

SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.01 SUMMARY

- A. This section applies to low-voltage AC induction motors, whether or not referenced by a motor-driven equipment specification. If equipment specification section deviates from this section in requirements such as, application, horsepower, enclosure type, mounting, shaft type, or synchronous speed, then those listed requirements shall take precedence over this section.
- B. This section does not apply to motors used in electrically-actuated gates or valves.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Bearing Manufacturers Association (ABMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
 - c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C50.41, Polyphase Induction Motors for Power Generating Stations.
 - c. MG 1, Motors and Generators.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 5. UL:
 - a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.
 - b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
 - c. 2111, Standard for Safety for Overheating Protection for Motors.

1.03 DEFINITIONS

- A. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.
- B. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.
- C. ODP: Open drip-proof enclosure.
- D. TEFC: Totally enclosed, fan-cooled enclosure.
- E. TENV: Totally enclosed, nonventilated enclosure.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Descriptive information.
 - 2. Nameplate data in accordance with NEMA MG 1.
 - 3. Additional Rating Information:
 - a. Service factor.
 - b. Locked rotor current.
 - c. No-load current.
 - d. Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
 - e. Guaranteed minimum full load efficiency and power factor.
 - 4. Enclosure type and mounting (such as, horizontal, vertical).
 - 5. Dimensions and total weight.
 - 6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
 - 7. Bearing type.
 - 8. Bearing lubrication.
 - 9. Bearing life.
 - 10. Space heater voltage and watts.
 - 11. Description, ratings, and wiring diagram of motor thermal protection.
 - 12. Motor sound power level in accordance with NEMA MG 1.
 - 13. Maximum brake horsepower required by the equipment driven by the motor.
- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
 - 2. Factory test reports.

3. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
4. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 67 00, Product Requirements.

PART 2 PRODUCTS

2.01 MOTORS, GENERAL

A. Physical Characteristics:

1. Equipment Finish:
 - a. Exterior Finish: Manufacturer's standard.
 - b. Interior Finish: Bore and end turns coated with clear polyester or epoxy varnish.
2. Enclosures: Conform to NEMA MG 1.
3. Lifting Lugs: Provide for all motors weighing more than 50 pounds.

B. Functional Characteristics:

1. Meet requirements of NEMA MG 1.
2. Provide motors specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
3. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
4. Horsepower Rating:
 - a. As designated in motor-driven equipment specification.
 - b. Brake horsepower of driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.
5. Service Factor: 1.15 minimum at rated ambient temperature, unless otherwise noted.
6. Voltage and Frequency Rating:
 - a. Voltage Rating:
 - 1) Unless otherwise indicated:

Voltage Rating		
Size	Voltage	Phase
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3

- b. Suitable for full voltage starting.
 - c. System Frequency: 60 Hz.
7. Locked Rotor Ratings: Locked rotor kVA Code G or lower if motor horsepower not covered by NEMA MG 1 tables.
8. Safe Stall Time: 12 seconds or greater.

9. Insulation:
 - a. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.
 - b. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class F at nameplate horsepower and designated operating conditions.
10. Bearings and Lubrication:
 - a. Horizontal Motors:
 - 1) 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 - 2) 1 hp Through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 - b. Vertical Motors:
 - 1) Thrust Bearings:
 - a) Antifriction bearing.
 - b) Manufacturer's standard lubrication.
 - 2) Guide Bearings:
 - a) Manufacturer's standard bearing type.
 - b) Manufacturer's standard lubrication hp and smaller.
 - c. Regreasable Antifriction Bearings:
 - 1) Readily accessible, grease injection fittings.
 - 2) Readily accessible, removable grease relief plugs.
11. Terminal Boxes:
 - a. Terminal for connection of equipment grounding wire in each terminal box.
 - b. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on the Drawings.
12. For TEFC and TENV motors, furnish with drain hole and porous drain/weather plug.

C. Performance Characteristics:

1. Operating Conditions:
 - a. Site Elevation: 7,500 feet above sea level.
 - b. Maximum ambient temperature not greater than 40 degrees C.
 - c. Provide motors suitable for operating conditions without reduction in nameplate rated horsepower or exceeding rated temperature rise.
 - d. Overspeed in either direction in accordance with NEMA MG 1.
2. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

3. Efficiency:
 - a. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
 - 1) Efficiency:
 - a) Tested in accordance with NEMA MG 1, Paragraph 12.59.
 - b) Guaranteed minimum at full load in accordance with NEMA MG 1, Table 12-12, Full-load Efficiencies for NEMA Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound), or as indicated in motor-driven equipment specification.
4. Noise:
 - a. Measured in accordance with NEMA MG 1.
 - b. Maximum Sound Level for Motors Controlled by Adjustable Frequency Drive Systems: 3 dBA higher than NEMA MG 1.
5. Balance and Vibration: In accordance with NEMA MG 1, Part 7.

2.02 SPECIAL MOTORS

- A. Physical Characteristics: Requirements in this article are supplementary to the requirements in the Article Motors, General. They take precedence over conflicting requirements specified elsewhere in this section.
- B. Functional Characteristics:
 1. Requirements in this article are supplementary to the requirements in the Article Motors, General. They take precedence over conflicting requirements specified elsewhere in this section.
 2. Horsepower Rating:
 - a. As designated in motor-driven equipment specification.
 - b. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.
 3. Inverter Duty Motor:
 - a. Motor Supplied Power by Adjustable Voltage and Adjustable Frequency Drives: Inverter duty rated in accordance with NEMA Parts 30 and 31.
 - b. Service Factor:
 - 1) Inverter-Duty Motors: 1.0 at rated ambient temperature, unless otherwise noted provide winding insulation rated 1,600 peak volts, minimum.
 - c. Meet or exceed NEMA MG 1 corona inception voltage rating.
 - d. Suitable for operation over speed range indicated.

- e. Provide forced ventilation where speed ratio is greater than published range for motor provided.
 - f. Bearing Insulation, Motors Larger than 30 hp: Provide at least one insulated bearing.
 - g. Shaft Grounding Device, Motors Larger than 7-1/2 hp: Furnish with shaft grounding brush or conductive microfiber shaft grounding ring solidly bonded to grounded motor frame.
4. Submersible Equipment Motors:
- a. Insulation System: Manufacturer's standard Class B or Class F.
 - b. Motor capable of running dry continuously.
 - c. Enclosure:
 - 1) Hermetically sealed, watertight, for continuous submergence up to 65-foot depth.
 - 2) Listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group D hazardous atmosphere.
 - 3) Seals: Tandem mechanical.
 - d. Bearing and Lubrication:
 - 1) Permanently sealed and lubricated, replaceable antifriction guide and thrust bearings.
 - 2) Minimum 15,000 hours L-10 bearing life.
 - e. Inrush kVA/horsepower no greater than NEMA MG 1 and NFPA 70, Code F.
 - f. Winding Thermal Protection:
 - 1) Thermal sensor and switch assembly, one each phase, embedded in stator windings and wired in series.
 - 2) Switches normally-CLOSED, OPEN upon excessive winding temperature, and automatically reclose when temperature has cooled to safe operating level.
 - 3) Switch contacts rated at 5 amps, 120V ac.
 - g. Motor Seal Failure Moisture Detection:
 - 1) Probes or sensors to detect moisture beyond seals.
 - 2) Probe or sensor monitoring module for mounting in motor controller, suitable for operation from 120V ac supply.
 - 3) Monitoring module with control power transformer, probe test switch and test light, and two independent 120V ac contacts, one opening and one closing when flux of moisture is detected.
 - a) Provide monitoring module mounted inside NEMA Type 4X, Type 316 stainless steel terminal junction box. Size the terminal box to accommodate the monitoring module, motor power conductors, field wiring connections to the monitoring module, wiring connections to the probes or sensors, motor power wiring, and terminal blocks. Provide terminal blocks for termination of all wiring entering or passing through the box.

5. Bearing Overtemperature Protection for Motors Larger than 100 hp:
 - a. Sensor on lower bearing housing monitoring bearing temperature.
 - b. Any monitoring relay necessary to provide 120V ac contact opening on bearing overtemperature.
6. Winding thermal protection, moisture detection, and bearing overtemperature specified above may be monitored by single device providing two independent 120V ac contacts, one closing and one opening on malfunction.
7. Connecting Cables:
 - a. Suitable for hard service, submersible duty with watertight seal where cable enters motor.
 - b. Length: 30 feet minimum.
 - c. UL 83 listed and sized in accordance with NFPA 70.

C. Performance Characteristics:

1. Requirements in this article are supplementary to the requirements in the Article Motors, General. They take precedence over conflicting requirements specified elsewhere in this section.
2. Submersible Equipment Motor Efficiency (at full load).
 - a. For Motors with Synchronous Speeds Less Than 1,200 rpm: Manufacturer's standard.
 - b. For Motors with Speeds 1,200 rpm and Greater:

Submersible Equipment Motor		
Rated Horsepower	Guaranteed Minimum Efficiency	Guaranteed Minimum Power Factor
5 to 10	80%	0.82
Greater than 10 to 50	85%	0.82
Greater than 50 to 100	87%	0.82
Greater than 100	89%	0.82

2.03 MOTOR ACCESSORIES

A. Physical Characteristics: None.

B. Functional Characteristics:

1. Winding Thermal Protection:
 - a. Thermal sensor and switch assembly, one each phase, embedded in stator windings and wired in series.

- b. Switches normally-CLOSED, open upon excessive winding temperature, and automatically reclose when temperature has cooled to safe operating level.
 - c. Switch contacts rated at 5 amps, 120V ac.
 - 2. Space Heaters:
 - a. Provide winding space heaters with leads wired out to separate conduit or terminal box.
 - b. Provide extra hole or hub on motor terminal box as required.
 - c. Unless shown otherwise, heater shall be suitable for 120V ac supply, with wattage suitable for motor frame size.
 - 3. Nameplates:
 - a. Raised or stamped letters on stainless steel or aluminum.
 - b. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
 - c. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.
 - 4. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.
- C. Performance Characteristics: None.
- D. Horizontal Motors:
 - 1. For Direct Drive Equipment: Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
 - 2. For Belt Driven Equipment: Minimum 30,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
- E. Vertical Motors:
 - 1. Thrust Bearings: Minimum 50,000 hours L-10 bearing life.
 - 2. Guide Bearings: Minimum 100,000 hours L-10 bearing life.

2.04 FACTORY TESTING

- A. Tests:
 - 1. In accordance with IEEE 112 for polyphase motors.
 - 2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
 - 3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower: In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts.

3.02 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative at Site in accordance with Section 01 79 00, Demonstration and Training, for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 40 hp.

END OF SECTION

