

PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following Specification sections apply to all Work herein:
1. Section 21 00 10 - General Requirements
 2. Section 21 00 20 - Fire Suppression Scope of Work
 3. Section 21 05 07 - Design Conditions
 4. Section 21 05 93 - Testing
 5. Section 21 13 00 - Fire Suppression Sprinkler Systems
 6. Section 21 30 00 - Fire Pumps and Controllers

1.2 SUMMARY

- A. Furnish and install all electric motors required for equipment furnished under this Division. Electric motors shall be factory mounted on equipment wherever possible and shall be constructed as specified in this Section. If electric motors are shipped loose and must be installed by the Division 26 Electrical Subcontractor, the Division 21 Subcontractor shall notify each Electrical Subcontractor in writing prior to the bid date. In general, all motor controllers will be furnished and installed under Division 26 unless the motor controller is an integral part of a piece of equipment specifically required to be furnished under this Division.

1.3 REFERENCE STANDARDS

- A. Each motor, controller and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards:
1. National Electric Manufacturers Association Standards (NEMA)
 2. ANSI/NEMA MG 1 -1978 - Motors and Generators
 3. NFPA 70 - National Electrical Code (NEC)
 4. IEEE-112, Test Method "B"
 5. IEEE Standard 519-1992
 6. NEMA - ICS-3-303
 7. IEEE STD 444 (ANSI C34.3)
 8. Energy Policy Act of 1992 (EP Act)
- B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the General Conditions and Section 21 00 10 and shall include, but not be limited to:
1. Electric Motors - for all equipment not included under another Section. Shop Drawings shall state the motor manufacturer, frame size, horsepower, frequency, voltage, power factor, efficiency, speed starting torque class, insulation class, service factor and winding material. In addition, special shaft or mounting detail requirements as well as shaft limitation details and any other special requirements shall be listed on these Drawings.
 2. Motor Controllers - for all controllers not included under another Division.
 3. Proposed test procedures, recording forms, test equipment, and list of personnel and qualifications for all tests proposed. Refer to Section 21 05 93 titled "Testing" for additional requirements.
- B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 21 00 10. See Section 21 00 10 for certification requirements.

1.5 WARRANTY

- A. Comply with the requirements of the General Conditions and Section 21 00 10.

PART 2 PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. If it complies with these Specifications, motors manufactured by one of the following manufacturers will be acceptable:
1. Baldor
 2. Century/ MagneTek
 3. General Electric
 4. Marathon
 5. Lincoln
 6. Reliance
 7. Siemens
 8. Toshiba
 9. Westinghouse
- B. If it complies with these Specifications, controllers manufactured by one of the following manufacturers will be acceptable:
1. Allen Bradley
 2. Cutler Hammer/Westinghouse
 3. General Electric
 4. Siemens
 5. Square D

2.2 MOTORS

- A. In general, motor voltages shall be as follows, unless specified or indicated otherwise:
1. 3/4 hp and larger - 460V, three (3) phase, 60 hertz
 2. Smaller than 3/4 hp - 120V, one (1) phase, 60 hertz
- B. All motors shall be started across the line, unless specified otherwise. All motors 100 horsepower and larger shall be suitable for wye-delta starting unless specified otherwise. Motors shall be selected with low starting current and shall be designed for continuous duty to provide the running torque and pull in torque required to suit the load. Unless otherwise indicated on the Contract Documents, all motors shall be single speed (1750 rpm). All motors shall have standard open drip proof enclosures unless otherwise specified. All motors exposed to or actually installed outside in the weather shall be of the totally enclosed fan cooled (TEFC) or totally enclosed air over (TEAO) types. All motors not utilized with variable speed drives shall have a minimum service factor of 1.15 and shall be selected to operate at design conditions without exceeding their nameplate rating (without exploiting the service factor rating). Motors used in conjunction with variable speed drives shall have a 1.00 service factor unless otherwise indicated. Two (2) speed motors shall be two (2) speed, two (2) winding or two (2) speed, single winding type as specified herein and as indicated on the Contract Documents.
1. Standard open drip proof three (3) phase motors ten (10) horsepower and smaller shall have cast aluminum end bells with steel frames. Three (3) phase motors fifteen (15) horsepower and larger shall have cast iron end bells and housings.
 2. Standard open drip proof single phase motors shall have cast aluminum end bells with steel frames.
 3. Totally enclosed fan cooled (TEFC) and totally enclosed air over (TEAO) three (3) phase motors shall have cast iron housings. TEFC motors shall have corrosion resistant fans.
 4. Vertical pump motors shall have cast iron end bells and a cast aluminum housing. These motors shall be sized to drive the pump through its characteristic curve without exceeding the rated motor full load horsepower.
- C. Windings and Insulation:
1. All motors shall have copper windings.
 2. Motors shall be equipped with Class B, 80°C rise or Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. All motors used for cooling tower applications shall be equipped with Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. Windings shall be treated with an epoxy varnish to inhibit the absorption of moisture.

- D. Bearings:
 1. Single phase, fractional horsepower motors shall be equipped with quiet operating, all angle, babbitt lined sleeve bearings.
 2. Polyphase motors shall be equipped with deep groove type ball bearings, generously sized for the loads to which applied and for severe duty application. Provide the necessary seals on the shaft to keep the bearing system free of contamination and moisture.
 3. All motors shall be factory lubricated.
 4. Provide inlet and outlet plugs on poly-phase motors so that grease fittings can be easily inserted for bearing re-lubrication except as otherwise specified. The end shields shall be carefully machined to add extra grease capacity. Lower outlet plugs shall be equipped with combination breather/drains on TEFC and TENV motors.

- E. Motors shall be specifically designed for quiet operation and for severe duty. Standard open drip proof motors shall be equipped with aluminum or stainless steel stamped nameplates. Totally enclosed fan cooled and air over motors shall be equipped with stainless steel stamped nameplates with either zinc or cadmium plated hardware. Motor nameplates shall clearly indicate frame size, horsepower, frequency, voltage, speed, starting torque class, insulation class, service factor and winding material.

- F. Premium™ efficiency, three (3) phase, general purpose, continuous duty, T-frame, squirrel cage induction motors shall be specifically designed per IEEE-112, test method “B” procedures and shall have at least the following efficiency:

Size Horsepower	ODP Motors Full Load Efficiency* 1800 RPM	TEFC Motors Full Load Efficiency* 1800 RPM
1	85.5	85.5
1-1/2	86.5	86.5
2	86.5	86.5
3	89.5	89.5
5	89.5	89.5
7-1/2	91.0	91.0
10	91.7	91.7
15	93.0	93.0
20	93.0	93.0
25	93.6	93.6
30	94.1	94.1
40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	95.0
100	95.4	95.4
125	95.4	95.4
150	95.8	95.8
200	95.8	95.8

*Minimum efficiencies as per NEMA MG-1-1998, Rev 2, Table 12-12 for “Premium™ Efficient” motors.

- G. Refer to various Sections of this Division for special requirements for specific items of equipment requiring motors and for any other special requirements such as variable speed, multiple windings/speeds, reduced voltage starting, etc. Motors used in conjunction with variable speed drives shall be compatible with the drive and rated for inverter output duty. Inverter rated motors used in conjunction with variable speed drives shall be equipped with a set of shaft grounding bushings.

- H. Electric motors on fire pumps shall be standard efficiency.

2.3 MOTOR CONTROLLERS

- A. In general, motor controllers for all motors will be furnished and installed under Division 26 unless indicated or specified otherwise. Any motor controller that is an integral part of a piece of equipment and all variable speed motor controllers shall be furnished under this Division and shall be in accordance with the following specifications.
- B. All motor controllers shall be UL and/or ETL listed. The motor controllers shall be steel mounted and front wired with all terminals accessible for wiring directly from the front. No slate or ebony asbestos shall be permitted on any size controller from Size 00 through Size 8. All contacts shall be solid silver cadmium oxide alloy, which will not require any filing, dressing or cleaning throughout the life of the control equipment. Bare copper or silver flashed type shall not be permitted. Operating coils shall be pressure molded and so designed that if accidentally connected to excessive voltage they will not expand, bubble, or melt. When a coil fails under over voltage conditions, the motor controller shall definitely drop out and not freeze the contacts in the "ON" position. All internal wiring in the motor controller shall be copper. See Section 26 05 19 titled "Electrical Conductors – 600 Volts" in Division 26 for termination requirements and space in the housing.
- C. All three (3) phase full voltage magnetic motor controllers shall have overload protection in all three (3) phases. All single phase full voltage magnetic motor controllers shall have overload protection in both phases. All two (2) speed full voltage magnetic motor controllers shall have overload protection in all six (6) legs of the controller. Overload relays shall be furnished for each phase and shall be of the hand reset, trip free variety so that blocking the reset mechanism in the reset position will not prevent the starter from dropping out if the motor is overloaded. This specifically excludes those overload relays, which change to automatic reset from hand reset when the reset mechanism is blocked unless the automatic reset feature can be removed or voided. Accidentally depressing the reset button or mechanism shall not shut off the motor. Overload relays shall not be field convertible from hand to automatic reset type.
- D. Motor Controllers shall be provided with auxiliary dry contacts as follows:
 - 1. NEMA size 3 and larger: two (2) N.O. and two (2) N.C.
 - 2. NEMA size 2: two (2) N.O. and one (1) N.C.
 - 3. NEMA size 1 and O: one (1) N.O. and one (1) N.C.
- E. Any full voltage magnetic motor controller to be furnished under this Division shall be similar and approved equal to Allen-Bradley Bulletin Numbers as follows:
 - 1. Individual three (3) phase motor controllerAB Bul. 509.
 - 2. Individual single phase motor controllerAB Bul. 509SP.
 - 3. Combination three (3) phase motor controller with circuit breaker.....AB Bul. 513.
 - 4. Combination three (3) phase motor controller with non-fused switchAB Bul. 512.
 - 5. Combination three (3) phase, two (2) speed, single winding motor controller with circuit breaker AB Bul. 523F.
 - 6. Combination three (3) phase, two (2) speed, two (2) winding motor controller with circuit breaker AB Bul. 523E.
- F. In general, motor controller enclosures shall be NEMA Type 1 general purpose unless exposed to the weather or otherwise indicated on the Drawings. Any motor controller exposed to the weather shall have NEMA Type 4X water tight, dust tight, corrosion resistant, stainless steel or fiber glass enclosures.
- G. Generally, holding coils in full voltage magnetic motor controllers shall be suitable for use on 120V, AC control voltage. Each controller shall have a control transformer with primary and secondary fuses. Control power transformer shall have 75 VA capacity over and above the standard capacity required for holding coil and LED pilot light duty. Sizing of control power transformers shall be coordinated with the Division 25 Subcontractor.
- H. Two (2) speed motor controllers for two (2) speed motors shall have "decelerating relay" between high and low speeds.
- I. Motor controllers shall be provided with accessories such as H.O.A.'s, selector switches, LED neon pilot lights, etc. All internal wiring shall be copper.

- J. Each motor controller shall be equipped with a 120V red running LED or neon pilot light, control transformer, auxiliary contacts and a hand-off-automatic switch. Two (2) speed motor controllers shall have "fast-slow" LED or neon lights as well as a fast-slow selector switch in conjunction with the H.O.A. Controllers for sump pumps and sewage ejectors shall have "test" position in lieu of "hand" position. Neon or LED pilot lights will be operated by an interlock on the motor controller not placed across the operating coil. In addition to the "holding interlock and LED light interlocks", each controller shall have four extra interlock contacts - two (2) normally open and two (2) normally closed.
- K. Manual motor controllers where indicated on the Drawings, required and/or specified shall be similar and approved equal to Allen-Bradley Bul. 600 in NEMA Type 1 enclosure or as otherwise required for the location of the installation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Motor and controller installation shall be in accordance with the manufacturer's recommendations and as indicated on the Drawings. Align pulleys and install all belts at proper tension to minimize wear on belts and drives.

3.2 FACTORY TESTING

- A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.3 FIELD TESTING

- A. Refer to Section 21 05 93 for additional testing requirements motors and controllers.

END OF SECTION