

## SECTION 26 00 10

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1: GENERAL

##### 1.01 SCOPE OF WORK

- A. Contractor shall provide all labor, materials, equipment, machinery and tools necessary to put into satisfactory operation all electrical equipment specified and as shown on the Drawings. Contractor shall connect the various items or sections of the Work to form a complete and properly operating entity. All items not specified in detail or shown on Drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.
- B. Test all electrical conductors after completion of installation of wiring and apparatus to ensure continuity, proper splicing, freedom from grounds, except "made grounds" and those required for protection and insulation resistance. Use testing instruments, i.e. megger. Activation of each circuit will be required as final test. Testing shall be done at no additional expense to AW.
- C. Drawings are indicative of work to be installed but do not indicate all bends, fittings, boxes, etc. that will be required in this Contract. The structural and finished conditions of the project shall be investigated prior to construction.
- D. Coordinate work with other trades to avoid interference between piping, ducts, equipment, architectural or structural features. In case of interference, the Owner decides which work is to be relocated, regardless of which is first installed. Avoid installing conduits that may create tripping or overhead hazards. Conduits shall be adequately marked to avoid potential tripping or overhead hazards.
- E. All equipment pads located in areas receiving a floor finish (i.e.: tile, paint) shall be painted. Type of paint shall be approved for concrete application. The color is to be selected by the Owner.

##### 1.02 STANDARDS, CODES AND PERMITS

- A. All work shall be performed in strict compliance with all applicable Local and State codes. In addition, all practices shall be in accordance with the latest editions of the NEC of the NFPA, the National Electrical Safety Code, and OSHA.
- B. All material and equipment shall comply with Local and State electrical codes, the latest requirements of the National Electrical Code, OSHA and the applicable standards of the NEMA, ASTM, IEEE, ANSI, ICEA.

- C. Local codes shall have precedence over the standards setting organizations and OSHA shall have precedence over local codes. Contractor shall furnish any and all labor or material, in addition to that described herein or shown on the Drawings, necessary to comply with the previously mentioned codes and standards.

#### 1.03 DESIGN REQUIREMENTS

- A. All electrical installations must comply with all Federal and State, and local base rules and/or regulations.
- B. Electrical inspections by the required authorities may be made for verifying that the installations associated with this Project are in compliance with the NEC and other Regulatory Agencies governing electrical work. Original final wiring certificates shall be submitted to the Owner for review, at no additional cost to AW.
- C. Where possible, all electrical equipment and its components and materials shall meet all applicable UL criteria and bear the appropriate label of the UL. Where UL is not applicable or available, electrical equipment, cabling and components shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) as outlined in the NEC.
- D. All control panels, MCC, VFD assemblies, and related electrical equipment assemblies shall bear the UL 508A listing from the manufacturer or assembler/supplier; individual serial listing/labeling is not otherwise required. In addition, these assemblies shall be constructed and labeled in accordance with Article 409 of the NEC and shall include appropriate safety labeling with respect to short-circuit rating, arc-flash hazard and other governing criteria as outlined in the Code. As stated, all completed assemblies shall be NRTL listed and labeled; UL or other NRT Laboratory.
- E. All electrical equipment or apparatus of any one system shall be of the same quality as produced by one or more manufacturers, suitable for use in a unified system. The term "manufacturer" shall be understood as applying to a reputable firm or supplier/assembler who shall assume full responsibility for those products provided on this project.

#### 1.04 ARC FLASH WARNING LABEL REQUIREMENTS

- A. All new and rehabilitated electrical equipment including control panels, switchboards, panel boards, meter socket enclosures, MCC, VFD assemblies, etc., must have an Arc-Flash Hazard Analysis conducted, and shall be field marked to warn qualified personnel of potential electric arc flash hazards. Warning labels shall be clearly visible and shall be provided in compliance with NEC 110.16 and most current edition of the NFPA 70E.

- B. The arc flash analysis shall be performed according to the latest revision of IEEE 1584. The services of a qualified, licensed Professional Engineer shall be used to

conduct the actual analysis, evaluation, and preparation of the Report and Arc Flash labeling. At a minimum, the report should include the following information: Equipment ID, available fault current, method and software used for calculations, relevant data to support the calculations, and a one line diagram. The Owner (AW) should be provided with two (2) hard copies and one electronic copy of the final AFHA report

- C. Provide an ANSI Z535.4 compliant (size 4 in. x 6 in.) thermal transfer or equivalent type two color die-cut arc flash label as provided by DuraLabel or Brady for each work location analyzed and included in this project. Material type to be suitable for the locations; IE indoor, outdoor, chemical resistively, etc. An example of an arc flash label showing the required information is appended to this specification section.
- D. The label shall have either an orange header with black lettering and the wording, **"WARNING, ARC FLASH HAZARD"**, or a red header with white lettering and the wording, **"DANGER, ARC FLASH HAZARD"**. Include the ANSI Safety Symbol in the header as recommended. The Danger signal wording shall be provided for all incident energy values calculated greater than 40 Cal/cm<sup>2</sup>; Warning to be used for all values calculated below 40 Cal/cm<sup>2</sup>. These labels shall include the following information:
1. Location designation
  2. Shock Hazard Information including: Nominal voltage, Limited Approach, Restricted Approach, and Prohibited Approach
  3. Flash protection boundary
  4. Hazard/Risk category (HRC) including PPE Category
  5. Incident energy
  6. Working distance not to exceed 18 inches for all voltage levels
  7. Engineer/Company responsible for conducting study

#### 1.05 MATERIAL AND INSTALLATION WORK

- A. All material and equipment shall be new without defects, and shall bear the inspection labels of the UL, if the material is of a class inspected by the said laboratories.
- B. Contractor shall install and/or wire all electrical equipment as per the manufacturer's recommendations or per MAWC specifications.
- C. Installation shall be periodically inspected by the Owner. Any defects shall be corrected at the Contractor's expense.

#### 1.06 SUPERVISION

- A. Contractor shall provide competent supervision of all phases of the electrical installations.

#### 1.07 SUBMITTALS

- A. Shall conform to the requirements of Specification Section 01 33 00 – Submittals.
- B. Contractor shall furnish to the Owner for review detailed shop drawings, including elementary, connection and interconnection wiring diagrams. These diagrams shall show the interconnection of all equipment requiring electrical connections.

#### 1.08 TESTING

- A. The Contractor shall demonstrate to the Owner operation of all equipment and systems. All tests shall be completed to the satisfaction of the Owner and AW. Each test shall be performed as indicated in the individual specification section. Such tests shall demonstrate the proper functioning of all equipment and wiring and the adequacy of the entire electrical system. Any equipment or material, which fails to perform satisfactorily, shall be repaired or replaced and then retested until satisfactory results are obtained. All testing and retesting shall be at the Contractor's expense.

#### 1.09 QUALITY ASSURANCE

- A. All Work shall be provided in conformance with the latest Standards as well as the requirements associated with products and systems outlined within these Contract Documents including the manufacturer's criteria, code compliance and the industry standards indicated.

#### 1.10 ACCEPTANCE

- A. The operation by AW of the equipment and/or the electrical installations does not constitute an acceptance of the Work. Final acceptance of equipment and/or the electrical installation shall be made only after the Contractor has demonstrated that the electrical installation fulfills the requirements of the Contract Documents, and has furnished all the required certificates, "as built" Drawings and a satisfactory operations and maintenance manual.

#### 1.11 GUARANTEE

- A. Contractor assumes full responsibility for the proper functioning and quality of the entire electrical installation. Any breakdowns, deficiencies or deteriorations caused by poor workmanship, materials, method of installation or inferior equipment furnished by this Contract shall be promptly remedied, replaced or repaired by the Contractor.
- B. The Contractor shall guarantee that all materials, equipment and workmanship shall be free from defects for a period of one year from the date of acceptance of the work and shall replace any defective Work or equipment at no cost to AW.

## 1.12 DELIVERY, STORAGE AND HANDLING

- C. Contractor shall make all necessary arrangements and provisions for the receiving, storage and protection of materials and equipment to be used in executing this Contract.

## PART 2: PRODUCTS

### 2.01 U.L. LISTING

- A. All products shall be U.L. listed where a U.L. listing exists for a similar product. If any non U.L. listed products are found in the installation they shall be removed and replaced with U.L. listed products at no additional expense to the AW.

### 2.02 ONLY NEW PRODUCTS SHALL BE ALLOWED

- A. All products used on this project shall be new, without defects and covered by the manufacturer's full U.S. warranty. Only specific items or equipment noted or specified by the Owner will be allowed to be reused.

### 2.03 INDUSTRIAL GRADE PRODUCTS REQUIRED

- A. All products shall be of industrial grade and shall be compatible with the required use. All electrical components shall be rated for continuous 24 hour/day, 7 day/week operation. Components shall not overheat nor fail prematurely when used continuously. All equipment shall be adequately protected from corrosion and shall not rust or deteriorate.

## PART 3: EXECUTION

### 3.01 INSTALLATION

- A. All equipment shall be installed as per the manufacturer's recommendations and in accordance with accepted construction practices.
- B. Protection of Installation:
  - 1. All equipment shall be protected during construction.
  - 2. All damaged equipment caused by noncompliance with this requirement shall be repaired at no additional expense to AW.
- C. Openings and Chases:
  - 1. Determine locations of chases and openings prior to construction so that same may be provided where required.
  - 2. If openings or chases are made after building construction is accomplished, such cutting and repairing of the building shall be made by the Contractor in complete coordination with other trades on the job site to match original

conditions in quality, color and type of materials used, and at no additional expense to the AW.

- D. Position of Outlets and Equipment: The Owner shall determine the position of all outlets and equipment if the required location differs from that indicated on the Drawings. The Contractor shall coordinate and confirm the position of outlets and equipment prior to the rough-in work for such equipment and associated finish materials associated with the space.
- E. Moving Outlets and Equipment: AW reserves the right to move any outlet or rough-in termination for a device, item, or equipment a distance of ten (10) feet prior to roughing in by the Contractor at no additional expense to the Project. Contractor shall coordinate all outlet and equipment termination requirements with the approved shop drawing submittals and other disciplines performing work in the area. Outlets located in brick, tile or block walls, as well as those devices associated with special finished areas of the building shall be coordinated with the special finish and the Owner in advance of roughing in. Provide coordination drawings where outlined in these Documents.
- F. Materials:
  - 1. All work shall be installed in a first-class, neat and workmanlike manner as defined in the NEC, Article 110.12 (and other locations throughout the Code) by skilled mechanics trained in the application of the materials being provided. Proof of adequate training of personnel performing the Work associated with this Project from the Manufacturer or Supplier shall be provided by the Contractor upon request from the Owner.
  - 2. All materials shall be new unless otherwise indicated or specified.
  - 3. Firmly support all materials and equipment.
  - 4. Any materials and/or workmanship found to be of inferior quality, damaged, improperly installed, or having been exposed to harmful substances or conditions at any time during the construction work, shall be immediately replaced upon notification from AW to the Contractor. Contractor shall at all times provide protective equipment meeting all Regulatory Agency requirements as may become necessary to protect all parts of the Work from damage or exposure to harmful conditions or contaminating substances.
  - 5. Where equipment is indicated to be relocated/reinstalled, the Contractor shall first conduct an inspection of such, prior to removal and report (document in writing) any component noted as defective or inoperable. Removal of the equipment constitutes acceptance of the equipment

indicating that operable equipment is now the responsibility of the Contractor for storage, reinstallation and proper operation (based on original) after the Work is completed. In relocating and/or reinstalling any existing equipment, the Contractor shall clean and inspect the equipment

as part of the Work; performing routine maintenance to the affected equipment prior to reinstallation. Any component found to be defective shall be brought to the Owner's attention in writing requesting direction.

G. Cutting, Repairing and Finishing:

1. All cutting, repairing, finishing and painting required for the installation of work under this Contract shall be performed under this Contract.
2. All disturbed surfaces shall be repaired and finished to match adjacent surfaces by skilled tradesperson working in their respective fields.

H. Excavation, Backfilling and Blasting: Excavation, backfilling and blasting work shall be in accordance with the requirements of AW Standard Specifications and as required to complete the work according to details on Drawings.

I. Concrete: Concrete work shall be in accordance with the requirements of AW Standard Specifications and as required to complete the Work according to details on the Drawings.

J. Cutting and Patching of Asphalt Paving and Concrete Areas:

1. Openings in concrete or asphalt paving required for electrical construction shall be made by taking extreme precautions to prevent excessive damage to existing facilities.
2. Prior to completion, all disturbed areas shall be closed, restored to normal and finished to match surrounding areas.

K. Access: Install all conduit, wire, cable, wiring devices and equipment to preserve access to all equipment and required areas. Where necessary, provide access panels in walls or ceiling, coordinated with the finish materials and type applicable to the area, to gain working access to the work installed. Minimum size of access panels shall be 18-inch by 18-inch unless otherwise approved by the Owner.

L. Layout of Wiring and Work:

1. The layout of wiring and work as shown on the Drawings shall not be considered as absolute; it shall be subject to changes where necessary to overcome obstacles in construction.
2. Where a major deviation from the Drawings is indicated by practical consideration, shop drawings shall be submitted showing all deviations in detail to clearly indicate the necessity or desirability for the change and the resulting new layout for acceptance by the Owner.

M. Furnish and install all necessary structural steel supports (i.e. angles, beams, channels), hanger rods or other required support/bracing needed for equipment and raceways furnished under this Contract requiring support or suspension from



building structure, except building support steel where otherwise noted on the plans.

N. Continuity of Service:

1. Uninterrupted electrical and telephone service shall be maintained during the entire time required for complete installation of the Work required under these Specifications and Drawings.
2. Temporary equipment, cable and additional materials and/or provisions as necessary shall be provided by the Contractor to maintain electrical, special systems and telephone services. Temporary service facilities, if required at any time, shall not be disconnected or removed until new services are placed in proper operation.
3. If any service or system must be interrupted, the Contractor shall request permission in writing stating the date, time, etc. the service that will be interrupted and the areas affected. This request shall be made in sufficient time for proper arrangements to be made with a minimum of 72 hours notification and additional notification time necessary as determined by Owner. Written permission shall be obtained from AW and appropriate regulatory agencies before interrupting electrical, special systems and telephone/communications systems.

O. Clean Up:

1. Upon completion of all work under electrical specifications, furnish labor, materials, and equipment to accomplish the following: remove all dirt, foreign materials, stains, fingerprints, etc. from all lighting fixtures, glassware, panel boards, MCC's, switchboards, VFD's, wall plates, system equipment, floors, walls and ceilings adjacent to the above equipment and leave the electrical work in such a condition that no cleaning will be required by AW.
2. The complete system shall be subject to inspection and approval by the Owner.

P. Start-up and Acceptance Testing:

1. Provide the services of a manufacturer's representative to start-up, adjust and test each piece of equipment. All operating conditions and startup sequences shall be tested during startup period.
2. All start-up and testing shall be performed in the presence of the Owner. All startup data and controls configuration and programming shall be recorded at startup or training on approved data recording sheets and verified. Completed data sheets shall accompany the O&M manuals provided for use in training. Scheduling and coordination arrangements are to be made a minimum of two weeks in advance and approved by AW.



Q. Training – General Requirements:

1. Contractor shall provide training sessions for the individual equipment and systems to designated customer personnel. Training shall include theory of operation, maintenance, startup, and troubleshooting procedures. Training shall include control and monitoring/metering systems with specific emphasis on use and performance of these systems in concert with the customer's framework of controls and reporting systems.
2. All training shall be performed by qualified and manufacturer-certified representatives.
3. One hard copy and a electronic copy of the O&M manuals shall be submitted prior to scheduling of training. Scheduling and commencement of training shall be contingent on the approved status of the O&M manuals.


3.02 TESTING AND VERIFICATION

- A. All electrical connections shall be verified before circuits are energized. Any equipment damaged due to a failure to check for short circuits or miswiring shall be corrected by the Contractor at no additional expense to the AW.

3.03 SAFETY DURING CONSTRUCTION

- A. All electrical equipment shall be maintained in a safe manner during construction. No exposed live circuits shall be accessible to other than qualified personnel. Contractor shall lock out circuits as required to prevent accidental starting of equipment. The work area shall at all times be kept neat and free from hazards.


Example of an "Arc Flash Danger and Warning Label"


DANGER

Arc Flash and Shock Hazard Present  
No Safe PPE Exists

Arc Flash Boundary	NOT DETERMINED	Energy Level
Incident Energy	NA cal/cm <sup>2</sup>	FCT NOT
Working Distance	18 in	DETERMINED
Shock Hazard Exposure	480 VAC	PPE: See AW AF Manual for
Insulating Glove Class	00	Minimum Arc Rating of Clothing
Shock Hazard when covers removed		
Limited Approach Boundary	3 ft 6 in	Refer to Power Study for Equipment's
Restricted Approach Boundary	1 ft 0 in	Available Fault Current
		Engineer: CMT

Equipment MDS-1 Date: 02-07-2021


WARNING

Arc Flash and Shock Hazard Present  
Appropriate PPE Required

Arc Flash Boundary	1 ft 6 in	Arc Flash PPE Category
Incident Energy	1.2 cal/cm <sup>2</sup>	1
Working Distance	18 in	PPE: See AW AF Manual for
Shock Hazard Exposure	240 VAC	Minimum Arc Rating of Clothing
Insulating Glove Class	00	
Shock Hazard when covers removed		Refer to Power Study for Equipment's
Limited Approach Boundary	3 ft 6 in	Available Fault Current
Restricted Approach Boundary	1 ft 0 in	Engineer: CMT

Equipment BOX 18 Date: 02-07-2021

All values shown on the examples shall be calculated values for the equipment the label is to be affixed.

### 3.04 ABBREVIATIONS

- A. ANSI – AMERICAN NATIONAL STANDARDS INSTITUTE
- B. ASTM – AMERICAN SOCIETY for TESTING and MATERIALS
- C. ICEA – INSULATED CABLE ENGINEERS ASSOCIATION
- D. IEEE – INSTITUTE of ELECTRICAL and ELECTRONICS ENGINEERS
- E. MCC – MOTOR CONTROL CENTER
- F. NEC – NATIONAL ELECTRIC CODE
- G. NEMA – NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
- H. NFPA – NATIONAL FIRE PROTECTION ASSOCIATION
- I. NRTL- NATIONALLY RECOGNIZED TESTING LABORATORY
- J. OSHA – OCCUPATIONAL SAFETY and HEALTH ADMINISTRATION
- K. UL- UNDERWRITERS LABORATORIES
- L. VFD – VARIABLE FREQUENCY DRIVE

**END OF SECTION 26 00 10**