
HydroCool XT Product Inverter Duty Motors

NEMA Frames 360 - 440 Family

(Specifically designed for operation with
Adjustable Speed Controls)

Installation and Operating Manual

September 2022

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Important:

Be sure to check www.baldor.com to download the latest version of this manual in Adobe Acrobat PDF format.

Note! The manufacturer of these products, Baldor Electric Company became ABB Motors and Mechanical Inc. on March 1, 2018. Nameplates, Declaration of Conformity and other collateral material may contain the company name of Baldor Electric Company and the brand names of Baldor-Dodge and Baldor-Reliance until such time as all materials have been updated to reflect our new corporate identity.

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Section 1

General Information

- Overview** This manual contains general procedures that apply to Baldor-Reliance Motor 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. A Warning statement indicates a possible unsafe condition that can cause harm to personnel. A Caution statement indicates a condition that can cause damage to equipment. Baldor-Reliance mining motors are sold to OEM (Original Equipment Manufacturers) companies who 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.
- Important:** 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.
- Before you install, operate or perform maintenance, become familiar with the following:
- 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:** 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.
- 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:** **Disconnect all electrical power from the motor windings and accessory devices before disassembling of the motor. Electrical shock can cause serious or fatal injury.**
- 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:** **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.**
- WARNING:** **Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.**
- 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 to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.**
- WARNING:** **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.**
- WARNING:** **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.**
- WARNING:** **Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.**
- WARNING:** **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.**
- WARNING:** **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.**
- 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:** **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.**
- WARNING:** **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.**
- WARNING:** **Motors that are to be used in flammable and/or explosive atmospheres must display the CSA listed logo. Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.**
- WARNING:** **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.**

Safety Notice Continued

- WARNING:** HydroCool XT Product 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.
- 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:** HydroCool XT Product 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 Baldor-Reliance 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. Replace the grease drain plug after greasing.
4. The motor shaft must be rotated a minimum of 15 times after greasing.
5. 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.
6. 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.

Operation On Frequency Converters:

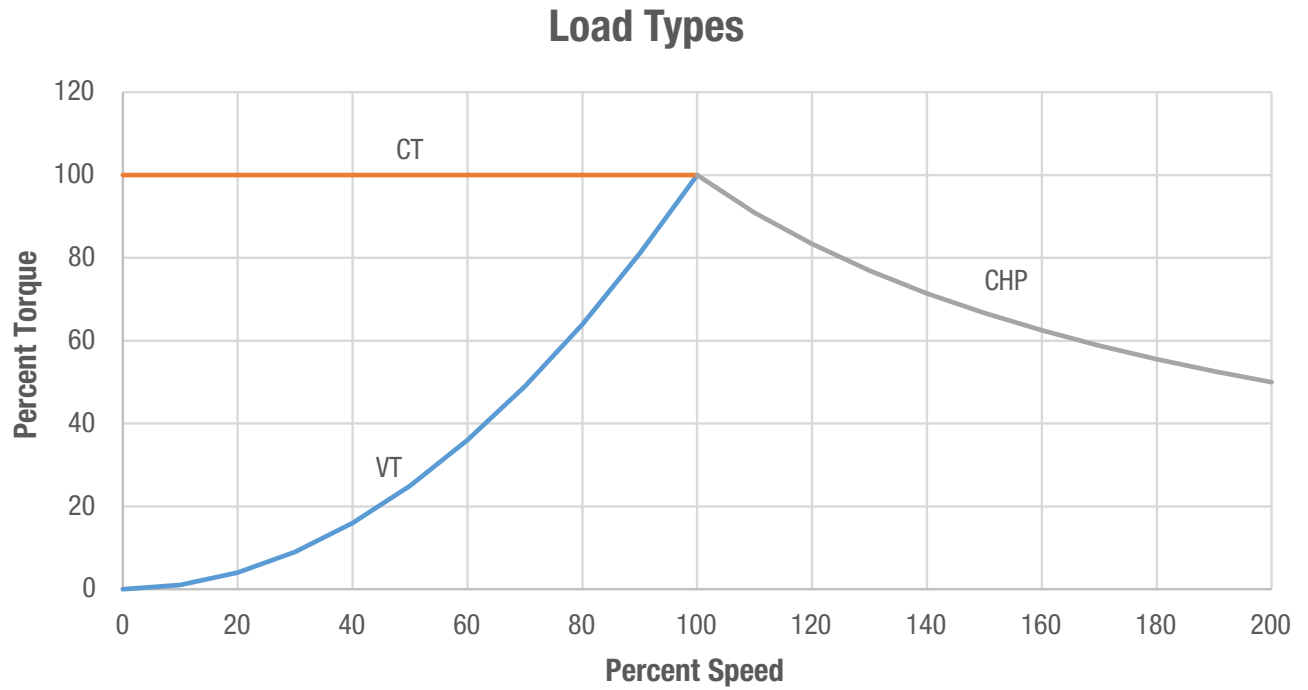
If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0- 120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed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

Table 1-1 Unit Conversions

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 1-1. For values relative to your specific motor, consult the motor nameplate marking.

Figure 1-1 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-Reliance instruction manual MN1383.

Section 2

Installation & Operation

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.

HydroCool XT Product 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. HydroCool XT Product 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:

HydroCool XT Product 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.

Table 2-1 HydroCool Bolt Torques

NEMA Frames	Hole Dia. (Inch)	Bolt Size & Thread	Torque lb–ft for Bolt Grade	
			SAE 5	SAE 8
360	0.69	5/8-11	150	212
400	0.81	3/4-10	267	376
440	0.81	3/4-10	267	376

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.

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. 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).

Mounting Location

All HydroCool XT Product 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.

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 as shown in Table 2-1.

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 HydroCool XT Product 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 HydroCool XT Product motors are inverter 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 Parts 30 & 31.

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, HydroCool XT Product 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.

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 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.

HydroCool XT Product 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 HydroCool XT Product 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.

Table 2-3 Minimum cross sectional area of the protective conductors

Crosssectional area of phase conductors, S	Minimum crosssectional area of the corresponding protective conductor, S _p
mm ²	mm ²
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 HydroCool XT Product motors, please consult the encoder installation and instruction diagrams provided with the device.

Smart Sensor

The HydroCool XT Product Family is equipped with provisions for mounting the Smart Sensor on the end of the frame (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

HydroCool XT Product motors 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

HydroCool XT Product 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 2-4 Radial Load Capacity– No Axial Load (L10 Life of 10,000 hours)

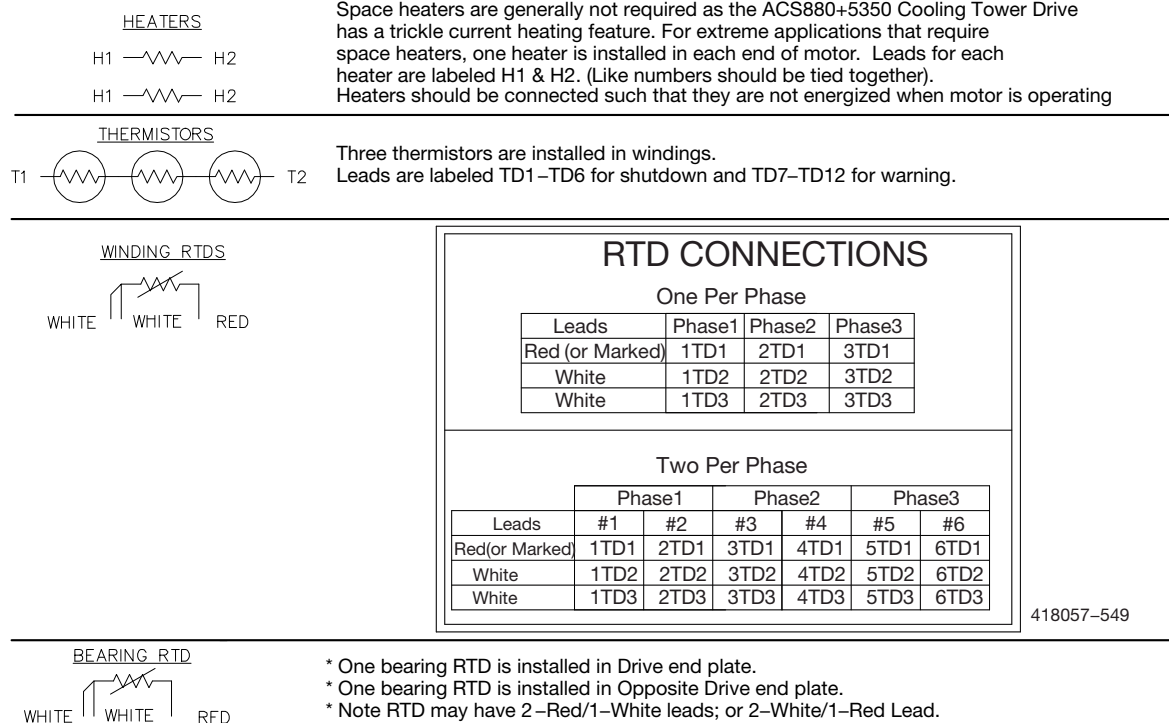
1750 RPM								
Frame	Ball Bearing Radial Load Limit (lbs)				Roller Bearing Load Limit (lbs)			
	DE Bearing	17500 Hours	50000 Hours	100000 Hours	DE Bearing	17500 Hours	50000 Hours	100000 Hours
WC367T	6313	1110	760	580	NU313	2160	1550	1240
WC407T	6316	1420	970	740	NU316	2940	2120	1710
WC445T	6318	1600	1080	820	NU222	3680	2640	2110
WC447T	6318	1580	1040	770	NU222	3740	2660	2120
WC449T	6318	1560	990	710	NU222	3810	2680	2110
WCL449T	6318	1540	900	630	NU222	3650	2550	1990
1200 RPM								
Frame	Ball Bearing Radial Load Limit (lbs)				Roller Bearing Load Limit (lbs)			
	DE Bearing	17500 Hours	50000 Hours	100000 Hours	DE Bearing	17500 Hours	50000 Hours	100000 Hours
WC367T	6313	1280	880	680	NU313	2500	1760	1420
WC407T	6316	1640	1120	870	NU316	3340	2410	1930
WC445T	6318	1860	1260	960	NU222	4170	3000	2400
WC447T	6318	1850	1230	920	NU222	4260	3040	2420
WC449T	6318	1830	1180	860	NU222	4350	3080	2430
WCL449T	6318	1730	1090	780	NU222	3880*	2940	2310
900 RPM								
Frame	Ball Bearing Radial Load Limit (lbs)				Roller Bearing Load Limit (lbs)			
	DE Bearing	17500 Hours	50000 Hours	100000 Hours	DE Bearing	17500 Hours	50000 Hours	100000 Hours
WC367T	6313	1420	980	760	NU313	2660*	1930	1550
WC407T	6316	1820	1250	970	NU316	3650	2630	2120
WC445T	6318	2060	1400	1080	NU222	4570	3290	2640
WC447T	6318	2060	1380	1040	NU222	4670	3340	2660
WC449T	6318	2060	1340	990	NU222	4780	3390	2680
WCL449T	6318	1940	1240	900	NU222	3880	3240	2550

**Table 2-5 HydroCool XT Product Application Data Update
Axial Load Capabilities (L10 Life of 10,000 hours)**

HORIZONTAL THRUST CAPABILITIES L-10 BEARING LIFE. WC360, WC400 & WC440							THRUST CAPABILITIES (SHAFT DOWN) L-10 BEARING LIFE DOWN THRUST IN POUNDS						THRUST CAPABILITIES (SHAFT DOWN) L-10 BEARING LIFE UP THRUST IN POUNDS							
RPM	FRAME SIZE	SKF ONLY HORIZONTAL ALLOWABLE THRUST (LBS)					RPM	FRAME SIZE	VERTICAL SHAFT, ALLOWABLE DOWN THRUST (LBS)					RPM	FRAME SIZE	VERTICAL SHAFT, ALLOWABLE UP THRUST (LBS)				
		1 YR	2 YR	3 YR	50K HRS	100K HRS			1 YR	2 YR	3 YR	50K HRS	100K HRS			1 YR	2 YR	3 YR	50K HRS	100K HRS
3600	360	1068	811	673	480	356	3600	360	1082	772	625	436	280	3600	360	1394	1084	937	748	592
	400	1060	798	661	469	346		400	1031	721	575	385	230		400	1461	1151	1005	815	660
	445	1051	789	652	460	336		445	961	651	505	315	160		445	1505	1195	1049	859	704
	447	1024	760	627	437	314		447	820	510	363	174			447	1642	1332	1185	996	840
	449	1021	757	618	428	305		449	695	385	238				449	1608	1298	1151	961	806
	L449	982	704	565	389	266		L449	590	279	132				L449	1964	1653	1506	1316	1161
1800	360	1511	1106	923	663	476	1800	360	1465	1050	857	610	402	1800	360	1838	1423	1230	983	775
	400	1835	1449	1195	851	618		400	1365	950	757	508	302		400	1907	1492	1299	1050	844
	445	1802	1612	1339	943	694		445	1235	815	625	375	170		445	2047	1627	1437	1187	982
	447	1802	1569	1302	910	661		447	1070	653	462	213			447	2256	1839	1648	1399	1193
	449	1802	1558	1292	903	656		449	945	525	335				449	2229	1809	1619	1369	1164
	L449	1802	1496	1235	849	608		L449	665	250					L449	2497	2082	1892	1642	1435
1200	360	1811	1326	1109	789	572	1200	360	1790	1275	1050	757	516	1200	360	2179	1664	1439	1146	905
	400	1835	1719	1441	1025	736		400	1675	1165	937	645	403		400	2291	1781	1553	1261	1019
	445	1802	1802	1610	1150	827		445	1550	1040	810	520	277		445	2400	1890	1660	1370	1127
	447	1802	1802	1569	1106	794		447	1270	755	528	235			447	2485	1970	1743	1450	1210
	449	1802	1802	1527	1072	760		449	1175	665	433	145			449	2771	2261	2029	1741	1497
	L449	1802	1802	1479	1025	724		L449	895	385	158				L449	2916	2406	2179	1886	1646
900	360	2071	1508	1260	903	656	900	360	1860	1340	1100	800	540	900	360	2085	1565	1325	1025	765
	400	1835	1835	1633	1166	843		400	1780	1250	1010	710	450		400	2105	1575	1335	1035	775
	445	1802	1802	1802	1311	941		445	1600	1080	840	540	280		445	2085	1565	1325	1025	765
	447	1802	1802	1802	1273	907		447	1388	863	623	427	258		447	2093	1568	1328	1132	963
	449	1802	1802	1802	1238	871		449	1130	600	360	290	231		449	2102	1572	1332	1262	1203
	L449	1802	1802	1802	1195	832		L449	1002	472	232	162	103		L449	2102	1572	1332	1262	1203
720	360	2274	1659	1392	1005	728	720	360	2004	1443	1185	862	582	720	360	2229	1669	1410	1087	807
	400	1835	1835	1835	1292	943		400	1917	1347	1088	765	485		400	2243	1672	1413	1090	810
	445	1802	1802	1802	1450	1045		445	1724	1163	905	582	302		445	2209	1648	1390	1067	787
	447	1802	1802	1802	1413	1007		447	1495	930	671	460	278		447	2200	1635	1376	1165	983
	449	1802	1802	1802	1371	971		449	1217	646	388	313	248		449	2189	1618	1360	1285	1220
	L449	1802	1802	1802	1323	933		L449	1079	508	250	313	248		L449	2179	1608	1350	1285	1220
600	360	2466	1815	1508	1083	789	600	360	2129	1534	1259	916	618	600	360	2354	1759	1484	1141	843
	400	1835	1835	1835	1414	1020		400	2038	1431	1156	813	515		400	2363	1756	1481	1138	840
	445	1802	1802	1802	1576	1149		445	1832	1236	962	618	321		445	2317	1721	1447	1103	806
	447	1802	1802	1802	1538	1111		447	1597	992	716	491	297		447	2302	1697	1421	1196	1002
	449	1802	1802	1802	1494	1068		449	1311	696	418	337	267		449	2283	1668	1390	1309	1239
	L449	1802	1802	1802	1449	1025		L449	1163	548	269	337	267		L449	2263	1648	1369	1437	1367

Optional Accessories

Figure 2-1 Accessory Connections



- * 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:
HydroCool XT Product 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.
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 HydroCool XT Product 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.

Minimum Water Flow

Cooling water 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 2-6.

Table 2-6 Water Flow

Frame	TEWC (Min Flow)
	Size
360	15
400	15
440	15

The cooling water circulates in ducts integrated in the machine frame. The material of the frame and ducts is carbon steel according to ASTM A-36. This material is prone to corrosion in saline and foul water. The corrosion products and fouling deposits might block.

Standard values for the cooling water to be used in the cooling system:

- pH 6.5 – 8.5
- Alkalinity (CaCO₃) > 1 mmol/kg
- Chloride (Cl) < 120 mg/kg
- Conductivity < 1500 µS/cm

In most of the cases, normal tap water, i.e. water for domestic consumption, fulfils all these requirements.

The cooling water must also be inhibited with an agent protecting the cooling system against corrosion, fouling and when necessary, against freezing. All materials in touch with the cooling water (pipes, heat exchanger, etc.) must be considered when selecting a suitable inhibitor.

Recommended inhibitor:

Manufacturer ASHLAND

Product RD-25

which is suitable for steel, copper, aluminum and many other materials.

Use only suitable and high-class connection parts and seals to connect the machine to the water circuit. Check for possible leaks after the piping and joints have been connected.

- 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.

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 HydroCool XT Product 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.

Table 2-7 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 nA, [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 (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter 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.

HydroCool XT Product Induction Motors

The HydroCool XT Product 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.

HydroCool XT Product 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 away from the area surrounding a permanent magnet motor.
- WARNING:** HydroCool XT Product 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 HydroCool XT Product motors. See Table 3-3 for relubrication interval.

Table 3-1 Relubrication Amount

Frame Size (IEC)	Weight oz (gram)
360 (225)	1.0 (28)
400 - 440 (250 - 280)	1.25 (35)
5800	2.0 (56)
5800	2.0 (56)

Note: The motors 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 Relubrication Periods for RPM AC Motors

service condition	Use/Day	Atmosphere	Bearing Load
Standard	8	Clean	Steady
Severe	8 to 24	Medium Dirt, Abrasives, Corrosion (less than .2 in/sec.	Medium Shock, Vibration
Extreme	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 HydroCool XT Product Motors

Maximum Normal Operating Speed RPM *	Relubrication Interval in Months **		
	Standard Service	Severe Service	Extreme Service
3450 and higher	9	4	1
2400 thru 3449	9	3	1
1700 thru 2399	18	6	2
800 thru 1699	36	12	3
500 thru 799	36	24	8
499 and lower	48	36	12

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

HydroCool XT Product 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.
360 thru 440	.051	1.29	.013	.33



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