

## **SECTION 23 04 00 - MOTORS AND CONTROLLERS**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 01 00, "Mechanical General Provisions", govern this Section.

#### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide motors required for equipment furnished under this Division. All motors shall be factory-installed on equipment whenever possible. Motor controllers will, in general, be provided under Division 26 except for motor controllers which are integrally mounted on equipment or which are specifically specified under this Division.
  - 1. In general, all motorized or electrically operated equipment will be set in place by the furnishing Contractor with all integrally mounted starters, controls and disconnect switches installed. The furnishing Contractor will furnish for installation and connection to Division 26 all starters, controllers and disconnect switches which are furnished with their equipment but not integrally mounted.
  - 2. Division 26 shall furnish, install and connect all starters and disconnect switches which are not provided with the served equipment.
  - 3. Division 26 shall furnish and install all interconnecting wiring, conduit and make all connections ready for operation between motors, starters and control devices, as required by wiring diagrams (on approved shop drawings) provided by the Division furnishing the equipment.
  - 4. Division 26 shall furnish miscellaneous 120 volt control power circuits as required for systems and equipment furnished by other Divisions. These control power circuits shall be furnished by Division 26 for all systems and equipment and where shown on the Drawings or approved shop drawings by the Division furnishing the system or equipment.
  - 5. All starters and controllers for non 120 volt equipment and motors shall be furnished with control power transformers and control power circuits shall typically not be required.

#### 1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
  - 1. Baldor.
  - 2. Century/Gould.
  - 3. General Electric.
  - 4. Louis Allis.
  - 5. Reliance.
  - 6. Siemens-Allis.
  - 7. U.S. Motors.
  - 8. Westinghouse.

#### 1.4 SUBMITTALS:

- A. Shop drawing submittals for motorized equipment shall include, but not be limited to, the following information on motors provided with equipment.
  - 1. Manufacturer's name and cutsheets.
  - 2. Motor type.
  - 3. Horsepower.
  - 4. Voltage/Phase/Hertz.
  - 5. RPM.
  - 6. Service factor.
  - 7. Insulation class.
  - 8. NEC code number.
  - 9. Motor efficiency and testing method and results.

### **PART 2 - PRODUCTS**

#### 2.1 ELECTRIC MOTORS:

- A. General: Motor voltages shall be as follows, unless noted or specified otherwise:
  - 1. 3/4 hp and larger - 460 volts, 3-phase, 60 Hz.
  - 2. Smaller than 3/4 hp - 120 volts, 1-phase, 60 Hz.
- B. Motors: All motors 7 ½ and up shall have VSD's with bypass, unless specified otherwise. All motors 60 hp and larger shall be reduced voltage started with wye-delta reduced voltage starters for fire pumps and closed transition autotransformer reduced voltage starters for all other motors, unless noted otherwise. All motors shall have copper windings. Motors shall be selected with low starting current and shall be designed for continuous duty to attain the running torque and pull-in torque required to suit the load. Motors for indoor protected use shall be open dripproof (ODP) construction, unless noted or specified otherwise. All motors exposed to the weather or contaminated environments shall be of the totally-enclosed fan-cooled (TEFC) or totally-enclosed air over (TEAO) type. All motors shall be single speed (1750 rpm), unless otherwise noted or specified. Two-speed motors shall be two-speed, one-winding (2S-1W) or two-speed (1750/1200 rpm, unless noted or scheduled otherwise), two-winding (2S-2W), unless otherwise noted or specified. All motors used with wye-delta reduced voltage starting shall be wound with taps for wye-delta reduced voltage starting. Motors used with variable speed drives shall be designed for variable speed use and shall be fully compatible with the furnished variable speed drives. Refer to other Sections herein and the Electrical Drawings for two-speed motors and motors with reduced voltage starting.
- C. Service Factor: All open motors shall be 1.15 service factor and all enclosed motors shall be 1.0 service factor, unless specified otherwise. All motors shall be rated for continuous duty. All motors shall be selected at design conditions without exceeding nameplate data assuming a 1.0 service factor.
- D. Bearings: Motors shall have either sealed or field-lubricated type roller or ball-bearings. Field lubricated ball bearings shall be drilled for grease fittings and have fittings installed. Where motors are installed inside equipment, extended grease fittings shall be provided. All bearings shall be designed for B-10, 100,000 hour minimum life hours of continuous service.
- E. Balancing: Motors shall be statically and dynamically balanced and tested at the factory prior to shipment and shall be selected for quiet operation.
- F. Windings: All motors shall have copper windings.
- G. Insulation: Open single phase motors shall have Class A or Class B insulation, open 3-phase motors shall have Class B insulation and all enclosed motors shall have Class F insulation.
- H. Single Phase Motors: All single phase motors shall be capacitor start or permanent split capacitor type selected to suit the load served. Single phase motors 1/4 hp and smaller shall have internal thermal protection.

- I. Housings: All open motors 10 hp and smaller shall have cast aluminum end bells with steel frames. All open motors 15 hp and larger, all enclosed motors and all motors used with variable speed drives shall have cast iron housings, and premium efficiency ratings.
- J. Rotation: The Mechanical Contractor shall be responsible to verify that the rotation of all 120 volt, single phase motors for mechanical equipment is in the correct direction prior to installation. The Electrical Contractor shall be responsible for correct rotation of all 3-phase motors.
- K. Nameplates: A motor nameplate shall be securely affixed to each motor and shall clearly indicate the electrical data, horsepower, rpm, frequency, NEC code number, motor efficiency, class of insulation, winding material, and service factor.
- L. Energy Efficient Motors: Energy efficient motors shall be provided [for all standard frame motors 5 hp and larger, unless noted otherwise] [where noted or specified]. Motor efficiency shall be based upon dynamometer testing per IEEE 112-E Test Standard, Method B, as set forth by NEMA MG 1-12.53a standard for efficiency testing and motor shall be labeled in accordance with NEMA MG1-12.53b. Motors shall be Baldor Super-E motors or an approved equal. Motors shall have a minimum efficiency as follows:

<u>Horsepower</u>	<u>ODP Efficiency</u>	<u>TEFC Efficiency</u>	<u>Minimum Power Factor</u>
1 to 1-1/2 hp	82%	-	0.77
1-1/2 to 2 hp	84%	-	0.80
3 to 5 hp	86%	89%	0.81
7-1/2 to 15 hp	88%	91%	0.87
20 to 40 hp	92%	93%	0.85
50 to 100 hp	93.5%	95%	0.87

- M. Additional Requirements: Refer to the various equipment Sections of this Division for additional motor requirements.

2.2 MOTOR CONTROLLERS:

- A. General: All motor starters, controllers, and disconnect switches shall conform to requirements of Division 16 and additional requirements specified elsewhere in this Division or noted on the Drawings.
- B. Control and Interlock Wiring: The Mechanical Contractor shall provide all low-voltage control (or line-voltage control where used as an alternate) and interlock wiring required by the temperature control system, except as otherwise noted or specified. Line-voltage power wiring shall be by the Electrical Contractor.
- C. Local Controls: Pushbuttons with or without pilot lights, hand-off-automatic switches and other scheduled apparatus shall be standard duty type mounted in NEMA enclosures or in cover of starter as specified or scheduled, and shall be furnished by the trade furnishing the starter except as specifically indicated elsewhere. Hand-Off-Automatic switches for equipment which could damage itself if left in the "hand" position (such as sump pumps), shall be spring-returned to "off" from the "hand" position.

**PART 3 - EXECUTION**

3.1 GENERAL:

- A. Motors shall be leveled, set in true angular and concentric alignment with driven equipment, and bolted firmly to motor base, if not mounted on equipment. Motors factory-mounted on equipment shall be checked for alignment to driven equipment and mounting bolts shall be checked to ensure bolts are tightly fastened.
- B. Coordination: The Mechanical Contractor shall have the responsibility to provide adequate rough-in information to the Electrical Contractor. Any costs, such as patching and refinishing of walls, resulting from inadequate information shall be the responsibility of the Mechanical Contractor.

**END OF SECTION 23 04 00**