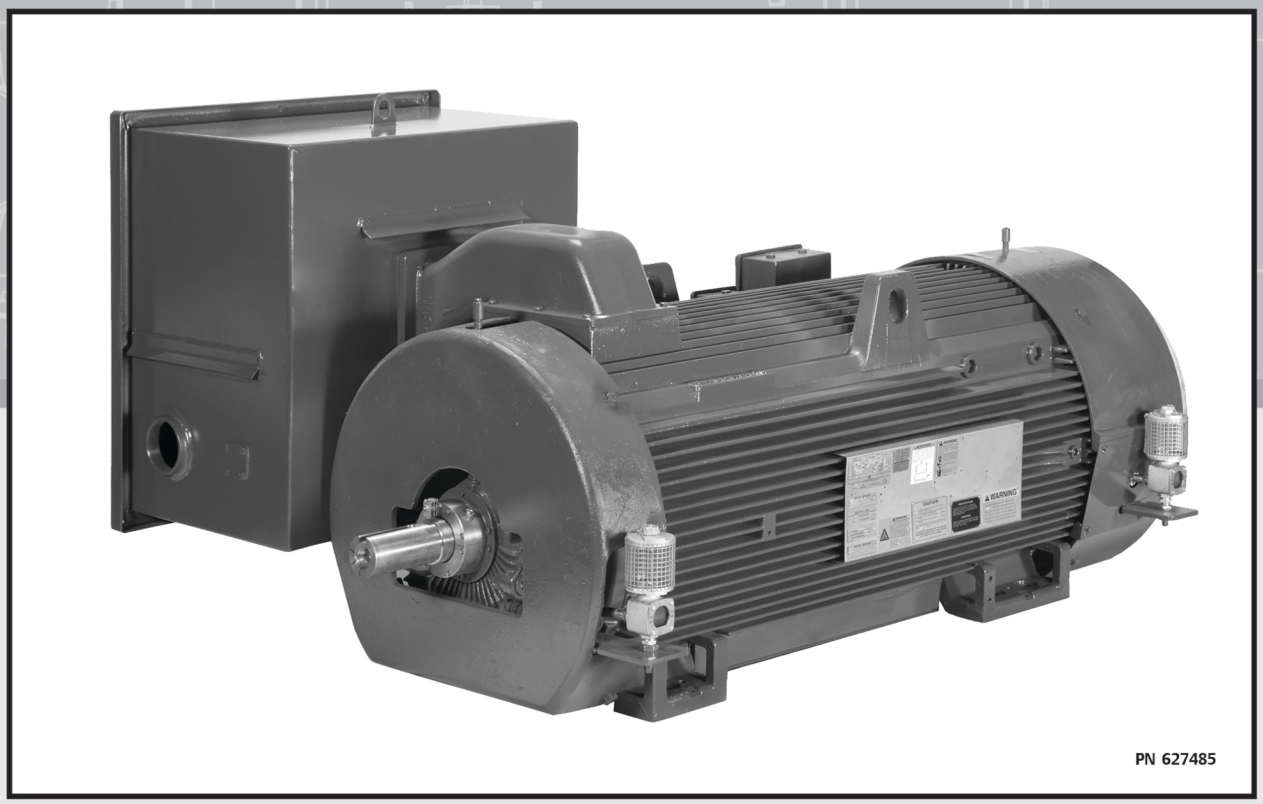
TITAN® HORIZONTAL
LARGE AC ELECTRIC MOTORS



PN 627485

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

US MOTORS

EMERSON™
Motor Technologies

EMERSON. CONSIDER IT SOLVED™

SAFETY FIRST!

High voltage and rotating parts can cause serious injury or loss of life. Installation, operation and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA®† MG2, the National Electric 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. Also ensure that driven equipment connected to the motor shaft will not cause the motor to rotate (windmilling of fans, water flowing back through pump, etc.).

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 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 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, before energizing unit.

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. Electric motors can retain a lethal charge even after being shut off. Certain accessories (space heaters, etc.) are normally energized when the motor is turned off. Other accessories such as power factor correction capacitors, surge capacitors, etc. can retain an electrical charge after being shut off and disconnected.

14. Do not apply power correction capacitors to motors rated for operation with variable frequency drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult drive supplier for further information.

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1. 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 and Emerson Motor Company.

When contacting Emerson Motor Company 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).

2. HANDLING

The equipment needed to handle the motor includes a hoist and spreader bar arrangement of sufficient strength to lift the motor safely. The spreader bar arrangement should be employed whenever multiple lifting lugs or eyebolts are provided **(See Figure 1A & 1B.)** The spreader bar should have the lifting hooks positioned to equal the span of the eyebolts or lifting lugs. The eyebolts or lifting lugs provided are intended to lift the motor weight only. See **Table 7** for motor weights.

> ⚠ ***WARNING***
> ***Lifting the motor by other means may result in damage to the motor or injury to personnel.***

> ⚠ ***CAUTION***
> ***Do not move motor with oil sumps filled. Sloshing action of oil in sumps can result in oil leaks and motor damage.***

FIGURE 1A
Typical Construction With Four Lifting Lugs

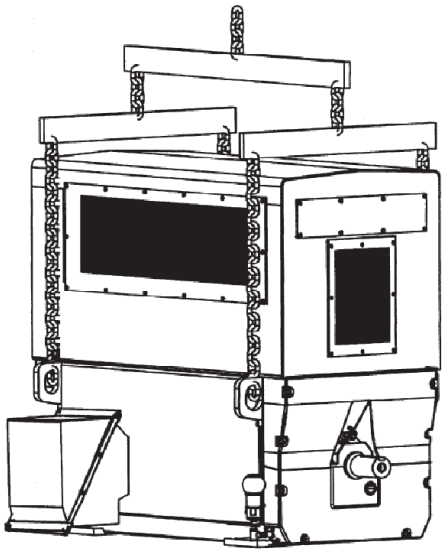
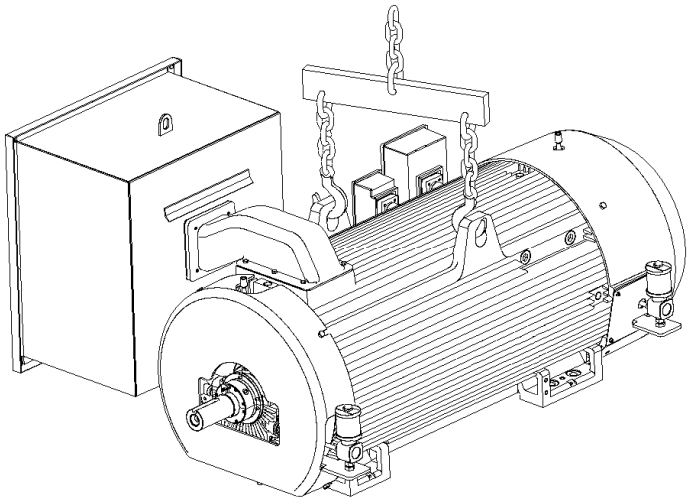


FIGURE 1B
Typical Construction With Two Lifting Lugs



3. STORAGE

3.1 When to put a Motor in Storage.

If a motor is not put into immediate service (one month or less), or it is taken out of service for a prolonged period, special storage precautions should be taken to prevent 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 **Section 3.2 A, B, C, D, E, F (2) and G, Section 3.3 A, B and C, and Section 3.4.**

C. Out of service or in storage for six months or more – all recommendations.

3.2 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 a 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.

NOTICE

Immediately remove any shrink wrap used during shipping. Never wrap any motor in plastic for storage. This can turn the motor into a moisture trap causing severe damage not cover by Emerson Motor Company's warranty

C. Whether indoors or out, the area of storage should be free from excessive ambient vibration which can cause bearing damage.

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

E. Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. 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. The condition of the coating should be checked periodically and surface re-coated as necessary.

F. Bearings:

(1) When storage time is six months or more, grease lubricated cavities must be completely filled with lubricant. Remove the drain plug and fill cavity with grease until grease begins to purge from drain opening. Refer to **Section 7.5** and/or review motor's lubrication nameplate for correct lubricant.

(2) Oil lubricated motors are shipped without oil. When storage time exceeds one (1) month, the oil sumps must be filled to the maximum capacity as indicated on the oil chamber sight gauge window. Refer to motor lubrication nameplate or **Table 5** for proper oil.

NOTE: Motor must not be moved with oil in reservoir. Drain oil before moving to prevent sloshing and possible damage. With a clean cloth, wipe any excess oil from the threads of the drain plug and the inside of the drain hole. Apply GASOILA®† or equivalent thread sealant to the threads of the drain plug and replace the plug in the oil drain hole. Refill oil when motor has been moved to the new location.

G. To prevent moisture accumulation, some form of heating must be utilized. This heating should maintain the winding temperature at approximately 5°C above ambient. If space heaters are supplied, they should be energized. If none are available, single phase or 'trickle' heating may be utilized by energizing one phase of the motor's winding with a low voltage. Request the required voltage and transformer capacity from Emerson Motor Co. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing filtered warm air into the motor.

3.3 Periodic Maintenance

A. Oil should be inspected monthly for evidence of moisture or oxidation. The oil must be replaced whenever contamination is noted or every twelve months; which ever occurs first. It is important to wipe excess oil from the threads of the drain plug and the drain hole and to coat the threads with GASOILA®† or equivalent thread sealant before replacing the drain plug.

B. Grease lubricated bearings must be inspected once a month for moisture and oxidation by purging a small quantity of grease through the drain. If any contamination is present, the grease must be completely removed and replaced.

C. All motors must have the shaft rotated once a month to maintain a lubricant film on the bearing races and journals.

D. Insulation Testing:

Two tests are used to evaluate the condition of the winding insulation. The first of these is the one minute insulation resistance test (IR_1) and the second is the polarization index test (PI), which can also be referred to as a dielectric absorption test. The results of either of these tests can be skewed by factors such as the winding temperature and its relation to the dew point temperature at the time the test was conducted. The PI test is less sensitive to these factors than the IR_1 test, but its results can still be affected significantly. Due to these factors, the most reliable method for evaluating the condition of the winding insulation is to maintain a record of periodic measurements, accumulated over months or years of service, for one or both of these tests. It is important that these tests be conducted under similar conditions of winding temperature, dew point temperature, voltage magnitude and duration, and relative humidity. If a downward trend develops in the historical data for either test, or if the readings from both tests drop below a minimum acceptable value, have an authorized electrical apparatus service shop thoroughly clean and dry the winding, and retreat, if necessary.

The recommended procedure for the IR_1 test is as follows:

(1) Disconnect all external accessories or equipment that have leads connected to the winding and connect them to a common ground. Connect all other accessories that are in contact with the winding to a common ground.

> ⚠ ***WARNING***
>
> ***Failure to have accessories grounded during this test can lead to the accumulation of a hazardous charge on the accessories.***

(2) Using a megohmmeter, apply DC voltage at the level noted below for 1 minute and take a reading of the insulation resistance between the motor leads and ground.

Rated Motor Voltage	**Recommended DC Test Voltage**
Up to 1000 (inclusive)	500 VDC
1001 to 2500 (inclusive)	500 to 1000 VDC
2501 to 5000 (inclusive)	500 to 2500 VDC
5001 and up	500 to 5000 VDC

> ⚠ ***WARNING***
>
> ***Follow appropriate safety procedures during and after high voltage testing. Refer to the instruction manual for the test equipment. Make sure the winding insulation is discharged before beginning the test. The winding insulation will retain a potentially dangerous charge after the DC voltage source is removed, so use proper procedures to discharge the winding insulation at the end of the test. Refer to IEEE 43 Standard for additional safety information.***

(3) The reading should be corrected to a 40°C base temperature by utilizing the formula:

$$R_{40C} = K_T R_T$$

Where:
R_{40C} = insulation resistance (in megohms) corrected to 40°C
K_T = insulation resistance temperature coefficient at temperature T°C
R_T = measured insulation resistance (in megohms) at temperature T°C

The value of K_T can be approximated by using the formula:

$$K_T = (0.5)^{(40 - T)/10}$$

Where:
T = the winding temperature in °C that the insulation resistance was measured at

The recommended procedure for the PI test is as follows:

(1) Perform steps 1 and 2 from the IR_1 test procedure. Heed the safety warnings given in the IR_1 test procedure.

(2) With DC voltage still being applied by the megohmmeter, take an additional reading of insulation resistance between the motor leads and ground 10 minutes after the DC

voltage was initially applied. To minimize measurement errors, the variation in winding temperature between the 1 minute and 10 minute readings should be kept to a minimum.

(3) Obtain the polarization index by taking the ratio of the 10 minute resistance reading to the 1 minute resistance reading.

If historical data from previous IR_1 and / or PI tests is available, then a comparison of the present test result to previous tests can be used to evaluate the condition of the insulation. To minimize error, all readings that are compared should be taken at test voltages, winding temperatures, dew point temperatures, and relative humidities that are as similar as possible. If a downward trend in the readings develops over time, have an authorized electrical apparatus service shop thoroughly clean and dry the winding and, if necessary, retreat the winding. Then, repeat the tests and re-check results before returning the motor to service.

If historical data from previous IR_1 or PI tests is not available, then compare readings from the present test to the recommended minimum values listed below. If the readings from both tests fall below the minimum, have an authorized electrical apparatus service shop thoroughly clean and dry the winding and, if necessary, retreat the winding. Then, repeat the tests and re-check results before returning the motor to service.

The recommended minimum value for the 1 minute insulation resistance reading corrected to 40°C is:

Rated Motor Voltage	Minimum Insulation Resistance
Up to 999 (inclusive)	5 Megohms
1000 and up	100 Megohms

The recommended minimum value for the polarization index is 2.0. If the 1 minute insulation resistance reading corrected to 40 °C is above 5000 megohms, however, the polarization index may not be meaningful. In such cases, the polarization index may be disregarded as a measure of insulation condition.

Refer any questions to the Emerson Motor Company Product Service Department.

For more information, refer to the IEEE®† 43 Standard.

3.4 Start-up Preparations After Storage

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

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

C. When storage time has been six (6) months or more, oil and/or grease must be completely changed using lubricants and methods recommended on the motor's lubrication plate, or in **Section 7.5**.

D. The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in **Section 3.3, item D**.

E. Contact Emerson Motor Co. Product Service Department prior to start-up if storage time has exceeded one year.

4. INSTALLATION LOCATION

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

The location should be clean, dry, well ventilated, properly drained and provide accessibility for inspection, lubrication and maintenance. Ambient vibration should be kept to a minimum. Outdoor installations on Open Dripproof motors require protection from the elements.

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

The temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level and a maximum ambient temperature of 40°C. See NEMA MG-1 20.28 for usual service condition.

To avoid condensation inside of motor, motors should not be stored or operated in areas subject to rapid temperature changes unless they are energized or protected by space heaters.

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

Recommended Minimum Installation Clearances

This is a general guide and cannot cover all circumstances. Unusual arrangements should have inquiries to Emerson Motor Co. Product Service Department. Unusual arrangements might include high ambient, limited ventilation, or a large number of motors in a confined space. The distance to the wall is at the side or end of the motor. The distance to another motor is considered as surface to surface and for side-by-side arrangements. This recommendation considers all motors to be mounted in the same orientation (e.g. all main conduit boxes facing east).

SPEED	DISTANCE TO WALL	DISTANCE TO ANOTHER MOTOR
3600 RPM	2 x MOTOR WIDTH	2 x MOTOR WIDTH
1800 RPM OR LESS	1 x MOTOR WIDTH	

5. FOUNDATION

Concrete (reinforced as required) makes the best foundation, particularly for large motors and driven units. A sufficient mass provides rigid support that minimizes deflection and vibration. It may be located on soil, structural steel or building floors, provided that the total weight (motor, driven unit and foundation) does not exceed the allowable bearing 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 of different types of soil.) It is recommended that a fabricated steel base (sole plate) be used between the motor and the foundation. See **Figure 2**. Base foot pads should be level and in the same plane.

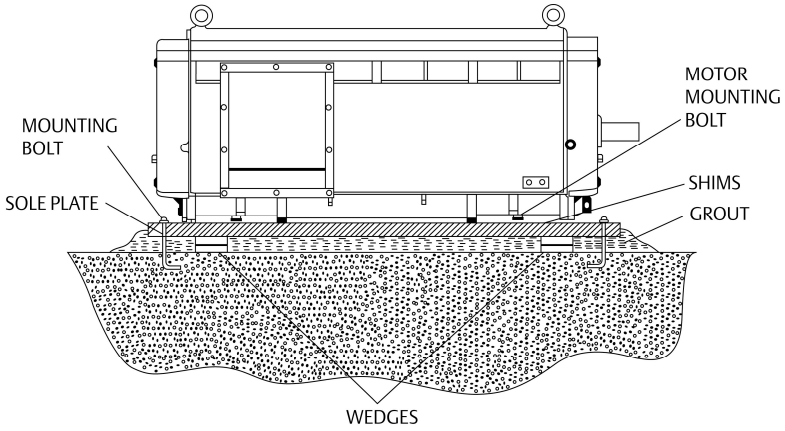
5.1 Grouting

Grouting is the process of firmly securing equipment to a 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 that 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 integral part of the principal foundation. In order to function properly, the principal foundation should be allowed to fully set through chemical reaction and dehydration as recommended by the grout manufacturer, prior to motor installation.

FIGURE 2

TYPICAL MOTOR MOUNTING ARRANGEMENT



6. INITIAL INSTALLATION

> ⚠ ***CAUTION***
> ***Sleeve bearing motors are shipped without oil. Oil reservoirs must be filled during installation.***

6.1. Coupling or Pulley Installation

Remove the shaft clamping device shipped on the motor (as applicable). Do not discard the clamping device as it will be needed should the motor require transport in the future. Wash protective coating from the motor shaft extension(s) with solvent. Install couplings or pulleys on motor shaft per manufacturers' recommended fit and mounting practices.

> ⚠ ***CAUTION***
> ***Hammering or pounding with a mallet to install couplings or pulleys will damage bearings.***

⚠ CAUTION

For units with <u>Sleeve Bearings:</u>

Sleeve bearing motors should be direct-coupled to the driven equipment. See coupling recommendations for recommended coupling type. Never use a pulley or sprocket as they transmit unacceptable radial loads to the motor bearings.

In belted applications, the driver pulley should be positioned as close to the shaft shoulder as possible to assure longest bearing life and keep shaft bending moment to a minimum. Take care to ensure that the inboard edge of the pulley hub does not ride-up on the shaft shoulder blend radius.

⚠ CAUTION

For units with <u>Antifriction Bearings:</u>

Belt tension should not exceed the transmission drive manufacturers' recommendations. Excessive belt tension reduces belt life. Overload due to over tensioning of belts reduces bearing life and can induce shaft fatigue failure.

Excessive bending movement due to placing of pulley far out on shaft extension will reduce bearing life and may lead to shaft fatigue failure.

Placing the pulley hub onto the shaft against the shaft shoulder blend radius may cause a large stress riser in the shaft, resulting in shaft fatigue failure. Prevent this from occurring by using a chamfered spacer ring or by chamfering the end of the hub bore.

6.2 Rough Alignment

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

Position and shim the motor such that the coupling hubs are aligned within 1/32 inch and the motor shaft is level. The motor shaft <u>must</u> be slightly lower than the driven shaft to allow for final adjustment shims. Shims and support mounting should provide support under the entire foot area.

6.3 Final Alignment

Accurate shaft alignment between motor and driven equipment is essential for trouble-free operation. Improper alignment can result in vibration, bearing overload and excessive shaft stresses. Flexible couplings may not adequately compensate for excessive misalignment.

Whenever aligning a motor to driven equipment, keep the following rules in mind:

- Do not place more than five shims in a shim pack under any one machine foot, as flexibility of the shim pack will contribute to a soft foot condition.
- After any corrective adjustment, tighten 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 for approximately one week and readjust as necessary.

A. Angular Alignment **(See Figure 3A)**

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 .001 inch per foot of coupling radius.

B. Parallel Alignment **(See Figure 3B)**

Fasten a dial indicator onto one coupling hub with the indicator button on the cylindrical surface of the opposite coupling hub. Rotate shafts together and take readings at four points, 90° apart. Relocate motor until total indicator movement in full rotation does not exceed .002 inch. Transfer indicator to opposite hub and repeat the parallel alignment procedure. Recheck angular alignment as described in Step A.

FIGURE 3
FLEXIBLE COUPLINGS

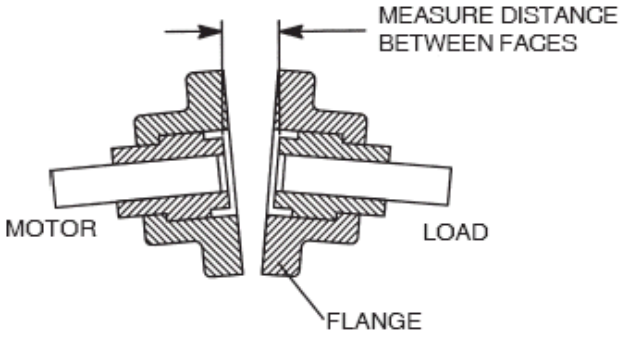


FIGURE 3A
ANGULAR MISALIGNMENT

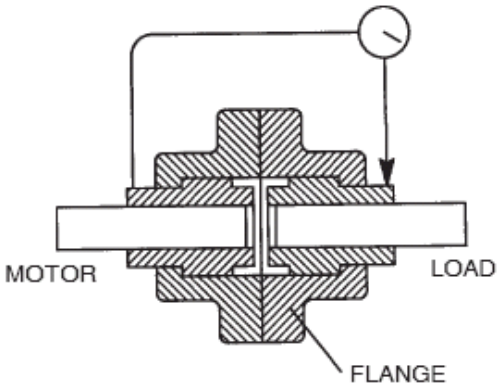


FIGURE 3B
PARALLEL ALIGNMENT

C. Soft Foot Check

Check and correct any 'soft foot' condition to assure that equal pressure is exerted on each motor foot by the following shimming procedure. Bolt all motor feet down solidly to the motor bedplate or foundation. Mount the base of the dial indicator on the motor's foundation, and place and zero out the indicator on the motor shaft or coupling. Back off one of the drive end mounting bolts and check indicator for change in reading. Change should not exceed .001 inch. Shim at foot if required and go to other take-off end bolt. This procedure should be repeated on the opposite end until no reading is greater than .001 inch.

D. Hot Alignment

It is possible for the motor shaft height to change relative to the driven equipment and this should be compensated for during the alignment procedure. Recheck parallel alignment (vertical) of

coupled drive by repeating after normal operating temperature is reached. If shimming is changed, repeat alignment procedure to the extent necessary to assure proper alignment.

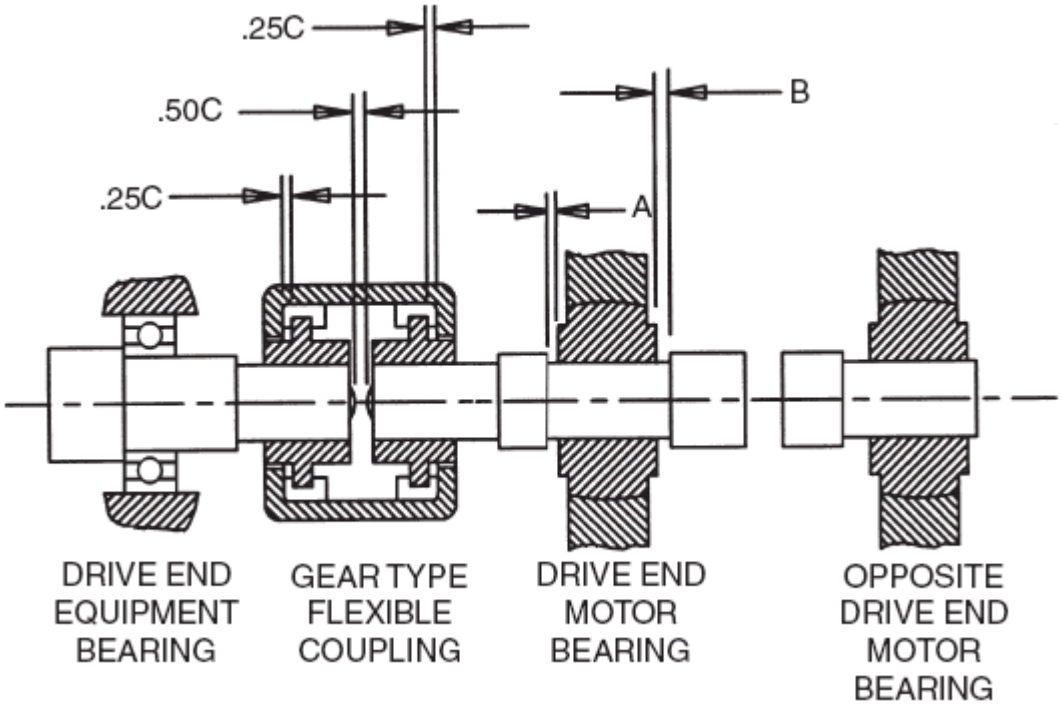
6.4 Coupling Requirements

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 to take all the thrust load. The driven equipment shaft should have its axial end play limited as necessary to prevent applying any axial load 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. This requires that a limited end float coupling, in accordance with the following is used.

A. Gear Type
B. Tapered Grid Type
C. Disk Type with Positive Stops
D. Roller Chain Type
E. Rubber Biscuit Type

FIGURE 4



A + B = TOTAL MIN ROTOR END FLOAT
C = TOTAL MAX COUPLING END FLOAT

Table 1 – Coupling End Play and Rotor Float

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 included	3600 & 3000	0.50	0.19
600 & Higher	All Speeds	0.50	0.19

6.5 Electrical Connection

Refer to the motor nameplate for power supply requirements and to the connection diagram for connection parameters. Be sure connections are tight. Recheck carefully and assure that they agree with the connection diagram. Insulate all connections to insure that they will not short against each other or to ground. Be sure the motor is grounded to guard against 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 motor starter manufacturer. Apply the above precautions to all accessories as well.

6.6 Reversing Rotation

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

⚠ CAUTION

Some motors have unidirectional ventilating fans. Running such a unit in reverse for any extended length of time will result in motor damage. On motors that are unidirectional, the direction of rotation is noted by an arrow mounted on the motor 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 insure driven equipment is not damaged by reverse rotation. Motor coupling may require removal or support if motor is operated uncoupled from driven equipment.

6.7 Initial Start

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

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

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

C. Check insulation resistance according to **Section 3 'Storage', Part 3.3.**

D. Check all foundation and base bolts to insure that they are tight.

E. If motor has been in storage, either before or after installation, refer to **Section 3 'Storage', Part 3.4.**

F. Check for proper or desired rotation. See **Part 6.6** of this section.

G. Insure that all protective devices are connected and are operating properly.

H. 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.

I. Run motor at minimum possible load long enough to be certain that no unusual condition develops. Listen and feel for excessive noise, vibration, clicking or pounding. If any are present, stop motor immediately. Investigate the cause and correct before putting motor into service. In the case of vibration, see **Part 6.8** of this section.

⚠ 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 MG1-12.54, MG1-20.11 and MG1-20.12 for allowable starting frequency and load inertia (WR2).

J. When checks are satisfactory to this point, increase the load slowly up to rated load and check unit for satisfactory operation.

6.8 Vibration

Motors are supplied as standard in accordance with NEMA MG-1, Section 7, which dictates that the motor no-load vibration when mounted on a resilient base shall not exceed the limits as outlined in the following table:

TABLE 2
NO-LOAD VIBRATION LIMITS

Speed, RPM	Rotational Frequency, Hz	Velocity, Inches per second peak
3600	60	0.15
1800	30	0.15
1200	20	0.15
900	15	0.12
720	12	0.09
600	10	0.08

If vibration is deemed excessive, check for and correct any misalignment and/or 'soft foot' condition per **Part 6.3** of this section.

6.9 Doweling

Doweling the motor (and driven unit) accomplishes the following:

- Restricts movement of the motor and driven unit.
- Eases realignment if motor is removed from base.
- Temporarily restrains the motor, should mounting bolts loosen.

The following procedure for inserting dowel pins is recommended.

A. Check the alignment after the unit has been operational approximately one week. Correct if necessary.

B. Drill through motor feet on drive end and into base. Use holes in motor feet (if provided) as a pilot. Drill diameter must be slightly smaller than the intended dowel size to allow for reaming operation.

C. Ream holes in the feet and base to the proper diameter for the pins (light press fit).

D. Insert dowel pins.

7. ROUTINE MAINTENANCE

Start the motor in accordance with the 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.

7.1 General Maintenance

Routine maintenance prevents costly shutdown and repairs. Major elements of a controlled maintenance program include:

A. Trained personnel who KNOW the work.

B. Systematic records, which contain at least the following:

(1) Complete nameplate data.

(2) Prints (wiring diagrams, certified outline dimensions).

(3) Alignment data (departures from perfect alignment, allowance for temperature).

(4) Winding resistance and temperature.

(5) Results of regular inspection, including vibration and bearing temperature data as applicable.

(6) Documentation of any repairs.

(7) Lubrication data (method of application, type of lubricant used, maintenance cycle by location).

7.2 Inspection & Cleaning

> ⚠ ***DANGER***
> ***Assure against accidental starting of motor. Disconnect and lock out power before working on equipment. See 'Safety' section.***

Stop the motor before cleaning. Clean the motor, inside and outside, regularly. The frequency depends upon actual conditions existing around the motor. Use the following procedures, as they apply:

A. Wipe any contaminants from external surfaces of the motor.

B. Remove dirt, dust or debris from ventilating air inlets. Use compressed air as necessary. Never allow dirt to accumulate near air inlets. Never operate motor with the air passages blocked or restricted.

C. Clean motors internally by vacuuming or blowing with clean, dry compressed air. Generally a pressure not exceeding 30 PSI is recommended. 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 bristle brush. **DO NOT SOAK.** Oven dry (150 - 175° F) solvent-cleaned windings thoroughly before assembly.

> ⚠ ***CAUTION***
> ***When using compressed air, always use proper eye protection to prevent accidental injury.***

D. After cleaning and drying the windings, check the insulation resistance. Refer to **Section 3.3.**

7.3 Bearings

Proper care will help prolong the life of the motor bearings. Ensure the alignment, belt tension and lubrication is properly maintained.

Motors are supplied with different types of bearings based on application and rating. Bearings supplied are either anti-friction or sleeve type bearings. Bracket construction varies with the type of bearing. Brackets for anti-friction bearings are one piece while those of sleeve bearing have split hubs.

7.4 Bearing Insulation

To prevent bearing damage from circulating current, one or both bearings may be insulated. Either the shaft or the bearing may be insulated. Note that not all motors are equipped with insulated bearings.

During overhauls, an insulation resistance check may be performed to assure that the insulation has not been weakened or damaged. Resistance can be checked by the use of an ohmmeter.

On sleeve bearing units with both bearings insulated, the bearing grounding strap must be disconnected before testing.

7.5 Bearing Lubrication

A. Relubrication

> ⚠ ***DANGER***
> ***Assure against accidental starting of motor. Disconnect and lock out power before working on equipment. See 'Safety' section.***

If motor is being taken out of storage, refer to **'Storage' - Section 3.4** for preparation instructions.

For units with <u>Sleeve Bearings:</u>

Select a premium-quality turbine oil which is fully inhibited against rust and oxidation. Refer to **Table 5** for recommendations. Oil Pour Point must be below the minimum starting temperature unless sump heaters are used. Oil Viscosity Index must be at least 90.

> ⚠ ***CAUTION***
> ***Oil 'Pour Point' temperature must be below the minimum starting air temperature to ensure adequate bearing lubrication at startup. If this cannot be achieved by oil selection alone then sump heaters should be specified and used to preheat the oil.***

Add oil to the bearing at the oil fill hole located at the top of each bearing housing. Oil level should be between the 'Maximum' and 'Minimum' lines located on the housing sight gauge windows. Also fill constant level oilers, if supplied. Refer to motor nameplate for approximate quantity of oil required.

For units with <u>Antifriction Bearings:</u>

Units with grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubrication interval depends upon speed, type of bearing and service. Refer to **Table 3** for suggested relubrication intervals. Note that operating environment and application may dictate more frequent lubrication.

To relubricate bearings, remove grease drain plug. Inspect grease drain and remove any blockage. Add new grease at the grease inlet. New grease must be compatible with grease already in the motor (refer to **Tables 3 and 4** for compatible greases and replenishment quantities).

> ⚠ ***CAUTION***
> ***Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disassembling motor, remove all old grease and repacking with new grease. (Refer to Table 4 for recommended grease).***

Run motor for 15 to 30 minutes with the grease drain plug removed to allow purging of any excess grease. Shut off unit and replace drain plug. Put motor back into operation.

> ⚠ ***CAUTION***
>
> ***Over-greasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against over-greasing.***

7.6 Bearing Replacement

> ⚠ ***DANGER***
>
> ***Ensure against accidental starting of motor. Disconnect and lock out power before working on equipment. See 'Safety' section.***

For units with <u>Antifriction Bearings:</u>

A. Disassembly

See **Figure 5** for Bearing Housing Cross-Section.

(1) Ensure power is disconnected.

(2) Remove grills, fan cover, fan, air scoops, and/or weather-protected top hat as required.

(3) Loosen and remove bearing cap screws.

(4) Remove bearing temperature detectors as applicable.

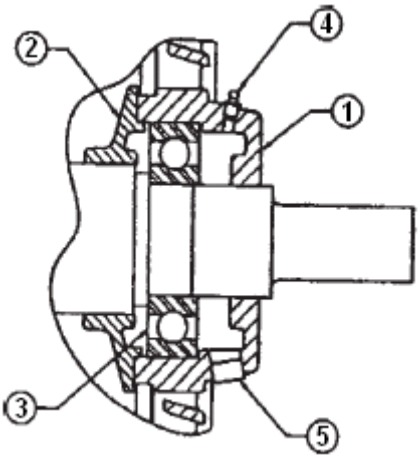
(5) Remove bracket-to-stator bolts and remove brackets.

(6) If bearings are to be replaced, remove bearings from rotor shaft with a bearing puller.

Pull on inner bearing race to remove bearing without damage.

Hazardous Location Motors: (Underwriter's Laboratories Requirements)
These motors are built to specifications approved by Underwriter's Laboratories. Assembly and inspection is made by authorized personnel at our factory before the Underwriter's Label is affixed. The Label is void if the unit is disassembled at other than Emerson Motor Company plant of manufacture or an Emerson Motor Company authorized and U.L. approved service shop, unless specific approval for such action is obtained from Underwriter's Laboratories.

FIGURE 5
Antifriction Bearing Housing Construction



1. **BEARING BRACKET**
2. **BEARING CAP**
3. **BEARING**
4. **GREASE FILL FITTING**
5. **GREASE DRAIN PLUG**

B. Reassembly

(1) Clean all machined and matting surfaces on bearing caps, bracket fits, etc.

(2) Remove old grease from grease cavities and bearings.

(3) Carefully inspect bearings for nicks, dents or any unusual wear patterns. Damaged bearings must be replaced.

(4) If motor is supplied with insulated bearing or insulated bearing shaft journals, inspect for damage and repair as necessary before reassembly.

(5) Reassemble motor by reversing the disassembly procedure in **Section 7.6 – Bearing Replacement – 'Disassembly'**. Bearings should be installed per bearing manufacturer's recommended procedure. Pack bearings and housings with grease per **Tables 3 and 4**.

(6) Torque bolts per values in **Table 6**.

(7) Touch up any scratched or chipped paint to protect motor surfaces

For units with <u>Sleeve Bearings:</u>

A. Disassembly

See **Figure 6** for Bearing Housing Cross-Section.

(1) Ensure power is disconnected.

(2) Drain oil from sumps.

(3) Remove grills, fan cover, fan, air scoops, etc.

NOTICE

Perform the remaining steps on both ends of the motor to complete disassembly.

(4) Drain and remove constant level oilers and oil fill and drain hardware.

(5) Remove the screws holding the access cover on the motor (screws 40.1). Remove access cover.

(6) Remove the screws from the upper half external baffle (25.2) and remove baffle (25.1).

(7) Remove the housing split line screws (1.3) and the screws (15.2) on the upper half of the seal carrier. Remove the upper part of the seal carrier (15.1).

(8) Loosen flange screws (30.3) and split line screws (30.4) of the upper part of the machine seal (30.1) and remove it.

(9) Raise and remove the upper half of the bearing housing (1.1).

(10) Dismantle the floating labyrinth seals (20.1 & 21.1) by raising the upper half and tilting it. Then, open the garter spring (20.2 and 21.2) and dismantle together with the lower half.

(11) Loosen and remove the bearing shell screws. Carefully raise the upper half of the bearing shell (5.1). Release the loose oil ring (10) screws, separate and remove both parts.

NOTICE

Bearing shells are manufactured as matched pairs. Do not mix bearing shell halves.

(12) Remove bearing temperature detector probes (if provided).

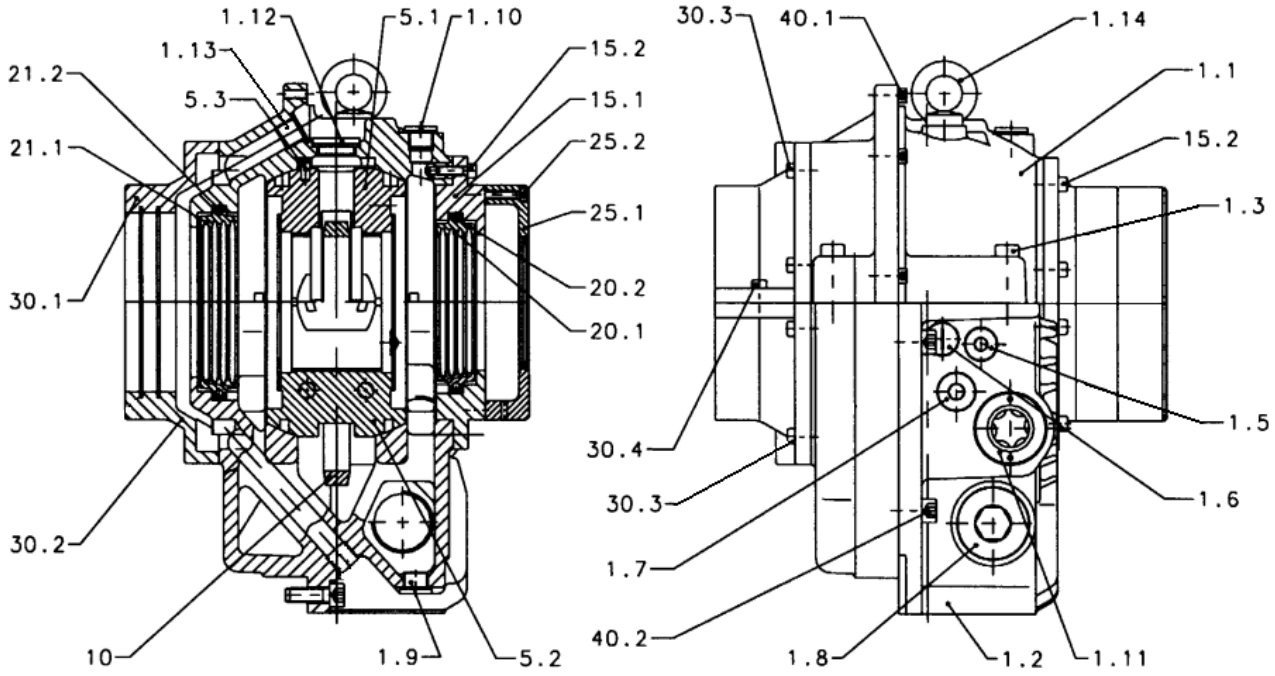
(13) Raise the shaft just far enough to give sufficient clearance to turn the lower shell half (5.2) through 180° and lift it away.

(14) Loosen and remove lower bearing housing screws (40.2). Carefully remove the lower bearing housing (1.2) along with the lower half of the machine seal (30.2) as a unit from the adapter bracket.

(15) Remove adapter bracket from stator frame.

FIGURE 6

Sleeve Bearing Housing Construction



1.1	Upper bearing housing	10	Oil ring
1.2	Lower bearing housing	15.1	Seal carrier
1.3	Bearing housing retaining screws	15.2	Seal carrier retaining screws
1.5	Sealing plug with seal (Oil inlet for circulated oil)	20.1	Floating labyrinth seal
1.6	Ground cable exit (Drive End Bearing Only)	20.2	Garter spring for floating labyrinth seal
1.7	Sealing plug (Temperature sensor port)	21.1	Floating labyrinth seal (machine side)
1.8	Sealing plug (Connection for heater, sump thermometer, Oiler Return)	21.2	Garter spring for floating labyrinth seal (machine side)
		25.1	Bolt on external baffle
1.9	Sealing plug (drain)	25.2	Bolt on external baffle retaining screws
1.10	Sealing plug (oil fill)	30.1	Machine seal upper half
1.11	Oil level gauge (or oil outlet for circulated oil)	30.2	Machine seal lower half
1.12	Oil sight window (Oil ring view port)	30.3	Machine seal retaining screws
1.13	Sealing plug (upper half pressure balance)	30.4	Machine seal split line screw
1.14	Eyebolt	40.1	Upper bearing housing retaining screws
5.1	Bearing shell upper half	40.2	Lower bearing housing retaining screws
5.2	Bearing shell lower half		
5.3	Anti-rotation pin		

B. Reassembly

NOTICE

Cleanliness is critical in assembling sleeve bearing motors. Make every effort to prevent contamination from getting into the bearing housing.

(1) Ensure all parts in the bearing housing are clean and not damaged.

(2) Ensure that the shaft journals are clean and there are no gouges or corrosion present.

(3) Insert rotor into stator such that rotor and stator are approximately aligned with each other. Use caution to make sure that shaft is not damaged during this operation.

(4) Install the adapter brackets onto the stator frame.

NOTICE

Perform Steps "5" thru "12" on one end of the motor and then repeat for the other end of the motor.

(5) Coat the face of lower half of machine seal (30.2) with a thin film of Curil-T sealant. (Lower half has threaded holes in split face while upper half has thru holes). Secure the lower half of the machine seal (30.2) loosely to the lower bearing housing (1.2) with screws (30.3). These screws will be fully tightened later.

(6) Align the lower bearing housings (1.2) to the adapter brackets. Insert screws (40.2) and tighten.

(7) Slightly raise the shaft using a sling or an eyebolt in end of shaft attached to a hoist.

(8) Apply a film of oil to both the spherical seats in the lower part of the bearing housing (1.2) and to the lower half of the bearing shell (5.2). Also apply a thin film of oil to the shaft bearing journal and to the inner diameter of the bearing shell (5.2). Use the same oil as is to be used during operation of the bearing.

(9) Place the lower half of the bearing shell (5.2) onto the shaft bearing journal, with the numbers stamped near the split line facing away from motor rotor, and turn it to the correct position in the lower part of the housing. Take care that bearing faces are not damaged while the shell is turned. Align the split line surface of the shell with that of the housing.

(10) Next, assemble the loose oil ring (10). Position both halves of the oil ring on the shaft and around the lower half of the shell using the notch provided, then press both halves together on the dowel pins. Following this, tighten the fixing screws to 12 inch-lbs (1.4 Nm).

(11) Lower the shaft so that the shaft rests on the lower half of the bearing shell.

(12) Apply a thin film of oil to the inner diameter of the bearing shell upper half (5.1) and place it over lower half (5.2). Number stamped near split line of bearing should face away from motor rotor and number should match number on lower half of bearing. Check to ensure the oil ring moves freely. Tighten bearing shell screws.

NOTICE

Stop here and repeat steps "5" thru "12" on the opposite end of the motor. Once completed, the remaining steps can be performed on both ends of the motor.

(13) Squirt a small quantity of lubricating oil into the top of each bearing shell (5.1). Spin the rotor by hand approximately 30-60 RPM. While the rotor is spinning, rap the side of each lower bearing housing (1.2) a few times with a leather or rubber-tipped mallet. This action will ensure the bearing shells are properly seated.

(14) Install the lower half of the machine seal (30.2) such that the clearance between the shaft and bottom of the seal is a least .001 inch and there is .003 inch on each side. Use feeler gauges to install and check seal clearance. Tighten screws (30.3) to secure seal. Recheck clearance after fully tighten screws.

(15) Prepare floating labyrinth seals for installation. Coat the split surface and exterior faces - all the way around - of the spring guide of seals (20.1 and 21.1) with a thin layer of Curil-T, as shown in **Figure 7**.

(16) Place lower half of the machine side labyrinth seal (21.1) onto shaft and turn into correct position. The drain slot should be at 6 o'clock position and drain hole should face toward bearing. Place the upper half of the seal onto the lower half and secure with garter spring (21.2).

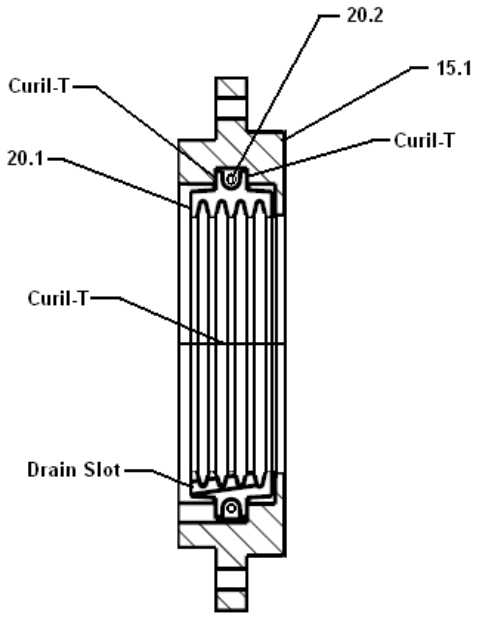


FIGURE 7

Floating Labyrinth Seal Detail
(External side shown, with seal carrier. Sealant instructions apply to both seals.)

(17) Install drive end bearing ground wire (if applicable) to bearing shell. Make sure the wire does not interfere with the oil ring.

(18) Coat the following part/surfaces with a thin layer of Curil-T:
   a. Split surfaces of upper housing (1.1)
   b. Back surface of upper housing (1.1) where the machine seal top half (30.1) will mate
   c. Split surfaces of lower housing (1.2)
   d. Split surfaces of machine seal (30.2)

(19) Very slowly lower the upper part of the housing (1.1) onto the lower half. Ensure that during lowering the already assembled machine-side seal (21.1) locates into the groove provided. Avoid jamming. The upper part must be correctly aligned. Tighten the cover screws (1.3) in a crossways pattern to 30 ft-lbs (41 Nm).

(20) Install upper half of machine seal (30.1) onto lower half (30.2). First tighten the split-line screws (30.4) and then the face screws (30.3) to 7 ft-lbs (10 Nm). Re-check clearance between seal and shaft. Clearance must be at least .001 inch at bottom and .003 inch at sides and top.

(21) Coat split lines and flange faces of seal carrier (15.1) with a thin coat of Curil-T. Prepare the external floating labyrinth seals (20.1) same as was done for the internal ones previously. Place seal carrier halves (15.1) around the assembled floating labyrinth seal (20.1, 20.2) and push the assembly over the shaft and onto the housing. Tighten seal carrier screws (15.2) to 8 ft-lbs (10.5 Nm).

(22) Coat split lines and flange face of bolt-on baffle (25.1) with Curil-T. Position the lower half of the baffle (with drain hole in bottom) such that there is at least .001 inch of clearance to shaft at bottom and .003 inch on each side. Use feeler gauges to install and check clearance. Tighten screws (25.2) to secure lower half. Install upper half on lower half and tighten screws (25.2). Clearance at top of seal to shaft should be .003 inch minimum. Re-check clearance all the way around after all screws are tightened.

(23) Install Access Cover to upper half of bearing and to adapter bracket with screws (40.1).

(24) Install constant level oilers with sight gauges. The oiler height should be adjusted so that the MAX line on the sight gauge window is above the bottom of motor feet within .06 inch (1.5 mm) of the following values:

Frame Size	Height to Max Level Line
5000	9.87 inches (251 mm)
5800	11.25 inches (286 mm)

Note that the opposite drive end oiler should be installed with fan cover sealing plate properly oriented relative to the oiler hose and oiler support bracket.

(25) Install bearing temperature probes (if provided) and oil fill and drain pipes.

(26) Install fan, fan cover, intake grill, air scoop, conduit box(es) and any other accessory supplied with the motor.

Table 3: Suggested Re-greasing Quantities and Intervals

Bearing Number		Bearing Type	Grease Fl. oz.	Lubrication Interval		
Common	AFBMA			1801-3600 RPM	1201-1800 RPM	0-1200 RPM
6313	65BC03	Ball	0.8	6 months	12 months	12 months
6315	75BC03		1.0			
6316	80BC03		1.2			
6318	90BC03		1.5	3 months		
6220	100BC02		1.1			
6320	100BC03		1.8	N/A		
6222	110BC02		1.4			
6322	110BC03		2.1		6 months	
6226	130BC02		1.6			
6228	140BC02		1.9			
6232	160BC02		2.5			6 months
6234	170BC02		2.9			
6334	170BC03		4.6			
6236	180BC02		2.8			
NU220	100RU02	Roller	1.1		3 months	
NU222	110RU02		1.4			
NU226	130RU02		1.6			
NU228	140RU02		1.9			
C2220 CARB	N/A		1.4			
C2222 CARB	N/A		1.8			
C2226 CARB	N/A		2.5			

For motors mounted vertically, or in hostile environments, reduce intervals shown by 50%. For bearings not listed in **Table 3**, the amount of grease required may be calculated by the formula:

$G = 0.11 \times D \times B$

Where: G = Quantity of grease in fluid ounces
D = Outside diameter of bearing in inches
B = Bearing width in inches

Table 4: Recommended Greases for Motors with Antifriction Bearings

Motor Enclosure	Grease Manufacturer	Product Name	Description
Totally-Enclosed	Mobil	Mobilith SHC 100	Lithium Complex NLGI #2
Open and Weather-Protected		PolyrexEM	Polyurea NLGI #2

Table 5: Recommend Oil Viscosity for Sleeve Bearing Motors

Ambient Air Temperature	Motor Enclosure	Motor RPM	ISO VG Viscosity Grade	Oil Change Interval
-18 through +50°C (0 thru 122°F)	Totally Enclosed	1801-3600	32	6 Months
		1201-1800	46	12 Months
		300-1200	68	
-30 through +20°C (-22 thru 68°F)		1801-3600	15	6 Months
		1201-1800	22	12 Months
		300-1200	32	
-18 through +50°C (0 thru 122°F)	Open Weather-Protected	1801-3600	32	6 Months
		300-1800	68	12 Months
-30 through +20°C (-22 thru 68°F)		1801-3600	15	6 Months
		300-1800	32	12 Months

⚠ CAUTION

Oil Change Intervals shown are based on 'Normal Conditions'. Interval should be reduced for 'Severe Duty' conditions, such as dirty or damp atmosphere, consistently high ambient air temperature, high vibration, etc.

Table 6: Recommended Fastener Torque Values

Fastener Size	Torque* (Ft – Lbs.)
1/4 - 20 UNC	8
5/16 - 18 UNC	17
3/8 - 16 UNC	30
7/16 - 14 UNC	50
1/2 -13 UNC	75
9/16 - 12 UNC	110
5/8 - 11 UNC	150

Fastener Size	Torque* (Ft – Lbs.)
3/4 - 10 UNC	260
7/8 - 9 UNC	430
1 - 8 UNC	640
1-1/8 - 7 UNC	800
1-1/4 - 7 UNC	1120
1-3/8 - 6 UNC	1460
1-1/2 - 6 UNC	1940

* Based upon a dry (unlubricated) Grade 5 fastener

Table 7: Maximum Motor Weights (lbs.)

Frame Size	Enclosure			
	ODP/WP-I	WP-II	TEFC	TEAAC
449	2200	N/A	2600	N/A
5004	N/A	N/A	3200	N/A
5006	3500	3800	N/A	N/A
5008	4100	4400	4400	N/A
5010	4800	5100	5300	6100
5012	5500	5800	6600	6900
5807	N/A	N/A	5500	N/A
5809	N/A	N/A	6200	N/A
5810	5400	6300	8100	7800
5811	6300	7200	6800	8800
5812	7500	8400	9700	10000
5813	8600	9500	N/A	11200
6809	7000	7700	N/A	9800
6810	7500	8200	N/A	10300
6811	8100	8800	N/A	11000
8007	10500	12100	N/A	13800
8008	11200	12900	N/A	15100
8009	12200	14000	N/A	16300
8010	13300	15300	N/A	17700
8011	14600	16800	N/A	19300
9606	18200	20900	N/A	N/A
9607	19500	22400	N/A	N/A
9608	21000	24200	N/A	N/A
9609	22700	26100	N/A	N/A
9610	24500	28200	N/A	N/A

8. RENEWAL PARTS AND SERVICE

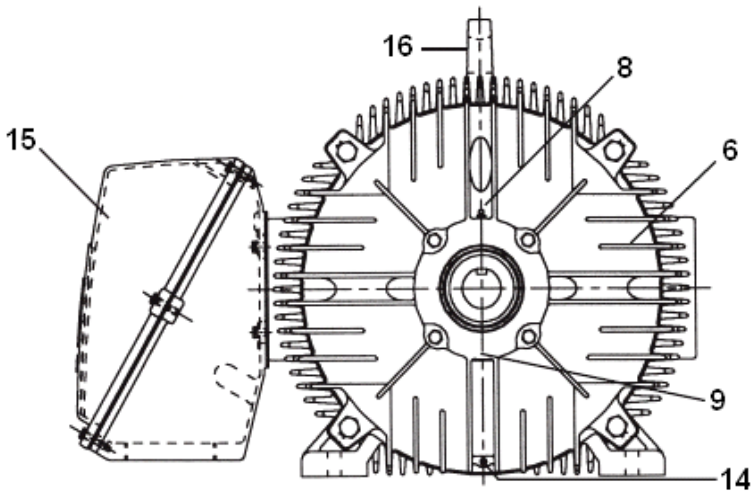
Parts lists for specific units can be furnished upon request. Parts may be obtained from local Emerson Motor Company distributors and authorized service shops, or via the Emerson Motor Company Distribution Center. To ensure prompt, accurate response, you should obtain all of the pertinent information from the motor nameplate. This information should include the motor model number (if applicable) and serial number, the horsepower, speed, motor type and frame size.

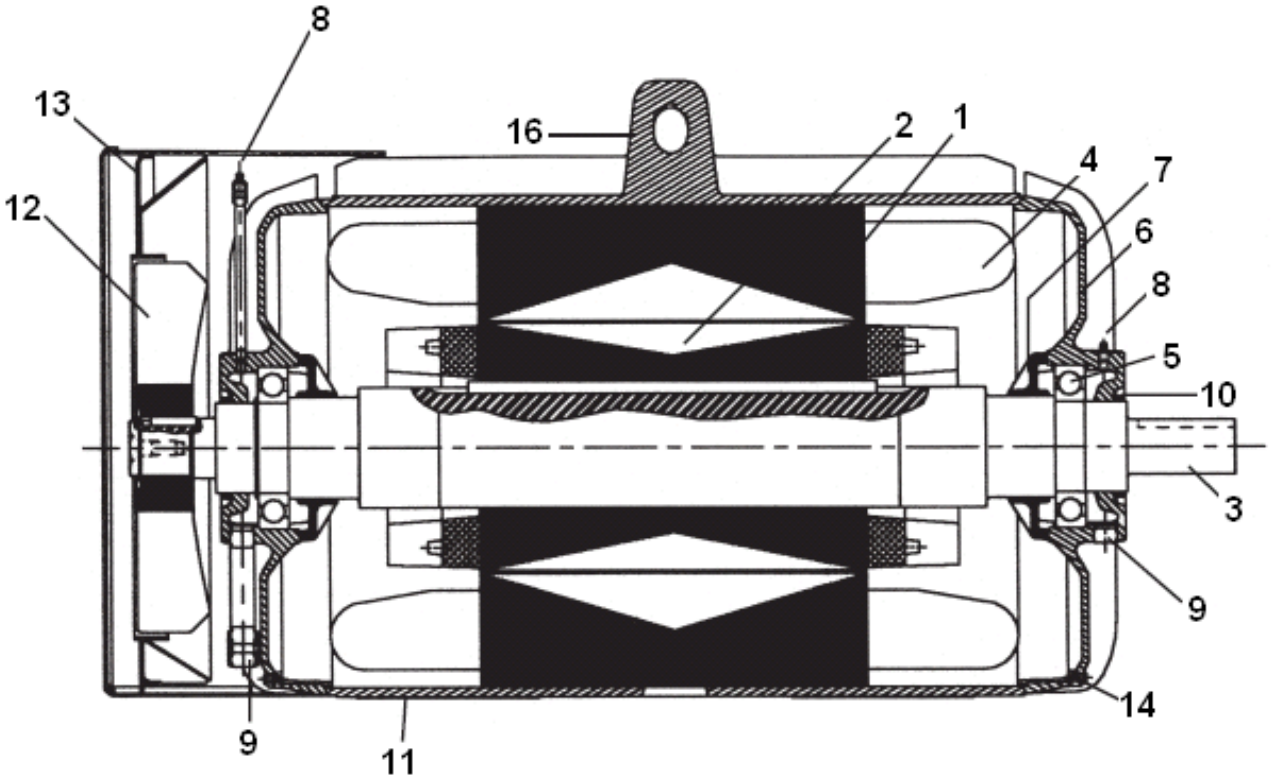
EMERSON MOTOR CO. DISTRIBUTION CENTER
710 VENTURE DRIVE
SUITE 100
SOUTHAVEN, MS 38672
PHONE (662) 342-6910
FAX (662) 342-7350

9. CUTAWAY DRAWINGS

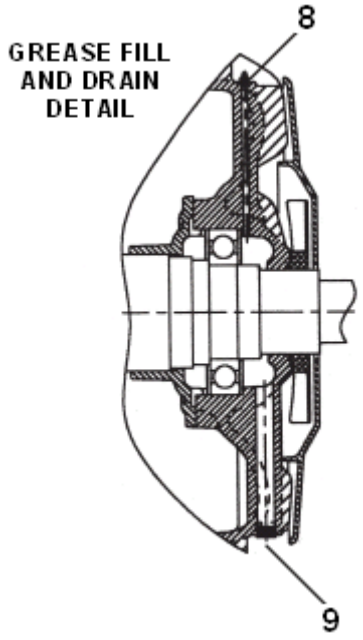
449 Frame, Type J

1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Fill
9. Grease Drain Plug
10. Shaft Seal Slinger
11. Stator Housing (Frame)
12. Fan
13. Fan Cover Guard
14. Condensate Drain
15. Terminal Box
16. Lifting Lug

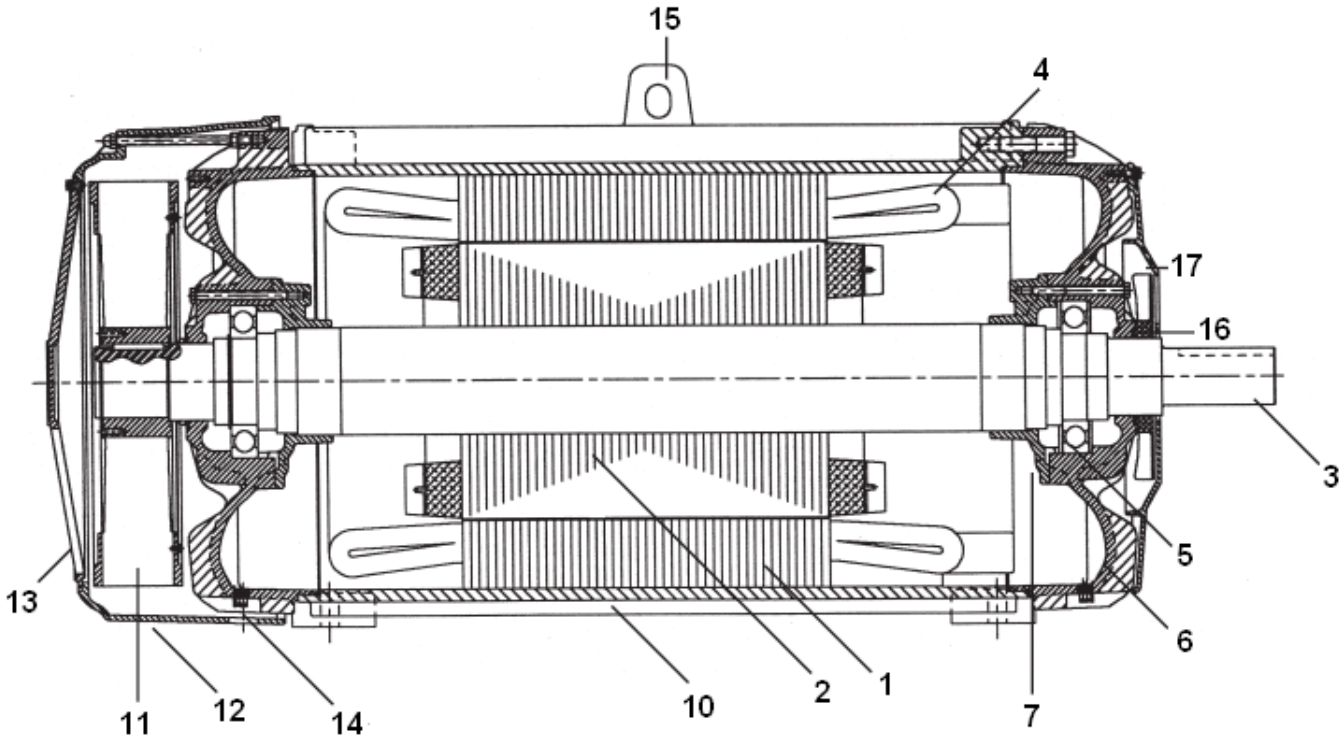




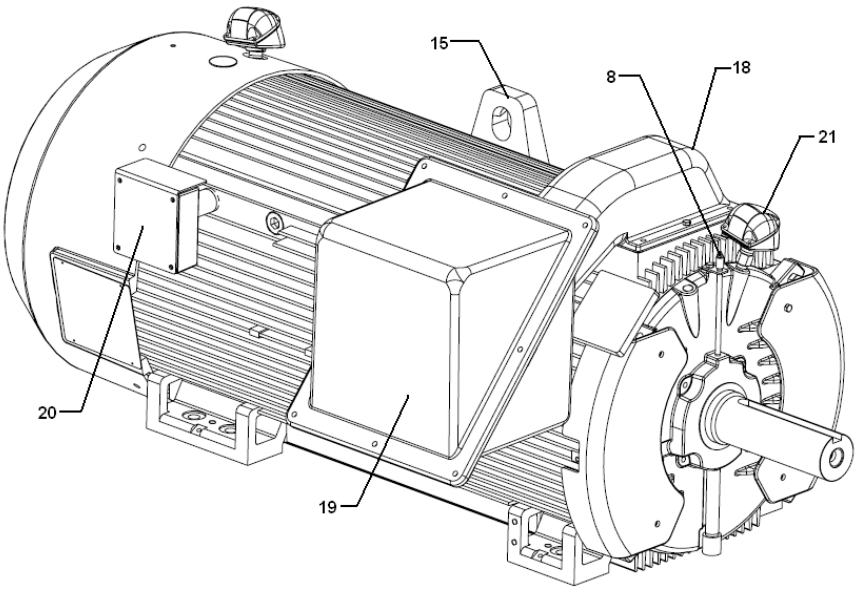
5800 Frame, Types J, E



1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Fill
9. Grease Drain Plug
10. Stator Housing (Frame)
11. Main Cooling Fan
12. Fan Cover Guard
13. Grill
14. Condensate Drain
15. Lifting Lug
16. Drive End Cooling Fan
17. Drive End Fan Cover Guard

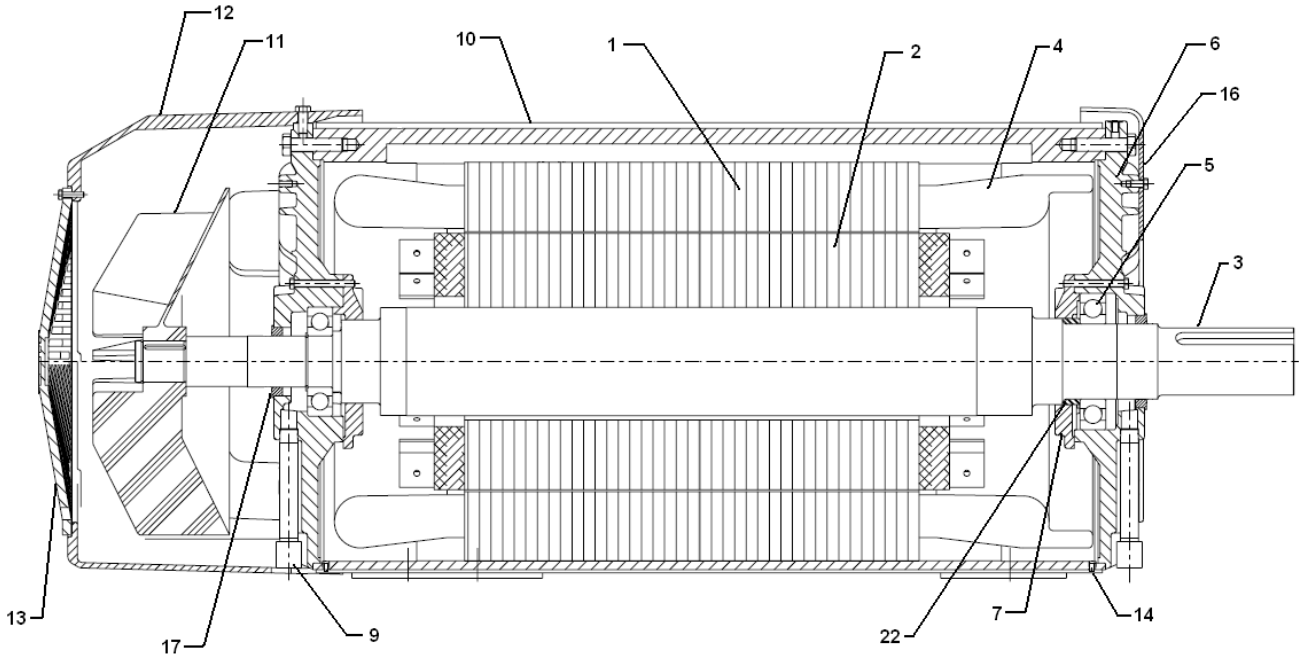


5000 Frame, Types J, JP



1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Ball Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Fill
9. Grease Drain
10. Stator Housing (Frame)
11. Cooling Fan
12. Fan Cover Guard
13. Grill
14. Condensate Drain
15. Lifting Lug (Diag Opp)
16. Drive End Air Scoop
17. Bushing / Labyrinth Seal *
18. Conduit Box Adapter
19. Main Conduit Box
20. Accessory Conduit Box *
21. Brg Temp Detector Box *
22. Bearing Spacer *

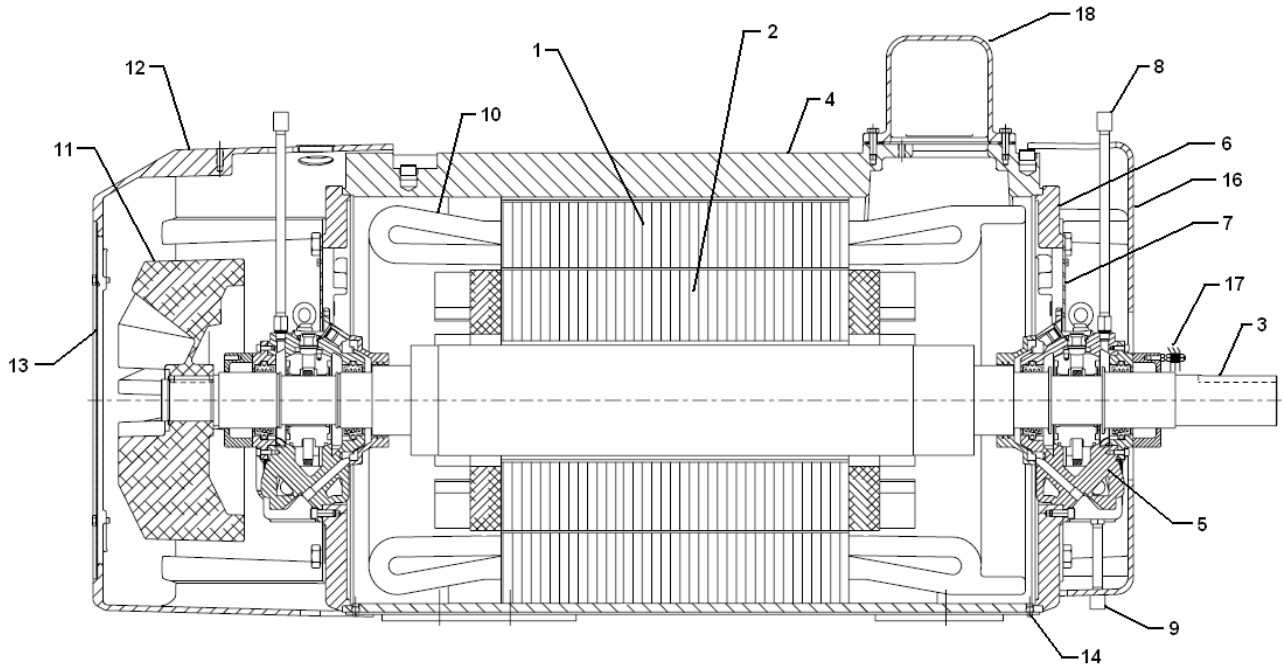
* Item not provided on all motors



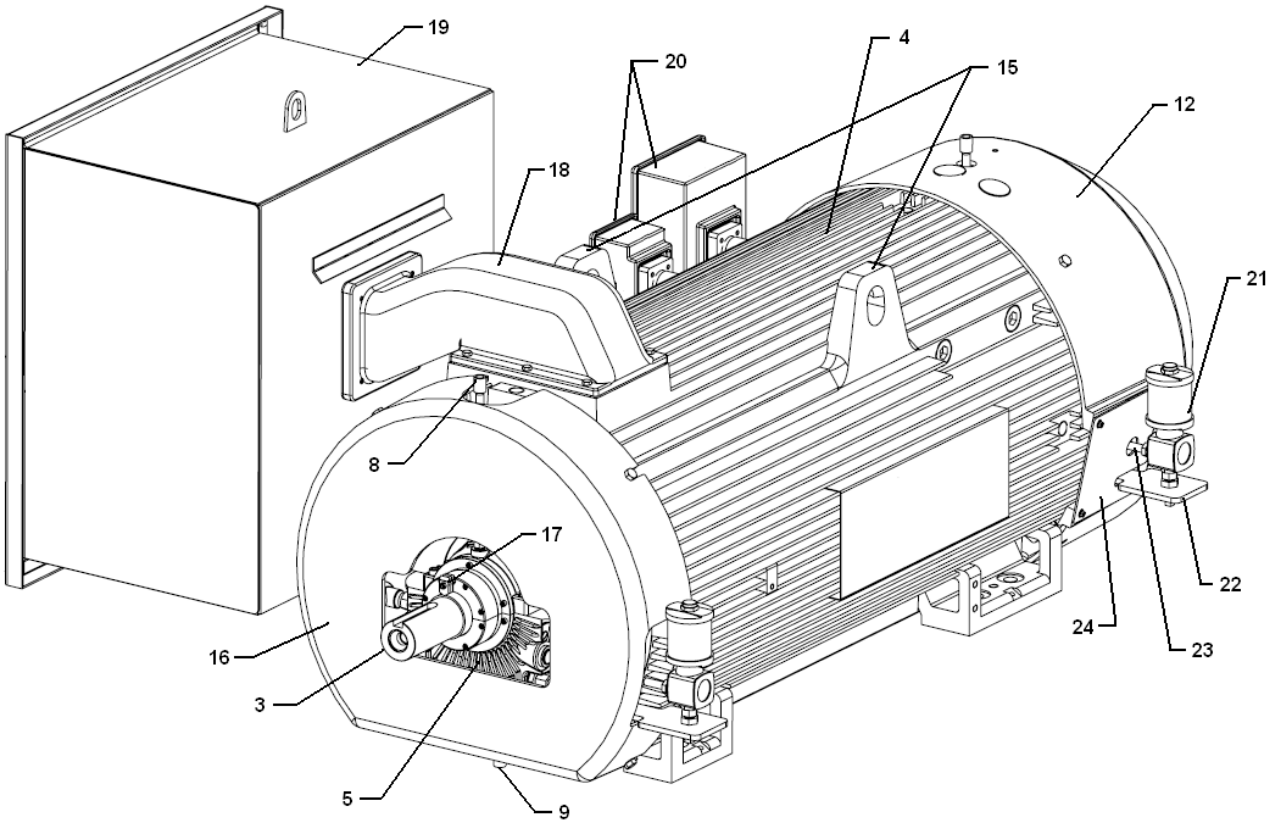
5000 Frame, Types JS, JPS

1. Stator
2. Rotor
3. Shaft
4. Stator Housing (Frame)
5. Bearing Assembly (see *Figure 6* for details)
6. Adapter Bracket
7. Access Cover
8. Oil Fill
9. Oil Drain
10. Stator Coils
11. Cooling Fan
12. Fan Cover Guard
13. Grill
14. Condensate Drain
15. Lifting Lug (Diag Opp)
16. Drive End Air Scoop
17. Mag C/L Indicator *
18. Conduit Box Adapter
19. Main Conduit Box
20. Accessory Conduit Box *
21. Constant Level Oiler with Sight Gauge Window
22. Oiler Support Bracket
23. Oiler Feed Hose
24. Fan Cover Sealing Plate

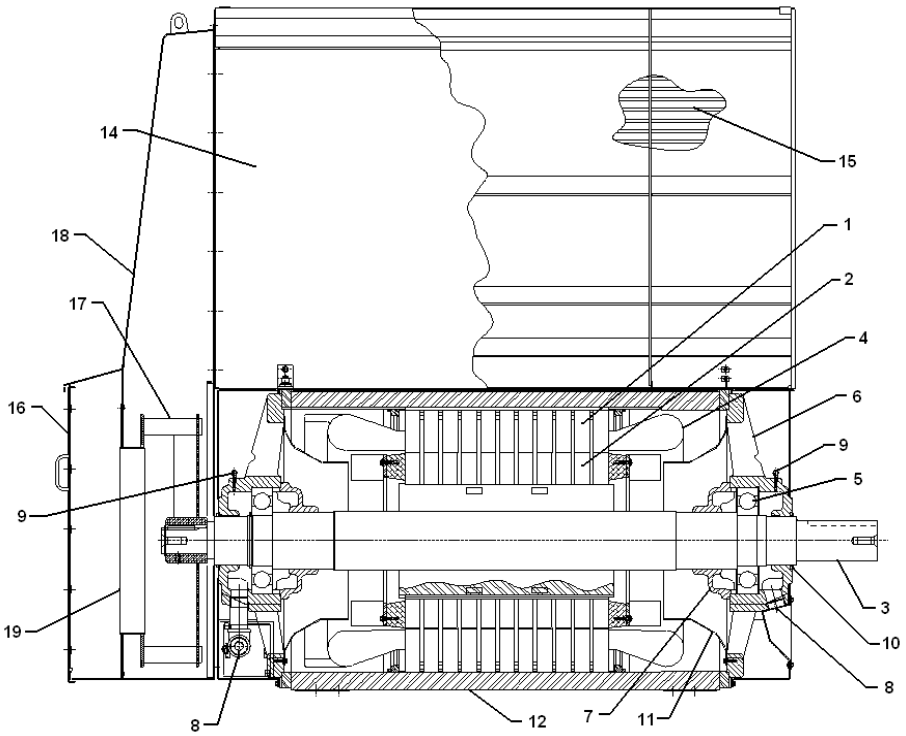
* Item not provided on all motors

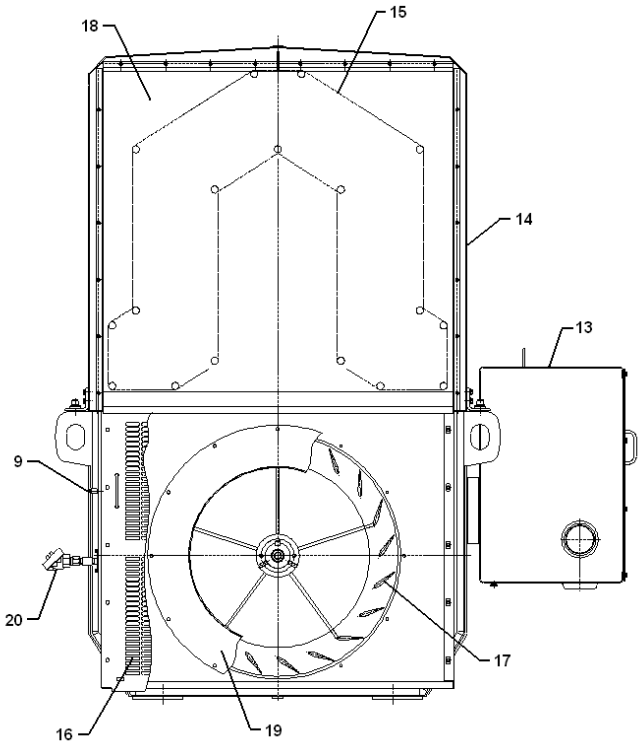


5000 Frame, Types JS, JPS (Continued)



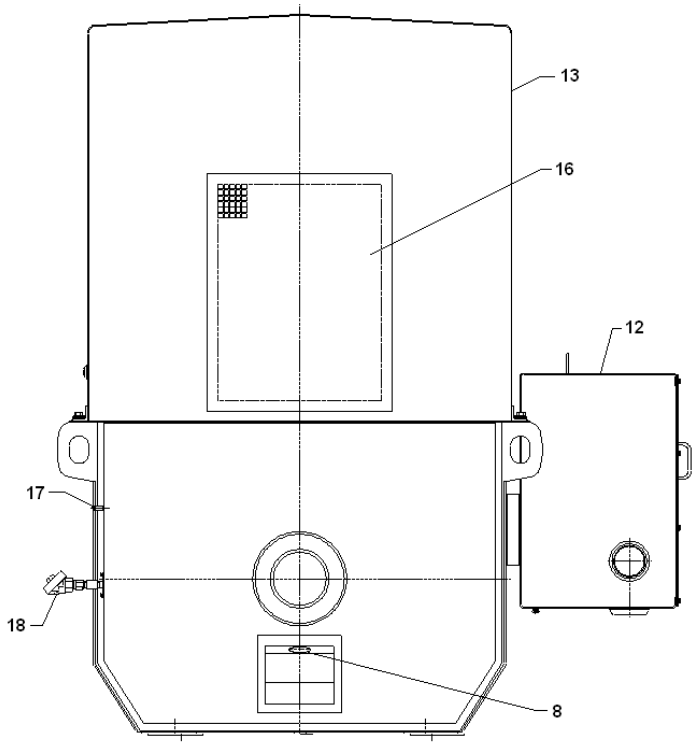
8000 Frame, Type JT



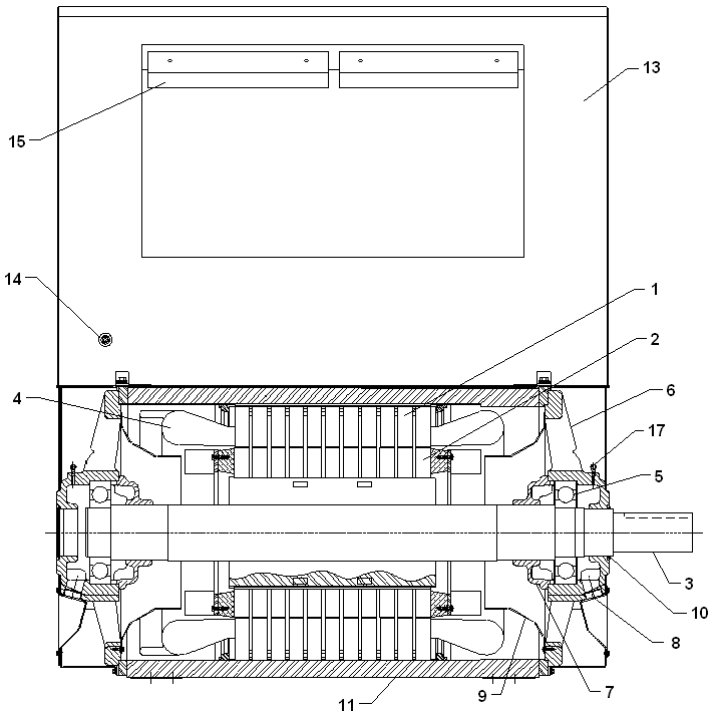


1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Drain
9. Grease Fill
10. Shaft Seal Slinger
11. Air Deflector
12. Stator Housing (Frame)
13. Terminal Box
14. Top Hat
15. Tube Bundle
16. Air Intake Grill
17. Fan
18. Fan Cover Assembly
19. Air Baffle
20. Bearing Temperature Detector Housing

8000 and 9600 Frame, Type R WP-II



1. Stator
2. Rotor
3. Shaft
4. Stator Coils
5. Bearing
6. Bearing Bracket
7. Bearing Cap
8. Grease Drain
9. Air Deflector
10. Shaft Seal Slinger
11. Stator Housing (Frame)
12. Terminal Box
13. Top Hat
14. Air Pressure Port
15. Filter Retaining Plate
16. Air Exhaust Screen
17. Grease Fill
18. Bearing Temperature Detector Housing



10. TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	CORRECTION
Motor will not start	Blown fuse or overload relay tripped.	Check and correct if needed.
	Open stator windings	Disconnect motor from load. Check no load amps for balance in all three phases. Check stator resistance is all three phases for balance.
	Grounded winding	Perform dielectric test. Repair as needed.
	Improper connections	Check integrity of connections. Compare connection to motor connection diagram.
	Unbalanced voltage	Check voltage, all phases.
	Incorrect voltage	Check voltage at all three phases. Compare to motor nameplate.
	Overload (Motor rotates but does not come up to full speed)	Disconnect motor from load to verify if motor starts without load. Reduce load or replace motor with motor of greater load capacity.
Excessive motor humming	High voltage, improper connection	Check input voltage and proper motor lead connection.
Noise - Clicking	Contaminants in air gap	Remove rotor assembly and clean motor.
Noise - Rapid knocking	Bad antifriction bearing; contaminated grease	Replace bearing and relubricate per lubrication section.
Vibration (For vibration problems, obtain vibration spectrums if possible. This type of data is invaluable in identifying cause.)	Unbalanced rotor	Balance rotor assembly
	Unbalanced or damaged fan	Inspect fan for damage or dirt accumulation. Repair if needed.
	Unbalanced coupling or improper coupling key length	Check and correct if needed.
	Damaged bearing, insufficient lubrication.	Check and replace bearing as needed.
	Misalignment in coupling or feet, or motor not running on magnetic center.	Realign motor per initial installation section.
	Vibration in driven equipment	Disconnect motor from driven equipment. Run motor uncoupled and check vibration. If vibration drops dramatically, then driven equipment or alignment may be the cause of vibration.
	Ambient Vibration	Check vibration with motor “off.”
	System natural frequency (resonance) near running speed, Especially if vibration is much higher in one direction than in other directions.	Confirm with “bump” tests or coast-down tests. Revise rigidity of motor base structure.
	Loose mounting or Soft-Foot condition	Check mounting.
	Rubs between stationary and rotating parts	Inspect parts and correct as needed.
	Bent Shaft	Repair or replace rotor shaft.

TROUBLE	POSSIBLE CAUSE	CORRECTION
Fine dust under coupling with rubber buffers or pins	Misalignment	Realign couplings, inspect couplings. See initial installation section.
Bearing overheating (Anti-Friction Bearing)	Misalignment	Realign unit. See initial installation section.
	Excessive tension in belt drive	Reduce belt tension.
	Too much grease in bearing	Relieve bearing cavity of grease to level specified in lubrication section
	Insufficient grease in bearing	Add grease.
	Incorrect Lubricant or mixing of incompatible greases.	Refill with approved grease. Clean bearing and housing of mixed greases and repack with approved grease.
Bearing overheating (Sleeve Bearing)	Misalignment	Realign unit. See initial installation section.
	Axial Thrust, or motor positioned off of magnetic center.	Coupling must be limited end float type to eliminate thrust on motor. Check alignment to ensure motor rotor is on magnetic center.
	Insufficient, or Excess oil quantity.	Check sight gauge window to ensure proper oil level. If flood feed system is used, ensure proper flow rate.
	Incorrect Lubricant (wrong viscosity)	Drain and refill with approved lubricant.
	Damaged Oil Ring	Inspect and replace if needed.
	Shaft bearing journal rough or rusted	Dress/polish shaft.
	Misaligned bearing or mismatched bearing halves.	Disassemble, inspect, correct.
Oil Leaks (Sleeve Bearing)	Incorrect or contaminated oil causes foaming.	Drain and refill with correct oil.
	Oil level too high	Check oil level and adjust oil level and/or height of oiler as needed.
	Flood Lubrication System – Excess oil feed rate, or insufficient oil drain rate, or ineffective venting of oil return.	Check flood lubrication system.
	Bearing seals worn or damaged	Check and replace seals
	Rotor positioned away from magnetic center	Check alignment.
	Leaks at fittings	Check tightness and use of proper sealant on pipe fittings.
	Leaks between fitted parts (split lines and faces)	Check for use of proper sealant and flatness of mating parts.

TROUBLE	POSSIBLE CAUSE	CORRECTION
Motor overheating Check with thermocouple, RTD, or by resistance methods – do not depend on hand.	Overload	Measure load, compare amps with nameplate rating; check for excessive friction in motor or complete drive. Reduce load or replace motor with greater capacity motor.
	Intake or exhaust openings blocked.	Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped. Provide sufficient clearance between motor intakes and nearby obstacles.
	Totally-Enclosed motor exterior (cooling fins) dirty	Clean motor exterior
	TEAAC / Tube-Cooled motor tubes dirty/clogged	Clean tubes with ramrod or pressurized air.
	Damaged cooling fan	Check and replace if needed.
	Improper rotation direction (Unidirectional motors only)	Check direction of rotation against motor directional arrow nameplate. If they do not agree then change direction of rotation or change fan(s).
	High air temperature at air intakes.	Check ambient air temperature near motor and compare to nameplate rating. Ensure clearance to heat sources. Minimize recirculation of cooling air. Increase ventilation to room.
	Unbalanced voltage	Check voltage, all phases.
	Over / Under voltage	Check voltage at all three phases. Compare to motor nameplate.
	Open stator windings	Disconnect motor from load. Check no load amps for balance in all three phases. Check stator resistance is all three phases for balance.
	Grounded winding	Perform dielectric test. Repair as needed.
	Improper connections	Check integrity of connections. Compare connection to motor connection diagram.

† All non-Emerson Electric Co. marks shown within this document are properties of their other respective owners.

11. INSTALLATION RECORD

NAMEPLATE ID # _____ CUSTOMER ID # _____

FRAME _____ TYPE _____ HORSEPOWER _____ RPM _____ VOLTAGE _____

PHASE _____ FREQUENCY _____ AMPS _____ DESIGN _____ CODE _____

DATE OF PURCHASE _____ DATE INSTALLED _____

PURCHASED FROM _____

LOCATION OF MOTOR _____ INSTALLATION # _____

DRIVE END BEARING # _____ OPPOSITE END BEARING # _____

MOTOR RESISTANCE LINE TO LINE AT TIME OF INSTALLATION _____

INSULATION TO GROUND READING AT TIME OF INSTALLATION _____

GRADE & TYPE OF LUBRICANT USED _____

INSPECTION RECORD

DATE CHECKED							
Bearings							
Lubrication							
Excess Heat							
Excess Noise							
Speed							
Voltage							
Amps							
Insulation							
Cleaning							
Alignment							
Vibration							
Temperature							
Insul. Resistance							
Condition							

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