

SECTION 23 0513 - MOTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 SUBMITTALS

- A. Motor product data including wiring diagrams.
- B. Operation and maintenance data.
- C. Northwestern University Maintenance Requirement Forms, see Division 01.
- D. [Submittals for LEED as required.]**

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers and variable frequency drives.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

1.4 QUALITY ASSURANCE

- A. Comply with FM Global requirements for motors and VFD's and for monitoring and diagnosis of vibration in rotating machinery.

1.5 SPECIAL WARRANTY

- A. Five (5) years, see Division 01.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/MODELS

- 1. Siemens Electric Type RGZE.

2. Reliance Type XE.
3. US Electric Motors Type UTE or CE.
4. General Electric Type E4.
5. Marathon Electric XRI Blue Chip.

## 2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Motor efficiencies shall at a minimum comply with the most recent editions of the International Energy Conservation Code and ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. Motors shall be selected such that the brake horsepower (bhp), including drive losses of the driven equipment, does not exceed 90% of the motor nameplate at design conditions.

## 2.3 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. The service factor for HVAC motors shall be 1.15.

## 2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium Efficiency, as defined in NEMA MG 1.
- C. Multispeed Motors: Variable torque.
  1. For motors with 2:1 speed ratio, consequent pole, single winding.
  2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. Code Letter Designation:
  1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: (Ratings, characteristics, and features coordinated with and approved by controller manufacturer.)

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Motors driven by a VFD shall not operate in their service factor.
6. Motors driven by a VFD shall be provided with shaft grounding brushes/rings similar to AEGIS SGR's to prevent bearings from shaft currents.
7. See 2.7-F herein also.

## 2.6 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## 2.7 MORE SPECIFIC MOTOR REQUIREMENTS

A. Motors within air handling unit air streams shall be totally enclosed fan cooled (TEFC).

- B. HVAC motors outdoors, not in an airstream, shall be totally enclosed fan cooled (TEFC) and shall have epoxy sealed windings using vacuum and pressure with rotor and stator surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.
- C. HVAC motors indoors, and not in an airstream, shall be open drip proof (ODP).
- D. All motors over 5 hp shall have rigging fixtures for easy removal and installation.
- E. All "critical" motors shall have vibration analysis monitoring tied into the BAS system. Coordinate with the University during bidding and construction.
  - 1. Critical is defined as any location that is serving a research location or a process that is essential to "day to day" operations of the University.
- F. Additional Requirements for Three Phase Motors Used with Variable Frequency Drives:
  - 1. Motors shall be "inverter-ready" by complying with or exceeding MG1 Part 31 requirements regarding special purpose motors for use with variable frequency drives.
  - 2. Windings shall be copper magnet wire with moisture resistant insulation, varnish, and designed and tested to resist transient spikes, high frequencies, and short time pulses produced by PWM inverters.
  - 3. Motors shall be equipped with shaft grounding rings to dissipate potential VFD-induced motor shaft currents by grounding through the motor housings. ***(This provision for grounding devices shall not apply to motors used in environments defined as Class 1 Division 1, Division 2, or Class 1 Zone 1, Zone 2 hazardous locations.)***

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 23 0513**