SECTION 16150

PUMP MOTORS

# GENERAL

## DESCRIPTION

### This section describes materials, installation, and testing of induction motors and applies to motors which are provided as part of equipment specified in other sections. When it applies, this section is referenced in these other sections.

## RELATED WORK SPECIFIED ELSEWHERE

### Section 16010: General Electrical Requirements.

### Section 16260: Variable Frequency Drives.

### Section 16480: Low-Voltage Motor Control.

## SUBMITTALS

### Submit shop drawings in accordance with the General Conditions.

### Submit motor housing material, winding material, NEMA design letter, NEMA code letter, ambient temperatures and maximum elevations in which motor is designed to operate continuously, service factor, NEMA insulation class, temperature rise, type of enclosure, voltage, locked rotor current, full load current, bearing life, and dynamic balance.

### Nameplate data. Show complete nameplate data, ratings, characteristics, mounting arrangements, size and location of conduit entry, location and size of grounding lug, and coatings

### Dimensions and weights of motors.

### Submit percent efficiency and power factor data at full, 75%, and 50% load.

### Cycle time requirements based on motor heating and cooling characteristics and motors installed with an ambient design temperature of 40°C.

### Submit factory test results for each motor.

## FACTORY TESTS

### For each motor provide routine (short commercial) test data. Tests shall comply with NEMA MG 1-12.51 and MG 1-23.46.

### Perform noise tests by measurement in accordance with the latest revision of IEEE-85, Test Procedure for Air Borne Noise Measurements and Rotating Electrical Machinery. The motor shall be operating during test on rubber at no load with rated voltage and frequency.

### Perform vibration tests per NEMA MG 1-12.06 or MG 1-20.53.

### Test thermally protected motors in accordance with NEMA MG 1 winding temperature and trip current tests.

## CONTROLLER COORDINATION

### Where a motor controller other than a standard across-the-line type is specified, furnish reviewed shop drawings to the controller manufacturer for coordination and sizing of the controller.

### When motor furnished differ from the ratings indicated, notify controller manufacturer to make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment for no additional cost to the DISTRICT.

## QUALITY CONTROL

### NEMA Compliance: Unless otherwise indicated, comply with NEMA MG 1.

# MATERIALS

## GENERAL MOTOR DESIGN REQUIREMENTS

### Motors shall be manufactured by U.S. Electrical Motors.

### Motors shall be single speed, squirrel cage induction, NEMA Design B. Motors 15 horsepower and larger shall be NEMA Starting Code F or G. Motors smaller than 15 horsepower may have manufacturer’s standard starting characteristics.

### Motors shall be vertical weather-protected Type 1, NEMA WP-1.

### Stator windings shall be copper.

### Torque and slip characteristics shall be as recommended by the manufacturer of the driven equipment and as specified.

### The connected load (maximum horsepower required) of each motor shall not exceed [90% of] its nameplate horsepower rating (exclusive of service factor) under any operating condition.

### Motors shall be sized to start and accelerate the design load of the driven equipment without exceeding any of the specified design requirements. Replace or repair any motor failing these requirements with a motor that will meet the specifications and requirements at no additional cost to the DISTRICT.

### Connection box shall be cast metal with gaskets between the box and housing and between the box and cover. Provide a grounding terminal in the connection box. For motor rated 250HP or higher, the connection box shall be one size larger to accommodate cable splices.

### Motors shall be rated for continuous duty at a service factor of 1.15 on sinusoidal power, an ambient temperature of 50°C, and at an altitude of 3,300 feet.

### Open dripproof and weather-protected motors 7.5 horsepower and larger shall have stainless-steel screens over openings.

### Motors shall have cast-iron frames. Do not provide aluminum frames.

### For motors controlled by VFDs, the critical vibration speed of the motor/load combination shall either not fall within the operating range of the VFD or such frequency shall be blocked with the VFD critical speed avoidance circuit.

### Motors shall have minimum guaranteed full load efficiencies in accordance with NEMA MG 1-12.59. The efficiency shall be determined by IEEE 112 Method B using sine wave power for motors up to 300 horsepower and Method F for motors above 300 horsepower. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1-12.58.2.

### Outdoor motor and motor located in wet area shall have 120-volt motor space heater.

### Provide motor with a guaranteed maximum sound power level of 72 dBA, measured per IEEE 85, when running at no-load connected to sine wave power.

### In addition to nameplate information required by NEMA MG 1-10.37 through 39, show on the nameplate the bearing numbers for both bearings, efficiency, power factor at full load, and the maximum recommended kVAR of power capacitors to result in a 90% power factor. Nameplates and fasteners shall be stainless steel.

### Equip motor with thermal protection in accordance with NEMA MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection.

#### Provide three series connected, normally closed switches, one in each winding.

#### For motors 300 horsepower and larger, provide 120-ohm platinum resistance-temperature detectors (RTD), with two RTDs in each winding and one RTD in each bearing, for a total of eight. The RTDs shall be designed to function in two temperature steps: the first to indicate an alarm and the second to stop the motor.

#### Motor supplier to provide Motor Protection Relays

### Motor powered by VFDs shall be inverter duty and suitable for use with a 6 pulse, active front end harmonic filter, pulse width modulated variable frequency drive with nonfiltered output. Design the motor to limit temperature rise to within the specified requirement at a 1.0 service factor when powered from the drive. Provide a nameplate on the motor stating that it is rated for VFD applications.

### All motors shall be dynamically balanced and measured per NEMA Method MG1-12.06.

### When motor furnished differ from the ratings indicated, notify controller manufacturer to make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment.

### Conduit opening at the motor connection box shall be coordinated with the incoming conduit sizes and provided accordingly. If a set of parallel conductors are shown in the drawings, Contractor may optionally provide a pull box at the conduit stub-up, sized per the NEC, and continue with a single conduit, sized per the NEC, to carry the parallel set of conductors to the motor connection box.

### **Motor Types:** Motor designations consist of type number and suffix letter. The number and letter are intended to be compatible and the motor shall meet the requirements of both.

#### **Type 1:** Vertical weather-protected Type 1, NEMA WP-

#### **Type 2:** Horizontal or vertical weather-protected Type 2, NEMA WP-2.

#### **Type 3:** Horizontal, open drip proof.

#### **Type 4:** Totally enclosed, fan cooled.

#### **Type 5:** Totally enclosed, non-ventilated.

#### **Type 6:** Horizontal, heavy duty, totally enclosed, fan cooled (General Electric "Severe Duty," Westinghouse "Mill and Chemical Service," Reliance "XT," or equal) and shall have the following feature:

##### Non-hygroscopic insulation.

##### Extra dips and bakes of insulating varnish for moisture protection of windings.

##### Gasketed cast-iron conduit box halves and moisture seal between conduit box and motor frame.

##### Weep holes to vent enclosure and drain condensation.

##### Chemically inert fan.

#### **Suffix E:** Motor shall be classified as “Premium Efficient” and shall have minimum guaranteed full load efficiencies in accordance with NEMA MG 1- 12.60. The efficiency shall be determined by IEEE 112 Method B using sine wave power. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1-12.58.2.

#### **Suffix H:** Motor shall have 120-volt motor space heater.

#### **Suffix R:** Equip motor with a non-reversing ratchet.

#### **Suffix T:** Equip motor with thermal protection in accordance with NEMA MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection. Provide three series-connected, normally closed switches, one in each winding.

### Manufacturer

#### Motor shall be manufactured in the United States by U.S. Motors or equal.

## VERTICAL MOTOR BEARINGS

### Vertical motors shall be designed for vertical operation and shall have thrust bearings with a rated L-10 life of 40,000 hours as defined by Anti-Friction Bearing Manufacturers Association (AFBMA). Bearings shall be designed for 30% momentary up thrust capacity.

### Thrust bearings for motors 75 horsepower and larger shall be oil lubricated. Guide bearings may be antifriction, grease lubricated, or oil lubricated. Oil-lubricated bearings shall be a reservoir type with a sump for settling foreign matter, exterior fill and drain plugs, and a visual oil level indicator with maximum and minimum indicator levels.

### Equip grease-lubricated bearings with fittings in each bearing housing. Fittings shall be accessible without removal of any covers or guards. Provide drains to prevent over lubrication.

## INSULATION AND TEMPERATURE RISE

### Provide Class F non-hygroscopic insulation system with two dips and bakes of insulating varnish. Size motor to limit temperature rise to a Class B rise Requirements, per NEMA MG 1-12.43 at unity service factor.

### Provide Class H insulation system consisting of vacuum pressure impregnation of 100% solid epoxy resins.

## VOLTAGE

### [460] volts, [3] phase, [60] Hz.

[Note to the Engineer: Edit above bracketed design criteria if necessary]

## COATING

### The castings shall be coated with a red-oxide zinc-chromate primer and finished with a corrosion-resistant epoxy coating. All fabricated steel enclosures shall be coated on all inside and outside surfaces except shafts and register fits.

# EXECUTION

## STORAGE

### Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

### Store motors in an air-conditioned, ventilated, or protected environment similar to or better than the environment in their final location.

## FIELD OPERATING TESTS

### Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

### Record current in each phase of each motor and include in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

## COATING

### Touch up field-damaged factory finish with paint that is equal in quality and color to the original factory finish.

### Coat cast-iron frame motor. Apply prime coat at the factory which shall be compatible with field-applied finish coat(s).

### Field-apply finish coat(s) specified in the applicable equipment section.

## MOTOR CABLE TERMINATION

### Taped terminations are first wrapped with varnished cambric tape then with Scotch 130C or equal and then with Scotch 33+ or equal.

## NOISE LEVELS

### Motor shall have no-load sound power levels not to exceed the values specified in NEMA MG 1, Section I, Part 9.

## EFFICIENCY

### Motor shall be classified as “Premium Efficient” and shall have minimum guaranteed full load efficiencies in accordance with NEMA MG 1.

## STORAGE

### Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

### Store motors in an air-conditioned, ventilated, or protected environment similar to or better than the environment in their final location.

## FIELD OPERATING TESTS

### Perform NETA ATS induction motor acceptance tests. Exclude optional tests.

### Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

### Record measured running current in each phase of each motor and include in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

### Vibration Tests

#### The test shall be conducted for each motor when ordered by the Owner in cases of discernible abnormal vibration.

#### Measure N-S and E-W vibration at front and rear of upper and lower bearing housing.

**END OF SECTION**