

## SECTION 16100

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. Drawings are schematic and diagrammatic. Use judgment and care to install all electrical work in a practical manner to function properly and fit the construction and systems. Electrical conductors, conduit, components, etc., not shown or specified which are required of any device or system to produce a complete and operative system are a requirement of this specification.

B. Provide the proper number of conductors and conduits or cables to produce an operative system as specified herein.

C. No two ungrounded conductors will be connected to the same circuit breaker/fused switch in any panel. No splicing of branch circuit conductors in any panels, safety switches, or non-automatic circuit breakers in separate enclosures is allowed.

D. All materials are new. Conform to the latest requirements of Underwriter's Laboratories, National Electrical Code, National, State or local agency having jurisdiction, and National Fire Protection (NFPA) Codes.

E. Any new piece of equipment, switch, device, etc., shown mounted on and/or adjacent to any equipment which if installed, would impair the proper operation of that existing equipment, will be removed and relocated by the Contractor with no cost to Owner as required in order that equipment will function properly.

F. Individual documents are not exclusive but are an integral part of the complete construction documents. Refer to the entire construction documents for requirements. Refer to other sections and drawings for specific information and requirements. Provide a complete operable system.

G. Work shall be performed in accordance with the International Building Code, International Mechanical Code, International Plumbing Code, National Electrical Code, and authority having jurisdiction.

H. Coordinate installation and connection methods and requirements of equipment with equipment manufacturer's requirements and recommendations, and provide as required.

##### 1.02 REFERENCES

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A. ANSI/NFPA 70 - National Electrical Code.

B. NECA "Standard of Installation."

### 1.03 RECORD DRAWINGS

A. Furnish to the Owner at job acceptance and completion one (1) set of drawings, showing an accurate location of the work actually installed related to the original Drawings. Include all approved and installed Change Orders, field condition changes, and other variations from the original Drawings and Specifications. Drawings shall be the record drawing sets that are updated on a daily basis and kept at the project site until the project has been completed.

### 1.04 POSTED OPERATING INSTRUCTIONS

A. Operating instructions approved by Owner shall be provided for each system and each principal piece of equipment for the use of operation and maintenance personnel. Operating instructions shall include such instructions as start-up, proper adjustment, operating, lubrication, shut-down, safety-precautions, procedure in the event of equipment failure, and any other necessary items of instruction as recommended by the manufacturer of the unit.

B. A copy of the one-line diagram with revisions shall be stored near the main distribution panel.

### 1.05 GUARANTEE

A. Guarantee work performed and all equipment installed under this contract shall be free from defects in workmanship and materials for a period of one year from date of final written acceptance by Owner, unless a longer guarantee is specified in the various sections..

### 1.06 CORROSION PROTECTION

A. All joints, connections, etc., exposed to climatic conditions to be completely watertight

### 1.07 SITE VISIT AND FAMILIARIZATION

A. Contractors proposing to undertake work shall:

1. Visit the site of the work, and fully familiarize themselves of all conditions that affect the work or cost thereof.

2. Examine the Drawings and specifications as related to the site conditions.

3. Acquaint themselves with all utility companies from whom services shall be

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supplied; verify locations of utility service points, demarcations and interfaces and determine exact requirements.

B. Consideration will not be granted for any alleged misunderstanding of the amount of work to be performed.

## **PART 2 PRODUCTS**

### **2.01 WIRE AND CABLE**

A. Power conductors: Single conductor insulated wire, copper, 600V, 90 degrees C, ANSI/NFPA 70, Type THHN/THWN, minimum size #12.

B. Controls: Copper, 300V, minimum size #16.

### **2.02 CONDUIT REQUIREMENTS**

A. Galvanized rigid steel (GRC) UL6 or Intermediate grade rigid steel (IMC) UL 1242

B. Indoors in offices and lab: electrical metallic tubing (EMT).

C. Liquidtight flexible conduit for exterior connections to motors or other rotating or vibrating equipment. Interlocked steel and aluminum construction with PVC jacket.

D. Fittings, junctions, and boxes: Maleable iron, zinc plated, gasketed covers. Bushings shall be insulated.

### **2.03 CONDUIT STRAPS AND HANGERS**

A. Two (2) hole push on stamped steel straps. Use on surface areas such as concrete, masonry, wide flange beams, columns and wood.

B. Where conduits are grouped together, use trapeze hangers consisting of all thread rods sized as required 1/2" x 1-7/8" (12 gauge) with single bolt channel pipe straps and rolled strut.

### **2.05 ITEMS OF ELECTRICAL DISTRIBUTION SYSTEM**

A. Including switchboards, panelboards, safety switches, etc. manufactured by one of the following, unless otherwise indicated on Drawings: General Electric, Square D, Eaton (Cutler-Hammer, Challenger), or Siemens.

### **2.08 ENCLOSED SWITCHES**

A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

## 2.09 LIGHT FIXTURES, DEVICES, AND MISCELLANEOUS EQUIPMENT

A. All light fixtures shall be from one manufacturer and shall be UL labeled.

B. All devices shall be new and UL labeled. Receptacles shall be GFI (except in offices) and exterior receptacles shall have weatherproof covers. All switches shall be toggle style snap switches. All coverplates shall be stainless steel.

C. Refer to plans for miscellaneous exhaust fans and heaters.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. All penetrations by electrical raceways or equipment through roofs, ceilings, walls or floors shall be sealed and made permanently water tight. Penetrations in fire rated assemblies and designated smoke barriers shall be sealed with UL listed fire retardant material.

B. The National Electrical Contractors Association publication Standard of Installation shall be used as a reference as to the minimum quality of workmanship required.

C. Mixing of conductors from different voltage classes is prohibited.

D. All equipment, material, and devices shall be installed per manufacturer's instructions and per code. Coordinate locations prior to rough-in and installation.

E. Firestop all penetrations of rated partitions. Weathertight seal all penetrations to exterior and penetrations of partitions separating spaces of differing conditions.

### 3.02 INSTALLATION OF WIRES AND CABLES

A. Swab raceway before installing wire.

B. Install products in accordance with manufacturers instructions.

C. Use #10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

D. Use #10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

E. Pull all conductors into raceway at same time and protect cables from damage.

F. Clean conductor surfaces before installing lugs and connectors.

G. Make splices, taps, and terminations to carry full ampacity of conductors.

H. Use only compression connectors for copper conductor splices and taps, #6 AWG and larger.

I. Use solderless pressure compression connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller 90 degrees C rated.

J. Inspect wire and cable for physical damage and proper connection.

K. Verify continuity of each branch circuit conductor.

L. Install a properly sized grounding conductor in all raceways containing power circuits.

M. Comply with the following color code or as required by local authority:

208Y/120 Volt System

Phase A - Black

Phase B - Red

Phase C - Blue.

Neutral - White.

Equipment Ground - Green.

### 3.03 INSTALLATION OF CONDUITS, DUCTS, BOXES, ETC.

A. Size all raceway in accordance with NEC.

B. Group related conduits; support using conduit rack. Construct rack using approved steel channel.

C. Arrange conduit to maintain headroom and present neat appearance. Route all conduit whether exposed or concealed parallel and perpendicular to walls, ceilings, building structures, etc. Maintain adequate clearance between conduit and piping. Cut conduit square; de-burr cut ends and ream. Bring conduit to shoulder of fittings; fasten securely.

D. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

E. Provide suitable nylon pull string in each conduit except sleeves and nipples.

F. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

G. Ground and bond conduit.

H. Install knockout closures in unused box openings.

I. Support boxes independently of conduit.

J. Support conduits as required by NFPA 70 (N.E.C.)

K. Install conduits to preserve fire resistance or weathertight ratings of partitions and other elements with appropriately rated materials. Coordinate penetration location with other trades. Complete installation of all raceway prior to painting of area. Any raceway installed after painted must be painted to match with the same paint to the satisfaction of the owner. All cable and wiring installed must be concealed in raceway or in cable tray.

### 3.04 INSTALLATION OF ELECTRICAL DISTRIBUTION SYSTEM

A. Install materials in accordance with manufacturer's recommendations, power company requirements, and as indicated on Drawings.

B. Install panelboards in accordance with NEMA PB 1.1. Height: 6 ft to top of panelboard; install panelboards taller than 6 ft with bottom no more than 4 inches above floor. Top breaker maximum height not to exceed 6'-8".

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. The branch circuit directory shall clearly indicate load served.

E. Tighten accessible bus connections and mechanical fasteners after placing switchboard. Tighten bolted bus connections in accordance with manufacturer's instructions.

F. Height: 5 ft to operating handle.

G. Select Motor overload elements in motor controllers to match installed

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motor characteristics.

H. Provide engraved plastic nameplates on all panelboards indicating name; and on all disconnects, starters, etc. indicating load name.

### 3.05 COORDINATION

A. Interferences and clearances shall be coordinated and corrected before proceeding with the work.

B. The electrical work shall be coordinated with the work of the other trades. Obtain appropriate information of equipment prior to connection. Coordinate connection requirements, locations, etc.; some equipment may require multiple connections.

C. Where a new service or modifications to existing service are required coordinate with the local electrical utility and provide as required for a complete installation.

### 3.06 EQUIPMENT IDENTIFICATION

A. Provide complete warranty information for each item. Include date of beginning of warranty or bond, duration of warranty or bond, and names, addresses, telephone numbers and procedures for filing a claim to obtain warranty services.

### 3.07 TESTING

A. Perform tests as specified to prove installation is in accordance with contract requirements. Tests shall be conducted during the construction period and at completion to determine conformity with applicable codes and with these Specifications. Typed records of all the following tests shall be included in maintenance instructions. Tests, in addition to specific system test described elsewhere, shall include:

B. Electrical Tests:

1. Perform insulation resistance test on each feeder and branch circuit conductor with respect to ground and adjacent conductors. Applied potential: 1000 volts dc for 1 minute.

2. Perform continuity test to insure proper cable connection.

3. Minimum insulation resistance values: two megohms.

C. Demonstrate and instruct to owner or owner's representative the proper operation and maintenance of all systems and equipment.

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END OF SECTION



TFK Engineering, Inc  
CofA #5206, Expires 06/2012