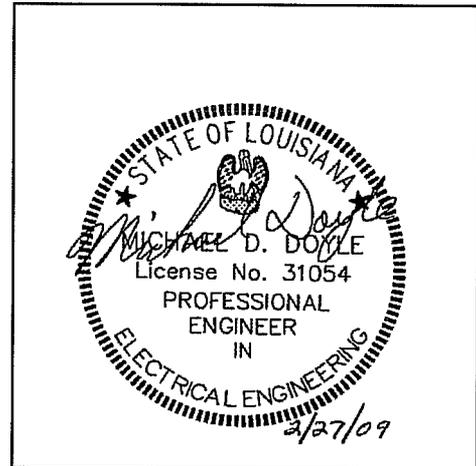
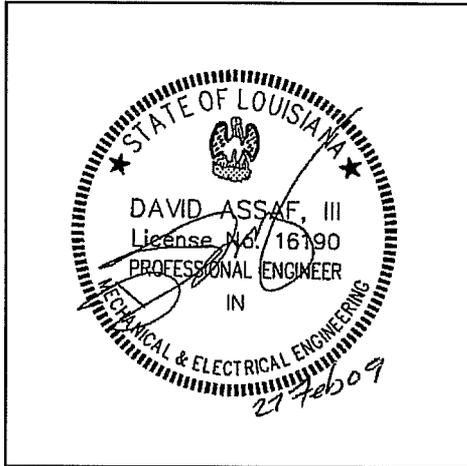


ELECTRICAL SPECIFICATIONS

The following Specification Sections were prepared by me or under my direct personal supervision:



Assaf, Simoneaux, Tauzin & Associates, Inc.

- 16000 - ELECTRICAL SYSTEMS
- 16010 - BASIC MATERIALS AND METHODS
- 16020 - DISTRIBUTION EQUIPMENT
- 16030 - LIGHTING

(END OF ELECTRICAL)

SECTION 16000 - ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. These Specifications are intended to provide for labor, materials, equipment and services and of performing all operations required for the complete electrical system as specified herein or shown on the accompanying Drawings. Obtain all necessary permits and work orders required and pay for all fees for such permits. Include all such fees in bid.

1.02 GENERAL CONDITIONS

- A. The Instructions to Bidders, General Conditions and Special Supplementary Conditions all contained in the General Specifications, shall be part of this section of the Specifications the same as if attached hereto. The Electrical Contractor shall read and be thoroughly familiar with all provisions of the General Specifications.

1.03 MANUFACTURERS OR TRADE NAMES

- A. The Electrical Contractor shall furnish the items as specified or an equal as listed by addendum. Review of substitutions shall be requested in writing as described in the General Specifications and shall contain all data to indicate equality to what was specified. All items shall be new unless specifically noted otherwise.

1.04 PRIOR REVIEW

- A. The Electrical Contractor shall submit six copies of manufacturer's data and descriptive literature and drawings, including complete model numbers, for all equipment and material. This literature shall contain all pertinent information necessary for the Architect to properly evaluate the item. No item of equipment or material shall be placed on order until Final Review is received from the Architect. Unless noted otherwise, all distribution equipment, transformers, transfer switches, wiring devices and lighting fixtures, all as applicable, shall be submitted for review. Requests for review shall comply with the above or will not be considered for review.

1.05 ORDINANCES, RULES AND REGULATIONS

- A. All work shall conform to the requirements of all building codes and laws and ordinances in force in the locality in which the work is to be done. All work and all equipment used shall conform to the requirements of the National Fire Protection Association and Underwriter's Laboratories.
- B. Items of this Specification shall comply with the NFPA 70, National Electrical Code -2008, NFPA 101 - 2006, International Building Code - 2006 and the latest edition of referenced Codes and Standards.
- C. Work called for in these Drawings and Specifications shall be executed by competent workmen.

- D. The Drawings show approximate locations only of feeders, branch circuits, outlets, etc., except where specific routing or dimensions are indicated. The Architect reserves the right to make reasonable changes in locations indicated, before roughing-in, without additional cost to the Owner.

1.06 EXISTING CONDITIONS

- A. The Electrical Contractor shall visit the building site to determine existing conditions and will be held responsible for allowing for these conditions in his bid.
- B. Note that this area of work has existing drainage, mechanical and electrical utilities located underground. It is part of this work for the Electrical Contractor to determine the scope and location of all existing utilities and the scope and location of all new utilities to be installed concurrent with this project and to arrange his work around others.

1.07 GUARANTEE

- A. The Electrical Contractor shall guarantee the work installed by him for one year from the date of final acceptance of the project and shall furnish free of cost to the Owner materials and labor necessary to repair or replace defective items or workmanship. The Electrical Contractor shall guarantee all equipment to be of the quality and capacity specified.

1.08 PROTECTION OF APPARATUS

- A. The Electrical Contractor shall take precautions necessary at all times to properly protect his apparatus from damage. Failure on the part of the Contractor to comply with the above to the Architect's satisfaction shall be sufficient cause for the rejection of the particular piece of apparatus in question.

1.09 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide three copies of typewritten systems operating instructions and three copies of operating and maintenance brochures for each piece of equipment including manufacturer's descriptive bulletins with wiring diagrams, parts lists and specific maintenance instructions, warranties and guarantees. Brochures shall be bound in permanent type binders and suitably indexed.
- B. At project completion and before the final observation of the work, provide to the Owner written, oral and hands-on demonstrations of the operation, function and maintenance of each piece of equipment provided under this contract. Instruction to the Owner shall be sufficient for the Owner to completely understand the operation and maintenance for each piece of equipment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Panelboards, safety switches, equipment cabinets, motor starters and other equipment shown on the Drawings and furnished and/or installed under this section of the Specifications shall be labeled with laminated plastic nameplates inscribed to identify equipment with description shown on the Drawings for panels, the name of the equipment

controlled for motor starters or the system or function involved for other equipment. Nameplates shall be white with black etched letters. Provide typewritten panelboard directories indicating the equipment served, final approved room numbers, etc., as shown on the Drawings or as directed by the Architect.

PART 3 - EXECUTION

3.01 COORDINATION OF TRADES

- A. Where work is in close proximity to the work of other contractors, the Electrical Contractor shall review plans of other contractors and coordinate his work with theirs. The Electrical Contractor shall verify the location of lighting fixtures, beams, structural members, conduit, ductwork, pipes and other obstructions before beginning his work in the area. Notify the Architect where proper clearances do not occur or where the work of others would interfere with the safe and/or proper operation of this work.

3.02 SUPPORTS AND FOUNDATIONS

- A. Support all items covered by this Specification directly from building structural members independent of any ceilings or any other installed item. Panelboards and switches may be attached to suitably reinforced walls. Ground or slab mounted equipment shall be mounted on a separate four inch high concrete slab.
- B. Do not attach items of this Specification to HVAC ductwork, ceiling grids and ceiling support members, piping or other equipment unless specifically shown otherwise. Where applicable, **all equipment including conduit** shall be supported from overhead using wall, floor or roof structures using galvanized channel or angle members for a rigid support. Position supports and equipment such that access through lay-in ceilings or panels is not impaired and all Code required clearances are maintained.
- C. Where applicable, under no circumstances is the Electrical Contractor to attach to or support from any bar joist bridging. Any supports to the bar joists or any structural systems shall be approved by the Architect. All supplemental angle or channel iron required to support equipment of this Specification shall be provided for by the Electrical Contractor.

3.03 EQUIPMENT LAYOUT

- A. The physical location and arrangements of electrical equipment are shown on the Drawings and shall be used by the Electrical Contractor as a guideline in construction. It is the responsibility of the Electrical Contractor to review the Drawings with the proposed equipment and equipment of other contractors that are affected, and to insure that all Code required clearances, wiring distances and maintenance accesses, including equipment heights, of all items are maintained. Alternate arrangements to accomplish the above due to field conditions or changes in physical size of the equipment proposed for the project are to be submitted to the Architect for review before any work is begun or equipment ordered. The alternate arrangement is to be presented in a 1/4 inch scaled drawing showing all equipment, including those of other contractors. Include shop drawing cut sheets and applicable information. Indicate on the drawing by dimension all required Code clearances, wiring distances and maintenance access requirements. Where equipment heights are required to be coordinated with architectural or other items, indicate revised heights. Refer to "MOUNTING HEIGHTS."

3.04 SERVICE CONTINUITY

- A. At all times during the construction of the project, electric service shall be maintained to all portions of the site, except with prior written approval of interruptions. Any required interruptions of electric service due to work being performed under this contract shall be scheduled in advance after consultation with the Architect and the Owner, and shall generally occur between the hours of 5:00 p.m. and 5:00 a.m. The Contractor shall be responsible for any material and labor costs, including overtime pay, to meet these requirements as part of the Division 16 scope of work.

- B. At least 14 days prior to the requirement of any interruption of electrical service, the Contractor shall furnish to the Architect for approval a written plan for the work associated with the outage, including a description of the installation and removal of temporary wiring and facilities necessary to be installed.

END OF SECTION

SECTION 16010 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 PAINTING

- A. Refer to other sections of these Specifications concerning the scope of work. No painting will be done by the Electrical Contractor except for touch up work on factory finished equipment furnished under this contract.

1.02 TEMPORARY POWER AND LIGHTING

- A. The Electrical Contractor shall provide for temporary power and lighting for all aspects of the construction as part of this work. This shall include, but not be limited to, coordination with the power company to provide for temporary services, paying all fees incurred, or providing for and maintaining on site locally derived power as suitable, required and allowed. Provide for temporary distribution as appropriate for the scope of the project. Follow Chapter 6, NFPA 241:
 - 1. All branch circuits shall originate in an approved power outlet or panelboard.
 - 2. Conductors shall be permitted within multiconductor cord or cable assemblies or as open conductors.
 - 3. All conductors shall be protected by overcurrent devices rated for the ampacity of the conductors.
 - 4. Runs of open conductors shall be located where the conductors are not subject to physical damage, and the conductors shall be fastened at intervals not exceeding 10'-0".
 - 5. Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor where run as an open conductor.
 - 6. Temporary lights shall be equipped with guards to prevent accidental contact with the bulb.
 - 7. Temporary lighting fixtures, such as quartz, that operate at temperatures capable of igniting ordinary combustibles shall be fastened securely so that the possibility of their coming in contact with such materials is precluded.
 - 8. Temporary lights shall be equipped with heavy duty electrical cords with connection and insulation maintained in safe condition.
 - 9. Temporary lights shall be suspended by their electrical cords if UL Listed and designed for that purpose.
- B. For 15 and 20 ampere circuits feeding single phase 125 volt receptacles, provide ground fault protection as per NEC 590.6.

- C. Temporary lighting shall be sufficient for normal, safe working conditions and installed clear of building structural members and kept in good repair. Lamps and ballasts required for the temporary lighting are to be considered as part of this work.
- D. Before the final observation and acceptance of the project, **all** temporary power and lighting shall be removed. **Do not** abandon any wiring in attic spaces or plenums.

1.03 ELECTRICAL SERVICE AND PAYMENT OF UTILITY COMPANY CHARGES

- A. Coordinate with the power company having jurisdiction in the area of this project. Where new service is shown, or where additional or upgraded service is required, coordinate all aspects of the service and metering requirements, including temporary service, pay for any fees required by the power company, arrange for inspections by the appropriate authorities and include all costs for the service in the bid. This shall include any temporary services noted above.
- B. The Contractor shall obtain from the utility company providing power to this project the fee for the work for the utility company to extend the mains, provide transformation needed, foundations, conduit and other connection charges. Where this cost is given, include said cost as part of the bid to be paid for by this Contractor. Where the cost is not given, the Contractor shall request in writing clarification from the power company and the Architect as to what costs shall be charged. Any costs for services subsequently listed in addenda to the work will be the responsibility of the Contractor. Actual costs will be adjusted by change order.

1.04 WIRING FOR EQUIPMENT BY OTHERS

- A. Electric service required for all equipment furnished under this general contract shall be roughed-in and connected by the Electrical Contractor. It is the responsibility of the Electrical Contractor to obtain correct roughing-in dimensions and requirements for this equipment. Refer to the Mechanical Section of these Specifications.

1.05 MOTOR AND CONTROL WIRING

- A. Other contractors will furnish and install motors and will furnish motor starters except where noted otherwise. The Electrical Contractor shall connect motors and shall install and connect starters where called for.
- B. Apparatus required for temperature controls and firestats will be furnished by the Temperature Controls Contractor as specified under Mechanical Work. The rough-in and connection for power wiring, for line voltage firestats and for all motors shall be furnished and installed by the Electrical Contractor in accordance with diagrams which will be supplied by the Temperature Controls Supplier. All control wiring and all interlock wiring shall be by the Temperature Controls Contractor as part of the Mechanical Work. Refer to other sections of the Specifications.
- C. Apparatus required for temperature controls and firestats will be furnished and installed by the Temperature Controls Contractor as specified under Mechanical Work. The rough-in and connection for power wiring, for line voltage firestats and for all motors and all interlock and control wiring shall be furnished and installed by the Electrical Contractor in accordance with diagrams which will be supplied by the Temperature Controls Supplier.

All control wiring shall be installed in conduit as specified for the general wiring system. Refer to other sections of the Specifications.

1.06 FLEXIBLE CONDUIT SYSTEMS

- A. Where flexible conduit is called for, only steel flexible conduit and fittings that are specifically listed as an assembly for grounding shall be allowed as per NEC 250.118 (5). Use non-jacketed steel constructed UL listed type BR cable. For lighting fixture wiring, do not loop from fixture to fixture with flexible conduit. See "LIGHTING" section. All flexible conduit runs shall have a separate grounding conductor run the entire length of the circuit. This shall include all lighting, power and receptacle circuits. See "GROUNDING" below. This Specification does not allow packaged flexible conduit systems (metal clad cable or "BX" systems) unless specifically noted otherwise.
- B. Flexible connections shall be made between the stationary conduit system and motors, HVAC equipment and other items likely to experience movement. No more than 24 inches of flexible steel PVC jacketed conduit shall be installed for this purpose. In addition, flexible conduit for all exterior flexible conduit shall be as above. For both applications, use UL Listed Anaconda Type UA, Liquatite Type LA, or equal as listed by addendum, PVC clad liquid-tight flexible conduit. Flexible steel PVC jacketed conduit and fittings shall be constructed and installed in accordance with Article 350 of the National Electrical Code and be UL 360 listed. Flexible conduit for all motor connections shall be installed in accordance with Article 350 of the National Electrical Code.

1.07 GROUNDING

- A. Main electric service equipment, conduit work, motors, panelboards and all other electrical equipment shall be effectively and permanently grounded. Grounding connections and conductor sizes shall be in accordance with requirements of the National Electrical Code, Article 250 and local ordinances.
- B. **For all circuits, provide separate grounding and neutral (where required) conductors.** This shall include runs of non-metallic conduit. The grounding conductor shall be sized in accordance with NEC Table 250.122 and shall run in the conduit with the circuit conductors. The grounding conductor shall be green jacket colored insulated copper. Conduit runs shall be increased in size where necessary to accommodate the grounding conductor in addition to circuit conductors.

1.08 WIRING AT OUTLET BOXES AND JUNCTION BOXES

- A. Grounding:
 - 1. All outlet boxes and junction boxes shall be permanently grounded using a screw terminal integral to the box construction. The grounding conductor shall terminate at this point with a jumper to the device such that removal of the device shall not disturb the grounding conductor connection and grounding of the box. This requires either a splice to the incoming grounding conductor or a looped connection from the grounding contact to the device.
 - 2. Where grounding conductors of different voltage class are installed in the same raceway, cable assembly, junction box, wireway or any enclosure, each system

grounded conductor shall be color-coded as noted below or marked with tape as the colors noted below at each junction box or accessible point in the system including panelboards and switchboards.

3. The neutral of branch circuits shall be spliced with a jumper to the device such that removal of the device shall not interrupt the continuity of the neutral conductor.

1.09 MULTIWIRE BRANCH CIRCUITS

1. All branch circuits requiring a neutral conductor shall not share the neutral with another branch circuit. All required neutrals shall be unique and separate for all branch circuits. Multiple circuits in a single conduit run are subject to derating as per NEC Table 310.15(B) (2) (a).

1.10 GROUND RODS

- A. Where shown on the Drawings, ground rods to be 3/4 inch diameter copper clad steel, ten feet long. Where multiple ground rods are called for, the minimum spacing is ten feet between each rod. Non-encased rod connections to be accessible and made with an approved brass constructed jaw-type bolt-on clamp.

1.11 MOUNTING HEIGHTS

- A. Unless otherwise noted on the Drawings or required by the Architect, the following mounting heights shall apply:
 1. Toggle Switches: 4'-0" to center
 2. Receptacles, Telephone Outlets: 1'-3" to bottom
 3. Panelboards: 6'-6" maximum to top
 4. Motor Control Equipment, Disconnect Switches: 5'-0" maximum centerline
 5. Wiring Devices Above Counters, Benches: 0'-8" above top to bottom of device
- B. All mounting heights may be adjusted in the field to reduce visibility at outside and in certain inside areas. Coordinate heights of all equipment with screen walls, fencing, other equipment, etc., with Architect **before** rough-in. This will include wall and rack mounted equipment inside or outside. Refer to "EQUIPMENT LAYOUT."
- C. Upon permission of the Architect, mounting heights may be adjusted to simplify cutting of masonry units or to facilitate furniture, base and cabinet arrangements. All mounting heights may be field adjusted by the Architect without any additional cost.

PART 2 - PRODUCTS

2.01 WIRE (600 VOLT AND BELOW)

- A. All conductors used in the work shall be of soft drawn annealed copper having a conductivity of not less than 98% of that of pure copper. Conductors shall be standard code gauge in size, insulated, and shall have insulation rated for use at 600 volts.
- B. Unless noted otherwise or specified, insulation for all sizes shall be Type THWN for feeders and branch circuits and rated for circuit applications for 75°C unless required lower by NEC 110.14(C). Lighting fixture wire shall be approved heat resistant type. Wires shall be of the single conductor type. Sizes No. 8 AWG and larger shall be stranded. Wires No. 12 and 10 AWG terminated in screw terminal connections shall be solid. Wiring may be stranded only when terminated in screw lug or pressure plate type connections.

2.02 WIRING COLOR CODE

- A. Throughout the system all conductors shall be identified as to the phase and voltage of the system by color coding as follows:
 - 1. 3 Phase 480V System:
 - a. Phase A - Brown
 - b. Phase B - Orange
 - c. Phase C - Yellow
 - d. Neutral - Gray
 - 2. 3 Phase 208V System
 - a. Phase A - Black
 - b. Phase B - Red
 - c. Phase C - Blue
 - d. Neutral - White
 - 3. 1 Phase 120/240V System
 - a. Phase A - Black
 - b. Phase C - Blue
 - c. Neutral - White
- B. For installations where more than one of the above voltage systems is present, the Contractor shall use the color coding for the voltage class identification as per Article 210.5(C). This color coding shall be permanently posted at each switchboard and each panelboard in the system.
- C. For conductor sizes No. 10 AWG and smaller, color coding shall be continuous the full length of the wire. For conductor sizes No. 8 AWG and larger, color coding shall be made with standard electrical color coding tape at all termination, junction, splice and pull locations. White or gray colored insulation shall be used only for neutral conductors. All equipment grounding conductors shall have green color coding. Surface printing at regular intervals on all conductors shall indicate manufacturer, size, voltage and insulation type.

2.03 WIRING - GENERAL

- A. Unless otherwise specified, all wiring shall be installed in conduit. No wire shall be smaller than No. 12 AWG unless noted otherwise. Wire for each branch circuit shall be of single size, type and color from the branch circuit protective device to the last outlet on the circuit.
- B. Type THWN conductors may be connected directly to recessed fixtures only when the fixtures are equipped with factory approved and supplied outlet boxes listed by Underwriters Laboratories, Inc. for use with wire having insulation rated for maximum operating temperatures of 75°C (167°F); otherwise, for fixtures not rated for 75°C direct connection, use approved high temperature insulated conductors from the fixture to a separate outlet box placed at least one foot, but not more than four feet, from the fixture. Refer to the "LIGHTING" Section of these Specifications.
- C. Branch circuit home run numbers shown on the Drawings shall be used as a guide for connection of circuit wiring to similarly numbered protective devices in branch circuit panelboards. Any deviation from the wiring shown or indicated on the Drawings shall be submitted to the Architect by the Electrical Contractor in writing before any changes are made.
- D. Where the length of a power, receptacle or lighting fixture home run, from panel to first outlet, exceeds 75 feet for 120 volt circuits or 175 feet for 277 volt circuits, the conductor size shall be No. 10 AWG or that shown on the Drawings, whichever is larger.

2.04 CONDUCTOR DERATING

- A. Multiple conductors routed in the same conduit shall be treated as if fully loaded for the purposes of establishing the proper conductor size due to derating, as per Article 310.15 of the NEC. All conductor quantities routed in the same conduit and not derated shall be removed and either routed separately, or the size of the conductor and conduit shall be increased to accommodate the derating adjustment factor. Note, for 3-phase, 4-wire runs utilizing a common neutral, the neutral shall be considered current carrying.

2.05 SPLICES AND TERMINATIONS FOR COPPER CONDUCTORS

- A. Feeders and motor circuit conductors shall run their entire length without joints or splices. Splices and joints in branch circuit wiring shall be made only at outlets or in accessible junction boxes. Joints and splices in branch circuit wiring shall be made with compression type solderless connectors or spring loaded, tapered, screw on type insulated units. **Terminations or splices for conductors No. 6 AWG and larger and all stranded wiring of any size shall utilize bolted connecting lugs. Do not use wirenuts on splices of solid wiring to stranded wiring; use split bolt type.** All splices and terminations shall be insulated in an approved manner by integral or separate covers or by taping to provide insulating values equal to that of the conductors being joined.
- B. Contractor may use factory fabricated insulated packaged in-line connectors featuring dual rating for copper or aluminum conductors, oxide preventer pre-installed, insulated formed around a milled aluminum block. Use Burndy Unitap, NSI Polaris System, Greaves USA Series, or ILSCO Type PCT Series. Unit shall be UL 486B Listed and rated for 90°C splice use.

- C. Conductors splicing into a circuit of 100 amperes or less that already contains 60°C rated conductors or equipment shall be 75°C rated conductors as above, but sized as if they were 60°C rated as per NEC 110.14(C). All other equipment and conductors are to be rated for 75°C rise. The Contractor is to field adjust wire and conduit size larger to accommodate.

2.06 CONDUIT - GENERAL

- A. Unless otherwise specified or shown on the Drawings, all conduit shall be heavy wall, non-intermediate rigid metal, electrical metallic tubing (EMT) or rigid non-metallic. Metallic conduit shall be metallized, sherardized, or hot-dipped galvanized. Non-metallic conduit shall be schedule 40 PVC. All conduit shall be new and shall bear the inspection label of the Underwriters Laboratories, Inc.
- B. Fittings for rigid metal conduit and EMT shall be hot-dipped galvanized steel and shall be of a type especially designed and manufactured for their purpose. Rigid conduit joints for single conduit runs shall be made with threaded fittings made up tight with at least five threads fully engaged. Double side by side or looped conduit risers for rigid conduit rising out of concrete and terminating in an outlet or junction box within a wall may use rigid metal threadless fittings. Compression type threadless fittings and set screw type fittings shall not be used for rigid metal conduit.
- C. EMT conduit joints shall be made with wrench applied compression fittings. Set screw fittings shall not be used for EMT.
- D. Fittings for non-metallic conduit shall be solvent welded.
- E. Where they enter boxes or cabinets that do not have threaded hubs, rigid metal conduits shall be secured in place with galvanized locknuts inside and outside the cabinet. Provide a plastic insulating bushing at the threaded end of all rigid metal conduits. EMT conduits shall have a locknut fastened compression fitting with bushing, or a fitting with an insulated smooth throat at the cabinet, with the conduit inserted on the outside at the fitting.
- F. For all conduit types on the ends of conduit 1 inch trade size and larger, whether filled or empty, provide an insulated smooth throat bushing fitting.
- G. All conduits shall be installed concealed or as indicated or scheduled on the Drawings and shall be of sufficient size to accommodate the required number of insulated conductors including equipment grounding conductor. Where conduit is shown as concealed, do not install exposed without prior review by Architect.
- H. Conduit runs shall be straight; elbows and bends shall be uniform, symmetrical and free from dents or flattening. Exposed conduits shall be installed with runs parallel or perpendicular to walls, ceilings or structural members and shall be located to avoid any conflicts with ceiling inserts shown on the Drawings. Such inserts shall not be used for suspension of conduit installed by the Electrical Contractor. Additional inserts shall be provided by the Electrical Contractor as required for installation of conduit as specified herein. Refer to "SUPPORTS AND FOUNDATIONS."
- I. Conduit shall be run no closer than six inches to covering of hot water piping except where crossings are unavoidable. In this case, conduit shall be kept at least 1 inch from covering of pipe crossed.

- J. Conduit shall be held securely in place by separate and independent hangers and fasteners of appropriate design and dimensions for the particular application. Support shall be such that no strain will be transmitted to outlet box and pull box supports. Wire shall not be used, with or without spring steel fasteners, clips or clamps, for the support of any conduit. Conduit shall not be supported by or attached to ductwork or ceiling support systems. Refer to "SUPPORTS AND FOUNDATIONS."
- K. Hangers and other fastenings shall be supported on solid masonry with inserts or expansion sleeves and bolts, on wood with wood screws, on hollow masonry with toggle bolts, on steel with machine screws or welded threaded studs. Fastenings shall be proof tested by the Electrical Contractor for secure mounting.
- L. All conduits shall be cut square and reamed at the ends. The conduit system shall be complete and cleaned before any conductors are installed. Open ends of all conduit shall be capped until conductors are installed. A non-metallic fish wire shall be installed in all empty conduit. For services, use 1/4" diameter polypropylene rope. Empty conduit shall remain capped.

2.07 CONDUIT - MATERIALS AND METHODS

- A. Conduit shall be installed as per NEC and NEMA regulations and the manufacturer's recommendations. Underground, underslab and in slab runs shall be watertight. Seal all ends of underground, underslab conduit runs with non-foam type waterproof sealant.
- B. All multiple runs of cable and/or conduit routed underground or underslab must be spaced no closer than 2 inches. Provide pre-molded vertical and horizontal spacers to maintain uniform spacing of the installed system.
- C. All conduit passing through or rising from underground or in slab runs or otherwise entering the building shall have rigid metal conduit, rigid metal risers, rigid metal ells and bends and be connected with adapters designed for the purpose.
- D. Where conduits are installed underground in trenches, provide 3" wide underground warning tape 12" above conduits. Tape shall be yellow and have the following printed sentence, "CAUTION - ELECTRICAL CONDUIT."
- E. Where underground conduit is run, provide rigid metal ells and bends 45° and greater for all turns.
- F. Conduit shall be as follows:
 - 1. Rigid Metal Conduit shall be used for all conduit external to and not enclosed by the building, exposed on roofs, exterior walls and under canopies and in crawl spaces, conduit embedded in non-building concrete slabs on grade and underground conduit except where non-metallic conduit is specified or shown on the Drawings.
 - 2. Electrical Metallic Tubing shall be used for all other feeders, branch circuit and communications and control wiring where rigid metal or non-metallic conduit is not used.

3. Non-Metallic Conduit shall be used as called for below. Non-metallic conduit shall not be used in any environmental air plenum.
4. Conduit - Under Building Slabs: Unless shown otherwise conduits installed under building slabs on grade shall be rigid metal or rigid non-metallic conduit buried under vapor barrier out of the concrete pour and a minimum of 12 inches below the top of slab. Do not install non-metallic conduit in building slabs.
5. Conduit - Under Non-Building Slabs: Unless shown otherwise, conduit installed in non-building slabs on grade shall be rigid metal or non-metallic as specified with minimum of 4" thick concrete over the top of the conduit. Where 4" thick cover is not possible, install below slab.
6. Conduit - Underground: Unless shown otherwise, all conduit underground and not underslab shall be rigid metal or rigid non-metallic conduit buried 36 inches below grade.
7. Conduit - Hydraulically Bored: For hydraulically bored and installed conduits, conduit shall be continuous roll of Schedule 80 HDPE conduit, UL listed as an electrical raceway.
8. Conduit - Innerduct:
 - a. Where shown on the Drawings and where innerducts are used in fiber optic or coaxial cable runs, the innerducts shall be HDPE Type SDR 13.5 rated, longitudinal ribbed, lubricated and bundled with quantities shown on the Drawings. Use screw-on self-threading couplers. Each innerduct shall be different colors and continuous the full length of the run.
 - b. Where inner ducts are called for on the Drawings to be used for telecommunication purposes that uses copper cable and for all power applications, the innerducts shall be UL Listed for the raceway; use smooth walled HDPE Type SDR 13.5 and bundled with quantities shown on the Drawings. Use screw-on self-threading couplers.

2.08 PULL AND JUNCTION BOXES

- A. Provide pull and junction boxes where noted or required. Boxes shall be galvanized Code-gauge steel with screw-on tight fitting steel covers, sized as per NEC Article 314. Junction boxes serving circuits containing a separate insulated, non-isolated, equipment grounding conductor shall be equipped with listed grounding provisions.
- B. Boxes for interior and exterior locations exposed to weather or moisture shall be listed for use in wet locations and shall not contain any unused openings, including screwed sealed openings, at the top of the box. All pull and junction boxes shall be installed with required Code accessibility. Units containing splices shall be sized accordingly as per NEC Article 314.
- C. Unless noted otherwise, boxes shall be supported independently of the raceway systems connected to them. See "SUPPORTS AND FOUNDATIONS." Boxes shall not be supported by conduit alone, except where noted under "WEATHER RESISTANT RECEPTACLES" below. Conduit entering and leaving pull and junction boxes shall be

adequately and firmly supported such that no strain is transmitted to the box fitting. Support all boxes securely and independently of the support afforded by connecting conduit.

- D. Where the connecting conduit of pull and junction boxes is exposed to different temperatures which may result in condensation formation, seal all conduit openings to the enclosure. Likewise, for conduits through which moisture may enter the enclosure, seal the conduit at the enclosure.

2.09 OUTLET BOXES

- A. Outlet boxes in concealed conduit systems shall be flush mounted. Outlet boxes shall be galvanized steel of sufficient size to accommodate devices shown and shall have raised covers where required to meet requirements of NEC Article 314. All outlet boxes shall be securely fastened to wall or ceiling framing for rigid installation and to allow the device to ground solidly to the box and finish flush with the adjacent surface.
- B. Outlet boxes installed in metal stud walls or ceilings shall utilize metal telescopic mounting brackets B-Line BB2 Series or Caddy TSGB Series. **DO NOT MOUNT BOX DIRECTLY TO STUD.**
- C. Outlet boxes for lighting fixtures shall be one-piece, 4 inch octagon, galvanized steel, not less than 1-1/2 inches deep, with fixture stud fastened through from back of box. Where outlet boxes are installed in a concrete slab, units designed for this application shall be used.
- D. Outlet boxes for switches in concealed work shall be standard one-piece switch units with the required number of gangs. Outlet boxes for receptacle use in concealed work shall be one-piece, 4 inch square, not less than 2-1/8 inches deep. Provide appropriate plaster ring arrangement for flush to surface mounting.
- E. Outlet boxes for telecommunications and data use in concealed work shall be 4-inch square, 2-1/8 inches deep. Outlet boxes for telecommunications and data use in exposed systems to be cast iron or aluminum, 4 inches square, not less than 2-1/8 inches deep.
- F. Outlet boxes for installation in any masonry constructed wall shall be a UL listed masonry box with internal to box device mounting ears. Box shall be number of gangs as required, 3-1/2 inch deep and mounted flush to the face of the wall.
- G. Outlet boxes shall not be installed back to back in walls or floors. Offset with connecting conduit as specified. Do not use long, extended boxes that would effectively couple light and sound between adjoining spaces. Where boxes are installed in a fire rated wall, separate the boxes by at least 24 inches.
- H. All outlet boxes shall comply with NEC 250.148 and be equipped with a grounding conductor screw terminal.

2.10 OUTLET COVER PLATES FOR WIRING DEVICES AND OUTLETS

- A. Unless otherwise specified, all outlets including telephone outlets shall be fitted with cover plates. Cover plates shall be standard size, uniform in design, single manufacturer and finish for switches, receptacles and other outlets requiring cover plates. Plates shall be one piece of the required number of gangs. Plates shall be thermo-plastic or non-conductive

flexible nylon or Lexan on finished drywall or paneled construction. Use Type 302 satin brushed finish stainless steel on concrete or masonry construction.

- B. Where plates require special identification, such plates shall be factory etched in a contrasting color. The color of the device and the device cover plate shall be uniform in color and finish throughout the project. All colors in any area shall be coordinated with color scheme of the Architect. This will apply to all switches wall box dimmers, receptacles, data and telephone outlets and all associated cover plates.

2.11 WEATHER RESISTANT RECEPTACLES

- A. Weather resistant receptacles shall be duplex receptacles as specified under "WIRING DEVICES." For surface mounted applications, mount in a horizontal or vertical fashion, use cast Type FD conduit box and fitting. For recessed, in wall mounting, use a 4" x 4" galvanized steel block with extension rings and single gang mud ring as needed to finish flush to the wall surface. For both instances, use a full heavy gasketed non-metallic cover with upward operating self-closing spring door, capable of full U.L. wet location rating with the device plugged in and cover closed as per NEC 406.8. Use Pass & Seymour WIUC10-G Series or TayMac X0310 Series gray colored enclosures. For exterior walls, weatherproof receptacles shall be flush mounted. Receptacles mounted outside of walls and on conduit supports must be rigidly supported with no openings, including screwed sealed openings at the top of the box. All boxes must have the required volume capacity for the number of conductors present. All installations must comply with NEC 406.8 and NEC 314.15.

2.12 WIRING DEVICES

- A. Wiring devices shall be as listed. The color of cover plates and all devices, data and telephone outlets, special use devices and cover plates shall be the same and shall be uniform throughout the project. All colors in any area shall be coordinated with the color scheme of the Architect. It shall be the responsibility of the Electrical Contractor to provide plugs, receptacles and fittings required for any equipment furnished or installed or connected under the contract. Devices shall be as listed below, or equal as listed by addendum. Submit for review all devices to be used.

2.13 COMMERCIAL GRADE WIRING DEVICES

- A. Where devices are shown to be commercial grade and non-residential, devices shall be as listed below or equal as listed by addendum. Submit for review all devices and cover plates to be used.
- B. Single Pole Toggle Switch: Metal flange mounting plate, silent actuating, 120 volt and 277 volt rating as required:
 1. Leviton 1221-2 Series, 20 Amp with red face, grey body, back and side wired.
 2. Hubbell 1221 Series, 20 Amp with red face, black body, back and side wired.
 3. Cooper 2221 Series, 20 Amp with red face, black body, back and side wired.

4. Pass & Seymour PS20AC Series, 20 Amp with red face, black body, back and side wired.
- C. Three Pole Toggle Switch: Metal flange mounting plate, silent actuating, 120 volt and 277 volt rating as required:
1. Leviton 1223-2 Series, 20 Amp with red face, grey body, back and side wired.
 2. Hubbell 1223 Series, 20 Amp with red face, black body, back and side wired.
 3. Cooper 2223 Series, 20 Amp with red face, black body, back and side wired.
 4. Pass & Seymour PS20AC3 Series, 20 Amp with red face, black body, back and side wired.
- D. Receptacles: Metal flange mounting plate, duplex, 20 Amp, 125 volt, 3 wire, grounded frame:
1. Leviton 5362 Series, flat face, red back, back and side wired.
 2. Copper 5362 Series, single colored, back and side wired.
 3. Hubbell 5362 Series, grey back, back and side wired.
 4. Pass & Seymour 5362 Series, black back, back and side wired.
- E. Self-Contained, Ground Fault Interrupting Duplex Receptacle for Indoor Use: 20 Amp, 125 volt, UL 943 (2003) compliant, recessed mount with matching face plate. **Do not** combine neutrals or grounds of ground fault circuits with any other circuit.
1. Leviton 7899 Series.
 2. Hubbell GF5362 Series.
 3. Cooper XGF20 Series.
 4. Pass & Seymour 2095 Series.
- F. Weather Resistant Self-Contained, Ground Fault Interrupting Receptacles for Outdoor Use: 20 Amp, 125 volt, UL 943 compliant, recessed mount with matching face plate. Do not combine neutrals or grounds of ground fault circuits with any other circuit. The wiring device shall have the letters "WR" in a contrasting color etched into the face of the device.
1. Hubbell GFTR20
 2. Leviton W7899
 3. Pass & Seymour 2095TRWR
 4. Cooper WRVGF20

2.14 LIGHTING CONTROLS

- A. Photoelectric Controls: Provide where shown on Drawings a photoelectric control rated for the service and load connected. Control shall be Tork 2100 Series, Fisher Pierce FT Series or Paragon CW Series. Submit for review.

PART 3 - EXECUTION

3.01 TESTS AND BALANCING

- A. At such times as the Architect directs, the Electrical Contractor shall conduct in the Architect's presence operating tests to demonstrate that the electrical systems are installed and will operate properly and in accordance with the requirements of the Specifications. The Electrical Contractor shall furnish instruments and personnel required for such tests. Any work and materials tested and found varying from the requirements of the Drawings or Specifications shall be replaced by the Electrical Contractor without additional cost to the Owner.
- B. The Electrical Contractor shall balance the load of the completed project such that no panelboard or distribution device is overloaded, and so that the load between phases is within 15% of each other.

3.02 OPENINGS, CUTTING AND PATCHING

- A. Cut all openings as required for the Electrical work. Patching will be done by the various crafts whose work is involved. Furnish and install all necessary sleeves, thimbles, hangers, inserts, etc., at such times and in such a manner as not to delay or interfere with the work of other contractors. Caulk, flash or otherwise make weatherproof all penetrations through the roof and exterior walls.
- B. Where conduit, cable or other items that are provided for under this contract penetrate fire rated walls or floors, the Electrical Contractor shall seal around the item to maintain the integrity of the rated system. All openings shall be sealed with an approved method using either a heat activated putty and high temperature fiber insulation backing material or a room temperature vulcanized silicone foam. Systems shall be U.L. rated for two-hours minimum under U.L. File R9658. Submit complete information for review.

3.03 EXCAVATING, TRENCHING AND BACKFILLING

- A. Excavating and backfilling for installation of underground and underslab electrical facilities shall be by the Electrical Contractor. All debris and excess dirt shall be removed from the building site. Backfill material shall be free of grass, roots and other debris. Backfill shall be installed in accordance with acceptable methods.
- B. Backfill material shall be deposited in maximum 9 inch layers, fully tamped by mechanical means, then backfilled in layers to grade level. Any settling of the trench area shall be filled and tamped so that at project completion no change of grade elevation is noticed at the trench area.

END OF SECTION

SECTION 16020 - DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish and install panelboards and switches as specified herein and as indicated on the Drawings. All equipment specified under this section is to be new, completely factory assembled and rated, and be constructed as per the latest edition of the National Electrical Code, all applicable NEMA regulations and shall be U.L. labeled.
- B. Where a specific interrupting rating is shown on the Drawings or exists with in place equipment or reused equipment, panelboards and all associated branch protection devices shall be fully rated for that value as a minimum. Bus arrangements for new panelboards shall not have any reduction in the rating of the bus; the rating indicated is to be full and continuous throughout the length of the bus.
- C. All bus and bus connections may be high quality tin plated aluminum unless noted otherwise. Do not purchase panelboards or cabinets until shop drawings have been reviewed.
- D. All distribution equipment must be U.L. and NEC rated for utilization with 75°C rise conductors. All equipment that cannot meet these criteria must use the conductors as specified, but sized for a 60°C rise as noted by NEC 110.14(C).

1.02 PANELBOARDS

- A. Panelboards shall be circuit breaker type using quick-make, quick-break, trip free, bolt-on circuit breakers. Two and three pole branches and mains shall be common trip. Panelboards shall be dead front safety type with main breaker or main lugs and number and size of branches as shown on Drawings. Panelboards shall have single, feed through or double lugs to accommodate feeder conductors as shown on the Drawings and shall have neutral, ground and/or isolated busses where required for termination of grounded and grounding conductors.
- B. Bus material shall be as specified in the "General" part of this section. Provisions shown on the schedules shall include the hardware and bus relay for addition of a branch device.
- C. For multiple section panelboards, route the full size grounding conductor from ground bus to ground bus. Metal to metal cabinet grounding is not solely sufficient. All ground bus shall be configured as per NEC 408.40.
- D. Provide doors full length and width with double hinges. **Doors shall be front hinged to box style to allow hinged access to panel interior without removal of door panel.** Doors shall be fitted with flush cylinder locks, keys to which shall all be alike: two keys shall be furnished for each lock. Provide for each panel a directory frame with transparent plastic window on inside of door and place therein a typewritten identification of all circuits. Cabinets shall be galvanized steel not less than 20 inches in width. Gutters shall be at least the minimum dimensions required by the National Electrical Code.

- E. In branch circuit panelboards having two vertical columns of devices, circuit numbers shall be such that, starting at the top, odd numbers shall be used in sequence down the left hand side. Construction of the panelboard shall be such that any three vertically adjacent single-pole devices can be individually connected to each of the three different phases in such a manner that 2-or 3-pole devices, when available, can be installed at any location. Panelboards to be no larger than the standard 42 circuit arrangement unless shown otherwise. See Schedule of Panelboards on Drawings for circuit device sizes and number of poles.
- F. Where panelboards are indicated to be of the "double section" type, the bus rating shall be continuous through both sections, not tapered or diminished in size or rating. Cable from one section to another shall be full capacity and not reduced.

1.03 SPECIAL CIRCUIT BREAKER NOTES

- A. Current limiting circuit breakers, where called for on the Drawings, are to limit the peak current and let-through energy of any fault without the use of fuse type elements. The current limiting circuit breakers shall contain a conventional common trip, thermal magnetic mechanism and fault limiting high speed actuating blow apart contacts. The unit must be rated for 100,000 minimum RMS symmetrical amperes interrupting capacity. All circuit breakers located downstream of the current limiting circuit breakers must have a combination series U.L. rating when connected in series with the current limiting circuit breaker of 100,000 minimum RMS symmetrical amperes.

1.04 SERIES RATING OF CIRCUIT BREAKERS

- A. Series rating of circuit breakers is not acceptable.

PART 2 - PRODUCTS

2.01 BRANCH CIRCUIT PANELBOARDS (120/208 VOLT OR 120/240 VOLT OPERATION), 75°C RATED

- | | | |
|----|------------------|--------------|
| A. | General Electric | AQ |
| B. | Square D | NQOD |
| C. | Cutler-Hammer | POW-R-LINE 1 |
| D. | Siemens | P1 |

2.02 BRANCH CIRCUIT PANELBOARDS (480 VOLT RATING, LESS THAN 600 AMP MAINS), 75°C RATED

- | | | |
|----|------------------|-------------------|
| A. | General Electric | AE or AD |
| B. | Square D | NF |
| C. | Cutler-Hammer | POW-R-LINE 2 or 3 |
| D. | Siemens | P2 and P3 |

2.03 DISTRIBUTION PANELBOARDS (600 VOLT RATING - 600 AMP MAINS AND LARGER), 75°C RATED. Provide engraved nameplates identifying branch circuits.

- | | | |
|----|------------------|---------------------------------|
| A. | General Electric | Spectra Series |
| B. | Square D | I-Line (Type HCW, HCWM, HCWM-U) |

- C. Cutler-Hammer POW-R-LINE 4 Series
- D. Siemens P4 or P5

2.04 SAFETY SWITCHES

- A. The Electrical Contractor shall furnish and install safety switches at locations and with capacities shown on the Drawings, as hereinafter specified and/or as required by the latest edition of National Electrical Code. All switches shall be U.L. and NEC rated for used with 75°C conductors.
- B. Safety switches shall be fused as required to comply with the nameplate data of the equipment served. Safety switches shall be non-fused only when the branch circuit protection device ahead of the safety switch complies with the protection required by the nameplate. Fusible switches shall be provided with a feature that will reject non current limiting fuses where current limiting fuses are specified. Units shall be NEMA Type GD or HD. Use Type GD for systems less than 150 volts to ground. Use Type HD for systems greater than 150 volts to ground. Safety switches exposed to the weather shall be NEMA 3R. Lug sizes shall be as required for the conductors listed. All units shall contain equipment grounding conductor lugs. Safety switches shall be capable of being locked in the open and closed positions.
- C. Galvanized angle, channel or other suitable supports, shall be provided for switches that cannot be mounted on walls or other rigid surfaces, such as at equipment mounted on roofs. Switches shall not be supported by conduit alone. Only where shown for equipment mounted switches, take special care to avoid damage to working components and to maintain servicing access panels. Refer to "SUPPORTS AND FOUNDATIONS."
- D. Safety switches shall be Cutler-Hammer Type DP, DG or DH, General Electric Type TG or TH, Square D Series D or H, Siemens GD or HD, or equal as listed by addendum.

2.05 FUSES

- A. Fuses shall be full sized configuration with metal conducting end caps permitting testing on the end cap itself. Insulated or bushed isolated end caps on reduced size fuses are not acceptable. Fuses shall be configured such that the metal conducting end caps are protected by the device shields.
- B. Install fuses so that indicator device is easily viewable without removal.
- C. Fuses protecting panelboards shall be U.L. Class Type and listed Class RK with time delay feature. Fuses shall be full size and have end caps that can be tested to determine if the fuse is blown. Units shall be true dual element, time delay and have an indicating feature which clearly indicates when the fuse has opened (blown). Indicating feature shall be completely integral within the main fuse body and shall be clearly visible from front of the fuse when installed properly in equipment. In order that indicating fuses shall be suitable for use in all equipment, the indicating feature shall not use pop-out pins or similar means for indication. The means of indication shall completely isolate voltage after operation and be visible when the circuit has been de-energized. Class RK1 fuses shall be Littelfuse LL (N or S) RK Series fuses or Shawmut A2D or A6D Series fuses. Class RK5 fuses shall be Littelfuse FLSR_ID Series fuses or Shawmut A2D or A6D Series fuses.

- D. Fuses 601 amps or larger shall be U.L. type and listed with time delay feature and silver fuse links. Fuses shall have an interrupting rating of 300,000 amperes. Class L fuses shall have ten second time delay at 500% rated current; shall have 99% pure silver fuse links to obtain maximum current limitation. Units shall have "O" ring seals between the end bells and the fuse body to prevent sand leakage and improve current limiting ability. Class L fuses shall be Littelfuse KLPC Series fuses or Shawmut A4BQ Series fuses.
- E. All other fuses shall be dual element time delay type U.L. listed Type Class RK-5, Littelfuse FLSR_ID Series or Shawmut A2D or A6D Series.

2.06 MAGNETIC CONTACTORS

- A. The Electrical Contractor shall furnish and install NEMA rated contactors where shown on the Drawings. All contactors shall be suitable for use at the voltage rating of the circuits controlled and shall have the number of poles and ampere rating shown on the Drawings as a minimum. Where ampere ratings are not shown, ratings shall be 30 amperes as a minimum.
- B. Contactors shall be of the single or double coil, electrically operated, electrically held type, NEMA rated. Positive locking shall be obtained without the use of hooks, latches or semi-permanent magnets. Provide hand-off-auto controls or on-off controls as per drawings. Contacts shall be self-aligning silver alloy type and be renewable from the front of the unit. Contactors shall be fully rated and marked for use in motor service where circuits feed primarily inductive loads. "Lighting" type contactors are to be used only for circuits feeding primarily lighting loads.
- C. Unless noted otherwise, contactors shall be mounted in NEMA 1 general purpose enclosures with hinged covers and latches. Submit for review. Units shall be Square D Type L, Cutler-Hammer CN 35, Siemens CLM, General Electric CR Series, or equal as listed by addendum.

2.07 DRY TYPE TRANSFORMERS

- A. Furnish and install a packaged dry type transformer with capacities, characteristics, voltage and phase ratings as shown on Drawings. The unit shall have minimum two each 2-1/2% full current below and above normal taps, grounded isolated core and windings with lug for external grounding. Provide for U.L. recognized, 220°C, NEMA ST20 insulation class with temperature rise as scheduled on the Drawings at 40°C ambient. Transformers shall be manufactured and be factory tested as per ANSI C57.12.91 and NEMA ST20. Indoor units shall be extra quiet operating.
- B. Transformers must be rated for the above at full KVA load and be cool operating, non-overloading and non-overheating, with minimum voltage and current wave distortion at full load.
- C. Standard transformers shall be Cutler-Hammer DS-3, Square D Class 7400, Siemens 3F3Y, Olsun Electrics Corp TRAN-PAC Series, General Electric Type QL, or equal as listed by addendum.

PART 3 - EXECUTION

3.01 GENERAL

- A. Furnish and install equipment as per manufacturer's recommendations.

END OF SECTION

SECTION 16030 - LIGHTING

PART 1 - GENERAL

1.01 SCOPE

- A. The Electrical Contractor shall furnish and install lighting fixtures, lamps and accessories as shown on the Drawings and/or described herein. Shop drawings shall be submitted for review and shall include complete catalogue data, photometrics and other data necessary to describe the fixture proposed to be furnished.

1.02 TEMPERATURE LIMITATIONS

- A. All lighting fixtures shall be rated for connecting conductors at 75°C temperature. Where fixtures must be rated at 60°C, use conductors as specified, but sized using the 60°C sizing criteria as per NEC 110.14(C).

PART 2 - PRODUCTS

2.01 LAMPS

- A. Unless noted otherwise on the Drawings, lamps installed in each fixture shall be of the type specifically recommended by the manufacturer of the fixture for use in the fixture. Fluorescent lamps shall be reduced wattage, energy efficient type.
- B. T8 lamps 48 inches long shall meet the U.S. EPA Test TCLP (Toxic Characteristic Leaching Procedure) for mercury dosage of no more than 4 mg of mercury without acidifiers and no greater than 8 mg with the acidifiers added. These low mercury lamps shall have a 4100K correlated color temperature with a CRI of 75 minimum: General Electric F32T8/ECOLUX Series, Philips F32T8/TL741/Alto, or Osram Sylvania F032/741/ECO Series with 2800 minimum initial lumens and 32 nominal lamp watts for a four-foot length lamp.
- C. HID lamps shall be phosphor coated for all indoor applications and clear for outdoor applications unless noted otherwise. All HID lamps shall have the base permanently stamped with the installed date. Refer to Drawings for additional information.
- D. All lamps of the different types (fluorescent or HID) must be by the same manufacturer. Any lamp as judged by the Architect as having a different apparent color or apparent color rendering shall be replaced by the Electrical Contractor without any additional cost.
- E. Submit all lamps for review.

2.02 BALLASTS

- A. Ballasts shall be furnished where required to operate fluorescent and metallic discharge lighting fixtures. Ballasts shall be ETL tested as meeting ANSI Standards, shall be CBM certified, shall comply with EMI and RFI limits set by the FCC (CRF47, Part 18) for non-consumer applications, and shall not interfere with normal electrical equipment.
- B. Where lamps are shown to be T5 or T5HO, provide for a compatible ballast. T5 lamps shall have electronic ballast with ballast factor of 1.0 minimum. These ballast shall be electronic

type. Provide for programmed start and shall be high power factor, discrete component constructed, full light output, having less than 10% THD to the connecting circuit. Ballasts shall have following minimum characteristics:

	1-Lamp	2-Lamp
Ballast Factor	≥ 1.00	≥ 1.00
Power Factor	≥ 0.98	≥ 0.98
Circuit Wiring	Parallel	Parallel
Starting Type	Programmed	Programmed

- C. Where lamps are shown to be T8, F032 or F32T8 type, provide for a compatible ballast. These ballasts shall be electronic type, shall provide for programmed instant start, and shall be high power factor, discrete component constructed, full light output electronic type having less than 10% THD to the connecting building circuit. The crest factor shall be 1.7 or less. Ballasts shall have the following minimum characteristics:

	1-Lamp	2-Lamp	3-Lamp	4-Lamp
Ballast Factor	≥ 0.88	≥ 0.88	≥ 0.88	≥ 0.88
Power Factor	≥ 0.98	≥ 0.98	≥ 0.98	≥ 0.98
Circuit Wiring	Series	Series	Series	Series
Starting Type	Programmed	Programmed	Programmed	Programmed

2.03 COMPACT FLUORESCENT BALLASTS:

- A. Where lamps are shown to be compact fluorescent, provide compatible ballast. These ballasts shall be electronic type, shall provide for programmed start, full light output having less than 10% THD to the connecting building circuit. The crest factor shall be 1.7 or less. Circuit wiring shall be Series. These ballasts shall be capable of operating one or two lamps on the branch circuit and shall automatically adjust to match the input voltage. Ballasts shall have the following minimum characteristics:

Ballast Factor	≥	0.93
Power Factor	≥	0.98

- B. Manufacturer shall be Advance ICF Series, Magnetek/Universal C Series, or equal as listed by addendum.
- C. The use of a single one, two, three or four-lamp fluorescent ballast is acceptable by the supplier, provided it does not require ballast wiring between fixtures and is fully compatible with the switching schemes as shown on the Drawings.
- D. Fluorescent ballasts shall be Class P, sound rated A, and shall be provided with an automatic thermal cutout device to deactivate the ballast in the event of overheating.

2.04 BALLASTS - GENERAL

- A. Ballasts for use with HID fixtures shall be designed to operate the type of lamps specified for use with the fixture and shall be constructed in accordance with NEMA, U.L. and ANSI standards. In addition, such ballasts shall be designed to limit inrush current on starting to a

value less than steady state operating current; this requires the use of a constant wattage auto-transformer type ballast.

- B. All ballasts shall be high power factor, low noise, low radio interference type and shall be provided with an automatic thermal cutout device.
- C. Submit all ballasts for review.
- D. Any ballasts that are used in dimming service shall be electronic-digital type for protection against voltage fluctuations.

2.05 LIGHTING - FIXTURES

- A. Catalogue numbers scheduled for lighting fixtures may indicate fixture compatibility with certain types of ceiling construction. The Electrical Contractor shall determine exact type of ceiling actually to be furnished in each area and shall obtain fixtures to suit. Additionally, ceiling space requirements shall be verified and fixtures compatible for operation within the confines present shall be provided. This would include any special mounting required due to temperature, space limiting or above ceiling access requirement factors. Provide for heat resisting shielding or spacers and access panels as required. Submit any deviation to the Architect for review.
- B. Fixtures and accessories requiring above the ceiling access in inaccessible ceilings shall be provided with an approved access panel of type and configuration and finish as approved by the Architect. This access panel is to be located by the Architect and provided for by the Electrical Contractor.
- C. For fixtures that are recessed ceiling mounted, provide for National Electrical Code required thermal safety cutout devices attached to the lamp housing. If the fixture is ballast powered, the thermal protection may be part of the ballast assembly only if the ballast is mounted at the lamp housing, otherwise use a separate thermal protection device clamped to the lamp housing. Fixtures so protected are to be suitably marked.

PART 3 - EXECUTION

3.01 GENERAL

- A. Except as noted below, the Electrical Contractor shall support each lighting fixture directly from building structural members independent of any ceilings or other installed item. Provide supplemental angle or channel trapeze supports required to span across piping, ductwork or other objects where direct above the fixture support is not possible. Do not attach to the ductwork; all support and weight of the fixture must be borne by the structure. These supports shall be installed by the Electrical Contractor as required by field conditions without additional cost. Ceiling framing members shall not be used to support fixtures except in specific areas where ceiling supports for this purpose have been specified elsewhere in these Specifications. Unless otherwise specified, lighting fixtures shall be permanently installed and connected to the wiring system.
- B. **ONLY WHERE NOTED, THE CONTRACTOR MAY FASTEN A SURFACE MOUNTED BOX AND SUPPORT FROM A SUITABLY REINFORCED T-BAR**

GRID UL APPROVED FOR SUCH MOUNT. USE 50 POUND CAPACITY B-LINE BAX SERIES OR CADDY 4G SERIES FASTENERS.

- C. Provide a maximum of 4 feet of steel constructed flexible metal conduit between the last branch wiring junction box and the junction box at the fixture for all installations within an environmental air plenum as defined by NEC-300.22 (B) and (C). For all other installation locations, provide a maximum of 6 feet of flexible metal conduit between the last branch wiring junction box and the junction box at the fixture, as per NEC 250.118 (5). All such flexible metal conduit connecting lighting fixtures shall contain No. 12 AWG wiring minimum. Where flexible metal conduit must be longer than 6 feet, use Type MC or Type AC cable with integral ground and provide an integral grounding conductor for the entire circuit. Do not loop from fixture to fixture with flexible conduit. Refer to "FLEXIBLE CONDUIT" as hereinbefore specified.

END OF SECTION