

# SIEMENS

## Induction Motors/ Generators

Installation  
Operation  
Maintenance

Large Frame Vertical  
680, 800, 1120 Frames

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Types CGV, CGHS, CGIIV, CGIHS, CGGV, CGGHS, CAZV, CAZHS,  
CAZBV, CAZBHS

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**Note** - These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purposes, the matter should be referred to;

1. Your local Siemens Sales Office.

--Or--

2. Siemens Technical Support Communication Center:

Inside the U.S.: 1-800-333-7421

Outside the U.S.: +1 423-262-5710

Online: [www.industry.usa.siemens.com/industry](http://www.industry.usa.siemens.com/industry) and click on Industry Services

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

Siemens machines are built in accordance with the latest applicable revision of the National Electric Code, Underwriters Laboratories Standards and Procedures, and NEMA (National Electrical Manufacturers Association) Standards. These publications and this instruction manual should be thoroughly read and understood prior to beginning any work on this equipment.

The information contained within is intended to assist operating personnel by providing information on the general characteristics of the purchased equipment. It does not relieve the user of the responsibility of using accepted engineering practices in the installation, operation and maintenance of this equipment.

Should a conflict arise between the general information in this manual and the contents of the drawings and supplementary material, the latter shall take precedence.

The illustrations in this book show typical machines. Special features deviate from those pictured.

## Safety Procedures

This equipment contains hazardous voltages. Death, serious personal injury or property damage can result if safety instructions are not followed.

The successful and safe operation of motors and generators is dependent upon proper handling, installation, operation and maintenance, as well as upon proper design and manufacture. Failure to follow certain fundamental installation and maintenance requirements may lead to personal injury and the failure and loss of the motor as well as damage to other property.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices and maintenance procedures contained herein. Only qualified personnel should be involved in the inspection, maintenance and repair procedure and all plant safety procedures must be observed.

**Qualified Person:** For the purpose of this manual and product labels, a **Qualified** person is one who is familiar with the installation, construction and operation of the equipment, and the hazards involved. In addition, he or she has the following qualifications:

- a. Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- b. Is trained in the proper care and use of protective equipment, such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety practices.
- c. Is trained in rendering first aid.


**Danger:** For the purpose of this manual and product labels, **Danger** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

**Warning:** For the purpose of this manual and product labels, **Warning** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

**Caution:** For the purpose of this manual and product labels, **Caution** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It is also used to alert against unsafe practices.

Motors should be installed and grounded per local and national codes.

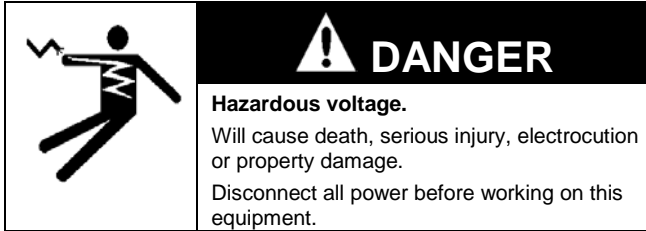
Do not operate this equipment in excess of the values given on nameplate or contrary to the instructions contained in this manual. The equipment (or a prototype) has been factory tested and found satisfactory for the condition for which it was sold. Operating in excess of these conditions can cause stresses and strains beyond design limitations. Failure to heed this warning may result in equipment damage and possible personal injury.

	<b>! DANGER</b>
	<b>Hazardous voltage.</b> Will cause death, serious injury, electrocution or property damage. Disconnect all power before working on this equipment.

<b>NOTE</b>
Squirrel cage induction machines can be driven by various types of prime movers. These will act as induction generators. This instruction manual applies to both motors and induction generators. However, for clarity reasons, the machine will be referred to as a "motor".

## Introduction

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These instructions present general recommendations for installation, operation and maintenance of induction motors built at the Norwood plant. If additional information is required, contact Siemens Energy & Automation.

### Warranty

See your sales contract for warranty coverage. Documentation of storage maintenance, alignment and regreasing may be required for certain warranty considerations.

### Receiving

Motors are shipped in first class condition. They have been inspected and are skidded to prevent damage from ordinary handling during shipment.

Inspect new motors for shipping invoice. Make the examination before removing from cars or trucks. If damage or indication of rough handling is evident, file a claim with the carrier at once, and notify your Siemens sales representative.

Remove only the shipping invoice. Do not remove tags pertaining to lubrication, operation and storage instructions. Read and follow all instructions to insure that no damage to motor bearings, (due to condensation) and motor windings occurs during storage.

Use care in handling. Dropping the motor or otherwise imposing shock loads can cause unseen and undetected damage to bearings. This damage such as false brinelling of the races of anti-friction bearings can result in early bearing failure.

If supplied, energize space heaters to help prevent condensation within the motor enclosure.

Motors having oil lubricated bearings are shipped WITHOUT OIL in the bearing reservoir. These bearings and journal surfaces are protected during shipment by a TEMPORARY film of rust inhibiting oil.

### Immediately upon receiving a unit with oil lubricated bearings:

1. Check for moisture accumulation. Remove any traces of oxidation before putting the motor in service.
2. Fill bearing reservoirs to normal level with a non-foaming, non-detergent turbine oil (See Maintenance Section).
3. Rotate the shaft several turns, by hand, to distribute the oil over bearing parts.

# Introduction

## **WARNING**

### **Heavy equipment.**

Improper handling may cause death, serious injury or property damage.

Check lifting devices before lifting. Use proper slings, chains and spreaders.

Note any warning plates on motor and follow instructions on each plate.

## Handling

Lifting devices are provided for handling only. An experienced rigger should be used to install motors.

To avoid damage, the use of spreader bars is recommended on other than single point lifts. Lifting devices are provided to facilitate handling with shackles and cables. Avoid pounding or bumping shaft, coupling or bearing parts, as shocks may damage bearings.

**NOTE WEIGHT BEFORE LIFTING.** The weight is indicated on the outline drawing. Apply tension gradually to cables. Do not jerk or attempt to move the unit suddenly.

## Temporary Storage

If the equipment is not to be installed and operated soon after arrival, store it in a clean, dry, well-ventilated place, free from vibration and rapid or wide variations in temperature. Rotate the shaft a minimum of 10 complete turns by hand each month to coat the bearings with lubricant which will retard oxidation or corrosion, and prevent possible false brinelling. If drain plugs are provided in enclosed motors, they must be removed periodically to drain any water accumulation from the motor. Consider a unit in storage when:

1. It has been delivered to the job site and is awaiting installation.
2. It has been installed but operation is delayed over 30 days pending completion of plant construction.
3. There are long (30 day) periods between operating cycles.
4. The plant (or department) is shut down for 30 days.
5. Energize space heaters, if supplied.

## **NOTE**

Storage requirements vary, depending on the length of storage and the climate. For storage periods of thirty (30) days or longer or climate variations, consult Siemens Storage Recommendations ANIM-03114. Storage maintenance is to be documented for warranty information.

## Description

"P" flanged, vertical type units above NEMA frames 680/800/1120 are the subjects of this manual. The instructions include high thrust, oil lubricated spherical roller or Kingsbury-type bearings.

Check rating plate for your particular type construction.

## Type Designations

The motor type designation consists of a basic letter or letters indicating the motor enclosure type to which other letters may be added denoting modifications.

Motor Type	Motor Enclosure
CGV, CGHS	Open Drip Proof or Weather Protected Type I
CGIIV, CGIHS	Weather Protected Type II
CGGV, CGGHS	Totally-Enclosed Water-to-Air Cooled
CAZV, CAZHS	Totally-Enclosed Air-to-Air Cooled with shaft-mounted fan
CAZBV, CAZBHS	Totally-Enclosed Air-to-Air Cooled using auxiliary blower

## Installation

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### NOTE

The information contained in this book is intended to assist operating personnel by providing information on the general characteristics of the purchased equipment.

**IT DOES NOT** relieve the user of the responsibility of using accepted engineering practices in the installation, operation and maintenance of this equipment, and complying with Federal, State and local rules and regulations, including OSHA.

### Location

Select a location for the motor and driven unit that will:

1. Be clean, dry, well ventilated, properly drained, and provide accessibility for inspection, lubrication and maintenance. Outdoor installations may require protection from the elements.
2. Provide adequate space for motor removal without shifting the driven unit.
3. Permit the motor to safely deliver adequate power. Temperature rise of a standard motor is based on operation at an altitude not higher than 3,300 feet above sea level.
4. Avoid condensation of moisture in bearings and on windings. Motors should not be stored or operated in areas subject to rapid temperature changes unless motors are energized or protected with space heaters.

### Foundation

Concrete (reinforced as required) makes the best foundation, particularly for large motors and driven units. In sufficient mass it provides rigid support that minimizes deflection and vibration. It may be located on soil, structural steel, or building floors provided the total weight (motor, driven unit, foundation) does not exceed the allowable bearing load of the support.

Allowable bearing loads of structural steel and floors can be obtained from engineering handbooks. Building codes of local communities give the recommended allowable bearing loads for different types of soil. For rough calculation the foundation should be approximately 2-1/2 times total unit weight.

### NOTE

If normal vibration or noise will be objectionable (as in office buildings), it may be advisable to use vibration dampeners between the machine or driven/drive unit, and the foundation.

### Mounting

Mount the machine securely and align accurately with the driven equipment.

1. Direct mounted to driven/drive equipment: the two units must be firmly secured and the driven equipment placed on an adequate foundation.
2. Floor plate mounted equipment must be very rigid and free from vibration.

Any excessive vibration of either method will cause loss of alignment, premature bearing wear and eventual breakdown.

### NOTE

If motor is driving a pump and the back pressure is maintained after shut-down, protect the motor with quick-acting check valves or non-reverse mechanism within the motor.

### Flange Mounting Solid Shaft Motors

To mount round frame motor to driven unit proceed as follows:

### NOTE

Round frame motors can be rotated within flange mounting bolt spacing to gain a satisfactory position for grease fittings and conduit attachments, and to mate run-out differences to avoid shimming flange fits. Terminal boxes without accessory devices can be turned to four equally spaced positions for access to conduit system; arrange the system so that water will not accumulate and drain into motor connection box.

1. Use a hoist; rig a sling around the lifting lugs.
2. Position motor (per note above) and move toward driven unit - engaging cleaned flanged surfaces.
3. Insert flange mounting bolts and tighten to snug tight.
4. Secure attachments between motor and shaft and load. (i.e. set screws tightened against shaft key.)
5. Turn shaft by hand; check for free rotation; binding; scraping; sticking.
6. Tighten all flange bolts. (Avoid warping or springing the flange.)
7. Turn shaft again to check for free rotation.

# Installation

## Hollow Shaft Motors

The motor should be set on its base first, and the driven shaft inserted through the hollow shaft. There are times, however, when these motors are lifted and lowered over the driven shaft. In either case, do not cause damage to the shaft by bending or scraping the threads.

Proceed as follows:

1. Remove coupling cover and raise motor with sling and hoist.
2. Slowly lower motor; carefully engage stud ( if used) and rabbit. (Position motor to allow access for power connection and lubrication.) Install flange nuts (bolts, if used) and snug.
3. Insert pump drive shaft into hollow shaft; arrange coupling and driven shaft in line with Gib Key Slot.
4. Insert Gib Key, connect driven shaft to coupling and adjust pump nut for proper impeller clearance. (Remove Locking Bar if provided.)
5. Turn shaft by hand to check for free rotation and shaft alignment. There must be no binding, scraping, or sticking.
6. If used, check the operation of the non-reverse device: also check action of self-release coupling, if that type of coupling is used (see Figure 12).

### NOTE

A self-release coupling is shipped with three bolts holding it in place. These bolts must be removed to allow coupling to operate.

7. After alignment, uniformly and securely tighten all flange nuts (bolts).
8. Turn shaft by hand again; check for free rotation.
9. Replace coupling cover.


### CAUTION

**Continuous upthrust may damage motors.**  
Eliminate upthrust before operating.

### CAUTION

**Improper lubrication can cause damage to bearings.**  
Check oil reservoir for proper oil grade and level before starting or storing motor.

## External Wiring

	<b>! DANGER</b>
	<b>Hazardous voltage.</b> Will cause death, serious injury, electrocution or property damage. Disconnect all power before working on this equipment.

### NOTE

Before running motor, see **Initial Start** in Operation Section.

### CAUTION

**FOR MOTORS EQUIPPED WITH BACKSTOP OR NON-REVERSE DEVICE**  
**Attempting to rotate motor with non-reverse device in wrong direction may result in severe damage to the motor.**

Connect power supply phases to motor terminals exactly as indicated on motor nameplate to insure proper direction of rotation. Any other connection will result in wrong direction of rotation.

Starting and overload control devices must be matched to motor rating. For safety or convenience they may need to be installed some distance from the motor. Follow the control manufacturer's instructions to make proper installations and connections. Observe the following:

1. Connect electrical power supply to conform to National Electric Code and any local regulations. Line voltage and wire capacity must match motor rating stamped on the nameplate.
2. With the driven equipment disconnected, momentarily energize the motor to check rotation.
3. If motor is three-phase type, reverse rotation (if required) by interchanging any two of the three power leads.

## Installation

### Changing Direction of Rotation

Look for rotation plates usually mounted on opposite drive end of the motor.

#### CAUTION

##### Excessive heat.

Motor may overheat if motor cooling fans run in the wrong direction. Run motor in direction shown on motor or change fans.

#### NOTE

If open or enclosed units have non-reverse ratchets and rotation is changed, the ratchets must be changed.

The internal rotor fan direction must be considered if changing direction of rotation.

**To reverse rotation – consult factory.**

### Vibration

After flange mounting bolts have been tightened, check end play. Run the unit at a minimum load and check vibration.

The standard unfiltered vibration limits per NEMA MG1 for a resiliently mounted motor are:

Speed, RPM	Rotational Frequency/Hz	Velocity, in/s Peak (mm/s)
3600	60	0.15 (3.8)
1800	30	0.15 (3.8)
1200	20	0.15 (3.8)
900	15	0.12 (3.0)
720	12	0.12 (3.0)
600	10	0.12 (3.0)

If vibration is excessive, loosen flange mounting bolts and shift within mounting flange clearance. If this shifting does not reduce vibration to acceptable limit, and unit is coupled to load, check shaft alignment and system reed frequency.

### System Frequency (Resonance)

To achieve reasonable vibration levels when a motor, pump, and support are operating together, the responsibility is with the system designer.

If the probable vibration characteristics of a system are calculated before construction begins proper design can often reduce trouble before it becomes a costly reality. The effect of most pump heads because of the access openings for coupling, bearing, and pump adjustments, will lower the system reed frequency.

Generally, the reed frequency of the unit alone mounted on an infinite mass is at least 15% above or below the unit operating speed. If the system reed frequency is at or near operating speed, a decision must be made to raise or lower the system reed frequency by altering the rigidity of the motor-support structure.

### Alignment

Accurate shaft alignment between motor and driven equipment is essential. Improper alignment may result in vibration, bearing overloads and excessive shaft stresses. Flexible couplings will not compensate for excessive misalignment.

#### Alignment Procedure (Solid Shaft)

The following checking procedure applies to a unit consisting of motor/generator, coupling, and a driven/drive component. Although applicable to most types of couplings, it is primarily intended for the rabbet-fit type. For other types, where the procedures differ, refer to the coupling manufacturer's Installation and Maintenance Instructions.

Work in one plane at a time and test for parallel or angular alignment with a dial indicator mounted as shown in Figure 1. Proceed as follows:

1. Set indicator dial to zero, at starting point.
2. Slowly turn both coupling halves a complete turn.
3. Observe dial reading at 90 degree increments from starting point.
4. Acceptable parallel alignment occurs when the total indicator readings do not exceed 0.002 inches.
5. Acceptable angular alignment occurs when the total indicator readings do not exceed 0.002 in./ft. radius to dial indicator.

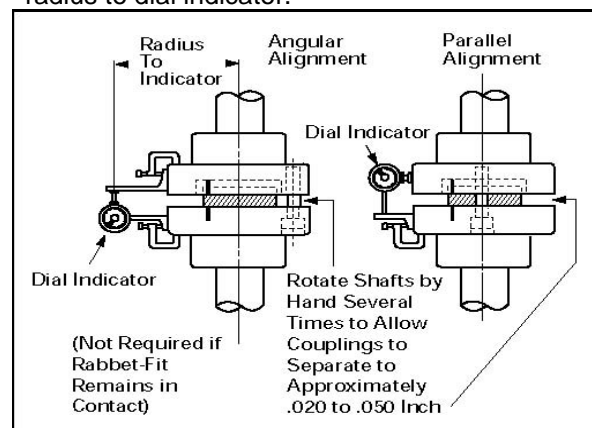


Figure 1



# Installation

## Alignment Procedure (Hollow Shaft)

Hollow shaft units require accurate alignment with respect to the unit shaft and the driven/drive equipment shaft. The pump shaft acts as a pendulum supported by the top coupling and unit bearing.

Align the unit as follows:

1. Clamp dial indicator to pump shaft, align with base-bolt plane and set dial indicator to zero (Figure 2).
2. Remove top cover and rotate both unit and pump shafts.
3. Read dial indicator at 90 degree increments from starting point.
4. Acceptable alignment occurs when indicator readings do not exceed 0.0005 inches.
5. Shim flange faces if necessary (Figure 3).

When alignment and vibration of unit are within limits, engage drive. Run unit at minimum load and check for vibration - continue to increase load and checking vibration until full load is obtained.

### CAUTION

Excessive vibration may cause damage to bearings or other motor components.

Determine and correct cause(s) of vibration before operating.

## Shimming Technique

To avoid the possibility of twisting the flange when shimming between the flanges, minor shims should be one-half the thickness of the major shim. Shims should not penetrate deeper than the bolt hole circle and not be wider than twice the penetration distance (Figure 3).

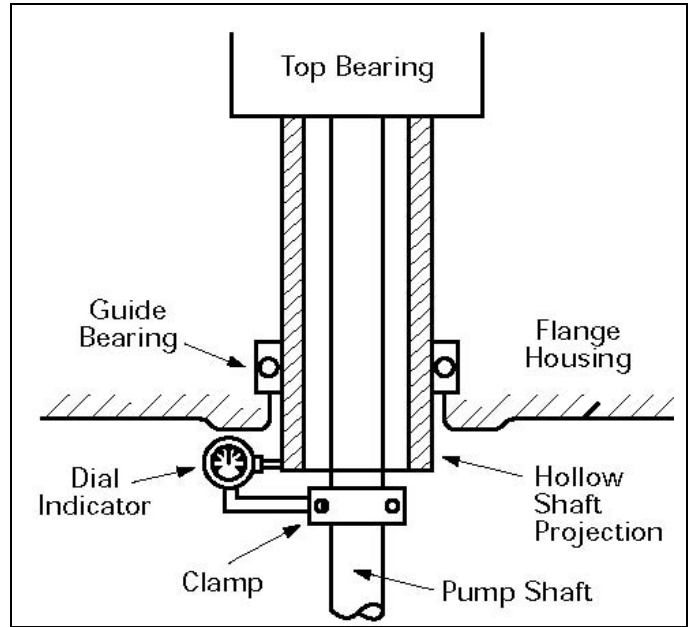


Figure 2

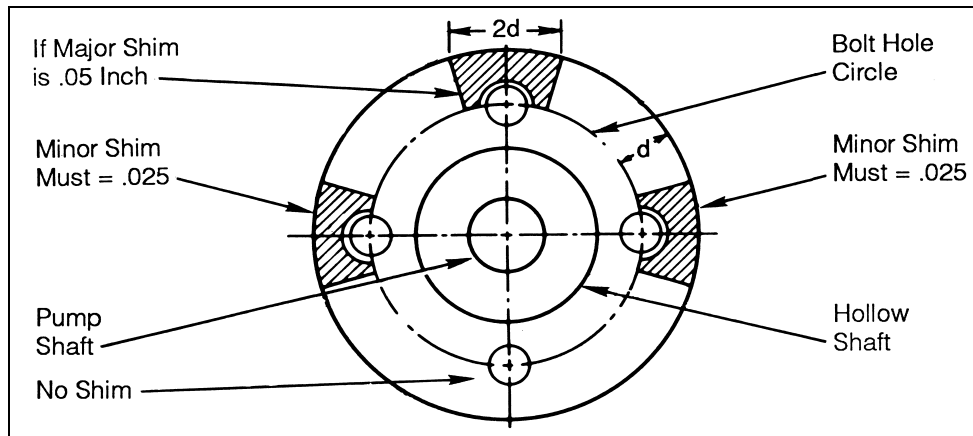


Figure 3

## Installation

### Tests Before Operation


#### Insulation Resistance

Check insulation resistance prior to connecting motor to power supply. A hand cranked or solid state electronic insulation resistance tester, at least 500 volts d.c., but not over rated voltage, is usually used (see Maintenance).

See IEEE Recommended Practice for Testing Insulation Resistance Rotating Machinery IEEE Std 43.

#### Dielectric (Hi-Pot) Tests

All motors receive a factory dielectric test in accordance with ANSI and IEEE Standards.

	<p><b>! DANGER</b></p> <p><b>Dielectric testing may result in personal injury or death.</b></p> <p>Operate dielectric test equipment only with qualified personnel, in accordance with manufacturer's instructions.</p>
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If a dielectric test is made on an old or repaired winding, to evaluate service reliability, the test voltage applied may vary from the rated terminal voltage to some higher value. The factory should be consulted when establishing the test voltage and procedure for testing old or repaired equipment.

#### CAUTION

**Excessive dielectric testing may cause damage to insulation.**

Test only in accordance with IEEE Std. 43.

#### Winding Resistance (Temperature)

The change in resistance of a winding provides an accurate measure of the average temperature of a winding, and is generally used to determine the temperature of the stator windings. The measurements must be made carefully with instruments known to be accurate, and preferably with the same instruments for both hot and cold measurements.

#### NOTE

If normal vibration or noise will be objectionable (as in Instruments that operate on the principle of the Kelvin Bridge are preferred. (See "Temperature Measuring Devices" - IEEE Publication No. 119.)

The cold resistance, or the resistance at normal room temperature, must be measured after the machine has been idle for some time, usually before starting, or cold resistance value may be obtained from the factory. The cold temperature of the coils should be measured because coil temperature may not be the same as the surrounding air.

The average temperature of the winding is obtained by taking resistance measurements, at the motor load terminals and using the following equation:

$$T = \frac{R}{r}(234.5 + t) - 234.5$$

Where  $T$  = hot temperature in degrees C  
 $R$  = hot resistance

$r$  = cold resistance at temperature  $t$

$t$  = cold temperature of winding in deg C (amb)

As an example, assume the cold resistance of 0.50 ohms at 25°C, and the hot resistance (taken immediately after motor is de-energized, and has stopped rotating) is 0.61 ohms, then:

$$T = \frac{0.61}{0.50}(234.5 + 25) - 234.5$$

$$T = 82$$

The temperature measured by imbedded detectors or by the change in resistance is generally higher than thermometer measurements and is closer to the true hottest spot temperature in the machine. For this reason, the Standards permit higher observable temperatures when measurements are taken in this manner.

## Installation

### Typical Motor Control Settings

	Alarm	Trip (Shutdown)	Timer Trip Setting <sup>(1)</sup>
Winding Temperature <ul style="list-style-type: none"> <li>• Class B Insulation</li> <li>• Class F Insulation</li> </ul>	130°C 155°C	155°C 170°C	
Motor Bearing Temperature (Thermocouple or RTD's) <ul style="list-style-type: none"> <li>• Sleeve Bearing</li> <li>• Antifriction Bearing</li> </ul>	90°C 100°C	95°C 105°C	
Ground Fault	4 Amps <sup>(2)</sup> Primary Circuit	8 Amps <sup>(2)</sup> Primary Circuit	0.2 sec. <sup>(2)</sup>
Instantaneous Overcurrent <ul style="list-style-type: none"> <li>• With ½ Cycle Delay</li> <li>• Without Time Delay</li> </ul>	1.8 times Locked Rotor Amps <sup>(2)</sup> 2.4 times Locked Rotor Amps <sup>(2)</sup>		
Maximum Voltage	110 % of Rated Voltage		10 sec.
Minimum Voltage (the minimum voltage also applies to starting unless otherwise specified)	90 % of Rated Voltage		10 sec.
Maximum Frequency Deviation	±5%		10 sec.
Maximum of Voltage Plus Frequency Deviation	±10%		10 sec.
Maximum Voltage Unbalance <sup>(3)</sup>	1%		15 sec.
Maximum Current Unbalance <sup>(3)</sup>	8%		15 sec.

Suggested Vibration Limits				
RPM	3600	1800	1200	900 and Slower
Shaft (mils, pk-to-pk) – Alarm <sup>(4)</sup>	2.8	3.2	3.8	4.5
Shaft (mils, pk-to-pk) – Trip <sup>(4)</sup>	3.3	3.7	4.3	5.0
Housing (in./sec.) - Trip	0.25	0.25	0.25	0.25

<sup>(1)</sup> Maximum time at maximum condition before control device is to operate.

<sup>(2)</sup> Increase as necessary to avoid nuisance trips.

<sup>(3)</sup> This is the maximum deviation from the average of the three phases.

<sup>(4)</sup> Applies only when vibration probes are supplied.

## Operation

### Initial Start

#### **WARNING**

**Improper operation may cause personal injury or damage to equipment.**

Operate within nameplate ratings and in accordance with instructions in this manual.

#### **CAUTION**

**Do not exceed number of Siemens specified hot and cold starts per hour.**

Will cause overheating.

Allow time between starts to permit stator windings and rotor cage to cool.

#### **NOTE**

If motor has been out of service or in storage for more than 30 days, consult Siemens Storage Recommendations ANIM-03114, **Preparation for Service**

#### **CAUTION**

**FOR MOTORS EQUIPPED WITH BACKSTOP OR NON-REVERSE DEVICE**

**Attempting to rotate motor with non-reverse device in wrong direction may result in severe damage to the motor.**

Connect power supply phases to motor terminals exactly as indicated on motor nameplate to insure proper direction of rotation. Any other connection will result in wrong direction of rotation.

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

1. Check that motor, starting, and control device connections agree with wiring diagrams.
2. Check that voltage, phase, and frequency of line circuit (power supply) agree with motor nameplate.
3. If motor has been out of service or in storage (installed or uninstalled) see Out of Service/Storage Section before proceeding.
4. Check motor service record and tags accompanying motor. Be certain bearings have been properly lubricated and oil wells are filled. See motor outline drawing to determine proper oil level.

5. If possible, remove external load (disconnect drive) and turn shaft by hand to assure free rotation. This may have been done during installation procedure; if so, and conditions have not changed, this check may not be necessary.
6. If drive is disconnected, run motor at no load long enough to be certain that no unusual condition exists. Listen and monitor for excessive noise, vibration, clicking or pounding and that oil rings are turning if so equipped. If present, stop motor immediately. Investigate the cause and correct before putting motor in service.
7. If drive cannot be disconnected, interrupt the starting cycle after motor has accelerated to low speed. Carefully observe for unusual conditions as motor coasts to a stop. Repeat several times if necessary. Refer to motor's Starting Duty nameplate (if so equipped) or Motor Data Sheet for recommended number of starts and cooling period between starts.
8. If both bearings are insulated, make sure ground strap or brush is connected so rotor is grounded. Disconnect ground strap, if used, only when unit is not operating to check bearing insulation integrity.
9. When checks are satisfactory, operate at lowest load possible and look for any unusual condition. Increase load slowly to maximum, checking unit for satisfactory operation.

### Out of Service/Storage (over 30 Days)

#### Cleaning

Both the interior and exterior of the motor should be free of spilled oil, water, dust and dirt. The exterior should be wiped and the interior blown out with compressed air at reduced pressure or with a small hand bellows.

#### **WARNING**

**Flying dirt, dust or other particles.**

May cause eye injury.

Wear safety glasses and dust mask when using compressed air.

Make sure that the bearings and lubricant cavities are free of dust and dirt, and that oil plugs are tight. Scratches, bruises, or rust on the shaft journal must be carefully removed.

## Operation

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Relubricate Bearings (see **Bearings** Section).

Remove Desiccant (if present).

Test Insulation Resistance (see **Tests Before Operation**).

Regardless of the method of storage, the windings of every motor should be tested prior to placing in service. See Insulation Resistance Section under Corrective Maintenance Section.

### Normal Operation

Start the motor in accordance with standard instructions for the starting equipment used. Sometimes the load should be reduced to the minimum, particularly for reduced voltage starting, and/or high inertia connected loads.

### Voltage/Frequency Variation


Motors will operate successfully under the following conditions of voltage and frequency variation, but not necessarily in accordance with the standards established for operating under rated conditions:


1. If the variation in voltage does not exceed 10% above or below rated voltage, with all phases balanced. Voltage unbalance should not exceed 1%.
2. If the variation in frequency does not exceed 5% above or below rated frequency.
3. If the sum of the voltage and frequency variations does not exceed 10% above or below rated values provided the frequency variation does not exceed 5%.

# Operation

## Trouble Shooting

Between regular maintenance inspections, be alert for signs of motor trouble. Common symptoms are listed in the following table. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUT DOWN.





**DANGER**

**Hazardous voltage.**  
Will cause death, serious injury, electrocution or property damage.  
Disconnect all power before working on this equipment.

TROUBLE	POSSIBLE CAUSES	CORRECTION
Motor will not start.	Usually line trouble. Single phasing at starter.  Under Voltage.  Excessive Load.	Check power source. DO NOT check with motor energized! Check overloads, controls and fuses. Check voltage and compare with nameplate rating.  Check voltage at motor terminals. Compare to nameplate.  Disconnect motor from load to see if it starts without load. Reduce load or replace motor with unit of greater capacity.
Excessive hum.	High Voltage.  Unbalanced rotor.  Excessive wear of bearings.	Check input voltage. Check for proper connections.  Balance rotor.  Replace bearings. Check to determine cause of wear and replace as necessary. Check alignment.
Regular clicking.	Foreign matter in air gap.	Remove foreign matter.
Rapid knocking.	Bad anti-friction bearing or dirt in lubricant.	Replace bearing, clean wells and renew lubricant.
Vibration.	Misalignment in coupling or flange.  Accumulation of dirt on fan.  Vibration in driven machine.  System natural frequency (Reed critical). Twisted base or flange Excessive end play. Shaft bent or flange face runout.	Realign motor and driven equipment.  Clean motor.  Run motor disconnected from driven load and check for vibration. Eliminate source in driven equipment.  Alter rigidity of base structure. Check flange alignment and shims. Adjust end play. Straighten or replace shaft. Reface or replace housing.
Vibration following motor repair.	Rotor out of balance; balance weights of fans shifted on rotor.	Balance rotor.
Motor overheating. (Check with thermocouple or by resistance method, do not depend on touch).	Overload.  Single phase.  Dirt in motor.    Unbalanced voltage.  Rotor rubbing on stator.	Measure load and compare with nameplate rating. Check for excessive friction in motor or complete drive. Reduce load or replace motor with unit of greater capacity.  Check current, all phases.  Check flow of air. Check filters, if so equipped. <span style="float: right;">Check Clean motor.</span>  Check voltage, all phases.  Check air gap. Repair motor as necessary.

# Operation

## Trouble Shooting



**! DANGER**

**Hazardous voltage.**  
Will cause death, serious injury, electrocution or property damage.  
Disconnect all power before working on this equipment.


TROUBLE	POSSIBLE CAUSES	CORRECTION
Motor overheating (continued...)	<p>High ambient.</p> <p>Open stator windings.</p> <p>Air Recirculation.</p> <p>Over voltage/under voltage.</p> <p>Ground.</p> <p>Improper electrical connections.</p> <p>Heat exchanger tubes blocked.</p> <p>Loose heat exchanger tubes.</p>	<p>Check air inlet temperature.</p> <p>Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases for balance.</p> <p>Check air intake and exhaust for obstructions. Check air inlet temperature.</p> <p>Check voltage and compare to rating plate.</p> <p>Locate with test lamp or insulation tester and repair.</p> <p>Recheck electrical connections.</p> <p>Clean tubes, if so equipped.</p> <p>If so equipped, Roll tubes to expand tube inside diameter using proper expansion tool.</p>
Fine dust under coupling having rubber buffers or pins.	Misalignment.	<p>Realign motor and driven equipment.</p> <p>Inspect coupling.</p>
Bearing overheating.	<p>Oil level too high or low.</p> <p>Misalignment.</p> <p>Excessive end thrust.</p> <p>Too much grease (ball or roller bearing).</p>	<p>Correct oil level. See <b>Maintenance</b> section of this instruction book to determine proper oil level.</p> <p>Realign motor and driven equipment.</p> <p>Reduce thrust. Recheck mounting and alignment.</p> <p>Relieve supply to point set by manufacturer.</p>
Oil leakage or excessive oil usage.	<p>Excessive pressure or vacuum in bearing cavity:</p> <ol style="list-style-type: none"> <li>1. Heat exchanger tubes blocked.</li> <li>2. Oil stand pipe eccentric or out of round.</li> <li>3. Parts not properly sealed.</li> </ol> <p>4. Loose heat exchanger tubes.</p>	<p>Clean tubes.</p> <p>Straighten or replace pipe and reseal fits.</p> <p>Seal parts;</p> <p>Drains: condensate and/or breather vent.</p> <p>Conduit boxes (auxiliary and motor leads).</p> <p>Partings: joints and oil guards</p> <p>Loose heat exchanger tubes.</p> <p>Roll tubes expanding tube inside diameters using proper expansion tool.</p>
Excessive oil level fluctuation.	High pressure or vacuum in bearing cavity.	<p>Measure pressure or vacuum using manometer (See "Cavity Pressures" under <b>Bearings</b>).</p> <p>Check atmospheric vents for obstructions.</p> <p>Check oil seal gap for uniformity.</p>
Excessive oil foaming	<p>Improper oil used.</p> <p>High oil level.</p> <p>Moisture in oil.</p>	<p>Use non-foaming oil.</p> <p>Correct oil level as indicated on sight gauge.</p> <p>Clean and replace oil.</p>

# Maintenance

## Preventive Maintenance

Motors are designed to give many years of reliable service with a minimum of attention. Trouble-free operation cannot be expected if proper maintenance is postponed or neglected.

Provide proper maintenance on the equipment. Follow carefully the instructions contained herein. Be certain personnel review, understand, and follow these procedures during periodic maintenance inspections.

	<b>⚠ DANGER</b>
	<b>Hazardous voltage.</b> Will cause death, serious injury, electrocution or property damage. Disconnect all power before working on this equipment. Maintenance should be performed only by qualified personnel.

<b>CAUTION</b>
<b>Flying dirt, dust or other particles.</b> May cause eye injury. Wear safety glasses and dust mask when using compressed air.

<b>CAUTION</b>
<b>Loose parts or fire.</b> Can result in product failure or serious property damage.

### Maintenance Checklist

1. Verify motor is clean and verify that stator and rotor ventilation passages are unobstructed.
2. Check for excessive loading or service factor.
3. Verify winding temperature rise not in excess of rated value.
4. Verify insulation resistance is above recommended minimum.
5. Verify voltage and frequency variation.
6. Check air gap.
7. Verify that bearing temperatures are within limits and that lubricant is clean and proper level maintained.
8. Verify no unusual vibration or noise exists.
9. Check alignment.
10. Check for proper lubrication.

A definite schedule of preventive maintenance inspections should be established to avoid breakdown, serious damage and extensive downtime. The schedule will depend on operating conditions and experience with similar equipment. To assure adequate maintenance, and warranty consideration, it is essential that complete records be kept for each motor including description and rating, maintenance schedule and repairs required or carried out.

This checklist does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of this equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens Sales Office.

<b>⚠ WARNING</b>
<b>Improper maintenance can cause death, serious injury or property damage.</b> Use only factory authorized parts for repair of equipment. Maintenance should be performed only by qualified personnel.

## Inspection

Each motor should be inspected at regular intervals. The frequency and thoroughness will depend on the operating hours, nature of service, and the environment.

### Cleanliness

The exterior should be kept free of oil, dust, dirt, water, and chemical. It is particularly important to keep the air intake and exhaust openings free of obstructions.

<b>NOTE</b>
If equipment is operated intermittently in very damp locations, it should be protected by space heaters. To retard corrosion, grease all machined fits when the unit is reassembled after a maintenance check.



# Maintenance

## Loading

Overloading causes overheating and reduces insulation life. A winding subjected to a 10°C temperature rise above the maximum limit for its class may have its insulation life halved.

Under loading a motor is improper as it lowers the motor power factor and efficiency which results in higher power cost.

## Temperature

Electrical apparatus operating under normal conditions becomes quite warm. Although some places may feel hot to the touch, the unit may be within limits. If checking total temperature by winding resistance or imbedded detector (RTD), the total temperature should not exceed the following:  
When operating at full load:

		Class of Insulation System		
		B	F	H
Temp. by Resistance	All HP	120°C (248°F)	145°C (293°F)	165°C (329°F)
Temp. by Embedded Detector	1500HP or less	130°C (266°F)	155°C (311°F)	180°C (356°F)
	Over 1500HP -Under 7000V	125°C (257°F)	150°C (302°F)	175°C (347°F)
	Over 1500HP -Over 7000 V	120°C (248°F)	145°C (293°F)	165°C (329°F)

When operating at 1.15 service factor load:

		Class of Insulation System		
		B	F	H
Temp. by Resistance	All HP	130°C (266°F)	155°C (311°F)	175°C (347°F)
Temp. by Embedded Detector	1500HP or less	140°C (284°F)	165°C (329°F)	190°C (373°F)
	Over 1500HP -Under 7000V	135°C (275°F)	160°C (320°F)	185°C (365°F)
	Over 1500HP -Over 7000 V	130°C (266°F)	155°C (311°F)	175°C (347°F)

These temperatures represent the maximum temperature for each class of insulation and include a 40°C ambient temperature. Operation above these temperatures will result in reduced insulation life.

## Vibration

Most problems can be detected when inspected visually. Check for;

1. Loose or missing parts, such as fan blades, nuts, bolts, screws, couplings, etc.
2. Accumulation of dirt on fan or rotor.
3. Associated equipment - Disconnect equipment to determine where the vibration is being generated.
4. Foundation construction - Base, grouting and associated equipment supporting drives must be in good condition. Vibration can be amplified by weak construction. Vibration of base just below motor feet should not exceed 25% of motor vibration.
5. History - When was vibration first noted? Was there a change in loading and/or duty of equipment? Has ambient vibration changed?

More important than the actual vibration is the vibration change over a period of time.

## Corrective Maintenance

Two factors that require corrective maintenance are electrical failure or mechanical failure. The first sign of electrical failure is usually low insulation resistance. Mechanical failures are usually preceded by excessive bearing noise or heat.

### Low Insulation Resistance

Factors that usually cause low insulation readings are:

1. Dirty windings (oil, dust, grease, salt, etc.).
2. Excessive moisture.
3. Mechanically damaged insulation.
4. Heat deterioration

Dirty windings can be cleaned and moist windings dried; however, items 3 and 4 require extensive repairs by a certified service center.

**CAUTION**

**Flying dirt, dust or other particles.**  
May cause eye injury.  
Wear safety glasses and dust mask when using compressed air.

# Maintenance

## Cleaning

Clean the inside and outside of the motor regularly. Actual conditions existing around the motor dictate the frequency of cleaning operations. Use the following procedures as they apply.

1. Wipe off dust, dirt, oil, water, etc., from external surfaces of the motor. These materials can work into or be carried into the motor windings and may cause overheating or insulation breakdown.
2. Remove dirt, dust, or other debris from ventilating air inlets and exhausts. Do not operate motor with air passages blocked or restricted.

## Rotor Cleaning

Remove rotor. Inspect air vents and remove any obstructions.



## Stator Cleaning

MICLAD™ form wound VPI (vacuum pressure impregnated) insulated coils may be cleaned with a quick drying solvent and lint free cloths or steam cleaned with low-pressure steam, then the entire stator oven baked at 200°F for 12 hours and then 230°F for 12 hours.

The stator winding insulation resistance should be measured before and after any cleaning operation.

The windings may be cleaned with a solvent compatible with the insulation system and oven dried. Water and detergents with an oven drying cycle may be used as an alternate on MICLAD™ VPI insulation systems.

MICLAD™ is a Siemens trademark.

	 <b>DANGER</b>
	<p><b>Hazardous voltage.</b> Will cause death, serious injury, electrocution or property damage. Disconnect all power before working on this equipment.</p>

<b>CAUTION</b>
<p><b>High Voltage.</b> May damage semi-conductors, small transformers, voltage regulators, and other devices. Disconnect from circuit before testing insulation resistance.</p>

## Insulation Resistance

Check insulation resistance periodically. Use a hand cranked or solid state insulation resistance tester and test with at least 500 volts, but not greater than motor rated voltage.

For motors with newer insulation systems such as MICLAD™ VPI, the insulation resistance after one minute should be greater than 1000 megohms. (Values in excess of 5000 megohms are common.) For older motors, the minimum value recommended in IEEE Standard 43 can be used. The value in megohms, when corrected to 40°C, is equal to the motor rated voltage in kilovolts plus 1. For example, for a motor with a rated voltage of 2300 volts, the limit value would be:

$$2.3 + 1 = 3.3 \text{ (megohms).}$$

## Drying Insulation

If the insulation resistance is less than satisfactory, and the cause is believed to be excessive moisture in the windings, dry the windings by applying heat from:

1. A warm air oven.
2. Electric strip heaters.
3. Circulating currents through the coils.

The heat should be applied slowly so the desired temperature will not be obtained in less than six hours.

Insulation Drying Temperature*		
Class "B"	Class "F"	Class "H"
200°F	245°F*	275°F*
94°C	118°C	135°C
<small>*Class "F" and "H" insulated units should be baked at 70% specified temperature (to avoid steam inside winding) for about six hours, before temperature is raised to drying temperature.</small>		

Insulation resistance should be measured before the heat is applied, and every six to eight hours thereafter.

<b>NOTE</b>
<p>Insulation resistance will decrease as the motor warms up; but will begin to increase as the drying process continues.</p>

## Maintenance

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A uniform temperature must be maintained in the motor to obtain constant resistance readings. When the megger readings remain constant, the drying process is complete and may be discontinued. Check for other causes if readings are still low.

### Warm Air Oven Drying

1. Remove bearing housings.
2. Remove rotor.

Bake in oven at temperatures specified in Insulation Drying Temperature table, and follow procedures described for drying insulation.

### Electric Strip Heater Drying

1. Remove bearing housings.
2. Remove rotor.
3. Direct a fan on stator to carry away the moisture.
4. Attach temperature indicators to winding and apply heat as specified in the Insulation Drying Temperature table and follow procedures described for drying insulation.
5. Radiant type heaters are not recommended because some parts may become scorched before remote parts reach desired temperature.

### Circulating Current Drying

1. Remove bearing housings.
2. Center the rotor in the stator core.
3. Wedge fiber strips into the lower part of the air gap so rotor does not touch stator core, or remove rotor.
4. Direct fan on unit to blow away excessive moisture.
5. Attach temperature indicators to windings. Do not exceed the drying temperatures in the Insulation Drying Temperature table.
6. An external source of current can be used to circulate direct current through the winding of any type of alternating current motor. A portable low voltage motor-generator set, such as is used for welding, is usually suitable.

## CAUTION

### High temperatures.

May cause damage to insulation.

Avoid hot spots and radiant type heat

When this method is used on the stator, the stator phases may be connected in series or in parallel to suit the available power supply if both ends of all phases are accessible. If only three leads are brought out of the motor, the current may be circulated between one terminal and the other two connected together. If this is done, the temperature of the single lead connection must be checked frequently, and it is desirable to shift the leads occasionally. Usually 50 to 100% of full load current will produce the required temperature. The dc voltage required for this current will be 0.25 - 5.0% of the normal voltage per phase, and the corresponding power will be 0.50 - 3.25% of the rating.

Alternating current can be used on the stators of squirrel cage induction motors if the rotors are removed. Alternating current is usually not as easy to control as required voltage control, and a.c. requires a higher voltage source, approximately 10 to 30% of the rated winding voltage. In addition, care must be taken that miscellaneous parts adjacent to the windings, such as lead studs, core supporting member, etc., do not overheat due to induced currents and the lack of normal ventilation.

## CAUTION

### High temperatures.

May cause damage to insulation.

Avoid hot spots and radiant type heat

## Bearings

Long life of bearings is assured only by maintaining proper alignment and good lubrication at all times. Some factors that can cause excessive bearing noise and heat are:

1. Incorrect alignment of couplings.
2. Excessive or wrong direction of thrust.
3. Improper lubrication.

## Bearing Lubricants - Grease

Prior to shipment, bearings are lubricated with the proper amount and grade of grease to provide satisfactory service under normal operation and conditions. See the lubrication plate mounted on the motor for regreasing intervals and recommended type of grease. It is good practice, however, to check bearings of newly installed machines for proper lubrication.

## Maintenance

For best results, grease should be compounded of a polyurea type and a good grade of petroleum oil and stabilized against oxidation.

The frequency of relubricating bearings and the amount added each time depends on two factors - speed and service.

All grease lube bearing motors will have affixed a plate with lubricating instructions. The instructions on this plate should be followed to achieve optimum bearing life and to avoid consequential damage to rotating parts.

Relubricate with the type of grease specified on the lubrication plate mounted on the motor, or compatible grease. Mixing of non-compatible greases can cause bearing failure.

Relubricate bearings with the proper grade of grease as follows:

1. Stop the motor and lock out the switch.
2. Thoroughly clean the grease inlet fitting or plug. If the motor has a plug, remove plug and clean the inlet.

3. Remove the drain plug (and overflow plug, if so equipped) and clean out any hardened grease.
4. Slowly pump the correct amount of grease into the grease inlet, per the lubrication plate mounted on the motor. Replace inlet plug (and overflow plug, if so equipped).
5. Start motor and allow to run at least one (1) hour to expel any excess grease from the drain opening before re-installing the drain plug.
6. Stop the motor and lock out the switch.
7. Re-install the drain plug.
8. Put the motor back in operation.

### NOTE

If unit has been in operation for several years the old grease can harden. If this occurs remove bolts holding bottom inside end cap, raise end cap and wipe out hardened grease. Reassemble and add a small amount of fresh grease.

If machine is a totally-enclosed or weather-protected type disassembly of the lower bearing may be required to remove old grease. Also clean and refill inlet, overflow, and drain grease pipes.

### NOTE

Because the lower bearing is single shielded, the grease will not pass through the drain port unless the motor is run for some time.

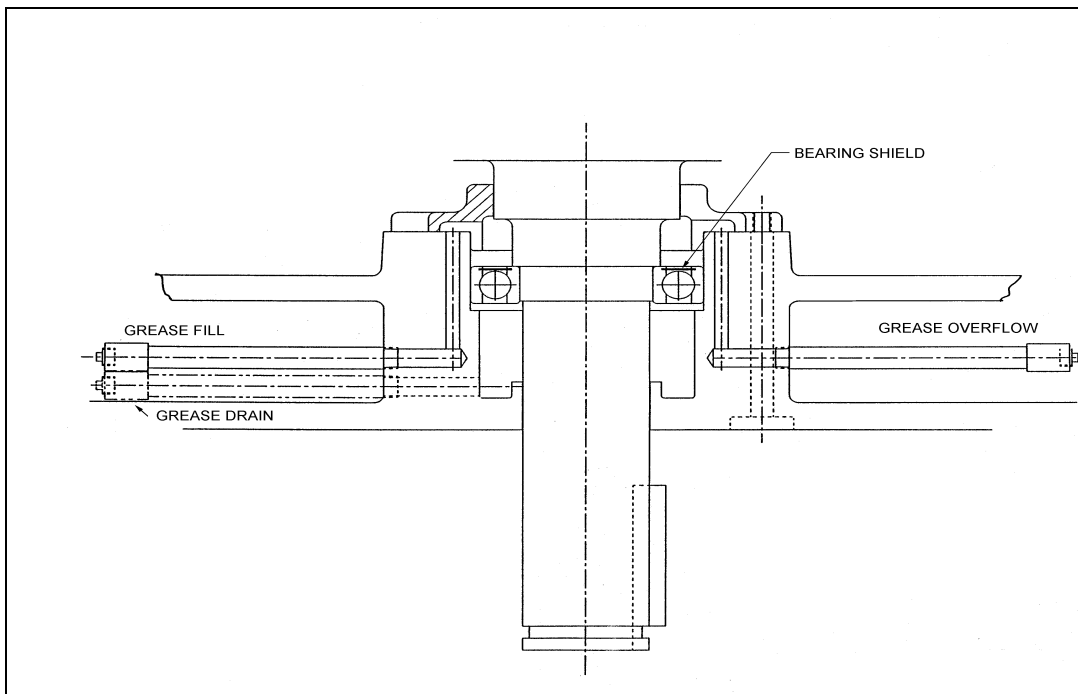


Figure 4

## Maintenance

### Bearing Lubricants - Oil

SSU at 100°F	Typical Oil ISO VG	Bearing Type
300-350	68	Antifriction Bearing
700-800	150	Spherical Roller
300-350	68	Kingsbury
300-350	68	Sleeve Guide Bearing

The preceding table lists "typical" lubricating oils only. See the lubrication plate mounted on the motor for the correct oil and relubrication frequency for your motor.

Before starting the machine, fill bearing chamber to the correct oil level as indicated on the motor outline drawing. Always fill through the pipe or plug at the side of the motor. Do not overfill, as the oil may then escape along the shaft and enter the unit. To change oil, drain the oil reservoir by removing the pipe plug. Clean and flush with solvent and refill with fresh filtered oil every three to twelve months, depending upon severity of service. Use a high grade turbine oil having a viscosity indicated on the motor lubrication data plate..

Always correct oil or water leaks and replace lost lubricant promptly.

### CAUTION

Improper oil level reading may cause improper lubrication of machine.

Avoid adding oil while unit is running.

### Bearing Replacement

Replacement bearings may be of a different manufacturer; but must be equal to the originals used on the motor. See nameplate on unit or outline drawing for bearing numbers. When ordering bearings specify as follows:

1. Identify numerals and manufacturer stamp on the bearing (number is also on motor nameplate).
2. Bearing Tolerance Class, i.e. (A.B.E.C.-1) Annular Bearing Engineer's Committee - Tolerance Class One.
3. Electric motor quality.
4. If deep groove bearings, specify the internal radial clearance, i.e. (A.F.B.M.A.-3) Antifriction Bearing Manufacturers Association, Clearance Class Three.

5. Angular contact type bearing replacements must be equivalent in angle of contact. 40% contact angle is standard.
6. The complete A.F.B.M.A. bearing number from the motor nameplate.

### Spherical Roller Bearings

External thrust transmitted from the driven unit is normally carried by the top bearing. If replacement is necessary, the new bearing must be the same type as the original (See Figure 5).

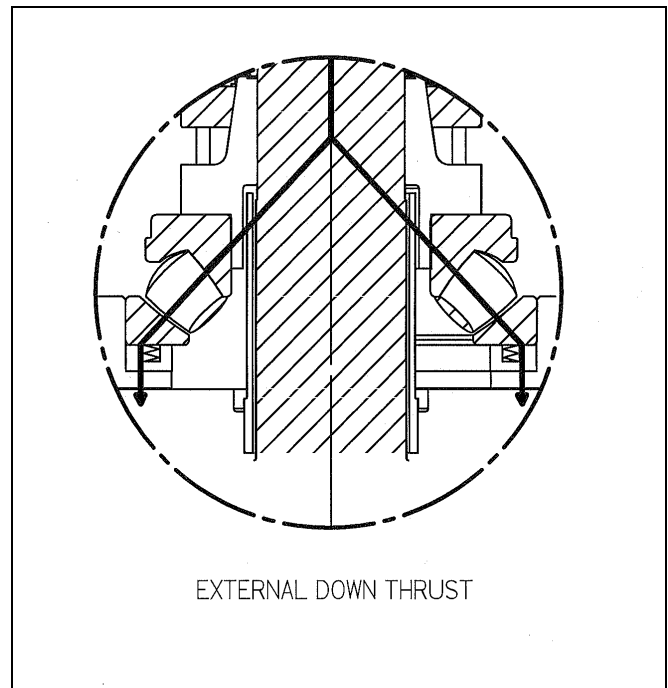


Figure 5

# Maintenance

## To Replace Bearings

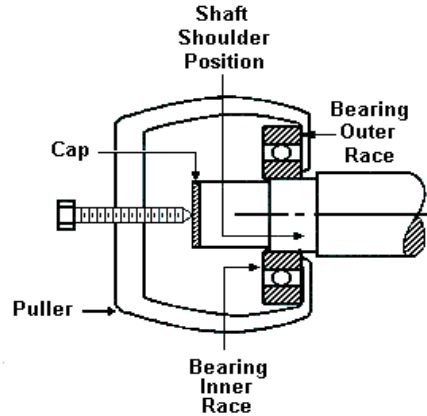
1. Remove bolts holding bearing housing to yoke.
2. Remove bolts holding end caps to housings.
3. Remove end housings. Observe location of bearing shims, and remove shims if necessary.
4. Remove snap ring or locknut in front of bearing.
5. Use bearing puller and exert force only on inner race to remove bearing from shaft.
6. Check shaft and housing diameter for proper size with micrometer. Clean or replace inner bearing cap, and slide cap onto shaft.
7. Heat the new bearing in an oven (200°F). While hot, slide the bearing onto shaft (high thrust units using angular contact bearings having a slip-fit on shaft and need not be heated). Make certain the inner race makes a firm even contact with shaft shoulder.
8. Let bearing cool - if grease lubricated bearing, pack caps per Grease Repacking Table with proper grade of grease. Pack all open bearings full between balls or rollers, but remove excess grease from the outside of the retainers. Packing of a cap or bearing housing cavity should be done with a grease gun.
9. Before reassembling the top end cap after installing new bearings, check the top edges of the inner and outer races with a dial indicator for squareness of mounting. To assure quiet operation and good bearing life, total indicator reading in each case must be within 0.001 in.
10. Indicate the outer race, attach the indicator body to the shaft, allow the button to bear on the outer race, and then rotate the shaft slowly by hand.
11. Indicate the inner race, attach the indicator body to the bearing bracket, allow the button to bear on the top edge of the inner race, and then rotate the shaft slowly by hand.
12. Reinstall bearing shims; if used; reassemble end caps and end housings.

### CAUTION

**Striking outer race exposes the race to brinelling**

Do not subject bearing to impact.

Protect the shaft end with a cap. If bearing is reusable, make certain the puller applies pressure against the bearing inner race only. If puller will not hook the bearing inner race, fabricate a split bushing and install it between the bearing and the puller hooks.



**Figure 6.** Removing Bearing with a Puller

Grease Repacking Table					
Type Bearing	Operating Position (Shaft)	Grease Quantity			
		Top End Cap		Bottom End Cap	
		Outer	Inner	Outer	Inner
Open Deep Groove	Vertical	2/3 Full	1/3 Full	1/3 Full	2/3 Full
Angular Contact	Vertical	2/3 Full	1/3 Full	1/3 Full	2/3 Full
Single Shielded	Vertical	Full	1/3 Full	1/3 Full	Full
Roller	Vertical	2/3 Full	1/3 Full	1/3 Full	2/3 Full

### End Play

Machines designed for applications involving primarily continuous heavy downthrust but having momentary upthrust are equipped with angular contact or spherical roller bearings. Spherical roller bearings may be preloaded with springs (See Figure 8). The end play is most often 0.005 to 0.008 in. but see the motor outline for the exact value for your motor. The bottom bearing takes the momentary upthrust and prevents reverse loading of the top bearings. End play is limited by shims when the thrust block is shrunk on the shaft or by tightening the locknut on the shaft above the bearing mounting sleeve. The thrust bearings on 2 pole motors are mounted directly on the shaft and do not require an adjustment by the shims or locknut.

## Maintenance

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### NOTE

Spherical roller thrust bearings are spring loaded and require a positive down thrust in addition to the rotor weight to prevent up thrust on lower guide bearing (See Figure 8).

Measure axial end play by jacking the shaft upward while measuring the shaft axial movement with a dial indicator attached to the upper bearing housing. For motors with spring loaded spherical roller bearings, the rotor end play will most often be downward. The downward rotor displacement can be measured by jacking the rotor downward using a hydraulic jack placed between the top of the shaft and a beam fastened to the upper bearing housing.

When jacking the rotor upward or downward CAUTION should be taken not to exert excessive force on the rotor as this may damage the end cap or add structural deflections to the axial end play measurement.

Adjust the end play using shims of proper design and thickness under the end cap of the lower bearing in motors with shrink fit thrust block design or by adjusting the thrust block travel by loosening the nut above the thrust block in the slip fit thrust block design. It is a good practice to check the end play after final adjustments.

## Kingsbury-type Bearings

### Thrust Bearing

Principle elements of the Kingsbury-type thrust bearing are the rotating thrust runner and the stationary pivotal thrust shoes (See Figure 7) The runner is the highly polished bottom surface of the thrust block and receives the thrust load through a massive nut above the thrust block threaded on the top end of the shaft. The pivotal thrust shoes are faced with tin-hard Babbitt and machined to form an accurate surface plate.

During operation, the thrust bearing revolves in an oil bath which covers the bearing. Each shoe is free to tilt slightly in any direction and sets itself by pivoting at a minute angle causing a wedge-shaped film of oil to form between the shoe and the runner. An end play of 0.012 – 0.017 inches is preset at the factory by shims between the thrust plate and the upper guide (upthrust) bearing.

### Upper Guide (Upthrust) Bearing

The upper guide (upthrust) bearing with a Kingsbury-type bearing is located just above the rotating thrust runner and is mounted in the stationary thrust plate. This bearing is babbitted on the inside diameter surface which bears on a ground and polished surface of the thrust block. This bearing is also babbitted on the bottom surface which bears on the ground and polished surface of the thrust block. This bearing locates the shaft in the radial direction and transfers upthrust from the shaft through the thrust block to the thrust plate. The thrust bearing and the lower half of the upper guide bearing are immersed in oil. The upper portion of the upper guide bearing receives oil through radial holes in the thrust block and discharges oil through radial and helical grooves in the guide bearing surface. The discharged oil is deflected through the oil cooler tubes by an oil baffle mounted on the bottom of the thrust plate.

### Lower Guide Bearing

The function of the lower guide bearing with a Kingsbury-type bearing is to provide radial location of the shaft with no thrust or end play limit. This bearing may be one of three types – grease-lubricated ball bearing, oil-lubricated ball bearing, or oil-lubricated sleeve bearing (See Figures 9, 10 and 11).

### Oil Operating Temperature

The normal temperature of the oil should be about 50°C to 70°C. The maximum safe temperature for most bearings is 95°C to 100°C at the babbitt.

### NOTE

Bearing temperature should not be judged by feeling the bearing with the hand; temperature should be measured by a thermometer or thermocouple placed as close to the babbitt as possible.

The thrust bearing is cooled by water passing through the heat exchanging copper tubes in the bearing oil bath. The rate of water flow is dependent on water temperature, volume of oil, and the total friction losses (load) of the bearing. Supply the necessary amount of water required to cool the bearing, but not to exceed the amount specified on the outline drawing.

## Maintenance

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To test the tubing for water-tightness empty the oil reservoir, and if possible raise water pressure 50% above normal and observe for a period of time for leaks. Another way is to leave oil in reservoir, pressurize tubes with air and look for bubbles.

If a hot bearing is discovered, or if the oil temperature climbs abnormally fast, the cause must be found and corrected immediately. The most common causes of hot bearings are:

1. Stoppage or reduction of cooling water.
2. Lack of oil (low oil level).
3. Contaminated (dirty) oil.
4. Misalignment (couplings or bearings).
5. Plugged oil passages.
6. Rough spots on shaft or bushings.
7. Improper internal clearances (radial or axial).

### Installation / Inspection of Kingsbury-type Thrust Bearings

#### Rotor Removal

1. Drain oil, unbolt and lift off the upper bearing housing cover.
2. Unbolt inner end cap in lower bearing housing.
3. Unbolt and remove outer end cap in lower bearing housing.
4. Lift upper bearing housing along with the rotor only far enough to reach the air deflector bolts by using the openings provided in the housing
5. Unbolt air deflector and remove, if necessary.
6. Lift upper bearing and rotor completely free of stator.

#### Thrust Bearing Removal

1. Support rotor weight at shaft extension with jack or block.
2. Unbolt and lift off upper bearing housing cover.
3. Unbolt thrust plate from bearing housing and lift off thrust plate and upper guide bearing.
4. Remove lock nut from shaft and pull thrust block from shaft.
5. Lift off the Kingsbury-type thrust bearing from bearing housing or adapter ring.

#### Cleaning

All parts of the bearing and housings must be thoroughly cleaned before assembly.

Remove anti-rust coatings with an approved solvent. Use lint-free rags or cloths for cleaning. Remove all burrs, bruises or nicks, and rust from bearing surfaces. Bruises or dents on shoe faces should be removed with a scraper.

Slight rusting of the runner face may be removed with a fine oil-stone. If deep rusting occurs, refinishing will be necessary.

### CAUTION

**Indentations on face of bearing runner may cause bearing failure or improper operation.**

Never use a coarse-grained stone, scraper, or a file on the runner face

**Assembly Notes:** Dowels, keys, and bolts must not bottom or bind. Each shoe should be free to tilt in any direction. Oil the runner face. Seal with Silicone RTV or equivalent, all housing joints previously sealed.

**Start Up:** Make sure oil is at the proper level (check sight gauge). After the bearing has been turned a few times under load, inspect the shoe faces - high spots should be removed by scraping.

### CAUTION

**Excessive heat may cause damage to insulation or lubrication.**

Allow time between starts to permit windings to cool.



### UPPER BEARING ARRANGEMENTS

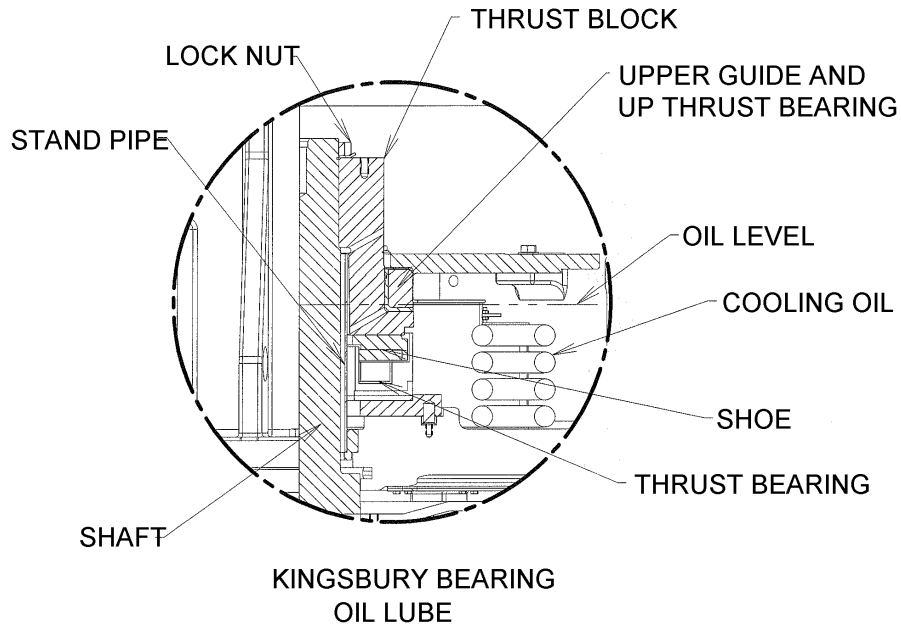


Figure 7

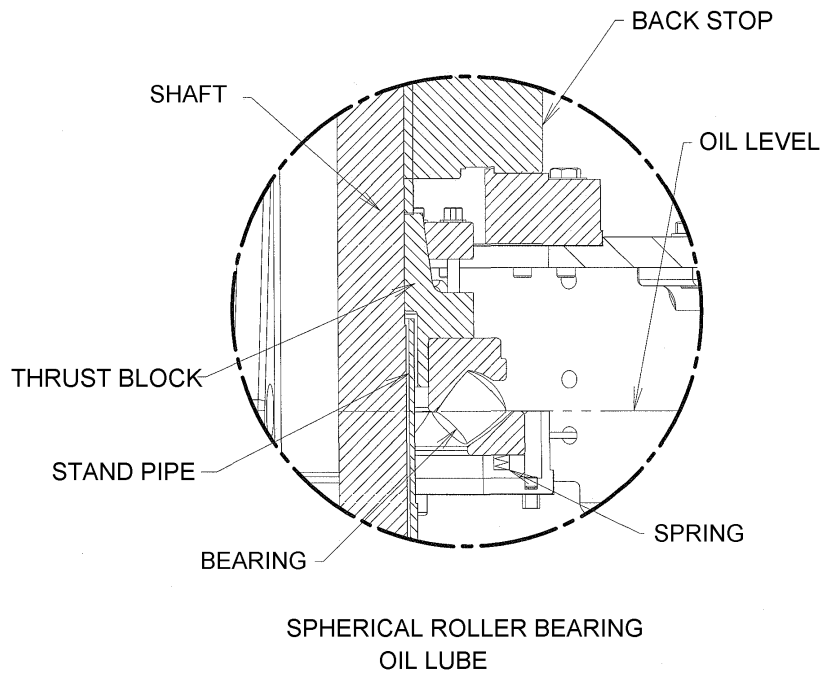
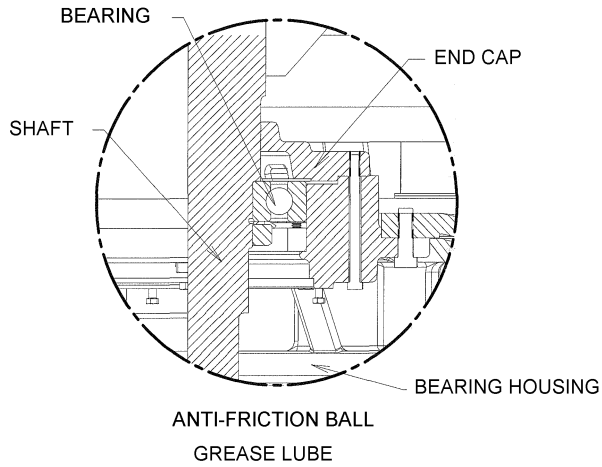
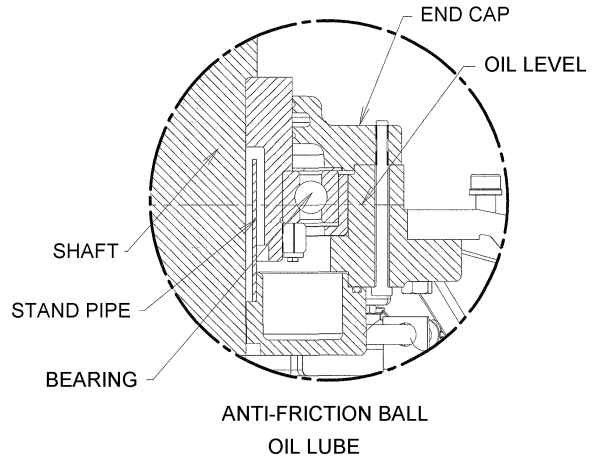


Figure 8

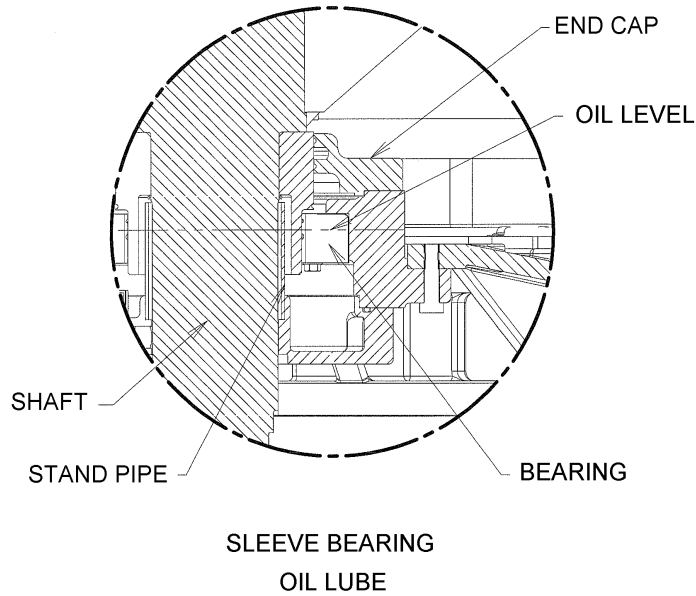
**LOWER BEARING ARRANGEMENTS**



**Figure 9**

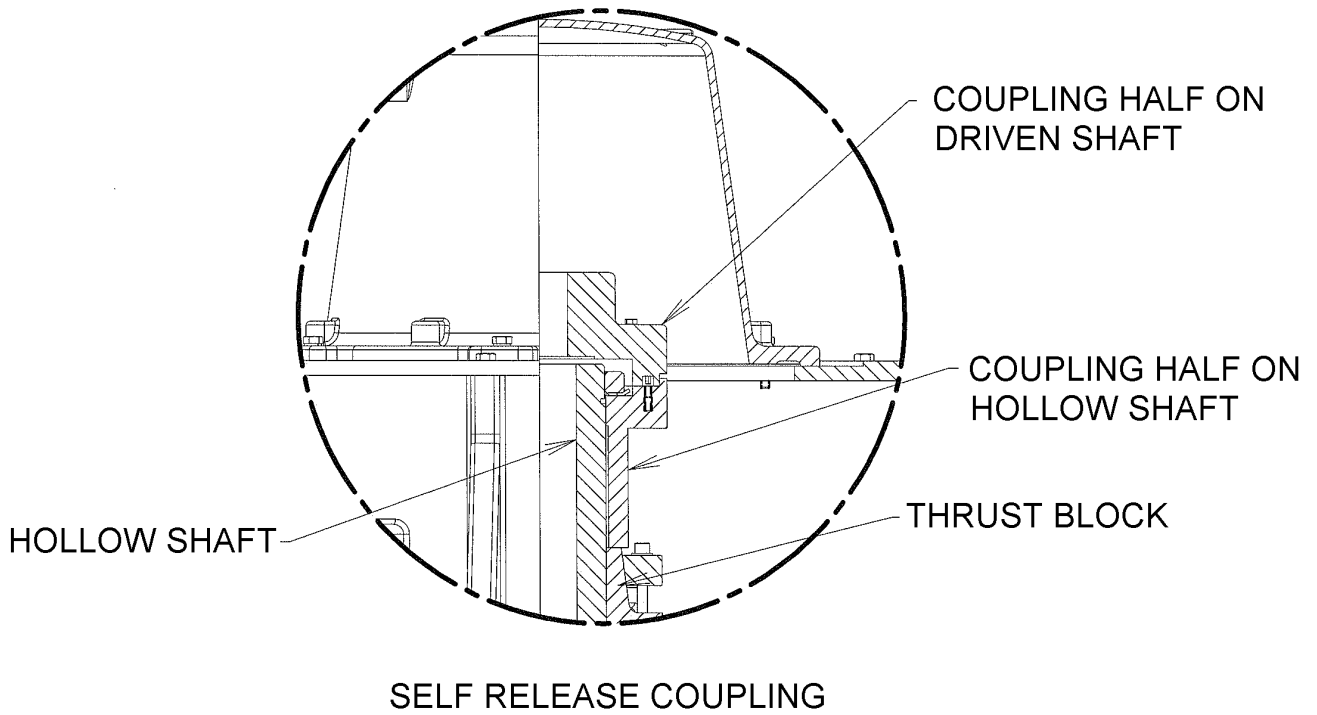


**Figure 10**



**Figure 11**

**Self Release Coupling Arrangement At Top Of Motor**



**Figure 12**

# Maintenance

## Shaft or Flange Face Runout

Because inspection of flange faces, eccentricity and shaft runout is rigorously enforced at the factory, vibrations caused by this alignment problem are rare and usually if shaft runout, face runout, or eccentricity are excessive; the equipment has been mistreated in some way.

The method for checking shaft and flange faces is as follows:

### NOTE

On antifriction bearings, it is recommended that the test be made with the shaft vertical to minimize the effect of bearing clearances.

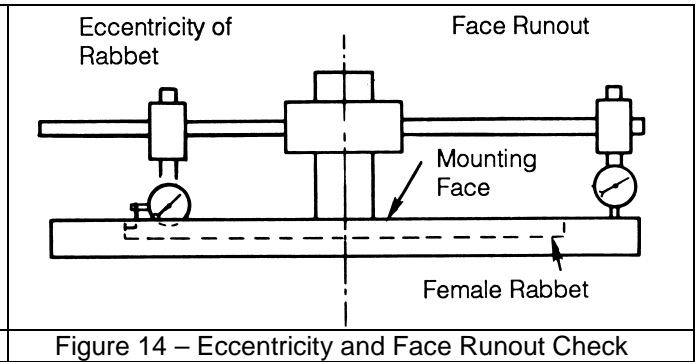
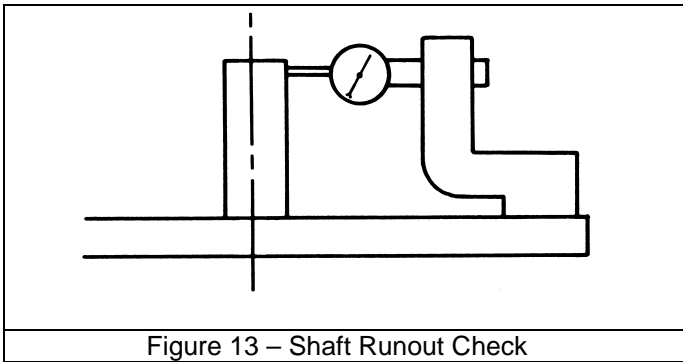
## Shaft Runout

The shaft runout is measured with the indicator stationary with respect to the machine and with its point at the end of the finished surface of the shaft. See Figure 13 for typical fixture.

Read the maximum and minimum values on the indicator as the shaft is rotated slowly through 360 degrees. The difference between the readings shall not exceed 0.003 inches.

## Eccentricity and Face Runout of Mounting Surfaces

The eccentricity and face runout of the mounting surfaces is measured with indicators mounted on the shaft extension. The point of the eccentricity indicator shall be at approximately the middle of the rabbet surface, and the point of the face runout indicator shall be approximately the outer diameter of the mounting face. See Figure 14 for typical fixture. Read the maximum and minimum values on the indicators as the shaft is rotated slowly through 360 degrees. The difference between the readings shall not exceed 0.007 inches.



## Spare Parts

### Identification

All units have an identification nameplate affixed to the frame (Figure 15). All the necessary information pertaining to the motor can be found on this plate including;

1. Serial Number
2. Type and Frame Size
3. Horsepower and Speed
4. Bearing Designations

It is important when ordering spare parts or discussing service to have as much data from this plate as possible.

### Parts Identification

Figures 16 through 20, are of a standard design. Your motor may differ slightly.

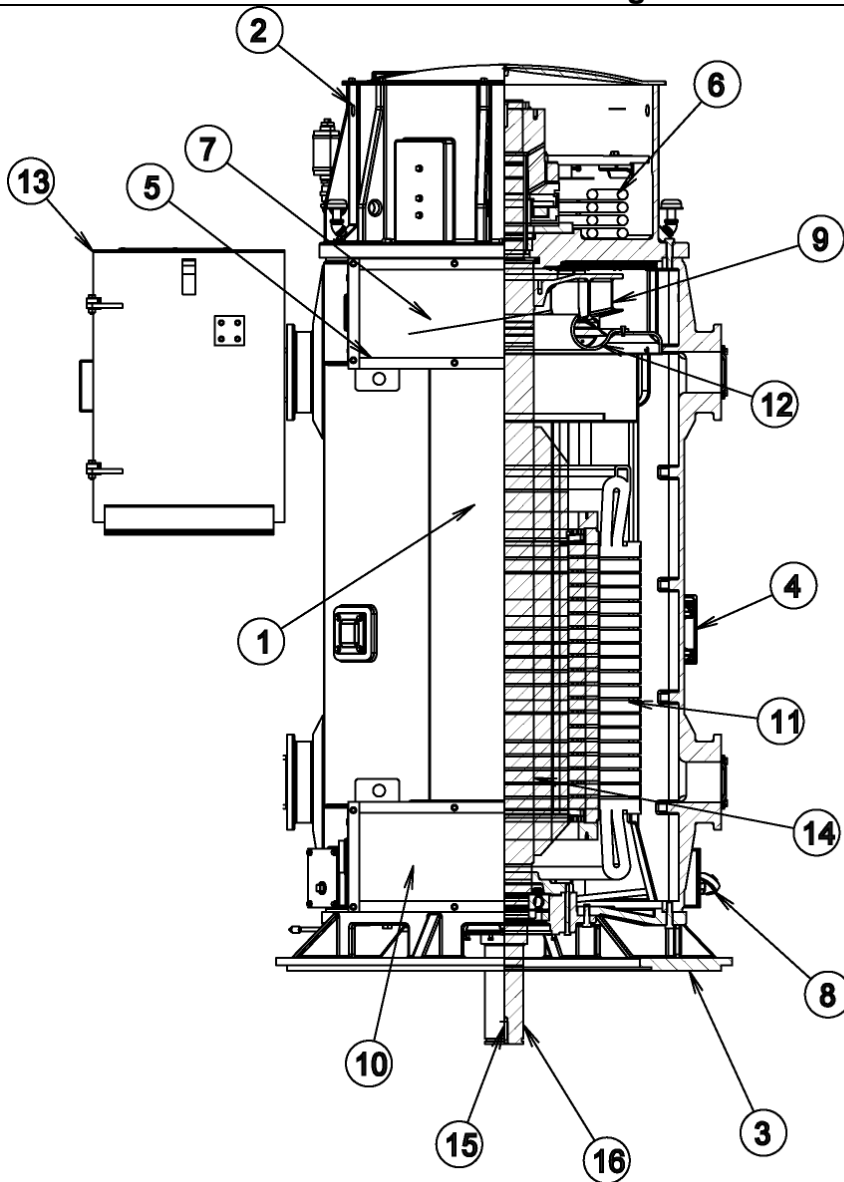
A recommended list of spare parts is available upon request.

<b>SIEMENS</b>							
Induction Motor							
SER. NO.		TYPE			DATE OF MFG.		
H.P.		FRAME			SERVICE FACTOR		
AMPS		VOLTS			CLASS INSUL.		
R.P.M.		HERTZ			NEMA NOM. EFF.		
DUTY		°C PHASE 3			KVA CODE		NEMA DESIGN
SH. END BRG.		END OPP. BRG.			OPERATING INSTRUCTIONS		M3115
ROTATION	FACING	DRIVE END	WITH	PHASE	SEQUENCE A-B-C		
CCW A-T	B-T2	C-T	CW	A-T B-T2	C-T		
Siemens Energy & Automation, Inc. Norwood Ohio Made in U.S.A.							

Figure 15. Identification Plate

# Spare Parts

Figure 16



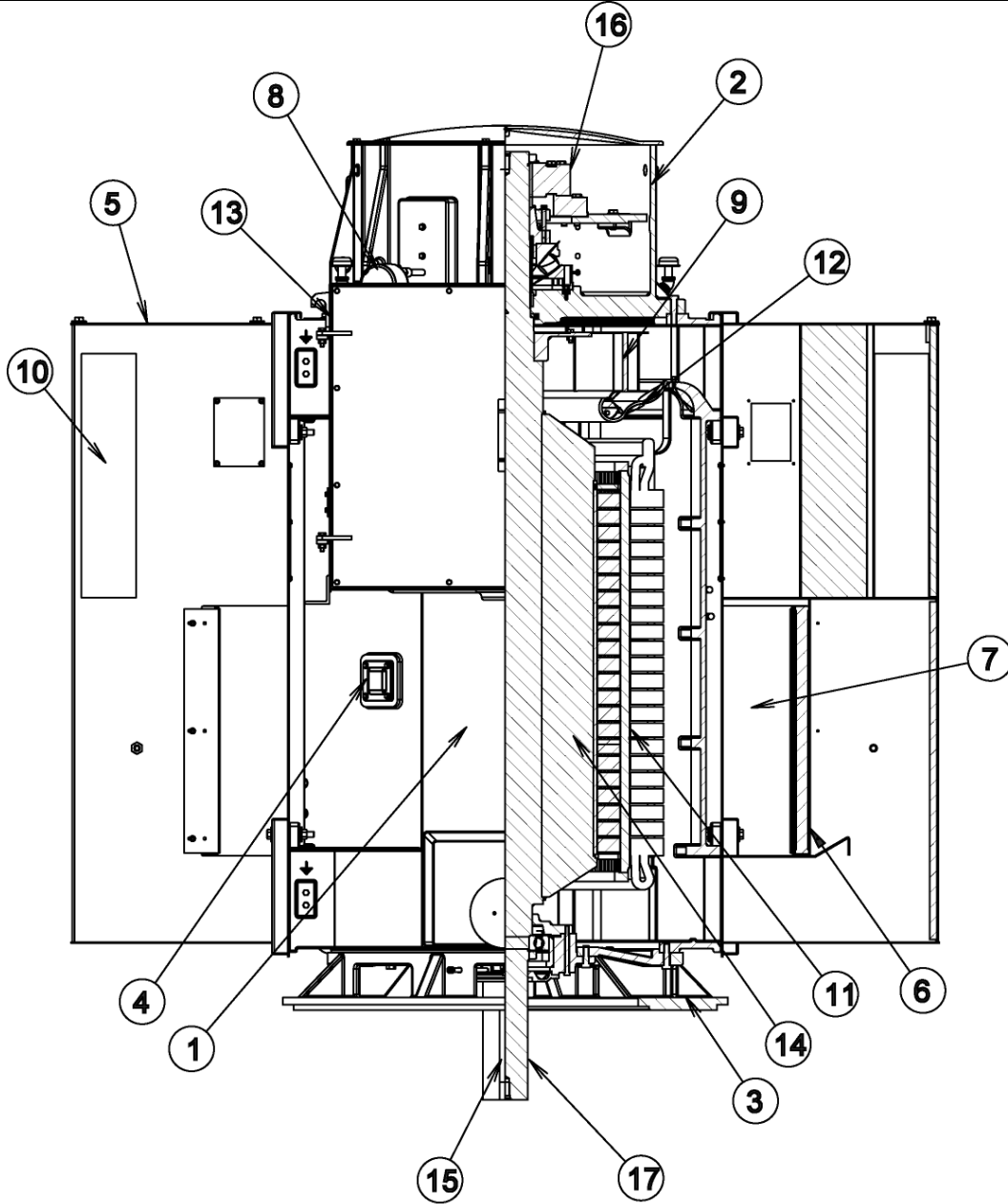
SEQ #	Title
1	YOKE
2	HSG ASM,BRG,UPR
3	HSG ASM,BRG,LWR
4	BOX ASM,ACC
5	SCREEN ASM
6	COOLER ASM
7	AIR EXHAUST
8	RTD ASM ,BRG
9	ROTOR FAN ASM
10	AIR INLET
11	STATOR ASM
12	DEFLECTOR,AIR
13	BOX ASM FAB
14	ROTOR ASM
15	KEY
16	SHAFT EXT

**TYPICAL VIEW OF 680, 800, AND 1120 FRAME WPI**

**LOWER BEARING: ANTI-FRICTION BALL  
UPPER BEARING: KINGSBURY THRUST  
OPTION: NONE**

# Spare Parts

Figure 17



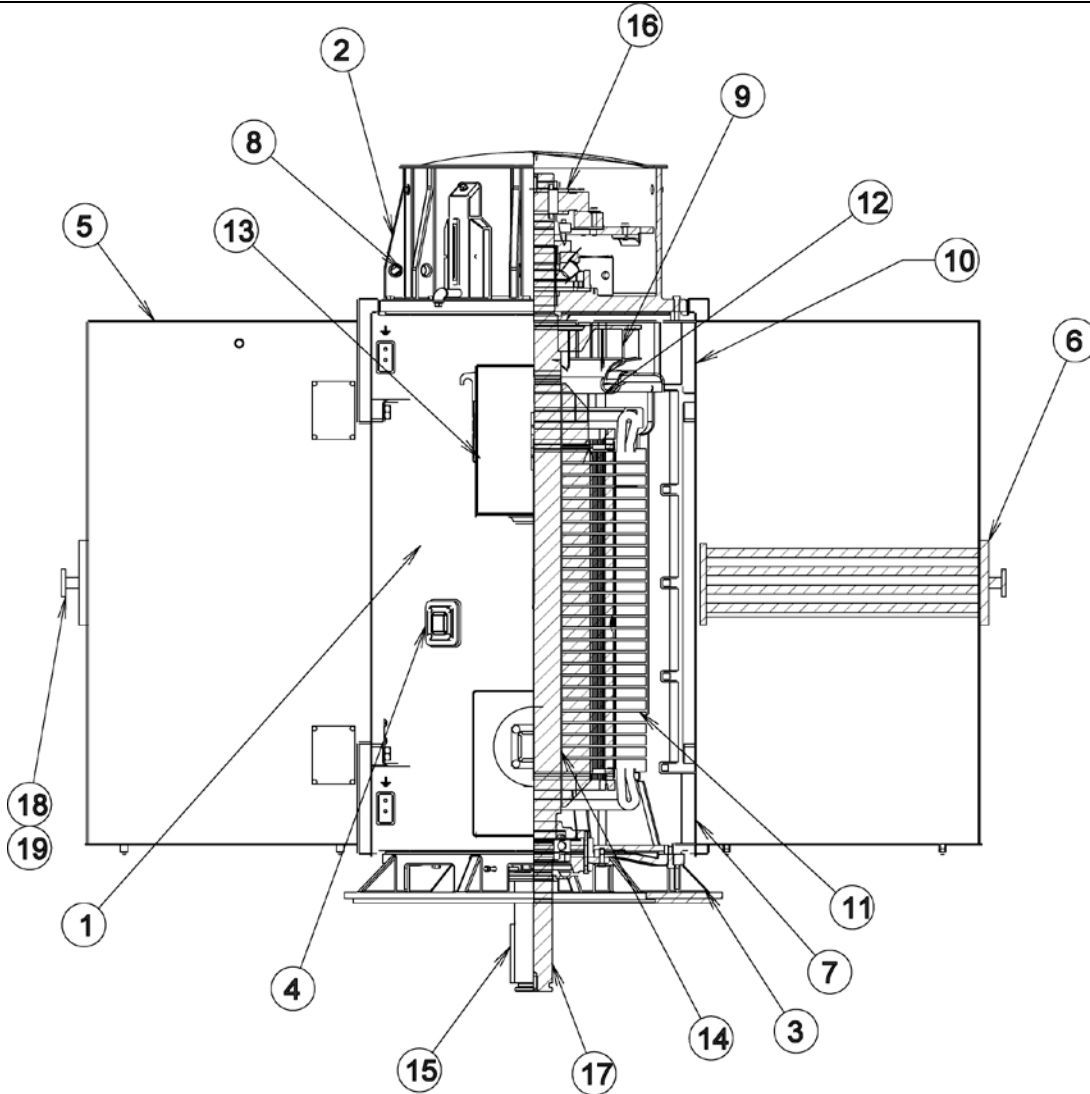
SEQ #	Title
1	YOKE
2	HSG ASM,BRG,UPR
3	HSG ASM,BRG,LWR
4	PROVISIONS FOR BOX ASM,ACC
5	ENCLOSURE ASM
6	FILTER
7	AIR INLET
8	RTD ASM ,BRG
9	ROTOR FAN ASM
10	AIR EXHAUST
11	STATOR ASM
12	DEFLECTOR,AIR
13	BOX ASM FAB
14	ROTOR ASM
15	KEY
16	BACK STOP
17	SHAFT EXT

**TYPICAL VIEW OF 680, 800, AND 1120 FRAME WP11**

**LOWER BEARING: ANTI-FRICTION BALL  
UPPER BEARING: SPHERICAL ROLLER BEARING  
OPTION: BACK STOP**

# Spare Parts

Figure 18



SEQ #	Title
1	YOKE
2	HSG ASM,BRG,UPR
3	HSG ASM,BRG,LWR
4	PROVISIONS FOR BOX ASM,ACC
5	ENCLOSURE ASM
6	HEAT EXCHG ASM
7	AIR INLET
8	RTD ASM ,BRG
9	ROTOR FAN ASM
10	AIR EXHAUST
11	STATOR ASM
12	DEFLECTOR,AIR
13	BOX ASM FAB
14	ROTOR ASM
15	KEY
16	BACK STOP
17	SHAFT EXT
18	WATER IN
19	WATER OUT

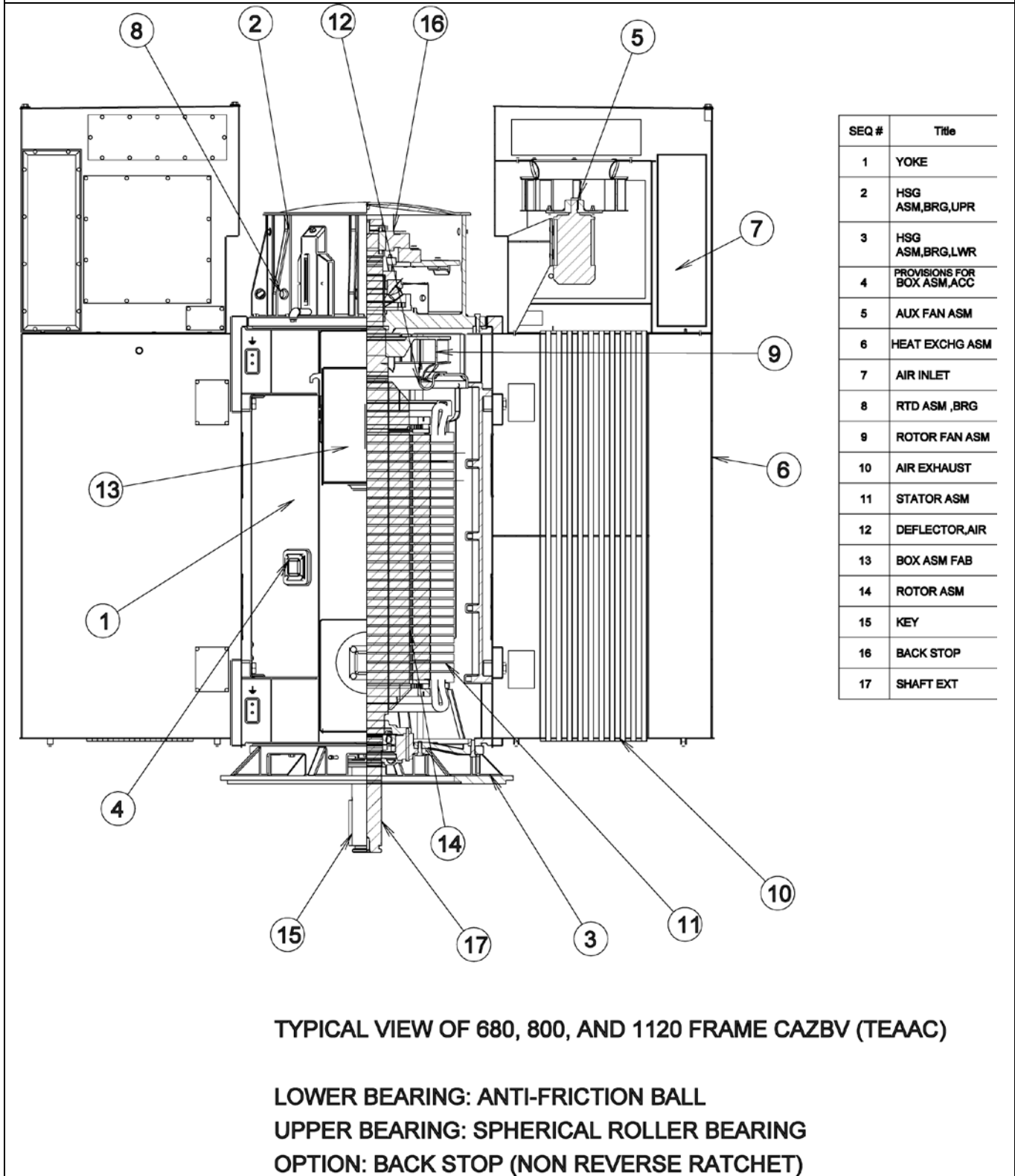
TYPICAL VIEW OF 680, 800, AND 1120 FRAME CGGS (TEWAC)

LOWER BEARING: ANTI-FRICTION BALL  
 UPPER BEARING: SPHERICAL ROLLER BEARING  
 OPTION: BACK STOP (NON REVERSE RATCHET)



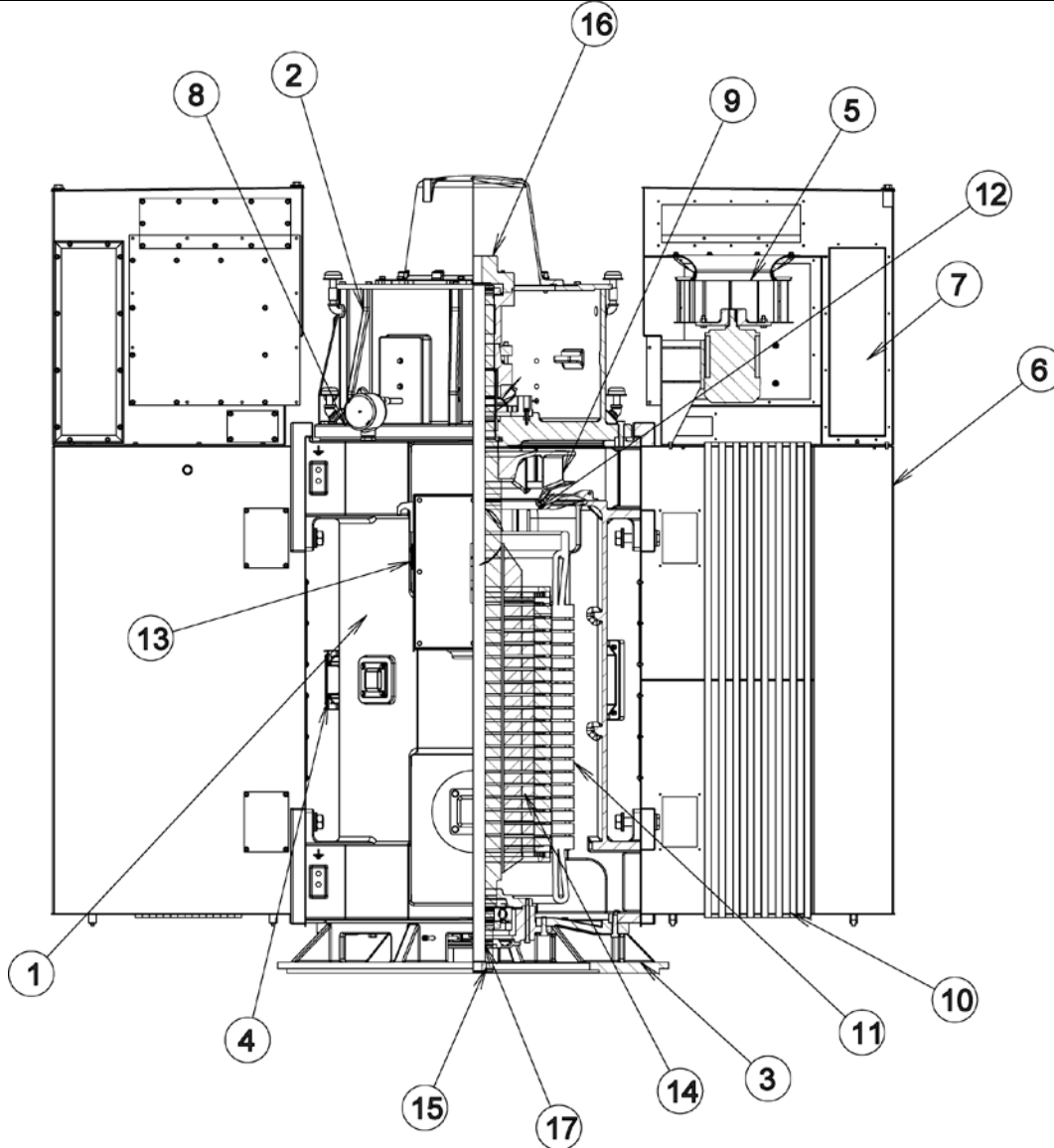
# Spare Parts

Figure 19



# Spare Parts

Figure 20



SEQ #	Title
1	YOKE
2	HSG ASM,BRG,UPR
3	HSG ASM,BRG,LWR
4	BOX ASM,ACC
5	AUX FAN ASM
6	ENCLOSURE ASM
7	AIR INLET
8	RTD ASM ,BRG
9	ROTOR FAN ASM
10	AIR EXHAUST
11	STATOR ASM
12	DEFLECTOR,AIR
13	BOX ASM FAB
14	ROTOR ASM
15	BUSHING
16	COUPLING
17	HOLLOW SHAFT

TYPICAL VIEW OF 680, 800, AND 1120 FRAME HOLLOW SHAFT (TEAAC)

LOWER BEARING: ANTI-FRICTION BALL

UPPER BEARING: SPHERICAL ROLLER BEARING

OPTION: SELF RELEASE COUPLING

## Spare Parts

---

### Vertical Solid & Hollow Shaft Nomenclature

Angular Contact Bearing - An antifriction thrust bearing capable of taking high thrust in one axial direction only.

DT Bearing - Two (2) angular contact bearings mounted together to take extra high thrust in one axial direction only.

DB Bearings - Two (2) angular contact bearings mounted together such that each one will take high thrust in opposite directions.

End Play - The axial movement of the shaft.

Four Point Bearing - An angular contact bearing which will take thrust in both directions.

Guide Bearing - The bearing mounted in the housing opposite the thrust bearing. Most are deep groove antifriction bearings.

Thrust block or Bearing Mounting Sleeve - The member keyed to the motor shaft on which the inner race of the thrust bearing is mounted.

Continuous Down Thrust - The thrust developed by the weight of the pump shaft and hydraulic unbalance. This is the thrust value to which the motor thrust bearings are sized.

Maximum Down Thrust - the momentary down thrust that can be developed during shut down of the pump.

Momentary Upthrust - This thrust may develop in some shallow settings during startup. Momentary upthrust is mostly carried by the Guide Bearing in most vertical motors.

Non-Reverse Ratchet or Backstop - A device that permits motor to turn in only one direction. It is used mostly in conjunction with Rigid Couplings to prevent turbine pump backspin caused by the water column receding when the motor is de-energized.

### Applicable to Hollow Shaft Only

Rigid Coupling or Bolted Coupling - The member to which the pump shaft is keyed. Coupling is bolted to the Thrust Block so that during startup the Guide Bearing will carry the momentary upthrust.

Self-Release Coupling - Similar to the Rigid Coupling except that it will release from the Thrust Block in the event an accidental reversal begins to unscrew the pump shaft. After being disengaged, the motor is free to revolve without damage to the motor or pump.

Coupling Bore or Clutch Bore - That bore or hole in the coupling in which the pump shaft fits.

Pump Adjusting Nut - The nut mounted on the pump shaft above the coupling used to raise and lower the pump shaft to set the impeller to its proper position. After the impeller is set, the nut is bolted to the coupling. The nut is supplied by the pump company.

Hold Down Bolts for Self-Release Coupling - Bolts used to hold the coupling in place during shipment. They must be removed during installation.

Locking Bar - A bar used to prevent the motor shaft from turning while the pump adjusting nut is being turned.

Pump Shaft Guide Bushing - A bronze bushing pressed in a counterbored hole in the bottom of the hollow shaft. This bushing supports the pump shaft from lateral movement. Supplied only upon request.

**NOTE:** If the lower bearing is insulated this bushing must also be insulated.

# Motor Service Record

Serial No _____	Horsepower _____	Type _____
Speed _____	Volts _____	Amperes _____
Insulation Class _____	Temperature Rise _____ °C	Frame Size _____
Owner Order No _____	Item No _____	Date Of Manufacture _____

MACHINE TYPE	BEARINGS	SHAFT EXTENSION
<input type="checkbox"/> Horizontal <input type="checkbox"/> Vertical  <input type="checkbox"/> Open Drip-Proof <input type="checkbox"/> Totally-Enclosed <input type="checkbox"/> Explosion Proof <input type="checkbox"/> Weather Protected	<input type="checkbox"/> Ball <input type="checkbox"/> Roller <input type="checkbox"/> Sleeve  Size: Drive End (DE) _____ Opposite Drive End (ODE) _____ Lubrication _____	Length _____ Diameter _____ Internal Thread _____ External Thread _____ Keyway _____

Date Installed	Location	Application

Date Repaired or Replaced	Repairs or Parts Replaced <sup>(1)</sup>	Fault	Repaired by	Total Cost

(1) Name of Part	No. Per Motor	Siemens No.	Date	Qty Repl.	Cost	Date	Qty Repl.	Cost
Rotor								
Stator Coils								
Bearing, DE								
Bearing, ODE								
Other								

INSPECTION									
Date Checked									
Bearings									
Lubrication									
Excess Heat									
Excess Noise									
Speed									
Voltage									
Amps									
Insulation									
Clean									
Alignment									
Vibration									
Temperature									



# SIEMENS

Siemens Industry, Inc.

Norwood Motor Plant  
4620 Forest Avenue  
Norwood, OH 45212-3396  
(513) 841-3100