

SECTION 26 20 00

LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

1.2 REFERENCES

- A. The following is a list of standards (latest edition) which may be referenced in this section:
1. CSA C22.2 No. 100, Motors and Generators.
 2. CSA C22.2 No. 145, Motors and Generators For use in Hazardous Locations.
 3. CSA C390, Energy Efficiency Test Methods for Three-Phase Induction Motors.
 4. American Bearing Manufacturers Association (ABMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
 5. American National Standards Institute (ANSI): C50.41, Polyphase Induction Motors for Power Generating Stations.
 6. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 85, Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery.
 - b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
 - c. 114, Standard Test Procedures for Single-Phase Induction Motors.
 - d. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Motors.
 - e. 841, Standard for Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – up to and Including 500 hp.
 7. National Electrical Manufacturers Association (NEMA):
 - a. MG 1, Motors and Generators.
 - b. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.
 - c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 8. Underwriters Laboratories (UL):
 - a. 1, Flexible Metal Conduit.
 - b. 674, Standard for Safety Electric Motors and Generators for use in Division 1 Hazardous (Classified) Locations.
 - c. 2111, Overheating Protection for Motors.
 9. EEMAC Standard M1-6, Motors and Generators.

10. EEMAC Standard MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.

1.3 DEFINITIONS

- A. CISD-TEFC: Chemical industry, severe-duty enclosure.
- B. DIP: Dust-ignition-proof enclosure.
- C. EXP: Explosion-proof enclosure.
- D. ODP: Open drip-proof enclosure.
- E. TEFC: Totally enclosed, fan cooled enclosure.
- F. TENV: Totally enclosed, non-ventilated enclosure.
- G. WPI: Open weather protected enclosure, Type I.
- H. WPII: Open weather protected enclosure, Type II.
- I. Motor Nameplate Horsepower: That rating after any de-rating required to allow for any issues such as extra heating caused by the harmonic content in the voltage applied to the motor by its controller.
- J. Inverter Duty Motor: Motor meeting all applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.

1.4 DESIGN REQUIREMENTS

- A. Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with national and local building codes. Submit written certification from a professional engineer licensed in the Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of the 2010 NBCC with the 2011 Manitoba Amendments at the time of shop drawing submittals.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. Descriptive information.
 2. Nameplate data in accordance with NEMA MG 1.
 3. Additional Rating Information:
 - a. Service factor.
 - b. Locked rotor current.
 - c. No load current.
 - d. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.
 - e. Guaranteed minimum full load efficiency and power factor.

4. Enclosure type and mounting (e.g. horizontal, vertical).
 5. Dimensions and total weight.
 6. Conduit box dimensions and usable volume as defined in NEMA MG 1.
 7. Bearing type.
 8. Bearing lubrication.
 9. Bearing life.
 10. Space heater voltage and watts, where applicable.
 11. Description, ratings, and wiring diagram of motor thermal protection.
 12. Motor sound power level in accordance with NEMA MG 1.
 13. Maximum brake horsepower required by the equipment driven by the motor.
 14. For Motors 447 kW and Larger:
 - a. Thermal limit curves in accordance with IEEE 620.
 - b. Speed torque curve.
 - c. Starting time-current curve.
 - d. Thermal capability during starting.
 15. Description and rating of submersible motor moisture sensing system.
- B. Factory test reports.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. GE Canada.
- B. Leeson Canada.
- C. Reliance Electric.
- D. MagneTek.
- E. Siemens Energy and Automation, Inc., Motors and Drives Division.
- F. Baldor.
- G. U.S. Electrical Motors.
- H. TECO-Westinghouse Motor Co.
- I. Toshiba International Corp., Industrial Division.
- J. WEG Electric Motors Corp.

2.2 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.

- B. In order to obtain single source responsibility, utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.
- D. Frame assignments in accordance with NEMA MG 1.
- E. Provide motors for hazardous (classified) locations that conform to CSA Standards and have an applied CSA or cUL listing mark and associated approval number.
- F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
- G. Operating Conditions:
 - 1. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.
 - 2. Over-speed in either direction in accordance with NEMA MG 1.

2.3 HORSEPOWER RATING

- A. As designated in motor-driven equipment specifications.
- B. Constant Speed Applications: Brake horsepower of the driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.
- C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding any service factor.

2.4 SERVICE FACTOR

- A. 1.15 minimum at rated ambient temperature, unless otherwise indicated.

2.5 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60-Hz.

- B. Voltage Rating:

Size	Voltage	Phases
0.37 kW and smaller	115	1
0.56 kW or larger	575	3

- C. Suitable for full voltage starting and VFD operation as applicable.
- D. 74 kW and larger also suitable for reduced voltage starting with 65 or 80 percent voltage tap settings on reduced inrush motor starters.

- E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.
- F. Motors rated at 575 volts, 3 phase, 60 Hz shall be suitable for operation on nominal 600 volt, 3 phase, 60 Hz systems.
- G. Motors shall operate successfully with any variation in voltage or frequency as permitted in NEMA MG 1-12.44.

2.6 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 0.56 kW, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
 - 1. Efficiency:
 - a. Tested in accordance with CSA C390, paragraph 12.59.
 - b. Guaranteed minimum at full load in accordance with Section 12.60 Table 12-12 of NEMA MG 1 or as indicated in Table 1 of these specifications.
 - 2. Power Factor: Guaranteed minimum at full load in accordance with Table 1 of these specifications.

2.7 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code G or lower, if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe stall time 12 seconds or greater.

2.8 INSULATION SYSTEMS

- A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system. Class F insulation with Class B (130 C) temperature rise.
- B. Three-Phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specifications, Class F at nameplate horsepower and designated operating conditions with Class B (130 C) temperature rise, except EXP and DIP motors which must be Class B with Class B rise.

2.9 ENCLOSURES

- A. Enclosures to conform to NEMA MG 1.
- B. TEFC and TENV: Furnish with a drain hole with porous drain/weather plug.
- C. Explosion-Proof (EXP):
 - 1. TEFC listed to meet UL 674, NFPA 70 and CSA requirements for Class I, Zone 1 or Division 1, Group C and D hazardous locations.
 - 2. Drain holes with drain and breather fittings.

- 3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
 - 4. Terminate thermostat leads in terminal box separate from main terminal box.
- D. Submersible: In accordance with the Special Motors section of this specification, NEMA MG 1 and specifically MG 1 Part 18.
- E. Chemical Industry, Severe-Duty (CISD-TEFC): In accordance with the Special Motors section of this specification and other relevant requirements in the listed standards.

2.10 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for all motors. NEMA 4 rated.
- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.
- D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19:

Terminal Box Usable Values		
Voltage	Horsepower/kW	Percentage
Below 600	15/11 through 125/93	500
Below 600	150/112 through 300/224	275
Below 600	350/261 through 600/448	225

- E. Terminal for connection of equipment grounding wire in each terminal box.

2.11 BEARINGS AND LUBRICATION

- A. Horizontal Motors:
 - 1. 0.56 kW and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with grease pressure relief units.
 - 2. 0.74 and above: Regreasable ball bearings in labyrinth sealed end bells with grease pressure relief units.
 - 3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and 11.
- B. Vertical Motors:
 - 1. Thrust Bearings:
 - a. Antifriction bearing.
 - b. Manufacturer's standard lubrication; 74 kW and smaller.
 - c. Oil lubricated; 93 kW and smaller.
 - d. Minimum 50,000 hours L-10 bearing life.

2. Guide Bearings:
 - a. Manufacturer's standard bearing type.
 - b. Manufacturer's standard lubrication; 149 kW and smaller.
 - c. Oil lubricated; 186 kW and smaller.
 - d. Minimum 100,000 hours L-10 bearing life.
 - C. Regreasable Antifriction Bearings:
 1. Readily accessible, grease injection fittings.
 2. Readily accessible, grease pressure relief units.
 - D. Oil Lubrication Systems:
 1. Oil reservoirs with sight level gauge.
 2. Oil fill and drain openings with opening plugs.
 3. Provisions for necessary oil circulation and cooling.
 - E. Bearing Isolation: Motors rated for inverter duty shall have electrically isolated bearings on the non-driven end to prevent stray current damage.
 - F. Bearing Isolator Mechanical Shaft Seals: To prevent internal motor contamination from bearing grease.
- 2.12 NOISE
- A. Measured in accordance with IEEE 85 and NEMA MG 1.
 - B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.
- 2.13 BALANCE AND VIBRATION CONTROL
- A. In accordance with NEMA MG 1, Part 7.
- 2.14 EQUIPMENT FINISH
- A. Protect Motor for Service Conditions:
 1. TEFC Enclosures: Indoor industrial atmospheres.
 2. Other Enclosures: Outdoor industrial atmospheres, including moisture and direct sunlight exposure.
 - B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.
- 2.15 SPECIAL FEATURES AND ACCESSORIES
- A. Nameplates:
 1. Raised or stamped letters on stainless steel or aluminum.
 2. Display motor data required by NEMA MG 1, paragraphs 10.39 and 10.40 in addition to bearing numbers for both bearings.

3. Premium efficiency motor nameplates to also display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.
 4. Include CSA or cUL certifications.
- B. Anchor Bolts: Provide anchor bolts meeting manufacturer's recommendations and of sufficient size and number.
- C. Where indicated on data sheets and all motors 75 kW (100 hp) and larger provide two three-wire RTD's, 100 ohm at 0C platinum per phase, inserted in the end turns of the stator winding, with leads brought out to a separate terminal box. Identify temperature sensor terminals as to phase location. Also provide one RTD, 100 ohm 0C platinum per bearing.
- D. Provide vibration accelerometers for all motors rated at 186 kW (250 hp) or larger.
- E. Submersible motors shall have the following protection accessories:
1. Motors greater than 2.2 kW (3 hp); humidity /leak detection
 2. Motors greater than 7.5 kW (10 hp); humidity/leak detection and a winding temperature switch
 3. Motors greater than 75 kW (100 hp); humidity/leak detection (in applicable compartments), winding temperature RTDs and bearing temperature (as noted above)
 4. Motors greater than 186 kW (250 hp); Same as 75 kW plus bearing vibration
- F. For motors at 37 kW (50 hp) and above that are subjected to high humidity and with expected periods of idle time as part of their normal utilization cycle, provide anti condensation heaters.

2.16 SPECIAL MOTORS

- A. Requirements in this article take precedence over conflicting features specified elsewhere in this Section.
- B. Severe-Duty Explosion-Proof: Meet requirements for EXP enclosures and CISD-TEFC motors.
- C. Multispeed: Meet requirements for speeds, number of windings, and load torque classification indicated in the motor-driven equipment specifications.
- D. Inverter Duty Motor:
1. Motor supplied power by adjustable voltage and adjustable frequency drives shall be inverter duty rated.
 2. Motor shall be suitable for operation over entire speed range indicated.
 3. Provide forced ventilation where speed ratio is greater than published range for motor being installed.
 4. Motor installed in Division 1 hazardous (classified) locations shall be identified as acceptable for variable speed when used in a Division 1 location.

- E. Inclined Motors:
1. Motors suitable for operation only in horizontal position not acceptable.
 2. Bearings designed for thrust imposed by driven equipment and by motor rotor when motor is in inclined position.
 3. Lubrication system designed to provide adequate bearing lubrication when motor is in inclined position.

2.17 FACTORY TESTING

- A. Tests:
1. In accordance with CSA C390 for polyphase motors and for single-phase motors.
 2. Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.
 3. For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:
 - a. In accordance with CSA C390 or IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.59. and 12.60.
 - b. For motors 373 kW and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by CSA C390 or IEEE 112, Test Method F.
 4. Power Factor.
 5. Speed.
 6. Current at rated horsepower.
 7. kW input at rated horsepower.
 8. For motors 74 kW and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.
 9. Temperature rise at rated horsepower for motors 596 kW and larger.
 10. Vibration (balance).
- B. Test Report Forms:
1. Routine Tests: IEEE 112, Form A-1.
 2. Efficiency and power factor by CSA C390 or Test Method B, IEEE 112, Form A-2, and NEMA MG 1.
 3. Efficiency and power factor by CSA C390 or Test Method F, IEEE 112, Forms F-1, F-2, and F-3.
 4. Temperature Test: CSA C390 or IEEE 112, Form A-2.

PART 3 EXECUTION

3.1 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts.

3.2 QUALITY CONTROL

- A. Refer to other relevant sections of these Specifications for functional and performance testing requirements.
- B. Test and inspect all materials and workmanship in accordance with this specification and all applicable codes and regulations.
- C. Furnish certified test documentation.

3.3 SUPPLEMENTS

- A. Table supplements, following “End of Section,” are part of this Specification.
 - 1. Table 1 - Motor Performance Requirements.

END OF SECTION

**TABLE 1
MOTOR PERFORMANCE REQUIREMENTS**

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp / kW	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
1 / 0.75	1,800	85.5	85.5			Mfr.'s Std.	Mfr.'s Std.		
	1,200	82.5	82.5			Mfr.'s Std.	Mfr.'s Std.		
1.5 / 1.1	3,600	84.0	84.0			Mfr.'s Std.	Mfr.'s Std.		
	1,800	86.5	86.5			Mfr.'s Std.	Mfr.'s Std.		
	1,200	86.5	86.5		82.0	Mfr.'s Std.	Mfr.'s Std.		Mfr.'s Std.
2 / 1.5	3,600	85.5	85.5			Mfr.'s Std.	Mfr.'s Std.		
	1,800	86.5	86.5			Mfr.'s Std.	Mfr.'s Std.		
	1,200	87.5	88.5	83.7	83.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	82.9	82.5	82.9	81.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
3 / 2.2	3,600	85.5	86.5	82.0	82.0	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	89.5	89.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	88.5	89.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	84.1	83.0	84.1	82.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
5 / 3.7	3,600	86.5	88.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	89.5	89.5	84.8	84.8	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	89.5	89.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	85.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
7.5 /	3,600	88.5	89.5	84.8	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

**TABLE 1
MOTOR PERFORMANCE REQUIREMENTS**

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp / kW	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
5.6	1,800	91.0	91.7	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	90.2	91.0	88.4	87.5	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	87.5	85.5	87.5	86.6	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
10 / 7.5	3,600	89.5	90.2	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	91.7	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	91.7	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
15 / 11	3,600	90.2	90.2	88.4	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	93.0	91.0	90.9	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	91.7	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	89.3	88.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
20 / 15	3,600	92.4	90.2	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	93.0	91.0	91.7	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	91.0	90.2	90.2	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
25 / 19	3,600	91.7	91.7	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	93.6	93.6	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	93.0	93.0	90.9	89.3	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	90.2	89.5	89.3	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.

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		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp / kW	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
30 / 22	3,600	91.7	91.7	89.5	88.4	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,800	94.1	93.6	92.4	91.7	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	1,200	93.6	93.0	91.7	90.2	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
	900	91.7	91.0	90.9	90.9	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.	Mfr.'s Std.
40 / 30	3,600	92.4	92.4	90.2	89.3	86.6	86.1	87.0	89.0
	1,800	94.1	94.1	92.8	91.7	78.2	78.2	83.0	84.5
	1,200	94.1	94.1	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.0	90.9	90.2	70.0	70.5	70.0	70.5
50 / 37	3,600	93.0	93.0	90.2	89.3	85.1	86.7	89.0	89.0
	1,800	94.5	94.5	92.8	91.7	79.5	79.4	82.5	82.5
	1,200	94.1	94.1	91.7	90.9	81.5	81.5	81.5	81.5
	900	91.7	91.7	90.9	90.9	78.5	72.9	78.5	80.0
60 / 45	3,600	93.6	93.6	91.7	90.9	85.8	88.3	87.5	89.0
	1,800	95.0	95.0	93.5	92.8	80.5	79.9	80.5	80.5
	1,200	94.5	94.5	92.8	91.7	81.5	81.5	81.5	81.5
	900	92.4	91.7	91.7	90.9	79.5	73.2	79.5	79.5
75 / 56	3,600	93.6	93.6	91.7	91.7	87.1	88.5	88.5	88.5
	1,800	95.0	94.4	93.5	93.5	81.0	81.5	81.0	81.5
	1,200	94.5	94.5	93.5	92.8	82.0	82.0	82.0	82.0

**TABLE 1
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		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp / kW	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
	900	92.8	92.4	92.8	91.7	80.5	74.5	80.5	81.0
100 / 75	3,600	93.6	94.1	91.7	91.7	87.0	88.2	87.0	88.5
	1,800	95.4	95.4	94.0	93.5	81.0	81.0	81.0	81.0
	1,200	95.0	95.0	92.8	92.8	82.1	81.7	85.5	85.5
	900	93.5	92.4	92.8	91.7	77.0	77.3	77.0	80.0
125 / 93	3,600	94.1	95.0	91.7	91.7	86.4	89.1	87.0	90.5
	1,800	95.4	94.5	93.5	92.8	85.4	85.5	87.5	86.0
	1,200	95.0	95.0	93.5	92.8	82.7	82.3	85.5	85.5
	900	93.5	93.0	92.8	92.4	78.5	78.5	78.5	78.5
150 / 112	3,600	94.1	95.0	92.4	91.7	86.5	90.0	86.5	90.5
	1,800	95.8	95.8	94.5	94.0	82.5	85.0	84.5	85.0
	1,200	95.4	95.8	93.5	94.0	81.5	81.5	81.5	81.5
	900	93.5	93.0	92.8	92.4	78.0	78.5	78.0	78.5
200 / 149	3,600	95.0	95.4	92.4	93.0	87.8	89.4	91.0	91.0
	1,800	95.8	96.2	94.0	94.0	85.2	86.5	87.0	87.0
	1,200	95.4	95.8	93.5	93.5	79.0	82.5	79.0	82.5
250 / 186	3,600	94.50	95.0	91.7	92.4	85.0	86.5	85.0	86.5
	1,800	95.0	95.0	94.5	94.5	79.0	79.0	79.0	79.0

**TABLE 1
MOTOR PERFORMANCE REQUIREMENTS**

		% Guar. Min. Full Load Efficiency				% Guar. Min. Full Load Power Factor			
		Horizontal		Vertical		Horizontal		Vertical	
hp / kW	Nom. Speed rpm	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC	Drip-proof ODP	TEFC
	1,200	95.0	95.0	94.5	93.5	82.0	82.0	82.0	82.0
300 / 224	3,600	94.5	95.0			89.8	89.9		
	1,800	95.0	95.0	94.5	94.0	80.0	80.0	80.0	80.0
	1,200	95.0	95.0			84.5	90.1		
350 / 261	3,600	94.5	95.0			89.4	85.9		
	1,800	95.0	95.0			85.9	85.9		
	1,200	95.0	95.0						
400 / 298	3,600	94.5	95.0			88.4			
	1,800	95.0	95.0			86.8			
	1,200	95.0	95.0						
450 / 336	3,600	94.5	95.0			89.1			
	1,800	95.0	95.0						
	1,200	95.0	95.0						
500 / 373	3,600	95.0	95.0			88.3			
	1,800	95.0	95.0						
	1,200	95.0	95.0						