

SECTION 26 0000
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Do all work in accordance with regulations of serving electrical utility, telephone utility, National Electrical Code, National Electrical Safety Code, National Fire Codes, and other applicable codes.
- B. Whenever the requirements of the Electrical Specifications or Drawings exceed those of the applicable code or standard, the requirements of the Specifications and Drawings shall govern.
- C. This Contractor is bound by the General Conditions, Supplementary Conditions, Special Conditions, and Division 1 bound herewith in addition to this Specification and accompanying Drawings.
- D. Bidders shall view the site and shall include all costs incurred by existing conditions in the bid proposal.
- E. The work shall include, but not be limited to, the following systems:
 - 1. Electrical service complete per serving utility company requirements.
 - 2. Electrical service and distribution equipment.
 - 3. Complete lighting and power systems, including panelboards or Loadcenters, branch circuits, wiring devices, light fixtures, etc.
 - 4. Telephone, Cable TV, and Data service conduit, terminal boards, terminal cabinets, outlets, raceway system, and grounding per utility requirements.
 - 5. Fire alarm initiating and annunciating devices and cabling system.
 - 6. Connection of electrical equipment furnished under other Divisions of this Specification.
 - 7. Connection of electrical equipment or appliances furnished outside of these Specifications and Contract but described on the Electrical Drawings.
 - 8. Special systems as specified herein.
 - 9. Grounding and bonding.
 - 10. Raceway and boxes for security system.
- F. Advise subcontractors, suppliers, and vendors involved in the work specified in this Section of the applicable requirements.

1.02 QUALITY ASSURANCE

- A. All materials shall be new, of manufacturer's latest design and of the best quality. The materials shall be manufactured in accordance with applicable standards of NEMA, ANSI, or UL and shall be UL listed.
- B. Complete each system as shown and place in operation except where only rough-in or partial systems are called for. Each system shall be tested and left in proper operation free of faults, shorts, or unintentional grounds.
- C. Protect electrical work, wire and cable, materials and equipment installed under this Division against damage by other trades, weather conditions, or any other causes. Equipment found damaged or in other than new condition will be rejected as defective.
- D. The Drawings and Specifications are complementary. What is called for by one shall be as though called for by both. If Drawings and Specifications contradict each other, the Contractor shall obtain written clarification prior to the bid. If time constraints are such that this is not possible, then the more stringent of the conflicting requirements shall be included in the bid. The Specifications are not automatically more authoritative than the Drawings.

1.03 WORK OF OTHER CONTRACTS

- A. Work under this contract shall be conducted in a manner to allow for the future installations of work of other contracts, and include the wiring and/or devices shown on the Drawings or listed in other Sections of this Specification. Also see "Equipment Connections."

1.04 WORK OF OTHER DIVISIONS

- A. Work under this Division shall be conducted in a manner to cooperate with the installation of work of other Divisions.
- B. Control devices (i.e. magnetic starters) and control wiring relating to the heating, ventilating and air conditioning systems and plumbing systems are specified under other Sections of these Specifications except for provisions or items specifically noted on the Drawings or specified herein.
- C. Consult all Drawings and Specifications in this project and become familiar with all equipment to be installed. Coordinate all aspects of the construction with the other trades on the job to ensure that all work and materials required to provide a complete and operational facility are included in the bid.

1.05 SUBMITTALS AND SHOP DRAWINGS

- A. Submit in accordance with Division 1 full technical and descriptive shop drawing data on proposed materials and equipment.
- B. Include the manufacturer, type, style, catalog number, complete specification, certified dimensions, and description of physical appearance for each item and option submitted. Reproduction of catalog data sheets shall be clean and legible to show all details.
- C. Include only information on exact equipment to be installed, not general catalogs of the manufacturer. Where sheets show proposed equipment as well as other equipment, identify proposed equipment with arrow or surrounding box or other similar concise method.
- D. Submit with each copy a transmittal letter verifying that all included equipment submittals have been carefully considered for quality, dimensions, function, and have been coordinated with the Drawings and Specifications. Guarantee that proposed materials will meet or exceed the quality and function of those specified.
- E. The submittal review process is a means to determine quality control. The action noted to be taken (or where conflicts with the contract documents are not noted) shall not be interpreted by the Contractor as automatic "change orders". Approval of the data for substitution and shop drawings shall not eliminate the contractor's responsibility for compliance with the Drawings or Specifications, nor shall it eliminate the responsibility for freedom from errors of any sort in the data discovered prior to or after the review process. Deviations, discrepancies, and conflicts between the submittals and the Contract Documents shall be called to the Architect's attention in writing at the time of transmittal of the data.
- F. Unless otherwise directed by Division 1, submittal data shall be in a 3-ring plastic binder with a clear plastic sleeve cover and a project identification sheet inserted. Arrange submittals numerically with specification Sections identified on divider tabs. All required sections shall be submitted at one time.

1.06 PRODUCT SUBSTITUTION

- A. Material other than those specified may be approved for this project providing a written request is submitted to the Architect prior to bid in accordance with Instructions to Bidders. Requests shall include complete specifications, dimensions, manufacturer and catalog number for each item for which approval is desired. If, in the opinion of the Architect, the material is not complete or if it is not an acceptable substitute, he may reject it. The Architect's evaluation will be based solely on the material submitted.

- B. The Architect reserves the right to require the submission of an actual sample of the specific item before the review and acceptance of any product as an equal to that specified.

1.07 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied by a complete itemized breakdown of labor and materials without exception. At the Architect's request, the Contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor must be separated and allocated for each item of work.

1.08 RECORD DOCUMENTS

- A. Contractor shall maintain a set of record drawings as directed in Division 1.
- B. Keep Drawings clean, undamaged, and up to date.
- C. Record and accurately indicate the following:
 - 1. Depths, sizes, and locations of all buried and concealed conduits/cables.
 - 2. Changes, additions, and revisions due to addenda, RFIs, change orders, obstructions, etc. Eradicate extraneous information.
- D. Make Drawings available when requested by the Architect for review.
- E. Submit as part of the required Project Closeout documents as indicated in Division 1.
- F. Use standards set in contract documents. Note field modifications, all addenda and change order items on project record drawings. If deficiencies are found in either the quality or the accuracy of the drawings, they will be returned unapproved.

1.09 OPERATING AND MAINTENANCE DATA AND INSTRUCTIONS

- A. Upon completion of the Contract and after no further action is noted as being required on catalog data submitted for review, submit multiple sets of Operating and Maintenance Manuals for inclusion in Owner's Maintenance Brochure as specified in Division 1. Operating and maintenance manuals shall include descriptive and technical data, maintenance and operation procedures, wiring diagrams, spare parts lists, service representatives, supplier for replacement parts, etc. Bind each set of Operating and Maintenance Manuals in 3-ring, vinyl covered, loose leaf binders organized with index and thumb-tab marker for each classification of equipment or data.
- B. At the completion of the project, at a time scheduled by the Owner, assemble key mechanics, subcontractors, vendors, factory representatives and similar personnel required to explain all facets of maintenance and operation of the installed system to the Owner's personnel. Instructions shall include actual operation of systems and methods of maintenance.

1.10 ALTERNATE BIDS

- A. Refer to Division 1 for possible effect of bid alternates upon Work of this Division.

1.11 WARRANTY

- A. Furnish, prior to application for final payment, three copies of written and signed guarantee effective a period of at least one year from date of completion and acceptance of entire project; agree to correct, repair and/or replace defective materials and/or equipment or the results of defective workmanship without additional expense to the Owner. Where no response satisfactory to the Owner has occurred within three working days from the written report of a warranty covered defect, the Contractor shall agree to pay for the cost of repair of the reported defect by a Contractor of the Owner's choice.

- B. Where the manufacturer's guarantee exceeds one year, the longer guarantee shall govern and include the Contractor's labor.

PART 2 PRODUCTS

2.01 RACEWAYS AND BOXES

- A. Electrical metallic conduit may be used in dry locations not subject to mechanical injury. Raceways within six feet of the floor in passages, storage areas or where exposed to passing traffic are deemed subject to mechanical injury.
- B. Non-metallic plastic conduit (PVC) shall be used for power systems underground feeders, including runs under the building slab. Minimum 3/4" trade size. PVC shall not be used inside buildings.
- C. Flexible metal conduit is permitted where flexibility is necessary. Exposed flex shall be jacketed, equal to Seal-Tite, with approved fittings, limited to nominally 18 inches maximum length.
- D. Galvanized Rigid Conduit (GRC) and Intermediate Metal Conduit (IMC) shall be used where exposed to weather, or damp location, or where subject to mechanical injury.
- E. Electrical Nonmetallic Tubing (ENT) may be used in concrete slabs and in concealed walls.
- F. GRC and IMC shall be coupled and terminated with threaded fittings. Ends shall be bushed with insulating bushings equal to T&B 1220 or 1230 series.
- G. Connectors and couplings for EMT shall be steel concrete tight compression type with insulated throats on connectors. Connectors shall have a T&B 5030 and 5040 series insulating bushing. Indent type connectors shall not be used.
- H. The Contractor shall provide supplemental ground bus in terminating switchboards, meter centers, panelboards, and loadcenters, and green ground wire as per code rules, for all PVC runs.
- I. Provide duct-seal at ends of all underground and under slab conduits.
- J. All elbows installed in PVC conduit runs shall be long sweep galvanized rigid steel.
- K. Outlet boxes may be galvanized stamped steel or non-metallic where allowed by applicable codes.

2.02 CONDUCTORS AND CONNECTORS

- A. Types NM, NMC, SE, USE cables may be used where permitted by applicable codes, in lieu of conduit and wire. Where conduit and wire is shown on Drawings, substitute appropriate cable type and size.
- B. Branch circuit conductors shall be copper, unless otherwise shown on the Drawings, No. 14 minimum size. Insulation to be type THHN or THWN except where adverse conditions require other insulation type.
- C. Service and feeder conductors (60A ampacity and higher) may be copper or aluminum alloy. Smaller conductors shall be copper.
- D. Splices and Terminations: Splices shall utilize wing nut connector installed properly; splices for No. 8 and larger wires shall be made with approved pressure type connectors; all taped joints shall be applied in half-lap layers without stretching to deform. Listed anti-oxidant compound shall be used on all aluminum alloy conductor terminations, unless information from the device manufacturer specifically states that it is not required.

2.03 SAFETY DISCONNECT SWITCHES

- A. Safety disconnect switches shall be general duty, quick-make, quick-break, dual rated with electrical characteristics as required by system voltage and the load served. Provide fused or non-fused as required. Approved manufacturers: Siemens, Square D, Cutler Hammer, G.E..

2.04 SERVICE ENTRANCE AND SWITCHBOARDS

- A. Service entrance and distribution switchboards shall be of the modular type construction, constructed in accordance with the latest NEMA PB-2 and UL 891 standards, with the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw-on code gauge steel plates. Switchboards shall include all protective devices and equipment as designed with necessary interconnections, instrumentation, and control wiring. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Service entrance switchboards shall be suitable only for use as service equipment and be labeled in accordance with UL requirements. System voltage, amperage and interrupting capacity shall be as designed. Enclosure construction shall be NEMA 1 indoor or NEMA 3R outdoor as is suitable for the installation.
- B. The bus shall be temperature based and shall be tapered per UL standards. The bus shall be braced and supported to withstand mechanical forces exerted during a short circuit from a power source having the available short circuit current as indicated in the fault current calculations. Provide a full capacity neutral. The through bus on the end section shall be extended and pre-drilled to allow the addition of future sections. Ground bus and grounding conductor lug shall be furnished. Ground bus shall extend the entire length of the switchboard and shall be firmly secured to each vertical section. Bus material shall be tin plated aluminum.
- C. To isolate incoming underground service conductors, an underground cable pull or auxiliary section shall be used. This section shall be of the non-bussed type and shall be sealable per local utility requirements, when required.
- D. The service section shall be designed for the system parameters as designed and shall have a metering compartment per utility requirements.
- E. If required, the fire pump tap section shall be on the line side of the main disconnect(s) and contain only through-bus and tap lugs to feed the fire pump.
- F. Individual sections shall be front accessible, not less than 20" deep and the rear of all sections shall align. Incoming line termination, main device connection and all bolts used to join current-carrying parts shall be installed so as to permit servicing from the front only so that no rear access is required. The branch devices shall be front removable and panel mounted with line and load side connections front accessible.
- G. All molded case circuit breakers, fusible switches, insulated case circuit breakers, bolted pressure switches or low voltage power circuit breakers used as a protective device in a branch circuit shall meet the requirements of the appropriate paragraph below.
 - 1. Molded case circuit breakers (MCCB's) shall be of quick-make, quick-break, trip-free thermal magnetic type with frame, trip and voltage ratings as designed. The switchboard shall have space or fully equipped provisions for future units as designed.
 - 2. Fusible switches shall be of the quick-make, quick-break, trip-free type. Switch ratings and options shall be as designed.
 - 3. High contact pressure switch shall be quick-make, quick-break, trip-free type. Switch ratings and options shall be as designed.
 - 4. Bolted pressure switch shall be the quick-make, quick-break type, equipped with Class L fuses suitable for application on a system with available fault current as indicated in the fault calculations. Ampere ratings shall be as designed.

5. Each insulated case circuit breaker shall be stationary frame, stored energy type, trip free, manually operated with solid-state trip device. Frame sizes and trip ratings to be as designed. All breakers to have an interrupting capacity as indicated in the fault calculations.
- H. Furnish and install in the service equipment and/or switchboard ground fault protection and indication equipment as indicated on the Drawings in accordance with NEC 230. All parts of the systems specified shall be UL listed. All new ground fault protection and indication equipment shall be factory installed, wired and tested by the switchboard manufacturer.
- I. The complete switchboard shall be phosphatized and finished with ANSI 61 light gray polyester powder paint.
- J. Each switchboard section shall have a factory label permanently affixed to it, listing the following information: Name of manufacturer, system voltage, ampacity, type, manufacturer's shop order number, and date.
- K. Each section of switchboard shall bear a UL listing mark, where qualified and a short circuit rating label.
- L. Front, side, rear, and top of each switchboard section shall have a DANGER label in accordance with NEMA Standard PB-2.
- M. Approved Manufacturers: Siemens, Square D, Cutler-Hammer, G.E.

2.05 GROUNDING AND BONDING

- A. Provide grounding of the electrical system in accordance with Article 250 of the National Electrical Code. All raceway systems and power cables are to contain a grounding conductor sized in accordance with the NEC.

2.06 RESIDENTIAL METER CENTERS

- A. Meter centers shall be designed and constructed for use in residential or commercial applications. The metering shall be compact, pre-bussed modular construction with the ability to add modules to either side in the future.
- B. The meter center shall meet or exceed the local utility and "authority having jurisdiction" requirements. It shall consist of an incoming service module and meter modules. The modular metering shall be US listed for short circuit current ratings of at least that available per the serving utility, and 65K AIC minimum.
- C. The meter socket devices shall have individual covers. Meter sockets shall have a sealing provision.
- D. The meter sockets shall be made of high impact resistant, non-tracking, glass reinforced polyester resin. Socket jaws shall be tin-plated copper with spring steel reinforced clips.
- E. The bus bars shall be tin-plated aluminum. All unmetered bus shall be barriered and protected. Inaccessible bus connections shall be welded to assure continued reliability.
- F. Approved Manufacturers: Siemens, Square D, Cutler-Hammer, G.E.

2.07 LOAD CENTERS AND CIRCUIT BREAKERS

- A. Load Centers shall be factory pre-assembled using copper bussing and plug-on circuit breakers. Separate feeder lugs shall be provided for each feeder conductor. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machine drilling or tapping. Full size neutral bus bars shall be provided, and shall have a suitable lug for each outgoing feeder requiring a neutral connection. A separate ground bus shall be included in

all load centers. There shall be a neutral and ground bus lug for each breaker location listed as space. Approved manufacturer: Siemens, Square D, Cutler Hammer/Westinghouse, G.E.

- B. Circuit breakers shall be fully interchangeable, without disturbing adjacent units, quick-make, quick-break, ambient compensated, and trip indicating, minimum 15A. Provide complete, accurate, typewritten resulting circuit schedules in panel.
- C. Single-pole circuit breakers shall be full module size; two poles shall not be installed in a single module (tandem). Each breaker shall be securely fastened to prevent movement and trims shall fit neatly and tightly to the breaker assembly. Interrupting rating shall be minimum 10K AIC or higher as indicated on the Drawings.
- D. Combination-type arc-fault circuit interrupter circuit breakers shall be UL 1699 listed.
- E. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. A nameplate shall be provided listing panel type and ratings.
- F. Permanent numbers shall be affixed to each pole next to breakers.
- G. Load centers shall be coated with a rust inhibiting phosphate primer and two coats of light gray enamel.

2.08 WIRING DEVICES

- A. Wiring devices and cover plates shall be residential grade, color as selected by Architect. Duplex Receptacles: 15Amp, 125Volt, NEMA 5-15R, 2-Pole, 3-Wire, Duplex Receptacle, Straight Blade, Grounding, Push-in and Side terminals, Thermoplastic, UL 498 listed. Switches: 15Amp, 120Volt, Toggle Framed Single-pole AC Quiet Switch, Residential grade, Grounding, Push-in and Side terminals, Thermoplastic. Other receptacles and switches to suit intended ampacity and use. Cover plates to be thermoset.
- B. Tamper-resistant (child-proof) receptacles shall be a type which contains internal contacts which require the presence of both blades to energize the receptacle, and shall be UL 498 listed.
- C. Ground Fault Circuit Interrupter receptacles shall be UL 943 listed, and shall have a RESET button that tests the GFCI every time it is pushed.
- D. Approved Manufacturers: Hubbell, Leviton, Cooper, Legrande.

2.09 LIGHTING AND LIGHTING CONTROLS

- A. Provide all lighting outlets indicated on the Drawings with a fixture of the type designated for the location. Outlet symbols on the Drawings without a type designation shall have a fixture the same as those used in similar or like locations. Provide lamps for all fixtures.
- B. Ballasts for linear lamps of 2' to 8' length shall be high frequency electronic type. Total harmonic distortion (THD) shall be less than 20% Power factor (PF) at least 98%, ballast factor (BF) at least 87%, and ballast efficacy factor (BEF) at least 95%. Minimum 5 year ballast and complete replacement labor warranty by manufacturer. Approved manufacturer: Advance, Motorola, and Magnetek.
- C. Linear fluorescent lamps shall be: 32 watt, T8 rapid start, 3500K color temperature, 85 CRI, 20,000 hours rated life.
- D. Approved lamp manufacturers: General Electric, Osram/Sylvania and Philips.
- E. Type 1 occupancy sensors shall be wallbox-mount passive infrared type, 180 degree field view, 900 square foot range, 30 sec to 30 min adjustable time delay, user-adjustable sensitivity, manual override switch, Watt Stopper WS series or equal.

- F. Type 2 occupancy sensors shall be ceiling-mount dual-tech infrared and ultrasonic type, 360 degree field view, 5 to 30 min adjustable time delay, Watt Stopper DT-300 series or equal.

2.10 LED FIXTURES

- A. General:
1. LED lighting fixtures shall be in accordance with IES, NFPA, UL, as shown on the Drawings and as in these Specifications.
 2. LED drivers shall include the following features unless otherwise indicated:
 - a. Power factor: > 0.9 nominal
 - b. Input Voltage: 120V – 277V, 60 Hz
 - c. Total Harmonic Distortion: < 20%
 - d. Temperature Rating: 0 deg C – 40 deg C
 - e. Integral short circuit, open circuit, and overload protection.
 3. LED modules shall include the following features unless otherwise indicated.
 - a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum 80 CRI and color temperature 3500 deg K (interior) and 4000 deg K (exterior) unless otherwise specified in Lighting Fixture Schedule/List.
 - c. Minimum Rated Life: 70,000 hours per IES L70, unless otherwise specified in Lighting Fixture Schedule/List.
 - d. Light output initial lumens as specified in Lighting Fixture Schedule/List.
 - e. LED modules shall be field replaceable and contain quick-disconnects.
 4. LED lighting fixtures shall have available digital IES files from a NVLAP accredited testing laboratory in accordance with IESNA LM-79, which specifies the entire luminaire as the source, resulting in an efficiency of 100%. Lighting fixtures that do not have these test results available will not be accepted.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. Electrical plans are diagrammatic. Verify exact equipment locations for all equipment. Coordinate with architectural drawings and installations to avoid conflicts
- B. All work shall be installed in a neat, inconspicuous, professional manner. Conduit runs shall parallel structural lines where exposed.
- C. Support conduits nominally every 6 feet along runs and within 18 inches of terminations, ells and fittings. Outlet boxes, fixtures and equipment shall be securely mounted and supported.
- D. The site shall be left clean and free of dirt and debris. Loadcenters, fixtures, outlets and equipment shall be left clean and free of foreign materials and dirt.
- E. Loadcenters, switches, distribution centers and all controls shall be clearly and permanently labeled as follows:
- F. Loadcenters shall be labeled with designation, voltage and phase. Labels shall be black on white phenolic plastic with the lettering engraved to expose white lettering. Loadcenter designation shall have 1/2" high letters and voltage and phase shall be 1/4" high. Nameplates shall be secured with screws. Adhesive is not acceptable.
- G. Lamps and lighting fixtures of types and sizes as indicated shall be furnished and installed complete. Provide with all required mounting accessories.
- H. Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project. Provide lamp type as recommended by the fixture manufacturer.

- I. Fixtures shall be left clean at the time of acceptance of the work with every lamp in operation. If fixtures are deemed dirty by the Architect at completion of the project, the Contractor shall clean them.
- J. Fixtures shall be carefully aligned, leveled in straight lines, and located as shown on the Architectural reflected ceiling plan. The final decision as to adequacy of support and alignment shall be made by the Architect. The fixtures shall be supported and fastened to the ceiling system.
- K. It shall be the contractor's responsibility to locate and aim occupancy sensors in the correct location required for a complete and proper volumetric coverage within the range of coverage of controlled areas per the manufacturer's recommendations. The contractor shall provide the quantity of sensors necessary to properly and completely cover each room indicated to have occupancy sensing.
- L. The contractor shall provide power packs as required to accomplish the occupancy sensing indicated.
- M. It is the contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensor and installation criteria.
- N. The contractor shall provide, at the Owner's facility, the training to familiarize the Owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the lighting control equipment and systems.
- O. The contractor shall provide, at the Owner's facility, factory authorized representatives for training of the Owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the Gen-set and transfer switch equipment and systems.
- P. Receptacles shall be tamper-resistant in dwelling unit areas as required by the NEC.
- Q. Circuit breakers shall be combination-type arc-fault circuit interrupter where serving dwelling unit areas as required by the NEC.

END OF SECTION