Division 26: GENERAL ELECTRICAL REQUIREMENTS

1. GENERAL INSTRUCTIONS

A. GENERAL REQUIREMENTS

All requirements under Division 01 and the general and supplementary conditions of these specifications apply to this section and division. Where the requirements of this section and division exceed those of Division 01, this section and division take precedence. Become thoroughly familiar with all its contents as to requirements that affect this division, section, or both. Work required under this division includes all material, equipment, appliances, transportation, services, and labor required to complete the entire system as required by the drawings and specifications, or reasonably inferred to be necessary to facilitate the function of each system as implied by the design and the equipment specified.

The specifications and drawings for the project are complementary, and any portion of work described in one shall be provided as if described in both. In the event of discrepancies, notify the Engineer and request clarification prior to proceeding with the Work involved.

Drawings are graphic representations of the work upon which the contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They convey the scope of work, indicating the intended general arrangement of the systems without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the drawings as a guide when laying out the work and to verify that materials and equipment will fit into the designated spaces, and which when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory, and properly operating system.

B. DEFINITIONS

Division: References contained in this specification follow the numbering system defined in the Construction Specifications Institute (CSI) MasterFormat 2004 Edition. Specification Divisions 01 through 13 provided with this project may reference the CSI MasterFormat 1995 Edition. The corresponding division references between the 2004 Edition and 1995 Edition are as follows:

2004 Edition 1995 Edition

1. Division 21 - Fire Suppression Division 15
2. Division 22 - Plumbing Division 15
3. Division 23 - HVAC Division 15
4. Division 26 - Electrical Division 16
5. Division 27 - Communications Division 16
6. Division 28 - Electronic Safety and Security Division 16

Furnish: "to supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."

Install: "to perform all operations at the project site including, but not limited to, the actual unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."

Provide: "to furnish and install."

Furnished by Owner (or Owner-Furnished) or Furnished by Others: "an item furnished by the Owner or under other divisions or contracts, and installed under the requirements of this division, complete, and ready for the intended use, including all items and services incidental to the work necessary for proper installation and operation. Include the installation under the warranty required by this division.

Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the work under this division, and is a consultant to, and an authorized representative of the Architect, as defined in the General and/or Supplementary Conditions. When used in this division, Engineer means increased involvement by and obligations to the Engineer, in addition to involvement by and obligations to the Architect.

AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.

NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA), and acceptable to the AHJ over this project. Nationally recognized testing laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ and standards that meet the specified criteria.

Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle, or switch with termination at an electrical panelboard. Note: Where MC cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box located in an accessible ceiling space as close as possible to the first load.

The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, certified, or all three, by an NRTL, and acceptable to the AHJ over this project.

C. PRE-BID SITE VISIT

Prior to submitting bid, visit the site of the proposed work and become fully informed as to the conditions under which the work is to be done. Failure to comply with this requirement shall not be considered sufficient justification to request or obtain extra compensation over and above the contract price.

D. MATERIAL AND WORKMANSHIP

Provide new material, equipment, and apparatus under this contract unless otherwise stated herein, of best quality normally used for the purpose in good commercial practice, and free from defects. Model numbers listed in the specifications or shown on the drawings are not necessarily intended to designate the required trim, written descriptions of the trim govern model numbers.

Provide markings or a nameplate for all material and equipment identifying the manufacturer and providing sufficient reference to establish quality, size, and capacity. All workmanship shall be of the finest possible by experienced mechanics of the proper trade. In general, provide the following quality grade(s) for all materials and equipment.

Commercial specification grade:

Provide all hoists, scaffolds, staging, runways, tools, machinery, and equipment required for the performance of the electrical work. Store and maintain material and equipment in clean condition, and protected from weather, moisture, and physical damage.

Furnish only material and equipment that are listed, labeled, certified, or all three, by an NRTL whenever any listing or labeling exists for the types of material and equipment specified.

At a minimum, general work practices for electrical construction shall be in accordance with NECA 1 (latest edition), "Standard Practices for Good Workmanship in Electrical Construction".

E. MANUFACTURERS

In other articles where lists of manufacturers are introduced, subject to compliance with requirements, provide products by one of the manufacturers specified.

Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

Where manufacturers are not listed, provide products subject to compliance with requirements from manufacturers that have been actively involved in manufacturing the specified product for no less than 5 years.

F. COORDINATION

Coordinate all work with other divisions and trades so that various components of the systems are installed at the proper time, fit the available space, and allow proper service access to those items requiring maintenance. Components which are installed without regard to the above shall be relocated at no additional cost to the Owner.

Unless otherwise indicated, the General Contractor shall provide chases and openings in building construction required for installation of the systems specified herein. Contractor shall furnish the General Contractor with information where chases and openings are required. Contractor shall keep informed as to the work of other trades engaged in the construction of the project and shall execute work in a manner as to not interfere with or delay the work of other trades.

Figured dimensions shall be taken in preference to scale dimensions. Contractor shall take his own measurements at the building, as variations may occur. Contractor shall be held responsible for errors that could have been avoided by proper checking and inspection.

Provide materials with trim that will properly fit the types of ceiling, wall, or floor finishes actually installed. Model numbers listed in the specifications or shown on the drawings are not intended to designate the required trim.

Make all offsets required to clear equipment, beams, and other structural members, and to facilitate concealing raceways in the manner anticipated in the design. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.

G. ORDINANCES AND CODES

Work performed under this contract shall, at a minimum, be in conformance with applicable national, state and local codes having jurisdiction. Equipment furnished and associated installation work performed under this contract shall be in strict compliance with current applicable codes adopted by the local AHJ, including any amendments and standards as set forth by the following:

1. National Fire Protection Association (NFPA)
2. Underwriters Laboratories (UL)
3. Occupational Safety and Health Administration (OSHA)
4. American National Standards Institute (ANSI)
5. American Society of Testing Materials (ASTM)
6. Rules and regulations of public utilities and municipal departments affected by connection of services.
7. Other national standards and codes where applicable.

Where the contract documents exceed the requirements of the referenced codes, standards, etc., the contract documents shall take precedence. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent.

Promptly bring all conflicts observed between codes, ordinances, rules, regulations, referenced standards, and these documents to the attention of the Architect and Engineer for final resolution. Contractor will be held responsible for any violation of the law.

Procure and pay for permits and licenses required for the accomplishment of the work herein described. Where required, obtain, pay for, and furnish certificates of inspection to Owner. Provide all safety lights, guards, and warning signs required for the performance of the work and for the safety of the public.

H. PROTECTION OF EQUIPMENT AND MATERIALS

Store and protect from damage equipment and materials delivered to job site. For materials and equipment susceptible to changing weather conditions, dampness, or temperature variations, store inside in conditioned spaces. For materials and equipment not susceptible to these conditions, cover with waterproof, tear-resistant, heavy tarp or polyethylene plastic as required to protect from plaster, dirt, paint, water, or physical damage. Equipment and material damaged by construction activities shall be rejected, and Contractor shall furnish new equipment and material of a like kind at his own expense.

Keep premises broom clean of foreign material created during work performed under this contract. Conduit, equipment, etc. shall have a neat and clean appearance at the termination of the work.

Plug or cap open ends of conduits while stored and installed during construction when not in use to prevent the entrance of debris into the systems.

I. SUBSTITUTIONS

The base bid shall include only the products from manufacturers specifically named in the drawings and specifications. No substitution will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids. Each such request shall include the name of the material or equipment for which substitution is being requested and a complete description of the proposed substitution including drawings, cut sheets, performance and test data, and all other information necessary for an evaluation. Include a statement setting forth changes in other materials, equipment, or other work that incorporation of the substitution would require. The burden of proof of the merit of the proposed substitution is upon the proposer. The Engineer's decision to approve or disapprove a substitution in a bid is final.

Coordinate and verify with other trades whether or not the substituted equipment can be installed as shown on the construction drawings without modification to associated systems or architectural or engineering design. Include additional costs for additional and engineering design fees in bid if drawing modifications are required because of substituted equipment.

If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other way. Verbal approval will not be given. No substitutions will be considered after the contract is awarded unless specifically provided in the contract documents.

The terms "approved", "approved equal", and "equal" refer to approval by the Engineer as an acceptable alternate bid. No substitutions will be considered that are not bid as an alternate. No material substitutions shall be considered for approval prior to award of contract.

Provide factory generated point-by-point calculations for all exterior light fixtures (photometric files provided so the engineer can generate a point-by-point do not suffice for the point-by-point calculations). Provide interior point-by-point calculations at the discretion of the engineer.

J. SUBMITTALS

Assemble and submit for review shop drawings, material lists, manufacturers' product literature for equipment to be furnished, and items requiring coordination between contractors under this contract. Prepare submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Prior to submitting submittals, verify that the equipment submitted is mutually compatible and suitable for the intended use, will fit the available space, and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location or configuration, submit a shop drawing showing the proposed layout.

Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Only resubmit those sections requested for resubmittal.

Submittals shall contain the project name, applicable specification section, submittal data, equipment identifications acronym as used on the drawings, and the Contractor's stamp. The stamp shall certify that the submittal has been checked by the Contractor, complies with the drawings and specifications, and is coordinated with other trades. Manufacturer product literature shall include shop drawings, product data, performance sheets, samples, and other submittals required by this division. Highlight, mark, list, or indicate the materials, performance criteria, and accessories that are being proposed. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

Submittals and shop drawings shall not contain the name, logo, the seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, refer to paragraph "Electronic Drawing Files" for procedures to be used.

Separate submittals according to individual specification sections. Illegible submittals will be rejected and returned without review. Catalog data shall be properly bound, identified, indexed and tabbed in a 3-ring binder. Each item or model number shall be clearly marked and options indicated. Label the catalog data with the equipment identification acronym or number as used on the drawings and include performance curves, capacities, sizes, weights, materials, finishes, wiring diagrams, electrical requirements and deviations from specified equipment or materials. Mark out inapplicable items. Shop drawings will be returned without review if the above mentioned requirements are not met.

Provide the quantity of submittals required by Division 01. If not indicated and hard-copy sets are provided, submit a minimum of six (6) copies. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name, and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the designated representatives of the Architect and Engineer. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

The checking and subsequent acceptance of submittals by the Engineer and/or Architect shall not relieve the Contractor from responsibility for deviations from the drawings and specifications, errors in dimensions, details, sizes of equipment, or quantities, omissions of components or fittings, coordination of electrical requirements, and not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

K. ELECTRONIC DRAWING FILES

In preparation of shop drawings or record drawings, Contractor may, at his option, obtain electronic drawing files in AutoCAD or DXF format on CD-ROM disk, DVD disk, flash drive, or direct download, as desired, from the Engineer for a shipping and handling fee of $200 for a drawing set up to 12 sheets and $15 per sheet for each additional sheet. Contact the Architect for written authorization and Engineer for the necessary agreement form and to specify shipping method and drawing format. In addition to payment, the written authorization from the Architect and release agreement form from the Engineer must be received before electronic drawing files will be sent.

L. RECORD DRAWINGS (AS-BUILT DRAWINGS)

During progress of the work in this division, Contractor shall maintain an accurate record of all changes made during the installation of the system. Upon completion of the work, accurately transfer all record information to three identical sets of the approved shop drawings. Insert one set into each copy of the manual described below.

See Division 01 and General Conditions for additional information.

M. OPERATION AND MAINTENANCE INSTRUCTIONS

During the course of construction, collect and compile a complete brochure of equipment furnished and installed on this project. Include operational and maintenance instructions, manufacturer's catalog sheets, wiring diagrams, parts lists, approved submittals and shop drawings, warranties, and descriptive literature as furnished by the equipment manufacturer. Include an inside cover sheet that lists the project name, date, Owner, Architect, Engineer, General Contractor, Sub-Contractor, and an index of contents.

Submit three copies of literature bound in approved binders with index and tabs separating equipment types to the Architect, for Engineer's review, at the termination of the work. Paper clips, staples, rubber bands, loose-leaf binding, and mailing envelopes are not considered approved binders. Final approval of systems installed under this contract shall be withheld until this equipment brochure is received and deemed complete by the Architect and Engineer. Instruct workmen to save required literature shipped with the equipment itself for inclusion in this brochure.

Include Record Drawings as described above.

Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, refer to paragraph "Submittals" for requirements.

N. TRAINING

At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel on the operation and maintenance of the equipment provided for this project.

Provide training to include, but not be limited to, an overview of the system and/or equipment as it relates to the facility as a whole; operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention; and review of data included in the operation and maintenance manuals.

Submit a certification letter to the Architect stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The Contractor and the Owner's representative shall sign the certification letter indicating agreement that the training has been provided.

Schedule training with Owner with at least 7 days advance notice.

O. WARRANTIES

Warrant each system and each element thereof against all defects due to faulty workmanship, design, or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these construction documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects occurring within the warranty period(s) as stated in the General Conditions and Division 01.

Warranties shall include labor and material, including travel expenses. Make repairs or replacements without any additional costs to the Owner, and to the satisfaction of the Owner, Architect, and Engineer.

Perform the remedial work promptly, upon written notice from the Engineer or Owner.

Also warrant the following additional items:

1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
2. All raceway seals are effective.
3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.

At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period and any actions the Owner must take in order to maintain warranty status. Each warranty instrument shall be addressed to the Owner and state the commencement date and term.

2. GENERAL MATERIALS AND INSTALLATION

A. BUILDING OPERATION

Comply with the schedule of operations as outlined in the architectural portions of this specification. Building shall be in operation at all times. Accomplish work requiring interruption of building operation at a time when the building is not in operation and only with written approval of building Owner and/or tenant. Coordinate interruption of building operation with the Owner and/or tenant a minimum of seven (7) days in advance of work.

B. EXISTING EQUIPMENT REUSE AND REMOVAL

Provide all demolition of existing electrical systems and new electrical system modifications required because of building remodeling, as noted on the Drawings, or necessary for proper operation and new construction. Remove all abandoned cables and wiring and conduit above accessible ceilings and ventilation shafts.

Remove all existing wiring, light fixtures, exposed conduits, and other electrical installations not reused prior to substantial completion of the work.

Existing raceways may be reused if their points of terminations are suitable; if they are clean inside with no evidence of rust or burrs; if free from cracks, flattened sections, or sharp bends; and, if suitably located to avoid conflicts with other trades or installations. Carefully "fish" all existing conduits reused under this contract to remove all debris and obstructions, and swab until all moisture is removed.

Cut, patch, and repair where required for new electrical installations, and patch and repair all surface damage resulting from this work. Cut flush with the floor and plug at both ends raceways stubbed above the floor and not used at substantial completion of the work.

Relocate all existing electrical systems required to be in operation at substantial completion of the contract, if required, as a result of work included under this contract, even if not specifically indicated in the drawings or specifications.

Existing service entrance conductors and feeder conductors may be reused if all of the following conditions are met:

1. Conductor sizes meet or exceed the sizes specified on the drawings.
2. Conductor insulation is in good or better condition.
3. Conductor insulation is the correct type for the conditions.

C. EXCAVATION AND BACKFILLING

Perform excavation and backfill required for installation of underground work under this contract. Trenches shall be of sufficient width. Crib or brace trenches to prevent cave-in or settlement. Do not excavate trenches close to columns and walls of new building without prior consultation with the Architect. Use pumping equipment if required to keep trenches free of water. Backfill trenches in maximum 6-inch layers of well tamped dry earth in a manner to prevent future settlement.

Excavation as specified herein shall be classified as common excavation. Common excavation shall comprise the satisfactory removal and disposition of material of whatever substances and of every description encountered, including rock, if any, within the limits of the work as specified and shown on the drawings. Excavation shall be performed to the lines and grades indicated on the drawings. Dispose of excavated materials that are considered unsuitable for backfill, and surplus of excavated material, which is not required for backfill, all to the satisfaction of the Engineer.

D. COINCIDENTAL DAMAGE

Repair streets, sidewalks, drives, paving, walls, finishes, and other facilities damaged in the course of this Work. Repair materials shall match existing construction. Repair work shall meet all requirements of the Owner, local authorities having jurisdiction, and meet the satisfaction of the Architect. Repair work shall be thoroughly first class.

E. CUTTING AND PATCHING

Conform to the requirements in Division 01. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this division. Obtain permission of the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect. Cut holes as small as possible. Patch walls, floors, and other portions of the facility as required by work under this division. Patching shall match the original material and construction including fire ratings, if applicable. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

F. ROUGH-IN

Coordinate without delay all roughing-in with other divisions. Conceal all conduit and raceways except in unfinished areas and where otherwise indicated on the drawings.

G. CONCRETE BASES

Provide concrete bases (e.g., housekeeping pads) for equipment where indicated on the drawings and as specified herein. Concrete bases shall have chamfered edges. Size of base shall be a minimum of 4 inches greater than the footprint of the equipment that it is supporting and shall have a minimum height of 3-1/2 inches.

Construct equipment bases of a minimum 28-day, 4000-psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. Exposed exterior concrete shall contain 5 to 7 percent air entrainment.

Unless otherwise specified or shown on the structural drawings, reinforce equipment bases with No. 4 reinforcing bars conforming to ASTM A615 or 6x6 - W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Place reinforcing bars 24 inches on center with a minimum of two bars each direction.

Provide galvanized anchor bolts for equipment placed on concrete bases or on concrete slabs. Anchor bolts size, number, and placement shall be as recommended by the manufacturer of the equipment.

H. SUPPORT SYSTEMS

Steel Slotted Support Systems (Slotted Channel): Comply with MFMA-3, factory-fabricated components for field assembly; 12-gauge, 1-5/8-inch by 1-5/8-inch.

Finishes:

1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane or polyester coating applied according to MFMA-3.
3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.
4. Stainless Steel: Type 304, per ASTM A240.

Aluminum Slotted Support Systems (Slotted Channel): Comply with MFMA-3, Type 6063-T6, per ASTM B221, factory-fabricated components for field assembly; 12-gauge, 1-5/8-inch by 1-5/8-inch.

Manufacturers: Cooper B-Line, ERICO International, Hilti, Power-Strut, Thomas and Betts, or Unistrut.

Field Fabrication:

Field cutting of standard lengths of channel are required, make cuts straight and perpendicular to manufactured surfaces.

For field-cut or damaged surfaces of coated channel, dress cut ends or damaged surfaces, or both, with an abrasive material (e.g., file, grinding stone, or similar) and cleanser to remove oil, rust, sharp edges, and shards.

For channel with a factory-applied coating, re-finish cut ends with a coating compatible with the factory finish and as recommended by the manufacturer (e.g., manufacturer's touch-up paint or zinc-rich cold-galvanizing compound, as applicable).

I. ACCESS DOORS

Provide access doors for all concealed equipment where indicated or as required, except where above lay-in ceilings. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches. Access doors must be of the proper construction for the type of construction in which it is installed. Obtain Architect's approval of type, size, location and color before ordering. Provide factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation, concealed hinges, flush screwdriver-operated cam lock, and anchor straps. Provide access doors manufactured by: Bar-Co, J.L. Industries, Karp Associates, Milcor, Nystrom Building Products, Wade, or Zurn.

J. PENETRATIONS

Coordinate sleeve selection and application with selection and application of fire-stopping specified in Division 07 section "Through-Penetration Firestop Systems."

Roofs:

1. Coordinate all roof penetrations with Engineer, Owner, and as applicable, the roofing contractor providing a roof warranty.

2. Keep all raceway penetrations within mechanical equipment curbs wherever possible. Coordinate with Division 01 .

3. Flash and counterflash all openings through roof, and/or provide pre-fabricated molded seals compatible with the roof construction installed, or as required by the Engineer, Owner, or roofing contractor. All roof penetrations shall be leaktight at the termination of the work and shall not void any new or existing roof warranties.

Walls and Floors:

1. Steel Pipe Sleeves for Raceways and Cables: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, and drip rings.

2. Cast-Iron Pipe Sleeves for Raceways and Cables: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

3. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052 inch thickness and of length to suit application.

K. FIRESTOPPING

Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ.

Manufacturers: Hilti, RectorSeal, Specified Technologies Inc., United States Gypsum Company, or 3M corp.

Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating, and installation drawing for each penetration fire stop system.

Where project conditions require modification to qualified testing and inspecting agency's illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Include qualifications data for testing agency.

L. EQUIPMENT FURNISHED BY OTHERS

Provide necessary equipment and accessories that are not provided by the equipment supplier or Owner to complete installation of equipment furnished by others in locations as indicated on the drawings, specified herein, or both. Equipment and accessories not provided by the equipment supplier may include, but not be limited to, flexible cords and plugs as required for proper operation of the complete system, in accordance with the manufacturers' instructions.

Contractor shall be responsible for correct rough-in dimensions, and verify them with Architect and/or equipment supplier prior to rough-in and service installations.

M. SYSTEM TESTING AND ADJUSTING

Adjust, align, and test all electrical equipment on this project provided under this division and all electrical equipment furnished by others for installation or wiring under this division for proper operation.

Test all systems and equipment according to the requirements in NETA ATS (latest edition) and all additional requirements specified in following sections.

Maintain the following on the project premises at all times: a true RMS reading voltmeter, a true RMS reading ammeter, and a megohmmeter insulation resistance tester. Provide test data readings as requested or as required by the Engineer.

N. EQUIPMENT IDENTIFICATION

Provide equipment identification nameplates on all switchboards, panelboards, electrical equipment enclosures, access doors, transformers, disconnect switches, enclosed circuit breakers, motor starters, feeder devices in switchboards, distribution panelboards, and motor control centers.

Nameplates:

1. Engraved, contrasting color, three-layer, laminated plastic , indicating the name of the equipment, load, or circuit as designated on the drawings and in the specifications:
2. Field-applied permanent epoxy adhesive, compatible with the equipment finish.
3. Self-adhering, with a permanent weatherproof adhesive.
4. Attached with stainless steel screws and hardware.

Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied.

Nameplate Color:

1. Black background with white letters for Normal Power;
2. Red background with white letters for Emergency Power.

Letter height: 3/8-inch minimum .

B. SYSTEM START UP

Perform the following prior to starting up the electrical systems:

1. Check all components and devices and lubricate items accordingly.
2. Tighten screws and bolts for 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 and UL 486B.
3. Adjust taps on each transformer for rated secondary voltage when the transformer is at minimum load.
4. Check and record building's service entrance voltage, grounding conditions, grounding resistance, and proper phasing.
5. Replace all burned-out lamps and lamps used for temporary construction lighting in permanent light fixtures.
6. After all systems have been inspected and adjusted, confirm all operating features required by the drawings and specifications and make final adjustments as necessary.

END OF SECTION 26

Division 26: BASIC ELECTRICAL MATERIALS AND METHODS

1. RACEWAYS

A. METALLIC CONDUIT AND TUBING

Electrical Metallic Tubing, Couplings, and Fittings (EMT): ANSI C80.3, UL 797. Only steel products allowed. Reduced wall EMT is not allowed.

Flexible Metal Conduit (FMC): Zinc-coated steel or aluminum, UL 1. Reduced-wall FMC is not allowed .

Intermediate Metal Conduit (IMC): Hot-dip Galvanized Rigid Steel Conduit, ANSI C80.6, UL 1242.

Liquidtight Flexible Metal Conduit (LFMC): Flexible steel conduit with PVC jacket, UL 360; fittings: NEMA FB 1.

Rigid Metal Conduit (RMC):

1. Hot-dip Galvanized Rigid Steel Conduit (GRS): ANSI C80.1, UL 6.
2. Rigid Aluminum Conduit (RAC): ANSI C80.5, UL 6A .

Plastic-Coated IMC, RMC, and Fittings: NEMA RN 1, NRTL listed. Coating thickness of 0.04 inches minimum.

IMC and RMC Fittings: NEMA FB 1; compatible with conduit type and material, NRTL listed.

Manufacturers: AFC Cable, Alflex, Anamet Electrical, Electri-Flex, Indalex, Manhattan/CDT/Cole-Flex, O-Z/Gedney, Republic Raceway, Tyco International, Western Tube and Conduit, or Wheatland Tube.

B. NON-METALLIC CONDUIT AND TUBING

Rigid Nonmetallic Conduit (RNC): Schedule 40 PVC, 90 deg C rated, NEMA TC-2, UL 651

Fittings: NEMA TC 3, TC 6, UL 651, compatible with conduit/tubing type and material, NRTL listed.

Manufacturers: AFC Cable, American International, Anamet Electrical, Arnco, Cantex, Certainteed, Condux International, Elecsys, Electri-Flex, Lamson and Sessions, Manhattan/CDT/Cole-Flex, Prime Conduit, Raco, Spiralduct, Superflex Ltd, or Thomas and Betts.

2. RACEWAY INSTALLATION

A. GENERAL RACEWAY INSTALLATION REQUIREMENTS

Install raceways parallel and perpendicular to building lines.

Install raceways to requirements of structure, to requirements of all other work on the project, and to clear all openings, depressions, pipes, ducts, reinforcing steel, and other immovable obstacles.

Install raceways set in forms for concrete structure in such a manner that installation will not affect the strength of the structure.

Except where approved in writing by the Engineer, install no raceway in a slab-on-grade. Locate raceway below granular fill below slabs-on-grade.

Install raceways continuous between connections to outlets, boxes, and cabinets with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between connections. Use manufactured elbows for all 45- and 90-degree bends, unless approved by the Engineer in advance. Make other bends smooth and even and without flattening raceway or flaking galvanizing or enamel. Radii of bends shall be as long as possible and never shorter than the corresponding trade elbow.

Use long radius elbows for all underground installations, where necessary, or where otherwise indicated.

Securely fasten raceways in place with approved straps, hangers, and steel supports as required. Attach raceway supports to the building structure. Hang single raceways for feeders with malleable split ring hangers with rod and turnbuckle suspension from inserts spaced not over 10 feet apart in construction above. Clamp groups of horizontal feeder raceways to steel channels that are suspended from inserts spaced not over 10 feet apart in construction above. Securely clamp vertical feeder raceways to structural steel members attached to structure. Install cable clamps for support of vertical feeders where required. Add raceway supports within 12 inches of all bends, on both sides of the bends. Do not support raceways from suspended ceiling components.

Ream raceway ends, thoroughly clean raceways before installation, and keep clean after installation. Plug or cover openings and boxes as required to keep raceways clean during construction and fish all raceways clear of obstructions before pulling conductor wires. Provide raceways of ample size for pulling of wire, not smaller than code requirements and not less than 1/2-inch in size, unless indicated otherwise on Drawings. Homeruns containing more than one branch circuit shall not be less than 3/4-inch in size.

Protect all raceway installations against damage during construction. Repair all raceways damaged or moved out of line after roughing-in to meet Engineer's approval without additional cost to the Owner.

Align and install true and plumb all raceway terminations at panelboards, switchboards, motor control equipment, and junction boxes.

Install approved expansion/deflection fittings where raceways pass through (if embedded) or across (if exposed) expansion joints and when using RNC or RAC in exposed environments in accordance with NFPA 70 and expansion/contraction properties of RNC or RAC.

Install a pull wire in each empty raceway that is left for installation of conductors or cables under other divisions or contracts. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 24 inches of slack at each end of pull wire.

Make all joints and connections in a manner that will ensure mechanical strength and electrical continuity.

For raceways penetrating freezer and cooler walls, effectively seal raceways by installing a conduit fitting at the boundary between spaces and filling it with an approved pliable material after conductors or cables have been installed. Provide fitting where raceways pass from non-cooled to cooled spaces, raceways transition from outside a cooled enclosure to inside, or where buried or exposed.

B. ABOVE GROUND RACEWAY USE:

Install all circular raceways concealed above suspended ceilings or concealed in walls or floors wherever possible, except where otherwise indicated. Provide GRS for all conduits exposed to weather or other hazardous conditions.

Unless noted otherwise, all other raceways shall be EMT where approved by local code. Use compression type fittings with all fittings NRTL listed for the environment in which they are used. Unless noted otherwise, set-screw type fittings are not allowed.

C. UNDERGROUND RACEWAY USE:

Provide GRS installed below grade with a corrosion-resistant bonded plastic or approved mastic coating. This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.

D. EQUIPMENT CONNECTIONS

Use FMC for final connection to each motor, transformer, and any device that would otherwise transmit motion, vibration, or noise. Use LFMC where exposed to liquids, vapors, or sunlight, and to connect to kitchen and food service equipment. Provide all FMC and LFMC with an insulated bonding conductor.

Use only metal raceways for all power wiring from the output of variable frequency drives to their respective motors.

3. BUSHINGS AND LOCKNUTS

Rigidly terminate conduits entering sheet metal enclosures to the enclosure with a bushing and locknut on the inside and a locknut or an approved hub on the outside. Conduits shall enter the enclosure square.

Provide bushings and locknuts made of galvanized malleable iron with sharp, clean-cut threads.

Where EMT enters a box, provide approved EMT compression connectors.

Use insulated, grounding, or combination bushings wherever connection is subject to vibration or moisture, when required by NFPA 70, or both.

4. CONDUCTORS AND CABLES

Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL standards 44 or 83 as applicable .

Where aluminum conductors terminate existing panelboards , switchboards or switchgear that utilize compression connections use hydraulic-compression type connectors with a zinc base, anti_oxidizing compound. Use compression tools of the type that will not release unless the correct pressure has been applied.

Conductor Insulation Types: 90-degree C-rated, Type THHN/THWN-2 or XHHW-2 complying with ICEA S-95-658/NEMA WC70.

Sizes of conductors and cables indicated or specified are in American Wire Gage (AWG - Brown and Sharpe).

All feeder and branch circuit conductors No. 8 AWG and larger: Stranded.

All conductors, No. 10 AWG and smaller: Solid copper.

All Branch Circuit Wiring: Not smaller than No. 12 AWG. If no conductor size is indicated on the Drawings for a branch circuit, provide conductors and conduit sized per NFPA 70 and based on the indicated branch circuit overcurrent protective device (OCPD) rating and number of poles. Where no circuit size (i.e., conductors and OCPD) is indicated on the drawings for a branch circuit, provide three No. 12 AWG conductors, in 3/4-inch raceway, and a 20A circuit breaker.

Control Wiring: Stranded copper conductors, 600V insulation, of the proper type, size, and number as required to accomplish specified function. Minimum size: No. 14 AWG, unless noted otherwise.

Flexible Cords and Cables: Stranded copper conductors for all, unless noted otherwise.

Special Purpose Conductors And Cables, Such As Low Voltage Control And Shielded Instrument Wiring: As recommended by the system equipment manufacturer unless indicated otherwise.

Copper Conductor Manufacturers: Advance Wire and Cable, AFC Cable, Alan Wire, Alflex, American Insulated Wire, Encore Wire, Northern Cables, Okonite, or Southwire.

Connections: Apply a zinc based anti_oxidizing compound to connections. Do not use terminals on wiring devices to feed through to the next device.

5. CONDUCTORS AND CABLES INSTALLATION

Install all wiring in approved raceway and enclosures, except
where specified or indicated for low-voltage wiring, where specified or indicated for direct-buried cables, or where type MC cable is indicated or specified as acceptable.

Install all conductors and cables in raceways continuous without taps or splices. Splice or tap only in approved boxes and enclosures with approved solderless connectors, or crimp connectors and terminal blocks for control wiring, and keep to the minimum required. Insulate all splices, taps, and joints as required by codes.

All materials used to terminate, splice, or tap conductors: designed for, properly sized for, and NRTL listed for the specific application and conductors involved, and installed in strict accordance with the manufacturer's recommendations, using the manufacturer's recommended tools.

Where wiring is indicated as installed, but the connection is indicated "FUTURE" or "BY OTHER DIVISION, TRADES, OR CONTRACTS", leave a minimum 3-foot "Pigtail" at the box, tape the ends of the conductors, and cover the box.

In general, the direction of branch circuit "home run" routing is indicated on the drawings, complete with circuit numbers and panelboard designation. Continue all such "home run" wiring to the designated panelboard, as though "circuit runs" were indicated in their entirety.

Common or shared neutrals are not allowed unless shown on the drawings to be used or specifically noted to be allowed.

Where multi-wire branch circuits (i.e., shared neutral) are allowed, they shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single-pole breakers with a handle tie are two examples.

When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:

Normal or Non-Essential circuits:

1. Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4-inch. For greater than eight conductors, minimum raceway size: 1-inch. Do not install any other type of circuit in this raceway.

2. Minimum wire size for all conductors in this raceway: No. 10 AWG.

3. Only 15A and 20A branch circuit homeruns may be combined into one raceway.

GFCI circuits:

1. Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.

For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.

Properly identify all terminal blocks and wire terminals for control wiring with vinyl stick-on markers or equivalent. Provide Engineer with a list of proposed identifying numbers for review prior to installing markers.

Provide an equipment-grounding conductor or bonding jumper, as applicable, in all feeders and branch circuits, sized in accordance with NFPA 70 Tables 250.66 or 250.122, as applicable, unless indicated as larger on the drawings.

Voltage drop in branch circuits shall not exceed 3 percent.

Wiring shall have insulation of the proper color to match color code system in the table below unless there is a color system currently in use by the facility, in which case the colors are to match the existing system. In larger sizes where properly colored insulation is not available, use vinyl plastic electrical tape of the appropriate color around each conductor at all termination points, junctions, and pull boxes.

System Voltage:

240V and under, including 208Y/120, 120/240, 120/208, and 240D/120 systems:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.
4. Neutral: White.
5. Equipment Ground: Green.
6. Isolated Ground: Green with yellow stripe.

7. MC CABLE

A. CABLE SPECIFICATIONS

Metal-clad cable (MC Cable): 600V, unjacketed; UL Standard 83, 1569, and 1665; NFPA 70 Article 330; aluminum or galvanized steel interlocked armor; THHN- or XHHW-insulated conductors; color code: ICEA Method 1, with green insulated grounding conductor; listed for use in UL 1, 2, and 3 hour through-penetration firestop systems. MC Cable manufacturers: AFC Cable Systems, Encore Wire Corporation, Kaf-Tech, or Southwire.

B. APPLICATIONS OF MC CABLE

1. In lieu of flexible conduit and wiring from light fixtures located in accessible ceilings to junction boxes attached to building structure directly above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5 foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.

2. For vertical drops in stud walls.

3. In lieu of EMT, only for 15A and 20A branch circuits (with up to four (4) conductors, not including ground conductor), and only in dry concealed locations above grade, except where specifically not permitted by NFPA 70 , owner, landlord, AHJ, or noted in list below.

C. PROHIBITED USE OF MC CABLE UNLESS NOTED ABOVE

Examples of those uses include, but are not limited to the following:

1. Homeruns to panelboards (refer to Section 26: Definitions).
2. Where exposed to view.
3. Where exposed to damage.
4. Hazardous locations.
5. Wet locations.
6. When restricted otherwise.
7. When specifically disallowed by the local AHJ.
8. When specifically disallowed by the landlord.
9. Circuits supplied by an emergency or standby power source.

7. MC CABLE INSTALLATION

Secure and support cable per NFPA 70 Article 330. Secure cable within 12 inches of every box or fitting. Securing and supporting intervals shall not exceed six feet. Maintain consistent spacing to avoid derating due to bundling per NFPA 70 Section 310.15. Utilize steel cable hangers, Arlington SMC series or equivalent, to support wherever possible so cables can be routed in a neat and workmanship like manner.

8. JUNCTION BOXES, PULL BOXES, CABINETS, AND WIREWAYS

Provide junction boxes, pull boxes, cabinets, and wireways wherever necessary for proper installation of various electrical systems according to NFPA 70 and where indicated on the drawings. Size as required for the specific function or as required by NFPA 70, whichever is larger. Construction shall be of a NEMA design suitable for the environment installed.

Junction boxes installed behind wall cases and in or on other store fixtures, except where otherwise specified, shall be 4 inches square or larger with galvanized covers.

Horizontally mount junction boxes under center fixtures (and cases), handy boxes or 4-inch square boxes with tops of boxes not more than 3-1/2 inches above the floor. Size junction boxes to adequately contain all required conductors and splices.

9. OUTLET BOXES

All outlets including light fixture, switch, receptacle, and similar outlets: galvanized steel knockout boxes suitable in design to the purpose they serve and the space they occupy. Size as required for the specific function or as required by NFPA 70, whichever is larger. Set all outlet boxes in walls, columns, floors, or ceilings so they are flush with the finished surface, accurately set, and rigidly secured in position. Provide plaster rings, extension rings and/or masonry rings as required for flush mounting. Provide approved cast outlet boxes with hubs and weatherproof covers in all areas subject to damp, wet, or harsh conditions.

Manufacturers: Appleton, Cooper, Erikson Electrical, Hoffman, Killark, O-Z/Gedney, Raco, Robroy Industries, Hubbell, Fetzer, Spring City Electrical, Thomas and Betts, Walker Systems, or Wiremold.

10. OUTLET LOCATIONS

Coordinate locations of outlet boxes. Outlets are only approximately located on the small scale drawings. Use great care in the actual location by consulting the various large scale detailed drawings used by other division trades before selecting definite locations from the Architect.

11. MOUNTING HEIGHTS

Unless noted otherwise, install wiring devices as indicated below. Note: All dimensions are to the center of the outlet box unless noted otherwise):

A. RECEPTACLES

Vertically aligned, with ground slot mounted at the top: Bottom of outlet box 16 inches above finished floor.

Horizontally aligned, with ground slot mounted at the top: Bottom of outlet box 16 inches above finished floor.

For 36-inch high counter tops: 42 inches above finished floor, vertically aligned.

For 34-inch high counter tops: 40 inches above finished floor, vertically aligned.

Mechanical and electrical equipment rooms and janitors closets: 44 inches above finished floor, vertically aligned.

Garages: 24 inches above finished floor, vertically aligned.

Weatherproof exterior receptacles: 24 inches above finished grade, vertically aligned.

GFCI receptacles: Same as general receptacles .

Isolated ground receptacles: Same as general receptacles .

USB receptacles: Same as general receptacles .

Clock receptacles: 84 inches above finished floor.

Concrete Block Walls: As long as ADA requirements are maintained, dimensions above may be adjusted slightly as required to compensate for variable joint dimensions such that bottom or top of boxes, as applicable, are at block joints.

B. SWITCHES

General: Top of outlet box a maximum of 44 inches above finished floor. All switches shall be mounted at the same height throughout the project unless noted otherwise.

Above Counters: Same as for receptacles.

Concrete Block Walls: As long as ADA requirements are maintained, dimensions above may be adjusted slightly as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.

Walls with Wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.

C. TELEPHONE/DATA OUTLET BOXES

General: Match mounting height of adjacent wiring device listed above.

Wall-mounted Telephone (Public): One at 48 inches above finished floor and one at 36 inches above finished floor.

For other than wiring devices, refer to paragraphs, articles, sections, divisions, or drawings to obtain mounting heights for specific equipment or systems.

12. WIRING DEVICES

The catalog numbers listed for wiring devices are generally for 20A rated devices. Where 15A rated devices are indicated on the drawings or required for circuit rating limitations, provide wiring devices equivalent to those specified for 20A, but rated for 15A.

All receptacles located outdoors or in damp or wet locations: Listed as 'weather Resistant', designated by a 'WR' on the faceplate.

Minor changes relative to the location of electrical equipment may be made to comply with structural and building requirements as determined in the course of construction. Provide all wiring devices of the same manufacturer and not mixed on the project, to the maximum extent possible. Provide color of toggles and receptacles as requested by the Architect . Refer to detail showing receptacles table.

Wiring Devices: Unless noted otherwise, devices shall be commercial grade and rated for 20A. Wiring device manufacturers: Cooper, Hubbell, Legrand, or Leviton.

Floor Boxes: UL 514A listed for scrub water exclusion. For slab on grade - Watertight, Class 1, and fully adjustable cast iron box. For slab above grade - Concrete-tight, fully adjustable, stamped galvanized steel box. Floor box shape, quantity of gangs, type and quantity of devices, finish, and flange type per drawings. Floor box manufacturers: Hubbell, Legrand, Thomas and Betts, or Walker.

13. SWITCH AND OUTLET COVER PLATES

Switch and Outlet Plates: Colored, smooth nylon; by the same manufacturer as the wiring devices, wherever possible. Verify desired materials and colors with Architect before installation. Switch plates in unfinished rooms and spaces: Stamped steel, cadmium plated. Install groups of switches under one ganged-plate, usually horizontally; or, where required by details, vertically. Set all cover plates plumb, parallel, and finished flush with the wall.

14. WEATHERPROOF COVER PLATES

Provide GFCI receptacles for designated weatherproof receptacles, unless indicated otherwise on the drawings .

Unattended Exterior, Wet Locations or Other Locations as Indicated: In-use, NEMA 3R, recessed or flush mount, NRTL labeled plates molded from a clear high impact ultraviolet stabilized polycarbonate material for easy verification that cords are plugged in and that the GFCI is functioning. Back box must be suitable for conduit connecting. Coordinate back box with wall depth. Intermatic WP1000RC/HRC or equal.

Attended Wet Or Damp Locations: Weatherproof cover plates NRTL listed for wet locations with cover(s) closed; die-cast aluminum or Type 302 stainless steel; single-cover for switches and vertically mounted receptacles; double-cover for horizontally mounted receptacles; self-closing covers.

Cover Plates: By the same manufacturer as the wiring devices; complying with NFPA 70 ARTICLES 406.9 (A) or (B) requirements for attended or unattended use as applicable.

15. DISTRIBUTION AND CONTROL EQUIPMENT

A. POWER DISTRIBUTION PANELBOARDS: CIRCUIT BREAKER, 1200A BUS OR SMALLER

Panelboards: Dead-front distribution panelboards with number and sizes of circuit breakers as indicated on the drawings; where installed as service entrance equipment, permanently label as suitable for use as service entrance equipment; fully-rated for the available fault current indicated on the drawings; hinged, lockable front door that covers the circuit breaker handles. Circuit breakers: Quick-make, quick-break, indicating type; engraved nameplates for circuit identification of each circuit breaker. Provide a typewritten card directory indicating exactly what each circuit breaker controls on the inside face of the door for circuit identification.

Manufacturers: Square D Type I-Line, Eaton type Pow-R-Line 4, G.E. types CCB or AV-1, or Siemens types S4 or S5.

B. LIGHTING AND APPLIANCE PANELBOARDS

Panelboards: Complete with bolt-on thermal magnetic, molded case circuit breakers assembled in a dead-front finished cabinet containing a typewritten card directory indicating exactly what each circuit breaker controls; fully-rated and with the integrated short circuit current ratings indicated on the drawings. Plug-in type breakers will not be acceptable. All two- and three-pole breakers: Common trip type.

1. Type SWD Circuit Breakers: Use when breaker serves as a switch for 120V or 277V lighting circuits.

2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Use as indicated on drawings.

3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip). Use as indicated on drawings.

4. Handle Clamp: Loose attachment for holding circuit breaker handle in "on" position. Use for all circuits containing emergency lighting loads, fire alarm loads, and as indicated on drawings. Breakers serving fire alarm loads must have a permanently-affixed red label stating "FA" in white letters adjacent to the circuit breaker.

5. Handle padlocking device: fixed attachment for locking circuit breaker handle in "on" or "off" position. Use as indicated on drawings.

Manufacturers: Square D Type NQOD or NF (as applicable, based on voltage and ampere ratings and required short circuit interrupting ratings as scheduled on the drawings) or approved equal by Eaton, G.E., or Siemens.

C. CIRCUIT BREAKERS IN EXISTING PANELBOARDS /SWITCHBOARDS

Provide new circuit breakers for installation in existing panelboards/switchboards, of the same manufacturer and type as the existing panelboard/switchboard circuit breakers. Short circuit current interrupting rating of the circuit breaker shall be the larger of the existing panel rating or the available fault current indicated on the drawings.

D. DISCONNECT (SAFETY) SWITCHES

Disconnect (Safety) Switches: Heavy-duty, fused or non-fused (as indicated on drawings or required) horsepower rated, externally operated, visible-blade safety switches; NEMA enclosure type as indicated on the drawings or suitable for the environment in which installed. based on fusible switch and fuse sizes indicated, include Class R, J, or L fuse provisions as applicable.

Where indicated, provide fusible switches permanently labeled as suitable for use as service entrance equipment with integral and separate neutral and ground assemblies, suitable for the sizes of conductors indicated. Do not double-lug any terminations not specifically listed as suitable for more than one conductor.

Provide switches where not furnished with the starting equipment, at all locations required by NFPA 70, and where indicated on the drawings.

Manufacturers: Eaton, G.E., Siemens, or Square D.

F. FUSES

Provide each circuit and switch fuse clips throughout the work with sizes and types as required or indicated. All fuses larger than 600A: UL Class L, similar to KRP-C Bussmann Low Peak or equal. Fuses used to protect motors: UL Class RK5, Bussmann Fusetron or equal. Fuses used to protect all other electrical equipment: UL Class RK1, dual element, Bussmann LPS/LPN or equal. All fused devices shall be labeled with type and size of fuse required.

Furnish three spare fuses of each size and type used on the project (except for main switch fuses, furnish one spare), neatly contained in a properly labeled cabinet.

Manufacturers: Bussmann, Edison Fuse, Ferraz Shawmut, or Littlefuse.

G. DRY-TYPE TRANSFORMERS

Transformers: General purpose, NRTL listed/labeled. Comply with NEMA ST 20 and UL 1561.

Insulation Class: For three-phase transformers less than 15 kVA and all single-phase, 185 degrees C, NRTL-component-recognized insulation system with a maximum of 115 degree C rise above a 40 degree C ambient temperature; for three-phase transformers 15 kVA and larger, 220 degrees C, NRTL-component-recognized insulation system with a maximum of 150 degree C rise above a 40 degree C ambient temperature. NRTL-component-recognized insulation system replaces the UL 1446 insulation rating system that used letters.

Phases, Voltages, and Sizes: As indicated on the drawings.

Sound Level: Not exceeding 3 dBa less than NEMA ST 20 standards for the sizes indicated when factory tested according to IEEE C57.12.91.

Full-Capacity Primary Taps: For three-phase below 25 kVA and all single-phase, one 5 percent tap above and one 5 percent tap below; 25 kVA to 500 kVA, six 2.5 percent taps (2 above, 4 below); above 500 kVA, four 2.5 percent (2 above, 2 below).

Transformer Core and Coil Assemblies: Mounted on integral vibration-absorbing pads.

Transformers 75 kVA and larger shall be floor mounted unless indicated otherwise. Transformers 45 kVA and smaller may be wall mounted where wall construction is suitable for the load. Floor mounted transformers shall be securely bolted to a 4 inch house keeping pad with vibration isolation pads. Wall mounted or suspended transformers shall have a means of isolating vibration from the support. Wall mounts must be by same manufacturer as and provided with transformer.

Transformers up through 1000 kVA shall be mounted on elastomeric vibration isolation pads. Pad shall be constructed of neoprene, rubber, glass fiber, or a combination thereof. Pads shall be "ribbed" or "waffled" in texture. Pads shall be selected for smallest durometer (hardness), preferably less than 50. Deflection of pad shall be 0.25 inches static minimum. Stack pads until the desired deflection is achieved.

Make final conduit connections to transformers with flexible conduit, with at least 6 inches of slack in all directions. Minimum flexible conduit length shall be 2 feet.

Transformer Enclosures: Removable front cover, core and coil encapsulated within resin compound, drip-proof, fabricated of heavy gauge sheet steel construction. Dry locations: Ventilated, NEMA 250 Type 2. Damp or wet locations: Ventilated with weather shields, NEMA 250 Type 3R. Corrosive locations: Totally enclosed, non-ventilated, NEMA 250 Type 4X, stainless steel.

Provide energy-efficient transformers complying with federal regulation 10 CFR 431.192 thru 431.196 requirements.

K-rated transformers shall be provided as indicated on the drawings and be listed for 115 degree C rise.

Manufacturers: ACME, Eaton, G.E., Siemens, Hammond, Sola/Hevi-Duty, or Square D.

H. FRACTIONAL HORSEPOWER MANUAL CONTROLLER

Manual motor starters for fractional horsepower single-phase motors shall consist of a manually operated toggle switch equipped with melting alloy type overload relay. Thermal unit shall be of one piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed. Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starters shall have NEMA I general purpose enclosure, unless otherwise indicated, and be rated for the motor horsepower required. Provide with handle guard with locking provisions and an integral pilot light.

Manufacturers: Square D Class 2510 Type F, Eaton 9101 series, G.E. CR101 series, Siemens MSF series, or Westinghouse MST series.

I. INTEGRAL HORSEPOWER MANUAL CONTROLLER

Manual motor starters shall consist of a manually operated switch equipped with melting alloy type thermal overload relays. Thermal unit shall be of one piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed. Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starters shall have NEMA I general purpose enclosure, unless otherwise indicated, and be rated for the motor horsepower required. Provide with handle guard with locking provisions and an integral pilot light.

Manufacturers: Square D Class 2510 Type M, Eaton 9115 or A302 series, G.E. CR1062 series, Siemens MS series, or Westinghouse MST series.

J. MOTOR STARTING SWITCHES

Motor starting switches shall consist of a toggle operated two- or three-pole switch. Contacts shall be double break silver alloy, visible from both sides of the switch, and shall have a direct linkage to the operator for positive break. Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starters shall have NEMA I general purpose enclosure, unless otherwise indicated, and be rated for the motor horsepower required. Provide handle guard with locking provisions.

Manufacturers: Square D Class 2510 Type K, Eaton 9115 series, G.E. TC2000 series, Siemens MS series, or Westinghouse MST series.

17. LIGHT FIXTURES, LAMPS AND BALLASTS

A. LIGHT FIXTURE LOCATIONS

Light fixtures shown on the drawings represent general arrangements only. Refer to architectural drawings for more exact locations. Coordinate location with all other trades before installation to avoid conflicts. Coordinate light fixture locations in mechanical rooms with final installed piping and ductwork layouts.

B. LIGHT FIXTURES

Provide light fixtures as scheduled on drawings, including all lamps, all necessary accessories, material and labor to securely hang, clean, and make light fixtures completely ready for use. Light fixture model numbers scheduled on the drawings show only the manufacturer, grade, and style of light fixtures required. Provide all hangers, supports, and miscellaneous hardware required to install light fixtures, proper trim to fit each ceiling condition actually encountered, and additional tie wires connected to structure to conform to seismic requirements where required by the applicable building code.

Packaging of light fixtures will not be allowed. Only those luminaires listed in the Light Fixture Schedule will be accepted in accordance with substitutions of these specifications will be accepted. Where the Light Fixture Schedule indicates an allowance for a specific light fixture, the price is a Contractor price. Include all additional costs for freight, lamps, and installation of light fixtures and lamps.

Install fluorescent light fixtures hung in continuous rows on channel struts specifically designed for this purpose.

Surface-mount all fluorescent light fixtures located in areas with a ceiling but without suspended ceilings unless otherwise indicated on the drawings. Provide rigid metal spacers finished in white enamel between the top of each light fixture and the ceiling above to maintain a 1-1/2 inch space. Spacers shall be approved before installation.

Install all fluorescent light fixtures located in areas without ceilings immediately below the roof-framing members suspended from chain hangers suitable in length to provide the indicated mounting height. Hangers: chain hanger type with suitable fittings, complete with grounding receptacle, plug, 3-wire cord and hung by chain.

Through-wiring of recessed light fixtures in suspended ceilings is not permitted. Connect each light fixture by a whip to a junction box. Provide cable whips of sufficient length to allow for relocating each light fixture within a 5 foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.

C. EMERGENCY LIGHTING UNITS AND EXIT SIGNS

Description: Self-contained units complying with UL 924.

Battery: Sealed, maintenance-free, lead-acid type. The batteries shall be of suitable rating and capacity to supply and maintain at not less than 87-1/2 percent of the nominal battery voltage the total lamp load associated with the unit for a period of at least 1-1/2 hours, or the unit equipment shall supply and maintain not less than 60 percent of the initial emergency illumination for a period of at least 1-1/2 hours.

Charger: Fully automatic, solid-state type with sealed transfer relay.

Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power, and demonstrates unit operability.

LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge, and bright glow indicates charging at end of discharge cycle.

Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

D. LAMPS

Provide lamps and color temperatures as indicated on the drawings for all light fixtures; or, if not indicated, per the Architect and/or lighting designer. Lamps shall be by the same manufacturer for color consistency. Lamps shall be compatible with the specified light fixture. Fluorescent, metal halide, and incandescent lamp manufacturers: Eiko, G.E., Osram/Sylvania, Philips, Soraa, or Venture.

Fluorescent Lamps: Low-mercury type in compliance with NEMA LL 1; minimum color-rendering index (CRI) of 82 unless noted otherwise; minimum average rated life of 24,000 hours.

Metal Halide Lamps: Pulse-start (ceramic when available); coated; minimum CRI of 80 unless noted otherwise; minimum average rated life of 18,000 hours in the vertical position and 12,000 hours in the horizontal position; low-wattage lamps shall have a protective shroud or other suitable containment material for use in open fixtures.

Incandescent Lamps: Type and wattage as shown on the drawings; rated 130V unless otherwise scheduled or specified.

LED Lamps and Luminaires: Comply with ANSI C78.377 for white light LED color range; minimum CRI of 80 unless noted otherwise; LED binning specification tolerance to be within 3 macadam ellipses of rated values; all LEDs used for same fixture type throughout the project must originate from the same production bin; minimum average rated life of 20,000 hours for LED lamps and 50,000 hours for LED luminaires; Rohs compliant. LED lamp manufacturers: Bridgelux, Cree, Nichia, Osram, or Xicato.

E. BALLASTS

Fluorescent Ballasts (General Requirements): Comply with UL 935 and ANSI C82.11; designed for type and quantity of lamps served; high-efficiency electronic type with NEMA premium label for linear lamps; electronic programmed-start; sound levels not exceeding Class A ambient noise levels; line transient withstand ratings as defined in ANSI/IEEE C62.41, Category A; lamp current crest factor of 1.7 or less; 95-percent power factor or greater; low heat type; thermally protected against overheating. Ballasts in indoor locations shall have disconnecting means either internal or external to the luminaire. Fluorescent ballast manufacturers: Philips Advance/Bodine, Fulham, G.E., Osram/Sylvania, Robertson, Lutron, or Universal.

Indoor Fluorescent Ballasts: 10 percent or less total harmonic distortion; operating frequency of 42 kHz or greater with no visible flicker.

Exterior Fluorescent Ballasts: 20 percent or less total harmonic distortion; operating frequency of 20 kHz or greater with no visible flicker; minimum starting temperature of -20 degrees F; Class P and Type 1 outdoor.

Compact Fluorescent Ballasts: 20 percent or less total harmonic distortion; operating frequency of 20 kHz or greater with no visible flicker.

High-Intensity Discharge (HID) Ballasts, including High Pressure Sodium (HPS) and Metal Halide (MH): Comply with UL 1029 and ANSI C82.4; designed for type of lamp served; sound levels not exceeding Class A ambient noise levels; total harmonic distortion less than 15 percent; line transient withstand ratings as defined in ANSI/IEEE C62.41, Category A; lamp current crest factor of 1.5 or less; 90-percent power factor or greater; minimum starting temperature of -20 degrees F; lamps from 150W-500W must be pulse-start and meet EISA requirements. HID ballast manufacturers: Philips Advance/Bodine, Aromat, Fulham, G.E., Hatch, Osram/Sylvania, Universal.

LED Drivers: Comply with NRTL requirements and ANSI C82.77; designed for type and quantity of lamps served; sound levels not exceeding Class A ambient noise levels; lamp current crest factor of 1.5 or less; 90-percent power factor or greater; line transient withstand ratings as defined in ANSI/IEEE C62.41, Category A.; total harmonic distortion less than 20 percent; shall tolerate sustained open circuit and short circuit output conditions without damage; shall not over-drive LEDs at a current or voltage above LED rated values; ROHS compliant; meets EN610000 requirements for input harmonics.

F. DIMMABLE LIGHT FIXTURES

For dimmable light fixtures provide both control and power wiring between light fixture and control device and between light fixtures. Quantity of low voltage and line voltage wiring and wire type shall be per manufacturer's recommendations. Coordinate light fixture and control device dimming types for compatibility.

18. MISCELLANEOUS ELECTRICAL

A. WIRING OF MECHANICAL EQUIPMENT

Provide all raceways and power wiring for all Division 23 equipment requiring electrical connections, including but not limited to pumps, water heaters, and HVAC equipment, and all line-voltage control and interlock wiring not provided under Division 23. Connect per manufacturers' wiring diagrams. Coordinate with Division 23 for disconnects and variable frequency drives (VFD) furnished with equipment, and provide all disconnect switches and final connections as required. If VFD is separate or does not have an integral disconnect feature, provide disconnect switch with auxiliary contact such that motor will be turned off if switch is off. provide VFD cable, Belden or approved equivalent, for connection of VFD to motor when required. After installing wiring, verify that each motor load has the correct phase rotation.

Verify the actual "Maximum Overcurrent Protection" (MOCP) device ratings and "Minimum Circuit Ampacity" (MCA) conductor sizing for mechanical equipment from the equipment nameplate. Base electrical installations on actual required amperages, which may vary somewhat from the conductor and equipment sizes shown on the drawings; however, in no case, reduce the size of conductors indicated on the drawings without authorization from the Engineer. Provide properly sized electrical wiring and equipment without extra cost to the Owner. Notify the Engineer of all changes required in the electrical installation due to equipment variances so that the effects on feeders, branch circuits, panelboards, fuses and circuit breakers can be checked prior to purchasing and installation. Be responsible for coordinating with Division 23 to verify the actual ampacities and correct sizes of all conductors and overcurrent protective devices for all equipment, and correct overload heaters for all motors, when starters are provided under Division 26.

B. WIRING OF THERMOSTATS, TIME AND TEMPERATURE CONTROLS

Provide all raceways, power wiring, and line-voltage control and interlock wiring not provided under Division 23, for all thermostats, temperature control devices, and controls, including, but not limited to, night-stats, water heater interlocks, time switches and override timers. See mechanical drawings for locations and temperature control diagrams. Low-voltage conductors for thermostats and temperature control system may be run exposed above finished accessible ceilings, if approved and listed for this purpose, but shall be installed in conduit within walls and where exposed in the work areas.

C. TELEPHONE SYSTEM PROVISIONS

Provide incoming telephone service raceways as indicated on drawings or as required by the serving telephone company. Provide 3/4-inch thick plywood board, fire-retardant-treated and stamped FRT, securely anchored to the wall, at the location and of the size as indicated on the drawings. Provide flush mounted telephone outlet boxes with 1 inch conduit stub-up with pull-string concealed to accessible ceiling space at locations as indicated on the drawings.

D. DATA SYSTEM PROVISIONS

Provide flush mounted data outlet boxes with 1 inch conduit stub-up with pull-string concealed to accessible ceiling space at locations as indicated on the drawings.

E. MISCELLANEOUS EQUIPMENT AND CONNECTIONS

All wiring and connections for refrigerated cases and boxes including lighting, superstructure lighting, and control cable and wiring as required by refrigeration wiring diagrams.

All wiring and connections to illuminated cases.

All wiring and connections to equipment furnished by others, including but not limited to bakery equipment, deli equipment, meat room equipment, kitchen equipment, check stand and scanners, exhaust hood fire extinguishing system, etc. Install scan system electronic communication cable in underfloor duct (cable provided by others).

All raceways, wiring, and connections of devices to energy management system that are not the responsibility of Division 23 .

All wiring and connections of exit door alarms.

END OF SECTION 26

NOTE:

EXISTING CONDITIONS WERE TAKEN FROM ORIGINAL DRAWINGS & SITE VISITS AND MAY NOT REFLECT EXACT "AS-BUILT" CONDITIONS. FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO SUBMITTING FINAL BIDS. CAREFULLY COORDINATE NEW WORK AND DEMOLITION WITH ALL OTHER DISCIPLINES AND EXISTING CONDITIONS.

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Project Address
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