BALDOR • RELIANCE

Nuclear Service Class 1E
Nuclear Service Non-Class 1E
Integral and Fractional Horsepower
AC Induction Motors
TENV, TEFC Enclosures
48 – 449 Frame

1/15 Installation & Operating Manual MN438

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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.

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Section 1

General Information

Overview This manual contains general procedures that apply to Baldor 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.

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 Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.**

Limited Warranty

www.baldor.com/support/warranty_standard.asp

Baldor Nuclear-class Motors are categorized as “Definite Purpose AC Motors”

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 NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code 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: **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. National Electrical Code and Local codes must be carefully followed.**

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: **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: **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.**

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.**

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: **This equipment is at line voltage when AC power is connected. Disconnect and lockout all ungrounded conductors of the AC power line before proceeding. Failure to observe these precautions could result in severe bodily injury or loss of life.**

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: **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: **Rotating parts can cause serious or fatal injury. If relubrication is performed with the motor running, to avoid injury do not contact any rotating parts.**

WARNING: **Solvents can be toxic and/or flammable. Follow manufacturer’s safety procedures and directions. Failure to observe this precaution could result in bodily injury.**

Continued on next page.

Safety Notice Continued

WARNING: **Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying carrying conductors and permanent magnet motors can result 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: **Use of an air jet may cause flying debris and generate particulate matter. Wear suitable skin, eye and respiratory protection. Failure to observe these precautions may result in bodily injury.**

WARNING: **Space Heaters operate at line voltage. Disconnect power to space heaters before performing maintenance work on motor. Failure to observe this precaution could result in severe bodily injury or loss of life.**

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: **Baldor Nuclear-class motors must only be repaired by a factory-authorized nuclear service motor service center to maintain the original factory Environmental Qualification. Due to the critical nature of these motors it is important that the motors be dismantled, repaired, and reassembled consistent with original manufacturing procedures using original factory materials for certain components.**

Caution: **Only Chevron SRI No. 2 and ExxonMobil Polyrex EM greases have been Environmentally Qualified for use in Baldor Nuclear-class motors having ball or roller bearings. Do not use other grease types.**

Caution: **To avoid damage to the windings do not use air pressures greater than 30 psi (200 kPa). Avoid directing the air in such a way that the dirt will be blown into inner crevices.**

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. Over–lubricating can cause excessive bearing temperatures, premature lubrication breakdown and 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 from the motor shaft before moving the motor.**

Caution: **The lifting direction should not exceed a 45° angle from the lifting angle. Excessive 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 HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG1 and MG2 standards to avoid equipment damage.**

Caution: **To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your local Baldor District Office for additional information.**

Caution: **Do not use solvents containing trichloroethane to clean interior or exterior of motor. Damage may occur to paint and insulation systems.**

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

Receiving

Each Baldor Nuclear-class Motor is thoroughly tested at the factory and carefully packaged for shipment. Where specified, Class 1E motors are packaged in accordance with NQA-1, Part II, Subpart 2.2 Level B for shipment. When the motor is received, there are several things that should be done immediately. Do not unpack until ready for use.Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered the motor.
2. Verify that the part number of the motor received is the same as the part number listed on the purchase order.
3. Class 1E motors should be placed in a NQA-1, Level B storage facility until installed on the driven equipment.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

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.**

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.
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. 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

The following storage requirements should be observed for motors that will not be placed into service for at least six months from the 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.

Motors packaged in accordance with NQA-1 Level B requirements should be stored in their original containers in a clean, dry, protected warehouse that complies with the requirements of NQA-1 Level B. For motors with standard commercial packaging, 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 reclosing many times without damage to the “shell”.

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

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

Example: For a 480VAC rated motor Rm =1.48 meg–ohms (use 5 M Ω).

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 ºC (50 ºF) to 49 ºC (120 ºF) must be maintained.
   c. Relative humidity must not exceed 60%. Desiccants or other humidity control methods should be used to minimize condensation in and around the motor.
   d. Minimize the accumulation of condensed water in and around the machine.
   e. 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 Baldor 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.

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–regreasable 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. Motor with regreasable bearings 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 to each bearing every nine months (see Section 3).
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 to ground with an insulation resistance meter. If the winding insulation resistance is above the acceptable minimum, the motor may be placed into service. A decrease in winding resistance below the acceptable minimum indicates moisture in the windings and necessitates electrical or mechanical drying before the motor can be placed into service. If the winding resistance is below the acceptable minimum, contact your Baldor District office.
3. For storage periods exceeding 24 months, a thorough bearing inspection and visual inspection of the stator winding and motor leads is required.
4. Regrease the bearings as instructed in Section 3 of this manual.
5. 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.

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.

Location

The Baldor Nuclear-class motors described in this instruction manual are offered in Totally Enclosed, Severe Duty constructions only and may be installed either indoors or outdoors in installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material unless specifically designed for this type of service in accordance with local codes and standards.
Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

Caution: **Class 1E motors have been designed for specific applications in the nuclear power plant. These motors must be installed in the locations for which they were originally purchased. Environmental and Seismic Qualification of these motors is based on the parameters given for these locations.**

Mounting Location

To allow adequate air flow, the following clearances must be maintained between the motor and any obstruction:

Table 2-1 Enclosure Clearance

TEFC Enclosures	
Fan Cover Air Intake	48 – 140T Frame, 1” (25 mm)
	180 – 210T Frame, 1” (25 mm)
	250 – 449T Frame, 4” (100 mm)
Exhaust	Envelope equal to the P Dimension on the motor dimension sheet

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.

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.

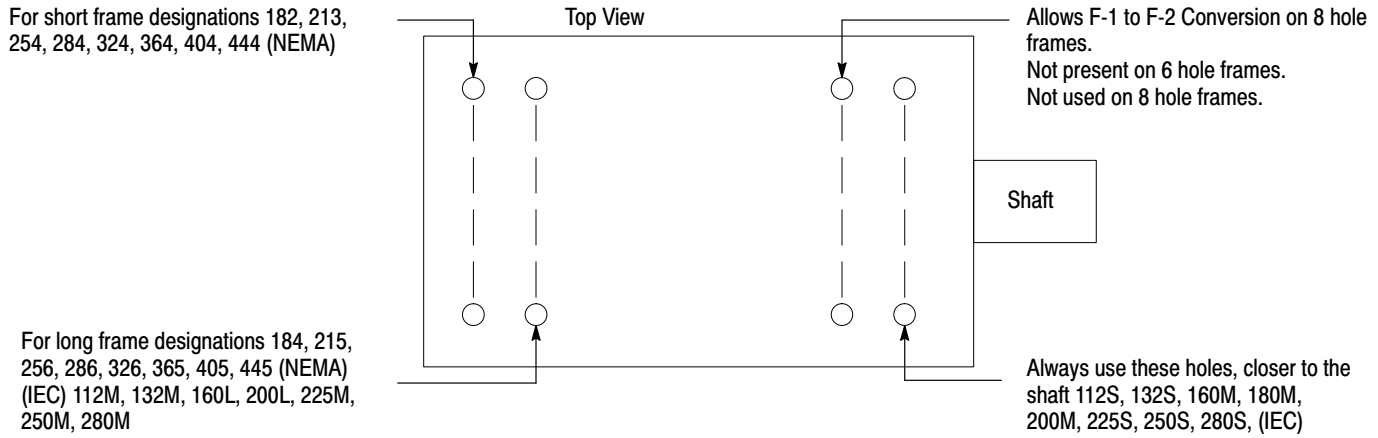
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

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

Frame Mounting Holes

Some motors have standardized frames containing 6 or 8 mounting holes. 6 hole frames are not suitable for field reversal of mounting from F–1 to F–2, etc. Figure 2-1 indicates the proper mounting holes to use.

Figure 2-1 6 & 8 Hole Motor Frame Mounting



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.**

In the case of assemblies on a common base, any lifting means provided on the motor should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. Assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important. The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. It is recommended to heat the pulley, sprocket, or gear before installing on the motor shaft. Forcibly driving a unit on the motor shaft will damage the bearings.

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.
2. End-Play Adjustment
   The axial position of the motor frame with respect to its load is also extremely important. The standard motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. Pulley Ratio
   The best practice is to not exceed an 8:1 pulley ratio.

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

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 in the locations provided.
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.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices. After the motor is unpacked, examine the nameplate data to see that it agrees with the circuit to which it is to be connected. The motor as a minimum will fully meet the requirements outlined in NEMA MG-1 20.14 including any special voltage and frequency requirements imposed by the contract between Baldor and its Customer.

Grounding

In the USA consult the National Electrical Code, 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 terminal housing, and the motor frame if frame grounding provisions are available. In non–USA locations consult the appropriate national or local code applicable.

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 multi-motor 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 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. When careful consideration of the hazards involved in a particular application indicate the machine frames should not be grounded or when unusual operation conditions dictate that a grounded frame cannot be used, the installer should make sure the machine is permanently and effectively insulated from ground. In those installations where the machine frame is insulated from ground, it is recommended that appropriate warning labels or signs be placed be placed on or in the area of the equipment by the installer.

Conduit Box For ease of making connections, an oversize conduit box is provided. Most conduit boxes on motor frame sizes 180 and larger can be rotated 360 ° in 90 ° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

AC Power Motors with flying lead construction must be properly terminated and insulated.

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).

OR

2. AC power is within ±5% of rated frequency with rated voltage.

OR

3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-3.

Figure 2-2 Accessory Connections

HEATERS H1 — H2 H1 — H2	One heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together).
THERMISTORS TD1 — TD2	Three thermistors are installed in windings and tied in series. Leads are labeled TD1 & TD2.
WINDING RTDS RED RED WHITE	Winding RTDs are installed in windings (2) per phase. Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.
BEARING RTD RED RED WHITE	* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE. * One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE. * Note RTD may have 2–Red/1–White leads; or 2–White/1–Red Lead.

Rotation All three phase motors are reversible. To reverse the direction of rotation, disconnect and lock out power and interchange any two of the three line leads for three phase motors. Adjustable Frequency Power Inverters used to supply adjustable frequency power to induction motors produce wave forms with lower order harmonics with voltage spikes superimposed. Turn–to–turn, phase–to–phase, and ground insulation of stator windings are subject to the resulting dielectric stresses. Suitable precautions should be taken in the design of these drive systems to minimize the magnitude of these voltage spikes. Consult the drive instructions for maximum acceptable motor lead lengths, and proper grounding.

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.**

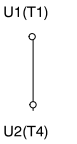
AC Motor Connection Diagram

IEC VERSUS NEMA LEAD MARKING

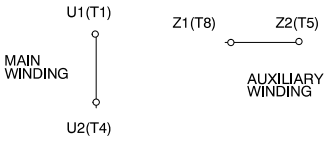
EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

SINGLE PHASE MOTORS

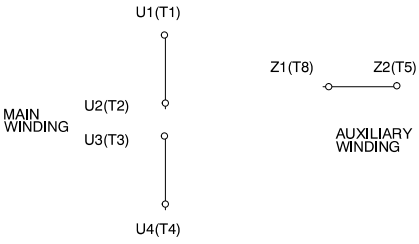
SINGLE VOLTAGE NON REVERSIBLE



SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

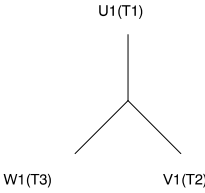
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1	U2=T4	U5=T7	U6=T10
V1=T2	V2=T5	V5=T8	V6=T11
W1=T3	W2=T6	W5=T9	W6=T12

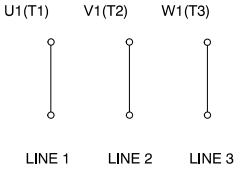
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

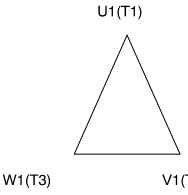
WYE CONNECT



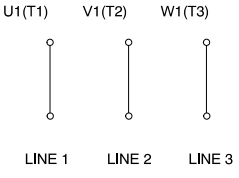
WIRING DIAGRAM



DELTA CONNECT



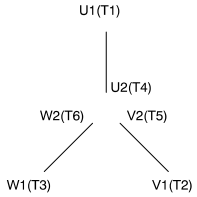
WIRING DIAGRAM



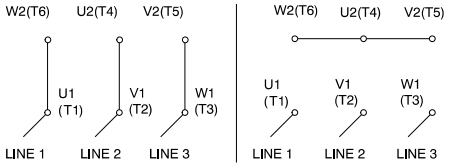
AC Motor Connection Diagram

SIX LEADS

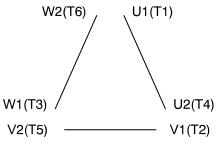
DELTA-WYE CONNECT



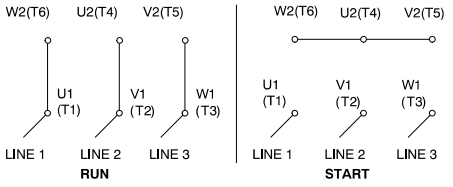
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

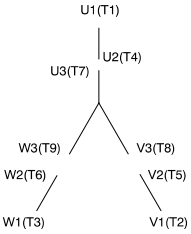


AC Motor Connection Diagram

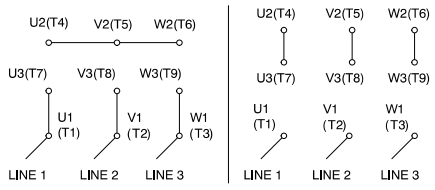
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

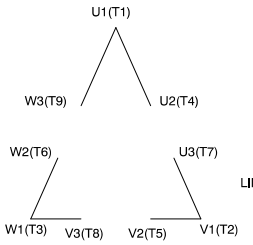
WYE CONNECT



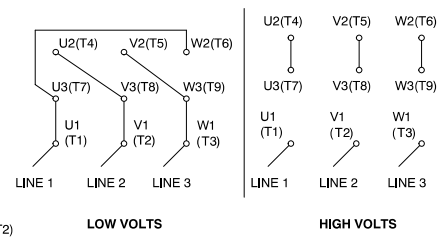
WIRING DIAGRAM



DELTA CONNECT



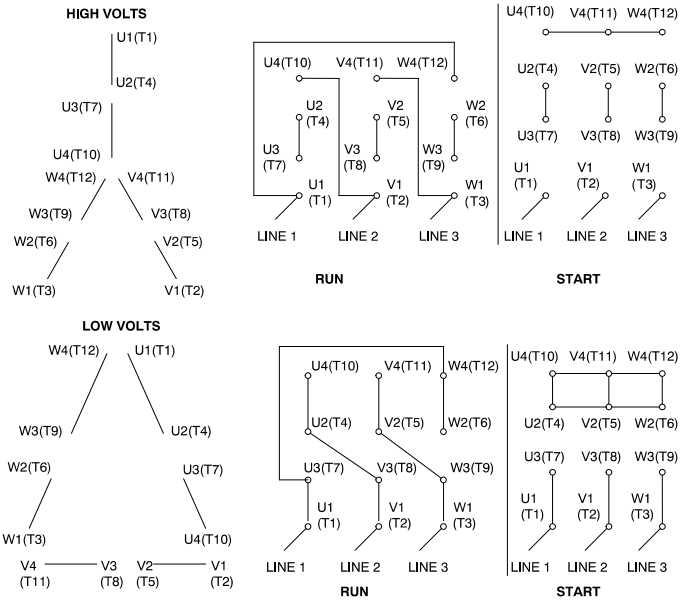
WIRING DIAGRAM



AC Motor Connection Diagram

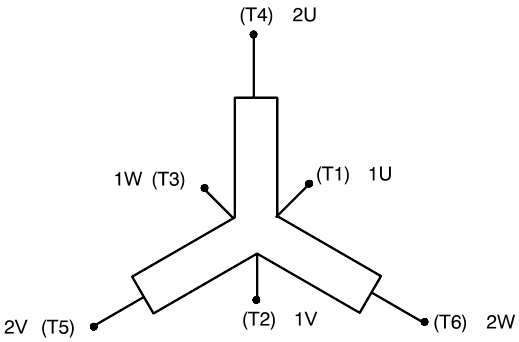
TWELVE LEADS

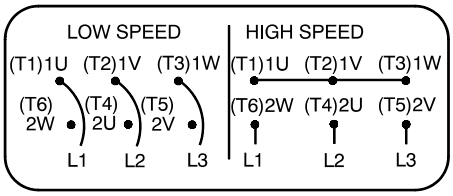
DUAL VOLTAGE WYE START – DELTA – RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

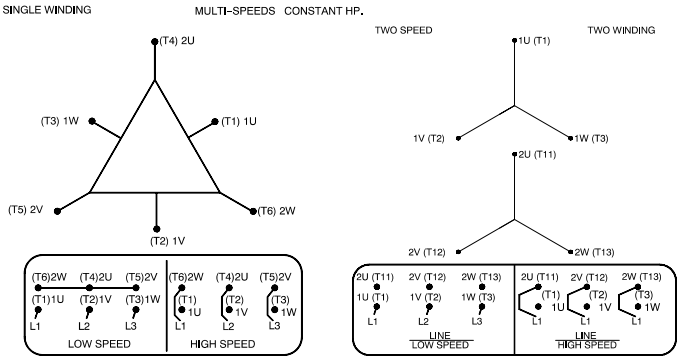




(N.P. 1634-DE)

AC Motor Connection Diagram

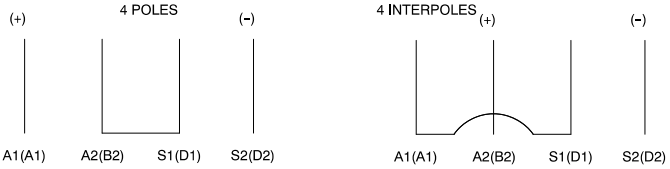
SINGLE WINDING MULTI-SPEEDS CONSTANT HP.



TWO SPEED TWO WINDING

DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



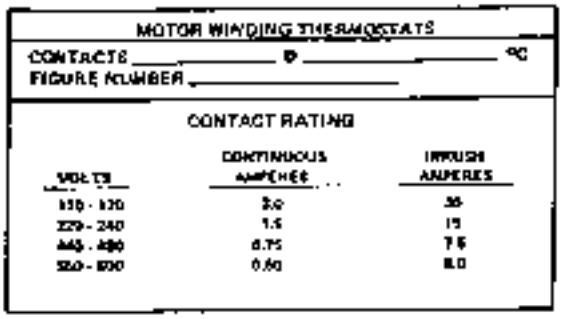
COUNTERCLOCKWISE ROTATION CLOCKWISE ROTATION

ROTATION – FACING COMMUTATOR END

COMPARISON OF IEC AND NEMA LEAD MARKINGS
FOR DIRECT CURRENT MOTORS

A1--A1
A2--B2
S1--D1

S2--D2



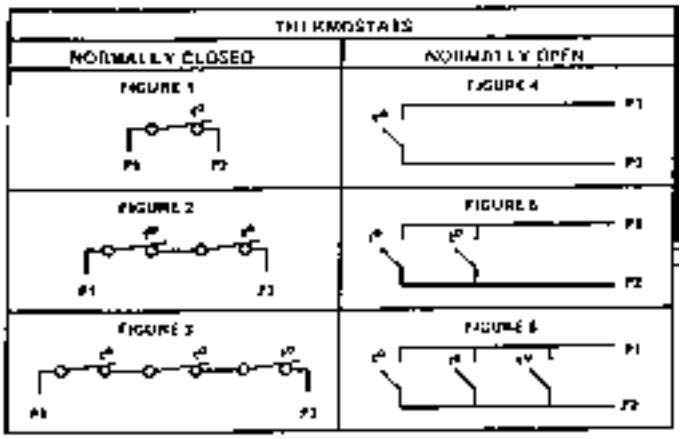
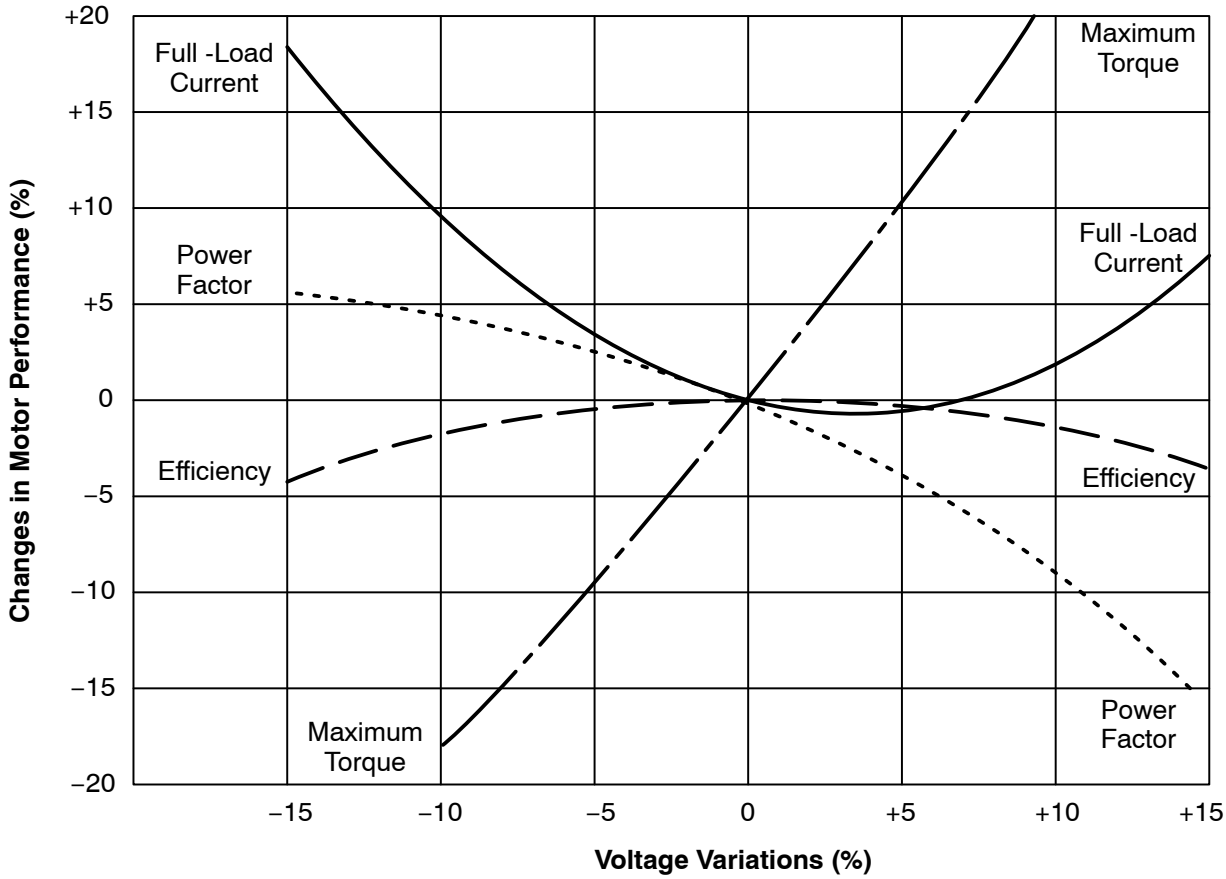


Figure 2-3 Typical Motor Performance VS Voltage Variations



Initial Lubrication

Baldor Nuclear-class Motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be re-lubricated (regreaseable type) prior to starting.

First Time Start Up

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.
10. 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.
11. 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.

Coupled Start Up

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation.
   Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts

Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

WARNING: The user is responsible for conformation with the National Electrical Code and all other applicable local codes. Wiring practices, grounding, disconnects, and over-current protection are of particular importance. Failure to observe these precautions could result in severe bodily injury or loss of life.

WARNING: Ensure that all guards are properly installed before proceeding. Exercise extreme care to avoid contacting rotating parts. Failure to observe these precautions could result in bodily injury.

WARNING: Rotating parts such as couplings, pulleys, external fans, and unused shaft extensions should be permanently guarded against accidental contact with hands or clothing. This is particularly important where the rotating parts have surface irregularities such as keys, keyways, or set-screws.

Operation:

Due to the inherent characteristics of insulating materials, abnormally high temperatures shorten the operating life of electrical apparatus. The total temperature, not the temperature rise, should be the measure of safe operation. Aging of insulation occurs at an accelerated rate at abnormally high temperatures.

Unbalanced voltage or single-phase operation of poly-phase machines may cause excessive heating and ultimate failure. It requires only a slight unbalance of voltage applied to a poly-phase motor to cause large unbalanced currents and resultant overheating.

Periodic checks of phase voltage, frequency and power consumption of a motor while in operation are recommended; such checks ensure the correctness of frequency and voltage applied to the motor and yield an indication of the load offered by the apparatus which the motor drives. Comparisons of this data with previous no-load and full-load power demands will give an indication of the performance of the complete machine. Any serious deviations should be investigated and corrected.

Section 3

Maintenance & Troubleshooting

Caution: **Baldor Nuclear-class motors must only be repaired by a factory-authorized nuclear service motor service center to maintain the original factory Environmental Qualification. Due to the critical nature of these motors it is important that the motors be dismantled, repaired, and reassembled consistent with original manufacturing procedures using original factory materials for certain components.**

Periodic Inspection

Baldor Nuclear-class motors should be inspected at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Class 1E motors must be inspected periodically to maintain qualification. Keep the motors clean and the ventilation openings clear. The following steps should be performed at each inspection:

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.**

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.

Caution: **Only Chevron SRI No. 2 and ExxonMobil Polyrex EM greases have been Environmentally Qualified for use in Baldor Nuclear-class motors having ball or roller bearings.**

Relubrication Intervals

Recommended relubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-2, 3-3 and 3-4.

Table 3-1 Relubrication Intervals *

NEMA Frame Size	Rated Speed - RPM			
	3600**	1800	1200	900
48 – 210 incl.	5,500 Hrs.	12,000 Hrs.	18,000 Hrs.	22,000 Hrs.
Over 210 to 280 incl.	3,600 Hrs.	9,500 Hrs.	15,000 Hrs.	18,000 Hrs.
Over 280 to 360 incl.	*2,200 Hrs.	7,400 Hrs.	12,000 Hrs.	15,000 Hrs.
Over 360 to 449 incl.	*2,200 Hrs.	3,500 Hrs.	7,400 Hrs.	10,500 Hrs.

* Relubrication intervals are for ball bearings.
For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3-2 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40 ºC	Clean, Little Corrosion
Severe	16 Plus	50 ºC	Moderate dirt, Corrosion
Extreme	16 Plus	65° C	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration

Table 3-3 Relubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

Table 3-4 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description ("Large" / Drive End)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in^3	teaspoon
48 to 140	6203	0.08 (2.4)	0.15	0.5
140	6205	0.15 (3.9)	0.2	0.8
180	6206	0.19 (5.0)	0.3	1.0
210	6307	0.30 (8.4)	0.6	2.0
250	6309	0.47 (12.5)	0.7	2.5
280	6311	0.61 (17)	1.2	3.9
320	6312	0.76 (20.1)	1.2	4.0
360	6313	0.81 (23)	1.5	5.2
400	6316	1.25 (33)	2.0	6.6
440	6318	1.52 (40)	2.5	8.2
440	6319	2.12 (60)	4.1	13.4
360 to 449	NU319	2.12 (60)	4.1	13.4

* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Caution: **To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.**

Relubrication Procedure

Caution: **Only Chevron SRI No. 2 and ExxonMobil Polyrex EM greases have been Environmentally Qualified for use in Baldor Nuclear-class motors having ball or roller bearings. Do not use other grease types.**

Caution: **Do not over–lubricate motor as this may cause premature bearing failure. Over–lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.**

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.
3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Caution: **Baldor Nuclear-class motors must only be repaired by a factory-authorized nuclear service motor service center to maintain the original factory Environmental Qualification. Due to the critical nature of these motors it is important that the motors be dismantled, repaired, and reassembled consistent with original manufacturing procedures using original factory materials for certain components.**

The motor must be returned to a factory-authorized nuclear service motor center for all maintenance.

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. Eccentric air gap.	Check input line connections. Have motor serviced at local Baldor service center.
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.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings. Tighten “Thru Bolts”.
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	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 motor lead 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.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately 3/4 filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately 3/4 filled.

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

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80 °C) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

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 (40 °C Maximum Ambient)

Motor Load (Typical Design)	Class B Temp Rise ≤ 80 °C		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: • Winding RTDs are factory production installed, not from Mod–Express.
• When Class H temperatures are used consider bearing temperatures and relubrication requirements.

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

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Notes: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.

** High temperature lubricants include some special synthetic oils and greases.

Only Chevron SRI-2 and ExxonMobil Polyrex EM have been Environmentally Qualified for use in Baldor Nuclear-class motors having ball or roller bearings.

Contact Baldor engineering for further clarifications.

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