

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Section includes single-phase and three-phase motors for application on equipment furnished under Division 23, and for motors furnished loose.
- B. Electric motors shall be rated in accordance with NEMA standard MG-1, and shall be suitable for continuous operation at rated load at service conditions defined in the standard.
- C. Size motors to meet the horsepower requirements of the driven unit at design conditions, including V-belt and/or drive and coupling losses which are incurred, without loading the motor beyond its nameplate horsepower rating. Motors shall also be sized to accelerate the driven load from zero to full rated speed in ten seconds or less under a full voltage start.
- D. All motors shall be approved by the manufacturer as being appropriate for the services, duties, applications, and operating environments in the manner which they are installed, operated, connected to driven equipment, and otherwise used in mechanical systems. Whenever an equipment supplier purchases motors separately and factory-assembles them into systems that he then provides as assemblies, the equipment supplier shall secure the motor manufacturer's approval that said motors are appropriate for all intended uses.
- E. Size motors to be non-overloading under all possible conditions of operation.
- F. Motors shall not be smaller than indicated on drawings or in the specifications, but may be larger to meet the above requirements.
- G. If any manufacturer uses motors requiring larger NEMA size control equipment than motors shown, this Contractor shall be responsible for the extra cost for such control equipment.
- H. Motors with V-belt drives shall be furnished with two-bolt adjustable motor bases.

1.2 RELATED SECTIONS

- A. Section 26 00 10 Basic Electrical Requirements.
- B. Section 23 00 10 Basic Mechanical Requirements

1.3 REFERENCES

- A. NEMA MG-1 National Electrical Manufacturers Association – Motors and Generators.
- B. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- C. ANSI/NFPA 70 - National Electrical Code.
- D. NECA 1 (National Electrical Contractors Association) - Standard Practices for Good Workmanship in Electrical Contracting.
- E. ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
- F. AFBMA Anti-Friction Bearing Manufacturers Association

1.4 SUBMITTALS

- A. Submit under Section 01 33 00 and 23 00 10.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.5 CLOSEOUT SUBMITTALS

- A. Submit under Section 01 33 00 and 23 00 10.
- B. Indicate the locations of all electric motors on the drawings.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Testing Agency: Member of International Electrical Testing Association and specializing in testing products specified in this section, with minimum five years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure.
- D. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY

- A. Motor performance shall be warranted against material and workmanship defects by manufacturer's warranty and service policy for the period of at least 18 months from the day of shipment from the factory or the manufacturer's warehouse.
 - 1. Premium efficiency motors shall be warranted for 36 months.
 - 2. Severe duty motors (as applicable) shall be warranted for 60 months.
 - 3. Extended warranty shall be offered for certain products, or as agreed by additional terms, and specified elsewhere.

PART 2 - PRODUCTS

2.1 SINGLE PHASE MOTORS

- A. Unless specifically noted otherwise, motors less than ½ HP shall be T-Frame, Design B, 1.25 service factor 115 VAC, 60 HZ, single phase, capacitor start or permanent split capacitor, open drip-proof type with minimum class B insulation for 40 DEG. C ambient.
 - 1. Refer to equipment schedules for motor horse powers, voltages, phases, construction type, and accessory requirements.
- B. Motor efficiency shall be not less than 75 percent.
- C. Single phase motors shall be Baldor, Reliance, Siemens-Allis, General Electric, Marathon, Century, or approved equal.

2.2 THREE PHASE MOTORS

- A. Unless specifically noted otherwise, motors ½ HP and larger shall be 460 VAC, 60 Hz, three phase, NEMA MG-1, B design, energy-efficient squirrel cage induction type, with open drip-proof construction, unless noted to be TEFC. Units shall be T-frame with minimum Class F insulation designed for continuous operation in 40 DEG. C ambient.
 - 1. Refer to equipment schedules for motor horse powers, voltages, phases, construction type, and accessory requirements.
- B. Motors shall have copper windings, steel or cast iron frames, and heavy duty, grease-lubricated, anti-friction bearings.
- C. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with pulley centerline at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- D. Sound Power Levels: Conform to NEMA MG 1.
- E. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.
- F. Motors shall have the following service factor:

HP	Service Factor
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½ to 1 HP	1.25
1½ HP and larger	1.15

- G. Motors shall be of the highest efficiency design available from manufacturer, and shall equal or exceed the values listed in the following Table.
- H. Minimum motor full-load electrical efficiencies shall be based on motor size, shall be as indicated in the following table, and shall comply with ASHRAE 90.1-2013, whichever is greater:

Motor Size	Minimum Full Load Efficiency
½ to 1 HP	81.5%
1½ HP - 5 HP	86.5%
7½ HP and larger	91%

- I. Motors shall be premium efficiency as defined by the National Electrical Manufacturers Association (NEMA).
- J. Efficiency ratings shall be determined in accordance with NEMA Standard MG1-12.53a and MG1-12.53b.
- K. Motors used with variable frequency drives shall be premium efficiency inverter duty rated in accordance with NEMA. These motors shall meet NEMA corona inception voltage requirements, withstanding peak voltages up to 1600 volts, and be manufactured in accordance with NEMA MG 1 Part 30 and 31. If distance between motor and controller is greater than 150 feet, provide filter on controller.
- L. Manufacturers: Motors shall be Baldor, General Electric, Marathon, WEG, TECO, NIDEC or approved equal.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft grounding ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the shaft grounding ring manufacturer's recommendations.

2.4 GENERAL REQUIREMENTS - HIGH-FREQUENCY BONDING:

- A. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided,

tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal.

- B. Application Note: High-frequency grounding straps must be used to ensure the proper grounding of all inverter-driven induction motor frames.

2.5 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG-1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors and accessories according to manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Provide electrical service, devices, and connections in accordance with Division 26, Electrical, and as shown on the Contract Documents.
- D. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- E. Ground and bond motors under the provisions of Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.15.

3.3 SHAFT GROUNDING RINGS (All Motors With Variable Frequency Drives)

- A. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGR's may be field installed by installing contractor subject to Engineer's approval. Provide AEGIS SGR Colloidal Silver Shaft Coating, or approved equal, on shafts prior to rings installation, per SGR manufacturer's recommendations, after first cleaning shafts.
- B. Install and test SGR's in accordance with manufacturer's recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of EP2400 AEGIS Conductive Epoxy, or approved equal, to secure the screws in place.
- C. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or Scotch-Brite. If the shaft is visibly clean, a non petroleum based solvent may be used to remove any residue. Check the

conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.

- D. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer's requirements.

3.4 HIGH-FREQUENCY BONDING (All Motors With Variable Frequency Drives)

- A. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter.

END OF SECTION

Note for section 2 and 3:

The following Motor Manufacturers include full product lines with ***AEGIS Shaft Grounding Rings installed*** by the manufacturer:

1. Baldor (Stock ODP, TEFC up to 100 HP, PM and JP up to 20 HP)
2. WEG (Stock ODP and TEFC up to 100 HP)
3. TECO (Stock ODP, TEFC and TENV up to 75 HP)
4. GE (Stock ODP and TEFC up to 100 HP)
5. Marathon (Stock ODP and TEFC up to 50 HP; TEAO Cooling Tower up to 250 HP; XP up to 50 HP)