U. S. ELECTRICAL MOTORS

INSTALLATION, OPERATION, AND MAINTENANCE

INSTRUCTION MANUAL

HIGH THRUST VERTICAL MOTORS WITH PLATE TYPE THRUST BEARING

9600 FRAME, TYPES RV-5 (SOLID SHAFT) AND RU-5 (HOLLOSHAFT)
OPEN DRIPPROOF, WEATHER PROTECTED TYPES I AND II.

Part No. 985333

U.S. Electrical Motors
Installation, Operation, and Maintenance

Index

U.S. Electrical Motors
Installation, Operation, and Maintenance

SAFETY FIRST

High voltage and rotating parts can cause serious or fatal injury. Safe installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Disconnect all power to motor prior to initiating any maintenance or repairs.
2. Avoid contact with rotating parts.
3. Act with care in accordance with prescribed procedures in handling and lifting this equipment.
4. Be sure unit is electrically grounded and proper electrical installation wiring and controls are used consistent with local and national electrical codes. Refer to "National Electrical Code Handbook" - NFPA No. 70. Employ qualified electricians.
5. Be sure equipment is properly enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.
6. Make certain that all electrical connections have been properly terminated including proper insulation and all outlet accessory and access covers have been returned to their original intended position.
7. Be sure shaft key is fully captive before unit is energized.
8. CAUTION - All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing.
9. Always be sure oil reservoirs are filled with correct oil to proper level before operating.
10. Provide proper safeguards for personnel against rotating parts and applications involving high inertial loads which can cause overspeed.
11. Avoid extended exposure to equipment with high noise levels.
12. Observe good safety habits at all times and use care to avoid injury to yourself or damage to equipment.
13. Motors can retain a lethal charge even when turned off. This is especially true when either surge arrestors (capacitor) or power factor correction capacitors are utilized. In addition, accessories may be energized when the motor is shut off.
14. Be familiar with the equipment and read all instructions thoroughly before installing or working on this equipment.

I SHIPMENT

Prior to shipment, all motors undergo extensive mechanical and electrical testing, and are thoroughly inspected. Upon receipt of motor, carefully inspect for any signs of damage that may have occurred during shipment. Should such damage be evident, unpack the motor at once in the presence of a claims adjuster and immediately report all damage to the transportation company

When contacting U. S. Electrical Motors concerning the motor, be sure to include the complete motor identification number, frame and type which appear on the nameplate.

II HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement of sufficient strength to lift the motor safely. Motor weight will vary between 15,000 and 25,000 lb., depending on rating and on whether accessories such as Weather Protected shrouding and non-reverse ratchet are supplied. The spreader bar should have the lifting rings or hooks positioned to equal the span of the lifting lugs. **The lifting lugs are intended to lift the motor weight only.**

CAUTION

Lifting the motor by other means may result in damage to the motor or injury to personnel.

III STORAGE

1. Store motor indoors, in an area free from excessive ambient vibration.

2. Motors are shipped with a special rust preventative circulating oil in the bearing housings which should be left in during motor storage. When taking a unit out of service and putting it into storage, drain housings of oil and add approximately 1/2 gallon (1.9 liters) of circulating oil such as ENLUBOL 453VPRP, available from Engineered Lubricants, (USEM part number 868238) or equivalent into each oil sump. For storage times exceeding 6 months or in unusual environments, consult USEM.

3. To prevent moisture accumulation in the motor, space heaters supplied with motor should be energized during storage.

4. Periodically inspect the rust preventative coating on all external machined surfaces, including shaft extension. If necessary, re-coat the surfaces with a rust preventative material such as Rust Veto No. 342, manufactured by E. F. Houghton Co., or an equivalent.

5. Start-up preparation after storage.

   A. Thoroughly clean and inspect motor to restore to an "as-shipped" condition.

   B. Drain circulating oil from bearing housings and refill with lubricant recommended in this manual or on motor lubrication plate. Secure all pipe fittings, etc. to prevent leakage.

C. Check insulation resistance.

The only accurate way to evaluate the condition of the winding insulation is to maintain a history of insulation readings. Over a period of time, these readings will tend to indicate a trend. If a downward trend develops, or if the resistance drops too low, thoroughly clean and dry the windings, retreating as necessary at an authorized electrical apparatus service shop.

The recommended insulation resistance test is as follows:

(1) Using a megohm meter, with winding at ambient temperature, apply DC voltage (noted below) for sixty (60) seconds and take reading.

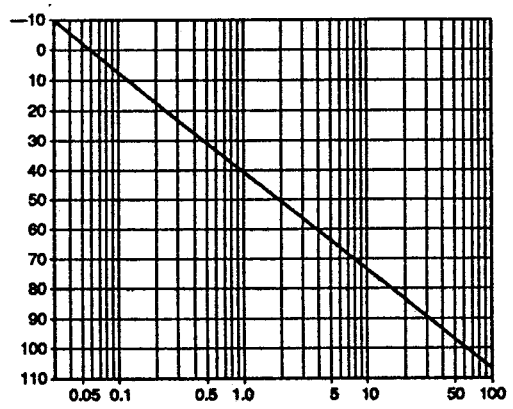
Rated Motor Voltage	Recommended DC Test Voltage
600 and less	500 VDC
601 through 1000	500 to 1000 VDC
1001 and up	500 to 2500 VDC (2500 VDC optimum)

(2) For comparison, the reading should be corrected to a 40°C base temperature. This may be done by utilizing the following formula:

$$R_{40C} = R_t \times K_t$$

Where:
R_{40C} = insulation resistance (megohms) corrected to 40°C
R_t = measured insulation resistance (megohms)
K_t = temperature coefficient from Graph 1

GRAPH 1



(Adapted from IEEE 43)

INSULATION RESISTANCE TEMPERATURE COEFFICIENT (Kt)

(3) Insulation resistance readings must not drop below the value indicated by the following formula:

$$R_m = K_v + 1$$

Where:
R_m = minimum insulation resistance (megohms)
K_v = rated motor voltage in kilovolts

(4) Dielectric absorption ratio:

In addition to the individual test reading, a dielectric absorption ratio may be required. The dielectric absorption ratio is obtained by taking megohm meter readings at a one minute and ten minute interval, or when hand powered megohm meters are used, at a thirty second and sixty second interval. The voltage should be the same as outlined in item 3C, part 1.

The ratio is obtained by dividing the second reading by the first reading and is based on a good insulation system increasing its resistance when subjected to a test voltage for a period of time. The ratios are as follows:

10 Minute : 1 Minute			60 Second : 30 Second		
Dangerous	=	Less than 1.0	Poor	=	Less than 1.1
Poor	=	1.0 to 1.4	Questionable	=	1.1 to 1.24
Questionable	=	1.5 to 1.9	Fair	=	1.25 to 1.3
Fair	=	2.0 to 2.9	Good	=	1.4 to 1.6
Good	=	3.0 to 4.0	Excellent	=	Over 1.6
Excellent	=	over 4.0			

If a lower insulation resistance reading is obtained in either the individual test or dielectric absorption ratio test, thoroughly clean and dry the windings. Recheck insulation resistance and dielectric absorption ratio.

NOTE: Slightly lower dielectric absorption ratios may be acceptable when high initial insulation resistance readings are obtained (1000 + megohms). Refer any questions to U.S.E.M. Product Service Department. For additional information on insulation testing, refer to IEEE Transaction No. 43.

IV INSTALLATION LOCATION

When selecting a location for the motor and driven unit, keep the following items in mind:

1. The location should be clean, dry, well ventilated, properly drained, and provide accessibility for inspection, lubrication and maintenance. The location should also provide adequate space for motor removal without shifting the driven unit.

2. The motor should not be installed in close proximity to any combustible material or where flammable gases may be present.

V INITIAL INSTALLATION

1. General

Reliable, trouble free operation of a motor and driven unit depends on a properly designed foundation and base plus good alignment. Improper installation may result in noisy operation, excessive vibration, bearing damage or failure, or motor failure.

2. Electrical Connection.

   Refer to the motor nameplate for power supply requirements and to the connection diagram on the motor. All electrical connections must be tight and in agreement with the connection diagram. Carefully tape all connections with electrical tape to be sure that they will not short against each other or to ground. The motor must be grounded to guard against possible electrical shock. Refer to the National Electrical Code Handbook (NFPA No. 70) and to local electrical codes for proper wiring, protection, and wire sizing. ***Be sure proper starting equipment and protective devices are used for every motor.*** For assistance, contact the local sales office of the motor starter manufacturer for the particular brand of equipment to be used.

3. Direction Of Rotation.

   Standard motors are designed to operate in either CCW or CW direction facing the top of the motor. To reverse direction of rotation (if the motor is not operating in the desired direction) interchange any two of the three power leads on the motor. Note that if a Non-Reverse Ratchet is supplied on the motor, it will prevent the motor from rotating in one direction.

CAUTION

Be sure the power is off and steps are taken to prevent accidental restarting of the motor before attempting to change any electrical connection.

---

4. Initial start.

   After installation is completed, but before motor is put into regular service, make an initial start as follows:

   A. Assure that motor and control device connections agree with wiring diagrams.

   B. Assure that voltage, phase, and frequency of line circuit (power supply) agree with motor nameplate.

   C. Check insulation resistance as outlined in Section III.

   D. Check all foundation, base, and coupling bolts to assure that they are tight.

   E. Check for proper or desired rotation. See item 3 of this section for details.

   F. Assure that all protective devices are connected and operating properly, and that all outlet box, accessory and access covers have been returned to their original intended position.

   G. Start motor and monitor closely to assure that no unusual condition develops.

   H. CAUTION: All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing.

VI NORMAL OPERATION

Start the motor in accordance with standard instructions for starting equipment used.

1. General Maintenance.

   Regular, routine maintenance is the best assurance of trouble-free, long-life motor operation. It prevents costly shutdown and repairs. Major elements of a controlled maintenance program are:

   A. Trained personnel who have a working knowledge of rotating equipment and have read this manual.

   B. Systematic records which contain at least the following:

      1. Complete nameplate data.
      2. Prints (wiring diagrams and certified outline dimensions).
      3. Alignment data.
      4. Results of regular inspection.
      5. Repairs.
      6. Lubrication data: - Method of application
         - Types of lubricants for wet, dry, hot, or adverse conditions
         - Maintenance cycle by location

2. Inspection and Cleaning.

   Stop the motor before cleaning. ***CAUTION: Assure against accidental starting of the motor.*** Clean the motor inside and out regularly. The frequency of cleaning depends upon actual conditions existing around the motor. Use the following procedures as they apply:

   A. Wipe off dirt, dust, oil, water, or other liquids from external surfaces of the motor. These materials can work into or be carried into the motor windings and may cause overheating or insulation breakdown.

   B. Remove dirt, dust, or debris from ventilation air inlets. Never allow dirt to accumulate near air inlets. Never operate a motor with air passages blocked.

CAUTION

When using compressed air, always use proper eye protection to prevent eye injury

---

   C. Clean motors internally by blowing with clean, dry, compressed air at 40 to 60 PSI. If conditions warrant, use a vacuum cleaner.

   D. When dirt and dust are solidly packed, or windings are coated with oil or greasy grime, disassemble the motor and clean with solvent. Use only high-flash naphtha, mineral spirits, or Stoddard solvent. Wipe with solvent dampened cloth, or use suitable soft-bristled brush. DO NOT SOAK. Oven dry (150 to 175 F) solvent cleaned windings thoroughly before reassembly.

   E. Filters in the air intakes, if provided, should be inspected regularly and cleaned or replaced as required to maintain adequate air flow to motor.

3. Insulation Resistance.

   Measurements should be taken at time of initial motor installation and periodically thereafter. Measurements are also important when repairs are made, after moisture is removed from winding, or winding is cleaned. Refer to section III for measurement procedures.

VII MOTOR ASSEMBLY AND DISASSEMBLY PROCEDURES

Assembly Procedure (To disassemble motor, follow procedure in reverse)

1. Assemble **air deflectors** onto upper and lower end brackets. Install **cooling coils** with straps into upper and lower end brackets (Cooling coil in lower end bracket is not supplied on some slow speed ratings). Inspect and clean bracket oil sump areas as necessary.

2. Install **stator assembly** onto **lower bracket**. Be sure to properly orient the main conduit box opening with respect to the oil fill and drain. (Refer to motor dimension print for proper orientation.)

3. Install **rotor assembly** into stator. Rotor shaft shoulder will rest on top of the lower bracket. Use caution when handling and installing rotor to not scratch or otherwise damage the bearing journal on the lower end or the insulated mounting journal on the upper end.

4. Install **upper bracket** onto stator assembly. Use caution to not damage the shaft journals. Be sure to properly orient the oil fill and drain relative to the main conduit box opening. (Refer to motor dimension print for proper orientation.)

5. Assemble **thrust bearing assembly (with tilting pads)** into upper bracket. Note that bearing temperature probe hole must line up with corresponding hole in upper bracket.

6. Install bearing **axial retention screws** radially into upper bracket bearing hub at two (2) places, opposite, to secure bearing axially.

7. Apply a thin film of lubricating oil to all bearing surfaces on the bearing **thrust block** and install onto shaft, keyed to shaft with **insulated key**. Use caution not to damage shaft journal or bearing surface finish.

8. **Set rotor end play** (total motion of the rotor if thrusted in both directions) as follows:
   a. Install **upper guide bearing** to upper bracket *without* shims between the guide bearing mounting surface and the bracket mounting surface. Measure the gap between the bracket and guide bearing mounting surfaces and add .020 to .025 inches to the measurement. The resulting number is the total thickness of shims to be added between the guide bearing and the upper bracket mounting face.

   b. Remove the upper guide bearing and add shims as determined in the previous step. Re-assemble upper guide bearing to upper bracket. Assure proper orientation between bearing temperature probe hole in bearing and corresponding hole in upper bracket.

9. After end play is set, install **bearing temperature detector probes** into upper guide and thrust bearings.

10. Install **insulated washer** above thrust block.

11. If a **non-reverse ratchet** is supplied on the motor, install as follows:
    a. Assemble **ratchet adapter, connection spring** and **stationary ratchet** to upper bracket. Dowel pins in ratchet adapter and stationary ratchet are to engage ends of connection spring.
    b. Install **pressure plate** with studs, nuts and die springs. Die springs are to be compressed as outlined on the instructions stamped on pressure plate.
    c. Install **rotating ratchet** with quantity-2 .06 inch thick shims between the insulated washer and the bottom of the rotating ratchet. Rotating ratchet is secured to shaft with a **square key** and **locknut and lockwasher.** Gap between the rotating ratchet and stationary ratchet is to be .06 inch minimum to .13 inch maximum all the way around. Add or remove shims between the rotating ratchet and insulated washer as required to obtain proper gap.
    d. Install **ratchet pins, retainer plates** and **gaskets** to rotating ratchet.

12. If a **non-reverse ratchet** is **not supplied** on the motor, install **coupling adaptor and key,** with **shaft locknut and lock-washer** to secure thrust block in place. Install **upper dust cover** to upper bracket.

13. Bolt **coupling** to top of rotating ratchet or coupling adaptor (HOLLOSHAFT motors only).

14. Install **canopy cap** and **gasket** to upper bracket.

15. Apply a thin film of lubricating oil to the shaft lower bearing journal and assemble the **lower guide bearing** into lower bracket. Use caution not to damage bearing journal surface finish.

16. Install **lower bearing access cover** and **O-ring** to lower bracket. O-ring to be lubricated with silicone grease.

17. At this point in the assembly process, **check rotor end play** by mounting a dial indicator tip at the upper end of the shaft with the base securely mounted to a stationary part of the motor. Carefully lift up the rotor and observe the indicator reading. Indicator movement should be between .020 and .025 inches. If it is not within the required range, remove parts on upper end necessary to gain access to the guide bearing shims. Add or remove shims as necessary to obtain correct end play. Reassemble motor and recheck. Repeat this process as necessary to obtain proper end play.

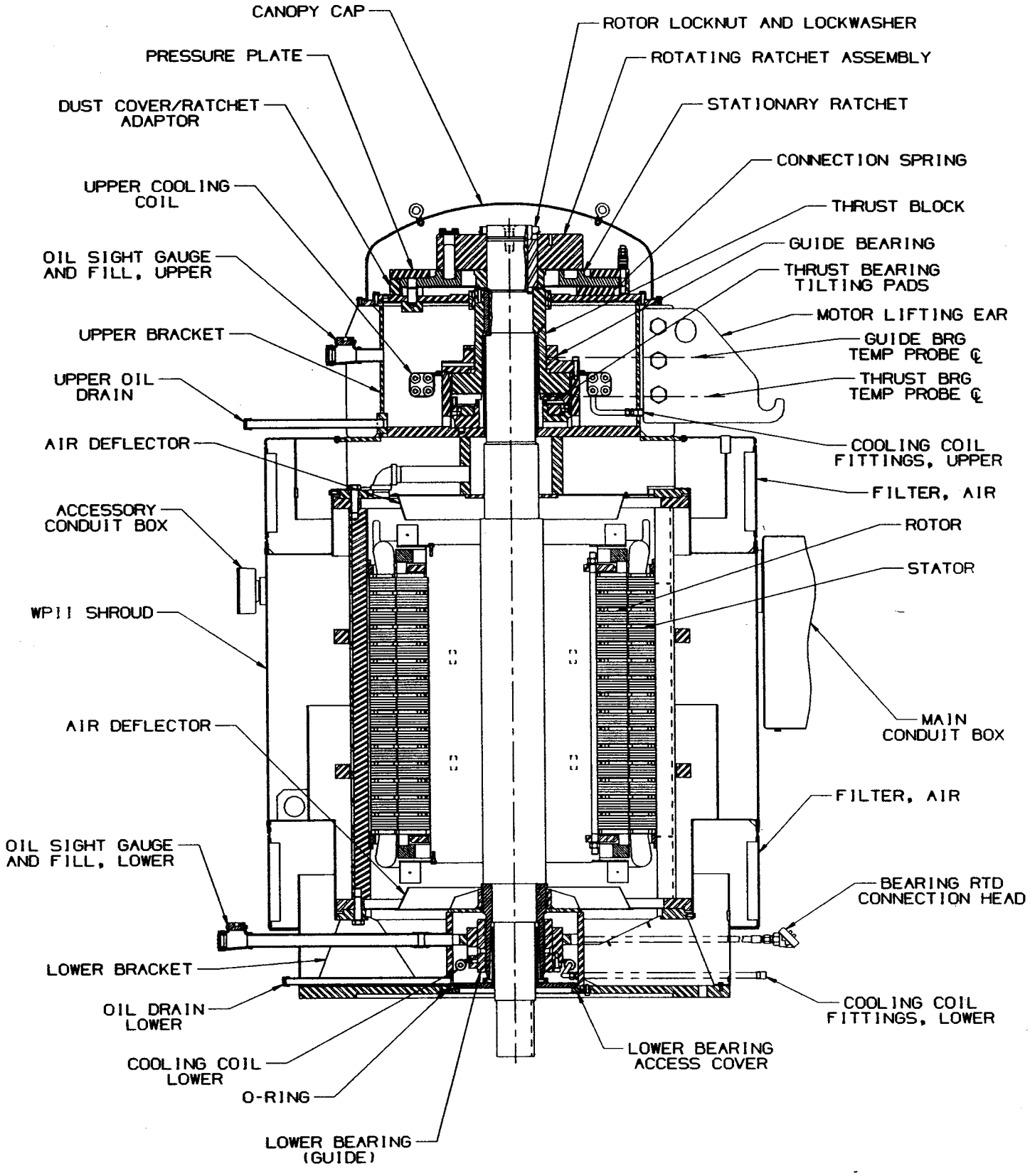
18. On **Weather Protected Type-II motors,** install **shrouding, screens** and **filters** to motor. Bolted-on motor **lifting ears** must be temporarily removed to allow assembly of shrouding. While assembling, pay close attention to orientation of oil fill and drain, bearing probes and cooling coil inlet and exit pipe locations on lower end shroud. Also note location of motor lead exit on stator relative to opening in center shroud. Re-install motor lifting ears after assembly of shrouding is complete.

19. Install all pipe fittings for oil fill and drain, cooling coil connections and bearing temperature detector probe into lower bracket. Install lower bearing temperature detector probe. Install conduit boxes to motor.

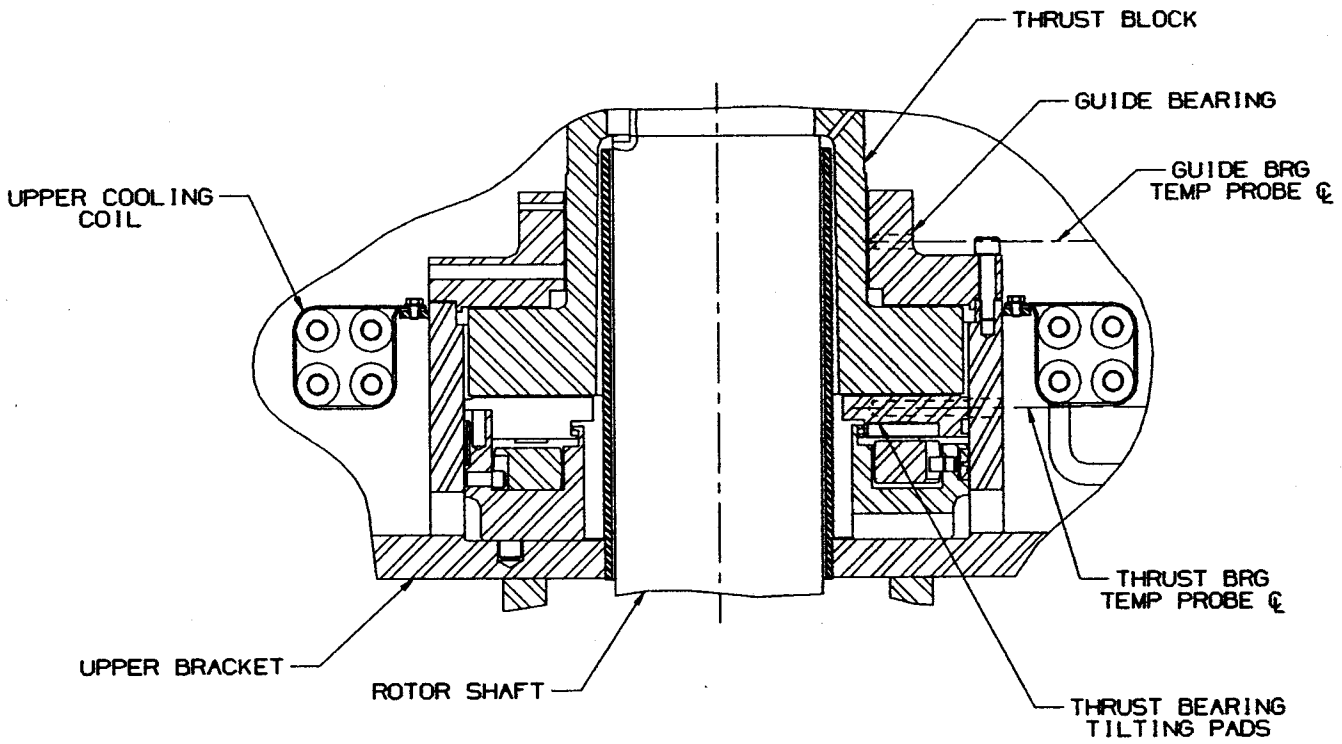
Recommended Fastener Torque Values (Based upon unlubricated Grade 5 Fastener):

Fastener Size	Torque (Ft-Lb.)	Fastener Size	Torque (Ft-Lb.)
1/4 - 20	8	3/4 - 10	260
5/16 - 18	17	7/8 - 9	430
3/8 - 16	30	1" - 8	640
7/16 - 14	50	1-1/8 - 7	800
1/2 - 13	75	1-1/4 - 7	1120
9/16 - 12	110	1-3/8 - 6	1460
5/8 - 11	150	1-1/2 - 6	1940

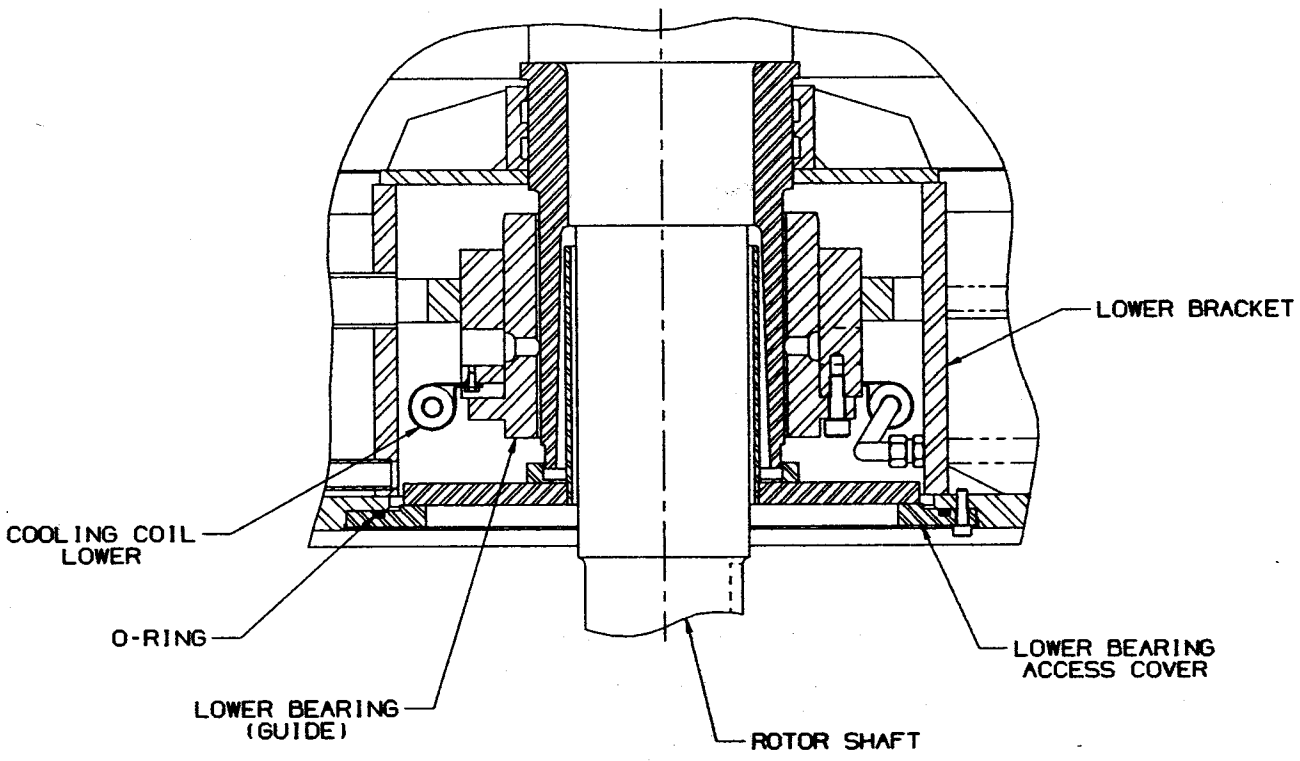
9600 FRAME MOTOR TYPE RV-5



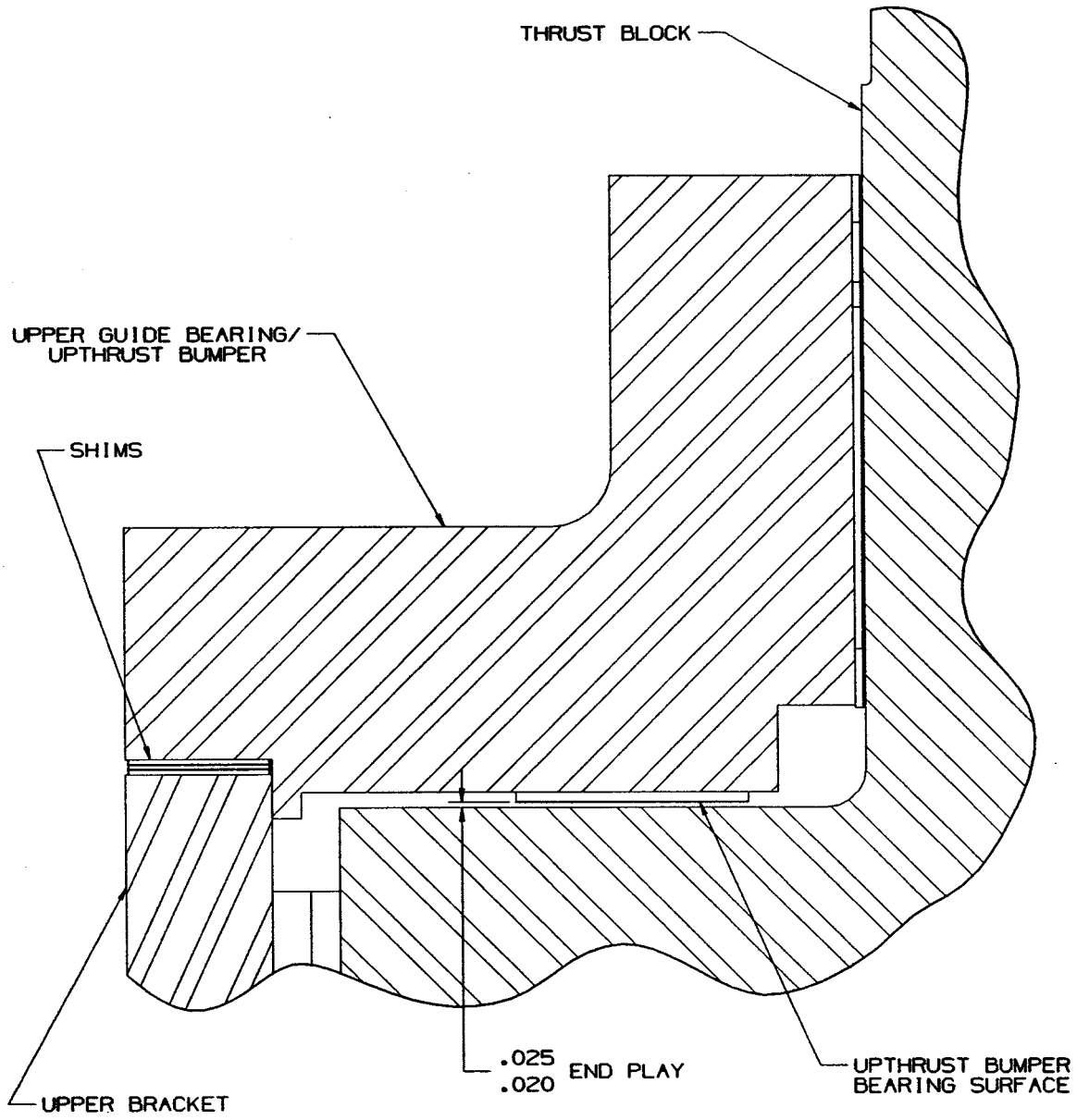
UPPER BEARING DETAIL



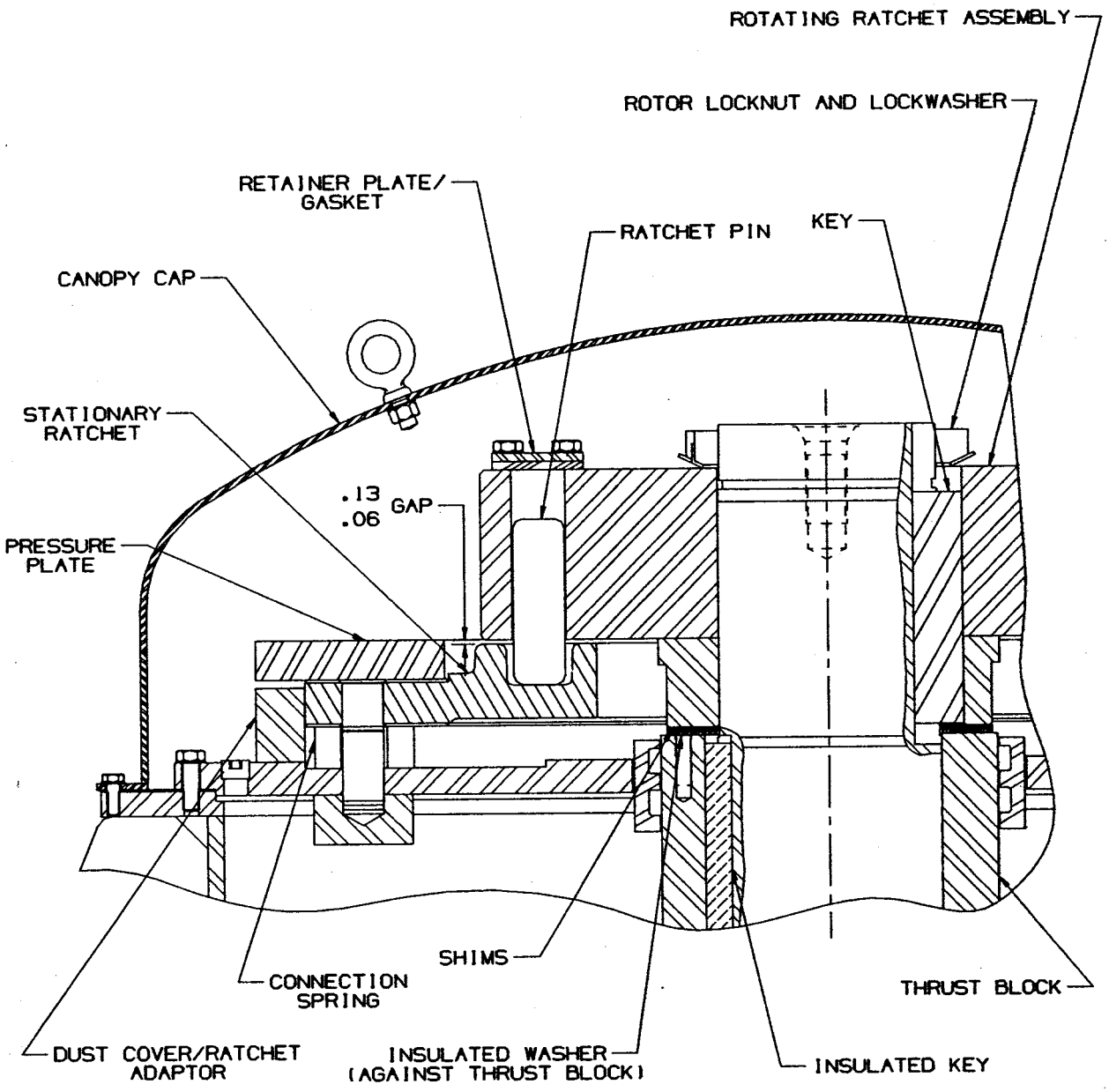
LOWER BEARING DETAIL



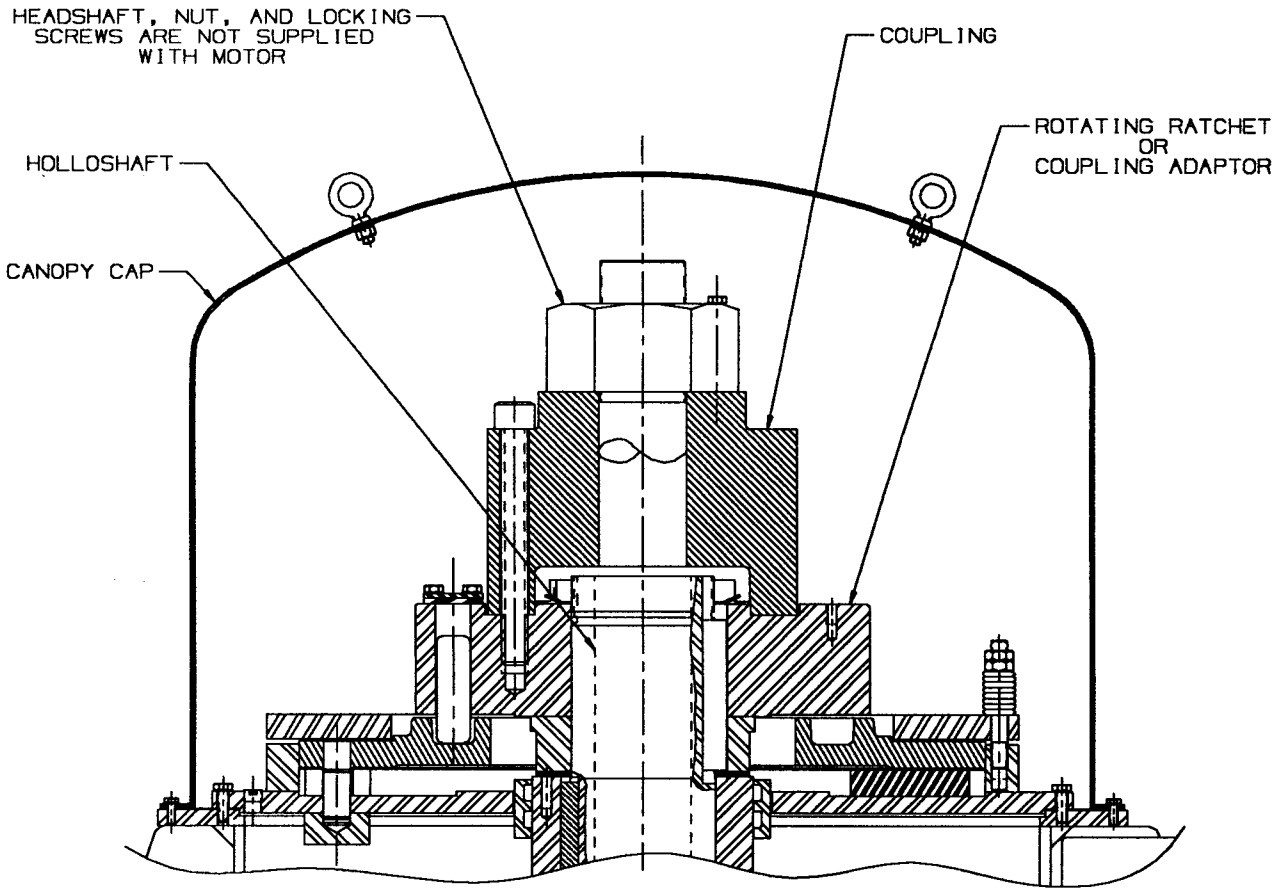
UPPER BEARING SHIM DETAIL



NON-REVERSE RATCHET DETAIL



UPPER END DETAIL - HOLLOSHAFT MOTOR



VIII LUBRICATION

Motor must be at rest and electrical controls should be locked open to prevent motor energizing while being serviced. If motor is being taken out of storage, refer to section III "STORAGE" for preparation instructions.

Fill bearing oil sumps to proper level as indicated on sight gauge windows. Use oil as indicated in the table below.

Recommended oil change interval is every 2500 hours of running or 1 year, whichever comes first. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service condition may warrant more frequent oil changes. Refer to lubricant manufacturer for recommendation on oil change intervals where conditions of contamination, excessive heat and oxidation or other severe duty exist.

For optimum bearing life, it is recommended that oil sumps be flushed at the time of oil change to remove any particulate matter which could be carried into the bearings. Use the same type of oil to flush reservoir as specified for lubrication. Whenever the motor is fully disassembled for any reason, the sump should be washed with a suitable detergent and allowed to dry completely.

The primary purpose of any lubricant is to provide a film between moving parts, thus minimizing metal-to-metal contact. Friction, wear, scoring and seizure of bearing surfaces can be greatly reduced by using a lubricant of the proper viscosity (a measurement of a liquid's resistance to flow). Also important in specifying lubricating oil is the viscosity index. This term describes the change in viscosity of an oil due to a given change in temperature.

Turbine oils are ideally suited to motor bearing lubrication. These high quality mineral oils are refined to remove unstable elements. They also contain additives such as anti-oxidants, anti-foaming agents and corrosion inhibitors.

Because of the special nature of turbine oil, it is wise to keep a supply on hand as it is not always immediately available.

Recommended oils:
ISO Oil Grade: 68
Oil Viscosity: 284 to 347 SSU at 100° F
Viscosity index: 90 Minimum

Oil Manufacturer	Specification
Conoco, Inc.	Dectol R & O 68
Exxon Oil Co.	Teresstic 68
Mobil Oil Co.	DTE Oil Heavy Medium
Shell Oil Co.	Tellus 68
Texaco, Inc.	Regal 68
Chevron, Inc.	OC Turbine Oil 68

Note: Information contained on the motor lubrication nameplate supersedes the information in this manual. The above recommended oils are given assuming ambient temperature is between 40° F (4° C) and 120° F (49° C). For ambient temperatures other than these, a different oil viscosity may be required. Refer to US Electrical Motors.

IX WATER COOLING FOR BEARINGS

Bearings require water cooling to maintain proper oil viscosity at operating conditions. Clean, non-corrosive water at 4 GPM (15 l/min) minimum should be provided to cooling coils at a maximum inlet temperature of 90 °F (32 °C) and a maximum pressure of 125 PSIG (860 kPa-gauge). External water connections must be self-draining to prevent cooling coil rupture at freezing temperatures.

X NON-REVERSE RATCHET

The non-reverse ratchet prevents the pump and motor from operating in the reverse direction. The assembly consists of a pin-type rotating ratchet and a stationary plate with teeth to engage the pins. A C-shaped connection spring acts as a dampening device to limit the impact force on the ratchet components.

The ratchet pins are held in place during motor operation by centrifugal force. At the instant of zero rotation, the pins drop into engagement with the teeth in the stationary plate.

XI BEARING DESCRIPTION AND INSPECTION PROCEDURES

BEARING DESCRIPTION

The bearings consist of upper and lower end sleeve-type guide bearings and a multiple-shoe tilting pad thrust bearing with a flat land plate bearing for momentary upthrust. All bearings are faced with tin based babbitt on a steel backing and operate on the hydrodynamic principle, being self-lubricated in normal service. The lubricating oil's cleanliness, quality and proper viscosity are vital to attaining the optimum bearing life.

Standard motors are supplied with bearing temperature detectors, which should be monitored during all motor operation. Maximum operating temperature under steady-state conditions is 80 °C at the bearing babbitt.

A bearing which overheats should be carefully inspected. Overheating of the bearing may be caused by one of the following factors:

1. Insufficient quantity of oil in the reservoir.
2. Oil of poor quality.
3. Dirty, contaminated or oxidized oil.
4. Rough bearing surfaces due to corrosion or careless handling.
5. Excessive end thrust.
6. Incorrect cooling water supply.

INSPECTION OF LOWER GUIDE BEARING

CAUTION: Do not attempt work on lower bearing with upper rotor locknut removed.

1. Drain oil from lower bearing chamber.
2. Remove bottom cover assembly from lower bracket.
3. Remove bearing temperature detector probe and bearing retaining screws and carefully remove the bearing.
4. Inspect bearing bore and shaft journal for any unusual or excessive wear patterns or distinct scratches. Damaged bearings should be repaired or replaced. Scratches or marks on shaft journals are not acceptable and must be "polished" out.

5. All parts, including bearing chamber, are to be thoroughly cleaned before re-assembly. Any traces of dirt, chips, loose paint, etc. are not acceptable.
6. To re-assemble the lower bearing, reverse the procedure for disassembly. Coat shaft and bearing surfaces with lubricating oil. When installing the bottom cover assembly, coat the o-ring with brick grease or silicone grease.

INSPECTION OF UPPER BEARINGS

1. Drain upper oil chamber.
2. Remove canopy cap and gasket.
3. Remove coupling (HOLLOSHAFT motors only).
4. Lower rotor shaft by releasing rotor locknut.
5. Remove dust cover or ratchet as applicable. Note the quantity of shims between the rotating ratchet and the bearing thrust block for future reassembly.
6. Remove upper guide / bumper bearing assembly. Note shim quantity between the guide bearing and upper bracket for future reassembly.
7. Remove upper thrust block.
8. Thrust bearing tilting pads are now exposed and may be inspected.
9. Inspect bearing bore and shaft journal for any unusual or excessive wear patterns or distinct scratches. Damaged bearings should be repaired or replaced. Tilting thrust pads should be replaced as a set. Scratches or marks on bearing journals are not acceptable and must be "polished" out.
10. All parts, including bearing chamber, are to be thoroughly cleaned before re-assembly. Any traces of dirt, chips, loose paint, etc. are not acceptable.
11. Extreme care must be exercised in cleaning and handling of all bearing components.
12. To re-assemble, fill oil chamber to approximately 1/8" (3 mm) above tilting thrust pad babbitt surface.
13. Install insulated key into shaft and lower the thrust block down rotor shaft.
14. Lubricate thrust block bearing surfaces with oil.
15. Install upper guide / bumper bearing, adjust end play and install ratchet (if supplied) per section VII MOTOR ASSEMBLY AND DISASSEMBLY PROCEDURES.
16. Assemble canopy cap and gasket.

XII FUNDAMENTAL TROUBLESHOOTING / PROBLEM ANALYSIS

This chart can reduce work time spent on motor analysis. Always check the chart first before attempting pump and/or motor disassembly.

SYMPTOM	PROBABLE CAUSE	ANALYSIS
Motor fails to start	Defective power supply	Check voltage across all phases above disconnect switch.
	Blown or defective primary fuses	
	Blown or defective secondary fuses	Check voltage below fuses (all phases) with disconnect closed.
	Open control circuit	Push reset button.
	Overload trips are open	
	Defective holding coil in magnetic switch	Push start button and allow sufficient time for operation of time delay, if used, then check voltage across magnetic holding coil. If correct voltage is measured, coil is defective. If no voltage is measured, control circuit is open.
	Loose or poor connections in control circuits	Make visual inspection of all connections in control switch.
	Magnetic switch closes	Open manual disconnect switch, close the magnetic switch by hand and examine contacts and springs.
	Poor switch contact	
	Open circuit in control panel	Check voltage T1, T2, and T3.
	Open circuit in leads to motor	Check voltage at leads in conduit box.
	Leads improperly connected	Check lead numbers and connections
Motor fails to come up to speed	Low or incorrect voltage	Check voltage at T1, T2, and T3 in control panel and at motor leads in conduit box.
	Incorrect connection at motor	Check for proper lead connections at motor and compare with connection diagram on motor.
	Overload - Mechanical	Check impeller setting. Check for a tight or locked shaft.
	Overload - Hydraulic	Check impeller setting. Check GPM against pump capacity and head.
Motor runs hot	Inadequate ventilation	Assure adequate supply of fresh air. Check air inlets and exits to assure that they are clear. Check air filters and clean or replace as necessary.
	Overload	Check load with ammeter.
	Unbalanced supply voltage	Check voltage supply with voltmeter.
Motor vibrates	Head shaft misaligned	Uncouple and check alignment.
	Worn line shaft bearings or bent line shaft	Disconnect motor from pump and run motor only to determine source of vibration.
	Hydraulic disturbance in discharge piping	Check isolation joint in discharge piping near pump head.
	Ambient vibration	Check base vibration level with motor off.
	System natural frequency (resonance) at or near operating speed	Revise rigidity of motor mounting base to change its resonant frequency.
	Rotor out of balance (usually following motor repair).	Balance rotor assembly.
Motor noisy	Worn thrust bearing	Disassemble motor as needed and examine condition of bearings. Repair or replace damaged bearings.
	Electrical noise	Check for proper input voltage and motor lead connection.
Bearing overheating	Head shaft misaligned	Uncouple and check alignment.
	Excessive thrust	Reduce thrust from driven machine.
	Improper lubrication	Check oil level. Check oil for contaminants and oxidation.
	Incorrect water supply at cooling coils	Check flow and inlet temperature of water.

XIII RENEWAL PARTS AND SERVICE

A parts list is available for your unit and will be furnished upon request. Parts may be obtained from local U. S. Motors distributors and at authorized service shops, or through the U.S. Electrical Motors Distribution Center:

U.S. ELECTRICAL MOTORS
3363 Miac Cove
Memphis, Tennessee 38118
(901) 367-5918

XIV INSTALLATION RECORD

Serial No._____ Horsepower_____ Frame Size_____ Type_____

Speed_____ Volts_____ Amperes_____ Phase_____ Cycles _____

Insulation Class_____ Temperature Rise_____ Connection Diagram_____

Owner Order No._____ Item No._____ Date Purchased_____

Lubricant Used_____ Bearing Cooling Water Flow Rate:_____ Temperature:_____

Motor Resistance Line to Line at Time of Installation_____

Insulation to Ground Reading at Time of Installation_____

Date Installed	Location	Application

Date Repaired or Replaced	Repairs or Parts Replaced *	Fault	Repaired By	Total Cost

* Name of Part	Manufacturer's Part No.	Date	Cost	Date	Cost	Date	Cost
Bearing, Upper Thrust							
Bearing, Upper Guide							
Bearing, Lower							
Rotor Assembly							
Stator Assembly							
Other							
Other							

INSPECTION / MAINTENANCE RECORD

Date Checked										
Oil Level										
Condition of Oil										
Oil Change										
Bearing Temperature										
Bearing Cooling Water										
Speed										
Voltage										
Amps										
Insulation										
Screens and Filters										
Motor Temperature										
Alignment										
Vibration										

NOTES

U.S. ELECTRICAL MOTORS

Emerson Motor Company
8100 West Florissant Avenue
P.O. Box 3946
St. Louis, MO 63136

REGIONAL OFFICES	PHONE	FAX	REGIONAL OFFICES	PHONE	FAX
DOMESTIC U.S. SALES	(888) 637-7333	(314) 553-1101	MONTERREY, MEXICO	(52) 8-389-1312	(52) 8-389-1310
INTERNATIONAL SALES	(314) 553-3185	(314) 553-2135	CARACAS, VENEZUELA	(58) 02-2377522	(58) 02-2329727
MONTREAL, QUEBEC/CANADA	(800) 361-5509	(514) 332-5912	BOGOTA, COLOMBIA	(57)1- 439-5420	(57)1- 439-5417
TORONTO, ONTARIO/CANADA	(905) 475-4670	(905) 475-4672			

IN596 **2/03**