TITAN NORMAL THRUST VERTICAL MOTORS

6800 FRAME AND LARGER

INSTALLATION AND MAINTENANCE MANUAL

P/N 946400

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 resembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing.
9. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.
10. Provide proper safeguards for personnel against rotating parts and applications involving high inertia 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 your equipment.
13. Motors can retain 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 maybe energized when the motor is shut off.

I SHIPMENT

Prior to shipment, all Titan Motors undergo extensive electrical and mechanical testing and are thoroughly inspected. Upon receipt of the 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 and breakage 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 appears on the nameplate (see installation record in this manual).

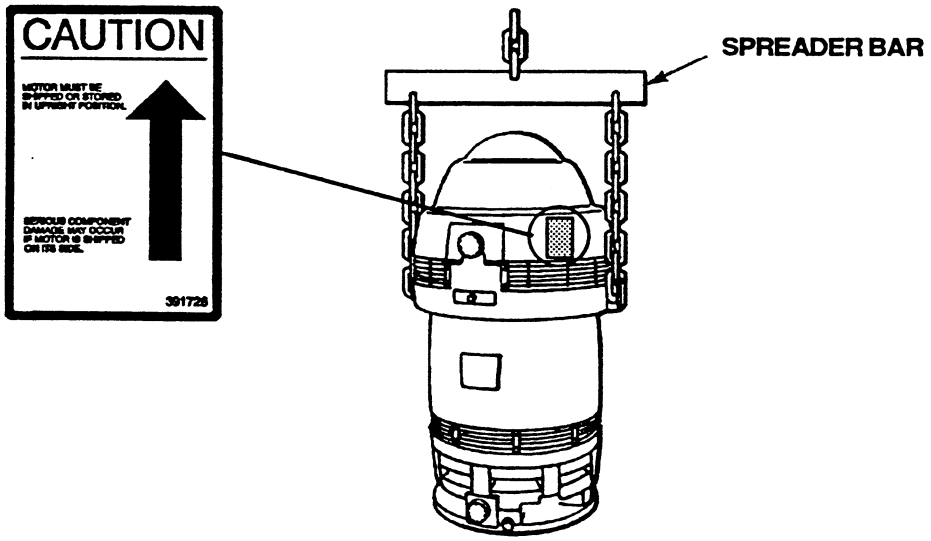
II HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement (see Figure 1) of sufficient strength to lift the motor safely. The spreader bar should have the lifting rings or hooks positioned to equal the span of the lifting lugs or eyebolts. ***The lifting lugs or eyebolts 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.

FIGURE 1



III STORAGE

1. When To Put A Motor In Storage.

   If a motor is not put into immediate service (one month or less), or if it is taken out of service for a prolonged period, special storage precautions should be taken to prevent environmental damage. The following schedule is recommended as a guide to determine storage needs.

   A. Out of service or in storage less than one month — no special precautions except that space heaters, if supplied, must be energized at any time the motor is not running.

B. Out of service or in storage for more than one month but less than six months - store per items 2A, B, C, D, E and G, and items 3A and B.

C. Out of service or in storage for six months or more - all of items 2, 3 and 4.

2. Storage Preparation.

A. Where possible, motors should be stored indoors in a clean, dry area.

B. When indoor storage is not possible, the motors must be covered with tarpaulin. This cover should extend to the ground; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation. Care must also be taken to protect the motor from flooding or from harmful chemical vapors.

C. Whether indoors or out, the area of storage should be free from ambient vibration. Excessive vibration can cause bearing damage. A unit which must be stored in areas with high ambient vibration, such as from heavy construction equipment, must have the shaft locked to prevent any movement.

D. Precautions should be taken to prevent rodents or other small animals from nesting inside the motors. In areas where they are prevalent, precautions should be taken to prevent insects, such as dauber wasps, from gaining access to the interior of the motor.

E. Inspect the rust preventive coating on all external machined surfaces, including shaft extension. If necessary, recoat the surfaces with a rust preventive material, such as Rust Veto No. 342 (manufactured by E. F. Houghton Co.) or an equivalent.

F. Grease lubricated bearing cavities must be completely filled with lubricant during storage. Remove the drain plug and fill cavity with grease until grease begins to purge from the drain opening. Refer to section IX - "LUBRICATION" for correct lubricant.

CAUTION

Do not attempt to grease bearings with the drain closed, or when unit is in operation.

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

3. Periodic Maintenance.

A. Grease should be inspected once a month for moisture and oxidation. On the upper end of the motor, this is most easily done by removing the bearing cap and visually inspecting the grease pack. On the lower end, the grease may be inspected by purging a small quantity of grease through the drain. If any contamination is present, the grease must be completely removed and replaced per section IX "LUBRICATION".

B. All motors must have the shaft rotated at least once a month to maintain a lubricant film on the bearing races and rotating elements.

C. Insulation History:

The only accurate way to evaluate the condition of the winding insulation is to maintain a history of the insulation readings. Over a period of months or years 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 if necessary, by 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 seconds and take reading.

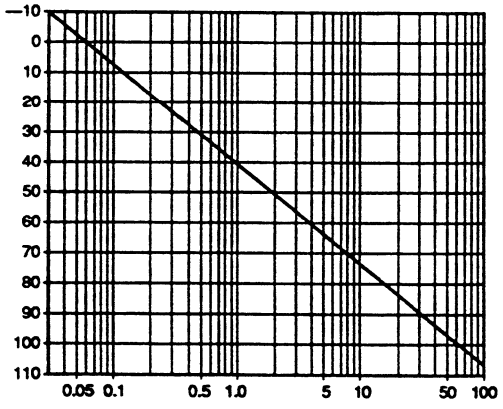
Rated Motor Voltage	Recommended DC Test Voltage
600 and less	500 VDC
601 to 1000 (incl.)	500 to 1000 VDC
1001 and up	500 to 2500 VDC (2500 VDC optimum)

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

$$R40C = Kt \times Rt$$

Where R40C = insulation resistance (in megohms) corrected to 40°C
Rt = measured insulation resistance (in megohms)
Kt = temperature coefficient (from Graph 1)

GRAPH 1



(Adapted from IEEE 43)

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

$$Rm = Kv + 1$$

Rm = minimum insulation (in megohms) at 40°C
Kv = 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. Service Department. For additional information on insulation testing, refer to IEEE Transaction No. 43.

4. Start-up Preparations After Long-Term Storage (6 months or more)

A. Motor should be thoroughly inspected and cleaned to restore to an "As Shipped" condition.

B. Motors which have been subjected to vibration must be disassembled and each bearing inspected for damage.

C. Grease must be completely changed using lubricants and methods recommended in section IX - "LUBRICATION" of this manual.

D. The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in section III, item C.

E. If storage has exceeded one year, the U.S.E.M. Quality Assurance Department must be contacted prior to initial start-up.

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.

As a standard, Bow Thruster 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.

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.

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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 according to section III, item 3.

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

E. If motor has been in storage, either before or after installation, refer to section III "STORAGE", item 4 for preparations.

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

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

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

I. 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 rotational 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

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   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 naptha, 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.

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

MOTOR ASSEMBLY PROCEDURES: (To disassemble motor, follow procedure in reverse)

1. Slide lower bearing cap onto shaft with machined face toward shaft extension.

2. Assemble lower guide bearing, lock washer and lock nut to the shaft. Pack bearing 100 percent full of grease *. Remove any grease extending beyond the edges of the bearing races and retainers.

3. If removed, install air deflector and screen to lower bracket. Include a bead of RTV silicone at joint where air deflector meets the mounting ring to reduce vibrational noise.

4. Pack lower bearing housing with grease * to approximately 30 percent full both above and below the bearing. Temporarily install studs into lower bearing cap and assemble rotor/bearing cap assembly into lower bracket. Remove studs and secure bearing cap into bracket with socket head cap screws. Install bearing RTD pipe nipple into lower bracket.

5. Install stator to lower bracket. Observe orientation of bearing RTD pipe nipple with respect to main and accessory outlet boxes as shown on dimension print supplied with motor. Install one (1) support bracket beneath one of the lower bracket-to-stator mounting bolts such that the RTD pipe nipple passes through the hole in the support bracket.

6. If removed, install air deflector to upper bracket. Include a bead of RTV silicone at joint where air deflector meets the mounting ring to reduce vibrational noise.

7. Install bearing RTD pipe nipple into upper bracket and then install upper bracket to stator. Observe orientation of bearing RTD pipe nipple with respect to main and accessory conduit boxes as shown on dimension print supplied with motor. Install one (1) support bracket beneath one of the upper bracket-to-stator mounting bolts such that the RTD pipe nipple passes through the hole in the support bracket.

8. Install thrust bearing onto upper bearing mounting with the thick side of the inner bearing race against the bearing mounting bearing shoulder. Pack thrust bearing 100 percent full of grease *. Remove any grease extending beyond the edges of the bearing races and retainers.

9. Pack upper bracket bearing housing (below bearing) approximately 30 percent full of grease *. Install square key into keyway in upper end of shaft and assemble bearing mounting/bearing assembly onto shaft and into upper bracket. Pack upper bearing housing (above bearing) approximately 30 percent full with new grease.

10. Set end play as shown in section VIII "END PLAY ADJUSTMENT".

11. Install upper bearing cap to upper bracket. Install grease fitting and drain plug into bearing cap. Rotate rotor by hand to ensure free rotation with no binding or rubbing.

12. Install canopy cap onto bearing cap. Install quantity-8 bracket covers onto upper bracket outer diameter. One cover has a hole in it to clear the bearing RTD pipe nipple.

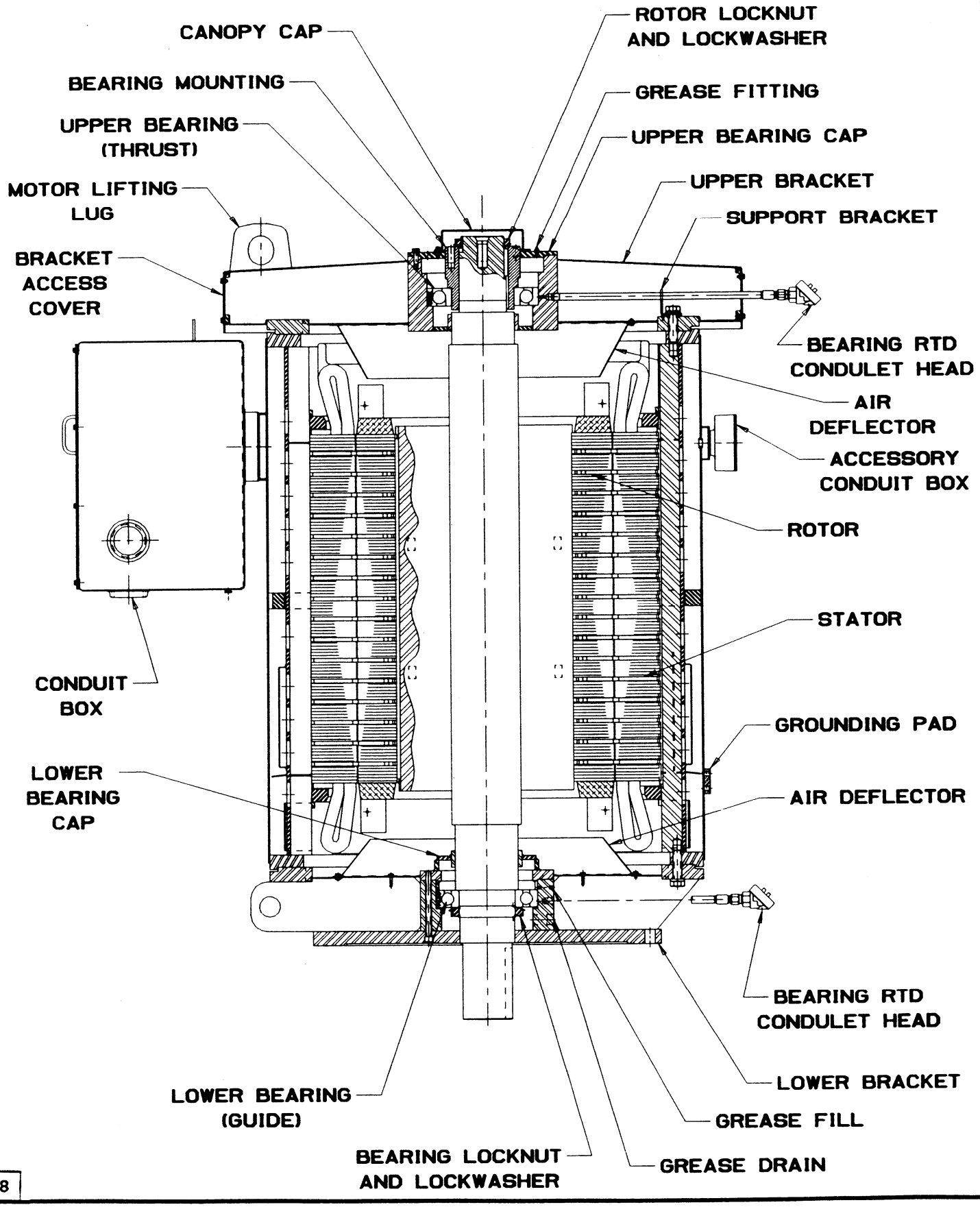
13. Install bearing RTDs into upper and lower bracket RTD pipe nipples.

14. Install main conduit box base to stator.

15. Install accessory conduit box base to stator. Wire accessories in accessory conduit box as shown on customer connection diagrams supplied with motor.

* NOTE: Refer to section IX "LUBRICATION" for approved greases.

MOTOR CUTAWAY DRAWING



VIII END PLAY ADJUSTMENT

Should the motor be disassembled for any reason, the rotor end play must be readjusted as follows:

Install locking arm provided with motor beneath one of the bearing cap mounting bolts, with the locking arm pin inserted into one of the 1/2" diameter holes in the bearing mounting as shown in Figure 3. Position a dial indicator to read axial shaft movement as shown in Figure 2. Rotate the rotor lock nut using a spanner wrench with an 8-foot long extension until the dial indicator shows no movement. This indicates that the lower bearing has been pulled up against the lower bearing cap. Back-off the lock nut .005 to .010 inches (20 to 45 degrees) and secure the lock nut with the lock washer.

After adjusting end play, the locking arm should be moved into the stored position as shown in Figure 3.

Special equipment needed: - Spanner wrench with extension
- Dial indicator

CAUTION

After setting end play, run the unit for fifteen (15) minutes and recheck end play setting. If not within range, end play must be reset. All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit and secure locking arm in stored position before energizing the motor.

FIGURE 2

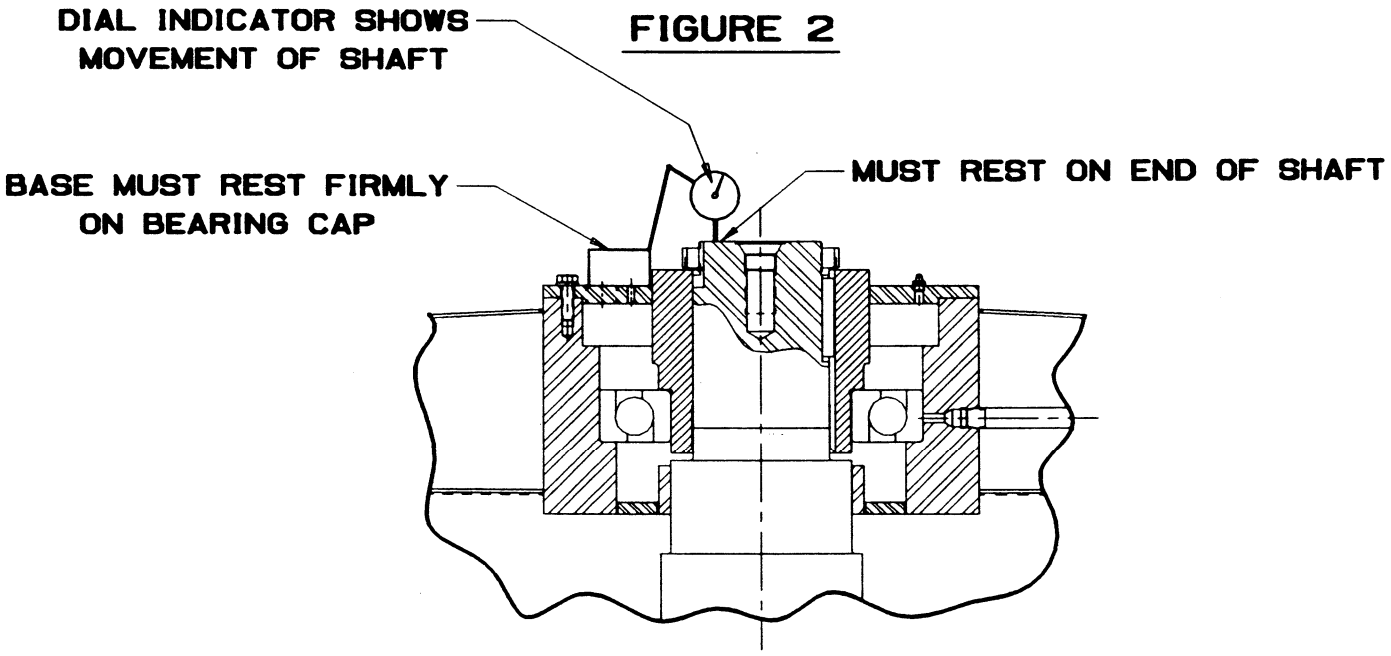
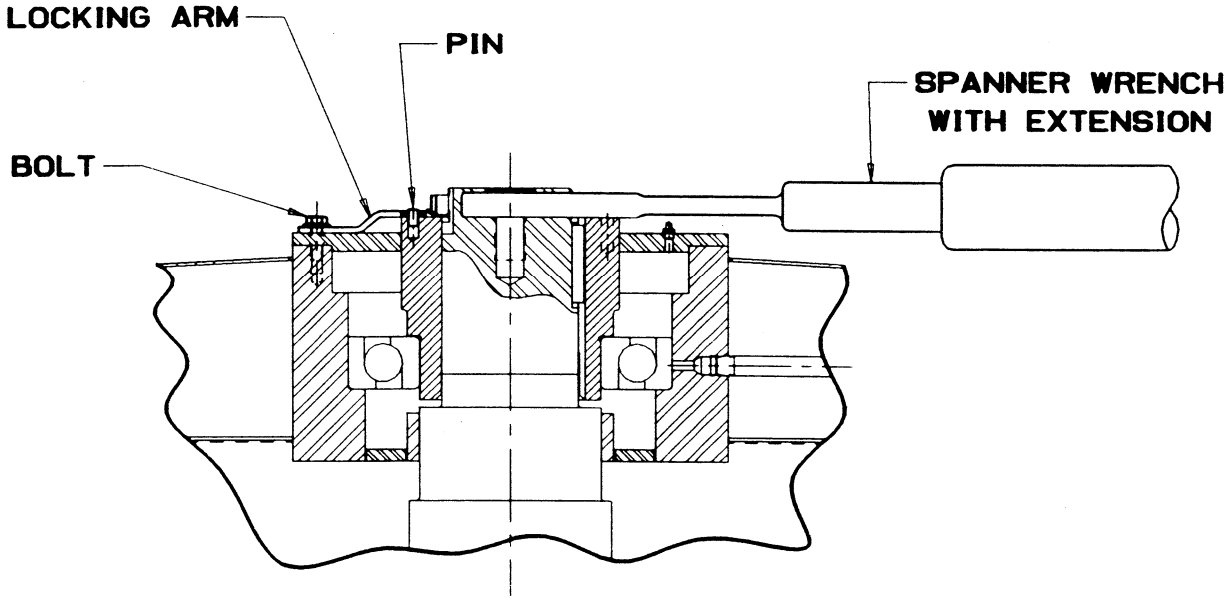
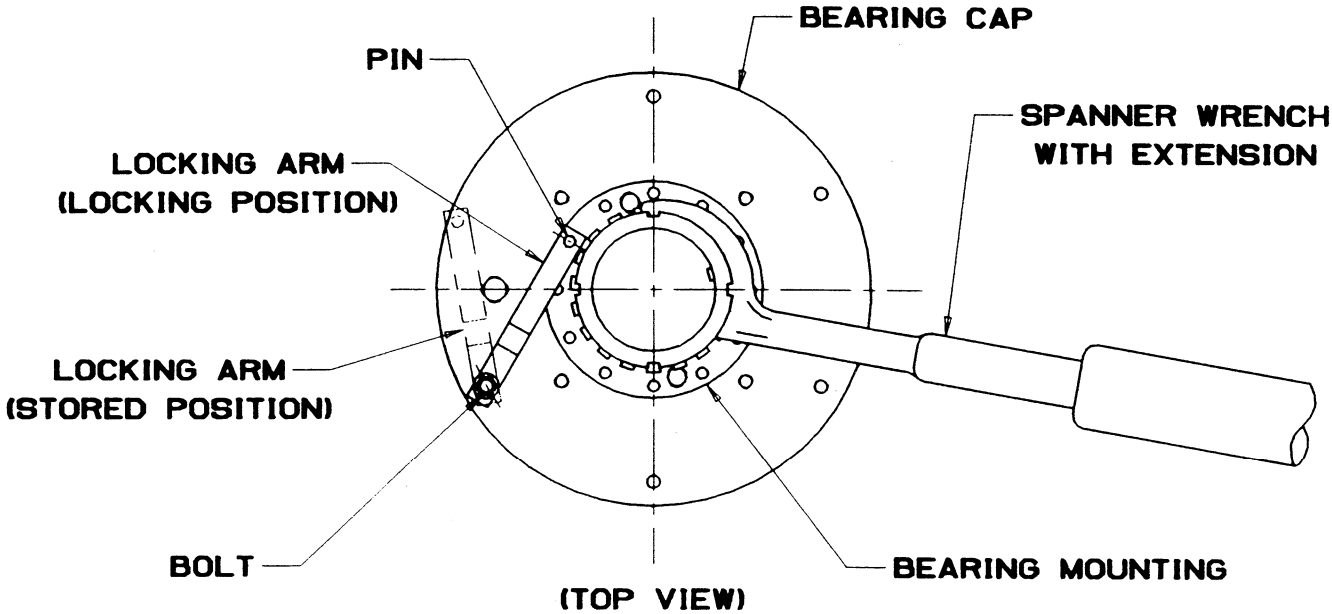


FIGURE 3



ROTOR IS LIFTED
BY TURNING LOCKNUT



(TOP VIEW)

IX LUBRICATION

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

LUBRICATION INSTRUCTIONS:
Bearings are prelubricated at the factory so that units will require no initial lubrication.

To relubricate bearings, remove the drain plug and add 3-4 ounces of new grease at the grease inlet. Run the motor for approximately ten (10) minutes with the drain plug removed to allow any excess grease to purge from the grease cavity. Replace the drain plug.

RECOMMENDED GREASES:
Relubricate with a good quality NLGI grade 2 grease. Unless noted otherwise on the motor with a special nameplate, units are prelubricated with a polyurea-thickened grease (ExxonMobil Polyrex-EM or Chevron SRI #2).

CAUTION

Greases of different bases (lithium, polyurea, clay) may not be compatible when mixed. Prevent such intermixing by using greases compatible with the grease originally supplied, or by completely changing the grease per instructions in this manual. Refer to grease manufacturer for compatibility of greases.

RECOMMENDED REGREASING INTERVAL:
Relubricate motor every 6 months if used no more than 12 hours per day in a clean and dry atmosphere. If use is more frequent or in dirty or damp atmosphere, relubricate motor every 3 months.

GREASE CHANGING INSTRUCTIONS:
If the unit has been in storage for 6 months or more, or if the grease has become contaminated, the grease should be completely changed using the following procedure:

To change upper bearing grease, remove upper bearing cap and bearing mounting/bearing assembly from the motor. Clean out all old grease from the bearing and inside of housing. Pack thrust bearing 100 percent full of grease. Remove any grease extending beyond the edges of the bearing races and retainers. Pack bearing housing (both above and below the bearing) approximately 30 percent full of fresh grease. Reassemble motor per section VII "MOTOR ASSEMBLY AND DISASSEMBLY PROCEDURES."

To change the lower bearing grease, disassemble the lower end of the motor. Clean out all old grease from bearing and housing. Pack bearing 100 percent full of grease. Remove any grease extending beyond the edges of the bearing races and retainers. Pack bearing housing (both above and below the bearing) approximately 30 percent full of fresh grease. Reassemble motor per section VII "MOTOR ASSEMBLY AND DISASSEMBLY PROCEDURES."

CAUTION

Overgreasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised to ensure against overgreasing.

X FUNDAMENTAL TROUBLESHOOTING — PROBLEM ANALYSIS

This chart can reduce work and time spent on motor analysis. Always check the chart first before starting pump motor disassembly, as what appears to be a motor problem may often be located elsewhere.

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 magnetic by hand, and examine contractors and springs.
	Poor switch contact	
	Open circuit in control panel	Check voltage at T1, T2, & T3
	Open circuit in leads to motor	Check voltage at leads in outlet 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, & T3 in control panel and at motor leads in outlet 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 blast through motor by feeling air discharge at bottom of stator.
	Overload	Check load with ammeter.
	Unbalanced supply voltage	Check voltage supply with voltmeter.
Motor vibrates	Shaft misaligned	Check alignment of motor to driven equipment.
Motor noisy	Worn thrust bearing	Remove dust cover, rotate rotor by hand, and make visual examination of balls and races. Bearing noise is usually accompanied by a high frequency vibration.
	Electrical noise	Most motors are electrically noisy during the starting period. This noise should diminish as motor reaches full speed.

XI 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. Electrical Motors distributors and autorized service shops, or through U.S. Electrical Motors distribution centers located at:

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

XII INSTALLATION RECORD

NAMEPLATE AND INSTALLATION INFORMATION

SERIAL NUMBER OR MODEL NUMBER ..... _____

HORSEPOWER ..... _____

MOTOR RPM ..... _____

PHASE ..... _____

FREQUENCY ..... _____

AMPS ..... _____ AT _____ VOLTS

DESIGN ..... _____

FRAME ..... _____

TYPE ..... _____

DATE PURCHASED _____ P.O. NUMBER _____

DATE INSTALLED ..... _____

LOCATION OF JOB SITE ..... _____

MACHINE OR INSTALLATION NUMBER ..... _____

PURCHASED FROM ..... _____

MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION ..... _____

INSULATION TO GROUND READING AT TIME OF INSTALLATION ..... _____

RECORD OF MAINTENANCE

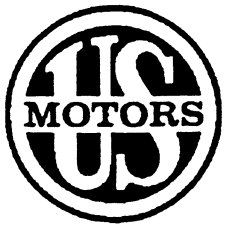
GRADE AND TYPE OF LUBRICANT USED ..... _____

DATE OF LAST RELUBRICATION	INSULATION RESISTANCE		OVERHAUL OR REPAIR	
	DATE	MEGOHMS	DATE	ACTION

NOTES

U.S. ELECTRICAL MOTORS

Division of EMERSON ELECTRIC CO.
8100 West Florissant Avenue
P.O. Box 3946
St. Louis, MO 63136



REGIONAL OFFICES	PHONE	FAX	REGIONAL OFFICES	PHONE	FAX
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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			

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