

**PART 1 - GENERAL REQUIREMENTS**

**1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Single phase electric motors.
  - 2. Three phase electric motors.

**1.02 SUBMITTALS**

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification Sections.
  - 1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

**1.03 QUALITY ASSURANCE**

- A. All motors shall be UL listed.

**PART 2 - PRODUCTS AND MATERIALS**

**2.01 MANUFACTURERS**

- A. Century
- B. General Electric
- C. Westinghouse
- D. Baldor
- E. Gould

**2.02 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Motors Less Than 250 Watts, for Intermittent Service: Provide equipment manufacturer's standard. Motor's need not conform to these specifications.
- B. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.
  - 1. Motors 3/4 HP and Larger: 480 volts, three phase, 60 Hz.
  - 2. Motors 1/2 HP and Smaller: 120 volts, single phase, 60 Hz.
- C. Type:

1. Open drip-proof except where noted otherwise.
  2. Motors: Design for continuous operation in 40 degrees C environment.
  3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  2. For fractional horsepower motors, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

### **2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.

### **2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

### **2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

- E. Insulation System: NEMA Class B or better.
- F. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.
- G. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- H. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- I. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 16 - Motor Controlling Equipment.
- J. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- K. Sound Power Levels: To NEMA MG 1.
- L. All totally enclosed motors shall be fan cooled type. Non-ventilated type motors are not acceptable.
- M. Variable Frequency Drive Motors: Motors controlled by variable frequency drives shall be rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.
  - 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. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
  - 3. Grounding: Provide shaft grounding system equal to AEGIS SGR Bearing Protection Ring, Inpro/Seal Current Diverter Ring (CDR) or approved equal. Install system in accordance with manufacturer's recommendations.
- N. Nominal Efficiency: Motors shall have minimum efficiency meeting the requirements of the Energy Policy Act of 1992 and as scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- O. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Single phase motors for pumps and air compressors: Capacitor start type.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation.
- C. Check line voltage and phase and ensure agreement with nameplate.

### 3.03 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

### 3.04 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1-1/2	3600	143T	82.5	85
2	3600	145T	84	87
3	3600	182T	85.5	87
5	3600	184T	87.5	88
7-1/2	3600	213T	88.5	86
10	3600	215T	89.5	86
15	3600	254T	90.2	91
20	3600	256T	90.2	89
25	3600	284T	91	92
30	3600	286T	91	92
40	3600	324T	91.7	91
50	3600	326T	92.4	92
60	3600	364T	93	93
75	3600	365T	93	91
100	3600	405T	93.6	92

**END OF SECTION**

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