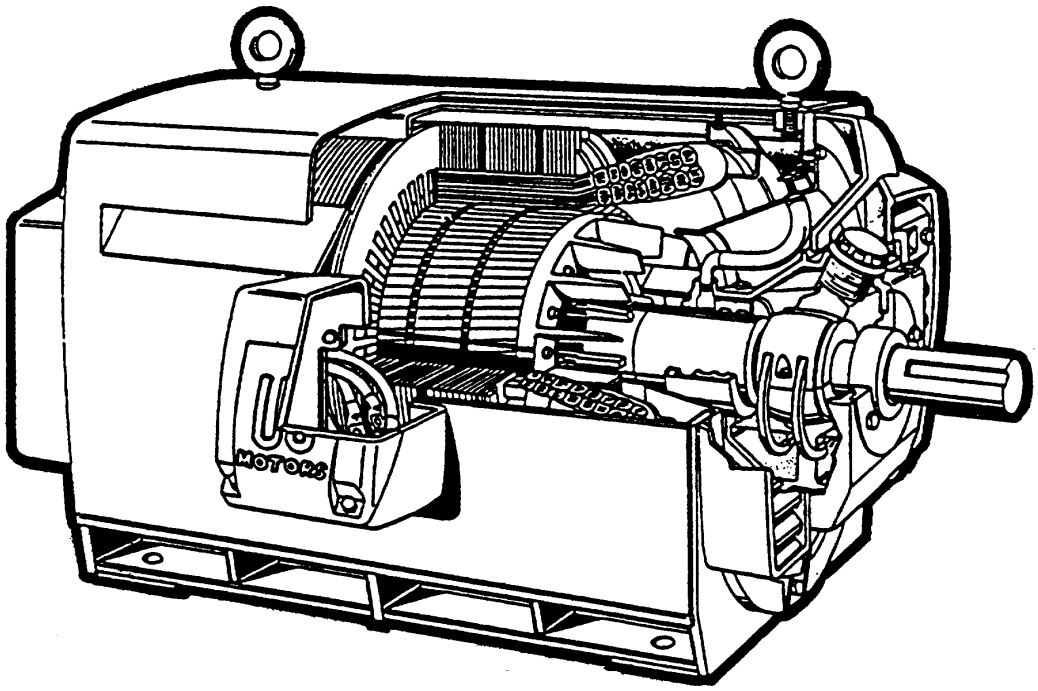
TITAN
LARGE AC ELECTRIC MOTORS



HORIZONTAL OPEN SLEEVE BEARING, DRIPPROOF, WPI, WPII MOTOR ENCLOSURE

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

P/N 958562

USMOTORS

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 and accessories prior to initiating any installation, maintenance or repairs.

2. Avoid contact with rotating parts.

3. Act with care in accordance with this manual's prescribed procedures in handling and installing this equipment.

4. Be sure unit and accessories are electrically grounded and proper electrical installation wiring and controls are used in accordance 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. Be sure shaft key is fully captive before unit is energized.

7. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.

8. Avoid extended exposure to equipment with high noise levels.

9. Observe good safety habits at all times and use care to avoid injury to yourself or damage to your equipment.

10. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.

11. Observe all special instructions attached to the equipment. Remove shipping fixtures if so equipped.

12. Check motor and driven equipment for proper rotation and phase sequence prior to coupling. Also check if a unidirectional motor is supplied and note proper rotation.

13. Do not apply power factor correction capacitors to motors rated for operation with variable frequently drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult your drive supplier for more information.

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I. SHIPMENT

Prior to shipment, all Titan-Line motors undergo extensive electrical and mechanical testing and are thoroughly inspected. Upon receipt of the motor, carefully inspect the unit 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 writing to U.S. Electrical Motors concerning the machine, be sure to include the complete motor identification number, frame size and type which appears on the motor nameplate.

Note that a clamping device on the shaft prevents motion of the motor rotor. This must be removed prior to motor startup; however, leave the clamp in place until the instructions call for its removal.

⚠ CAUTION ... **THE SHAFT CLAMPING DEVICE MUST BE IN PLACE TO PREVENT SHAFT MOVEMENT ANY TIME THE MOTOR IS SHIPPED. FAILURE TO DO SO MAY RESULT IN MOTOR BEARING DAMAGE.**

II. HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement (see Figure 1A) of sufficient strength to lift the motor safely. The spreader bar should have lifting hooks positioned to equal the span of the eyebolts or lifting lugs. When four lifting lugs are provided, a spreader bar arrangement similar to Figure 1B should be used. The eyebolts or 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.**

FIGURE 1A

Typical Construction with Two Eyebolts

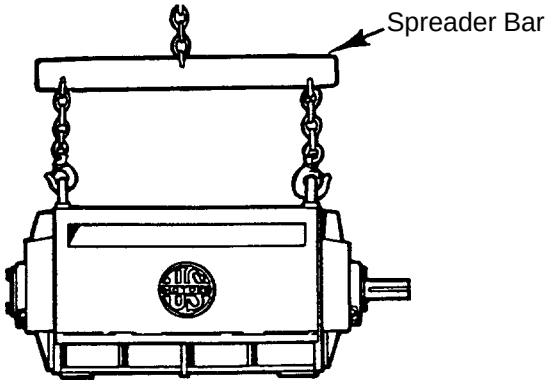
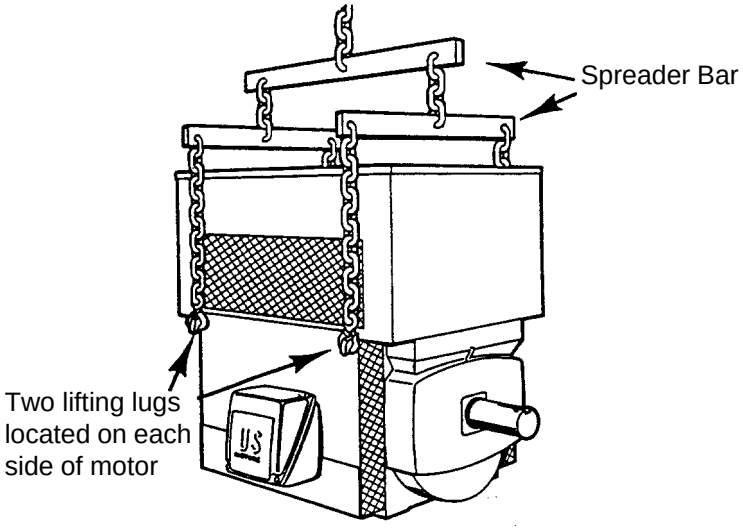


FIGURE 1B

Typical Construction with Four Lifting Lugs



III. STORAGE

If the motor is not placed immediately into service (one to six months depending on environmental conditions) or is taken out of service and put in storage, the following precautions should be taken:

1. Store indoors if possible.

2. Motors should not be stored on vibrating bases or floors. Any motor stored under these conditions should be disassembled and inspected for bearing damage prior to service. If bearing damage is evident, replace bearing.

3. Check shaft extension coating for damage. If necessary, recoat it and all external machined surfaces with a rust preventative coating such as Rust Veto No. 342 as Mfg. by E.F. Houghton Co. or equivalent. The condition of the rust preventative coating should be checked periodically and surfaces be recoated as recommended by the coating manufacturer.

4. Drain oil from both bearing housings and refill with a circulating type oil such as Enlubol 453 VPRP (available from Engineered Lubricant) or equivalent. Oil should be changed every 12 months while the motor is in storage.

5. Rotate motor shaft several revolutions by hand once per month while in storage to insure a protective lubricant film on bearing journals. (Remove or loosen shaft clamping device to allow rotation of the shaft. Do not discard clamping device as it will be needed when motor is transported).

6. Take precautions as necessary to prevent rodents, snakes or other small animals from nesting inside motor.

7. Prevent moisture or condensation from accumulating by energizing space heaters if provided, or apply reduced voltage to one phase of motor windings (trickle-voltage-heating). Request % of rated voltage and transformer capacity to be used from U.S. Electrical Motors. The winding should be maintained at a minimum of 5°C above ambient temperature (some locations require a higher temperature above ambient) to prevent condensation.

8. If motor is to be covered by plastic or similar material, additional precautions such as heated or circulating air and silica gel may be necessary to protect against moisture or condensation.

9. Start-up preparation after storage:
   A. Thoroughly clean and inspect motor.
   B. Change oil in bearing housings using lubricant recommended in instruction manual and lubrication plate. Secure all plugs and fittings to prevent leakage.
   C. Check insulation resistance as described in Section VII "Normal Operation" Part 3.

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. Outdoor installations on open dripproof motors require protection from the elements.

2. The location also should provide adequate space for motor removal without shifting the driven unit.

3. The temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level.

4. The motor should not be installed in close proximity to any combustable material or where flammable gases may be present, unless motor is specifically built for that environment and is U.L. labeled accordingly.

V. FOUNDATION

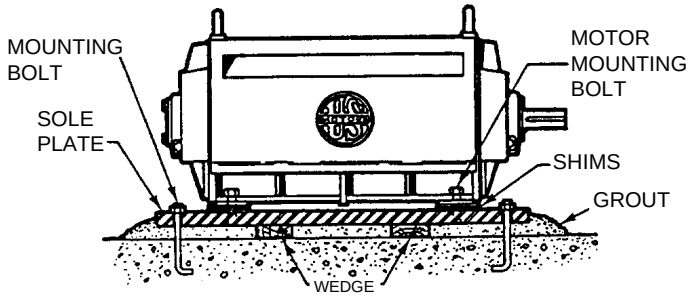
Concrete (reinforced as necessary or required) makes the best foundation, particularly for large motors and driven units. In sufficient mass it provides rigid support that minimizes deflection and vibration. It may be located on soil, structural steel or building floors provided the total weight (motor, driven unit, foundation) does not exceed the allowable bearing load of the support. Allowable bearing loads of structural steel and floors can be obtained from Engineering Handbooks; building codes of local communities give the recommended allowable bearing loads for different types of soil.

It is recommended that a fabricated steel base (sole plate) be used between motor feet and foundation (See Figure 2).

Grouting
Grouting is the process of firmly securing equipment to the concrete base. This base is a continuation of the main foundation designed to dampen any machine vibration present and prevent the equipment from shaking loose during operation. A serviceable and solid foundation can be laid only by careful attention to proper grouting procedure.

In practical terms, "grout" is a plastic filler which is poured between the motor sole plate and the foundation upon which it is to operate. Being plastic, it is expected to fill all spaces and cavities before it sets or solidifies and becomes an intergral part of the principal foundation. Wherever practical, the principal foundation is allowed to set through chemical reaction and dehydration for approximately four weeks before loading to permit it to substain its full static load without deformation.

FIGURE 2
TYPICAL MOTOR MOUNTING ARRANGEMENT



VI. INITIAL INSTALLATION

1. Coupling Installation

Remove the shaft clamping device shipped on motor. Do not discard clamping device as it will be needed should the motor require transport in the future. Wash protective coating from Motor Shaft Extension(s) with solvent. Install couplings on motor and driven equipment considering the following. Couplings should fit tight to shaft. See coupling manufacturers instructions on recommended fit up and mounting practices. Any burrs or irregularities on mating parts should be removed prior to attempting to install.

⚠ CAUTION

Installing couplings by hammering or pounding with a mallet can result in damage to motor bearings. Always install couplings per the manufacturer's recommended procedure.

⚠ CAUTION

Sleeve Bearing Motors should be direct coupled to the driven equipment. See Section VI "Initial Installation" Part 4 for recommended coupling type. Never use a pulley or sprocket as they transmit unacceptable radial loads to the motor bearings.

2. Rough Alignment

Inspect sole plate mounting pads and bottom of motor feet for dirt or irregularities that would prevent the motor from seating properly.

Position and shim the motor such that the coupling hubs are aligned within 1/32 of an inch. The motor shaft must be slightly lower that the driven shaft to allow for final adjustment shims. The motor should be shimmed level within 1/32" during this procedure.

If flexible coupling is the free-float type, the coupling end play should be limited to values shown in Table 1 to prevent damage to the motor bearings arising from axial loads. To limit float many couplings require a separator between the coupling hub faces. This separation distance is specified either in the coupling manufacturers literature or on the coupling shroud. A separator of thickness equal to this distance plus one half of the coupling end float (see Table 1 and Figure 4), may be used to assist in aligning the motor (for motor operation the separator thickness should be the amount specified by the coupling manufacturer).

The motor and the driven equipment should be assembled and adjusted so that the scribe line on the motor shaft, which indicates magnetic center of the motor is in line with the outer seal face during operating condition. In some applications (e.g. Boiler-Feed Pump Drives) the motor should be aligned in accordance with instructions supplied by the driven equipment manufacturer.

3. Final Alignment

A. Check to insure coupling hubs are not eccentric. Mount a dial indicator on a stationary part and read the eccentricity of the outside diameters of the coupling hubs as they are rotated.

B. Check to be sure that the motor feet lie in the same plane. Bolt the feet down securely. Mount a dial indicator on the driven half of the coupling. Take readings of the movement of the motor half of the couplings as the feet bolts are loosened. Loosen a shaft end foot bolt, take a reading and re-tighten. On the same side of the motor, loosen the opposite shaft-end foot bolt and take a reading. Now add shims to the feet until motion of the coupling is less than 0.003" when either foot bolt is loosened. Repeat this procedure for the foot bolts on the opposite side of the motor.

C. Check for angular misalignment of motor to driven unit shaft. (See Figure 3A). Measure distance between coupling hub faces (with feeler gauges) at four places equally spaced around the outside diameters. Position motor as necessary to be within the maximum allowable misalignment of 0.001" per foot of coupling radius.

D. Check for offset alignment. Fasten a dial indicator on one coupling hub with the indicator button contracting the alignment surface of the opposite coupling hub. (See Figure 3B) Rotate shaft onto which the indicator is attached and take readings at four points 90 degrees apart. Relocate motor until total indicator movement in a full rotation does not exceed 0.002 inches. Transfer indicator to opposite hub and repeat the offset alignment procedure. Recheck angular alignment as described in Step C.

E. Miscellaneous
After each corrective adjustment, tighten the foot bolts securely and recheck alignment. When making shim adjustments, change only one foot at a time. Recheck alignment after the motor has been in service approximately one week. Readjust as necessary.

Note: Alignment is at operating conditions and any thermal growth should be taken into account.

FIGURE 3
FLEXIBLE COUPLINGS

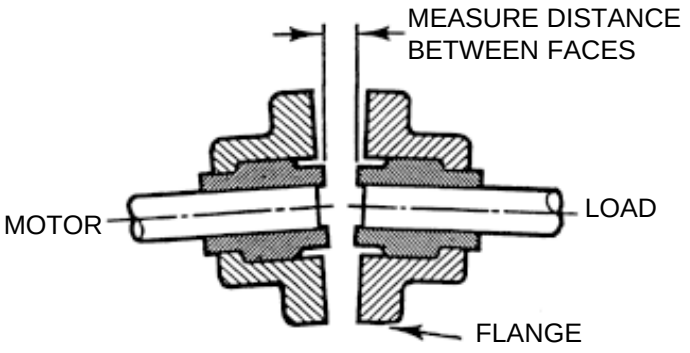


FIGURE 3A
ANGULAR ALIGNMENT

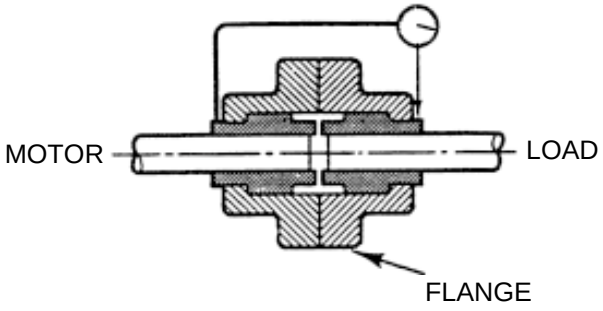


FIGURE 3B
OFFSET ALIGNMENT

4. Coupling Recommendations

Standard sleeve bearing motors are not designed to withstand axial thrust loads. Machines that are to be driven by motors with sleeve bearings should be designed with bearings to take all the thrust load. The driven equipment shaft should have its axial end play limited as necessary to prevent applying any axial loads to the motor sleeve bearings.

Operating experience on horizontal sleeve bearing motors has shown that sufficient thrust to damage bearings may be transmitted to the motor through some flexible couplings. It is recommended that limited end float couplings, in accordance with the following, be used:

A. Gear Type
B. Tapered Grid Type
C. Roller Chain Type
D. Rubber Biscuit Type

FIGURE 4

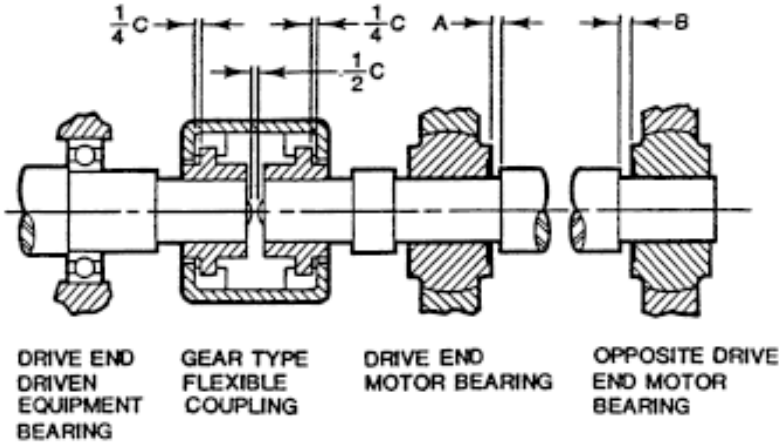


TABLE 1 -- COUPLING END PLAY AND ROTOR FLOAT
(Adapted from NEMA MG1-20.81)

MOTOR HP	SYNCHRONOUS SPEED OF MOTOR, RPM	TOTAL MINIMUM MOTOR ROTOR END FLOAT(IN.)	TOTAL MAXIMUM COUPLING END FLOAT (IN.)
500 & below	1800 & below	0.25	0.09
300 to 500 incl.	3600 & 3000	0.50	0.19
600 & higher	all speeds	0.50	0.19

5. Electrical Connection

Refer to the motor nameplate for power supply requirements and to the connection diagram on the motor. Be sure connections are tight. Check carefully and assure that they agree with the connection diagram, then carefully tape all connections with electrical tape to be sure that they will not short against each other or ground. Be sure the motor is 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 size. 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.

Part Winding Starters used with part winding start motors should have the time set at a minimum time consistent with the power company requirements. Two seconds is the recommended maximum time on part winding. Setting the timer for longer periods can cause permanent damage to the motor and may void the warranty.

6. Reversing Rotation

The direction of the rotation may be reversed by interchanging any two of the three power leads to the motor leads. Be sure that the power is off and steps are taken to prevent accidental restarting of the motor before attempting to change any electrical connections.

⚠ CAUTION

All 2 pole and some 4 pole motors have unidirectional ventilating fans. Running one of these backwards for any extended length of time will result in motor damage. The direction of rotation is noted by an arrow mounted above the take-off-shaft and by a warning plate mounted near the main nameplate. To determine direction of rotation for which leads are connected, apply power momentarily and observe rotation. Motor should be uncoupled from driven equipment to assure driven equipment is not damaged by reverse rotation.

7. Initial Start
After installation is completed but before motor is put in regular service, make an initial start as follows:

A. Be certain 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 VII "Normal Operation" Part 3.

D. Check all foundation and base bolts to be sure they are securely tightened.

E. If motor has been in storage, either before or after installation, refer to Section III "Storage" Part 9 for preparations.

F. Check sleeve bearing housings to be certain that they have been filled to the "Max" level with the correct lubricant recommended in the instruction manual and lubrication plate.

G. Check for proper or desired rotation. See Section VI "Initial Installation" Part 6.

H. If possible, disconnect motor from driven equipment and turn motor shaft by hand to insure free rotation. If this step was taken during installation procedures and conditions have not changed this check may not be necessary.

I. Assure that all protective devices are connected and operating properly.

J. If drive is disconnected run motor at no-load long enough to be certain that no unusual condition develops. Inspect for free rotation of oil rings and adequate flow of oil over sleeve bearings. Listen and feel for excessive noise, vibration, clicking or pounding. If present, stop motor immediately. Investigate the cause and correct before putting motor into service. In the case of vibration see Section VI "Initial Installation" Part 8.

⚠ CAUTION

Repeated trial starts can overheat the motor (particularly for across-the-line starting) or the external starting equipment. If repeated trial starts are made, allow sufficient time between starts to permit heat to be dissipated from windings and controls to prevent overheating, refer to Starting Duty Nameplate (if supplied) and NEMA MG1-12.50 and MG1-20.42 for allowable starting frequency and load WR .

K. When checks are satisfactory to this point, operate at the minimum possible load and look for any unusual condition. Increase the load slowly and check unit for satisfactory operation.

8. Vibration

After alignment has been completed, run motor at minimum possible load (uncoupled from driven equipment if possible) and check for vibration. If vibration is excessive (See Table 2) loosen one Motor Mounting Bolt. If vibration decreases, add shims and retighten bolt. Repeat as necessary for all bolts until vibration is reduced to acceptable limits. Recheck coupling alignment after any change in shims.

Recheck vibration after unit has run under full load and has reached operating temperature.

TABLE 2 -- UNFILTERED VIBRATION LIMITS
Adapted from NEMA MG1-7.08

SPEED RPM	Rotational Frequency/HZ	Velocity, in/s peak (mm/s)
3600	60	0.15 (3.8)
1800	30	0.15 (3.8)
1200	20	0.15 (3.8)
900	15	0.12 (3.0)
720	12	0.09 (2.3)
600	10	0.08 (2.0)

VII. NORMAL OPERATION

Start the motor in accordance with standard instructions for the starting equipment used. Connected load should be reduced to the minimum, particularly for reduced voltage starting and/or high inertia connected loads, until the unit has reached full speed.

1. General Maintenance

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

   A. Trained personnel who **KNOW** the work.

   B. Systematic records, which contain at least the following:
      1. Complete nameplate data
      2. Dimension prints & Wiring diagrams
      3. Alignment data (departures from perfect alignment; allowance for high temperature)
      4. Results of regular inspection
      5. Repairs
      6. Lubrication data:
         a. Method of application
         b. Types of lubricants for wet, dry, hot or adverse locations
         c. Maintenance cycle by location (some require more frequent lubrication)

2. Inspection & Cleaning

   Stop the motor before cleaning. (⚠**CAUTION**: **INSURE AGAINST ACCIDENTAL STARTING OF MOTOR). Clean the motor, inside and out, regularly. The frequency 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 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 ventilating air inlets. Use compressed air. Never allow dirt to accumulate near air inlets. Never operate motor with air passages blocked.

⚠ CAUTION

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

   C. Filters in weather protected units should be cleaned per the filter manufacturers' recommendations.

   D. Clean motors internally by blowing with clean, dry compressed air up to 30 psi. If the condition warrants, use a vacuum cleaner.

   E. 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 bristle brush. DO NOT SOAK. Oven dry (150-175°F) solvent cleaned windings thoroughly before reassembly.

   F. After cleaning and drying the windings, check the insulation resistance (See the following section).

3. Insulation Resistance

Measurements should be taken at time of initial motor installation and periodically thereafter. Measurements also are important when repairs are made or after moisture is dried from windings.

A. Insulation History: The only accurate way to predict insulation failure is to maintain a history of the insulation resistance readings. Over a period of months or years these readings will tend to indicate a trend. If a downward trend develops or if the resitance drops too low, thoroughly clean and dry the windings as described in Section VII "Normal Operation" Part 2.

The recommended insulation resistance test is as follows:

1. Using a megohmeter, with winding at ambient temperature, apply DC Voltage (noted below) for 60 seconds and take reading.

Rated Motor Voltage	Recommended DC Test Voltage
600 and less	500 VDC
601 - 1000	500 - 1000 VDC
1001 and above	500 - 2500 VDC (2500 VDC Optimum)

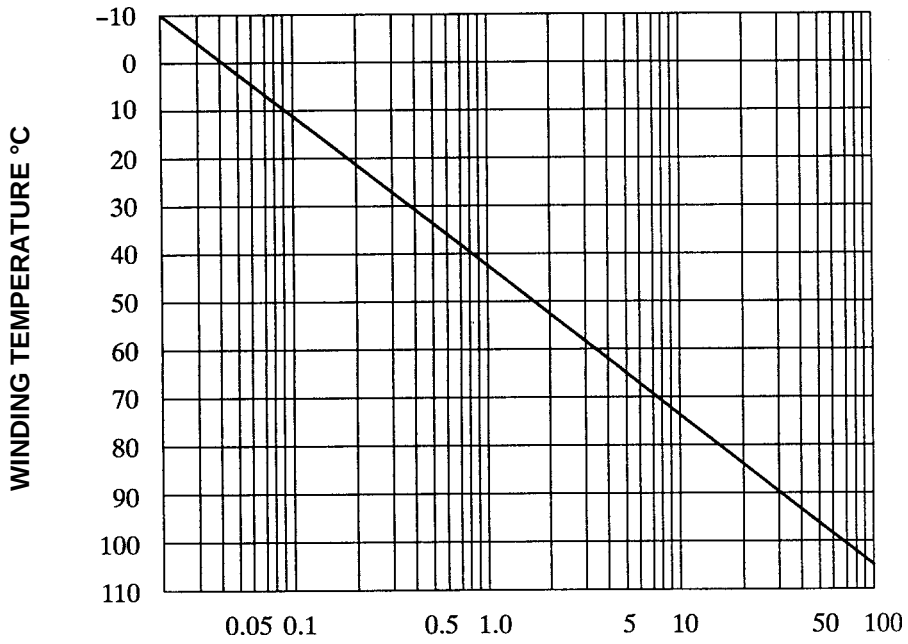
2. For comparison the reading should be corrected to a 40°C base temperature. This may be done by utilizing the following:

$$R40C = Kt \times Rt$$

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



B. Individual Readings: If an insulation history is not available and it becomes necessary to determine the acceptability of the winding, the following formula can be used. However, it must be realized that it is only a guideline and that operator and equipment safety must also be considered. The test & voltage should be the same as outlined in Section VII "Normal Operation" Part 3, Item A.

Rm = Kv + 1
Where Rm = Recommended minimum insulation resistance in megohms at 40°C
Kv = rated motor voltage in Kilovolts.

C. 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 megohmmeter readings at a one minute and ten minute interval or when hand powered megohmmeters are used, at a thirty second and sixty second interval. The voltage should be the same as outlined in Section VII "Normal Operation" Part 3, Item A.

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

The ratings are as follows:

10 minute: 1 minute
Dangerous = less than 1.0
Poor =1.0 to 1.4
Questionable =1.5 to 1.9
Fair = 2.0 to 2.9
Good = 3.0 to 4.0
Excellent = 0ver 4.0

60 seconds: 30 seconds
Poor = less than 1.1
Questionable = 1.1 to 1.24
Fair =1.25 to 1.3
Good = 1.4 to 1.6
Excellent = Over 1.6

If a lower insulation resistance reading is obtained in either the individual test or dielectric absorption ratio test, thoroughly clean and dry the windings as described in Section VII "Normal Operation" Part 2. Recheck insulation resistance and dielectric absorption ratio.

For additional information on insulation testing, refer to IEEE Transaction No. 43.

VIII. DISASSEMBLY

1. Disassembly of sleeve bearing motors
See Figure 5 for sleeve bearing housing cross-section

A. Disconnect power and assure against accidental starting of motor.
B. Unbolt and remove end grills or shrouding.
C. Remove screws from inner shaft seals.
D. Unbolt outer shaft seal, cover plate (opposite shaft end) and remove with their gaskets. Bearing caps are not interchangeable and have been identified to allow installation on the same bracket from which they are removed.
E. Remove all thermostats, probes, thermocouples, etc from bearings and brackets.
F. Disconnect vent tube from inner seal. Remove bolts that hold inner seal. Unbolt and remove bearing caps.
G. Unbolt and remove upper halves of bearings.

⚠ CAUTION

The upper halves of the bearings are not interchangeable and must be installed on the same lower halves from which they are removed.

For the insulated bearing(s) supplied, care should be exercised to prevent damage to the insulating coating while installing, removing, or handling the bearing. An insulated bearing is always installed on the end of the motor opposite the take-off end. A double end shaft should use an insulated coupling on the end of the motor which contains the insulated bearing.

H. Raise the motor shaft approximately 1/32 inch. The take-off end of the shaft can be lifted by placing a sling directly around the shaft extension. The end of the shaft opposite the take-off end can be lifted by threading a bolt or eyebolt into the threaded hole in the end of the shaft and placing the sling around it. Once the shaft is raised, rotate the lower halves of the bearing cartridges out from under the shaft.

⚠ CAUTION

Raising the shaft beyond the free movement of the rotor may damage the shaft, rotor or stator.

I. Remove the oil rings.

J. Drain oil from bracket reservoirs.

K. Remove bolts holding brackets to frame and remove brackets.

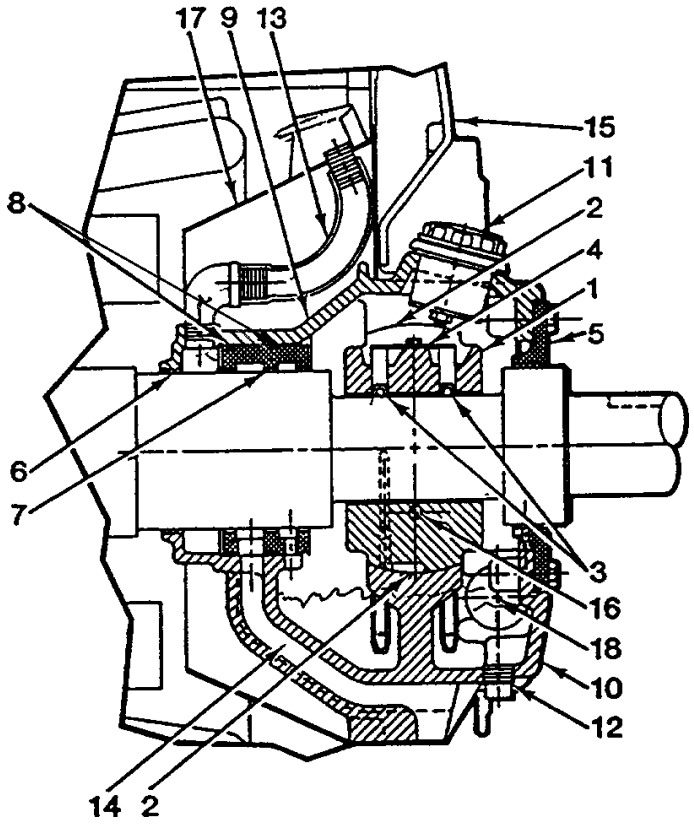
L. Slide the bushing and inner shaft seals off the shaft.

M. Remove rotor from stator.

N. If the atmosphere is corrosive or the motor will be disassembled for an extended length of time, protect all motor parts as necessary to prevent rust, damage or accumulation of dirt or moisture.

O. For reassembly see Section IX "Reassembly" Part 1.

FIGURE 5
SLEEVE BEARING CONSTRUCTION



1. 2 Piece Babbitt-Lined Bearing
2. Spherical Seat
3. Oil Rings
4. Oil Ring Guides
5. Outer Seal
6. Inner Seal
7. Bushing
8. O-Ring Seals
9. Bearing Cap

10. Lower Half Oil Housing (B racket)
11. Oil Fill and Oil Ring View Plug
12. Oil Drain
13. Vent Tube (for Pressure Balance)
14. Atmosphere Vent Channel
15. Grill
16. Temperature Detector Location
17. Air Deflector
18. Oil Level Inspection Window

IX. REASSEMBLY

⚠CAUTION

When reassembling, all fasteners should be torqued to the values shown in Table 5 at the rear of this manual.

1. Reassembly of Sleeve Bearing Motors (See Figure 5)

   All parts must be thoroughly cleaned with High-Flash Naptha, mineral spirits or Stoddard Solvent and inspected prior to assembly. Particular attention should be paid to the following areas:

   Bearing and Seal Journals: Any scratches or marks on these diameters are not acceptable and must be "polished" out.

   Bearing Housings: Thoroughly clean (use cleaner as noted above) the inside of the bearing housing and inspect for foreign particles. Any traces of dirt, chips, loose paint, sand, etc. are not acceptable.

   Bearing: Inspect the bearing babbitt bore surface for any unusual or excessive wear patterns, inbedded dirt or distinct scratches. Bearings so damaged should be repaired or replaced (see Section XII "Sleeve Bearing Replacement").

   O-Ring Seals on Bushing: Inspect for any damaged area. O-Rings that are damaged must be replaced.

   To reassemble motor, reverse procedure for disassembly Section VIII "Disassembly," Part 1 Items A through N. Coat O-Ring Seals with silicone grease prior to assembling bushing on shaft. Coat the shaft bearing journals, bearing surfaces and spherical seat surfaces with oil (see Table 3 & 4 for proper oil) prior to assembly. Assure that the Socket Head Cap Screw located on the side of the bearing is securely in place. This cap screw prevents the bearing from rotating in its seat during motor operation and must be in place. When installing the bearing cap, coat its mating surface and the mating surface of the bracket with Permatex #2 or an equivalent non-hardening sealant.

   A minimum gap of 0.004" (verified by feeler gauge) is to be provided all around between the seals and shaft to prevent rub. Check clearance and reposition seals as required.

   When motor is fully assembled and housings have been filled with proper oil (see Table 3 & 4) turn the shaft by hand and check for free rotation. Oil rings should be viewed at this time to check for free rotation.

   Touch up any scratched or chipped paint to protect motor surfaces.

X. GENERAL SLEEVE BEARING DESCRIPTION

The U.S. Electrical Motors sleeve bearing consists of a spherically seated, cast iron shell which is split on the horizontal centerline and is babbitt lined. This split bearing construction allows for ease of inspection and assembly and also allows for bearing replacement without uncoupling the driven unit. The bearing halves are fastened together with 2 socket head cap screws and held in alignment with 4 dowel pins. One end of the bearing has thrust face which is adequate to take any momentary thrust from the motor itself. However, this part of the bearing will quickly wear if subject to any external thrust load or if the rotor is allowed to oscillate axially and pound against the surface.

The assembled bearing is seated in a mating spherical seat in the bearing housing. The spherical seat makes this bearing self aligning. The oil is supplied to the bearing by oil rings which hang loosely over the shaft with their lower portion hanging in the oil sump. As the shaft turns so do the oil rings, carrying oil to properly lubricate the bearings. Each housing has an inspection port located on top for checking the oil ring operation and filling with lubricant. Each housing also is supplied with an oil drain and an oil level sight window.

XI. SLEEVE BEARING INSPECTION

Many sleeve bearing motors are supplied with some type of bearing temperature detector and/or relay. These devices will provide a warning or shut-down of the equipment if bearings are overheating. The maximum safe operating temperature for most bearings is 90 degrees C (194 degress F) at the babbitt. For an insulated bearing, the temperature detector or relay is insulated from the bearing housing to prevent an electrical path from the bearing to ground. Do not remove any insulator used in connection with a bearing temperature detector or relay for the above reason. Incoming conduit to an insulated bearing temperature detector or relay must be insulated to prevent an electrical path from bearing to ground.

Overheating of a bearing may be caused by one or more of the following factors:

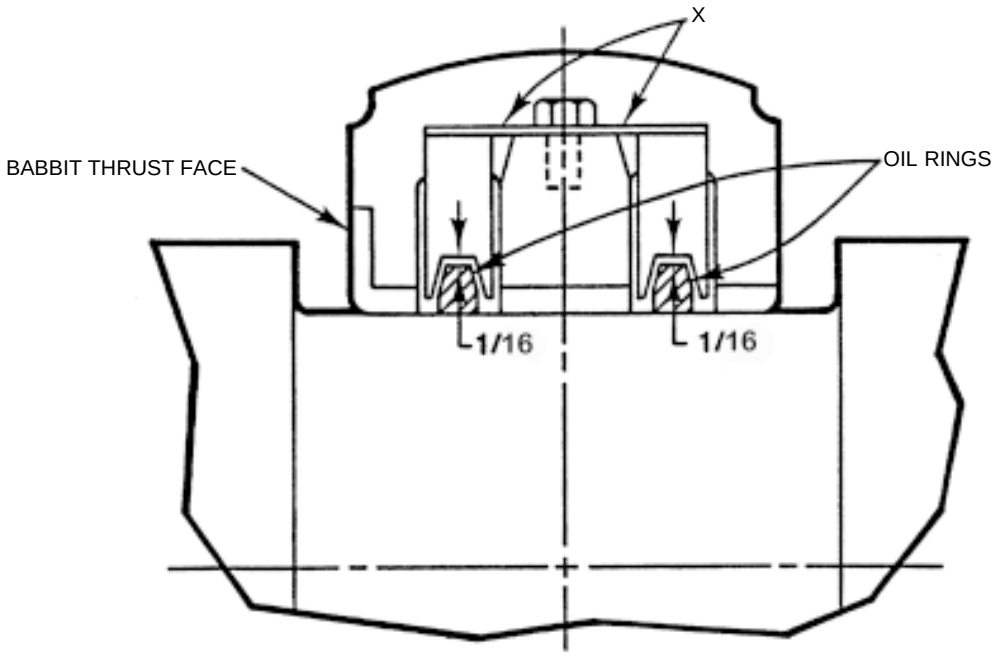
1. Improper oil level (too low or too high)
2. Dirty oil or oil of the wrong type
3. Failure of oil rings to rotate (binding)
4. Oil ring guides not adjusted properly
5. Bent shaft
6. Rough bearing surfaces due to corrosion or careless handling
7. Thrust from driven equipment (usually due to improper coupling selection)
8. Poor alignment to driven equipment
9. Excessive loading or cycling
10. Insufficient bearing clearance
11. Insufficient cooling air flow (air intake restricted or incorrect rotation direction)
12. Excessively high ambient temperature

A bearing which overheats should be carefully inspected and corrective action taken to resolve the problem. Bearings may be removed by following the instructions in Section XII "Sleeve Bearing Replacement."

XII. SLEEVE BEARING REPLACEMENT

1. Bearing may be removed by following procedure in Section VIII "Disassembly" Part 1 Steps A through H.
2. Clean and inspect all parts thoroughly, taking precautions noted in Section IX "Reassembly" Part 1.
3. Remove the oil ring guides and screws on the old bearing and set aside for use on replacement bearing.
4. For replacement bearings contact a U.S. Electrical Motors Service Center.
5. Install the oil ring guides onto the replacement bearing and adjust by bending at "X" to obtain dimensions shown in Figure 6.
6. When installing the replacement bearing, the babbitt thrust face indicated in Figure 6 must be positioned towards the motor.
7. For reassembly follow procedure in Section IX "Reassembly" Part 1.

FIGURE 6
OIL RING ADJUSTMENT



XIII. LUBRICATION

Motor must be at rest and electrical controls should be locked open to prevent energizing while motor is being serviced (Refer to section on Safety, page i). If motor is being taken out of storage, refer to Section III. "Storage". Part 4, for preparation instructions.

Use a premium quality turbine oil from Table 4 which is fully inhibited against oxidation and corrosion.

Oil is added to a bearing by pouring through the oil fill hole at the top of each bearing housing. Add oil until the oil level reaches the "maximum" mark located on the oil sight gauge window. See the motor nameplate for the approximate quantity of oil required.

Table 3: Recommended Oil Specification for Sleeve Bearing Motors

Ambient Starting and Operating Temperatures Range (°F)	Shaft Speed RPM's	Viscosity Grades ◆◆	Lubrication Interval
Below 50°	All	May require heaters for start-up. Refer to USEM Engineering for exact requirements	
50° - 104°	Above 1800	ISO 32 Min. Viscosity index = 90	5,000 Hours or 1 Year ◆ (Whichever comes first)
	1800 and below	ISO 68 Min. Viscosity index = 90	1 Year ◆
Above 104°	All	Consult USEM Engineering for requirement	

◆ Frequent starting and stopping, damp or duty environment, extreme temperature, or any other severe service conditions, will warrant more frequent oil changes. If there is any question, consult USEM Engineering for recommended oil change intervals regarding your particular situation.

◆◆Use Viscosity range noted unless lubrication plate on motor indicates otherwise.

Table 4: U.S. Motors Approved Oils for Sleeve Bearing Motors

	ISO VG 32		ISO VG 68	
	Viscosity: 130-165 SSU at 100 F		Viscosity: 284-347 SSU at 100F	
Oil Manufacturer	**MINERAL BASE OIL**	**SYNTHETIC BASE OIL**	**MINERAL BASE OIL**	**SYNTHETIC BASE OIL**
Chevron USA, Inc.	GST Turnbine Oil 32	Tegra 32	GST Turbine Oil 68	Tegra 68
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 68	Syncon 68
Exxon Co., USA	Teresstic 32	Synnestic 32	Teresstic 68	Synnestic 68
Mobil Oil Co.	DTE Oil Light	SHC 624	DTE Oil Heavy Medium	SHC 626
Pennzoil Co., Inc.	Pennzbell TO 32	Pennzbell SHD 32	Pennzbell TO 68	Pennzbell SHD 68
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68
Shell Oil Co.	Tellus 32	Tellus HD Oil AW SHF 32	Tellus 68	Tellus HD Oil AW SHF 68
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetys PAO 68

Installation Record

NAMEPLATE & INSTALLATION INFORMATION

SERIAL NUMBER OR MODEL NUMBER _____
HORSEPOWER _____
MOTOR SPEED/RPM _____
PHASE & FREQUENCY/HERTZ _____
TYPE _____
AMPS (AT _____VOLTS) _____
DESIGN _____
FRAME _____

DATE PURCHASED _____ PO NUMBER _____
DATE INSTALLED _____ INSTALLATION NO. _____
LOCATION OF JOB SITE _____
PURCHASED FROM _____
MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION _____
INSULATION TO GROUND READING AT TIME OF INSTALLATION _____

RECORD OF MAINTENANCE

GRADE & TYPE OF LUBRICATION USED _____

DATE OF LAST OIL CHANGE		VIBRATION LEVEL		DATE OF LAST OVERHAUL OR REPAIR	

TABLE 5
RECOMMENDED FASTENER TORQUE VALUES

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

**based upon using a dry (nonlubricated) Grade 5 fastener*

RENEWAL PARTS & 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 authorized service shops, or through U.S. MOTORS distributor center listed below.

U.S. ELECTRICAL MOTORS DISTRIBUTION CENTER
3363 MIAC COVE
MEMPHIS, TN 38118
PHONE (901) 794-5500
FAX (901) 366-4225

U.S. Electrical Motors Division, Emerson Electric Co.
8100 West Florissant Avenue, St. Louis, MO 63136

REGIONAL OFFICES	PHONE	FAX
ORANGE, CONNECTICUT	(800) 243-2700	(203) 891-1077
CHICAGO, ILLINOIS	(800) 323-5223	(630) 893-0182
MEMPHIS, TENNESSEE	(901) 794-5500	(901) 794-0741
DALLAS, TEXAS	(800) 683-4126	(972) 644-0254
SANTA FE SPRINGS, CALIFORNIA	(800) 854-3302	(562) 941-1858
INTERNATIONAL SALES	(314) 553-2196	(314) 553-2135

REGIONAL OFFICES	PHONE	FAX
MONTREAL, QUEBEC/CANADA	(800) 361-5509	(514) 332-5912
TORONTO, ONTARIO/CANADA	(905) 475-4670	(905) 475-4672
MONTERREY, MEXICO	(52) 8-389-1300	(52) 8-389-1310
CARACAS, VENEZUELA	(58) 2-237-7522	(58) 2-232-9727
BOGOTA, COLOMBIA	(571) 439-5420	(571) 439-5417

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