A-97
50-348/364-CIVP
2/13/92

APCo Ex: 97

JUNE, 1976

INSTRUCTION MANUAL B-3620-8

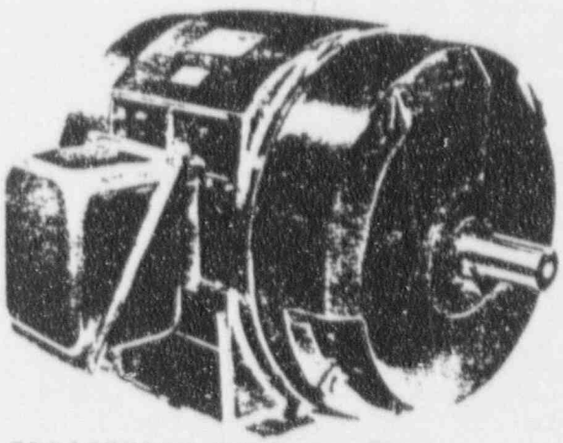
0034210

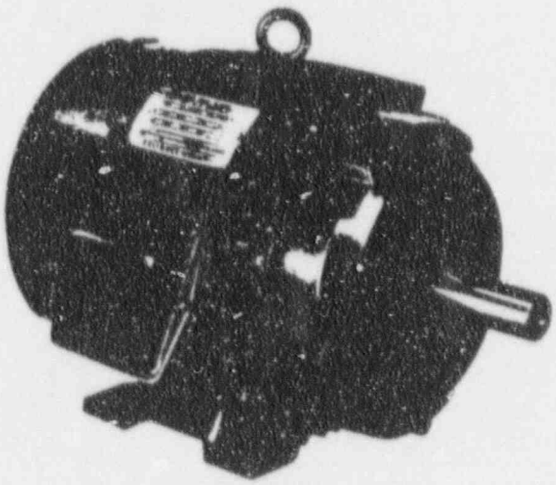
INSTALLATION, OPERATION AND CARE OF

RELIANCE

STANDARD INTEGRAL HORSEPOWER INDUCTION MOTORS

(180 - 449 FRAMES)





IMPORTANT: It is important that these instructions be studied by the men installing and operating this equipment. Read thoroughly before starting. Keep these instructions for future reference.

RELIANCE ELECTRIC COMPANY

NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. _____

In the matter of _____

Staff _____

Applicant _____

Intervenor _____

Cont'g Off'r _____

Contractor _____

Other _____

Reporter _____

NUCLEAR REGULATORY COMMISSION

Docket No. 50-348/364 Official Exh. No. APC 17

In the matter of _____

Staff _____ IDENTIFIED 2/13/92

Applicant ✓ RECEIVED 2/13/92

Intervenor _____ REJECTED _____

Cont'g Off'r _____

Contractor _____ DATE _____

Other _____ Witness _____

Reporter L Estep

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RECEIVING AND HANDLING

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ACCEPTANCE

Thoroughly inspect the equipment before accepting shipment from the transportation company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept them until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage in shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the Reliance invoice, nor should the Reliance invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If damage has been incurred and the situation requires, contact the nearest Reliance District Office immediately. Please keep a written record of all correspondence.

STORAGE – DUTY MASTER A-C MOTORS

Storage requirements for motors under negotiated extended warranty are listed below. When a negotiated extended warranty is in effect, these extended storage requirements must be followed to allow the submission of a valid warranty claim.

1. The motors, if not mounted, are to be stored in the original containers in a clean, dry, protected warehouse.
2. The storage area is to be free from any vibration and from extremes in temperature.
3. Bearings
   a. Ball & Roller (anti-friction) The bearings are to be fully greased at the time of going into extended storage. Motor shafts are to be rotated manually every 6 months and additional grease added purging some of that in cavity. Grease in the bearings is to be purged at the time of removal from storage, making sure that an ample supply of fresh grease is in each grease cavity.
   b. Sleeve (oil lub) The bearings are tested using an oil containing a rust inhibitor. Prior to shipment the oil is drained. If motor is stored more than one month the oil reservoirs must be refilled to the indicated level with the specified lubricant. (See Instruction Manual) The shaft should be rotated by hand every month at least 10 to 15 revolutions to assure that an oil film is on the shaft and bearing surfaces.
4. All drains to be fully operable while in storage, and/or the 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 at points other than through the bearing fits. Vertical motors should be stored in the vertical position.
5. All units equipped with heaters are to have the heaters connected if storage conditions in any way simulate or approach atmospheric conditions experienced in operation.
6. Windings to be megged at the time equipment is put in storage. At the time of removal from storage, the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying. Where a large quantity of motors is stored, an inspection or sampling should be made by removing the end brackets and visually inspecting for the presence of water in the grease or rust on the bearing. If present, replace the bearings and relubricate.
7. All external parts and motors subjected to corrosion should be protected by some corrosive resistant coating.
8. Where motors are not installed in the original containers, but are removed and mounted on other pieces of machinery, the mounting must be such that the drains and breathers are fully operable. In this respect, the drains must be kept at the lowest point in the motor and/or the drain plugs removed so that all condensation can automatically drain out. Vertical motors should be stored in the vertical position.
9. All other storage conditions apply, including rotation of motor shafts. Where such conditions cannot be met, then the equipment must be treated the same as if it were mounted in its normal position, and all protective devices such as heaters, breathers, and drains fully operable.

UNPACKING

After unpacking and inspection to see that all parts are in good condition, turn the shaft by hand to be sure there are no obstructions to free rotation. Equipment which has been in storage for sometime should be tested and relubricated prior to being put into service. Refer to "Test for General Condition" and "Lubrication" for procedure to be performed after extended storage.

Equipment with roller bearings is shipped with a shaft block at the opposite pulley end. In removing the shaft block, be sure to replace the bolts which are used to hold the shaft block in place during shipment.

WARRANTY

The Reliance Electric Company warrants workmanship and materials on this motor for a period of one year from date of shipment from the Reliance factory. In every case concerning warranty, contact the nearest Reliance Sales Office or authorized Reliance Service Shop.

INSTALLATION

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INSPECTION

After the motor is unpacked, examine the nameplate data to see that it agrees with the power circuit to which it is to be connected. The motor is guaranteed to operate successfully with frequency not more than 5% and voltage not more than 10% above or below the nameplate data, or combined variation of voltage and frequency of not more than 10% above or below nameplate data. Efficiency, power factor and current may vary from nameplate data.

TABLE 2. General Effect of Voltage and Frequency Variation on Induction-motor Characteristics

Variation	Starting and max running torque	Synchronous speed	% slip	Full-load speed	Efficiency			Power factor			Full-load current	Starting current	Temp rise, full load	Max overload capacity	Magnetic noise—no load in particular
					Full load	3/4 load	1/2 load	Full load	3/4 load	1/2 load					
Voltage variation:															
120% voltage	Increase 44%	No change	Decrease 30%	Increase 1.6%	Small increase	Decrease ½–2 points	Decrease 7-20 points	Decrease 5-15 points	Decrease 10-30 points	Decrease 15-40 points	Decrease 11%	Increase 25%	Decrease 5-6°C	Increase 44%	No objectionable increase
110% voltage	Increase 21%	No change	Decrease 17%	Increase 1%	Increase ½–1 point	Practically no change	Decrease 1-2 points	Decrease 3 points	Decrease 4 points	Decrease 5-6 points	Decrease 7%	Increase 10-12%	Decrease 3-4°C	Increase 21%	Increase slightly
Function of voltage	(Voltage) 2	Constant	1 / (voltage) 2	(Synchronous speed slip)								Voltage		(Voltage) 2	
90% Voltage	Decrease 19%	No change	Increase 23%	Decrease 1.6%	Decrease 2 points	Practically no change	Increase 1-2 points	Increase 1 point	Increase 2-3 points	Increase 4-6 points	Increase 11%	Decrease 10-12%	Increase 6-7°C	Decrease 19%	Decrease slightly
Frequency variation:															
95% frequency	Decrease 10%	Increase 5%	Practically no change	Increase 5%	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Slight increase	Decrease slightly	Decrease 5-6%	Decrease slightly	Decrease slightly	Decrease slightly
Function of frequency	1 / (frequency) 2	Frequency		(Synchronous speed slip)								1 / frequency			
95% frequency	Increase 11%	Decrease 5%	Practically no change	Decrease 5%	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Slight decrease	Increase slightly	Increase 5-6%	Increase slightly	Increase slightly	Increase slightly

NOTE: This table shows general effects, which will vary somewhat for specific ratings.

LOCATION

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

LIFTING MEANS

WARNING – WHEN A LIFTING MEANS IS PROVIDED FOR HANDLING THE MOTOR OR GENERATOR, IT SHOULD NOT BE USED TO LIFT THE MOTOR OR GENERATOR PLUS ADDITIONAL EQUIPMENT SUCH AS GEARS, PUMPS, COMPRESSORS, OR OTHER DRIVEN EQUIPMENT. In the case of assemblies on a common base, any lifting means provided on the motor or generator should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around base or by other lifting means provided on the base. In cases, care should be taken to 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.

MOUNTING

Mount the motor on a foundation sufficiently rigid to prevent excessive vibration. Ball-bearing motors may be mounted with the feet at any angle. After carefully aligning the motor with the driven unit, bolt securely in place.

DRIVE

The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. Heat to install. Driving a unit on the shaft will damage the bearings.

Belt Drive: Align the pulleys so that the belt will run true; tighten the belt just enough to prevent slippage, any tighter will cause premature bearing failure. If possible, the lower side of the belt should be the driving side.

INSTALLATION (Cont'd)

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Chain Drive: Mount the sprocket on the shaft as close to the bracket as possible. Align the sprockets so that the chain will run true. Avoid excessive chain tension.

Gear Drive and Direct Connection: Accurate alignment is very essential. Secure the motor and driven unit rigidly to the base.

ROTATING PARTS

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 PARTS HAVE SURFACE IRREGULARITIES SUCH AS KEYS, KEYWAYS 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 or driving equipment.
2. Providing covers for the rotating parts. The openings in or at the edges of such covers should not be over 1/2 inch wide (3/4 inch if the rotating parts are more than 4 inches from the opening) in the direction, usually above and to the side, from which contact is to be expected. In other directions where other stationary parts, such as a sub-base provide partial guarding, somewhat wider openings may be used. Covers should be sufficiently rigid to maintain adequate guarding in normal service.

WIRING

Connect the motor to the power supply according to the diagram on the motor nameplate. For most 230 and 460 volt motors, nine leads are brought out from the stator windings so that the motor may be connected for either 230 or 460 volts.

GROUNDING

WARNING – THE FRAMES AND OTHER METAL EXTERIORS OF MOTORS AND GENERATORS (EXCEPT FOR INSULATED PEDESTAL BEARINGS) USUALLY SHOULD BE GROUNDED TO LIMIT THEIR POTENTIAL TO GROUND IN THE EVENT OF ACCIDENTAL CONNECTION OR CONTACT BETWEEN LIVE ELECTRICAL PARTS AND THE METAL EXTERIORS. See the *National Electrical Code*, Article 430 for information on grounding of motors, Article 445 for grounding of 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. A common method of providing a ground is through a grounded metallic conduit system.

Motors with resilient cushion rings are usually supplied with a bonding conductor across the resilient member (see MG 2-2.06). 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 (see MG 2-2.06) to determine that it is adequate for the rating of the branch circuit overcurrent 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 part 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 operating 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 on or in the area of the equipment by the installer.

STARTING

WARNING – BEFORE STARTING MOTOR, REMOVE ALL UNUSED SHAFT KEYS AND LOOSE ROTATING PARTS TO PREVENT THEM FROM FLYING OFF.

When starting the motor, check the following items:

1. The rotor should turn freely when disconnected from the load.
2. Driven machine should be unloaded when first starting the motor.

The motor should run smoothly with little noise. If the motor should fail to start and produces a decided hum, it may be that the load is too great for the motor or that it has been connected improperly. Shut down immediately and investigate for trouble.

DRAIN PLUGS

If motor is totally enclosed fan-cooled or non-ventilated it is recommended that condensation drain plugs be removed. These are located in the lower portion of the endshields. Totally enclosed fan-cooled "XT" motors are equipped with automatic drains which should be left in place as received.

INSTALLATION (Cont'd)

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ROTATION

To reverse the direction of rotation, disconnect from power source and interchange any two of the three line leads for three phase motors, for two phase four wire, interchange the line leads on any one phase. For two phase three wire, interchange phase one and phase two line leads.

TEMPERATURE RISE

Under normal operating conditions, with the motor applied in accordance with the nameplate rating, the temperature rise will not exceed the proper limits. Always use a thermometer to determine the heating of a motor. The hand is not reliable in determining whether or not the motor is too hot.

TEST FOR GENERAL CONDITION

If the motor has been in storage for an extensive period or has been subjected to adverse moisture conditions, it is best to check the insulation resistance of the stator winding with a megohmeter.

If the resistance is lower than one megohm the windings should be dried in one of the two following ways:

1. Bake in oven at temperatures not exceeding 90°C. until insulation resistance becomes constant.
2. With rotor locked, apply low voltage and gradually increase current through windings until temperature measured with thermometer reaches 194°F. Do not exceed this temperature.

INITIAL LUBRICATION

"Reliance 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 relubricated prior to starting."

OPERATION

Due to the inherent characteristics of insulating materabnormally high temperatures shorten the operating of electrical apparatus. The total temperature, not the temperature rise, should be the measure of safe operation. The class of insulation determines the maximum safe operating temperature. Aging of insulation occurs at an accelerated rate at abnormally high temperatures. A general rule for gauging the effect of excessive heat is that for each 10°C. rise in temperature above the maximum limit for the insulation, the life of the insulation is halved.

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

Periodic checks of phase voltage, frequency and power consumption of a motor while in operation are recommended; such checks assure 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.

Stator troubles can usually be traced to one of the following causes:

Worn bearings	Operating single phase
Moisture	Poor insulation
Overloading	Oil and dirt

Dust and dirt are usually contributing factors. Some forms of dust are highly conductive and contribute materially to insulation breakdown. The effect of dust on the motor temperature through restriction of ventilation is a principal reason for keeping the windings clean.

Squirrel-cage rotors are rugged and, in general, give little trouble. The first symptom of a defective rotor is lack of torque. This may cause a slowing down in speed accompanied by a growling noise or perhaps failure to start the load.

This is caused by an open or high resistance joint in the rotor bar circuit. Such a condition can generally be detected by looking for evidence of localized heating.

Rotating parts, such as couplings, pulleys, internal-external fans and unused shaft extensions should be permanently guarded against accidental contact with hands or clothing.

MAINTENANCE

The fundamental principle of electrical maintenance is KEEP THE APPARATUS CLEAN AND DRY. This requires periodic inspection of the motor, the frequency depending upon the type of motor and the service.

The following should be checked at regular intervals:

1. Windings should be dry and free of dust, grease, oil, and dirt. Windings may be cleaned by suction cleaners or by wiping. Nozzles on suction type cleaners should be non-metallic. Gummy deposits of dirt and grease may be removed by using a commercially available low volatile solvent. WARNING – DO NOT USE GASOLINE OR OTHER INFLAMMABLE SOLVENTS.
2. Terminal connections, assembly screws, bolts and nuts should be tight. They may loosen if motor is not securely bolted and tends to vibrate.
3. Insulation resistance of motors in service should be checked periodically at approximately the same temperature and humidity conditions to determine possible deterioration of the insulation. When such measurements at regular intervals indicate a wide variation, the cause should be determined. Motor should be reconditioned if the motor has been subjected to excessive moisture, or by re-winding or re-insulating if necessary. Enclosed motors require very little attention. Be sure that external air chamber of fan-cooled motors does not become clogged with foreign material which will restrict passage of air.

DISASSEMBLY

If it becomes necessary to disassemble the motor, care should be taken not to damage the stator windings as the insulation may be injured by improper or rough handling. Precautions to keep bearings clean should be exercised.

Before removing either end shield:

1. Disconnect motor from power source. Tag the leads to insure proper reconnection.
2. Remove motor from mounting base.
3. Make end brackets relative to position on frame so they can be easily replaced.

REMOVING BRACKETS AND ROTOR

4. Remove bearing cartridge nuts or screws. (If used)
5. Remove front end bracket bolts.
6. Pull bracket.
7. Remove back end bracket in same manner.
8. Remove rotor.

REMOVING AND REPLACING BALL BEARINGS

BEARINGS SHOULD NOT BE REMOVED UNLESS THEY ARE TO BE REPLACED. WHEN REMOVAL IS NECESSARY, USE A BEARING PULLER. A BEARING PULLER MAY BE RIGGED BY USING A METAL PLATE, WITH HOLES DRILLED TO MATCH THE TAPPED HOLES IN THE INNER CAP. USE CARE TO KEEP THE PRESSURE EQUAL TO PREVENT BREAKING THE CAP.

TO INSTALL A BEARING, HEAT THE BEARING IN AN OVEN AT 250°F. THIS WILL EXPAND THE INNER RACE, ALLOWING IT TO SLIP OVER THE BEARING SEAT. ALL BEARINGS MUST BE REPLACED WITH THE IDENTICAL PART USED BY RELIANCE. IN MANY CASES SPECIAL BEARINGS ARE USED WHICH CANNOT BE IDENTIFIED BY MARKINGS ON BEARING.

THE MAJORITY OF BEARINGS USED NOW HAVE A C3 INTERNAL LOOSENESS.

REASSEMBLY

Follow reverse procedure as outlined for Disassembly. Having marked the brackets in the original position, replace as marked.

INTRODUCTION LUBRICATION AND BEARING

The following instructions are for standard units only for special units and applications requiring different greases and regreasing schedules -- contact the closest Reliance District Office.

Reliance designs provide for mounting anti-friction bearings in rotating machines to afford (1) maximum protection to windings and interior of machines by prevention of grease leakage from bearing housing into machines, and (2) maximum protection to bearings against excess lubricant, insufficient lubricant, dirt and moisture.

In the machining of shafts and mounting parts, extreme care is taken to insure proper fits. Cartridges are made of ferro-silicon iron to reduce distortion after machining.

Various types of anti-friction bearings are used in the wide range of Reliance motors, as needed to meet specific load, speed and service requirements. All anti-friction bearings used by Reliance are carefully selected by the bearing manufacturer.

The following types of anti-friction bearings are commonly used in the Reliance equipment - ted below each:

Single Row, Double-Shielded Ball Bearings

- Series C, D and T-Frame A-c. Motors
- Type "T", Super "T" and "RPM" D-c. Motors
- Rotating V*S Drive Power Units

Cylindrical Roller Bearings

- Type "T" D-c. Motors, Frame 1050-T and Larger. (Opposite Commutator End Only)
- Super "T" D-c. Motors, Frame 500-A and Larger. (Opposite Commutator End Only).
- D60 V*S and above - 3600 RPM. (Commutator End Only).

LUBRICATION OF DOUBLE-SHIELDED BALL BEARINGS

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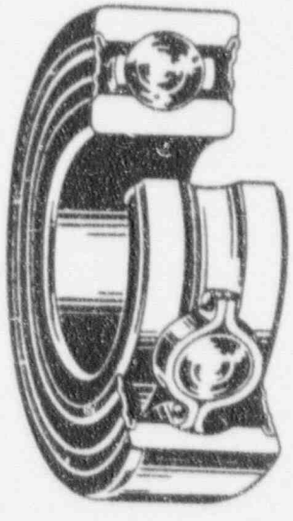
The user of Reliance motors with double-shielded ball bearings can continue whatever general practice he has established for greasing ball-bearing motors throughout his plant.

Shielded bearings are not sealed bearings. With the shielded type of bearing, as shown on the front page, and in cross-section below and at right, grease may readily enter the bearing, but dirt is restricted by the close fitting shields. Bearings of the sealed design will not permit entry of new grease.

Shielded bearings are pre-lubricated as a regular manufacturing procedure by the bearing supplier.

The housings, which serve as a lubricant reservoir, are also filled with grease prior to shipment. By regulating the flow of grease into the bearing, the shields act to prevent excessive amounts from being forced into the bearing. A grease retainer labyrinth is designed to prevent grease from reaching the motor windings on the inner side of the bearing.



Double-Shielded Ball Bearing

It is not necessary to pack the housing next to the bearing full of grease for proper bearing lubrication. It does help, however, to prevent dirt and moisture from entering. Oil from this grease reservoir can and does, over a long period, enter the bearing to revitalize the grease within the shields. Grease in the housing outside the shields, which are stationary, is not agitated or churned by the rotation of the bearings—consequently, it is less subject to oxidation. Furthermore, if foreign matter is present, the fact that the grease in the chamber is not being churned reduces the chance of its contact with the bearing.

Lubricant from the grease reservoir is automatically metered to the bearing by the metering plate. Grease in the housing outside the metering plate is not agitated or churned, by the rotation of the bearing because of the bearing shields and the metering plate—consequently, it is less subject to oxidation. The metering plate, in addition to the bearing shields, protects the bearing against the entry of foreign matter from the outside of the motor. The use of the metering plate permits the use of a larger than normal grease reservoir to insure an adequate source of lubricant at all times. The metering plate provides the right lubrication at all times.

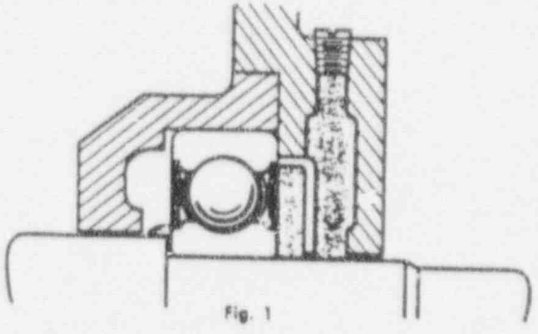


Fig. 1

The cross sectional view of the end bracket, bearing and housing of a motor with cap is shown in Figure 1.

Motors and generators, which include the NEMA standardized frame sizes in a-c. and d-c., and two-bearing motor-generator sets and V*S units are not provided with a drain plug. When grease is added and the housing becomes filled, some grease will be forced into the bearing, and any surplus grease will be squeezed out along the close clearance between the shaft and the outer cap because the resistance of this path is less than the resistance presented by the bearing shields, metering plate, and the labyrinth seal.

Figure 2 is a cross-sectional view of a double-shielded bearing without cap on a motor on which the automatic grease metering plate is used.

The overall design of the shielded bearing and its mounting is effective in any position from horizontal to vertical.

METERMATIC LUBRICATION

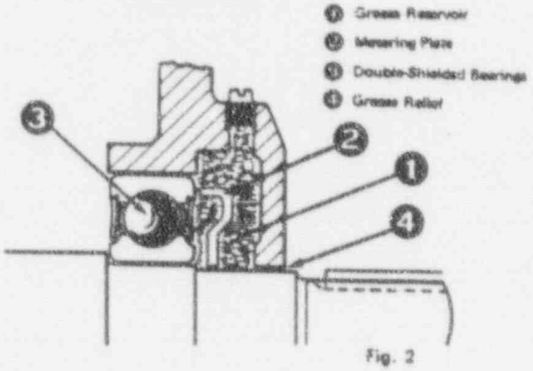


Fig. 2

SIMPLIFIED MAINTENANCE

Properly lubricated, over-greased, or under-greased, the Reliance design provides the answer to securing longer bearing life.

LUBRICATION OF DOUBLE-SHIELDED BALL BEARINGS (Cont'd)

The following procedure is for standard motor bearing installation and does NOT apply to any special motors with a non-standard lubrication system or requirements.

A. Double Shield Ball Bearings
   1. Pack (completely fill) the cavity in the side of the metering plate adjacent to the bearing after metering plate has been pressed into bracket but prior to assembly. Use necessary precautions to prevent contaminating this grease before motor is assembled.
   2. After assembly, lubricate stationary motor until a full ring of grease appears around the shaft at the relief opening in the bracket.

B. Cylindrical Roller Bearings
   1. Hand pack bearing before assembly.
   2. Proceed as outlined in (1) and (2) for double shielded ball bearings.

If under-lubricated after installation, the double-shielded metermatic bearing will last longer than an open (non-shielded) bearing given the same treatment because of grease retained within the shields (plus grease remaining in the housing from its initial filling).

If over-greased after installation, the double-shielded metermatic bearing will operate satisfactorily without overheating because the excess grease is allowed to escape through the clearance between the shield and inner race, and the grease in the housing adjacent to the bearing is not churned, agitated and caused to overheat. An open bearing under the same treatment may fail.

It is not necessary to disassemble motors at the end of fixed periods to grease bearings. Bearing shields do not require replacement.

Double-shielded ball bearings should not be flushed for cleaning. If water and dirt are known to be present inside the shields of a bearing because of a flood or other circumstances, the bearing should be removed from service. All leading ball-bearing manufacturers are providing reconditioning service at a nominal cost when bearings are returned to their factories.

SUGGESTED LUBRICATION PROCEDURE

For many applications, double-shielded ball baerings will operate indefinitely without the addition of grease to the initial supply in the housing, which was filled before shipment.

For most 1800 rpm. and slower speed applications, Reliance motors and generators may be greased in accordance with established plant policy. In general, small motors, frames 180A, through 286A, D3 through D30 V*S, 3600 rpm. power units, and 180 through 326 a-c. motors, on an eight-hour-day basis, operating at 0°–50°C., and under normal plant conditions are adequately lubricated, if greased twice a year.

Frequency of greasing is dependent upon such factors as speed, temperature, size of bearing, load, and type of bearing; e.g., ball bearing and cylindrical roller bearing.

In general, the following equipment operating at temperatures of 0°–50°C., under normal plant conditions, need to be greased only 3 or 4 times a year: large ball bearing motors - d-c. motors, frames 364A through 406A, and a-c. motors, frames 364 through 445, operating at speeds of 1800 rpm. and slower; D40 through D200 V*S, 1800 rpm. and 1200 rpm., 3 and 4-bearing power units; and D40 through D100 V*S, 3600 rpm. power units. Under the same conditions the Super "T" d-c. motor roller bearing should be greased 6 or 8 times a year.

When adding grease, use a product which conforms to the requisites stated on page 4, and

(1) Remove plug from filling hole.

(2) Force grease through filling hole until grease appears at drain hole or along shaft.

(3) Replace plug after motor has run for at least 2 Hrs.

(4) Wipe away excess grease which has appeared at drain hole or along shaft.

In greasing fan-cooled motors, grease the bearing at the end opposite the fan end first, forcing grease through filling hole until grease appears along shaft. Note how much grease has been added, then in greasing the fan-end bearing, add approximately two thirds of this amount.

C-Face, D-Flange, and P-Base bracket type motors in addition to Explosion-Proof and Tachonite construction motors do not incorporate grease relief around the shaft. Grease relief on these motors is through a relief fitting. In lubricating these motors, grease should be added until it begins to relieve out through any hole in the relief fitting.

LUBRICATION OF CYLINDRICAL AND SPHERICAL ROLLER BEARINGS

Sufficient grease to form a film over the rollers and races of the bearing is all that is required for perfect lubrication of roller bearings.

Due to the friction of the grease, bearings may overheat if packed full of some grades of grease.

Motors as shipped from the factory have sufficient grease to lubricate the bearings adequately for at least three months in normal applications. We recommend inspection of the bearings at the end of two or three months, to see if it is necessary to add grease. Caution—whenever the bearing

LUBRICATION OF CYLINDRICAL AND SPHERICAL ROLLER BEARINGS (Cont'd)

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housing is opened, keep bearing and grease absolutely free om dirt.

As a practical matter, bearings should be lubricated at definite intervals. Study will be required to determine how frequently this should be done for any particular application.

Cylindrical Roller Bearing

Spherical Roller Bearing

HOW TO CLEAN ROLLER BEARINGS

When it is necessary to clean a non-shielded bearing to maintain or restore operation (such as after motor has been flooded or the bearing exposed to dirt), wash out the bearing with clean carbon tetrachloride or gasoline until all foreign matter is removed. To prevent corrosion, the bearing should be given a final wash with light lubricating oil fore filling with new grease.

Cylindrical roller bearings, where used, are single row and the method of greasing is the same as for ball bearings, except that they must be lubricated more frequently.

Figure 3 is a cut away view of the cylindrical roller bearing and housing in an a-c. motor.

Spherical roller bearings must be lubricated on each side since grease does not readily pass from one row of rollers to the other. A-c. motors using spherical roller bearings are provided with two filling holes having plugs or fittings. Generators and d-c. motors have one filling hole feeding both sides of the bearing to permit the lubricant to distribute evenly over both sets of rollers. These bearings must be lubricated more frequently than ball bearings, and a low-consistency (high penetration) grease should be used.

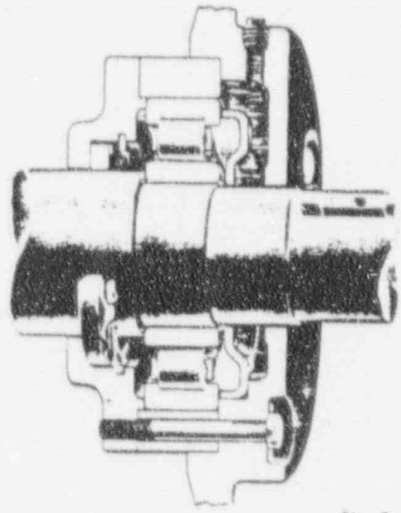

Fig. 3

HIGH TEMPERATURE CONDITIONS AND LARGE BEARINGS OPERATING AT HIGH SPEEDS

Bearings operating with actual grease temperatures of 80° - 90°C., large bearings (size 315 and larger) used in frames 1050-T and larger, and bearings operating at speeds above 1800 rpm., need lubrication at more frequent intervals. These larger bearings are usually found in a-c frame sizes 504 and larger, and d-c. frames sizes 503A, Super 'T', and above.

Suggested procedure is to add a small amount of grease about every 700 hours of operation. Grease should be added slowly, preferably with the motor running, and results observed carefully.

Too much grease may cause overheating in high speed bearings which can result in bearing failure.

If the temperature in the grease reservoir rises to above 80°C. from a previously lower temperature, shut down the motor. By removing excess grease and allowing time for cooling, the bearing should regain its normal clearance and operating temperature.

GREASE FOR ANTI-FRICTION BEARINGS OF RELIANCE MOTORS

There are a number of greases which are suitable as a bricant for anti-friction bearings in electric motors. It is impossible to list all of the suitable greases in this instruction manual. Our experience has indicated that characteristics which are listed below are desirable requisites for a lubricant. The user's own experience will undoubtedly determine the grease to be used.

Use a grease which is neutral, non-fibrous, with a high melting point (350°F.), and with a minimum tendency to

GREASE FOR ANTI-FRICTION BEARINGS OF RELIANCE MOTORS (Cont'd)

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separate into oil and soap. The grease should have a very slow oxidizing rate.

In general, the lubricant used should have a melting point of at least 100°F. higher than the operating temperature to which it is subjected.

The following greases are listed as having properties desirable for the proper lubrication of anti-friction bearings in Reliance motors. This list does not constitute an endorsement of these products.

American Oil Co.	Rykon #2
ARCO	Litholine Industrial #2
BP Oil Co.	CC-EP #2
Gulf Oil Co.	Precision No. 2
Humble Oil & Refining Co.	Andok 260
Master Lubricants Co.	Lubriko M-21
Mobil Oil Co.	Mobilux #2
Shell Oil Co.	Alvania No. 2
ϕ Standard Oil of California	Chevron SD 12
Sun Oil Co.	Prestige 42
Texas Oil Co.	Texaco AFB #2

ϕ Reliance standardized grease.

PRECAUTIONS IN HANDLING

The most important single factor in securing good service from sleeve, ball and roller-bearing motors is to keep dirt, dust and foreign particles out of the bearing. One bearing manufacturer claims that 90 percent of all bearing failures are caused by dirt.

1. Use only clean grease from clean containers, and handle so as to keep it clean.
2. Never open a bearing housing in a dusty atmosphere.
3. Never open a bearing housing without first cleaning off all dirt from adjacent surfaces.
4. Always protect an exposed bearing by a protective cover (clean paper or lint-free cloth).

SLEEVE BEARINGS

Motors with sleeve bearings are shipped from the factory without oil. Fill the reservoirs to the center of the oil level gauge (minimum) to 3/8 above center (maximum) with a good grade of turbine oil as recommended for electric motor and generator use by a reputable oil manufacturer.

THESE OILS MAY BE USED

Mobil DTE Light or Heavy Medium
Texaco Regal A or PC

Use Oil of the viscosity range indicated in the following table:

Speed Range RMP	Recommended Viscosity Range SSU @ 100°F
1500 and below	250-350
1800 and over	100-200

Watch oil rings when first starting to see that they revolve.

Change oil every six months or more often under severe operation conditions.

CONSTANT LEVEL OILER

When supplied, refer to instructions accompanying the constant level oiler.

REPLACEMENT BEARINGS

Your maintenance program will not be complete without including spare bearings. It must be remembered that the bearing is a wearable component and therefore must eventually be replaced. To insure that you are able to maintain original operation, we recommend the purchase of spares directly from Reliance.

All bearings used in Reliance motors are subject to exact specifications and tests necessary to satisfy performance requirements. In this manner, it is possible to duplicate your present bearing. Markings on the bearing do not indicate complete specifications.

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