
RPM AC Inverter Duty Motors

NEMA Frames FL180 - FL/RL5800 Family

IEC Frames FDL112 - FDL/RDL280 Family

(Specifically designed for operation with adjustable speed controls)

Installation and Operating Manual

July 2025

Section 1

General Information

Overview	<p>This manual contains general procedures that apply to ABB products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements.</p> <p>A Warning statement indicates a possible unsafe condition that can cause harm to personnel.</p> <p>A Caution statement indicates a condition that can cause damage to equipment.</p> <p>ABB mining motors are sold to OEM (Original Equipment Manufacturers), companies that provide motors and equipment containing these motors as their product offerings. Be sure to consult the OEM documents for safety and regulatory information that is important to the application of these products.</p>
Important:	<p>This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by ABB. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your OEM for more information or clarification.</p> <p>Before you install, operate or perform maintenance, become familiar with the following:</p> <ul style="list-style-type: none">• NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators• IEC 60034-1 Electrical and IEC60072-1 Mechanical specifications• NFPA 70® National Electrical Code (NEC) and local codes and practices
Safety Notice:	<p>This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment. Be sure that you are completely familiar with MSHA (Mine Safety and Health Administration), safety standards for selection, installation and use of electric motors and generators and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.</p>
WARNING:	<p>Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.</p>
WARNING:	<p>Disconnect all electrical power from the motor windings and accessory devices before disassembling of the motor. Electrical shock can cause serious or fatal injury.</p>
WARNING:	<p>The Adjustable Speed Controller may apply hazardous voltages to the motor leads after power to the controller has been turned off. Verify that the controller is incapable of delivering hazardous voltages and that the voltage at the motor leads is zero before proceeding. Failure to observe this precaution may result in severe bodily injury or death.</p>
WARNING:	<p>Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.</p>
WARNING:	<p>Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.</p>
WARNING:	<p>Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.</p>
WARNING:	<p>Guards must be installed for rotating parts to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.</p>
WARNING:	<p>This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.</p>
WARNING:	<p>Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.</p>
WARNING:	<p>Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.</p>
WARNING:	<p>Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.</p>
WARNING:	<p>Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.</p>
WARNING:	<p>Incorrect motor rotation direction can cause serious or fatal injury or equipment damage. Be sure to verify motor rotation direction before coupling the load to the motor shaft.</p>
WARNING:	<p>Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying conductors and permanent magnet motors can result in a serious health hazard to persons with cardiac pacemakers, metal implants and hearing aids. To avoid risk, stay away from the area surrounding a permanent magnet motor.</p>
WARNING:	<p>Thermostat contacts automatically reset when the motor has slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor is not possible when the thermostat resets.</p>
WARNING:	<p>Motors that are to be used in flammable and/or explosive atmospheres must display a third part agency (i.e. CSA or UL) logo. Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.</p>
WARNING:	<p>Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.</p>

Safety Notice Continued

- WARNING:** RPM AC permanent magnet motors can induce voltage and current in the motor leads by rotating the motor shaft. Electrical shock can cause serious or fatal injury. Therefore, do not couple the load to the motor shaft until all motor connections have been made. During any maintenance inspections, be sure the motor shaft will not rotate.
- WARNING:** Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.
- WARNING:** UL Listed motors must only be serviced by UL Approved Authorized ABB Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.
- WARNING:** C-Face motor is intended for mounting auxiliary equipment such as pumps and gears. When mounted horizontally Frames 280 thru 440 (IEC 180 thru 280) must be supported by the feet and not by the C-Face on D-Flange alone. C-Face motors should be supported by the feet and not by the C-Face. Installations requiring a horizontally mounted motor in frames 280 thru 440 (IEC 180 thru 280) must be supported by the feet as well as C-Face, D-Flange or IEC Flange.
Failure to observe these precautions can result in bodily injury and equipment damage.
- Caution:** Use only a shielded motor power cable with a complete circumferential braided or copper film/tape ground jacket around the power leads. This ground should be secured to the motor frame from within the motor terminal box and must return without interruption to the drive ground. In addition, if the motor and coupled equipment are not on a single common metal base plate, it is important to equalize the equipment ground potentials by bonding the motor frame to the coupled equipment using a high frequency conductor such as a braided strap.
- Caution:** To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.
- Caution:** Do not over-lubricate motor as this may cause premature bearing failure.
- Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.
- Caution:** If eye bolts are used for lifting a motor, be sure they are securely tightened. Lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excess lifting angles can cause damage.
- Caution:** To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.
- Caution:** If a Motor Insulation test (High Potential Insulation test) must be performed, disconnect the motor from any Speed Control or drive to avoid damage to connected equipment.
- Caution:** Do not use an induction oven to heat noise tested bearings. Arcing between the balls and races may damage the bearing. Failure to observe this precaution may result in equipment damage.
- Caution:** Do not operate motors with a roller bearing unless a radial load is applied so that damage to the roller bearing does not occur.
- Caution:** RPM AC permanent magnet motors with an open enclosure, such as DP-FV, should not be used where ferrous dust or particles may be present. Totally enclosed permanent magnet motors are recommended for these applications.
If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your OEM.
- Receiving** Each ABB Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.
1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
 2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.
- Caution:** Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.
- Handling** The motor should be lifted using the lifting lugs or eye bolts provided.
1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WPII motor. If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt. Excessive lifting angles can cause motor damage.
 2. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
 3. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation. Do not lift the assembly using the motor lugs or eye bolts provided. Lugs or eye bolts are designed to lift motor

only. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Storage

Storage requirements for motors and generators that will not be placed in service for at least six months from date of shipment.

Improper motor storage will result in seriously reduced reliability and failure. An electric motor that does not experience regular usage while being exposed to normally humid atmospheric conditions is likely to develop rust in the bearings or rust particles from surrounding surfaces may contaminate the bearings. The electrical insulation may absorb an excessive amount of moisture leading to the motor winding failure.

A wooden crate "shell" should be constructed to secure the motor during storage. This is similar to an export box but the sides & top must be secured to the wooden base with lag bolts (not nailed as export boxes are) to allow opening and closing many times without damage to the "shell".

Minimum resistance of motor winding insulation is 5 Meg ohms or the calculated minimum, whichever is greater. Minimum resistance is calculated as follows: $R_m = kV + 1$

where: (R_m is minimum resistance to ground in Meg-Ohms and kV is rated nameplate voltage defined as Kilo-Volts.)

Example: For a 480VAC rated motor $R_m = 1.48$ meg-ohms (use 5 M Ω).

For a 4160VAC rated motor $R_m = 5.16$ meg-ohms.

Preparation for Storage

1. Some motors have a shipping brace attached to the shaft to prevent damage during transportation. The shipping brace, if provided, must be removed and stored for future use. The brace must be reinstalled to hold the shaft firmly in place against the bearing before the motor is moved.
 2. Store in a clean, dry, protected warehouse where control is maintained as follows:
 - a. Shock or vibration must not exceed 2 mils maximum at 60 hertz, to prevent the bearings from brinelling. If shock or vibration exceeds this limit vibration isolation pads must be used.
 - b. Storage temperatures of 10°C (50°F) to 49°C (120°F) must be maintained.
 - c. Relative humidity must not exceed 60%.
 - d. Motor space heaters (when present) are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional.
- Note: Remove motor from containers when heaters are energized, reprotect if necessary.
3. Measure and record the resistance of the winding insulation (dielectric withstand) every 30 days of storage.
 - a. If motor insulation resistance decreases below the minimum resistance, contact your ABB District office.
 - b. Place new desiccant inside the vapor bag and re-seal by taping it closed.
 - c. If a zipper-closing type bag is used instead of the heat-sealed type bag, zip the bag closed instead of taping it. Be sure to place new desiccant inside bag after each monthly inspection.
 - d. Place the shell over the motor and secure with lag bolts.
 4. Where motors are mounted to machinery, the mounting must be such that the drains and breathers are fully operable and are at the lowest point of the motor. Vertical motors must be stored in the vertical position. Storage environment must be maintained as stated in step 2.
 5. Motors with anti-friction bearings are to be greased at the time of going into extended storage with periodic service as follows:
 - a. Motors marked "Do Not Lubricate" on the nameplate do not need to be greased before or during storage.
 - b. Ball and roller bearing (anti-friction) motor shafts are to be rotated manually every 3 months and greased every 6 months in accordance with the Maintenance section of this manual.
 - c. Sleeve bearing (oil lube) motors are drained of oil prior to shipment. The oil reservoirs must be refilled to the indicated level with the specified lubricant, (see Maintenance). The shaft should be rotated monthly by hand at least 10 to 15 revolutions to distribute oil to bearing surfaces.
 - d. "Provisions for oil mist lubrication" – These motors are packed with grease; rotate motor shaft every six months and grease in accordance with the Maintenance section of this manual.
 - e. "Oil Mist Lubricated" – These bearings are protected for temporary storage by a corrosion inhibitor. If stored for greater than 3 months or outdoor storage is anticipated, connected to the oil mist system while in storage. If this is not possible, add the amount of grease indicated under "Standard Condition" in Section 3, then rotate the shaft 15 times by hand.
 6. All breather drains are to be fully operable while in storage (drain plugs removed). The motors must be stored so that the drain is at the lowest point. All breathers and automatic "T" drains must be operable to allow breathing and draining at points other than through the bearings around the shaft. Vertical motors should be stored in a safe stable vertical position.

7. Coat all external machined surfaces with a rust preventing material. An acceptable product for this purpose is Exxon Rust Ban # 392.

Non-Regreaseable Motors

Non-regreaseable motors with “Do Not Lubricate” on the nameplate should have the motor shaft rotated 15 times to redistribute the grease within the bearing every 3 months or more often.

All Other Motor Types

Before storage, the following procedure must be performed.

1. Remove the grease drain plug, if supplied, (opposite the grease fitting) on the bottom of each bracket prior to lubricating the motor.
2. The motor with regreaseable bearing must be greased as instructed in Section 3 of this manual.
3. Standard RPM AC Motors in frames FL180, FL210, and FL 250 (IEC frames FDL 112, FDL132 and FDL160) use double shielded bearings with oversized grease reservoirs that provide lifetime lubrication with no maintenance.
4. Replace the grease drain plug after greasing.
5. The motor shaft must be rotated a minimum of 15 times after greasing.
6. Motor Shafts are to be rotated at least 15 revolutions manually every 3 months and additional grease added every nine months (see Section 3) to each bearing.
7. Bearings are to be greased at the time of removal from storage.

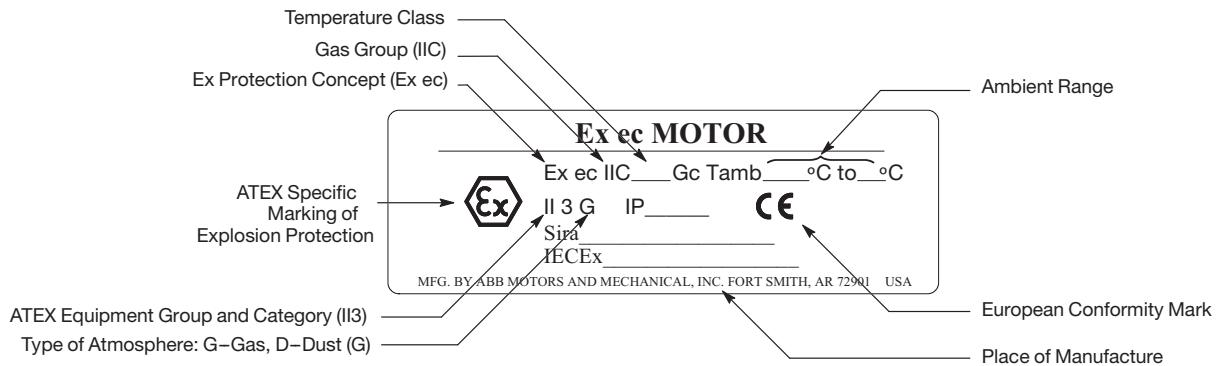
Removal From Storage

1. Remove all packing material.
2. Measure and record the electrical resistance of the winding insulation resistance meter at the time of removal from storage. The insulation resistance must not be less than 50% from the initial reading recorded when the motor was placed into storage. A decrease in resistance indicates moisture in the windings and necessitates electrical or mechanical drying before the motor can be placed into service. If resistance is low, contact your ABB District office.
3. Regrease the bearings as instructed in Section 3 of this manual.
4. Reinstall the original shipping brace if motor is to be moved. This will hold the shaft firmly against the bearing and prevent damage during movement.

Equipment Marking for IEC Certified Product

IEC certified products have special markings that identify the protection concept and environment requirements. An example is shown in Figure 1-1.

Figure 1-1 IEC Certified Product Markings



Specific Conditions of Use:

If the motor certificate number is followed by the symbol “X”, this indicates that the motor has specific conditions of use which are indicated on the certificate. It is necessary to review the product certification certificate in conjunction with this instruction manual.

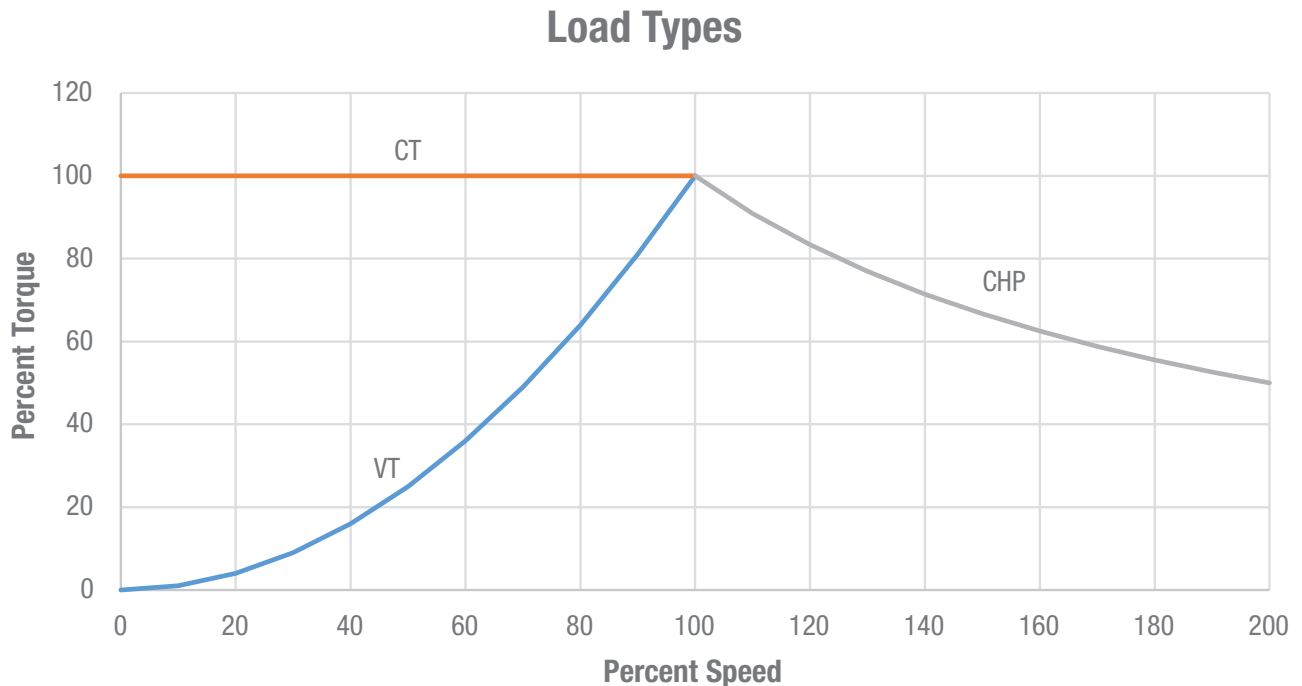
Operation On Frequency Converters:

If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0- 120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed drive manual for proper set up. IECEx Certificates are available online at www.iecex.com

Unit Conversions	
Inches to Millimeters	Inches x 25.4 = mm
Millimeters to Inches	mm x .03937 = Inches
Horsepower to Kilowatts	Hp x .746 = Kw
Kilowatts to Horsepower	Kw x 1.341 = Hp
Pounds to Kilograms	Lbs x .454 = Kg
Kilograms to Pounds	Kg x 2.205 = Lbs

Typical Speed versus Torque Curves are shown in Figure 1-2. For values relative to your specific motor, consult the motor nameplate marking.

Figure 1-2 Typical Speed vs. Torque Curves



EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC and 2014/30/EU. These motors are commercial in design and not intended for residential use. When used with converters, please consult converter manufacturers literature regarding recommendations on cable types, cable shielding, cable shielding termination, connection recommendations and any filters which may be recommended for EMC compliance. For additional information, consult Baldor MN1383.

Section 2

General Information

Overview Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

RPM AC motors are high performance motors specifically designed for use with adjustable frequency controllers. The basic design includes Class H insulation, 1.0 service factor, 40°C ambient, continuous duty. Standard enclosures are totally enclosed blower cooled, totally enclosed fan-cooled, totally enclosed non ventilated, totally enclosed air over piggy back and drip-proof force ventilated. Many modifications, and accessories are available. Motors are available as both induction and permanent magnet construction. RPM AC motors are equipped with metric hardware.

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. Open motors are intended for use in relatively clean, dry locations with adequate supply of cooling air.
2. Standard Totally Enclosed motors provide additional protection from moisture and dust compared to Open motors. Severe Duty and Washdown Duty motors provide additional protection compared to Standard Totally Enclosed motors.
3. IEC Motors are designed and built in accordance to IEC34-1 and IEC72-1 specifications.

Note: Motors located in a damp, moist environment must have space heaters to protect against condensation when motor is not operating.

Mechanical Installation

WARNING: C-Face motor is intended for mounting auxiliary equipment such as pumps and gears. When mounted horizontally Frames 280 thru 440 (IEC 180 thru 280) must be supported by the feet and not by the C-Face on D-Flange alone. C-Face motors should be supported by the feet and not by the C-Face. Installations requiring a horizontally mounted motor in frames 280 thru 440 (IEC 180 thru 280) must be supported by the feet as well as C-Face, D-Flange or IEC Flange. Failure to observe these precautions can result in bodily injury and equipment damage.

Caution: Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.

Caution: If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.

Caution: RPM AC permanent magnet motors with an open enclosure, such as DP-FV (IP23/IC06), should not be used where ferrous dust or particles may be present. Totally enclosed permanent magnet motors are recommended for these applications.

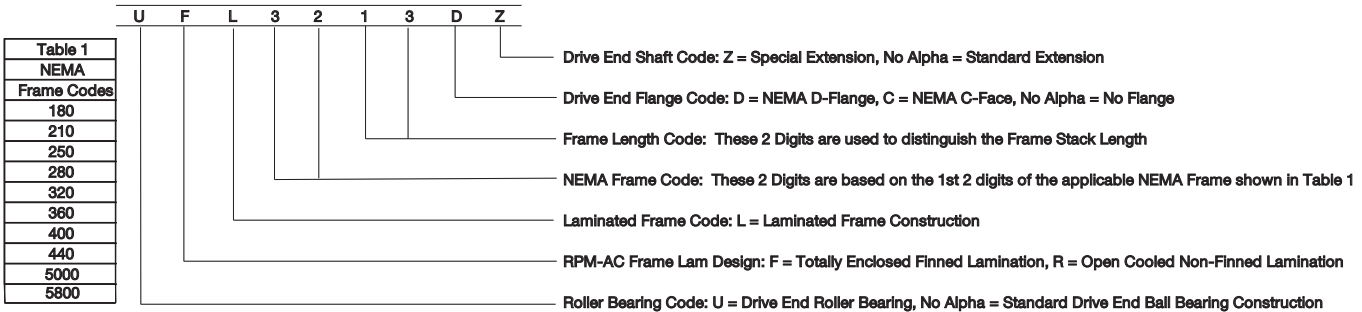
After storage or after unpacking and inspection to see that all parts are in good condition, do the following:

1. Rotate the motor shaft by hand to be sure there are no obstructions to free rotation.
2. A motor that has been in storage for some time should be tested for moisture (dielectric withstand insulation test) and relubricated (regreaseable type) prior to being put into service.
3. A motor with roller bearings is shipped with a shaft block. After removing the shaft block, be sure to replace any bolts used to hold the shaft block in place during shipment that are required in service.

Figure 2-1 RPM AC Frame Code Designation

RPM-AC Frame Code Designation
Updated: 1/17/2020

NEMA Example: (UFL3213DZ)



IEC Example: (UFDL2012DZ)

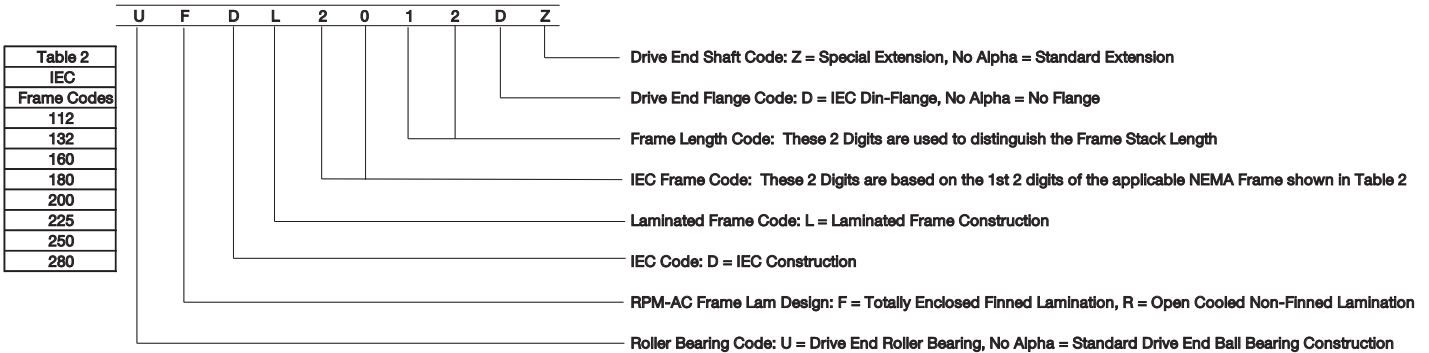


Table 2-1 Bolt Torque

NEMA Frame	Hole Dia. (Inch)	Bolt Size & Thread	Torque lb-ft for Bolt Grade		IEC Frame	Hole Dia. (mm)	Bolt Size & Thread	Torque NM for Bolt Grade	
			SAE 5	SAE 8				ISO 8.8	ISO 12.9
FL180	0.44	3/8-16	31	44	FDL112	12	M10-1.5	50	84
FL/RL210	0.44	3/8-16	31	44	FDL/ RDL132	12	M10-1.5	50	84
FL/RL250	0.56	1/2-13	75	106	FDL/ RDL160	15	M12-1.75	88	148
FL/RL280	0.56	1/2-13	75	106	FDL/ RDL180	15	M12-1.75	88	148
FL/RL320	0.69	5/8-11	150	212	FDL/ RDL200	19	M16-2.5	218	366
FL/RL360	0.81	3/4-10	267	376	FDL/ RDL225	19	M16-2.5	218	366
FL/RL400	1.06	7/8-9	429	606	FDL/ RDL250	24	M22-2.5	600	969
FL/RL440	1.06	7/8-9	429	606	FDL/ RDL280	24	M22-2.5	600	969
RL5000	1.18	1-8	644	909					
FL5800	1.19	1-8	644	909					
RL5800	1.44	1.25-7	1121	1817					

Typical Bolt Tightening Tolerance -0% to +5%

Stub Shaft Installation

1. Turn off and lock out power to the motor.
2. Remove in-line blower motor and cover assembly by removing the Hex head cap screws on cover (if enclosure is TEAO-Blower cooled or IC416).

NOTE: An extended blower cover maybe required when a feedback device is installed. Contact your local ABB District Office for assistance with an in-line blower.

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3. Check the motor shaft center hole for chips, dirt, or other residue and clean as required.
 4. Apply an even coat of Loctite 271 (red thread lock) to stub shaft thread.
 5. Place stub shaft in motor shaft threaded hole and hand tighten.
 6. Use a spanner wrench on motor shaft drive end (or alternate means of locking motor shaft), tighten the stub shaft to 20 lb-ft (27NM).
 7. Use a dial indicator with .0005" (1.01mm) graduations, indicate the stub shaft to within .002" (.05mm) T.I.R., except for Inland tachometers. Inland tachometer stub shafts must indicate to within .001" (.025mm) T.I.R.
 8. Mount feedback device per manufacturer's instructions.

Stub Shaft Removal

1. Turn off and lock out power to the motor.
2. Remove in-line blower motor and cover assembly by removing the Hex head cap screws on cover (if enclosure is TEAO-Blower cooled or IC416).
3. After removal of blower assembly, motor shaft will need to be locked from turning. The use of a spanner wrench on motor drive shaft or alternate means can be used. Place an open-end wrench on stub shaft flats and turn counter clockwise (right-hand) threads).
4. Replace blower motor and cover assembly (if TEAO - blower cooled or IC416) with the correct extended blower cover, using the hex head cap screws previously removed.

Mounting Location

All RPM AC motors are designed to be mounted by the "Mounting Feet".

Use appropriate hardware (not furnished).

The motor should be installed in a location compatible with the motor enclosure and specific ambient.

Allow adequate air flow clearance between the motor and any obstruction. Locate the machine where the ambient temperature does not exceed 104°F (40°C) unless otherwise marked on the nameplate and where clean air has free access to ventilating intake and outlet openings. Except for machines with a suitable protective enclosure (IC06), the location should be clean and dry.

Note: The cooling system on (Non-Finned) frame RPM AC drip proof guarded force ventilated requires clean air to be forced through ducts which are integral to the frame.

It is important that these air passages be kept clean and that sufficient clearance be provided on the blower motor air inlets and outlets for unrestricted flow of air.

For Drip-Proof Force Ventilated Enclosures (IC06) sufficient clearance must be provided on all inlet and outlet openings to provide for unrestricted flow of air. Separately ventilated motors with exhaust to ambient (pipe-in only) must have at least 6 inches of clearance between the opening and adjacent walls or floor.

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage. All hold down bolts must be the correct grade for the type of mounting and must be torqued to their recommended value.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your ABB District Office for further information.

Belted Drive

Motor slide bases or rails, when used, must be securely anchored to the foundation with the proper bolts.

Note: The motor shaft and the load shaft must be parallel and the sheaves aligned.

Coupled Drive

Standard RPM AC Motors will operate successfully mounted on the floor, wall or ceiling, and with the shaft at any angle from horizontal to vertical. Special mountings may have duty or thrust demands that may require a different bearing system.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important.

1. Direct Coupling

For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.

Note: Roller bearing motors are not suitable for coupled duty applications.

2. End-Play Adjustment

The axial position of the motor frame with respect to its load is also extremely important. The motor

bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.

3. Pulley Ratio

The pulley ratio should not exceed 8:1.

Caution:

Do not over tension belts. Over tension of the V-Belts may result in damage to the motor or driven equipment. Unless otherwise indicated, V-belt load must not exceed values given in Table 2-2.

4. Belt Drive

Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor-Reliance motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet.

2. Drill corresponding holes in the foundation.

3. Ream all holes.

4. Install proper fitting dowels.

5. Mounting bolts must be carefully tightened to prevent changes in alignment.

Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure.

Flanged nuts or bolts may be used as an alternative to washers.

WARNING:

Guards must be installed for rotating parts such as couplings, pulleys, external fans and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.

Guarding

Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions. This is particularly important where the parts have surface irregularities such as keys, key ways or set screws. Some satisfactory methods of guarding are:

1. Covering the machine and associated rotating parts with structural or decorative parts of the driven equipment.

2. Providing covers for the rotating parts. Covers should be sufficiently rigid to maintain adequate guarding during normal service.

Electrical Installation

Flying Leads

Motors with flying lead construction must be properly terminated, connected with bolt, lock washer and nut and wrapped with two full layers of electrical grade tape or heat shrink tubing.

Bypass Mode

All RPM AC motors are inverter/converter duty motors using optimum pole design. They are not intended to be used in bypass mode (across the line). Consult your ABB district office to determine suitability of motor for specific applications in bypass mode. Permanent magnet motors cannot be run in bypass mode.

WARNING:

Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

WARNING:

The Adjustable Speed Controller may apply hazardous voltages to the motor leads after power to the controller has been turned off. Verify that the controller is incapable of delivering hazardous voltages and that the voltage at the motor leads is zero before proceeding. Failure to observe this precaution may result in severe bodily injury or death.

Caution:

Use only a shielded motor power cable with a complete circumferential braided or copper film/tape ground jacket around the power leads. This ground should be secured to the motor frame from within the motor terminal box and must return without interruption to the drive ground. In addition, if the motor and coupled equipment are not on a single common metal base plate, it is important to equalize the equipment ground potentials by bonding the motor frame to the coupled equipment using a high frequency conductor such as a braided strap.

Note: Main power leads for CE Marked Motors may be marked U,V,W – for standard configurations, please consult connection diagrams.

1. Single Voltage/Three Lead Motors

Connect leads marked U/T1, V/T2 and W/T3 to the appropriate control output terminals (refer to the Controller Instruction Manual). See Figure 2-2.

2. Dual Voltage Motors

Be sure the motor leads are connected properly for “Low” or “High” voltage connection, see Figure 2-2. Connect leads marked U/T1, V/T2 and W/T3 to the appropriate control output terminals (refer to the Controller Instruction Manual).

Leads P1 & P2 are thermostat leads. They are to be connected in series with the holding coil of the motor controller, which uses a manual momentary start switch.

Motor Insulation

The motor insulation system meets the following levels listed in Table 2-2 per IEC 60034-12 and NEMA MG1

Table 2-2 Motor Insulation levels

Voltage (peak and gradient) withstand levels			
Nameplate voltage	0 to 480	481 to 600	601 to 700
Peak voltage withstand (volts)	1600	1850	2300
Gradient withstand (volts/microsecond)	0.1	0.1	0.1

Thermostat Leads Connection

As a standard feature, RPM AC motors have three (3) normally closed thermostats (one per phase) connected in series, with leads P1 and P2 terminated in the main conduit box. To protect against motor overheating, thermostats must be connected to the appropriate controller circuit (function loss). Failure to connect the thermostats will void the motor warranty. Follow the controller instruction manual for correct thermostat lead connections.

Blower Motor Connection Three phase blower motors.

RPM AC motors which are blower cooled incorporate an independently powered three phase AC blower motor to assure continuous cooling air flow regardless of RPM AC motor speed.

The specific RPM AC blower motor depends on frame size and enclosure, see Figures 2-2 and 2-3.

1. Connect the blower leads as shown in the connection diagram supplied with the blower motor, see Figure 2-3
2. Connect for low or high voltage as shown in Figure 2-2.

Figure 2-2 Connection Diagram

Connection Diagram 422927-1

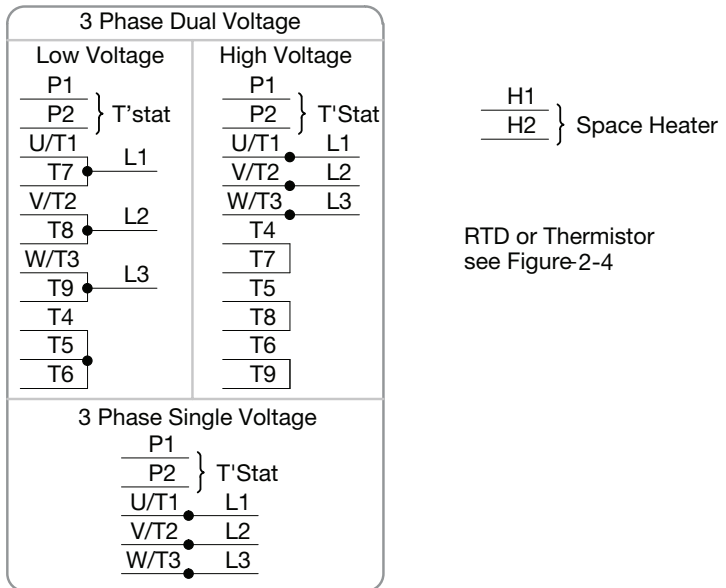
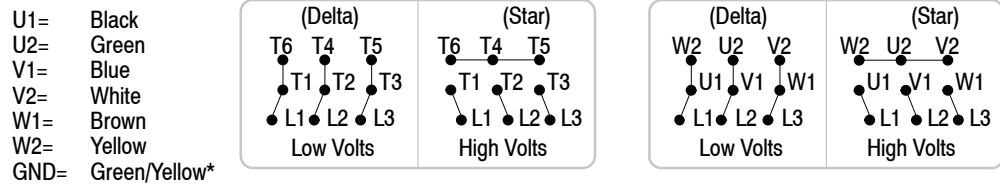


Figure 2-3 Blower Motor Connections



* GND is ground lead normally connects to ground lug in blower terminal box.

Grounding

In Europe, the customer is responsible to ensure ground method conforms to IEC and applicable local codes.

In the USA consult the National Electrical Code (NEC), Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing and the motor or generator frame.

Motors with resilient cushion rings usually must be provided with a bonding conductor across the resilient member. Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked to determine that it is adequate for the rating of the branch circuit over current protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical parts of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security.

Select a motor starter and over current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

Caution:

Use only a shielded motor power cable with a complete circumferential braided or copper film/tape ground jacket around the power leads. This ground should be secured to the motor frame from within the motor terminal box and must return without interruption to the drive ground. In addition, if the motor and coupled equipment are not on a single common metal base plate, it is important to equalize the equipment ground potentials by bonding the motor frame to the coupled equipment using a high frequency conductor such as a braided strap.

Due to the high switching frequencies of inverter/converter controls, the ground connection/path must be low impedance, not only low resistance. The NEC grounding instructions are intended to protect from low frequency, high current considerations and are not adequate for grounding of high frequency circuits.

RPM AC induction motors are designed to operate with a high frequency adjustable speed drive. To avoid damage to the motor and driven equipment due to bearing currents, the motor must be grounded and bonded properly. A low impedance ground conductor should be used to ground all RPM AC motors.

Failure to ground the motor properly for high frequency transients (1MHz to 10MHz) may result in electric discharge damage to the motor bearings and/or the driven equipment.

The drive manufacturer should specify a shielded motor power cable that includes a complete circumferential braided or copper film/tape ground. This ground should be secured to the motor frame from within the motor terminal box and must return without interruption to the drive ground. In addition, if the motor and coupled equipment are not on a single common metal base plate, it is important to equalize the equipment ground potentials by bonding the motor frame to the coupled equipment using a high frequency conductor such as a braided strap.

For motors installed in compliance with IEC requirements, the following minimum cross sectional area of the protective conductors should be used:

Crosssectional area of phase conductors, S	Minimum crosssectional area of the corresponding protective conductor, S _p
mm2	mm2
6	6
10	10
16	16
25	25
35	25
50	25
70	35
95	50
120	70
150	70

Equipotential bonding connection shall made using a conductor with a cross-sectional area of at least 4 mm².

Shipping Blocks

Motors supplied with roller bearings at the drive end are shipped with wooden blocking to prevent axial movement of the shaft during shipment. Remove the blocking and bolts securing it and discard. Make sure motor shafts turn freely. If motor is to be reshipped, blocking of bearing is required.

Encoder Connections

Due to the wide variety of brands and types of feedback devices provided for RPM AC motors, please consult the encoder installation and instruction diagrams provided with the device.

Smart Sensor

The RPM-AC Family is equipped with provisions for mounting the Smart Sensor on the drive end bracket in 2 locations F1 & F2 (M6-1.0 Thread)

For additional information please use the QR code to access the Smart Sensor page or access via the link: <https://new.abb.com/motors-generators/service/advanced-services/smart-sensor/hazardous-areas>



Drain Plugs

Condensation drains are typically provided in each endplate. For optimal drainage, drains should be located in the lowest portion of the motor. For Washdown motors with multiple drain plugs, drain holes at the lowest portion of the motor should be open or have a T-drain installed. Drain holes not at the lowest portion of the motor should be plugged.

Drive

RPM AC motors FL180 thru FL/RL250 and FDL112 thru FDL160 are supplied with a shaft suitable for a belt or coupled drive. Belt loads should be verified with maximum allowable radial loads, see “Shaft Loads”. Proper alignment is critical for long life of bearings, shafts and belts, and minimum downtime. Misalignment can cause excessive vibration and damaging forces on shaft and bearings. For direct coupled drives, flexible couplings facilitate alignment. For belt drives, the sheave must be placed as close as possible to the motor bracket.

Minimum V-Belt Sheave Diameters

Application of Pulleys, Sheaves, Sprockets and Gears on Motor Shafts. To avoid excessive bearing loads and shaft stresses, belts should not be tightened more than necessary to transmit the rated torque.

The pretension of the V-belt drive should be based on the total tightening force required to transmit the horsepower divided by the number of belts. This procedure avoids the excessive load caused by tightening

individual belts to a prescribed level recommended by belt manufacturers.

Mounting

In general, the closer pulleys, sheaves, sprockets or gears are mounted to the bearing on the motor shaft, the less will be the load on the bearing. This will give greater assurance of trouble-free service.

The center point of the belt, or system of V-belts, must not be beyond the end of the motor shaft.

The inner edge of the sheave or pulley rim should not be closer to the bearing than the shoulder on the shaft but should be as close to this point as possible. The outer edge of a chain sprocket or gear must not extend beyond the end of the standard motor shaft.

Shaft Loads – Axial and Radial

RPM AC motors are suitable for limited shaft loads as shown in Tables 2-2 and 2-3.

Recommended maximum thrust loads depend on the mounting position, either horizontal or vertical.

For recommendations for loads in excess of those shown, for higher speeds and special shaft extensions contact your local ABB District office.

Caution:

Use of these radial load capacities requires the accurate calculation of the radial load. Radial loads for gears, sprockets, and flywheel are usually accurately determined but the radial loads due to V-belt drives are subject to miscalculations because they do not include all of the pre-tension load (belt tightening). The calculations of the radial load for a V-belt drive must include the pre-tension for transmitting the horsepower, pretension for centrifugal force on the belts, pre-tension for high start torques, rapid acceleration or deceleration, pre-tension for drives with short act-of-contact between the V-belt and sheave, and low coefficient of friction between belt and sheave caused by moisture, oil or dust. Over tension of the V-Belts may result in damage to the motor or driven equipment. Unless otherwise indicated, V-belt load must not exceed values given in Table 2-2.

Table 2-3 Radial Load Capacity– No Axial Load (L10 Life of 10,000 hours)

Frame (IEC)	Radial Load Capacities at the End of the Shaft in lb(N)								
	Drive End	2500 RPM		1750 RPM		1150 RPM		850 RPM	
	Brg	lbs	N	lbs	N	lbs	N	lbs	N
FL180 (FDL112)	209	445	1979	445	1979	445	1979	445	1979
FL/RL210 (FDL/RDL132)	310	875	3892	875	3892	875	3892	875	3892
FL/RL250 (FDL/RDL160)	313	1375	6116	1525	6784	1525	6784	1525	6784
FL/RL280 (FDL/RDL180)	215	825	3670	930	4137	1065	4737	1180	5249
UFL/URL280 (UFDL/URDL180)	NU215	2150	9564	2150	9564	2150	9564	2150	9564
FL/RL320 (FDL/RDL200)	217	1300	5783	1475	6561	1475	6561	1475	6561
UFL/URL320 (UFDL/URDL200)	NU217	2850	12677	2850	12677	2850	12677	2850	12677
FL/RL360 (FDL/RDL225)	219	1625	7228	1830	8140	2105	9363	2325	10342
UFL/URL360 (UFDL/URDL225)	NU219	4550	20239	4550	20239	4550	20239	4550	20239
FL/RL400 (FDL/RDL250)	219	1685	7495	1895	8429	2180	9697	2415	10742
UFL/URL400 (UFDL/URDL250) (3)	NU219	3000	13345	3000	13345	3000	13345	3000	13345
UFL/URL400 (UFDL/URDL250)	NU222	5000	22241	5000	22241	5000	22241	5000	22241
FL/RL440 (FDL/RDL280)	222	2100	9341	2400	10676	2800	12455	3150	14012
UFL/URL440 (UFDL/URDL280) (3)	NU222	3500	15569	3500	15569	3500	15569	3500	15569
UFL/URL440 (UFDL/URDL280)	NU224	4650	20684	4650	20684	4650	20684	4650	20684
RL5000	224	1465	6517	1740	7740	2115	9408	2420	10765
URL5000	NU224	-	-	6000	26689	6000	26689	6000	26689
FL5800	228	-	-	1000	4448	1150	5115	1250	5560
UFL5800	NU228	-	-	4500	20017	4500	20017	4500	20017
RL5800	228	-	-	1850	8229	2250	10008	2590	11521
URL5800	NU228	-	-	7250	32249	8300	36920	9200	40923

(1) All bearing and shaft data is based on foot mounted, coupled motor enclosures (i.e. DPFV, TENV, TEFC & TEBC).

(2) Loads are based on Standard Shaft Diameters and Lengths.

(3) These values are based on a Stock Motor modified with a Roller Bearing, which uses a smaller bearing than the Standard Roller Bearing design

**Table 2-4 RPM AC Application Data Update
Axial Load Capabilities (L10 Life of 10,000 hours)**

Frame (IEC)	Horizontal Mounting								Vertical Mounting Thrust Down								Vertical Mounting Thrust Up							
	2500RPM		1750RPM		1150RPM		850RPM		2500RPM		1750RPM		1150RPM		850RPM		2500RPM		1750RPM		1150RPM		850RPM	
	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N	lbs	N
FL180 (FDL112)	430	1913	480	2135	480	2135	480	2135	385	1713	455	2024	555	2469	630	2802	445	1979	470	2091	570	2535	645	2869
FL/RL210 (FDL/RDL132)	775	3447	880	3914	1015	4515	1125	5004	705	3136	805	3581	905	4026	1005	4470	870	3870	970	4315	1070	4760	1170	5204
FL/RL250 (FDL/RDL160)	1160	5160	1310	5827	1520	6761	1680	7473	1050	4671	1205	5360	1410	6272	1580	7028	1310	5827	1465	6517	1670	7428	1840	8185
FL/RL280 (FDL/RDL180)	590	2624	700	3114	850	3781	975	4337	405	1802	515	2291	665	2958	795	3536	830	3692	940	4181	1090	4849	1225	5449
FL/RL320 (FDL/RDL200)	1205	5360	1395	6205	1675	7451	1905	8474	850	3781	1050	4671	1315	5849	1535	6828	1630	7251	1830	8140	2095	9319	2315	10298
FL/RL360 (FDL/RDL225)	1395	6205	1615	7184	1945	8652	2210	9831	920	4092	1150	5115	1460	6494	1720	7651	1985	8830	2215	9853	2525	11232	2785	12388
FL/RL400 (FDL/RDL250)	1315	5849	1535	6828	1855	8251	2120	9430	485	2157	715	3180	1025	4559	1290	5738	1955	8696	2305	10253	2695	11988	2960	13167
FL/RL440 (FDL/RDL280)	1300	5783	1550	6895	1800	8007	2050	9119	110	489	345	1535	610	2713	825	3670	2410	10720	2645	11765	2910	12944	3125	13901
RL5000	1435	6383	1715	7629	2050	9119	2400	10676	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FL5800	-	-	1300	5783	1600	7117	1800	8007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RL5800	-	-	1965	8741	2350	10453	2750	12233	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Vertical Mounting Assumes Vertical Shaft Down.

Optional Accessories

Figure 2-4 Accessory Connections

HEATERS



Space heaters are generally not required as the ACS880+5350 Cooling Tower Drive has a trickle current heating feature. For extreme applications that require space heaters, one heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together). Heaters should be connected such that they are not energized when motor is operating

THERMISTORS



Three thermistors are installed in windings. Leads are labeled TD1–TD6 for shutdown and TD7–TD12 for warning.

WINDING RTDS



RTD CONNECTIONS

One Per Phase

Leads	Phase1	Phase2	Phase3
Red (or Marked)	1TD1	2TD1	3TD1
White	1TD2	2TD2	3TD2
White	1TD3	2TD3	3TD3

Two Per Phase

Leads	Phase1		Phase2		Phase3	
	#1	#2	#3	#4	#5	#6
Red(or Marked)	1TD1	2TD1	3TD1	4TD1	5TD1	6TD1
White	1TD2	2TD2	3TD2	4TD2	5TD2	6TD2
White	1TD3	2TD3	3TD3	4TD3	5TD3	6TD3

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BEARING RTD



- * One bearing RTD is installed in Drive end plate.
- * One bearing RTD is installed in Opposite Drive end plate.
- * Note RTD may have 2-Red/1-White leads; or 2-White/1-Red Lead.

-
- Caution:** The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a Division 2 or Zone 2 environment this excessive temperature may cause ignition of hazardous materials. Space heaters should be connected such that they are not energized when motor is operating
- WARNING:** Incorrect motor rotation direction can cause serious or fatal injury or equipment damage. Be sure to verify motor rotation direction before coupling the load to the motor shaft.
- WARNING:** Guards must be installed for rotating parts such as couplings, pulleys, external fans and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.
- Caution:** Do not operate motors with a roller bearing unless a radial load is applied so that damage to the roller bearing does not occur.

First Time Start Up

1. Be sure that all power to motor and accessories is off.
2. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.
3. Remove all unused shaft keys and loose rotating parts to prevent them from flying off.
4. Verify the mechanical installation is secure. All bolts and nuts are tightened etc., covers and protective devices are securely in their places.
5. If motor has been in storage or idle for some time, check winding insulation integrity.
6. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
7. Be sure all shipping materials and braces (if used) are removed from motor shaft.
8. Manually rotate the motor shaft to ensure that it rotates freely.
9. Replace all panels and covers that were removed during installation.
10. Momentarily apply power and check the direction of rotation of the motor shaft. If motor rotation is wrong be sure power is off and change the motor lead connections as follows:
RPM AC motors are designed to be capable of bi-directional shaft rotation. When voltages in an A-B-C phase sequence are applied to leads U/T1, V/T2, W/T3 clockwise shaft rotation facing the opposite drive end will result. If shaft rotation is incorrect, change the direction of rotation as follows:
 - a. Turn off and lockout all power to the motor and verify that the voltage at the motor leads is zero.
 - b. Reverse any two of three motor power leads.
 - c. Restore power.
11. Start the motor and ensure rotation is correct and operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
12. Momentarily apply power and check the direction of air flow is in agreement with the "direction of air flow" arrows mounted on the motor. If directional flow is incorrect be sure power is off and interchange power leads to T1 and T2 or U1 and V1, Figure 2-2.
13. After 1 hour of operation, disconnect power and connect the load to the motor shaft. Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.
14. If motor is totally enclosed fan-cooled or non-ventilated it is recommended that condensation drain plugs, if present, be removed. These are located in the lower portion of the end-shields. Totally enclosed fan-cooled "XT" motors are normally equipped with automatic drains which may be left in place as received.

While operating the motor, observe the performance. It should run smoothly with little noise. The bearings should not overheat and should reach a leveling off temperature. Any undue noise, overheating, or erratic performance should be investigated and necessary corrective action taken immediately to prevent serious damage. Please contact your ABB District office.

All RPM AC motors are lubricated before shipment and will operate for a long period before regreasing is required. The period will vary depending on environmental and service conditions.
Refer to Maintenance section.

Air Flow Volume

Separately ventilated motors DPSV, TESV (IP23 IC17 and IP44-IC37) must have the following volume of air to adequately cool the motor unless the nameplate specifies a different value. Cooling air temperature must not exceed the maximum ambient temperature indicated on the nameplate (standard is 40°C). This data applies to all base speeds for frame sizes in Table 2-4.

Table 2-5 Air Supply

Frame Size (IEC)	DPSV OR TESV Data			
	CFM	M ³ /hr	in of H ₂ O	mm of H ₂ O
FL180 (FDL112)	175	297	2.00	51
RL210 (RDL132)	225	382	3.00	76
RL250 (RDL160)	400	680	3.50	89
RL280 (RDL180)	500	850	3.75	95
RL320 (RDL200)	650	1104	4.50	114
RL360 (RDL225)	800	1359	5.25	133
RL400 (RDL250)	1100	1869	6.50	165
RL440 (RDL280)	1500	2549	7.20	183
RL5000	1850	3143	7.60	193
RL5800	2300	3908	4.25	108

Frame Size (IEC)	TEBC Data				TEAO Air Velocity	
	CFM	M ³ /hr	in of H ₂ O	mm of H ₂ O	ft/min	m/s
FL180 (FDL112)	150	255	1.00	25	1100	5.6
FL210 (FDL132)	230	391	1.80	46	1200	6.1
FL250 (FDL160)	365	620	2.00	51	1800	9.1
FL280 (FDL180)	550	934	2.25	57	2000	10.2
FL320 (FDL200)	850	1444	3.20	81	3000	15.2
FL360 (FDL225)	1370	2328	3.60	91	3000	15.2
FL400 (FDL250)	1275	2166	3.00	76	3000	15.2
FL440 (FDL280)	2150	3653	2.00	51	4000	20.3
FL5800	3400	5777	3.00	76	4500	22.9

- WARNING:** Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.
- WARNING:** Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.
- WARNING:** Incorrect motor rotation direction can cause serious or fatal injury or equipment damage. Be sure to verify motor rotation direction before coupling the load to the motor shaft.
- WARNING:** Guards must be installed for rotating parts such as couplings, pulleys, external fans and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.
- Caution:** Do not operate motors with a roller bearing unless a radial load is applied so that damage to the roller bearing does not occur.

Caution: RPM AC permanent magnet motors with an open enclosure, such as DP-FV (IP23/IC06), should not be used where ferrous dust or particles may be present. Totally enclosed permanent magnet motors are recommended for these applications.

Operation During operation observe the motors' performance. It should run smoothly with little noise. The bearings should not overheat and should reach a normal operating temperature. Any undue noise, overheating, or erratic performance should be investigated and corrective action taken immediately to prevent serious damage. All RPM AC motors are lubricated before shipment and will operate for a long period before regreasing is required. The period will vary depending on environmental and service conditions. Refer to Maintenance section of this manual.

Maximum Safe Speed

The maximum safe operating speed of the motor is listed on the motor nameplate. Do not exceed this speed.

When the maximum speed of the motor control can exceed the maximum safe motor speed (motor nameplate value), the speed characteristics of the control must be set so the speed is limited to this maximum.

Balance

Motors are dynamically balanced to meet the dynamic balance limits of NEMA MG1 Part 7 second for peak value of the unfiltered velocity in inches per second unless ordered differently. Balance is done with a full length 1/2 height shaft key. A full shaft key is shipped with motor. Sheave or coupling should be balanced with a 1/2 height shaft key. Std. Dynamic Balance Limits.

Table 2-6 Dynamic Balance

RPM	NEMA	IEC
	Velocity Peak (in/sec)	Velocity (mm/sec RMS)
0-1200	0.15	2.7
1201-1800	0.15	2.7
1801-3600	0.15	2.7
3601-5000	0.2	3.6
5001-8000	0.2	3.6

Hazardous Locations

Hazardous locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers or flyings.

Selection

Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code. In international hazardous location areas, guidance for gas / vapor / mist classification is given in IEC60079-14. This classification process lets the installer know what equipment is suitable for installation in that environment, and identifies what the maximum safe temperature or temperature class is required.

It is the customer or users responsibility to determine the area classification and select proper equipment. Areas are classified with respect to risk and exposure to the hazard. In the US market, areas are typically classified as follows Class, Division, Group and Temperature Class. In some newer installations in the US and in most international markets, areas are classified in Zones.

Class I Division 2 / Zone 2 Ex ec [Equipment Protection Level (EPL) Gc]

This protection concept relies on having no sources of ignition present such as arcing parts or hot surfaces. For this protection concept, internal temperatures as well as external temperatures are considered. In many cases, the internal temperatures are higher than the external temperatures and therefore become the limiting factor in determination of temperature code designation. In these applications, it is very important to use a motor that has been evaluated thermally for use with an inverter or converter, if variable speed operation is desired. Thermostats used for Class I Division 2 and Ex nA motors are used to protect the motor only. For motors using flying lead construction, it is important to use connection lugs and insulate with heat shrink tubing or a double wrap of insulation grade electrical tape to avoid the risk of spark or ignition.

Class II Division 2 / Zone 22 [Equipment Group III, Equipment Protection Level (EPL) Dc]

This area classification is one where the risk of exposure to ignitable concentrations of dust are not likely to occur under normal operating conditions and relies heavily on the housekeeping practices within the installation.

Variable Frequency Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22

Hazardous Location (motors with maximum surface temperature listed on the nameplate).

Only motors with nameplates marked for use on inverter/converter (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter/converter power. The motor is designed to operate at or below the maximum surface temperature (or T-Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded.

If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause

the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperature above nameplate value
3. Voltage (at each operating frequency) above or below rated nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Operation outside of the nameplate speed / frequency range
7. Altitudes above 3300 feet / 1000 meters
8. Single phase operation of polyphase equipment
9. Unstable current wave forms
10. Lower than name plate minimum carrier frequency

Thermal Limiting

Thermal limiting devices are temperature sensing control components installed inside the motor to limit the internal temperature of the motor frame by interrupting the circuit of the holding coil of the magnetic switch or contactor. They are required for most Division 1 and Zone 1 applications. For Division 2 or Zone 2 applications, motors should be selected that preclude running temperatures from exceeding the ignition temperatures for the designated hazardous material. In Division 2 or Zone 2 classified locations, thermal limiting devices should only be used for winding protection and not considered for limiting all internal motor temperatures to specific ignition temperatures.

**Specific Conditions of Use” for Ex Equipment or “Schedule of Limitations” for Ex Components:
“See Certificate supplied with the motor for Specific “Conditions of Use” for Ex Equipment or “Schedule of Limitations” for Ex Components.**

RPM AC Induction Motors

The RPM AC series of induction motors are designed for high power density and can only be used in conjunction with a converter. They cannot be operated directly across the line. The motors are optimized for the nameplate rating. The optimum Volts and Current are provided on the nameplate for the optimum rating. When optimum voltage and current is not supplied to the motor optimum rating may not be obtained.

When sizing the motor for use with a converter the voltage drop of all components such as filters, long cables, etc. have to be taken into account. The motor nameplate identifies the optimum voltage into the motor from the converter.

When programming the converter and motor system the motor parameters such as; motor voltage, motor current, motor frequency, etc. should be taken from the motor nameplates and the converter output current limit should be set at the motor full load current shown on the nameplate. Setting the converter current limit should prevent a converter with additional current capability from supplying damaging current to the motor.

RPM AC motors are designed for operation at switching / carrier frequencies of 3 kHz or greater for optimum rating. For operation with switching / carrier frequencies less than 3 kHz the rating must be reduced by 10%. Contact ABB for correct sizing.

Section 3

Maintenance & Troubleshooting

- WARNING:** UL Listed motors must only be serviced by UL Approved Authorized ABB Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.
- WARNING:** Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying conductors and permanent magnet motors can result in a serious health hazard to persons with cardiac pacemakers, metal implants, and hearing aids. To avoid risk, stay way from the area surrounding a permanent magnet motor.
- WARNING:** RPM AC permanent magnet motors can induce voltage and current in the motor leads by rotating the motor shaft. Electrical shock can cause serious or fatal injury. Therefore, do not couple the load to the motor shaft until all motor connections have been made. During any maintenance inspections, be sure the motor shaft will not rotate.
- WARNING:** Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.
- WARNING:** The Adjustable Speed Controller may apply hazardous voltages to the motor leads after power to the controller has been turned off. Verify that the controller is incapable of delivering hazardous voltages and that the voltage at the motor leads is zero before proceeding. Failure to observe this precaution may result in severe bodily injury or death.
- WARNING:** Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.
- WARNING:** Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear.

The following steps should be performed at each inspection:

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Perform a dielectric with stand test periodically to ensure that the integrity of the winding insulation has been maintained. Record the readings. Immediately investigate any significant decrease in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Relubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program. Relubrication with the shaft stationary and a warm motor is recommended.

Lubrication Procedure

- WARNING:** Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.
1. Relubrication with the shaft stationary and a warm motor is recommended. If lubrication must be done with motor running, stay clear of rotating parts and electrical circuits.
 2. Wipe all dirt from the outside of the grease fills and drains.
 3. Locate the grease inlet at the top of the bearing hub, clean the area and replace the 1/8-inch pipe plug with a grease fitting if the motor is not equipped with grease fitting.
 4. Remove grease drain plug located opposite the grease inlet.
 5. Using a manual grease gun, pump in the recommended grease in the amount shown. This amount of grease will provide an ample supply of lubricant between lubrication periods for the service condition listed in Table 3-1, Table 3-2 and Table 3-3. Use only clean, fresh grease from clean containers and handle so as to keep it clean. In general, mixing of greases is not recommended. If an incompatible grease is used, the lube system must be completely cleaned then repacked with the new grease.
 6. Wipe away any excess grease at the grease drain or relief and replace drain plugs.
 7. Rubbing Seals need to be periodically greased.
 8. Non-rubbing Seals or Labyrinth type seals have a clearance between stationary and rotating parts of not less than .05mm.

Type of Grease

See the motor nameplate for replacement grease or oil recommendation. Use Mobil Polyrex EM or equivalent grease unless motor nameplate specifies special grease. Amount of grease to be added to RPM AC motors. See Table 3-3 for relubrication interval.

Table 3-1 Relubrication Amount

Frame Size (IEC)	Vol. in Cubic in (Cubic cm)	Weight oz (gram)
180 - 280 (110 - 180)	1.0 (16)	0.5 (14)
320 - 360 (200 - 225)	2.0 (32)	1.0 (28)
400 - 5000 (250 - 280)	2.5 (40)	1.25 (35)
5800	4.0 (64)	2.0 (56)

Note: NEMA frames 180, 210 and 250 (IEC frames 112, 132 and 160) have maintenance free non regreasable double shielded ball bearings as standard. The 280 - 440 frames have open ball bearings, with inner caps as part of PLS System. Determine service condition on the basis of the most severe operating parameter; that is temperature, bearing load, atmosphere, or operating hours per day.

Table 3-2 Service Condition

Service Condition	Ambient	Use/Day	Atmosphere	Bearing Load
Standard	-18°C to 40°C (0°F to 104°F)	8	Clean	Steady
Severe	-30°C to 50°C * (-22°F to 122°F)	8 to 24	Medium Dirt, Abrasives, Corrosion (less than .2 in/sec.	Medium Shock, Vibration
Extreme	-54°C to 65°C * (-65°F to 149°F)	8 to 24	Heavy Dirt, Abrasives, Corrosion	Heavy Shock, Vibration (more than .44 in/sec)

* Motors must be specially designed for operation in ambient in this range. Special grease is required.

Table 3-3 Relubrication Periods For RPM AC Motors

Maximum Normal Operating Speed RPM *	Frame (IEC)	Relubrication Interval in Months **		
		Standard Service	Severe Service	Extreme Service
3450 and higher	All	9		1
2400 thru 3449	280 - 5000 (180 - 280)	9		1
1700 thru 2399	180 - 280 (180 - 200) 320 - 5000 (200 - 280) 5800	36 18 9	12 6 3	3 2 1
800 thru 1699	180 - 280 (180 - 200) 320 - 5000 (200 - 280) 5800	36 36 9	24 12 6	8 3 1
500 thru 799	180 - 280 (180 - 200) 320 - 5000 (200 - 280) 5800	48 36 18	36 24 12	12 8 4
499 and lower	320 - 5000 (200 - 280) 5800	48 24	36 18	12 6

Relubrication intervals are for ball bearings.

For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

Connection Box Maintenance

For motors certified as Ex nA and Ex ec, in order to maintain the protection level, it is necessary to periodically inspect and tighten covers and gland plates. The torque values shown below can be used for guidance:

Table 3-4 TORQUE VALUES

INCH-THREADED			
BOLT SIZE	THREAD PITCH	STANDARD DRY TORQUE	
		FT. POUND FORCE TOLERANCE +/- 5%	NEWTON METER TOLERANCE +/- 5%
1/4	20	8.45	11.5
5/16	18	17.4	23.6
3/8	16	30.9	41.9
METRIC THREADED			
BOLT SIZE	THREAD PITCH	STANDARD DRY TORQUE	
		FT. POUND FORCE TOLERANCE +/- 5%	NEWTON METER TOLERANCE +/- 5%
6	1.00	9.972	13.52
8	1.25	24.19	32.80
10	1.50	47.90	64.94

Table 3-5 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage.	Check input line connections.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Improper ventilation.	Check external cooling blower to be sure air is moving properly across cooling fins. Check blower for proper direction of rotation. Check filter for dirt, clean or replace. Excessive dirt build-up on motor. Clean motor.
	Rotor rubbing on stator.	Check air gap clearance and bearings.
		Tighten Thru Bolts that hold the endplates to frame.
	Full voltage on field with motor stopped.	Reduce field voltage to 60% with field economy circuit in the control.
	Grounded winding.	Perform dielectric test and repair as required.
Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to connection diagram.	
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately 3/4 filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately 3/4 filled.
	Dirt in bearing.	Contact your ABB Service Center.

Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked and repaired at your ABB Service Center.
	Resonance.	Contact your ABB Service Center.
Noise	Foreign material in air gap or ventilation openings.	Contact your ABB Service Center.
Growling or whining	Bad bearing.	Replace bearing.

Suggested bearing and winding RTD setting guidelines for Non-Hazardous Locations ONLY

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Table 3-6 Winding RTDs – Temperature Limit In C (40C Maximum Ambient)

Motor Load	Class B Temp Rise ≤ 80°C (Typical Design)		Class F Temp Rise ≤ 105°C		Class H Temp Rise ≤ 125°C	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note:

- When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

Table 3-7 Bearing RTDs – Temperature Limit In C (40C Maximum Ambient)

Bearing Type Grease	Anti-Friction	
	Alarm	Trip
Standard	100	110

Axial Float

RPM AC motors have a wave spring washer between the opposite drive end bracket and bearing. The drive end bearing is positioned axially by a float restricting inner cap. Axial float (including bearing internal clearance) should be within the following limits:

Axial Float - In./Min.

Frame Size	Maximum		Minimum	
	In.	mm.	In.	mm.
180 thru 440 (IEC 112 thru 280)	.051	1.29	.013	.33
RL5000				

FL5800 has a roller bearing on the opposite drive end of the motor and does not use a wavy spring.

Section 4

IEC 60079 Series

INFORMATION REQUIRED PER IEC 60079-0

All italicized information below is quoted from the standard, clause 30.

Clause 30 (instructions) – Instructions are provided with each motor, the most recent version of this manual can be download at baldor.com.

Instructions for purposes of this standard consists of the following that are shipped with your motor in the literature package:

- Instruction Manual MN406
- Ex Certificates applicable for your motor
- Nameplate marking photos for your motor

Clause 30.1 (general)

Marking **The instructions prepared by the manufacturer shall include the following particulars as a minimum.**

A recapitulation of the information with which the equipment is marked, except for the serial number (see Clause 29), together with any appropriate additional information to facilitate maintenance (for example, address of the importer, repairer, etc.)

A copy of the nameplates is included in the literature package and is shipped with each motor. These instructions are used for a range of motors. An example of typical certification marking is shown in Section 1. For motor specific information, please refer to the certification nameplate photos, electrical rating information and any specific conditions conveyed in the motor marking such as but not limited to ambient range, water flow, converter set up parameters and refer to the data package shipped with the product.

on-site assembling:

Not typically required.

adjustment and parameter setting

If operated on a converter, refer to nameplate marking for set-up parameters.

Use and setting-up;

Ratings such as electrical values, ambient temperatures and pressures, maximum surface temperatures and other limit values related to a designated use are included on the product nameplate photos and in the product data package..

- putting into service- of the equipment / of the whole installation:

ii) Information about verifications / tests prior to first use

Refer to Section 2, Installation and Operation

ii) detailed information about any special installation requirements for the Type of Protection(s) employed

i) information about verifications / tests prior to (first) use

Refer to Section 2, Installation and Operation

ii) detailed information about any special installation requirements for the Type of Protection(s) employed

- maintenance;

ii) Information such as cleaning, oil level check or recalibration requirements;

Cleaning- The enclosure is non-conducting and may generate an ignition capable level of electrostatic charge under extreme conditions. The user should ensure that the equipment is not installed in a location in a location where it might be subjected to external conditions which might cause a build-up of electrostatic charges on non-conducting surfaces. Additionally, cleaning of the equipment should be done only with a damp cloth.'

Additional information on maintenance such as Information on bearing inspection is in the Maintenance Section 3

iii) Requirements for the maintenance of the explosion protection.

For Ex e machines, consult manufacturer for winding details

For permanent magnet motors, the voltage that may be present at the motor terminals, when the supply is disconnected, when the motor is rotating. Open circuit vs. speed data is normally supplied.

For motors using permanent magnet rotors, consult warning marking, which is provided with the Instructions.

Information on any maintenance required to ensure continued compliance with the rubbing seal requirements of 5.2.12

Inspect Seal during the bearing lubrication process to ensure the integrity of the seal.

- repair

i) Repair should be conducted in accordance with the requirements given in IEC 60079-19

Refer to Repair of Motors used in Hazardous Locations

Information related to the fitting or removal of parts / components; As each motor design is unique, it is necessary to Contact the manufacture for additional repair details. Use only original manufacturer's parts.

ii) information related to the fitting or removal of parts / components

Contact ABB regarding any spare parts.

iii) Information about spare parts

Contact ABB regarding any spare parts.

iv) Requirements for a documentation of such repairs.

As any repair is undertaken after consultation with IEC60079-19, the documentation requirements for the repair in this standard apply.

- taking out of service and dismantling

i) Use appropriate lock out tag out procedures to prevent restart and prior to making or breaking any electrical connection.

• where applicable, Specific Conditions of Use according to 29.3 e)

As Specific Conditions of Use may vary with each certificate, if Specific Conditions are applied, the certificate is shipped with each motor forming part of the Instructions. Refer to Marking and Acceptance section for an explanation of the "X" suffix to certificate numbers.

Clause 30.3 (electrical machines)

In addition to the information required according to 30.1, the following additional information shall be prepared for electrical machines, as applicable:

machines intended to be supplied by a converter

For speed torque information on motors intended to be supplied by converter, consult motor nameplate.

bearing lubrication requirements for both commissioning and maintaining;

Instructions for lubrication are included in the Bearing Maintenance Section. Only use ABB recommended grease or contact ABB Motors and Mechanical Inc., product support team for guidance on equivalents suitable for hazardous locations.

the permitted axial and radial loading of the shaft;

Please refer to Table 2-2 and Table 2-3 in this manual for information.

- **the thermal expansion of the shaft and housing under rated conditions**

Maintain minimum clearances necessary to accommodate thermal growth of up to 3mm of the frame and up to 5mm (8mm for Furnace Fan Motor Designs) of the shaft during design operating conditions. Consult engineering for application specific solutions where these minimum clearances are not permissible.

- **any necessary maintenance of the protection provided by the manufacturer against stray circulating currents in the bearings or shafts.**

Ensure that the motor is properly earthed and bonded. For motors operated by converter, consult converter manufacturers instructions relative to cable recommendations.

- **any necessary protection of the bearings from vibration, including during transportation, storage, or standby service;**

Protection of bearings from vibration during storage and transportation are addressed in General. Bearings requiring blocking are blocked during shipment.

- **guidance on maintenance and replacement intervals for bearings based on the operating conditions.**

Instructions for lubrication are included in the Bearing Maintenance Section



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Additional information

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