NC) relays.
5. Lighting control system shall be digital and consist of a Master LCP, Slave LCPs, Micro LCPs with up to 4 individual relays, digital switches, digital interface cards and if required, SmartBreaker panelboards. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. Analog systems are not acceptable.
6. The lighting control system is a networked system that communicates via RS485 and includes centralized relay panels, micro relay panels, digital switches, photocells, various interfaces and operational software. The intent of the specification is to integrate all lighting control into one system. Lighting control system shall include all hardware and software. Software to be resident within the lighting control system. System shall provide local access to all programming functions at the DTC and remote access to all programming functions via dial up modem and through any standard computer workstation running an industry standard internet browser. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorized workstation. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital system not acceptable.

B. Standard Output Relays

1. Electrically held, electronically latched SPST relay.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #10AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.
3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
4. Relays to be rated for 250,000 operations minimum at a full 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
5. Optional relay types available shall include: Normally Open (NO) relay rated for 100,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

C. Interfaces

1. For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans:
 - (a) A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
 - (b) Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
 - (c) An interface card that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats to be able to done locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.

- (d) A voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.
- (e) Software pre-installed to run Unity GX Graphical Interface Software. Unity GX software shall provide via local or remote PC a visual representation of a specific area or the total area of the project. GX full graphic pages shall be designed to the owner's specifications. Owner to provide to manufacturer all necessary files and criteria. Provide ____ GX pages.
- (f) Direct digital interface to SmartBreaker panelboards. Relay panel and SmartBreaker panelboard circuits shall appear on the system software as similar, yet distinct, items and maintain all functions and features of the system software.
- (g) Direct digital interface to DMX 512 based systems. DMX interface shall provide 14 global commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time response from the lighting control system to DMX commands.
- (h) Direct digital interface to building automation systems using DDC protocols such as BACnet and Metasys (N2) that accept on/off commands, time schedules and report status of all relays in all panels in real time. Interface cards shall "self populate" each individual relay and each group to the BAS.nts

D. Approved Manufacturer and Products.

- 1. Theatrical Relay Rack Lighting Controls and Design DMX Relay Rack, or approved equal.
- 2. Supply the Following:

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote Quantity</u>
DMX48ENC	LC&D 48 Space DMX Relay Enclosure, with 42 – 20A Single Pole Normally Open Relays.	1
95250	Phase Loss Sense Panel, 120V, 3-Phase	1

2.2 SIGNAL PROCESSING RACK

A. General.

- 1. The auxiliary control panel shall be a surface mounted cabinet free of visible fasteners and shall be of aesthetic appearance.
- 2. The cabinet shall have a hinged locking door cover to protect and secure internal components.
- 3. Terminal Strips and necessary electrical and electronic terminations will be included.

B. Components.

- 1. Internal control components for the panel will be factory assembled and tested.
- 2. The panel shall contain all necessary wiring and terminations for assembly of panel mount components, including internal power supply, plug strips, and cabling.
- 3. Provide Wall Mounted, Locking 12U Shallow Rack To Include the Following:

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote Quantity</u>
63054RM	Vision.Net to DMX Interface, Rack Mount	1
66666RM	Emergency DMX Bypass Switch, UL924, 4-Way Output	1
1103	Pathway eDIN Rack Mount Panel to Include 30W PSU and (2) 4-Way DMX Opto Splitter	1
	The Following Is To Be Mounted Internally:	
NEMA515R	NEMA 5-15 Duplex Receptacle in Back Box.	1

2.3 CONTROL CONSOLE SPECIFICATION

A. Overview.

1. The control console shall be a microprocessor based lighting system designed specifically for the control of theatrical, television, and live performance dimming systems.

B. Channel Capacity.

1. The console shall support the processing of up to 512 total DMX512 outputs with the Starter or Pro 512 console or 1024 total DMX512 outputs with the Pro1024 console.
2. Communication to system devices over a network shall be available utilizing the Pathport protocol with Starter console. The Pathport, E1.31 sACN, and Art-Net protocols shall be available on the PRO512 and PRO1024 console.

C. Mechanical.

1. The console shall consist of a free standing tabletop console with integrated 7" capacitive touchscreen, 4 Encoders, and 20 Fader handles. Consoles that do not include 7" integrated touchscreen shall not be accepted.
2. The control surface shall be designed for table or rack mounting with removable end pieces to facilitate this.

D. Electrical.

1. Console shall be powered through the use of an independent power supply with a molded plug appropriate to the specific geographic locale of use or Power-Over-Ethernet. Control consoles that are unable to be powered by Power-Over-Ethernet shall not be accepted.
2. The following data input/output connectors shall be provided:
 - a. (2) DMX512 Out (5-pin XLR - Female).
 - b. (1) DMX512 In (5-pin XLR - Male).
 - c. (1) RJ-45 Network cable port for Art-Net communication protocol.
 - d. (2) USB Port.
 - e. (3) Contact Closure
3. The power supply shall be UL, cUL listed and the entire system shall be CE marked.

E. Operational Overview.

1. These consoles are touchscreen driven control desk that has submaster storage, memory playback, effects storage and playback and additional advanced features specifically engineered for LEDs and moving lights.

F. Operational Features.

1. The system shall be available to patch any dimmer or group of dimmers to a single channel. It shall be possible to set every dimmer with a level (0% to 100%) that shall scale the channel level proportionally.
2. Grand Master and Blackout Switch: the entire system output shall be mastered by this potentiometer and switch.
3. Flash Switches: a "bump" button with a LED indicator associated with each channel or scene potentiometer shall be provided to flash channels or scenes to a level set by the flash level potentiometer. These switches shall be instructed to operate in a flash or solo fashion. When the console is in record mode, the switches shall be used for rapid recording the total live output into a selected submaster.
4. It shall be possible to create and edit Scenes and Effects either Live or in a Preview mode.
5. Playback Controls: playback of channels shall be provided via manual channel faders, submasters, manual scene masters, effects playback, LED mode or Moving Light mode.
 - a. The Preset mode A/B manual split crossfader shall have separate incoming and outgoing preset controllers to provide a dipless crossfade between the two manual potentiometers.
 - b. The submaster mode A/B manual split crossfader shall have separate incoming and outgoing preset controller to provide a dipless crossfade between sequential and/or non-sequential recorded submasters.
 - c. The Time fader potentiometers shall enable timed fades between 0 (manual) and 10 minutes. Timed crossfades may be stopped, paused and continued, manually over-ridden or reversed at any time prior to fade completion.

G. Operating Environment.

1. The console should be operated under general office level conditions, with a minimum of dust.
2. The maximum operating ambient temperature shall be 32 - 104 degrees Fahrenheit (0 - 40 degrees Celsius).
3. The relative humidity shall be 0% - 95% (non-condensing).

H. Included Furnishings.

1. Universal Power Supply (90 - 240VAC, auto-ranging).
2. Dust Cover.
3. Operation Manual.

I. Approved Manufactures and Products

1. Control Console shall be Pathway Coginto series, or Approved Equal
2. Supply the Following

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote Quantity</u>
07007111	Pathway Cognito2 Console, Starter512	1
NPN	19" LCD Monitor	1
NPN	25' DMX Cable	1

2.4 DISTRIBUTION

A. Wiring Devices

1. Wiring devices specified shall conform to the following standards of construction:

B. Connector Strips

1. Each section shall consist of a 4" x 4" (102mm x 102mm) 18 gauge steel or aluminum wireway with removable cover sections for access, labeled with circuit numbers
2. Each strip shall have a terminal compartment which shall be factory installed on the right or left end as required and shall contain molded barrier type terminals for feed connection. Knockouts, cables clamps and "Kellums" cable grips shall be provided, when appropriate.
3. Each connector strip shall be provided with 50' of Multi-Cable appropriate for number of circuits.
4. The strip shall be provided with heavy steel mounting straps on approximately 5' (1.52m) centers, to grip up to 2" (51mm) pipe.
5. Type S or SO, 18" (457mm) cable pigtails shall be secured by strain reliefs and shall be furnished with three pole grounded female receptacles. Flush receptacles are available in lieu of pigtails. Internal wiring shall be rated at 125 C.
6. External finish shall be black powder coat epoxy. The entire unit shall be UL and CSA approved and labeled.

C. Plug Boxes

1. Female receptacles shall be three pole grounded type, flush mounted.
2. Finish shall be baked flat enamel.
3. The unit shall be UL listed and CSA approved in Canada.
4. The surface mounted unit shall weigh 11lbs. (5kg). The recessed unit shall weigh 9lbs. (4kg).
5. The dimensions of the unit shall be 12" x 6" x 5" (305 x 150 x 127mm)

D. Approved Manufacturer and Products.

1. Distribution shall be Performance Electric, Altman Lighting, or Lex Products.
2. Supply the Following:

<u>Description</u>	<u>Base Quote Quantity</u>
FOH CONNNECTOR STRIP - 50' Connector Strip with (12) 5-20 Duplex Receptacles on (6) 20A Circuits. Connector Strip Shall Also Contain (1) DMX OUT Receptacle. Include (11) Threaded Rod Hanging Brackets and 50' of Batten Pipe.	1
OVERSTAGE CONNECTOR STRIPS - 56' Connector Strip with (12) 5-20 Duplex Receptacles on (6) 20A Circuits. Connector Strip Shall Also Contain (1) DMX OUT Receptacle. Include (12) Single Pipe Mount Brackets and 56' of Batten Pipe.	4

2.5 LED ELLIPSOIDAL SPOTLIGHTS.

A. General

1. The instrument shall be a LED ellipsoidal spotlight as manufactured by Altman Lighting or approved equal.

B. Physical

1. The unit shall be constructed die cast aluminum and sheet metal construction, and finished in black, high temperature powder coated paint. Tools shall not be required for either lamp alignment or cleaning the reflector or lens
2. The following shall be provided:
 - a. Thermally insulated knobs and shutter handles
 - b. Shutter assembly shall allow for 360° rotation
 - c. Locking, 20 gauge stainless steel shutters
 - d. Interchangeable lens tubes for different field angles with Teflon guides for smooth tube movement
 - e. Positive locking, hand operated yoke clutch
 - f. Slot with sliding cover for motorized pattern devices or optional iris

C. Performance

1. The unit shall be available in 150w or 250w. The 150w unit shall be convection cooled. .
2. The unit shall provide, but not be limited to:
 - a. RGBA, RGBW, 3000K, or 5600K as specified in bid documents
 - b. 5, 10, 19, 26, 36, 50 degree field angles
 - c. High-quality pattern imaging
 - d. Adjustable hard and soft beam edges
 - e. The unit shall be ETL, cETL, & CE listed and so labeled.

D. Approved Manufacturer and Products.

1. LED Ellipsoidal Spotlight be Altman LED Phoenix, or Approved Equal
2. Supply the Following:

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote</u> <u>Quantity</u>
PHX2RGBW19	LED Profile Spot, 19°, 250W, RGBW Array. Supply Fixture with 5' Power-Con to 15A Male Edison Connector, Safety Cable, and Color Frame. Fixture To Be Supplied With Pole Operated Pan/Tilt Mount. Supply Each Fixture With 10' DMX Extension and Power-Con Extension Cable	7
PHX2RGBW26	LED Profile Spot, 26°, 250W, RGBW Array. Supply Fixture with 5' Power-Con to 15A Male Edison Connector, Safety Cable, and Color Frame. Fixture To Be Supplied With Pole Operated Pan/Tilt Mount. Supply Each Fixture With 10' DMX Extension and Power-Con Extension Cable	7
PHX2RGBW50	LED Profile Spot, 50°, 250W, RGBW Array. Supply Fixture with 5' Power-Con to 15A Male Edison Connector, Safety Cable, and Color Frame. Fixture To Be Supplied With Pole Operated Pan/Tilt Mount. Supply Each Fixture With 10' DMX Extension and Power-Con Extension Cable	8

2.6 LED WASH FIXTURES

A. Overview

1. The luminaire shall be a full spectrum color mixing luminaire employing a red, green, blue, and white LED engine. The engine shall be capable of providing tunable white color temperature matched presets as well as millions of permutations of color.
2. The luminaire shall have a 10 to 60 degree electronic control of spot to flood beam spread with an output in excess of 2,000 lumens.
3. The luminaire shall have an integrated control system that provides local controls offering access to set up parameters, preset color temperatures, stored custom presets, and status reporting.
4. The luminaire shall have control inputs for DMX512 with input/output connectivity
5. The beam will have a soft edge with minimal spill.
6. Tilt adjustment shall be by means of a screw lock system secured by a hand sized insulated "T" handle which also allows one hand adjustment. The yoke position shall be adjustable along the length of the fixture.
7. The fixture is provided with a formed steel yoke with a central hole for a 1/2 inch (M12) suspension bolt set comprising 1/2 inch set screw (M12), nut and two washers.

B. Physical

1. Fixture shall not exceed 266mm when the luminaire is at a zero degree angle (at 90 degrees) to the mounting structure. .
2. The luminaire shall allow for a manual rotation of 360 degrees pan and 270 degrees tilt (through utilization of the sliding yoke) to provide optimum luminaire orientation at all times. Luminaires offering limited range of motion shall not be accepted.
3. The construction of the unit shall be a extruded aluminum, sheet metal and molded engineering grade plastic.
4. Weight shall not exceed 12 lbs. [5.5 kg] luminaire only.

C. Electrical

1. Supply Voltage shall be 100-240VAC nominal
2. The luminaires current draw shall not exceed 151W.

D. Environmental

1. Maximum operating ambient temperature shall not exceed 40 degrees Celsius.
2. A variable speed cooling system shall be employed to maintain the optimal operating temperature of the luminaire.

E. Approved Manufacturer and Products.

1. LED Wash Fixture Shall Be Martin Rush Series, or Approved Equal
2. Supply the Following:

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote Quantity</u>
90480040	Martin Rush Par 2 RGBW Zoom. Supply Fixture with 5' Power-Con to 15A Male Edison Connector, C-Clamp, Safety Cable, and Color Frame	32

2.7 SPARES AND ACCESSORIES

A. Provide the following:

<u>Cat. No.</u>	<u>Description</u>	<u>Base Quote Quantity</u>
25DMXEXT	25' DMX Extension Cable	4
15DMXEXT	15' DMX Extension Cable	10
10DMXEXT	10' DMX Extension Cable	45
10PCEXT	10' Power-Con Extension Cable	45
300TIELINE	300' Roll of Tie-Line	1

PART 3 - SYSTEM COMMISSIONING AND TESTING

A. General

1. Prior to operational checkout, the Electrical Contractor shall confirm the following conditions.
 - a. All control stations are installed and terminated per the vendor's integration drawings.
 - b. Availability of owner's staff for instruction
 - c. Space is clear of workmen and may be blacked out for extended periods
 - d. Building and equipment feeders are energized
 - e. HVAC systems are operational in Control Booths and Dimmer Equipment Spaces
 - f. Stage luminaries are installed and connected to the dimming system to confirm that individual dimmed circuits are in operational order
 - g. Dimmer rack and all equipment is cleaned and ready for operational check-out.
2. Notify vendor in writing, at least 21 days prior to requested startup date, that the system is ready for startup.
3. Costs of additional or repeat visits due to delay, lateness, or negligence on the part of the Electrical Contractor shall be borne by the Electrical Contractor.

B. Fixture Hang and Focus

1. Systems Integrator shall unbox, assemble, address, hang and focus all theatrical lighting fixtures to a plot supplied by end user or lighting designer.

C. Testing

1. The vendor's Field Service Representative shall complete the following:
 - a. Inspect the Electrical Contractor's installation for conformance to vendor's instructions.
 - b. Confirm all wiring runs and termination and make notes as required.
 - c. Make notes and diagrams as needed for completion of As-Built Documents as specified elsewhere in this section. Make note of any deviations from vendor's directions
 - d. Measure incoming voltages at the dimmer rack and record

- e. Configure Dimmer rack, console, stations and other components for proper operation.
- f. Test each wired space of Dimmer Rack for proper operation
- g. Test all control stations, consoles and auxiliary controls for proper operation.
- h. Replace any equipment not operating as specified.
- i. Test all load circuits for proper dimming operation, from 0 to 100% with a minimum 500-watt load.

D. Training

- 1. A knowledgeable representative of the vendor shall instruct the Owner's staff or representatives in the operation and maintenance of the system. This instruction session shall be scheduled to last a minimum of eight (8) hours. These training session shall be broken into two (2) individual training sessions. While it may be possible to schedule this instruction session to coincide with the system checkout, such coincidence shall not be assumed.

END OF SECTION 265561

SECTION 270610 – VOICE/DATA COMMUNICATIONS SYSTEM

PART 1 - GENERAL SPECIFICATIONS

1.1 RELATED DOCUMENTS

- A. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- B. The use of proprietary or copyrighted names or reference to patented trade items within this specification or elsewhere in the Contract Documents is meant to establish a standard of quality and performance. In no way does such use establish a restrictive competitive bidding situation, or exclude materials or equipment that is truly equivalent to the standard of quality. All materials and equipment proposed for installation must meet or exceed all specified requirements and be approved. Known equals are listed, but will require cut sheets with performance parameters to be submitted for final approval at least 10 days prior to bid.

1.2 SUMMARY

- A. Section Includes:
 - 1. Work Area Outlets
 - 2. 110 Copper Termination Block & Patch Panels
 - 3. Racks, Cabinets and Cable Management
 - 4. Horizontal Distribution Cable
 - 5. Backbone & DAS Cabling Cable
 - 6. Fiber Optic Termination Hardware
 - 7. Fiber Jumpers
 - 8. Pathways & Penetrations
 - 9. Audio Visual Infrastructure
 - 10. Power (UPS and PDU)
 - 11. Grounding and Bonding
 - 12. Copper Cable Protection Units
 - 13. Firestopping
 - 14. Cable System Identification System

1.3 SCOPE OF WORK

- A. The intent of this specification section is to cover the materials and installation of a structured cabling system and termination equipment as outlined herein and as detailed on the drawings. Work shall consist of
 - 1. Work area outlets including faceplates, jacks (voice, data, CATV, A/V), and labels. Boxes and conduit are being provided by Div 26 contractor.
 - 2. Voice and data copper station cabling from work area outlets to telecommunications rooms including termination testing and labeling.
 - 3. Voice and data work area equipment cords.
 - 4. Voice and data horizontal cross-connect jumpers and patch cables including labeling.
- B. System Description -- Voice and Data station cabling (copper) system shall consist of:
 - 1. Workstation outlet jacks.

2. Voice and data station cabling as specified herein from each workstation outlet to the termination equipment located in the Main Distribution Frame (MDF) or the Intermediate Distribution Frame (IDF).
3. Station Cable Termination Equipment in each MDF and IDF.
4. Final connections of the station cabling at the workstation outlet jack and the termination equipment in each MDF and IDF.
5. Cross connects / patch cable to connect work area outlets to backbone / network electronics.
6. Testing and labeling.

1.4 REGULATORY REFERENCES:

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the local Electrical Code and present manufacturing standards.
- B. All materials shall be UL or ETL Listed and shall be marked as such. If UL/ETL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL/ETL has an applicable system listing and label, the entire system shall be so labeled.
- C. All modular jacks, patch cords, consolidation point, and patch cords performance shall be verified (not just tested) by a third party to be category 6A component and channel compliant.
- D. The cabling system described in this is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
 1. ANSI/TIA-568.0-D, Generic Communications Cabling for Customer Premises, September 2015
 2. ANSI/TIA-568.1-D, Commercial Building Communications Cabling Standard Part 1: General Requirements, September 2015
 3. ANSI/TIA-568.2-D, Balanced Twisted-Pair Communications Cabling and Components Standard, September 2018
 4. ANSI/TIA-568.1-D, Optical Fiber Cabling Components Standards, October 2016
 5. ANSI/TIA-569-D, Telecommunications Pathways and Spaces, November 2015
 6. ANSI/TIA-606-C, Administration Standard for Communications Infrastructure of Commercial Buildings, June 2017
 7. ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) Requirements for Customer Premises, November, 2015
 8. TIA-758-B, Customer-Owned Outside Plant Communications Cabling Standard, March 2012.
 9. ANSI/TIA-1179-A, Healthcare Facilities Telecommunications Infrastructure Standard, October, 2017
 10. BICSI - TDMM, Building Industries Consulting Services International, Communications Distribution Methods Manual (TDMM) – 13th Edition.
 11. National Fire Protection Agency (NFPA – 70)
 12. FCC 47 CFR 68
 13. NEMA 250
 14. NEC 2017
 15. ADA, Americans with Disabilities Act
- E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

1.5 APPROVED VENDORS

- A. The Installation Vendors (Contractors) must at a minimum possess the following qualifications:
1. Be in business a minimum of five (5) years
 2. Shall demonstrate satisfaction of sound financial condition and shall be adequately bonded and insured per owner's requirements.
 3. Possess those licenses/permits required to perform communications installations in the specified jurisdiction
 4. Personnel knowledgeable in local, state, province and national codes and regulations. All work shall comply with the latest revision of the codes and regulations. When conflict exists between local and national codes or regulations, the most stringent codes or regulations shall be followed.
 5. Must possess and provide proof of current owners insurance certificates
 6. Installers with RCDD on staff are preferred, at least one BICSI certified technician required.
 7. Must have prior experience with this type of installation or work activity. The customer may, with full cooperation of the contractor, visit client installations to observe equipment operations and consult with references. Specified visits and discussion shall be arranged through the contractors; however, the contractor's personnel shall not be present during discussions with references. The contractor must provide a minimum of three (3) references of similar jobs, one within the past 6 months and one at least 3 years ago where the same solution was installed.
 8. Documentation of ALL certifications to be provided in bid package
 9. Outside Plant Projects – will be done by pre approved vendor according to demographic and size of project

1.6 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
1. Furnish and install a complete telecommunications wiring infrastructure.
 2. Furnish, install, and terminate all UTP and Optical Fiber cable
 3. Furnish and install all wall plates, jacks, patch panels, and patch cords.
 4. Furnish and install all required cabinets and/or racks as required and as indicated.
 5. Furnish any other material required to form a complete system.
 6. Furnish and install j-hooks where needed for the horizontal distribution
 7. Furnish and install all materials to build out the MDFs/IDFs as depicted on drawings
 8. Telecommunications contractor is responsible for the basket tray in MDFs/IDFs. The basket tray for the horizontal distribution may be done by or in coordination with the electrical contractor
 9. Perform link testing (100% of horizontal and/or backbone links/channels) and certification of all components.
 10. Furnish test results of all cabling to the owner electronically, listed by each closet, then by workstation ID.
 11. Adhere and comply with all requirements of Manufacturer Certification.
 12. Provide owner training and documentation. (Testing documentation and As-built drawings)

1.7 SUBMITTALS

- A. Under the provisions of this request for proposal, prior to the start of work the telecommunications contractor shall:
1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
 2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.
 3. No substitutions/alternatives from the manufacturers listed in this document will be permitted. No substituted materials shall be installed except by written approval.
 4. Product Data: For each type of product indicated.
 - a. Submittals shall include manufacturer's data sheets (cut sheets) and be accompanied by a detailed bill of material, including part numbers and quantities.
 5. Shop Drawings:
 - a. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - b. Wiring diagrams to show typical wiring schematics including the following:
 - 1) Cross-connects.
 - 2) Patch panels.
 - 3) Patch cords.
 - c. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - d. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1) Vertical and horizontal offsets and transitions.
 - 2) Clearances for access above and to side of cable trays.
 - 3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - 4) Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 6. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
 7. Source quality-control reports.
 8. Field quality-control reports.
 9. Maintenance Data: For connectors to include in maintenance manuals.
- B. Work shall not proceed without the Owner's approval of the submitted items.

1.8 QUALITY ASSURANCE

- A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not. All installers must be employees of the contractor.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Cable shall be stored according to manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from theft, vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.
- B. If the telecommunications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

1.10 DRAWINGS

- A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the telecommunications contractor in bidding the job. The telecommunications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.
- B. The contractor shall verify all dimensions at the site and be responsible for their accuracy.
- C. Prior to submitting the bid, the telecommunications contractor shall call the attention of the Engineer to any materials or apparatus the telecommunications contractor believes to be inadequate and to any necessary items of work

1.11 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, Engineer, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of racks, sleeves, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of utility demarcation, telephone and LAN equipment.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 EQUIVALENT PRODUCTS

- A. Due to the nature and type of communications all products and solutions in this document have a standard of quality listed. Substitutions are listed, but products MUST demonstrate performance equivalency.

2.2 WORK AREA OUTLETS

- A. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a faceplate.
- B. The Telecommunications Outlet Assembly shall accommodate:
 - 1. A minimum of two (2) modular jacks unless specified. Additional copper cables as necessary.
 - 2. A blank filler will be installed when extra ports are not used.
 - 3. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
 - 4. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet. Printed labels shall be permanent and compliant with ANSI/TIA-606-C standard specifications. Hand printed labels shall not be accepted.
- C. Faceplates: Standard of quality is Legrand Part # OR-403STJ14 (4 port) or OR-403STJ12 (2 port)
The faceplates shall:
 - 1. Be of the style as appropriate to fit the modular jack used
 - 2. Have mounting screws located under recessed designation windows.
 - 3. Comply with ANSI/TIA 606-C work area labeling standard.
 - 4. Workstation Outlets: Connector assemblies mounted in faceplate. Provide number of ports as shown on the Drawings.
 - 5. Stainless Steel Faceplate.

6. For use with snap-in jacks accommodating any combination of UTP, F/UTP, optical fiber, and coaxial work area cords.
7. Acceptable substitutions are Systimax and Panduit

D. Voice / Data Jacks: Standard of quality is Legrand

1. Jacks: 100-ohm, unshielded balanced, twisted-pair connector; four-pair, eight-position modular. Comply with ANSI/TIA-568.2-D up to 500 MHz.
2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance. Modular jack performance shall be third-party verified by a nationally recognized independent testing laboratory.
3. The modular jack shall be backwards compatible to Category 3, 5e and 6.
4. The modular jack shall be center tuned to category 6A test specifications.
5. Cat 6A jacks to be used for Wireless Access Points for speeds in excess of 1 Gigabit transmission
6. Acceptable substitutions are Systimax and Panduit

Part Number	Description
OR-HDJ6A-36	Legrand Category 6A T568A/B High Density (HD) Jack Blue (Data)
OR-HDJ6A-44	Legrand Category 6A T568A/B High Density (HD) Jack Yellow (Voice)
OR-HDJ6A-43	Legrand Category 6A T568A/B High Density (HD) Jack Orange (Wireless Access Points)
OR-HDJ6A- xx	xx - Refer to systems plans for breakdown of systems by color.

2.3 110 COPPER TERMINATION BLOCK

- A. The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips.
- B. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire.
- C. Backbone and horizontal blocks shall use 4-pair connecting blocks. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.
- D. Standard of quality: Legrand
- E. 110 Block Kits shall:
 1. Include both the wiring block in a 50, 100, 300 pair footprint and the connecting block C6110C5
 2. be manufactured using fire retardant molded plastic.
 3. support termination of 22-24 AWG solid conductor
 4. wiring block shall contain back openings for the feed through of cable
 5. have color-coded tips on the wiring block and color coding on the connector blocks for installation identification.
 6. shall use standard termination practice requiring a single conductor 110 impact tool
 7. have termination hardware that maintains the paired construction of the cable to facilitate minimum untwisting of the wires.
 8. be backwards compatible to category 3, 5 and 5e

- F. 110 Cross-Connect System Backboard Channels Shall
 - 1. be available in 300 and 900 pair sizes.
 - 2. allow the mounting of 110 100-pair blocks without legs.
 - 3. include bottom trough and grounding bar.
 - 4. be wall mountable.
 - 5. be of cold roll steel construction.
- G. 110 Wall Mount Vertical Trough Shall
 - 1. be available in single channel or dual channel configurations.
 - 2. in dual channel configuration shall be used to provide separation for different wiring media.
 - 3. be available in 300 pair and 900 pair sizes.
 - 4. be wall mountable.
 - 5. be used with wall mountable backboard channels. Acceptable configurations include a 300 pair and a 900 pair.
 - 6. be of cold roll steel construction.

Note: Project may require horizontal analog and backbone cables to be terminated on patch panels in IDF/MDF's. Contact Telecom Representative for details.

2.4 MODULAR PATCH PANELS

- A. The Modular Patch Panels shall
 - 1. meet category 6A component compliance and be verified by a third-party nationally recognized independent testing laboratory
 - 2. be backward compatible to category 3, 5 and 5e
 - 3. be center tuned to category 6A test specifications
 - 4. An unloaded patch panel with Legrand High Density Category 6A jacks is preferred.
 - 5. Standard of Quality is Legrand

Part Number	Description
OR-PSAHJU48	48 Port unloaded 2RU Angled Panel (for HD Jacks)

- 6. Acceptable Substitutions are Systimax and Panduit

2.5 RACKS, CABINETS, AND CABLE MANAGEMENT

The equipment rack shall provide vertical cable management and support for the patch cords at the front and back of the rack. Waterfall cable management shall be provided at the top of the rack to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack.

- A. Free-Standing Rack shall:
 - 1. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA 568.2-D.
 - 2. have ANSI/TIA hole pattern on front and rear.
 - 3. Provide channels with 10" depth for routing of horizontal cable
 - 4. provide pre-drilled base for floor attachment of rack.
 - 5. be available in standard color of black or white.
 - 6. Standard of quality for 2 and 4 post racks shall be Legrand Mighty Mo 20.

Part Number	Description
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OR-MM20710-B	Black 2 Post Rack, 7' high with 10" channel depth
OR-MM20742ADJ12-B	Adjustable 4 Post MM Rack, 7' high with tapped mounting holes
OR- MM20742ADJ38-B	Adjustable 4 Post MM Rack, 7' high with square mounting holes

7. Acceptable substitutions are Middle Atlantic and Tripp Lite

B. The vertical and horizontal cable management shall be utilized and installed with the 2 and 4 post racks.

1. They shall include snap on covers/doors that can swing either direction.
2. Standard of quality for cable management shall be Legrand MM20 for vertical and SHMC series for horizontal.

Part Number	Description
OR-MM20VMD706-B	Single Sided 6" Vertical Cable Management with door, 6" W x 10.25" D x 7' H (for end of row or single racks)
OR- MM20VMD710-B	Single Sided Vertical Cable Management with door, 10.5" W x 15" D x 7' H (for between racks)
OR-SHMC2RU	2U Horizontal cable manager to be used between patch panels and/or switch gear
OR-SHMC4RU	4U Horizontal cable manager to be used to pass patch cords from one side of the rack to the other

3. Acceptable substitutions are Middle Atlantic and Tripp Lite

C. Wall Mounted Cabinet shall:

1. provide the necessary strain relief, bend radius and cable routing for proper installation of high performance cross connect products, meeting all specifications of ANSI/TIA 568.2-D.
2. have wall mount braces with locator posts for easy wall mounting.
3. have side access points that allow for access to manage/install distribution cables in the vertical channels.
4. be lockable.
5. contain integrated vertical cable management
6. The standard of quality for wall mount cabinet shall be Legrand:

Part Number	Description
SWM12RUPL-26-26	26"W x 25"H x 28"D, plexi-glass door 12 RU; 200 lbs*
SWM26RUPL-26-26	26"W x 28"D x 49.5"H, plexi-glass door 26 RU; 300 lbs*

*weight capacity

7. Acceptable substitutions are Middle Atlantic and Tripp Lite

D. Free-Standing Cabinet shall have full flat mesh front door with locking swing handles

1. Standard of quality is Legrand

Part Number	Description
OR-QC422442	Legrand Server Cabinet, free-standing, 42U, 24" W, 42"D, with side panels (cabinet accessories to be specified)
OR-QC422942	Legrand Network Cabinet, free-standing, 42 RU, 29.5" W, 42" D with side panels (cabinet accessories to be specified).

2. Acceptable substitutions are Middle Atlantic and Tripp Lite

2.6 HORIZONTAL DISTRIBUTION CABLE

- A. All horizontal data station cable and voice cable shall terminate on modular patch panels (copper), or patch/splice cabinets (fiber) in their respective MDF or IDF as specified on the drawings.
- B. Copper or fiber cable that offers EPDs (Environmental Product Declaration) and / or HPDs (Health Product Declaration) to apply toward LEED certification are PREFERRED.
- C.
 - 1. Products covered by EPDs and HPDs contribute towards one (1) point each in the Material and Resources credit (MRc) category for projects pursuing those credits
 - 2. Products that have both EPDs and HPDs will effectively contribute towards two (2) separate credits in the MR category
- D. 100 OHM Category 6A UTP with fire-resistant thermoplastic jacket with separator or divider between pairs and isolation wrap.
 - 1. Physical Characteristics:
 - a. Plenum
 - 1) Insulation FEP
 - 2) Jacket: FR, low smoke PVC
 - 3) Nominal Velocity of Propagation: 73
 - b. Non Plenum
 - 1) Insulation: Polyolefin
 - 2) Jacket: FR PVC
 - 3) Nominal Velocity of Propagation: 70
 - c. Solid annealed copper conductors
 - d. 23 AWG copper conductors
 - e. Low-dielectric thermoplastic insulation
 - f. Pair-separator for improved performance
 - g. Characteristic Impedance: 100 ± 15 Ohms
 - h. Comply with UL 444
 - i. Comply with NFPA 262
 - j. Comply with ICEA S-90-661 for mechanical properties.
 - k. Comply with ANSI/TIA-568-C.2 for Category 6A UTP cables.
 - l. Verified for Category 6A performance by an NRTL
 - m. RoHS compliant materials
 - 2. Performance Characteristics:
 - a. Guaranteed electrical performance up to 400 MHz
 - b. Guaranteed 3 dB margin over ANSI/TIA-568.2-D requirements for NEXT and PSNEXT
 - c. Guaranteed 4 dB margin over ANSI/TIA-568.2-D calculated requirements for ACR and PSACR
 - d. Printed with unique alpha-numeric code for each package of product
 - e. Printed in both feet and meters with the units of length decrementing to indicate the amount of cable remaining in the box.
 - f. Tip colors shall be a lighter version of the ring color.
 - g. 4 pair UTP for Wireless Access Points for speeds in excess of 1 Gigabit transmission (A/C): Cat 6A with isolation wrap (no ground required) or actual shield (needs grounding).
 - 3. Design Make:

- a. Standard of quality is Superior Essex 10GainXP Cat 6A UTP.

Plenum Part Number	Description
6H-272-2B	Data / Blue / CMP
6H-272-6B	Voice / Yellow CMP

Non-Plenum Part Number	Description
6H-272-2A	Data / Blue / CMR
6H-272-6A	Voice / Yellow CMR

Plenum Part Number	Description
6H-272-DB	Wireless / Orange / CMP

Non-Plenum Part Number	Description
6H-272-DA	Wireless / Orange / CMR

- b. Acceptable Substitutions are Panduit or General (w/ Isolation Wrap) and Systimax (shielded)

2.7 BACKBONE CABLE

A. Intrabuilding multipair unshielded twisted pair

- General purpose 25 pair plenum Cat 5e (Superior Essex cmp part #51-478-48)
- For higher pair counts when Cat 3 is acceptable; 100 pair category 3 plenum unshielded twisted pair (Superior Essex Category 3 cmp part number 18-799-36) may be used.

B. Fiber Optic Cables

- Fiber cable that offers EPDs (Environmental Product Declaration) and / or HPDs (Health Product Declaration) to apply toward LEED certification are PREFERRED.
- Products covered by EPDs and HPDs contribute towards one (1) point each in the Material and Resources credit (MRc) category for projects pursuing those credits
- Products that have both EPDs and HPDs will effectively contribute towards two (2) separate credits in the MR category
- Multimode: Armored Optical Fiber Plenum (OFCP) Tight Buffered With 10 Gigabit OM3 Laser Optimized 50/125 Optical Fibers
 - Each Multimode Fiber shall be:
 - Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
 - The fiber shall comply with the latest revision of ANSI/TIA-492AAAC.
 - Attenuation shall be measured in accordance with ANSI/TIA-455-78.
 - Information transmission capacity shall be measured in accordance with ANSI/TIA-455-204 or -455-220.
 - The measurements shall be performed at 23°C ± 5°C.
 - Maximum attenuation dB/km @ 850/1300 nm: 3.5/1.5
 - Bandwidth: 1500 MHz-km @ 850nm for overfilled launch,
 - Bandwidth 500 MHz-km @ 1300nm.

- 9) Optical Fiber shall be laser optimized and guaranteed for 40/100 Gigabit Ethernet distances of 100 meters
- 10) Optical Fiber shall be laser optimized and guaranteed for 10 Gigabit Ethernet distances of 300m/300m for 850nm and 1300nm respectively
- 11) Optical Fiber shall be laser optimized and guarantee Gigabit Ethernet distances of 1000m/600m for 850nm and 1300nm respectively

b. Physical Characteristics:

- 1) Shall be suitable for use in indoor applications.
- 2) Shall be suitable for use in risers, plenums and horizontal applications.
- 3) Shall be available with a fiber strand count range from 6 to 144.
- 4) Shall meet NFPA 626
- 5) Shall comply with Telcordia GR-409.
- 6) Shall comply with the requirements of ICEA S-83-596.
- 7) Buffered fibers shall be color coded in accordance with TIA-598 with an overall aqua jacket.
- 8) Shall have a central strength member
- 9) Suitable for operation between -20°C to +75°C
- 10) Shall meet UL 1569, UL 1651
- 11) Shall be RoHS compliant
- 12) Shall have spiral wrapped aluminum armor and outer jacket

c. Design Make:

- 1) Standard of quality for Premise Distribution optical fiber cable with OM3 laser optimized 50/125 micron multi mode fiber is Superior Essex, part numbers below

Part Number	Description
L4012N401	12 strand armored laser optimized 50 micron multi mode
L4024NK1Q	24 strand armored laser optimized 50 micron multi mode
L4048N401	48 strand armored laser optimized 50 micron multi mode

- 2) Acceptable Substitutions are Systimax and Corning

5. Single Mode: Armored Optical Fiber Plenum (OFCP) Tight Buffered With Enhanced (Low Water Peak) Single-mode Optical Fibers

a. Each Single-mode Fiber shall be:

- 1) Class IVa dispersion - unshifted single mode optical fibers with Low Water Peak complying with ANSI/ TIA-492CAAB-2000.
- 2) The nominal mode field diameter shall be 9.1 μm with a tolerance of $\pm 0.4 \mu\text{m}$ at 1310 nm when measured in accordance with ANSI/TIA-455-191-B.
- 3) Transmission Characteristics:
- 4) Maximum cabled attenuation dB/km @ 1310/1550 nm: 0.7/0.7
- 5) The cabled cutoff wavelength shall be ≤ 1260 nm when measured in accordance with ANSI/TIA-455-80-C
- 6) Distance vs. bandwidth using a Laser transmitter operating at a 1310 nm wavelength

b. Physical Characteristics:

- 1) Shall be suitable for use in indoor applications.
- 2) Shall be suitable for use in risers, plenums and horizontal applications.
- 3) Shall be available with a fiber strand count range from 6 to 144.
- 4) Shall comply with Telcordia GR-409.
- 5) Shall comply with the requirements of ICEA S-83-596.

- 6) Buffered fibers shall be color coded in accordance with TIA-598 with an overall yellow jacket.
- 7) Shall have a central strength member
- 8) Suitable for operation between -20°C to +75°C
- 9) Shall meet UL 1569, UL 1651
- 10) Shall have spiral wrapped aluminum armor and outer jacket

c. Design Make:

- 1) Standard of quality for Armored Plenum Single Mode Low Water Peak is Superior Essex

Superior Essex Part Numbers

Part Number	Description
L4012K401	12 strand, Single-Mode armored plenum optical fiber
L4024KK1Q	24 strand, Single-Mode armored plenum optical fiber

- 2) Acceptable Substitutions are Corning and Systemax

C. DAS (Distributed Antenna System)

1. Regardless of which DAS active equipment is to be installed, (Andrews, Mobile Access, Tyco Electronics, etc) standard of quality for 6A or Helix Copper DAS cabling & connectors as well as fiber shall be Superior Essex/Legrand.
2. DAS Integrator will be required to work with certified cabling contractor for pulling of and termination of all DAS copper and fiber cabling infrastructure.

a. RF Feeder Infrastructure

1) Cable

- a) LHF Series – Low Loss High Flexible Foam Dielectric
- b) HFSC Series – Super Flexible Foam Dielectric
- c) FTTA – Fiber to the Antenna

2) Jumpers

- a) Available in 3/8 inch and 1/2 inch diameters, jumper cables are used in areas that require extremely small bending radius, such as between main feeders and antennas or between main feeders and RF equipment

3) Connectors

- a) DIN Series for LHF and HFSC
- b) N Series for LHF and HFSC

b. In Building Infrastructure

1) Cable – Available in Plenum or Riser

- a) DAS Hybrid – Fiber + Copper
- b) LHF Riser – Low Loss High Flexible Foam Dielectric
- c) LHF Plenum – Low Loss High Flexible Air Dielectric
- d) HFSC Riser – Super Flexible Foam Dielectric
- e) HFSC Plenum – Super Flexible Air Dielectric

2) Jumpers Available in Plenum or Riser

- a) Available in 1/2 inch diameters, jumper cables are used in areas that require an extremely small bending radius between main feeders and antennas or between main feeders and RF equipment.

3) Connectors

- a) DIN Series for LHF and HFSC

b) N Series for LHF and HFSC

2.8 FIBER OPTIC TERMINATION HARDWARE

A. FIBER OPTIC ENCLOSURES

1. Fiber optic termination hardware is rack mountable and holds various coupler panels based on density requirements.
2. Fusion Splicing (splice cassettes, pigtails, or splice on connectors) shall be the preferred termination style for any new installations, unless otherwise stated.
3. Internal lighting for ease of use
4. Pivot arms for fiber slack management
5. Standard of quality is Legrand
6. Acceptable Substitutions are Systimax and Corning
7. Fiber Enclosures

Part Number	Description
OR-INFC01U-M4	1U combo splice/patch enclosure, holds 4 adapter panels,
OR-INFC02U-M4	2U combo splice/patch enclosure, holds 8 adapter panels,
OR-INFC04U-M4	4U combo splice/patch enclosure, holds 16 adapter panels,

B. SPLICE CASSETTES (used instead of fiber optic adaptor panels)

Part Number	Description
OR-M4LCD12-50ES2A1	Fusion Splice Cassette 50um Multimode, LC Duplex, 12 fiber
OR-M4LCD12-09S1A1	12 Fiber Singlemode Splice Cassette, LC Duplex

- a. Fan Out Kits (if needed to build up 250um fiber before termination)

Part Number	Description
OR-61500858	Breakout Kit 12 fiber

C. FIBER OPTIC ADAPTER PANELS (used w/ pigtail or splice on connector terminations)

Legrand Adapter panels will be of 6 duplex LC connectors (12 fibers) for both multimode and single mode connections.

Part Number	Description
OR-HDFP-LCD12LC	6-LC Duplex multimode, aqua adapters, ceramic sleeve
OR-HDFP-LCD12AC	6-LC Duplex Single mode, blue adapters, ceramic sleeve
OR-HDFP-BLANK	Blank Filler modules

D. FIBER OPTIC PIGTAILS / CONNECTORS

1. For fiber splicing, utilize Legrand 12 strand LC fiber pigtails or fusion splice on connectors. Legrand part numbers:
 - a. Single Mode OR-P1TC4ZRSZZZ001M
 - b. Multi Mode OR-P1TF4ZRGZZZ001M
 - c. Single mode fusion splice on connector, OR-205KNF9SA-09
 - d. Multi Mode fusion splice on connector, OR-205KNF9FA-50T

2. When mechanical terminations are acceptable for MAC work, Utilize Legrand LC single mode (OR-205KNT9SA-09) and Legrand LC multimode (OR-205KNT9GA-50T) Infinium Connectors for standard terminations.

Part Number	Description
OR-P1TC4ZRSZZZ001M	12 strand Single mode LC fusion splice pigtail
OR-P1TF4ZRGZZZ001M	12 strand Multimode LC fusion splice pigtail
OR-205KNF9SA-09	Single mode fusion splice on connector,
OR-205KNF9FA-50T	Multi Mode fusion splice on connector
OR-205KNT9SA-09	LC Single mode Infinium mechanical connectors
OR-205KNT9GA-50T	LC Multimode Infinium mechanical connectors

3. Acceptable Substitutions are Systimax and Corning

2.9 PATCH CORDS & FIBER JUMPERS

- A. The contractor shall provide factory terminated and tested optical fiber patch cords for the complete cabling system.

- B. Copper (UTP) patch cords shall:

- Standard of quality is Legrand Cat 6A; OR-MC6A-zz-xx (zz=length; xx = color)
- Standard lengths include, 3 ft, 5 ft, 7 ft, 9 ft, 10 ft, 15 ft.
- use 8 position connector with impedance matched contacts and designed using dual reactance.
- be constructed of 100 ohm, 4 pair, 24 AWG, stranded conductor, unshielded twisted pair copper per the requirements of the ANSI/TIA 568.2-D.
- meet TIA category 6A component specifications in ANSI/TIA 568.2-D
- 100% factory tested to meet category 6A performance and
- ETL or any other nationally recognized 3rd party verification
- be capable of universal T568A or T568B wiring schemes.
- Modular connector shall maintain the paired construction of the cable to facilitate minimum untwisting of the wires.
- have "snagless" protection for the locking tab to prevent snagging and to protect locking tab in tight locations and provide bend relief
- be backwards compatible to Category 3, 5e and 6
- be manufactured by an ISO 9001 registered company.
- Provide one 10 foot Cat6A patch cord for every switch port.
- Provide one 7 foot Cat6A patch cord for every workstation phone and computer
- Provide one 3 foot Cat6A patch cord for every wireless access point.
- The contractor shall include the labor cost in the quote to install all patch cords in the wiring closets as well as the workstation.
- Acceptable substitutions are Quiktron, Systimax and Panduit

- C. Fiber jumper cords shall:

- Standard of quality for Multimode duplex 5 meter 50 um 10 gig aqua for multimode applications is Legrand LC to LC (OR-P1DF2LRGZGZ005M).
- Provide four (4) duplex LC-LC 5 meter jumpers per switch in each TR.
- Standard of quality for Single Mode duplex 5 meter for single mode applications is Legrand LC to LC (OR-P1DC2IRSZSZ005M).
- Provide two (2) duplex LC-LC 5 meter jumpers per rack in each TR.
- Acceptable substitutions are Quiktron, Systimax and Corning

2.10 PATHWAYS & PENETRATIONS

A. Conduit

1. All conduit work shall meet the requirements of the National Electrical Code.
2. All voice, data and video wiring inside rooms shall be protected by metallic conduit or other means such as Legrand/Wiremold or troughs in the floor. Aluminum is not acceptable in caustic environments. EMT conduit shall be used for all interior wiring. All conduits are to be concealed.
3. No more than an equivalent of two 90-degree bends are allowed in a run between junction boxes or pull boxes.
4. Entrance to junction boxes or distribution panels shall be adjacent to the corners.
5. In major renovation and new construction projects where the MDF/IDF are not in alignment, the contract shall include provisions for installation of four riser conduits (4 inches minimum diameter) from the MDF to each IDF. A pull string and appropriate junction pull box shall also be provided in each conduit run to facilitate future installation of cable(s). Maxcell fabric innerduct should be used to create multiple pathways in each 4" conduit.
6. All conduits in slab shall be a minimum of 1 inch. All exceptions shall be determined during the design stage of the project and shall be subject to the approval of the engineer.
7. All sleeves must protrude 4 inches AFF and below and be capped at both ends. Coordinate with customer for the number of conduits entering the facility. All sleeves must be bonded to the telecommunications bonding system.
8. No horizontal conduit run shall be more than 100 feet between pull boxes.
9. Pull boxes must be installed every 180 degrees or 100 feet of the conduit run. All conduit stubs must be bonded to the telecommunications grounding system.

B. Conduit/Raceway Capacity

1. Conduit shall be sized using industry standard guidelines for telecommunications distribution methods. Guidelines can be found in the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual and/or cabling manufacturers' guidelines. Utilize Maxcell fabric innerduct to maximize conduit fills

Part Number / Series	Description
MXC4003 series	Standard 4" 3 Cell fabric innerduct
MXP4003 series	Plenum 4" 3 Cell fabric innerduct
MXR4003 series	Riser 4" 3 Cell fabric innerduct
MXD4003 series	Detectable 4" 3 Cell fabric innerduct
MXC3456 series	Standard 3" 3 Cell fabric innerduct
MXP3456 series	Plenum 3" 3 Cell fabric innerduct
MXR3456 series	Riser 3" 3 Cell fabric innerduct
MXD3456 series	Detectable 3" 3 Cell fabric innerduct

C. Cable Trays

1. Standard of quality for basket tray is **Cablofil**.
2. All cable trays shall be designed to accommodate all types of cabling. Note that installation shall be in non-return air plenum space only. All telecommunications pathways (Caddy J-hooks, basket tray or Legrand/Wiremold raceways) shall be used for communications medium (voice, data and fiber optic cabling) only.
3. The minimum dimensions for a cable tray shall be 12 inches wide and 4 inches deep. The tray must consist of continuous, rigid, welded steel or stainless steel wire mesh cable management

system. The cable tray systems are defined to include, but are not limited to, straight sections, supports and accessories. Wire mesh cable tray will have continuous Safe-T-Edge T-welded top side wire to protect cable insulation and installers. Basket tray shall be spliced using EDNRs on the sides as well as an SWK washer/nut in the bottom of the tray.

4. Contract documents shall show cross section of the communication wire way or cable tray. The drawing must show reference to other utilities in the building. All sections of the cable tray must be bonded together with approved bonding methods and devices. For installation of other types of "approved" low voltage cables in the cable tray, a separate tray or at minimum a divider in the basket tray to prevent interference from unshielded cables is required.
 5. Supports for cable trays larger than 12 inches in width are to be installed according to the manufacturer specifications. A single support is not acceptable. All supports are to be fastened to the building structure above. If the cable tray will be of a wall mount type, it must be installed properly to provide proper permanent support at trays maximum capacity.
 6. Radius Drop outs shall be used whenever multiple cables are exiting the tray.
 7. **STI's EZ Path's (44, 33 or 22 series)** shall be used in conjunction with the tray whenever cabling is going through a fire rated wall.
 8. Cable trays must maintain a minimum of 6-inch clearance from obstructions above the tray and a minimum of 8 feet AFF. Trays are to provide access via the most direct path to all communications outlets on the floor.
 9. Install sweeping factory 90's for all turns. Use end-of tray terminations where wire drops down to walls to prevent abrasions and cuts from metal tray edges. Use a trapeze supported cable tray mounting method suspended by manufacturer recommended size all-thread. Fasten all-thread to ceiling anchors, allowing no bends in all-thread. Support the cable tray in this manner at every section-to-section junction and at 5 feet to 6 feet intervals (mid span) between joints. Whenever possible, the tray should be no closer than 6 inches from the structural ceiling, ducts or pipes, considering all other possible obstructions. A minimum of 5 inches distance from lighting, especially fluorescent lighting, is desired.
 10. Coordinate layout and installation of cable tray with other trades. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect. Basket tray installation in the TRs shall be installed as depicted on the drawings by the Telecommunications Contractor. The basket tray that is to be installed for the horizontal and backbone distribution will be provided and installed by the electrical contractor.
 11. Storage and Handling: Avoid breakage, denting and scoring finishes. Damaged products will not be installed. Store cable trays and accessories in original cartons and in clean dry space; protect from weather and construction traffic. Wet materials will be unpacked and dried before storage.
 12. Refer to the drawings for the size and location of the tray to be installed.
 13. Ground cable trays at end of continuous run. Ground continuous cable tray runs every 60 feet. Cable trays that are not UL Classified will be grounded per NEC requirements and manufacturer recommendations.
 14. Ground cable trays against fault current, noise, lightning, and electromagnetic interference by mounting grounding wire to each 10' cable tray section with grounding clamp.
- D. Open Top Cable Supports (J-hooks)
15. Standard of quality is Erico/**Caddy HP** series of j-hook

16. All open top cable supports (J-hooks) must be suspended from or attached to the structural ceiling or walls with hardware or other installation aids from Caddy specifically designed to support their weight. When used, Caddy J hooks shall be located on 48 to 60 inch centers to adequately support and distribute the cables weight. These types of supports may typically hold up to fifty 0.25-inch diameter cables.
17. No other cables shall be run in the same j-hooks along with the voice and data cables. A separate painted (white, red, blue, green) Caddy j-hook system must be provided to facilitate the installation of other low voltage cabling.
18. For larger quantities of cables that convene at the Telecommunications Closet, provide Cablofil cable trays or other special ERICO/CADDY supports that are specifically designed to support the required cable weight and volume.
19. No plastic j-hooks will be allowed.
20. Substituted material must demonstrate product equivalency.

E. Floor Mounted Assemblies (Floor Boxes and Poke Throughs)

1. All Floor Mounted Assemblies including floor boxes, poke through, floor outlets, floor mounted whips, tombstones, etc. shall be sized using industry standard guidelines for telecommunications distribution methods; specifically relating to cable fill ratios and limitations. Guidelines can be found in the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual and/or through individual cabling manufacturers' installation guidelines.
2. Standard of quality for all Poke-throughs and floor boxes is the Evolution series from Legrand/Wiremold.
3. Floor boxes Shall:
 - a. be used in concrete, raised floor and wood floor applications and are fully adjustable both pre and post concrete pour.
 - b. have removable dividers and a tunnel feature that allows all compartments to be connected.
 - c. have removable modules through the top or back of the floor box.
 - d. The floor box hinge must be able to open to a full 180° and lie flat on the floor surface providing easy access to interior modules. Cable egress doors lock in position when open and will automatically close around wires to protect cabling and avoid tripping hazards.
 - e. accept single, double or triple wall plates as well as accommodate power, communications and A/V devices.
 - f. be designed to maintain up to a 2 hour fire rating.
4. Poke throughs Shall
 - a. provide the interface between power, communication and audio/ visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power communication and/or A/V device outlets are required.
 - b. provide recessed device outlets that will not obstruct the floor area. The poke-thru device shall be compatible with the complete line of workstation connectivity outlets and modular inserts.
 - c. permit all wiring to be completed at floor level.
 - 1) The 6AT, and 6ATCFF units shall mount in a 6" [152mm] cored hole, actual 6 1/16" [154mm] core hole.
 - 2) The 8AT units shall mount in an 8" [203mm] cored hole, actual 8 1/16" [205mm] core hole. Use is defined by the UL Fire Resistance Directory as a minimum spacing of "2 ft. [610mm] on center and not more than one device per each 65 sq. ft. [6m2] of floor area in each span."

F. Wall Boxes (A/V, Power, Data behind flat screens)

1. Standard of quality for all wall boxes is the Evolution series from Legrand/Wiremold.
2. Wall Boxes Shall:
 - a. be used for TVs, Monitors, & Digital Signage for use in new construction and renovation construction projects.
 - b. be compatible with complete line of workstation connectivity outlets and modular inserts, and most audio/video manufacturers' products.
 - c. provide the interface between power, communication and audio/video (A/V) cabling new construction and renovation location where power and communication and/or A/V device outlets are required.
 - d. provide recessed device outlets that will not obstruct the wall area.
 - e. permit all wiring to be completed at box level

G. Conference/Collaboration/Training Room Solutions (Table Boxes; Cable Retractors, Under-table cable management)

1. Standard of quality is Wiremold/Legrand Integreat series
2. **Table Boxes / Table penetrations:**
 - a. Cover: Brushed, anodized aluminum cover in a black or aluminum finish with beveled edges and "soft-touch" handle.
 - 1) Cover contains a "pocket" door which fully recesses into the box when open, giving access to connections without obstructing work surface. A finishing plate hides hardware on activation surface and permits labeling of the AVIP plates.
 - 2) Cover flange allows for 1/4-inch [6.4mm] of forgiveness in the cut out opening.
 - b. Activation Surface: Adjustable downward in 1/2-inch [12.7mm] increments, from one (1) inch to four (4) inches [25mm to 102mm] to allow cover to close even when large style connectors are used.
 - c. Provide table boxes with a 12 foot SJT cord for easy connection to electrical infrastructure.
 - d. Supply tables boxes with a cable grommet kit that can accommodate up to eight (8) pull out connections. Boxes shall also be capable of accepting up to five (5) Wiremold AVIP connectors.
 - e. Provide table boxes with two (2) 15 amp receptacles in top compartment and one (1) 15 amp receptacle on underside of box.
3. **Cable Retractors:** InteGreat™ Series cable retractors; mounts directly to InteGreat™ Series A/V Table Box or underside of conference room table using a horizontal mounting bracket.
 - a. Cable Retractors with Category 6 Cable: Catalog No. TBCRCAT6; loaded with 12 feet [3.66m] of Cat6 cable that extends out five (5) feet [1.52m] from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.
 - b. Cable Retractors with VGA Cable: Catalog No. TBCRVGA; loaded with 12 feet [3.66m] of VGA cable that extends out five (5) feet [1.52m] from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.
 - c. Cable Retractors with HDMI Cable: Catalog No. TBCRHDMI; loaded with 12 feet [3.66m] of HDMI cable that extends out five (5) feet [1.52m] from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side. Provide input side with mounting tab that allows installer to cable tie HDMI to retractor to minimize chances of loose connections.
 - d. Cable Retractors with 3.5MM Audio Cable: Catalog No. TBCR3.5MM; loaded with 12 feet [3.66m] of audio cable that extends out five (5) feet [1.52m] from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.
 - e. Cable Retractor Horizontal Mounting Brackets: Catalog No. TBCRHMK; permits retractor to mount horizontally under conference room table, enabling cable access through a table

grommet. Multiple retractors can be mounted to each other by attaching the mounting brackets to each other.

4. **Under Table Cable Management Kit:** InteGreat™ Series under table cable management kit provides clean cable management for power, communication and A/V cables on horizontal underside of table.
 - a. Under Table Cable Management Kit: Catalog No. UTCM5; includes five (5) feet [1.524mm] length of divided base, five (5) feet [1.524mm] length of mounting hinge rail and four (4) latching clips; black, nonmetallic construction.
 - b. Transition Channels: InteGreat™ Series transition channels continue cable management and protection from underside of the table to the floor, where cables can gain access to building infrastructure. Channel fits directly into under table cable management kit on underside of table and mates with poke-thru device or over floor raceway for smooth transition to building infrastructure.
 - c. Transition Channels: Catalog No. MRTC; consists of aluminum center spline with steel mounting plate and four (4) screws, black aluminum side channels, black nonmetallic bottom boot and two (2) black nonmetallic transition covers.

Part Number / Series	Description
EFB Series	Evolution Floor Box
6AT Series	Evolution Poke Throughs 6"
8AT Series	Evolution Poke Throughs 8"
EFSB2 Series	Evolution 2 Gang Wall Box
EFSB4 Series	Evolution 4 Gang Wall Box
TB Series	Integreat A/V Table Box
TBCRCAT6	InteGreat Cable Retractor Cat 6
TBCRVGA	InteGreat Cable Retractor VGA
TBCRHDMI	InteGreat Cable Retractor HDMI
UTCM5	InteGreat Under Table Cable Mgmt.
MRTC	InteGreat Transition Channel

5. Substituted materials for floor boxes, poke throughs, wall boxes and conference room applications must be able to demonstrate product equivalency.

2.11 AUDIO/VISUAL INFRASTRUCTURE

For applications involving patient rooms, classrooms, conference rooms, collaborative work spaces, etc., that require HDMI, USB, Display Port, VGA, and other digital and/or analog A/V connections, the cabling infrastructure shall utilize Quiktron as the standard of quality. Substituted materials for all A/V applications must be able to demonstrate product equivalency.

A. HDMI-to-HDMI, HDMI-to-DVI, DVI-to-HDMI and DVI-to-DVI

1. Direct (native signal) connections (point-to-point) shall be HDMI High Speed Rated and designed and tested to handle video resolutions of 1920 x 1080p or greater, including advanced display technologies such as 4K, UltraHD, 3D, and Deep Color
2. Direct (native signal) connections (point-to-point) shall not exceed 20 meters in total combined length and may be CMP, CMR, CM, CL3 or CL2 rated as appropriate to the installation and applicable code
1. Connections less than 20 meters in total combined length shall be a certified copper cable or connectivity solution, except when:

- a. Direct (native signal) connections (point-to-point) that require a form factor different than that typically available in a quality copper assembly may leverage the selection of “media conversion” and other solutions offered for such situations, and will include as acceptable alternatives RapidRun™, RapidRun Optical™ HDMI-over-Coax, HDBaseT, HDMI-over-UTP.
 2. Connections greater than 20 meters in total combined length shall be certified connectivity solutions, as best serves the form factor needed, from the selection defined below:
 - a. RapidRun Optical™
 - b. HDMI-over-UTP, HDMI w/ serial RS232-over-UTP, HDMI w/ VGA-over-UTP, HDMI w/ VGA and Stereo Audio-over-UTP, HDMI w/ VGA, Audio, and Composite Video-over-UTP or HDMI-over-Coax
 3. In installations where it is determined that insufficient bus power (Vbus) exists for reliable performance, the Quiktron HDMI Power Inserter may be used
- B. Universal Serial Bus (USB)
1. USB connections (point-to-point) less than 5 meters total length shall be Quiktron USB 2.0 rated for all applications
 - a. Systems specifically requiring USB 3.0 or faster speed transfer ability (SuperSpeed or SuperSpeed Plus) may include Quiktron USB 3.0 cables, which may not exceed 3 meters total combined length
 2. USB connections (point-to-point) more than 5 meters in total length shall be Quiktron connectivity solutions, as best serves the form factor needed for installation, from the selection defined below:
 - a. USB connections greater than 5 meters but less than 12 meters in length shall be Quiktron USB Active Extender Cable solutions, or
 - b. USB connections greater than 5 meters but less than 100 meters in length shall be Quiktron USB 1.1 over Cat 5 SuperBooster or Quiktron USB 2.0 over Cat 5 SuperBooster solutions as required by the system design
 3. USB external hubs shall be Quiktron USB 3.0 SuperSpeed rated with dedicated power supply (powered hubs)
 - a. No more than four (4) tiers of USB connectivity shall be allowed without inclusion of a powered hub to restore full USB bus (V_{bus}) power for proper operation of downstream devices and links
- C. DisplayPort
1. DisplayPort cables shall be Quiktron DisplayPort rated 1.1 performance or greater, and
 2. DisplayPort point-to-point direct connections shall not be more than 10 meters in total combined length
 3. DisplayPort point-to-point direct connections greater than 10 meters in total combined length shall be transported via DisplayPort-to-HDMI conversion (dongle) and shall then use an HDMI connection solution approved for connections of HDMI signals beyond 20 meters as detailed above (see HDMI), or
 4. DisplayPort point-to-point direct connections greater than 10 meters in length shall be transported via RapidRun Optical
- D. D-sub 15, mini sub D15, mini D15, DB-15, HDB-15, HD-15 or HD15, hereafter collectively called VGA
1. VGA direct (native signal) connections (point-to-point) shall be designed and tested to support video resolutions of up to QXGA (2048x1536) and pass Extended Display Identification Data (EDID) signals
 2. VGA direct (native signal) connections (point-to-point) shall not exceed 50 meters in total combined length without appropriate signal conditioning and may be CMP, CMR, CM, CL3 or CL2 rated as appropriate to the installation and applicable code
 3. VGA direct (native signal) connections (point-to-point) shall be certified connectivity solutions, as best serves the form factor needed, from the selection defined below:

- a. RapidRun™
- b. RapidRun Optical™
- c. Select or Select w/audio
- d. Premium Shielded or Premium Shielded w/audio

2.12 POWER – UPS AND PDU OPTIONS

A. UPS (Uninterrupted Power Supply)

1. Standard of quality for Communications Rack Online UPS is Tripp Lite. Substituted material must be able to demonstrate product equality
2. Provide true online battery back-up, power conditioning UPS, rack mounted in each TR to serve network electronics as indicated on the drawings. UPS shall have the following features:
 - a. 5000/3000/2200/1500 VA capacity as indicated
 - b. Output operating range—280V (5000VA)/120V (<3000VA) nominal
 - c. Communications—Unit shall provide an Ethernet based SNMP management interface, through the LAN to provide remote diagnostics and alarm conditions.
 - d. Expandability—Unit shall provide for the connection of external battery packs in modules to extend the total unit run-time.
 - e. Complete battery independence- Battery independent restart ensures automatic UPS power-up without user interaction after lengthy power outages, even when batteries are completely drained/discharged.
 - f. Cord Length - 10'.
 - g. Transfer Time- zero transfer time to battery.
 - h. Battery Type- maintenance free sealed lead acid with electrolyte: leakproof.
 - i. LED Status- On battery/Replace Battery/and overload indicators.
 - j. Audible Alarms.
 - k. Filtering -full time multi- pole noise filtering
 - l. All UPS units shall be rack mountable with proper mounting hardware and support.
 - m. UPS External battery Packs for 2200 or 3000 VA Tripp Lite for systems that specify extended run time such as the phone system.
3. UPS Sizes
 - a. 1500 VA UPS (Tripp Lite part number SU1500RTXLCD2U) – Used in podiums, credenzas, conference rooms or classrooms
 - 1) Output Power Capacity- 1350W/ 1500VA.
 - 2) Nominal Output Voltage- 120V.
 - 3) Output Connections - (6) NEMA 5-15R
 - 4) Nominal Input Voltage- 120V.
 - 5) Input connections- NEMA 5-15P.
 - b. 2200 VA UPS (Tripp Lite part number SU2200RTXLCD2U). Used in podiums, credenzas, conference rooms, classrooms & IDFs
 - 1) Output Power Capacity - 1800 watts/2200VA.
 - 2) Nominal Output Voltage- 120V.
 - 3) Output Connections- (6) NEMA 5-15\20R and (1) NEMA L5-20R.
 - 4) Nominal Input Voltage- 120V.
 - 5) Input connections - NEMA 5-20P.
 - 6) Rack Mounted - 2U rack space.
 - 7) Backup time- 12 minutes at half load (925 watts) 4 minutes at full load (1800 watts.)
 - 8) Surge energy Rating – 570 joules.
 - c. 3000 VA UPS (Tripp Lite part number SU3000RTXLCD3U). Used in MDFs and IDFs
 - 1) Output Power Capacity- 2700 watts/3000VA.
 - 2) Nominal Output Voltage- 120V.
 - 3) Output Connections- (4) NEMA 5-15R and (4) NEMA 5-15\20R and (1) NEMA L5-30.

- 4) Nominal Input Voltage- 120V.
 - 5) Input connections- NEMA L30P.
 - 6) Rack Mounted - 2U rack space.
 - 7) Backup time- 11 minutes at half load (1350 watts) 4 minutes at full load (2700 watts.)
 - 8) LED Status- On battery/Replace Battery/and overload indicators.
 - 9) Surge energy Rating - 570 joules.
- d. 5000 VA UPS (Tripp Lite part number SU5000RT4U) – Used in MDFs
- 1) Output Power Capacity--3800 Watts/5000 VA
 - 2) Max Configurable Power--3800 Watts/ 5000 VA
 - 3) Nominal Output Voltage--120V, 208V
 - 4) Power factor equals 75% or greater
 - 5) Output Voltage Distortion--Less than 2%
 - 6) Output Frequency--(sync to mains) 50/60 Hz +/- 3 Hz user adjustable +/- 0.1
 - 7) Other Output Voltages--240
 - 8) Crest Factor--3 : 1
 - 9) Topology--Double Conversion Online
 - 10) Waveform Type--Sine wave
 - 11) Output Connections--(8) NEMA 5-15\20R, (2) NEMA L6-30R, (2) NEMA L6-20R
 - 12) Bypass--Internal Bypass (Automatic and Manual)
 - 13) Nominal Input Voltage--208V
 - 14) Input Frequency--50/60 Hz +/- 5 Hz (auto sensing)
 - 15) Input Connections--NEMA L14-30P
 - 16) Input voltage range for main operation--100 - 140VAC (L1-N:L2-N)
 - 17) Input voltage adjustable range for mains operation--85 - 136V
 - 18) Other Input Voltages--240
 - 19) Interface Port(s)--RJ-45 10/100 Base-T
 - 20) Control panel LED status display with load and battery bar-graphs and On Line : On Battery : Replace Battery : Overload and Bypass Indicators
 - 21) Alarm when on battery : distinctive low battery alarm : overload continuous tone alarm
 - 22) Emergency Power Off (EPO)
 - 23) Surge energy rating 365 Joules
 - 24) Filtering Full time multi-pole noise filtering : 0.3% IEEE surge let-through : zero clamping response time : meets UL 1449
- B. PDU Standard of quality is Tripp Lite part number PDUMV20NET SWITCHED/IP FEATURE SET REQUIRED. Substituted material must be able to demonstrate product equivalency.
1. Raceway and all components shall be UL listed. The base and cover shall be ivory in color, and shall be attached to the cable ladder of the rack system or wall field as per the drawings.
 2. Electrical outlet strip shall have (13) NEMA 5-15\20 outlets.
 3. Provide all attachment hardware required to securely attach the outlet strip to the back of the vertical cable ladder or wallfield. Refer to the detailed drawings for required locations.
 4. All power strips shall be equipped with surge protection.
 5. All power strips shall be come with adjustable mounting brackets for 2 or 4 post installation.
 6. Strips shall be 20A-120V with NEMA 5·20P on a 15 foot line cord.
 7. Install and test all outlets prior to project completion.
 8. Provide outlet strip with attached cord and 3-prong plug.
 9. All power strips will plug into UPS units unless otherwise specified.

2.13 COPPER CABLE PROTECTION UNITS

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the TC ground point.
- B. Standard of quality of protection units is Circa.
- C. The two most frequently used lightning protectors are listed below.
- D. Circa Protector -- “Circa”, part number 1900A1-100, and Circa 3B3S-300 “Red” modules -100 for 100 pair.
- E. Use Circa ,part number 1880ENA1/NSC-6 for single drops of 6-pair or less. Use Circa, part number 3B1E gas protector modules.

Part Number / Series	Description
1890BC1-25	25 Pair Protector
1890BC1-50	50 Pair Protector
1900A1-100K	100 Pair Protector
3B1E	Solid State Protector Module for 189B1
2626QC/QC	Protection Block (66 connection must add gas modules 3B1E (black) or 3B3E (red))
4B1E	Gas state Protector 5 Pin Black with Heat Coil
4B3S-75	Protector Module 5 Pin Red Solid state with Heat Coil
3B3S-300	Protector module 5 Pin Red Solid state w/o Heat coil
4B1S-300	Protector Module 5 Pin Black Solid state with Heat Coil
1880ENA1/NSC-6	6 Pair Protector

2.14 FIRESTOP

- A. Standard of quality is EZ Path Fire rated cable pathway devices shall be used in fire-rated construction for ALL low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:
 - 1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.
 - 2. Be tested for the surrounding construction and cable types involved.
 - 3. Have UL Systems permitting cable loads from; “Zero to 100% Visual Fill.” This requirement eliminates need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.
 - 4. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.
 - 5. Be “Zero-Maintenance”, zero-maintenance is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:

- a. Opening or closing of doors.
 - b. Spinning rings to open or close fabric liner.
 - c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
 - d. Furnish letter from manufacturer certifying compliance with this definition of “Zero-Maintenance”.
6. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
 7. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
 8. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.
 9. Cable pathway shall replace conduit sleeves in walls and floors, and;
 10. When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.
 11. When installed individually in floors, devices shall pass through core-drilled opening utilizing tested floor plates.
 12. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
 13. When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates or integrated flanges.
 14. When multiple units are ganged in walls, devices shall be anchored by means of a tested grid.
 15. Cable tray shall terminate at each barrier (wall) and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier (wall). Cable tray shall NOT pass through the barrier (wall).
 16. Substituted material must demonstrate product equivalency.
- B. As an alternate to using a fire-rated or non-rated cable pathway device for single low voltage cables (up to 0.27 in. (7 mm) O.D) penetrating one or two-hour, gypsum board/stud wall assemblies or non-rated assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated EZ Path individual cable grommet may be substituted. The product shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable. The grommet product shall be capable of locking into place to secure the cable penetration within the wall assembly. The grommet shall be UL Classified and tested to the requirements of ASTM E814 (UL1479) and CAN/ULC S115.
17. Acceptable Products from STI:

Part Number / Series	Description
EZD22	2" EZ Path Firestop Device
EZD33FWS	3" EZ Path Firestop Device
EZDP133CWK	3" EZ Path Firestop Device Kit (for 4" conduit)
EZDP33FWS	3" EZ Path Firestop Device Kit (square mount)
EZP433W	3" Ganging Accessory (Qty 4) for 3" EZ Paths
EZD44S	6" EZ Path Firestop Device
EZDP44S	6" EZ Path Firestop Device Kit (square or round mount)

EZP544W	Ganging Accessory (Qty1-5) for 6" EZ Paths
EZGxxxxx	Grid for riser applications
RFG2	Individual Cable EZ firestop grommet (10 pack)

2.15 GROUNDING AND BONDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607 Telecommunications Bonding and Grounding Standard.
- B. The main entrance facility/equipment room in each building shall be equipped with a PBB (Primary Bonding Busbar) formerly known as the telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a SBB (Secondary Bonding Busbar formerly known as the telecommunications ground bus bar (TGB). The PBB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective SBB or PBB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.
- E. Standard of quality for all grounding and bonding products shall be Legrand.
- F. Acceptable substitutions are Erico and Panduit

PART 3 - EXECUTION

3.1 WORK AREA OUTLETS

- A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where Caddy box-eliminators are used, excess wire can be stored in the wall. No more than 12" of UTP and 36" of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA 568-1.D document, manufacturer's recommendations and best industry practices.
- C. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
- D. Bend radius of the twisted-pair horizontal cable shall not be less than 4 times the outside diameter of the cable.

- E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.
- F. Data jacks, unless otherwise noted in drawings, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- G. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.2 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA 569-D maximum fill for the particular raceway type or 40%.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Where transition points, or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- F. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- G. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- H. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- I. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- J. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- K. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- L. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA 606-C. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- M. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- N. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

3.3 HORIZONTAL CROSS CONNECT INSTALLATION

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA 568-D standard, manufacturer's recommendations and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained as close as possible to the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.4 OPTICAL FIBER TERMINATION HARDWARE

- A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- E. A maximum of 12 strands of fiber shall be spliced in each tray
- F. All spare strands shall be installed into spare splice trays.

3.5 BACKBONE CABLE INSTALLATION

- A. Backbone cables shall be installed separately from horizontal distribution cables
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
- D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.
- E. Where backbone cables and distribution cables are installed in a cable tray or wireway, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- F. All backbone cables shall be securely fastened to the sidewall of the TR on each floor.
- G. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- H. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.6 COPPER TERMINATION HARDWARE

- A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568-D standard, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 12 mm (one-half inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.
- F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.7 RACKS

- A. Racks shall be securely attached to the concrete floor using a minimum 3/8" hardware or as required by local codes.
- B. Racks shall be placed with a minimum of 36 inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.
- C. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 2.11 of this document.

- D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.
- E. Wall mounted termination block fields shall be mounted on 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.
- F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18" from the finished floor.

3.8 FIRESTOP SYSTEM

- A. All firestop systems shall be installed in accordance with the manufacturer recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

3.9 GROUNDING SYSTEM

- A. The TBB shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The TBB shall adhere to the recommendations of the ANSI/TIA 607-C standard, and shall be installed in accordance with best industry practice.
- B. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

3.10 IDENTIFICATION AND LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA-606-C.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-C. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:

1. Label each cable within **4 inches** of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 3. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 4. Both ends of all backbone cable shall be labeled. Labels will be self laminating and machine generated. The label shall contain the following information:
 - a. The Origination (TR it is feeding from).
 - b. The Destination (TR it is feeding).
 - c. Number of pairs or fibers
 5. Both ends of all horizontal cables shall be labeled. Labels shall be self-laminating and machine generated. The cable, workstation faceplate, panel ports and block positions shall be labeled with the room number, location in room, outlet type & # (data D1, D2, etc). In rooms with multiple outlets, label clockwise as you enter the room: 1, 2, 3 e.g. a data port at the first drop location to the left of Room 216 door would be (216-1 D1). When terminating workstation cables in the TR, organize and label the cables in numeric room number order at the patch panel.
 6. CNS will approve all labeling schematics prior to installation. "As-Built" drawing with all outlets identified shall be provided.
- F. Labels shall be self-laminating or computer-printed type with printing area and font color that contrasts with cable jacket color. Handwritten labels will not be acceptable.
1. Cables use flexible vinyl or polyester that flex as cables are bent.
 2. All labeling methodology, identification logic, and materials will be approved by customer prior to installation.
 3. If existing labeling scheme is in place, all labeling will defer to currant scheme as to stay consistent with facility.

3.11 TESTING AND ACCEPTANCE

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA 568-D; marginal passes (*PASS) are not acceptable. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

2. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Legrand Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance.
2. Horizontal cabling shall be tested using a Level III test unit for category 6 performance compliance.
3. The basic tests required are:
 - a. Wire Map
 - b. Length
 - c. Attenuation
 - d. NEXT (Near end crosstalk)
 - e. Return Loss
 - f. ELFEXT Loss
 - g. Propagation Delay
 - h. Delay skew
 - i. PSNEXT (Power sum near-end crosstalk loss)
 - j. PSELFEXT (Power sum equal level far-end crosstalk loss)
4. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
5. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA 568-D Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
6. Category 6A Performance
 Shall meet the channel requirements outlined below for a 100-meter, 4-connector channel.

Channel Margin Guarantees

Parameter	Margin vs. TIA-568.2-D
Insertion Loss	3%
NEXT	4 dB
PSNEXT	5 dB
Return Loss	4 dB
ACRF	8 dB
PSACRF	8 dB

PSANEXT	4dB
PSAACRF	10 dB
ACR	7 dB
PSACR	7 dB

C. Fiber Testing

1. Testing procedures shall be in accordance with the following:
 - a. ANSI/TIA 568.3-D
 - b. ANSI/TIA 568-1.D
 - c. ANSI/TIA 526-7-A, Method A.1
 - d. ANSI/TIA 526-14-C, Method B
 - e. Tier 1 fiber testing is required. Tier 2 Fiber Testing is recommended
2. Preparation
 - a. Properly clean all connectors, adapters, and jumpers prior to testing.
 - b. Insure that the testing jumpers are of the same fiber core diameter and connector type as the fibers to be tested.
 - c. The power meter shall be properly calibrated prior to testing. Contractor to provide written confirmation of the calibration, with the power meter serial number, to the Owner, if requested. If this documentation is not available upon request, the Contractor shall re-test all optical fiber cables after documented calibration of the power meter is accomplished.
3. Test Equipment
 - a. Optical power meter and source (Certification tester Fluke or Agilent preferred). Suitable OTDR with launch cable for Tier 2 testing. OTDR Launch Cable length recommendation is 75 meters for MMF and 300 meters for SMF systems.
4. Testing
 - a. All Multimode fibers shall be tested to the requirements of ANSI/ TIA-568-3-D, TIA-526-14-C (Method B). Optical fibers shall be tested at both 850 nm and 1300 nm wavelengths for end-to-end insertion loss, and bi-directional (MTR to TR-1, TR-1 to MTR)
 - b. All Single-mode fibers shall be tested to the requirements of ANSI/ TIA-568-3-D, TIA-526-7A (or Method A.1). Optical fibers shall be tested at both 1310 nm and 1550 nm wavelengths for end-to-end insertion loss, and bi-directional (MTR to TR-1, TR-1 to MTR)
 - c. Insure that the power meter and light source are set to the same wavelength prior to testing each fiber.
 - d. Connect an appropriate test jumper to the light source and power meter.
 - e. Power on both the power source and light meter, allowing them to stabilize.
 - f. Record the reference power reading in dB. If the jumper is removed from the light source for any reason, the reference power reading must be re-established.
 - g. Insert a second appropriate jumper, using an appropriate adapter, between the first jumper and the power meter. Record the power reading in dB.
 - h. Provide written documentation of all test results to owner. Provide electronic copy of test results, in original tester format, to manufacturer when registering project for warranty on-line.

3.12 SYSTEM DOCUMENTATION

- A. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.
- B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the

request of the Engineer, the telecommunications contractor shall provide copies of the original test results.

- C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.13 TEST RESULTS

- A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- B. The field test equipment shall meet the requirements of the most current version of ANSI/TIA 568 including applicable TSB's and amendments. The appropriate Level III tester shall be used to verify Category 6 cabling systems.
- C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The telecommunications contractor must furnish this information in electronic form (CD-ROM).
- D. Test documentation shall also be provided to the manufacturer within three weeks after the completion of the project. Test results shall be uploaded when registering the project for warranty using the manufacturer's on-line system. Test results shall be in the tester's original format from an approved tester listed on manufacturer's website. All test results must show a PASS; marginal passes (*PASS) are not accepted.
- E. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.14 AS-BUILT DRAWINGS

- A. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD rel. 14) formats on which as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
- B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD rel. 14) form.

PART 4 - WARRANTY AND SERVICES

4.1 WARRANTY

- A. A warranty shall be provided for all internal infrastructure wiring as it pertains to voice and data networking for both copper and fiber systems. All installations must be performed according to the manufacturer's System Warranty and Performance Application.
- B. The warranty will combine an extended product and applications assurance warranty for a minimum of 25 years.
- C. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system from the date of registration. The Extended Product Warranty shall warrant the installed horizontal and/or backbone copper, and both the horizontal and the backbone optical fiber portions of the cabling system.
- D. The Application Assurance Warranty shall cover the failure of the wiring system to support the applications that are designed for the link/channel specifications of ANSI/TIA-568-1-D. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
- E. The contractor shall provide a minimum of a 1 year warranty on the physical installation.

4.2 CONTINUING MAINTENANCE

- A. The contractor shall furnish an hourly rate with the proposal submittal, which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes to the system (MACs). MACs shall be performed by a certified Contractor and shall be added to the warranty when registered with manufacturer.

4.3 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

- A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a certificate, from the manufacturer, registering the installation.

END OF SECTION 270610

SECTION 275100 – PAGING INTERCOM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The drawings and general provisions of the Contract Documents apply to this Section.

1.2 SUMMARY

- A. The platform shall provide complete internal communications employing state of the art IP Technology including the minimum functions listed.
 - a. System must employ IP technology to each classroom and Paging Zone in each school.
 - b. Two-way Loud Speaking Internal Intercommunications utilizing standard eight ohm and 25 volt Speakers.
 - c. District Wide Class “Bell” Event announcements and Tones. Access to schedules via the internet with no special software at the user computer.
 - d. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every speaker location.
 - e. Capability of playing prerecorded emergency and general announcements that may simply be activated at a computer or mobile device Soft Key, dedicated call-switch, or “Panic Button”, or connected SIP Telephone.
 - f. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
 - g. Web-based, permission driven user interface.
 - h. Ability to temporarily change local bell and announcement schedules to match School Testing schedules without reprogramming the entire school’s set schedule.
 - i. Connect to the schools existing Email service and local texting services to facilitate quick response messaging to persons assigned.
 - j. Provide ability to initiate the School’s Emergency Plan from mobile Devices.
 - k. Have the ability to integrate with existing school Access Control, Building Automation, Emergency “Panic” buttons, Two-way Radio Systems, Video Distribution Systems to facilitate quick response and communication during a crisis.
- 2. The system shall support a minimum of 1000 level priorities, which shall be user definable, allowing each end point to place a minimum of 5 different priority calls at the same time.
- 3. Any authorized administrator shall be able to call from outside the school into any classroom, zone or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools)
- 4. Authorized system users shall be able to create a minimum of twenty (20) automated sequences for each school with instructions, emails and relay activations and replay them. Automated message strings shall be, manually played from a single-button access on the console, on a SIP connected telephone, a button or from the web interface.

5. Authorized system users shall be able to create a minimum of 5 automated emergency sequences (including All Clear) which include tones, voice messages, relay activations and replay them. Emergency Sequences shall be initiated from a Console, a SIP phone, a panic buttons or from the web interface.
6. Paging and two-way loud speaking features shall be accessible from any system console or SIP connected telephone.
7. The platform shall synchronize its system time to the network time server or a web-based time server.
8. Each single school installation shall be locally survivable for intercom, paging, bells, and emergencies such as lockdown, even when the district connection is unavailable.
9. Perform a "Needs Assessment" where day-to-day system operation is reviewed with School Office Staff. Also review the school safety plans and provide programming and functionality to automate steps in the Safety Plan; such as per-recorded announcements, event notification via email/text, and interconnection with other safety systems.
10. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.

1.3 SUBMITTALS

- A. Product data for each component.
- B. Shop Drawings: Prior to proceeding with the work: System integrator shall provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection, and a complete schedule of all equipment and materials with associated manufacturers product information on which are to be used.
 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout the system.
 2. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.
 3. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, System Integrator Company's name in the title block.
 4. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- C. Product Certificates: Signed by manufacturers of equipment certifying that products furnished comply with specified requirements.
- D. System Integrator Certificates: Signed by manufacturer certifying that System Integrators comply with requirements.
- E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final settings, and measurements certified by System Integrator.

- G. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
 - a. Record of Owners equipment-programming option decisions.
 - b. All instructions necessary for proper operation and manufacturers instructions.
 - c. "Proof of Performance and School District Safety Compliance" information.
 - d. Manufacturer's maintenance information.
 - e. Software programs and information on all programmable features of the installed platform.
- H. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".
- I. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with specifications.
 - a. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
 - b. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the system.
 - c. Include with the submittal a current copy of trainer's need's assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
 - d. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.

PRODUCT DATA SHEET 1 - A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications system is covered with the required **five-year** warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

1.1 QUALITY ASSURANCE

- A. System Integrator Qualifications: An experienced System Integrator who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following within thirty (30) days after notification to proceed:
 - 1. Provide a list of installations that the System Integrator has specifically installed for verification by the Owner. Random installations from other vendors and/or System Integrators shall not be accepted. The System Integrator, not its employees, must meet these qualifications.
 - 2. The System Integrator shall be bondable.
 - 3. The System Integrator shall demonstrate to the satisfaction of the Owner or his representative that he has:
 - a. Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. Adequate staff and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.
 - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.

- B. Any System Integrator, who intends to bid on this work and does not meet the requirements of the "Quality Assurance" paragraph(s), shall employ the services of a "Installer" who does meet the requirements and who shall provide the equipment, make all connections and continuously supervise the installation. A subcontractor so employed as the "Installer" must be acceptable to the Architect/ Engineer. The "Installer" shall be identified within thirty (30) days of notification to proceed for acceptance by the Architect/Engineer
- C. Because the life expectancy of this type of communications platform normally exceeds 10 years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturers product for at least 10 years, the following is required:
 - 1. A list of (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds 10 years
 - 2. A letter from the manufacturer outlining the details of changes in service providers over the last 10 years and what actions they will take to ensure continuity of service to the customer.
- D. Each major component of equipment shall have the manufacturers name, address and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL Label, or other data that is die-stamped into the surface of the equipment shall be easily visible.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Comply with NFPA 70
- G. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools. .
- H. Comply with UL 60950.

1.2 IN-SERVICE TRAINING

- A. The System Integrator shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.
- B. The training program shall be implemented by a staff member/trainer employed by the System Integrator. The trainer must be factory certified to provide training on their product. The trainer must be a Crisis Communications Automation Specialist who will work with the district to help them utilize the system to support the individual school crisis plans set by the district.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received, and completed the training program.

1.3 WARRANTY

- A. Provide a **manufacturer's five-year warranty** of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic equipment, as well as analog clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary. The standard five-year warranty is an important element in establishing a standard of quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. System Integrator shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the System Integrator shall provide "loaner" equipment to the facility at no charge.
- D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period. **Provide minimum FIVE-YEAR WARRANTY PERIOD.**
- E. System Integrator shall provide documentation for all software maintenance charges for years 2 thru 10 as part of their proposal or provide documentation that software maintenance charges are not required to maintain warranty.

1.4 MANUFACTURERS

- A. Manufacturers: Rauland Telecenter Campus Platform, FrontRow, ThreeSixty.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. The platform shall utilize state of the art IP Technology, Call-in Notification, School Safety Paging and Evacuation tones, IP infrastructure, Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Intercommunications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web based and user friendly to allow the system administrator the ability to easily program system features.
- B. Provide complete and satisfactorily operating district/school communications and district/school safety communication system as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

- C. The platform shall be a single electronic system consisting of a minimum of 10 intercom channels per facility, (classroom) IP Modules connecting standard analog speakers, corridor speakers, inside and outside horn type speakers, call-in switches, SIP phone integration and district wide integration for paging, emergency notifications and configuration..
- D. The platform shall lend itself to expansion by simple addition of hardware modules.
- E. The platform shall directly connect to the WAN/LAN without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.
- F. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any connected Console or SIP telephone within the facility or outside the facility to any other location within the facility or district.
- G. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any Console or SIP connected telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands free and will not require any interaction by the classroom user.
- H. IP addressable speaker modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six digit number as well as name and description. Any extension may be reassigned at any time.
- I. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in the system. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when speaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.
- J. Integrated Master Clock with a minimum of 20 schedules per school, a minimum of 500 events per schedule, and automatic Daylight Savings time correction. Up to 5 schedules may be active on any given day for each school. User shall be able to select from 25 standard included tones or unlimited user created and uploaded audio files for class change signaling and messaging. In addition scheduled events shall include relay actions, paging and tone exclusion, email notifications and configuration changes. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate computer at the school location. Bell schedules can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

2.2 EQUIPMENT AND MATERIAL

- A. District-Wide Server Software
 - 1. Provides district wide paging, bell event scheduling, emergency notification and configuration for entire district.
 - 2. Reports on feature usage, system activity, etc. shall be available from the district-wide web interface.

3. Ability to configure system and initiate system features via district wide web based interface.
 4. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server
 5. The software will provide a web-browser interface to deliver district wide emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN of an alarm condition.
 6. The software can automatically broadcast page emergency instructions via associated system hardware throughout an entire district when an alarm (e.g. lockdown, lockout, security, fire) is initiated via the web-based interface. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems
 7. The software shall support any combination of VoIP Telecenter Campus Controllers and Telecenter Page Modules for a minimum of 1000 facilities.
 8. The software shall support a minimum of 50,000 IP Speaker modules, district wide.
 9. Connect with the school districts Active Directory
 10. Provide reporting capabilities offering at minimum a timeline and audit trail of events within the system.
- B. VoIP Single Campus Controller Rauland-Borg Telecenter Series – with the following features and capabilities:
1. Provides call routing for paging and intercom for a single facility
 2. System shall connect to the district provided Telephone Network via a SIP connection.
 3. The VX Works based Operating System and system programming database shall be stored in non-volatile flash memory. The Operating System can be easily upgraded through configuration without requiring replacement of any chips.
 4. Support a flexible numbering plan allowing two, three, four, five, or six digit extensions.
 5. The SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages and change priorities of call-ins in progress..
 6. Direct Dialing, two-way amplified voice intercom between any provided telephone or admin console and speaker without the use of a press-to-talk or talk-listen switch.
 7. Ability to place two levels of call-in from any call in switch
 8. The ability to answer intercom call-ins registered at pre-selected telephones.
 9. The ability to automatically escalate incoming call-ins to an alternate telephone or group of telephones if they remain unanswered for a predetermined amount of time.
 10. The ability to remotely locate IP Campus Controller . The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP LAN network.
 11. Single button access from any Console or SIP telephone on the system to distribute emergency announcements within the facility to all or select locations equipped with speakers. Emergency announcements originating from any assigned administrative telephone shall have priority over all regular system functions.
 12. Stores a minimum of 48 hours worth of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.
 13. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.
 14. System's SIP Interface shall provide:

- a. Audio paging access from any telephone to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire facility.
 - b. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
- 15. The system will have the ability to utilize a web-browser and USB microphone to deliver district wide live emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.
The system can automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
- C. IP addressable Classroom Modules: Provide Units as indicated on drawings.
 - 1. System shall provide multiple IP addressable modules for intercom, paging and relay activation.
 - a. All modules are POE 802.3af compliant
 - b. All Modules support DHCP
 - c. All Modules connect to network with a single RJ45 connector
 - 2. IP Speaker Module shall interface to school's data network, a speaker, and multiple call switches.
 - a. A minimum of 5 levels of call-in can be placed from a IP Speaker Module. The call-ins route to designated administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones and consoles, and announce over selected or all speakers and.
 - b. An option for Privacy call-in switches is supported When the Privacy switch is activated it prevents administrative or classroom telephones from monitoring the specific classroom/location intercom speaker.
 - c. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone reception; this assignment is a programmable function, change able by time of day. Each IP Speaker Modules location shall be programmed in software to belong to any combination of software zones. Software/hardwired zones must be configured as part of an unlimited number of district wide groups for school district emergency announcements. These district announcements must be accessed via microphone, a web-browser or telephone.
 - d. IP Speaker Modules shall be designed to mount near ceiling and wall speakers and in the plenum space.
 - 3. IP-addressable Zone Paging Module: Provide Units as indicated on drawings.
 - a. Zone paging module shall drive an amplifier to connect multiple speakers for district all page, all page, zone paging, bells, audio events and, emergency notification.
 - b. Zone Paging Modules shall be rack and wall mountable.

- c. Zone Paging modules shall be able to belong to one or more of 100 independent zones for live paging, bells, pre-recorded audio and emergency notification
 - d. Zone Paging Modules shall be able to interface to local sound systems to play audio over these system.
- 4. IP Addressable Aux I/O Module: Provide Units as indicated on drawings. Provide no less than ONE
 - a. Aux I/O Module shall have two input contacts and two output contacts.
 - b. Input and output contacts are individually addressable.
 - c. Aux I/O Module shall be wall and rack mountable.
 - d. User can program relays to be activated manually, through an event/bell schedule and during emergency notification.
 - e. Provide for receiving contact closure notification from School Fire Alarm System when FA System in alarm.
- D. IP Addressable Administrative Console. Provide Units as indicated on drawings. Provide no less than ONE.
 - 1. A full color screen with 4 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
 - 2. Audio paging access from any Console to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire school.
 - 3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
 - 4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
 - 5. Ability to perform intercom to any single IP Addressable Speaker Module.
 - 6. Ability to display 3 call-ins at a time on the screen, with unlimited number of call-ins annunciating and the ability to scroll to view all call-ins.
 - 7. Ability to upgrade a call-in via soft key
 - 8. Programmable soft key access from any console for activating relays, school wide
 - 9. Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging in the event of district wide connection loss.
- E. Audio Paging/Program Amplifiers: Provide as needed to support a minimum of 10 Paging Zones.
 - 1. Power amplifier(s) shall be provided to provide a minimum of 5 watts of power to each paging speaker, and 15 watts of power to each paging horn.
 - 2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.

- F. Normal Call Switch (TCC2201PB) – Rauland Single Level Call In Switch Cancel. *Provide as indicated on drawings.*
1. Normal Call Switches indicated on the drawings shall provide the following functions and features:
 - a. One (1) “Normal” call switch that shall activate a distinctive “NORM” level call from a single button activation. The button shall be clearly marked “NORM” and will route the call-in to any one or more Administrative Telephones or SIP interface to offsite telephones. This button may also be used as a “check-in” button during crisis situations.

PRODUCT DATA SHEET 1 - Classroom Speaker

1. The pre-assembled Rauland BAFKIT2X2CS can immediately “lay-in” to a new or existing ceiling grid and be wired to finish the installation. The BAFKIT2X2CS Ceiling Speaker Assembly consists of an 8 Ohm, 8" loudspeaker, mounted on a 2 foot by 2 foot lay-in baffle, and an integrated back box that covers the full area of the baffle. The BAFKIT2X2CS is designed with a feature to allow attachment of safety straps when required. Connection is simply a pair of speaker wires through a hole suitable for ¾" conduit
2. The Rauland ACCWB10 Series Speaker Assemblies consist of a Rauland USO188 8" loudspeaker complete with a 25V/70V line matching transformer, mounted in a Rauland ACC1003 Wall Baffle. Wall Baffle has a tapered face and is white in color. To be used in classrooms where no lay-in ceiling is present.
3. The Rauland ACC1412 is a fully assembled Back-box, Baffle, and Horn with a universal 25/70V Matching Transformer. Includes a high efficiency 16 Watt Paging Horn to product sound levels up to 121 dB. Constructed of 14-Gauge Steel, 11.7 inches square by 4 inches deep. White in color. To be used in large rooms such as Gymnasiums.

B. Corridor Speaker

1. The pre-assembled Rauland BAFKIT2X2L70V can immediately “lay in” to a new or existing ceiling grid and be wired to finish the installation. The BAFKIT2X2L70V Ceiling Speaker Assembly consists of a USO188-type, 8" loudspeaker complete with a 70V line matching transformer, mounted on a 2 foot by 2 foot lay-in baffle, and an integrated back-box that runs the full length of the baffle. The BAFKIT2X2L70V is designed with a feature to allow attachment of safety straps when required. With a tap selector switch on the back-box, an installer can quickly select an appropriate power level of, 1, 2 or 4 Watts.
2. The Rauland ACCWB10 Series Speaker Assemblies consist of a Rauland USO188 8" loudspeaker complete with a 25V/70V line matching transformer, mounted in a Rauland ACC1003 Wall Baffle. Wall Baffle has a tapered face and is white in color. To be used in classrooms where no lay-in ceiling is present.

C. Outdoor Horn Speaker

1. The paging projector(s) shall be a Rauland 3603 or approved equal wide-angle paging projector. It shall have an integrated driver assembly combined with a double re-entrant, non-resonant heavy-duty ABS resin horn. It shall contain a built-in, weatherproofed 25- and 70-volt line matching transformer and shall be provided with a screwdriver adjustable impedance wattage switch. Power taps shall be available as follows: 70-volt

line: 1.8, 3.7, 7.5, 15, 30 watts 25-volt line: 1.8, 3.7, 7.5, 15 watts. The loudspeaker driver assembly shall have a heavy-duty magnet, and a self-aligning, field replaceable diaphragm. Power handling capacity shall be 30 watts at full range and produce 107dB at 1 meter on axis with 1-watt input. Frequency response shall be 225 to 14,000 Hz. Dispersion shall be no less than 120° horizontal and no greater than 60° vertical. The unit shall include a die-cast universal mounting bracket permitting single locking pin adjustment on vertical or horizontal planes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with the System Integrator present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components and equipment for a complete operational system.
- C. Impedance and Level Matching: Carefully match input and output impedance's and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
 - 1. Necessary Network PoE connections are to be provided by others. All network connectivity including, Network Patch Panels, Patch Cords, Connectors, and CAT6 Plenum wire are to be provided within this section.
 - 2. Provide necessary speaker and Call Switch wire in Classrooms, and Corridors within this scope of work.
 - 3. CAT6 wire and related Patch Cables must be colored as requested by the owner.
 - 4. CAT6 cable must be terminated with a Network Module Connection and Patch Panels.
 - 5. Locate Patch Panels at main Computer Network Cabinets. Cabinets location is noted on Architectural drawings.
 - 6. Owner shall provide PoE Network Electronics supporting the new system.
- E. All housings are to be located as indicated. Surface wire track and back boxes are to be provided for Call-In Units.
- F. Place new Speakers near center of each classroom. Distribute speakers in corridors in order to provide adequate coverage. Speakers are to be placed no more that 35 feet on center in corridors.

- G. The System Integrator shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- H. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- I. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- J. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- K. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

3.3 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection: Make observations to verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at System Integrator's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.5 FINAL ACCEPTANCE TESTING

- A. The Final Acceptance Testing shall be provided to the Owner or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The System Integrator will provide a Final Acceptance Test record document signed by both the System Integrator and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

3.6 COMMISSIONING

- A. The System Integrator shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6, paragraphs 3, 5 & 6 of these specifications. In addition to the Training Materials provided, the System Integrator will also furnish Operators Manuals and Users Guides at the time of this training.
- B. Schedule training with Owner through the owners representative, with at least seven days advance notice.
- C. Perform drills to ensure all safety function programming operate correctly

3.7 OCCUPANCY ADJUSTMENTS

- A. The System Integrator shall provide Occupancy Adjustments in accordance with Section 1.6, paragraph 9 of these specifications. A response scenario amenable to both the owner and the System Integrator will be established and followed for the first year of service.

3.8 CLEANING AND PROTECTION

- A. Prior to final acceptance, the System Integrator shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked and all cabinet keys will be turned over to the owner or designated owner's representative.

END OF SECTION 275100

SECTION 275120 – A/V SYSTEMS**SCOPE OF WORK**

- A. Furnish and install an electronic, frequency-controlled sound system in accordance with these specifications.
- B. Provide new materials and equipment that conform to the applicable requirements of Underwriters' Laboratories (UL), National Electrical Code (NEC), and all applicable local codes.
- C. The work specified herein shall be performed by a Professional AV Contractor including but not limited to the installation of cabling, devices, termination, programming, and training.
- D. Final placement of speaker clusters and steering of coverage patterns is to be determined by the installing AV Contractor providing optimal direct sound field coverage and Intelligibility.
- E. This specification represents information solely concerned with the sound system. Refer to specifications of other trades and contractors for items that might affect the work under this section.
- F. All material and equipment needed for proper operation of the system not specified or described herein shall be deemed part of the specifications.

QUALITY ASSURANCE

- A. All equipment shall be UL listed.
- B. All equipment and Installation Practices shall comply with the latest ANSI/NFPA-70 National Electric Code.
- C. All equipment Installation Practices shall comply with the Local Electric Code.
- D. All equipment and installation practices shall comply with ANSI/INFOCOMM 2M-2010 Standard Guide for Audiovisual Systems Design and Coordination Processes.
- E. All equipment and Installation Practices shall comply with the latest BICSI Telecommunications Distribution Methods Manual (TDMM).
- F. All equipment shall comply with the latest ANSI TIA/EIA-568, 569, 606, 607, 862, standards as applicable.
- G. Performance Verification: All systems shall be pre-tested to verify the complete compatibility of all sending, receiving and distribution components and the performance and integrity of the transmission media. The performance of each system shall be demonstrated, with all proposed components, in the presence of the Design Engineer and/or Owner prior to approval and installation. Any system failing to meet the specified performance requirements shall be rejected and re-configured as required prior to re-testing.
- H. All equipment described herein or otherwise required to perform the specified system functions shall be a regular product line, produced by the system manufacturer.

- I. All materials furnished under this contract shall be new, of highest quality and shall be of a regularly manufactured line, currently in production at the time of installation.
- J. All terminations shall be performed using industry standards. Cold solders, exposed copper in terminal blocks, and wire splicing without prior approval shall be deemed unacceptable.
- K. All cabling shall be in a neat, tidy bundle and routed using existing paths, cable trays, and conduits. Rogue cable paths unless pre-approved shall be deemed unacceptable.
- L. It is the responsibility of the contractor to remove any unacceptable radio interference, buzzing, or noise from cable circuits.
- M. All cable circuits shall contain an acceptable service loop allowing for enough length to re-terminate and/or access and inspect devices without disconnecting or removing cabling.
- N. All audio, video, antenna, and power circuits shall be grouped by signal type with a minimum of 6 inches between each signal group. (I.E. microphone circuits shall be grouped together with a separation of at least 6 inches from all power, video, and antenna circuits).
- O. All cables shall be labeled according to AVIXA Standard F501.01:2015 (Formerly INFOCOMM F501.01:2015), identifying each cable by system and a unique identifier.

QUALIFICATIONS

- A. It is the intent of this package to procure a supplier who can provide labor for the installation of new equipment, pulling cables, and for furnishing all cables and accessories necessary. The CONTRACTOR is responsible for leaving in place proper sized conduits with pull wires and boxes for the AV System Contractor use.
- B. The AV equipment package (including cable, equipment, labor, and terminations) shall be furnished and installed by a contractor who meets all the requirements listed herein. It shall not be acceptable for the AV contractor to utilize a Subcontractor for any portion of the work, unless the Subcontractor has been approved in writing by the Design Engineer or owner based upon adherence to the qualifications listed herein.
- C. The AV System supplier shall be an "AV System Contractor" who regularly engages in the furnishing and installation of both Professional Sound Reinforcement and Video Systems.
- D. The AV System contractor shall be an authorized and certified Dealer of the equipment listed within this specification. A copy of factory programming certification (QSC Control Professional) with respect to the AV Control System shall be included within the submittal package.
- E. The AV System Supplier shall demonstrate to the satisfaction of the A/E and OWNER that they have:
 - a. Adequate staff and equipment to pursue the work properly and expeditiously.
 - b. Adequate technical experience.
 - c. Suitable financial status to meet the obligations of the work.
 - d. Supplier to provide maintenance and warranty service for a period of 1 year after acceptance of installation to be included in the lump sum bid.

- F. The Contractor shall have on staff an AVIXA certified CTS responsible for overseeing the project.

GENERAL CONDITIONS

- A. Offers will only be considered from sound contractors who have at least five years of experience in the furnishing and installation of sound reinforcement systems that employ an equalization device comparable to that specified.
- B. The sound contractor shall employ competent electronic technicians who are trained and knowledgeable in the area of sound systems.
- C. At completion of the installation of the sound system and before final acceptance by the owner or owner's representative, the sound contractor shall furnish two copies of the following:
- a. Operating manuals, installation manuals, descriptive literature, and other information that is pertinent to the operation and performance of the system.
 - b. Wiring diagrams for equipment and the system that indicate the wire and cable connections, including the connections between the amplifiers and associated loudspeakers.
 - c. Manufacturer's warranties and the sound contractor's warranties.
- D. The AV contractor shall have available to the purchaser a service department capable of servicing all the equipment. Maintenance shall be provided on the premises during normal working hours at no cost to the purchaser for a period of 12 months from the date of system acceptance unless the failure or damage is caused by misuse, neglect, or accident. Service on the premises during other than normal working hours must also be available and may be charged at current labor rates.
- E. The equipment described and furnished under these specifications shall be the standard product of one manufacturer. All equipment items that are identified by model number, type, or brand name are done so to establish the quality, function, and performance required of the specific equipment. Alternates must be approved ten (10) days prior to the bid date. If submitting alternate speakers, provide EASE plots showing coverage at 200 Hz, 500 Hz, and 5 KHz.

SUBMITTALS

- A. A complete list of the major equipment to be used in this system shall be submitted to the owner's representative for approval.
- B. Shop drawings of the following shall be submitted:
- a. A block drawing that shows the functional relations of all portions of the system.
 - b. 30x42 floor plans at a scale of not less than 1/8" = 1'-0" showing the locations of the following:
 - i. All locations of AV equipment, mounting type and height.
 - ii. Conduit requirements, rough-in box size requirements and heights
 - iii. Each location where electrical power is required, and the specific configuration of that power connection (voltage, plug type, mounting height, etc.)
 - c. Rack Layout drawings showing components and locations.
 - d. EASE plots showing the proposed location and the area covered by each loudspeaker.
- C. Network Coordination — the Contractor shall provide network topology diagram illustrating complete network plan for the project. The contractor shall work with the Owner's IT department to identify all PoE, VLAN, firewall and other networking requirements to provide a fully functioning AV system.

- a. The Contractor shall obtain blocks of static IP addresses from the Owner's IT department in a timely fashion ahead of implementation as to give the Owner's IT department ample time to develop these IPs.
- b. A meeting with the Owner's IT department is required to discuss plan of implementation and procedure.

D. Manufacturer's data sheets for each major component of the system shall be submitted.

System Requirements

- A. The audio-visual system contractor shall furnish all the equipment, accessories and necessary material for a complete system as indicated on the drawings and described hereinafter.
- B. The sound system operator shall be capable of controlling all aspects of the AV system from the touch panel including recalling presets for day to day use.
- C. Where applicable the video system shall be a matrixed system capable of routing any video input to any video output and also allow for selection of audio source to be heard in the speaker system.
- D. The Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, and Orchestra shall all act independently while running off the same Master Core510i System.
- E. The system shall have a redundant Core510i that automatically takes over all functions of the primary Core should the primary Core fail.
- F. Each Room shall be capable of being controlled from the touch panel or an iPad.
- G. The control system shall be capable of controlling the displays, screens, and projectors assuming those devices are controllable via network, rs-232 and/or contact closure.
- H. The AV traffic shall be on its own network and the control system shall be accessible from the school's network.

O & M MANUALS — FINAL DOCUMENTATION

- A. Copies of all approved shop drawings with the project engineer's specific approval clearly indicated.
- B. Comprehensive Bill of Materials with manufacturers, model numbers, quantities and descriptions.
- C. Owner's manuals for every item of equipment, when available from the manufacturer.
 - a. These shall be the technical manuals provided by the manufacturer and shall not consist of generic sales brochures. Technical manuals shall provide complete specifications for the equipment as well as complete operating, maintenance, troubleshooting and product repair/replacement information.
- D. Provide statement of warranty with O&M Manuals.

E. WARRANTY

Warranty the entire system, including all equipment and wiring, to be free of mechanical and electrical defects for a period of one (1) year from the date of system completion and acceptance.

System Bill of Materials

Auditorium:

- (5) FSR Floor/Wall Boxes
- (8) Sennheiser Networked Wireless Lavalier Systems with (4) Handheld Mics
- (1) Sennheiser Distributed Antenna System
- (8) Point Source Earset Mics
- (6) Audio-Technica Engineered Micro-Line Choir Mics
- (1) Wired Mic Package
- (1) Denon Media Player

- (1) Denon Bluray Player
- (1) Atterotech Synapse D32i
- (1) Allen & Heath SQ-7 Digital Board
- (1) Allen & Heath DX Network Hub
- (2) Allen & Heath DX 16 Channel Stage Boxes
- (2) QSC 8 Channel Digital Network Amplifier
- (4) Presonus CDL12 Array Modules
- (5) Presonus 12" Speakers
- (1) Presonus 8" Speaker
- (2) Presonus Double 18" Super Subs
- (5) QSC 6" Ceiling Speakers and Volume Controls
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 16 Receivers Kits with Charger
- (1) QSC 48 Port Network Switch
- (1) QSC 24 Port Network Switch
- (1) Visionary Solutions Duet Video Encoders
- (2) Visionary Solutions Duet Wall Plate Encoder
- (1) Visionary Solutions Duet Video Decoder
- (6) Middle Atlantic 20A Rack Link Non-Destructive Power Centers
- (1) 48-Port Shielded Patch Bay
- (1) Fiber Enclosure
- (2) Middle Atlantic BGR 27" Deep Racks
- (1) Middle Atlantic DTRK Desktop Rack
- (1) Da-Lite 16:10 226" HD1.3 Electric Screen with 120" Drop
- (1) Epson 12,000 Lumen Projector with Wall Mount and Medium Throw Lens
- (1) ClearCom 2 Channel Base Station with (3) Wall Speaker Stations, and (8) Beltpack/Headset Sets

Aux Gym:

- (2) Sennheiser Networked Wireless Lavalier Systems
- (2) Sennheiser Networked Wireless Handheld Systems
- (1) Sennheiser Distributed Antenna System
- (2) Point Source Earset Mics
- (1) Denon Media Player
- (2) Atterotech 6 input media plates
- (2) Atterotech Bluetooth Plate
- (1) QSC 8" Touch Panel
- (1) QSC 8 Channel Flexible I/O
- (1) QSC 4 Channel Digital Network Amplifier
- (9) QSC Acoustic Performance 12" Speakers
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories

Band Room:

- (1) Denon Media Player
- (1) Denon Media Recorder
- (1) Atterotech 6 input media plates
- (1) Atterotech Bluetooth Plate
- (2) Audio-Technica Engineered Cardioid Choir Mics

- (1) QSC 8 Channel Flexible I/O
- (1) QSC 8" Touch Panel
- (1) QSC 4 Channel Digital Network Amplifier
- (2) QSC Acoustic Design 12" Speakers
- (1) QSC Acoustic Design 12" Subwoofer
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories

Cafeteria:

- (2) Sennheiser Networked Wireless Handheld Systems
- (1) Sennheiser Distributed Antenna System
- (1) Denon Media Player
- (1) Denon Bluray Player
- (2) Atterotech 6 input media plates
- (2) Atterotech Bluetooth Plate
- (1) QSC 8" Touch Panel
- (1) QSC 8 Channel Digital Network Amplifier
- (15) QSC Acoustic Design 6" Ceiling Speakers
- (2) QSC Acoustic Design 12" Speakers
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories
- (1) Visionary Solutions Duet Video Encoders
- (2) Visionary Solutions Duet Wall Plate Encoder
- (1) Visionary Solutions Duet Video Decoder
- (1) Da-Lite 16:10 226" Parallax 1.0 Thin Bezel Fixed Screen
- (1) Epson 25,000 Lumen Projector with Ceiling Mount and Standard Lens

Choir Room:

- (1) Denon Media Player
- (1) Denon Media Recorder
- (1) Atterotech 6 input media plates
- (1) Atterotech Bluetooth Plate
- (2) Audio-Technica Engineered Cardioid Choir Mics
- (1) QSC 8 Channel Flexible I/O
- (1) QSC 8" Touch Panel
- (1) QSC 4 Channel Digital Network Amplifier
- (2) QSC Acoustic Design 12" Speakers
- (1) QSC Acoustic Design 12" Subwoofer
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories

Gym:

- (2) Sennheiser Networked Wireless Lavalier Systems
- (2) Sennheiser Networked Wireless Handheld Systems
- (1) Sennheiser Distributed Antenna System
- (2) Point Source Earset Mics
- (1) Denon Media Player
- (3) Atterotech 6 input media plates
- (3) Atterotech Bluetooth Plate
- (1) QSC 8" Touch Panel
- (1) QSC 16 Channel Flexible I/O
- (1) QSC 4 Channel Digital Network Amplifier
- (12) Presonus CDL12 Array Modules
- (2) Presonus Double 18" Super Subs
- (10) Presonus 12" Speakers
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 12 Receivers Kits with Charger
- (1) QSC 24 Port Network Switch
- (6) Middle Atlantic 20A Rack Link Non-Destructive Power Centers
- (1) Fiber Enclosure
- (1) Middle Atlantic BGR 27" deep wall rack with accessories

Media Center:

- (2) Sennheiser Networked Wireless Lavalier Systems
- (2) Sennheiser Networked Wireless Handheld Systems
- (1) Sennheiser Distributed Antenna System
- (2) Point Source Earset Mics
- (1) Denon Media Player
- (1) Denon Bluray Player
- (3) Atterotech Bluetooth Plate
- (1) QSC 11.6" Touch Panel
- (1) QSC 8 Channel Flexible I/O
- (1) QSC 4 Channel Digital Network Amplifier
- (4) QSC Acoustic Design 6" Ceiling Speakers
- (8) QSC Acoustic Design 6" Pendant Speakers
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories
- (1) Visionary Solutions Duet Video Encoders
- (3) Visionary Solutions Duet Wall Plate Encoder
- (3) Visionary Solutions Duet Video Decoder
- (2) Da-Lite 16:10 137" HD1.3 Electric Recessed Screen
- (1) Da-Lite 16:10 189" HD1.3 Electric Recessed Screen
- (2) Epson 6,000 Lumen Projector with Ceiling Mount and Standard Lens
- (1) Epson 7,000 Lumen Projector with Ceiling Mount and Standard Lens

Orchestra Room:

- (1) Denon Media Player
- (1) Denon Media Recorder

- (1) Atterotech 6 input media plates
- (1) Atterotech Bluetooth Plate
- (2) Audio-Technica Engineered Cardioid Choir Mics
- (1) QSC 8 Channel Flexible I/O
- (1) QSC 8" Touch Panel
- (1) QSC 4 Channel Digital Network Amplifier
- (2) QSC Acoustic Design 12" Speakers
- (1) QSC Acoustic Design 12" Subwoofer
- (1) Listen 72Mhz System with Wall Mounted Antenna, and 4 Receivers Kits
- (1) QSC 24 Port Network Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure
- (1) Middle Atlantic 16 space by 22" deep wall rack with accessories

MDF:

- (2) QSC CORE510i Audio Processors
- (1) Dell 24 SFP Port Core Switch
- (1) Middle Atlantic 20A Rack Link Non-Destructive Power Center
- (1) Fiber Enclosure

Equipment Specifications

Floor/Wall Boxes

Provide (3) FSR FL-600P-6-B with (3) FL-600P-SLD-BLK-C

Side floor boxes in the Auditorium shall have (4) XLR female panel mount connectors with gold contacts, (4) Speakon NL4 panel mount connectors, and (4) shielded CAT6 female panel mount connectors.

The Auditorium center floor box shall have (2) XLR female panel mount connectors with gold contacts, (4) Speakon NL4 panel mount connectors, and (4) shielded CAT6 female panel mount connectors.

All Auditorium connector plates shall be laser engraved identifying the input/output. The engraved labels shall match the patch panel, far-end connector, and digital labels.

Provide (9) FSR FL-600P-6-B with (9) FL-600P-JL-C

Side floor boxes in the Auditorium shall have (4) XLR female panel mount connectors with gold contacts, (4) Speakon NL4 panel mount connectors, and (4) shielded CAT6 female panel mount connectors.

All Auditorium connector plates shall be laser engraved identifying the input/output. The engraved labels shall match the patch panel, far-end connector, and digital labels.

Wall boxes in the Aux Gym, Cafeteria, and Gym. Shall be lockable. Media Plates, Bluetooth Signal, and Wall Boxes shall be labeled to match programming labels seen on the touchscreen.

Wired Microphones (Cables and Stands)

Provide the following wired microphones and accessories with equals by Shure, Audio-Technica, and Sennheiser:

- (6) Audio-Technica ES933PMML Hanging Choir Mics (Auditorium Installed)
- (6) Audio-Technica ES933PMC Hanging Choir Mics (2- each Band, Choir, Orchestra, Installed)

(22) Sennheiser e 835 Handheld Mics. Each mic shall have a 25' mic cable and a tripod boom stand (8-Auditorium, 2-Aux Gym, 2-Band, 2-Cafeteria, 2-Choir, 2-Orchestra, 4-Gym) and provide (8) tabletop stands (4-Auditorium, 4-Gym).

(4) Audio-Technica ATM650 Instrument Mics each with a 25' mic cable and tripod boom stand (Auditorium).

(1) Audio-Technica ATM250 Kick Drum Mic with a 25' mic cable and kick mic stand (Auditorium).

(2) Audio-Technica AE3000 Large Diaphragm Instrument Mic each with 25' mic cable and tripod boom stand (Auditorium).

(4) Audio-Technica AE5100 Large Diaphragm Instrument Mic each with 25' mic cable and tripod boom stand (Auditorium).

(7) Whirlwind IM2 Direct Boxes each with 25' mic cable (4-Auditorium, 1-Band, 1-Choir, 1-Orchestra)

(1) Whirlwind PCDI Direct Box for Computer each with 25' mic cable (Auditorium)

Provide additional (4) 10' mic cables, (4) 15' mic cables, (4) 50' mic cables (Auditorium)

DANTE Digital Audio Interface

The audio device shall be a 32-channel networked audio interface supporting Dante with AES67 interoperability. The balanced line level inputs shall support a software-switchable input pad for each bank to accommodate a mix of line level consumer and professional analog audio devices. All inputs shall be independently available for routing from the Dante / AES67 network audio interfaces. A Q-SYS control plugin shall be available that enables simple integration of the Synapse D32i into the Q-SYS Ecosystem.

The interface shall be configured to DANTE to act as an input to the digital audio mixing console.

Provide 1 Atterotech Synapse D32i DANTE Digital Audio Interface. (Auditorium)

Wireless Handheld Microphones

A wireless RF transmission system consisting of a stationary receiver and a handheld transmitter including a microphone head. The system shall operate within twelve UHF frequency ranges, with a switching bandwidth of up to 42 MHz: 470 – 516 MHz, 516 – 558 MHz, 520 – 558 MHz, 566 – 608 MHz, 606 – 648 MHz, 626 – 668 MHz, 734 – 776 MHz, 780 – 822 MHz, 823 – 865 MHz, 806 – 810 MHz, 925 – 937.5 MHz, 1785 – 1800 MHz; receiving frequencies shall be 1,680 per range and shall be tunable in 25 kHz steps. The system shall feature 20 fixed frequency banks with up to 12 compatible frequency presets and 1 user bank with up to 12 user programmable frequencies. The receiver shall be menu-driven with a backlit LC display showing the current frequency, frequency bank and channel number, metering of RF level, metering of AF level, lock status, pilot tone evaluation, muting function, and battery status of the associated transmitter. An auto-lock feature shall be provided to prevent settings from being accidentally altered. The receiver shall feature an integrated guitar tuner and shall provide a sound check mode. Some receiver parameters such as receiving frequency, receiver name and pilot tone setting shall be synchronizable with the associated transmitter via an integrated infrared interface. The receiver shall feature a balanced XLR-3M audio output with a maximum output of +18 dBu along with an unbalanced ¼" (6.3 mm) audio output with a maximum output of +12 dBu. The receiver shall have two DATA ports (RJ 10) to set up a multichannel system. Two BNC-type input sockets shall be provided for connecting the antennas. Nominal/peak deviation shall be ± 24 kHz/ ± 48 kHz. Squelch threshold shall be adjustable to three levels: Low (5 dB μ V), Middle (15 dB μ V) and High (25 dB μ V). The receiver shall incorporate the Sennheiser HDX compander system and a defeatable pilot tone squelch. Sensitivity shall be < 2 μ V for 52 dBA eff S/N with HDX engaged at peak deviation. Adjacent channel rejection shall be ≥ 65 dB (typical). Intermodulation attenuation shall be ≥ 65 dB (typical); blocking shall be ≥ 70 dB. Four selectable equalizer presets shall be provided: "Flat", "Low Cut" (-3 dB at 180 Hz), "Low Cut/High Boost" (-3 dB at 180 Hz/ $+6$ dB at 10 kHz) and "High Boost" ($+6$ dB at 10 kHz). Signal-to-noise ratio at 1 mV and peak deviation shall be ≥ 110 dBA. Total harmonic distortion (THD) shall be ≤ 0.9 %. The audio output level shall be adjustable within a 48 dB range in steps of 3 dB. The receiver shall operate on 12 V power supplied from the NT 2-3 CW mains unit (for 100 – 240 V AC, 50/60 Hz). Power consumption shall be 300

mA. The receiver shall have a rugged metal housing; dimensions shall be approximately 190 x 212 x 43 mm (7.48" x 8.35" x 1.69"). Weight shall be approximately 980 grams (2.16 lbs). Operating temperature shall range from -10 °C to +55 °C (+14 °F to +131 °F). The receiver shall be the Sennheiser EM 100 G4. The radio microphone shall be menu-driven with a backlit LC display showing the current frequency, frequency bank and channel number, metering of AF level, transmission status, lock status, pilot tone transmission, muting function, and battery status. An auto-lock feature shall be provided to prevent settings from being accidentally altered. The radio microphone parameters shall either be configurable in the associated receiver's menu and synchronized with the radio microphone via an integrated infrared interface or shall be programmable in the radio microphone menu. Receiver parameters such as receiving frequency, receiver name and pilot tone setting shall be synchronizable with the radio microphone via an integrated infrared interface. The handheld vocal radio microphone shall be equipped with a mute switch, which shall be switchable between "AF on/ off", "RF on/off" and "Disabled" via the user interface. Nominal/peak deviation shall be ± 24 kHz/ ± 48 kHz. Frequency stability shall be $\leq \pm 15$ ppm. RF output power at 50 Ω shall be 30 mW (typical). The radio microphone shall incorporate the Sennheiser HDX compander system and a defeatable pilot tone squelch. Audio frequency response shall range from 80 – 18,000 Hz. Signal-to-noise ratio at 1 mV and peak deviation shall be ≥ 110 dBA. Total harmonic distortion (THD) shall be ≤ 0.9 %. Input sensitivity shall be adjustable within a 48 dB range in steps of 6 dB. Power shall be supplied to the radio microphone by two 1.5 V AA size batteries or by one Sennheiser BA 2015 rechargeable accupack. Nominal voltage shall be 2.4 V, current consumption shall be typical 180 mA at nominal voltage; ≤ 25 μ A when radio microphone is switched off. Operating time shall be typical 8 hours. The radio microphone shall have a rugged metal housing; dimensions shall be approximately 50 mm (1.97") in diameter and 265 mm (10.43") in length. Weight including the batteries shall be approximately 450 grams (0.99 lbs). Operating temperature shall range from -10 °C to +55 °C (+14 °F to +131 °F). A range of microphone heads shall be available for the radio microphone.

Provide (8) Sennheiser ew 100 G4-835-S vocal set microphone systems and (8) microphone boom stands. (2-Aux Gym, 2-Cafeteria, 2-Gym, 2-Media Center)

Wireless Lavalier Microphones

A wireless RF transmission system consisting of a stationary receiver, a bodypack transmitter and a clip-on microphone. The system shall operate within twelve UHF frequency ranges, with a switching bandwidth of up to 42 MHz: 470 – 516 MHz, 516 – 558 MHz, 520 – 558 MHz, 566 – 608 MHz, 606 – 648 MHz, 626 – 668 MHz, 734 – 776 MHz, 780 – 822 MHz, 823 – 865 MHz, 806 – 810 MHz, 925 – 937.5 MHz, 1785 – 1800 MHz; receiving frequencies shall be 1,680 per range and shall be tunable in 25 kHz steps. The system shall feature 20 fixed frequency banks with up to 12 compatible frequency presets and 1 user bank with up to 12 user programmable frequencies. The receiver shall be menu-driven with a backlit LC display showing the current frequency, frequency bank and channel number, metering of RF level, metering of AF level, lock status, pilot tone evaluation, muting function, and battery status of the associated transmitter. An auto-lock feature shall be provided to prevent settings from being accidentally altered. The receiver shall feature an integrated guitar tuner and shall provide a sound check mode. Some receiver parameters such as receiving frequency, receiver name and pilot tone setting shall be synchronizable with the associated transmitter via an integrated infrared interface. The receiver shall feature a balanced XLR-3M audio output with a maximum output of +18 dBu along with an unbalanced 1/4" (6.3 mm) audio output with a maximum output of +12 dBu. The receiver shall have two DATA ports (RJ 10) to set up a multichannel system. Two BNC-type input sockets shall be provided for connecting the antennas. Nominal/peak deviation shall be ± 24 kHz/ ± 48 kHz. Squelch threshold shall be adjustable to three levels: Low (5 dB μ V), Middle (15 dB μ V) and High (25 dB μ V). The receiver shall incorporate the Sennheiser HDX compander system and a defeatable pilot tone squelch. Sensitivity shall be < 2 μ V for 52 dBA eff S/N with HDX engaged at peak deviation. Adjacent channel rejection shall be ≥ 65 dB (typical). Intermodulation attenuation shall be ≥ 65 dB (typical); blocking shall be ≥ 70 dB. Four selectable equalizer presets shall be provided: "Flat", "Low Cut" (-3 dB at 180 Hz), "Low Cut/High Boost" (-3 dB at 180 Hz/+6 dB at 10 kHz) and "High Boost" (+6 dB at 10 kHz). Signal-to-noise ratio at 1 mV and peak deviation shall be ≥ 110 dBA. Total harmonic distortion (THD) shall be ≤ 0.9 %. The audio output level shall be adjustable within a 48 dB range in steps of 3 dB. The receiver shall operate on 12 V power supplied from the NT 2-3 CW mains unit (for 100 – 240 V AC, 50/60 Hz). Power consumption shall be 300 mA. The receiver shall have a rugged metal housing; dimensions shall be approximately 190 x 212 x 43 mm (7.48"

x 8.35" x 1.69"). Weight shall be approximately 980 grams (2.16 lbs). Operating temperature shall range from -10°C to $+55^{\circ}\text{C}$ ($+14^{\circ}\text{F}$ to $+131^{\circ}\text{F}$). The receiver shall be the Sennheiser EM 100 G4. The transmitter shall be menu-driven with a backlit LC display showing the current frequency, frequency bank and channel number, metering of AF level, transmission status, lock status, pilot tone transmission, muting function, and battery status. An auto-lock feature shall be provided to prevent settings from being accidentally altered. The transmitter parameters shall either be configurable in the associated receiver's menu and synchronized with the transmitter via an integrated infrared interface or shall be programmable in the transmitter menu. The transmitter shall be equipped with a mute switch, which shall be switchable between "AF on/off", "RF on/off" and "Disabled" via the user interface. Nominal/peak deviation shall be $\pm 24\text{ kHz}/\pm 48\text{ kHz}$. Frequency stability shall be $\leq \pm 15\text{ ppm}$. RF output power at $50\ \Omega$ shall be 30 mW (typical). The transmitter shall incorporate the Sennheiser HDX compander system and a defeatable pilot tone squelch. Audio frequency response shall range from 80 – 18,000 Hz (microphone) or 25 - 18,000 Hz (line). Signal-to-noise ratio at 1 mV and peak deviation shall be $\geq 110\text{ dBA}$. Total harmonic distortion (THD) shall be $\leq 0.9\%$. Input sensitivity shall be adjustable within a 60 dB range in steps of 3 dB. Power shall be supplied to the transmitter by two 1.5 V AA size batteries or by one Sennheiser BA 2015 rechargeable accupack. Nominal voltage shall be 2.4 V for a rechargeable battery or 3 V for a battery, current consumption shall be typical 180 mA at nominal voltage; $\leq 25\ \mu\text{A}$ when transmitter is switched off. Operating time shall be typical 8 hours. The transmitter shall have a rugged metal housing; dimensions shall be approximately 82 x 64 x 24 mm (3.23" x 2.52" x 0.94"). Weight including the batteries shall be approximately 160 grams (0.35 lbs). Operating temperature shall range from -10°C to $+55^{\circ}\text{C}$ ($+14^{\circ}\text{F}$ to $+131^{\circ}\text{F}$).

Provide (14) Sennheiser ew 100 G4-ME4 lavalier set microphone systems with (4) Sennheiser SKM 300 G4-S, (4) Sennheiser MME 865-1 BK, (5) Sennheiser ASA 214-UHF, (1) Sennheiser ASP 212, (10) Sennheiser WM1, Sennheiser A 2003, and (14) Point Source CO-8WS-XSE-BE (8-Auditorium(4 handhelds), 2-Aux Gym, 2-Gym, 2-Media Center)

Media Player

- Audio Specifications
 - Audio channels: 2 channels / stereo
 - Frequency response: 10 - 20,000 Hz, +/- 1.0dB
 - Dynamic range: $> 85\text{ dB}$ (10- 20,000 Hz A-weighted)
 - Signal to Noise ratio: $> 90\text{ dB}$ (1kHz, 0db, A-weighted)
 - Channel separation: $> 80\text{ dB}$ (1kHz, 0dB, A-weighted)
 - Total Harmonic Distortion (THD): $< 0.01\%$ (1kHz, 0dB, A-weighted)
- Bluetooth Specifications
 - Output class: Class C
 - Bluetooth version: 4.0
 - Support profile: A2DP, AVRCP (1.3/1.4)
 - Support codecs: SBC, MP3, AAC, aptX
- Outputs
 - XLR (balanced) 2.0Vrms
 - RCA (unbalanced) +4dBu
- Remote Control

- IR Remote
 - Infrared protocol / NEC format
 - Transmit output level: >200mVp-p
- Serial Remote
 - D-sub 9-pin female RS-232C
 - Mode: Full duplex
 - Baud rate: 9600/38400 b/s (selectable in the menu)
 - Data: 8bits
 - Start bit: 1bit
 - Stop bit: 1bit
 - Parity: none
 - Flow control: none
- Audio File / SIGNAL
 - Sample rate: CD-DA, Audio file 44.1kHz
 - Word length: CD-DA, Audio file 16-bit
 - File format: Audio file WAV/MP3/AAC
 - Bit rate: MP3, AAC, CBR/VBR ST/Mono 32~320kps
 - ID3 tag: MP3 V1.x~2.4
- CD Drive
 - Media
 - File system: CD-DA (CD-TEXT), CD-ROM (ISO9660)
 - Disc: CD, CD-R
- USB Storage Device
 - File system: FAT 16/32
 - Media type: Flash/ HDD
- Environmental
 - Operating temperature: 40° - 95° F (5° - 35° C)
 - Operating humidity: 25 ~ 85% non-condensing
- General
 - Power
 - Power requirements: 100-230 VAC
 - Power consumption: <30W

- LCD Display: LCD 2 lines, 16 characters x 2 lines LCM display
- Dimensions: 19" x 13.7" x 1.73" (483 x 347 x 44mm)
- Weight: 6.4 lbs (2.92kg)

Provide (8) Denon DN-500CB Media Players with (8) Global Cache IP2SL-P (Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, Orchestra)

Bluray Player

Digital System

- System
 - Digital media player (Blu-ray Disc, DVD, CD, SD, USB device [mass storage class]) AVCHD playback format
- Supported Disc Formats
 - Blu-ray Disc: BD25, BD50, BD-ROM, BD-R, BD-RE
 - DVD: DVD, DVD+R, DVD-R, DVD+RW, DVD-RW
 - CD: CD, CD-R, CD-RW, DTS Music Disc (DTS Audio CD, 5.1 Music Disc), HDCD, Super Video CD (SVCD), Video CD (VCD)
- Supported File Formats
 - Video: .3gp, .asf, .avi, .dat, .divx, .mkv, .mov, .mp4, .mpg, .m2ts, .ogm, .rmvb, .tp, .ts, .wmv
 - Subtitles: .ass, .smi, .srt, .ssa, .sub
 - Audio: .ape, .flac, .m4a (AAC), .mp3, .wav, .wma
 - Picture: .gif, .jpg (or .jpeg), .png
- Supported File Systems
 - FAT16, FAT32, NTFS
 - SD card with 128GB total capacity
 - USB drive (mass storage class) with 2 TB total capacity
- Video
 - Resolutions Auto, 480i/576i, 480p/576p, 720p, 1080i, 1080p
 - Aspect Ratios 16:9 Full, 16:9 Normal, 4:3 Pan & Scan, 4:3 Letterbox
 - System NTSC, PAL, Multi (if supported by TV)
 - HDMI Color Space: RGB PC Level, RGB Video Level, YCbCr (4:4:4), YCbCr 4:2:2
- Decoding
 - Video: DivX 3, 4, 5, 6; DivX HD; MPEG-1; MPEG-2; MPEG-4; MPEG-4 AVC (H.264); VC-1 (Windows Media Video); Xvid

- Audio: AAC; Dolby Digital; Dolby Digital Plus; Dolby TrueHD; DTS Digital Surround; DTS-HD; WMA
- Audio
 - Analog Outputs
 - Output Level (balanced XLR): +4 dBu = +1.786 dBV
 - Output Level (unbalanced RCA): +6 dBV
 - Digital Output
 - Output Level (coaxial): 0.5V, 75Ω, 1
 - Signal Format: AES/EBU
 - Surround Audio
 - DTS-Master Audio, DTS-HD High Resolution Audio, DTS Digital Surround, Dolby TrueHD, Dolby Digital (AC-3), Dolby Digital Plus (7.1ch)
 - Frequency Response: 20 Hz – 20 kHz (+0.5 dB)
 - Signal-to-Noise Ratio: > 100 dB (A-weighted)
 - Total Harmonic Distortion: < 0.05%
 - Dynamic Range: > 100 dB (A-weighted)
 - Headroom: 6 dB
 - Channel Separation: > 90 dB
- Outputs
 - (2) XLR audio outputs (L/R, balanced)
 - (2) RCA audio outputs (L/R, unbalanced)
 - (8) RCA audio outputs (7.1 surround sound)
 - (1) Coaxial digital audio/visual output
 - (1) HDMI audio/visual output
 - (1) RJ-45 LAN port
 - (1) 9-pin D-Sub female RS-232C port
 - (1) IEC power connection
- Communication
 - Remote Control
 - Infrared protocol, > 200 mV transmission output level
 - Serial Remote
 - Connector: 9-pin D-Sub female, RS-232C

- Mode: Full duplex
- Baud Rate: 9600 or 38400 bps (selectable)
- Ethernet
 - Connector: LAN port
 - Standards: Ethernet (10 Mbps), Fast Ethernet (100 Mbps)
- Environmental Conditions
 - Operating temperature: 41 – 95 °F (5 – 35 °C)
 - Operating humidity: 25 – 85%, no condensation
- General
 - Power
 - Connection: IEC
 - Requirement: 100–240 VAC, 50/60 Hz
 - Consumption: 15 W typical, < 0.5 W standby
 - Dimensions (width x depth x height, with rack ears)
 - 19.00” x 10.75” x 1.73” (483 mm x 273 mm x 44 mm)
 - Weight (with rack ears)
 - 5.9 lbs. (2.7 kg)

Provide (3) Denon DN-500BD MKII Bluray player with (3) 3’ C2G Locking HDMI cable. (Auditorium, Cafeteria, Media Center)

Digital Media Recorder

- Inputs
 - Mic/Line In (2 XLR connectors)
 - Line In (2 RCA connectors)
 - Digital In (1 AES/EBU, 1 S/PDIF)
 - Dante Digital In (RJ-45 Connector)
- Balanced Analog In L/R
 - Type: XLR (1: GND, 2: HOT, 3: COLD)
 - Line Setting Input Level: +4dbu
 - Maximum Input Level: +24 dBu/+20 dBu/ +18 dBu
 - Input Impedance: 20 k Ω
 - Mic Setting Input Level: -60 to 16 dBu
 - Input Impedance: 5 k Ω
 - EIN: Less than -127 dBu (Rs = 150 Ω)
 - CMRR: < 80 dB
- Unbalanced Analog In L/R
 - Type: RCA terminal
 - Input Level: -10 dBV
 - Maximum Input Level: +10 dBV/ +6 dBV/ 4 dBV

- Input Impedance: 10 k Ω
- Unbalanced Digital In
 - Type: RCA terminal
 - Input Impedance: 75 Ω
 - Standard Input Level: 0.5 Vp - p
 - Format: IEC-60958 (Coaxial)
- Balanced Digital In
 - Type: XLR (1: GND, 2: HOT, 3: COLD)
 - Input Impedance: 110 Ω
 - Standard Input Level: 3.5 Vp - p
 - Format: IEC-60958 (AES/EBU)
- Dante Digital In
 - Type: 10/100 Ethernet RJ-45 connector
 - Format: 24 bit; 96, 48, 44.1 kHz sampling rates, uncompressed
- Outputs
 - Balanced Analog Out L/R (XLR)
 - Unbalanced Out L/R (RCA)
 - Balanced Digital Out (AES/EBU)
 - Unbalanced Digital Out (S/PDIF)
 - Headphone Output (1/4" / 6.35mm)
 - Dante Digital Out (RJ-45 connector)
- Balanced Analog Out L/R
 - Type: XLR (1: GND, 2: HOT, 3: COLD)
 - Load Impedance: over 600 Ω
 - Output Level: +4 dBu at 600 Ω load
 - Maximum Output Level: +24 dBu/ +20 dBu/ +18 dBV
- Unbalanced Analog Out
 - Type: RCA terminal
 - Load Impedance: Over 10 k Ω
 - Output Level: -10 dBV
 - Maximum Output Level: +10 dBV/ +6 dBV/ +4 dBV
- Balanced Digital Out
 - Type: XLR (1: GND, 2: HOT, 3: COLD)
 - Output Impedance: 110 Ω
 - Standard Output Level: 3.0 Vp - p
 - Format: IEC-60958 (AES/EBU)
- Unbalanced Digital Out
 - Type: RCA terminal
 - Output Impedance: 75 Ω
 - Standard Output Level: 0.5 Vp - p
 - Format: IEC-60958 (Coaxial)
- Dante Digital Out
 - Type: 10/100 Ethernet RJ-45 connector
 - Format: 24 bit; 96, 48, 44.1 kHz sampling rates, uncompressed
- Dante Network Audio
 - Latency: Less than 1 ms (excluding auxiliary signal paths)
 - Sample Rate: DN-900R uses SRC on its output to Dante to convert recorder sample rates to Dante Network sample rates
 - Sample Bit Depth: 24 bit
- Storage
 - Maximum Storage Capacity: Up to 2 TB

- Maximum File Size: 2 GB
- Maximum Number of Files: 2000 files (for 1 folder)
- Maximum Number of Folders: 1000 folders
- Maximum Number of Folder Hierarchies: 8 (under the root directory)
- File System: FAT16, FAT32, HFS+, exFAT
- File Format Specifications
 - Compatible Media: SD, SDHC, USB memory, USB HDD
 - Extension: WAV, AIFF, AIF
 - Resolution: 16 bit, 24 bit
 - Sampling Frequency: 44.1k, 48k, 96k
- Playable MP3 Format
 - Extension: MP3
 - Bit Rate: 32 - 320 kbps, VBR
 - Sampling Frequency: 44.1k, 48k
- Playable AAC Format
 - Extension: M4A
 - Compression Method: AAC-LC
 - Bit Rate: 64 - 320 kbps, VBR
 - Sampling Frequency: 44.1k, 48k
- Audio Specification
 - Number of Channels: 2 (stereo), 1 (mono)
 - Audio Frequency Characteristics: Line / Mic (-16 dBu) (+0.5 dB / -1 dB)
 - S/N Ratio: < 89 dB (A-weighted)
 - Total Harmonic Distortion: Less than 0.01 %
 - Dynamic Range: <106 dB (for 24 bit WAV playback)
 - Channel Separation: > -90 dB
 - Variable Pitch Width: -16 % to + 16 % Variable Trim Adjustment Width: ± 2.0 db
- Power
 - Connection: Standard IEC (switching power supply)
 - Input Voltage: 120V AC, 60Hz (US and Canada models) 230V AC 50/60 Hz (EU, UK, Asia/Pacific models)
 - Power Consumption: 30 W, 0.4 W (standby), 3.4W (network standby)
- Environmental Conditions
 - Operating Temperature: 41 - 95 °F
 - Operating Humidity: 25 - 85 %, non-condensing
 - Storage Temperature: -4 to 140 °F
- Physical
 - Dimensions (width x depth x height): 16.92" x 9.48" x 1.68" (430 x 241 x 43mm)
 - Weight: 5.7 lbs (2.6 kg)

Provide (3) Denon DN-900R Digital Media Recorders. (Band, Choir, Orchestra)

Dante Wall Plate

The unD6IO Dante™ Audio Interface multi-IO wall plate shall feature two balanced mic/line XLR inputs, two balanced outputs on side panel de-pluggable connectors, two RCA line level inputs and a 3.5mm TRS line level input. The unit shall have a 3.5mm TRS line level output. The unD6IO shall fit into a dual-gang US junction box and be PoE enabled, so all connectivity (power, control and audio data) is provided by a single CAT-5e/6 cable.

Provide (10) Atterotech unD6IO Dante Wall Plates. (2-Aux Gym, 1-Band, 2-Cafeteria, 1-Choir, 3-Gym, 1-Orchestra)

Bluetooth Wall Plate

The Dante Bluetooth® interface unit shall provide stereo Bluetooth® wireless connectivity onto a Dante network, and a simple, one-button pairing interface. The unit shall provide two RCA line level inputs and one 3.5mm TRS line level input. The unit shall provide a 3.5mm TRS line level output, on the front of the unit. This outputs shall have software controlled volume. The Dante™ Bluetooth interface shall support bidirectional call-bridging capabilities as well as unidirectional media streaming receiver functionality. The internal analog to digital signal conversion shall be performed at 24-bit resolution with a sampling frequency of 48 kHz. The Dante interface unit shall receive power over the Ethernet cable from an 802.3af PoE compliant network switch. The Dante interface shall be wall mounted in a standard US dual gang junction box. The Dante interface shall be compatible with Attero Tech unIFY software for flexible control and monitoring in system applications. The Dante interface shall be compliant with the RoHS directive. The Dante interface unit shall be compliant with the EMI/EMC requirements for FCC and CE. The Dante interface shall be the Attero Tech unD6IO-BT.

Provide (13) AtteroTech unD6IO-BT Bluetooth wall plate. (2-Aux Gym, 1-Band, 2-Cafeteria, 1-Choir, 3-Gym, 3-Media Center, 1-Orchestra)

Digital Soundboard

The mixer shall be a compact digital mixer built around a 96kHz XCVI FPGA core with 48 input channels mixing to LR and 12 stereo mix outputs. The surface shall include 33 moving faders with 6 layers, each layer having dedicated keys, giving easy access to input channels, mixes, FX sends, FX returns, DCA masters and MIDI control. Each fader strip shall have dedicated PAFL, Select, and Mute buttons with indicators, a variable LED meter, a peak indicator LED and variable colour backlit LCD display. There shall be dedicated physical controls which allow for adjustment of key processing parameters, and which follow the select button for the input and output channels. The fader and rotary controls shall be of a high contrast colour to the mixer surface for excellent visibility during operation in low light conditions. The rotary controls shall also be illuminated to indicate function and availability for use. Send levels to mixes shall be displayed and adjusted using the faders. Surface illumination shall be integrated into the bodywork of the mixer. Local analogue inputs shall use balanced XLR sockets and connect to fully recallable digitally controlled preamplifiers. These shall be able to provide up to +60dB of gain, industry standard 48V phantom power, and include a switchable -20dB Pad to allow a maximum input level of +30dBu. Local analogue outputs shall be provided on 16 XLR sockets and 2 balanced TRS ¼ inch Jack sockets. These will have a nominal line output of +4dBu and a maximum output of +22dBu. There shall be a local “SLink” Ethernet audio expansion port with locking EtherCON connector, supporting multiple AoIP protocols and providing access to a maximum 128x128 digital channels, connected over a single cable ‘digital snake’ and allowing remote preamp control of Allen & Heath Remote Audio Units, as well as connection to Allen & Heath ME Personal Mixing Systems. A digital I/O Port shall be provided to accept optional cards, supporting a maximum 128x128 channels and the ability to interface with 3rd party AoIP protocols such as Dante and Waves. All input and output processing, routing options and system configuration shall be accessed and adjusted via a 7-inch colour touchscreen and associated dedicated rotary control. 16 user-assignable SoftKeys with variable colour LED illumination shall be provided for quick access to Input/Mix/DCA/Group Mutes, Tap Tempo, Scene Controls, MMC and SQ-Drive Controls, as well as 8 assignable rotary encoders with LCD display showing their current function. A footswitch connection shall be provided to allow assignable control from an optional single or dual footswitch. There shall be dedicated keys for quick Copy/Paste/Reset of processing parameters and mixes. The ability to assign channel on/off status and to switch between Pre/Post fade to the currently selected mix shall also be provided with dedicated keys. All input channels shall contain the following processing: Polarity, Trim, Insert, Gate, High Pass Filter, Parametric EQ, Compressor, Delay, Pan. All FX Return channels shall contain the following: Parametric EQ, Pan. All output mix channels shall contain the following processing: External input, Polarity, Trim, Insert, Parametric EQ, and Graphic EQ with RTA and faderflip mode, Compressor, Delay, Balance. All signal delays in the system shall be adjustable in Milliseconds. The mixer will allow the insertion of Allen & Heath DEEP processing models to channels, without affecting latency or processing abilities. 8 user-assignable effect racks shall be provided with a library of factory preset FX emulations. The FX racks shall be individually configurable as send/return from a

channel or FX/Mix, or inserted into input or output channels. There shall be 8 DCA groups and 8 Mute groups. An Automatic Mic Mixer shall be provided for automatic and dynamic adjustment of gain in spoken word applications. A global source option for the direct out of each input channel shall be provided in the routing screen. The tap-off point shall be adjusted to the following positions in the processing path: post Preamp, post HPF, post Gate, post Insert return, post PEQ, post Compressor, and post Delay. There shall be further global options to follow Fader, DCA and Mute. Direct outputs shall be assignable via the mixer soft patch bay. A Talkback facility shall be provided with the ability to send to any output mix with on screen status indication. An option to enable talkback latching and HPF shall be provided. A signal generator shall be provided with the ability to send a variable level signal to any output mix with visual assignment status on-screen. The following types of signals shall be available: Sine, White Noise, Pink Noise, and Band-Pass. Comprehensive input, output, and FX channel and RTA metering shall be provided on-screen. 12-LED bar meters on the surface shall indicate the Main mix bus level and the PAFL signal shall override the LR meters accompanied by a PAFL-active indicator. A default Mains to PAFL sub-mix shall be provided. There shall be a USB Type-A connector on the surface for stereo/multitrack recording/playback, data-transfer, archiving, and firmware updates direct to USB drives. On the rear panel there shall be a USB-B connection following the USB 2.0 standard for multi-channel, bidirectional audio streaming and MIDI DAW control between the mixer and a computer. A DAW transport control using popular DAW control protocols for computer shall be available via the touch-screen. Stereo digital output shall be provided on XLR following the AES/EBU standard and with switchable sample rates. The mixer shall provide a Fast Ethernet (100 Mbit/s) port for Cat5 cable connection to a computer for MIDI over TCP/IP control of mixer parameters via a wireless router (access point) for live mixing control, and the mixing system shall include application software for tablet and phone devices connected via a wireless network router to the LAN port. Input and output channel processing and parameters in the mixer shall be saved on demand as a user library item for recall in other channels. All library items shall be archived with the show-file. Library items shall be transferrable to USB drive as portable data to be used in other systems. The mixer shall provide the facility to save 300 scenes of the settings of the mixing system and these scenes shall be nameable. A comprehensive table of 'Scene Safes' shall be provided to prevent selected items from being changed from their state when the safe was enabled. A comprehensive scene filter shall be provided per scene to Allow / Block each parameter saved in a scene from being changed as that scene is recalled. An option shall be provided for password protection for log-in of several users with different levels of system access and permissions. A particular scene may be chosen to be recalled per change of userlogin if desired. The mixing system shall periodically record all current settings and return the mixer to that state after reboot following a power-cycle. The mixing control surface shall have a built in power supply accepting AC mains voltages of 100~240V, 50/60 Hz, 110W max via an earthed 3-pin IEC male connector mounted on the rear chassis. A Two Pole Push-Button switch shall be provided near the mains input. Recommended operating temperature for the mixer shall be 5 to 35 degrees Celsius.

Provide (1) Allen & Heath SQ-7 Digital Soundboard with (1) Allen & Heath AP11334 dust cover, (1) Allen & Heath M-SQ-SDANTE-A DANTE card, (1) Allen & Heath DX-HUB, and (2) Allen & Heath DX168. (Auditorium)

8 Channel Flexible Input/Output Endpoint

The network channel expander shall provide remote audio and control I/O to the System Processor leveraging the same native networked audio and control technology as the System Processor. The network channel expander shall operate natively on a standard gigabit Ethernet infrastructure available from a broad range of network infrastructure manufacturers, employing DiffServ quality of service, IEEE 1588-2008 (PTPv2) precision time protocol, UDP/IP audio data transport with floating point format audio data representation. The system shall not require IEEE 802.1AS, IEEE 802.1Qat or IEEE 802.1Qav support on the network infrastructure to function. The overall system latency from analog input to synchronized analog outputs anywhere on the network shall be 3.167ms. The system shall also be able to achieve an overall system latency of 3.167ms over Layer-3 routed network infrastructure without any additional hardware, software or connection services between subnets. The network channel expander shall offer eight "FLEX" channels that can be configured in real-time via software as either a mic/line input with +48v phantom power or a line level output with single channel granularity across the bank of eight channels. It shall also offer eight GPI control pins, eight GPO control pins, RS232 on a 3-pin Euroblock connector, Audio-to-USB Bridging via USB Type-B Device port as well as dual redundant networked audio, two USB Type-A Host

connectors, 2-pin Euroblock for +24v DC power and PoE+ power via the Q-LAN A network port. The network channel expander shall have the following front panel controls and indicators: blue monochrome OLED display with page forward capacitive touch button, Unit ID capacitive touch button, Power On blue LED, Two USB A Type ports. The system processor shall provide a monochrome 304x96 blue OLED graphics display displaying the device name, design name and system status, LAN A and B settings, and the firmware version. Device Status shall be displayed on the OLED display including I/O status, muting, level present indication, and system status. The network channel expander shall feature multiple mounting options for both under-table, on-wall, in rack (half-rack and full 19" rack widths) as well as the ability to securely mount alongside a companion device using the same mounting scheme to occupy a full, single 1RU rack space. All mounting hardware shall ship with the product. The network channel expander dimensions shall be: 1.75" x 8.66" x 9.43" (44mm x 305mm x 102mm).

Provide (5) QSC I/O-8 Flex 8-channel flexible input/output endpoint. (1 each Aux Gym, Band, Choir, Media Center, Orchestra)

Modular Input/Output Audio Frame

The system shall operate on a native gigabit Ethernet network, employing DiffServ quality of service, IEEE 1588 audio clock synchronization, UDP/IP data transport, and floating-point format audio data representation. The overall system latency from analog input to synchronized analog output(s) shall be 2.5 ms or less. For routed networks, the end to end system latency shall be 3.2 ms or less. The I/O Frame shall have the capability of being redundant. The Q-Sys I/O Frame can have a backup that has the same input source as the primary. The outputs of the backup are disconnected by relays, until a failover occurs, at which time the primary outputs are disconnected. Each I/O Frame shall have redundant "hot" network connections for seamless audio stream failover. The I/O capacity shall be up to 16 analog input and/or output channels using any combination of the following: Mic/Line Input card (High Performance or Standard), Line Output card, DataPort Output card. The I/O capacity shall be up to 32 digital channels using the AES-3 Input/Output card. The I/O Frame shall have the following front panel controls and indicators: LCD page forward momentary switch, Unit ID momentary switch, Clear settings momentary switch, Power on - blue LED, Device status - tri-color LED, audio signal - five tri-color LEDs per I/O card slot, 240 x 64 monochrome LCD graphics display. The I/O Frame shall have the following rear panel connectors: RS232 - DE-9 (male 9-pin D shell connector), GPIO - DA-15 (female 15-pin D shell connector), Q-Sys Network LAN A and LAN B - RJ45 1000 MBps only, line voltage connection for 100 VAC - 240 VAC, 47 - 63 Hz. The I/O Frame dimensions shall be: (HWD) 1.75" x 19" x 15" (44.45 mm x 482.6 mm x 381 mm)

Provide (1) QSC I/O Frame Modular Input/Output Audio Frame with (2) QSC CIML4, (2) QSC COL4 (Gym)

11.6" Touch Panel

The networked touch-screen controller shall enable control of a Q-SYS system via a full-color LCD screen display with in-plane switching (IPS) technology to drive the liquid crystals and a capacitive touch surface for user input.

The controller's display shall be rectangular with a 16:9 aspect ratio and a diagonal dimension of 11.6 inches (295 mm). It shall have 1920 x 1080 pixel resolution and up to 350 candelas/m² (or nits) brightness. The display shall be framed by a rectangular black trim 12.3 inches x 7.9 inches (313.6 mm x 201.5 mm). The controller shall be designed to mount on a wall surface and attach to standard North American and European wall and junction boxes in either a landscape or portrait orientation. When mounted, the face of the controller's panel shall protrude 1.6 inches (39.85 mm) from the wall surface.

The controller shall communicate with the Q-SYS core system processor via 1000 Mbps Ethernet using standard TCP/IP protocols and shall have an RJ-45 jack on the rear panel for this purpose. The touch-screen controller's user control interface (UCI) pages with graphics, controls, and indicators shall automatically load from the active Q-SYS design in the Q-SYS core system processor via the Ethernet connection. The UCI pages shall be developed in Q-SYS Designer Software using its UCI tool; its supported graphics types shall include such common color or grayscale bitmap formats as .png, .jpg, .svg, and .gif. Any Q-SYS objects that can be placed on the Q-SYS Designer

Schematic shall also be placeable on UCI pages; these shall include linear and rotary faders, buttons, meters, indicators, etc.

The controller shall be an IEEE 802.3af class 3 device that can be powered through its Ethernet connection from a Power over Ethernet (PoE) supply. It shall also have a locking two-position Euro-style terminal block for +24 V DC auxiliary power (up to 0.5 A) for redundancy or instead of PoE.

The controller shall have an operating temperature range of 0 C to 50 C (32° to 122° F) and shall be operable in non-condensing relative humidity as high as 85%. It shall typically dissipate 17 BTU (4.3 kcal) heat per hour but not more than 40 BTU (10.1 kcal) per hour.

The networked touch-screen controller shall be the QSC TSC-116w-G2.

Provide (1) QSC TSC -116w-G2 Touch Panels. (Media Center)

8" Touch Panel

The networked touch-screen controller shall enable control of a Q-SYS system via a full-color LCD screen display with in-plane switching (IPS) technology to drive the liquid crystals and a capacitive touch surface for user input.

The controller's display shall be rectangular with a 16:10 aspect ratio and a diagonal dimension of 8.0 inches (203 mm). It shall have 1280 × 800 pixel resolution and up to 400 candelas/m² (or nits) brightness. The display shall be framed by a rectangular black trim 8.8 inches × 5.8 inches (223.5 mm × 148.4 mm). The controller shall be designed to mount on a wall surface and attach to standard North American and European wall and junction boxes in either a landscape or portrait orientation. When mounted, the face of the controller's panel shall protrude 1.4 inches (36 mm) from the wall surface.

The controller shall communicate with the Q-SYS core system processor via 1000 Mbps Ethernet using standard TCP/IP protocols and shall have an RJ-45 jack on the rear panel for this purpose. The touch-screen controller's user control interface (UCI) pages—with graphics, controls, and indicators—shall automatically load from the active Q-SYS design in the Q-SYS core system processor via the Ethernet connection. The UCI pages shall be developed in Q-SYS Designer software using its UCI tool; its supported graphics types shall include such common color or grayscale bitmap formats as .png, .jpg, .svg, and .gif. Any Q-SYS objects that can be placed on the Q-SYS Designer Schematic shall also be placeable on UCI pages; these shall include linear and rotary faders, buttons, meters, indicators, etc.

The controller shall be an IEEE 802.3af class 3 device that can be powered through its Ethernet connection from a Power over Ethernet (PoE) supply. It shall also have a locking two-position Euro-style terminal block for +24 V DC auxiliary power (up to 0.5 A) for redundancy or instead of PoE.

The controller shall have an operating temperature range of 0 C to 50 C (32° to 122° F) and shall be operable in non-condensing relative humidity as high as 85%. It shall typically dissipate 23 BTU (5.8 kcal) heat per hour but not more than 40 BTU (10.1 kcal) per hour.

The networked touch-screen controller shall be the QSC TSC-80w-G2.

Provide (6) QSC TSC-80w-G2 Networked Touch Screen Controller with (3) Recessed Locking Boxes (1-Aux Gym (Recessed Locking Box), 1-Band, 1-Cafeteria (Recessed Locking Box), 1-Choir, 1-Gym (Recessed Locking Box), 1-Orchestra)

8 Channel Digital Networked Power Amplifier

The power amplifier shall be an eight-channel network-processing device that is designed to operate exclusively with a QSC Q-SYS ecosystem on a Gigabit Ethernet network. The amplifier shall be powered by a universal switch-mode power supply that supports operation at any AC voltage from 100 to 240 V at 50 or 60 Hz. The power supply

shall have power factor correction (PFC) to make the current flow nearly sinusoidal and analogous to the voltage waveform. The amplifier shall offer multi-stage sleep modes to automatically reduce AC power consumption during idle time. The amplifier shall be cooled by forced air, with the intake at the rear and exhaust at the front. The fan speed shall be thermally controlled and also shall be visible in units of revolutions per minute (RPM) on the amplifier's front panel as well as on its network control panel. The amplifier shall utilize a class D output circuit topology with eight individual channels, arranged in two banks of four (channels A–D and E–H) providing up to 8000 watts (maximum short term) total power and 4800 watts (continuous) total power. The amplifier outputs shall utilize a technology called FlexAmp™, which provides up to 2000 watts of power to each pair of channel outputs, to be apportioned between themselves as needed. The outputs shall also utilize Flexible Amplifier Summing Technology™, which allows multiple channel outputs to also be combined in series (i.e., bridged) and/or parallel. The amplifier shall be configurable via Q-SYS, including arranging the output channels as single units as well as in various bridged and parallel combinations. The amplifier's audio signals shall originate in the Q-SYS ecosystem and shall also be configurable in Q-SYS. The power amplifier shall have eight balanced analog mic/line audio inputs that stream digital audio data into the Q-SYS ecosystem in the form of Q-LAN data delivered via the network port. The impedance of each input shall be greater than 8 kΩ balanced or 4 kΩ unbalanced. The power amplifier shall meet the following performance criteria: typical distortion (into 8 ohm loads) of 0.02% to 0.05%; maximum distortion (4 to 8 ohms) of no worse than 1%; a frequency response (into an 8 ohm load) of from 20 Hz to 20 kHz at ±0.25 dB; noise at -104 dB (A weighted, with output section muted); maximum gain of 38.4 dB (on 1.2 V setting); IHF damping factor of greater than 100. Channel muting and gain shall be controllable via the amplifier's front panel controls or the Q-SYS ecosystem. Changes made either way shall immediately reflect in the other as well. The amplifier shall indicate network status and monitoring, including faults. The front panel shall offer a summary of fault and error conditions. The amplifier shall have output load monitoring on each output. The load monitor shall have the range to detect and calculate impedance of conditions including short circuits, low impedance loudspeakers, and lightly loaded 70 V and 100 V lines with impedances as high as 1 kΩ. The load monitor shall report the calculated load impedance on each channel via the front panel and the Q-SYS network. The amplifier front panel shall feature LED metering of all eight inputs and eight outputs, a 400 × 240 TFT color display, navigation buttons, an LED power button/indicator, a fault indicator, a control knob, and cast aluminum handles. The amplifier rear panel shall feature dual RJ-45 jacks for connecting to the Q-LAN network, enabling integration into the Q-SYS ecosystem for bi-directional passage of digital audio, control signals, and status monitoring data. The rear panel shall provide eight 3-pin Phoenix connectors for the balanced analog audio inputs (for mic or line signal levels), and eight touch-proof Phoenix connectors for connecting loudspeaker cables to the channel outputs. The amplifier rear panel shall also provide eight GPIO terminals that extend Q-SYS control to or from external devices. The amplifier shall be 3.5 in (89 mm) high, 19 in (482 mm) wide, and 16 in (406 mm) deep. The amplifier shall have a net weight of 26 lb (11.8 kg).

Provide (2) QSC CX-Q 8K8 8 Channel Digital Networked Power Amplifier. (Auditorium)

4 Channel Digital Networked Power Amplifier

The power amplifier shall be a four-channel network-processing device that is designed to operate exclusively with a QSC Q-SYS ecosystem on a Gigabit Ethernet network. The amplifier shall be powered by a universal switch-mode power supply that supports operation at any AC voltage from 100 to 240 V at 50 or 60 Hz. The power supply shall have power factor correction (PFC) to make the current flow nearly sinusoidal and analogous to the voltage waveform. The amplifier shall offer multi-stage sleep modes to automatically reduce AC power consumption during idle time. The amplifier shall be cooled by forced air, with the intake at the rear and exhaust at the front. The fan speed shall be thermally controlled and also shall be visible in units of revolutions per minute (RPM) on the amplifier's front panel as well as on its network control panel. The amplifier shall utilize a class D output circuit topology with four individual channels (A through D) providing up to 8000 watts (maximum short term) total power and 4800 watts (continuous) total power. The amplifier outputs shall utilize a technology called FlexAmp™, which provides up to 4000 watts of power to each pair of channel outputs, to be apportioned between themselves as needed. The outputs shall also utilize Flexible Amplifier Summing Technology™, which allows multiple channel outputs to also be combined in series (i.e., bridged) and/or parallel. The amplifier shall be configurable via Q-SYS,

including arranging the output channels as single units as well as in various bridged and parallel combinations. The amplifier's audio signals shall originate in the Q-SYS ecosystem and shall also be configurable in Q-SYS. The power amplifier shall have four balanced analog mic/line audio inputs that stream digital audio data into the Q-SYS ecosystem in the form of Q-LAN data delivered via the network port. The impedance of each input shall be greater than 8 k Ω balanced or 4 k Ω unbalanced. The power amplifier shall meet the following performance criteria: typical distortion (into 8 ohm loads) of 0.02% to 0.05%; maximum distortion (4 to 8 ohms) of no worse than 1%; a frequency response (into an 8 ohm load) of from 20 Hz to 20 kHz at ± 0.25 dB; noise at -104 dB (A weighted, with output section muted); maximum gain of 38.4 dB (on 1.2 V setting); IHF damping factor of greater than 100. Channel muting and gain shall be controllable via the amplifier's front panel controls or the Q-SYS ecosystem. Changes made either way shall immediately reflect in the other as well. The amplifier shall indicate network status and monitoring, including faults. The front panel shall offer a summary of fault and error conditions. The amplifier shall have output load monitoring on each output. The load monitor shall have the range to detect and calculate impedance of conditions including short circuits, low impedance loudspeakers, and lightly loaded 70 V and 100 V lines with impedances as high as 1 k Ω . The load monitor shall report the calculated load impedance on each channel via the front panel and the Q-SYS network. The amplifier front panel shall feature LED metering of all eight inputs and eight outputs, a 400 \times 240 TFT color display, navigation buttons, an LED power button/indicator, a fault indicator, a control knob, and cast aluminum handles. The amplifier rear panel shall feature dual RJ-45 jacks for connecting to the Q-LAN network, enabling integration into the Q-SYS ecosystem for bi-directional passage of digital audio, control signals, and status monitoring data. The rear panel shall provide four 3-pin Phoenix connectors for the balanced analog audio inputs (for mic or line signal levels), and four touch-proof Phoenix connectors for connecting loudspeaker cables to the channel outputs. The amplifier rear panel shall also provide eight GPIO terminals that extend Q-SYS control to or from external devices. The amplifier shall be 3.5 in (89 mm) high, 19 in (482 mm) wide, and 16 in (406 mm) deep. The amplifier shall have a net weight of 26 lb (11.8 kg).

Provide (2) QSC CX-Q 8K4 4 Channel Digital Networked Power Amplifier. (Aux Gym, Gym)

4 Channel Digital Networked Power Amplifier

The power amplifier shall be a four-channel network-processing device that is designed to operate exclusively with a QSC Q-SYS ecosystem on a Gigabit Ethernet network. The amplifier shall be powered by a universal switch-mode power supply that supports operation at any AC voltage from 100 to 240 V at 50 or 60 Hz. The power supply shall have power factor correction (PFC) to make the current flow nearly sinusoidal and analogous to the voltage waveform. The amplifier shall offer multi-stage sleep modes to automatically reduce AC power consumption during idle time. The amplifier shall be cooled by forced air, with the intake at the rear and exhaust at the front. The fan speed shall be thermally controlled and also shall be visible in units of revolutions per minute (RPM) on the amplifier's front panel as well as on its network control panel. The amplifier shall utilize a class D output circuit topology with four individual channels (A through D) providing up to 4000 watts (maximum short term) total power. The amplifier outputs shall utilize a technology called FlexAmp™, which provides up to 2000 watts of power to each pair of channel outputs, to be apportioned between themselves as needed. The outputs shall also utilize Flexible Amplifier Summing Technology™, which allows multiple channel outputs to also be combined in series (i.e., bridged) and/or parallel. The amplifier shall be configurable via Q-SYS, including arranging the output channels as single units as well as in various bridged and parallel combinations. The amplifier's audio signals shall originate in the Q-SYS ecosystem and shall also be configurable in Q-SYS. The power amplifier shall have four balanced analog mic/line audio inputs that stream digital audio data into the Q-SYS ecosystem in the form of Q-LAN data delivered via the network port. The impedance of each input shall be greater than 8 k Ω balanced or 4 k Ω unbalanced. The power amplifier shall meet the following performance criteria: typical distortion (into 8 ohm loads) of 0.02% to 0.05%; maximum distortion (4 to 8 ohms) of no worse than 1%; a frequency response (into an 8 ohm load) of from 20 Hz to 20 kHz at ± 0.25 dB; noise at -104 dB (A weighted, with output section muted); maximum gain of 35 dB (on 1.2 V setting); IHF damping factor of greater than 100. Channel muting and gain shall be controllable via the amplifier's front panel controls or the Q-SYS ecosystem. Changes made either way shall immediately reflect in the other as well. The amplifier shall indicate network status and monitoring, including faults. The front panel shall offer a summary of fault and error conditions. The amplifier shall have output load monitoring

on each output. The load monitor shall have the range to detect and calculate impedance of conditions including short circuits, low impedance loudspeakers, and lightly loaded 70 V and 100 V lines with impedances as high as 1 k Ω . The load monitor shall report the calculated load impedance on each channel via the front panel and the Q-SYS network. The amplifier front panel shall feature LED metering of all eight inputs and eight outputs, a 400 \times 240 TFT color display, navigation buttons, an LED power button/indicator, a fault indicator, a control knob, and cast aluminum handles. The amplifier rear panel shall feature dual RJ-45 jacks for connecting to the Q-LAN network, enabling integration into the Q-SYS ecosystem for bi-directional passage of digital audio, control signals, and status monitoring data. The rear panel shall provide four 3-pin Phoenix connectors for the balanced analog audio inputs (for mic or line signal levels), and four touch-proof Phoenix connectors for connecting loudspeaker cables to the channel outputs. The amplifier rear panel shall also provide eight GPIO terminals that extend Q-SYS control to or from external devices. The amplifier shall be 3.5 in (89 mm) high, 19 in (482 mm) wide, and 16 in (406 mm) deep. The amplifier shall have a net weight of 25 lb (11.3 kg).

Provide (4) QSC CX-Q 4K4 4 Channel Digital Networked Power Amplifier. (Band, Choir, Media Center, Orchestra)

8 Channel Digital Networked Power Amplifier

The power amplifier shall be an eight-channel network-processing device that is designed to operate exclusively with a QSC Q-SYS ecosystem on a Gigabit Ethernet network. The amplifier shall be powered by a universal switch-mode power supply that supports operation at any AC voltage from 100 to 240 V at 50 or 60 Hz. The power supply shall have power factor correction (PFC) to make the current flow nearly sinusoidal and analogous to the voltage waveform. The amplifier shall offer multi-stage sleep modes to automatically reduce AC power consumption during idle time. The amplifier shall be cooled by forced air, with the intake at the rear and exhaust at the front. The fan speed shall be thermally controlled and also shall be visible in units of revolutions per minute (RPM) on the amplifier's front panel as well as on its network control panel. The amplifier shall utilize a class D output circuit topology with eight individual channels, arranged in two banks of four (channels A–D and E–H) providing up to 4000 watts (maximum short term) total. The amplifier outputs shall utilize a technology called FlexAmp™, which provides up to 1000 watts of power to each pair of channel outputs, to be apportioned between themselves as needed. The outputs shall also utilize Flexible Amplifier Summing Technology™, which allows multiple channel outputs to also be combined in series (i.e., bridged) and/or parallel. The amplifier shall be configurable via Q-SYS, including arranging the output channels as single units as well as in various bridged and parallel combinations. The amplifier's audio signals shall originate in the Q-SYS ecosystem and shall also be configurable in Q-SYS. The power amplifier shall have eight balanced analog mic/line audio inputs that stream digital audio data into the Q-SYS ecosystem in the form of Q-LAN data delivered via the network port. The impedance of each input shall be greater than 8 k Ω balanced or 4 k Ω unbalanced. The power amplifier shall meet the following performance criteria: typical distortion (into 8 ohm loads) of 0.02% to 0.05%; maximum distortion (4 to 8 ohms) of no worse than 1%; a frequency response (into an 8 ohm load) of from 20 Hz to 20 kHz at ± 0.25 dB; noise at -104 dB (A weighted, with output section muted); maximum gain of 38.4 dB (on 1.2 V setting); IHF damping factor of greater than 100. Channel muting and gain shall be controllable via the amplifier's front panel controls or the Q-SYS ecosystem. Changes made either way shall immediately reflect in the other as well. The amplifier shall indicate network status and monitoring, including faults. The front panel shall offer a summary of fault and error conditions. The amplifier shall have output load monitoring on each output. The load monitor shall have the range to detect and calculate impedance of conditions including short circuits, low impedance loudspeakers, and lightly loaded 70 V and 100 V lines with impedances as high as 1 k Ω . The load monitor shall report the calculated load impedance on each channel via the front panel and the Q-SYS network. The amplifier front panel shall feature LED metering of all eight inputs and eight outputs, a 400 \times 240 TFT color display, navigation buttons, an LED power button/indicator, a fault indicator, a control knob, and cast aluminum handles. The amplifier rear panel shall feature dual RJ-45 jacks for connecting to the Q-LAN network, enabling integration into the Q-SYS ecosystem for bi-directional passage of digital audio, control signals, and status monitoring data. The rear panel shall provide eight 3-pin Phoenix connectors for the balanced analog audio inputs (for mic or line signal levels), and eight touch-proof Phoenix connectors for connecting loudspeaker cables to the channel outputs. The amplifier rear panel shall also provide

eight GPIO terminals that extend Q-SYS control to or from external devices. The amplifier shall be 3.5 in (89 mm) high, 19 in (482 mm) wide, and 16 in (406 mm) deep. The amplifier shall have a net weight of 25 lb (11.3 kg).

Provide (1) QSC CX-Q 4K8 8 Channel Digital Networked Power Amplifier. (Cafeteria)

Hybrid Point Source/Line Array 12" Loudspeaker

- Hybrid Point Source/Line Array Constant Directivity Loudspeaker
- Incorporates eight 2-inch high-frequency drivers centered in front of a 12-inch woofer
- 2-inch x 8 HF, 20-degree driver array with 1-inch voice coils
- Custom 12-inch LF Driver with 2.5-inch voice coil
- 420 Hz crossover frequency minimizes comb filtering
- Truly symmetrical 120° x 20° coverage with reduced variation in SPL levels throughout the listening area
- Dante enabled with accessible system tuning via WorxControl
- Integrated rigging hardware that can accommodate up to six enclosures when flown
- 500 x 500 watt class D amplifier with on-board DSP presets
- Robust Neutrik PowerCon In and Out connectivity

Provide (16) Presonus CDL12 constant directivity loudspeakers and all necessary rigging, power cables, and audio cables. (4-Auditorium, 12-Gym)

12" Passive Speaker

System Performance

- Frequency Response (-3 dB): 54 Hz – 17 kHz
- Frequency Range (-10 dB): 45 Hz – 19 kHz
- Recommended High-Pass: 40 Hz – with minimum 24 dB / octave (4th order) Butterworth slope
- Nominal directivity (-6 dB): Horizontal: 75°
- Nominal directivity (-6 dB): Vertical: 75°
- Recommended Crossover Frequency: 1.6 kHz (acoustic, active, external DSP)
- RMS handling capacity: LF: 200W, HF: 60W
- Maximum SPL @ 1 Meter : 124 dB ([WorxAudio] preset)

Transducers

- Components: LF- 12" (304.8 mm) x 1, HF- 1" Exit (25.4 mm) x 1
- Nominal Impedance: LF = 8 ohms, HF = 8 ohms, Self Powered, Passive= 8 ohms

Physical

- Enclosure: Baltic birch plywood, engineered plastics, and aluminum frame
- Finish: Two-part spray catalyzed Polyurea coating on plywood
- Grille: 16-gauge (0.06 mm) perforated steel, powder-coated finish, black
- Environmental: Indoor use only
- Connectors: Passive Version: Two (2) parallel-wired NL4 Neutrik® Speakon® connectors
- Power Amp Connectors: Self Powered Version: Neutrik® PowerCon (AC) XLR M/F (In/Out) or Dante
- Suspension/Mounting: Internal bracket w/ threaded 0.375" flying points (x12)
- Dimensions: 23.5" H x 18.25" W x 17.5" D (596.9 mm x 463.55 mm x 444.5 mm)
- Net Weight: 54 lb. (24.49 kg)

- Shipping Weight: 62 lb. (28.12 kg) - approximate with carton
- Product Versions: 12Ai: Passive; 12Ai-P: Powered
- Digital Power Amp:
 - 1000W driving passive 8 ohm
 - Digital program processing
 - XLR I/O Dante-enabled
 - AC powerCON I/O

Provide (15) Presonus W-12Ai 12" Passive Speakers with necessary rigging hardware. (5-Auditorium, 10-Gym)

8" Passive Speaker

System Performance

- Frequency Response (-3 dB): 68 Hz – 17 kHz
- Frequency Range (-10 dB): 48 Hz – 19 kHz
- Recommended High-Pass: 40 Hz – with minimum 24 dB / octave (4th order) Butterworth slope
- Nominal directivity (-6 dB): Horizontal: 75°
- Nominal directivity (-6 dB): Vertical: 75°
- Recommended Crossover Frequency: 1.6 kHz (acoustic, active, external DSP)
- RMS handling capacity: LF: 150W, HF: 60W
- Maximum SPL @ 1 Meter: 121 dB ([WorxAudio] preset)

Transducers

- Components: LF- 8" (203.2 mm) x 1, HF- 1" Exit (25.4 mm) x 1
- Nominal Impedance: LF = 8 ohms, HF = 8 ohms, Self Powered, Passive=8 ohms

Physical

- Enclosure: Baltic birch plywood, engineered plastics, and aluminum frame
- Finish: Two-part spray catalyzed Polyurea coating on plywood
- Grille: 16-gauge (0.06 mm) perforated steel, powder-coated finish, black
- Environmental: Indoor use only
- Connectors: Passive Version: Two (2) parallel-wired NL4 Neutrik® Speakon® connectors
- Power Amp Connectors Self Powered Version: Neutrik® PowerCon (AC) XLR M/F (In/Out) or Dante
- Suspension/Mounting: Internal bracket w/ threaded 0.375" flying points (x12)
- Dimensions: 18.25" H x 11.25" W x 12" D (463.55 mm x 317.5 mm x 285.75 mm)
- Net Weight: 34 lb. (15.42 kg)
- Shipping Weight: 39 lb. (17.69 kg) - approximate with carton
- Product Versions: W-8Ai: Passive; W-8Ai-P: Powered
- Digital Power Amp:
 - 1000W driving passive 8 ohm
 - Digital program processing
 - XLR I/O Dante-enabled
 - AC powerCON I/O

Provide (1) Presonus W-8Ai 8" Passive Speakers with necessary rigging hardware. (Auditorium)

Double 18" Subwoofer

System Performance

- Frequency Response (-3 dB): 25 Hz – 150 Hz
- Frequency Range (-10 dB): 18 Hz – 150 Hz
- Recommended High-Pass: 20 Hz – with minimum 24 dB / octave (4th order) Butterworth slope
- Nominal directivity (-6 dB): Omni or cardioid
- Recommended Crossover Frequency: 90 Hz (acoustic, active, external DSP)
- RMS handling capacity: LF: 4000 W
- Maximum SPL @ 1 Meter: 143 dB ([WorxAudio] preset)

Transducers

- Components: LF: 18" (457.2 mm) x 2
- Nominal Impedance: LF = 4 ohms, Self Powered

Physical

- Enclosure: Baltic birch plywood, engineered plastics, and aluminum frame
- Finish: Two-part spray catalyzed Polyurea coating on plywood
- Grille: 14-gauge (1.0 mm) perforated stainless steel, powder-coated finish, black
- Environmental: Indoor use only
- Connectors: Two (2) parallel-wired NL4 Neutrik® Speakon® connectors
- Power Amp Connectors: Neutrik® powerCON (AC) XLR M/F (In/Out)
- Suspension/Mounting: Internal bracket w/ threaded 0.375" Flying points (x17)
- Dimensions: 22.5" H x 48" W x 30" D (571.5 mm x 1,219.2 mm x 762 mm)
- Net Weight: 285 lb. (129.27 kg)
- Shipping Weight: 295 lb. (133.80 kg) - approximate with carton
- Digital Power Amp: PXD-2500, 2500W (x1) LF, Digital (100) program processing, LCD readout, XLR M/F Isolated I/O, AC powerCON I/O

Provide (4) WorxAudio TL218SSi Subwoofer with rigging hardware. (2-Auditorium, 2-Gym)

12" Full Range Speakers

The professional high-power installation loudspeaker system shall be a two-way full-range design incorporating a 12-inch (305 mm) low frequency transducer with 3-inch (76 mm) voice coil and a 3.0 inch high-frequency ferrite compression driver mounted to an axisymmetric waveguide that matches the woofer beamwidth through the crossover to ensure flat sound-power response. The loudspeaker system shall be capable of operation in either passive mode or bi-amped with a recommended crossover frequency of 950 Hz.

The loudspeaker system shall meet the following performance criteria: frequency response of 48 Hz to 18 kHz @ 10 dB, measured on-axis; sensitivity (1W @ 1m) of 95 dB SPL in free field; maximum rated SPL at 1m of 122 dB continuous and 128 dB peak; rated power capacity of 60V or 550W (passive) based on a two-hour power test using IEC60268 noise; recommended amplifier power of 1100 W (passive); nominal impedance of 8 Ohms. The loudspeaker system's nominal coverage shall be axisymmetric at 90 degrees in both vertical and horizontal planes.

The loudspeaker system input connectors shall include both an NL4 Speakon connector and covered barrier strip terminals. The trapezoidal loudspeaker enclosure shall be constructed of 15-ply Baltic birch plywood and finished in either of two RAL colors: black (9011) or white (9010). The front of the full range system shall be protected by a

16-Gauge powder-coated steel grille that is lined with acoustically transparent backing and is free of logos or other embellishment. The enclosure shall have fifteen M10 threaded-insert mounting points (two on each side, three on the back, and four each on the top and bottom) for suspension via eye bolts as well as mount points for an optional yoke bracket.

The loudspeaker system enclosure shall be 26 in (660 mm) high, 15 in (381 mm) wide, and 13 in (330 mm) deep. The loudspeaker shall have a net weight of no more than 65 lb (29.5 kg).

Provide (9) QSC AP-5122 12" Full Range Speakers with (6) Yoke Mounts. (Aux Gym)

12" Surface Mount Speaker

The professional small format, surface mount loudspeaker system shall be a two-way full-range design utilizing Directivity Matched Transition (DMT) to match low and high frequency coverage at the crossover point. The loudspeaker low-frequency transducer shall be an 12-inch (305 mm) woofer with a weather-resistant paper cone and a 3-inch voice coil. The loudspeaker high-frequency transducer shall be a 1-inch (25 mm) compression driver with a 1.4-inch voice-coil coupled to a baffle-integrated waveguide. The loudspeaker system shall meet the following performance criteria: effective frequency range of 52 Hz to 20 kHz (free-field, -10 dB from on-axis sensitivity); broad-band sensitivity of 95 dB SPL (on-axis, free-field sensitivity, 2.83V, 1 m); maximum rated SPL (calculated) of 120 dB continuous and 126 dB peak; rated power capacity of 50V or 300W (two hours IEC60268-1 noise); recommended amplifier power of 600W; rated impedance of 8 Ohms. The loudspeaker system's nominal coverage angle shall be 75 degrees (-6 dB) axisymmetric. The loudspeaker system connectors shall be mounted on a sealed input panel including a Euroblock connector and parallel output terminals, and shall be fitted with a protective weather cup. The loudspeaker enclosure, which shall meet IEC60529 IP-54 specifications for dust and splash resistance, shall be constructed of ABS polymer and finished in either of two RAL colors: black (9011) or white (9010). The front of the full range system shall be protected by a powder-coated aluminum grille that is free of logos or other embellishment. The enclosure shall be fitted with an integral mounting plate for a mounting system (QSC X-Mount) that allows the speaker to be rotated in four orientations and includes a tab whose removal makes the loudspeaker theft-resistant. The enclosure shall also have four M10 threaded-insert mounting points (one on the top and three on the bottom) for suspension via eye bolts as well as mount points for an optional yoke bracket. The enclosure shall be 23.5 in (596 mm) high, 13.9 in (354 mm) wide, and 12.7 in (323 mm) deep. The loudspeaker system shall have a net weight of 35 lb (16 kg).

Provide (8) QSC AD-S12T 12" Surface Mount Speakers. (2-Band, 2-Cafeteria, 2-Choir, 2-Orchestra)

12" Dual Subwoofer

The subwoofer system shall incorporate two 12-inch low frequency transducers, each with a 2.5 in (64 mm) voice coil. The transducers shall be reverse mounted on a V-baffle. The enclosure itself shall be ported, with sufficient port area to minimize turbulence and distortion.

The subwoofer system shall have an effective and usable frequency range of 35 Hz to 250 Hz. It shall have a continuous power rating of 600 watts (49 V rms), determined by an AES2-1984 noise test for two hours. Its nominal impedance shall be 4 ohms. Its free-field sensitivity, measured on-axis with a 2 V rms signal (i.e., 1 watt into 4 ohms), shall be 93 dB.

The enclosure and its internal bracing shall be constructed of 15 mm Baltic birch plywood, finished in an environmentally friendly black polymer finish (RAL 9011). The front grille shall be constructed of 16-gauge steel, powder coated also in RAL 9011 black. The grille shall have no logos or adornments, and shall be lined with acoustically transparent backing to enhance its appearance.

The enclosure shall have two M20 threaded-insert pole attachment points: one for a vertical orientation of the enclosure and one for horizontal. The enclosure shall feature four integrated handles and may, as an option, be fitted with a kit of four casters.

The subwoofer system's inputs shall comprise two cross-connected NL4 Speakon connectors, one being "input" and the other, "thru."

The subwoofer system enclosure shall measure 660 mm high (26 in) x 381 mm wide (15 in) x 610 mm deep (24 in) and shall have a net weight of 29.7 kg (65.4 lb).

The subwoofer system shall be the QSC AP-212sw.

Provide (3) QSC AP-212sw 12" Dual Subwoofers. (Band, Choir, Orchestra)

6" Ceiling Mount Speaker

The ceiling mount 2-way co-axial system shall incorporate a 6.5-inch woofer with treated-paper cone and a 19 mm aluminum dome tweeter. The tweeter shall be mounted coaxially in front of the woofer on a waveguide that matches the directivity of the two drivers at the crossover point. The system shall meet the following performance criteria: conical coverage angle of 140 degrees; frequency response of 65 Hz to 20 kHz ± 10 dB, measured on axis; sensitivity of 88 dB SPL in half space at 1 meter with an input of 4 V rms; maximum continuous output of 106 dB SPL; maximum peak output of 112 dB SPL on axis at 1 meter; power handling of 60 watts for 8 hours with an IEC noise signal; recommended amplifier power of 120 watts; nominal impedance of 16 ohms. The loudspeaker shall have a switchable low-distortion, wide-bandwidth laminated core transformer with taps for 60, 30, 15, and 7.5 watts at 70V and 60, 30, and 15 watts at 100V. The system shall be switchable between 16 Ω (bypass) and constant-voltage operation. The loudspeaker shall have a powder coated steel back can. The baffle and the grille shall have either a white (RAL 9010) or black (RAL 9011) paintable finish with UV inhibitors to prevent discoloration. The enclosure shall retain the grille magnetically. Any logo on the grille shall be removable without leaving a blemish. The loudspeaker shall have a double-stepped long-travel dog-ear blind mounting system that can capture ceiling thicknesses from 0 to 2.25 in. The conduit cover plate shall be removable, retained by a captive Phillips head screw. A mud ring shall be provided to allow pre-installation wiring. The loudspeaker connections shall be a locking 4-pole Euro-block that accepts four 18 AWG wire pairs. The loudspeaker shall be listed as safe for use in air-handling spaces under UL1480 and UL2043. The loudspeaker shall meet or exceed IP-34 for ingress protection; it shall meet the IEC 60529 IP-X3 splash rating. The switchable transformer shall be listed under UL1876. The baffle shall meet UL94-V0 and UL94-5VB flammability ratings and shall comply with IEC60849/EN60849 safety standards. The loudspeaker's enclosure shall be 9.32 in (23.7 cm) high and 11.02 in (28.0 cm) in diameter. The loudspeaker shall weigh no more than 9.5 lb (4.3 kg). The ceiling mount 2-way co-axial system shall be the QSC AD-C6T.

Provide (24) QSC AD-C6T 6" Ceiling Mount Speakers with (3) QSC WCP-1 Volume Controls. (5-Auditorium w/volume controls, 15-Cafeteria, 4-Media Center)

6" Pendant Mount Speaker

The pendant-style 2-way co-axial system shall incorporate a 6.5-inch woofer with treated-paper cone and a 19 mm aluminum dome tweeter. The tweeter shall be mounted coaxially in front of the woofer on a waveguide that matches the directivity of the two drivers at the 1900 Hz crossover point. The system shall meet the following performance criteria: conical coverage angle of 135 degrees; effective frequency range of 56 Hz to 20 kHz ± 10 dB, measured on axis; broadband sensitivity of 88 dB (measured at 1 m with 4 V rms input); maximum continuous output of 106 dB SPL and maximum peak output of 112 dB SPL on axis at 1 meter; power handling of 60 watts for 8 hours with an IEC noise signal; recommended amplifier power of 120 watts; nominal impedance of 16 ohms. The loudspeaker shall have a switchable low-distortion, wide-bandwidth laminated core transformer with taps for 60, 30, 15, and 7.5 watts at 70V and 60, 30, and 15 watts at 100V. The system shall be switchable between 16 Ω (bypass) and constant-voltage operation. The loudspeaker shall have an ABS enclosure. The baffle and the grille shall have either a white (RAL 9010) or black (RAL 9011) paintable finish with UV inhibitors to prevent discoloration. The enclosure shall

retain the grille magnetically. Any logo on the grille shall be removable without leaving a blemish. The loudspeaker enclosure shall have a steel hanger tab for support and shall include two 3.25 m quick-link 2 mm suspension cables with slip-lock fasteners. The loudspeaker connections shall be a locking 4-pole Euro-block that accepts two 12 AWG wire pairs. The loudspeaker shall be listed as safe for use in air-handling spaces under UL1480. The loudspeaker shall meet or exceed IP-34 for ingress protection. The switchable transformer shall be listed under UL1876 and shall be CE and RoHS compliant. The baffle shall meet UL94-V0 and UL94-5VB flammability ratings and shall comply with IEC60849/EN60849 safety standards. The loudspeaker's enclosure shall be 12.7 in (32.3 cm) high and 11.3 in (28.7 cm) in diameter. The loudspeaker shall weigh no more than 9 lb (4.1 kg). The pendant-style 2-way co-axial system shall be the QSC AD-P6T.

Provide (8) QSC AD-P6T 6" Pendant Mount Speakers. (Media Center)

Assistive Listening System

The stationary RF transmitter shall be capable of broadcasting on 57 channels. The transmitter shall have an SNR of 80 dB or greater. The output power shall be adjustable to quarter, half or full. Channel tuning shall be capable of being locked. The device shall have an audio frequency response of 50 Hz to 15k Hz, ± 3 dB at 72 MHz. It shall have two (2) mixing audio inputs and a mixed signal output. The device shall have the following audio controls: input level, mix level and an adjustable low pass filter (contour). The device shall have an audio processor that is capable of automatic gain control and limiting.

The RF receiver shall be capable of receiving on 57 wide and narrow band channels. The device shall tune to a single channel and user shall not be able to change the channel. The receiver shall have a signal-to-noise ratio of 80 dB or greater and shall have an audio frequency response of 50 Hz – 15 kHz (± 3 dB). The device shall employ a unique DSP SQTM noise reduction technology. The unit shall have a programmable squelch circuit. The unit shall incorporate a multi-functional display that indicates battery status, inventory number and channel. The device shall have the option of being lanyard or belt clip worn and the lanyard shall have the option of an integrated neck loop. The device shall have a USB connector used for inventory control, set up, charging and firmware upgrades. The device shall incorporate automatic battery charging circuitry and use a non-proprietary lithium ion battery. The device shall have additional charging contacts to allow multiple charging options.

Provide:

- (8) Listen LT-800-72-01 ALS Transmitters with (8) Listen LA-326 rack kits (Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, Orchestra)
- (8) Listen LA-122 Antennas (Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, Orchestra)
- (8) Listen LA-304 Signage Kits (Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, Orchestra)
- (1) Listen LA-465 DANTE adapters. (Cafeteria)
- (52) Listen LR-4200-072 ALS Receivers with (52) Listen LA-430 Intelligent Ear Phone/Neck Loop, (52) Listen LA-401 Universal Ear Speaker (16-Auditorium, 4-Aux Gym, 4-Band, 4-Cafeteria, 4-Choir, 12-Gym, 4-Media Center, 4-Orchestra)
- (2) Listen LA-381 Intelligent 12 Unit Charging Tray. (Auditorium, Gym)

48 Port POE+ Network Switch

The network switch shall provide forty-eight 10/100/1000 Mbps half/full duplex ports on RJ45 connections. Twenty-four of the 10/100/1000 Mbps ports also provide IEEE 802.3at compliant PoE+ with up to 375-Watts total power budget. Additionally, the switch shall offer four 10 Gbps SFP/SFP+ ports. The switch shall be fully Layer 2 managed (non-blocking) and preconfigured with appropriate quality of service (QoS) for use with Q-SYS Q-LAN audio, video, and control networks as well as related network AV technologies including AES67 and Dante. It shall provide IGMP snooping and IGMP querying for networked audio and video multicast traffic. The network switch shall have an internal 500 Watt power supply with a rear panel IEC power input socket for 120-240 VAC. Operating temperature range shall be 32° to 113° F (0° to 45° C) with a maximum operating humidity of 95% and maximum thermal output of 1566 BTU/hr. The network switch shall meet UL/cUL/CSA/CE/EAC/GS safety requirements and

comply with CE and FCC Class A emissions limits. The device shall be RoHS, WEEE, and REACH compliant. The full-width 1U chassis shall be constructed of cold rolled steel and molded plastic. The dimensions of the network switch shall be 1.75" x 17" x 10" (44 mm x 432 mm x 254 mm) and standard 19" 1U rack mounting hardware shall be included.

Provide (1) QSC NS-1148P 48 port POE+ network switch, (2) fiber GBIC's, (1) Fiber Box, and (1) 48-port shielded CAT6 patch bay (Auditorium)

24 Port POE Network Switch

The network switch shall provide twenty-four 10/100/1000 Mbps half/full duplex ports on RJ45 connections. Twelve of the 10/100/1000 Mbps ports also provide IEEE 802.3at compliant PoE+ with up to 190-Watts total power budget. Additionally, the switch shall offer four 10 Gbps SFP/SFP+ ports.

The switch shall be fully Layer 2 managed (non-blocking) and preconfigured with appropriate quality of service (QoS) for use with Q-SYS Q-LAN audio, video, and control networks as well as related network AV technologies including AES67 and Dante. It shall provide IGMP snooping and IGMP querying for networked audio and video multicast traffic.

The network switch shall have an internal 250 Watt power supply with a rear panel IEC power input socket for 120-240 VAC. Operating temperature range shall be 32° to 113° F (0° to 45° C) with a maximum operating humidity of 95% and maximum thermal output of 852 BTU/hr.

The network switch shall meet UL/cUL/CSA/CE/EAC/GS safety requirements and comply with CE and FCC Class A emissions limits. The device shall be RoHS, WEEE, and REACH compliant.

The full-width 1U chassis shall be constructed of cold rolled steel and molded plastic. The dimensions of the network switch shall be 1.75" x 17" x 10" (44 mm x 432 mm x 254 mm) and standard 19" 1U rack mounting hardware shall be included.

The network switch shall be the QSC Q-SYS NS-1124P Network Switch.

Provide (8) QSC Q-SYS NS-1124P 24 Port POE Network Switches, (16) fiber GBIC's, and (8) Fiber Boxes. (Auditorium, Aux Gym, Band, Cafeteria, Choir, Gym, Media Center, Orchestra)

Provide (1) SFP+ Core Switch capable of handling Q-LAN traffic and (1) Fiber Box (MDF)

Networked Video System

Provide (3) Network Video Encoders by Visionary Solutions (Duet), Atlona (Omni), or QSC (NV) (Auditorium, Cafeteria, Media Center)

Provide (7) Network Video Encoder Wallplates by Visionary Solutions (Duet), Atlona (Omni), or QSC (NV) (2-Auditorium, 2-Cafeteria, 3-Media Center)

Provide (5) Network Video Decoders by Visionary Solutions (Duet), Atlona (Omni), or QSC (NV) (1-Auditorium, 1-Cafeteria, 3-Media Center)

Screen Control

Provide (3) Global Cache IP2CC-P (1-Auditorium, 3-Media Center)

Projection Screen

Provide (1) projection screen(s), 120" (H) x 192" (W), electrically operated 120 volt (60Hz) not more than 2.4 amp. Shall have specially designed motor mounted inside the roller, to be three wire with ground quick reversal type, oiled for life, with automatic thermal overload cut-out, integral gears, capacitor and an electric brake to prevent coasting. To have pre-set but adjustable limit switches to automatically stop picture surface in the "up" and "down"

positions. The roller to be of aluminum. Screen fabric to be flame retardant and mildew resistant vinyl with black masking borders standard. Each side of fabric to have a tab guide cable system to maintain even lateral tension and hold surface flat. Bottom of fabric to be inserted into a custom aluminum slat bar with added weight to provide vertical tension on the screen surface. The ends of the slat to be protected by heavy duty plastic caps enclosing a preset adjustable mechanism for screen tensioning. Case to be a two-piece design made of extruded aluminum with a white, lightly textured powder coat finish. Screen to include a three-position control switch and cover plate. Screen to be listed by Underwriters' Laboratories.

Provide (1) Da-Lite model 24848L, 16:10, tensioned, HD Progressive 1.3, 226" Diagonal screen with 120" drop, Low Voltage Control, and (1) Global Cache IP2CC-P (Auditorium)

Projection Screen

Provide 120"(H) x 192"(W), To have flexible screen surface, fire retardant and mildew resistant. Screen surface standard with reinforced black binding on all four sides and will attach to frame with metal grommets. Screen surface to wrap around the frame. Frame to be 2 1/2" wide x 1 3/8" deep with 1/8" lip to eliminate marks on the surface. Frame to be made of aluminum and slipjointed at corners. Screen to have a bezel that will conceal frame, grommets and binding. Front lip of bezel to be 1/4" all around viewing area surface. Bezel to be made of aluminum. Bezel to have Acid Etched Black finish. Standard wallmounting brackets will be included. Bottom back of screen to be secured, with a screw, to a bottom wall bracket .

Provide (1) Da-Lite model 29958, 16:10, Parallax Stratos 1.0, 226" Diagonal screen. (Cafeteria)

Projection Screen

(2) projection screen(s), 72.5" (H) x 116" (W), electrically operated 120 volt (60 Hz) not more than 2.4 amp. with a quick connect male plug-in connector on the motor. Shall have specially designed motor mounted inside the roller, to be three wire with ground, quick reversal type, oiled for life, with automatic thermal overload cutout, integral gears, capacitor and an electric brake to prevent coasting. To have preset but adjustable limit switches to automatically stop picture surface in the "up" and "down" positions. Junction box shall be externally integrated into the housing making it possible to install the housing and wire to the building's electrical system during construction. The junction box shall contain a quick connect connector that is mounted in the housing for easy plug-in connection to the motorized fabric and roller assembly. The motorized fabric and roller assembly to be installed in the case at the factory or at a later time at the job site. The fabric roller to be of rigid steel. Screen to be designed for left or right-hand motor installation. Screen fabric to be seamless and mildew resistant with black masking borders standard. Each side of the fabric to have tab guide cable system to maintain even lateral tension and hold surface flat. Custom slat bar with added weight maintains vertical tension on the screen surface. The ends of the slat to be protected by heavy duty plastic caps enclosing a preset adjustable mechanism for screen tensioning. Top, front and back of case to be made of extruded aluminum powder coated white. End caps to be of heavy gauge steel powder coated white. Bottom of case to have a removable access door. Door to be of extruded aluminum powder coated white. Bottom of case to be self-trimming, with a built-in flange around the bottom of the case. To be complete with integrated low voltage control unit and three position control switch and cover plate. Suitable for use in environmental air space in accordance with section 300-22 (c) of the National Electric Code, and sections 2-128, 12-010 (3) and 12-100 of the Canadian Electrical Code, part 1, CSA C22.1. Screen to be listed by Underwriters' Laboratories.

Provide (2) Da-Lite model 24716LS, 16:10, tensioned, HD Progressive 1.3, 137" Diagonal screen with Low Voltage Control and (2) Global Cache IP2CC-P. (Media Center)

Projection Screen

(1) projection screen(s), 100" (H) x 160" (W), electrically operated 120 volt (60 Hz) not more than 2.4 amp. with a

quick connect male plug-in connector on the motor. Shall have specially designed motor mounted inside the roller, to be three wire with ground, quick reversal type, oiled for life, with automatic thermal overload cutout, integral gears, capacitor and an electric brake to prevent coasting. To have preset but adjustable limit switches to automatically stop picture surface in the "up" and "down" positions. Junction box shall be externally integrated into the housing making it possible to install the housing and wire to the building's electrical system during construction. The junction box shall contain a quick connect connector that is mounted in the housing for easy plug-in connection to the motorized fabric and roller assembly. The motorized fabric and roller assembly to be installed in the case at the factory or at a later time at the job site. The fabric roller to be of rigid steel. Screen to be designed for left or right-hand motor installation. Screen fabric to be seamless and mildew resistant with black masking borders standard. Each side of the fabric to have tab guide cable system to maintain even lateral tension and hold surface flat. Custom slat bar with added weight maintains vertical tension on the screen surface. The ends of the slat to be protected by heavy duty plastic caps enclosing a preset adjustable mechanism for screen tensioning. Top, front and back of case to be made of extruded aluminum powder coated white. End caps to be of heavy gauge steel powder coated white. Bottom of case to have a removable access door. Door to be of extruded aluminum powder coated white. Bottom of case to be self-trimming, with a built-in flange around the bottom of the case. To be complete with integrated low voltage control unit and three position control switch and cover plate. Suitable for use in environmental air space in accordance with section 300-22 (c) of the National Electric Code, and sections 2-128, 12-010 (3) and 12-100 of the Canadian Electrical Code, part 1, CSA C22.1. Screen to be listed by Underwriters' Laboratories.

Provide (1) Da-Lite model 24718L, 16:10, tensioned, HD Progressive 1.3, 189" Diagonal screen with Low Voltage Control and (1) Global Cache IP2CC-P. (Media Center)

Projectors

Provide (1) Epson V11H910820 Pro L1505UHNL 12,000 Lumen Projector with (1) Epson V12H004M0B ELPLM11 Mid-Throw Lens. (Auditorium)

Provide (1) Epson V11H679820 Pro L25000UNL 12,000 Lumen Projector with (1) Epson V12H004U05 ELPLU05 Short-Throw Lens. (Cafeteria)

Provide (2) Epson V11H941020 Pro L1060U 6,000 Lumen Projector Standard Lens. (Media Center)

Provide (2) Epson V11H940020 Pro L1070U 7,000 Lumen Projector Standard Lens. (Media Center)

Power Distribution and Management

Premium+ Rack Mount PDU with RackLink™ Series power management products shall be Middle Atlantic Products model # RLNK-P920R-SP. Premium+ Rack Mount PDU with RackLink™ power products shall be 1.75"H x 19"W x 9.83"D. Premium+ Rack Mount PDU with RackLink™ shall have a 20 amp power capacity. Premium+ Rack Mount PDU with RackLink™ shall provide Series surge and spike protection. Premium+ Rack Mount PDU with RackLink™ shall provide 9 total outlets, 8 of which shall be individually controllable. Premium+ Rack Mount PDU with RackLink™ shall include a 9' power cord. Premium+ Rack Mount PDU with RackLink™ shall monitor specific remote IP devices and services and shall automatically reboot an unresponsive network device and provide alerts via e-mail. Premium+ Rack Mount PDU with RackLink™ shall allow local export of log files in CSV format, and shall allow log files to be extracted to 3rd party databases via IP. Premium+ Rack Mount PDU with RackLink™ shall include an integrated web server for browser-based access and control. Premium+ Rack Mount PDU with RackLink™ shall support the SNMP, SSL/TLS/SSH, SMTP, NTP, DDNS, Cloud, CLI TCIP/IP/USB RS-232, HTTPS, HTTP, HyperTerminal, and Telnet communication protocols. Premium+ Rack Mount PDU with RackLink™ shall support up to 32 external sensors. Premium+ Rack Mount PDU with RackLink™ shall be Wi-Fi capable. Premium+ Rack Mount PDU with RackLink™ shall have an LCD Display. Premium+ Rack Mount PDU with RackLink™ shall support the Internet Explorer 11, Windows Edge, Firefox 25 and later, Safari (MAC) Google Chrome, Android, and iOS web browsers. Premium+ Rack Mount PDU with RackLink™ shall utilize an open-architecture serial communications protocol that is cloud compliant without being

cloud dependent, and provide an API for seamless integration into any IP based architecture. Premium+ Rack Mount PDU with RackLink™ shall be fully compliant with any control system or aggregator. Premium+ Rack Mount PDU with RackLink™ shall be constructed of phosphate pre-treated steel with a black powdercoat finish. Premium+ Rack Mount PDU with RackLink™ shall meet the EU RoHS Directive 2011/65/EU. Premium+ Rack Mount PDU with RackLink™ shall be manufactured by an ISO 9001 and ISO 14001 registered company. Premium+ Rack Mount PDU with RackLink™ shall be warrantied to be free from defects in materials and workmanship under normal use and conditions for a period of 12 years. Premium+ Rack Mount PDU with RackLink™ shall be listed to UL standard 60950-1 in US and to CAN/CSA C22.2 #60950-1 in Canada and FCC Part 15, Class B.

Provide (10) Middle Atlantic RLNK-P920R-SP Power Distribution and Management. (2-Auditorium, 1-Aux Gym, 1-Band, 1-Cafeteria, 1-Choir, 1-Gym, 1-Media Center, 1-Orchestra, 1-MDF)

Power Distribution and Management

Premium+ Compact PDU with RackLink™ Series power management products shall be Middle Atlantic Products model# RLNK-P420. Premium+ Compact PDU with RackLink™ power products shall be 1.75”H x 11.58”W x 7.82”D. Premium+ Compact PDU with RackLink™ shall have a 20 amp power capacity. Premium+ Compact PDU with RackLink™ shall provide two-stage surge and spike protection. Premium+ Compact PDU with RackLink™ shall provide 4 individually controllable outlets. Premium+ Compact PDU with RackLink™ shall include a 9’ power cord. Premium+ Compact PDU with RackLink™ shall monitor specific remote IP devices and services and shall automatically reboot an unresponsive network device and provide alerts via e-mail. Premium+ Compact PDU with RackLink™ shall allow local export of log files in CSV format, and shall allow log files to be extracted to 3rd party databases via IP. Premium+ Compact PDU with RackLink™ shall include an integrated web server for browser-based access and control. Premium+ Compact PDU with RackLink™ shall support the SNMP, SSL/TLS/SSH, SMTP, NTP, DDNS, Cloud, CLI TCIP/IP/USB RS-232, HTTPS, HTTP, HyperTerminal, and Telnet communication protocols. Premium+ Compact PDU with RackLink™ shall support up to 32 external sensors. Premium+ Compact PDU with RackLink™ shall be Wi-Fi capable. Premium+ Compact PDU with RackLink™ shall have an LCD Display. Premium+ Compact PDU with RackLink™ shall support the Internet Explorer 11, Windows Edge, Firefox 25 and later, Safari (MAC) Google Chrome, Android, and iOS web browsers. Premium+ Compact PDU with RackLink™ shall utilize an open-architecture serial communications protocol that is cloud compliant without being cloud dependent, and provide an API for seamless integration into any IP based architecture. Premium+ Compact PDU with RackLink™ shall be fully compliant with any control system or aggregator. Premium+ Compact PDU with RackLink™ shall be constructed of phosphate pre-treated steel with a black powdercoat finish. Premium+ Compact PDU with RackLink™ shall meet the EU RoHS Directive 2011/65/EU. Premium+ Compact PDU with RackLink™ shall be manufactured by an ISO 9001 and ISO 14001 registered company. Premium+ Compact PDU with RackLink™ shall be warrantied to be free from defects in materials and workmanship under normal use and conditions for a period of 3 years. Premium+ Compact PDU with RackLink™ shall be listed to UL standard 60950-1 in US and to CAN/CSA C22.2 #60950-1 in Canada and FCC Part 15, Class B.

Provide (9) Middle Atlantic RLNK-P420 Power Distribution and Management. (4-Auditorium, 5-Gym)

AV & Control System Processor

The System Processor shall be a fully integrated audio, video and control processor capable of centralized, distributed and hybrid deployment architecture designs. The system processor shall perform all of its real-time audio, video and control processing using Intel processors running a purpose built, real-time Linux operating system developed by QSC, LLC. The System Processor shall be a single-chassis processor with no internal or external audio busses to other processors. The system shall operate natively on a standard gigabit Ethernet infrastructure available from a broad range of network infrastructure manufacturers, employing DiffServ quality of service, IEEE 1588-2008 (PTPv2) precision time protocol, IP audio and video transport with floating point format data representation for audio. The system shall not require IEEE 802.1AS, IEEE 802.1Qat or IEEE 802.1Qav support on the network infrastructure to function. The overall system latency from analog input to synchronized analog outputs

anywhere on the network shall be fixed at 3.167ms. The system shall also be able to achieve an overall system latency of 3.167ms over Layer-3 routed network infrastructure without any additional hardware, software or connection services between subnets.

The system processor shall manage external control interfaces such as Touchscreen Controllers, Paging Stations, Networked Audio I/O Expanders, Network Connected Amplifiers, AV-to-USB Bridging interfaces and IP based PTZ Conference Room Cameras.

The system shall have the capability of operating in a completely dual-redundant manner. The processor shall be able to support a second synchronized backup processor with complete automatic failover in ten seconds or less. Each processor and I/O peripheral shall have redundant network connections with simultaneous, identical network streams for seamless networked audio failover.

The system processor shall be configurable via software to behave as either a system Core processor or as an I/O-Frame network channel expander in which case it can provide up to 128 x 128 remote channels for a System Processor elsewhere on the network.

The system processor shall natively offer a minimum network channel capacity of 256 input channels and 256 output channels with each stream being configurable as either native Q-LAN networked audio stream format or AES67 formatted audio streams. In addition, the processor will be able to accommodate a minimum of 128 local audio input channels plus 128 local audio output channels of 32-bit (internal processing) audio. Local I/O shall be accommodated using eight configurable card slots in to which any combination of nine I/O circuit cards can be installed (DataPort Amp Out, Line Out, High-performance Mic/Line In, Standard Mic/Line In, CobraNet In/Out, Dante In/Out, AVB In/Out, AES/EBU In/Out and high channel count AES/EBU Out).

The system processor shall have the following front panel controls and indicators: blue monochrome OLED display with page forward capacitive touch button, Unit ID capacitive touch button, Power On blue LED, Two USB A Type ports. The system processor shall provide a monochrome 304x96 blue OLED graphics display displaying the device name, design name and system status, LAN A and B settings, and the firmware version. Device Status shall be displayed on the OLED display including I/O status, muting, level present indication, and system status.

On the rear panel, the system processor shall have one RS232 DE-9 (male 9-pin D-shell) connector, HDMI Video Out, GPIO A: DA-15 (female 15-pin D shell) connector, GPIO B: DA-15 (female 15-pin D shell) connector, Q-Sys Network: LAN A RJ45 1000 Mbps only, LAN B: RJ45 1000 Mbps only, AUX LAN: 10/100/1000 Mbps, four USB-A Host ports. The dimensions of the System processor shall be: 3.5" x 19" x 15" (89 mm x 483 mm x 381 mm).

The system processor shall store a design that shall be comprised of audio, video and control components, wiring, links, text, and graphics on a single or multiple schematic pages. Designs shall include any of the following audio DSP, video, test and measurement components, control components, and layout components: Acoustic Echo Cancellers, Audio Players, Audio Streaming components, Crossfaders, Crossovers, Delay components, Auto Gain control elements, Compressors, Gates, Duckers, Expanders, Ambient Noise Compensators, Limiters, Gain blocks, Graphic Equalizers, Parametric Equalizers, FIR Filters, All-Pass Filters, Band-Pass Filters, Band-Stop Filters, High-Pass Filters, Low-Pass Filters, FIR High-Pass filters, FIR Low-Pass Filters, Dual-Shelf Equalizers, Notch Filters, Meters, Matrix Mixers, Gain-Sharing Automatic Mixers, Gated Automatic Mixers, Signal Routers, Public Address Routers, Room Combiners, Signal Presence Meters, Tone Generators, Tone and Noise Generators, Dual Trace FFT Measurement Modules, Real Time Analyzers, Signal Injectors, Signal Probes, Logic, Value and Position control functions, Lua scripting components, Command Buttons and Triggers, Camera Router, USB Audio Bridge, USB Video Bridge.

The system processor shall support custom user control interfaces either on purpose built touch screen controllers, network computers utilizing a control application or iOS devices via Wi-Fi. Custom control interfaces shall be capable of having multiple user-selectable pages with different controls on each.

The system processor and control engine shall be the QSC Q-Sys Core 510i.

Provide (2) QSC Q-SYS CORE510i's, (2) Perpetual Scripting Engine Software Licenses, (2) Perpetual UCI Deployment Software Licenses, and (2) 15 pin GPIO connectors. (MDF)

Free Standing Floor Rack

EIA compliant 19" gangable equipment rack shall be Middle Atlantic Products model #BGR-4527. Overall dimensions of BGR shall be 82.875"H x 23"W x 27"D. Useable height of BGR shall be 45 rackspaces, useable depth shall be 24.4". BGR shall come equipped with two pairs of fully adjustable steel rackrail with two 10-32 threaded holes per side of each marked rackspace, and a cage-nut style mount that is compatible with tool-free Forward Series rackmount accessories. BGR rackrail shall include cable management lacing provisions and accept tool-free Forward Series cable management accessories. BGR shall have .100" thick steel along rackrail brackets, .310" thick steel at corners. BGR shall include vented locking and latching rear door, which shall be capable of accepting up to six 4-1/2" fans. Top and bottom of BGR shall feature vertical slotted vent pattern for ventilation. BGR shall have two 1" x 7" rear obround knockouts with 1/2", 1", 1-1/4" and 1-1/2" electrical knockouts and 5/8" and 1/2" D UHF/ VHF antennae knockouts in base and top. BGR shall have a configurable open top with vertical cable management entry points. BGR shall accept patent-pending LeverLock™ tool free and hardware free internal cable and device management system accessories. BGR shall have pre-threaded 5/16"-18 ganging holes. BGR shall be capable of ganging while fully loaded, using bolts only. BGR shall have marked rackrail depth indicators. BGR shall be of fully welded construction. BGR shall be finished in an environmentally friendly, durable black powdercoat. Grounding and bonding studs shall be 1/4-20 threaded, installed in top and base of enclosure (19 and 25 space have stud in bottom only). Fully welded construction shall provide a UL Listed load capacity of 3,000 lbs. BGR Series enclosures shall satisfy the 1997 UBC; 2001, 2007 & 2010 CBC; 2000, 2003, 2006 & 2009 IBC; ASCE 7-02, ASCE 7-05, ASCE 7-10 and the 2003, 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 1,175 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with BGR-Z4 or BGR-ISO-Z4 (isolated) seismic floor anchor bracket. BGR shall be OSHPD approved for fixed equipment anchorage in California healthcare facilities. BGR shall be UL Listed in the US and Canada. BGR shall be GREENGUARD Gold Certified. BGR enclosure shall meet the RoHS EU Directive 2011/65/EU. BGR shall be manufactured by an ISO 9001 and ISO 14001 registered company. BGR enclosure shall be warrantied to be free from defects in material or workmanship under normal use and conditions for the lifetime of the rack.

Provide (2) Middle Atlantic BGR-4527 Free Standing Rack with

- (2) VFD-45A Front Door
 - (2) BGR-RDC45 Rear Door
 - (10) sets of keys
 - (2) FWD-LT-UTL-44-45-D Rear Lights
 - (2) Side Panels
 - (2) BGR-552FT-FC Fan top
 - (2) CBS-BGR Casters
 - (2) FWD-LB-1A-4PK Cable Management
 - (12) LL-VP2110 with side clamps and cable saddles
 - (4) LACE-44-OW-A
 - (2) SS Sliding Shelves
 - (4) D2 Drawers
 - (4) LT-GN-PNL Gooseneck Lights
- Fill All Empty Spaces
(Auditorium, Gym)

Free Standing Floor Rack

EIA compliant 19" gangable equipment rack shall be Middle Atlantic Products model #BGR-2527. Overall dimensions of BGR shall be 47.875"H x 23"W x 27"D. Useable height of BGR shall be 25 rackspaces, useable depth shall be 24.4". BGR shall come equipped with two pairs of fully adjustable steel rackrail with two 10-32 threaded holes per side of each marked rackspace, and a cage-nut style mount that is compatible with tool-free Forward Series rackmount accessories. BGR rackrail shall include cable management lacing provisions and accept tool-free Forward Series cable management accessories. BGR shall have .100" thick steel along rackrail brackets, .310" thick steel at corners. BGR shall include vented locking and latching rear door, which shall be capable of accepting up to six 4-1/2" fans. Top and bottom of BGR shall feature vertical slotted vent pattern for ventilation. BGR shall have two 1" x 7" rear obround knockouts with 1/2", 1", 1-1/4" and 1-1/2" electrical knockouts and 5/8" and 1/2" D UHF/ VHF antennae knockouts in base and top. BGR shall have a configurable open top with vertical cable management entry points. BGR shall accept patent-pending LeverLock™ tool free and hardware free internal cable and device management system accessories. BGR shall have pre-threaded 5/16"-18 ganging holes. BGR shall be capable of ganging while fully loaded, using bolts only. BGR shall have marked rackrail depth indicators. BGR shall be of fully welded construction. BGR shall be finished in an environmentally friendly, durable black powdercoat. Grounding and bonding studs shall be 1/4-20 threaded, installed in top and base of enclosure (19 and 25 space have stud in bottom only). Fully welded construction shall provide a UL Listed load capacity of 3,000 lbs. BGR Series enclosures shall satisfy the 1997 UBC; 2001, 2007 & 2010 CBC; 2000, 2003, 2006 & 2009 IBC; ASCE 7-02, ASCE 7-05, ASCE 7-10 and the 2003, 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 1,175 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with BGR-Z4 or BGR-ISO-Z4 (isolated) seismic floor anchor bracket. BGR shall be OSHPD approved for fixed equipment anchorage in California healthcare facilities. BGR shall be UL Listed in the US and Canada. BGR shall be GREENGUARD Gold Certified. BGR enclosure shall meet the RoHS EU Directive 2011/65/EU. BGR shall be manufactured by an ISO 9001 and ISO 14001 registered company. BGR enclosure shall be warranted to be free from defects in material or workmanship under normal use and conditions for the lifetime of the rack.

Provide (1) Middle Atlantic BGR-2527 Free Standing Rack with

- (1) VFD-XXA Front Door
 - (1) BGR-RDCXX Rear Door
 - (1) sets of keys
 - (1) FWD-LT-UTL-24-27-D Rear Lights
 - (1) Side Panels
 - (1) BGR-552FT-FC Fan top
 - (1) CBS-BGR Casters
 - (1) FWD-LB-1A-4PK Cable Management
 - (1) LL-VP2110 with side clamps and cable saddles
 - (1) LACE-XX-OW-A
 - (1) SS Sliding Shelves
 - (1) D2 Drawers
 - (1) LT-GN-PNL Gooseneck Lights
- Fill All Empty Spaces
(Auditorium)

Wall Rack

EIA compliant 19" wall mount rack shall be Middle Atlantic Products model #DWR-16-22. Overall dimensions shall be 23.4" W x 35" H x 22.3" D. Weight capacity shall be 200lbs. Tool-Free Quick-Mount™ system enables one-person installation. Useable depth shall be 20" and shall extend into the back pan 3.5". Center section and back pan shall be steel, phosphate pre-treated and finished in a black textured powder coat. Adjustable rackrail shall be constructed of 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing with black e-coat finish

and marked rack spaces. Rack shall be constructed to swing open for component cabling access, center section shall pivot for either left or right opening. Rack shall have a rear knockout panel with 1/2", 3/4", 1", 1-1/2", 2" and 3" electrical knockouts installed in base, and a rear knockout panel with 1/2", 3/4", 1", 1-1/2", 2" and 3" electrical knockouts, and BNC knockouts for UHF/VHF antennas installed in top. Large laser knockout on back pan shall have a 12-1/2" x 12-1/2" cutout for electrical pull-box. Fan knockouts on top and bottom shall allow for installation of up to four 4-1/2" fans. Rack shall have 2" knockouts, 4" knockouts for Wiremold 4000® Series raceways, and knockouts for UCP Series universal connector panels on the side. Top, bottom and sides shall feature vertical vent pattern. DWR Series enclosures shall satisfy the 2013 CBC; 2012 IBC & ASCE 7-10 (2010 Edition) for use in areas of high seismicity, using an assumed Site Class D soil condition with lateral force requirements for protecting 155 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with DWRSR-ZL Latch. DWR Series shall be OSHPD approved for fixed equipment anchorage in California healthcare facilities. Rack shall be UL Listed in the US and Canada to the UL-2416 (NWIN) Category when used with optional bonding kit. DWR Series shall meet all enclosure requirements towards PCI DSS (Payment Card Industry Data Security Standard) Compliance. Rack shall be GREENGUARD Gold Certified. Rack shall comply with the requirements RoHS EU Directive 2011/65/EU. Rack shall be manufactured by an ISO 9001 and ISO 14001 registered company. Rack shall be warranted to be free from defects in materials or workmanship under normal use and conditions for the lifetime of the rack.

Provide (6) Middle Atlantic DWR-16-22 Free Standing Rack with

(6) VFD-XX Front Door

(12) sets of keys

(6) FWD-LT-UTL-16-21-D Rear Lights

(6) FWD-LB-1A-4PK Cable Management

(12) LACE-XX-OW-A

(6) SS Sliding Shelves

(6) D2 Drawers

(6) LT-GN-PNL Gooseneck Lights

Fill All Empty Spaces

(Aux Gym, Band, Cafeteria, Choir, Media Center, Orchestra)

Desktop Rack

EIA compliant 19" desktop/under-desk equipment rack shall be Middle Atlantic Products model #DTRK-1018. Overall dimensions of DTRK shall be 19.38"H x 21.38"W x 19.5"D. Useable height of DTRK shall be 10 rackspaces, useable depth shall be 18.5". DTRK shall come equipped with two pairs of steel rackrail with tapped 10-32 mounting holes in universal EIA spacing, black e-coat finish and numbered rackspaces. Sides of DTRK shall feature vertical slotted vent pattern for ventilation. DTRK shall accept patent- pending LeverLock™ tool free and hardware free internal cable and device management system accessories when used with optional LL-DTRK adapter. DTRK shall be of fully welded construction. DTRK shall be finished in an environmentally friendly, durable metallic grey powdercoat. Fully welded construction shall provide a static capacity of 1,200 lbs. and a UL Listed load capacity of 300 lbs. DTRK shall be UL Listed in the US and Canada. DTRK shall be GREENGUARD Indoor Air Quality Certified for Children and Schools. DTRK enclosure shall comply with the requirements of RoHS EU Directive 2002 / 95 / EC compliant. DTRK shall be manufactured by an ISO 9001 and ISO 14001 registered company. DTRK enclosure shall be warranted to be free from defects in material or workmanship under normal use and conditions for the lifetime of the rack.

Provide (1) Middle Atlantic DTRK-1018 Desktop Rack with:

(1) DT-PVFD-XX Vented Plexi Door

(1) DT-RAPXX Rear Access Panel

(1) LBP-01A Horizontal Cable Management

(2) D2 Drawer

(1) LT-GN-PNL Gooseneck Light
 Fill All Empty Spaces
 (Auditorium)

Production Intercom

Panel Microphone Input

Input Type: Electret
 Input Impedance: $\geq 2K$
 Mic Limiter Threshold: $0 \text{ dBu} \pm 3 \text{ dB}$
 Mic Limiter Range: $\geq 20 \text{ dB}$

Headset Microphone Input

Input Type: Dynamic
 Input Impedance: $\geq 1K$
 Mic Limiter Threshold: $0 \text{ dBu} \pm 3 \text{ dB}$
 Mic Limiter Range: $\geq 15 \text{ dB}$

Program Line Input

Maximum Level before Clipping: $\geq 20 \text{ dBu}$
 Input Impedance: $\geq 5K$

Headset Output

Load Impedance: ≥ 8
 Output Impedance: ≤ 25
 Output Limiter Threshold: $+5 \text{ dBu} \pm 3 \text{ dB}$
 Maximum Output Level before Distortion: $\geq 17 \text{ dBu}$

Speaker Output

Load Impedance: ≥ 4
 Max Output Level before 1% Distortion: $20 \text{ dBu} \pm 2 \text{ dBu}$

Partyline Output

O Noise: $< -74 \text{ dBu}$
 Output Impedance: $> 10 K$

Partyline Input

Crosstalk: $< -60 \text{ dB}$
 Max level before Clipping: $\geq 12 \text{ dBu}$
 Sidetone Null Capability: $> 25 \text{ dB}$

Stage Announce/Balanced Line Out

Type: Balanced
 Output Impedance: ≥ 200
 Load Impedance: ≥ 600

IFB/Hot Mic

Type: Unbalanced
 Output Impedance: 180
 Load Impedance: ≥ 600

Frequency Response

Panel Mic – Partyline: $600 - 10KHz \pm 3 \text{ dB}$
 Headset Mic – Partyline: $200 - 12KHz \pm 3 \text{ dB}$
 Headset Mic – Line Out: $200 - 12KHz \pm 3 \text{ dB}$
 Program Input – Partyline: $100 - 17KHz \pm 3 \text{ dB}$
 Program Input – Headset Out: $200 - 10KHz \pm 3 \text{ dB}$
 Program Input – Speaker Out: $300 - 10KHz \pm 3 \text{ dB}$
 Partyline – Headset Out: $200 - 10KHz \pm 3 \text{ dB}$
 Partyline – Speaker Out: $300 - 10KHz \pm 3 \text{ dB}$
 Max Distortion

Panel Mic – Partyline: $\leq 0.5\%$

Headset Mic – Partyline: $\leq 0.5\%$

Headset Mic – Line Out: $\leq 0.5\%$

Program Input – Partyline: $\leq 0.2\%$

Program Input – Headset Out: $\leq 0.2\%$

Program Input – Speaker Out: $\leq 0.5\%$

Partyline – Headset Out: $\leq 0.2\%$

Partyline – Speaker Out: $\leq 0.5\%$

Noise

Panel Mic – Partyline: < -65 dBu

Headset Mic – Partyline: < -70 dBu

Headset Mic – Line Out: < -55 dBu

Program Input – Partyline: < -85 dBu

Program Input – Headset Out: < -60 dBu

Program Input – Speaker Out: < -60 dBu

Partyline – Headset Out: < -50 dBu

Partyline – Speaker Out: < -50 dBu

Max Gain

Panel Mic – Partyline: ≥ 37 dB

Headset Mic – Partyline: $41 \text{ dB} \pm 2 \text{ dB}$

Headset Mic – Hot Mic Out: $55 \text{ dB} \pm 3 \text{ dB}$

Headset Mic – Announce Out: $55 \text{ dB} \pm 3 \text{ dB}$

Program Input – Partyline: ≥ -16 dB

Program Input – Headset Out: ≥ 18 dB

Program Input – Speaker Out: ≥ 24 dB

Partyline – Headset Out: ≥ 34 dB

Partyline – Speaker Out: ≥ 40 dB

Min Gain

Panel Mic – Partyline: ≤ 25 dB

Mains Power

Input Voltage Range: 100 – 240 VAC

Input Frequency Range: 50 – 60 Hz

Input Power: ≤ 60 VAC

Output Voltage : $30 \text{ VDC} \pm 0.5 \text{ V}$

Output Current per Channel (Continuous): 1.2 A

Output Current per Channel (Peak): 2 A (Do not exceed the 1.2A rating for more than 2 seconds per 1 minute period)

Short Circuit Recovery Time (1st short): ≤ 0.5 sec

Short Circuit Recovery Time ≥ 20 shorts in 20sec: ≤ 20 sec

Environmental

$32 - 122^\circ\text{F}$ ($0 - 50^\circ\text{C}$)

Dimensions

1.75 x 19 x 6.5 in (HxWxD)

(44 x 483 x 165 mm)

Weight

6.1 lbs (2.8 kg)

Provide (1) Clear-Com MS-702 production intercom base station with (8) Clear-Com RS-702 beltpacks, (8) Clear-Com CC-300-X4 headsets, (8) (6-pin) 25' cables, (3) KB-702 Speaker Wall Stations, (4) WP-6 Wall Plates. (Auditorium)

Microphone Cable

CONDUCTOR PARAMETER

- Number of Pairs: 1
- AWG Size: 22
- Conductor Stranding: 7x30
- Conductor Type: Bare copper
- Nominal DCR: 17 Ohm/1000ft

INSULATION PARAMETER

- Insulation Type: Polypropylene – PP
- Insulation Thickness: 0.007 in
- Insulation Color Code: 1. Black 2.Red

SHIELDING PARAMETER

- Shield Type: Overall 100% Aluminum Foil
- Drain Wire Type: Tinned Copper
- Drain Wire AWG: 24 AWG

ELECTRICAL CHARACTERISTICS

- Nom. Cap. Between Conductors: 34 pF/ft
- Nom. Cap. Conductor to Shield: 67 pF/ft

OVERALL CONSTRUCTION PARAMETERS

- Jacket Type: PVC
- Jacket Thickness: 0.020 in
- Nominal Cable O.D.: 0.135 in
- Plenum: No
- NEC UL Rating: CMR, CMG
- RoHS Compliant: Yes
- Pull Tension: 28 lbs
- Bend Radius: 1.215 in
- Cable Weight: 14 lbs

Installation microphone cable shall be manufactured by Belden, West Penn Wire, or Windy City Wire. Coordinate speaker cable color with architect.

Speaker Cable

CONDUCTOR PARAMETER

- Number of Conductors: 2
- AWG Size: 14
- Conductor Stranding: 19x27
- Conductor Type: Bare copper
- Nominal DCR: 2.7 Ohm/1000ft
- Cabling Lay Length: 4 in
- Twists/Foot: 3 twist/ft

INSULATION PARAMETER

- Insulation Type: PVC
- Insulation Thickness: 0.012 in

- Insulation Color Code: 1. Black 2. White

SHIELDING PARAMETER

- Shield Type: None

OVERALL CONSTRUCTION PARAMETERS

- Jacket Type: PVC
- Jacket Thickness: 0.017 in
- Nominal Cable O.D.: 0.23 in
- NEC UL Rating: CL3R, FPLR
- RoHS Compliant: Yes
- Pull Tension: 79 lbs
- Bend Radius: 2.07 in
- Cable Weight: 42 lbs

Installation speaker cable shall be manufactured by Belden, West Penn Wire, or Windy City Wire. Coordinate speaker cable color with architect.

50 Ohm Wireless Antenna Coax

CONDUCTOR PARAMETER

- Number of Conductors: 1
- AWG Size: 20
- Conductor Stranding: Solid
- Conductor Type: Tinned Copper
- Nominal DCR: 10.1 Ohm/1000ft

INSULATION PARAMETER

- Insulation Type: Foam Polyethylene
- Insulation Thickness: 0.116 in

SHIELDING PARAMETER

- Shield Type: 100% Aluminum Foil 95% Tinned Copper Braid

ELECTRICAL CHARACTERISTICS

- Nominal Impedance: 52 Ohm
- Nom. Cap. Between Conductors: 25 pF/ft

OVERALL CONSTRUCTION PARAMETERS

- Jacket Type: PVC
- Jacket Thickness: 0.031 in
- Nominal Cable O.D.: 0.195 in

- Plenum: No
- NEC UL Rating: CM
- RoHS Compliant: Yes
- Pull Tension: 45 lbs
- Bend Radius: 1.95 in
- Cable Weight: 30 lb

50 Ohm Antenna Coax cable shall be manufactured by Belden, West Penn Wire, or Windy City Wire. Coordinate speaker cable color with architect.

Shielded CAT5E

CONDUCTOR PARAMETERS

- Number Of Pairs: 4
- AWG Size: 24
- Conductor Stranding: Solid
- Conductor Type: Bare Copper
- Nominal DCR: 26 Ohm/1000ft

INSULATION PARAMETERS

- Insulation Type: Polyolefin
- Insulation Color Code: 1.Blue,WH-Blue 2.Orange,WH-Orange 3.Green,WH-Green 4.Brown, WH-Brown

SHIELDING PARAMETERS

- Shield Type: Overall 100% Aluminum Foil (F/UTP)
- Drain Wire AWG Size: 24 AWG
- Drain Wire Type: Tinned Copper

ELECTRICAL CHARACTERISTICS

- Nominal Impedance: 100 Ohm
- Nominal Capacitance Between Conductors: 15 pF/ft

OVERALL CONSTRUCTION PARAMETERS

- Total Number of Conductors: 8
- Jacket Type: PVC
- Nominal Cable O.D.: 0.252 in

- Plenum: No
- NEC UL Rating: CMR
- RoHS Compliant: Yes
- ANSI/TIA Category: Category 5E TIA/EIA 568C.2
- TIA Test: ANSI/TIA-568-C.2
- Pull Tension: 35 lbs
- Bend Radius: 1.26 in
- Cable Weight: 29 lbs

Shielded CAT5E cable shall be manufactured by Belden, West Penn Wire, or Windy City Wire. Coordinate speaker cable color with architect.

Installation 2 Channel Intercom Cable

- Number of Conductors: 4
- AWG Size: 22
- Conductor Stranding: 7x30
- Conductor Type: Bare copper
- Nominal DCR: 17 Ohm/1000ft
- Cabling Lay Length: 2.5 in
- Twists/Foot: 4.8 twist/ft
- Insulation Type: Thermoplastic
- Insulation Thickness: 0.007 in
- Insulation Color Code: 1. Black 2.Red
- Shield Type: Overall 100% Aluminum Foil
- Drain Wire Type: Tinned Copper
- Drain Wire AWG: 24 AWG
- Nom. Cap. Between Conductors: 34 pF/ft
- Nom. Cap. Conductor to Shield: 67 pF/ft

Installation 2 Channel Intercom Cable shall be manufactured by Belden, West Penn Wire, or Windy City Wire

Provide Panduit Fiber and (9) Panduit Fiber Enclosures.

Tests and Adjustments

The Audio Visual Contractor shall perform all tests and adjustments required to obtain the specified performance.

The tests and adjustments shall be performed under the following conditions:

All ceiling tiles, furniture, and other items shall be in their final position and ready for personnel.

Using an AC impedance meter or bridge, the impedance of all loudspeaker circuits at 1kHz shall be measured and recorded while they are disconnected from the amplifier output. This ensures that the speaker circuits are free of faults and will not overload the amplifiers.

The ambient sound level shall be measured and recorded in 1/3-octave bands with all HVAC systems and lights on. The ambient sound level shall also be measured and recorded as a single wide-band, A-weighted (dBA) reading.

The system shall be checked for hum and noise with the 1/3-octave filter off, power amplifier on, and all input volume controls set at 50 percent rotation. The system hum and noise must be inaudible in all areas to be covered by the sound system system.

A pink noise signal shall be applied to the system and adjusted for a working level of 10dB above ambient sound level. The sound system shall be checked for any buzzes, rattles, or other defects.

The uniformity of coverage shall be checked by measuring the 1/3-octave band centered at 500Hz. The level in all areas must not deviate more than ± 3 dB. If the number of speakers is not sufficient to meet these requirements, the vendor shall install and supply additional speakers at their own expense to meet these specifications.

The 1/3-octave band frequency response shall be checked, and the system adjusted so that there is a flat response from 250 Hz through to 5kHz. Each octave below and above shall be rolled off at 3 dB per octave.

Provide printed test results of the final system tuning curve, SPL, and STI results. Include these results with the O & M Manuals as specified.

END OF SECTION 275120

SECTION 281353– IP NETWORK COMPATIBLE INTERCOM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. IP Video Intercom. (Aiphone IX Series)

1.2 RELATED SECTIONS

- A. Section 16710 Voice/Data Network
- B. Section 16720 Integrated Network Communication System

1.3 REFERENCES

- A. American National Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.

1.4 SYSTEM DESCRIPTION

- A. IP Network Compatible Video Intercom System: A network-based communication and security system featuring video entry security, internal communication, emergency stations, and paging. All units and app in the systems shall be able to unlock doors remotely on a network, assist onsite visitors from an offsite location, broadcast emergency announcements, and communicate using a PoE network.
 - 1. Power Source: Power over Ethernet (802.3af).
 - 2. Network Interface: 10 BASE-T / 100 BASE-TX Ethernet (RJ-45).
 - 3. Network Protocols: IPv4, IPv6, TCP, UDP, SIP, HTTP, HTTPS, MJPEG, RTSP, RTP, RTCP, IGMP, MLD, SMTP, DHCP, NTP, DNS.
 - 4. Bandwidth Usage:
 - a. G.711: 64Kbps x 2 per video call.
 - b. 64Kbps per monitor.
 - c. H.264: 24Kbps ~ 2,048Kbps.
 - 5. Communication: Hands-free (VOX), push-to-talk (simplex), or handset (full-duplex).
 - 6. Video Display: 7 inch color LCD.
 - 7. Camera: Type:
 - a. 1/3 inch color CMOS. 1.23 Megapixels.
 - b. View Area at 0 degree camera angle mounted at 4 feet 11 inches (1500 mm)
AFF: 2 feet 3 inches (700 mm) vertical x 3 feet 9 inch (1150 mm) horizontal at 19 inches (500 mm).
 - 8. Video Stream: ONVIF Profile S.
 - 9. Door Release: Programmable Form C dry contact, 24V AC/ DC, 500mA (use RY-24L for larger contact rating, which requires 24V DC power supply) or use RY-IP44 with 4 multipurpose relays.
 - 10. Wire Type: CAT-6.
 - 11. Distance:
 - a. Any station to Network Node: 330 feet (100 meters).

1.5 SUBMITTALS

- A. Submit under provisions of Section 16020 Shop Drawings.

- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Submit the following:
 - 1. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
 - 2. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- D. Installation and Operation Manuals:
 - 1. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
 - 2. Provide detailed information required for Owner to properly operate equipment.
- E. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001:2015 certified company.
- B. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Handling: Protect materials during handling and installation to prevent damage.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Aiphone Corp., which is located at: 6670 185th Ave. NE; Redmond, WA
- B. Requests for substitutions must be submitted in writing 10 days minimum prior to bid.
- C. IP Video Intercom System: IX Series Intercom System as manufactured by Aiphone Corporation.

2.2 SYSTEM DESIGN

- A. Master Station(s): Provide 1 master stations.
- B. Audio Video Door Stations:
 - 1. Model IX-DV (Video Door Station - Surface Mount - Hands Free): Provide quantity as indicated on drawings.
- C. Provide Selective Door/Gate Release.
- D. Provide Audio/video streaming via ONVIF Profile S.
- E. Provide ONVIF Profile S camera input (max 500).
- F. Provide Overhead paging.
- G. Provide Contact input at door station.

2.3 FUNCTIONAL COMPONENTS:

- A. Functional Components: As indicated on the drawings or as required to complete system.
 - 1. Video Master Station Series IX-MV7:
 - a. Model IX-MV7-B (Master Station - Black, Hands Free).
 - b. An IP addressable video master station with a 7 inch color LCD monitor and desk stand. The IX-MV7 offers handset (duplex) and hands-free (VOX/PTT) communication and call up to 500 other IX stations. It connects directly to a network using CAT-5e/6 cable. This station requires a 802.3af compliant Power-over-Ethernet network.
 - 2. IXW-MA IP Programmable Relay Adaptor: Multi-purpose adaptor - PoE
 - 3. RY-IP44 IP Programmable Relay Adaptor:
 - a. 4 contact inputs and 4 relay outputs (compatible with the IX Series, IS-IP Series, and IPW-1A only).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive integrated security and communication system.
- B. Notify Architect of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 PREPARATION

- A. Verify the following compliance before starting installation.
 - 1. The unit turns inoperative during power failure.
 - 2. Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.
 - 3. If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.
 - 4. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.

5. The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.3 INSTALLATION

- A. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.
- C. Integrate video feed of door station(s) into IP security camera system for recording. Coordinate with IP security system contractor to provide license for additional cameras, one for each door station as required.

3.4 SET-UP AND ADJUSTING

- A. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstration:
 1. Demonstrate that integrated security and communication system functions properly.
 2. Perform demonstration at final system inspection by qualified representative of manufacturer.
- B. Instruction and Training:
 1. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
 2. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
 3. Provide instruction and training by qualified representative of manufacturer.

3.6 PROTECTION

- A. Protect installed integrated security and communication system from damage during construction.

END OF SECTION 281353

SECTION 281600 – ACCESS CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Security/Perimeter Access Control System.
- B. Digital Surveillance System.

1.2 SYSTEM DESCRIPTION - SECURITY/PERIMETER ACCESS CONTROL SYSTEM

- A. Software Application shall be System Galaxy software communicating with 635 Series Access Control Panels (ACPs).
- B. Access Control: shall connect to all reader and alarming devices to support the following:
 - 1. Access Control: the access control system to the building and selected/restricted areas shall support the following technologies:
 STANDARD CARD & BIOMETRIC TECHNOLOGIES
 - a. Proximity (125 KHz),
 - b. *MIFARE*[®], *MIFARE DESFire*[®], *MIFARE DESFire*[®] EV1, (13.56 MHz)
 - c. Biometric Identification & Authentication (1:1 and 1:N multi-factor),
 - d. *HID*[®] *iCLASS*[®],
 - e. NFC,
 - f. Magnetic Swipe
 Barcode (1D linear, 2D datamatrix, US & International formats)
 - 2. Exterior Doors: Control access into building at locations as shown on drawings.
 - 3. Interior Building Areas: Control access into areas as shown on drawings.
 - 4. Restrict Access of individual credential-holders by time of day, day of week/month/year and specific points of entry via user-configurable software.
 - 5. Unlock Doors to building and selected areas automatically, where shown on drawings, for a scheduled period of time throughout the day allowing free access and egress without the use of a card and avoiding the generation of an alarm condition on the access control system. The system operator shall be able to lock and unlock doors from the computer system.
 - 6. Monitor Points in building and selected areas as shown on drawings that may provide unauthorized access or egress and may be a point for forced entry. The system shall report changes in status for all monitored points indicating the specific location so the operator can respond appropriately.
- C. Photo Badge Creation and Printing: the system shall be able to design Photo Identification ID Badges using the same cardholder photographs that are stored in the System Galaxy database / system and shall support and perform the following:
 - 1. Digital photographs shall be stored as Blob in the database, or as JPEG, or both methods as a

- Blob and JPEG, as determined by system owner.
2. System shall be able to add static and dynamic data fields from the cardholder information, as well as photographs, graphic images, shapes logos, and backgrounds.
 3. System shall be able to apply style and layout changes to any static or dynamic data fields; including resize, scale, rotate, flip, border/outline, color, font-style, font-size, and text related attributes such as bold, italics, underline.
 4. Shall support standard graphic image editing, cropping, resize/scale, flip and rotate, border.
 5. Shall be able to add and print unique, functioning bar codes in 1D (linear) and 2D (data matrix) formats.
 6. Shall print badge designs in portrait or landscape layout, and shall be able to print single-sided or double-sided (i.e. one or both sides) PVC type cards using an IP or USB compatible, dye-sublimation printer.
- D. Photo Verification: The photo verification feature shall be enabled on a workstation basis and shall use the digital image stored in the database as a blob, or the JPG image stored in the specified system folder.
- E. Video Monitoring of doors and alarm points shall be provided when access is requested, or a door is violated. The system interface between the Access Control System and Video Surveillance System shall utilize a TCP/IP connection.
1. The Video Monitoring interface shall be compatible with the **WiseNet Wave** video product line(s), or other approved alternate brands.
 2. Video and Camera Control shall be supported within System Galaxy.
 - a. System shall be able to associate cameras with doors, inputs/alarm points, elevator doors.
 - b. System shall support manually and automatically calling up video and shall be capable of playing live video from system-linked points when a system alarm is generated.
 - c. System shall be able to retrieve associated video from historical event report.
- F. Visitor Management shall support the ability to assign access privileges and add credentials to the access control system, as well as set credential expiration through the visitor management interface. Shall include ability to manage visitor credentials and access privileges including credential expiration from the access control system (System Galaxy). Shall support visitor signing into and out of the visitor management system and be registered with the Access Control System (ACS) and with the access privileges activated/deactivated as appropriate. Shall support visitor management through HID Global EasyLobby® or STOPware® PassagePoint Global.
- G. Real-time Guard Tour shall track and monitor progress and times from tour start and progress to check points, to tour stop. Sequential and Random tours supported, track late/overdue tour start, late/overdue to check points, late to finish tour. System shall report missed points, expired and incomplete tours, successful tours, and time expired between tours. System shall support multiple tours using a common start reader and starting tours with PIN codes.
- H. Real-Time Hall Pass / Card Tour shall track and monitor progress and times from tour start and progress to select checkpoints, to tour stop. The system shall provide notification based on skipped checkpoints and incomplete / overdue tours.
- I. Graphical Display of building maps shall be provided on all access control workstations using dynamic icons that display real-time status of doors and alarm points.

- J. Report Generation shall be provided for all system events and alarm events by date and time.
- K. System Interface shall provide the following:
 - 1. A real-time display of all alarms and system events
 - 2. The ability to archive all events to the SQL database
 - 3. And shall serve as the instrument through which all system programming is accomplished.
- L. Computers/Workstations shall be configured for the intended system function by installing the appropriate system software, services and operating system.
 - 1. Security Monitoring Workstation: The Security Monitoring Workstation shall be installed in the appropriate secure location and shall run the appropriate System Galaxy software and services needed for interfacing the system activity and database administration with all System Galaxy Clients on the LAN/WAN Network.
 - a. This workstation shall have a Windows-10 or Windows-8 operating system.
 - b. This workstation shall support event and alarm monitoring, video surveillance and be configured as required by system-owner.
 - 2. Badging Workstation: The Badging Workstation shall be installed in the appropriate secure location and connected to the LAN/WAN Network. The Badging Workstation computer shall run the System Galaxy software and services.
 - a. This workstation shall also have a Windows-10 or Windows-8 operating system.
 - b. The badging workstation shall support the following devices for card/credential issuance:
 - 1) Ultra Magicard IP or USB Printer (dye-sub, PVC card compatible).
 - 2) Videology Digital USB Camera (TWAIN, or WIA, or WDM compatible).
 - 3) GCS USB Card Enrollment Station.
 - 4) HID OMNIKEY USB Smart Card Reader/Writer Enrollment Station.
 - 5) Sagem MorphoTrak MSO-300 USB Fingerprint Enrollment Station.
 - 6) Topaz USB Signature Pad.
 - 3. Central Database Server: The Central Database Server shall be installed in the appropriate secure location. The system shall provide connectivity between the Central Database Server all Access Control Panels over a Local/Wide Area Network (LAN/WAN).
 - a. The database server shall serve as the instrument through which all system programming is stored.
 - b. The system shall provide real-time transactional storage of all system events.
 - c. The system shall archive date/time-ordered events in a separate archive database.
 - d. The database server shall have Windows Server 2012 R2 | 2016 operating system.

Access Control Panels (ACPs): The ACPs shall be installed in the secure equipment rooms as indicated on the Contract Documents, communicating to the Central Server over a local LAN/WAN connection.

1.3 SYSTEM DESCRIPTION FOR DIGITAL SURVEILLANCE

- A. The surveillance system shall be capable of operating in a multi-system configuration using

LAN/WAN connection.

1. The Digital Surveillance Software shall be capable of operating with System Galaxy software and security monitoring stations; and shall be capable of producing court-admissible video evidence for use by officials and law enforcement.
 2. The System shall be capable of supporting up to a minimum of 32 IP cameras or Analog cameras in various frame-rate speeds at up to 30 frames/second per camera.
 - a. The camera connectivity and frame-rate performance shall use the identical application software.
 3. Systems shall be interchangeable and be connectable through the same Remote Access Software within a security management system, regardless of the scale or system configuration.
 4. The System shall be configurable in a desktop or rack-mount model for indoor use in a secure location that maintains the appropriate environment for computer equipment.
 5. The Application software shall allow multiple systems to be concurrently accessed by remote users from a single screen.
 6. The Application software shall allow multiple systems to intercommunicate using LAN/WAN connections without additional hardware or software.
- B. The Network Video Recorder (NVR) shall offer current digital recording technology, product reliability, security, ease of use, and customer support structure.
1. Model availability in 16, 32 or 64 channel configurations with a system-wide recording rate up to 960 IPS (NTSC or PAL).
 2. The Network Video Recorder (NVR) shall be a complete network video recording solution. The combination of motion detection features, email alarms, advanced search capabilities, full megapixel support on all channels, and specialized remote monitoring technologies shall provide a highly robust and reliable system.
- C. The Hybrid Digital Recorder (DVR) shall offer current digital recording technology, product reliability, security, ease of use, and customer support structure.
1. Model availability in 16 and 32 channel configurations with a system wide recording rate up to 480 IPS (NTSC or PAL); supporting both IP cameras and Analog cameras.
 2. The Digital Video Recorder (DVR) shall be a complete hybrid digital video recording solution. The combination of motion detection features, email alarms, advanced search capabilities, full hybrid support on all channels, and specialized remote monitoring technologies shall provide a highly robust and reliable system.

1.4 RELATED WORK

- A. In addition to work described above, the work shall include, but not necessarily be limited to, the following:
1. Equipment identification, as specified elsewhere.
 2. Access control devices and surveillance identification, as specified elsewhere.
 3. Providing all cabling, conduit and connections as required for complete and functional systems, as specified elsewhere.
 4. Providing 120/220 VAC uninterruptible power as required for all equipment provided under this section, as specified elsewhere.
 5. Furnished equipment shall be assembled and installed in accordance with manufacturer's recommendations and instructions, as specified elsewhere.

6. Providing door hardware for remote monitoring and control of openings as scheduled under this section as specified elsewhere.

1.5 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the contract, apply to this section.
- B. Refer to all electrical drawings and specifications for additional requirements.

1.6 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- B. Shop Drawings: Include system components and controls, installation requirements, and relationship with adjacent construction.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. Company specializing in manufacturing the products specified with minimum 30 years documented experience.
 2. Manufacturer shall be capable of providing through its resellers a sole-source, turn-key solution including, but not limited to system server, customary cameras, wiring, networking components, and other peripherals essential for operation of the solution.
 3. Manufacturer shall be directly accessible to end users for advice on service, support, and warranty issues. Manufacturer shall maintain support information for public access on a web site and facilitate contact with technical resources.
 4. Software updates shall be freely accessible for download from the manufacturer's web site and available at no charge with a valid maintenance agreement. Terms for release of software revisions offering substantially new capabilities shall be offered for sale or at no cost with a valid maintenance agreement.
 5. Manufacturer's operation manual and training tutorials shall be directly accessible through the software main menu and provided on PC-compatible CD for installation on any personal computer. The manual and tutorial shall provide for intuitive topic search and help for system operation and function explanations. Additional computer support and help utilities shall be included on the system server main menu to assist in managing functions such as multi-media control, file management, disk and media management, file authentication, backup and more.
- B. Installer Qualifications:
 1. Company specializing in installing the Products specified in this section and Related Work with minimum five (5) years documented experience. Experience shall include projects with access control systems of similar scope and magnitude of the project. Company shall be a Certified Dealer/Value Added Reseller of the manufacturer and within 100 miles of project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 COORDINATION

- A. Provide system including networked computers, access control panels (ACPs), credential readers, credentials and badging station.
- B. Provide detection devices.
- C. Connect electric strikes and monitor status of door controls.
- D. Provide request for egress Passive Infrared Detectors (PIR) and/or pushbuttons.
- E. Provide all required power supplies.
- F. Provide all cabling connections required.
- G. Provide all specialty conduit requirements. Coordinate with the Electrical Contractor.
- H. The security contractor in coordination with the door hardware supplier shall provide the security components as scheduled and indicated on the Contract Drawings.

1.11 WARRANTY

- A. Manufacturer's Warranty of Security/Perimeter Access Control System:
 - 1. Provide a full performance and material guarantee for two years from the final acceptance of the Galaxy manufactured hardware. The warranty shall be unconditional for all Galaxy manufactured hardware.
 - 2. Technical support shall be available for 24 hours per day and 7 days per week to all Certified Dealers/Value Added Resellers.
- B. Manufacturer's Warranty of Digital Surveillance System:
 - 1. The digital recorder shall come with a minimum 3-year manufacturer's warranty with the 1st year including advance replacement service. Each unit shall have the purchase option to upgrade the warranty period up to 5 years and 2 years of advance replacement service.
 - 2. Technical support shall be available for 24 hours per day and 7 days per week to all integrators and Certified Dealers/Value Added Resellers free of charge.
 - 3. Certified Dealer/Value Added Reseller shall include a 3-year conditional warranty and shall offer additional services such as manufacturer system configuration.
 - 4. Manufacturer's warranty shall include 30-day exchange for new equipment from the Dealer/VAR's date of invoice plus one-year depot parts and labor repair for systems not

having had the terms of the warranty voided. Extended warranty contracts shall include extended term and hot-swap provisions.

1.12 SPECIAL TOOLS, EQUIPMENT AND MATERIALS

- A. All necessary equipment, materials, and special tools that are required to maintain each system provided under this Contract, shall be delivered to the System Owner or owner's representative by the Contractor. Additionally, a complete list of said necessary equipment, materials, and special tools shall be submitted to the System Owner within a **minimum of two (2) weeks prior** to final acceptance test.

1.13 CODES, STANDARDS, REGULATIONS AND COMPLIANCES

- A. The codes, standards, regulations and compliances listed in the Contract Documents are part of the Contract to the extent of their applicability to the project. The latest edition of the following codes, standards and regulations apply:
- B. Precedence & Conformity:
 - 1. In the event of any conflicts between or among different codes or standards, the Contractor shall notify the Design Professional to obtain clarification before proceeding with the work.
 - 2. Conform to local jurisdictional requirements where appropriate.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 101 - National Life Safety Code.
- D. Safety Standards:
 - 1. UL 294, Fifth Edition, Access Control System Units.
 - 2. UL 1076, Fifth Edition, Proprietary Burglar Alarm Units and Systems.
 - 3. CSA C22.2 No. 205-M1983, First Edition, Signal Equipment.
- E. Federal Communications Commission (FCC) Rules and Regulations: (Title 47 CFR) Part 15 - Subpart-B: Radio Frequency Devices – Unintentional Radiators.
- F. Encryption Standards: (AES) Advanced Encryption Standard Algorithm.
- G. Homeland Security Presidential Directive 12 (HSPD-12) Policies for Common Identification Standard for Federal Employees and Contractors.
 - 1. Federal Information Processing Standards (FIPS): FIPS 201 thru 201-2 (PIV, PIV-I, PIV-II): Personal Identity Verification of Federal Employees and Contractors.
 - 2. Option to perform PKI challenge to the Personal Certificate (PACS)
- H. DoD Information Assurance Certification and Accreditation Process (DIACAP): United States Department of Defense (DoD) process to ensuring the application of risk management to information systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Galaxy Control Systems.
- B. Substitutions: Requests for substitutions will be considered if equivalence to basis of design is demonstrated by submitted product data for review.
- C. Cards shall be manufactured by Allegion Plc., Farpointe Data Inc., HID Corporation, or pre-approved equal.
- D. Card readers, long range proximity card reader shall be manufactured by Allegion Plc., Bridgepoint Systems Inc., Essex Electronics Inc., Farpointe Data Inc., HID Corporation, Identive Inc., Nedap N.V., Veridt Inc., or pre-approved equal.
- E. Dye-sublimation "badging" printers shall be Magicard manufactured by Ultra Electronics.

2.2 ACCESS CONTROL AND MANAGEMENT SYSTEM

- A. System: Access Control System shall be System Galaxy provided by Galaxy Control Systems, or pre-approved equal.
- B. System Requirements:
 - 1. The contractor shall be responsible for providing a complete and functional system as specified. All devices required to complete the installation may not be described within this subsection but shall be provided as if specifically called for within the specification. All system components shall be approved and certified for the function they will perform.
 - 2. The Access Control System (ACS) shall be an enterprise-class system that supports system programming, system monitoring, administrative activities, report generation, card/credential enrollment and ID badge issuance.
 - 3. The system's database server shall be Microsoft SQL Server 2012 R2 / 2012 R2.
 - 4. A workstation that gives a user an interface allowing the control of the local/global sites shall be provided by Contractor or Customer as agreed upon in contract documents.
 - 5. The system shall be capable of utilizing a true client-server network that is configured to support the system database, all services, all applications, all access control panels.
 - 6. The Contractor shall optimize existing system settings as required by system owner to support the system operation, system monitoring, credential enrollment, badge ID issuance, and record keeping.
 - 7. Contractor / VAR shall provide adequate system & end-user training
 - 8. A single Microsoft SQL database shall store both credential-holder's records, access system information, and programming parameters.
- C. Access Control Panels (ACPs) and Cabinet Enclosures:
 - 1. The Access Control Panels (ACPs) shall be of a distributed database design; and shall use intelligent microprocessors to make smart decisions at the Access Control Panel.
 - 2. Physical Specifications for wall-mounted Access Control Panels (ACPs):
 - a. Enclosure shall be a NEMA 1 / IP1-A standard.
 - b. Description: 18-gauge, metal electrical cabinet with hinged, locking door.
 - c. Electrical requirements: 120/220 VAC, 60/50 Hz, 220 Watts, POE 15/30 Watts.
 - d. Panel Configurations & Physical Dimensions:

- 1) 2-door panel - 2 amps; (12" x 12" x 4" in).
 - 2) 2-door POE panel - 15/30 Watts; (12" x 12" x 4" in).
 - 3) 8-door panel - 2 amps; (18" x 13.75" x 6.25" in).
 - 4) 16-door panel - 10 amps; (32" x 13.75" x 6.25" in).
3. Physical Specifications for rack-mounted Access Control Panels (ACPs):
 - a. Description: 18-gauge, metal electrical cabinet with hinged, locking door.
 - b. Electrical requirements: 85/264 VAC, 60/50 Hz, 220 Watts.
 - c. Standard Rack Units: 4 Units(4U). Dim: 7x19x18.75 in. HxWxD (18 x 49 x 48 cm).
 - d. Weight: 26 lbs. (11.79 kg).
 4. Environmental Specifications for Access Control Panels (ACPs):
 - a. Temperature Range: -10° C to +60° C, non-condensing.
 5. Relay Output Ratings for Access Control Panels (ACPs):
 - a. Form-C Relays, 24 VAC, 1.5 amps maximum.
 6. Communication Specifications for Access Control Panels (ACPs):
 - a. TCP/IP 10/100 MB Ethernet
 7. The following components shall be mounted in appropriate location in relation to the access control panel:
 - a. Central Processing Unit (CPU) for the Galaxy Access Control Panel (ACP).
 - b. The appropriate daughter boards (DRM, DIO, DSI, AMM or Output Modules) as required to provide proper access control and to control of inputs and outputs or other peripheral devices (hardwired or wireless) according to the system requirements.
 - c. Two-piece, standard DB type connectors, for connecting boards to peripheral hardware.
 - d. The supervision resistors shall be installed as close as possible to the device-end and according to requirements of system owner.
 - e. Lock diodes shall be installed over locking device, as required per lock type.
 - f. Power Supply(s) and Batteries: power supply and sealed back-up batteries shall be included with the ACP.
 - g. Tamper switch: The cabinet shall be protected by an anti-tamper device in such a way that a tamper alarm shall be generated if any portion of any door moves more than one quarter of one inch from its closed position. This alarm shall be sent to the Monitoring Station.
 - h. Other equipment required to provide a functional, working system.

D. Power Requirements:

1. The Access Control Panels and related hardware shall be fed from a UPS system power at 120/220 VAC as required.
2. Each Access Control Panel shall have the following:

- a. Sealed, no-maintenance, rechargeable batteries.
- b. Sufficient power shall be included to allow the ACP to operate a minimum of 8 hours when loaded to its maximum configuration and capacities.
- c. Power back-up shall be of such size and capacity that 8 hours can be increased to a minimum of 24 hours.
- d. An alarm with descriptive message shall be generated at the Computer whenever an ACP loses AC power and is operating on battery power.
- e. An alarm with descriptive message shall be generated at the Computer whenever an ACP loses back-up battery power.

3. Lock Power Supply:

- a. The electric lock power supply shall be +24 VDC at 4 Amp, 6 Amp, or 10 Amp as required by site loads.
- b. The lock power supply shall include multiple DC outputs on separate Class 2 current-limited fuses, fused line voltage input, and individual manual on/off switching with individual LED indicated power status.
- c. Provide quantity of BPS-24 power supplies and batteries as required to maintain maximum 75% load for each power supply set.
- d. Provide a means to release doors as required by NFPA or local jurisdiction.

E. Life Safety

- 1. Card access system's lock power supply shall be connected to the fire alarm system by the Security Contractor.
- 2. All electric doors in pathway of building egress shall release as required by life safety codes.

F. Access Control System - Database Server Requirements:

- 1. Provide computer operating current, compatible Microsoft Server operating system supported by manufacturer, with the following specifications:
 - a. Microsoft SQL Server 2012 R2 | 2016
 - b. 16 Gigabytes (GB) of RAM,
 - c. 40 GB Free Hard Drive Space (minimum); or scale to size of system.
 - d. 10/100/1000 Mbps fiber optic NIC Ethernet card,
 - e. CD-RW Drive,
 - f. Two (2) USB Ports (minimum speed 2.0),
 - g. Additional ports as required to meet each manufacturer's interface requirements and to provide a fully integrated system.
 - h. Wide-screen Monitor, capable of 1280x1024 minimum resolution
 - i. Optical Mouse,
 - j. Keyboard,
 - k. LaserJet report printer (USB or network),

1. The database server shall meet or exceed specified requirements for the current version of System Galaxy software.
2. Provide complete programming as required for proper operation:
 - a. Provide password protection and operator levels.
 - b. Microsoft Database Management Studio software shall be installed.
 - c. Provide integration to 3rd Party Applications as required by Owner under Contract agreement at commissioning of system.

G. Access Control System - Security Monitoring Workstation Requirements:

1. Provide computer operating current, compatible Microsoft Server operating system supported by manufacturer, with the following specifications:
 - a. Microsoft Windows-10 or Windows-8 operating system
 - b. 4 Gigabyte (GB) of RAM,
 - c. 40 GB Free Hard Drive Space (minimum); or scale to size of system
 - d. 10/100/1000 Mbps fiber optic NIC Ethernet card.
 - e. CD-RW Drive,
 - f. Two (2) USB Ports (minimum speed 2.0),
 - g. Additional ports as required to meet each manufacturer's interface requirements and to provide a fully integrated system.
 - h. Wide-screen Monitor, capable of 1280x1024 minimum resolution
 - i. Optical Mouse,
 - j. Keyboard,
 - k. LaserJet report printer (USB or network),
 - l. The monitoring workstation shall meet or exceed specified requirements for the current version of System Galaxy software.
2. Provide complete programming as required for:
 - a. Password protection and operator levels.
 - b. Graphical User Interface (GUI), including graphic maps/floor plans with all devices shown. Provide all alarm, trouble, access, Alarm/event reporting, and GUI operator interfacing through the graphic maps in the system software.
 - c. Alarm notification, acknowledgement and actions taken.
 - d. Provide integration to 3rd Party Applications as required by Owner under Contract agreement at commissioning of system.
 - e. Interface with Video Surveillance System for integrated GUI screens and on-screen camera call-up and control.
 - f. System Management Reports: Provide an interface report printer as specified in this Section.

H. Access Control – Credential Enrollment & Badging Client Workstation:

1. Provide computer operating current generation Microsoft operating system supported by manufacturer, with the following specifications:
 - a. Microsoft Windows-10 or Windows-8 operating system
 - b. 4 Gigabyte (GB) of RAM,
 - c. 40 GB Free Hard Drive Space
 - d. 10/100/1000 Mbps fiber optic NIC Ethernet card
 - e. CD-RW Drive,
 - f. Wide-screen Monitor, capable of 1280x1024 minimum resolution
 - g. Optical Mouse,
 - h. Keyboard,
 - i. Two (2) USB ports, minimum 2.0.
 - j. Additional ports as required to meet each manufacturer's interface requirements and to provide a fully integrated system. See following subparagraph for full list of devices supported by System Galaxy for credential enrollment and badge issuance, as well as manufacturer's specifications for visitor management software.
 - k. Videology USB Camera - either TWAIN, or WIA, or WDM compatible; including flash, tripod and backdrop.
 - l. Ultra Magicard, Dye-sublimation Printer for printing PVC ID-badges.
 - m. LaserJet Report/Dossier Printer (USB or network).
 - n. The badging workstation shall meet or exceed specified requirements for the current version of System Galaxy software.
2. Provide complete programming as required for:
 - a. Password protection and operator levels.
 - b. Provide integration to 3rd Party Applications as required by Owner under Contract agreement at commissioning of system.
 - c. Credential Management: The credential enrollment and badging workstation shall support the following devices for card/credential and ID badge issuance:
 - 1) Ultra Magicard IP or USB Printer (dye-sub, 1-/2-sided PVC card compatible).
 - 2) Videology Digital USB Camera (TWAIN, or WIA, or WDM compatible).
 - 3) GCS USB Card Enrollment Station.
 - 4) HID OMNIKEY USB Smart Card Reader/Writer Enrollment Station.
 - 5) Sagem MorphoTrak MSO-300 USB Fingerprint Enrollment Station.
 - 6) Topaz USB Signature Pad.
 - d. System Management Reports: Provide an interface report printer as specified in this Section.
 - e. Client workstation may be additionally configured to support system programming,

diagnostics, and security monitoring operations as a secondary line of duty when not in use as a badging, or credential enrollment, or cardholder management station.

I. Software Capacities:

1. The software development tools and language shall be an existing, industry-accepted, type that is widely used in commercial systems. The system shall be modular in nature, allowing the system capacities to be easily expanded without requiring major changes to the system operation, while maintaining all defined system data as well as historical information.
2. Graphical User Interface (GUI): All System functions shall be accessible via point and click mouse control. Systems requiring command string control or complex syntax are not acceptable.
3. The following features are included in the system:
 - a. Access Control Panel Capacities and Hardware Attributes:
 - 1) 10,000-event log buffer for disconnect transaction storage at intelligent ACP.
 - 2) 50,000 credential capacity at the intelligent ACP; Unlimited card/credential capacity from SQL Database with Card Lookup enabled at the ACP.
 - 3) Up to 32,000 Input/Output capacity with the ability to control field devices using Boolean logic (configured through software) .
 - 4) 256 Time Schedules per loop/cluster with unlimited loops/clusters per site; includes “Always”, “Never”, and 254 user-definable schedules/periods.
 - 5) Two (2) Time Formats for programming Time Schedule (15-Minute Schedule format and 1-Minute Schedule format; defined at the loop-level).
 - 6) Nine (9) unique Holiday Types when using 15-minute schedules; i.e. 9 x 254 user-definable schedules per loop/cluster (unlimited loop/clusters per site).
 - 7) 100 Day Types / Holiday Types when using 1-Minute Schedules, including 256 user-definable Time Periods and 256 user-programmable Schedules per loop/cluster (with unlimited loop/clusters per site).
 - 8) 2000 user-defined Access Groups. Scales to unlimited access privilege combinations by using the Individual/Personal Doors feature, which can be assigned exclusively or in tandem with Access Control Groups.
 - 9) Dedicated Door Contact and Request to Exit (REX) inputs for each defined reader.
 - 10) Provides primary and auxiliary door outputs for each defined door/reader.
 - 11) User-definable Door Supervision
 - 12) User-definable Alarm Input Supervision
 - 13) Traditional Elevator Control through general output relays
 - 14) Otis Compass® Destination Entry elevator system integration.
 - 15) Schindler Port Technology Destination Dispatch elevator system integration.
 - b. Access Control Privileges:
 - 1) 2000 user-defined Access Groups. Scales to unlimited access privilege combinations by using the Individual/Personal Doors feature, which can be assigned exclusively or in tandem with Access Control Groups.
 - 2) Ability to assign any combination individual doors to credential using the Individual/Personal Doors feature.

- 3) Ability to assign multiple Access Groups per credential as well as combine both Access Groups and Individual/Personal Doors on credentials.
 - 4) Access Override from Server – configurable through user-defined override rules and exception conditions.
 - 5) Access Group deactivation option – changes affected access group from the scheduled privileges to “Never” only for all users’ who are assigned to the deactivated Access Group upon applying deactivation.
 - 6) Automatic Activation and Expiration by Date & Time for Access Groups.
 - 7) Automatic Active/Expire Dates for cards/Credentials.
 - 8) Automatic Expire by Date & Time for cards/credentials.
 - 9) Automatic Expire by Maximum “number of uses”.
- c. Additional Hardware Functions Configured from Software:
- 1) Setup Wizards – for adding hardware loop/cluster and panels
 - 2) Software Diagnostic Tools
 - 3) Global Anti-Passback.
 - 4) Door Interlocking (Mantrap).
 - 5) Door Groups – lock/unlock access and/or door group reporting.
 - 6) Schedulable PIN Required option
 - 7) Scheduled Unlock, with optional rule to require a Valid Unlock on the “day of” the scheduled unlock.
 - 8) Remote Door Control - lock/unlock access.
 - 9) User-selectable Reader LED behavior.
 - 10) Optional door programming to meet Americans with Disabilities Act (ADA) compliancy in door and access operation.
 - 11) Input/Outputs linking with Boolean logic.
 - 12) Wireless Reader Interfaces for door access control (ASSA Aperio, Salto Sallis, and Schlage AD-400/AD-300).
 - 13) IP Reader Interfaces for door access control ASSA ABLOY.
- d. Access Control, Event and Alarm Monitoring & Control:
- 1) Routable Alarm events.
 - 2) Event Log Output by email, TCP/IP, RS-232, and text file.
 - 3) Alarm Event Priority - user-definable priority ranges, priority assignment at the individual device level (reader/door, input, camera, etc.);
 - 4) Dynamic Device Graphic Screen (fixed GUI display; or detachable/floating GUI window with one-click preset command).
 - 5) Manual, Automated, and Scheduled Operator-command control of system hardware: control doors, inputs, outputs, elevators, request to enter, call up DVR/NVR video. Operator control commands issued through manual clickable GUI options and through user-definable automated script macros.
 - 6) Photo Verification, with trigger by Valid Access Events, Invalid Access Attempts, and/or on Passback Events; and optional ‘automatic next’ credential

queuing.

- 7) Traced Cards/credentials.
 - 8) Operator Commands: provides real-time operator control to control the state of the physical device through a mouse-click (lock/unlock, arm/disarm, shunt/unshunt, disable for service, etc.)
 - 9) Command Scripts: provides operator real-time intervention and scheduled control of the physical devices by launching a pre-configured script (lock/unlock, arm/disarm, shunt/unshunt, disable for service, etc.)
- e. Credential Management and ID Badge Issuance:
- 1) ODBC Data Import/Export (external databases) through an Import Utility.
 - 2) Import Cardholders and Credential IDs through an Import Utility from any ODBC compliant files.
 - 3) Import, activate & deactivate cardholders through Active Directory changes.
 - 4) Enroll access cards, proximity and smart cards; biometric credentials.
 - 5) Encode credentials: magnetic swipe, biometric, smart card (MIFARE®, MIFARE DESFire®, HID® iCLASS®).
 - 6) Supports multiple cards and/or biometric credentials per single cardholder.
 - 7) Enroll and assign alarm control cards - for arming/disarming the Access Control System from a card reader.
 - 8) Assign credentials as Guard Tour cards or as Hall Pass (Card Tour) cards.
 - 9) Design (create, modify, print) ID Badges – see Badge Printing in this section.
 - 10) Cardholder Badge: Print Tracking Print Count, Print Limit, Print Preview.
 - 11) Cardholder Dossier: Print Tracking, Print Count, Print Limit, Print Preview.
 - 12) 50 user-customizable Data Fields: supports user-customized field names (columns); function as text data entry or as pre-configured select lists;
 - 13) 14 additional user-definable Data Select Lists.
 - 14) Able to designate any system-default or user-customizable fields as mandatory, thereby requiring data entry or item selection before committing the cardholder record to the database.
 - 15) Configurable Alarm Panel User ID per person/cardholder (with Bosch).
 - 16) Operator-entered memo notes on Cardholder records.
 - 17) Programmable message text for LCD display: Supports system-wide text and unique-text per individual credential-holders.
 - 18) Ability to partition credential-holder population by “Customer” (DB entity)
 - 19) Ability to partition credential-holder population by “Department” (DB entity)
 - 20) View and Print credential activity reports & cardholder management reports.
 - 21) Cardholder Audit Reports: view and print chronological audit trails of change history by Operator name; date/time and description of actions are included.
 - 22) Online Help System: view and print information and instructions on how to configure and operate the system features.
- f. Integrations:

- 1) DVR/NVR integrations with **WiseNet Wave** video product line(s), or approved alternate brands.
 - 2) Import Camera names and link cameras to readers, inputs, and other devices.
 - 3) Active Directory Integration (LDAP protocol) allowing the system to manage cardholder accounts using the AD domain user management tools.
 - 4) Elevator System Interface with Otis Compass® Destination Entry, including passenger features. Reporting floor destination; controlling elevator call, speed, or exclusive car selection based on access privileges and USER-definable cardholder indicators for Otis Elevators (i.e. VIP, Split Group, Vertigo, and Extended Door Open Time for Accessibility).
 - 5) Elevator System Interface with Schindler PORT Technology Destination Dispatch: automatically import credential-holder access privileges and supports multiple Master Group configurations.
 - 6) Traditional Elevator Control Interface using relay output linking.
 - 7) Visitor Management via STOPware® Interface or EasyLobby® – including ability to manage visitor credentials and access privileges including credential expiration from the access control system (SG). When a visitor signs into visitor management system, the visitor is registered with the Access Control System (ACS) and their access rights/privileges activated.
 - 8) Alarm Panel Intrusion Detection Systems
- g. Activity Reporting using a selection matrix.
 - h. Embedded Crystal Report™ Templates
 - i. Customizable Operator Privileges: allow/restrict commands, system programming and viewing/editing data. Privileges are enforced system wide.

J. Software Operation:

1. The system shall provide a top-down configuration methodology. System shall allow the system operator to programmatically configure the software and hardware devices, options, and features in a fluid and logical method. The system shall organize the configuration of features so as to allow the operator to progress from the highest to the lowest configuration levels/entities in the system. The operator shall be able to move progressively through the configuration of dependent levels/entities in a logical manner without unnecessarily swapping between menus and screens.
2. The system shall utilize dynamic icons. The dynamic icons shall change appearance, in both color and icon display based upon the status of the associated object. This appearance change shall occur in real time and shall not require the system operator to perform a screen refresh or exit the current screen.
 - a. Dynamic icons shall be provided to represent:
 - 1) Doors lock control.
 - 2) Cameras and domes.
 - 3) Alarm inputs.
 - 4) Output control relay.
 - 5) Manual operator actions.
 - b. For intelligent access control panels that are online and communicating with the Communication Server, the dynamic icons shall reflect the true state of the device

represented by the icon.

3. User-definable/populated "Drop-down List" Data Fields (i.e. select-list, drop-list boxes):
Where certain data fields within data screens may contain the same information, the system shall provide the ability to define default settings for these data entry fields including "drop-down" select lists. The operator shall be able to change the default setting without impacting objects that have already been defined.
4. It shall be possible to use third party report tools, such as Crystal Reports to generate reports not already provided by the Access Control System, such as statistical or graphical reports of system activity.
5. Date format: The system shall support the date being formatted in the GUI display as dd/mm/yy or mm/dd/yy, depending upon the customary local date formatting.
6. Configurable Operator Account Profile: The system shall support creating unique operator accounts with unique login and passwords. System shall support operator levels that control access to viewing and editing data, online options and filters privileges.

K. Hardware Configurations:

1. Menu Configuration: The system software shall allow for the configuration of the access control panels through the use of simple menu commands. The menu commands may be executed by keyboard keystroke and point-and-click mouse control.
2. Clusters/Sites: The system software shall allow the configuration for up to 255 Clusters each maintaining up to 254 intelligent access control panels with ability to configure and maintain all Clusters simultaneously.
3. Database Updates: The system software shall download/upload information to/from the System Server automatically while the ACP is in communication with the CPU.

L. Time Specifications: Configuration of Time Periods and Holidays.

1. Configuration of Time Periods: Each time period shall represent a one (1) week and shall be divided into seven (7) days (i.e. seven fixed 24-hour time segments).
 - a. Each time 24-hour segment shall represent one (1) day and shall be divided into user-configurable time capsules. The number of time capsules (or their time equivalency) shall be determined by the chosen format assigned to the cluster (i.e. 1-minute or 15-minute formatting). All ACPs within the Cluster will operate on the same time formatting.
 - b. The software shall provide granular control of the time capsules by single-click, double-click and click-and-drag mouse functionality to allow the user activating and deactivating each individual time capsule.
 - c. The time period programming shall include the ability to assign holidays/special days and shall utilize the same granular formatting as assigned to the cluster (i.e. 1-minute or 15-minute formatting).
 - d. The software shall provide a utility to copy time segments and also support the operator defining time ranges to expedite the task of configuring time periods.
2. Configuration of Holidays: The system software shall not limit the number of days that can be chosen as a holiday. Holidays shall be considered as additional days of the week and shall have user-programmable date/time parameters that are independent from the normal date/time designations for each day.
 - a. When using the 15-minute time schedule format, the system shall allow up to nine (9) types of holidays to be defined/created per cluster/site. User shall have control over setting the 15-minute time segments as active or inactive, independently from the non-holiday programming.

- b. When using the 1-minute time schedule format, the system shall allow up to one hundred (100) day-types to be defined per cluster/site. The system operator shall be able to determine which Day Types are designated as holidays. User has control over setting the 1-minute time segments as active or inactive.
- 3. Global Cluster/Site Control of Schedules: using the Loop Group feature, the software shall allow the system to propagate changes to schedules, time periods, holidays and day types across all clusters/sites. A main cluster/site shall be able to selectively include or exclude other clusters/sites when propagating changes within a Loop Group. Clusters must be assigned to the Loop Group in order to participate in the propagation of time changes. Participating clusters/sites shall be able to override the propagated changes at the local level.

M. Time Zone Management:

- 1. General: The system shall allow the end user to configure the system server, workstations, and access control panels to be in different time zones (such as Eastern Standard Time, Pacific Time, etc.).
- 2. Operating System: The system shall support all time zones supported by the operating system. When defining a time zone to be used by the system, the system shall be provided with a drop-down listing of all time zones defined by the operating system. The operator shall be able to select the appropriate time zone from this listing.
- 3. Event Monitoring Workstations: The event activation date/time will be the date/time at the access control panel based on its geographical location according to its assigned time zone.

N. Alarm Events:

- 1. Alarm Event Function: Events shall be used to allow the system to react to system activity. When an event occurs, the system shall be able to perform multiple functions such as notify operator, display event message, activate a signal or bell, display list of response actions, call up live video, call up graphic map, etc.
- 2. Alarm Event Priority: The system shall allow a user-definable alarm priority (numeric value) to be assigned to individual devices and events.
 - a. The system shall provide 10,000 priority levels.
 - b. Each monitoring workstation shall be individually configurable to display alarm events in chronological order by date/time or display events in order of alarm priority value.
 - c. Each monitoring workstation shall be individually configurable to include (display) some or all alarm events by assigning a minimum and maximum range of priorities (value range), so that the events from an acknowledgeable alarm will only display if falls within that workstation's assigned range.
- 3. Configuration of Alarm Event behavior: The system shall allow alarm events to be configured as follows:
 - a. Displaying Alarm Events:
 - 1) Shall be able to display/or not display alarm events from each individual alarm input, device, or other configurable cause.
 - 2) Shall be able to display an alarm event for invalid access attempts, door forced and door open to long events.
 - 3) Shall be able to display incoming alarm events in order of highest importance based on an assigned priority value.
 - 4) Shall be able to include or excluded incoming alarm events from displaying at

specified workstations based on user-definable priority range and assigned priority levels.

- 5) Shall be able to configure the size of the event buffer of the display window.
 - 6) Shall be able to display alarm events for panel-level alarms at the ACP.
 - 7) Able to persist alarm events that are acknowledged but not restored.
- b. Audio-Visual feedback for incoming and pending Alarm Events:
- 1) The system shall display the incoming/pending alarm events in a different color than acknowledged alarm events; and will allow the system owner/administrator to change the system default colors of text and background.
 - 2) Shall be able to associate an audio wave file with an alarm event.
 - 3) Shall be able to repeat the alarm audio sound at a configurable interval.
 - 4) Shall be able to prevent the software application from being closed when and active alarm event is unresolved and is pending/unacknowledged.
- c. Operator Response, Acknowledging, and Clearing Alarm Events:
- 1) Shall be able to require an operator to acknowledge an alarm event.
 - 2) Shall be able to prevent operator from acknowledging an alarm event if the cause of the event has not been reset (restored).
 - 3) Shall be able to enforce an operator response above a specified priority level.
 - 4) Shall be able to require a text message to be entered when operator acknowledges an alarm event.
 - 5) Shall be able to define the minimum text length (number of characters) of an operator response.
 - 6) Shall be able to allow, or disallow, operator to acknowledge all pending alarm events with a single command (configurable).
 - 7) Shall be able to allow, or disallow, operator to delete alarm events with a command (configurable).
 - 8) Shall be able to allow, or disallow, operator to acknowledge alarm events with a double-click mouse function (configurable).
- d. Operator Instructions for Alarm Events:
- 1) Shall be able to display a predefined text message when an incoming alarm event activates; (up to 255-character message length).
- e. Automated features for Alarm Events:
- 1) Software shall be able to prevent application shutdown when pending alarm events are unacknowledged (configurable with operator confirmation).
 - 2) Software shall be able to 'pop' the Alarm Event screen to the forefront of the GUI focus when an incoming alarm event is logged.
 - 3) Shall be able to automatically open a Graphical Display (floor plan) on the Monitoring Station when an associated alarm event activates and is within the workstation priority range, if applied.
 - 4) Software shall be able to automatically call up the live digital video feed from the camera that is associated with the cause of the alarm activation.
 - 5) Software shall be able to automatically treat credentials that are 'non in system'

- as an alarm event/invalid attempt.
- 6) Software shall be able to automatically delete alarm events that are both acknowledged and restored.
- f. Incoming Alarm Event Instructions: The system shall allow the owner/administrator to preconfigure text instructions (up to 255 Characters) that shall be displayed to the system operator when responding to an incoming event activation.
- 4. Operator Command List (Action List): The system shall allow an event (input, valid access, etc.) or trigger to be configured to cause other system actions to occur. These system actions shall include:
 - a. Lock/Unlock door(s) and/or door group(s).
 - b. Momentary unlock of door(s) and/or door group(s).
 - c. Secure door(s) and/or door group(s).
 - d. Incremental counting results.
 - e. Decrementing counting results.
 - f. Limit counting results.
 - g. Alarm/disarm event(s) and/or I/O group(s).
 - h. Alarm/disarm alarm input(s) and/or input group(s).
 - i. Activate/deactivate output control relay(s) and/or output control relay group(s).
 - j. Momentary activate output control relay(s) and/or output control relay group(s).
 - k. Activate CCTV action.
 - l. Automatic display of an associated map on a Monitoring Station.
 - m. I/O Group set triggering.
 - n. Activate Discovery DVR (or approved equal) action.
 - o. Activate Discovery DVR (or approved equal) pop-up.
 - p. Activate PC audible alert.
- 5. Crisis Mode: The system shall control, on an action-by-action basis, dynamic physical access, input and output changes. So that when initiating Crisis Mode on a site, the access privileges will be modified to an alternate setting (system-wide) and the inputs and outputs can react accordingly.
 - a. System shall support triggering Crisis Mode through the GUI (graphical user interface).
 - b. System shall support triggering Crisis Mode through an input or a mechanical switch/button.
 - c. System shall provide the operator with a single-click capability (GUI) to issue and restore crisis mode. The single-click button shall always be visible and available to the system operator without having to navigate menus or open screens to see and invoke or revoke crisis mode condition/status.
 - d. System shall prompt operator with a confirmation/warning message that allows

operator to withdraw issuance or clearance of crisis mode commands before system-wide issuance occurs.

- e. The system shall provide the operator with the means to diagnostically confirm and display the current state of crisis mode (on vs. off) at each panel.
- 6. Graphical Map Display: The system shall allow a graphical map display to be linked to an event. This graphic map shall be available to the system operator when responding to an event activation. Graphical maps shall be centralized on the network on a shared location and be available for display on all operator workstations. See other sub-sections within this section for functionality of the Graphical Display
- 7. Automatic Graphical Map Display: The system shall allow for the automatic display of a graphic map-linked to an alarm event. This graphic map shall be available to the system operator to display when responding to the event activation. At the Monitoring Station, when an event is configured to automatically display a map, a map will pop up each time the event is activated. The map will disappear when the event is acknowledged. Graphical maps shall be centralized in the network on a shared disk and be available for display on all operator workstations. See other sub-sections within this section for associated parameters.

O. Graphical Display:

- 1. Graphical Floor Plan Map: The system shall provide a user interface Graphical Display of building floor plan maps with dynamic display of door status, device status, alarms, and cameras at all access control workstations.
- 2. Control Doors and Devices: The Graphical Display shall allow the system operator to control doors and devices from the dynamic icons. The dynamic icons shall support the operator's issuance of 'online commands'.
- 3. Start Live Surveillance Video: The Graphical Display shall support Dynamic Icons for surveillance cameras and shall support the operator's issuance of 'online commands' to request live video feed or request playback of recorded video.
- 4. User-definable Dynamic Icon State Image: The graphical appearance of dynamic icons shall be configurable. The system shall support the ability to assign a unique, static graphic image to every state that the dynamic icon must represent based on the type of device/door that the dynamic icon represents.
- 5. Drag-n-Drop Setup: The system shall be able to 'drag-n-drop' the dynamic icons for doors, cameras, and input/output devices from the Hardware Tree onto the graphical display of the floor plan map. The user shall be able to manage graphic icons including the ability to add, move, resize, reposition, and delete icons as needed

P. Floating Graphical Display:

- 1. Detachable or "Floating" Graphical Floor Plan Map: The software application shall support detachable or "floating" graphical displays of building floor plan maps with dynamic display of door status, device status and alarms at all access control workstations. The detachable floating graphic shall be able to be moved and repositioned on a second (dual) monitor and be in view at all times.
- 2. Configurable, Single-Click Commands: The dynamic icons on the Floating Graphic shall support single-click or one-click commands, which are issued from the operator by executing one mouse-click on the dynamic icon. The single-click or one-click command shall be uniquely configurable as the default single-click command for each individual device and door.
- 3. Control Doors and Devices: The Graphical Display shall allow the system operator to control doors and devices from the dynamic icons. The dynamic icons shall support the operator's issuance of 'online commands' from the operator command menu.
- 4. Start Live Surveillance Video: The Graphical Display shall support Dynamic Icons for

surveillance cameras and shall support the operator's issuance of 'online commands' to display and playback live video feed.

5. Drag-n-Drop Setup: The system shall be able to 'drag-n-drop' the dynamic icons for doors, cameras, and input/output devices from the Hardware Tree onto the graphical display of the floor plan map. The user shall be able to manage graphic icons including the ability to add, move, resize, reposition, and delete icons as needed.
- Q. Automated Operator Commander Scripts (macros): The system shall provide the means to issue a list or sequence of operator commands by executing a macro (i.e. set of script commands).
1. Command Script Editor: The system shall provide a Command Script Editor GUI that allows the user to create preconfigured macros that contain a sequence of Operator Commands. The Editor shall allow the user to create uniquely named macros and shall be able to add, delete and move (reorder) desired operator commands with the macros (scripts), as well as add descriptive notes to describe the purpose or function of the macro.
 2. Automatic Execution by Command Script Scheduling: The system shall be able to automatically execute Command Script Macros without operator intervention. The scheduling GUI shall allow the user to set the execution times by date (month/day/year) and time (hour:minute:seconds). The scheduling GUI shall allow the user to set the macro to run one time or on a repeat cycle with selectable cycles (every # seconds, or # hours, or # days, where '#' is configurable by the user; or by selected weekday(s).
 3. Manual Command Script Execution by Ad-hoc Selection: The system shall allow the operator to manually execute one or more macros (command scripts) by selecting them ad-hoc from the system list and clicking a GUI button to initiate the execution of the preconfigured macro(s).
- R. Door/Reader Configuration: The system shall support the configuring of options that affect the behavior of readers and doors. The options configured shall be stored in the ACP.
1. Door Names: Each door shall be addressed within the system by a unique, hard-coded name that represents its location within the ACP. The software shall also allow the user to create a descriptive, "user-friendly" name for easy recognition within the system.
 2. Reader/Door Operation: The system shall allow a reader/door to be configured to operate using the following functions:
 - a. Readers shall read cards while the door is in the open position.
 - b. The door lock automatically locks upon the door contact being opened.
 - c. The door lock may be configured to lock upon the door being closed.
 - d. The door lock may be configured to unlock upon request to exit.
 - e. Door Timers: The system shall provide separate timers for controlling and monitoring the states of the locks and door contacts for each door/access point. These timers shall be configurable in the software and stored in each ACP, as well as the system database.
 - 1) Unlock Duration (mm:ss): The system shall support a user-configurable amount of time that the ACP will wait before locking a door/access point after a valid access, request to exit, or pulse command has occurred. The ACP shall generate an event if this timer expires before the door is closed.
 - 2) Unlock Delay (mm:ss): The system shall support a user-configurable amount of time that the ACP will wait before unlocking a door/access point when a valid access occurs.

- 3) Reclose Time (mm:ss): The system shall support a user-configurable amount of time that the ACP will wait (shunt contact) for a door contact to reclose after a valid access, request to exit, or pulse. The ACP shall generate an event if this timer expires before the door is closed.
 - 4) 2-digit PIN Specifies Reclose Time: The system shall support a user-configurable option that enables a cardholder to enter the amount of time (mm) that the ACP should use as the Reclose Time (shunt contact) after a valid access occurs. The ACP shall generate an event if the time entered expires before the door is closed.
- f. Door Schedules: The system shall allow control (lock/unlock) of the door/reader based on assignment time schedules.
- 1) Scheduled Auto-unlock: The system shall support assigning a user-customizable time schedule that the ACP will use to automatically lock and unlock doors/access points.
 - 2) Require Valid Card before Scheduled Unlock (a.k.a. Snow Day rule): The system shall provide a user-configurable option that prevents an ACP from unlocking a door unless a 'Valid Access' occurs within the time period that is designated for the door to be unlocked.
 - 3) PIN Required Schedule: The system shall support assigning a user-customizable time schedule that the ACP will require a PIN code for valid access based on user-defined time parameters.
 - 4) Suppress Door Violation Events by Schedule: The system shall allow the system to suppress door forced and door open too long events based on user-defined time schedules. The events will be suppressed only during the scheduled time periods as configured.
- g. Ingress areas shall be disarmed based on Valid Access at the door by a software mechanism without the use of an auxiliary relay.
- h. Readers may be configured to disarm I/O Groups (partitions) via Valid Access.
- i. Door Alarms: The system shall allow each door to be configured to cause a variety of events to occur based upon activity at that door. Alarm associations may be configured based on the following events:
- 1) Door Forced Open.
 - 2) Door Open too long.
 - 3) Invalid Access Attempt.
 - 4) Duress.
 - 5) Passback Violation.
 - 6) Reader Heartbeat
- j. Auxiliary Relay (R2) may be configured to react based upon events:
- 1) Door Forced Open
 - 2) Door Open too long
 - 3) Invalid Access Attempt
 - 4) Valid unlock.
 - 5) Duress.

- 6) Passback Violation.
- k. Door Supervision: The system shall allow for unique configuration of door supervision resistors (series only, parallel only, and series-parallel, no resistor).
- l. Reader shall be configurable as a time and attendance reader.
- m. Automatic Photo Verification: The system shall allow for associating a reader with the Photo Verification Module so that the module is automatically launched when a credential is presented at an associated reader.
- n. Launch Photo Verification for Passback Violation: The system shall allow automatically launching the Photo Verification Module when a passback violation occurs at an associated reader.
- o. Surveillance Camera Association: The system shall allow a reader to be associated with a specific DVR and camera for displaying live video from the associated reader using the system's DVR Viewer module.
- 3. Output Activation: The system shall allow each reader to be configured to cause an output to activate based on activity at that door.
- 4. Report View: The system shall allow reports to be generated directly from the Reader Screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the door. Reports shall be available for viewing or printing.

S. Input/Alarm Configuration:

- 1. Input/Alarm point name: Each alarm point shall be addressed within the system by a unique, hard-coded name that represents its location within the ACP. The software shall also allow the user to create a descriptive, "user-friendly" name for easy recognition within the system.
- 2. Input/Alarm point configuration: The system shall accept as an alarm input: supervised alarm inputs, unsupervised alarm inputs and dedicated alarm points such as device tamper alarms and Access Control Panel AC power failure.
- 3. Input/Alarm arming: The system shall have the ability of monitoring input points in eight (8) trigger conditions as follows:
 - 1) Active: the input is active, whether or not it is armed.
 - 2) Alarm: the input has been activated while in an armed state.
 - 3) Armed: the input has been armed, either by an arming input or arming schedule.
 - 4) Disarmed: the input has been disarmed, either by a schedule, an event, or an operator command.
 - 5) Nothing: No states/conditions under which the input will trigger an output.
 - 6) On: the input that has been activated, but not armed.
 - 7) Trouble: a supervised input cannot validate the correct resistance value (due to cut or short).
 - 8) Trouble or Alarm: the input is set for either a trouble condition or alarm condition.
- 4. Report View: The system shall allow reports to be generated directly from the Input Screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the input. Reports shall be available for viewing or printing.

T. Output Control Relay:

1. Output Control Relay Name: Each output point shall be addressed within the system by a unique, hard-coded name that represents its location within the ACP. The software shall also allow the user to create a descriptive, "user-friendly" name for easy recognition within the system.
2. Activation Control: Output control relays shall be defined as maintained or momentary. Maintained output control relays shall be configured to be activated/deactivated based upon a user defined time schedule, linked to a system event or operator command. Momentary output control relays shall have a user-defined pulse time (defined in 1 second increments). It shall be possible to use the momentary output control relays for the momentary control of devices other than door locking hardware. Output control shall also have the inherent ability to utilize Boolean logic including ability to act upon logic, limiting, and counting triggers.
3. Virtual Outputs: There shall be the ability to trigger software-based outputs that can later be associated as future triggering inputs for advanced logical schemas.
4. Report View: The system shall allow reports to be generated directly from the Output Screen without having to search sub-set report menus. The system shall also allow for a right-click function to run reports from a Hardware Tree or event transaction of the input. Reports shall be available for viewing or printing.

U. Operators/Users:

1. Password: The system software shall be capable of identifying an unlimited number of system operators. Passwords shall be hidden from the Software GUI
2. Operator Name: Each operator authorized to operate any portion of the system shall be addressed within the system by a unique user defined name. The operator name will be used throughout the system to identify commands and functions that the operator has executed as part of an audit trail.
3. Operator Activity: All commands issued by a system operator while monitoring system activity including locking/unlocking doors, event acknowledgment, etc. shall be stored in the historical archive for later recall. The report command shall include the operator name, time and date the command was issued and the command issued by the operator.
4. Report View: The system shall allow reports to be generated directly from the Operator Screen without having to search sub-set report menus. Reports shall be available for viewing or printing.
5. Operator Privileges:
 - a. Privilege Control: Each operator shall be assigned an operator privilege matrix. Operator privilege matrices define the individual commands within the system that the operator is authorized to execute. Privilege matrices also determine which fields the operator can see and/or edit. The privileges and filters shall be unique to each operator.
 - b. Administrative/Master Privilege: When selecting the Master Operator privilege option within the system, the operator shall be given access to assign/modify the Operator privileges along with select Workstation options. Certain system programming or configuration may be reserved for operators with master privileges.
 - c. Online-Actions Privilege Control: Each operator may be configured to have access to perform online (software generated) actions with Doors/Readers, Inputs, Outputs, I/O Groups, Elevators, and Card Commands to include:
 - 1) Unlock: Unlocks the door/reader until a subsequent command, trigger, or schedule relocks the device.

- 2) Lock: Locks the door/reader until a subsequent command, trigger, valid access, or schedule unlocks the device.
- 3) Pulse: Performs a momentary (pre-configured duration) unlock of the door/reader.
- 4) Enable (Reader): Enables the reader after a disable command.
- 5) Disable (Reader): Disables the reader (typically for service operation).
- 6) Relay 2 On (Reader): Fires (Turns On) the auxiliary relay of the door/reader port.
- 7) Relay 2 Off (Reader): Releases (Turns Off) the auxiliary relay of the door/reader port.
- 8) Shunt (Input): Masks reporting of the input device until a subsequent command trigger or schedule unshunts the device.
- 9) Unshunt (Input): Enables reporting of the input device until a subsequent command, trigger or schedule shunts the device.
- 10) Service Mode (Input): Disables Input actions for service operations.
- 11) Restore (Input): Enables input actions after Service Mode is selected.
- 12) Arm (Input): Manually places input into an armed state until a subsequent command, trigger, valid access or schedule disarms the device.
- 13) Disarm (Input): Manually places input into a disarmed state until a subsequent command, trigger, or a schedule arms the device.

V. Credential Record Definitions:

1. User Defined Field Labels: The system shall allow a privileged user to specify field name, field type, field restrictions and whether or not a field is mandatory and/or functions as a select list.
2. Personnel Records: Personnel records shall be constructed to contain personnel data and user-defined fields. The personnel data shall consist of the following data fields:
 - a. Cardholder Personnel and Data Fields:
 - 1) Record ID number (system-defined, Primary Key)
 - 2) Common ID (user-determined identification code)
 - 3) Cardholder Name (credential-holder name)
 - 4) Cardholder Inactive option (deactivates all credentials of cardholder)
 - 5) Cardholder Trace option (traces all credentials of cardholder)
 - 6) Last Access (door/reader name, date, time)
 - 7) Date/time Cardholder record was added to database
 - 8) Date/time Cardholder record was last modified
 - 9) Assign Department at Cardholder level.
 - 10) Assign Customer at cardholder level.
 - 11) Phone and address of the cardholder.
 - 12) Date of Birth of cardholder.
 - 13) 2 user-definable date fields.

- 14) 10 user-definable select lists.
 - 15) 50 user-defined data fields
 - 16) Stored photo image of the person (card/credential-holder).
 - 17) Store alternate photo image of the person (card/credential-holder).
 - 18) Stored signature of the person (card/credential-holder).
 - 19) Assign Otis Elevator criteria (Split Group, VIP, Vertigo, Physical Disability)
- b. Card/Credential Data:
- 1) Card Technology Type (multiple card types supported)
 - 2) Card number (store the encoded card ID number)
 - 3) Personal Identification Number (PIN code)
 - 4) Facility number / Facility Code (with Wiegand format)
 - 5) Card Role (Access Control, Alarm Control)
 - 6) PIN Exempt option
 - 7) Passback Exempt option
 - 8) Multiple Card Credentials per Cardholder
 - 9) Multiple Biometric Credentials per Cardholder
 - 10) Store biometric fingerprint identification of the person (cardholder)
 - 11) Biometric data capture and encode: encoding biometric finger data on contactless smart cards (HID® iCLASS®, MIFARE®); storing biometric finger data, comparing biometric finger data,
 - 12) BioPIN data and encode: assigning and encoding biometric finger data on contactless smart cards (HID® iCLASS®, MIFARE®); storing biometric finger data, comparing biometric finger data
 - 13) Capture and encode card code on contactless smart cards (HID® iCLASS®, MIFARE®);
 - 14) Card Disabled (Credential Disabled)
 - 15) Credential Activation by Date.
 - 16) Credential Automatic Expiration by Date & Time,
 - 17) Credential Automatic Expiration by Date only
 - 18) Credential Automatic Expiration by “number of uses”
 - 19) Assign Access Privileges: Loop/Cluster Access Profiles, Access Groups, Personal Doors,
 - 20) Assign Credential to Card Tour/Hall Pass
 - 21) Configure Access Override and Server Exception rules.
 - 22) Forward Cardholder data to Time and Attendance system
- c. Cardholder Identification & Badge Printing:
- 1) Assign ID Badge Design to the cardholder
 - 2) Assign Dossier Design to the cardholder
 - 3) Print and Preview Badge and Dossier with photograph

- 4) 'Date last printed' for Identification Badge and Dossier
- 5) Print Limit and Print Count for Identification Badge and Dossier
- d. Operator Notes: system allows operator to create/store chronological notes in the cardholder's record (date/time stamped)
3. Mandatory Data Fields: The software shall provide a means whereby the user may configure fields in the personnel record as being mandatory. Personnel performing data entry on a cardholder record will be required by the system to enter information in all fields marked by the system as mandatory.
4. Select List Fields (droplists): The software shall provide a means whereby the user may configure certain data fields in the personnel record as 'select list' fields. The user shall be able to define the selectable values to be available in the select lists. The operator, when performing data entry, shall be able to choose one of the values defined (available) in the select list for the record being modified.
5. Database Query Capabilities: The system shall provide a cardholder selection list, allowing the operator to choose individual cardholder records from the selection list. The selection list shall provide a quick sorting display of all cardholder records and advanced SQL query tools including an SQL query builder.
6. Report View: The system shall allow reports to be generated directly from the cardholder screen without having to search sub-set report menus. The system shall also allow for a right-click function (context menu/shortcut menu) to run reports from the event transaction of a cardholder.

W. Automated Personnel Data Import:

1. Overview: The system shall provide a means to import personnel information from a Galaxy provided Application Programming Interface (API), a Database Stored Procedure, or an external ODBC data source. Additionally, the import shall execute in the background periodically. The import procedure shall also perform the necessary validity checking.
2. Bulk/Batch Import/Export: The system software shall provide means for bulk importing and bulk editing of card records through the use of a data file generated from another source. The external source file shall be ODBC compliant. The system shall also provide the means to generate/export the same format file of existing card records, allowing the information in the system to be exported to other computers and applications. The system shall allow the user to select the records that shall be included in the export file.
3. Active Directory Integration (LDAP protocol): The system shall support use of domain user management tools to manage the cardholder accounts. Options shall include the ability to add and remove users from the cardholder database through group membership administration via a Windows domain, and a single sign-on feature that passes SG user log on credentials to the SG software. Shall allow control of user passwords and configuration of permissions— user-definable, automatic import (pull) by AD Group of personnel data (text fields) and images (person photographs) and assign access privileges.

X. Reports:

1. Data Storage: All programmed and transactional history is automatically stored to the database for later recall. Information written to the database shall be immediately available for report generation.
2. System Function: The system software shall be able to generate reports without affecting the real-time operation of the system.
3. Media: Reports shall be generated from the database and generated to the operator's screen, hard disk, floppy disk or printer(s).
4. Search Criteria: The database shall be structured such that the operator shall determine the

search parameters based on variables available on the individual report matrix. Systems requiring the user to type complicated search strings are not acceptable.

5. Report Types: Programmed data reports shall be available for Database Configuration and Historical Activity.
 6. Database Configuration Reports: The system shall be capable of producing reports of database configuration information. These database configuration reports shall include hardware and software configuration, group, time zone, activity and audit log reports.
 7. Report Selection: Depending upon the type of report being generated by the system operator, the system shall provide a listing of previously defined reports. The operator shall be able to pick an existing report, modify an existing report or generate a new report.
 8. System-Defined Reports: The system shall contain pre-defined reports that shall report the database configuration for area, holiday, time specifications, time zones, elevator, event, all groups, control outputs and authorized cardholders.
- Y. User Status "Who's-In" Report: The "Who's-In" report shall provide a listing of all personnel that the system has determined to be in a user-specified area. The "Who's-In" report can be used in emergency evacuation situations, to determine if personnel are in the building, and where they are in the building. The "Who's-In" report can be initiated by an event or run as a report by a system operator that can be automatically refreshed on the screen to keep current as personnel exit the area.
- Z. Audit Trail: The system shall provide an audit trail function that records permanent changes in data configured by system operators. The audit trail shall record permanent changes made to the configuration database by manual operator data entry. Data Audit Trail reporting shall provide the chronological actions (date/time) of all operators by name for the following: additions, modifications, deletions performed for programming and configuration of software features, hardware and hardware functions, programming related to access privileges, rules, schedules, and programming of cardholders and their credentials. Audit Trail Reporting also covers the operator accounts themselves – i.e. creation and changes to their accounts, permissions and filters. Audit Reports are available for printing or online viewing.
- AA. Help Screens - On line help: The system software shall have online help available at any point requiring operator input. The help screen shall be accessible from a pull-down menu. This help screen shall contain information that shall allow the operator to enter correct data.
- BB. System-wide and workstation-specific settings: The system software shall provide the ability to control (enable and disable) select settings on a system-wide and workstation-specific basis.
- CC. System Redundancy/Double-Take:
1. Overview: The system shall support redundant server with automated failover for disaster recovery using the Double-Take software to create a hot-redundant copy of the system database including all data, system programming, and system activity.
- DD. Activity (Event) Monitoring:
1. General Display Features: The activity monitoring screen shall include the event, date/ time display, user, active events, events require acknowledgement and loop/site information.
 2. Event Audible Annunciation: Event audible annunciation refers to the beeping behavior of the operator workstation when there is at least one active and unacknowledged event. The operator workstation shall beep continuously as long as there is at least one active and unacknowledged event. The beeping shall continue until the operator acknowledges all such events or uses the "Silence" button to silence all audible for all such events.
 3. Pop-Up Events:
 - a. When an event needing acknowledgment becomes active, the alarm monitoring

screen shall be displayed on all operator workstations currently logged in designated to receive such a priority alarm.

- b. If the System Galaxy program has been minimized on the Windows taskbar or as an icon, the alarm monitoring window shall pop open and be displayed on the operator workstation as the front-most window.
 - c. If the monitoring window is behind other tabs/windows, the alarm monitoring window shall be pop forward and displayed on the operator workstation as the front-most tab.
4. Scrolling Display: The system shall contain a scrolling display of system activity.
 - a. The system shall provide a vertical and horizontal scroll bar to allow the system operator to move up/down among the event messages on the screen.
 - b. The system operator shall be able to scroll back through the previous 1000 transactions of system activity
 - c. Length of event log buffer shall be configurable per workstation.
 5. Display Types: The system shall provide an activity (event) monitoring screen which shall operate in multiple modes. The first mode shall allow the system operator to view all system activity (including scheduled actions, card accesses events, etc.) in chronological order. The second mode shall display only those system events, which require operator action. The system shall allow the operator to view events in order based upon alarm priority or time of activation. A third mode shall allow for a split screen (on one or multiple monitors) providing the ability to display both General Events and the Alarm Events.
 6. Event Instructions: The operator shall also have the ability to view additional details of the event through the use of a single keystroke. By clicking on the event item with the mouse, the operator shall be presented with alarm response instructions that have been programmed into the system.
 7. Message Color: The system shall allow the operator to select the color that shall be used in displaying event messages on the operator workstation. The operator shall be able to choose from any of fourteen (14) colors. The event message color shall be based upon event message type and event priority.

EE. Graphics:

1. File Format for Graphic Map/Floor Plan: The system software shall allow the importation of existing drawings and shall support .bmp, .jpg, .dxf, .dib, .rle, .pcx, and .dcx formats for graphic maps/floor plans.
2. File Format for Graphic Symbols/Device Icons: The system software shall allow the importation of graphic icons in .bmp format.
3. Configuration: The system software shall allow the graphic symbols to be mapped or associated to every state that each hardware/field device can report, and will allow, the device icons to act as a dynamic icon when being monitored on the graphic map/floor plan. The system software shall allow each device icon to be placed on the graphic map/floor plan through the use of a mouse (drag-&-drop). The system shall allow each device icon to be moved and resized as necessary. The graphic icons placed on the floor plan shall include alarm inputs, output control points, doors, cameras, motion detectors, alarms, and other graphic symbols that represent field devices and their states. On a floating graphic floor plan, the system shall allow each device icon to be preconfigured to issue a specified operator command with a single mouse-click when selected.
4. Operation: Upon activation of an event, the operator shall, by the use of a single keystroke, be able to view the associated graphic/floor plan on the workstation monitor. The dynamic icons shall display the graphic symbol that is mapped in the system for the current state of

each field device represented. The operator shall use the mouse to click on any of the icons on the graphic and issue a command that is associated with the field device.

5. Storage: The graphics feature shall take advantage of the Client/Server system configuration, with all graphics being created/stored on a shared drive/location on the system's network. These graphics shall be available to all authorized monitoring workstations.

FF. Field-upgradable Flash ROM for Access Control Panels: the Security Management System shall utilize a field-upgradable Flash ROM for storing the ACP's operating program. The Flash ROM operating program shall be field-upgradable directly from the Security Management System. The system shall not require a technician to physically change a ROM chip in the ACP in order to change a panel's operating system. The system shall not require special hardware or hand-held device to load the panel.

1. Loading the Flash Program from the Security Management System:

- a. The Security Management System shall provide the system user with the ability to display the version/revision level of the flash operating program that is currently loaded and running in each access control panel (ACP).
- b. The Security Management System shall provide controls to allow a privileged system operator to issue a command to load the Flash program to each/all ACPs. The privileged operator shall be able to select which ACPs shall receive the flash load. The operator shall also be able to choose the version/revision level of the Flash program that the ACPs shall receive.
- c. If an ACP is not communicating with the Security Management System, the loading of the Flash program shall be delayed until communications are restored, or until a system operator cancels the load request.

2. Access Control Panel (ACP) Operation:

- a. The access control panel shall continue to operate as normal while the Flash operating program is being loaded from the Security Management System.
- b. The Flash program being loaded shall be stored in temporary memory of the ACP until the entire operating program is received. When the ACP receives the entire Flash program, the system shall provide the operator the option of when begin running the new Flash program. The ACP shall delete the previous version of the Flash program when the ACP begins running the new operating program.

GG. Access Control Panel Design: The access control panel shall be an intelligent ACP with a modular design that is capable of supporting any combination of field devices within one panel.

1. ACP Communications: Each ACP is responsible for initiating the connection and communications to the Main Communication Server using the Security Management System's software services.

- a. Security Management System's Software Services: The software services are a set of common functions and applications that shall handle system events and bidirectional communications between the ACPs and the system (database, system software, monitoring workstation, credential enrollment station, and other hardware). The Security Management System shall also handle events and communications between other ACPs.

2. Access Control Panel Design:

- a. Network Communication: The 635 Series ACP shall support 10/100 auto-negotiating Ethernet Communication. The interface to the Ethernet services shall be through a standard RJ-45 connector.
- b. ACP Inputs/Outputs: The ACP shall provide three (3) on-board inputs. The inputs

are reserved for reporting tamper, AC power fail, and low battery conditions.

- c. Serviceable Hot-Swap Modules: The ACP shall allow for "Hot-Swap" serviceability. This allows for modular boards (DRM, DIO, DSI, AMM, ORM/ERM, etc.) to be changed without an ACP power-down.
- d. Diagnostic LEDs: There shall be diagnostic LEDs indicating the receiving and transmitting data for the on-board communications.
- e. ACP Reader Sections: There shall be multiple on-board communication sections per ACP that support external readers. The number of readers supported varies according to the ACP configuration.
- f. Intelligent ACP Design: the ACPs shall be able to determine the validity, authorization privileges, and schedules associated with each credential presented. The ACP shall be able to validate credentials without having to connect or communicate with the Security Management System in order to accurately grant or deny access. The ACP shall be capable of storing in resident memory all access credentials and their privileges, all door and other hardware configuration, and all associated schedules, I/O groups, timers, delays, and any related hardware linking and configured behavior. Each ACP shall have the capacity to store 10,000 system events at the panel until reconnection with the system communication server is established; including the activation of reader/door events, inputs/outputs, ACP inputs, scheduled events, etc.
- g. Embedded Diagnostic Web Tools (DWT): Each ACP shall have an embedded web tool that allows for identification of boards, display and configuration of panel options, and diagnostics of the ACP's hardware operations.
 - a) Availability: The authorized technician shall be able to access (open and view) the ACP's embedded web pages.
 - b) Identification of Boards/Interfaces: The Diagnostic Web Tools shall support identification of hardware modules within the ACP; including board type, board address, position, and currently running flash firmware version. The DWT shall also report the current status of each attached module (i.e. normal operation, updating flash, etc.)
 - c) Configuration: The DWT shall allow configuration of special options and other parameters available in the ACP panel.
 - d) Diagnostics: The Embedded Web Tool shall provide an automated means exercise and prove the operation of the hardware components on each daughter board in the ACP (i.e. states and conditions of locks, relays, inputs, outputs, etc.). In this way the ACP can be field-tested for proof of operation and as a diagnostic troubleshooting of the ACP, system, and hardware peripherals.
- h. ACP Boards & Interface Modules:
 - 1) CPU Board (Central Processing Unit):
 - a) Purposes: The CPU Board shall provide the intelligent access control and bidirectional communication with the Security Management System. The CPU shall store all configuration for doors, readers, timers, delays, door locks, door contacts, REXs, relays, user credentials, access privileges, schedules, holidays, inputs, output relays, door groups, floor groups, i/o groups, and any related options and linking between field devices.
 - b) ACP Network Addressing: Each Central Processing Unit (CPU) shall be

capable obtaining an IP address through DHCP server or maintaining a static IP Address if DHCP is not used.

- c) Special Features and panel options: Enabling/disabling of special features and extended options shall be supported at the CPU and shall be accessible through the Embedded Diagnostic Web Tool.
 - d) Configuration and Diagnostics: The CPU shall provide an embedded web page for online configuration, diagnostics, and operational testing using the network connection. A direct-connect serial port shall be provided to support field configuration and diagnostics as an alternative.
- 2) Dual Reader Module (DRM):
- a) Purposes: The DRM Board shall provide bidirectional communication with readers, monitoring and control of door hardware such as locks, contacts, RTE/REXs for the purpose of controlling and monitoring access and egress in a building, facility, or designated area.
 - b) Connections for Standard Reader & Hardware: Each DRM shall support two (2) Reader Sections per board. Each reader section shall support an access control reader and the accompanying door hardware (door contact, REX, Lock Relay-1, and alternate Relay-2).
 - c) Door Supervision: Each DRM shall provide two (2) on-board, socketed resistors for door supervision (one for each section) that can be changed for a different resistor values as allowed.
 - d) Relays: Each DRM board shall provide four (4) Form-C SPDT relays per board. Each reader section on the DRM shall operate Relay-1 for the door lock control and Relay-2 for an alternate output purpose as required.
 - e) RS-485 Communication: A DRM board shall provide one (1) RS-485 communication port allowing the DRM to be remotely deployed from the RS-485 Section of a Dual Serial Interface (DSI) Board.
- 3) Digital I/O Board (inputs/outputs):
- a) Purposes: The DIO Board shall provide supervised monitoring and control of inputs, and shall provide control and monitoring of outputs.
 - b) Inputs: Each Digital I/O Board (DIO) shall provide eight (8) fully supervised, on-board inputs. These inputs shall provide four-state supervision with user-selectable resistor values for Normally Open, Normally Closed, Trouble Open, and Trouble Short.
 - c) Outputs: Each Digital I/O board shall provide four (4) Form-C SPDT Relays for output control. Each output terminal connection shall have contacts for Normally Open (NO) or Normally Closed (NC) states.
- 4) Dual Serial Interface Board (DSI):
- a) Purposes: The DSI Board shall provide monitoring and control of multiple devices the serial communication channel.
 - b) Connections: Each Dual Serial Interface Board (DSI) shall provide two (2) RS-485 Sections on the board. Each RS-485 Section shall provide A/B contacts and ground (GND) for RS-485 communication.
 - c) Output Power: Each RS-485 Section of the DSI Board shall provide a

configurable +12/+24 VDC output power.

- d) Termination: The DSI Board optional on-board termination (120Ω) for each RS-485 Section.
- 5) 635-Series Alarm Monitoring Module (AMM):
 - a) Purposes: The AMM Board shall provide supervised monitoring and control of inputs.
 - b) Communication: Each AMM shall communicate on an RS-485 Channel (section) of a Dual Serial Interface (DSI) Board.
 - c) Each AMM shall provide sixteen (16) fully supervised contacts for connecting field inputs. Each input shall provide four-state supervision with user-selectable resistor values for Normally Open, Normally Closed, Trouble Open, and Trouble Short.
 - d) LED Indicators: Each AMM shall provide sixteen (16) discrete LEDs (one for each input position), with each LED indicating the state of the contact – i.e. Normally Open or Normally Closed.
 - e) Voltage & Tamper Inputs: Each AMM Module shall provide an on-board tamper input and on-board voltage input that detects safe, high, and low voltage conditions.
- 6) 635-Series ORM/ERM (Output Relay Module / Elevator Relay Module):
 - a) Purposes: The ORM/ERM Board shall provide control and monitoring for general-purpose output (GPO) or traditional elevator output control.
 - b) Communication: Each ORM/ERM shall communicate on an RS-485 Channel (section) of a Dual Serial Interface (DSI) Board.
 - c) Output Relays: Each ORM/ERM board shall provide eight (8) Form-A SPST Output Relays. Each ORM/ERM board shall support eight (8) general-purpose outputs (ORM) or shall support eight (8) traditional elevator relays (ERM) representing 8 floors.
 - d) LED Indicators: Each ORM/ERM shall provide eight (8) discrete LEDs with each LED indicating the state of the relay – i.e. On/Engaged or Off/Disengaged.

HH. The ACP Finder & Web Configuration Tool:

1. Availability: The Web Configuration Tool shall reside on a networked PC and provide the ability to view the networked ACPs from a standard web browser, such as Internet Explorer.
2. ACP Finder: The Web Configuration Tool shall be capable of detecting a networked access control panel (ACP) by MAC address.
3. Addressing and Configuring the ACP: The Web Configuration Tool shall provide the ability configure the IP addressing for each ACP, as well as configure whether a panel uses DHCP or static IP Addressing.
4. Configuring ACP Options: The Web Configuration Tool shall provide the ability to configure a descriptive, logical name for each ACP, which can further distinguish the panel's location and purpose from other ACPs on the same network.

II. 635 Series Access Control Panel (ACP) Software Features and Settings:

1. Access Control Operation:

- a. Door Access Control: The ACP shall handle the door control based upon configurations stored locally at the panel (door/reader, configurations, authorized credentials, privileges, schedules, etc.). The door configuration defines the behavior of a door and includes the following parameters:
 - 1) Monitor & Control the Lock Relay (Relay 1): The ACP shall monitor and control the state of the door lock relay (lock/unlock). If a door contact is open when the lock is in the locked state, the ACP will generate a Door Forced Open alarm event.
 - 2) Door Lock Timers: The ACP shall store and maintain the timers for Unlock Duration and Unlock Delay. The ACP shall unlock the door immediately when a valid access, REX, or pulse command occurs. If the door contact is still open when the timer expires, the ACP will generate an alarm event. If an Unlock delay is configured, the ACP will wait to unlock the door when a valid access occurs.
 - 3) Monitored Door Contact: The ACP shall monitor changes in the state of the door contact (door opened or closed). If the door contact input becomes active while contact is not shunted, the ACP will generate a Door Forced Open alarm event.
 - 4) Door Shunt Times: The ACP shall store and maintain the shunt times (Reclose Within, and PIN-specified Reclose timers) that determine how long a door contact should be shunted after a valid access. If the door contact remains open after a shunt time expires, the ACP shall generate an alarm event.
 - 5) Request to Exit (REX) Input: The REX device Input shall be placed on the protected side of the door.
 - 6) Door Control: The ACP shall allow door control from a Security Management System. The door mode may be set to lock, unlocked, momentarily unlocked, or access disabled modes. A momentary unlock request will start a valid access cycle process on the door.
 - 7) Door Status Reporting: The ACP shall report door events and alarm status changes including *door open too long* and *door forced open*.
 - 8) Door Event Configuration: The ACP shall allow the configuration of Events that are activated by certain door events. The supported events shall include:
 - a) Door held open causes an Event.
 - b) Door forced causes an Event.
 - c) All valid access causes an Event.
 - d) All invalid access attempt causes an Event.
 - e) Duress causes an Event.
 - f) Passback violation causes an Event.
 - g) Reader Heartbeat causes an Event.
2. Door Groups: The ACP shall allow the configuration of door groups by the Security Management System. Door groups may then be used in emergencies, or to group doors for common control.
3. Reader Configuration: The access control panel (ACP) shall allow reader configuration from the Security Management System software. The reader configuration defines the behavior specific to a reader on a door and includes the following parameters:

- a. Default PIN Mode - If a card reader includes a keypad, it may be configured to require the cardholder to enter a Personal Identification Number (PIN), in addition to presenting a card, to gain access at a door. A Time Specification may be entered to control this mode on a time basis.
 - b. Card Only Mode – a valid access card shall be granted access to the door/access point. An invalid or unknown card shall be denied access to the door/access point. The ACP shall generate the valid access, invalid access attempt or unknown card events as appropriate.
 - c. PIN Only Mode – a valid access PIN code shall be granted access to the door/access point. An invalid PIN shall be denied access to the door/access point. The ACP shall generate the valid access or invalid access attempt events as appropriate.
 - d. Card plus PIN Entry through Combo Keypad Reader - If card reader includes a keypad, a valid card with valid PIN shall be granted access to the door/entry point. An invalid or unknown card and/or an invalid PIN shall be denied access to the door/entry point. The ACP shall report the valid access, invalid access attempt or unknown card as appropriate.
 - e. Biometric Modes: a valid biometric credential shall be granted access to the door/access point. An invalid or unknown credential shall be denied access to the door/access point. The ACP shall generate either a valid access, invalid access attempt, or unknown card event, as appropriate. The following modes/factors are supported:
 - 1) Single-factor (1:1) and Multifactor (1:n)
 - 2) Finger Only mode
 - 3) Card Only mode
 - 4) Card + PIN mode
 - 5) Card + PIN + Finger (or BioPIN) mode
 - 6) Card + Finger (or BioPIN) mode
4. Input Monitoring and Control: The access control panel (ACP) shall allow the configuration and control of inputs, whether they are connected to AMM modules, or to DIO boards and any logical input that may be maintained by the ACP.
- a. Input Control: The ACP shall allow the control of inputs including arming/disarming the input.
 - b. Input Status Reporting: The ACP shall allow the retrieving of the current status of inputs and shall log changes in input status.
 - c. Input Event Configuration: The ACP shall allow the configuration of input Events. These Events will include:
 - 1) Activation during a specified time specification causes Event.
 - 2) Activation outside a specified time specification causes Event.
 - 3) Supervision error causes Event.
 - 4) Tamper on AMM input board Event.
5. I/O Groups: The access control panel (ACP) shall allow the configuration of input/output groups which may be used to control input and outputs. I/O Groups may be referenced by Events.
6. Output Monitoring and Control: The access control panel (ACP) shall allow the configuration

and control of outputs connected to the ACP.

- a. Output Definition: The ACP shall allow the configuration of outputs. Output configuration controls the behavior of the Output and includes Enabled/Disabled and reversed outputs.
- b. Output Control: The ACP shall allow the control of outputs, including setting the current state to activated, deactivated, or momentarily activated.
- c. Output Groups: The ACP shall allow the configuration of output groups.

2.3 DIGITAL SURVEILLANCE SYSTEM

- A. General Description: The surveillance system server and software capabilities shall consist of the following components and facilitate camera connection, administer the control program, create sequential and multiplexed camera displays, store recorded video, provide for computer assisted search and playback, and facilitate for authorized connection from remote computers.
 1. System: Discovery Series Video Solution as manufactured by Galaxy Control Systems.
- B. Installation of the system shall include battery backup and power conditioning for server and cameras with auto-recovery upon restoration of main power.
- C. Operating Specifications for the NETWORKED Digital Recorder NVR – the specifications in this paragraph and subparagraphs apply to the Networked NVR.
 1. Environmental Conditions: the Digital Recorder shall be designed to operate under the following environmental specifications:
 - a. Operating Temperature: 40°F to 104°F (5°C to 40°C) non-condensing.
 2. Power Requirements: Components shall have the following electrical specifications:
 - a. Power Requirement: 115 – 230 VAC
 - b. Output over voltage protection
 3. Product Label Requirements:
 - a. The digital recorder shall have the RoHS certification all clearly labeled on the outside of the box.
 4. Dimensions (H x W x D): 6.9” x 16.9” x 26” (176 mm x 430 mm x 660 mm)
 5. Weight: 80 lbs. (36.3 kg)
- D. NVR Networked Digital Recorder - Operational Requirements: The network video recorder shall include, as a minimum, the following features/functions/specifications. The network video recorder shall:
 1. Be fully assembled in the U.S.A.
 2. Include a minimum Intel Dual Core i3 processor with the ability to expand to an Intel Quad Core i7 processor performance upgrade on the 16- and 32-channel models.
 3. Include an Intel Quad Core i7 processor on the 64-channel model.
 4. Include 4 Gigabytes of system memory with the ability to expand to 8 Gigabytes of system memory on the 16- and 32-channel models.
 5. Include 8 Gigabytes of system memory on the 64-channel model.
 6. Include two onboard 10/100/1000 Network Interface connections offering stability, security, and allow the user to easily modify the system network settings.

7. Be optimized and support the Windows-7 Embedded Operating System.
8. Provide recording support for high-resolution Megapixel IP video, selectable by user, on all video channels.
9. Support the recording of up to sixteen (16) audio streams dependent on the IP device (cameras and encoders) capabilities.
10. Provide remote capabilities including remote for Windows, remote for Macintosh, multi-site management software and mobile applications for Apple and Android devices.
11. Include the ability to unlock additional IP camera licenses offering up to a combined total of 64 IP cameras per NVR with a maximum recording throughput of 400 Mbps in a RAID 5 configuration and 200 Mbps in a single drive configuration.
12. Include support for the ONVIF 1.01 and 1.02 core specifications. Full list of ONVIF compliant and tested devices: www.galaxysys.com
13. Support a majority of IP cameras from major manufacturers including:
 - a. OpenEye
 - b. ACTi
 - c. Arecont
 - d. Axis
 - e. IQ Invision
 - f. Panasonic
 - g. Toshiba
 - h. Samsung
 - i. Sanyo
 - j. Sony
 - k. VIVOTEK
 - l. Full list of IP compatible devices: www.galaxysys.com
14. Provide a Live Digital Zoom function for IP cameras that allows the operator to zoom in and out of a live picture.
15. Support static IP and DHCP IP addressing through configurable TCP/IP settings.
16. Include DDNS (Dynamic Domain Name System) for free for the life of the product. DDNS shall allow the operator to use a URL address instead of a static IP address.
17. Be capable of recording up to 30 IPS on a single channel in an environment where all channels are being utilized. The operator shall have the ability to assign each channel a specific recording rate varying from 1 to 30 IPS.
18. Be able to assign each channel a different recording resolution and frame rate based on the network video device capabilities.
19. Offer support for M-JPEG, MPEG4, or H.264 network video devices. Shall allow multiple compression formats to be used simultaneously.
20. Allow the user to adjust the resolution, quality, motion sensitivity, and number of images per second each camera will record. These adjustments shall be configurable based on the network video device capabilities.
21. Offer the following on-board hard drive capacity options with sixteen removable hard drive bays that include exceptional fan cooling, 3.0 Gbps and large capacity HDD (3 Terabyte

drives) support:

- a. 16.0 Terabytes
 - b. 24.0 Terabytes
 - c. 32.0 Terabytes
 - d. 48.0 Terabytes
 - e. 64.0 Terabytes
22. Non-RAID configurations will only use high performance AV (Audio/Video Surveillance) rated hard drives engineered for reliability and 24x7 “always on” “non-RAID” environments.
 23. RAID configurations will only use high performance enterprise RE (RAID Edition) rated hard drives engineered for reliability and 24x7 “always on” “RAID” environments.
 24. Be housed in a high performance 4U metal chassis. The chassis shall be designed to fit into a 19” EIA rack. The front panel shall come with the ability to be locked by a key.
 25. Include a standard Slide Rack Rail kit for server rack mount installations.
 26. Provide exceptional internal cooling through five high output 80mm fans mounted in the center of the chassis, two high output 80mm fans mounted in the rear of the chassis and front/rear cooling intakes for maximum in/out cooling.
 27. Have the ability to easily backup important video to an external media location, CD/DVD disk, or a USB Drive. The recorder must not stop recording during the backup process. To ensure the integrity of data, the digital recorder shall use a proprietary viewer that can detect image tampering.
 28. Allow the inclusion of backup viewer software during the backup of media to allow viewing of the proprietary video from any location.
 29. Include a standard DVDRW drive capable of Read/Write/Burn at the following speeds: 24x DVD±R Burn, 18x DVD±R Read, 8x DVD+RW, 6x DVD-RW, 8x DVD±R9, 12x DVD-RAM, 48x32x CD-R/RW to which the operator may backup video in its proprietary format or in AVI format.
 30. Have the ability to span backed up recorded video over multiple DVDs.
 31. Include a minimum of the following front panel controls and LEDs:
 - a. DVD-RW drive
 - b. Hard drive activity LED
 - c. Power LED
 - d. Two 2.0 USB ports
 - e. Power switch
 32. Include a minimum of the following rear-panel connectors:
 - a. Power input
 - b. Two high-speed USB 3.0 inputs
 - c. Six USB 2.0 inputs
 - d. HDMI
 - e. DVI-D

- f. VGA
- g. Display Port
- h. Two 10/100/1000 RJ-45 Network Jack
- i. Line in / Speaker out – RCA
- j. Include the following components:
- k. USB Mouse
- l. USB Keyboard QWERTY
- m. NVR System Image Disc
- n. Software Accessory Disc
- o. Power Adapter
- p. Rack mount attachments with screws
- q. NVR chassis front bezel and door key
- r. User Manual (Digital format)
- s. HDMI to DVI adapter

33. Offer the following accessory hardware components (add-ons):

- a. On the 16 and 32 channels models: Factory or Field upgradable Quad Core i7 Processor. Expands system memory to 8 Gigabytes.
- b. Fully equipped internal RAID 5 configuration capable of full data redundancy and exceptional management capabilities. There shall be a separate dedicated RAID 5 ACP Card that will provide off-loaded XOR parity calculation. RAID parity calculations shall be handled on the RAID 5 card exclusively and shall not utilize resources from the motherboard's on-board processor. The RAID 5 configuration shall only use high performance enterprise level hard drives manufactured specifically for RAID environments. Recording throughput maximum will be 400Mbps with a minimum guaranteed value of 300Mbps during RAID rebuild conditions.
- c. Field storage upgrades that include internal hard drive capacities ranging from 1 terabyte to 4 terabytes.
- d. Internal iSCSI upgrade for separate external iSCSI storage option.
- e. 4U rack mountable external iSCSI storage option capable of RAID 5, 6, and 10 in the following storage capacities:
 - 1) 16.0 Terabytes
 - 2) 24.0 Terabytes
 - 3) 32.0 Terabytes
 - 4) 48.0 Terabytes
 - 5) 64.0 Terabytes
- f. Solid State Drive (SSD) capable of operating as a BOOT drive in a RAID configuration or in a Single drive configuration. The SSD shall be exclusively

dedicated to the Operating System. No Video will be allocated to the solid-state drive for the purposes of video storage and archiving. This Solid-State Drive shall be internal to the NVR and should not replace any of the system hard drives. Overall storage capacity shall not be decreased by adding an SSD hard drive.

- g. Dual Redundant SSD BOOT drive in a RAID 1 (Mirror) configuration.
- h. A single or dual port 10/100/1000 Gigabit Network Interface Card.
- i. Serial RS-232 expansion capabilities providing up to 4 independent Serial connections for Joystick control or POS connectivity.
- j. Dual Redundant 820W Power Supply Unit

E. NVR RECORDING CAPABILITIES – The NVR recording capabilities shall provide the following characteristics/features/functions. The NVR recording capabilities shall:

1. Provide support for 360° view cameras. Digital pan, tilt and zoom shall be supported in both live and recorded video.
2. Provide an advanced Dual Stream feature allowing the user to record an HD stream while transmitting a low-resolution stream to remote/VMS clients. The Dual Stream shall support H.264, MJPEG or MPEG4 codecs.
3. Provide an iFrame Only live view feature that reduces CPU load allowing the user to enable up to 16 channels of live view IP HD recording. iFrame shall support H.264 and MPEG4 codecs.
4. Be able to run Point of Sale Software. The system shall have the capability to overlay text from POS systems directly onto the video and maintain an index of transaction data associated with the video for indexing and searching.
5. Be able to natively run optional Video Analytics software allowing intelligent video monitoring including real time notification of detected events and search capabilities selectable on a per camera basis.
6. Provide a LAN/WAN connection. Required software or hardware shall be provided for operating the digital recorder over the network free of charge. The remote operator shall also be capable of backing up still JPG images, and/or video segments to the local hard disk in AVI or proprietary file format.
7. Include a dynamic System Log to record and display information pertaining to alarm events, digital recorder reboots, and other related information, record/display hardware information pertaining to system recording successes and failures, and other related information.
8. Provide exportable system and event log files which may also be viewed and searched by date in the software interface.
9. Provide email notification to one or more recipients for video loss, motion, sensor, hard drive smart check, and system health events.
10. Provide a CPU performance meter clearly visible in the main GUI indicating the current CPU load status.
11. Include the ability to discover IP cameras from the network with an integrated camera discovery protocol and add them to your digital recorder from a single interface.
12. Include an option to enable Wide Screen support for monitors that output in 16:9 ratios. The feature shall allow the operator to switch between the standard 4:3 ratio and the widescreen 16:9 ratio.
13. Have the ability to customize cameras with operator-defined names. These names must be viewable and transferable after proprietarily backing up.
14. Provide the ability to Bookmark a video clip during search with the option to export

bookmark data. Additional options shall include the ability to change the start or end time of the clip, add comments, change the title and add additional cameras.

15. Provide a Clip Backup feature allowing the backup of a single camera or multiple cameras at a time. Options include backup time frame, specific camera selection, memo inclusions, and the ability to include a copy of the proprietary Backup Viewer Software.
16. Have built-in motion detection for each camera (including all IP cameras). The operator shall be able to independently select the cameras motion detection area with the ability to draw up to 5 different motion detection boxes within the cameras view. The operator shall be able to adjust the cameras sensitivity independently.
17. Include Advanced Motion detection capabilities and when enabled, will allow for up to 15 motion boxes to be set. A combination of rectangles, circles and complex polygon shapes can be set within the Advanced Motion detection area.
18. Have the ability to hide cameras from general users, yet still record.
19. Include Active Directory integration (LDAP protocol) which allows domain user management tools to manage the digital recorder user accounts. Options shall include the ability to add and remove users from the digital recorder through group membership administration via a Windows domain ACP, and a single sign-on feature that passes digital recorder user log on credentials to the video management and remote software. Shall allow control of user passwords and configuration of permissions.
20. Be able to restart upon unpredictable power outage while restoring operator custom configurations.
21. Include a hardware monitoring (watchdog) system which will monitor the systems hardware devices. If the system should ever lockup the hardware monitoring system shall automatically reboot the system. Therefore, allowing the system to begin recording immediately upon startup.
22. Provide for at least 100 different usernames (and passwords) to which specific privileges such as search, setup, PTZ, shutdown, and backup may be assigned. The administrator shall be capable of hiding any different combination of cameras from each of the users.
23. Have up to 16 sensor input capabilities, dependent on the network video device, which are capable of triggering alarm events or initiating recording. A pre-alarm recording feature shall be available to record up to 60 seconds of video prior to the sensor input being activated. A record of all sensor events shall also be provided.
24. Have up to 16 alarm output capabilities, dependent on the network video device, to activate external devices.
25. Provide the necessary software for image authenticity verification of each image recorded.
26. Be capable of programming the system locally through a standard PC keyboard and mouse or remotely over a LAN/WAN via a Remote Management Software Client.
27. Provide a camera sabotage function to allow an alarm event to occur when the camera field of view experiences significant pixel change (e.g. changing the view of the camera, obscuring the lenses, significant shaking or vibration, or blinding light). When a video loss event occurs, the operator shall have the option to enable an alarm beep or a custom WAV file audible alert utilizing the internal speaker of the digital recorder, and/or activate an alarm output.
28. Be capable of notifying the local operator by sound in the event video from a camera is lost (video loss alarm).
29. Be capable of triggering an external alarm device through a control output in the event video a camera is lost (video loss alarm). Dependent on network video device capabilities.
30. Be capable of triggering an external alarm device through a control output in the event power is lost (power loss alarm). Dependent on network video device capabilities.
31. Have pre and post alarm/motion recording. A pre-alarm recording feature shall be available

to record up to 60 seconds of video prior to motion being detected. Furthermore, a post-alarm recording feature shall be available to record up to 255 seconds of video after motion has left the motion grid.

32. Have the ability to playback recorded video on the main screen by simply clicking the middle mouse scroll button.
33. Have the ability to automatically adjust for Daylight Savings Time changes, with no loss of video when the hour jumps forward or back.
34. Allow an operator to flag video clips distributed across multiple cameras. This feature will allow the operator to back up all clips from multiple cameras in one operation from the backup menu screen. The feature will allow the operator to add a memo to each video clip for review at a later date.
35. Provide dynamic abilities to record images including continuous, motion detection, alarms/events and according to a use defined time schedule.
36. Provide a schedule from which the operator may choose whether the system will record based upon motion detection or continuously 24 hours a day, seven days a week.
37. Accept special day preprogramming so recording schedules may be adjusted around holidays and/or special day events.
38. Have intensive recording. This will allow the digital recorder to begin recording or boost recording speed based on sensor or motion detection.
39. Be capable of automatically adjusting its recording resolutions and recording rates upon the activation of sensor input and/or motion detection.
40. Have the ability to instant record any camera by simply double left clicking on the camera from the main screen.
41. Include an Administrator privilege level, which allows the user to create, edit, and delete user accounts. Each account can be assigned different permissions that limit the usage of the system including:
 - a. Search
 - b. Set up
 - c. Pan/Tilt
 - d. Backup
 - e. Forbidden Cameras
 - f. Shut down
42. The ability to enable or disable access by the Web Viewer Software, allowing a user to view live video using an Internet browser.
43. The ability to adjust the resolution setting when sending video to remote clients.
44. The ability to throttle the bandwidth of the digital recorder to ensure that images and system messages are delivered as quickly as possible within the capabilities of the network's available bandwidth.
45. Include a User Management Console, which allows the user to create, edit, and delete user accounts. Each account can be assigned different privileges that limit the usage of the system. Privileges shall include, but not be limited to, the following functions:
 - a. Search
 - b. Setup
 - c. Pan/Tilt

- d. Backup
 - e. Shutdown
 - f. Intensive
 - g. Relay Out
 - h. Pan/Tilt Advance
 - i. Hidden Cameras/Audio
 - j. User Ranking
 - k. Auto Log Off
46. Provide the user ability to obtain the software version of the digital recorder.
47. Run a series of self-tests during power up, and display messages as the various hardware and software sub-systems are activated. After power up, the digital recorder's software must automatically load and display the main screen.
48. Display the camera status for each camera next to the camera number (or name) in the video display area. The information must include:
- a. Camera number and custom name
 - b. Recording status, which must show whether a camera is currently recording continuously, or whether a camera is recording based on motion.
 - c. Special recording status, which must indicate whether a camera's associated sensor has been activated, and/or when the user activates the instant recording option for the selected camera.
49. Offer the following screen division sets (depending on the model):
- a. Display the first four videos (1–4) in the video display area.
 - b. Display the next four videos (5–8) in the video display area.
 - c. Display the next four videos (9–12) in the video display area.
 - d. Display the next four videos (13–16) in the video display area.
 - e. Display all sixteen (16) videos in the video display area.
50. Have the ability to adjust each video input's brightness, contrast, and hue, to optimize the clarity and detail of recorded video.
51. Incorporate motion detection, including the ability to create multiple detection regions for each video input.
52. Include the ability for post-alarm recording, which must record video for a specified time before and/or after a motion or sensor alarm has occurred. The time period must be selectable from zero (0) to **ninety-nine (50)** seconds.
53. Include a video loss alarm function to allow an alarm event to occur when a camera loses the signal for any reason (e.g. camera power failure, cable being cut, camera damage, etc.). When a video loss event occurs, the operator shall have the option to enable an alarm output.
54. Include Alarm Monitor software to stream video across a LAN to a client PC when an alarm is detected on the unit. The operator shall have the ability to stop, play forward and backward, frame by frame or at real speed, the video that streams across. The program must constantly monitor for a signal from the digital recorder, and when an alarm signal is

detected the Alarm Monitor must notify the operator of an event. The Alarm Monitor image viewer shall also allow the user to search through past events that have been recorded on the client PC.

55. The Instant Recording feature allows users to manually initiate recording on a specific camera, overriding the current schedule.
56. Provide, through the remote software, the ability to export single images in the JPG file format and save video clips in the AVI format. A digital signature must be attached to every JPG and AVI file exported by the unit for use with the bundled Digital Verifier application. This function must be unique to the unit and its verification software; and shall not interfere with viewing files using other applications.
57. Offer on screen PTZ camera control by clicking and dragging the mouse over the live video display and include play controls to play back the recorded video either forward or reverse, at multiple speeds.
58. Include the ability to search by using fast forward or rewind. Using the feature, the operator shall be able to search frame by frame using any number of cameras and have the ability to speed up or slow down the speed of playback using a slow/fast slide bar.
59. Include an index search. Using this feature the operator shall be able to search through previously recorded video based on motion detection, sensor trip or instant record.
60. Include a preview search function. Using this feature the operator shall be able to search using a 24-hour visual overview of one single camera by separating a 24-hour period into 24 images, each one representing the first second of each hour. The operator must then have the ability to drill down to the search to 10-minute increments and then 1-minute increments by simple double left clicking on a displayed image.
61. Include a panorama search function. Using this feature the operator shall be able to search one camera frame-by-frame using a 16-image grid.
62. Include an object or post motion (forensic) search. Using this feature the operator shall be able to search through previously recorded video for motion within an operator defined field.
63. Include a status search. Using this feature the operator shall be able to see a single camera on the screen and, using a split view, view each frame sequentially side by side.
64. The ability to search recorded video on the main screen by simply clicking the middle mouse scroll button and selecting rewind and fast forward options.
65. Provide simultaneous playback viewing while recording live images, and backing up recorded images in true multiplex operation.
66. Incorporate a software watchdog for restarting the system in the event of a system lock-up.

- F. **MULTI-SITE MANAGEMENT SOFTWARE (ENTERPRISE VMS):** The digital recorder shall come with multi-site management software free of charge. The Digital Recorder Manufacturer shall provide additional copies of the Multi-Site Management software via the web at no additional charge, along with upgrades free of charge during the product warranty period.

The MULTI-SITE MANAGEMENT SOFTWARE shall include, as a minimum, the following benefits/features/functions/specifications. The Multi-Site software shall:

1. Provide the operator, with administrator privileges, of remotely administering most of the functions that the user has locally, including administration privileges, camera/PTZ adjustments, frame setup, recording schedule, network configuration, and log file retrieval and viewing. The administrator shall also be able to add, delete, or update users when connected to the system remotely.
2. Provide configuration of user accounts with a multitude of assigned privileges that allow or

deny access to different functions, therefore ensuring that only authorized personnel are allowed to log in to the Digital Recorder and perform operational functions.

3. Be able to perform remote health check of all systems connected; monitoring Warning and Failures counts on hard drive status, recording status, video loss and disk free space %. The Health check feature shall also provide:
 - a. Selectable actions which include: Pop up on Failure/Warning or Voice Warning on failure.
 - b. The ability to define interval checks by day (up to 7 days), hour (up to 24 hours) or minutes (minimum 10 minutes).
 - c. E-mail notification options for warning and failure events.
4. Be able to send email alarms for motion detection and sensor events.
5. Use the same user accounts that the digital recorder uses locally.
6. Provide a detailed list of log events with the Log Manager.
7. Be able to support multiple digital recorder connections simultaneously and control the digital recorders using a single PC workstation with appropriate network connectivity.
8. Be capable of supporting up to 4 monitors. Shall be capable of enabling the Map Editor, Search windows and Live Display on any of the 4 monitor outputs.
9. Be capable of displaying up to 64 cameras in live view on one monitor or displaying a multitude of different live view camera divisions across 4 monitors.
10. Offer a highly configurable UI that provides user-friendly options including toolbar selections, a detailed Connection list providing individual NVR information, icon size selections, viewing pane selections and various main window selections including multiple open windows organized by tabs at the top of the Live View area.
11. Be capable of exporting AVI video and jpeg images - with a digital signature.
12. Be able to create custom interactive maps and incorporate cameras and/or sensors to locations on the map, link multiple maps, use linked internet maps (Google, etc.). Shall also provide support for AutoCAD (*.DXF, *.DWG) and Image files (*.JPG, *.BMP, *.WMF, *.EMF).
13. Allow 2-Way live audio communication with the digital recorder.
14. The Multi-Site software should provide the following Search capabilities:
 - a. Multiple Search: simultaneous search from multiple NVRs on a single screen.
 - b. Preview Search: allowing a single day of video to be searched by 1-hour, 10- and 1-minute blocks of time.
 - c. Index Search: provides search based on sensor, motion and instant record events.
 - d. Status Search: displays a timeline graph allowing recorded video to be located and instantly played from a selected time.
 - e. Point of Sale search: allowing search on information transmitted during POS transactions.
15. Provide detailed Search functions that include multiple Search methods, individual camera or screen division selections, Bookmarks for quickly marking video clips for later review or backup, JPG or AVI save file options, increase/decrease playback speeds, zoom in/out options, hour/minute control bars and the ability to Sync the playback of multiple cameras.
16. Be able to backup video data in proprietary format, AVI and/or JPEG. AVI backup shall provide the operator with an AVI duration selection and Quality selection.
17. Be capable of automatically transferring live images via TCP/IP to an emergency client

workstation in the event a sensor is activated. The emergency agent software shall be capable of automatically opening without assistance from the operator.

18. Be capable of alarm monitoring, keeping track of all incoming motion, alarm input and video loss alarms in real time. Filter options shall be included providing the operator with the ability to select a status level of the alarms. Alarm event indicators shall be color coded and include Video Loss, Motion, Sensor, Relay, No Signal, Write Fail, Connected and Disconnected.
19. Provide a shortcut list in the main screen that displays the following:
 - a. Server List: Displays all added NVRs and allows users to connect to NVRs and their associated cameras quickly
 - b. User Screen: Provides list of customized screens, allows adding new screens and editing existing screens.
 - c. Window List: Organizes open windows into categories – Live Windows, Search Windows and other active windows.
 - d. Hot Spot: Feature allowing users to zoom in on an AOI (area of interest).
20. Provide a Right-Click Live Camera option that allows for pausing Live Video, starting Live Video (after pause), Capturing a JPG snapshot, Full screen option, setting resolution and control of video screen display options.
21. Provide a Right-Click DVR option that allows for instant DVR and Camera connect/disconnect, Search feature, POS On/Off, Device Configuration, and Network/Clip backups.
22. Provide a Live Camera Tool bar that provides Full Screen options, ability to drag live cameras from one screen to another, options to enable an on-screen PTZ compass, Cloning Live View in another window and Screen division options.
23. Provide a Lock List function that locks specific functions based off a user-defined waiting period. The list includes, but is not limited to:
 - a. DVR configuration
 - b. Map editing
 - c. Log Viewer access
 - d. Health Check status
 - e. Search
 - f. Shutting down VMS software
24. Provide a rich Network Backup feature that allows the operator to backup any or all cameras on a selected NVR to a local or network drive. Functions shall allow for specific day selection and hour to minute selection blocks within each day. No Data, Existing Data and Selected Data blocks shall be color coded for easy to identify backup options. A download status bar shall provide Total and Current percentage completion times along with a Total overall file size (indicated in KB/s) indicator.
25. Provide a Clip Backup feature allowing the operator to backup one or more cameras to a local drive, CD/DVD or USB device. Functions shall include individual camera selection, backup target device, backup start and end time selections, clip information options including name/memo, and the option to include the backup viewer software with the data clip. Packet size configuration shall also be available providing the operator with the ability to lower the clip size for low bandwidth transmission environments.
26. Be capable of displaying POS text overlay on POS data within the live video display. Shall

provide multiple options for searching POS data recorded on DVRs. POS search should be defined through a user defined item name or selectable from a predefined item list. Search filter options should provide a value definable selection based off specific value conditions.

27. Provide the ability to Customize Screens by allowing the user to create groups of cameras called screens and customize the organization of the cameras. Each screen should allow up to 64 different cameras.
28. Have the ability to auto Save settings on log-off and auto Load settings on log-on.
29. Have a configurable alert sound setting for DVR disconnections from the VMS software.
30. Have the option to enable a Map Alarm Sound on an associated event.
31. Have the option to enable the Live Video window as a top-most application.
32. Have the ability to enable “pop up” live video of recorder associated with an alarm or event.
33. Provide the option to Auto-Switch the time between camera sequencing.
34. Have the ability to enable a full screen channel when live mode display is double-clicked.
35. Provide the user ability to hide the following on screen display text (OSD):
 - a. Hide all OSD
 - b. Hide channel number
 - c. Hide server name
 - d. Hide camera name
 - e. Hide 64 division to disable the 64-channel screen division option
 - f. Hide PTZ overlay
 - g. Hide Time/Date
36. Provide the option to enable PTZ ACP in advance mode on screen.
37. Allow screen ratio configurations of None, Original, 4:3 & 16:9 (Widescreen).
38. Provide an option for Full Screen Channel on motion and sensor alarms. Shall allow for user defined Full Screen durations of up to 100 (seconds) and an option to Ignore alarm events after Full Screen configurable in seconds up to 100.
39. Have the ability to define schedules to discard alarms. Shall provide a user configurable setting to filter, by category, including Motion, Sensor, Sensor (Camera) and Relay.
40. Offer the operator a user-friendly DVR Site List page displaying a list of all added recorders. Shall provide sections to add all DVR information including:
 - a. Server Name
 - b. IP/URL
 - c. Port #'s
 - d. User ID
 - e. Password
 - f. DVR Group
 - g. Additional information: Contact information including Manager Name, Telephone #, Police and Fire department information.
41. Provide the operator the ability to edit all information of any DVR in the list of connected recorders within the DVR Site List page.

42. Provide an option to custom name Sensors and Relays of any DVR in the list of connected recorders within the DVR Site List page.

G. MULTI-SITE SYSTEM HARDWARE for the NVR

Single / Multi-site software: The recommended hardware and operating system configuration for a PC workstation shall have:

1. Intel Quad Core i7 processor (or equivalent)
2. 4 GB System Memory
3. DirectX 9 or Higher
4. ATI 7770 Video Card (or equivalent) / Intel HD2000 onboard graphics (or newer)
5. 512k Network Connection
6. TCP/IP Installed
7. Microsoft Windows® 10, Windows Server 2012/2016
8. 1280 x 1024 Optimal Display Resolution

PART 3 EXECUTION

3.1 INSPECTION AND PREPARATION WORK

- A. This contractor shall examine the conditions under which the system installation is to be performed and notify the Owner's Representative or Design Professional in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to provide a workmanlike installation.
- B. Review areas of potential interference and resolve conflicts before proceeding with the work. Coordinate ceiling layout and wall layout and other work that penetrates or is supported throughout the space of the building. All work shall be flush and workmanlike in all finished areas.

3.2 INSTALLATION

- A. Install materials and equipment in accordance with manufacturer's printed instructions to comply with governing regulations and industry standards applicable to the work and as shown on approved shop drawings.
- B. Arrange and mount all equipment and materials in a manner acceptable to the Design Professional and Owner.
- C. Installation shall conform to the basic guidelines.
 1. Use of approved wire, cable, raceways, wiring, devices, hangers, supports and fastening devices.
 2. Separation of high and low voltage wiring is required throughout the installation.
 3. All wiring shall be thoroughly tested for grounds and opens.
- D. All power wiring shall be in metallic conduit. The maximum conduit fill shall not exceed 40% of rated capacity. Refer to NFPA 70-NEC for additional requirements.
- E. Cabling and Wire Requirements:

1. Low voltage signal and/or control wiring shall run in separate conduit/raceway from electric power cables. Cables for door locks are power cables. Provide separation from lighting fixtures and other electrical appurtenances. Provide electrical interference protection circuits as required to maintain the signal quality specified herein and required by system manufacturers.
2. The individual systems low voltage cabling shall use separate junction boxes and enclosures.
3. The minimum low voltage cabling for security, communications and safety systems shall be as required by the manufacturers without cost increases to owner for the full function intended. The systems cabling shall meet the requirements of NFPA 70/NEC Articles 725, 760 and 800 as applicable for each type of system specified.
 - a. All dimensions and conditions shall be verified in the field. The Contractor shall notify the Architect of any discrepancies before proceeding with the work.
 - b. Card reader cables shall be NFPA 70, Article 725 compliant.
 - c. Electrified mortise and door strike power cabling shall be NFPA 70, Article 725 compliant.
 - d. Touch sensor bar power cabling shall be NFPA 70, Article 725 compliant.
 - e. Door control/door monitoring power cabling shall be NFPA 70, Article 725 compliant.
 - f. Elevator and fire alarm interfacing cabling shall be NFPA 70, Article 725 compliant.
 - g. Card Readers to Control Panel: maximum length shall not exceed 500 feet.
 - h. Extended Reader Line Drivers: may be used between the Central Unit and the Remote Unit for a maximum length not to exceed 10,000 feet (3050 m). Cabling between the Central unit and the control panel shall be as specified for a reader, request to exit and a relay. Cabling between the Remote Unit shall be as specified for a reader, request to exit and a door strike.
 - i. Alarm Point and Request to Exit Point to Control Panel: maximum length shall not exceed 500 feet (150 m).
 - j. Relay to Device: maximum distance shall not exceed 1,000 feet (300 m).
 - k. Refer to the riser diagram located on the Contract Drawings.
4. The minimum bend radius of all security, communication conduits provided under this project shall be 6 inches (150 mm). Provide and maintain pull strings/tapes/ropes in all conduits for future installation of additional fiber optic cabling.

F. Fire Stopping:

1. Provide code required fire stopping at all fire rated wall, floor and partition penetrations with UL listed fire-stopping materials.

G. Junction Boxes, Enclosures/Cabinets, Equipment Racks:

1. The junction and pull boxes shall be securely attached to the structural members of the building at locations accessible for servicing. Provide access doors at locations accessible for servicing. Provide access doors at locations where access is not readily available.
2. The equipment enclosures shall be installed at approved locations and be typically ventilated as required to maintain the environmental conditions specified by the electronic equipment manufacturers.
3. All junction boxes and pull boxes shall be labeled. The box label shall state the system and

use of cabling. The labeling shall be made with markers which are indelible when and after in contact with water and oil.

4. Each box and enclosure shall contain a cabling and wiring log identifying all cabling accessible whether is connected or is passing by.

H. Grounding and Surge Protection:

1. Provide single point grounding of the individual systems as recommended by IEEE and system manufacturers. Provide all cabling, bonding and insulation materials as required. Provide surge protection and clamping for all circuits. Coordinate all grounding, surge protection and clamping circuit requirements with the system manufacturers.
2. Coordinate grounding requirements with other trades and contractors to preclude closing of ground loops via peripheral equipment supplied from different electrical power sources. Provide isolation transformers and other equipment as required.

3.3 FIELD QUALITY CONTROL

- A. A project manager shall be appointed during the course of the installation. This shall assure complete coordination and technical information when requested by other trades. This person shall be responsible for all quality control during installation, equipment set-up and testing. This individual shall have training to provide firsthand knowledge of the installation.

3.4 ADJUSTING, TESTING AND CLEANING

- A. Contractor shall be required to perform complete testing and verification of the following:
 1. Card Reader maximum access time shall be 0.75 seconds under all system loads, i.e. regardless of number of cards presented simultaneously.
 2. Proper operation of electric door strikes, egress switching (where required), door position monitor switches and exit hardware.
 3. Proper operation of electro-magnetic locks and strikes, including full interface, control and override by the Card Access System.
 4. Proper operation of magnetic door switches.
 5. Proper operation of keyed EML bypass / override stations.
 6. Proper operation of the intercom system(s) and their door release pushbuttons.

3.5 ADDITIONAL MATERIALS

- A. Contractor shall provide the following spare equipment for items scheduled:
 1. **Two (2)** card readers.
 2. **One (1)** DRM Board(s) (Dual Reader Module).
 3. **100 cards - one side printed/one side blank, as directed by the Owner.**

3.6 DEMONSTRATION

- A. Provide system demonstration.
 1. Demonstrate normal and abnormal modes of operation and required response to each.
 2. Provide system training.

3.7 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before substantial completion.

END OF SECTION 281600

DIVISION 28 – DIGITAL VIDEO SURVEILLANCE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes information on Video Management Software (VMS), IP video cameras, and Servers and Storage
- B. Product –
 - 1. Video Management Software
 - 2. IP video camera
 - 3. Video Servers and Storage
- C. Related Requirements

1.02 REFERENCES

- A. Abbreviations
 - 1. ACC: Video Codec “Active Content Compression”
 - 2. ADDS: Active Directory Domain Services
 - 3. AGC - Automatic Gain Control
 - 4. API: Application Programming Interface
 - 5. ARP – Address Resolution Protocol
 - 6. AVI: Audio Video Interleave
 - 7. AWB - Automatic White Balance
 - 8. Bit Rate: The number of bits/time unit sent over a network
 - 9. BLC – Back light compression
 - 10. CBR – Constant Bit Rate
 - 11. CVBS – Color, Video, Blanking, Sync
 - 12. DDNS – Dynamic Domain Name Server
 - 13. DHCP - Dynamic Host Configuration Protocol
 - 14. DNR – Digital Noise Reduction
 - 15. DNS - Domain Name Server
 - 16. DSCP – Differentiated Services Code Point
 - 17. fps - frames per second
 - 18. FTP - File Transfer Protocol
 - 19. GbE: Gigabit Ethernet (1000Mbps)
 - 20. GOV – Group of Video
 - 21. GUI – Graphical User Interface
 - 22. H.264/5 (Video Compression Format)
 - 23. HD – High Definition
 - 24. HDD – Hard Disk Drive
 - 25. HTTP - Hypertext Transfer Protocol
 - 26. ICMP – Internet Control Message Protocol
 - 27. IEEE 802.1x: Authentication framework for network devices
 - 28. IGMP - Internet Group Management Protocol
 - 29. IP - Internet Protocol
 - 30. iSCSI – Internet Small Computer System Interface
 - 31. JBOD – Just a Bunch of Disks
 - 32. JPEG - Joint Photographic Experts Group
 - 33. LAN: Local Area Network
 - 34. LDC – Lens Distortion Correction
 - 35. MJPEG - Motion JPEG
 - 36. MKV: Matroska video format

- 37. MP - Megapixel
 - 38. NAS – Network Attached Storage
 - 39. NTP - Network Time Protocol
 - 40. NTSC: National Television System Committee – a color encoding system based on 60Hz
 - 41. ONVIF: Global standard for the interface of IP-based physical security products
 - 42. PIM-SM - Protocol Independent Multicast-Sparse Mode
 - 43. PoE - Power over Ethernet
 - 44. POS – Point of Sale
 - 45. PPPoE – Pont to Point Protocol over Ethernet
 - 46. PTZ: Pan/Tilt/Zoom
 - 47. RADASS: Resolution and Algorithmic Data Adaptive Scaling System
 - 48. RAID: Redundant Array of Independent Disks
 - 49. RTCP – Real-Time Control Protocol
 - 50. RTP - Real-Time Transport Protocol
 - 51. RTSP - Real-Time Streaming Protocol
 - 52. SDK – Software Development Kit
 - 53. SMTP - Simple Mail Transfer Protocol
 - 54. SNMP – Simple Network Management Protocol
 - 55. SSL – Secure Sockets Layer
 - 56. TCP - Transmission Control Protocol
 - 57. TLS: Transport Layer Security
 - 58. UDP - User Datagram Protocol
 - 59. Unicast: Communication between a single sender and single receiver on a network
 - 60. UPnP – Universal Plug and Play
 - 61. VBR – Variable Bit Rate
 - 62. VMS - Video Management Software
 - 63. WDR – Wide Dynamic Range
- B. Reference Standards
- 1. Network - IEEE
 - a. 802.3 Ethernet Standards
 - b. 802.1x Port-based Network Access Control
 - 2. Video
 - a. H.265
 - b. H.264
 - c. ONVIF – Profiles S and G
 - 3. Emissions - Camera
 - a. FCC-47 CFR Part 15 Subpart B Class B
 - b. CE EN 55022:2010
 - 4. Emissions – Servers
 - a. FCC-47 CFR Part 15 Subpart B Class A
 - b. EN 55022:2010, Class A
 - 5. Immunity - CE
 - a. EN 50130-4:2011
 - b. EN 61000-3-3:2014
 - c. EN 61000-4-2:2009
 - d. EN 61000-4-3:2006+A2:2010
 - e. EN 61000-4-4:2012
 - f. EN 61000-4-5:2014
 - g. EN 61000-4-6:2009

- h. EN 61000-3-3:2008
 - 6. Safety
 - a. UL listed
 - b. CE EN 50581:2012 (hazardous substances)
- C. Definitions
 - 1. GOV (Group of Video object planes) - A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
 - 2. Advanced Dynamic Video Compression – Smart Codec that controls quantization parameter in H.265 and H.264 to efficiently manage bitrate of the video stream and reduce the storage required.
 - 3. Dynamic GOV – Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
 - 4. Multi-exposure wide dynamic range - Operation which automatically adjusts shutter speed to provide a wide range between dark and light areas visible at the same time, preventing backlighting issues. Long exposure is used for bright areas and a short exposure is used in dark areas.
 - 5. CIF Resolution – 352 x 288 pixels
 - 6. JBOD - a collection of hard disks that have not been configured to act as a redundant array of independent disks (RAID) array.
 - 7. ARB (Auto Recovery Backup) – Automatic backup mechanism that enables cameras to store videos on to SD card during the network failure and stream it to the storage device after the network is recovered.
- 1.03 SUBMITTALS (Integrator to Provide)
 - A. Product Data
 - 1. Manufacturer’s printed or electronic data sheets
 - 2. Manufacturer’s installation and operation manuals
 - 3. Warranty documentation
 - B. System Documentation
 - 1. List of all equipment with part numbers, manufacturer, firmware, assigned IP addresses, and physical locations and details for all components to be installed under this scope of work
 - 2. Placement Diagram - the System Integrator will provide a placement diagram showing the proposed location of all system hardware devices.
 - 3. System Calculation - the System Integrator will provide a calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.
- 1.04 QUALIFICATIONS
 - A. Manufacturer shall have a minimum of five years’ experience in producing IP video equipment and software.
 - B. Installers shall be certified by the Manufacturer to sell, install, integrate, test, commission, and provide ongoing support of the solution.
- 1.05 DELIVERY, STORAGE AND HANDLING
 - A. Deliver the camera in the manufacturer’s original, undamaged container with identification labels intact.
 - B. Store the product in a temperature environment of 0° C to 50° C (32° F to 122° F) and humidity environment of 5% - 85%, protected from mechanical and environmental conditions as designated by the manufacturer.
- 1.06 WARRANTY AND SUPPORT

- A. Integrator shall provide a minimum warranty of 1-year that fully warrants the materials (including wiring, software, hardware, and third-party products) and labor from date of the final acceptance of the Video Surveillance System.
- B. Manufacturer shall provide at least a limited 3-year warranty for the product to be free of defects in material and workmanship.

1.07 LICENSING

- A. Cameras should be free of any licenses for all feature sets including but not limited to embedded video analytics, web browser and onboard storage.
- B. VMS licensing should be on a per device basis (e.g. 1 x license for 1 IP Camera or I/O device) with no base license for additional features or capabilities.
- C. There shall not be licenses required for client workstations or servers.
- D. The VMS Software should be completely free for live streaming or playback of offline media files (images, videos).
- E. Lifetime software upgrades shall be provided free of charge by the Manufacturer without the need for an annual maintenance agreement. Installation of upgrades to be performed by Certified Integrator.

PART 2 VIDEO SURVEILLANCE SYSTEM

2.01 GENERAL DESCRIPTION – VIDEO MANAGEMENT SOFTWARE

The specified product shall be an open video platform designed for use in any video application. The architecture needs to include Desktop, Server, Mobile, and Cloud applications. Any API or SDKs necessary to integrate 3rd party devices and systems will be included free of charge.

A. VMS OVERVIEW

1. Basis of Design: Hanwha WAVE
 - a. VMS System Architecture
 - 1.) The VMS shall have a Server Hive Architecture wherein:
 - a.) All servers in a system are equal and synchronize system databases in real-time
 - b.) A user can connect to any system server to see and manage the entire system
 - c.) Servers support automatic camera failover to ensure limited loss of video recording in the event of hardware or network failure.
 - d.) Servers will use an SQLite - a free database technology - included in the installation package
 - 2.) The VMS shall support one-click system wide updates.
 - a.) System Administrators shall be able to upgrade an entire system via a single button in the Desktop Application.
 - b.) System Administrators shall be able to upgrade on demand to the latest release or specific builds with specific functionality or bug fixes
 - c.) System Administrators shall be able to apply an OTA (over-the-air) update
 - d.) System Administrators shall be able to generate a URL to download a portable system- specific update package in .zip file format which can be used to update servers without an active Internet connection.
 - 3.) The VMS will use secure technologies for inter-application communication and security.
 - a.) OpenSSL for network connections - deprecated and insecure protocols and use only TLS v1+.
 - b.) Server->Client (Mobile, Desktop, Web) Communications - HTTPS Email - TLS / SSL - TLS is the default option for the Email Server.
 - c.) Salted/Hashed Passwords - Local Credentials will be protected using a salted MD5 hash, Cloud Credentials should use a complex multi-level hash

- 4.) The VMS will not require any licenses to increase the number of supported devices, users, or servers.
 - b. VMS Developer & Integration Tools
- B. The VMS shall have built-in developer tools which are accessible from any System Server's Web Admin Interface (compatible with all major browsers) and should include, at a minimum:
1. A Generic Events Generator - a tool which helps build HTTP Generic Event calls, a method of sending events from 3rd party systems to the VMS, which can be used to trigger system actions in the VMS.
 2. Server API – SUNAPI implementation that gives developers the ability to access every system feature available.
 - a. API Change Log - list of breaking changes in API from version to version
 - b. Video Source Integration SDK - provides the ability to integrate virtually any live or recorded video source (IP Cameras, NVRs, DVRs, etc.) into the VMS with methods for discovering, displaying, analyzing and recording video, as well as integrating device I/O ports and related motion detection information.
 - c. Storage SDK - provides the ability to integrate potential storage into System. It allows developers to read from or write to any storage location: local, remote, and even cloud one. Creating a storage plugin requires implementing standard functions such as: I/O stream, if file exist, delete file, list of files in the folder, etc. Storage SDK also contains an example for using an FTP server as a storage location.
 3. VMS Software Components
 - a. Server - a media server responsible for discovering, connecting to, and managing system users, devices, and associated data.
 - b. Desktop - a desktop application capable of acting as a stand-alone media player or as a client application for connecting to and managing systems.
 - c. Mobile - a mobile application for iOS and Android devices that allows users to connect to, view, search, and control IP cameras over Wi-fi or Data networks.
 - d. Cloud - a cloud application that enables simple remote connectivity, viewing, and management of an unlimited number of systems and users.
 4. VMS Applications
 - a. VMS Server Application

VMS Server application shall be able to run on any of the following operating systems	
Operating System	Versions
Microsoft Windows	Windows 7 Windows 8 Windows 8.1 Windows 10 Windows Server 2008 Windows Server 2008 R2 Windows Server 2012 Windows Server 2012 R2 Windows Server 2016 (Long-Term Servicing Channel) 1607 Windows 10 Enterprise

Ubuntu Linux	Ubuntu 14.04 LTS: "Trusty Tahr" Ubuntu 16.04 LTS: "Xenial Xerus"
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- 1.) Minimum Compatible Computing Hardware
 - a.) The VMS Server application will be capable of operating on any hardware able to run a compatible operating system.
 - b.) The VMS Server will be capable of recording 128 dual-streaming IP cameras (256 streams) on a single core of an Intel Core i3 processor.
- 2.) Initial Installation & Setup
 - a.) The VMS Server application installer should not exceed 100 MB (megabytes).
 - b.) The VMS Server application should be a publicly available, free download.
 - c.) The VMS Server application should require no prerequisite proprietary or 3rd party software and database technologies during installation.
 - d.) The VMS Server installation process should require no user input once initiated
 - e.) After installation is complete the VMS server setup process will allow system administrators to create a new system or to merge newly installed server(s) with existing systems.
- 3.) Features
 - a.) The VMS Server Application shall automatically discover, stream, and record any ONVIF Profile S IP camera located on the same subnet as the server application.
 - b.) The VMS Server Application shall manually discover, stream, and record RTSP, HTTP, or UDP (multicast, unicast) streams.
 - c.) The VMS Server application shall support up to 1000 concurrent TCP connections
 - d.) The VMS Server application shall record and stream video of any resolution and framerate, limited only by hardware.
 - e.) The VMS Server application shall support automatic camera failover without any additional licenses.
 - f.) The VMS Server application will support an unlimited number of users and custom user roles
 - g.) The VMS Server application shall support any type of storage medium - HDD's, SSD's, SD cards, DAS, NAS, or other network-attached storage devices or locations.
 - h.) The VMS Server application shall support LDAP / Active Directory / Open LDAP integration for user login credential management
 - i.) The VMS Server application shall record and stream H.264, H.265, and MJPEG streams
 - j.) The VMS Server application shall record and stream AAC, PCM (Mu-Law, A-law), g726, and MP3 audio
 - k.) The VMS Server application shall transcode streams on demand for delivery to 3rd party systems or devices in H.265, H.264, MJPEG or WebM codecs.
 - l.) The VMS Server application shall be able to provide pass-through high or low-res HLS streams from connected devices.
 - m.) The VMS Server application shall store archive indices in the same location as recorded video files

- n.) The VMS Server application shall allow system administrators to recover archives from any storage medium using a re-index archive feature.
- o.) The VMS Server application will contain a Boolean events engine allowing operators to program and trigger system actions based on system, connected device, or HTTP events sent from 3rd party system or device.
- p.) The VMS Server application shall be able to send HTTP PUT or GET requests to 3rd party systems or devices.
- q.) The VMS Server application shall support IPv4 or IPv6 addressing
- r.) The VMS Server application shall allow operators to set custom network routing configurations for system servers to optimize network routing and usage.
- s.) The VMS Server application shall allow operators to monitor the CPU, RAM, NIC, and HDD usage in real time.
- t.) The VMS Server application shall track all operator actions to allow audits
- u.) The VMS Server application shall generate automatic crash files every time there is an unexpected crash of the Server application.
- v.) The VMS Server application shall allow operators to change the size of reserved disk space for storage drives.
- w.) The VMS Server application shall automatically disable any system drive (drive containing the operating system) in computing hardware with more than one drive to ensure the operating system drive does not become full.
- x.) The VMS Server application shall support configuration and events from binary I/O contactson supported devices - including IP cameras and I/O devices.
- y.) The VMS Server application shall support sending email notifications via SMTP using TLS, SSL or unsecured connections.
- z.) The VMS Server application shall support scheduled backup of recording archives to local, networked, or cloud storage locations.
- aa.) The VMS Server application shall allow on-demand backup of recording archives to local, networked, or cloud storage locations.
- bb.) The VMS Server application shall allow concurrent-recording of all connected cameras / streams to two (2) servers in real-time.
- cc.) The VMS Server application will allow server-side, CPU-based motion analysis for all connected IP cameras with no perceptible increase (<3%) in CPU usage.
- dd.) The VMS Server application will require no dedicated GPU in order to perform at maximum capacity.
- ee.) The VMS Server application will have a web administration interface that allows users to view live or recorded video from a single camera at a time in high or low resolutions.
- ff.) The VMS Server application will have a web administration interface that allows system administrators to view real-time server health monitoring statistics (CPU, NIC, andHDD usage).
- gg.) The VMS Server application will have a web administration interface that

allows operators to disconnect the VMS Server from the VMS cloud application.

- hh.) The VMS Server application will have a web administration interface that allows users to view all available servers in the system.
- ii.) The VMS Server application will have a web administration interface that allows operators to switch between server interfaces.
- jj.) The VMS Server application will have a hidden advanced page that gives system administrators the ability to modify advanced system settings.
- kk.) The VMS Server application will support any RAID configuration of storage medium

b. VMS Desktop Application

VMS Client application shall be able to run on any of the following operating systems	
Operating System	Versions
Microsoft Windows	Windows 7
	Windows 8
	Windows 8.1
	Windows 10
	Windows Server 2008
	Windows Server 2008 R2
	Windows Server 2012
	Windows Server 2012 R2
	Windows Server 2016 (Long-Term Servicing Channel) 1607
Ubuntu Linux	Windows 10 Enterprise
	Ubuntu 14.04 LTS: "Trusty Tahr"
Apple / Mac	Ubuntu 16.04 LTS: "Xenial Xerus"
	OSX 10.11: "El Capitan"
	OSX 10.12: "Sierra"
	OSX 10.13: "High Sierra"

1.) Minimum Hardware Requirements

- a.) The VMS Desktop application will be capable of operating on any hardware

- able to run a compatible operating system with a CPU that supports OpenGL 2.1 and Intel HD Graphics3000 (or higher).
- b.) The VMS Desktop application shall not require any dedicated graphics drive to work at full capacity (64 streams on a 64-bit OS, 24 streams on a 32-bit OS) and shall use the CPU for all video decoding and rendering.
 - c. Installation & Configuration
 - 1.) The VMS Client application installer should not exceed 100 MB.
 - 2.) The VMS Client application should be a publicly available, free download.
 - 3.) The VMS Client application should require no prerequisite proprietary or 3rd party software and database technologies during installation.
 - 4.) The VMS Client installation process should require no user input once initiated.
 - 5.) Features
 - a.) The VMS Desktop application will have the following basic structure:
 - i. Navigation Panel - with a main menu button, an interactive cloud-login icon, tabbed layouts, minimize and maximize icons, a contextual help icon, and a close application icon.
 - ii. Resource Panel (Left) - contains all system resources (Servers, Devices, Users, Layouts, Offline files, etc.) with collapsible structure and a keyword search mechanism to allow operators to quickly search for a display live streams / cameras, offline video and image files, or any combination thereof.
 - iii. Notifications Panel (Right) - shows all system or rules-engine generated notifications which can be clicked on to display relevant resource in the Viewing Grid
 - iv. Timeline Panel (Bottom) - allows for navigation and search of recorded video files
 - v. Viewing Grid (Main Viewing Area) - a flexible adaptive grid interface which allows operators to create and share customized layouts of system resources.
 - b.) The VMS Desktop application shall allow operators to view and interact with the following types of media:
 - i. Live Streams: H.265, H.264, MJPEG
 - ii. Offline Media: AVI MKV MP4 MOV TS M2TS MPEG MPG FLV WMV 3GP JPG PNG GIF BMP TIFF
 - iii. I/O Devices: Status and Triggers
 - iv. Servers: Real-Time Server Health Monitoring Status
 - c.) The VMS Desktop application shall allow the operator to scroll to zoom in to any part of the Viewing Grid.
 - 6.) The VMS Desktop application shall allow operator to drag & drop to reassign cameras from one server to another server.
 - a.) The VMS Desktop application will have a flexible timeline that allows operators to view the dates of any and all archived video in the System for a specific camera, or groups of cameras.
 - b.) The VMS Desktop application will allow operators to manually create bookmarks - with a start time, end time, name, description, and tags - for later search. Bookmarks shall also be able to be created using the Rules

engine.

- c.) The VMS Desktop application shall allow operators to create Soft Triggers - programmable, customizable buttons which sit on top of streams in the Viewing Grid - to trigger any available system action.
- d.) The VMS Desktop application shall have icons located on the top of live camera streams which allow operators to dewarp fisheye cameras, control PTZ cameras, apply client-side image enhancement, execute smart motion search, create zoom windows, rotate items to any orientation, and activate stream or file info.
- e.) The VMS Desktop application shall allow operators to create Zoom Windows (up to 63 zoom windows on a single item in a 64-bit OS, 23 zoom windows in a 32-bit OS) - a magnified view of a part of a live stream, recorded videos, or static images.
- f.) The VMS Desktop application shall allow operators the ability to execute a Smart Motion search by selecting a subset of a live camera stream with results shown in red on the flexible timeline. Smart Motion search should be able to search a year (12 months, 365 days) of archived video in less than one (1) second.
- g.) The VMS Desktop application will allow users to search live cameras by name, manufacturer, IP address, MAC address, and status (e.g. live).
- h.) The VMS Desktop application shall allow operators to search video archives by date and time with a responsive, adaptive timeline.
- i.) The VMS Desktop application will allow operators to customize the background image of the application with supported image types.
- j.) The VMS Desktop application will support digital mapping by allowing operators to add and customize background images - including opacity and number of grid points.
- k.) The VMS Desktop application will utilize adaptive scaling technology to automatically switch between high- and low-resolution streams during live and recording playback to optimize CPU and network usage.
- l.) The VMS Desktop application will allow operators to log in to the Cloud application in order to quickly connect to any shared system.
- m.) The VMS Desktop application will allow operators to quickly switch between previously connected or cloud-accessible systems using searchable tiles that show system name and status.
- n.) The VMS Desktop application will have a Storage Analytics feature allowing operators to analyze storage capacity of the system based on available drives and real-time and historical bandwidth analysis.
- o.) The VMS Desktop application will allow management and configuration of all System devices, users, and resources in a single

unified interface.

- p.) The VMS Desktop application will allow fast-forward and fast-reverse of archived video up to 16x normal speed.
- q.) The VMS Desktop application will show operators which system server they are connected to.
- r.) The VMS Desktop application will allow operators to connect to previous versions by automatically downloading and switching to compatible versions.
- s.) The VMS Desktop applications will automatically discover available systems on the same network as the computer running the Desktop application.
- t.) The VMS Desktop application will automatically recover and reconnect to a system in the instance the server the operator is connected to becomes inaccessible for any reason.
- u.) The VMS Desktop application will allow operators to show or hide adaptive thumbnails in the timeline panel.
- v.) The VMS Desktop application will allow operators to synchronize all items on a layout or disable synchronization to view live and recorded video at the same time.
- w.) The VMS Desktop application will have adaptive settings dialogs, allowing operators to switch dialog content while the dialog is open by clicking on a resource.
- x.) The VMS Desktop application will allow batch configuration of camera recording schedules, fps, and quality.
- y.) The VMS Desktop application will allow operators to drag and drop multiple system resources onto the Viewing Grid at the same time.
- z.) The VMS Desktop Application will allow administrators to modify time synchronization settings for the system to utilize online resources (NTP servers) or to set a dedicated local time server.
- aa.) The VMS Desktop Application will allow system administrators to view a full list of system cameras and devices in a single dialog.
- bb.) The VMS Desktop application will allow operators to view, search and export all system events.
- cc.) The VMS Desktop application will allow operators to view, search and export all system bookmarks.
- dd.) The VMS Desktop application will allow operators to view, search, and export system logs.
- ee.) The VMS Desktop application will allow operators to view, search, and export an audit trail of all operator actions and replay related video.
- ff.) The VMS Desktop application will allow administrators to backup and restore the system database.
- gg.) The VMS Desktop application will allow administrators to create an

unlimited number of custom user roles.

- hh.) The VMS Desktop application will allow administrators to create and share lockable layouts.
- ii.) The VMS Desktop application will allow administrators to update layouts in real time.
- jj.) The VMS Desktop application will allow users to record their screen in full resolution and up to 30fps.
- kk.) The VMS Desktop application will allow users to add a local folder to add local files for search and playback.
- ll.) The VMS Desktop application will have a Video Wall mode which will allow operators to control the application remotely.
- mm.) The VMS Desktop application will have a Media Player mode which will allow operators to use the application as a media player.
- nn.) The VMS Desktop application will remember past system connections and user credentials and will allow operators to quickly search for and switch between systems.
- oo.) The VMS Desktop application will allow operators to adjust the aspect ratio and streaming quality (high resolution or low resolution) of items displayed on the viewing grid.
- pp.) The VMS Desktop application will display I/O devices as an individual item on the viewing grid and allow operators to create custom names for inputs and output.
- qq.) The VMS Desktop application will allow users to customize the layout of I/O panels on the item in the viewing grid including indicators for inputs and buttons for outputs.
- rr.) The VMS Desktop application will allow users to de-warp any fisheye lens using automatic calibration or manual calibration without the need for any third (3rd) party SDKs.
- ss.) The VMS Desktop application will allow users to create fully customizable viewing tours which include any combination of live video streams, offline videos, images, websites (or URLs), I/O devices, and Server health monitoring status.
- tt.) The VMS Desktop application will allow system administrators to modify and save a shared layout to affect an instantaneous change to that layout on the VMS Desktop application of any user connected to the system viewing that layout (when the system administrator saves the layout the layout will update in real time for any user viewing that layout).
- uu.) The VMS Desktop application will support two-way audio between operators and supported devices.
- vv.) The VMS Desktop application will support audio alerts as an action that can be played on users' computers or connected system devices.

- ww.) The VMS Desktop application will support PTZ presets and tours.
- xx.) The VMS Desktop application will support PTZ presets and tours in fisheye cameras using de-warp mode.
- yy.) The VMS Desktop application will allow operators to schedule recording for connected cameras and devices with options to force minimum and maximum storage durations.
- zz.) The VMS Desktop application will allow operators to configure pre and post recording for motion events.
- aaa.) The VMS Desktop application will allow operators to optimize camera streaming quality from connected devices automatically using low, medium, high, best quality selectors or manually in the camera.
- bbb.) The VMS Desktop application will allow users to export video by selecting an area on the timeline and right clicking to export.
- ccc.) The VMS Desktop application will support single video export in .avi, .mp4, or .mkv formats and will offer the option to transcode any client-side effects (image enhancement, de-warping, timestamps) as part of the exported video.
- ddd.) The VMS Desktop application will support multi-video export in an executable format to create a fully portable version of the VMS Desktop application including all exported video files.
- eee.) The VMS Desktop application shall have a rapid review export feature which will allow operators to compress any length of video into a short video (e.g. export 8 hours of archives into a 30 second video clip).
- fff.) The VMS Desktop application shall allow system administrators to activate or deactivate system licenses on Internet connected systems.
- ggg.) The VMS Desktop application shall allow users to force open an alarm layout triggered by any system or 3rd party event with one or many associated cameras or resources.
- hhh.) The VMS Desktop application will have a hidden configurable method of increasing the number of items allowed on the viewing grid.
- iii.) The VMS Desktop application shall allow users to adjust configuration of devices.
- jjj.) VMS will now allow analytics from the camera and other supported device with analytics
- kkk.) The VMS Desktop application will force users to set the camera's initial password upon enrollment for best cyber security practices.

5. Mobile Application

Mobile Client shall be able to run on the following operating systems	
Operating System	Versions

Google Android	Android 4.0: "Ice Cream Sandwich" Android 4.1, 4.2, 4.3: Jelly Bean Android 4.4: "KitKat" Android 5.0: "Lollipop" Android 6.0: "Marshmallow" Android 7.0, 7.1: "Nougat" Android 8.0, 8.1: "Oreo"
Apple iOS	iOS 5 iOS 6 iOS 7 iOS 8 iOS 9 iOS 10 iOS 11

- a. Installation - The VMS Mobile application will be available as a free download from Google Play or Apple iTunes stores.
- b. Features
 - 1.) The VMS Mobile application will automatically discover available Systems on a local area network (LAN).
 - 2.) The VMS Mobile application will store past system connections and credentials and will allow users to quickly search for switch between systems.
 - 3.) The VMS Mobile application will have adaptive streaming and automatically adjust the stream being displayed based on network speed.
 - 4.) The VMS Mobile application will allow users to adjust streaming resolutions manually.
 - 5.) The VMS Mobile application will allow users to search for cameras by name.
 - 6.) The VMS Mobile application will allow fisheye de-warping of any fisheye lens without the need for any 3rd party SDK.
 - 7.) The VMS Mobile application will allow users to view live video from one system.
 - 8.) The VMS Mobile application will allow users to log in to the VMS Cloud layer in order to view and access all systems shared with a user.
 - 9.) The VMS Mobile application will allow users to control the display of any connected "Lite Clients" in the system.
 - 10.) The VMS Mobile application will utilize a custom media player to

render and display live thumbnails and video.

11.) The VMS Mobile application will allow users to search video using a calendar.

12.) The VMS Mobile application will allow users to search video using a flex timeline.

6. VMS Cloud Application

- a. The VMS Cloud application will be an optional add-on to the VMS requiring no additional licensing.
- b. The VMS Cloud application will allow users to log in from any modern web browser (Google Chrome, Mozilla Firefox, Microsoft Edge, Opera, etc.) from any type of device (mobile, pc, etc.)
- c. The VMS Cloud application will be an optional add-on to the VMS requiring no additional licensing.
- d. The VMS Cloud application will allow users to connect an unlimited number of systems to a single user account.
- e. The VMS Cloud application will allow system administrators to share access to a system using only an email address.
- f. The VMS Cloud application will allow system administrators to assign custom user roles when sharing system access.
- g. The VMS Cloud application will allow users to quickly search for and connect to cloud-connected systems by name.
- h. The VMS Cloud application will allow operators to view live or recorded video from one camera at a time on any cloud-connected system.
- i. The VMS Cloud application will first attempt a direct connection to system servers using NAT Traversal technology and will be able to proxy traffic to ensure access to a system in the case of ISP or routing issues.
- j. The VMS Cloud application will allow an unlimited number of connected users and systems with no additional licensing.
- k. The VMS Cloud application will utilize secure networking technologies (OpenSSL, HTTPS) and a complex Salted MD5 hash for any stored passwords.

2.02 GENERAL DESCRIPTION – SERVER, STORAGE and CLIENT HARDWARE

A. Network Video Recorder (NVR) Server

The NVR server shall record video and audio at a minimum of 470 Mbps and send data from video cameras to a hard disk array of 1 -12 HDD's within a rack mountable format and enable playback of video and audio from the hard disk array.

1. Basis of Design: Wisenet WRR-5501-XXTB
2. Storage Calculation Parameters
 - a. Length of time: 30 Days
 - b. Video Quality Level: Best
 - c. Compression: H.265
 - d. Outdoor Cameras FPS: 10
 - e. Indoor Cameras FPS: 10
 - f. Cameras are to record a continuous low-resolution stream at provided FPS and switch to high-resolution stream at provided FPS upon motion detection
 - g. Outdoor camera motion percentage: 50%
 - h. Indoor camera motion percentage: 50%
 - i. PTZs will be set for continuous (100%) high-resolution recording
 - j. Storage
 - 1.) Up to 12 HDDs in JBOD configuration.
 - 2.) RAID Support – RAID 0/1/5/6/10/50/60 +BBU (backup battery unit).
 - 3.) USB connection for memory/storage device for video clip backup and settings export
 - k. VGA and High Definition (HDMI) local monitor outputs live viewing, playback, & backup functions
3. System

- a. Processor: Intel Core i5-7500 3.4GHz
- b. Memory: 8 GB DDR4
- c. Operating Systems: Windows 10 IoT Enterprise
- d. USB Ports: 6x USB 3.0(rear), 2x USB 3.0(front)
- e. Network Ports: 1000 Base-T Ethernet, 2 x RJ-45 connectors
- f. Video Output: 1x Display Port (rear), 1x HDMI (rear), 1x DVI (rear)
- g. Other ports: 3.5mm audio in/out, 1x SPDIF out
- h. Keyboard: Included
- i. Mouse: Included
- j. Sliding Rail Kit: Included
- k. RAID Support: RAID 0/1/5/6/10/50/60 +BBU (backup battery unit)
- 4. Recording
 - a. Channel capability: 128 Channels per server
 - b. Bit Rate: Up to 470 Mbps
 - c. Resolution range: 352 x 288 - 4000 X 3000
 - d. OS Drive Bays 1 – 256GB SSD internally Mounted
- 5. Storage
 - a. Internal
 - 1.) Number of HDD's bays: 12
 - 2.) RAID Level Support: RAID 0/1/5/6/10/50/60 +BBU (backup battery unit)
 - b. External USB HDD/Flash drive
- 6. Electrical
 - a. Power: 100 – 240VAC
- 7. Power Supply: 800 W Redundant
- 8. Mechanical and Environmental
 - a. Front Bezel Includes front bezel and lock
 - b. Form Factor 2U Rack Mount Chassis, sliding rails included
 - c. Dimensions (W x H x D): 17.2 in. x 3.5 in. x 26 in. (438 mm x 87.0 mm x 660 mm)
 - d. Weight 30.86 lbs. (14kg)
 - e. Operating and Storage Temp: 0° C to 50° C (32° F to 122° F)
 - f. Humidity: 5% - 85%, RH non-condensing
- B. Client Workstation

The Client Workstation shall be the primary interface for system operators and shall display video images from system cameras and allow for complete programming of the NVR servers within system.

 - 1. Basis of Design: Wisenet WWT-5301
 - 2. The workstation shall provide complete system programming capabilities based on user password
 - 3. The workstation shall provide a remote monitoring environment for video and audio over the network.
 - 4. The Workstation shall support dual monitor outputs.
 - 5. The Workstation shall be capable of a minimum of 32TB of storage
 - 6. The Workstation shall have multiple USB connections for exporting video clips and backup/settings exports
 - 7. The Workstation shall have two High Definition (HDMI) monitor outputs live and playback viewing
 - 8. System
 - a. Processor: Intel Core i5-7500 3.4GHz
 - b. Memory: 8 GB DDR4
 - c. Operating Systems: Windows 10 IoT Enterprise
 - d. USB Ports: 4x USB 3.0(rear), 1x USB 3.0 Type-C (rear), 2x

- | | | |
|----|---|--|
| | USB 2.0(front) | |
| e. | Video Output: | 2x HDMI (rear), 1x DVI (rear) |
| f. | Wi-Fi | IEEE 802.11ac |
| g. | Other ports: | 1x PS2, 2x Wi-Fi Antennas, 3.5mm audio in/out, |
| | 1x SPDIF out | |
| h. | Keyboard: | Included |
| i. | Mouse: | Included |
| j. | RAID Support: | none |
| k. | OS Drive | |
| | 1.) OS Drive Bays | 1 – 256GB SSD internally Mounted |
| l. | Storage | |
| | 1.) Internal | 4 available HDD bays |
| | 2.) External | USB HDD/Flash drive |
| m. | Audio | |
| | 1.) Direction: | Bi-directional |
| | 2.) Output: | Line level (RCA) |
| n. | Electrical | |
| | 1.) Power: | 100 – 240VAC |
| | 2.) Power Supply: | 250 W |
| o. | Mechanical and Environmental | |
| | 1.) Color | Black, Silver / Metal |
| | 2.) Front Panel | Front panel with lock |
| | 3.) Form Factor | Mini-Tower form factor |
| | 4.) Dimensions (W x H x D): | 7.87in x 10.63in x 12.2in |
| | 5.) Weight | 15.4 lbs. |
| p. | Operating and storage Temp: | 0° C to 50° C (32° F to 122° F) |
| q. | Humidity: | 5% - 85%, RH non-condensing |
| 9. | Security features: | |
| | a. user password protection with group restrictions | |
| | b. IP address filtering - list of allowed or blocked IP addresses | |
| | c. HTTPS(SSL) login authentication | |
| | d. User access log | |
| | e. 802.1x authentication | |
| | f. Restriction of all network access/web viewer access | |
- 2.03 GENERAL DESCRIPTION - CAMERA
- A. Basis of Design is the Hanwha Wisenet Family of Cameras
- B. Video Compression and Transmission – The camera shall have the following properties relating to the video signals it produces.
1. H.265, H.264 compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously
 2. Minimum Framerate capable with Wide Dynamic Range enabled
 - a. 2MP – 30 fps
 - b. 4MP – 20 fps
 - c. 5MP – 30 fps
 - d. 8MP – 30 fps
 - e. 12MP – 20 fps
 3. The camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
 4. Simultaneous unicast access by up to 20 users
 5. Advanced Dynamic Compression, Dynamic Framerate and Dynamic GOV to efficiently manage bitrate of the video stream.
- C. Physical and performance properties of cameras
1. Vandal rating for outdoor cameras - IK10 for protection against impacts.

2. Vandal rating for indoor cameras – IK08 for protection against impacts.
3. For outdoor cameras - dust proof and water proof (IP66 or IP67 rated)
4. Temperature range for indoor cameras:
 - a. Operating: -10° C to 55° C (+14° F to 131° F)
 - b. Storage: -30° C to 60° C (-22° F to 140° F)
5. Temperature range for outdoor cameras:
 - a. Operating: -30° C to 55° C (-22° F to 131° F)
 - b. Storage: -30° C to 60° C (-22° F to 140° F)
6. 2D and 3D digital noise reduction
7. 16 privacy masking regions utilizing polygons
8. Wide Dynamic Range – 120dB
- D. Intelligence and Analytics – The camera shall have a suite of integral intelligent operations and analytic functions to include:
 1. Motion detection with eight definable detection areas, Minimum object size definition and a learning algorithm that ignores false alarms such as trees and waves on water.
 2. Detection of logical events of specified conditions from the camera's video input
 - a. camera tamper (scene change)
 - b. virtual line
 - c. enter/exit
 - d. appear/disappear
 - e. audio detection
 - f. defocus detection
 - g. digital auto tracking with metadata
- E. Interoperability – The camera shall be ONVIF Profile S and G compliant.
- F. The camera shall possess the following further characteristics:
 1. Built-in web server, accessed via standard browsers including Internet Explorer, Firefox, Chrome & Safari
 2. Micro SD/SDHC/SDXC memory card (minimum capacity of 128GB) and NAS recording options, with configurable pre-alarm and post-alarm recording intervals
 3. Bi-directional audio
 4. Alarms and notifications
 - a. alarm notification triggers:
 - 1.) alarm input
 - 2.) motion detection
 - 3.) video analytics
 - 4.) audio detection
 - 5.) network disconnects
 - b. available notification means upon trigger:
 - 1.) file upload via FTP and e-mail
 - 2.) notification via e-mail
 - 3.) record to local storage (SD/SDHC/SDXC card)
 - 4.) NAS recording at event triggers
 - 5.) external output
 5. Pixel Counter available in the plug-in web viewer.
 6. POE capable
- G. Network
 1. Connectivity: 10/100 Base-T Ethernet via RJ-45 connector
 2. Protocols supported:

- a. Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP)
 - b. Configuration: Dynamic Host Configuration Protocol (DHCP)
 - c. Web services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS)
 - d. Network services: Address Resolution Protocol (ARP), Bonjour, Domain Name System (DNS), Internet Control Message Protocol (ICMP), Network Time Protocol (NTP), Protocol Independent Multicast-Sparse Mode (PIM-SM), Simple Network Management Protocol (SNMP v1/2c/3 – MIB-2), Universal Plug and Play (UPnP)
 - e. Media: Real-Time Transport Protocol (RTP), Real-Time Control Protocol, Real-Time Streaming Protocol (RTSP)
 - f. Multicast: Internet Group Management Protocol (IGMP)
 - g. Notifications: File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP)
 - h. Remote Access: Point-to-Point Protocol over Ethernet (PPPoE)
 - 3. Multicast or unicast capable
 - 4. DDNS – The camera shall support DDNS services offered by the Manufacturer and other publicly available service offerings.
 - 5. Quality of Service (QoS) – Layer 3 DSCP
 - 6. Security features:
 - a. user password protection
 - b. IP address filtering - list of allowed or blocked IP addresses
 - c. HTTPS(SSL) login authentication
 - d. HTTPS(SSL) secured communications
 - e. Digest login authentication
 - f. User access log
 - g. 802.1x authentication
 - 7. Discovery - Manufacturer shall offer a discovery program to identify all devices of his manufacture on the network.
- H. Camera Software
- 1. The camera shall have a built-in web server which supports browser-based configuration using Internet Explorer, Google Chrome, Mozilla Firefox, and Apple Safari, for which web viewer plug-ins are available, from a PC or Mac.
 - 2. The web viewer shall provide a monitoring screen which displays live camera video and simultaneously provides same-screen access to the following functions:
 - a. Live view window size
 - b. Resolution setting
 - c. Image (snapshot) capture
 - d. Manual recording to SD or NAS
 - e. Audio/microphone control
 - f. Access Playback and Setup menus
 - 3. The web viewer shall provide a playback screen which provides access to the following functions:
 - a. Search date and time range
 - b. Search event type
 - c. Play an event video
 - d. Set resolution
 - e. Play audio if present
 - f. Generate a backup copy of saved video data
 - 4. The web viewer shall provide a setup screen which provides access to the following configuration settings and functions in the camera:

- a. Digital video profile to include compression type, maximum or target bit rate, frame rate, multicast parameters, crop encoding area
- b. User profile to include password, access level, authentication
- c. Date and time
- d. Network settings and IP version
 - 1.) DDNS
 - 2.) SSL, including certificate management
 - 3.) 802.1x authentication
 - 4.) Quality of Service settings
 - 5.) SNMP to include version selection and settings
 - 6.) Auto configuration
- e. Video setup to include flip and mirror mode, hallway view mode, video type, privacy zone
- f. Audio setup to include source, audio codec type, gain, and bit rate
- g. Camera settings to include image preset, sensor frame capture, dynamic range, white balance, back light, exposure, day/night operation, on-screen display, IR illumination, sharpness, contrast, and color level.
- h. Event detection setup to include notification parameters, recording rules, time schedule, tamper protection, motion detection, event triggers
- i. System function to include reboot, upgrade, check system and event logs, application (SDK) management
- j. View profile information
- 5. Client requirements
 - a. Acceptable Operating Systems: Windows 7 / 8.1 / 10, MAC OS X 10.9~10.11
 - b. Acceptable browsers
 - 1.) Plug-in free web viewer: Google Chrome 47, MS Edge 20
 - 2.) Plug-in web viewer: MS Explore 11, Mozilla Firefox 43, Apple Safari 9 * Mac OS X only
- I. CAMERA STYLE
 - 1. Bullet
 - 2. Dome
 - a. Fixed
 - b. PTZ
 - 3. Multi-Imager
 - 4. Panoramic
 - a. Multi-Imager Stitched
 - b. Fisheye
 - 5. Specialty
- J. CAMERA APPLICATION
 - 1. Cameras utilized in large open spaces – Parking Lots, Athletic Fields, Gymnasiums, Cafeterias, Building Perimeter, and for General Surveillance
 - a. 8MP
 - b. 6MP
 - c. 5MP
 - d. 4MP
 - 2. Cameras utilized to watch hallways, entryways, office space, enclosed areas, small spaces, cash registers, aiseways, and for forensic capture of faces and license plates.
 - a. 2MP
 - 3. Cameras utilized when there is an operator and/or in conjunction with cameras supporting PTZ handoff for tight observation and long distances.

- a. Pan/Tilt/Zoom (PTZ)
- 4. In order to reduce material and labor costs (e.g. number of VMS camera licenses, cable runs and installed cameras), multi-imager cameras can be strategically utilized. Multi-imagers work well in locations where 2 or more cameras are being used in close proximity to each other to cover an area (e.g. hallways pointing in both directions, in the corner of hallways pointing multiple directions, hallway intersections, large rooms (gymnasiums, cafeterias) in the center of the room or multiples overlapping to get multiple views of the scene, parking lots (360° coverage), building perimeters (corners allow for 270° coverage and one pointed down to eliminate blind spots) (center of building in a 180° layout)
- K. CAMERA TYPES
 - 1. Drawing Camera Label Naming Convention
 - a. C* (e.g. CZ)
 - 1.) C = Refers to Camera
 - 2.) * = Camera Type
 - 2. Mounting Hardware – Model numbers referenced below are for comparative purposes only, contractor is expected to provide the correct mounting hardware for the specific camera they are providing.
 - a. Wall Mount – Design Basis – Wisenet SBP-300WMW2
 - b. Hanging Mount – Design Basis – Wisenet SBP-317HWMW w/SBP-300CM
 - c. Corner Mount – Design Basis – Wisenet SBP-300KMW1 w/SBP-300CM

Drawing Camera Labels: Refer to schedule on drawings for camera types and requirements.

PART 3 EXECUTION

3.01 INSTALLERS

- A. Contractor personnel shall comply with all applicable state and local licensing requirements.

3.02 PREPARATION

- A. The network design and configuration shall be verified for compatibility and performance with the camera(s).
- B. Network configuration shall be tested and qualified by the Contractor prior to camera installation.
- C. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA) or Network Video Recorder (NVR).
- D. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

3.03 INSTALLATION

- A. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to insure all steps have been taken to provide a reliable, easy-to-operate system.
- B. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- C. Before permanent installation of the system, the Contractor shall test the system in conditions simulating the final installed environment.

3.04 STORAGE

- A. The hardware shall be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

END OF SECTION 282000

SECTION 283100 - FIRE ALARM SYSTEM**1. GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
 - 1. Division 26 Electrical
 - 2. Division 21 Fire-Suppression System
 - 3. Division 23 Mechanical
 - 4. Division 25 Direct Digital Controls
- C. The system and all associated operations shall be in accordance with the following:
 - 1. Requirements of the following Model Building Code: IBC, 2015 Edition
 - 2. Requirements of the following Model Building Code: KBC, 2018 Edition
 - 3. NFPA 72, National Fire Alarm Code, 2013 Edition
 - 4. NFPA 70, National Electrical Code, 2017 Edition
 - 5. ADA Accessibility Guidelines

1.2 SUMMARY

- A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
- B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 - 1. Fire alarm system detection and notification operations.
 - 2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, and other equipment as indicated in the drawings and specifications.
 - 3. Two-way supervised firefighter's phone operations.
 - 4. One-way supervised automatic voice alarm operations.

1.3 SCOPE OF WORK

- A. The intent of this specification is to provide a new, fully tested and operational addressable voice based fire alarm system. The fire alarm system shall include all necessary integrations as required by applicable codes and as called out on drawings and in other specification sections. The fire alarm control panel shall be provided with a cellular dialer as the primary means of communication with an IP dialer backup.

1.4 SYSTEM DESCRIPTION

- A. General: Provide a complete, non-coded addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.
 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
 3. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.
 4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
 5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
 6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
 7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
 8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.
- C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
 - D. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

E. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.
2. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.
3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.
4. Constant Supervision Audio: When provided, audio notification appliance circuits shall be supervised during standby by monitoring for DC continuity to end-of-line resistors.

F. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
2. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.
3. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.
4. Selective Alarm: A system alarm shall include:
 - a) Indication of alarm condition at the FACU and the annunciator(s).
 - b) Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).
 - c) Operation of audible and visible notification appliances until silenced at FACU.
 - d) Closing doors normally held open by magnetic door holders.
 - e) Unlocking designated doors.
 - f) Shutting down supply and return fans building wide.
 - g) Closing smoke dampers on system building wide.
 - h) Initiation of smoke control sequence.
 - i) Transmission of signal to the supervising station.
 - j) Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.
5. Supervisory Operations: Upon activation of a supervisory device such as a fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
 - a) Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
 - b) Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
 - c) Record the event in the FACU historical log.
 - d) Transmission of supervisory signal to the supervising station.
 - e) Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

6. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
 7. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
 - a) The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
 - b) Control relay functions associated with one of the 8 testing groups shall be bypassed.
 - c) The control unit shall indicate a trouble condition.
 - d) The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
 - e) The unit shall automatically reset itself after signaling is complete.
 - f) Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
- G. Fire Suppression Monitoring:
1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
 2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
- H. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.
1. Automatic Voice Evacuation Sequence:
 - a) The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
 - b) All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.
- I. Speaker: Speaker notification appliances shall be listed to UL 1480.
1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.
 2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
 3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets,

exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.
 3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.
 4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
 5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
 6. Operating instructions for FACU.
 7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
 8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
 9. Record of field tests of system.
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.6 MAINTENANCE SERVICE

- A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives
- B. Basic Services: Routine maintenance visits on an "as needed" basis at times scheduled with the Owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

PART 2 - PRODUCTS

2.1 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

- A. Manufacturers: The equipment and service described in this specification are those supplied and supported by Tyco SimplexGrinnell and represent the base bid for the equipment.
 1. Subject to compliance with the requirements of this specification, provide products by one of the following: Simplex, Siemens/Cerberus, Edwards, Thorn or Notifier will be acceptable.
- B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

- C. Alternate products must be submitted to the Engineer two weeks prior to bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
- D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level IV certified technicians, and shall maintain a service organization within 50 miles of this project location. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

- 1. Manual stations.
- 2. Heat detectors.
- 3. Smoke detectors.
- 4. Duct smoke detectors.
- 5. Automatic sprinkler system water flow.

- B. Fire-alarm signal shall initiate the following actions:

- 1. Continuously operate alarm notification appliances.
- 2. Identify alarm at fire-alarm control unit and remote annunciators.
- 3. Transmit an alarm signal to the remote alarm receiving station.
- 4. Unlock electric door locks in designated egress paths.
- 5. Release fire and smoke doors held open by magnetic door holders.
- 6. Activate voice/alarm communication system.
- 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
- 8. Activate stairwell and elevator-shaft pressurization systems.
- 9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
- 10. Recall elevators to primary or alternate recall floors.
- 11. Record events in the system memory.

- C. Supervisory signal initiation shall be by one or more of the following devices and actions:

- 1. Valve supervisory switch.
- 2. Low-air-pressure switch of a dry-pipe sprinkler system.

3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

2.3 FIRE ALARM CONTROL UNIT (FACU)

A. General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems".

B. The following FACU hardware shall be provided:

1. Power Limited base panel with platinum cabinet and door, 120 VAC input power.
2. 2,500 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
3. 2000 points of annunciation where one (1) point of annunciation equals:
 - a) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
 - b) 1 LED on panel or 1 switch on panel.
4. 9 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACU LCD display.
5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
7. Three (3) Class B Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
 - a) NAC's shall be conventional reverse polarity operation and shall be for synchronized strobes and independent horn/strobe operation over two wires.
 - b) NACs shall be selectable as auxiliary power outputs derated to 2 A for continuous duty.
 - c) Strobe synchronization and audible cadence synchronization shall be across all panel NAC circuits. Systems that cannot provide listed synchronization across all panel NAC's shall not be acceptable.
8. The FACU shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall

be capable of two-way communications.

9. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
10. Programmable DACT for either Common Event Reporting or per Point Reporting.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
- E. Voice Alarm: Provide an emergency communication system, integral with the FACU, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:
 1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.
 2. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.
 3. When required, Redundant Voice Command Centers shall be capable of generating voice paging from more than one node in a network audio system.

2.4 ADDRESSABLE INITIATING

A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Addressable single- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.
3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.

B. ADDRESSABLE ANALOG SMOKE SENSORS

1. General Requirements for System Smoke Detectors:

- a) Operating Voltage: 24 VDC, nominal and shall be two-wire type.
- b) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
- c) Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. Provide terminals in the fixed base for connection to building wiring. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor base shall contain an integral visual-indicating LED that wi
- d) Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.
- e) Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
- f) Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.
- g) The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.
- h) Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2. Addressable Sensor Bases

- a) Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.
- b) Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)

C. ADDRESSABLE DUCT SMOKE SENSOR

1. Standard Addressable Duct Smoke Sensor Unit. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Duct housing shall include relay or relay driver as required for fan shutdown.
 - a) Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.
 - b) The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.
 - c) Duct Housing shall provide a magnetic test area and Red sensor status LED and Duct Housing shall provide a relay control Yellow LED trouble indicator.

- d) Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
- e) Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
- f) For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
- g) Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.
- h) Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

D. ADDRESSABLE HEAT SENSORS

1. General Requirements for Heat Detectors: Comply with UL 521.
2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.
4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.
5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
6. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACU for either 15-deg F or 20-deg F per minute.
7. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.
8. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.
 - a) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

E. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their

operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.

3. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.5 CONVENTIONAL NOTIFICATION

A. STANDARD ALARM NOTIFICATION APPLIANCES

1. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
2. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
3. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480.
 - a) Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC.
 - b) The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
 - c) The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.
 - d) The S/V installs directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.
4. Speaker: Speaker notification appliances shall be listed to UL 1480.
 - a) The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted / shielded wire.
 - b) The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
 - c) The Speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.
 - d) The Speaker installs directly to a 4" square, 1 ½" deep electrical box with 1 ½" extension.
5. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with an On Steady operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.
6. Accessories: The contractor shall furnish any necessary accessories.

B. NAC Power Extender

1. The SLC NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class B, Style Y rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.
2. The internal power supply and battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
3. The NAC extender panel may be mounted close to the host control unit or can be remotely located. The SLC Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via an SLC communications channel. Via the SLC channel each output NAC can be individually controlled for general alarm or selective area notification.
4. For SLC connected NAC extender panels up to five panels can be connected on a single SLC channel.
5. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control unit may be used to activate all the circuits on the NAC power extender panel.
6. Alarms from the host fire alarm control unit shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

2.6 MAGNETIC DOOR HOLDERS

- A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.
- B. Material and Finish: Match door hardware.

2.7 REMOTE LCD ANNUNCIATOR

- A. Provide a remote LCD Annunciator, where required, with the same "look and feel" as the FACU operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACU.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
 1. 40 character custom location label.

2. Type of device (e.g., smoke, pull station, waterflow).
 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACU.

2.8 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
1. Verification that both telephone lines are available.
 2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address or loss of power.
 4. Low battery.
 5. Abnormal test signal.
 6. Communication bus failure.
- E. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.9 EMERGENCY POWER SUPPLY

- A. General: Components include battery, charger, and an automatic transfer switch.

- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.10 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of device.
 - 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
 - 1. Factory trained and certified personnel.
 - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
 - 3. Personnel licensed or certified by state or local authority.

3.2 EQUIPMENT INSTALLATION

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.
- B. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.
- C. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- D. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units, duct smoke detectors .
- E. Automatic Detector Installation: Conform to NFPA 72.
- F. Ethernet Drop: A standard RJ-45 Ethernet connection to the owner's Ethernet network shall be provided at each fire alarm control unit as part of the contract.

3.3 WIRING INSTALLATION

- A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
- B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
 - 1. Factory trained and certified.
 - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
 - 3. International Municipal Signal Association (IMSA) fire alarm certified.
 - 4. Certified by a state or local authority.
 - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
- C. Inspection:
 - 1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
 - 2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
- D. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.
- E. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.7 TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
 1. Train Owner's maintenance personnel in the procedures and schedules involved in Fowensbro operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
 2. Schedule training with the Owner at least seven days in advance.

END OF SECTION 283100

SECTION 311000 - SITE CLEARING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Clearing and protection of vegetation.
- B. Removal of existing debris.
- C. Removal of existing site improvements including pavements, utilities and utility structures, foundations or other site improvements.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 015713 - Temporary Erosion and Sediment Control.
- D. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 312200 - Grading: Topsoil removal.
- F. Section 312323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- G. Section 312513 - Permanent Erosion Controls
- H. Section 311500 - Protection of Existing Trees

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Fill Material: As specified in Section 312323 - Fill and Backfill

PART 3 EXECUTION**3.01 SITE CLEARING**

- A. Comply with other requirements specified in Section 017000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.
- E. Pavements and slabs are to be saw cut to provide a clean edge. Concrete pavements are to be cut at the nearest control joint to the required demolition area.

3.03 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, planting beds, borrow areas (when applicable) and disposal areas (when applicable).
- B. Do not remove or damage vegetation beyond the limits indicated on drawings.
- C. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
 - 1. At vegetation removal limits.
- D. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 - 3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
 - 4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- E. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- F. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.04 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 311500 - PROTECTION OF EXISTING TREES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protection of existing and newly planted trees is to be performed on the project site and at any areas adjacent to or near the site where construction activities impact the Tree Protection Zone (TPZ). Tree protection will function as follows:
 - 1. The foliage canopy and branching structure are to be kept clear from contact with equipment, vehicles, materials and activities
 - 2. The roots and soil conditions are to be preserved in an intact and non-compacted state
 - 3. No Soil disturbance is permitted within the identified Tree Protection Zone (TPZ) unless otherwise approved.
- B. Work included: Furnish all labor, materials, equipment and services necessary to protect existing trees on site and on adjacent road right-of-way and sites, including but not limited to:
 - 1. Survey and layout, installation, maintenance, adjustment during construction, and final removal of protective barriers and signs.
 - 2. Pruning as required, including hand excavation and root pruning if required and approved by the landscape architect and/or arborist.
 - 3. Excavation, soil stabilizing

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 013000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. Section 015713 - Temporary Erosion and Sedimentation Control.
- D. Section 024100 - Demolition: Selective demolition, site demolition, structure removal.

1.03 DEFINITIONS AND PROCEDURES

- A. Tree Protection Zone (TPZ) (May be interchanged with Critical Root Zone (CPZ) and Drip-Line below): An area around the base of a tree with a radius of 10 times the diameter of the tree's trunk or twenty feet, whichever is greater.
- B. Tree Protection Barrier: any fencing or other barrier material, including supports and bracing for such, to be used to surround and enclose the TPZ.
- C. Critical Root Zone Area (CRZ): The area of undisturbed natural soil around a tree defined by a horizontal circle drawn at grade with the trunk at the center and extending for a radial distance equal to the distance from the center of the trunk to the outermost portion of the drip line.
- D. Drip Line: the area surrounding a tree directly below the outermost portions of the tree canopy, or a circular area with a radius of one-half of the height of the tree extending outward from the center point of the tree.
- E. Warning Sign: A warning sign is to be prominently displayed on each fence at 25- foot intervals.
- F. Root Protection: Materials or devices installed at ground level to protect the root system of trees from compaction during construction.
- G. Root Boring for utility installation: Directional micro-tunneling and boring may be permitted within the limits of the TPZ subject to approval by the Landscape Architect.
- H. Tree Topping: Practice of removing a substantial portion or all of the upper canopy of a tree. Tree Topping will not be allowed in this project.

- I. Root Boring: Boring beneath protected trees to provide a tunnel for the installation of utilities.

PART 2 PRODUCTS

2.01 TREE PROTECTION PRODUCTS

- A. Fencing: 4'-0" high orange plastic 'snow' or barrier fence. Provide steel posts spaced at 6 ft. minimum.
- B. Tree Protection Area Signs: minimum size 12" x 18", may be lettered vertically or horizontally.
 - 1. Size: minimum 12" x 18", vertical or horizontal placement.
 - 2. Text: CAUTION - TREE PROTECTION ZONE - DO NOT REMOVE. NO DUMPING, BURNING, STORAGE, CUTTING, MACHINERY OR VEHICLES.
 - 3. Material to be painted plywood or other weather resistant material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to the beginning of demolition or construction work, field verify the TPZ for each existing tree to be preserved. Perform any root exploratory excavation necessary to determine root location and condition and/or other existing conditions.
- B. Instruct all construction workers to observe the TPZ limits.

3.02 INSTALLATION

- A. No construction activity including grade changes, surface treatments or excavations of any kind is permitted within the TPZ of any existing tree to remain unless otherwise indicated on the project plan drawings. The area within the TPZ must remain undisturbed at all times.
- B. No root cutting is permitted unless done with the approval of the landscape architect and requiring the services of a qualified arborist or approved tree professional. An exploratory excavation by hand or using a low water pressure hydro vac method must be completed prior to commencing with open face cuts outside the TPZ.
- C. Do not store materials or fill within the TPZ.
- D. Do not allow movement, parking or storage of vehicles or equipment within the TPZ.
- E. Do not discharge exhaust into foliage or allow fires under and adjacent to trees.
- F. Do not allow run off of spillage of damaging materials into the TPZ, including but not limited to concrete overflow or sleuth, gas, oil, paint, etc.
- G. Root Pruning: Before the start of machine excavation, hand excavate along the established limit of excavation approved by the landscape architect and/or arborist and prune all roots along the line. Cuts are to be clean per accepted and approved Arboricultural practice.
 - 1. Where machine trench occurs adjacent to the drip line of trees, roots smaller than 2" are to be hand trimmed to make clear, clean cuts.
 - 2. All damaged, torn and cut roots are to be given a clean cut to remove ragged edges.
 - 3. Trenches are to be filled with 24 hours, otherwise the side of the trench adjacent to the trees is to be kept shaded with four layers of dampened, untreated burlap, wetted as frequently as necessary to keep the burlap wet.
 - 4. Inform the landscape architect/arborist if roots of greater size than 2 inches are found. The root(s) may need to be either cut or hand excavated and protected. Keep exposed roots covered with dampened burlap as above.
- H. Protection Barrier Fencing Layout:

1. Typical Layout: Fencing is to enclose the entire area under the canopy drip line or TPZ (whichever is greater) of each tree or group of trees to be protected throughout the demolition and construction period.
- I. Install Tree Protection Barrier Fencing
 1. Orange safety fence: Embed posts a minimum 18 inches at no more than 5 (five) foot spacing. Fencing is to be tied closed completely surrounding the TPZ.
- J. Install Tree Protection Area and Enclosure Signage.
- K. Tree Topping: No Tree Topping will be allowed.
- L. Tree Pruning: Branches which are found to be a barrier to construction or a health and safety hazard may be removed subject to the approval of the landscape architect/arborist.
 1. When removing a branch, cut outside the branch bark ridge and collar. Do not make a flush cut adjacent to the trunk of the tree or branch being pruned.
 2. Make a partial cut from beneath at a point several inches away from the trunk.
 3. Make a second cut from above several inches out from the first cut to allow the limb to fall safely.
 4. Complete the removal with a final cut just outside the branch collar (the raised area that surrounds the branch where it joins the trunk).
 5. Make all cuts clean and remove any jagged edges carefully.

3.03 INTERFACE WITH OTHER WORK:

- A. Coordinate tree protection with all demolition, excavation, grading and utility work in the area..

3.04 FIELD QUALITY CONTROL

- A. See Division 1 for Quality Requirements.
- B. Inspect for existing soil conditions which may be detrimental to tree health and survival; existing utilities within or adjacent to the TPZ; and extent of root system beyond the visible drip line.
- C. Any trees which are found to be in poor or damaged condition are to be evaluated by the landscape architect or arborist. Trees that are deemed to have a minimal chance of survival or which pose a health or safety risk may be removed or pruned by more than one-third subject to approval of the landscape architect/arborist and Owner.

3.05 MAINTENANCE

- A. See Division 1 for additional requirements relating to maintenance service.
- B. Repair or replace any fencing, ground protection or signage that has been removed or damaged. Inspect installations on a continuous basis.
- C. Tree protection devices are to be removed at the end of the project (after final completion) and the area beneath the TPZ returned to original condition.

END OF SECTION

SECTION 312200 - GRADING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Removal of topsoil.
- B. Rough grading the site for site structures.
- C. Finish grading.
- D. Post-construction site survey requirements.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Control.
- B. Section 311000 - Site Clearing.
- C. Section 312316 - Excavation.
- D. Section 312316.13 - Trenching: Trenching and backfilling for utilities.
- E. Section 312316.26 - Rock Removal.
- F. Section 312323 - Fill: Filling and compaction.
- G. Section 312513 - Permanent Erosion Controls
- H. Section 329219 - Seeding: Finish ground cover.
- I. Section 329223 - Sodding: Finish ground cover.
- J. Section 329300 - Plants: Topsoil in beds and pits.

1.03 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Kentucky, Highway Department standards.

1.05 PROJECT CONDITIONS

- A. Per the Geotechnical Exploration Report, the soils found on this site sensitive to changes in the moisture content, and they will quickly degrade in such conditions or when subjected to construction traffic. The Contractor should carefully evaluate weather conditions and the equipment to be used on the site so as to minimize degradation of the soils. In addition, the Contractor is to include in their bid the undercutting and stabilization (lime stabilization, #2 crushed stone, geosynthetics, etc.) or repair/replacement of soils that will be affected by construction activities.
- B. It is recommended that earthwork be done during the warm and dry months. If earthwork is to be done during cold or wet months, the use of DGA in lieu of general soil fill should be considered for structural and pavement areas. Time extensions will not be considered for any delays due to the Contractor choosing to not use DGA in lieu of general soil fill during cold or wet months.
- C. The Geotechnical Exploration Report indicates the presence of existing fat clays (CH). This existing material is to be removed below structures, slabs and pavements per the report recommendations and in accordance with Specification Section 312316 and Section 312323. It is highly recommended that the contractor excavate test pits prior to preparation of their bids in order to further clarify the extent of these materials.

- D. The soils found on this site are very sensitive to changes in the moisture content and will quickly degrade in such conditions and when subjected to construction traffic. The Contractor should carefully evaluate equipment to be used on the site so as to minimize degradation of the soils. In addition, the Contractor is to include in their bid the stabilization or repair of soils that will be affected by construction activities.
- E. The new vehicular pavement and stone base areas are not designed for construction traffic and should not be used for construction activities unless they are stabilized using #2 crushed stone and geogrid. Stabilization should include any undercutting and material handling, borrow or disposal necessary to maintain the design subgrade elevations after stabilization has been done. Any areas of subgrade, road base or pavement damage are to be repaired.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Excavated from site and free of weeds. Supplement as needed with imported fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0. Topsoil to be amended as needed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.02 PREPARATION

- A. All site grading is unclassified.
- B. Identify required lines, levels, contours, and datum.
- C. Stake and flag locations of known utilities.
- D. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- E. Notify utility company to remove and relocate utilities.
- F. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading. Refer to Specification Section 312319 for additional Dewatering requirements.
- G. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- H. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- I. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.03 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

- E. See Section 312323 for filling procedures.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- H. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.04 SOIL REMOVAL and STOCKPILING

- A. Stockpile excavated topsoil on site. No topsoil is to be removed from the site. Topsoil stockpile is to be covered or seeded and mulched to protect the pile from erosion.
- B. Stockpile subsoil that is to be re-used on site; remove remainder from site. Cover stockpile to prevent erosion and saturation of the material.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

3.05 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove soil contaminated with petroleum products and legally dispose of it off-site.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches.
- E. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded with Grass: 6 inches.
 - 2. Areas to be Sodded: 5 inches.
 - 3. Shrub Beds: 24 inches.
 - 4. Tree Pits: 3-times the diameter of the foot ball and a minimum of 12-inches beneath the root ball.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants, buildings, and other improvements spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.06 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.07 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

- B. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 FIELD QUALITY CONTROL

- A. See Section 312323 for compaction density testing.
- B. At substantial completion of this project, the Contractor is to provide a topographic survey of the construction area in order to verify that the grading meets the contract requirements. The survey is to be done by a third-party surveyor approved by the Owner and is to be to the same quality as the survey included in the construction documents. The survey is to be provided in hard copy and as a digital file in Autocad 2004 or newer format. Items to be included are:
1. All property line data within the survey boundary area including bearings, distances, chords, arc lengths and radii are to be shown, as well as all corner markers. An actual Boundary Survey is not required, but located property lines and markers are to be shown.
 2. The street address for the property.
 3. Existing and new structures and buildings including elevations at all interior and exterior corners and finish floor elevations at each entrance into the existing structures inside the original survey boundary.
 4. Location of roads, pavements and sidewalks with spot elevations at a maximum of every 20 feet along all pavements including: the top and bottom of curbs and retaining walls, along both edges of sidewalks, roads, and along the centerline of road. The width of roads, lanes and location of roadway centerlines are to be identified, as are the pavement materials.
 5. All paint striping of roads and parking lots including individual and ADA parking spaces.
 6. Utilities on the property and on adjacent streets up to their connections with the main lines. All new Utility Piping and Conduits are to be surveyed **prior to backfilling** of the utility trench. Utilities to be surveyed include but are not limited to the following:
 - a. All water lines, fire hydrants, water meters, valves, etc. with pipe sizes and pipe material identified.
 - b. All sanitary sewers, manholes, pump stations, vents, etc. with rim elevations, inverts, pipe sizes and types of piping.
 - c. Gas piping, valves, meters, etc. with pipe sizes, materials and gas pressures where available from
 - d. Storm sewers, manholes, surface inlets, headwalls, etc. with rim elevations, inverts, pipe sizes and types of piping.
 - e. Underground and overhead electric lines with transformers, pole lights, guy wires, meters, etc. and identification of 2-phase or 3-phase.
 - f. All communication lines (underground and overhead) for telephone, television, satellite, etc. with poles, manholes, satellite dishes, pull boxes, etc.
 - g. All other utilities that may be present (steam piping, geothermal well fields and piping, gas transmission piping, septic tanks, grease traps, known underground storage tanks, etc.)
 - h. Survey information is to include pipe sizes and materials for all piped utilities.
 7. Name of the operating authority for each utility on or adjacent to the site.
 8. All easements and right-of-ways on or adjacent to the site.
 9. Site contours at one-foot intervals with spot elevations located between contours as needed for an accurate representation of grades. Topography for the site survey shall include all areas within the property boundary.
 10. Landscape features including all new individual trees and existing trees of 4" diameter and over as shown on the original survey.
 11. All survey information is to be referenced to the NAD83 datum using Latitude/Longitude projections in decimal degrees and true elevations in feet above sea level.

3.09 CLEANING

- A. Sediment Control/Silt Fencing: Provide fabric silt fencing and other erosion control devices as required and shown on plans to control erosion and allow lawn crew to establish grass uniformly across slope areas.
- B. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- C. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 312316 - EXCAVATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, and non-utility excavations in the building pad.
- B. Over-excavation and structural flowable fill backfill to achieve adequate support for foundations.
- C. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.
- C. Section 311000 - Site Clearing: Vegetation and existing debris removal.
- D. Section 312200 - Grading: Soil removal from surface of site.
- E. Section 312200 - Grading: Grading.
- F. Section 312316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- G. Section 312316.26 - Rock Removal: Removal of rock during excavating.
- H. Section 312319 - Dewatering
- I. Section 312323 - Fill: Fill materials, backfilling, and compacting.
- J. 312323.13 - Flowable Fill
- K. Section 334100 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Temporary Support and Excavation Protection Plan.
- C. Shoring Installer's Qualification Statement.
- D. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

1.05 DEFINITIONS

- A. Finish Grade Elevations: Indicated on the Drawings.
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3-times the footing width.
- C. Fat Clays: Soil types with the classification of CH and Plasticity Index (PI) above 30%.

1.06 QUALITY ASSURANCE

- A. Temporary Support and Excavation Protection Plan:

1. Indicate sheeting, shoring, and bracing materials and installation required to protect excavations, adjacent structures and property.
 2. Bracing and shoring design to meet requirements of OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
- B. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.07 PROJECT CONDITIONS

- A. All excavation is unclassified including bedrock excavation.
- B. Verify that survey bench mark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by Architect. If the proposed excavation extends more than 1 foot into the prevailing groundwater, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by Geotechnical Engineer. Refer to Specification Section 312319 for additional Dewatering requirements.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 311000 for clearing, grubbing, and removal of existing debris.
- C. See Section 312200 for topsoil removal.
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Notify utility company to remove and relocate utilities.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- G. Protect plants, lawns, rock outcroppings, and other features to remain.
- H. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect. Refer to Specification Section 312319 for additional Dewatering requirements.

3.03 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
1. Excavations in stable rock or in less than 5 feet in depth in ground judged as having no cave-in potential do not require excavation support and protection systems.
 2. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:
 - a. Sloping and benching systems.
 - b. Support systems, shield systems, and other protective systems.

3.04 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
 - 1. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
- B. Excavate foundations to allow for bearing on sound, durable bedrock. If fractured or non-durable bedrock is encountered, it is to be excavated until sound, durable bedrock is encountered.
- C. Ensure that all areas being re-graded have a minimum of 24-inches of soil cover over bedrock.
- D. The Geotechnical Report indicates the presence of fat clay (CH) soils present on site. This existing material is to be excavated to a depth of 36-inches below the proposed subgrade elevations for the new building footprints and pavement areas, and 36-inches below the proposed subgrade elevations for future athletic pavements, fieldhouse and plaza areas. The excavation is to be brought back up to subgrade elevation in an engineered manner in accordance with Specification Section 312323.
- E. Fill areas that do not pass proof-roll are to be undercut and/or stabilized as necessary to provide a stable platform for fill placement.
- F. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- G. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- H. Do not interfere with 45 degree bearing splay (zone of influence) of foundations without approval from the Architect and approved specific backfill requirements.
- I. Cut utility trenches wide enough to allow inspection of installed utilities.
- J. Hand trim excavations. Remove loose matter.
- K. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. See Section 312316.26 for removal of larger material.
- L. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.
- M. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control. Refer to Specification Section 312319 for additional Dewatering requirements.
- N. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect. If the proposed excavation extends more than 1 foot into the excavation, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by the Geotechnical Engineer. Refer to Specification Section 312319 for additional Dewatering requirements.
- O. Remove excavated material that is unsuitable for re-use from site.
- P. Stockpile excavated material to be re-used in area designated on site 312200.
- Q. Remove excess excavated material from site.

3.05 REPAIR

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.

3.06 FIELD QUALITY CONTROL

- A. See Division 1 for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

3.07 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 312316.13 - TRENCHING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Excavation, backfilling and compacting for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

- A. Section 310519 - Geosynthetics for Earthwork.
- B. Section 015713 - Temporary Erosion and Sediment Control.
- C. Section 312200 - Grading: Site grading.
- D. Section 312316 - Excavation: Building and foundation excavating.
- E. Section 312316.26 - Rock Removal: Removal of rock during excavating.
- F. Section 312323 - Fill: Backfilling at building and foundations.
- G. Section 312323.13 - Flowable Fill: Backfill of utilities and excavations in the zone of influence of a foundation, footing or structural element inducing a load to the subgrade materials.
- H. Section 334100 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.

1.05 SUBMITTALS

- A. See Division 1 for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.

- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill - Fill Type Lean Clay (CL): Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D2487 Group Symbol CL.
 - 4. Having no more than 5-percent rock/gravel in the top 24-inches in landscape areas, and no more than 15-percent rock/gravel in any location.
- B. Structural Fill - Fill Type DGA: Conforming to State of Kentucky Highway Department standard.
- C. Flowable Fill: A controlled low-strength material made of cement, water, sand, and an air-entraining admixture that it can be excavated by hand or use of a backhoe. See Section 312323.13.
- D. Concrete for Surge Block Fill and structure/pipe encasement: Lean concrete with a compressive strength of 1000 psi.
- E. Graded Granular Fill - Fill Type #57: Graded aggregate, conforming to State of Kentucky Highway Department standard.
- F. Pipe Bedding Granular Fill - Fill Type #8 crushed limestone: Fine aggregate, conforming to State of Kentucky Highway Department standard.

2.02 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, non-woven, needle punched, 6-oz/sy(minimum weight) .

2.03 SOURCE QUALITY CONTROL

- A. See Division 1 for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. All trenching is unclassified, including trenching in bedrock.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 312200 for additional requirements.
- D. Locate, identify, and protect utilities that remain and protect from damage.

- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect. Refer to Specification Section 312319 for additional Dewatering requirements.

3.03 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations (Zone of Influence) without approval from the Architect and Structural Engineer and approved specific backfill procedures.
- D. Cut trenches wide enough to allow inspection of installed utilities, but no more than twice the pipe diameter or 12-inches, whichever is greater for the total trench width.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove excavated material that is unsuitable for re-use from site.
- H. Stockpile excavated material to be re-used in area designated in Section 312200.
- I. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control. Refer to Specification Section 312319 for additional Dewatering requirements.
- J. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect. Refer to Specification Section 312319 for additional Dewatering requirements.
- K. If a trench is to be left open for more than 48-hours or when a rain event occurs, the trench is to be excavated an additional 4-inches and a lean concrete mud mat or layer of flowable fill should be placed 4-inches thick over the bottom of the excavation.

3.04 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with:
 - 1. Structural Flowable Fill in areas located in the zone of influence of any footing or foundation.
 - 2. Structural Fill in areas within the building footprint or under pavements that are not located in the zone of influence.
 - 3. General Fill in landscape areas
- B. Remove loose soil and any debris from the excavation prior to installing the utility and backfill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.05 BACKFILLING

- A. Prior to backfilling utility trenches, all new Utility piping and conduits are to be surveyed prior to backfilling of the utility trench. Refer to Specification Section 312200 for additional information.

- B. Backfill to contours and elevations indicated using unfrozen materials.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular/Crushed Stone Fill: Place and compact materials in equal continuous layers not exceeding 6 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- H. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 98 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under slabs-on-grade and similar construction: 98 percent of maximum dry density.
 - 2. At paving: 95 percent of maximum dry density.
 - 3. At landscape locations: 85 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.

3.06 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Utility Piping, Conduits, and Duct Bank:
 - 1. Bedding: Use Fill Type Pipe bedding granular fill for the initial 4-inch thick utility setting/leveling bed.
 - 2. If pipe is larger than 12-inches or if there are multiple pipes of any size utilizing the same trench (hoizontally or vertically), then the leveling bed and pipe bedding backfill is to be wrapped in filter fabric.
 - 3. Cover with pipe bedding granular fill to 6-inches above the utility and finish with general fill in non-structural locations, and structural fill in building and pavement locations. If the utility is located within the zone of influence of a foundation, the trench is to be backfilled with structural flowable fill from the top of the initial utility setting/leveling bed and encompassing the utility until it is at least 1-foot above the zone of influence. When using flowable fill as a utility trench backfill, care should be taken to prevent the utility from floating by using deadman anchors or another anchoring system.
 - 4. Fill up to subgrade elevation.
 - 5. Compact to 98 percent of maximum dry density.
 - 6. Compact in maximum 6 inch loose lifts to 98 percent of maximum dry density.
- B. At Sanitary Pipes:
 - 1. Bedding: Use Fill Type Pipe bedding granular fill for the initial utility setting/leveling bed.
 - 2. If pipe is larger than 12-inches or if there are multiple pipes of any size utilizing the same trench (hoizontally or vertically), then the leveling bed and pipe bedding backfill is to be wrapped in filter fabric.
 - 3. Cover with pipe bedding granular fill to 6-inches above the utility pipe and finish with general fill in non-structural locations, and structural fill in building and pavement locations. If the sanitary pipe is located within the zone of influence of a foundation, the trench is to be

backfilled with structural flowable fill from the top of the 6-inch cover until it is at least 1-foot above the zone of influence. Felt paper (15 lb) is to be installed around any sanitary standpipes as necessary to prevent the pipe from being in direct contact with the flowable fill.

When using flowable fill as a utility trench backfill, care should be taken to prevent the utility from floating by using deadman anchors or another anchoring system.

4. Fill up to subgrade elevation.
 5. Compact to 98 percent of maximum dry density.
 6. Compact in maximum 6 inch lifts to 98 percent of maximum dry density.
- C. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
1. Drainage fill and geotextile: Section 310519.
 2. Cover drainage fill with general fill.
 3. Compact to 95 percent of maximum dry density.
- D. At French Drains:
1. Use Graded Granular Fill.
 2. Compact to 95 percent of maximum dry density.

3.07 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.08 FIELD QUALITY CONTROL

- A. See Division 1 for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: One (1) test for each 150 feet or less of trench length, but no fewer than two (2) tests..

3.09 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 312316.26 - ROCK REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Removal of identified and discovered rock during excavation.

1.02 RELATED REQUIREMENTS

- A. Section 312323 - Fill: Fill materials.

1.03 PRICE AND PAYMENT PROCEDURES

- A. All rock excavation is unclassified.

1.04 DEFINITIONS

- A. Peak Particle Velocity (PPV): The maximum speed measured in inches/second at which a particle in the ground is moving relative to its inactive state. Measurement of ground vibration.
- B. Airblast: An airborne wave emanating from a blast and measured in decibels (dB).
- C. Site Rock: Solid mineral material with a volume in excess of 1/3 cubic yard or solid material that cannot be removed with a 3/4 cubic yard capacity power shovel without drilling.
- D. Trench Rock: Solid mineral material with a volume in excess of 1/6 cubic yard or solid material that cannot be removed with a 3/4 cubic yard capacity power shovel .
- E. Heave Rock: Rock that is fractured during blasting thus creating voids and causing the rock to "heave" and have a greater volume. Heave rock is not suitable for supporting structures or pavements.
- F. Weathered bedrock is not considered to be bedrock in this definition.
- G. Mixed Rock: Mixture of soil and shot rock with more than 15-percent soil. Mixed rock is not suitable for structural fill and can only be used as deep fill (more than 10-feet of cover) in landscape areas if the maximum particle size is 12-inches or less in any dimension.
- H. Clean Shot Rock: Rock fractured by explosive means that contains less than 15-percent soil or shale.

1.05 REFERENCE STANDARDS

- A. NFPA 495 - Explosive Materials Code; 2013.

1.06 BLAST VIBRATION LIMITS

- A. Blasting vibrations as recorded adjacent to the foundations of the nearest aboveground structures surrounding the site in each direction shall be limited to a peak particle velocity (PPV) on any component of a 3-component particle velocity recording seismograph for low-frequency blasts (<40 Hz) as follows:
 - 1. 1.5 inches per second for steel framed structures less than 200 feet from the blast.
 - 2. 1.0 inches per second for steel framed structures greater than 200 feet from the blast.
 - 3. 1.0 inches per second for reinforced masonry or concrete structures less than 200 feet from the blast.
 - 4. 0.5 inches per second for reinforced masonry or concrete structures greater than 200 feet from the blast.
 - 5. 0.5 inches per second for unreinforced masonry or concrete structures less than 200 feet from the blast.
- B. Very slight changes in any blasting variable will result in changes in vibration intensities. Modification of the blasting method and reduction of the explosive charge weight per delay shall be used to ensure that the above limits are not exceeded. If at any time the above limits are exceeded, all blasting shall cease and a new blasting plan developed prior to additional blasting.

- C. The maximum peak particle velocity may be increased with the written approval of the Contractor's blasting consultant providing that the Contractor and his consultant prove that no damage to existing structures will result.

1.07 AIR BLAST LIMITS

- A. Air blast limits shall be controlled such that:
 - 1. The maximum allowable air blast at any inhabited structure resulting from blasting operations shall not exceed 130 decibels peak when measured by an instrument having a flat response (plus or minus 3 decibels) over the range of at least 6 to 200 Hz.
 - 2. The maximum allowable air blast at any construction resulting from blasting operations shall not exceed 140 decibels peak when measured by an instrument having a flat response (plus or minus 3 decibels) over the range of at least 6 to 200 Hz.

1.08 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. 30-days before blasting - Names and qualifications of the blasting consultant and the seismic monitoring consultant.
- C. 21-days before blasting - Results of pre-blast survey including photos, video tape and written report.
- D. 14-days before blasting - Blasting program developed by the Contractors blasting consultant and blasting plan for trial blasts. Blasting plan is to include the proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover to be used and intended rock removal method.
- E. 2-days before production blasting - Submit results of trial blasts with evaluation and recommendations of Contractors blasting consultant upon completion of the trial blasts and before any production blasts.
- F. Blasting log and reports at the conclusion of EACH blast event and prior to the next blast event, or daily for multiple daily blast events, except for the air blast reports which can be submitted on a weekly basis.
- G. The blast reports are to include but not limited to the following information:
 - 1. Blast date, time and location
 - 2. Weather and environmental conditions including wind speed and direction
 - 3. Blast hole quantity, sizes, depths, patterns, bench height and sub-drilling
 - 4. Shot volume and powder factor calculations
 - 5. Timing schemes - in-hole delays, surface delays and planned hole firing times.
- H. Shop Drawings: Indicate the proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock removal method.

1.09 QUALITY ASSURANCE

- A. Seismic Survey Firm: Company specializing in seismic surveys with 10 years documented experience.
- B. Blasting Consultant: Company specializing in preparation of blasting plans with 10 years documented experience. The Blasting Consultant shall not be an employee of the Contractor, explosive manufacturer or explosive distributor.
- C. Explosives Firm: Company specializing in explosives for disintegration of rock, with 10 years documented experience.
- D. Blasting shall be performed by a qualified explosives specialist employed by the Contractor and acceptable to authorities having jurisdiction.
- E. Blasting shall be done in accordance with all local, state and federal regulations and as specified herein.

- F. Contractor shall have a Registration Certificate and each employee engaged in the blasting activity shall carry a valid identification card issued by the Division of Fire Prevention.

1.10 PROJECT CONDITIONS

- A. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting, and photograph existing conditions identifying existing irregularities. Existing cracks in structures are to have gauge marks located at selected locations to be measured before and after blasting to determine if widening or displacement has taken place. All photographs and videos are to have date stamps.
- B. Structures with basements are to have basement floor slab elevations surveyed and recorded by a licensed land surveyor to document pre-blast conditions. Elevations are to be recorded on a 15-foot grid with a minimum of one shot at each corner and the center of each room adjacent to an exterior or interior load bearing wall.
- C. Advise Owner of adjacent buildings or structures in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.
- D. Obtain a seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without exceeding the provided maximum PPV and without damaging adjacent properties or other work.
- E. Schedule Work to avoid disruption to occupied buildings nearby.
- F. Develop a blasting plan that will not affect the existing buried and overhead utilities.
- G. Nothing in this specification section relieves the Contractor of any responsibilities for any damage to the existing structures or utilities as a result of blasting or rock removal activities.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Explosives: Type recommended by explosive firm following seismic survey and required by authorities having jurisdiction.
- B. Delay Device: Type recommended by explosives firm.
- C. Blast Mat Materials: Type recommended by explosives firm.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting work of this section.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Install ground vibration monitoring seismographs adjacent to the foundations of the closest structures in each direction.
- C. Install airblast monitoring equipment at the closest structures in each direction.

3.03 TRIAL BLASTING

- A. Conduct trial blasting as directed by the Contractor's blasting consultant before general excavation blasting may commence.
- B. Trial blasting shall determine the relationship between peak particle velocities and weight of the explosive charges by a planned program of trial blasts beginning with small explosive weights and

increasing as needed to make the determination. Particle velocities shall be measured at multiple distances for each trial blast. The information from these trials shall be used to prepare the controlled blasting program.

3.04 ROCK REMOVAL

- A. Bedrock is to be removed as required for all new construction.
- B. Remove bedrock to provide 24-inches of soil cover, including topsoil, for all areas to be re-graded.
- C. The building pad for the new school and all future building additions shown on the drawings, and immediate area surrounding these building footprints are to have a minimum Structural Fill cover of 4-feet below the FFE in areas where bedrock is present.
- D. No blasting areas are to be left in a heave rock situation. If rock has been blasted any distance below the designed rock removal elevation, all fractured rock or heave rock is to be removed and replaced up to the design rock removal elevation with lean concrete as approved by the Structural Engineer. The independent testing agency is to observe and document this work.
- E. Excavate and remove rock by either mechanical or explosive methods.
- F. Mechanical Methods: Drill holes and utilize expansive tools or hoe-ramming/jack hammering techniques to fracture rock.
- G. Use of Explosives: Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.
 - 1. Comply with NFPA 495 and applicable state and local codes.
 - 2. Prior to blasting, obtain a seismographic survey to verify the provided maximum charges that can be used at each location in area of excavation without damaging adjacent properties or other work.
 - 3. Prior to blasting, obtain a seismographic survey to determine maximum charges that can be used at each location in area of excavation without damaging adjacent properties or other work.
 - 4. Prior to executing seismographic survey, advise owners of adjacent buildings and structures in writing; explain planned survey and blasting operations.
 - 5. Prior to blasting, document conditions of buildings near locations of intended blasting and photograph existing conditions identifying existing irregularities.
 - 6. Schedule work to avoid working hours of occupied buildings nearby.
 - 7. Prevent fly rock using adequate, good quality stemming material and the covering of blasts, if necessary, with blasting mats or adequate soil cover.
- H. Form level bearing at bottom of excavations.
- I. Remove shaled layers to provide sound and unshattered base for footings.
- J. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- K. Ensure that the rock fracturing and/or rock removal do not create a "bathtub" effect and cause water to pond on the rock surface. This should be accomplished by daylighting the rock excavation and providing a path for water to exit the excavation via subdrainage piping shown on the plans.
- L. Durable shot rock is to be fractured during blasting and screened, or crushed with a rock crusher plant and screened, in a volume necessary to create the Structural Fill material needed for the building and pavement design requirements.
- M. Remove excavated materials from site.
- N. Correct unauthorized rock removal with minimum 3500 psi foundation concrete fill. Contractor shall submit concrete to Architect for approval prior to placement.

3.05 FIELD QUALITY CONTROL

- A. Provide for visual inspection of foundation bearing surfaces and cavities formed by removed rock.
- B. Provide for visual inspection of removal of heave rock and replacement in an engineered manner that will minimize future settlement or swell of the fractured rock.
- C. Survey the bedrock bench and obtain approval of the elevations from the Structural Engineer and Architect prior to placing building pad fill material. See Section 312200 for additional requirements.

END OF SECTION

SECTION 312319 - DEWATERING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Dewatering of site during construction.

1.02 RELATED SECTIONS

- A. Section 312316 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 312323 - Fill: Filter aggregate, up to subgrade elevation.
- C. Section 312316.13 - Trenching: Excavating and backfilling for site subdrainage systems.
- D. Section 312316.26 - Rock Removal
- E. Section 334600 - Subdrainage

1.03 REFERENCES

- A. ASTM D 2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2003.

1.04 PROJECT CONDITIONS

- A. The Contractor is to provide any temporary piping required to reroute downspout and roof drains away from the work areas until the permanent drainage system is installed and in working order.
- B. Damage or destabilization/degradation of the on-site soils due to failure to dewater or otherwise prepare the site will be repaired at the Contractors expense.

1.05 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance:
 - 1. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control surface and ground water flow into excavations and permit construction to proceed on dry stable subgrades.
 - 2. Prevent water from ponding inside foundation walls, including after the floor slabs have been installed, and causing the foundation soils to become saturated.

PART 2 - NOT USED**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades and from flooding the Project site and surrounding areas.
- B. Reroute surface water away from excavated areas. Do not allow water to accumulate in excavations or on footings that have already been installed but not backfilled. Do not use utility, foundation or other trenches as temporary drainage ditches unless specifically designed for only that purpose.
- C. Prevent water from ponding inside the foundation walls, within the building footprint and in pavement areas.
- D. The Contractor is to provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations and control the groundwater to a level at least 3'-0" below the lowest point of the excavation.

- E. Do not use open-sump pumping that leads to loss of fines, soil piping, subgrade softening and slope instability.
- F. Dispose of water removed by dewatering in a manner that avoids endangering public health, property and portions of work under construction or completed. Avoid creating an inconvenience to others, and maintain sedimentation controls as required by authorities having jurisdiction.
- G. All dewatering discharge is to be routed to a sediment pond or sediment bags so that the sediment can settle prior to the discharge water leaving the site or entering any waterway or storm sewer.

3.02 FIELD QUALITY CONTROL

- A. Dewatering systems are to be inspected at least weekly and any and all repairs or refinements performed to maintain a fully operational system that achieves the intended purpose.
- B. Standby equipment is to be maintained on site so that it can be immediately installed if failure of primary equipment occurs.

3.03 PROTECTION

- A. Protect pipe and dewatering system from other construction activities.
- B. Remove dewatering system at the completion of construction or when determined by the Architect that it is no longer needed. Any holes in interior slabs and voids under the slabs are to be repaired using lean concrete for the voids and a non-shrink concrete repair grout for the slabs.

END OF SECTION

SECTION 312323 - FILL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Filling, backfilling, and compacting for building volume below grade, footings, paving, and non-utility excavations located within the building and future building footprints.
- B. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 310519 - Geosynthetics for Earthwork.
- C. Section 312200 - Grading: Removal and handling of soil to be re-used.
- D. Section 312200 - Grading: Site grading.
- E. Section 312316 - Excavation: Removal and handling of soil to be re-used.
- F. Section 312316.13 - Trenching: Excavating and backfilling for utility trenches outside the building to utility main connections.
- G. Section 312316.26 - Rock Removal: Removal of rock during excavating.
- H. Section 312323.13 - Flowable Fill
- I. Section 312513 - Permanent Erosion Controls
- J. Section 334100 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Zone of Influence: Area beneath a footing or foundation that extends out from the bottom edge of the footing/foundation at a 45-degree angle down to a depth equal to 3 times the footing width.

1.04 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.05 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- D. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill - Fill Type Lean Clay: Subsoil excavated on-site and imported as necessary for new work..
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 3. Conforming to ASTM D2487 Group Symbol CL.
 - 4. Having no more than 5-percent rock/gravel in the top 24-inches in landscape areas, and no more than 15-percent rock/gravel in any location.
- B. Structural Fill - Fill Type DGA: Conforming to State of Kentucky Highway Department standard.
- C. Shot Rock Fill: Rock fractured by explosive means that contains less than 15-percent soil/shale and with a maximum particle size of 12-inches in any dimension.
- D. Crushed Shot Rock Fill: Durable shot rock that has been crushed to #2 and #3 sizes and contains less than 5-percent shale.
- E. Flowable Fill: A controlled low-strength material made of cement, water, sand, and an air-entraining admixture that it can be excavated by hand or use of a backhoe. See Section 312323.13.
- F. Graded Granular Fill - Fill Type #57: Crushed aggregate, conforming to State of Kentucky Highway Department Standard.
- G. Coarse Granular Fill - Fill Type #2: Coarse aggregate, conforming to State of Kentucky Highway Department standard.
- H. Topsoil: See Section 312200.

2.02 ACCESSORIES

- A. Geotextile Fabric: Water pervious type, black polypropylene, non-biodegradable, non-woven, needlepunched, 6 oz minimum weight.

2.03 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.

- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. All fill material is unclassified.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated.
- C. Identify required lines, levels, contours, and datum locations.
- D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- E. Verify structural ability of unsupported walls to support imposed loads by the fill.
- F. Verify that bedrock has been removed to an elevation 4-feet below the FFE of the new building footprint.
- G. Verify that fat clay (CH) material has been removed under all floor slab and pavement areas so that no fat clay is located within 36-inches of the top of subgrade.
- H. Proof roll all areas to receive fill prior to placing fill as required in the geotechnical report. Proof rolls should only be done when the soils are near optimum moisture content. Any areas that do not pass proof roll are to be stabilized and approved in accordance with the Geotechnical Report. Any suitable soils removed as part of the stabilization process due to moisture content issues are to be moisture conditioned and used as fill in other locations.
- I. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill or as outlined per over-excavation below.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Soils are not to be "over-compacted" or worked in a manner that will cause them to break down and lose strength.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth for heavy equipment compaction, and layers not exceeding 4 inches for small or hand operated compaction equipment.

- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth for heavy equipment compaction, and layers not exceeding 4 inches for small or hand operated compaction equipment.
- H. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- I. Correct areas that are over-excavated.
 - 1. Floor slab areas: Use structural fill, compacted to 98 percent of maximum dry density, to slab subgrade elevation in areas outside of the zone of influence of any footings or foundations. All excavations in the zone of influence of any footings or foundations are to be backfilled in accordance with load bearing foundation surfaces below.
 - 2. Load-bearing Foundation Surfaces: In locations where the footing excavation was over-excavated, use structural flowable fill or lean concrete, to subgrade elevation. All excavations in the zone of influence of any footings or foundations are to be backfilled with structural flowable fill or lean concrete.
 - 3. Drives and vehicular pavement areas: Use coarse granular fill, flush to required bottom of pavement section elevation where over-excavation exceeds 4-inches. In areas of over-excavation 4-inches or less, use structural fill densified to 95 percent of maximum dry density. If using coarse granular fill, filter fabric is to be placed between the stone material and the soil subgrade so that the stone does not come into direct contact with the soil material.
 - 4. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- J. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 98 percent of maximum dry density.
 - 2. At paving/paver areas: 95 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.04 FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Building Pad Mass Fill :
 - 1. Use General Fill or Structural Fill.
 - 2. Fill up to subgrade elevations.
 - 3. Maximum depth per lift: 6 inches, compacted.
 - 4. Compact to minimum 98 percent of maximum dry density.
- C. Excavations within the zone of influence (ZOI) of any footing or foundation:
 - 1. Use Structural Flowable Fill. See MEP and Structural Engineer drawings and specifications for utility excavation backfill requirements inside the building footprint.
- D. At Foundation Walls and Footings where excavation was done after the building pad was constructed and within the Zone of Influence:
 - 1. Use Structural flowable fill where excavation was done within the Zone of Influence. Flowable fill is to extend to a minimum of 1-foot above the Zone of Influence.
 - 2. Use structural fill where excavation was done outside of the Zone of Influence.
- E. Against Foundation Walls and Footings where foundation drainage is not required:

1. Use structural fill as backfill against the foundations/stem walls above the top of footing inside the building footprint, and general fill outside of the building footprint above the top of footing. Compact per above requirements.
 2. Fill up to subgrade elevation.
 3. Do not backfill against unsupported foundation walls.
 4. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
- F. Crushed Shot Rock Fill Below Pavements:
1. Shot rock that has been crushed to #2 and #3 size can be used as fill below the crushed stone base for roads and parking areas.
 2. Provide water and break down all shale material per KYTC highway construction requirements.
 3. Place in maximum 8-inch loose lifts and densify using vibratory roller compactor.
 4. Choke top surface of crushed shot rock with 3-inches of DGA prior to installation of additional fill or pavement stone base.
- G. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
1. Drainage fill and geotextile: Section 310519.
 2. Cover drainage fill with general fill.
 3. Compact to 95 percent of maximum dry density.
- H. At Lawn Areas:
1. Use general fill.
 2. Compact to 85 percent of maximum dry density.
 3. See Section 312200 for topsoil placement.
- I. At French Drains:
1. Use granular fill.
 2. Fill up to 8 inches below finish grade.
 3. Compact to 95 percent of maximum dry density.
- J. Landscape Area Backfill:
1. Do not backfill landscape planting beds, landscape islands, or tree pits with construction or other debris. These areas are to be free of debris and particles 1/2 inch or larger in size, down to a depth of 24 inches minimum.
 2. Gravel, rock or concrete particles of no more than 1/2 inch in any dimension, shall constitute no more than 10% of the backfill content of planting beds, planting islands, and tree pits.

3.05 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

3.06 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: One (1) test for every 2000 sq. ft. or less of paved area or building slab per lift, but in no case fewer than two (2) tests per lift.

- F. The Contractor should anticipate and allow for testing time of encountered and imported materials. Some testing can take three to four business days.
- G. Proof roll compacted fill at surfaces that will be under slabs-on-grade and paving.

3.07 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 312323.13 - FLOWABLE FILL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flowable Fill or Controlled Low Strength Materials (CLSM)
- B. Structural Flowable Fill for backfill of excavations in the zone-of-influence of any footing/foundation.
- C. Structural Flowable Fill for backfill of foundation over-excavation to sound, durable bedrock.
- D. Excavatable Flowable Fill for backfill of excavations in the building footprint that are not within the zone-of-influence of foundations; and for non-structural locations outside of the building where deemed necessary.
- E. Backfill for site utilities within the zone-of-influence of any footing/foundation.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast In Place Concrete: Foundation concrete.
- B. Section 312316.13 - Trenching: Excavation and backfilling for foundations and utilities outside the building footprint.
- C. Section 312323 - Fill: Filling and Compaction.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- C. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- D. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- E. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a.
- F. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- H. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2010b.
- I. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- J. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2011.
- K. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2011.
- L. ASTM D4832 - Preparation and Testing of Controlled Low Strength Material Test Cylinders
- M. ASTM D5971 - Sampling Freshly Mixed Controlled Low Strength Material
- N. ASTM D6103 - Flow Consistency of Controlled Low Strength Material
- O. ASTM D6023 - Unit Weight, Yield, Cement Content and Air Content (Gravimetric) of Controlled Low Strength Material

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on mix materials and admixtures.
- C. Design Data: Mix design and test results showing that the mix design meets the mix and performance requirements.

PART 2 PRODUCTS**2.01 CONCRETE MATERIALS**

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M Air Entraining - Type IA portland type, grey color.
- C. Fine Mix Aggregates: ASTM C33.
- D. Fly Ash: ASTM C 618, Class F - Optional for Non-Excavatable flowable fill.
- E. Water: Clean, and not detrimental to concrete.
- F. Air Entrainment Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.02 ACCESSORIES**2.03 FLOWABLE FILL/CLSM MIX DESIGN**

- A. The Flowable Fill/CLSM material is to be a self-leveling and self-compacting, cementitious material with low compressive strength (see below).
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. If flowable fill is to be pumped, a modified mixture shall be submitted along with test results that indicate that the mix will meet the strength restrictions. In addition, the supplier is to ensure that the air content at the point of discharge from the pump meets the below requirements.
- D. Excavatable Flowable Fill Properties (not-pumped):
 - 1. Compressive Strength, when tested in accordance with ASTM D4832 at 28 days: 30 to 80 psi maximum. Strength shall not exceed 130 psi at 180-days.
 - 2. Fly Ash Content: None
 - 3. Cement Content: 50 to 100 lb per cubic yard.
 - 4. Water: Content to provide self-leveling mix with flowability per below and without excess bleed water.
 - 5. Total Air Content: 20-30 percent, determined in accordance with ASTM D6023.
 - 6. Flowability: 6 to 8 inches in accordance with ASTM D6103.
 - 7. Unit Weight (wet): 90-115 pcf
 - 8. Aggregate Size: Concrete Sand
- E. Structural (Non-Excavatable) Flowable Fill Properties (not pumped):
 - 1. Compressive Strength, when tested in accordance with ASTM D4832 at 28 days: 125 to 250 psi minimum.
 - 2. Fly Ash Content: 200 lb per cubic yard.
 - 3. Cement Content: 175 lb per cubic yard.
 - 4. Water: Content to provide self-leveling mix with flowability per below without and excess bleed water.

5. Total Air Content: 5-15 percent, determined in accordance with ASTM D6023.
6. Flowability: 6 to 8 inches in accordance with ASTM D6103.
7. Unit Weight (wet): 100-125 pcf
8. Aggregate Size: Concrete Sand

2.04 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify trench subgrade is acceptable and ready to support fill and future loads.
- B. Verify gradients and elevations of base are correct.
- C. Verify that utilities have been properly anchored to eliminate vertical and horizontal movement.
- D. Verify any walls or structures being backfilled against are adequately braced and supported, and approved for filling against with a liquid Flowable Fill/CLSM fill material.
- E. Verify that subdrainage and wall drainage systems are adequately protected from sealing of the drainage system or damage from the fill installation.

3.02 PREPARATION

- A. Wrap utilities with protective felt paper or other protective wrap as approved by the governing body for the utility.
- B. Notify Testing Agent minimum 24 hours prior to filling operations.

3.03 FORMING

- A. Place and secure forms as necessary at the ends of each pour.

3.04 COLD AND HOT WEATHER INSTALLATION

- A. Follow recommendations of ACI 305R when installing during hot weather.
- B. Follow recommendations of ACI 306R when installing during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- D. Protect from freezing for a minimum of 36-hours after placement.

3.05 PLACING FLOWABLE FILL/CLSM

- A. Place fill in accordance with ACI 304R.
- B. Place fill material continuously over the full width of the trench/excavation.

3.06 TOLERANCES

- A. The contractor should anticipate a 1/8-inch per foot of depth shrinkage of the Flowable Fill/CLSM material during the initial 7-day curing period.
- B. Maximum Variation From True Position Post-Cure: Plus 1/4 inch (no minus).

3.07 FIELD QUALITY CONTROL

- A. The Owner will employ an independent testing agency to perform field quality control tests, as specified in Division 1 Sections.

1. Provide free access to Flowable Fill/CLSM operations at project site and cooperate with appointed firm.
 2. Submit proposed mix design of each class of Flowable Fill/CLSM to inspection and testing firm for review prior to commencement of installation operations.
 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM D4832. For each test, mold and cure five Flowable Fill/CLSM test cylinders. Obtain test samples for every truck delivered.
1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as material it represents.
 2. Perform one flowability test and one air content test for each set of test cylinders taken.
 3. Perform compression tests at 7-days, 14-days, 28-days, 56-days and 180-days
- C. Maintain records of placed Flowable Fill/CLSM items. Record date, pour time, batch time, location of pour, quantity, air temperature, and test samples taken. All test reports are to be typed.
- D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that material shall be considered unacceptable. Any material placed that is deemed unacceptable shall be removed and replaced with acceptable material.

3.08 PROTECTION

- A. Immediately after placement, protect from premature drying, excessive hot or cold temperatures, and mechanical injury for a minimum of 36-hours.
- B. Do not subject the fill material to foundation or other loads that may exceed the material strength.

END OF SECTION

SECTION 312513 - PERMANENT EROSION CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Erosion blankets and netting.
- B. Slope protection
- C. protection (non-rip rap)

1.02 RELATED SECTIONS

- A. Section 015713 - Temporary Erosion Controls
- B. Section 312200 - Grading
- C. Section 311000 - Site Clearing.
- D. Section 312316 - Excavation.
- E. Section 312323 - Fill: Filling and compaction.
- F. Section 313413 - Flexible Concrete Erosion Control
- G. Section 329219 - Seeding: Finish ground cover.
- H. Section 329223 - Sodding: Finish ground cover.
- I. Section 329300 - Plants: Topsoil in beds and pits.

1.03 REFERENCES

- A. Kentucky Erosion Prevention and Sediment Control Field Guide by Kentucky Division of Conservation. Refer to these guidelines for construction and maintenance of erosion control items.
- B. Kentucky Division of Water (www.water.ky.gov)

1.04 SUBMITTALS

- A. Erosion Control Material Data: Include manufacturer, product and design calculations for each product used.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Kentucky, Highway Department standards.

1.06 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from installation equipment and vehicular traffic.

PART 2 PRODUCTS

2.01 MATERIALS

- A. High Velocity Erosion-Control Blankets: Coconut-fiber mat enclosed in a double-net, UV stabilized polypropylene mesh with a minimum 36-month design life. Include manufacturer's recommended biodegradable stakes, 6 inches (150 mm) long. Acceptable products are:
 - 1. Curlex III by American Excelsior Company
 - 2. C125 by North American Green
 - 3. ECC-2 by East Coast Erosion Blankets

- B. Long-Term Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a double-net, photo-degradable woven mesh with a minimum 1-year design life. Include manufacturer's recommended biodegradable stakes, 6 inches long. Acceptable products are:
 - 1. Curlex II by American Excelsior Company
 - 2. S150 by North American Green
 - 3. ECS-2 and ECX-2 by East Coast Erosion Blankets
- C. Short-Term Erosion-Control Blankets: Biodegradable twisted jute or spun-coir mesh in a single-net product with straw or coconut-fiber fill. Include manufacturer's recommended steel wire staples, 6 inches long. Acceptable products are:
 - 1. Curlex I by American Excelsior Company
 - 2. S75 by North American Green
 - 3. ECS-1 by East Coast Erosion Blankets
- D. Other Materials: See Section 312323.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that finish grading and intended elevations for the Work are as indicated and that all debris and rock fragments larger than 1/2-inch have been removed from the area to be covered.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify and mark areas to receive erosion controls.

3.03 INSTALLATION

- A. Protect areas to be seeded as follows:
 - 1. Ditches and drainage swales are to receive high-velocity erosion-control blankets.
 - 2. Slopes 4:1 (H:V) or greater are to receive long-term erosion-control blankets.
 - 3. Slopes between 4:1 and 6:1 are to receive short-term erosion-control blankets.
 - 4. If drawings indicate installation of flexible concrete erosion controls, the flexible concrete erosion controls are to be installed over the erosion control blankets and not as a substitute.
- B. Roll out erosion controls beginning at the bottom of the slope or the lowest end of the ditch line.
- C. Overlap ends of the controls a minimum of 24-inches or per the manufacturers recommendation, whichever is larger.
- D. Overlap the edges of the controls a minimum of 12-inches or per the manufacturers recommendation, whichever is larger.
- E. Install biodegradable anchors per the manufacturers recommendation. If erosion controls begin to pull up, slide or otherwise come loose, install additional anchors as needed for proper installation.
- F. Sod can be used for all slopes identified above (not drainage swales or ditches) as a substitute for the listed erosion controls. Sod is to be laid perpendicular to the slope and staked to prevent slipping.

3.04 CLEANING AND PROTECTION

- A. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 313116 - TERMITE CONTROL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Chemical soil treatment.

1.02 RELATED REQUIREMENTS**1.03 REFERENCE STANDARDS**

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act; 1947 (Revised 2001).

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Manufacturer's Instructions: Indicate caution requirement.
- E. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.
- F. Record and document moisture content of soil before application.
- G. Maintenance Data: Indicate re-treatment schedule .
- H. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing this type of work and:
 - 1. Having minimum of three (3) years documented experience.
 - 2. Approved by manufacturer of treatment materials.
 - 3. Licensed in the State in which the Project is located.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for requirements for application, and comply with EPA regulations.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of toxicants.

1.07 SEQUENCING

- A. Apply toxicant 12 hours prior to installation of vapor barrier under slabs-on-grade.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.
 - 1. Inspect annually and report in writing to Owner. Provide inspection service for twelve months from Date of Substantial Completion.

PART 2 PRODUCTS**2.01 CHEMICAL SOIL TREATMENT**

- A. Toxicant Chemical: EPA (Title 7, United States Code, 136 through 136y) approved; synthetically color dyed to permit visual identification of treated soil.

- B. Manufacturers: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include;
 - 1. BASF: Product: Termidor 80 WG: www.basf.com
 - 2. Bayer Environmental Science Corp; ____: www.backedbybayer.com/pest-management/#sle.
 - 3. FMC Professional Solutions; Product Baseline: www.fmcprosolutions.com.
 - 4. Syngenta Professional Products; ____: www.syngentaprofessionalproducts.com/#sle.
- C. Toxicant Chemical: EPA (1) approved; synthetically color dyed to permit visual identification of treated soil.
- D. Diluent: Recommended by toxicant manufacturer.

2.02 MIXES

- A. Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply toxicant at following locations:
 - 1. Under Slabs-on-Grade.
 - 2. At Both Sides of Foundation Surface.
 - 3. Soil Within 10 feet of Building Perimeter For a Depth of 1' foot.
- D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.
- E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.
- F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- G. Re-treat disturbed treated soil with same toxicant as original treatment.
- H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 PROTECTION

- A. Do not permit soil grading over treated work.

END OF SECTION

SECTION 313413 - FLEXIBLE CONCRETE EROSION CONTROL MAT**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flexible Concrete Mat at swales, detention swales and pooling areas, and pipe and headwall out falls.

1.02 RELATED REQUIREMENTS

- A. Section 013329 - Sustainable Design Reporting
- B. Section 312200 - Grading.
- C. Section 312316 - Excavation.
- D. Section 312323 - Fill
- E. Section 312513 - Permanent Erosion Controls

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with the manufacturer's recommendations and as outlined below.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Concrete.
- B. Concrete specifications.
 - 1. Mix classification 4000 AE.
 - 2. Strength 4000 PSI per 28 days.
 - 3. Air content 4-8%.
 - 4. Slump 9" after super.
 - 5. Coarse Aggregate max. size 3/8 inch.
 - 6. Maximum water-cement ratio 0.46.
 - 7. Quantities per cubic yard:
 - a. 560 lbs. Type 1 cement.
 - b. 50 lbs granular cement.
 - c. 1220 lbs fine aggregate (sand).
 - d. 1600 lbs course aggregate (gravel).
 - e. 276 lb water.
 - f. 6 oz. Air Entrainment agent.
 - g. 64 oz. 260 AE Admixture.
 - h. 1 lb polyfiber.
 - 8. Concrete Cobblestone sizes: rectangular; 4 inches to 13 inches length/width, 1-3/4 inches to 5 inches thick at the crown.
 - 9. Concrete Cobblestone weight 10 lb per SF minimum.
- C. Geogrid Reinforcement
 - 1. 10oz/sq.yd Mass/Unit Area., ASTM D-5261
 - 2. Aperture size 1.2 inches
 - 3. 70 Percent Open Area, CW02215
 - 4. Wide Width Tensile Strength @ Ultimate Machine Direction and Cross Machine Direction, both 2600 lb/ft, ASTM D-6637.
 - 5. Creep Limited Strength Machine Direction and Cross Machine Direction @ 5%, 1610 lb/ft, ASTM D-5262.
 - 6. Elongation at Break 4-6%, ASTM-D6637
 - 7. Long Term Design Strength, Machine Direction:
 - a. Sand, Silt and Clay and Sandy Gravel, 1465 lb/ft, FHWA NHI-00-044

- b. 2" Minus Coarse Gravel, 1285 lb/ft, FHWA NHI-00-044

PART 3 EXECUTION

3.01 PLACEMENT

- A. Prepare ground surface per manufacturer's recommendations for specific site conditions including preparation of topsoil planting media.
- B. Seed area per Section 329219 - Seeding.
- C. Install long term erosion control blanket over prepared and seeded topsoil prior to installation of the Flexible Concrete Mat.
- D. Place Flexible Concrete Mat roll over erosion control blankets, unroll and cut to length. Overlap flexible concrete mat sections minimum 18 inches and pin unless system is interlocking.
- E. Install anchors along edges and hog ring connectors every 2-feet at adjoining end and every 5-feet along edges of adjacent rolls unless the manufacturer recommends closer spacing.

END OF SECTION

SECTION 321123 - AGGREGATE BASE COURSES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Paving aggregates.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of site for base course.
- B. Section 312316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 312323 - Fill: Compacted fill under base course.
- D. Section 321216 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 321313 - Concrete Paving: Finish concrete surface course.
- F. Section 334913 - Storm Drainage Manholes, Frames and Covers: Manholes and frames.

1.03 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; 1965 (2004).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; 2010.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- G. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Coarse Aggregate Type #2: Coarse aggregate, conforming to State of Kentucky Highway Department standard.
- B. Blended Aggregate Type DGA: Pug DGA conforming to State of Kentucky Highway Department standard.
- C. Medium Aggregate Type #57 crushed stone: Medium aggregate conforming to State of Kentucky Highway Department Standards
- D. Fine Aggregate Type #78: Sand; complying with State of Kentucky Highway Department standard.
- E. Herbicide: In accordance with State of Kentucky Highway Department Standards .

2.02 SOURCE QUALITY CONTROL

- A. See Division 1 for Quality Requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.
- C. Proof-roll areas to receive aggregate base course material and have proof-roll approved by the soils testing agent.
- D. Due to the type of soils encountered on the site, proof-rolling during wet periods or when the existing soils are above optimum moisture content will not be acceptable. All proof-rolling will need to be done during dry conditions.

3.02 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

- A. Under Bituminous Concrete Paving:
 - 1. Place blended aggregate type DGA to a total compacted thickness as identified on the drawings.
 - 2. Compact to 95 percent of maximum dry density.

- B. Under Portland Cement Concrete Paving:
 - 1. Place blended aggregate type DGA to a total compacted thickness as identified on the drawings.
 - 2. Compact to 95 percent of maximum dry density.
- C. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- D. Level and contour surfaces to elevations and gradients indicated.
- E. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- F. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- H. Apply herbicide to finished surface.

3.04 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.

3.05 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: One (1) test for every 2000 sq. ft. or less of paved area per lift, but in no case fewer than two (2) tests per lift.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.06 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

SECTION 321216 - ASPHALT PAVING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Double course bituminous concrete paving.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of site for paving and base.
- B. Section 312323 - Fill: Compacted subgrade for paving.
- C. Section 321123 - Aggregate Base Courses: Aggregate base course.
- D. Section 321713 - Parking Bumpers: Concrete bumpers.
- E. Section 330513 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

1.03 REFERENCE STANDARDS

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; 1997.
- B. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Kentucky Highways standard.
- B. Mixing Plant: Conform to State of Kentucky Highways standard.
- C. Obtain materials from same source throughout.

1.05 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Asphalt Cement: ASTM D946.
- B. Aggregate for Base Course: In accordance with State of Kentucky Highways standards.
- C. Aggregate for Binder Course: In accordance with State of Kentucky Highways standards.
- D. Aggregate for Wearing Course: In accordance with State of Kentucky Highways standards.
- E. Fine Aggregate: In accordance with State of Kentucky Highways standards.
- F. Tack Coat: Homogeneous, medium curing, liquid asphalt in accordance with Kentucky Transportation Cabinet Standard Specifications Section 406.

2.02 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Pavement:

1. Binder Course: State of Kentucky Highways standards for CL2 BASE 0.75 D PG 64-22.
 2. Wearing Course: State of Kentucky Highways standards for CL2 SURF 0.38 D PG 64-22.
- C. Recycled Asphalt Pavement (RAP): In accordance with State of Kentucky Highway Department Section 409 with a maximum of 15 percent RAP for PG 64-22.
- D. Submit proposed mix design of each class of mix for review prior to beginning of work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Asphalt Pavement may be placed between November 15th and April 1st if the ambient temperature requirements are met or if approved by the architect/engineer.

3.02 BASE COURSE

- A. Place and compact base course.

3.03 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Comply with provisions in KTC Standard Specifications Section 406
- C. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd.
- D. Coat surfaces of storm and sanitary sewer structure frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.04 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place binder course to compacted thickness identified on the contract drawings.
- C. Place wearing course within 72 hours of placing and compacting binder course. If the wearing course is placed more than 72 hours after the binder course, the binder course is to be cleaned and a tack coat installed prior to the wearing course installation.
- D. Place wearing course to compacted thickness identified on the contract drawings.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.
- G. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent.

3.05 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.
- D. Texture: Surface is to have a tight, smooth, uniform finish. Areas that have an abundance of exposed aggregate or porous texture, as determined by the Architect, shall be re-compacted or replaced as required by the Architect.

3.06 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Provide field inspection and testing. Take samples and perform tests in accordance with AI MS-2.

3.07 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.
- B. All pavements that are soiled or otherwise dirty are to be pressure washed and rinsed upon completion of the construction and landscaping work.

END OF SECTION

SECTION 321313 - CONCRETE PAVING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Concrete sidewalks, stair steps, integral curbs, and service drives.

1.02 RELATED REQUIREMENTS

- A. Section 031000 - Concrete Forming and Accessories.
- B. Section 312200 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- C. Section 312323 - Fill: Compacted subbase for paving.
- D. Section 321123 - Aggregate Base Courses: Aggregate base course.
- E. Section 321726 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.
- F. Section 321373 - Joint Sealers: Sealant for joints.
- G. Section 321613 - Concrete Curb and Gutters

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- D. ACI 305R - Hot Weather Concreting; 2010.
- E. ACI 306R - Cold Weather Concreting; 2010.
- F. ASTM A36 - Steel plate for plate dowel systems.
- G. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- J. ASTM B633 Type II - Electroplated zinc for plate dowel systems
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- O. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- P. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

- Q. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- R. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- S. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2014.
- T. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- U. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2013).

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, curing compound, and fiber reinforcement.
- C. Installer qualifications using Macro Fiber reinforcement in finished, exterior concrete pavement.
- D. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: As specified in Section 031000, conform to ACI 301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 - 1. Thickness: 3/8 inch.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 80 (80,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
- C. Bar Dowels: Heavy Duty Concrete - ASTM A615/A615M Grade 40 (280); deformed billet steel bars; unfinished finish.
- D. Plate Dowels: Light and Medium Duty Concrete - ASTM A36 steel plates with electroplated zinc coating meeting ASTM B633 Type II. Plate sizes and spacing to meet specified concrete thickness.

2.03 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of Kentucky Highways standards.
- C. Cement: ASTM C150/C150M, Normal - Type I Portland cement, gray color.
- D. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- E. Fly Ash: ASTM C 618, Class F - Optional for mixes used for slip forming of curb and gutter, or slip forming of concrete pavements. Fly ash is not to be used in concrete that is not slip formed or extruded except for summer installations where temperatures are 85 degrees or higher.
- F. Water: Clean, and not detrimental to concrete.

- G. Fiber Reinforcement: Shrinkage crack control, micro synthetic, fibrilated, polypropylene fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 3/4 to 1 inch length and designed to reduce shrinkage cracking of concrete.
 - 1. Acceptable Products:
 - a. PSI FIBERSTRAND F by Euclid Chemical
 - b. Procon F-E by Nycon Corporation
 - c. Fibermesh 300 by Propex Operating Company
 - d. Econo-Net by Forta Corporation
- H. Fiber Reinforcement: Structural, macro synthetic, fibrilated, polypropylene fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 1.5 to 2 inch length and manufactured to provide post-cure concrete strength and increase freeze/thaw resistance.
 - 1. Acceptable Products:
 - a. TUF-STRAND SF by Euclid Chemical
 - b. Nycon-XL200 by Nycon Corporation
 - c. Fibermesh 650 by Propex Operating Company
 - d. Forta-Ferro by Forta Corporation
- I. Air-Entraining Admixtures: ASTM C260/C260M.
- J. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.04 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.
- B. Curing Compound:
 - 1. Sonneborn's Sonosil
 - 2. L&M's L&M Cure
 - 3. Dayton Superior's Day Chem Sil-Cure (J-13)
- C. Joint Sealer: Type as specified in Section 321373.

2.05 CONCRETE MIX DESIGN

- A. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- B. Macro Fiber Reinforcement: Add to mix at rate of 7 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. Fiber is to be added at the plant after all other materials have been added, and have a minimum mix time of 5-minutes..
- C. Micro Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. Fiber is to be added at the plant after all other materials have been added, and have a minimum mix time of 5-minutes..
- D. Concrete Properties:
 - 1. Compressive strength (prior to fiber), when tested in accordance with ASTM C39/C39M at 28 days; 4500 psi. Testing of the concrete mix prior to adding fiber and again after fiber has been added is required to set the compressive strength requirement for fiber reinforced concrete. This should be done for the first pour of each mix design and the results used to confirm future pours.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Cement Content: Minimum 600 lb per cubic yard.
 - 4. Water-Cement Ratio: Maximum 0.44 percent by weight.
 - 5. Total Air Content: 6 percent +/- 1%, determined in accordance with ASTM C 173/C 173M.

6. Maximum Slump: 4 inches using base design, 5 inches when using fiber and mid-range water reducer, 6 inches when using a mid-range water reducer, +/- 1-inch.
7. Maximum Aggregate Size: 1 inch.

2.06 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 321123 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.
- C. When using Macro Fiber reinforcement, a representative of the fiber manufacturer must be on-site during the first pour and finishing process.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated and per the manufacturers recommendations.
- B. Provide doweled joints at all isolation joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not add water to concrete.
- C. Ensure reinforcement, inserts, embedded parts, formed joints and ____ are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

- E. Place concrete to indicated pattern.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide isolation joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
- C. Provide tooled contraction control joints:
 - 1. In pattern shown on drawings.
- D. Heavy Duty Concrete Areas - Saw cut the tooled contraction joints to a 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.09 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius. Remove tooling marks to prevent a picture frame effect.
- C. Median Barrier: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius.
- D. Remove "slop" created by the concrete finishing from all joints and edges.
- E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- F. Macro fiber reinforcement: exposed fibers are to be removed using a propane torch and brush. Care should be taken to not overheat the concrete and cause it to be discolored, damaged or lose strength.

3.10 JOINT SEALING

- A. See Section 321373 for joint sealer requirements.

3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.12 FIELD QUALITY CONTROL

- A. Allow the independent testing agency to perform field quality control tests, as specified in Division 1.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
 - 1. Test fiber reinforced concrete prior to the addition of fiber and again after fiber has been added to set the baseline for the fiber reinforced compressive strength, slump and air content. This is to be done for the first pour of each mix design, and the results used for later pour strength requirements.

2. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 3. Perform one slump test and one air content test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken. All test reports are to be typed.
- D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that concrete shall be considered unacceptable.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 2 days minimum after finishing.
- C. Do not permit vehicular traffic over pavement until 75 percent design strength of concrete has been achieved.
- D. All pavements that are soiled or otherwise dirty are to be pressure washed and rinsed upon completion of the construction and landscaping work.

END OF SECTION

SECTION 321373 - PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.
 - 3. Joints between cement concrete or asphalt pavement and adjacent structures.
- B. Related Sections include the following:
 - 1. Section 321216 - Asphalt Paving
 - 2. Section 321313 - Concrete Paving: constructing joints in concrete pavement.
 - 3. Section 321613 - Concrete Curbs and Gutters

1.03 SUBMITTALS

- A. Product Data: For each joint sealant product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- C. Qualification Data: For Installer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Use ASTM C 1087 or manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 - 5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the Notice to Proceed with the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 for testing indicated, as documented according to ASTM E 548.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 PROJECT CONDITIONS

- A. All expansion, isolation and cold joints, including those in concrete curbs, are to receive joint sealant.
- B. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C), whichever is higher.
 - 3. When joint substrates are wet or covered with frost.
 - 4. Where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
 - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 COLD-APPLIED JOINT SEALANTS

- A. Type S, Grade NS, Class 25 Polyurethane Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag urethane sealant complying with ASTM C920
 - 1. Sikaflex-1a
 - 2. Bostik Seal 'N' Flex FC
 - 3. Tremco Vulkem 116

2.04 JOINT SEALANT BACKER MATERIALS

- A. General: Provide joint sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- B. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.05 PRIMERS

- A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

PART 3- EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer, based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.04 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.
- B. Apply clean, white, silica sand dusting to the finished tooled surface of the joint sealant to help prevent tracking of the material.

END OF SECTION

SECTION 321413.19 - PERMEABLE INTERLOCKING CONCRETE PAVEMENT**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Permeable concrete pavers.
- B. Crushed aggregate bedding and open graded base materials.
- C. Geotextiles.

1.02 RELATED SECTIONS:

- A. Section 312200 - Grading
- B. Section 312316 - Excavation
- C. Section 312316.13 - Trenching
- D. Section 312323 - Fill
- E. Section 321613 - Concrete Curbs and Gutters
- F. Section 334913 - Storm Drainage Manholes

1.03 REFERENCES

- A. ASTM C33: Specification for Concrete Aggregates.
- B. ASTM C131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C. ASTM C136: Method for Sieve Analysis for Fine and Course Aggregate.
- D. ASTM C936: Standard Specification for Solid Interlocking Concrete Paves.
- E. ASTM C979: Specification for Pigments for Integrally Colored Concrete.
- F. ASTM D698: Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures using a 5.5 lb. (2.49 kg) Rammer and 12" (305 mm) drop.
- G. ASTM D1557: Test Methods for Moisture Density Relations for Soil and Soil Aggregate Mixtures using a 10 lb. (4.54 kg) Rammer and 18" (457 mm) drop.
- H. ASTM D1883: Test Method for California Bearing Ratio of Laboratory-Compacted Soils.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate perimeter conditions, junction with other materials, expansion and control joints, paver (layout pattern, color arrangement) installation details.
- B. Sieve analysis of aggregates for base and bedding materials per [ASTM C 136].
- C. Permeable Concrete Pavers:
 - 1. Manufacturer's product catalog sheets with specifications.
 - 2. Four (4) representative full-size samples of each paver type, thickness, color and finish. Submit samples indicating the extremes of color expected in the finished installation.
 - 3. Accepted samples become the standard of acceptance for the work of this Section.
 - 4. Laboratory test reports certifying compliance of the concrete pavers (slabs) with [ASTM C 936].
 - 5. Manufacturer's material safety data sheets for the safe handling of the specified materials and products.

- D. Statements of Installer Qualifications: Submit list of comparable projects completed by installer. Include list of completed projects with project names, addresses, names of Architect/Engineer and Owners with contact information and dates of construction.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has successfully completed permeable pavement installations similar in design, material and extent indicated for this Project.
- B. Single-Source Responsibility: Obtain each color, type and variety of permeable pavers, materials for the openings and bedding from single sources with resources to provide products and materials of consistent quality, appearance and physical properties without delaying progress of Work.
- C. Field-constructed Mock-up:
 1. Install 3 x 3 m (10 x 10 ft) area with base, bedding and pavers.
 2. Use area to determine surcharge of the bedding layer, joint sizes, lines, laying pattern(s), color(s) and textures of the job.
 3. Use the area as the standard to judge the remaining work.
 4. Subject to acceptance by the Architect, mock-up may be retained as part of the finished work.
 5. If mock-up is not retained, remove and dispose of mock-up.
 6. Field constructed Mock-up is to be completed prior to Pre-Installation meeting.

1.06 PRE-INSTALLATION MEETING

- A. Convene a meeting one week before starting subdrainage installation for pervious pavers to discuss coordination between various installers and review field constructed Mock-Up.
 1. Require attendance by personnel responsible for installation of subdrainage, aggregate base courses for pavers, pavers, and adjacent work.
 2. Include representatives of the General Contractor.
 3. Notify Architect at least 2 weeks prior to meeting.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver concrete pavers to the site palletized for transfer by forklift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the project or existing construction.
- B. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not install in heavy rain or snow.
- B. Do not install frozen bedding or base materials.
- C. Do not install on frozen soil subgrade.

1.09 WARRANTY

- A. Manufacturer's warranty: 5 year against manufacturing defects provided that the specified product is installed per the manufacturer's instructions.
- B. Manufacturer is to certify that the specified product meets or exceeds the requirements of ASTM C 936.

1.10 MAINTENANCE

- A. Extra materials: Provide 5 percent additional materials for use by Owner for maintenance and repair.

PART 2 - PRODUCTS**2.01 PAVING UNITS**

- A. Manufacturers:
 - 1. Product Description: Basis of Design: Wausau Tile, Inc; www.wausautile.com, V-Series Plank Permeable Architectural Paver
 - a. Location: P.O. Box 1520, Wausau, WI 54402
 - b. Phone: 800-388-8728 or 615-330-2746 contact sales rep: Jill Colby
 - c. Size: 7" x 12" x 2.75" thick
 - 2. Belgard; www.belgard.biz, Environmental Pavers - Aqualine Pavers
 - a. Location: 375 Northridge Road, Suite 250, Atlanta, GA 30350
 - b. Phone: 1-877-Belgard or 317-787-3201 contact sales rep: Yves LeGoff
 - c. Size: 9" x 4.5" x 3.149" thick
 - 3. Hanover Architectural Pavers, www.hanoverpavers.com, Permeable 4.5" x 9"
 - a. Location: 5000 hanover Road, Hanover, PA 17331
 - b. Phone: 717-637-0500
 - c. Size: 9" x 4.5" x 3.125" thick
- B. Spacing between pavers to be a minimum of 3/8". Equal spacing to be completely surrounding each individual paver. Spacing provides full perimeter infiltration around each individual paver.
- C. Meet [ASTM C 936]. Freeze-thaw requirements may be waived in applications with no freeze-thaw conditions.
 - 1. When testing 3 1/8" (80 mm) thick units for conformance to ASTM C936, compressive strength tests shall be corrected by multiplying the results by 1.18.
- D. Manufactured in a plant where paving products are certified by ICPI as having passed manufacturer designated [ASTM].
- E. Color(s): To be selected from manufacturers full range by Architect.
- F. Pattern: Running bond in direction shown on plans.

2.02 CRUSHED STONE BEDDING, BASE AND JOINT MATERIALS

- A. Do not use rounded river gravel. Base, bedding and joint materials must be crushed aggregates.
- B. Depths:
 - 1. No. 2 bedding stone (washed): 10 inches
 - 2. No. 57 bedding stone (washed): 4 inches
 - 3. No. 8 or 3/8 inch chips setting bed (washed): 2 inches
 - 4. No. 8 or 3/8 inch chips (washed) to fill open voids
- C. All stone materials are to be washed with less than 1% passing the No. 200 sieve.
- D. Joint/opening filler, bedding, base and subbase are to conform to ASTM D448 gradation.
- E. Gradation criteria:

Note: Dx is the particle diameter size at which x percent of the particles are finer. For example, D15 is the particle size of the aggregate for which 15% of the particles are smaller and 85% are larger.

 - 1. D15 base stone/D50 bedding stone <5.
 - 2. D50 base stone/D50 bedding stone >2.
- F. Crushed stone with 90% fractures faces, LA Abrasion <40, minimum CBR of 80%.

Note: The following gradations in Tables 1, 2 and 3 can be used for the crushed stone, open-graded bedding, base and joint materials. Check gradations against the above criteria.

Table 1
Grading Requirements for Jointing Material (ASTM No. 9)

Table 2
Grading Requirements for Bedding Course (ASTM No. 8)

Sieve Size	Percent Passing
12.5 mm (1/2")	100
9.5 mm (3/8")	85-100
4.75 mm (No. 4)	10-30
2.36 mm (No. 8)	0-10
1.16 mm (No. 16)	0-5

Table 3
Grading Requirements for Upper Sub-Base (ASTM No. 57)

Sieve Size	Percent Passing
37.5 mm (1 1/2")	100
25 mm	95-100
12.5 mm (1/2")	25-60
4.75 mm (No. 4)	0-10
2.36 mm (No. 8)	0-5

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Acceptance of site verification of conditions: Verify that base is free from standing water, uniformly graded, free of any organic material or sediment, debris, ready to accept bedding materials, pavers and imposed loads.
- B. General Contractor is to inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of permeable concrete pavers.
 - 1. Verify that subgrade preparation, compacted density and elevations conform to the specified requirements.
 - 2. Verify location, type and elevations of concrete collars around utility structures and drainage pipes and inlets.
 - 3. Verify location, type, installation and elevations of edge restraints around the perimeter to be paved. Ensure the side of the edge restraint adjacent to the paver is perpendicular to the bedding course. This will ensure a tight fit, eliminating a future trip hazard.
- C. Do not proceed with installation of bedding and interlocking concrete pavers until subgrade soil conditions are corrected by the earthwork contractor. Beginning of installation means acceptance of base, edge restraints, drainpipes and overflow devices.

3.02 INSTALLATION

- A. General
 - 1. Any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities shall be removed prior to application of the geotextile and subbase materials.

2. Pavement area is to be kept free from sediment during the entire job. Geotextiles, base and bedding materials contaminated with sediment are to be removed and replaced with clean materials.
 3. Protect drainpipes, overflow pipes, observation wells or any inlets and other drainage structures during installation.
 4. Proof roll the subgrade per Section 312323 and repair any areas that fail proofroll.
 5. Subdrainage pipe ditches are to be excavated, cleaned of all loose material and slopes verified prior to the installation of the geotextile fabric.
 6. No mulch, soil or any other material is to be stored or placed on the pavers at any time. If materials are stored on the pavers, removal and replacement of the pavers and drainage system may be required.
- B. Geotextile Fabric
1. Place on bottom and sides of soil subgrade including the bottom of the subdrainage system trenching. Secure in place to prevent wrinkling from vehicle tires and tracks.
 2. Overlap a minimum of 24 inches (0.6m) in the direction of drainage.
- C. Subdrainage
1. If the Pervious Paving Contractor is not installing the pervious paving subdrainage system, the paver installer is to coordinate with the General Contractor and Storm Drainage Contractor to ensure that the perforated pipe permeable paving subdrainage system construction coincides with the permeable paving system installation.
 2. The perforated subdrainage piping is to be installed in the piping trench and on top of the filter fabric with perforations facing down unless the pipe is uniformly perforated. The perforated piping is not NOT to have a filter fabric sleeve.
 3. The perforated pipe is to be backfilled with densified #57 crushed stone drainage fill to the top of the pipe ditch/bottom of the #2 stone base.
- D. Open Graded Subbase and Base
1. Moisten, spread and compact the sub-base in 4 to 6 inch lifts without wrinkling or folding the geotextile fabric. Place subbase to protect geotextile from wrinkling under equipment tires and tracks.
 2. For each lift, make at least two passes in the vibratory mode then at least two in the static mode with a minimum 10T vibratory roller until there is no visible movement of the sub-base stone. Do not crush aggregate with the roller.
 3. The surface tolerance of the compacted subbase is to be +/- 2-1/2 inches over a 10 ft. straightedge.
 4. Moisten, spread and compact the base stone in 4 inch lifts over the compacted No. 2 subbase with a minimum 10T vibratory roller until there is no visible movement of the base stone. Do not crush aggregate with the roller.
 5. The surface tolerance of the compacted base should not deviate more than +/- 1 inch over a 10 ft. straightedge.
 6. Compacted density is to be 95% of the index density established for the base and subbase stone per ASTM D4254.
- E. Bedding Layer
1. Moisten, spread and screed the stone bedding material.
 2. Fill voids left by removed screed rails with the joint/fill stone.
 3. The surface tolerance of the screeded bedding layer is to be +/- 1/4 inch over a 10 ft. straightedge.
 4. Do not subject screeded bedding material to any pedestrian or vehicular traffic before paving unit installation begins.
- F. Permeable concrete pavers and joint/opening material
1. Lay the pavers in the herringbone pattern indicated and joint widths as required by the manufacturer. Establish straight lines to begin laying pattern at edges indicated on the drawings. Maintain straight pattern lines.

2. Fill gaps at the edges of the paved area with cut units. Cut pavers subject to tire traffic are to be no smaller than 1/3 of a whole unit.
3. Cut pavers and place along the edges with a double-bladed splitter or masonry saw.
4. Fill the openings and joints with No. 8 joint/fill stone.
5. Remove excess aggregate on the surface by sweeping pavers clean.
6. Compact and seat the pavers into the bedding material using a low-amplitude, 75-90 Hz plate compactor capable of at least 4,000 lbs. centrifugal compaction force. This will require at least two passes with the plate compactor. Install a protective pad on plate compactor to prevent scratching or other damage to the paver unit finish.
7. Do not compact with 6 ft. of the unrestrained edges of the paving units.
8. Apply additional aggregate to the openings and joints, filling them completely. Remove excess aggregate by sweeping, then compact the pavers. This will require at least two passes with the plate compactor.
9. All pavers within 6 ft. of the laying face must be left fully compacted at the completion of each day.
10. The final surface tolerance of compacted pavers shall not deviate more than +/- 1/4 inch over a 10 ft. straightedge.
11. The surface elevation of pavers is to be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.

3.03 FIELD QUALITY CONTROL

- A. After sweeping the surface clean, check final elevations for conformance to the drawings.
- B. Lippage: No greater than 1/8 inch difference in height between adjacent pavers.
- C. The surface elevation of pavers is to be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.

3.04 PROTECTION

- A. After work in this section is complete, protect the paved area from sediment deposition, any construction traffic and damage due to subsequent construction activity on the site. Any locations that become contaminated with sediment or other material that may affect the permeability of the system are to be removed and replaced to a like-new condition.

END OF SECTION

SECTION 321613 - CONCRETE CURBS AND GUTTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete header curbs, curbs, and gutters.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of site for paving and base and preparation of subsoil at pavement perimeter for planting.
- B. Section 312323 - Fill: Compacted subbase for paving.
- C. Section 321123 - Aggregate Base Courses: base course.
- D. Section 321373 - Joint Sealers: Sealant for joints.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2005.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- D. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 1999.
- E. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 1988 (Reapproved 2002).
- F. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- G. ASTM C 33 - Standard Specification for Concrete Aggregates; 2007.
- H. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.
- I. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2007.
- J. ASTM C 150 - Standard Specification for Portland Cement; 2007.
- K. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2008a.
- L. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2006.
- M. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2007.
- N. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2008a.
- O. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2008a.
- P. ASTM C 685/C 685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2007.
- Q. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2008).

- R. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2004a (Reapproved 2008).

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, curing compound, and fiber reinforcement.
- C. Installer qualifications using Macro Fiber reinforcement in finished, exterior concrete.
- D. Design Data: Indicate curb/gutter thickness, designed concrete strength, reinforcement, and typical details. Separate mix designs are required for conventionally formed concrete and machine placed or slip-formed concrete.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Form Materials: Conform to ACI 301 and as follows.
- B. Steel forms with self-aligning joints designed to withstand the lateral and vertical loads associated with the concrete placement. Form sections are to be a minimum of 10-feet in length for runs that are 10-feet or longer in length.
- C. Joint Filler: Preformed; non-extruding bituminous type (ASTM D 1751) or sponge rubber or cork (ASTM D 1752).
 - 1. Thickness: 3/8 inch.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A 185/A 185M; in flat sheets; unfinished.
- C. Dowels: ASTM A 615/A 615M Grade 40 (280); deformed billet steel bars; unfinished finish.

2.03 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Concrete Materials: Provide in accordance with State of Kentucky Highways standards.
- C. Cement: ASTM C 150 Air Entraining - Type IA portland type, grey color.
- D. Fine and Coarse Mix Aggregates: ASTM C 33.
- E. Fly Ash: ASTM C 618, Class F - Optional for mixes used for slip forming of curb and gutter, or slip forming of concrete pavements. Fly ash is not to be used in concrete that is not slip formed or extruded..
- F. Water: Clean, and not detrimental to concrete.
- G. Fiber Reinforcement: Structural, macro synthetic, fibrillated, polypropylene fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 1.5 to 2 inch length and manufactured to provide post-cure concrete strength and increase freeze/thaw resistance.
 - 1. Acceptable Products:
 - a. TUF-STRAND SF by Euclid Chemical
 - b. Nycon-XL200 by Nycon Corporation
 - c. Fibermesh 650 by Propex Operating Company
 - d. Forta-Ferro by Forta Corporation

- H. Air Entrainment Admixture: ASTM C 260.
- I. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.04 ACCESSORIES

- A. Curing Compound: ASTM C 309, Type 1, Class A.
- B. Joint Sealer: Type as specified in Section 321373.

2.05 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- C. Macro Fiber Reinforcement: Add to mix at rate of 7 pounds per cubic yard, or as recommended by manufacturer for specific project conditions. Fiber is to be added at the plant after all other materials have been added, and have a minimum mix time of 5-minutes. Fiber reinforcement is only to be used when slip forming of concrete is performed.
- D. Concrete Properties:
 - 1. Compressive Strength (prior to adding fiber), when tested in accordance with ASTM C 39/C 39M at 28 days: 4500 psi. Testing of the concrete mix prior to adding fiber and again after fiber has been added is required to set the compressive strength requirement for fiber reinforced concrete. This should be done for the first pour of each mix design and the results used to confirm future pours.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Cement Content: Minimum 639 lb per cubic yard.
 - 4. Water-Cement Ratio: Maximum 0.44 percent by weight.
 - 5. Total Air Content: 6 percent +/- 1%, determined in accordance with ASTM C 173/C 173M.
 - 6. Maximum Slump: 4 inches using base design, 5 inches when using fiber and mid-range water reducer, 6 inches when using a mid-range water reducer, +/- 1-inch.
 - 7. Maximum Aggregate Size: 1 inch.

2.06 MIXING

- A. Transit Mixers: Comply with ASTM C 94/C 94M.
- B. Do not add water to the mix once the truck has left the concrete plant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 321123 for construction of base course for work of this Section.

3.03 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of storm structure frames with oil to prevent bond with concrete curb/gutter.

- C. Notify Architect minimum 24 hours prior to commencement of concreting operations. Architect is to review and approve sample pours prior to installation of permanent concrete.

3.04 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.
- D. Slip forming can be used for curb and gutter combinations. The slip form machine shall be self-propelled and designed to place, consolidate and finish the concrete in one pass, and be adjustable to install gutter lines that slope away from the curb where required.

3.05 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Use fiber reinforcement for all concrete.
- C. Provide doweled joints as indicated with one end of dowel set in capped sleeve to allow longitudinal movement.

3.06 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.07 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not place concrete when base surface is wet.
- C. Concrete can be placed using the slip form technique. If slip forming is used, fiber-reinforced concrete shall be used.
- D. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- E. Place concrete continuously over the full length of the run and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- F. Place expansion joints at the beginning and ending of each pour.
- G. Place expansion joints at the beginning and ending of each pour. Place control joints concrete to indicated pattern.

3.08 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch wide expansion joints at 40 foot intervals and to separate curb and gutter from adjacent sidewalks, vertical surfaces and other components .
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.

- C. Provide sawcut contraction control joints every 8-feet. Where the curb is adjacent to a sidewalk, install contraction joints that align with the sidewalk joints with spacing between 8-feet and 10-feet.
- D. Provide tooled contraction joints between curbs/gutters and adjacent traffic duty pavements.
- E. At 90-degree curb corners, the contraction joint is to be cut parallel to the traffic lane. Diagonal cuts at 90-degree corners are not acceptable.

3.09 FINISHING

- A. Curbs and Gutters: Uniform float finish and round edges. Correct all honeycombed areas by filling with mortar. Do not plaster. Finish the top and face while the concrete is plastic by wetting and rubbing with a carborundum brick. Finish the face of header curbs to 4-inches below the finished ground line. Provide uniform texture and color.
- B. Remove "slop" created by the concrete finishing from all joints and edges.
- C. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.
- D. Exposed macro fibers are to be removed using a propane torch and stiff brush after a minimum of 56-days curing of the concrete. Care should be taken to not overheat the concrete and cause it to be discolored, damaged or lose strength.

3.10 JOINT SEALING

- A. All expansion joints are to be sealed. See Section 321373 for joint sealer requirements.

3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness and Face Alignment: 1/4 inch in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

3.12 FIELD QUALITY CONTROL

- A. Allow an independent testing agency to perform field quality control tests, as specified in Division 1.
 - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
 - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
 - 3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- B. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 25 cu yd or less of each class of concrete placed.
 - 1. Test fiber reinforced concrete prior to the addition of fiber and again after fiber has been added to set the baseline for the fiber reinforced compressive strength, slump and air content. This is to be done for the first pour of each mix design, and the results used for later pour strength requirements.
 - 2. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
 - 3. Perform one slump test and one air content test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken. All test reports are to be typed.
- D. Any tests or time limits that do not meet the specified requirements are to be reported to the Contractor and that concrete shall be considered unacceptable.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic into curb/gutter area for 2 days minimum after finishing.
- C. Do not permit vehicular traffic into curb/gutter area until 75 percent design strength of concrete has been achieved.
- D. All concrete curb/gutter that is soiled or otherwise dirty are to be pressure washed and rinsed upon completion of the construction and landscaping work.

END OF SECTION

SECTION 321713 - PARKING BUMPERS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Precast concrete parking bumpers and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 321216 - Asphalt Paving.
- B. Section 321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Parking Bumpers: Precast concrete, conforming to the following:
 1. Nominal Size: 6 inches high, 9 inches wide, 6 feet long.
 2. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 5. Air Entrainment Admixture: ASTM C260/C260M.
 6. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 8. Embed reinforcing steel, and drill or sleeve for two dowels.
 9. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 10. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- B. Dowels: Steel, galvanized finish; 1/2 inch diameter, 16 inch long, pointed tip.

PART 3 EXECUTION**3.01 INSTALLATION**

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 2 dowels per unit.

END OF SECTION

SECTION 321723.13 - PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, and handicapped symbols.
- B. Roadway lane markings and crosswalk markings.

1.02 RELATED REQUIREMENTS

- A. Section 321216 - Asphalt Paving.
- B. Section 321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; Current Edition.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Manufacturer's Testing: Perform testing for Daytime and Nighttime Color, Contrast Ratio, Titanium Dioxide (white paints) and Volatile Organic Content (VOC) on each lot of waterborne acrylic paint to be delivered for use on projects.
 - 5. Certification: Submit manufacturer's certification stating conformance to the requirements of this section for each shipment of waterborne acrylic paint delivered for use on projects. Clearly state the manufacturer, product name, product code, lot number(s), expiration date, color sampling method, test results of manufacturer required testing, and quantity delivered.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Line and Zone Marking Paint: MPI (APL) No. 97 Latex Traffic Marking Paint; color(s) as indicated.
 - 1. Roadway Striping:
 - a. White single for same direction lane separation
 - b. Yellow dashed for opposite direction lane separation
 - 2. Parking Lot Striping:
 - a. White for typical parking spaces

- b. Yellow for no parking areas
 - c. Blue for ADA accessible parking and unloading areas
- 3. ADA Parking Symbols: Blue and white per the drawings.
- 4. Substitutions: See Section 016000 - Product Requirements.
- B. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- C. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- D. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- E. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
 - 2. At Contractor's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends. Standard lane and parking striping widths are 4-inches unless identified otherwise.
 - 1. Apply paint in one coat only.

2. Wet Film Thickness: 0.015 inch, minimum. If asphalt pavement can be seen through the paint, or if voids in the pavement are not filled, additional coat(s) will be required.
 3. Width Tolerance: Plus or minus 1/8 inch.
- G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
1. Conduct operations in such a manner that necessary traffic can move without hindrance.
 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
 4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
 5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
1. Mark the International Handicapped Symbol at indicated parking spaces (blue background with white symbol).
 2. Hand application by pneumatic spray is acceptable.
- I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

END OF SECTION

SECTION 321723.23 - THERMOPLASTIC PAVEMENT MARKINGS**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. This specification covers a reflectorized pavement striping material of the type that is applied to a road surface in a molten state with premixed glass beads by spray or extrusion means, with a supplemental surface application of glass spheres. When applied properly and at the designated thickness and width the stripe shall, upon cooling, be reflectorized and be able to resist deformation by traffic. The applied material shall be impervious to degradation by motor oil, diesel fuel, grease deposits and ice-preventative chemicals.

1.02 MATERIAL REQUIREMENTS

- A. The thermoplastic pavement marking materials used in this contract shall meet the following specifications. This specification covers reflectorized oil and grease impervious thermoplastic road marking materials which are (1) hot extrusion applied with a surface application of glass spheres and (2) heat fused applied. The properly applied markings shall be reflectorized and able to durably resist degradation and deformation by traffic.
- B. The thermoplastic materials shall be homogenously composed of pigment, filler, resins, and glass reflectorizing spheres, and shall be available in both yellow and white.
- C. Composition: The pigment, beads and filler shall be uniformly dispersed in the resin. The materials shall be free from all skins, dirt, and foreign objects and shall comply with requirements according to Table 1. Only new materials shall be acceptable for use on this project.

COMPONENT	WHITE	YELLOW
Binder (see note A)	18.0% min	18.0% min
Glass Beads		
(AAASHTO M247 Type D)	30.0 – 40.0%	30.0 – 40.0%
Titanium Dioxide	10.0% min--	
Yellow Pigments--	2.0% min	
Calcium Carbonate	42.0% max	50.0% max

Note A: The alkyd binder shall consist of a mixture of synthetic resins (at least one of which is solid at room temperature) and a high boiling point plasticizer. At least one third of binder composition shall be solid maleic modified glycerol ester resin and shall be no less than 8% by eight of the entire material formulation. The alkyd binder shall not contain petroleum based hydrocarbon resins.

Note B: The percentage of yellow pigment can be reduced if lead pigments are eliminated from the formulation.
- D. Temperature - The molten material temperature shall be between 400 and 440 F unless otherwise recommended by the manufacturer, and approved by the Engineer.
- E. Primer - A primer shall be used if thermoplastic is applied to Portland cement concrete. Any primer used shall be compatible with the thermoplastic material.
- F. Thickness - The pavement markings shall yield a solid thickness range of 80 to 95 mils above the roadway surface across the middle two-thirds of the line width when tested as specified in MSMT 729.
- G. Glass Beads - Glass beads shall be uniformly applied to the surface of the molten thermoplastic at the minimum rate of 7 to 9 lb/ 100 ft², as specified in MSMT 729.
- H. Color - The color of the dry markings shall match Federal Standard 595 (13538 – yellow or 17886 – white). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the thermoplastic material matches the specified color.
- I. Retro reflectance - The millicandel/lux/square meter values taken anytime within the first 30 days shall conform to the following:

1.03 RETROREFLECTANCE**COLOR RETROREFLECTIVITY CORRECTIVE ACTION**

White equal to or greater than 250 None

Yellow equal to or greater than 150 None

White less than 250 Necessary corrective actions, including grinding if necessary, and re-tracing.

Yellow less than 150 Necessary corrective actions, including grinding if necessary, and re-tracing.

- A. The "Drop-On" glass beads shall conform to AASHTO specifications M-247-81 except as follows:
The glass beads shall have the following gradation:
- | US Sieve Number | Percent Passing |
|-----------------|-----------------|
| 20 | 100 |
| 30 | 75-95 |
| 50 | 15-35 |
| 80 | 0-5 |
| 100 | 0 |
- B. The "Drop-On" glass beads shall be smooth, clear and free from air inclusions. The beads shall have a minimum refractive index of 1.50 and shall be a minimum of 80% true spheres overall, and minimum 70% true spheres on each sieve. The beads shall be moisture proof coated and shall meet the requirements of AASHTO M-247-81 Section 4.4.2 to insure optimum embedment of 60-65 percent (60-65%) in various thermoplastic traffic marking systems. The material shall set to bear traffic in not more than 2 minutes when the air temperature is 50 degrees F and not more than 10 minutes when the air temperature is 90 degrees F.
- C. Bond Strength - After heating the thermoplastic material for four hours at 425 degrees F the bond strength to Portland Cement Concrete shall exceed 180 psi (1.24 Mpa Method ASTM D4796-88)
- D. Cracking Resistance - For at least 90 days after application the materials shall show no cracks other than with substrate cracking.
- E. Smear and Softening Resistance - During the life of the materials, the applied markings shall not smear or soften apart from substrate movement.

1.04 QUALITY ASSURANCE

- A. Methods of Sampling and Testing: The Commission reserves the right to require the contractor to perform any quality assurance testing necessary to determine compliance with these specifications. Testing required shall be by industry standard and shall be the responsibility of the contractor and performed at no cost to the Commission.
- B. The Contractor shall obtain and provide to the Construction Manager, as part of the material submittal package, a written material specification compliance certification from the thermoplastic manufacturer, stating that the material being used on this contract meets the materials specifications in the Contract.

1.05 APPLICATION REQUIREMENTS

- A. The molten applied thermoplastic material shall readily screed/extrude at temperatures between 400 degrees F and 440 degrees F from the approved equipment to produce a line which shall be continuous and uniform in shape having sharp dimensions.
- B. The application of additional glass beads by drop-on methods shall be at a minimum rate of 8 lbs. per 100 sq ft of marking. Ambient and surface temperatures shall be at least 50 degrees F and rising at the time of application.
- C. Method of Application:

1. The Contractor shall furnish and install machine-applied extruded and/or sprayed hot thermoplastic with glass spheres (pre mixed and drop-on) in the proper ratio to immediately produce a highly reflective marking as described elsewhere in these specifications, in accordance with the details in this contract and the following provisions.
- D. Surface Preparation:
1. In order to insure maximum possible adhesion, the pavement surface upon which the pavement markings are to be placed shall be properly cleaned from grease, oil, mud, dust, dirt, grass, loose gravel, and other deleterious material prior to the application of the Thermoplastic pavement markings, and/or primer/sealer. Cleaning is required on all surfaces which are to receive new pavement markings, and shall be considered incidental to the application of the markings.
- E. Primer-Sealer:
1. It shall be the responsibility of the contractor to recommend to the Construction Manager and obtain the Construction Manager's concurrence as to whether primer-sealer is required on a given pavement in order to meet the material manufacturer's warranty conditions. Generally, on all Portland Cement concrete pavement surfaces and aged asphalt-concrete pavements having less than eighty percent (80%) bituminous concrete, primer-sealer shall be applied to the area where the thermoplastic pavement markings are to be placed. Also, the Commission reserves the right to direct the Contractor to apply primer/sealer for any given markings.
 2. The primer/sealer shall be that recommended by the manufacturer of the thermoplastic material, and approved by the Construction Manager. The material shall form a continuous film which shall dry rapidly and adhere to the pavement. The material shall not discolor nor cause any noticeable change in the appearance of the pavement outside the of the finished pavement markings. All solvents shall have evaporated from the primer/sealer prior to the application of the molten thermoplastic materials. A sample of the primer/sealer and the recommended method of application must be submitted to the Construction Manager, and shall have been approved by the Construction Manager and the manufacturer of the material before application.
 3. The Construction Manager has the authority to require the Contractor to apply the primer/sealer using a separate vehicle which may require additional traffic control.
 4. Payment for application of primer/sealer and any additional traffic control will be incidental to the marking item.

1.06 REMOVAL OF EXISTING PLASTIC OR PAINTED MARKINGS

- A. When called for in the contract or otherwise as directed by the Construction Manager, removal of existing painted or plastic pavement markings shall be accomplished by the Contractor using equipment and methods specifically approved by the Construction Manager. Marking removal shall not be by the "painting out" with black paint method nor shall it result in excessive scarring of the pavement. No more than 1/8 inch depth of scarred pavement will be allowed. At least 90 percent of all markings shall be removed.
- B. As directed by the Construction Manager, the Contractor shall be responsible for sweeping or otherwise adequately cleaning up debris after completion of markings required to be removed by the Construction Manager because they are improperly located or otherwise incorrect or improper. Unless permitted otherwise by the Construction Manager, where old markings are removed, the new markings must be applied the same day as the old markings are removed. Whenever grinding, scraping, sandblasting, or other operations are performed, the work shall be conducted in such manner that the finished pavement surface is not damaged or left in a pattern that will mislead or misdirect motorists. When these operations are completed, the pavement markings shall be cleaned to remove residue and debris resulting from the cleaning work.
- C. Where cleaning and/or removal of pavement paint striping or objectionable material is being performed within ten (10) feet of a lane occupied by traffic, the residue removal shall be by method(s) approved by the Construction Manager.

- D. Any damage to the pavement or pavement joint materials caused by pavement marking removal shall be repaired by the Contractor at not cost to the Commission by methods acceptable to the Construction Manager.
- E. The removal of pavement markings will be measured and paid for at the contract price as shown in the Bid Documents.
- F. No direct payment will be made for the removal of existing pavement markings which have not been authorized by the Construction Manager.

1.07 PRE-MARKING OF LINES

- A. When a line is required to be placed in the same location as an existing painted line, and existing painted markings not required to be removed are visible, they shall be retraced (i.e. new markings installed in exactly the same locations, patterns, and dimensions as the old markings). However, if the existing markings are to be removed or are not visible, or if new roadway surface has been placed before markings installation occurs, or if the contract requires a line to be installed where none currently exists, the Contractor will be required to pre-mark as directed by the Construction Manager and subsequently shall install the required markings in accordance with the requirement of other sections of the specifications.
- B. The actual placement of the pavement markings at any such site shall not be performed until the pre-marking has been inspected and approved by the Construction Manager. Pre-marking is incidental to the pavement marking installation work and there will be no separate payment for pre-marking.

1.08 MAINTENANCE OF TRAFFIC

- A. All work shall be performed in accordance with Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and section 104 of the MSHA Standard Specifications for Construction and Materials.. The Contractor shall furnish and place all warning devices, flag persons, and other traffic control devices required to direct, control and protect the traveling public while marking operations are in progress. Maintenance of traffic for this work will be paid under the Maintenance of Traffic item if an item is included in the bid proposal, otherwise it will be considered incidental to the work.

1.09 WARRANTIES

- A. The thermoplastic pavement marking materials and glass beads furnished under this contract shall assume the manufacturer's warranty for these materials and shall be guaranteed by the supplier against failure due to traffic oil degradation.
- B. The contractor shall assume all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the work, and agrees to indemnify and hold harmless the
- C. Commission and its duly authorized representatives from all suits at law or action of every nature for, or on account of , the use of any patented materials equipment, devices or processes. Further, the material shall meet the requirements of this specification for a period of one year.

1.10 METHOD OF MEASUREMENT AND PAYMENT

- A. Payment will be full compensation for all material, labor, equipment, tools, and incidental items necessary to complete the work. Payment shall be made on a unit rate or lump sum basis as shown in the bid proposal.

END OF SECTION

SECTION 321726 - TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 321313 - Concrete Paving: Concrete sidewalks.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. 49 CFR 27, 37, and 38 - Transportation for Individuals with Disabilities; Final Rule; Department of Transportation; current edition.
- C. AASHTO LRFD - Bridge Design Specifications, Customary U.S. Units (6th Edition); 2012.
- D. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2011.
- G. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser; 1984 (Reapproved 2009).
- H. ASTM C903 - Standard Practice for Preparing Refractory Castable Specimens by Cold Gunning; 2010.
- I. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine; 2011.
- J. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007.
- K. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2014.
- L. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- M. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
- N. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2010.
- O. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2010.
- P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- Q. ASTM G155 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.
- R. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
- C. Samples: For each product specified provide two samples, 8 inches square, minimum; show actual product, color, and patterns.
- D. Shop Drawings: Submit plan and detail drawings. Indicate:
 - 1. Locations on project site. Demonstrate compliance with referenced accessibility standards.
 - 2. Sizes and layout.
 - 3. Pattern spacing and orientation.
 - 4. Attachment and fastener details, if applicable
- E. Warranty: Submit manufacturer warranty; complete forms in Owner's name and register with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Tactile and Detectable Warning Surface Tiles:
 - 1. Basis of Design: Armor-Tile, a brand of Engineered Plastics, Inc:
www.armortiletransit.com.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory applied removable protective sheeting.
 - 1. Material Properties:
 - a. Water Absorption: 0.20 percent, maximum, when tested in accordance with ASTM D570.
 - b. Slip Resistance: 0.50 minimum dry static coefficient of friction, when tested in accordance with ASTM D2047.
 - c. Compressive Strength: 25,000 pounds per square inch, minimum, when tested in accordance with ASTM D695.

- d. Tensile Strength: 10,000 pounds per square inch, minimum, when tested in accordance with ASTM D638.
- e. Flexural Strength: 25,000 pounds per square inch minimum, when tested in accordance with ASTM D790.
- f. Chemical Stain Resistance: No reaction to 1 percent hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, or antifreeze, when tested in accordance with ASTM D543.
- g. Abrasion Resistance: 300, minimum, when tested in accordance with ASTM C501.
- h. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84.
- i. Accelerated Weathering: Delta-E of less than 5.0 at 2,000 hours exposure, when tested in accordance with ASTM G155.
- j. Adhesion: No delamination of tile prior to board failure in a temperature range of 20 to 180 degrees F, when tested in accordance with ASTM C903.
- k. Loading: No damage when tested according to AASHTO LRFD test method HS20.
- l. Salt and Spray Performance: No deterioration or other defect after 200 hours of exposure, when tested in accordance with ASTM B117.
- 2. Installation Method: Cast in place replaceable.
- 3. Shape: Rectangular.
- 4. Dimensions: 24 inches by width of walk or minimum 36 inches.
- 5. Pattern: In-line pattern of truncated domes complying with ADA Standards.
- 6. Edge: Square.
- 7. Joint: Butt.
- 8. Color: As selected by Architect from manufacturer's standard range.
- 9. Products:
 - a. Armor-Tile, a brand of Engineered Plastics, Inc; Product Herculite Series: www.armor-tile.com.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

- A. Fasteners: ASTM A666, Type 304 stainless steel
 - 1. Type: Countersunk, color matched composite sleeve anchors
 - 2. Size: 1/4 inch diameter and 1-1/2 inches long.
- B. Adhesive: Type recommended and approved by surfacing tile manufacturer.
- C. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
 - 1. Examine work area with installer present.
 - 2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
 - 3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
 - 1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.

2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
1. Cut units to size and configuration shown on drawings.
 2. Do not cut plastic tiles to less than 9 inches wide in any direction.
 3. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
 4. Orient so dome pattern is aligned with the direction of ramp.
 5. Align truncated dome pattern between adjacent units.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.
- D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. Concrete:
1. See Section 321313.
- B. Tamp and vibrate units as recommended by manufacturer.
- C. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.04 CLEANING PLASTIC UNITS

- A. Remove protective plastic sheeting within 24 hours of installation.
- B. Remove excess sealant or adhesive from joints and edges.
- C. Clean 4 days prior to date of scheduled inspection.

3.05 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 321731 - STEEL GUARDRAIL**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Steel guardrail and steel posts.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete foundation for posts.

1.03 REFERENCE STANDARDS

- A. AASHTO M 180 - Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail; 2012.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, anchorage, and schedule of components.
- C. Product Data: Provide data on rail, posts, accessories, hardware and structural capabilities of rail section.

1.05 WARRANTY

- A. Steel Guard Rail: Ensure that the manufacturer's logo and heat numbers remain legible for at least 5 years after galvanizing.

PART 2 PRODUCTS**2.01 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for rail height or location restrictions.

2.02 MATERIALS

- A. Guardrail Beam: AASHTO M 180 Class A Type II; W profile; rolled steel sections, die punched bolt holes for site assembly and attachment to posts, formed steel curved Type 4 terminating sections.
- B. Steel Posts: ASTM A501/A501M hot-formed tubing.

2.03 ACCESSORIES

- A. Hardware: Steel, bolts, nuts and washers to suit rail profile.

2.04 FINISHES

- A. Components: Galvanized in accordance with ASTM A123/A123M.
- B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install rails and posts and accessories in accordance with manufacturer's instructions.
- B. Set posts plumb, in concrete footings.
 - 1. Top of Footing: 2 inches above finish grade.
 - 2. Slope top of concrete for water run-off.
- C. Attach rails securely to posts with anchoring hardware.

3.02 TOLERANCES

- A. Posts - Maximum Variation From Plumb: 1/2 inch.
- B. Rail - Maximum Variation From True Height: 1/2 inch.
- C. Components shall not infringe adjacent property lines.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCES AND GATES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wire fabric.
- B. Manual gates with related hardware.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete anchorage for posts.
- B. Section 337900 - Site Grounding.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A428/A428M - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles; 2010 (Reapproved 2014).
- D. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- G. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- H. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2014.
- I. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2013.
- J. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in installation of products specified in this section with not less than three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Master-Halco, Inc.: www.masterhalco.com.
 - 2. Merchants Metals: www.merchantsmetals.com.
 - 3. Stephens Pipe and Steel: www.spsfence.com
 - 4. Capitol Wholesale: www.capitolwholesale.com
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 COMPONENTS

- A. Line Posts: 2.5 inch outside diameter.
- B. Corner and Terminal Posts: 3 inch outside diameter.
- C. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- D. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.66 inch diameter for welded fabrication.
- F. Fabric: 1-3/4 inch diamond mesh interwoven wire, 6 gauge, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
- G. Tie Wire: Aluminum alloy steel wire.

2.03 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.
- D. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.04 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 oz/sq ft.
- B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- C. Accessories: Same finish as framing.
- D. Color(s): To be selected by Architect from manufacturer's standard range, minimum of four colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris and conform with construction documents.

3.02 PREPARATION

- A. Removal: Obstructions or debris.

3.03 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail . Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Install center and bottom brace rail.
- I. Do not stretch fabric until concrete foundation has cured 28 days.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom brace rail with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- M. Do not attach the hinged side of gate to building wall; provide gate posts.
- N. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- O. Ground fence in accordance with Section 337900.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.

3.05 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Remove mortar from exposed posts and other fencing material using a 10 percent solution of muriatic acid followed immediately by several rinses with clean water.
- E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up paint color to factory-applied finish.

END OF SECTION

SECTION 323136 - SECURITY GATES AND BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Security gates and barriers.

1.02 RELATED REQUIREMENTS

- A. Section 312316 - Excavation: Excavating for footings, and utility trenching.
- B. Section 321313 - Concrete Paving: Installation of adjacent paved surfaces.
- C. Section 321413 - Precast Concrete Unit Paving: Installation of adjacent paved surfaces.

1.03 REFERENCE STANDARDS

- A. ASTM F2656/F2656M - Standard Test Method for Crash Testing of Vehicle Security Barriers; 2015.

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Shop Drawings: Provide detailed drawings showing:
 - 1. Layout and overall dimensions of each major element of the barrier equipment.
 - 2. Foundation and anchoring requirements of the barrier equipment.
- C. Manufacturer's Qualification Statement.
- D. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.07 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 NON-AUTOMATED BARRIERS

- A. Removable Bollards: Manually removable tubular steel bollards.
 - 1. Post Design: Round, diameter 8 inches.
 - 2. Mounting: Surface mounted through the flange.
 - 3. Locking Mechanism: Externally secured with owner provided padlock.
 - 4. Height: 36 inches.
 - 5. Finish: Stainless Steel.
 - 6. Stainless Steel Sleeves.
 - 7. Cap Style: Standard flat.
 - 8. Products:
 - a. Calpipe Security Bollards, www.calpipebollards.com.
 - b. Forms+Surfaces; Helio Bollard; www.forms-surface.com.
 - c. Substitutions: See Section 016000 - Product Requirements.

- B. Fixed Bollards: Permanently installed tubular steel bollards.
 - 1. Post Design: Round, diameter 6 inches.
 - 2. Mounting: Embedded within concrete.
 - 3. Height: 36 inches.
 - 4. 1/4" Plastic Bollard Cover: Polyethylene Thermoplastic (HDPE) tubes having ultra-violet resistance and anti static properties
 - a. Nominal Wall Thickness: 0.250 inches
 - b. Finish: Smooth surface with domed top
 - c. Diameter: 6 inch
 - d. Color: PMS 286
 - e. Fasteners: Neoprene adhesive tape
 - f. Manufacturers:
 - 1) Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - (a) Ideal Shield, 2525 Clark St., Detroit, Michigan 48209
 - 2) Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect.
 - (a) Other manufacturers which meet the requirements of this specification only as submitted and approved.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Verify location of existing utilities, grades and conditions of substrate.
 - 2. Coordinate installation of foundations with adjacent work, including but not limited to fencing, pavements, and structures.

3.02 PREPARATION

- A. Protect existing work from damage due to installation of this work.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.04 CLEANING

- A. Touch up scratched surfaces using materials recommended by manufacturer.

3.05 PROTECTION

- A. Protect installed units from subsequent construction operations.

END OF SECTION

SECTION 329219 - SEEDING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Preparation of subsoil.
- B. Hydroseeding, mulching and fertilizer.
- C. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 015713- Temporary Erosion and Sediment Control
- B. Section 312200 - Grading: Topsoil material.
- C. Section 31 2200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- D. Section 312323 - Fill: Topsoil material.
- E. Section 312513 - Permanent Erosion Controls:

1.03 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions. Include substrate preparation, amendments, materials, and application rate.
- B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer; and watering instructions.
- C. Hydroseed product and maintenance data including a hydroseed physical sample. Submit dry hydroseed material in one gallon bag.

1.05 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.06 PRE-INSTALLATION MEETING

- A. Convene a meeting one week before starting subdrainage installation for pervious pavers to discuss coordination between various installers and review field constructed Mock-Up.
 - 1. Require attendance by personnel responsible for installation of topsoil, plant materials, and hydroseeding.
 - 2. Include representatives of the General Contractor.
 - 3. Notify Architect at least 2 weeks prior to meeting.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.01 SEED MIXTURE

- A. Seed Mixture:
 - 1. Tall Fescue Grass Type: 40 percent. (Firecracker LS, Aggressor, Falcon IV, Col-M, 3rd Millenium or similar to be approved by the Landscape Architect).
 - 2. Fine Fescue Grass Type: 30 percent. (Reliant IV, Firefly, Epic, Fortitude, Finelawn Petite or similar to be approved by the Landscape Architect)
 - 3. Kentucky Blue Grass Type: 20 percent. (Freedom III, Blue Velvet, Midnight, Barrister, Nu Destiny, Quantum Lelap, Brilliant, Everglade or similar to be approved by the Landscape Architect).
 - 4. Perennial Rye: 10 percent.
 - a. Approved Varieties:
 - 1) Manhattan 5
 - 2) Divine
 - 3) Secretariat II

2.02 SOIL MATERIALS

- A. Topsoil: Type as specified in Section 312200.

2.03 ACCESSORIES

- A. Hydraulic Mulch: Fully biodegradable hydraulic mulch composed of 100% recycled wood fibers, cellulose fibers and wetting agents (including high-viscosity colloidal polysaccharides). The hydraulic mulch is to be sanitized, free from plastic netting, and upon application forms an intimate bond with the soil subsurface to create a porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.
 - 1. Basis of design: Flexterra Flexible Growth Medium by Profile Products, 750 Lake Cook Road, Suite 440, Buffalo Grove, IL 60089. p:800-508-8681, www.profileproducts.com.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Recommendations per the soil test.
- C. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.04 TESTS

- A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, percentage inorganic matter soluble salt content, organic matter content, and pH value.
- B. Submit minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
- C. Testing is not required if recent tests are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.
- B. Place topsoil in accordance with Section 312200.

- C. Treat any remaining weeds with approved herbicides prior to fertilizing. Agricultural dye to be added to herbicide in order to allow for varification of treatment.

3.03 FERTILIZING

- A. Apply fertilizer as recommended in the soil testing results.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 3 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 HYDROSEEDING

- A. Apply seed at a rate of 7 lbs per 1000 sq ft or as recommended by the seed producer and/or soil testing, evenly in two directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Contractor to clean all spills and overspray promptly. All adjacet pavements, buildings, and built structures exposed to overspray daily to prevent staining
- D. Slopes less than 3 foot horizontal to 1 foot verticle: Apply 3000 lbs of hydraulic mulch with tack per acre or as recommended by the hydroseed manufacturer. Maintain clear of shrubs, trees, and all built structures. Contractor is to submit bill of materials to architect for quantity of materials delivered to site. Contractor is to have a manufacturer representative present on site during the first day of installation of hydraulic mulch.
- E. Slopes equal to or steeper than 3 foot horizontal to 1 foot verticle: Apply 3500 lbs of hydraulic mulch with tack per acre or as recommended by the hydroseed manufacturer. Maintain clear of shrubs, trees, and all built structures. Contractor is to submit bill of materials to architect for quantity of materials delivered to site. Contractor is to have a manufacturer representative present on site during the first day of installation of hydraulic mulch.
- F. Contractor is to water hydroseeded area once every 7-days after hydroseeding for that area is complete or as recommended by the manufacturer.
- G. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.05 PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 18 inches. Space stakes at 30 inches.
- B. Protect seeded areas in accordance with Section 312513 - Permanent Erosion Controls
- C. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- D. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- E. Secure outside edges and overlaps at 36 inch intervals with stakes.
- F. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- G. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.06 MAINTENANCE

- A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
- B. See Division 1 Sections for additional requirements relating to maintenance service.
- C. Provide maintenance of seeded areas for three months from Date of Substantial Completion.
- D. Mow grass at regular intervals to maintain at a maximum height of 4 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- E. Neatly trim edges and hand clip where necessary.
- F. Immediately remove clippings after mowing and trimming.
- G. Water to prevent grass and soil from drying out.
- H. Roll surface to remove minor depressions or irregularities.
- I. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- J. Immediately reseed areas that show bare spots.
- K. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

SECTION 329223 - SODDING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Sod installation.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Topsoil material.
- B. Section 312200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- C. Section 312323 - Fill: Topsoil material.

1.03 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 REFERENCE STANDARDS

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding; 2006.

1.05 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.06 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Certification: Submit certification of grass species and location of sod source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer .
- D. Submit sod watering schedule.
- E. Submit a planting schedule. Coordinate the schedule with the construction work of the project and with expected climatic conditions.
- F. Submit topsoil analysis reports. Provide subsoil analysis reports where needed.
- G. Submit a list of soil amendments as recommended by the topsoil and subsoil analyses and recommendations.

1.07 QUALITY ASSURANCE

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Kentucky.

- B. Installer Qualifications: Company approved by the sod producer.

1.08 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sod on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours.
- A. Furnish service and maintenance of sodded areas for three months from Date of Substantial Completion.
- B. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft. Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.
 1. Tall Fescue Grass Type: 40 percent. (Firecracker LS, Aggressor, Falcon IV, Col-M, 3rd Millenium or similar to be approved by the Landscape Architect).
 2. Fine Fescue Grass Type: 30 percent. (Reliant IV, Firefly, Epic, Fortitude, Finelawn Petite or similar to be approved by the Landscape Architect)
 3. Kentucky Blue Grass Type: 20 percent. (Freedom III, Blue Velvet, Midnight, Barrister, Nu Destiny, Quantum Lelap, Brilliant, Everglade or similar to be approved by the Landscape Architect).
 4. Annual Rye: 10 percent.
 5. Thickness: "Thick" sod, minimum 1 inch and maximum 1-3/8 inch topsoil base.
 6. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.
- B. Topsoil: as specified in Section 312200.
- C. Fertilizer: per soil test requirements; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.
- D. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

2.02 ACCESSORIES

- A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.
- B. Place topsoil in accordance with Section 312200.

3.03 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 LAYING SOD

- A. Moisten prepared surface immediately prior to laying sod.
- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches minimum. Do not stretch or overlap sod pieces.
- D. Lay smooth. Align with adjoining grass areas. Top of sod surface to meet and match adjoining pavements.
- E. On slopes 6 inches per foot and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- F. Water sodded areas immediately after installation. Saturate sod to 4 inches of soil.
- G. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

3.05 MAINTENANCE

- A. Maintain sodded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
- B. Mow grass at regular intervals to maintain at a maximum height of 3 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Water to prevent grass and soil from drying out.
- D. Roll surface to remove irregularities.
- E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- F. Immediately replace sod to areas that show deterioration or bare spots.
- G. Protect sodded areas with warning signs during maintenance period.

END OF SECTION

SECTION 329300 - PLANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Topsoil bedding.
- C. New trees, plants, and ground cover.
- D. Mulch and Fertilizer.
- E. Tree watering bags.
- F. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Topsoil material.
- B. Section 312323 - Fill: Topsoil material.
- C. Section 329413 - Weed Control Fabric

1.03 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.
- B. Native Plants: plants that are endemic to the region, soil conditions, climate and planting zone of the planting location.
- C. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.04 REFERENCE STANDARDS

- A. ANSI/ANLA Z60.1 - American National Standard for Nursery Stock; 2004.
- B. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2008.

1.05 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer .
- C. Submit list of plant life and native plant sources.
- D. Submit a planting schedule. Coordinate the schedule with the construction work of the project and with expected climatic conditions.
- E. Submit topsoil analysis reports. Provide subsoil analysis reports where needed.
- F. Submit a list of soil amendments as recommended by the topsoil and subsoil analyses and recommendations.
- G. Submit mulch sample(s) and source.
- H. Submit tree watering bag catalog cut sheet, manufacturer's product specifications, and installation instructions.

1. Submit watering schedule for all landscaped areas. Include method for water application and water source.

1.06 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating native and other plants with three years documented experience.
- B. Installer Qualifications: Company specializing in the installation and maintenance of native and other plants with three years experience.
- C. The landscape contractor is to have a supervisor with a minimum of three years experience with the installation and maintenance of native and other plants in similar projects on-site during the preparation of planting areas and throughout planting installation, and during the maintenance period.
- D. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.
- E. Tree Pruning: Conform to ANSI A300 Part 1.
- F. Tree Root Balls: Trees indicated as balled and burlap wrapped are to be of the minimum size indicated on the planting schedule. Tree spaded trees in wire baskets must meet the requirements listed below.
 1. Root Ball Sizing
 - a. Trunk diameter (at caliper height) 1 inches requires root ball width 16", depth 12 inches minimum.
 - b. Trunk diameter 1.5 inches requires root ball width 24 inches, depth 12 inches minimum.
 - c. Trunk diameter 1-3/4 inches to 2 inches requires root ball width 30 inches, depth 15 inches minimum.
 - d. Trunk diameter 2.5 to 2.75 inches requires root ball width 35 inches, depth 15 inches minimum.
 - e. Trunk diameter 3 to 3.5 inches requires root ball width 36 inches, depth 18 inches minimum.
 - f. Trunk diameter 4 inches requires root ball width 48 inches, depth 24 inches minimum.
- G. Plant Inspection and Acceptance: All plants and source information are to be made available for the landscape architect to inspect and assess as to size, quality, form, condition and source. This is to be done prior to installation of any plants.
 1. Notice is to be given to the landscape architect a minimum of 7 (seven) working days prior to having the plants available to view. Plants may be viewed at the growing nursery or storage nursery/facility if these are within a reasonable distance from the site, or at the project site prior to installation of the plants.
 2. Landscape beds and planting pits will be inspected by the landscape architect prior to commencement of planting. The landscape contractor will inform the landscape architect a minimum of 7 (seven) working days in advance of when the planting beds and pits will be ready for planting.
- H. Non-native, Invasive Plant Species: Do not introduce, grow, or cultivate plant species that are non-native to the ecosystem of the project site, and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

1.07 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide composition.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of plants, fertilizer and herbicide mixture.
- C. Plant Materials: Described by ASTM Z60.1; free of disease or hazardous insects.

1.08 PRE-INSTALLATION MEETING

- A. Convene a meeting one week before starting subdrainage installation for pervious pavers to discuss coordination between various installers and review field constructed Mock-Up.
 - 1. Require attendance by personnel responsible for installation of topsoil, plant materials, and hydroseeding.
 - 2. Include representatives of the General Contractor.
 - 3. Notify Architect at least 2 weeks prior to meeting.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- B. Protect and maintain plant life until planted. Protect root balls and containers, plant and tree stems and branches, and maintain optimal moisture levels.
- C. Deliver plant life materials immediately prior to placement. Keep plants moist. Cover root balls with mulch or heel in at storage facility or at site if plants cannot be installed immediately upon delivery to the site.

1.10 FIELD CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 85 degrees F.
- B. Do not install plant life when wind velocity exceeds 30 mph.

1.11 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty.
- C. Warranty: Include coverage for one continuous growing season, for one year from the date of substantial completion. Replace dead or unhealthy plants.
- D. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

PART 2 PRODUCTS**2.01 PLANTS**

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.
- B. Trees, Plants, and Ground Cover: Species and size identifiable in plant schedule, grown in climatic and soil conditions similar to those in locality of the Work.

2.02 SOIL MATERIALS

- A. Topsoil: Imported and/or Excavated from site.

2.03 SOIL AMENDMENT MATERIALS

- A. Fertilizer: Containing fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
- B. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

- C. Bone Meal: Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.
- D. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates as indicated by soil analysis.
- E. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.
- F. Herbicide: Organic pre-emergent and post-emergent herbicides.
 - 1. Follow manufacturer's recommendations for suitability for the type of installed plantings being installed, application timing and application procedures.
 - 2. Use post-emergent soaps and safeners where applicable.
 - 3. No Herbicides are to be applied within the rain garden/infiltration basin.
- G. Pesticide: Antimicrobial or conventional active ingredient pesticides that are in compliance with national, state and local regulations..
 - 1. Follow manufacturer's recommendations for safe applications.
 - 2. Select pesticide type that is specific to the organism to be treated.
 - 3. Adhere to EPA and State of Kentucky Department of Agriculture Pesticide Regulations.
 - 4. No Pesticides are to be applied within the rain garden/infiltration basin.

2.04 MULCH MATERIALS

- A. Mulching Material: hardwood species ground bark, free of growth or germination inhibiting ingredients.

2.05 ACCESSORIES

- A. Wrapping Materials: Tree and plant stems and branches may be covered in burlap for protection from damage during transport. Coverings are to be removed immediately upon delivery to the storage facility or project site.
- B. Root ball wrapping materials: Burlap or polyethylene fabric. Burlap is to be cut down to 2/3 the height of the root ball. Polyethylene fabric is to be removed immediately and completely upon planting.
- C. Root ball materials for tree-spaded trees: galvanized wire baskets are to be truncated and have a 22 degree to 25 degree maximum side angle. Spaded trees with cone shaped wire baskets with a side angle of greater than 25 degrees (typically 30 degrees) are not suitable for clay or loam soils and will not be accepted. Wire baskets are to be cut down to one-third of the height of the basket and the cut section removed.
- D. Stakes: Trees may only be staked where indicated in the drawings and with the approval of the landscape architect. Stakes are to be softwood with pointed end or mild steel angle with pointed end, placed vertically where indicated.
- E. Staking ties are to be flexible material such as rubber ties, : of sufficient strength to withstand severe wind pressure but allow moderate movement of the tree stem. Do not use steel wire or turnbuckles.
- F. Plant Protectors: Rubber or heavy fabric sleeves placed over staking ties to protect plant stems, trunks, and branches.
- G. Tree Stem Wrapping: No tree stem wrapping is permitted except temporarily for transportation.
- H. Tree Watering Bags: Portable drip irrigation system bags are to be UV treated, reinforced polyethylene. Provide one per tree unless noted otherwise on the drawings.
 - 1. Basis of design: TreeDiaper by Zynnovation LLC; 9424 Atlee Commerce Boulevard, Suite E, Ashland, VA 23005. p. 540-300-1465. www.treeddiaper.com
 - a. Capacity: sized to accomidate installed rootball at a ratio of 2:1.
 - b. Bag is to be constructed to be installed and attached around the tree per manufacturers installation instructions

2.06 SOURCE QUALITY CONTROL

- A. Provide analysis of topsoil; comply with requirements of Section 014000.
- B. Provide testing of imported and existing topsoil.
- C. Analyze soil to ascertain:
 - 1. Organic and mineral component percentages
 - 2. Soil particle sizes (soil quality)
 - 3. Percentages of nitrogen, phosphorus, potash, calcium, sodium, aluminum, magnesium, sulfur, cadmium, ferrous oxide, copper, lead, manganese, and carbonate content.
 - 4. Soluble salts and conductivity
 - 5. pH value
 - 6. Analysis results listing soil remediation components and methods to be applied.
- D. Submit minimum 10 oz samples of topsoil proposed to the testing laboratory. Existing site topsoil should be tested at several areas of the site. Imported soil should be sampled from representative areas of the stockpile. Forward samples to testing laboratory in sealed containers to prevent contamination.
- E. If imported topsoil has been recently tested, retesting is not necessary. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that prepared subsoil is ready to receive work.
- B. Saturate soil with water to test drainage.
- C. Verify the locations of new and exiting underground site utilities and that their installation is complete. Coordinate planting bed preparation and planting locations.

3.02 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, construction debris, weeds and undesirable plants and their roots. Remove contaminated subsoil.
- C. Scarify subsoil to a depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- D. Planting pits and beds are to be dug and prepared to a minimum of 12 inches for perennials and annuals, 24 inches for shrubs and a minimum of 24 inches for trees or as necessitated by the height of the root ball. Tree and shrub pits are to be a minimum of 3 times the width of the root ball or container in diameter.
- E. For typical balled and burlap wrapped trees, the planting pit is to be a minimum of twice the width of the root ball or greater.

3.03 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove weeds, debris and foreign non-organic material from topsoil while spreading.

- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.
- E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.
- F. Provide soil amendments as indicated by soil analysis to planting bed subgrade soils (below topsoil).

3.04 FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches of topsoil.
- D. Lightly water to aid the dissipation of fertilizer.
- E. Do Not apply fertilizers within the rain garden/infiltration basin.

3.05 PLANTING

- A. Place plants for best appearance for review and final orientation by Landscape Architect.
- B. Set plants vertical. Ensure that the base of the root ball is supported beneath so that the tree or shrub will remain in an upright and vertical position.
- C. Remove non-biodegradable root containers, including wire cages and all synthetic or treated burlaps.
- D. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth of 6 inches under each plant. Remove burlap and other root ball materials, ropes, wires and wire baskets from the root ball.
- E. Set plants so that the top of the root ball/stem flare is at or slightly above the level at which the plant was grown at the nursery. Do not bury the top of the root ball or emergent stem.
- F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.06 PLANT SUPPORT

- A. Brace plants vertically with plant protector wrapped guy wires and stakes to the following:
 - 1. Tree Caliper: 2 to 4 inches; Tree Support Method: 3 guy wires

3.07 TREE PRUNING

- A. Prune trees as recommended in ANSI A300 Part 1.
- B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.08 FIELD QUALITY CONTROL

- A. Plants and plantings will be re-inspected upon completion of planting activities by the landscape architect.
- B. Plants will be rejected if the root ball, stem, branching system or overall acceptable condition of the plant has been damaged prior to or during planting.

3.09 MAINTENANCE

- A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
- B. See Division 1 Sections for additional requirements relating to maintenance service.
- C. Maintain plant life from the time of planting through the project construction period and for three months after Date of Substantial Completion.
- D. Install tree watering bags:

1. Supply the required number of bags.
 2. Install bag at all trees shortly after tree installation per manufacturer's directions. Water installed plants in accordance with submitted water schedule or as needed based on current site conditions. Check moisture level daily.
- E. Tree watering bag maintenance:
1. Check for damage to plants or watering bags. Remove watering bag temporarily to assess and treat tree damage; replace damaged watering bags as needed.
- F. Irrigate sufficiently to saturate root system and prevent soil from drying out.
- G. Cultivate and weed plant beds and tree pits.
- H. Remove dead or broken branches and treat pruned areas or other wounds.
- I. Neatly trim plants where necessary.
- J. Immediately remove clippings after trimming.
- K. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions or remove weeds and weed roots by hand cultivation.
- L. Control insect damage and disease. Apply pesticides in accordance with manufacturers instructions.
- M. Remedy damage from use of herbicides and pesticides.
- N. Replace mulch when deteriorated.
- O. Maintain flexible staking ties, tree protection and stakes where applicable. Check trees to ensure that staking does not become too loose or too tight. Repair or replace accessories when required.

END OF SECTION

SECTION 329413 - WEED CONTROL FABRIC**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Weed Control Barrier Fabric.

1.02 RELATED SECTIONS

- A. Section 013329 - Sustainable Design Reporting
- B. Section 312200: Grading.
- C. Section 321123: Aggregate base courses
- D. Section 323113: Chain Link Fences and Gates

1.03 REFERENCES

- A. ASTM D-5261: Test Method for Measuring Mass per Unit Area of Geotextiles
- B. ASTM D-5199: Test Method for thickness
- C. ASTM D-5035: Test Method for Strip Tensile and Elongation at Maximum Load
- D. ASTM D-4632: Test Method for Grab Breaking Load and Elongation of Geotextiles
- E. ASTM D-4833: Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
- F. ASTM D-4533: Test Method for Trapezoid Tear Strength of Geotextiles
- G. ASTM D-4491: Test Method for Water Permeability of Geotextiles by Permittivity
- H. ASTM D-4751: Test Method for Determining the Apparent Opening Size of a Geotextile
- I. ASTM D-4355: Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water
- J. ASTM D-737-961: Test Method for Air Permeability of Geotextiles

1.04 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Product Data: Provide product testing and manufacturing information.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate installation and assembly instructions.

1.05 QUALITY ASSURANCE

- A. Perform in accordance with KYDOT standards , State of Kentucky.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum one years of experience.

1.06 COORDINATION

- A. Coordinate installation of anchorages for posts, railing, gates and hardware. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.07 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

1.08 PROJECT CONDITIONS

- A. Coordinate weed control fabric installation with size, location and installation of service utilities.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum 20 year manufacturer warranty for weed control fabric.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Fiberweb PLC: Biobarrier II Preemergence Weed Control System; Typar or Soil-Tex. 1-800-257-6687.
- B. DeWitt Company: 20 year Weed Barrier. 1-800-888-9669.
- C. DuPont: Landscape Max. 1-800-448-9835.
- D. Dalen Products Inc.: Commercial Grade Weed-X. 1-865-966-3256.
- E. Shaw Fabric Products: Lumite. 1-970-568-0488.
- F. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Material A: 100% spun polypropylene, non-woven, needle punched and heat set.

2.03 PRODUCT REQUIREMENTS

- A. Provide product test data to comply with all ASTM testing methods and values as listed:
 1. Unit weight per ASTM D5161 minimum 3.0oz/sy.
 2. Thickness per ASTM D5199 minimum 27 mm.
 3. Grab Tensile Strength per ASTM D-4632 130 lbs (575N) and Elongation at Break min. 55%.
 4. Puncture Strength per ASTM D-4833 30 lbs. minimum.
 5. Permittivity (flow rate) per ASTM D-4491 minimum 0.7 sec.
 6. Opening Size per ASTM D-4751 .64mm maximum
 7. Ultraviolet Stability per ASTM D-4355 70% at 500 hours min.
 8. Burst per ASTM D-3786 minimum 325 ppsi.

PART 3 EXECUTION**3.01 EXAMINATION****3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

3.03 INTERFACE WITH OTHER WORK

- A. Coordinate with concrete and paving contractor for placement of weed barrier prior to application of gravel paving and after placement of concrete utility pads, utility lines and utility structures as needed.

END OF SECTION

SECTION 329423 - PLANTER EDGING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Steel and Aluminum planting bed edging and accessories.

1.02 RELATED SECTIONS

- A. Section 312200: Grading.
- B. Section 329219: Seeding
- C. Section 329223: Sodding
- D. Section 329300: Plants

1.03 REFERENCES

- A. ASTM A-366: Test Method for cold-rolled commercial carbon steel sheet.
- B. ASTM A-359: Test Method for hot-rolled commercial carbon steel sheet.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product testing and manufacturing information.
- C. Samples: Submit one 4x8 inch, in size, illustrating edging material.
- D. Samples: Submit one steel installation stake.
- E. Certificates: Certify that products of this section meet or exceed specified requirements.
- F. Manufacturer's Instructions: Indicate installation and assembly instructions.

1.05 COORDINATION

- A. Coordinate installation of anchorages for posts, railing, gates and hardware. Furnish setting drawings, templates and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.06 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage and to protect against damage, weather, vandalism and theft.

1.07 PROJECT CONDITIONS

- A. Coordinate seeding, sodding and planting installation with finish grading.
- B. Sequence installation to ensure plantings are achieved in an orderly and expeditious manner.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for steel landscape edging and accessories.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Col-Met Steel Landscape Edging 1-800-829-8225.
- B. Dura-Edge Steel Landscape Edging. 1-800-888-7425.
- C. Sur-Loc Steel Edging. 1-800-787-3562.
- D. Border Concepts Steel Landscape Edging. 1-704-541-5509.
- E. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Material A: 3/16" thickness x 4"height x 10' length.

2.03 ACCESSORIES

- A. Steel Stakes: 12 ga. tapered steel stakes, 14" length.
 - 1. Provide side, end and corner stakes as required.

PART 3 EXECUTION**3.01 EXAMINATION****3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Back Fill on both sides of edging during installation. Do not allow unsupported sections to move out of alignment. Compact back fill along edging ensuring that top edge is no more than 1/2 inch above finish grade on both sides.

3.03 INTERFACE WITH OTHER WORK

- A. Coordinate with earthwork, concrete and building contractor paving contractor for placement of landscape edging prior to installation of plantings and mulching as needed.

END OF SECTION

SECTION 334100 - SUBDRAINAGE**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Building Perimeter and Retaining Wall Drainage Systems.
- B. Filter aggregate and fabric and bedding.

1.02 RELATED REQUIREMENTS

- A. Section 312316 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 312316.13 - Trenching: Excavating and backfilling for site subdrainage systems.
- C. Section 312323 - Fill: Backfilling over filter aggregate, up to subgrade elevation.

1.03 REFERENCE STANDARDS

- A. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- B. AASHTO M 252M AND M 294M - Corrugated PE Drainage Pipe and Fittings.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and connections to the storm water system.
- C. Product Data: Provide data on pipe drainage products, pipe accessories, and filter fabric.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

PART 2 PRODUCTS**2.01 PIPE MATERIALS**

- A. Dual Walled Corrugated Plastic Pipe: Rigid type; 4 inch minimum diameter or as shown on the drawings, 10-foot or 20-foot lengths, with required fittings.
 - 1. Refer to Specification Section 334101 for approved manufacturer's.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.02 AGGREGATE AND BEDDING

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 312323.

2.03 ACCESSORIES

- A. Filter Fabric: Water pervious type, black non-woven, polypropylene, 6oz minimum weight.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with pipe bedding.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place filter fabric on clean cut subsoil or top of footing as indicated.
- C. Place drainage pipe on filter fabric.
- D. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- E. Place aggregate in maximum 4 inch lifts, consolidating each lift.
- F. Refer to Section 312323 for compaction requirements. Do not displace or damage pipe when compacting.
- G. Wrap filter fabric over levelled top surface of aggregate cover with minimum of 12-inches of overlap prior to subsequent backfilling operations. In cases where retaining wall waterproofing are required, lap the loosened section of drainage panel filter fabric over the filter aggregate fabric.
- H. Connect to storm sewer system with unperforated pipe, through installed sleeves.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 334101 - SITE STORM DRAINAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storm drainage piping, fittings, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
- B. Section 334413.23 - Cleanouts and Drains
- C. Section 334413.13 - Catch Basin and Curb Inlets
- D. Section 334416 - Trench Drains
- E. Section 334419.13 - Storm Water Quality Structures
- F. Section 334903 - Storm Drainage Inlets and Outlets
- G. Section 334913 - Storm Drainage Manholes

1.03 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.04 REFERENCE STANDARDS

- A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2008.
- B. ASTM C 76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe [Metric]; 2008.
- C. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2005a.
- D. AASHTO M 252M AND M 294M - Standard Specification for Corrugated Polyethylene (PE) Drainage Pipe.
- E. ASTM F 667 - Standard Specification for Large Diameter Corrugated Polyethylene (PE) Pipe and Fittings.
- F. ASTM F 447 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- G. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and fittings.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents:
 - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Concrete Pipe: Reinforced, ASTM C 76 (ASTM C 76M), Class III with Wall type B; mesh reinforcement; inside nominal diameter as identified on the drawings, bell and spigot end joints. Approved manufacturers include:
 - 1. Cloud Concrete Products
 - 2. Forterra (formerly Sherman Dixie)
- B. Reinforced Concrete Pipe Joint Device: ASTM C 443 (ASTM C 443M) rubber compression gasket joint.
- C. Corrugated PE Drainage Pipe and Fittings: Type S, dual wall with smooth waterway for coupling joints and PE sleeve with gasket material that mates with pipe and fittings to make them watertight. Approved manufacturers are:
 - 1. Advanced Drainage Systems, Inc., N-12 Pipe (www.ads-pipe.com)
 - 2. Timewell, Dual Wall Pipe(www.timewelltile.com)
 - 3. Baughman Tile Company, Dual Wall Pipe (www.baughmantile.com)
 - 4. Hancor, Blue Seal Pipe (www.hancor.com)
 - 5. Prinsco, Goldflow WT (www.prinsco.com)
 - 6. J.M. Eagle- product Eagle Corr Dual Wall Watertight Pipe. (www.jmeagled.com)
 - 7. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wye, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trace Tape: Magnetic detectable conductor, clear plastic covering, imprinted with "Storm Sewer Service " in large letters.

2.03 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 312316.13.
- B. Cover: As specified in Section 312316.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 312316.13 for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.

- E. Install continuous trace wire 6 to 12 inches below finish grade, above pipe line; coordinate with Section 312316.13.

3.03 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Alignment: Piping where less than the full diameter of the inside of the pipe is not visible between structures will require replacement.
- D. Deflection Test: Piping with deflection that prevents passage of a ball or cylinder of size not less than 92.5 percent of piping diameter will require replacement.
- E. Piping that is crushed, cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- F. The contractor is to provide someone to remove and replace all grates or covers on storm water structures for any punch list visits that involve the storm water system.

3.04 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 334413.13 - CATCH BASINS AND CURB INLETS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Catch basins and Combination Inlets.
- B. Precast concrete catch basins with grates, frames and accessories .
- C. Monolithic FRP catch basins and inlets, frames, covers, anchorage, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Controls for temporary inlet protection

1.03 REFERENCE STANDARDS

- A. ASTM A 48/A 48M - Standard Specification for Gray Iron Castings; 2003.
- B. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- C. ASTM C 913 - Standard Specification for Precast Reinforced Concrete Water Structures; 2008.
- D. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- E. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.
- F. ASTM C 923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2007.
- G. ASTM D 3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells; 2005.
- H. ASTM D3753 - 05e1 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components .

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Pre-Cast Structure Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with resilient connectors complying with ASTM C 923 (ASTM C 923M).
- B. Polyester Structure Sections: ASTM D 3753, glass-fiber reinforced polyester .
- C. Approved Pre-Cast Concrete Manufacturers include:
 - 1. Oldcastle Precast

2. Forterra (formerly Sherman-Dixie)
 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.
- D. Approved Polyester Structure Manufacturers include:
1. Advanced Drainage Systems (ADS)
 2. HARCO
 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 CATCH BASIN AND CURB INLET COMPONENTS

- A. Concrete Structure Inlets:
1. Catch Basin:
 - a. Grate Design: Per the storm drainage structure schedule on the drawings.
 2. Combination Inlet:
 - a. Grate Design: Per the storm drainage structure schedule on the drawings.
 - b. Curb Opening: Cast iron curb section to match height and width of designed concrete curb. Cast curb section to be adjustable with stainless steel or hot-dipped galvanized adjustment bolts.
- B. Polyester Structure Inlets:
1. Area Drains (Landscaped Areas):
 - a. Grate Design: Per the storm drainage structure schedule on the drawings. All grates must meet or exceed H-20 loading.
 - b. Approved Manufacturers include:
 - 1) Harco PVC Drain Basins and In-Line Drains
 - 2) ADS Nyloplast Drain Basins and In-Line Drains
 - 3) Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.03 OTHER COMPONENTS

- A. Grate and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable grate, designed for H-20 loading; . Frames in pavement areas to allow for full asphalt pavement section to be located above the top of the concrete structure. Frames in landscape areas to be a minimum of 6-inches tall to allow for topsoil cover over top of concrete structure. Approved manufacturers include:
1. J.R. Hoe and Sons
 2. Neenah Foundry Co.
 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.
- B. Inlet Structure Steps: Formed Poly-Coated Steel rungs; 3/4 inch diameter. Formed integral with structure sections.

2.04 CONFIGURATION

- A. Shape: As identified in the storm structure schedule on the drawings.
- B. Clear Inside Dimensions: as required for piping layout shown with 48 inch minimum diameter for circular structures.
- C. Design Depth: As indicated.
- D. Clear Lid Opening: 24 inches diameter.
- E. Pipe Entry: Provide openings as required.

- F. Steps: 12 inches wide, 16 inches on center vertically, set into structure wall. Steps are required for all concrete structures that are 42-inches deep or deeper from grate elevation to the bottom of the structure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 INSTALLATION - CATCH BASINS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for inlets and outlets as indicated.
- C. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- D. Mount grate and frame level in grout, secured to top slab to elevation indicated. Grate elevations shown on the drawings are for the highest point on the grate for combination inlets, and are the elevation where water will enter the structure for catch basins.
- E. All lift hook holes are to be grouted flush with the face of the structure using a hydraulic, non-shrink grout that will provide a finish to match that of the structure.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 sections for field inspection and testing requirements.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Structures and castings that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- D. The contractor is to provide someone to remove and replace all grates or covers on storm water structures for any punch list visits that involve the storm water system.

3.05 SCHEDULES

- A. Storm Sewer Structures: See contract drawings for the storm structure schedule.

END OF SECTION

SECTION 334413.23 - CLEANOUTS AND DRAINS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Plaza Drains and Cleanouts.

1.02 RELATED REQUIREMENTS

- A. Section 0321313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. ASTM A 48/A 48M - Standard Specification for Gray Iron Castings; 2003.
- B. ASTM B 584-90 - Copper Alloy Sand Casting

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components .

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS**2.01 MATERIALS AND MANUFACTURERS**

- A. Concrete: As specified in Section 321313.
- B. Concrete Reinforcement: As specified in Section 321313.
- C. Bronze: Copper Alloy No. 844
- D. Approved Manufacturers include:
 - 1. Zurn Industries
 - 2. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 CLEANOUT AND DRAIN COMPONENTS

- A. Grates and Covers: Bronze , hinged to frame.
 - 1. Plaza Drain:
 - a. Lid Design: Bronze, Linear grill; Heel Safe and Traffic Duty
 - b. Nominal Lid and Frame Size: 6 inches diameter.
 - 2. Cleanout:
 - a. Lid Design: Bronze with tamper resistant set screws; Textured Surface; Traffic Duty
 - b. Nominal Lid and Frame Size: 4 inches diameter.

2.03 ACCESSORIES

- A. Concrete Pad: For components that are located in landscape areas, a concrete pad of a shape that matches that of the component is to be installed. The pad shall be constructed in accordance with the requirements for concrete sidewalks, be a minimum of 4-inches thick, and extend a minimum

of 12-inches beyond the outer edge of the component. Refer to Section 321313 for concrete information.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

- A. Coordinate placement of pipe and pavements required by other sections.

3.03 INSTALLATION

- A. Ensure pipe connections is adequately bedded and backfilled to prevent movement.
- B. Install component to proper elevation. Ensure top is level and protected against damage from concrete pad installation or other work.
- C. Where components are not located in paved areas, form and place cast-in-place concrete pad. Ensure the pad is finished per the sidewalk requirements with tooled edges, and is sloped for proper drainage away from the component.
- D. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.
- E. Clean and polish cover/grate to like new condition upon completion of work.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Components that are gouged, scratched, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- D. The contractor is to provide someone to remove and replace all grates or covers for any punch list visits that involve the storm water system.

END OF SECTION

SECTION 334416 - TRENCH DRAINS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Vehicular Area Trench Drains and Pedestrian Area Trench Drains.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Controls for temporary inlet protection
- B. Section 321313 - Concrete Paving.
- C. Section 321313 - Concrete Paving for trench drain concrete.

1.03 REFERENCE STANDARDS

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2002.
- B. ASTM D 3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Structures; 2005.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames and other components .

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Concrete: As specified in Section 321313.
- B. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
- C. Stainless Steel: Type 304 or 316
- D. Ductile Iron - Grade 304 65-45-12
- E. Approved Manufacturers:
 - 1. Aco-Drain
 - 2. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.

2.02 TRENCH DRAIN COMPONENTS

- A. Pedestrian Grates: Polymer Coated Cast Iron with tamper resistant fasteners; heel safe; 8 inch wide grate area; medium duty.
- B. Vehicular Grates: Cast Iron and bolt down; 14 inch wide grate area; traffic duty, H-20 loading.

- C. Trench Channel: pre-molded polyester or Fiber-reinforced resin with traffic duty H-20 load rating.

2.03 CONFIGURATION

- A. Clear Inside Dimensions: as required for grate and exit piping sizes shown above and on the drawings.
- B. Clear Inside Dimensions: As indicated.
- C. Design Depth: 8 inch minimum depth. Channel is to slope to outlet pipe at a minimum of 1%.
- D. Pipe Penetrations: Provide openings as required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 INSTALLATION

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete anchors as required by system manufacturer.
- C. Level top surface of base pad; sleeve concrete sections to receive storm sewer pipe sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Anchor pre-manufactured channel sections to prevent floating during concrete installation.
- F. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014000.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- C. Structures that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- D. The contractor is to provide someone to remove and replace all grates or covers on storm water structures for any punch list visits that involve the storm water system.

END OF SECTION

SECTION 334903 - STORM DRAINAGE OUTLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete headwalls with grates and accessories .

1.02 REFERENCE STANDARDS

- A. ASTM A 48/A 48M - Standard Specification for Gray Iron Castings; 2003.
- B. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- C. ASTM C 478M - Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric]; 2007.
- D. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.
- E. ASTM C 923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2007.

1.03 SUBMITTALS

- A. See Division 1 Sections for submittal procedures.
- B. Shop Drawings: Indicate structure identification designations, locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide structure data including configuration, grates, frames, steps and other components .

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pre-Cast Headwalls: Reinforced precast concrete in accordance with Kentucky Transportation Cabinet requirements.
- B. All headwalls are to be in compliance with Kentucky Transportation Cabinet requirements.
- C. Approved Pre-Cast Concrete Manufacturers include:
 - 1. Oldcastle Precast
 - 2. Sherman-Dixie
 - 3. Substitutions: As submitted for review and approved by architect by addendum during the bidding process.

2.02 HEADWALL COMPONENTS

- A. Grates: Rectangular steel bars, hot-dipped galvanized per Kentucky Transportation Cabinet standard drawings. Grates are to have security chains attaching them to the structure.
- B. Screens: Perforated pipe headwalls are to have stainless steel or galvanized rodent screens installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.

- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for structure is correct.

3.02 PREPARATION

- A. Coordinate placement of pipe required by other sections.

3.03 INSTALLATION - HEADWALLS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Establish elevations and pipe inverts for outlets as indicated.
- C. Set grate in recessed notches formed into the headwall wing walls, secure to top headwall with galvanized chain of a length that will allow removal for inspection.
- D. All lift hook holes are to be grouted flush with the face of the structure using a hydraulic, non-shrink grout that will provide a finish to match that of the structure.
- E. Coordinate with other sections of work to provide correct size, shape, and location.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Structures that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- C. The contractor is to provide someone to remove and replace all grates for any punch list visits that involve the storm water system.

3.05 SCHEDULES

- A. Storm Sewer Headwalls: Refer to the storm structure schedule shown on the Contract Drawings.

END OF SECTION

SECTION 334913 - STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modular precast concrete manhole sections with tongue-and-groove joints covers, anchorage, and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 015713 - Temporary Erosion and Sediment Controls for temporary inlet protection

1.03 REFERENCE STANDARDS

- A. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International; 2005.
- B. ASTM A 48/A 48M - Standard Specification for Gray Iron Castings; 2003.
- C. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2007.
- D. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2007.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping sizes and elevations of penetrations.
- C. Product Data: Provide manhole covers, component construction, steps, features, configuration, and dimensions.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C 478 (ASTM C 478M), with resilient connectors complying with ASTM C 923 (ASTM C 923M).

2.02 COMPONENTS

- A. Lid and Frame: ASTM A 48/A 48M, Class 30B Cast iron construction, machined flat bearing surface, removable lid, scheduled lid design; live load rating of H-20; lid molded with identifying name ;.
 - 1. Solid lids shall have the designation of "STORM" cast into the lid.
- B. Manhole Steps: #4 Bar with formed Copolymer Polypropylene Plastic coating rungs; 3/4 inch diameter. Formed integral with manhole sections.

2.03 CONFIGURATION

- A. Shaft Construction: Concentric with eccentric cone top section as required; lipped male/female joints; sleeved to receive pipe sections. Top slab opening is to be per the drawings and steps are to be aligned with the lid/grate opening.

- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As required for shown pipe sizes and configurations. Structure diameter is to remain consistent from the bottom section to the cone or top slab that supports the casting.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: 24 inches diameter minimum.
- F. Steps: 12 inches wide, 16 inches on center vertically, set into manhole wall. Steps are required for all structures that are 36-inches deep or deeper from grate/lid to bottom of structure. Top manhole step is to be no more than 24-inches from the lid/grate elevation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 MANHOLES

- A. Place concrete base pad, trowel top surface level.
- B. Place manhole sections plumb and level, trim to correct elevations and anchor as necessary.
- C. Cut and fit for pipe.
- D. Seal section and top joints with Conseal Sealant or approved equivalent.
- E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- F. Set cover frames and covers level without tipping, to correct elevations.
- G. Coordinate with other sections of work to provide correct size, shape, and location.
- H. Grout pipes to structure.

3.04 FIELD QUALITY CONTROL

- A. See Division 1 Sections for general requirements for testing and inspections.
- B. Structures that are cracked, broken or otherwise damaged will require repair or replacement as determined by the Architect.
- C. The Contractor shall provide someone to remove and replace all grates for any punch list visits that involve the storm water system. Contractor shall also provide all required equipment needed to meet OSHA confined space requirements associated with inspecting the drainage structure.

END OF SECTION

SECTION 334993 - DOWNSPOUT BOOTS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Stainless Steel downspout boots.
 - 1. Contractors to provide stainless steel downspout boots.

1.02 RELATED REQUIREMENTS

- A. Section 334101 - Site Storm Utility Drainage Piping.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; 2005.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2005.

1.04 DESIGN REQUIREMENTS

- A. Conform to applicable code for size and method of rain water discharge.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- C. Product Data: Provide data on prefabricated components.
- D. Coordination Data: Provide table of downspout boots and their corresponding downspout size. Table should show boot top opening dimensions, downspout dimensions, boot length, boot outlet size and subsurface drainage pipe/fitting size.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Stainless Steel Downspout Boots: Subject to compliance with requirements, manufacturers offering the following products that may be incorporated into the work include:
 - 1. Basis of Design: Design concept and the drawings indicate the size, profiles, dimensional requirements and aesthetics of the following:
 - a. Stainless Steel: Piedmont Manufacturing - Type SO for connection for connection to underground piping.
 - 2. Products by other manufacturers (listed below) may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect:
 - a. Or equal approved through addendum prior to bidding.

2.02 MATERIALS

- A. Stainless Steel: ASTM A666 Type 304, soft temper, 12 gauge thick.
 - 1. Length: As needed to have 24" above grade and a minimum of 6" below grade.

2. Size: Coordinate with downspout sizes on Architectural plans
3. Finish: Powder coat
4. Color: Manufacturer's standard color choices

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.02 PREPARATION

- A. All non-factory painted downspout boots are to receive one coat of primer and two coats of finish color paint prior to installation. A minimum of one additional coat of finish color paint is to be applied after installation. Any damage to paint or boot is to be repaired to like new condition. Paint color is to match downspouts as selected by Architect.

3.03 INSTALLATION

- A. Install downspouts and accessories in accordance with manufacturer's instructions.
- B. Connect downspouts to downspout boots at 24" above grade. Seal connection watertight.
- C. Connect downspouts to storm sewer system with the pipe connection and sleeve being completely below grade. Boot is to extend below grade a minimum of 6-inches. Offset of downspout boot is to be completely below finished grade. Seal connection watertight.
- D. Where downspout boots extend through concrete pavement, protect boot from concrete using plastic or other protective material for the entire height of the boot. If concrete materials come into contact with the downspout boot, removal and replacement of the boot may be required. Remove plastic protection after concrete work has been completed.
- E. Where downspout boots extend through concrete pavement, provide isolation joint material around the boot. After concrete installation, remove top 1/2-inch of isolation joint material and install joint sealant in accordance with Section 321373- Pavement Joint Sealants.

END OF SECTION