

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Division 00 and 01, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 23.

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors provided with equipment specified in other sections of Division 23.

1.3 SUBMITTALS

- A. Product Data: Include each piece of motorized equipment: Complete nameplate data and ratings; insulation class, NEMA design, frame size, enclosure type, bearing type, type of lubrication, service factor; mounting arrangements; size and coatings. Motor wiring and connection diagrams for all external connections and drawing showing location of winding termination lugs, conduit entry, and grounding lug.
- B. Manufacturer's Shop Test Reports: Submit only if specifically requested.

1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

1.5 QUALITY ASSURANCE

- A. Comply with latest published edition of NFPA 70, National Electrical Code.
- B. All materials and equipment specified herein shall be within the scope of Nationally Recognized Testing Laboratory (NRTL) examination services, be approved by the NRTL for the purpose for which they are used, and shall bear the appropriate listing label. Any NRTL listing/label shall be as accepted by the local authority having jurisdiction.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Motors:
 - a. General Electric.
 - b. Siemens.
 - c. Century.
 - d. U.S. Motors.

- e. Reliance.
- f. Baldor.
- g. Or Approved Equal.

2.2 GENERAL REQUIREMENTS

- A. Design and Construction: Motors and enclosures to conform to requirements of latest publication of NEMA Standard MG 1.
- B. VFD Compatibility: Motors serving equipment that utilizes variable frequency drives shall be compatible with variable frequency drives, as outlined in Division 23 Section "Variable Frequency Drives." Motors that are used in conjunction with variable frequency drives shall be labeled by the manufacturer for inverter use.
- C. Motors 1/2 HP and Larger: Three-phase, unless specifically indicated otherwise.
- D. Motors Smaller than 1/2 HP: Single phase.
- E. Efficiency: Premium efficiency as defined by NEMA MG 1, unless otherwise indicated.
- F. Nameplates: Provide motors with stainless steel nameplates, secured with stainless steel fasteners, containing information required in NEMA MG 1; and motor connection diagram if more than three motor leads enter the motor terminal box.
- G. Frequency Rating: 60 Hz.
- H. Voltage Rating: Determined by voltage of circuit to which motor is connected or as indicated. Motor shall be capable of normal operation with voltage variations of plus or minus 10% of nameplate rating.
- I. Service Factor: Provide motors with 1.15 service factor, unless otherwise indicated.
- J. Duty and Torque Characteristics: Rated for continuous duty; sufficient to start, accelerate, and operate connected loads at designated speeds, in environments ranging from -4 to 104 Deg F, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- K. Enclosure Type:
 - 1. Indoor Service: Totally Enclosed Fan Cooled (TEFC) or Open Drip-Proof (ODP); provide ODP unless otherwise indicated. Provide drain plugs at the lowest part of the motor housing.
 - 2. Outdoor Service: Totally Enclosed Fan Cooled (TEFC) or Totally Enclosed Air Over (TEAO); provide TEFC unless otherwise indicated. Furnish with drain and breather plugs. Refer to individual sections for enclosure type.
 - 3. Hazardous Environment Duty: Explosion-proof motors where indicated. Furnish with drain and breather plugs.
- L. Vertical Motors: Motors used in vertical configuration shall be specifically designed to operate in vertical installation. Universal position motors are not acceptable. Thrust bearing rating shall be compatible with the loads imposed by the driven equipment.

2.3 THREE-PHASE MOTORS

- A. Description: Three-phase, single speed squirrel-cage induction type, 208-230V or 460V as indicated. In addition to requirements listed under General Requirements, provide motors with following:
1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated. Motor torque characteristics must allow the connected load to be accelerated to full load speed and then operate continuously at full load without damaging the motor. Unless otherwise indicated, motors shall be capable of full voltage across-the-line starts per NEMA MG 1, Section III, Part 20 as follows: Two starts in succession, coasting to rest between starts, motor initially at ambient temperature of 104 Deg F (40 Deg C).
 2. Insulation: NEMA Class F insulation with Class B temperature rise, unless otherwise indicated.
 3. Stator: High conductivity copper windings, cast iron frame and end bells unless otherwise indicated. Multispeed motors have separate winding for each speed.
 4. Rotor: Keyed or shrunk to shaft. Rotors welded to shaft are not acceptable. Where aluminum die-cast rotor assemblies are not provided, make rotor bars and conducting end rings of copper with bars brazed to rings.
 5. Bearings: Motors equipped with anti-friction bearings to meet the following: Motors serving belt-driven equipment use AFBMA 9 L-10 life, 50,000 hours minimum; direct-drive motors use AFBMA 9 L-10 life, 125,000 hours minimum.
 6. Lubrication: Motors shall be grease lubricated, unless otherwise indicated. Bearings shall be externally regreasable via accessible grease fittings without having to disassemble the motor; provide for the elimination of the purged grease through fittings. Provided seals to prevent grease from entering the motor interior. Vertical motor lubrication shall conform to the motor manufacturer's recommendations.
 7. Vibration: Test motor vibration at bearing housing and shaft in accordance with NEMA MG 1, Section I, Part 7. Maximum allowable vibration velocity is 0.08 inches per second (resiliently mounted).
 8. Winding Over-Temperature Protection: Imbedded (normally closed contact) thermostats, one per winding, shall be provided for an external thermal alarm or motor cut-out for all motors 40 hp and above, unless indicated otherwise. Thermostat automatically resets when the motor temperature returns to normal range. Thermal cutout leads shall be brought out to the motor terminal connection box.
 9. Connections: Conduit or terminal box shall be split construction with threaded hubs, able to rotate in 90-degree increments. Provide ground lug securely attached to motor frame in conduit box for ground connection.
 10. Noise Control: Comply with NEMA MG 1, Section I, Part 9.
 11. Lifting lugs: Provide lifting lugs on motors weighing over 100 lbs. Drilled and tapped holes for lugs shall not penetrate motor enclosure.
 12. Finish: Coat parts with zinc-rich primer prior to final coats of epoxy enamel.
- B. Additional Requirements for Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
- C. Additional Requirements for Motors Used with Variable-Frequency (VFD) Drives: Ratings, characteristics, and features coordinated with and approved by variable frequency drive manufacturer.
1. Motor Operating Frequencies: Critical motor vibration frequencies shall not be within operating range of drive output.
 2. Insulation: NEMA Class H with Class B temperature rise.

3. Winding Over-Temperature Protection: Provide winding over-temperature thermostat to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermostat automatically resets when the motor temperature returns to normal range. Thermal cutout leads shall be brought out to the motor terminal connection box.
 4. Maximum Rated Motor Speed: Motor nameplates shall indicate that motors are inverter duty motors capable of operation up to 200% nameplate speed.
 5. Shaft Grounding System: Motor shall have shaft grounding system to discharge electrical shaft currents within the motor and/or its bearings. The system shall use conductive micro-fiber shaft grounding rings and shall be designed to reduce shaft voltage levels to less than 2 volts peak-to-peak. On motors up to 100 hp, one grounding ring shall be provided on either the drive or non-drive end of the motor; on motors over 100 hp, provide grounding rings on both the drive and non-drive side of the motor.
- D. Manufacturer Shop Tests: Each three-phase motor shall be given a routine test to determine that is free from electrical and/or mechanical defects and provide assurance that it meets the specifications. The test shall conform to the latest applicable NEMA and IEEE standards and shall be defined as "Standard Commercial Test." Copies of the test report will not be required to be submitted unless the actual operation and installation suggest the motor's performance should be verified, in which case certified copies of the test report shall be submitted upon request.

2.4 SINGLE-PHASE MOTORS

- A. Description: Single-phase, single speed, 115/230V or 115-208/230V as indicated, designed for continuous duty. In addition to requirements listed under General Requirements, provide motors with following:
1. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
 - a. Permanent-split capacitor.
 - b. Split-phase start, capacitor run.
 - c. Capacitor start, capacitor run.
 - d. Shaded-pole: Do not use unless motors are smaller than 1/20 hp.
 2. Thermal Protection: Internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range.
 3. Insulation: NEMA Class B insulation, unless otherwise indicated.
 4. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.
 5. Enclosures: Heavy fabricated steel or cast iron.
 6. Finish: Coat parts with zinc-rich primer prior to final coats of epoxy enamel.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The motor installation shall be in conformance with the motor manufacturer's recommendations. Motors shall be factory installed on, aligned and connected to driven equipment, com

mon bases, stands, etc., with the driven equipment. Belt driven equipment shall have belt tension adjusted to manufacturer's recommendations.

- B. Electrical Connections: Install electrical connectors and terminals according to manufacturer's recommendations. Verify motor is properly grounded.
- C. Motors for Variable Speed Drives: Install shaft grounding system according to manufacturer's recommendations.

END OF SECTION