

PROJECT MANUAL FOR:  
 UNIVERSITY OF MISSOURI TEACHING HOSPITAL – CCA & TH EMERGENCY POWER  
 MODIFICATIONS

PROJECT NUMBER: CP210961

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## SECTION 07 84 13 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.02 SUMMARY:

- A. This Section includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

#### ~~1.03 Related Requirements:~~

- ~~A. **Section 07 84 43 – Joint Firestopping for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers. (Addendum #1)**~~

#### 1.03 REFERENCE STANDARDS:

- A. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- B. ASTM International:
  - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials
  - 2. ASTM E 814 - Test Method for Fire Tests of Penetration Firestop Systems
  - 3. ASTM E 2174 - On-Site Inspection of Installed Fire Stops
- C. California Department of Public Health:
  - 1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers. 2010.
- D. FM Global:
  - 1. FM Global 4991-2001: Approval of Firestop Contractors
  - 2. Building Materials Approval Guide. 2013.
- E. Intertek Group:
  - 1. Directory of Listed Building Products. 2013.
- F. Underwriters Laboratories Inc. (UL):
  - 1. UL 1479-2003: Fire Tests of Through-Penetration Firestops (ANSI)
  - 2. Fire Resistance Directory. 2013.
  - 3. Qualified Firestop Contractor Program Requirements. 2012.
- G. Firestop Contractors International Association (FCIA):
  - 1. FCIA Firestop Manual of Practice. Hillside, IL: FCIA, 2005. (4415 W. Harrison St., Suite 436, Hillside, IL 60162; 708-202-1108)

#### 1.04 PREINSTALLATION MEETINGS:

- A. Preinstallation Conference: Conduct conference at Project Site.

#### 1.05 SUBMITTALS:

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration

SECTION 07 84 13 – PENETRATION FIRESTOPPING: continued

firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

- C. Qualification Data: For Installer.
  - D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.
  - E. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- 1.06 QUALITY ASSURANCE:
- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- 1.07 PROJECT CONDITIONS:
- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
  - B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.
- 1.08 COORDINATION:
- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
  - B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS:
- A. Fire-Test-Response Characteristics:
    - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
    - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
      - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
        - (1) UL in its "Fire Resistance Directory."
- 2.02 PENETRATION FIRESTOPPING SYSTEMS:
- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
    - 1. Hilti, Inc.
    - 2. Specified Technologies, Inc.
    - 3. 3M Fire Protection Products.

SECTION 07 84 13 – PENETRATION FIRESTOPPING: continued

- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch w.g. (2.49 Pa).
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch w.g. (2.49 Pa).
  - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

2.03 FILL MATERIALS:

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- C. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.

SECTION 07 84 13 – PENETRATION FIRESTOPPING: continued

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- 3.03 INSTALLATION:
- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
  - B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
    1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
  - C. Install fill materials by proven techniques to produce the following results:
    1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
    2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
    3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- 3.04 IDENTIFICATION:
- A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
    1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
    2. Contractor's name, address, and phone number.
    3. Designation of applicable testing and inspecting agency.
    4. Date of installation.
    5. Manufacturer's name.
    6. Testing agency system number (UL System No. C-AJ-5090 for instance).
    7. Installer's name.
- 3.05 FIELD QUALITY CONTROL:
- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
  - B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
  - C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.



SECTION 07 84 13 – PENETRATION FIRESTOPPING: continued

3.06 CLEANING AND PROTECTION:

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.07 PENETRATION FIRESTOPPING SYSTEMS:

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
  - 1. Refer to drawings for specific systems. If a penetration is encountered that does not fit under the parameters of the noted systems, please coordinate with manufacturer's rep to obtain engineering judgements as needed.

END OF SECTION 07 84 13

## SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification Sections, apply to this Section.

#### 1.02 SUMMARY:

- A. This Section includes the following:
  - 1. Channel support systems.
  - 2. Restraint cables.
  - 3. Hanger rod stiffeners.
  - 4. Anchorage bushings and washers.
- B. Related Sections include the following:
  - 1. Section 26 05 29 – HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS for commonly used electrical supports and installation requirements.

#### 1.03 REFERENCE STANDARDS:

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM-A492, “Standard Specification for Stainless Steel Rope Wire”
  - 2. ASTM A603, “Standard Specification for Zinc-Coated Steel Structural Wire Rope”
  - 3. ASTM E488, “Standard Test Methods for Strength of Anchors in Concrete Elements”
- B. American Welding Society
  - 1. AWS D1.1/D1.1M, “Structural Welding Code – Steel”.
- C. International Building Code (IBC)
- D. International Code Council (ICC)
  - 1. ICC-ES, “ICC Evaluation Services”
- E. Metal Framing Manufacturers Association (MFMA)
  - 1. MFMA-3, “Metal Framing Standards Publication”
- F. National Fire Protection Association (NFPA).
  - 1. NFPA 70, “National Electrical Code (NEC)”.
- G. Nationally Recognized Testing Laboratory (NRTL)
- H. Occupational Safety and Health Administration(OSHA)
  - 1. OSHA 29 CFR 1910.7, “Definition and requirements for a nationally recognized testing laboratory”.
- I. Office of Statewide Health Planning and Development for the State of California (OSHPD)

#### 1.04 DEFINITIONS:

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

#### 1.05 PERFORMANCE REQUIREMENTS:

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: D.
  - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: IV.
    - a. Component Importance Factor: 1.5.
    - b. Component Response Modification Factor: Refer to ASCE 7 Table 13.6-1.
    - c. Component Amplification Factor: Refer to ASCE 7 Table 13.6-1.
  - 3. Mapped Spectral Response Acceleration at Short Periods:  $S_s = 0.162g$ .

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS: continued

4. Mapped Spectral Response Acceleration at 1.0-Second Period:  $S1 = 0.094g$ .

1.06 SUBMITTALS:

- A. Product Data: For the following:
  1. 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.
- B. Delegated-Design Submittal: For 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.
  1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select seismic restraints.
  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).

1.07 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- 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.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 SEISMIC-RESTRAINT DEVICES:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Amber/Booth Company, Inc.
  - 2. California Dynamics Corporation.
  - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 4. Hilti Inc.
  - 5. Loos & Co.; Seismic Earthquake Division.
  - 6. Mason Industries.
  - 7. TOLCO Incorporated; a brand of NIBCO INC.
  - 8. Unistrut; Tyco International, Ltd.
- 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.
- 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 A603 galvanized-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 E488. 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 E488.

2.02 FACTORY FINISHES:

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS: continued

2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 required 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.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION:

- A. Equipment and Hanger Restraints:
  1. Install restrained isolators on emergency and standby 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

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS: continued

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.

3.04 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.

END OF SECTION 26 05 48

## SECTION 262213 - TRANSFORMERS

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification SECTIONS, apply to this SECTION.

#### 1.02 SUMMARY:

- A. This SECTION specifies transformer work as indicated by drawings and schedules.
- B. Types of transformers specified in this SECTION include the following:
  - 1. Dry-type transformers, 600V and less.

#### 1.03 RELATED REQUIREMENTS:

- A. SECTION 260526 – GROUNDING for grounding.

#### 1.04 REFERENCE STANDARDS:

- A. American National Standards Institute (ANSI):
  - 1. C2 - National Electrical Safety Code.
  - 2. C57.12.01 - General Requirements for Dry-Type Distribution and Power Transformers.
  - 3. C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers 1-500 kVA, Single-Phase, and 15-500 kVA, Three-Phase with High-Voltage 601-34,500V, Low Voltage 120-600V.
  - 4. C57.12.51 – Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and larger, Three-Phase, with High-Voltage 601V to 34,500V; Low-Voltage 208Y/120V to 4160V.
  - 5. C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers.
- B. National Electrical Manufacturers Association (NEMA):
  - 1. TP1 - Guide to Determining Energy Efficiency for Distribution Transformers.
  - 2. TP2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
  - 3. TR1 - Transformers, Regulators, and Reactors. (Supplements ANSI C57 - Series Standards.)
  - 4. TR27 - Commercial, Institutional, and Industrial Dry-Type Transformers.
  - 5. ST20 - Dry-type Transformers for General Applications.
  - 6. 250 - Enclosures for Electrical Equipment.
- C. National Fire Protection Association (NFPA):
  - 1. 70 - National Electrical Code (NEC). Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
- D. Underwriters Laboratories (UL): Comply with applicable requirements of ANSI/UL 506 Safety Standard for Specialty Transformers. Provide transformers and components which are UL-listed and labeled.
  - 1. UL 1561 - Large General Purpose Transformers.

#### 1.05 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260510 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Include, but not limited to, the following:
  - 1. Product Data: Submit manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, wiring diagram, percent taps, polarity, impedance and certification of transformer performance efficiency at 100% load,

SECTION 262213 - TRANSFORMERS: continued

percentage voltage regulation at 100% load at 75°C, full-load losses in watts, percent impedance at 75°C, hot-spot and average temperature rise above 40°C ambient temperature, sound level in decibels, and standard published data.

2. Submit all field test data.
  3. Submit Operation and Maintenance manuals.
- C. ***Manufacturer Seismic Qualification Certification: Submit certification that transformer and components will withstand seismic forces defined in Section 260548 – Vibration and Seismic Controls for Electrical Systems. Include the following:***
1. ***Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.***
    - a. ***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. ***Dimensioned Outline Drawings of Equipment: Identify center of gravity and locate and describe mounting and anchorage provisions.***
  3. ***Detailed description of equipment anchorage devices on which the certification is based and their installation requirements. (Addendum #1)***

1.06 QUALITY ASSURANCE:

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete bases are specified in SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following (for each type of transformer):
  1. Eaton Cutler-Hammer.
  2. Square D, a brand of Schneider Electric.
  3. GE/ABB.



SECTION 262213 - TRANSFORMERS: continued

2.02 TRANSFORMERS

- A. General: Except as otherwise specified or indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation. Comply with NEMA TP 1, Class 1 efficiency levels for all transformers 15 kVA and larger. Core material shall be grain-oriented, non-aging silicon steel. Coils shall be continuous windings without splices except for taps. Internal coil connections shall be brazed or pressure type.
- B. Dry-Type Transformers (45 kVA or less): Factory-assembled and -tested, general-purpose, air-cooled, dry-type transformers; of sizes, characteristics, and rated capacities indicated.
  - 1. Single-phase transformer (where indicated):
    - a. 60-hertz.
    - b. 10-kV BIL.
    - c. Manufacturer's standard impedance.
    - d. 480V primary and 240/120V secondary with grounded neutral.
  - 2. Three-phase transformer (where indicated):
    - a. 60-hertz.
    - b. 10-kV BIL.
    - c. Manufacturer's standard impedance.
    - d. 480V delta connected primary and 208/120V wye connected secondary with grounded neutral.
    - e. Copper primary and secondary windings.
    - f. Provide primary winding with 4 full capacity taps; two 2-1/2% increments below and above full-rated voltage for deenergized tap-changing operation.
    - g. Insulate with 220°C, UL-component-recognized insulation system with a maximum of 115°C rise above 40°C ambient temperature.
    - h. Rate transformer for continuous operation at rated kVA.
    - i. Limit transformer surface temperature rise to maximum of 65°C.
    - j. Provide terminal enclosure, with cover, to accommodate primary and secondary winding connections and raceway connectors. Equip terminal leads with connectors installed.
    - k. Limit terminal compartment temperature to 75°C when transformer is operating continuously at rated load with ambient temperature of 40°C.
    - l. Provide wiring connectors suitable for copper wiring.
    - m. Cushion-mount transformers with external vibration isolation supports; sound-level ratings shall not exceed ANSI/NEMA standards.
    - n. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.
    - o. Provide transformers with ventilated or fully enclosed sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure.
  - 3. Provide transformers suitable for wall mounting, floor mounting, or suspended from structure. Provide all accessories including wall brackets for mounting location indicated on Drawings.
- C. Dry-Type Transformers (above 45 kVA): Factory-assembled and -tested, general-purpose, ventilated, dry-type transformers; of sizes, characteristics, and rated capacities indicated.
  - 1. 3-phase.
  - 2. 60-hertz.
  - 3. 10-kV BIL.
  - 4. 5.75% impedance.

SECTION 262213 - TRANSFORMERS: continued

5. 480V delta-connected, primary; and 208Y/120V 4-wire, wye-connected secondary with grounded neutral.
  6. Provide primary windings with a minimum of 6 full capacity taps; four 2-1/2% increments above full-rated voltage and two 2-1/2% increments below full-rated voltage for deenergized tap-changing operation.
  7. Copper primary and secondary windings.
  8. Insulate with 220°C, UL-component-recognized insulation system with a maximum of 115°C rise above 40°C ambient temperature.
  9. Rate transformer for continuous operation at rated kVA.
  10. Limit transformer surface temperature rise to maximum of 65°C.
  11. Provide terminal enclosure, with hinged cover, to accommodate primary and secondary winding connections and raceway connectors. Provide terminal board with clamp type connectors.
  12. Limit terminal compartment temperature to 75°C when transformer is operating continuously at rated load with ambient temperature of 40°C.
  13. Provide wiring connections suitable for copper wiring.
  14. Integrally mount vibration isolation supports between core and coil assembly and transformer enclosure.
  15. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.
  16. Do not exceed maximum sound-level rating in accordance with ANSI/NEMA standards.
  17. Provide transformers with ventilated steel enclosures and lifting lugs.
  18. Apply manufacturer's standard light gray outdoor enamel over cleaned and phosphatized steel enclosure.
  19. Provide transformers suitable for wall mounting, floor mounting, or suspended from structure. Provide all accessories including wall brackets for mounting location indicated on Drawings.
- D. Equipment/System Identification: Provide equipment/system identification nameplates complying with SECTION 260553 - ELECTRICAL IDENTIFICATION.
- E. Finishes: Coat interior and exterior surfaces of transformer, including bolted joints, with manufacturer's standard color gray baked-on enamel.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in SECTION 260526 – GROUNDING have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

SECTION 262213 - TRANSFORMERS: continued

3.02 INSTALLATION

- A. *Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 – Vibration and Seismic Controls for Electrical Systems. (Addendum #1)*
- B. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NESC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements. Arrange equipment to provide adequate space for access and for cooling air circulation.
- C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A-486B.
- D. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

3.03 CONNECTIONS

- A. Provide equipment grounding connections for transformers as specified, indicated, and as required. Tighten connections to comply with tightening torques specified in UL 486A-486B to assure permanent and effective grounding. Provide grounding in accordance with SECTION 260526 - GROUNDING.
- B. Connect wiring according to SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

3.04 IDENTIFICATION

- A. Provide identification of transformers as specified in SECTION 260553 - ELECTRICAL IDENTIFICATION.

3.05 TESTING

- A. Prior to energization of transformers, check all accessible connections for compliance with manufacturer's torque tightening specifications. Clean out any dust and dirt.
- B. Prior to energization, check circuitry for electrical continuity and for short circuits.
- C. Adjust transformer primary taps for nominal system voltage at initial installation.

END OF SECTION 262213

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 01 Specification SECTIONS, apply to this SECTION.

#### 1.02 SUMMARY:

- A. This SECTION specifies panelboards, including cabinets and boxes, as indicated by drawings and schedules, and as specified herein.
- B. Types of panelboards and enclosures required for the project include the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.03 RELATED REQUIREMENTS:

- A. Wires/cables, electrical boxes, fittings, and raceways required in conjunction with the installation of panelboards and enclosures: Other DIVISION 26 SECTIONS.
- B. SECTION 260526 - GROUNDING for grounding.
- C. SECTION 260553 - ELECTRICAL IDENTIFICATION for electrical identification.

#### 1.04 REFERENCE STANDARDS:

- A. National Electrical Manufacturers Association (NEMA):
  - 1. 250 - Enclosures for Electrical Equipment (1,000V Maximum).
  - 2. PB1 - Panelboards.
  - 3. PB1.1 - Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600V or Less.
  - 4. PB2.2 - Application Guide for Ground-Fault Protective Devices for Equipment.
- B. National Fire Protection Association (NFPA):
  - 1. 70 - National Electrical Code (NEC): Comply with applicable local code requirements of the authority having jurisdiction and NEC as applicable to installation and construction of electrical panelboards and enclosures.
- C. Underwriters Laboratories (UL): Provide panelboard units which are UL listed and labeled.
  - 1. 50 - Electrical Cabinets and Boxes.
  - 2. 67 - Electrical Panelboards.
  - 3. 486A-486B - Wire Connectors.
  - 4. 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures.
  - 5. 1449 - Surge Protective Devices.
- D. Federal Specification (FS) Compliance: Comply with applicable requirements of the following standards.
  - 1. FS W-C-375 Series - Molded-Case Circuit-Breakers, Branch Service and Circuit.

#### 1.05 PERFORMANCE REQUIREMENTS:

- A. ***Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 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." (Addendum #1)***

SECTION 262416 - PANELBOARDS: continued

1.06 SUBMITTALS:

- A. Refer to DIVISION 01 and SECTION 260510 - BASIC ELECTRICAL REQUIREMENTS for administrative and procedural requirements for submittals.
- B. Includes, but not limited to, the following:
  - 1. Product Data: Submit manufacturer's data on panelboards and enclosures.
    - a. Panelboard dimensions and weight.
    - b. Complete data on circuit breakers and fuses. Submit time - current characteristic curves of all devices.
    - c. Panelboard short-circuit interrupting capacity, and information on buses: phase, neutral, and ground.
    - d. Information on whether panelboard is fed from top or bottom.
    - e. Data on maximum and minimum incoming and outgoing feeder and branch circuit wire size.
    - f. Data on door, locks, and mounting: surface or flush.
    - g. Data on total number of poles and number of unused poles that are available for future use.
  - 2. ***Certificate of compliance for the seismic qualification. (Addendum #1)***
- C. All Field Test Data.

1.07 MAINTENANCE MATERIAL SUBMITTALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.
- B. Operation and Maintenance Manual.

1.08 QUALITY ASSURANCE:

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards 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 a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING:

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS:

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding -23°F to +104°F.
    - b. Altitude: Not exceeding 6,600 feet.

SECTION 262416 - PANELBOARDS: continued

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6,600 feet.
- C. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCD/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 applied.”

1.11 COORDINATION:

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete bases are specified in SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

1.12 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace surge protective devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):
  - 1. Eaton Cutler-Hammer.
  - 2. Square D, a brand of Schneider Electric.
  - 3. GE/ABB

2.02 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. ***Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS. (Addendum #1)***
- B. Except as otherwise indicated, provide panelboards, enclosures, and ancillary components of types, size, and ratings indicated, which comply with manufacturer's standard materials and with the design and construction in accordance with published product information.
- C. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.
- D. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- E. Equip with proper number of panelboard switching and protective devices as required for complete installation.
- F. Provide ground fault circuit interrupter type circuit breakers where indicated.
- G. Enclosures: Flush- and surface-mounted cabinets as indicated.
  - 1. Provide enclosures fabricated by same manufacturer as panelboards which mate and match properly with panelboards.

SECTION 262416 - PANELBOARDS: continued

2. Rated for environmental conditions at installed location. Provide NEMA type as described below, unless indicated or specified otherwise.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
  3. Materials: Galvanized sheet steel cabinet type enclosures, in sizes required. Provide code gage, minimum 16-gage, thickness steel.
  4. Front: Secured to box with adjustable, concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  5. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Front doors shall have flush locks with three keys per panelboard, all panelboard enclosures keyed alike.
  6. Finishes:
    - a. Color: Baked gray enamel finish over a rust inhibitor coating.
    - b. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - c. Back Boxes: Galvanized steel.
  7. Directory Card: Inside panelboard door, equip with interior circuit directory frame and removable card with clear plastic covering.
- H. Phase, Neutral, and Ground Buses:
1. Bus shall be braced to withstand available short circuit currents as indicated.
  2. Provide suitable lugs on neutral bus for incoming and outgoing feeders requiring neutral connections.
  3. Equipment Ground Bus: Bare, uninsulated, adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box. Provide as indicated.
  5. Extra-Capacity Neutral Bus and Lugs: Neutral bus and lugs rated 200% of phase bus and UL listed as suitable for nonlinear loads. Provide as indicated.
  6. Material: Hard-drawn copper, 98% conductivity.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98% conductivity, suitable for use with copper conductors.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Prohibited.
  5. Subfeed (Double) Lugs: Mechanical.
  6. Extra-Capacity Neutral Lugs: Rated 200% of phase lugs mounted on extra-capacity neutral bus. Provide as indicated.
  7. Provide terminals UL rated for 75°C (Minimum) conductors.
- J. Overcurrent Protection Devices: All devices on essential power system shall allow for electrical coordination.
- K. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals as indicated. Series rated devices are not permitted. Panelboards rated 250 Vac or less shall have short-circuit current rating as indicated on drawings or as scheduled herein, but not less than 10,000 amperes RMS symmetrical. Panelboards rated 480/277 Vac shall have short-circuit current rating as indicated on drawings or as scheduled herein, but not less than 14,000 amperes RMS symmetrical.

SECTION 262416 - PANELBOARDS: continued

2.03 DISTRIBUTION PANELBOARDS:

- A. Panelboards: NEMA PB 1, dead front, safety type, power and feeder distribution type, 480Y/277V and 208Y/120V (voltage rating as required), 3 phase, 4 wire, 60 hertz with full-sized neutral bus, as indicated with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Provide full height panels for all distribution panels.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Incoming Mains Location: Top or Bottom as required.
- D. Mains: Electronic trip circuit breaker with field replaceable rating plug or field adjustable trip unit.
- E. Branch Overcurrent Protective Devices:
  - 1. Bolt-on, molded-case circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal. Electronic trip type with field replaceable rating plug or field adjustable trip unit.
  - 2. Molded-case circuit breakers shall have toggle handles that indicate when tripped.
  - 3. Where multiple pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.
  - 4. Circuit breakers shall be replaceable without disturbing adjacent units.
  - 5. Provide double branch mounting configuration for all branch circuit breakers. Single mounting (center mounted) configuration is not permitted.
- F. Provide distribution panels with minimum enclosure height of 86" tall.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

- A. Panelboards: NEMA PB 1, dead front, safety type, 480Y/277V and 208Y/120V (voltage rating as required), 3 phase, 4 wire, 60 hertz with full-sized neutral bus, lighting and appliance branch-circuit type as indicated with switching and protective devices in quantities, ratings, types, and arrangements shown.
- B. Incoming Mains Location: Top or Bottom as required.
- C. Mains: Electronic trip circuit breaker with field replaceable rating plug or field adjustable trip unit.
- D. Branch Overcurrent Protective Devices:
  - 1. Bolt-on, molded-case circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
  - 2. Molded-case circuit breakers shall have toggle handles that indicate when tripped.
  - 3. Where multiple pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously.
  - 4. Circuit breakers shall be replaceable without disturbing adjacent units.
  - 5. Provide electronic trip type circuit breakers with field replaceable rating plug or field adjustable trip unit for circuits 30 amps and larger and where required for coordination to the 0.1 second interval for panelboards connected to the essential electrical system.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.



SECTION 262416 - PANELBOARDS: continued

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 125 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Factory assembled, bolt-on, standard frame sizes, trip ratings, and number of poles.
  - b. Voltage Ratings:
    - (1) All circuit breakers applied at 208Vac or 240Vac shall be rated 250Vac.
    - (2) All circuit breakers applied at 480Vac shall be rated 480Vac.
  - c. Interrupt Ratings:
    - (1) Minimum of 10,000 A rms, symmetrical for 120Vac, 208Vac, and 240Vac unless indicated otherwise.
    - (2) Minimum of 14,000 A rms, symmetrical for 277Vac, 480Vac, and 600Vac unless indicated otherwise.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and rated for use with copper conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (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. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75% of rated voltage.
  - h. Undervoltage Trip: Set to operate at 35 to 75% of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
  - i. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - k. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
  - l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

SECTION 262416 - PANELBOARDS: continued

- B. Arc Energy Reduction: Provide circuit breakers rated, or can be adjusted to, 1200A or higher with means to reduce circuit breaker clearing time using maintenance switching with local status indicator.

2.06 PANELBOARD SUPPRESSORS:

- A. Surge Protection Device: IEEE C62.41-compliant, externally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
  - 1. Accessories:
    - a. Fuses rated at 200-kA interrupting capacity.
    - b. Fabrication using bolted compression lugs for internal wiring.
    - c. Integral disconnect switch.
    - d. Redundant suppression circuits.
    - e. Redundant replaceable modules.
    - f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    - g. LED indicator lights for power and protection status.
    - h. Audible alarm, with silencing switch, to indicate when protection has failed.
    - i. Form-C contacts rated at 5 A and 250Vac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - j. Four-digit, transient-event counter set to totalize transient surges.
  - 2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
  - 3. Minimum single-impulse current ratings, using 8- by 20-mic.sec. waveform described in IEEE C62.41.2.
    - a. Line to Neutral: 70,000 A.
    - b. Line to Ground: 70,000 A.
    - c. Neutral to Ground: 50,000 A.
  - 4. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277V, 208Y/120V, three-phase, four-wire circuits shall be as follows:
    - a. Line to Neutral: 800V for 480Y/277, 400V for 208Y/120.
    - b. Line to Ground: 800V for 480Y/277, 400V for 208Y/120.
    - c. Neutral to Ground: 800V for 480Y/277, 400V for 208Y/120.

2.07 ACCESSORY COMPONENTS AND FEATURES:

- A. Accessories: Provide panelboard accessories and devices including, but not limited to, cartridge and plug time-delay type fuses, ground fault circuit interrupter (GFCI) breakers, split bus construction, circuit breaker handle locks, etc., as recommended by panelboard manufacturer for ratings and applications as indicated. Provide circuit breaker handle locks on all circuits that supply night lights, exit signs, emergency lights, emergency power, public address system panels, energy management and control system (EMCS) panels, and fire alarm panels.
- B. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

SECTION 262416 - PANELBOARDS: continued

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF PANELBOARDS:

- A. *Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 – Vibration and Seismic Controls for Electrical Systems. (Addendum #1)*
- B. Install panelboards and enclosures as indicated, providing NEC required working space, in accordance with manufacturer's written instructions, applicable requirements of NEC and in compliance with recognized industry practices to ensure that products fulfill requirements.
- C. Construct concrete bases and anchor floor-mounting panelboards according to manufacturer's written instructions and requirements in SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.
- D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A-486B.
- E. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- F. Provide properly wired electrical connections for panelboards within enclosures.
- G. Install numbers on all circuit breakers, and type the panelboard's circuit directory card upon completion of installation work. Clearly identify the load on each circuit and the circuit number.
- H. Insert fuses if any, of ratings indicated, within installed panelboards.
- I. Provide filler plates in all unused spaces.
- J. Provision for future circuits at all flush mounted panelboards (unless indicated otherwise): Extend four 1-inch empty conduit from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Extend four 1-inch conduit into raised floor space or below floor slab (not required for slabs on grade or basement floor slabs).

3.03 GROUNDING:

- A. Provide equipment grounding connections for panelboard enclosures as indicated and as required by NEC. Tighten connections to comply with tightening torques specified in UL 486A-486B to assure permanent and effective grounds. Provide grounding as specified in SECTION 260526 - GROUNDING.

3.04 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with SECTION 260553 – ELECTRICAL IDENTIFICATION.
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

SECTION 262416 - PANELBOARDS: continued

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in SECTION 260553 - ELECTRICAL IDENTIFICATION.
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified SECTION 260553 - ELECTRICAL IDENTIFICATION.

3.05 FIELD QUALITY CONTROL:

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each feeder and branch circuit 30 amps and larger.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.
  - 4. Prior to energization, check panelboard circuits for short circuits, electrical continuity of circuits, enclosure grounding and neutral grounding at service entrance and at incoming derived source transformer.
  - 5. Prior to energization of panelboards, check with insulation resistance tester: phase-to-phase and phase-to-ground insulation resistance levels of each phase bus to ensure requirements are fulfilled. Record and submit test results.
  - 6. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Instruments and Equipment:
      - (1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 7. Panelboards will be considered defective if they do not pass tests and inspections.
  - 8. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING AND CLEANING:

- A. Set field-adjustable overcurrent device trip characteristics according to overcurrent protective device study results.
- B. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

SECTION 262416 - PANELBOARDS: continued

1. Measure as directed during period of normal system loading.
  2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  4. Tolerance: Difference exceeding 20% between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- D. Upon completion of installation, clean interior and exterior of panelboards. Remove paint splatters, spots, dirt and debris.
- E. Touch-up scratched or marred surfaces to match original finishes.

END OF SECTION 262416