



Electric Motors

NEMA Premium® Efficiency Severe Duty Motor Specification

Totally Enclosed Fan Cooled Motor 1 - 700 HP

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NEMA Premium Efficiency Severe Duty Motor Specification TEFC - Totally Enclosed Fan Cooled Motor 1 - 700 HP

1.0 Purpose

The intent of this specification is to work in partnership with Electric Motor suppliers to supply superior quality motors that consistently perform with the highest efficiency, improved life cycle and lowest maintenance cost. The motors are built to provide: (1) safe operation; (2) reliability in an application which may be corrosive and wet; (3) minimum maintenance requirements due to the design and quality of materials and workmanship; (4) lowest noise figure.

2.0 Scope

This specification covers three-phase, TEFC (Totally Enclosed Fan Cooled), 1 to 700 horsepower squirrel-cage induction motors in integral horsepower frames 143T to 588/9T.

3.0 Motor Requirements

3.1 Applicable Codes and Regulations

Severe Duty NEMA Premium Efficiency motors meet the most demanding application requirements. The standard TEFC motors are cast iron construction with enclosures rated IP55 to handle both wet and dirty environments. They are painted with special system, using synthetic enamel alkyd resin paints and exceeding 200hrs corrosion resistance per ASTM B117 standard for salt spray test (ISO 12944 C3 Classification). All motors shall meet or exceed NEMA MG1 Table 12-12 levels of efficiency. All motor designs shall be tested according to IEEE 112 std., method 'B' and their efficiency values are certified by UL Labs (CSA C390). These motors are NEMA Design 'B' and maintain exceedingly high breakdown and locked rotor torque while providing the highest rated efficiency levels.

3.2 Enclosures

3.2.1 In general, all motors are TEFC, NEMA T frame, NEMA F1 assembly for horizontal applications and designed for the environment prescribed according to the customers' specifications. This specification concerns the manufacture of standard NEMA Premium Efficiency Severe Duty motors. Where special enclosures or assembly are required, it will be specified on the motor data sheet.

3.2.2 Frames, End shields and Conduit boxes shall be high strength (FC200) cast iron construction.

3.2.3 Lifting eyebolts are furnished for frames 182T and above for handling safety and convenience. Eyebolts are forged steel, shouldered, and threaded into blind holes to exclude water entry into the frame.

3.2.4 Motor fans are bi-directional, spark-proof, abrasion and corrosive resistant and made of durable plastic or metal. Fans are plastic for frame 143T up to 504/5T and aluminum fans for frames 5008T, 586/7 and 588/9. Fans are keyed or pinned to the shaft on all frames.

3.2.5 Motor nameplates are AISI 304 stainless steel material with laser etching on high contrast background and affixed to frame with four rivets. Nameplates have all information as described in NEMA MG-1 Part 1.70 plus Bearing lubrication data, Division 2 and VFD certification.

3.2.6 Motor connection diagram is included on nameplate.

3.3 Motor Terminal Boxes and Leads

3.3.1 Oversized cast iron terminal box is fitted with rubber sealing gasket and is rotatable in 90° increments. The lead channel is filled with self-extinguishing foam like material to seal the path through the frame.

3.3.3 Motors are provided with a single Frame ground from frames 143T to 326T, and with a double frame ground from frames 364/5 to 588/9T.

3.4 Electrical and Mechanical Design Requirements

3.4.1 NEMA Premium Efficiency motors are NEMA Design B Torque characteristics (normal starting torque, full voltage starting), squirrel cage, induction type. Where other designs are required, they will be specified on the Motor Data Sheet.

3.4.2 All frames 324T and larger utilize lamination steel incorporating a C4 or C5 inorganic inter-laminar insulation capable of withstanding temperatures of 500C, to ensure the designed efficiencies are achieved and can be maintained in the future if rewinding is required.

3.4.3 Per NEMA Premium[®] Nominal Efficiency levels, for TEFC motors are equal to or greater than those shown in NEMA MG1 Table 12-12

3.4.3 Motors are manufactured for 200, 230, 460, 230/460 or 575-volt, three-phase, 60-hertz, 1.25 service factor through 100HP and 1.15SF > 100HP and also available in 380-690 Volts, 50 hertz.

3.4.4 Windings shall be manufactured to include corona resistant enameled wire, insulating films, non-hygroscopic varnish impregnation system. Impregnation material and connection leads that provide better performance for inverter applications shall be standard. The motor insulation system complies with NEMA MG1-2021 Part 31.4.4.2 (Resistance to Voltage Spikes). All coils are phase insulated using DMD or NMN paper, or equal, and laced on both ends for strength. All stator connections are securely

brazed or crimp using specialize hardware for positive electrical connection. The total insulation System yields superior Electrical and mechanical endurance for long motor life.

3.4.5 NEMA Premium Efficiency motors have insulation Class F for all frames. All insulation materials are class 'H' (180°C) except motor leads and Slot/Phase material (Class F).

3.4.6 The insulation resistance of the complete stator winding shall be greater than 100 megohms when measured at 25° C with a megohm bridge having 1000 Volts direct current.

3.4.7 The motor design uses the best available materials and methods to achieve highest efficiency, power factor and maximum life.

3.4.8 Motors are designed for operation in either direction of rotation without a physical change in the motor.

3.4.9 All motors have anti-friction ball bearings. 254T and larger motors have grease fittings and relief plugs for external lubrication while machine is in operation. Fittings and reliefs are plugged. 215T and smaller are lubricated for life as standard. Regreasable features are optional.

3.4.10 The motor has tight mechanical bearing housing tolerances to insure long life. Either the D.E. or O.D.E. bearing must be locked to limit axial shaft movement.

3.4.11 Bearing cavities and grease passages are cleared of all contamination before lubricating. Motors are lubricated at the factory with Polyrex™ EM grease. Customer-specified grease may be supplied upon request.

3.4.12 Rotor assemblies are die cast aluminum. Rotors are pressed to the shaft with tight interference. Assembled motor should not exceed vibration limits of .08"/sec.

4.0 Special Application Requirements

4.1 Extra Severe Duty Use

For applications requiring special weather protection other than a standard TEFC motor, IEEE-841 NEMA Premium efficiency motors may be specified. These motors are supplied with additional features, including features like
InproSeal® bearing isolators on both endshields to exclude severe contamination
Stainless Steel Automatic condensation drains
Internal epoxy coating of steel parts
Improved G1 balance and lower vibration levels not exceeding .04"/sec overall.
External Epoxy paint system with 240Hr salt spray capability ISO 12944 C4 Corrosion classification

Test report with Vibration data in conduit box or available by download from APP

4.2 Hazardous Location Use

Motors with UL and CSA listed enclosures are available for use in hazardous locations. Only the end user or a qualified underwriter is to identify and select the proper class, group, division and temperature code motor to meet the requirements of each installation.

4.3 Adjustable Speed Use

4.3.1.1 NEMA Premium Efficiency motors are suitable to operate with inverter duty applications according to the table below:

| Motor Rated Voltage | Voltage Spikes Motor Terminals (fase-fase) | dV/dt at motor terminals (fase-fase) | Rise Time* | MTBP |
|--|--|---|------------------------|----------------------|
| $V_{NOM} \leq 460 \text{ V}$ | $\leq 2000 \text{ V}$ | $\leq 5200 \text{ V}/\mu\text{s}$ | $\geq 0,1 \mu\text{s}$ | $\geq 6 \mu\text{s}$ |
| $460 \text{ V} < V_{NOM} \leq 575 \text{ V}$ | $\leq 2200 \text{ V}$ | $\leq 6500 \text{ V}/\mu\text{s}$ | | |
| $575 \text{ V} < V_{NOM} \leq 690 \text{ V}$ | $\leq 2200 \text{ V}$ | $\leq 7800 \text{ V}/\mu\text{s}$ | | |

4.3.2 Standard NEMA Premium motors 200HP and below should be capable of 20:1 Constant torque(CT) operation and 1000:1 Variable torque(VT) operation without exceeding Class F temperature rise at full torque. Motors between 201HP and 500HP should be capable of 4:1CT and 1000:1 VT operation.

4.3.3 Shaft current protection is recommended on motors operated on VFD Power.

4.3.3.1 Critical applications or where experience dictates Shaft grounding devices should be applied to the Drive end of the motor

4.3.3.2 Motor 447T and larger (or where experience dictates) should incorporate ODE insulated bearing housings or insulated bearings.(Standard on L449T and larger)

5.0 Testing & Final Inspection

5.1 Electrical Tests

Each motor design shall receive the testing called out for "Polyphase Induction Motors and Generators", IEEE 112, latest edition. The routine tests shall, as a minimum, shall include Hi-Pot and No Load running. In addition to the normal factory tests and those already covered in this specification, the following tests may be performed:

5.1.1 The completed insulation system shall be capable of withstanding continuously a phase-to-ground rms voltage of 1000 volts minimum for a period of 30 minutes minimum.

5.1.2 The winding shall also be capable of passing a 2500 volt AC minimum, phase-to-ground test for one second.

5.1.3 List of tests available

| Item nº | List of tests Tests (from/to) | Test classification | | | Notes |
|------------|--|---------------------|------|---------|---|
| | | Routine | Type | Special | |
| 1 | Insulation resistance measurement | X | X | | |
| 2 | Winding electric resistance measurement (stator and rotor of slip ring motors at cold) | X | X | | |
| 3 | Dielectric | X | X | | |
| 4 | No load (at rated voltage) for determination of: | X | X | | It allows determination of the losses sum in the core and losses by friction and cooling. |
| | 4.1 - Input power | | | | |
| | 4.2 - Current | | | | |
| 5 | Locked rotor for determination of: | X | X | | Not applicable for wound rotor motors |
| | 5.1 - Current | | | | |
| | 5.2 - Torque | | | | |
| | 5.3 - Absorbed power | | | | |
| 6 | Secondary voltage measurement. | X | X | | Applicable only for wound rotor motors |
| 7 | Starting with typical curves of torque X speed and current X speed for determination of: | | | X | Not applicable for wound rotor motors, except for breakdown torque. |
| | 7.1 - Starting torque including pull-in and breakdown values | | | | |
| | 7.2 - Starting current | | | | |
| 8 | Temperature | | X | | |
| 9 | Efficiency determination at 100%, 75% and 50% of rated power. | | X | | |
| 10 | Losses determination at 100%, 75% and 50% of rated power. | | X | | |
| 11 | Power factor determination at 100%, 75% and 50% of rated power. | | X | | |
| 12 | Slip determination at 100%, 75% and 50% of rated power. | | X | | |
| 13 | Breakdown torque determination | | X | | |
| 14 | Overspeed | | | X | |
| 15 | Noise level (sound power at no load) | | | X | see IEC60034 |
| 16 | Shaft voltage and bearing insulation resistance measurement | | | X | Usually performed in motors with rated output power (simbolo) 350Kw (500HP) |
| 17 | Vibration (maximum vibration effective value in millimeters per second) | | | X | |
| 18 | Loss angle tangent measurement | | | X | For motors with rated output power (simbolo) 5Kw and 24Kw and with rated power (simbolo) 5MW. See NBR 5117. |

Tests classified as Type are those performed on one or more manufactured motors based on a certain design so as to evidence that such design meets certain specifications

Tests classified as Special are those considered as Routine as Type in the table above, and they are performed upon agreement between manufacturer and customer.

5.1.4 A line check test report as well as any additional tests specified shall be available for download via APP

6.0 Sliding Base Requirements

6.1 Application



When specified on the Motor Data Sheet, sliding bases of the heavy-duty type shall be furnished for V-belt drives.



6.2 Fabrication

6.2.1 Base construction shall be fabricated from heavy-duty steel to withstand vibration and corrosive atmosphere. Base is to be of single unit construction with a double-supported slide and adjusting bolts.

6.2.2 Base is to have a corrosion resistant finish.

7.0 Vendor Drawings and Data

7.1 Data sheet

7.1.1 The supplier will furnish a data sheet including:

7.1.2 Motor rated voltage, frequency, full load current, horsepower and rated speed.

7.1.3 Induction motor time constants.

7.1.4 Motor weight.

7.1.5 Bearing size and type data.

7.1.6 Efficiency and power factor at full load, 75% load, 50% load, and 0%.

7.1.7 Noise level.

7.1.8 Curves

7.2 Outline drawings with all options stated.

7.3 Motor installation and maintenance instructions.

8.0 Shipping

Motors from 143 and 215T frames may be packed in a cardboard box. Motors from 254T up to 588/9 frames shall be packed in crates. Motors shall be packed for fork truck handling and covered for protection against dirt and moisture during transit and short-term outdoor storage.

9.0 Limited Warranty

Warranty Period

Warranty shall be at least 36 months from the invoice date for stock products and 18 months from shipment on custom products