

**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. 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
- C. 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
- D. 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

**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 116833.23**  
**ATHLETIC EQUIPMENT -FIELD**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Provide all equipment and materials, and do all work necessary to furnish and install the athletic equipment, as indicated on the drawings and as specified herein. Athletic equipment shall include, but not be limited to:
  - 1. Baseball/Softball Net Replacement
  - 2. Softball bases, plates and pitching rubbers
  - 3. Baseball bases, plates and pitching rubbers
  - 4. Softball Pitching Mound Forming System
  - 5. Baseball Pitching Mound Forming System
  - 6. Softball Batters Box Forming System
  - 7. Baseball Batters Box Forming System
  - 8. Softball foul line poles
  - 9. Softball Batters Eye
  - 10. Backstop Wall Padding
  - 11. Modular Padded Lean Rail
  - 12. Tensioned Net Batting Tunnel

**1.02 RELATED WORK**

- A. Examine contract documents for requirements that affect work of this section. Other specification sections that directly relate to the work of this section include, but are not limited to:
  - 1. Section 033000 - Cast-In-Place Concrete
  - 2. Section 042000 - Unit Masonry
  - 3. Section 079005 - Joint Sealers
  - 4. Section 312200 - Grading
  - 5. Section 312316 - Excavation
  - 6. Section 312323 - Fill
  - 7. Section 321313 - Concrete Paving

**1.03 REFERENCES**

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
  - 1. National Federation of State High School Associations (NFHS)
  - 2. International Amateur Athletic Association (IAAF)
  - 3. American Sports Builders Association (ASBA)
  - 4. Manufacturers Data and Recommended Installation

**1.04 SUBMITTALS**

- A. Manufacturers Product Data
  - 1. Provide manufacturers product data prior to actual field installation work, for Architects or Owners representatives review.
- B. Shop Drawings
  - 1. Provide drawings of the manufacturers recommended installation and foundation requirements prior to actual field installation work, for Architect's or Owner's representatives review.
  - 2. Provide color options/ samples where applicable for Architect's or Owner's representatives review.
  - 3. Provide Kentucky professional engineer stamped and sealed design drawings and calculations for all items as requested below.



**1.05 QUALITY ASSURANCE**

- A. Manufacturers warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

**1.06 PRODUCT DELIVERY AND STORAGE**

- A. Materials delivered to the site shall be examined for damage or defects in shipping. Any defects shall be noted and reported to the Owners representative. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule. Sound materials shall be stored above ground under protective cover or indoors so as to provide proper protection.

**PART 2 PRODUCTS****2.01 All products and components contained in this specificaiton section are to be provided by a single supplier.****2.02 BASEBALL AND SOFTBALL REPLACEMENT NETTING**

- A. Basis of Design: BSSNUC Ultra Cross Dyneema UHMWPE Netting and accessories as manufactured by Sportsfield Specialties Inc., PO Box 231, 41155 State Highway 10, Delhi NY 13753, p. 888-975-3343, f.607-746-8481, www.sportsfieldspecialties.com.
  - 1. Other manufacturers of equal or similar systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  - 1. Tension Ball Safety Netting System Net and Rope Bound Border:
    - a. Length, Height and Configuration as Required to replace the existing netting systems.
    - b. BSSNUC Ultra Cross Knotless Dyneema Netting:
      - 1) Ultra Cross Knotless Netting
      - 2) Dyneema® Ultra-High Molecular Weight Polyethylene (UHMWPE) SK-75 Black Fiber Construction
      - 3) 4 Ply, 1.2 mm (0.0472") Diameter Twine
      - 4) 58,445 psi Minimum Breaking Strength
      - 5) 30% Maximum Elongation at Break
      - 6) 1-3/4" (44 mm) Square Mesh Size, 0.009 lbs. per Square Foot
      - 7) 4-Strand, Braided, Continuous Monofilament Dyneema® Fiber
      - 8) Black Multi-Filament Polypropylene Solid Braid Derby Rope Sewn Binding on Perimeter Edges - 1/4" Diameter, 530 lb. Minimum Breaking Strength
      - 9) Urethane Black Bonded Finish
      - 10) Strong Resistance to Ultraviolet (UV) Light Degradation
      - 11) Excellent Resistance to Chemicals and Water Absorption
  - 2. Included Accessories:
    - a. Stainless Steel and/or Hot Dipped Galvanized Attachment and Assembly Hardware - Quantities, Sizes and Configurations as Required
    - b. Black Multi-Filament Polypropylene Solid Braid Derby Rope For Net Binding Attachment to Wire Rope Support Structure - 1/4" Diameter, 530 lb. Minimum Breaking Strength – Quantities and Configurations as Required.

**2.03 SOFTBALL BASES**

- A. All bases, plates and pitching rubbers are to be from a single manufacturer and supplier.
- B. Second, and Third Base:
  - 1. Basis of Design: Schutt Hollywood Impact Bases for Synthetic Turf Application.
  - 2. Material:

- a. Whitened natural molded rubber
    - b. Steel Stanchion.
    - c. Non-break away style.
  - 3. Dimensions:
    - a. 15 inches x 15 inches square
    - b. 2-5 inches thick. Tapered edges are permissible.
  - 4. Accessories:
    - a. Hollywood ground anchors.
- C. First Base: (double style)
  - 1. Basis of Design: Schutt Hollywood Impact Double 1st Base for Synthetic Turf Application.
  - 2. Dimensions:
    - a. 15 inches x 30 inches, two-piece unit.
    - b. Color: white on one side, non-white in foul territory.
  - 3. Material:
    - a. Whitened natural molded rubber
  - 4. Accessories:
    - a. Hollywood ground anchors
- D. Home Plate/ Base:
  - 1. Basis of Design: Schutt Hollywood Bury All Home Plate for Synthetic Turf Application.
  - 2. Dimensions
    - a. 5-sided
    - b. 17-inch square with two corners filled in so that one edge is 17 inches long, two are 8 1/2 inches long, and two sides are 12 inches long.
  - 3. Material: Slab of whitened rubber or other material as approved by Architect.
  - 4. Placement: flush with ground in fair territory with the two 12-inch edges coinciding with the foul lines extending from home home plate to first base and third base, and with the 17-inch edge facing the pitcher's plate.
- E. Pitching Rubber for Synthetic Turf Application:
  - 1. Basis of Design: Shutt Holleywood MLB Four Sided Pitching Rubber, 24" x 6"
  - 2. Dimensions:
    - a. Rectangular shape, 24 inches x 6 inches (4-sides).
  - 3. Material:
    - a. Durable molded rubber construction around an Aluminum Cylindrical tube lining to be filled with dirt or concrete in the field.
  - 4. Placement:
    - a. Fill core with compacted clay or concrete. Set in ground with top flush with the playing surface at the specified elevation.
- F. Accessories:
  - 1. Base Plugs for all removable bases and plates
  - 2. Dig Out Tool
- G. Manufacturers:
  - 1. Basis of Design as indicated above.
  - 2. Other manufacturers of equal or similar systems may be submitted for review and approval by Architect by addendum during the bidding phase.

## 2.04 BASEBALL BASES

- A. First, Second, and Third Base for Synthetic Turf Application:
  - 1. Basis of Design: Schutt Hollywood Impact Bases
  - 2. Material:
    - a. Whitened natural molded rubber
    - b. Steel Stanchion.
    - c. Non-break away style.

3. Dimensions:
    - a. 15 inches x 15 inches square
    - b. 2-5 inches thick. Tapered edges are permissible.
  4. Accessories:
    - a. Hollywood ground anchors.
- B. Home Plate/Base for Synthetic Turf Application:
1. Basis of Design: Schutt Hollywood Bury All Home Plate
  2. Dimensions:
    - a. 5-sided
    - b. 17-inch square with two corners filled in so that one edge is 17 inches long, two are 8 1/2 inches long, and two sides are 12 inches long.
  3. Material: Slab of whitened rubber or other material as approved by Architect.
  4. Placement: flush with ground in fair territory with the two 12-inch edges coinciding with the foul lines extending from home plate to first base and third base, and with the 17-inch edge facing the pitcher's plate.
- C. Pitching Rubber for Synthetic Turf Application:
1. Basis of Design: Schutt Hollywood MLB Four Sided Pitching Rubber, 24" x 6"
  2. Dimensions:
    - a. 24" long x 6" wide four sided professional pitching rubber.
  3. Material:
    - a. Durable molded rubber construction around an Aluminum Cylindrical tube lining to be filled with dirt or concrete in the field.
  4. Placement:
    - a. Set in ground with top flush with the playing surface.
- D. Accessories:
1. Base Plugs for all removable bases and plates
  2. Dig Out Tool
- E. Manufacturers:
1. Basis of Design as indicated above.
  2. Other manufacturers of equal or similar systems may be submitted for review and approval by Architect by addendum during the bidding phase.

## 2.05 SOFTBALL PITCHING MOUND FORMING SYSTEM

- A. Softball Pitching Mound Form:
1. Basis of Design: Softball Pitching Mound Forming System, Model # PMFSS as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
    - a. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
  2. Mound forming system is required for softball game field and each bullpen location shown.
  3. Components:
    - a. Welded Construction, Fabricated of 1/8" Aluminum Sheet Structure
    - b. Two (2) Piece Welded Form Sections with Bolted Connections
    - c. Notched Cutouts for Rebar Bracing and Stake Holes for Rebar Anchoring
    - d. 8' Radius Per Specifications, Rules and Requirements
    - e. Rear Form Section is to include two (2) 1/2" Sch. 40 Aluminum Drainage Pipes and Removable Pitching Rubber Tray with Four (4) 3/4" Aluminum Round Stock Threaded Studs with 3/8" Stainless Steel Bolts for Pitching Rubber Height Adjustment
    - f. Include Replaceable SHBBPB Schutt® Four-Sided Professional Pitching Rubber. Refer to Part 2.04 of this specification for additional information on pitching rubber.
    - g. Is to include Synthetic Infill Turf Attachment Ledges

- h. Include Factory Pre-Installed 2" x 4" Synthetic Wood Nailer Boards Around the Outside Perimeter of the Form Sections for Synthetic Turf Attachment Purposes.
- i. Include 3/4-inch thick Roll Out Rubber Underlayment for High Traffic Areas
- j. Provides a Synthetic Turf Replacement Size is 48"W x 121"L

## 2.06 BASEBALL PITCHING MOUND FORMING SYSTEM

- A. Game Field Baseball Pitching Mound Form:
  - 1. Basis of Design: Baseball Pitching Mound Forming System, Model # PMFSB as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
    - a. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
  - 2. Mound forming system is required for baseball game field each bullpen locaiton shown.
  - 3. Components:
    - a. Welded Construction, Fabricated of 1/8" Aluminum Sheet Structure and 1/4" x 4" Aluminum Bar Outer Ring Rolled to an 18' Outside Diameter.
    - b. Official Size 18' Outside Diameter with a Center Section Height of 10" Above Finish Grade and Sloped 1" Vertical Per 1' Horizontal Per Specifications, Rules and Requirements.
    - c. Five (5) Welded Form Sections; Four (4) Corner Sections and One (1) Center Section with Bolted Connections.
    - d. Notched Cutouts for Rebar Bracing and Stake Holes for Rebar Anchoring.
    - e. Center Section is to Includes Two (2) 1/2" Sch. 40 Aluminum Drainage Pipes and Removable Pitching Rubber Tray with Four (4) 3/4" Aluminum Round Stock Threaded Studs with 3/8" Stainless Steel Bolts for Pitching Rubber Height Adjustment.
    - f. Two (2) Rear Mound Slope Profile Guides Fabricated of 1/8" Aluminum Sheet with Bolted Connections.
    - g. Is to include Replaceable SHBBPB Schutt® Four-Sided Professional Pitching Rubber. Refer to Part 2.05 of this specificaliton for attitional information on pitching rubber.
    - h. Is to include Synthetic Infill Turf Attachment Ledges
    - i. Include Factory Pre-Installed 2" x 4" Synthetic Wood Nailer Boards Around the Outside Perimeter of the Four (4) Corner Form Sections for Synthetic Turf Attachment Purposes.
    - j. Include 3/4-inch thick Roll Out Rubber Underlayment for High Traffic Areas
    - k. Provides a Synthetic Turf Replacement Center Section Size is 60"W x 135"L
- B. Bullpen Baseball Mound Forming System.
  - 1. Single Bullpen Pitching Mound Forming System
    - a. Basis of Design: Baseball Pitching Mound Forming System, Model # PMFSBPS as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  - 2. Double Bullpen Pitching Mound Forming System
    - a. Basis of Design: Baseball Pitching Mound Forming System, Model # PMFSBPD as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  - 3. Components:
    - a. Welded Construction, Fabricated of 1/8" Aluminum Sheet Structure
    - b. Knock Out Perforations for Concrete Flow in Multi-Mound Systems
    - c. Front and Rear Spacing Brackets for Multi-Mound Systems, Adjustable from 5' to 10' (for double bullpen pitching mound forming systems only).

- d. Center Section Height of 10" Above Finish Grade and Sloped 1" Vertical Per 1' Horizontal Per Specifications, Rules and Requirements
- e. Three (3) Piece Welded Form Sections with Bolted Connections
- f. Notched Cutouts for Rebar Bracing and Stake Holes for Rebar Anchoring
- g. Center Section Includes Two (2) ½" Sch. 40 Aluminum Drainage Pipes and Removable Pitching Rubber Tray with Four (4) ¾" Aluminum Round Stock Threaded Studs with 3/8" Stainless Steel Bolts for Pitching Rubber Height Adjustment
- h. Is to include replaceable SHBBPB Schutt® Four-Sided Professional Pitching Rubbers for each location shown on the drawings.
- i. Is to include Synthetic Infill Turf Attachment Ledges.
- j. Is to include ¼" Roll Out Rubber Underlayment for High Traffic Areas.
- k. Provides a Synthetic Turf Replacement Center Section Size is 58"W x 152"L.

## **2.07 SOFTBALL BATTER'S BOX FORMING SYSTEM:**

- A. Softball Batters Box Form:
  - 1. Basis of Design: Softball Batter's Box Forming System, Model # BBFSS as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, www.sportsfieldspecialties.com
    - a. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
  - 2. Batter's Box forming system required for softball game field and bullpens.
  - 3. Components:
    - a. Measures 17'L x 8'-5"W x 6"H
    - b. Welded Construction; Fabricated of 1/8" Aluminum Sheet with One (1) ½" Sch. 40 Aluminum Drainage Pipe and Five (5) ¾" Aluminum Round Stock Threaded Studs with 3/8" Stainless Steel Bolts for Home Plate Tray Height Adjustment
    - c. Three (3) Piece Welded Form Sections with Bolted Connections
    - d. Notched Cutouts for Rebar Bracing and Stake Holes for Rebar Anchoring (Rebar by Others)
    - e. Removable and Height Adjustable Home Plate Tray, Fabricated of 1/8" Aluminum Sheet
    - f. Include Replaceable SHSRHP Schutt Hollywood Bury All Home Plate
    - g. Include Synthetic Infill Turf Attachment Ledges
    - h. Include Factory Pre-Installed 2" x 4" Synthetic Wood Nailer Boards Around the Outside Perimeter of the Form Sections for Synthetic Turf Attachment Purposes
    - i. Include ¼" Roll Out Rubber Underlayment for High Traffic Areas
    - j. Include HPFSCP Removable Cover Plug: 1/8" (0.125") Aluminum Sheet with 1.5" Square Aluminum Support Structure.

## **2.08 BASEBALL BATTER'S BOX FORMING SYSTEM:**

- A. Baseball Batters Box:
  - 1. Basis of Design: Baseball Batter's Box Forming System, Model # BBFSB as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, www.sportsfieldspecialties.com
    - a. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
  - 2. Batter's Box forming system required for baseball game field and bullpens.
  - 3. Components:
    - a. Welded Construction; Fabricated of 1/8" Aluminum Sheet with One (1) ½" Sch. 40 Aluminum Drainage Pipe and Five (5) ¾" Aluminum Round Stock Threaded Studs with 3/8" Stainless Steel Bolts for Home Plate Tray Height Adjustment
    - b. Four (4) Piece Welded Form Sections with Bolted Connections

- c. Notched Cutouts for Rebar Bracing and Stake Holes for Rebar Anchoring (Rebar by Others)
- d. Removable and Height Adjustable Home Plate Tray, Fabricated of 1/8" Aluminum Sheet
- e. Include Replaceable SHSRHP Schutt Hollywood Bury All Home Plate
- f. Include Synthetic Infill Turf Attachment Ledges
- g. Include Factory Pre-Installed 2" x 4" Synthetic Wood Nailer Boards Around the Outside Perimeter of the Form Sections for Synthetic Turf Attachment Purposes
- h. Include 1/4" Roll Out Rubber Underlayment for High Traffic Areas
- i. Include i. HPFSCP Removable Cover Plug: 1/8" (0.125") Aluminum Sheet with 1.5" Square Aluminum Support Structure.

## 2.09 SOFTBALL FOUL POLES

- A. Basis of Design: Sleeve Mounted 20 Ft. Foul Pole with Wing, Model # LGFPW420 as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  - 1. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  - 1. Material: 4 inch O.D. x .125 inch wall 6061 Aluminum Tube
  - 2. Height: 20 feet above ground height
  - 3. Color: Powder Coated, High Visibility Yellow for Baseball, White for Softball.
  - 4. Ground Sleeve: Fabricated with 4.30 inch O.D. (4.10 inch I.D.) Aluminum Tube
    - a. 4 feet length
    - b. Aluminum Mill Finish
    - c. Provide Ground Sleeve Caps
  - 5. Mesh Wing: Fabricated of .125 inch Aluminum panel.
    - a. Stamped Mesh, 1.50 inch x 1.50 inch punchouts
    - b. 18 inches wide x 18 feet long from the top of the upright pole.
    - c. Double reinforced bents, welded at corners
    - d. Powder Coated to match
  - 6. Accessories: Stainless Steel Assembly Bolts and Nuts

## 2.10 SOFTBALL BATTERS EYE

- A. Basis of Design: 20' x 40' Single Sided Solid Surface Batter's Eye with Flush Profile Wall Panels and Accessories, Model #BESF2040S as Manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  - 1. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  - 1. Overall System Dimensions: 20'H x 40'W
    - a. Panel Height: 16'-4"
  - 2. Vertical Structure:
    - a. Exterior and Interior Columns:
      - 1) W8x24 Steel I-Beams
      - 2) Powder Coated Finish
        - (a) Owner to select color from manufacturer's full line of available colors.
    - b. 20-foot height above finished grade.
    - c. Embedment Depth: Foundation to be designed and submitted by manufacturer.
  - 3. Horizontal Structure:
    - a. Top and Bottom Beams:

- 1) W8x13 Steel I-Beam
- 2) Powder Coated Finish
  - (a) Owner to select color from manufacturer's full line of available colors.
- b. Horizontal Girts:
  - 1) 4" Square x 11ga Steel Tube
  - 2) Bolted to Welded Steel Angles
  - 3) Spacing: 5'-4" o.c.
  - 4) Powder Coated Finish
    - (a) Owner to select color from manufacturer's full line of available colors.
4. Wall Panels (Front Side Only):
  - a. Flush-Profile Concealed Fastener Metal Wall Panels
    - 1) MCBI® FW-120 12" W 24 Gauge Smooth Surface Metal Panels
    - 2) Galvalume® Coated with Signature 300® Two-Coat Fluoropolymer Finish
    - 3) Finish Available in Various Standard Colors
      - (a) Exposed Rear of Panels are Bare Primer White
    - 4) Panels Field Assembled with Lapped Edges
    - 5) Fastened to Horizontal Girts with Concealed Fasteners Painted to Match Paneling
  - b. Top, Bottom and Side Metal Trim with Attachment Hardware Included (Front Side Only)
5. Side Wind Shield and All Necessary Assembly Hardware
6. Manufacturer to Provide Stamped and Sealed Drawings and Calculations by a Licensed Professional Engineer of Record in the State of Project Location.

## 2.11 BACKSTOP WALL PADDING:

- A. Basis of Design: BaseZone® Field Wall Padding and Accessories, Model #FWPZHIXX as Manufactured by: Promats Athletics, LLC, P.O. Box 2489, Salisbury, NC 28145, p:1-800-617-7215, [www.promatsathletics.com](http://www.promatsathletics.com)
  1. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  1. Field Wall Padding
    - a. 3" Thick High Impact Polyurethane Foam.
    - b. 5/8" Water Resistant Composite Wood Panel, Primed, Stained and Sealed on all sides.
    - c. 18 oz. High UV Vinyl Fabric:, 5-year limited Fade Warranty.
      - 1) 1000 Denier Polyester Basic Fabric
      - 2) Tear Strength Test: Warp 78lbs; Fill 65 lbs.
      - 3) Tensile Strength: Warp 224 lbs., Fill 220 lbs.
      - 4) Weft Insertion: 9 x 9, Superior UV Inhibitors
      - 5) Cold Crack: Minus 20° Fahrenheit
      - 6) Vinyl Seams Double Stitched Using 6 lb. Bonded Polyester Black Thread
      - 7) Vinyl Color to be selected from Manufacturer's full range of colors.
    - d. Stainless Steel Assembly Hardware, Stables, T-Nuts, Bolts
    - e. Mounting: Removable; Z-clips fixed to wall and to backing board. 2.5" x .125" thickness, mounted to panel using 1/4" x 3/4" stainless steel bolts screwed into 1/4" threaded washer inserts
    - f. 1 Year Limited Warranty
    - g. Height to fit between wall cap and finished grade:
      - 1) Baseball Wall Padding: Hold bottom 4-inches minimum and 5-inches maximum above grade for Baseball.

- 2) Softball Wall Padding: Hold bottom 1-inch minimum and 2-inches maximum above grade for Softball.

## 2.12 MODULAR LEAN RAIL

- A. Basis of Design: 3'-6" Height Guard Rail System, Model # GRS42 as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  1. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  1. Modular Steel Structure
    - a. 2" x 2", 11 Gauge Steel Tube Frame
    - b. 7"x7", 3/8" thick base plate.
    - c. Stainless Steel Assembly Hardware
    - d. Finish to be powder coated black.
  2. Chain Link Mesh
    - a. Length, Height and Configuration as Required
    - b. Fabric: 2 inch diamond mesh interwoven wire, 6 gage thick, top selvage knuckle end closed, bottom selvage knuckle end closed. All fabric to be Aluminum - Coated Steel Fabric (Aluminized): ASTM A491.
    - c. Components and Fabric Finish: Vinyl coated over coating of 1.8 oz/sq ft galvanizing.
    - d. Hardware: Vinyl coated hardware for fabric attachment to modular lean rail structure.
  3. Guard Rail Top, Mid and Bottom Rail Padding.
    - a. Guard Rail Top Rail High Profile Padding Overall Dimensions: 6-1/8" x 6-3/4" (WxH), Length as required.
    - b. Guard Rail Mid and Bottom Rail Padding Overall Dimensions: 6"x2" (WxH), Length as required.
    - c. 1-1/4" Thick High Impact Polyurethane Foam.
    - d. 3/4" Water Resistant Composite Wood Panel, Primed, Stained and Sealed on all sides.
    - e. 18 oz. High UV Vinyl, 5-year limited Fade Warranty.
      - 1) 1000 Denier Polyester Basic Fabric
      - 2) Tear Strength Test: Warp 78lbs; Fill 65 lbs.
      - 3) Tensile Strength: Warp 224 lbs., Fill 220 lbs.
      - 4) Weft Insertion: 9 x 9, Superior UV Inhibitors
      - 5) Cold Crack: Minus 20° Fahrenheit
      - 6) Vinyl Seams Double Stitched Using 6 lb. Bonded Polyester Black Thread
      - 7) Vinyl Color to be selected from Manufacturer's full range of colors.

## 2.13 TENSIONED NET BATTING TUNNEL

- A. Basis of Design: Overhead Baseball Double Batting Tunnel, Model # BTOBD as manufactured by: Sportsfield Specialties Inc., P.O. Box 231, 41155 State Highway 10, Delhi, NY 13753, p. 888-975-3343, f. 607-746-8481, [www.sportsfieldspecialties.com](http://www.sportsfieldspecialties.com)
  1. Other manufacturers of equal systems may be submitted for review and approval by Architect by addendum during the bidding phase.
- B. Components:
  1. Overhead Baseball Double Batting Tunnel:
    - a. Fifteen (15) Upright Poles Fabricated of 4" Aluminum (4" O.D. x 0.125" Wall) Tube
      - 1) Alignment Notch
    - b. Ten (10) Crossbars Fabricated of 4" Aluminum (4" O.D. x 0.125" Wall) Tube



- c. Ground Sleeve:
  - 1) 30" Depth
  - 2) Aluminum Construction
  - 3) Welded Leveling Plate
  - 4) Alignment Bolt
  - 5) Press Fit Ground Sleeve Plug
- d. Fixed Net Stabilizer Extension Arms Fabricated of 3/8" Steel Plate x 18"L
- e. Super Durable Black Powder Coated Finish
  - 1) Enhanced Resistance to UV
- f. Two (2) 13'H x 14'W x 75'L Baseball Nets
  - 1) #36 Black Nylon 1-3/4" Square Mesh Net
    - (a) #36 Twisted Knotted Netting
    - (b) 100% Nylon Construction
    - (c) 2.6mm (0.1023") Diameter Twine
    - (d) 87% Open Mesh Area (See-Through Visibility)
    - (e) 13,363 psi Minimum Breaking Strength
    - (f) 1-3/4" (44mm) Maximum Square Mesh Size
    - (g) 0.0425 lbs. per Square Foot
    - (h) Black Multi-Filament Polypropylene Solid Braid Derby Rope  
Sewn Binding on Perimeter Edges – 1/4" Diameter, 530 lb.  
Minimum Breaking Strength
    - (i) UV and Weather Treated
  - 2) Two (2) 4'W x Full Height Openings with Curtain Style Exterior Overlap Flaps
  - 3) Weighted Rope Bottom
    - (a) Factory-Sewn / Integrated into Batting Tunnel
    - (b) Flexible / Easy to Handle
    - (c) 2,000 lbs. Average Strength
    - (d) 250 lbs. per 100 Fathoms Material Weight (0.42 lbs/ft)
- g. Fully Retractable Double Pulley System
- h. Model Specific Hardware Kit and Installation Instructions

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF EQUIPMENT**

- A. All athletic equipment shall be installed as recommended with manufacturer's written directions, and as indicated on the drawings.

**END OF SECTION**

**SECTION 220000 - GENERAL PROVISIONS FOR PLUMBING****PART 1 - GENERAL****1.1 SCOPE**

- A. Special Conditions section and General Requirements section are made part of this Division.
- B. This Division includes the sections, but not necessarily limited to, listed in the Division Table of Contents.

**1.2 GENERAL**

- A. The work included in this division consists of furnishing 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.
- B. 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.
- C. It is the intent of this Contract to deliver to the Owner's 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 items which interfere with the new work required for the complete installation without additional cost to the Owner.

**1.3 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.

**1.4 EXAMINATION OF SITE AND CONDITIONS**

- A. Each Proposer shall inform himself of all 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.

**1.5 DRAWINGS AND SPECIFICATIONS**

- A. The drawings are diagrammatic only and indicate the general arrangement of the work 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 parties 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. 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 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 drawings only indicate approximate locations of equipment, piping, 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 insure no conflict with other work.
- H. 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.
- I. 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.
- J. Where on the Contract Documents 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.
- K. 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.

#### 1.6 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

- A. By execution of this Contract, the Contractor warrants that he has visited the site of the proposed work, and fully acquainted himself with the conditions there existing relating to construction and labor and that he fully understands the facilities, difficulties, and restrictions attending the execution of the work under Contract. The Contractor further warrants that he has thoroughly examined and is familiar with the

drawings, specifications and all other documents comprising the Contract. The Contractor further warrants that by execution of this Contract, his failure, when he was bidding on this Contract, to receive or examine any form, instrument, or document, or to visit the site and acquaint himself with the conditions there existing, in no way relieves the Contractor. The Contractor agrees that the Owner shall be justified in rejecting any claim based on facts regarding conditions for which he should have been on prior notice.

- B. Before ordering material or performing any work, the Contractor shall verify all measurements at the work site. Any difference between dimensions on the Drawings and actual measurements shall be brought to the Engineer's attention for his consideration before the work may proceed. No extra compensation will be allowed because of difference between actual measurements and dimensions indicated on the Drawings. The Contractor shall assume full responsibility for accuracy of measurements obtained at the Work Site.
- C. Dimensions, which are lacking, shall be obtained from the Architect. In no case shall Drawings be scaled.
- D. All subcontractors shall familiarize themselves with all of the conditions relating to this Contract since the terms set forth in the General Conditions binds all subcontractors to the Contract.

#### 1.7 STRUCTURAL RESPONSIBILITY

- A. This contractor, in performing installation of his equipment and related work, shall be responsible for properly bracing, supporting, etc., any construction to guard against cracking settling, collapsing, displacing or weakening. No structural member shall be cut or otherwise weakened in any manner without the expressed consent of the Architect/Engineer.

#### 1.8 WORK LAYOUT

- A. This contractor shall layout his work from construction lines and levels established by the General Contractor and shall be responsible for the proper location and placement of his work.
- B. Maintain all benchmarks, monuments, and other reference points; replace as directed if disturbed or destroyed.

#### 1.9 UTILITIES

- A. Work confronting existing utilities shall be coordinated with the regulatory agencies and utility companies. Liability for damage to adjacent property and/or utilities shall be the burden of the contractor.

#### 1.10 COORDINATION BETWEEN TRADES

- A. Work under this Division shall be coordinated with work of the other Divisions.
- B. Each Proposer shall review all drawings and specifications 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 to 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 insure adequate spaces.

- C. It shall be the responsibility of this contractor to leave the necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating piping, equipment, etc., or equipment found encroaching on space required by others.
- D. This contractor shall make all mechanical connections, etc., to equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications, unless otherwise specified.

#### 1.11 CODES AND STANDARDS

- A. Pertinent Federal, State and Local requirements and regulations are hereby made part of this contract. In case of conflict between Contract Documents and above listed requirements, the latter shall govern. Requirements of authority having local jurisdiction shall supersede all other requirements. Use of the term "code" in sections of the specification refers to applicable requirements and regulations of above agencies.
- B. Compliance with the Occupational Safety and Health Act shall be the responsibility of the contractor and under no circumstances shall the Engineer be an authority or be held responsible for any acts concerning this regulation.
- C. All equipment and material shall meet the minimum requirements of seismic bracing as governed by the authority having jurisdiction.

#### 1.12 PROJECT CLEAN-UP

- A. The Contractor shall export off site, all debris resulting from work under this Division. Burning of debris at the project site is not permitted.
- B. Each contractor shall maintain his portion of this project in a neat and orderly fashion, disposing of debris, cartons, crates and boxes as the contents are installed in the project. This clean up shall be accomplished each day in order not to create hardships on the other trades.

#### 1.13 INSTALLATION

- A. Installation of all mechanical equipment for the project as specified in these specifications and indicated on the drawings shall be in accordance with the general requirements of this section. Additional installation requirements applicable to individual systems are specified in the specific system section.
- B. All equipment shall be installed at locations indicated on the drawings and as specified herein.
- C. Assembly and installation of equipment shall be in strict accordance with manufacturer's installation instructions.
- D. Equipment shall be securely anchored in place. Care shall be exercised to correctly orient equipment before securing in place.

- E. All equipment and material installations shall meet the minimum requirements of seismic bracing as governed by the authority having jurisdiction.

#### 1.14 PERMITS, FEES AND CERTIFICATES

- A. Each respective contractor shall obtain and pay all permits and licenses required by Federal, State and Local Ordinances for his type work. All fees in connection with inspections, permits, licenses, approvals, etc. shall be paid by the contractor whose work is affected.

#### 1.15 MECHANICAL CONTRACTOR QUALIFICATIONS

- A. The successful Mechanical Contracting Firm for this project shall have:
  1. Master and Journeyman Plumber's License.

#### 1.16 GUARANTEES AND WARRANTIES

- A. This Contractor shall guarantee all equipment, apparatus, materials, and workmanship entering into this contract to be the best of its respective kind, and shall replace all parts at his own expense, which have been proven defective, per the terms of the Contract. Items of equipment, which may have longer guarantees, shall have warranties and guarantees completed, in order, and in effect at the time of final acceptance of the work by the Engineer/Architect. This contractor shall furnish all such warranties and guarantees at the time of final acceptance of the work.

#### 1.17 SHOP DRAWINGS AND OTHER RELATED SUBMITTALS

- A. The type of submittal information required for each item of equipment is scheduled at the end of this section. Unless noted otherwise, submittals shall be furnished in electronic format. The Contractor shall furnish a single pdf file for each submittal. Submittals shall be clearly labeled as to what is contained within and shall note the related Specification Section. The Contractor shall be responsible for providing a numbering convention for submittals to allow easy tracking of submittals.
- B. Submittals for color selections shall not be electronically submitted. Provide hard copies of the colors. Printed color selections are not acceptable.
- C. Unless otherwise specified, materials and equipment must be a standard product of manufacturers regularly engaged in production of such items.
  1. The contractor shall secure right to use any patented article, method or apparatus used in work.
  2. When substitute item of equipment has been submitted for approval, the mechanical contractor shall submit layout drawings indicating the changes necessary to adapt the substitute item of equipment to the design, when requested by the Engineer. All cost of the requested drawings shall be the responsibility of the contractor offering the substitutions.
  3. Under no circumstances will materials be considered for substitution, which are not a product of a manufacturer regularly engaged in production of such material or which is a product of one who merely assembles products of other manufacturers into fabricated units. Material submitted for substitution shall be subject to express and implied warranties of one manufacturer only.
- D. If substitution of material results in incidental extra costs on part of any trade under contract, such costs shall be borne by contractor desiring substitution.

1. Submittal data shall include specification data, such as metal gauges, finishes, optional accessories, etc., even though such equipment and materials may be detailed on the drawings or specified. In addition, the submittal data shall include performance (certification) data, wiring diagrams where applicable, accurate dimensional data and a recommended spare parts list. Outline or dimensional drawings alone are not acceptable.
2. No roughing-in connections, etc., shall be done until approved equipment submittals are in the hands of the contractors. It shall be the contractor's responsibility to obtain approved drawings and to make all connections, etc., in the neatest and most workmanlike manner possible. Each contractor shall coordinate with all other contractors having any connections, roughing-in, etc., to the equipment.
3. In general, normal catalog information (with the particular items underlined or otherwise denoted as being the submitted item) will be acceptable as submittal data. Installation, operating and maintenance instructions must be that information, specifically applicable to the item furnished, ordinarily supplied with the equipment to the owner with any modifications indicated. Wiring diagrams must be correct for the application. Generalized wiring diagrams, showing alternate methods of connection, will not be acceptable unless all unrelated sections are marked out.
4. Submittal data sheets, which indicate several different model numbers, figure numbers, optional accessories, installation arrangements, etc., shall be clearly marked to indicate the specific items of equipment to be furnished. Samples and certificates shall be furnished as requested. Submittal data must be complete for each piece of equipment; piecemeal data will not be processed.
5. It shall be noted that approval of shop drawings by the Engineer applies only to general design, arrangement, type, capacity and quality. Such approval doesn't apply to quantities, dimensions, connection locations and the like. In all cases, the contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, that all equipment fits the available space in a satisfactory manner, and that all connections are suitably located.
6. Before the project is accepted, all submittal data (shop drawings, etc.) must be complete and approved.
7. In addition to shop drawings described above, the following information is required of the contractor to be furnished to the Engineer.

#### 1.18 MECHANICAL DOCUMENT REQUIREMENTS

ITEM OR DESCRIPTION OF EQUIPMENT REQUIRING SHOP DRAWINGS	P A R T S	L I S T	O P E R A T I N G	M A N U A L	W I R I N G	D I A G R A M	C E R T I F I C A T I O N	S A M P L E S
Valves		X						
Plumbing Specialties		X		X		X	X	
Floor Drains and Other Specialties		X		X				

**1.19 OPERATION AND MAINTENANCE DATA**

- A. The Contractor shall submit a single copy of the Operation and Maintenance Manuals prior to final completion.
- B. Operation and Maintenance Manuals (O&M's) shall be submitted in electronic format. Provide one pdf file per Specification Division.
- C. Prepare pdf files with the title for each file to include the Specification Division Number and brief description of contents (example: "Division 23 – HVAC Equipment").
- D. The first page of pdf file shall be a coversheet titled "Operation and Maintenance Manual". Include table of contents with page numbers. Provide bookmarks within the pdf file labeled for each section contained within the file.

**PART 2 – PRODUCTS (Not Used)****PART 3 – EXECUTION (Not Used)****END OF SECTION 220000**



**SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Sleeves.
  - 4. Identification devices for utilities.
  - 5. Escutcheons.
  - 6. Supports and anchorages.

**PART 2 - PRODUCTS****2.1 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

**2.2 JOINING MATERIALS**

- A. Refer to individual piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

**2.3 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

#### 2.4 SLEEVES

- A. Galvanized Steel Pipe: ASTM A 53, Galvanized Type E, Grade B, Schedule 10, plain ends.
- B. Sleeves shall extend a minimum 8-inch above roof penetrations, 2-inch above floor penetrations, and 2-inch outside of wall penetrations (when concealed).

#### 2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, duct and insulation of insulated piping or duct and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.

### PART 3 - EXECUTION

#### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by the Engineer.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and caulk. Select sleeve size to allow for 1/2-inch annular clear space between pipe and sleeve.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Q. All exposed piping shall be prepared, primed, and painted. Insulated piping shall not be painted unless noted otherwise.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Non-Pressure Piping: Join according to ASTM D 2855.
- H. Plastic Non-Pressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible clearances.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- D. Install equipment to allow clearance for piping installed at required slope.
- E. All equipment shall be identified with unique equipment number.
- F. All installed equipment shall meet the seismic bracing requirements of the governing jurisdiction

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

**END OF SECTION 220500**

**SECTION 221116 - DOMESTIC WATER PIPING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.

**1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

**1.3 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.
- D. Comply with NSF 372 for low lead content in water piping and components.

**PART 2 - PRODUCTS****2.1 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

**2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
  1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

### 2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

### 2.4 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

### 2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 180 deg F
    - b. End Connections: Solder-joint copper alloy and threaded ferrous.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install domestic water piping level and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install PEX piping with loop at each change of direction of more than 90 degrees.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE INSTALLATION

- A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

### 3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.
- C. Dielectric Fittings for NPS 2-1/2 and Larger: Use dielectric flanges.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
  - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.



### 3.8 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.9 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-ground, domestic water piping, shall be the following:
  - 1. Schedule 40 CPVC.
- D. Aboveground domestic water piping, NPS 3 and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L wrought copper solder-joint fittings; and soldered joints. Refer to drawings for minimum locations for copper.

### 3.10 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball valves for piping NPS 3 and smaller.
  - 2. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. CPVC and PVC valves may **NOT** be used.

**END OF SECTION 221116**

**SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following domestic water piping specialties:
  - 1. Hose bibbs.
  - 2. Wall hydrants.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

**1.4 QUALITY ASSURANCE**

- A. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
  - 3. Comply with NSF 372 "Drinking Water System Components – Lead Content."

**PART 2 - PRODUCTS****2.1 HOSE BIBBS**

- A. Hose Bibbs:
  - 1. Standard: ASME A112.18.1 for sediment faucets.
  - 2. Body Material: Bronze.
  - 3. Seat: Bronze, replaceable.
  - 4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
  - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
  - 6. Pressure Rating: 125 psig.
  - 7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
  - 8. Finish for Equipment Rooms: Rough bronze.

9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome plated.
11. Operation for Equipment Rooms: Metal wheel handle.
12. Operation for Service Areas: Metal wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome-plated hose bibb.

## 2.2 WALL HYDRANTS

### A. Non-freeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. Smith, Jay R. Mfg. Co.
  - c. Watts Drainage Products Inc.
  - d. Woodford Manufacturing Company.
  - e. Zurn Plumbing Products Group.
  - f. Approved equal.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Nozzle and Wall-Plate Finish: Polished nickel bronze.
9. Operating Keys(s): One with each wall hydrant.

## **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION 221119**

**SECTION 260000 – GENERAL PROVISIONS FOR ELECTRICAL****PART 1 - GENERAL****1.1 SCOPE**

- A. Special Conditions section and General Requirements section are made part of this Division.
- B. This Division includes the sections, but not necessarily limited to, listed in the Division Table of Contents.

**1.2 GENERAL**

- A. The work included in this division consists of furnishing all labor, equipment, transportation, excavation, backfill, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Electrical System(s) indicated or specified in the Contract Documents.
- B. 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/or specifications, shall be included as part of this Contract.
- C. It is the intent of this Contract to deliver to the Owner's 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 items which interfere with the new work required for the complete installation without additional cost to the Owner.

**1.3 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.

**1.4 EXAMINATION OF SITE AND CONDITIONS**

- A. Each Proposer shall inform himself of all 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.

## 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic only and indicate the general arrangement of the work 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 parties 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. 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 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 drawings only indicate approximate locations. 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 insure no conflict with other work.
- H. 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.
- I. 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.
- J. Where on the Contract Documents 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.
- K. 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.

## 1.6 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

- A. By execution of this Contract, the Contractor warrants that he has visited the site of the proposed work, and fully acquainted himself with the conditions there existing relating to construction and labor and that he fully understands the facilities, difficulties, and restrictions attending the execution of the work under

Contract. The Contractor further warrants that he has thoroughly examined and is familiar with the drawings, specifications and all other documents comprising the Contract. The Contractor further warrants that by execution of this Contract, his failure, when he was bidding on this Contract, to receive or examine any form, instrument, or document, or to visit the site and acquaint himself with the conditions there existing, in no way relieves the Contractor. The Contractor agrees that the Owner shall be justified in rejecting any claim based on facts regarding conditions for which he should have been on prior notice.

- B. Before ordering material or performing any work, the Contractor shall verify all measurements at the work site. Any difference between dimensions on the Drawings and actual measurements shall be brought to the Engineer's attention for his consideration before the work may proceed. No extra compensation will be allowed because of difference between actual measurements and dimensions indicated on the Drawings. The Contractor shall assume full responsibility for accuracy of measurements obtained at the Work Site.
- C. Dimensions, which are lacking, shall be obtained from the Architect. In no case shall Drawings be scaled.
- D. All subcontractors shall familiarize themselves with all of the conditions relating to this Contract since the terms set forth in the General Conditions binds all subcontractors to the Contract.

#### 1.7 WORK LAYOUT

- A. This contractor shall layout his work from construction lines and levels established by the General Contractor and shall be responsible for the proper location and placement of his work.
- B. Maintain all benchmarks, monuments, and other reference points; replace as directed if disturbed or destroyed.

#### 1.8 PROTECTION OF STORED EQUIPMENT

- A. Provide suitable storage for, and completely protect all materials and equipment prior to installation. Storage shall be dry, clean and safe. Any materials or equipment damaged, deteriorated, rusted or defaced due to improper storage shall be fully repaired, refinished or replaced, as directed by the Engineer and any materials or equipment lost through theft or mishandling shall be replaced, all without additional cost to the Owner.

#### 1.9 COORDINATION BETWEEN TRADES

- A. Each Proposer shall review all drawings and specifications 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 to 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 insure adequate spaces.

- B. It shall be the responsibility of this contractor to leave the necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating conduit, boxes, etc., or equipment found encroaching on space required by others.

#### 1.10 EQUIPMENT CONNECTIONS AND WIRING

- A. This contractor shall make all electrical connections, etc., to existing equipment to be reused and all equipment furnished by others whenever such equipment is shown on any part of the drawings or mentioned in any section of the specifications, unless otherwise specified. For bidding, if circuits are not specifically indicated, new code compliant circuit shall extend to the nearest suitable electrical panel with capacity and terminated on contractor furnish circuit breakers.
- B. Supervision, to assure proper functioning and operation shall be provided by the trade furnishing the equipment or apparatus so connected.
- C. Unless otherwise specifically noted on the drawings or elsewhere in these specifications, all wiring shall be done by this contractor, including connections, etc., to all equipment requiring electrical services furnished under other sections of this specification. This contractor shall furnish and install all disconnects, overload protection, motor control apparatus, etc., for all equipment unless otherwise specifically noted elsewhere as being provided with, or as a part of, the equipment.

#### 1.11 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. When this contractor requests approval of substitute materials and/or equipment, except when under formal alternate proposal, it shall be understood and agreed that such substitution, if approved, will be made without cost to the Owner or Engineer, regardless of changes in connections, spacing, electrical services, etc. In all cases where substitutions affect other trades, the contractor offering such substitutions shall reimburse all affected contractors for all necessary changes in their work.

#### 1.12 CODES AND STANDARDS

- A. Pertinent Federal, State and Local requirements and regulations are hereby made part of this contract. In case of conflict between Contract Documents and above listed requirements, the latter shall govern. Requirements of authority having local jurisdiction shall supersede all other requirements. Use of the term "code" in sections of the specification refers to applicable requirements and regulations of above agencies.
- B. All electrical installation shall be made in accordance with the latest edition of the National Electrical Code and supplements in force at the time of bid opening, all materials employed shall bear Underwriters' official labels where such labeling is customary. In the event that local codes are more rigid than the National Electrical Code, both codes shall be considered as jointly governing and the requirements of either and/or both then prevail.
- C. Following is a list of abbreviations for codes and standards, which are referred to in the specifications. Where such reference is made, the code or standard becomes a part of the specification as if the code or standard were included herein. Reference is always to the latest edition of the code or standard unless otherwise specifically noted.

- 1. Industry and Agency Standards, Codes and Specifications

ANSI - American National Standards Institution

ASTM - American Society of Testing and Materials

NBFU - National Board of Fire Underwriters'

NBS - National Bureau of Standards

NEMA - National Electrical Manufacturers Association

UL - Underwriters' Laboratories

NEC - National Electrical Code

NESC - National Electrical Safety Code

IPCEA - Insulated Power Cable Engineers Association

IEEE - Institute of Electrical and Electronics Engineers

- D. Compliance with the Occupational Safety and Health Act shall be the responsibility of the contractor and under no circumstances shall the Engineer/Architect be an authority or be held responsible for any acts concerning this regulation.

#### 1.13 MATERIALS AND EQUIPMENT

- A. General. Material and equipment shall be furnished as specified in this section and in each individual electrical section of these specifications and shall be in strict accordance with the required ANSI, ASTM, NEMA, IPCEA, UL, NEC, or other recognized standards, codes and specifications listed. Applicable codes, standards and manufacturers' products referred to in these specifications shall establish minimum requirements for material, equipment and installation furnished.
- B. Bolting shall be carbon steel conforming to ASTM A-307 with heavy hexagonal nut.
- C. Angles, Channels, Beams, Bars and Rods shall be steel conforming to ASTM A-36.

#### 1.14 INSTALLATION

- A. Installation of all electrical equipment for the project as specified in these specifications and indicated on the drawings shall be in accordance with the general requirements of this section. Additional installation requirements applicable to individual systems are specified in the specific system section.
- B. All equipment shall be installed at locations indicated on the drawings and as specified herein.
- C. Assembly and installation of equipment shall be in strict accordance with manufacturer's installation instructions.
- D. Equipment shall be securely anchored in place. Care shall be exercised to correctly orient equipment before securing in place.
- E. All equipment and material shall meet the minimum requirements of seismic bracing as governed by the authority having jurisdiction.



#### 1.15 OBSOLETE OR REMOVED EQUIPMENT AND MATERIALS

- A. The Electrical Contractor shall remove all existing materials and equipment made obsolete by, and interfering with the additions, alterations, or razing as shown on the plans and specified. Maintain such existing equipment and materials intact and in existing condition insofar as possible.
- B. Unless otherwise specifically stated in the specifications or shown on the drawings, all such removed material and equipment, not to be reused, shall be removed from the site and disposed of in a proper manner.

#### 1.16 TESTS

- A. Following the completion of all wiring installation, test the individual systems and eliminate any existing grounding of potential conductors, short circuits, other faults, etc.

#### 1.17 PERMITS, FEES AND CERTIFICATES

- A. Each respective contractor shall obtain and pay all permits and licenses required by Federal, State and Local Ordinances for his type work. All fees in connection with inspections, permits, licenses and approvals shall be paid by the contractor whose work is affected.

#### 1.18 ELECTRICAL INSPECTION FOR CONTRACT COMPLIANCE

- A. The contractor shall be responsible for obtaining and coordination of required electrical inspections. Inspections shall be made by an Electrical Inspector Certified by the authority having jurisdiction and any fees and charges associated with the inspections will be paid for by the contractor. The contractor shall furnish the Engineer and Owner a copy of the Electrical Certificate of approval before final payment will be made.

#### 1.19 PROJECT CLEAN-UP

- A. The Contractor shall export off site, all debris resulting from work under this Division. Burning of debris at the project site is not permitted.
- B. Each contractor shall maintain his portion of this project in a neat and orderly fashion, disposing of debris, cartons, crates and boxes as the contents are installed in the project. This clean-up shall be accomplished each day in order not to create hardships on the other trades.

#### 1.20 GUARANTEES AND WARRANTIES

- A. This Contractor shall guarantee all equipment, apparatus, materials and workmanship entering into this contract to be the best of its respective kind, and shall replace all parts at his own expense, which have been proven defective, within one year from final acceptance of the work by the Owner. Items of equipment, which may have longer guarantees, shall have warranties and guarantees completed, in order, and in effect at the time of final acceptance of the work by the Architect. This contractor shall furnish all such warranties and guarantees at the time of final acceptance of the work.

## 1.21 SHOP DRAWINGS AND OTHER RELATED SUBMITTALS

- A. The type of submittal information required for each item of equipment is scheduled at the end of this section. Unless noted otherwise, submittals shall be furnished in electronic format. The Contractor shall furnish a single pdf file for each submittal. Submittals shall be clearly labeled as to what is contained within and shall note the related Specification Section. The Contractor shall be responsible for providing a numbering convention for submittals to allow easy tracking of submittals.
- B. Submittals for color selections shall not be electronically submitted. Provide hard copies of the colors. Printed color selections are not acceptable.
- C. Unless otherwise specified, materials and equipment must be a standard product of manufacturers regularly engaged in production of such items.
  - 1. The contractor shall secure right to use any patented article, method or apparatus used in work.
  - 2. When substitute item of equipment has been submitted for approval, the mechanical contractor shall submit layout drawings indicating the changes necessary to adapt the substitute item of equipment to the design, when requested by the Engineer. All cost of the requested drawings shall be the responsibility of the contractor offering the substitutions.
  - 3. Under no circumstances will materials be considered for substitution, which are not a product of a manufacturer regularly engaged in production of such material or which is a product of one who merely assembles products of other manufacturers into fabricated units. Material submitted for substitution shall be subject to express and implied warranties of one manufacturer only.
- D. If substitution of material results in incidental extra costs on part of any trade under contract, such costs shall be borne by contractor desiring substitution.
  - 1. Submittal data shall include specification data, such as metal gauges, finishes, optional accessories, etc., even though such equipment and materials may be detailed on the drawings or specified. In addition, the submittal data shall include performance (certification) data, wiring diagrams where applicable, accurate dimensional data and a recommended spare parts list. Outline or dimensional drawings alone are not acceptable.
  - 2. No roughing-in connections, etc., shall be done until approved equipment submittals are in the hands of the contractors. It shall be the contractor's responsibility to obtain approved drawings and to make all connections, etc., in the neatest and most workmanlike manner possible. Each contractor shall coordinate with all other contractors having any connections, roughing-in, etc., to the equipment.
  - 3. In general, normal catalog information (with the particular items underlined or otherwise denoted as being the submitted item) will be acceptable as submittal data. Installation, operating and maintenance instructions must be that information, specifically applicable to the item furnished, ordinarily supplied with the equipment to the owner with any modifications indicated. Wiring diagrams must be correct for the application. Generalized wiring diagrams, showing alternate methods of connection, will not be acceptable unless all unrelated sections are marked out.
  - 4. Submittal data sheets, which indicate several different model numbers, figure numbers, optional accessories, installation arrangements, etc., shall be clearly marked to indicate the specific items of equipment to be furnished. Samples and certificates shall be furnished as requested. Submittal data must be complete for each piece of equipment; piecemeal data will not be processed.
  - 5. It shall be noted that approval of shop drawings by the Engineer applies only to general design, arrangement, type, capacity and quality. Such approval doesn't apply to quantities, dimensions, connection locations and the like. In all cases, the contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, that all equipment fits the available space in a satisfactory manner, and that all connections are suitably located.
  - 6. Before the project is accepted, all submittal data (shop drawings, etc.) must be complete and approved.

7. In addition to shop drawings described above, the following information is required of the contractor to be furnished to the Engineer.

## 1.22 ELECTRICAL DOCUMENT REQUIREMENTS

ITEM OR DESCRIPTION OF EQUIPMENT REQUIRING SHOP DRAWINGS	P A R T S	L I S T	O P E R A T I N G	M A T E R I A L	W I R I N G	D I A G R A M	C E R T I F I C A T I O N	S A M P L E S
Low-Voltage Power Conductors and Cables	X		X		X		X	
Light Fixtures	X		X		X		X	
Dry-Type Transformers	X				X		X	
Panelboards	X		X		X		X	
Switchboards	X		X		X		X	
Wiring Devices/ Lighting Controls	X		X					
Enclosed Switches and Circuit Breakers	X		X					
Components/Materials of Div. 27 and 28	X				X			
Enclosed Controller (motor starters)	X		X		X			
Transient-Voltage Suppression Devices (SPD's)	X		X		X			
Fire Alarm System	X		X		X		X	

## 1.23 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall submit a single copy of the Operation and Maintenance Manuals prior to final completion.
- A. Operation and Maintenance Manuals (O&M's) shall be submitted in electronic format. Provide one pdf file per Specification Division.
- B. Prepare pdf files with the title for each file to include the Specification Division Number and brief description of contents (example: "Division 23 – HVAC Equipment").
- C. The first page of pdf file shall be a coversheet titled "Operation and Maintenance Manual". Include table of contents with page numbers. Provide bookmarks within the pdf file labeled for each section contained within the file.
- D. Include the following within O&M's
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop drawings and product data.
    - b. Power quality test results (including any required grounding tests).
    - c. Certificates.
    - d. Photocopies of warranties and bonds.
- E. Submit one copy of completed pdf's in final form on DVD or solid-state media fifteen (15) days prior to final inspection. This copy will be returned after final inspection with Owner's comments. Revise content of documents as required prior to final submittal.
- F. Submit final pdf's revised within ten (10) days after final inspection. Provide at minimum three (3) DVD or solid-state copies.

## 1.24 TRAINING/INSTRUCTION

- A. General Operating/Maintenance Instruction: Arrange for each installer of work requiring continuing maintenance or operation, to meet with the Owner's personnel, at project site, to provide basic instructions needed for proper operation and maintenance of entire work. Include instructions by manufacturer's representatives where installers are not expert in the required procedures. Review maintenance manuals, record documentations, tools, spare parts and materials, lubricants, fuels,

identification system, control sequences, hazards, cleaning and similar procedures and facilities. For operational equipment, demonstrate start-up, shutdown, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, energy effectiveness, and similar operations. Review maintenance and operations in relation with applicable Warranties, Agreements to Maintain, Bonds, and similar continuing commitments.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION 260000**

**SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Sleeves for raceways and cables.
  - 2. Sleeve seals.
  - 3. Grout.
  - 4. Common electrical installation requirements.

**PART 2 - PRODUCTS****2.1 SLEEVES FOR RACEWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

**2.2 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

**PART 3 - EXECUTION****3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Comply with all requirements of N.E.C. article 110 and others, which apply.

- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in other sections of this specification or as indicated on the drawings.
- I. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with architectural approved means or flexible boot-type flashing units applied in coordination with roofing work.
- J. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- K. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

**END OF SECTION 260500**

**SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Fire-alarm wire and cable.
5. Connectors, splices, and terminations rated 600 V and less.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**PART 2 - PRODUCTS****2.1 COPPER BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
  1. Type THHN and Type THWN-2: Comply with UL 83.
  2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  3. Type XHHW-2: Comply with UL 44.



## 2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- D. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 3. Type XHHW-2: Comply with UL 44.

## 2.3 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
  - 1. Single circuit.
  - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Ground Conductor: Insulated.
- F. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
  - 2. Type XHHW-2: Comply with UL 44.
- G. Armor: Aluminum, interlocked.

## 2.4 FIRE-ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
  - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
  - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

## 2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. 3M Electrical Products.
  - 2. AFC Cable Systems; Atkore International.
  - 3. Hubbell Power Systems, Inc.
  - 4. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - 5. Tyco Electronics Corp.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
  - 1. Copper; stranded.
- B. Branch Circuits:
  - 1. Copper; stranded.
- C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."
  - 1. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
    - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.

2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
  3. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

**END OF SECTION 260519**

**SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Foundation steel electrodes.

**1.2 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data include the following:
  - 1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
    - a. Test wells.
    - b. Ground rods.
    - c. Ground rings.
    - d. Grounding arrangements and connections for separately derived systems.

**PART 2 - PRODUCTS****2.1 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**2.2 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B3.
  - 2. Stranded Conductors: ASTM B8.
  - 3. Tinned Conductors: ASTM B33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

## 2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.
- E. Conduit Hubs: Mechanical type, terminal with threaded hub.
- F. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- G. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- H. Straps: Solid copper, rated for 600 A.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 inch by 10 ft.

# PART 3 - EXECUTION

## 3.1 APPLICATIONS

- A. Conductors: Install stranded unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
  1. Bury at least 30 inch below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
  2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inch from the foundation.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 12 inch below finished floor or final grade unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.



1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

**END OF SECTION 260526**

**SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Type EMT-S raceways and elbows.
2. Type LFMC raceways.
3. Type PVC raceways and fittings.
4. Fittings for conduit, tubing, and cable.
5. Threaded metal joint compound.
6. Solvent cements.
7. Surface metal raceways and fittings.
8. Metallic outlet boxes, device boxes, rings, and covers.
9. Cabinets, cutout boxes, junction boxes, and pull boxes.
10. Cover plates for device boxes.
11. Hoods for outlet boxes.

**PART 2 - PRODUCTS****2.1 TYPE EMT-S RACEWAYS AND ELBOWS****A. Performance Criteria:**

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

**B. Steel Electrical Metal Tubing (EMT-S) and Elbows:**

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Thomas & Betts Corporation.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Wiremold Company (The); Electrical Sales Division.
2. Material: Steel.
3. Options:
  - a. Exterior Coating: Zinc.
  - b. Interior Coating: Zinc.
  - c. Minimum Trade Size: 1/2".
  - d. Colors: As indicated on Drawings.

## 2.2 TYPE LFMC RACEWAYS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

### B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Thomas & Betts Corporation.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Wiremold Company (The); Electrical Sales Division.
2. Material: Steel.
3. Options:
  - a. Minimum Trade Size: 1/2".
  - b. Colors: As indicated on Drawings.

## 2.3 TYPE PVC RACEWAYS AND FITTINGS

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL Category Control Number DZYR.

### B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Panduit Corporation.
  - b. Lamson & Sessions; Carlon Electrical Products.
  - c. Hubbell Incorporated; Wiring Device-Kellems Division.
  - d. Enduro Systems, Inc.; Composite Products Division.
  - e. Butler Manufacturing Company; Walker Division.
  - f. Wiremold Company (The); Electrical Sales Division.
  - g. Walker Systems, Inc; Wiremold Company (The).
2. Dimensional Specifications: Schedule 40.
3. Options:
  - a. Minimum Trade Size: 1/2".
  - b. Markings: For use with maximum 90 deg C wire.

### C. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Panduit Corporation.
  - b. Lamson & Sessions; Carlon Electrical Products.
  - c. Hubbell Incorporated; Wiring Device-Kellems Division.
  - d. Enduro Systems, Inc.; Composite Products Division.
  - e. Butler Manufacturing Company; Walker Division.
  - f. Wiremold Company (The); Electrical Sales Division.
  - g. Walker Systems, Inc; Wiremold Company (The).
- 2. Dimensional Specifications: Schedule 80.
  - 3. Options:
    - a. Minimum Trade Size: 1/2".
    - b. Markings: For use with maximum 90 deg C wire.

D. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Panduit Corporation.
  - b. Lamson & Sessions; Carlon Electrical Products.
  - c. Hubbell Incorporated; Wiring Device-Kellems Division.
  - d. Enduro Systems, Inc.; Composite Products Division.
  - e. Butler Manufacturing Company; Walker Division.
  - f. Wiremold Company (The); Electrical Sales Division.
  - g. Walker Systems, Inc; Wiremold Company (The).
- 2. Dimensional Specifications: Type EB.
- 3. Options:
  - a. Minimum Trade Size: 2".

## 2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type EMT Raceways:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold Company (The); Electrical Sales Division.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Thomas & Betts Corporation.
- 2. General Characteristics: UL 514B and UL Category Control Number FKAV.
- 3. Options:
  - a. Material: Steel.
  - b. Coupling Method: Setscrew coupling for conduits 2" and larger. Setscrew couplings with only single screw per conduit are unacceptable.

- c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type FMC Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold Company (The); Electrical Sales Division.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Thomas & Betts Corporation.
2. General Characteristics: UL 514B and UL Category Control Number ILNR.

D. Fittings for Type LFMC Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Wiremold Company (The); Electrical Sales Division.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Thomas & Betts Corporation.
2. General Characteristics: UL 514B and UL Category Control Number DXAS.

## 2.5 SURFACE METAL RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 5 and UL Category Control Number RJBT.

B. Surface Metal Raceways and Fittings with Metal Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Wiremold Company (The); Electrical Sales Division.
  - b. Walker Systems, Inc; Wiremold Company (The).
  - c. Thomas & Betts Corporation.
2. Options:
  - a. Galvanized steel base with snap-on covers.
  - b. Manufacturer's standard enamel finish in color selected by Architect.
  - c. Wiring Channels: Per detail on drawings.

## 2.6 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - f. Pass & Seymour; Legrand North America, LLC.
  - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - h. Wiremold; Legrand North America, LLC.
3. Options:
  - a. Material: Sheet steel.
  - b. Sheet Metal Depth: Minimum 2 inch.
  - c. Cast-Metal Depth: Minimum 2.4 inch.
  - d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
  - e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - b. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - d. Pass & Seymour; Legrand North America, LLC.
  - e. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

D. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

- d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
3. Options:
- a. Material: Sheet steel.
  - b. Sheet Metal Depth: minimum 2 inch.
  - c. Cast-Metal Depth: minimum 2.4 inch.

E. Metallic Floor Boxes and Floor Box Covers:

- 1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. FSR Inc.
  - b. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Leviton Manufacturing Co., Inc.
  - e. Pass & Seymour; Legrand North America, LLC.
  - f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - g. Wiremold; Legrand North America, LLC.

## 2.7 CABINETS, CUTOOT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

- 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- 2. General Characteristics:
  - a. Non-Environmental Characteristics: UL 50.
  - b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Junction and Pull Boxes:

- 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
- 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cooper B-line; brand of Eaton, Electrical Sector.
  - b. FSR Inc.
  - c. Hoffman; brand of nVent Electrical plc.
  - d. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Milbank Manufacturing Co.
  - g. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - h. Square D; Schneider Electric USA.
- 3. Additional Characteristics: UL Category Control Number BGUZ.
- 4. Options:

- a. Degree of Protection: Type 1.

C. Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Adalet.
  - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:
  - a. Degree of Protection: Type 1.

## 2.8 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
  - b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Intermatic, Inc.
  - g. Leviton Manufacturing Co., Inc.
  - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - i. Panduit Corp.
  - j. Pass & Seymour; Legrand North America, LLC.
  - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - l. Wiremold; Legrand North America, LLC.
2. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.

C. Nonmetallic Cover Plates for Device Boxes:



1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. Crouse-Hinds; brand of Eaton, Electrical Sector.
  - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - f. Leviton Manufacturing Co., Inc.
  - g. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
  - h. Panduit Corp.
  - i. Pass & Seymour; Legrand North America, LLC.
  - j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - k. Wiremold; Legrand North America, LLC.
2. Options:
  - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
  - b. Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish.
  - c. Color: Selected by Architect.

## 2.9 HOODS FOR OUTLET BOXES

### A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
  - a. Reference Standards:
    - 1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
    - 2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
3. Mounts to box using fasteners different from wiring device.

### B. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
  - b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
  - c. Leviton Manufacturing Co., Inc.
  - d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:
  - a. Provides clear, weatherproof, "while-in-use" cover.
  - b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

**PART 3 - EXECUTION****3.1 SELECTION OF RACEWAYS**

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
  - 1. Exposed and Subject to Physical Damage: ERM C.
  - 2. Exposed and Not Subject to Physical Damage: ERM C and PVC-80.
  - 3. Concealed Aboveground: ERM C.
  - 4. Direct Buried: PVC-80.
  - 5. Concrete Encased in Trench: PVC-EB.
  - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFM C.
- C. Indoors:
  - 1. Exposed and Subject to Severe Physical Damage: ERM C. Subject to severe physical damage includes the following locations:
    - a. Loading docks.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
    - e. Shop Spaces.
  - 2. Exposed and Subject to Physical Damage: ERM C. Subject to physical damage includes the following locations:
    - a. Locations less than 2.5 m above finished floor.
    - b. Stub-ups to above suspended ceilings.
  - 3. Exposed and Not Subject to Physical Damage: EMT.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Damp or Wet Locations: ERM C.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM C and IMC: Provide threaded type fittings unless otherwise indicated.
2. EMT: Set screw.

### 3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
  - a. Type 3R unless otherwise indicated.
2. Indoors:
  - a. Type 1 unless otherwise indicated.

C. Exposed Boxes Installed Less Than 2.5 m Above Floor:

1. Provide cast-metal boxes. Boxes with knockouts or unprotected openings are prohibited.
2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

### 3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
6. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.
7. Raceway Terminations at Locations Subject to Moisture or Vibration:
  - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
4. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
5. Support conduit within 12 inch of enclosures to which attached.
6. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
  - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - b. Where an underground service raceway enters a building or structure.
  - c. Conduit extending from interior to exterior of building.
  - d. Conduit extending into pressurized duct and equipment.
  - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - f. Where otherwise required by NFPA 70.
7. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
8. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
9. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
10. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
11. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERM and IMC:
  - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
2. Types FMC and LFMC:
  - a. Comply with NEMA RV 3. Provide a maximum of 72 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
3. Type PVC:
  - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.

- b. Comply with manufacturer's written instructions for solvent welding and fittings.
- D. Stub-ups to Above Recessed Ceilings:
  - 1. Provide EMT, IMC, or ERM for raceways.
  - 2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
  - 1. EMT: Provide steel, setscrew for conduits 2" and larger, otherwise compression fittings. Comply with NEMA FB 2.10.
  - 2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- F. Expansion-Joint Fittings:
  - 1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  - 4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
  - 5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

### 3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.
- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

### 3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

### 3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

### 3.7 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

## END OF SECTION 260533

**SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY****A. Section includes:**

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

**1.2 PERFORMANCE REQUIREMENTS****A. Seismic-Restraint Loading:**

1. Building Occupancy Category as Defined in ASCE 7: III.
2. Site Class as Defined in IBC: D.
3. Seismic Design Category as Defined in IBC: D.
4. Design Spectral Response Acceleration at Short Periods (0.2 Second): 41.7%.
5. Design Spectral Response Acceleration at 1-Second Period: 24.0%.

**1.3 SUBMITTALS****A. Product Data: For the following:**

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

**B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. The professional engineer must be licensed/registered for the state that the project is located.**

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

- a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
- 3. Field-fabricated supports.
- 4. Seismic-Restraint Details:
  - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
  - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Qualification Data: For professional engineer. The professional engineer must be licensed/registered for the state that the project is located.

#### 1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the 2007 Kentucky Building Code and ASCE Standard 7, unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. The professional engineer must be licensed/registered for the state that the project is located.
- D. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amber/Booth Company, Inc.



2. Kinetics Noise Control.
3. Mason Industries.
4. Approved equal.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## 2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Cooper B-Line, Inc.; a division of Cooper Industries.
3. Hilti Inc.
4. Mason Industries.
5. Unistrut; Tyco International, Ltd.
6. Approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATIONS**

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

#### **3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION**

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
  - C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
  - D. Drilled-in Anchors:
    1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
    2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
    3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
    4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
    5. Set anchors to manufacturer's recommended torque, using a torque wrench.
    6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  1. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  3. Test to 90 percent of rated proof load of device.
  4. Measure isolator restraint clearance.
  5. Measure isolator deflection.
  6. Verify snubber minimum clearances.
  7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

## 3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

## 3.6 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

EQUIPMENT/SYSTEM TYPE	ISOLATOR TYPE	BASE TYPE	COMPONENT IMPORTANCE FACTOR ( $I_p$ )	COMPONENT AMPLIFICATION FACTOR	COMPONENT RESPONSE MODIFICATION FACTOR	SEISMIC RESTRAINT SYSTEM REQUIRED (Y/N)
Switchgear and Panelboards	NR	NA	1.0	2.5	6.0	Y. See Exemptions
Communication Equipment	NR	NA	1.0	1.0	2.5	Y. See Exemptions
Lighting Fixtures	NR	NA	1.0	1.0	1.5	Y. See Exemptions
Life-Safety Distribution Systems	NR	NA	1.5	1.0	2.5	Y
Conduit and Bus Ducts	NR	NA	1.0	1.0	2.5	Y. See Exemptions
Suspended Cable Trays	NR	NA	1.0	2.5	6.0	Y. See Exemptions
Other Electrical Components	NR	NA	1.0	1.0	1.5	Y. See Exemptions

LEGEND:

- NA = Not Applicable
- NR = Not Required
- Y = Yes
- N = No

## A. Electrical Seismic-Restraint Exemptions:

1. Electrical components in Seismic Design Category B.
2. Electrical components in Seismic Design Category C provided that  $I_p = 1.0$ .
3. Electrical components in Seismic Design Categories D, E, and F where  $I_p = 1.0$  and either:

- a. Flexible connections between the components and associated conduit are provided.
  - b. Components are mounted at 4 ft or less above a floor level and weigh 400 lb or less.
4. Electrical components in Seismic Design Categories D, E, and F where  $I_p = 1.0$  and:
- a. Flexible connections between the components and associated conduit are provided.
  - b. The components weigh 20 lb or less or, for distribution systems, weighing 5 lb/ft or less.
5. Electrical conduit in any Seismic Design Category where  $I_p = 1.5$  and:
- a. Conduit is 2 ½ inch trade size or less.
6. Electrical trapeze assemblies (supporting conduit, bus duct, or cable tray) in any Seismic Design Category where  $I_p = 1.5$  and:
- a. Total weight of trapeze assembly weighs 10 lb/ft or less.

**END OF SECTION 260548**

**SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Labels.
  - 2. Tapes and stencils.
  - 3. Signs.
  - 4. Miscellaneous identification products.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
  - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
  - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
  - 1. Safety Colors: NEMA Z535.1.
  - 2. Facility Safety Signs: NEMA Z535.2.
  - 3. Safety Symbols: NEMA Z535.3.
  - 4. Product Safety Signs and Labels: NEMA Z535.4.
  - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

**2.2 COLOR AND LEGEND REQUIREMENTS**

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field.
  2. Legend: Indicate voltage.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color must be factory applied.
  2. Colors for 208Y/120 V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  3. Color for Neutral: White.
  4. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
1. Identify system voltage with black letters on orange background.
- D. Warning labels and signs must include, but are not limited to, the following legends:
1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
- E. Equipment Identification Labels:
1. Black letters on white field.
  2. Equipment to Be Labeled:
    - a. Panelboards, electrical cabinets, and enclosures.
    - b. Electrical switchgear and switchboards.
    - c. Transformers.
    - d. Disconnect switches.
    - e. Enclosed circuit breakers.
    - f. Motor starters.
    - g. Push-button stations.
    - h. Contactors.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:
  - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inch for raceway and conductors.
    - b. 3-1/2 by 5 inch for equipment.
    - c. Minimum letter height shall be 3/8".
    - d. As required by authorities having jurisdiction.

## 2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
  1. Tape:
    - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape must be permanent and may not be damaged by burial operations.
    - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  2. Color and Printing:
    - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
    - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
    - c. Inscriptions for Orange Tapes: "CAUTION BURIED CATV LINE BELOW", "CAUTION BURIED TELEPHONE LINE BELOW", "CAUTION BURIED FIBER OPTIC LINE BELOW", "CAUTION BURIED COMMUNICATION LINE BELOW".
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

## 2.5 SIGNS

- A. Baked-Enamel Signs:



1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inch.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inch.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
  - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. inch, 1/8 inch thick.
  - c. Engraved legend with black letters on white face.
  - d. Indoor Equipment: Self-adhesive.
  - e. Outdoor Equipment: Punched or drilled for mechanical fasteners with 1/4 inch grommets in corners for mounting
  - f. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
  - g. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.

## 2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- I. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- J. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- K. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- L. Self-Adhesive Labels:
  - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.
- M. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

S. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.

T. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

U. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels, self-adhesive wraparound labels, or self-adhesive vinyl tape to identify phase.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.
- F. Conductors to Be Extended in Future: Attach write-on tags, marker tape to conductors, and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels, Baked-enamel warning signs, or Metal-backed, butyrate warning signs.
  1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- K. Arc Flash Warning Labeling: Self-adhesive labels.
- L. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs, or Laminated acrylic or melamine plastic signs.
- M. Equipment Identification Labels:
  1. Indoor Equipment: Self-adhesive label, Baked-enamel signs, Metal-backed butyrate signs, Laminated acrylic, or melamine plastic sign.
  2. Outdoor Equipment: Laminated acrylic or melamine sign.

**END OF SECTION 260553**

**SECTION 262416 - PANELBOARDS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

**1.2 DEFINITIONS**

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
  - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 8. Include wiring diagrams for power, signal, and control wiring.
  - 9. Key interlock scheme drawing and sequence of operations.
  - 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Panelboard schedules for installation in panelboards.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

## 1.6 FIELD CONDITIONS

### A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

## 1.7 WARRANTY

### A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  2. Height: 84 inches maximum.
  3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
- F. Incoming Mains Location: Top and Bottom.
- G. Phase, Neutral, and Ground Buses: Tin-plated aluminum.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Tin-plated aluminum.

2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

- I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As indicated on Construction Drawings.

- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers, and Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

#### 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only as indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

#### 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 2. Eaton.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.



- f. Integral test jack for connection to portable test set or laptop computer.
- g. Field-Adjustable Settings:
  - 1) Instantaneous trip.
  - 2) Long- and short-time pickup levels.
  - 3) Long and short time adjustments.
  - 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. Subfeed Circuit Breakers: Vertically mounted.
- 7. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
  - h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install panelboards and accessories according to NEMA PB 1.1.

- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box.
- F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Manufacturer shall provide all necessary settings required for circuit breakers.
- H. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- I. Install filler plates in unused spaces.
- J. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- K. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. 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.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**END OF SECTION 262416**

**SECTION 262726 - WIRING DEVICES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. General-use switches.
  2. General-grade single straight-blade receptacles.
  3. General-grade duplex straight-blade receptacles.
  4. Receptacles with ground-fault protective devices.
  5. Locking receptacles.
  6. Connectors, cords, and plugs.

**1.2 ACTION SUBMITTALS**

- A. Product Data:
1. Toggle switches.
  2. Single straight-blade receptacles
  3. Duplex straight-blade receptacles.
  4. Receptacles with GFCI device.
  5. Locking receptacles.
  6. Spring-driven commercial/industrial-use cord reels.

**PART 2 - PRODUCTS****2.1 GENERAL-USE SWITCHES**

- A. Toggle Switch:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour; Legrand North America, LLC.
  2. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  3. General Characteristics:

- a. Reference Standards: UL CCN WMUZ and UL 20.
- 4. Options:
  - a. Device Color: Selected by Architect.
  - b. Configuration:
    - 1) Extra-heavy-duty, 120-277 V, 15 A, single pole, double pole, three way, four way.
    - 2) Extra-heavy-duty, 120-277 V, 20 A, single pole, double pole, three way, four way.
    - 3) Extra-heavy-duty, 120-277 V, 30 A, single pole, double pole, three way.
- 5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

### A. Single Straight-Blade Receptacle:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
- 2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
- 4. Options:
  - a. Device Color: Selected by Architect.
  - b. Configuration:
    - 1) General-duty, NEMA 5-20R.
- 5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

### 2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

#### A. Tamper-Resistant Duplex Straight-Blade Receptacle:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
  - a. Reference Standards: UL CCN RTRT and UL 498.
4. Options:
  - a. Device Color: Selected by Architect.
  - b. Configuration:
    - 1) General-duty, NEMA 5-20R.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

### 2.4 RECEPTACLES WITH GROUND-FAULT PROTECTIVE DEVICES

#### A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:
  - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
  - a. Device Color: Selected by Architect.
  - b. Configuration: Heavy-duty, NEMA 5-20R.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
  - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour; Legrand North America, LLC.
2. Regulatory Requirements:
  - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
3. General Characteristics:
  - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
4. Options:
  - a. Device Color: Selected by Architect.
  - b. Configuration: Heavy-duty, NEMA 5-20R.
5. Accessories:
  - a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
  - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

## 2.5 LOCKING RECEPTACLES

A. NEMA, 125 V, Locking Receptacle:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour; Legrand North America, LLC.
  - 2. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 3. General Characteristics:
    - a. Reference Standards: UL CCN RTRT and UL 498.
  - 4. Options:
    - a. Device Color: Black with yellow voltage indication on face.
    - b. Configuration: As noted on Drawings.
- B. NEMA, 250 V, Locking Receptacle:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Cooper Wiring Devices; a division of Cooper Industries, Inc.
    - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Leviton Manufacturing Co., Inc.
    - d. Pass & Seymour; Legrand North America, LLC.
  - 2. Regulatory Requirements:
    - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 3. General Characteristics:
    - a. Reference Standards: UL CCN RTRT and UL 498.
  - 4. Options:
    - a. Device Color: Black with blue voltage indication on face.
    - b. Configuration:
      - 1) As noted on Drawings.

## 2.6 SPECIAL-PURPOSE POWER OUTLET ASSEMBLIES

- A. Spring-Driven Commercial/Industrial-Use Cord Reel, No. 12 AWG Conductors:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Appleton; Emerson Electric Co., Automation Solutions.
    - b. Ericson Manufacturing Company.



- c. Gleason Reel; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
  - d. Reelcraft; Madison Industries.
- 2. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- 3. General Characteristics:
  - a. Reference Standards: UL CCN SBCV and UL 355.
  - b. Spring take-up retraction mechanism.
- 4. Options:
  - a. Electrical Rating with Cable: 600 V, 20 A.
  - b. Color: Black.
  - c. Enclosure Degree of Protection: Type 4.
  - d. Ball stop.
  - e. Pivot base.
  - f. Spool Capacity:
    - 1) No. 12 AWG, two wires and equipment ground, 30 ft.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

##### **A. Receptacles:**

- 1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

##### **B. Cord Reels:**

- 1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
- 2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
- 3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF SWITCHES**

##### **A. Comply with manufacturer's instructions.**

##### **B. Reference Standards:**

- 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
- 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
- 3. Consult Architect for resolution of conflicting requirements.

## C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
  - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
  - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

## 3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

## A. Comply with manufacturer's instructions.

## B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

## C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
  - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

## D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.

## 3.4 INSTALLATION OF LOCKING RECEPTACLES

## A. Comply with manufacturer's instructions.

## B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

## C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
  - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

## 3.5 INSTALLATION OF CORD REELS AND FITTINGS

- A. Comply with manufacturer's instructions.

## 3.6 FIELD QUALITY CONTROL OF SWITCHES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
  1. Perform tests and inspections in accordance with manufacturers' instructions.
- C. Nonconforming Work:
  1. Unit will be considered defective if it does not pass tests and inspections.
  2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

## 3.7 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
  1. Insert and remove test plug to verify that device is securely mounted.
  2. Verify polarity of hot and neutral pins.
  3. Measure line voltage.
  4. Measure percent voltage drop.
  5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
  6. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
  7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:
  1. Device will be considered defective if it does not pass tests and inspections.
  2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

### 3.8 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
  - 1. Insert and remove test plug to verify that device is securely mounted.
  - 2. Verify polarity of hot and neutral pins.
  - 3. Measure line voltage.
  - 4. Measure percent voltage drop.
  - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
  - 6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
- C. Nonconforming Work:
  - 1. Device will be considered defective if it does not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

### 3.9 FIELD QUALITY CONTROL OF CORD REELS AND FITTINGS

- A. Field tests and inspections must be witnessed by authorities having jurisdiction and Construction Administrator.
- B. Tests and Inspections:
  - 1. Perform tests and inspections indicated in manufacturer's instructions.
- C. Nonconforming Work:
  - 1. Components and assemblies will be considered defective if they do not pass tests and inspections.
  - 2. Remove and replace defective units and retest.
- D. Assemble and submit test and inspection reports.

### 3.10 ADJUSTING

- A. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.

### 3.11 PROTECTION

- A. Devices:
  - 1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.

2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Cord Reels and Fittings:

1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

**END OF SECTION 262726**

**SECTION 262416 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Nonfusible switches.
  - 2. Enclosures.

**1.2 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

**1.3 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

**2.2 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

- D. Comply with NFPA 70.

## 2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Eaton.
  - 2. General Electric Co.; Electrical Distribution & Control Division.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

## 2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12), a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel), copper-free cast aluminum alloy (NEMA 250 Types 7, 9).
- C. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R), externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

## PART 3 - EXECUTION

### 3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. As indicated on the drawings.

### 3.2 INSTALLATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Construction Manager's and Owner's written permission.
  - 4. Comply with NFPA 70E.
- B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Comply with NFPA 70 and NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
      - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.



- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

- a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

- a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
  - h. Perform adjustments for final protective device settings in accordance with the coordination study.
- 2. Electrical Tests:
  - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
1. Test procedures used.
  2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  3. List deficiencies detected, remedial action taken, and observations after remedial action.

**END OF SECTION 262416**

**SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes:
  - 1. Type 2 surge protective devices.
  - 2. Enclosures.

**1.2 DEFINITIONS**

- A.  $I_n$ : Nominal discharge current.
- B. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. For each type of product.
    - a. Include electrical characteristics, specialties, and accessories for SPDs.
    - b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:
      - 1) Tested values for VPRs.
      - 2)  $I_n$  ratings.
      - 3) MCOV, type designations.
      - 4) OCPD requirements.
      - 5) Manufacturer's model number.
      - 6) System voltage.
      - 7) Modes of protection.
- B. Field quality-control reports.

**PART 2 - PRODUCTS****2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Zero Surge Inc.
  - 2. United Power Corporation.

3. Tycor.
4. Transtector Systems, Inc.
5. Sutton Designs Inc.
6. Northern Technologies, Inc.
7. LEA International.
8. Innovative Technology, Inc.
9. General Electric Company.
10. Entrelec International.
11. Current Technology, Inc.
12. Atlantic Scientific.
13. Advanced Protection Technologies Inc. (APT).
14. Eaton.
15. Intermatic, Inc.
16. Leviton Manufacturing Co., Inc.
17. Liebert; Vertiv Holdings Co.
18. Schneider Electric USA, Inc.
19. Siemens Industry, Inc., Energy Management Division.
20. SSI, an ILSCO Company.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:

1. Reference Standards: UL 1449, Type 2; UL 1283.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 240 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
  - a. Line to Neutral: 700 V for 208Y/120 V.
  - b. Line to Ground: 700 V for 208Y/120 V.
  - c. Neutral to Ground: 700 V for 208Y/120 V.
  - d. Line to Line: 1200 V for 208Y/120 V.
5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
  - a. Line to Neutral: 700 V.
  - b. Line to Ground: 700 V.
  - c. Neutral to Ground: 700 V.
  - d. Line to Line: 1200 V.
6. SCCR: Equal or exceed 100 kA.
7.  $I_n$  Rating: 10 kA.

D. Options:

1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.

3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
4. Include surge counter.

## 2.2 TYPE 3, TYPE 4, AND TYPE 5 SURGE PROTECTIVE DEVICES (SPDs)

- A. Type 3, Type 4, and Type 5 SPDs are not approved for field installation.

## 2.3 ENCLOSURES

- A. Indoor Enclosures: Type 1.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

## 3.2 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
  1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
  2. Inspect anchorage, alignment, grounding, and clearances.
  3. Verify that electrical wiring installation complies with manufacturer's installation requirements.
- C. Nonconforming Work:
  1. SPDs that do not pass tests and inspections will be considered defective.
  2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.

## 3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

# END OF SECTION 264313

**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 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 015713 - Temporary Erosion and Sediment Control.
- C. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- D. Section 024100 - Building Demolition: Removal of built elements and utilities.
- 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

**1.03 Reference Standards**

- A. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance – Standard Practices. (Management Of Trees And Shrubs During Site Planning, Site Development, And Construction Operations); 2012.

**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. Protect existing vegetation to remain from damage and monitor according to ANSI A300 Part 5.
- F. 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. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
  - 1. At vegetation removal limits.
  - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
  - 3. Around other vegetation to remain within vegetation removal limits.
- C. 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. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- D. 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 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. 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.
- H. 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.
- I. Install Tree Protection Area and Enclosure Signage.
- J. Water retained trees thoroughly and deeply as necessary to supplement rainfall to maintain plant turbidity without prolonged saturation of the root zone. The method, amount and frequency of watering is to be per the recommendation of the arborist. Monitor soil moisture on a continual basis.

- K. Retained trees may require fertilizing and other measures to stimulate regeneration of lost roots and foliage. Fertilization and other measures are to be per the recommendation of the arborist.
- L. Tree Topping: No Tree Topping will be allowed.
- M. 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 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. Trees are to be watered, aerated and maintained as necessary to ensure survival.
- C. Repair or replace any fencing, ground protection or signage that has been removed or damaged. Inspect installations on a continuous basis.
- D. 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 new construction.
- C. Topsoil and finish grading for non-athletic field areas.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 015713 - Temporary Erosion and Sediment Control.
- B. Section 311000 - Site Clearing.
- C. Section 312200.13 - Laser Grading: Laser Grading for Athletic fields.
- D. Section 312316 - Excavation.
- E. Section 312316.13 - Trenching: Trenching and backfilling for utilities.
- F. Section 312323 - Fill: Filling and compaction.
- G. Section 312513 - Permanent Erosion Controls
- H. Section 329219 - Seeding: Finish ground cover.

#### **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 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.
- C. Fat Clays: Soil types with the classification of CH and a Plasticity Index (PI) above 30%.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with State of Kentucky, Highway Department standards.
- B. Athletic Field Contractor shall meet the following criteria:
  - 1. Operations:
    - a. Provide proof that they have been in business under the same name for a minimum of ten (10) years.
    - b. Provide a qualified installation foreman to coordinate and review the component parts of the field system. Submit a resume of experience for Architects approval prior to starting work.
    - c. Provide an American Sports Builders Association Certified Field Builder (CFB) to directly supervise all grading, drainage and installation of infield treatments and athletic equipment within the athletic competition field areas.
  - 2. Experience:
    - a. Must specialize in athletic field projects and the associated drainage and fine grading to tight tolerances, and this type of work being their primary income.
    - b. Have installed a minimum of ten (10) similar fields with two (2) fields within the past three (3) years.

**1.06 PROJECT CONDITIONS**

- A. 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 synthetic turf 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.
- B. The soils found on this site are silty and 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.

**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. 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.
- F. 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.
- G. 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.
- H. 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. The general earthwork contractor, if used instead of the athletic field contractor, is to meet the rough grade elevation requirements in these specifications for the synthetic turf field areas. The athletic field contractor is to then verify that the grades are met prior to starting their work.
- I. The finished subgrade of the synthetic turf areas is to be surveyed by a Licensed Land Surveyor to ensure that it is within a tolerance of 0.5-inches total (+/- 1/4") within a 25-foot grid. The surveyor is to provide a PDF and AutoCad drawing of the actual survey locations and elevations prior to installation of Aggregate Base Courses.
- J. 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 in a location approved by the Owner. 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 in areas where seeding are indicated.
- F. Place topsoil where required to level finish grade. Where sod is to be placed, topsoil is to be held 1-inch below finished grade.
- G. Place topsoil to the following compacted thicknesses:
  - 1. Areas to be Seeded with Grass: 6 inches.
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants, buildings, and other improvements spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. All finish grading within the Synthetic Turf Areas is to be done by a contractor that specializes in athletic field construction, and the areas are to be laser graded to elevations identified on the plans using high floatation, turf tire equipment. Refer to Specification Section 312200.13.

- M. Lightly compact placed topsoil.
- N. 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
  - 1. At Synthetic Turf Areas: A tolerance of 0.5-inches from required elevation.
  - 2. All Other Areas: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
  - 3. The finished subgrade of the baseball and softball areas (including bull pens) is to be surveyed by a Licensed Land Surveyor to ensure that it is within a tolerance of 0.5-inches total (+/- 1/4") within a 25-foot grid. The surveyor is to provide a PDF and AutoCad drawing of the actual survey locations and elevations prior to continuing with any aggregate base course work.
- B. Top Surface of Finish Grade
  - 1. At paved areas: A tolerance of plus or minus 0.125-inches (1/8-inch) from the required elevation based on a 25-foot grid with a maximum deviation of no more than 0.25-inch (1/4-inch)
  - 2. Grass and vegetated areas: 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.

### **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 312200.13****LASER GRADING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Laser Grading for Athletic Fields.

**1.02 RELATED REQUIREMENTS**

- A. Section 015713 - Temporary Erosion and Sediment Control.
- B. Section 312200 - Grading: Rough Grading
- C. Section 312316 - Excavation.
- D. Section 312316.13 - Trenching: Trenching and backfilling for utilities.
- E. Section 312323 - Fill: Filling and compaction.
- F. Section 321823.29 - Artificial Turf: Synthetic Turf System
- G. Section 334100 - Subdrainage: Field Subdrainage

**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 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.
- C. Fat Clays: Soil types with the classification of CH and a Plasticity Index (PI) above 30%.
- D. Athletic Field Contractor: Contractor specializing in the construction of athletic fields.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with State of Kentucky, Highway Department standards.
- B. Athletic Field Contractor shall meet the following criteria:
  - 1. Operations:
    - a. Provide proof that they have been in business under the same name for a minimum of ten (10) years.
    - b. Provide a qualified installation foreman to coordinate and review the component parts of the field system. Submit a resume of experience for Architects approval prior to starting work.
    - c. Provide an American Sports Builders Association Certified Field Builder (CFB) to directly supervise all grading, drainage and installation of infield treatments and athletic equipment within the athletic competition field areas.
  - 2. Experience:
    - a. Must specialize in athletic field projects and the associated drainage and fine grading to tight tolerances, and this type of work being their primary income.
    - b. Have installed a minimum of ten (10) similar fields with two (2) fields within the past three (3) years.



**1.06 PROJECT CONDITIONS**

- A. 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 synthetic turf 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.
- B. The soils found on this site are silty and 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.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. Fill Materials: See Section 312323.

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. The Laser Grading Contractor is to review and accept all subgrades by installed by the Grading Contractor in writing prior to starting their work.
- B. Verify that survey bench mark and intended elevations for the Work are as indicated.
- C. 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. 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.
- F. 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.
- G. 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.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

**3.03 ROUGH GRADING**

- A. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.
- C. The general earthwork contractor is to meet the rough grade elevation requirements in Specification Section 312200. The athletic field contractor is to then verify that the grades are met prior to starting their work.

- D. The Athletic Field Contractor is to laser grade the Synthetic Turf Field subgrade areas up to the perimeter curbs or buried nailer boards so that they meet the finished grade tolerance of 1/4 inch (+/- 1/8 inch) prior to installing the subdrainage piping or any aggregate base courses.
- E. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.
- F. The finished subgrade is to be surveyed by a Licensed Land Surveyor to ensure that it is within a tolerance of 0.5-inches total (+/- 1/4") within a 25-foot grid. The surveyor is to provide a PDF and AutoCad drawing of the actual survey locations and elevations prior to continuing with any field work.

### **3.04 SOIL REMOVAL and STOCKPILING**

- A. Stockpile subsoil that is to be re-used on site; remove remainder from site. Cover stockpile to prevent erosion and saturation of the material.
- B. 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 trench backfilling has been inspected and approved.
  - 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. All finish laser grading within the Synthetic Turf Areas is to be done by a contractor that specializes in athletic field construction, and the areas are to be laser graded to elevations identified on the plans using high floatation, turf tire equipment. The use of heavy tread wheeled equipment is prohibited.

### **3.06 TOLERANCES**

- A. Top Surface of Subgrade
  - 1. At Synthetic Turf Areas: A tolerance of 0.5-inches total (+/- 1/4-inch from required grade) within a 25-foot grid.
- B. Top Surface of Finish Laser Grade
  - 1. At Synthetic Turf Areas: A tolerance of plus or minus 0.25-inches (1/4-inch) from the required elevation based on a 25-foot grid with a maximum deviation of no more than 0.25-inch (1/4-inch) from required finish grade elevation.
  - 2. The finished subgrade of the baseball and softball areas (including bull pens) is to be surveyed by a Licensed Land Surveyor to ensure that it is within a tolerance of 0.25-inches total (+/- 1/8") within a 25-foot grid. The surveyor is to provide a PDF and AutoCad drawing of the actual survey locations and elevations prior to continuing with any field work.

### **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.

**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 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. 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 312200 - Grading: Soil removal from surface of site.
- D. Section 312200 - Grading: Grading.
- E. Section 312316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- F. Section 312319 - Dewatering
- G. Section 312323 - Fill: Fill materials, backfilling, and compacting.
- H. 312323.13 - Flowable Fill

**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.
- C. Fat Clays: Soil types with the classification of CH and a Plasticity Index (PI) above 30%.

**1.04 REFERENCE STANDARDS**

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

**1.05 SUBMITTALS**

- A. See Division 01 for Administrative Requirements and 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.

**1.06 QUALITY ASSURANCE**

- A. Temporary Support and Excavation Protection Plan:
  - 1. 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 - NOT USED****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 312200 for topsoil removal.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Notify utility company to remove and relocate utilities.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Ensure that dewatering measures have been implemented and are functioning prior to excavation activities. Refer to Specification Section 312319 for additional Dewatering requirements.
- G. 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.

**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. Underpin adjacent structures and pacements that could be damaged by excavating work. Due to the silty and sandy nature of the on-site soils, excavations will be prone to degradation and collapse and provisions for shoring and stabilization should be included in the bid.
- B. 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.

- C. If a footing/foundation trench or other excavation inside the building footprint is to be left open for more than 48-hours or when a rain event occurs, the excavation is to be over-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. This mud mat can extend no more than 4-inches into the minimum soil cushion between the footing and bedrock.
- D. 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.
- E. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- F. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- G. Do not interfere with 45 degree bearing splay (zone of influence) of foundations without approval from the Architect and approved specific backfill requirements.
- H. Cut utility trenches wide enough to allow inspection of installed utilities.
- I. Hand trim excavations. Remove loose matter.
- J. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.
- K. 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.
- L. 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.
- M. Remove excavated material that is unsuitable for re-use from site.
- N. Stockpile excavated material to be re-used in area designated on site 312200.
- O. 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.
- B. Backfilling of trenches excavated as a result of demolished utility lines and structures.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 015713 - Temporary Erosion and Sediment Control.
- B. Section 312200 - Grading: Site grading.
- C. Section 312316 - Excavation: Building and foundation excavating.
- D. Section 312319 - Dewatering.
- E. Section 312323 - Fill: Backfilling at building and foundations.
- F. 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.
- G. 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/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 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/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012.
- G. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- H. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- I. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.



- J. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- K. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- L. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- M. 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 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 and imported from off-site 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. 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 (also referred to as Drainage Fill) - Fill Type #57 Crushed Limestone: 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. Grade top perimeter of excavation to prevent surface water collection.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected work in area until notified to resume.
- C. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- E. 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.
- F. 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.
- G. Hand trim excavations. Remove loose matter.
- H. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Remove excess excavated material from site.
- K. Stockpile excavated material to be re-used in area designated in Section 312200.
- L. 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.
- M. 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.

- N. 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. 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. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain within 2% of the optimum moisture content of fill materials to attain required compaction density.
- E. Granular/Crushed Stone Fill: Place and compact materials in equal continuous layers not exceeding 6 inches loose depth when using heavy compaction equipment (smooth drums, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth when using heavy compaction equipment (sheepsfoot rollers, etc.) and not exceeding 4 inches loose depth when using hand operated or remote controlled equipment.
- G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. 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.
- I. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under slabs-on-grade and similar construction: 98 percent of maximum dry density.
  - 2. At Synthetic Turf Fields and Similar Construction: 98 percent of maximum dry density.
  - 3. At paving: 95 percent of maximum dry density.
  - 4. At landscape locations: 85 percent of maximum dry density.
- J. 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 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 utility trenches excavated as a result of demolition and removal of existing utility lines and structures.
1. At Building, Paving and Synthetic Turf Areas:
    - a. Trenches are to be backfilled with either flowable fill or DGA from the bottom of the removed utility's trench up to the subgrade elevation immediately adjacent to the trench. Refer to Specification 312323.13 - Flowable Fill.
  2. At all other areas:
    - a. Trenches are to be backfilled with General Fill or DGA from the bottom of the removed utility's trench up to the subgrade elevation immediately adjacent to the trench.

### **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. 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 D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. 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 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 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. Dewatering systems shall be installed prior to excavation activities in order to control surface and ground water flows. Dewatering measures shall be maintained and remain installed for the duration of project activities.
- C. 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. Dewatering systems shall be installed prior to excavation activities in order to control surface and ground water flows. Dewatering measures shall be maintained and remain installed for the duration of project activities.
  3. 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 312200 - Grading: Site grading.
- C. Section 312316 - Excavation: Removal and handling of soil to be re-used.
- D. Section 312316.13 - Trenching: Excavating and backfilling for utility trenches outside the building to utility main connections.
- E. Section 312323.13 - Flowable Fill
- F. Section 312513 - Permanent Erosion Controls
- G. 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/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 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/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 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.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.
  - 4. Bagged materials are to be covered with tarps until they can be installed or moved to a covered storage area.

**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. 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. Graded Granular Fill (also referred to as Drainage Fill) - Fill Type #57 Crushed Limestone: Crushed aggregate, conforming to State of Kentucky Highway Department Standard.
- E. Coarse Granular Fill - Fill Type #2 Crushed Limestone: Coarse aggregate, conforming to State of Kentucky Highway Department standard.

**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. Proof roll subgrade of all areas to receive fill or improvements immediately prior to placing fill or improvement with a heavy, non-knurled pneumatic-tire mounted equipment (minimum weight of 60,000 pounds) to identify soft near-surface subgrade conditions and areas of excess yielding. Do not proof roll wet or saturated subgrades. Areas exhibiting soil that deflects during proof rolling should be evaluated by the Special Inspector. The contractor is responsible for excavating failing areas identified by the Special Inspector and replacing with General or Structural Fill. Any soil that is removed due to moisture content issues shall be moisture conditioned and used as engineered fill in other locations.
- G. Confirm that fat clay (CH) material has been removed under all floor slab and pavement areas so that no fat clay is located within 24-inches of the top of subgrade.
- H. 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/Crushed Stone Fill: Place and compact materials in equal continuous layers not exceeding 6 inches loose depth when using heavy compaction equipment (smooth drums, etc.), and layers 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, etc.), and layers 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 feet, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

- I. Correct areas that are over-excavated.
  - 1. Load-bearing foundation surfaces and 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 with flowable fill. If the backfill of the over-excavated areas encroaches into the minimum of 12-inches of soil cushion between the bottom of the footing and the top of bedrock, the Architect and Structural Engineer are to be notified immediately to determine if an alternate backfill method is necessary.
  - 2. Synthetic Turf Areas: Use Structural fill, compacted to 98 percent of maximum dry density to subgrade elevation of the synthetic turf system.
  - 3. Drives and vehicular pavement areas: Use DGA over a layer of Tensar BX1200 geogrid up to the required bottom of pavement crushed stone base elevation.
  - 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. Refer to Specification Section 312319 for additional Dewatering requirements.

### **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. Fill is to be uniform and contractor shall not mix materials during filling operations.
  - 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 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 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. At Synthetic Turf Areas:
  - 1. Use General Fill

2. Fill up to synthetic turf subgrade elevation.
  3. Compact to 98 percent of maximum dry density.
- G. At Lawn Areas:
1. Use general fill.
  2. Compact to 85 percent of maximum dry density.
  3. See Section 312200 for topsoil placement.
- H. 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.
- I. 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.
- B. Top of Surface of Filling for Softball and Baseball competition areas:
  1. 0.25-inches total (+/- 1/8") within a 25-foot grid.

### 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. Backfill for site utilities within the zone-of-influence of any footing/foundation.

**1.02 RELATED REQUIREMENTS**

- A. Section 312316.13 - Trenching: Excavation and backfilling for foundations and utilities outside the building footprint.
- B. 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

### **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.

**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**