

DIVISION 16 - ELECTRICAL

**SECTION 16000 - ELECTRICAL GENERAL REQUIREMENTS**

**1.0 GENERAL**  
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- 1.1 The Conditions of the Contract apply to this Section.
- 1.2 Examine all plans and specifications, visit the site(s) of the proposed project, and become fully informed as to the extent and character of the work required.
- 1.3 **REQUIRED STANDARDS**
  - a. Laws and Regulations of the State of Texas.
  - b. Codes and ordinances of project's County of **Nueces**, and City of, **Corpus Christi**, location in Texas.
- 1.4 **COORDINATION**
  - 1.4.1 Coordinate work under this Division to avoid conflicts and to attain satisfactory and complementary systems.
  - 1.4.2 Coordinate work under this Division with work under other Divisions to avoid conflicts and to allow for adequate installation, maintenance, and operating space. Obtain the Engineer's approval for penetrations of other parts of the Work prior to effecting them.
  - 1.4.3 In resolving pipe, duct, and conduit coordination with other divisions, meet all requirements and be guided by these general orders of precedence:
    - a. Accommodate gravity flow lines with required slopes before conduit.
    - b. Accommodate lines with specific slope requirements (i.e., steam and refrigerant gas) before conduit.
    - c. Accommodate pipe and duct before conduit.
    - d. Accommodate work with a required reference elevation before other work.
- 1.5 **DEFINITIONS**
  - 1.5.1 Specific meanings used in Division 16 (variant forms are inferred):
    - a. Work: This project, or the part of it being referred to.
    - b. Provide:
      - 1. Furnish and install, complete with necessary appurtenances.
      - 2. "Provide" is implied throughout this Division unless language is specific.
    - c. Required: Required by the Contract Documents.
    - d. Necessary: Necessary in order to obtain a finished system in satisfactory operating condition, and meeting all requirements.
    - e. Furnish: Procure and deliver, ready for installation, necessary and/or required.

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- f. Install: Receive, place securely, ready for connection to work specified elsewhere, and bring into satisfactory operating condition, as necessary and/or required.
- g. Connect: Connect properly to electrical equipment.

### 1.6 SCOPE OF WORK

1.6.1 The work under this Division includes providing complete electrical systems for the project.

1.6.2 All items of labor, material or equipment not required in detail by the specifications or plans, but incidental to, or necessary for the complete installation and proper operation of all phases of work described herein, or reasonably implied in connection therewith, shall be furnished as if called for in detail by the Contract Documents.

### 1.7 WORKMANSHIP

All labor shall be performed in a workmanlike manner by mechanics skilled in their particular trades. All installations shall be complete in both effectiveness and appearance whether finally enclosed or left exposed. The Engineer reserves the right to direct the removal or replacement of any item which in his opinion shall not present a reasonable neat or workmanlike appearance, providing that same can be properly installed in an orderly way.

### 1.8 MANUFACTURER'S INSTRUCTIONS

Obtain written recommendations and installation and startup instructions from material vendors and comply, unless otherwise required. Bring discrepancies between these instructions and project requirements to the attention of the Engineer, and resolve prior to construction. Provide inspection by manufacturer's representative at system startup to verify construction and warrant ability.

### 1.9 PERMITS, FEES - UTILITY TRANSFORMERS/CONNECTIONS: - EXISTING

### 1.10 LICENSES

- a. Work under this Division shall be performed by organizations and individuals holding a current license to perform such type of work by the authority having jurisdiction. "License" in this sense means any process, regardless of its appellation, which is normally mandated by the authority in order to perform such type of work within its jurisdiction. The stipulation of this paragraph applies even if the work is located physically on property owned or controlled by a higher authority; e.g., to work within the city limits of a Texas municipality, on a Federal project, the State of Texas and City municipal licenses which would be mandated to work on a private project shall be required even though the City and State may have no jurisdiction over the higher government.
- b. In the event that the licensed organization loses its license or is unable to obtain one, or the licensed individual performing the work becomes unlicensed or departs the organization, notify Engineer immediately in writing.

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### 1.11 UTILITY COORDINATION - EXISTING

### 1.12 LISTING AND LABELLING

Materials that require listing shall be listed and labeled for the particular service if a listing is available. Obtain and comply with the terms of listing. Provide black laminate, white letter labels on all panels, starters, disconnects, MSB breakers, MCC modules, VFDs, and contactor switches.

### 1.13 MATERIALS AND EQUIPMENT

1.13.1 All materials and equipment shall be new. Products shall be currently manufactured.

1.13.2 All materials and equipment shall be clearly marked, stamped or labeled for identification. Do not obscure nameplates.

### 1.14 SUBMITTALS AND REVIEW

1.14.1 Contractor shall furnish to the Engineer, within a reasonable time after award of contract, and prior to commencing any work, complete brochures in quadruplicate of all materials and equipment that the contractor proposes to furnish on the project. Data shall include descriptive literature, performance data, diagrams, capacity information, etc., to substantiate that proposed equipment would meet all of the requirements of the plans and specifications.

1.14.2 All data must be checked and any required changes noted thereon by the contractor, signed and dated prior to furnishing it to the Engineer for approval. Contractor's attention is directed that it is mandatory that he thoroughly review data prior to furnishing same to assure that equipment is in accordance with plans and specifications and to assure prompt return of the data.

1.14.3 If above information is not provided complete as specified above and within the allocated time, all equipment shall be furnished exactly as specified without any substitutions or deviations.

1.14.4 Deviations: Specifically call to the attention of the Engineer every proposed deviation from the Contract Document requirements. Failure to identify deviations as such constitutes a representation that all requirements are met.

1.14.5 Review: Review of submittals shall not be construed as releasing the Contractor from responsibility, but rather as a means to facilitate coordination of the work and the proper selection and installation of the products. All work shall be subject to final acceptance by the Engineer at the completion of the project.

### 1.15 SUBSTITUTIONS

1.15.1 Refer to the Conditions of the Contract.

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- 1.15.2 Where one vendor is indicated for a product, provide that product. Alternate products may be submitted only after prior approval to do so is obtained from Engineer in writing. Exceptions to features and performance must be documented with two weeks advance notice of the deadline to order specified products.
- 1.15.3 Where multiple vendors are indicated for a product, any of those vendors meeting the requirements may be submitted.
- 1.15.4 Some product specifications in this Division are of the Acceptable Manufacturer type. Vendors listed as Acceptable Manufacturers are acceptable as vendors. However, the product submitted is subject to review as being fully equivalent in detail to the basis of design.
- 1.15.5 Where multiple vendors are listed with product model numbers, each model and vendor is acceptable, provided all requirements are met. Model numbers are indicated to the extent believed necessary to identify a type and are not necessarily complete.
- 1.16 DRAWINGS AND SPECIFICATIONS
- 1.16.1 These specifications are accompanied by Drawings. The Drawings and Specifications are complementary each to the other, and what is called for by one shall be as binding as if called for by both.
- 1.16.2 The Drawings are generally diagrammatic. Lay out work at the site to conform to existing conditions; architectural, structural, mechanical, and electrical conditions; to avoid all obstructions; and to conform to details of installation as required. Provide an integrated, satisfactorily operating installation. All necessary offsets in conduits required to avoid interferences between piping, equipment, architectural, and structural elements shall be provided by the Contractor.
- 1.16.3 Verify and provide sufficient space for the installation of proposed products and that adequate access will exist for service and maintenance of equipment.
- 1.17 COMPLEMENTARY DOCUMENTS
- a. Contract Documents are complementary; requirements are not necessarily repetitively stated at each possible subject; consider that a requirement applies wherever applicable.
  - b. In the event of conflicting requirements in different parts of the Documents, the more expensive shall be presumed to apply, unless the Engineer clarifies the requirement in a less expensive manner and waives the more expensive requirement in writing.
  - c. Since codes and standards are incorporated by reference, a particular conflict may appear in that a reference may use language that implies that a particular requirement in the Contract Documents is waived under the reference. This is not the case, unless specifically so clarified by the Engineer. Generally, the specific Drawings and Specifications take precedence over waivers in multi-purpose reference documents.

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- d. Because of licensure and workmanship requirements, persons performing the work are presumed to be familiar with applicable codes, ordinances, laws, regulations, and standards. Therefore, details of materials, methods, arrangements and size contained in such publications are not necessarily replicated in the Contract Documents. This in no way deletes the requirement of the Contractor to comply. In the event of an apparent conflict between such publications and the Contract Documents, request clarification from the Engineer prior to construction.

### 1.18 REGULATORY MATTERS

Comply with laws, rules and regulations, permit requirements, and ordinances. It is intended that the work of the Division be estimated and performed under the supervision of licensed master craftsmen who are familiar with these requirements, whether illustrated or specifically detailed in the particular Contract Documents of this project or not. Therefore, regulatory requirements may not be so illustrated or detailed.

### 1.19 PROTECTION

All work, equipment and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation. All material and equipment shall be covered and protected against dirt, water, chemicals or mechanical injury.

### 1.20 CUTTING AND PATCHING

The work shall be carefully laid out in advance and the exact size and locations of openings arranged.

### 1.21 VIBRATION AND NOISE

Objectionable vibration and/or noise will not be tolerated.

### 1.22 DEMOLITION

Coordinate with other Divisions before commencing work.

### 1.23 RECORD DOCUMENTS

1.23.1 Drawings: Prior to final acceptance, obtain bid set electrical drawings from the Engineer. Revise the drawings to reflect as-built conditions, including all addenda, change orders, final shop drawing reviews, and field routing. Underground utilities shall be dimensionally located relative to readily accessible and identifiable permanent reference points, with accurate slope and elevation indicated. Submit prints for review. Revise, certify accuracy, and provide two final sets to the Engineer.

1.23.2 Owner's Manual: Prior to final acceptance, provide bound volumes to the Engineer in accordance with Division 1. Index by subject. Include corrected submittals and shop drawings that reflect final review comments; installation, operation and maintenance instructions, parts lists, wiring diagrams, and piping diagrams; warranties.

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### 1.24 INSPECTION, OBSERVATION AND TESTING

1.24.1 Cooperate with Engineer's representative and authorities having jurisdiction. Provide complete access to the work at reasonable times.

1.24.2 Coverup: Prior to covering up work, or conducting observed tests, request observation as appropriate. Provide adequate advance notice, minimum one (1) week. In some cases the Engineer's representative may waive observation; otherwise arrange for observed construction and testing prior to cover-up, particularly installation of walls and ceilings.

1.24.3 Pre-Testing: Self-inspect, pre-test, and remedy work prior to performing observed tests.

1.24.4 Sectional Work: In circumstances where a requirement for phased construction or other considerations dictate sectional construction and/or testing, notify the Engineer when construction begins on the first section of a system, and when the first section will be ready for observed testing, as well as subsequent sections. Test in the largest practical sections.

### 1.25 WORK PERFORMED UNDER OTHER DIVISIONS

1.25.1 Refer to Division 15 for mechanical systems, control panels, starters and safety switches integral to equipment provided under Division 15.

### 1.26 REFERENCES TO OTHER DIVISIONS

1.26.1 Refer to Division 15 for additional mechanical system requirements. Provide power to all mechanical schedule equipment and field-verify voltage/phase.

### 1.27 TESTING SERVICES

1.27.1 Additional Testing: In addition to any specified testing, the Engineer may cause additional testing to be performed by an independent testing laboratory or any other qualified party. If such testing reveals deficient work by the Contractor, the Contractor shall pay for both the testing and remedial work. If such testing does not reveal deficient work by the Contractor, the Owner shall pay for the testing and the cost of repairing any damage caused by such testing.

1.27.2 Specified Testing Services: If independent testing services are specified regarding work under this Division, cooperate fully with the testing agency. Provide access to

the work. Remove work that is not tested on site, deliver to testing agency, and reinstall if undamaged; replace if damaged. Provide utilities, operational capability, and facilities for on-site testing as necessary.

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END OF SECTION

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DIVISION 16 - ELECTRICAL

**SECTION 16100 - ELECTRICAL DISTRIBUTION SYSTEM**

**1.0 GENERAL**

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1.1 The Conditions of the Contract apply to this Section.

1.2 Section 16000, "Electrical General Requirements", applies to this Section.

1.3 REFERENCE PUBLICATIONS

1.3.1 National Fire Protection Association (NFPA) Publications:  
Latest Edition of National Electrical Code

1.4 REQUIRED STANDARDS

- a. Laws and regulations of the State of Texas.
- b. County of Nueces, City of Corpus Christi, Texas, codes and ordinances.

1.5 WORK INCLUDED

1.5.1 The work to be accomplished under these specifications includes the furnishing of all labor, materials and equipment required for the complete installation as described herein and as indicated on the electrical drawings.

1.5.2 Work is to be completed from point of service to each outlet shown on plans and/or specified herein with all accessory construction as may be required to make the installation of each piece of equipment complete and ready for normal service.

1.5.3 The installation of this work, including all materials and labor, shall be first class in every respect and in exact accordance with these specifications and accompanying plans. It is intended that these specifications and accompanying plans shall include everything requisite and necessary for proper installation of electrical equipment, even though every item may not be particularly mentioned in detail.

1.6 ELECTRICAL SERVICE

1.6.1 The contractor is responsible for coordinating with the utility company and paying all costs involved and meeting all requirements of the utility company, whether shown or not.

1.6.2 Contractor shall provide either directly or through the local utility company all required utility transformers, primary feed systems, and secondary feed systems. All power entrance work, including equipment, conduit, conductor, main disconnect, trenching, transformer pads, and high voltage transformers shall be provided herein at the contractor's cost.

1.7 TEMPORARY POWER AND LIGHT

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- 1.7.1 In accordance with Division 1 and the latest edition of NEC, the Contractor shall provide the necessary wiring, service switches, poles, ground fault equipment, etc., required for temporary power and light during construction.

### **2.0 MATERIALS**

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#### 2.1 GROUNDING

- 2.1.1 The entire electrical system shall be grounded in accordance with the National Electrical Code, and as hereinafter specified.
- 2.1.2 Grounding conductors with a green colored insulated jacket or bare conductor shall be provided in all EMT raceways and all raceways containing a section of non-metallic conduit and which are not provided with a raceway ground at the first distribution point beyond the non-metallic raceway.
- 2.1.3 Flexible conduit sections shall be provided with a bonding jumper.

#### 2.2 CONDUIT AND TUBING

- 2.2.1 Conduit is sized for THWN/THHN conductors. Contractor shall adjust size per NEC for provided conductors.
- 2.2.2 All interior wiring shall be run in steel conduit, concealed in finished areas, unless noted. All interior conduit 2 inches and smaller and not run in concrete shall be E.M.T., with compression fittings only, unless noted.
- 2.2.3 Conduit 2 inches in size and larger or conduit installed on exterior, under buildings, in wet locations, or on roofs shall be rigid hot-dip galvanized steel (RGS) conduit, as manufactured by Republic, Allied, Triangle, or an approved equal, with screwed couplings and fittings, unless noted otherwise on plans. All fittings shall be hot-dip galvanized. Rigid polyvinyl chloride, (EPC-40 DB), conduit shall be used underground, in concrete slabs, and in concrete and masonry walls in accordance with National Electrical Code, and as shown on plans.
- 2.2.4 All conduit in furred ceiling spaces, interior masonry or stud partitions, and dry locations shall be galvanized thinwall (EMT) with watertight, gland ring type connectors. Indentor type or set screw type connectors will not be accepted. Couplings shall be Appleton 95T series or equal. Connectors shall be two-piece type with insulated throat, Appleton 86T series or equal.
- 2.2.4.1 Acceptable Manufacturers:
- a. T & B Electric Inc.
  - b. TOMIC.
- 2.2.5 Fittings and connections involving dissimilar metals shall not be allowed in damp or wet locations.
- 2.2.6 An equipment-grounding conductor shall be provided in all nonmetallic conduit

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raceways.

- 2.2.7 Flexible conduit may be used where absolutely necessary, and shall be installed in accordance with Article 350 of the N.E.C. In damp locations and motor connections, liquidtight flexible metal conduit and approved fittings shall be used, and shall be installed in accordance with Article 351 of the N.E.C.
- 2.2.8 Installation and Routing of Conduits:
- 2.2.8.1 Main feeders between distribution points shall be run the straightest possible route.
- 2.2.8.2 Not more than 360 degrees of bends will be permitted in any one conduit run, and no run shall be longer than allowed by the National Electrical Code without the installation of pull boxes. Pull boxes or junction boxes shall not be installed in inaccessible space.
- 2.2.8.3 Exposed conduit shall be run in straight lines, at right angles to, or parallel with walls, beams, or columns and shall be supported at maximum of 6 ft 0 inch by malleable conduit straps or suitable clamps on hangers to provide a rigid installation.
- 2.2.8.4 In no case shall conduit be fastened to other conduit, pipe or equipment or so installed as to prevent the ready removal of other conduit, pipes or equipment for repairs. Conduit shall be spaced from hot water and copper pipes three inches.
- 2.2.8.5 All rigid conduit ends are to have a minimum of five full threads. No running threads are to be used. All conduits shall be reamed after cutting and threading and before installation; runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. All conduits after installation and prior to completion of project shall be capped to prevent entrance of moisture and foreign objects. Conduit shall be swabbed and bushed before installation of wire. PVC conduit joints shall be made in accordance with manufacturer's recommendations.
- 2.2.8.6 All conduits terminating in metal enclosures shall have double locknuts and insulated bushings, except where otherwise noted, in which case the conduit shall be provided with a grounding clamp.
- 2.2.8.7 Underground PVC plastic conduit may be extended above grade at panels, junction boxes, etc. However, plastic conduit subject to physical damage, such as risers at outside service switches, shall have a formed concrete protective guard extending 12 inches below and 12 inches above finished grade with PVC sleeve between the concrete encasement and the plastic conduit.
- 2.2.8.8 Underground conduits shall be installed in accordance with details on the plans, and as hereinafter specified. All underground conduits shall have a minimum cover from top of conduit to finished grade of at least 24 inches. Marker tape shall be placed in trench 12 inches below grade.
- 2.2.8.9 Underground conduit encased in concrete shall have a minimum thickness at any point of 3 inches between the conduit and the earth. The concrete envelope shall be formed and shall extend at least 12 inches above the finished grade where the conduit rises above grade.

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- 2.2.8.10 PVC plastic underground feeder conduits outside of the lines of the building shall have a 4-inch thick concrete cap over the top of the conduit to protect the conduit from damage due to excavation.
- 2.2.9 Expansion Joints:
  - 2.2.9.1 Expansion joints in metal and PVC plastic conduits shall be provided where conduit rises from underground or crosses an exterior building expansion joint. Metal expansion joints shall be OZ Gedney, Type EX or AX, with bonding jumpers.
  - 2.2.9.2 Conduits which are freely suspended in space and crossing an interior building expansion joint shall be considered as having sufficient freedom for any expansion or movement.
  - 2.2.9.3 Underground PVC plastic conduit terminating in panelboard, cabinet, switch, or other fixed device shall have an approved PVC expansion joint fitting between the ground or floor slab and the device.
  - 2.2.9.4 Underground PVC plastic conduit shall pass through a PVC sleeve in the floor to allow movement between the underground conduit and structural members of the building.
- 2.2.10 Concrete: All concrete encasements shall be readymix concrete and shall be continuously agitated until poured. Concrete shall be 2,500-psi strength, colored red.
- 2.2.11 Pull Wire: Provide pull wire in empty conduit in which wire is to be installed by others. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum of 12 inches of slack at each end of pull wire.
- 2.3 HANGERS AND SUPPORTS
  - 2.3.1 Provide hangers and supports for conduit, gutters, cabinets, and equipment of all types. Hangers and supports shall be secure and of a type appropriate in design, application, and dimensions for the particular application. Supports for conduits shall be in accordance with N.E.C.
  - 2.3.2 Concrete inserts shall be malleable iron, concrete inserts. Selection of inserts shall be made with a minimum safety factor of 100 percent over published load ratings.
  - 2.3.3 Perforated hanger strap and wire shall not be acceptable for any purpose.
  - 2.3.4 Supports for conduit on roof, or any horizontal slab or surface, shall be manufactured by Miro Industries or equal.
- 2.4 CONDUCTORS
  - 2.4.1 All wiring and cables shall be insulated soft-drawn annealed, 98 percent conductivity copper and shall be new. Voltage rating of wire and cable operating on voltages in excess of 50 volts shall be 600-volts A.C. For circuits operating on voltage less than 50 volts, the voltage rating shall not be less than 300-volts A.C. All wire No. 8 AWG and

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larger shall be stranded, and wire of smaller size shall be solid.

- 2.4.2 Power feeder and branch circuit wire and cables shall be Type THW or THWN/THHN unless noted otherwise on plans. Wires shall not be smaller than No. 12 AWG copper and this size shall be used except where larger sizes are shown on the drawings or required by the Code. On any 20 Amp run 100 feet in length or longer, No. 10 AWG (minimum) copper shall be used. Suitable tags shall identify feeder cables where they pass through pull boxes. Conductors as manufactured by Cablec, Cyprus-Rome, Houston Wire and Cable, and Triangle will be acceptable.
- 2.4.3 Conductors for special systems and conditions shall be as hereinafter specified or as noted on the plans.
- 2.4.4 Wire Pulling Lubricants:
  - 2.4.4.1 Contractor shall use "Y-er-EAS" or approved wire-pulling lubricants for all wire installation. Soaps or other substitute material having electrical conduction properties are not acceptable.
- 2.4.5 Color-Coding and Tagging:
  - 2.4.5.1 Any wiring which is furnished which is not color-coded for ready circuit identification shall be identified or shall be removed and reinstalled as directed. Where two or more wires of the same color are used for different circuits in the same conduit, these wires shall be identified.
  - 2.4.5.2 All control wiring shall be color-coded, and the same color shall be used for the same circuit throughout the system, and a different color shall be used for each separate control function.
  - 2.4.5.3 Identification shall be accomplished by means of Brady "Quick-Labels" or approved equal attached permanently to all wire requiring identification in addition to the color-coding. This shall include "Quick-Labels" on all coded wiring installed between the cabinet, or devices to readily identify the circuit at each cabinet or device in which it appears. Acceptable manufacturers: Thomas and Betts, Ideal.
  - 2.4.5.4 All junction boxes shall be labeled with ink marker indicating the circuits enclosed.
- 2.4.6 Insulation of Splices and Cable Terminations:
  - 2.4.6.1 All connections must be made by means of a compression type connector specifically approved for the purpose to which it is used, except that wire #8 and smaller may be soldered in lieu of compression connections, if desired by contractor.
  - 2.4.6.2 All wire shall be insulated at splices and connections with Scotch #33 electrical tape. Any wiring subject to abrasion shall be protected with Okonite "Manson" friction tape over the Scotch plastic type. Wirenuts or similar patented insulation connectors meeting NEC requirements may be used in lieu of tape, if contractor so desires.

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- 2.5 OUTLET, SWITCH AND JUNCTION BOXES
  - 2.5.1 All boxes shall be galvanized metal and shall be set with covers flush and square with the finished surface.
  - 2.5.2 Boxes set in plaster finished walls or concrete shall be 4 inches square boxes, 1 1/2 inches deep or deeper, with 1/2-inch or 3/4-inch raised plaster rings as required by device.
  - 2.5.3 Boxes set in concrete block, structural tile, brick, plywood, Formica, or other field installed surfaces shall be square cut masonry boxes, or shall have standard square type corners.
  - 2.5.4 All boxes shall be securely attached to the structural members by suitable metal hangers. All ceiling outlet boxes shall be equipped with 3/8-inch no-bolt fixture studs.
  - 2.5.5 Junction boxes and pull boxes shall be furnished where shown on the plans, or as required by the N.E.C. Boxes shall be of code gauge galvanized steel or PVC to match conduit system, and shall have removable screw cover. Surface mounted or exposed boxes in finished areas shall have a prime coat of paint before installation, and finish coat after installation to match room finish. Flush boxes shall be used on all walls and ceilings where conduits are concealed. Where conduits are exposed, surface type boxes shall be used.
  - 2.5.6 The contractor shall remove any boxes not installed in a workmanlike manner, repair wall and reset box.
  - 2.5.7 Boxes and conduit fittings for outdoor work shall be cast metal type and have gasketed cover plates.
  - 2.5.8 Location of Boxes:
    - 2.5.8.1 Contractor shall determine from the electrical plans, the electrical details and plans, and from other subcontractors, the locations of all pieces of equipment prior to locating any outlet boxes or devices.
    - 2.5.8.2 All outlet boxes, devices, etc., shall be located so as to be clear of equipment, permanent fixtures, building trim, etc. If the exact location of any equipment is not clearly defined, the contractor shall request direction from the Engineer prior to locating the facilities for the equipment.
    - 2.5.8.3 Locations of services for equipment connections shall be determined accurately from certified shop drawings on equipment to be served, or from actual measurements of the equipment itself.
    - 2.5.8.4 All wall outlets for equipment on panel walls shall be located symmetrically with the pattern established by the panels. Determine exact location for all boxes from the Engineer before installation.

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- 2.5.8.5 All ceiling outlets shall be located in close cooperation with the air conditioning system and the ceiling finishes, so that outlets will be symmetrical with ceiling pattern established by the air conditioning diffusers and by the acoustical ceiling tile. Final lighting fixture locations shall be as approved by the Engineer. All corridor fixtures shall be mounted in a straight line.
- 2.5.8.6 Switches shall be located 48-inch centers above floor (or nearest coursing), except in areas that have a view window, a wainscot or splash that would interfere with the switch plate. In these areas, locate switches as directed by Engineer. Switches shall be mounted on strike side of doors.
- 2.5.8.7 The height of the various outlets above the floor elevation shall be in accordance with the Americans with Disabilities Act (ADA) and the following table of outlet heights, except as indicated otherwise on the drawings. All heights and locations shall be verified with Engineer before installation.

<u>Outlet</u>	<u>Location</u>	<u>Inches Above Floor</u>
Receptacles	Walls in general	18 inches
Receptacles	Walls at work counters	44 inches
Telephone	Walls in general	18 inches
	Wall or pay phone	42 inches
Thermostats	Walls	48 inches
Switches	Walls	48 inches

The exact location of outlets shall be as approved by the Engineer who reserves the right to change the position of any outlet from the position shown on the drawings before work is roughed-in, without cost to the owner.

- 2.5.8.8 Outlet boxes for special and/or recessed equipment shall be obtained from the contractor supplying the equipment.

## 2.6 WIRING DEVICES

- 2.6.1 Wiring devices, or approved equal, as scheduled and/or noted on the plans shall be provided. All receptacles shall be grounding type, and shall be polarized in accordance with the latest standards of the National Electrical Code.

## 2.7 COVERPLATES

- 2.7.1 All cover plates for switches, receptacles and devices, and any other systems, except as hereinafter specified, shall be stainless steel similar and equal in all respects to those manufactured by P.&S.

- 2.7.2 All cover plates shall have matching screws.

## 2.8 DISCONNECT SWITCHES

- 2.8.1 All disconnect switches shall be Square D Type GD (240V) or Type HD (600V), or approved equal, quick-make quick-break type safety switches with cover interlocked door.

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- 2.8.2 All switches on exterior of building and/or exposed to the weather shall be in NEMA 3R enclosures (**except at wet areas or as indicated provide NEMA 4X**) . NEMA 3R enclosures shall be finished with baked enamel over clean phosphatized surface.
- 2.8.3 All motors and fixed equipment connections shall have disconnects as required by the National Electrical Code.
- 2.8.4 All disconnect switches shall have the load served by the switch identified on the outside cover of the switch by means of phenolic or metal labels.
- 2.8.5 Acceptable Manufacturers:
- a. Square D
  - b. Cutler Hammer
- 2.9 FUSES:
- 2.9.1 Fuses shall be provided in each device requiring same. Fuses shall be dual element RK-5 Fuses as manufactured by Bussmann of the size required by the plans or load served.
- 2.10 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS:
- 2.10.1 The Owner or other contractors will furnish certain equipment that will require electrical services and connections by this contractor. Contractor shall rough in and make final connections to all equipment. Rough-in and final connections shall be based upon a certified layout, or actual measurements of existing equipment.
- 2.10.2 Division 15 will furnish and install all motors and control devices as shown on the mechanical plans and specifications.
- 2.10.3 Contractor shall provide all disconnects and motor starters (except those specifically noted as furnished by other Divisions), power connections to all equipment furnished by others and any control devices specifically included in the plans or specifications to be provided by this contractor.
- 2.11 HVAC CONTROL WIRING
- 2.11.1 Division 15 shall provide all conduit, wire, thermostats, sensors, control connections, and any and all other control work in connection with the installation of the air conditioning automatic temperature control systems, unless shown on the electrical plans.
- 2.12 WIRING OF MOTORS AND CONTROL EQUIPMENT
- 2.12.1 Motors provided under other Divisions will be set by the respective contractor. This contractor shall provide power and interlock equipment and wiring, unless noted on Division 16 drawings.
- 2.12.2 Contractor shall be responsible for checking all overload releases and holding coils in

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starters, interlocks, and control equipment and shall notify the contractor furnishing these items concerning any changes that are found necessary for safe and satisfactory operation and electrical maintenance of these items.

- 2.12.3 Contractor shall handle, set, adjust, mount motor base, and pulleys of motors furnished but not installed under other Divisions.
- 2.13 MOTOR STARTERS – SUMP PUMP WILL USE VARIABLE FREQUENCY DRIVES (VFD) PROVIDED UNDER DIV. 15 UNLESS OTHERWISE NOTED.
- 2.13.1 Magnetic starters shall have individual melting alloy overload relay elements in each phase. Minimum size magnetic motor starters shall be NEMA Size 1, unless noted otherwise. Unless noted otherwise, starters shall have "H-O-A" selector switch, red pilot light, and one additional convertible contact.
- 2.13.2 Magnetic starters shall be equal to Square D Class 8536, in NEMA 1 enclosure unless noted. Combination starters shall be equal to Square D Class 8538, in NEMA 1 enclosure unless noted.
- 2.13.3 Manual motor starters shall be equal to Square D Class 2510 with neon pilot light, in NEMA 1 enclosure, flush or surface mounted, as noted on plans.
- 2.13.4 Contractor shall be charged with the responsibility to see that all motor starters have the proper thermal elements installed prior to starting of the machine.
- 2.13.5 Acceptable Manufacturers:
- a. Square D
  - b. Cutler Hammer
- 2.14 LIGHTING PANELBOARDS
- 2.14.1 Contractor shall provide all panelboards as shown on the plans and riser diagrams. Panelboards shall be of dead-front type and shall be complete with door (with lock) and trim. Cabinets shall be code gauge steel, and boxes shall be galvanized and painted. Panel shall have main lugs and/or main breakers as specified. Branch circuits shall be equipped with plug-in type automatic circuit breakers for each circuit. Panel shall bear the Underwriter's Laboratories, Inc., seal of approval. Panel shall have silver plated connections and copper bussing throughout. Bus capacity shall be as noted. Panel shall be provided with ground bar and separate solid neutral bar and, where shown, isolated ground bar.
- 2.14.2 Branch circuits as shown on the plans shall be connected to the indicated breaker of the panels insofar as possible. Each circuit shall be identified on a typewritten directory card inside the door of each panel. If applicable, existing panels shall have new directories provided.
- 2.14.3 Two spare 1-inch conduits (capped) shall be provided from panels to an accessible location above the ceiling.

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- 2.14.4 Interior panels shall be NEMA 1, surface or flush mounted as shown. Exterior panels shall be with fully gasketed door, NEMA 3R unless noted 4X. Panels shall be finished with baked enamel electrodeposited over a clean phosphatized surface.
- 2.14.5 Panels shall be Square D Type NQOD with QO circuit breakers for 240 volt use and Square D Type NEHB (indoors), NF (outdoor) with EH/EDB breakers for 480 volt use. Multi-pole breakers shall be one handle common trip.
- 2.14.6 Acceptable Manufacturers:
- a. Square D
  - b. Cutler Hammer
  - c. General Electric
- 2.15 ACCESSORY CONSTRUCTION APPARATUS
- 2.15.1 It is the intention that these specifications shall provide a complete installation, except as herein specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation or testing of the work shall be provided. The omission of specific references to any part of the work necessary for such complete installation to any part of the work necessary for such complete installation shall not be interpreted as relieving the contractor from providing such work.

### 3.0 EXECUTION

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#### 3.1 TESTS

- 3.1.1 The entire system upon completion, or as directed, shall be "Meggered" for faults in accordance with methods approved by I.E.E.E. and N.E.C.
- 3.1.2 This test shall be in the presence of a representative of the Engineer. Equipment installed and/or connected by the contractor shall be put through their normal operating paces and all such equipment shall be required to operate to the satisfaction of the Engineer on completion of the job.

#### 3.2 WORKMANSHIP AND INSTALLATION

- 3.2.1 Contractor shall have his choice as to the location of conduits, pull boxes, etc., except for locations set by dimensions on drawings, provided his choices do not interfere with piping, fixtures, and equipment installed by other contractors working on the project, and do not interfere with the characteristic features of the building. In cases of such interferences, the Engineer will determine the locations of the interfering items.
- 3.2.2 The cutting of any structural member, regardless of material, shall be approved by the Engineer. Contractor shall pay for repairing damage to such members.

#### 3.3 PAINTING

- 3.3.1 Contractor shall provide painting of exposed junction boxes, conduits, hangers,

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supports, structural supports and other miscellaneous unfinished pieces in finished areas of the building.

3.3.2 Contractor shall touch-up or refinish if so directed by the Engineer any panels, cabinets, switchboards, fixtures and other equipment furnished with a factory finish, which shall become damaged in shipment or installation.

### 3.4 INSTRUCTIONS

3.4.1 Contractor shall provide for instructing employees of the Owner in the operation and maintenance of the systems. Two sets of manufacturer's certified drawings, specifications, operating instructions, maintenance manuals, and maintenance instructions on all equipment shall be provided to the Owner.

END OF SECTION