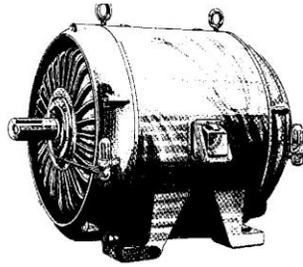


# General Service Manual



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## **Warnings!**

- \* This equipment should only be worked on by trained, qualified, electrical personnel, familiar with the construction of this equipment and the hazards involved in working on this equipment. The manual should be read in it's entirety, and understood prior to proceeding. Failure to follow these precautions could result in severe bodily injury or loss of life.**
- \* When servicing, all power sources to the motor and it's accessories should be disconnected and the motor should not be rotating.**
- \* The frame of the motor must be grounded in accordance with the National Electric Code.**
- \* The shaft key must be removed or be fully captive prior to the motor being started.**
- \* Explosion proof motors should only be installed in accordance with the classification listed on the nameplate. Repairs on these motors should only be made by Continental, or a UL approved service provider.**
- \* The motor is provided with lifting lugs or eyebolts to aid in unloading and positioning. These are sized for lifting of the motor and standard accessories only. Lift the motor using all the lugs and use spreader bars as necessary. The lifting straps or cables should never be pressed against the motor as they may cause damage.**
- \* The lifting lugs should never be used to move the motor when connected to pumps, gearing, or other equipment.**

## **Receiving and Inspection**

### **Caution!**

- \* The motor is provided with lifting lugs or eyebolts to aid in unloading and positioning. These are sized for lifting of the motor and standard accessories only. Lift the motor using all the lugs and use spreader bars as necessary. The lifting straps or cables should never be pressed against the motor as they may cause damage.**
- \* The lifting lugs should never be used to move the motor when connected to pumps, gearing, or other equipment.**



## Receiving

- Continental motors are completely inspected, tested, and ready for successful operation when they leave the plant. Upon removal from the delivering vehicle carefully inspect the motor for any damage caused by the carrier during transit and immediately report this to the carrier and Continental. Do not accept the motor until the carrier has made an
- appropriate note of the damages on the bill of lading.
- If any concealed damage is discovered later notify the carrier at once and have them make an immediate inspection
- Compare Nameplate data with the order acknowledgement so that the motor is properly identified upon receipt.
- Motors are typically shipped FOB our plant. The responsibility for receiving inspection, notification to the carrier, and collection for damages, if any, lies with the purchaser.

## Storage

If the motor is not to be immediately installed it will need to be stored in an appropriate manner to avoid damage.

### Short term storage (6 months or less)

- Store the motor, in its normal operating position, in a well ventilated, clean dry environment free from vibration and condensing humidity, cover machine with a tarp and energize the space heaters to keep the temperature of the windings a few degrees above the surrounding air. If machine does not have space heaters, auxiliary heat should be used to keep the windings warm and free of condensation.
- If the motor is oil lubed, it has been shipped without oil. As soon as the motor is received the oil reservoir should be filled to the proper level with an appropriate lubricating oil. If the motor is equipped with oil sump heaters they should be energized.
- The motor shaft should be rotated by hand every month to keep the bearings lubricated for rust and corrosion prevention and to change the position where the balls rest on the shaft to reduce the chance of brinelling.
- Grease lube motors are shipped with their grease cavities filled
- The windings should be meggered before connecting on line. The reading should be approximately 2 megohms per each 1000 volts of operating voltage plus 1 megohm, corrected to 40 degrees C. If the meggar reading is not satisfactory the motor windings must be dried out prior to connection. Contact Continental for advise on how to proceed. Drying out the windings is not considered a warranty item.

## **Long-term storage (long term storage is defined as over 6 months)**

- **Store the motor, in its normal operating position, in a well ventilated, clean dry environment, free from vibration and condensing humidity, cover machine with a tarp and energize the space heaters to keep the temperature of the winding a few degrees above the surrounding air. If machine does not have space heaters, auxiliary heat should be used to keep the windings warm and free of condensation.**
- **Shaft should be rotated by hand every month to keep the bearings lubricated for rust and corrosion prevention and to change the position where the balls rest on the shaft to reduce the chance of brinelling.**
- **For a grease lube motors the grease cavity should be completely filled with a moisture resistant grease for storage**
- **Upon removal from storage the bearings should be inspected for corrosion and brinelling, prior to installation, and should be re-lubed with an appropriate amount and quality of grease or oil.**
- **The windings should be meggered before connecting on line. The reading should be approximately 2 megohms per each 1000 volts of operating voltage plus 1 megohm, corrected to 40 degrees C. . If the meggar reading is not satisfactory the motor windings must be dried out prior to connection. Contact Continental for advise on how to proceed. Drying out the windings is not considered a warranty item.**
- **Any reconditioning required, as noted by the inspections after removal from storage should be performed prior to putting the motor into service. These reconditioning are not considered a warranty item. Failure to follow these procedures may void the warranty.**

## Installation

**Install motor on a solid level, flat base and securely bolt in position before starting. Shims may be required to assure that the motor is installed in a level position. Never “torque down” the motor to meet the shim. Shim properly so that the motor frame does not flex as it is tightened to the mounting base. No foot should move more than .002” when it’s mounting bolt is loosened. Use a dial indicator to check during installation.**

**Motor must be accurately aligned with driven unit. Misalignment between direct connect shafts will cause increase bearing loads and vibration, even when using a flexible coupling.**

**Alignment checks should be made prior to running. It may be necessary to recheck these values when the motor is hot in order to compensate for thermal expansion. Shaft angular misalignment must not exceed .0003” per inch of coupling hub radius. Shaft parallel misalignment must not exceed .003”.**

**The coupling should never be pressed or driven onto the shaft. It should be heated for proper mounting.**

**There should be sufficient area around the motor so that air flow to the motor for cooling is not restricted in any way.**

**Before connecting power check nameplate data for motor power requirements and be sure that the supplied utility power is appropriate. Do not try to run the motor on any other current, voltage or frequency than that for which it was designed.**

**Before connecting motor to the load check the nameplate data for motor speed and be sure that it matches the speed requirements of the driven equipment. Check for motor rotation consistent with the direction required by the driven equipment prior to connecting motor to the load. Also check to be sure that the shaft will rotate freely by hand.**

**Failure to follow this step may result in damage to the driven equipment and / or bodily injury or loss of life.**

**If it should become necessary to reverse the direction of rotation, simply interchange the connections of any pair of leads.**

## Caution

**Do not connect energize the motors until bearing lubrication has been checked. Oil lube motors must have their oil reservoirs filled to the proper level with an appropriate lubricant.**

**Grease lube motors must be greased properly. Oil mist motors must have the oil mist system connected and operational prior to running the motor. Refer to the Lubrication section of this manual for further information.**

**Installation should be in accordance with the National Electric Code as well as state and local codes, and consistent with local practices, prior to operation.**

## Maintenance - General

### Predictive Maintenance

- **Electric motors are among the most efficient machines known today, and will operate with a minimum of attention. To keep the equipment operating at a high level of efficiency, however, a proactive maintenance program must be set up. Regular inspections of equipment should be scheduled, and records should be kept of the findings of these inspections. These scheduled inspections should record the following data:**
  - **Ambient temperature**
  - **Motor vibration level (at the same point each time)**
    - .. **Radially DE**
    - .. **Radially ODE**
    - .. **Axially**
  - **Winding temperature (if temperature device exists)**
  - **Bearing temperature (if temperature device exists)**
  - **Winding meggar readings**
  - **Rotor meggar readings (if a wound rotor motor)**
  - **Lubrication check**
    - .. **Level if oil lube**
- **Examination of these records could provide an early warning of potential problems. A change in value from previously taken data may be an indicator of motor or machine problems.**

### General Maintenance Issues

- **Motors should be kept clean and free of dirt and oil buildup. If oil or grease is observed in significant quantities near shaft or seals an immediate determination should be made to determine the cause of the leak. Dirt and dust on a motor can also act as an insulator and can cause motor overheating.**

### Insulation Resistance

- **Insulation resistance is useful in determining the presence of moisture in the winding. It is suggested that insulation resistance readings be taken every three months.**
- **Any sudden downward trend of the insulation resistance values will indicate that special maintenance steps need be taken. See segment on Cleaning and Insulation Renewal.**

## Measurement of Insulation Resistance:

- The method of taking insulation resistance should be definitely controlled and following routine is suggested:
- Adopt a definite time of application for taking readings, preferably after one minute of voltage application. Make tests immediately after a shutdown. When machine is relatively free from moisture.
- Always use the same voltage instrument.
- Keep a complete record of date, temperature of winding and ambient temperature, relative humidity and condition of winding. Insulation resistance will vary inversely with the temperature. That is, the insulation will decrease with increase in temperature. Roughly the resistance will be double for each 15 degrees drop in temperature. For example, if a certain insulation has a known resistance @ 75 degrees C, then @ 60C the resistance should be approximately doubled and @ 25 degrees C it should be in the neighborhood of 10 times as great. It must be emphasized that these figures are only approximations and that the rate for individual machine will usually vary.
- Take readings at machine terminals; be sure other cables, switches, etc. are isolated.
- Whenever motor driven or electronic instruments are used to take readings over a period of time longer than one minute, as in the case of dielectric absorption curves, it is essential that, before a repeat reading of the same part is taking that the winding be discharged to ground for a time at least equal to the total time of voltage application when readings were first taken.

## Cleaning

### General

- Oil or grease covered machines should be cleaned thoroughly and a fresh coating of insulating varnish applied. Usually most of the oil or grease can be removed with a cloth moistened with a solvent such as VM & P Naptha. A brush should be used for surfaces difficult to reach by hand. Use a spray gun to clean inaccessible slots and passages. After using the solvent, be sure to dry the windings with compressed air, or can be cleaned with steam cleaner and detergent.
- No amount of cleaning will repair insulation which has been badly oil soaked.

**Warning: Do not use a solvent which has toxic effects, or which has a deteriorating effect on varnish.**



## **Cleaning Methods**

- o Compress air---**This is the most important convenient method if there is an excessive amount of dirt or oil present. Air pressure should be less than 50 psi., excessive pressure is capable of injuring the insulation.
- o Use dry air and allow any accumulation of water in the pipes to be blown out before turning the air blast on the machine. In blowing dust out of machines, the adjacent machine should be protected from flying dust by a suitable cover or shield.**
  
- o Suction—**Cleaning by a vacuum cleaning system is the preferred method as all dirt is carried away from the machines and the danger of blowing dirt into adjacent machines is completely avoided.
  
- o Wiping—**All accessible insulated parts, subject to copper or carbon dust, should be wiped clean with a dry cloth in addition to cleaning by suction or compressed air. When wiping, do not neglect such parts as inner surface of end windings, strip ring insulation, etc.
  
- o Solvent—**The use of solvents should be avoided in so far as practical and only used whenever it is necessary to remove hard or pasty deposits of grease, oil and other foreign matter. Before using any solvent, use a clean, dry rag to wipe off as much dirt as possible as mentioned in paragraph C. Then use a rag moistened (not dripping) with a petroleum solvent of the “safety type” such as Stoddard Solvent No. 1609-2 or equivalent. If a petroleum solvent has a little effect on the dirt, trichloroethane may be used. However, precautions must be taken as trichloroethane is an active solvent and somewhat corrosive in its action. Do not use on leads or other rubber insulation because it has a deteriorating effect on these items. Thorough drying afterwards is essential to avoid damage to the insulation.
  
- o Steam clean**
  
- o Dry Ice clean**
  
- o Note:** after using any cleaning method the windings should be meggedared to check for damage caused by the cleaning. Windings may need additional drying or other rework prior to being re-insulated.



# Anti Friction Bearing Replacement

## Bearing Replacement Guidelines

### General

Bearings should be replaced only with bearings of the same size, rating, and construction. If you have questions about replacement bearings contact Continental before proceeding.

- When removing or replacing a ball bearing, there are rules, which always should be observed. Following these rules closely will prevent damage to the bearing or motor and will result in longer bearing life.
- When removing a bearing, always use an approved bearing puller.
- Never open the protective cover on new bearings in any location where the bearings will be exposed to dust or dirt. Always open the package in a clean place and do not remove bearing from package until ready to install.
- Never try to clean a new ball bearing. The slushing oil on new bearings should not be removed.
- Do not force a bearing onto a shaft by means of the outer race. Do not attempt to force the bearing on a badly worn shaft or a shaft that is too large for the bearing.

### Methods of Replacement

**Caution:** Bearing replacement should only be performed by individuals trained for these procedures.

- **Pressing procedure**
  - .. Clean shafts and bearing housing thoroughly.
  - .. Clean dirt out of threads and grooves. Remove burrs and slivers.
  - .. Clean and oil bearing seats.
  - .. Press bearings on straight and square.
  - .. Press only on the ring, which takes the tight fit.
  - .. Press bearings until they are seated against the shaft or housing shoulder (if the bearing stops against these shoulders before the shaft reaches its operating temperature, the thermal growth of the shaft will pre-load both bearings. In this case the pre-load force tends to pull the bearings away from the shaft shoulder. This reduces design stiffness, and also result in a cocked bearing)
  - .. Use an arbor press if available and press the shaft into the bearing supporting the inner ring on blocks. Be sure the blocks do not scrape the shaft or threads.

- **Heating Procedure**

- .. Another method of installing ball bearings is to heat the bearing in an oven or oil bath so that it will slide onto the shaft. **DO NOT USE A TORCH TO HEAT THE BEARING.** Use a temperature of approximately 225 degrees F. Too high a temperature will damage the bearing and too low a temperature will cause the bearing to seize the shaft.
- .. All parts are interchangeable with any rating having the same size bearings. Jack screws and tapped holes allow for removal of the entire cartridge and bearings simultaneously. There are no contact seals to leak or wear out.

## **General Bearing Information**

### **Anti Friction Bearings**

If possible, check motor nameplate to identify the original bearings installed and replace with the same.

### **General**

The repeated stressing of the balls and races as a bearing rotates ultimately causes fatigue failure of the metal. The higher the load, the higher stress and the shorter the time until the bearing fails. Bearings are rated by their probability of fatigue failure. Bearing manufacturers have tested many groups of identical bearings under heavy loads to the point of fatigue failure. Bearings in a group have been found to have different lives even though they are under same loads. For this reason bearings are rated for either minimum life or average life. The life which 90% of a group bearing will exceed is known as the “minimum life”.

A commonly used term as “L10”. The life which 50% of a group bearing will exceed is the “median life” (L50) and is approximately five times the “minimum life”. Minimum bearing life is a period of time, base on continuous operation at design load.

### **Bearing Internal Clearance**

#### **General**

- Bearings are designed with a specific internal clearance that measures the total clearance between the rings and the rolling elements. Internal clearance provides:
  - o Free rotation of rolling elements.
  - o Compensation for thermal expansion.
  - o Optimum load distribution.
- Choosing the correct internal clearance is important because bearings hold shaft, armatures, gears and other rotating devices in proper alignment. The amount of internal clearance influences noise, vibration, and heat build-up and fatigue life. Impact loads severe vibration, and ring fit also effect internal clearance. To obtain the optimal internal clearance for a specific application, these parameters must bebalanced.

## **Radial And Axial Internal Clearance**

- **Internal clearance can be separated into two categories: radial and axial. The total internal clearance is the amount that one ring can be displaced relative to the other ring, either radially or axially.**
- **In rolling element bearings, the difference between the diameter of the ball / roller and the space between the inner and outer rings is radial clearance. The internal space is measured at a 90 degrees angle to the shaft. The clearance changes with the expansion or contraction of the bearing rings.**
- **The axial clearance is the total amount that one ring can be displaced relative to the other in an axial direction. As the radial clearance increases, the axial clearance increases as well. The more room between the balls and the rings (radial clearance), the more the elements can shift in relation to each other.**

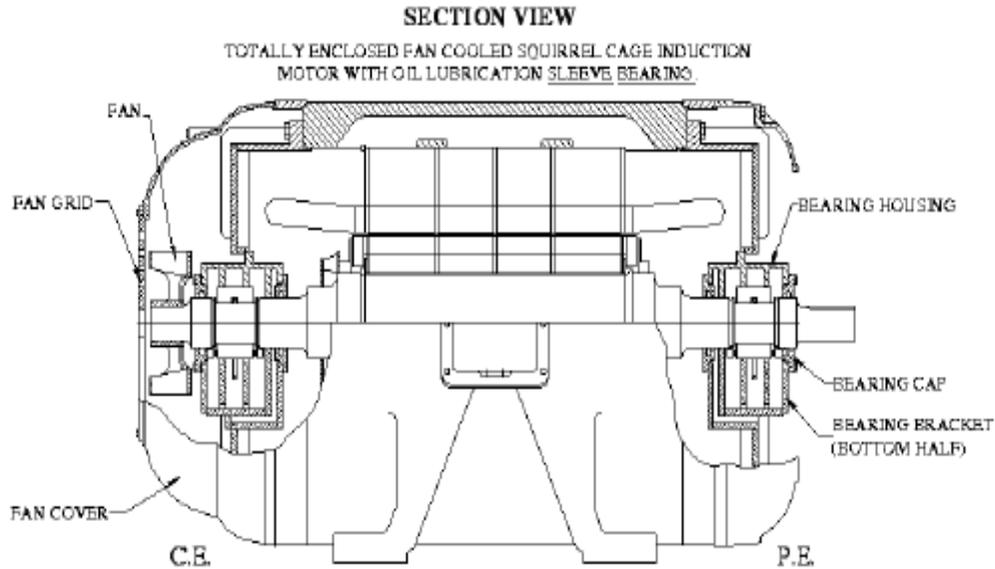
## **The Best Specification for the Job**

- **Internal clearances are designed from C1 (tightest) through C5 (loosest) or larger. The higher the number, the greater the radial clearance. With higher clearance there is more tolerance for externally induced heat. When noise and vibration must be restricted, lower clearances are necessary. The specific application and operating conditions determine the optimal internal clearance.**

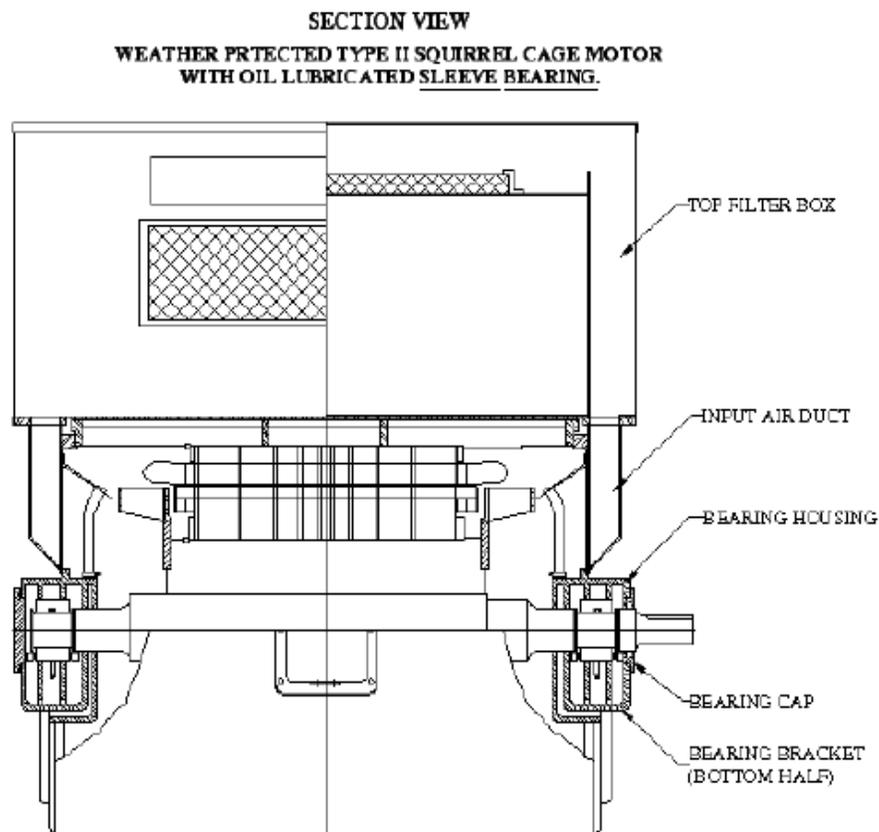
## **Thrust Bearings**

**Some motors, due to the application requirements, have “Thrust Bearings” to handle the axial load imparted from the driven equipment. If your motor has been supplied with a thrust bearing it should not be run for more than a few minutes unconnected to the load as the rolling element is likely to skid and slide (instead of roll) due to less axial loading than it was designed for. Damaged caused in this fashion is not considered a warranty failure.**

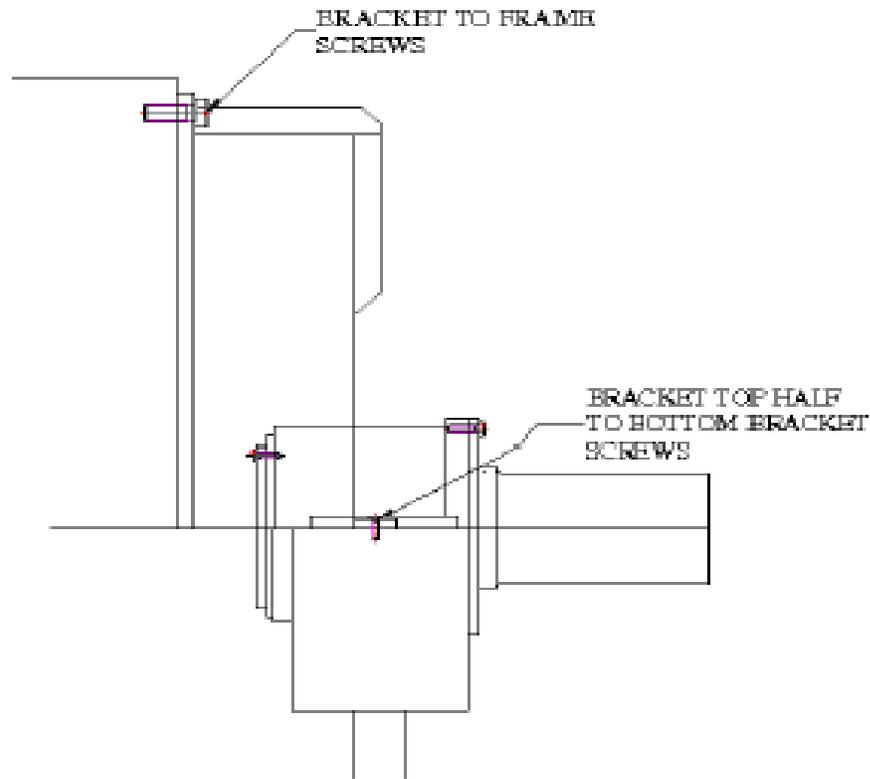
## REMOVAL AND REPLACEMENT OF SLEEVE BEARINGS.



**The sleeve bearing can be replaced without removal of the bottom brackets and without disturbing the motor alignment or removing the coupling.**

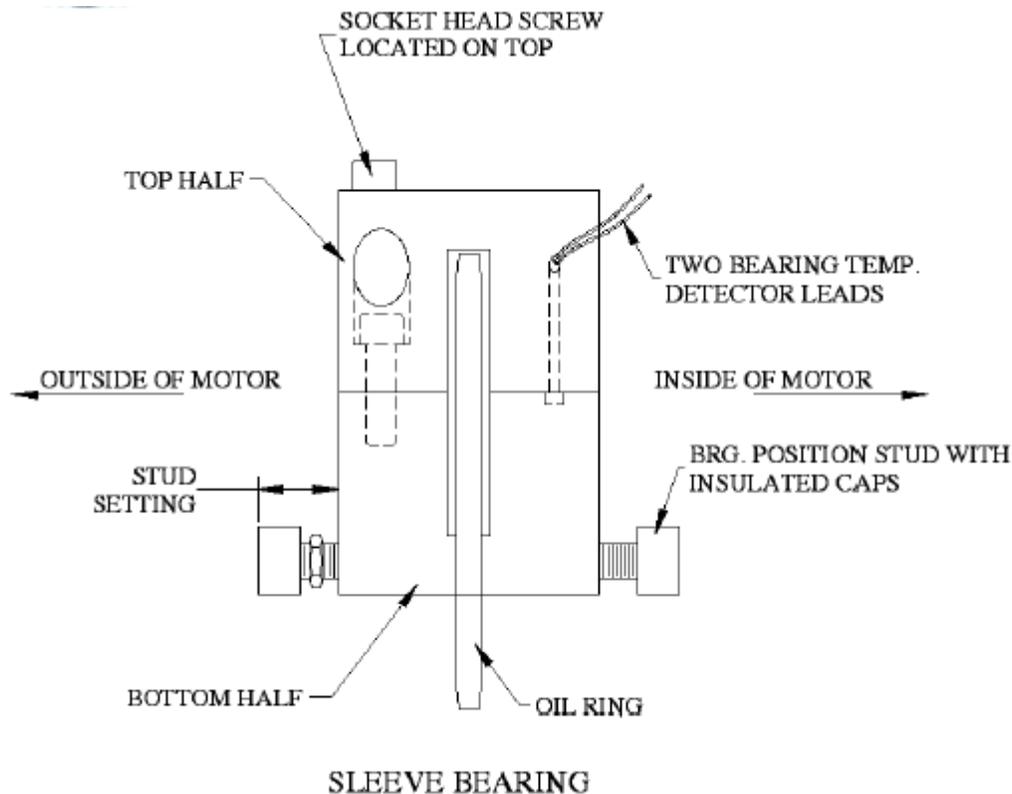


**The sleeve bearing can be replaced without removal of the filter box or bottom brackets and without disturbing the motor alignment or removing the coupling. Remove both input air ducts and their supporting pieces which are bolted to the frame so that the bearing housing and bracket are exposed.**



### **Part #1 - Accessing the Bearing Housing**

- 1) For the Non-Drive End of a Totally Enclosed Fan Cooled Machine you will have to remove the fan cover from the motor in order to access the bearing bracket and sleeve bearing assembly.**
- 2) Remove the four bolts holding the bearing bracket top half to bearing bracket bottom half.**
- 3) Remove the four bolts holding the bearing bracket top half to the stator frame.**



## Part #2 – Removing the Bearing

- 1.) Remove the four bolts holding the bearing housing to the bottom bearing bracket.
- 2.) Remove the bearing cap on the opposite drive end. Back off the drive end bearing cap.
- 3.) Cut the bearing temperature detector leads approximately in the middle. Note – these leads exit the top of the bearing housing.
- 4.) Break the seal of silicon between the bearing housing and bottom half of the bearing bracket and remove the upper bearing housing.
- 5.) Lift off the upper bearing half after removing the two socket head screws.
- 6.) Remove the bearing temperature detector and save. Pull the detector body away from the flat surface of the bearing joint. **DO NOT PULL ON THE DETECTOR LEADS.**
- 7.) Measure and record the insulated positioning stud projection from the bearing body. Note – the stud must be assembled with the same projection.
- 8.) To remove the lower bearing half relieve the weight of the rotor by the use of a wooden lever approx.  $\frac{3}{4}$ " x 2" x 24" placed against the shaft bottom and using the bearing cap rabbit fit as a fulcrum or by the use of a sling hoist.
- 9.) Raise the shaft only several mils to free the bearing bottom half, which can be rotated 180°. The
- 10.) Oil ring is now pushed toward the inside of the motor and off the bearing. Lift out the bearing half. Note – Before lifting the rotor be sure to loosen the bearing housing bolts on the opposite bearing to prevent damaging the other sleeve bearing.

### **Part #3 – Inspecting the Bearings**

- 1.) **Make sure the shaft has no nicks or burs. The shaft should be perfectly smooth and have a surface finish of 32 microinches or smaller.**
- 2.) **Check the Babbit of the bearing to confirm that no “Wipes” exist. A “wipe” is characteristic of a rub.**
- 3.) **The babbit should have a dull smooth finish. If the babbit has a mirror finish this is indicative of the shaft to bearing tolerance being too small. Consult the factory for the recommended tolerance for your particular motor.**

### **Part #4 – Assembling the Bearings**

- 1) **Remove all the old sealing compound from the machined joint of the bearing housing parts.**
- 2) **Place bottom bearing half on shaft journal, assemble oil ring in place and roll in the bottom half. Note – Assemble lower bearing half with the temperature detector hole on the inside of the motor. Reassemble the insulated position stud (adjusting nut must face outside of motor) with same projection as on replaced bearing. This will insure the bearings will be magnetically centered on the shaft journals while operating.**
- 3) **Install the bearing temperature detector in same position as before while threading the leads through the upper bearing half. DO NOT PULL ON THE LEADS.**
- 4) **Join the upper half of the bearing to the bottom of the bearing half, fitting the temperature detector in the hole in the bottom half. Bolt the two halves together. The socket head screw projecting above the bearing O.D. must be at 12 o'clock.**
- 5) **Apply a thin coat of sealing compound permatex # 2 to the mating surfaces of the bearing bracket and housing.**
- 6) **Lower the top bearing housing threading the temperature detector leads through the top lead hole. Make sure not to pinch the wire between the bearing and the housing. Secure top with four bolts. Seal lead hole with permatex #2 compound.**
- 7) **Reconnect the bearing temperature detector leads by soldering and taping them. When all the above steps are done the shaft will operate with approximately 1/4” end play on each side of magnetic center. Note – The shaft location at magnetic center is scribed on the shaft extension. To readjust the end play (or float) the insulated bearing positioning studs can be used. Take off the insulating cap while adjusting with a wrench and be sure to replace it when done. Replace gaskets and bearing caps**

### **Winding Temperature Protection**

**There are a number of devices that can be used to monitor the temperature of the windings and provide a signal to an alarming device. A listing of commonly used devices is as follows:**

- “Klixon” type thermostat with a normally closed contact**
- Resistance Temperature Detectors (RTD)**
- Thermocouple (TC)**
- Thermistor**

## The Setting Temperature Protection Devices:

Many times the manufacturer of motors is asked, by users of motors, and engineers writing specifications to recommend settings of alarms and shutdown devices that use winding detectors in the windings. However, the motor manufacturer is not in the best position to know the correct answer for all situations.

The most that can be expected of the motor manufacturer is for him to give general guides lines for the appropriate settings. The alarm and tripping point setting should be based on operation conditions. Generally, the users or the driven equipment manufacturers are in a better position to know the details required to make the proper selections.

Generally, a conservative practice is to set a shut down temperature at the nominal insulation system limit. However, this approach does not allow for any brief periods of over loads or abnormal environmental conditions. It can also cause a lot of needless nuisance tripping and costly production stoppages that should never be allowed to happen.

The following table contains some traditional alarm and tripping point settings based on the class of insulation used in the motor. It is also based on the condition that the motors are in 600-3600 rpm.

Class Insulation	Type Motor	Alarm	Shutdown
		Winding / Bearing	Winding / Bearing
B	Open	130 deg. C / 100 deg. C	140 deg. C / 110 deg. C
B	TEFC	130 deg. C / 100 deg. C	135 deg. C / 110 deg. C
F	Open	165 deg. C / 100 deg. C	175 deg. C / 110 deg. C
F	TEFC	165 deg. C / 100 deg. C	170 deg. C / 110 deg. C

The temperature given for alarm point represents the values specified for “Hot-spot” allowance as defined as being 10 deg. C over the temperature rise by resistance.

The choice for setting of an alarm and set points should be considered to the following:

- A. How critical to the operation of the plant or facility is the motor?
- B. Will safety be affected if the motor trips because of the setting without a catastrophic failure being imminent?
- C. Some times the only thing affected by exceeding the rated insulation temperature is the insulation life. Even then it decreases the life based on the time the rated temperature is exceeding.
- D. Does the ambient temperature vary significantly daily or seasonally?
- E. Can the driven equipment overload occasionally and cause nuisance tripping?
- F. In the event of overloads, are the trained operators nearby that can adjust load requirement?

**Remember: A winding is “too hot” only when actual temperature exceeds the insulation thermal limit, not just when the rise above ambient exceeds the nameplate figure.**

## Bearing Temperature Protection

There are a number of devices that can be used to monitor the temperature of the bearings and provide a signal to an alarming device. A listing of commonly used devices is as follows:

- Bearing Thermostat or Bearing Temperature Relay
- Resistance Temperature Detectors (RTD)
- Thermocouple (TC)

### The Setting of Temperature Protection Devices

Many times the manufacturer of motors is asked, by users of motors, and engineers writing specifications to recommend settings of alarms and shutdown devices.

However, the motor manufacturer is not in the best position to know the correct answer for all situations.

The most that can be expected of the motor manufacturer is for him to give general guides lines for the appropriate settings. The alarm and tripping point setting should be based on operation conditions. Generally, the users or the driven equipment manufacturers are in a better position to know the details required to make the proper selections.

Generally, a conservative practice is to set a shut down temperature at the nominal bearing temperature limit. However, this approach does not allow for any brief periods of over loads or abnormal environmental conditions. It can also cause a lot of needless nuisance tripping and costly production stoppages that should never be allowed to happen.

Once an operating temperature has been established, it is reasonable to expect this temperature to remain at a fairly constant value above ambient temperature. Instead of arbitrarily setting relays and alarms, it is recommended that the operator set the alarm temperature at some reasonable value, around 10 deg. F, above maximum expected temperature. Allowance should be made for normal changes in ambient and other fluctuating conditions to prevent unnecessary tripping of relays.

With the alarm set as suggested, an early warning would be given if any unusual condition occurred, and there would still be "Temperature to spare" to allow time for quick investigation or shut down. This margin may be the difference between saving or loosing the bearing. On the other hand, if the relay trips on its factory setting, and the reason for the higher operating temperature is known, it is permissible to rise the setting to some other value above operating temperature.

The choice for setting of an alarm and set points should be considered to the following:

- How critical to the operation of the plant or facility is the motor?
- Will safety be affected if the motor stops because of the setting without a catastrophic failure being imminent?
- Does the ambient temperature vary significantly daily or seasonally?
- Can the driven equipment overload occasionally and cause nuisance tripping?
- In the event of overloads, are the trained operators nearby that can adjust load requirement?

The following table contains some traditional alarm and tripping point settings. It is also based on the condition that the motors are in 600-3600 rpm.

Anti Friction	Alarm 100 deg C	Shutdown	110 deg C
Sleeve	82		100
If sensor in oil bath	60		65

## **Balance and Vibration**

**This section is not meant to be a scholarly discussion on vibration but a background discussion on motor vibration and some general guidelines from a maintenance standpoint.**

**Why is vibration important? A reduction in vibration will result in longer bearing life, reduced noise, and less stress on the motor frame and base. Also as energy goes into vibration efficiency is somewhat reduced.**

**Vibration in a motor can be the result of many factors. It's important to understand these when trying to analyze vibration issues. Some of the major items that can contribute to motor vibration are:**

- Rotor unbalance**
- Firmness of the mounting foundation**
- Shaft to bearing fits**
- Bearing to frame fits**
- Shaft straightness**
- Bearing Journal Runout**
- Non-uniform windings (electrical unbalance)**
- Uneven Airgap**
- Alignment of the rotor within the frame**
- Alignment of the motor to the driven equipment**
- Thrust – on vertical motors, is it present during the test?**

**All manufactured products have unbalance. Balancing compensates for less than perfect manufacturing. Most motor manufactures use two plane balancing...that is balance weights are added to an element near each end of the rotating assembly. API541 asks for 3 plane balancing. This requires adding or subtracting weight at the center of the rotor. This can be necessary if the motor is of flexible shaft design and the rotor will flex due to imbalance at the center. Balancing in this 3rd plane compensates for this. If the motor is of stiff shaft design this third plane balance is not necessary.**

**There are two components of rotor unbalance that affect the amplitude of vibration. The first component is the residual unbalance left in the rotor. The second and more critical component is the speed of the machine. For a given amount of residual unbalance the vibration amplitude increase with the square of increase speed. For example if you have a shaft that vibrates at .03 in/s peak at 1800rpm it will vibrate at .12 in/s peak at 3600RPM. Since you doubled the speed the vibration amplitude increases by the square of the speed increase.**

**Prior to assemble ALL Continental rotors are balanced to less than 2 oz-in per plane. After assembly ALL Continental motors receive a routine test during which vibration measurements are taken. The table below show's the NEMA standards and the Continental acceptable limits for shipment:**

**Vibration in in./sec. peak**

<b>Speed @ 60hz operation</b>	<b>NEMA std</b>	<b>Continental</b>
<b>3600</b>	<b>.15</b>	<b>.10</b>
<b>1800</b>	<b>.15</b>	<b>.08</b>
<b>1200</b>	<b>.15</b>	<b>.08</b>
<b>900</b>	<b>.12</b>	<b>.08</b>
<b>720</b>	<b>.09</b>	<b>.07</b>
<b>600</b>	<b>.08</b>	<b>.06</b>

**For the Continental Routine Test the motor is mounted on a test plate constructed to meet the NEMA definition of a “massive foundation”. A massive foundation is define by NEMA as one that has a vibration (in any direction or plane) limited, during testing, to .02 in s / peak above any background vibrations. The natural frequencies of the foundation should not coincide within 10% of the rotational frequency of the machine, within 5% of two times the rotational frequency, or within 5% of the one and two times electrical frequency.**

**The motor is run at no load for test measurements, and is usually not at rated temperature.**

**Generally the mounting and running conditions in the field are not the same as the above definition and the resultant vibration measurement will be different (usually higher) that that measured on the test floor.**

**It is important that the user of the motor have a regular program of vibration measurement. Beginning with a measurement of the vibration at installation and regular follow-up measurements. The measurement at installation will point out if there are problems with the installation and establish a baseline for monitoring changes in vibration level.**

**Note that motors with thrust bearings may measure higher on the test floor as a thrust is required to stabilize the bearing in the race. In this case measurements in the field, under load are more meaningful.**

## **Other Accessories**

- **Non-Reverse Ratchet:**

- o For motors equipped with non-reverse ratchets Continental uses a pin type designed that prevents the motor from being driven in the opposite direction by the pump when it is shut down. Caution should be observed when applying non-reverse ratchets due to pump head conditions and the motor should not be subjected to abnormal use, including frequent stopping, and starting of the motor. For rotation check the name plate on the motor.

- **Non-Reverse Clutch:**

- o Continental will usually utilize an overrunning, centrifugal throwout type clutch. There is no regular maintenance to perform except for lubrication. Clutches can be oil or grease lubed to be consistent with the motor bearing lubrication. Information on the maintenance of the clutch will be supplied with the order documentation as it is dependent on manufacturer and model chosen.

- **Space Heaters:**

- o Space heaters should be used in any installation where warm humid air can contact a cold motor causing condensation to occur. Space heaters are used to elevate the temperature inside the motor by 5-10 degrees F in order to prevent condensation within the motor during storage or shut down situations.

- o Space heaters are usually mounted on the end turns or mounted to the frame inside the motor enclosure. They should be interlocked with the motor control so that they are energized when the motor is off and never energized when the motor is running. Occasionally space heaters are mounted within the main conduit box. These may be energized during motor operation.

- o During regular maintenance the space heaters should be checked to be sure that their connections are tight and to be sure that they are free from dirt and dust accumulations. Be sure that power to the motor and the space heater is turned off and locked out before making these checks. There is no other maintenance to perform on a space heater.

- **Oil Circulation System:**

- o Continental can supply provisions for connecting an oil circulation system to the motor for bearing lubrication but does not supply the oil circulation system itself. These systems are used when the application requires more oil circulating than the oil rings can move. Please refer to the manual supplied by the system provider for maintenance instructions.

- **Differential Air Pressure Switch**

- o The switch is connected to probes mounted on the upstream and downstream sides of the filters in WPII applications and provides an indication of filters becoming clogged by closing a contact when the pressure drop between the two probes increases to a preset level.

- **Differential Air Pressure Indicator**

- o The indicator is connected to probes mounted on the upstream and downstream sides of the filters in WPII applications, and provides an indication of the filters becoming clogged by visually showing the actual pressure drop across the filters. It is important that maintenance monitor and record the reading on a regular basis in order to know when filter replacement is required.

- **Pressure Switch**

- o A pressure switch can be supplied to monitor, air pressure, oil pressure on force lube systems, or water pressure on TEWAC cooling systems. The device consists of an adjustable sensor and contacts. When the pressure drops below the setpoint a contact closes to provide indication to the user of low pressure.

- **Constant Level Oilers**

- o Continental provides constant level oilers as standard on all oil lube applications. They provide additional oil to replace that lost through normal long term leakage. Their use does not change the oil level in the sump.
- o They are preset at the factory and do not require any adjustments. They provide an indication of the rate of oil leakage by monitoring the level in the oiler.

- **Current Transformers for Differential Protection or Metering**

- o Current transformers are used to determine current flow through the motors power leads. Current transformers consist of a laminated iron core with windings of a predetermined ratio to be used with a specific metering device. Typically three current transformers are mounted in the main conduit box, one transformer per phase. Ratio supplied is based on user spec.

- **Lightning Arrestors**

- o Lightning arrestors are designed to limit the peak value of incoming voltage surges. The arrestors are mounted in the main conduit box and are connected from the main leads to ground as near to the motor as possible.

- **Surge Capacitors**

- o Surge capacitors are designed to lengthen the rise time of a surge. The capacitors are mounted in the main conduit box and are connected from the main leads to ground as near to the motor as possible.

- **Insulated Bearings**

- o Insulated bearings are used to prevent shaft currents from causing pitting on the bearings resulting in premature bearing failure. A motor may have one or both bearings insulated as requested by the customer. If Continental has been advised that the motor is to driven by a VFD we will supply an insulated bearing on the Opposite Drive End. If insulated bearings are provided then oil piping, vibration, and temperature probe connections, if provided, should also be insulated.

- **Tachometers / Encoders**

- o A variety of tachometers and encoders can be provided based on spec requirements. These are devices providing instrument level signals and are fragile in relationship to the robustness of the motor. Never force the coupling on the shaft of the device. If the coupling will not slide on easily use an emery cloth on the shaft until the coupling can be slipped on.

- **Removable Link**

- o This is a short segment of buss bar mounted between two insulating studs. The links can be removed to totally insure that the motor is disconnected from a power source.

- **Air Filters**

- o When filters are provided (standard on WP11 enclosures) Continental supplies Stainless Steel washable filters. We suggest that filters be cleaned whenever the pressure drop across the filter exceeds .15" WG.

- **Motor Grounding Provisions**

Grounding provisions on a motor will vary according to the owners specification. Some of the most common methods of grounding are as follows:

- o A ground connector placed in the main conduit box or on the motor frame is the most common. When the servit post is installed in the main conduit box it replaces one of the mounting bolts for the box. If mounted outside the box it is mounted into a hole drilled and tapped into the frame.

A copper or steel ground pad can be brazed or welded to the motor frame. The pad is then drilled and tapped to accept a cable terminal to be bolted to the frame.

# Oil Lubrication

## General

It is very hard to set up a re-lubrication schedule in the abstract. The conditions in which the motors operate such as high and low ambient temperature, dust, chemical, environment, ventilation paths around the motors, duty cycle moisture, etc. All play an important role in the lubrication cycle and these are best known to the motor users.

A re-lube should take place when the lube is depleted, burned out or contaminated. Therefore the following recommendations are offered as a guide. The maintenance people must analyze the lube requirements of each motor and determine its condition; if the oil is burnt, or if it feels gritty to the touch then it is time to change the lube. Adding oil is ok for the intervals between major overhaul period but Continental would recommend the entire oil reservoir be cleaned out and filled with fresh oil during the major overhaul, ideally within one or two year periods.

## Oil change schedule

Because of the various unknowns, Continental would recommend that the oil be checked at six months or 1500-2000 hours of operation whichever comes first.

If the oil is not burn or not contaminated continue to use it, checking again at approximately 300 hours intervals until a definite time can be set for each motor`s oil change. If you want to be on the conservative side, change the oil every six months or 2000 hours intervals but this can be a wasteful effort.

## Recommended Oil:

<b>Exxon</b>	<b>Teresstic #32</b>
<b>Gulf</b>	<b>Harmony #32</b>
<b>Citgo</b>	<b>Pacemaker #32</b>
<b>Texaco</b>	<b>Regal R&amp;O #32</b>
<b>Mobil</b>	<b>DTE Light</b>

Any turbine oil with a viscosity of 44 SSU @ 210F, (155 SSU @ 100F), this viscosity corresponds to an SAE #10 (non-detergent) weight.

## Vertical & Horizontal oil lubrication systems.

When motors are equipped with an oil lubrication systems we run the motor to test for proper oil circulation prior to the standard routine test. After completion of the routine test the oil is drained for shipment as it is considered a hazardous material.

Vertical motors are frequently used with oil lubrication when high thrust due to pump action or shafting is present. As standard Continental sizes thrust bearings for a 7-year average life. (For normal thrust & slow speed conditions, Continental recommends a Super-Conrad type ball bearing, grease lubrication for most durability but less maintenance.)

## Angular Contact Bearing Lubrication

Angular contact thrust bearings with bronze or phenolic cages are mounted according to thrust requirements. The lube system is designed to lubricate the entire assembly from top to bottom. An impeller is used for lifting the oil into contact with the bearings. The impeller pumps the oil up from the oil-chamber through the drilled hole in the cartridge housing from which the oil flows downward through the bearings by gravity. Attention is called to the drilled holes, which prevents possible siphoning out of the oil when the shaft is stationary. The oil is immediately available upon once the motor is started.

## Spherical Roller Thrust and Pivot Shoe Bearings

For special thrust applications with oil bath motors, spherical roller bearings or pivot shoe bearings are used when specified.

**Caution:** Do not lay the motor on its side as this will damage the spherical roller or pivot shoe bearings. Install coupling with motor in a vertical position. Do not run the motor for even more than a few minutes without being connected to the load as the lack of axial loading may cause the bearings to slide or skid and thus damage to the bearings

**Caution:** In many cases thrust bearings utilize a heavier lubricant than standard anti friction bearings. Refer to the motor lubrication nameplate for lubrication requirements.

The top bearing oil reservoir should be kept filled to the oil level mark on the sightgauge. The static oil level should not exceed the center line of the lowermost ball or roller. Overfilling can cause churning, which results in abnormally high operating temperatures. Systems of this type normally employ sight gauges to facilitate inspection of the oil level. The oil level may change slightly when motor is running because of the circulation of oil. Check the oil periodically for contamination. The oil may be drained from the oil pot by removing the bottom pipe plug from the level gauge. Evidence of oil leak should be checked to determine the source.

## Horizontal Lubricated Bearings

This system is designed to lubricate the motor bearing directly upon start up. An oil ring is used to lift the oil from the reservoir in the oil guide. The oil is lifted up and is guide directly on the balls of the bearing as they spin. Once the oil has passed through the bearing it is drained into the oil reservoir.

All Continental oil lubricated motors are completely tested and ready for successful operation when they leave the factory. Before installing, inspect the motor carefully to determine that no damage has occurred during transit. Turn the rotor by hand a few times to see that it turns freely in its bearings without undue noise or friction.

## INSTALLATION

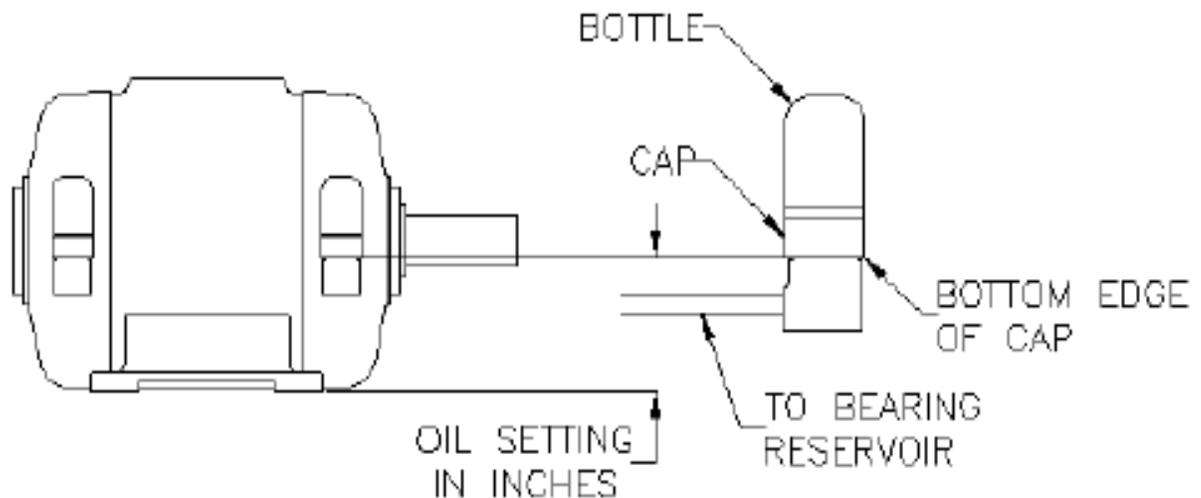
The motor must operate on a level base and oil pipes must be level. Make sure all pipe connections and pipe plugs are tight. Check oil level settings as shown lubricating instruction plate on motor. Measure setting from edge of frame to bottom edge of oil cup cap. If necessary to adjust oil level setting, loosen set screws in cap. Set screws must be tight after oil settings have checked.

**Caution:** To fill oil reservoir unscrew bottle from cap and fill bottle through the stem with a light turbine oil having a viscosity of 40-45 SSU at 210°F. Screw bottle back into cap. Repeat procedure when bottle empties until oil level remains stationary. This will indicate that the correct amount of oil is in the bearing reservoir. Allow at least 20 minutes for oil to enter reservoir before starting the motor.

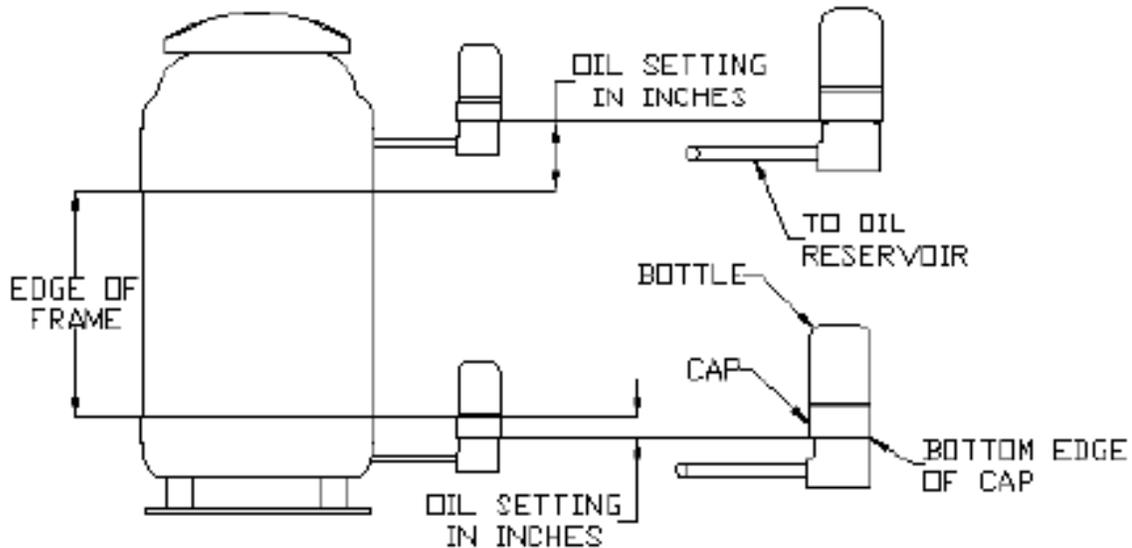
## MAINTENANCE

Always keep a visible supply of oil in the bottle. Do not refill the bottle if more than  $\frac{1}{4}$ " of oil is visible in the bottle. Too frequent filling of the bottle will flood the oil reservoir. Unusual loss of oil indicates a leak, investigate. Check oil pipe connections. If motor is kept idle, run motor a few seconds every two months to distribute oil in the bearings.

### Horizontal Motor



## Vertical Motor



### **Oil lubrication of Sleeve Bearings**

**Sleeve bearings are lubricated the same way as ball bearings.**

**The motor was shipped from the factory without lubricating oil. Oil must be added through oil ring viewing port on the upper side of the bearing housing before the motor can run. Do not fill the bearing housing beyond the mid-point of the bearing housing oil level sight-gauge. Use only high quality turbine oil with a viscosity of 150-200 SSU @ 100F, for normal ambient of 20F to 110F. The frequency of inspection, including addition of oil, changing the oil and checking the bearing wear, is best determine by a study of the particular operating conditions. Continental modern types of sleeve bearing housing are relatively dust and oil tight and require very little attention, since the oil does not become contaminated and oil leakage is negligible. Maintenance of the correct oil level is frequently the only upkeep required for years of service with this type of bearing.**

**If the motor is to be stored long before installation, sleeve bearing oil chamber should be filled to the mid-point of the bearing housing oil level sight gage and then turn the shaft at least ten or twenty times to insure that the shaft journals are completely covered. Every few months the shaft should be rotated a few turns for rust prevention.**

## Grease Lubrication

Grease lubricated motors are sufficiently lubricated to operate under **NORMAL CONDITION** for approximately one year in a redundant system running continuously. A relubrication schedule will vary widely with motor size, type of service and environment.

On horizontal motors the shielded side of the bearing is, placed toward the inside of the motor. On vertical motors shield is on the bottom side of each bearing in order to keep the grease contact with the bearing. On vertical motors with special shaft extension diameters there may be a grease retainer which is a separate component of the bearing.

It is very hard to set up a relubrication schedule in the abstract. The conditions in which the motors operate such as high and low ambient temperature, dust, chemical, environment, ventilation paths around the motors, duty cycle moisture, etc. All play an important role in the lubrication cycle and these are best known to the motor users.

A relube should take place when the lube is depleted, burn out or contaminated. Therefore the following recommendations are offered as a guide. The maintenance people must analyze the lube requirements of each motor and determine its condition; if the oil or grease smell burnt, if the grease is dry and hard, if it feels gritty to the touch then it is time to change the lube. Regreasing is ok for the intervals between major overhaul period but Continental would recommend the entire grease cavity be cleaned out and repack with fresh grease during the major overhaul ideally within one or two year periods.

When regreasing horizontal motors clean the area around the inlet and grease drain and remove plugs. If grease has hardened in the area around the drain plug use a wooden stick to remove the hardened grease. Removal of the drain plug serves as a pressure relief when regreasing. It is preferable to stop the motor and add grease slowly with a hand operated grease gun. Run the motor for about ten minutes with the drain plug removed to allow excess grease to drain out.

When regreasing vertical motors, follow same procedures for regreasing horizontal motors.

The following chart is a guide to the amount of grease to be added using a low pressure hand held grease gun.

Shaft Extension Diameter	Weight of grease to be added-oz.
3/4" to 1-1/4"	3/4
1-1/4" to 1-7/8"	1
1-7/8" to 2-3/8"	2
2-3/8" to 3"	3
3" to 4"	6
4" to 5"	8

Never fill the bearing housing with more than 1/3 to 1/2 full of grease as over greasing will cause excessive heat in the bearing.

### Recommended Grease

**Exxon Non-Fluid Oil S-58** or equivalent for normal condition.

**Shell Cyprina (NLGI #3)** premium motor grease

**Exxon Andok C**

For vertical motors use stiffer grease.

## Wound Rotor Motor - Supplement

### Slip Rings

Slip rings must be kept clean and free from grease, oil and dust. If necessary to clean the rings, use a fine grade of sandpaper to polish rings and wipe clean with a lint-free dry cloth. Never use emery cloth to clean the rings. A brown oxide color indicates good brush and slip life. If sparking has occurred, the surface of the slip ring will appear dull and black. In this case it should be cleaned with a fine sandpaper (do not use emery cloth). If excessive or prolonged sparking has caused the slip ring to become rough or pitted, the rotor should be removed and the slip ring turned down on a lathe. An investigation of overloads or improper brush seating which can cause sparking should be made to eliminate the trouble wherever possible.

### Brushes

Brushholders should be kept clean and dust free to prevent brushes from sticking in their holders. The spring tension on the brush should be kept as light as possible commensurate with good ring contact to prevent excessive wear of brush. As brushes become worn, they should be replaced by purchasing the proper size and from the motor manufacturer. Sparking at the brushes is a sign of improper ring contact and can be corrected by cleaning the rings, readjusting the brush or replacing with a new brush. This should be done as quickly as possible in order to avoid pitting the parts or causing more serious electrical damage to the motor.

Frequent inspection of the brushes should be made to see that:

- A. Brushes are not sticking in the holders.
- B. Pig-tail shunts are properly attached to brushes and holders.
- C. Correct tension is maintained as the brushes wear.
- D. Worn-out brushes are replaced before they reach their limit of travel and break contact with the slip ring.
- E. Remove any free copper picked up by the face of the brush.
- F. When a new brush is installed, be sure it is free in the brushholder.

## Services

Continental Electric Motors is committed to providing an extensive range of services to maximize your operation.

While this manual is designed to cover the customary procedures and most common problems which arise in the maintenance of motors, operating conditions vary widely and many questions may arise which could not be answered within the confines of these few pages.

In such cases, it is suggested that you contact Continental for the proper procedures for your specific type of motor. Please have the motor serial number available. We would be happy to assist you.

## Spare Parts

Wear and replacement parts are always available. All components are manufactured either in our own facility, or acquired from vendors pre-qualified to our quality standards.

For fast and accurate replacement parts, all you need is to obtain a motor serial number.

## Refurbishment of Continental Motors

Continental can “refurbish” any of the motors that it has manufactured. We completely evaluate the motor upon receipt with inspections and testing and then recommend a path forward based on this documented information. When we are finished you we return a motor in like new condition with a 1 year I service warranty on the complete motor.

**Our Refurbishment procedure is outlined below:**

**Receive motor, inspect and test the following:**

**Routine test if motor is able to run (if motor is not able to run we will complete all non-running checks noted in routine test below)**

- **Plus additional check as follows**
- **Check stator core loss**
- **Mechanical checks**
- **Dimensional check of all fits, machined surfaces, and shaft**
- **Inspect rotor for cracked or loose bars**

**Advise customer of results of inspections and tests, if no issues are identified proceed as described below. If issues identified, provide pictures and supporting documentation to the customer along with additional cost information. Achieve agreement on path forward prior to proceeding.**

## **Stator Refurbishment**

- **Steam clean and bake stator**
- **VPI stator with H rated polyester VPI (second VPI application optional)**
- **Megger and hi-pot after VPI**

## **Rotor Refurbishment**

- **Balance rotor to better than NEMA precision balance limits**
- **Clean and prime all castings with 240hr salt spray rated primer prior to re-assembly**
- **Re-assemble motor utilizing new bearings**
- **Final check is CEM Routine test.**
- **Apply finish coat of paint to completely assembled and tested motor**
- **Provide all documentation on inspections and tests to customer.**
- **Motor is returned to customer with 1 year from ship warranty.**