



# MORRISON

PUMP COMPANY

**A BUSINESS UNIT OF PATTERSON**

...delivering solutions

## **Installation, Operation and Maintenance Manual** **Mixed Flow Pumps & Pump Drivers**

Client name:	INDUSTRIAL PROCESS SYSTEMS WICHITA, KANSAS WASTEWATER TREATMENT PLANT
Project:	NO. 2, RAS PUMPS
MPC Project #:	J56178
Pump Model(s):	VOM-16-13
Pump Serial Number:	3358-17-0420, 3358-17-0421
Pump Delivery Date:	October 2017



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**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**



**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**


**Electric Motor**

**Pump Coating**


**Warranty**



**PUMP NAMEPLATE:**

 <b>MORRISON</b> PUMP COMPANY			
<b>Design Flow:</b>	3,500 GPM	<b>Model:</b>	VOM-16-13
<b>Design Head:</b>	13.5 FT. TDH	<b>Serial Number:</b>	3358-17-0420
<b>Design Speed:</b>	895 RPM	<b>Date Manufactured:</b>	SEPTEMBER 2017
<b>Pump Weight:</b>	2,050 LBS.	<b>Material:</b>	STANDARD
Morrison Pump Company P.O. Box 81-4414 Hollywood, Florida, USA, 33081		www.morrisonpump.com Telephone (954) 922-5880 Facsimile (954) 922-7729	

**PUMP NAMEPLATE:**

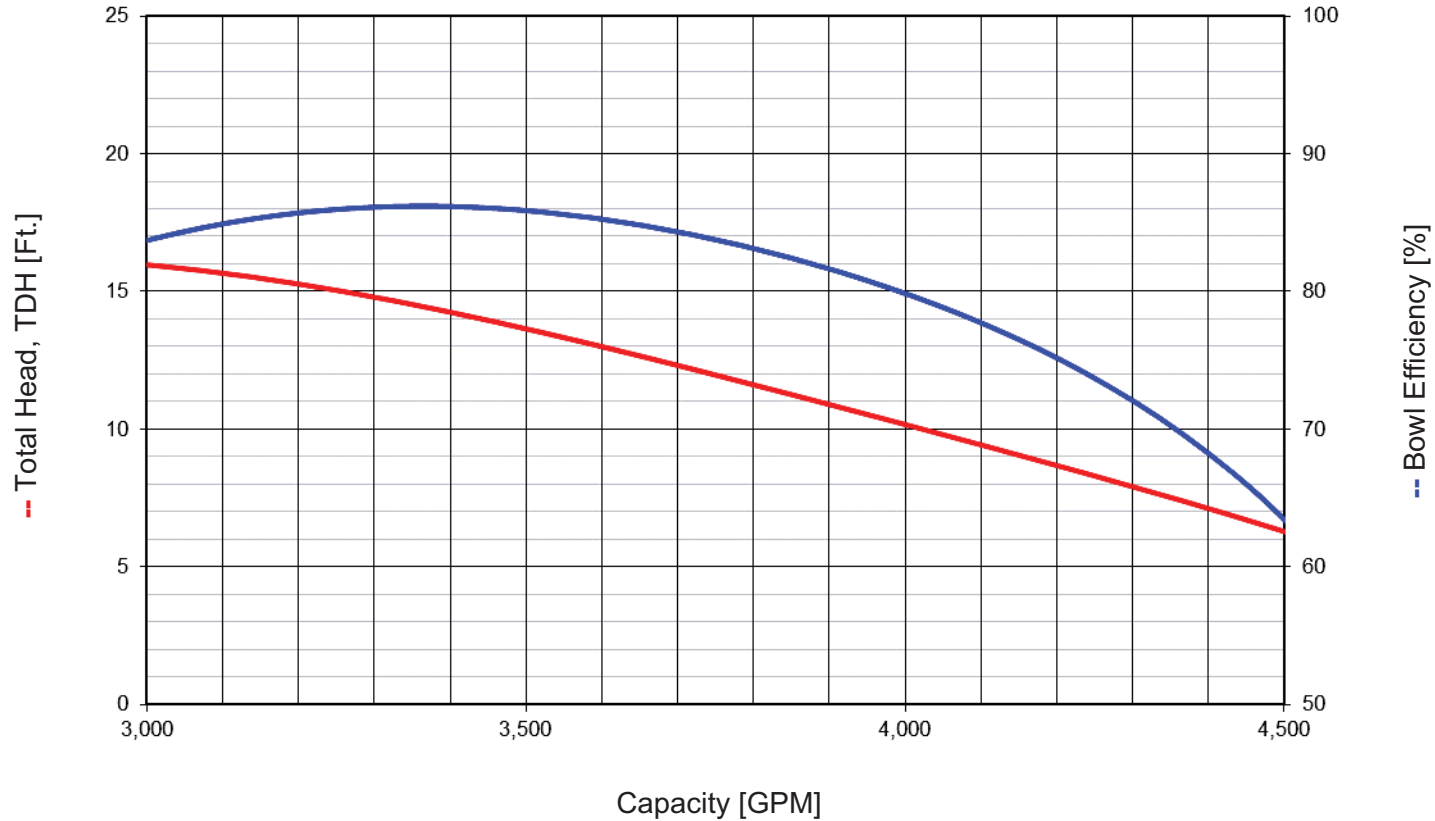
 <b>MORRISON</b> PUMP COMPANY			
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# Pump Performance

Mixed Flow Impeller, One-Stage, High-Efficiency

Project No.: MPC 56178A  
Project Name: IPS – Wichita WWTP No. 2  
Date: 19-September-2016

**Morrison Pump Model VPM-16-13**  
Design Condition = 3,500 GPM @ 13.5 Ft. TDH



Morrison Pump Bowl No.: MP-13-MD  
Impeller Diameter: 12.13 inches  
Shaft Speed: 895 RPM



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The curve provided is proprietary and for general reference  
use only. Pump performance is based on open sump testing  
on clean water with a specific gravity 1.00 at 76°F.

**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**





# MORRISON

PUMP COMPANY

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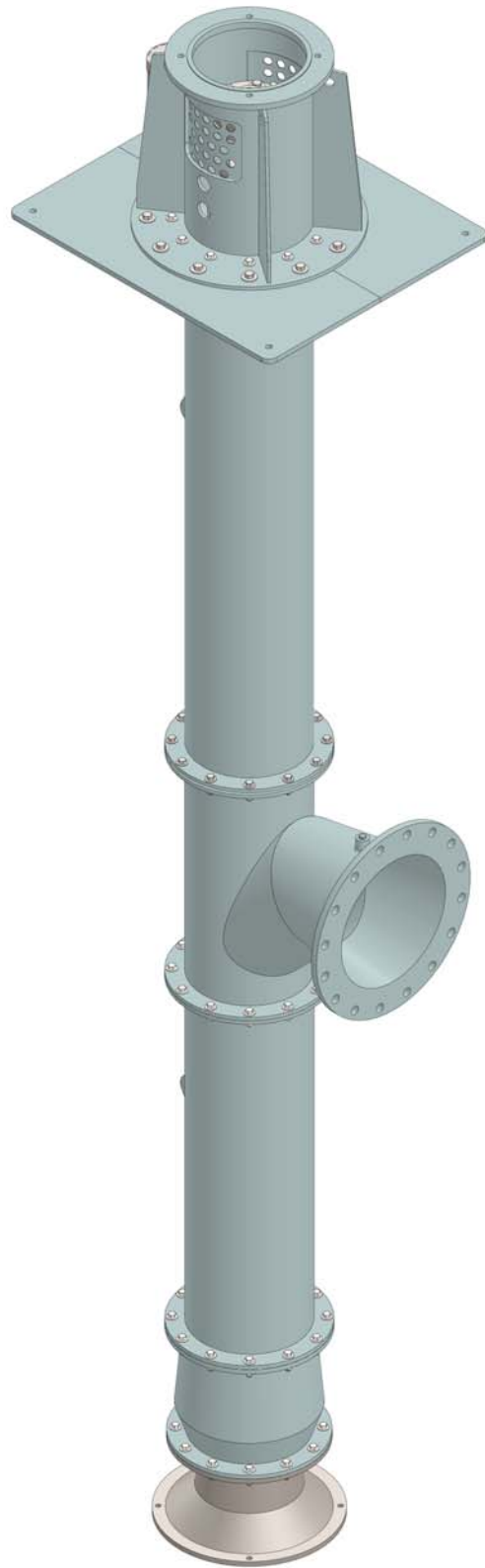
**INSTALLATION, OPERATION & MAINTENANCE (IOM) INSTRUCTIONS**

VERTICAL OIL-LUBRICATED MIXED FLOW PUMP

**MORRISON PROJECT NUMBER:**  
**PUMP SERIAL NUMBER(S):**

J56178  
3358-17-0420  
3358-17-0421

**Morrison Pump Company**  
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**Pump General View**

# Morrison Pump Company - IOM Instructions

Morrison Project Number:J56178

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## BOLT TORQUE CHART PUMP MAINTENANCE LOG FORM NOTES

## **1.0 INTRODUCTION**

### **1.1a GENERAL INFORMATION**

In order to keep and maintain your Morrison Pump operating at its optimum efficiency please refer to instructions in this manual for all installation, maintenance and operating procedures. The owner/operator of this equipment must have read, reviewed, and understood all the instructions, drawings, and technical data prior to handling, installing, or operating the pumping equipment. It is the responsibility of the owner and/or operator of the pump equipment to understand the pump equipment and its operating limits. For additional information and assistance regarding your pump installation, operation and maintenance please contact Morrison Pump Company's Engineering Department. Deviation from instructions in this manual could adversely effect the operation of your Morrison Pump and may void Warranty.

Your Morrison Pump has been designed and manufactured to offer maximum resistance against wear and corrosion. Your pump has been manufactured with lifting eyes or specified lifting locations. Any attempt to lift move or handle pump should be done utilizing these lifting points or locations. Under no conditions should the pump be handled by the propeller pump shaft, head shaft or bearing retainers. Any and all damage to the pump coating should be corrected immediately. Much care has been taken in applying a corrosion-inhibiting paint barrier. Uncorrected damages to this coating shall greatly reduce your pumps resistance to corrosion.

All procedures should be performed utilizing standard safety procedures and practices, and performed by qualified personnel.

## **1.2a SAFETY PRECAUTIONS**

Below is an overview of precautions and warnings found in this pump manual. It is important for the safety of all technicians, installers and field personnel to be mindful of industry standard safety practices and all handling and equipment operations be supervised by experienced and trained personnel. Only qualified personnel should handle, operate and/or maintain pumping equipment.

- a. Pumps have been manufactured with multiple lifting eyes. Only an experienced field technician in the lifting of heavy machinery should be authorized to handle or move pumps and/or gears/motors.
- b. All electrical connections and operations should be performed by a certified and experienced electrician.
- c. Prior to any and all pump and/or motor inspections and/or adjustments pump driver should be shut down and power supplies disconnected.
- d. All safety cover/guards should be installed and properly secured prior to the operation of pumps and/or drivers.

## **2.0 PUMP HANDLING & INSTALLATION**

Please review Section 1.0 Introduction. Please follow procedures in Section 2.0 for proper handling and installation of your Morrison Pump.

### **2.1a PRELIMINARY CHECKS**

Immediately after receipt of pumping equipment, verification must be performed for completeness and equipment must be inspected for any signs of damage. Verify equipment delivered and offloaded against shipping documents and/or packing lists. Every Morrison Pump contains a nameplate indicating pump serial number. Incomplete shipments or damage from transportation must be reported in writing immediately to Morrison Pump Company or claims/deficiencies may not be covered.

Prior to pump handling or installation, perform the following:

- a. Please review the supplied Morrison Pump Drawings and verify that pump dimensions correspond with pump station layout and dimensions.
- b. Carefully inspect pump for visual damage. Damage to pump's protective coating should be corrected/repaired as soon as possible and prior to pump installation.
- c. Carefully examine pump sump and sump inlet. Inlet and sump should be free of obstructions to pump and water flow. Obstructions could cause damage to pump or adversely affect pump performance.
- d. Please verify equipment weight (see nameplates, drawings, etc.) prior to handling/lifting of pump equipment to ensure that proper lifting equipment, devices and personnel are being utilized to properly and safely handle the pump equipment.

## 2.2a PLACEMENT OF PUMP

Variations in installations exist; therefore, these procedures are to be used as general guidelines for the handling and placement of your Morrison Pump. Please understand your specific installation, review all drawings, and perform per the following procedural guidelines:

- a. If Pump baseplate is a split-type and is not attached to the pump, connect baseplate to pump body using appropriate fasteners. See Morrison Pump drawings provided.
- b. Utilizing lifting points, carefully raise pump and lower to designated location. Pump support points should be clean and free of debris. Obstructions may effect pumps final alignment. Pump must be handled with care as to not damage hardware or cause injury to personnel.
- c. Verify that pump discharge and discharge pipe mate properly. If both are flanged, ensure flanges properly mate/seat to each other and bolt holes are aligned. If pump discharge is a plain end (nonflanged) for harnessed coupling connections, ensure the pump and discharge pipe align to tolerances as per harnessed coupling manufacturer's guidelines. In case of mis-alignment, pipe or pump must be adjusted until pipe ends are within indicated alignment tolerances (without the use of external force).
- d. Verify the pump baseplate (support plate) is seated firmly to pump station structure (sole plate, beam supports, concrete pad, etc.). If plates are not in firm contact, adjustments must be made or shims must be used to ensure adequate support, while maintaining pump discharge alignment.
- e. Prior to anchoring the pump, confirm its vertical position (pump gussets should be used as reference planes). The pumps driver pedestal (motor stand) should be vertical in both planes. If motor stand is not vertical, shim pump support plate until unit is vertical in both planes.
- f. Install pump discharge flange fasteners, if applicable. See pump drawings provided.
- g. Properly anchor pump to pumps station structure/foundation. Pump must be anchored at all anchor locations (open bolt holes) on pump baseplate. Anchor bolts must be of appropriate size, strength and length to properly secure the pump to the pump station/foundation. Grout under base as required. See applicable drawings.

## 2.3a PLACEMENT OF VHS GEAR

Variations in installations exist; therefore, these procedures are to be used as general guidelines for the handling and placement of the Vertical Holloshaft Right Angle Gear to the Morrison Pump. Please review and reference the Gear Manufacturer's O&M Manual and Drawings prior to any handling or installation of the gear unit. Please understand your specific installation, review all drawings, and perform per the following procedural guidelines:

- a. Locate pump head shaft and coupling. Carefully inspect head shaft and coupling threads. All threads should be clean and free from damages. Coupling has been factory installed. Please reference Pump Drawings.
- b. Inspect factory installed head shaft coupling for damage or irregularities.
- c. Locate right angle gear. Carefully inspect driver for any visual damage. Turn gear shaft and confirm that it turns freely and smoothly (use caution keyway edges are sharp). Locate head shaft nut, inspect threads. Nut threads should be clean and free from damages. Headshaft and adjusting nut may need to be cleaned with solvent.
- d. Carefully remove driver head shaft cover and clutch mechanism if necessary (as per manufacturer's instructions).
- e. Carefully raise gear (use gear lifting locations) and place on the pump gear/motor stand while carefully ensuring driver to gear/motor stand registers are aligned. The driver should sit securely on the motor stand. Slowly rotate driver until driver bolt holes and motor stand bolt holes are aligned and driver is facing in the required direction. Utilizing specified bolts, fasten driver to motor stand and tighten bolts.
- f. Locate and lower head shaft through driver hollow shaft. Align head shaft and coupling threads and tighten.
- g. Reinstall driver clutch (as per manufacturer's instructions).
- h. Place head key and head shaft nut (impeller adjustment nut) on head shaft. Engage impeller adjustment nut until it comes in contact with driver clutch. See Pump Drawings for further detail.

## **2.4b PUMP IMPELLER ADJUSTMENTS – VHS with mechanical seal**

Prior to initial pump operation, the pump impeller position and mechanical seal setting must be adjusted. Reference the HS gear or motor drawings. The following steps shall provide for correct impeller and lower mechanical seal setting. Any attempt to operate pump prior to impeller adjustment shall result in damage to the pump.

- a. Raise the impeller by tightening impeller adjustment nut until the impeller has been raised to its maximum position. At this point the impeller has come into contact with the diffuser.
- b. Lower the impeller by loosening adjustment nut a total vertical (90 deg to clutch face) distance of 0.1 inches. This will correctly set the mechanical seal position.
- c. Insert and tighten adjustment nut safety fasteners by aligning the adjustment nut to the nearest safety fastener locations. Install and tighten safety fasteners.
- d. Reinstall head shaft cover.
- e. If applicable, remove shaft clamp installed, immediately above pump upper seal area.
- f. After impeller and mechanical seal has set, pump may be filled with lubricating oil.

## 2.6a PUMP LUBRICATING OIL FILL

As soon as your Morrison Pump is mounted vertically, and impeller/seal has been properly set, it should be filled with lubricating oil. Review Pump Drawings for reference, and perform the following procedure:

- a. Verify oil reservoir is firmly mounted and oil lines from reservoir to pump upper seal location are connected and secured.
- b. Slowly fill pump oil reservoir with small quantity of oil (approx. ½ full), oil will drain into pump. Inspect oil lines for possible leaks. Tighten fittings as necessary.
- c. Slowly fill pump with lubricating oil via oil reservoir, allowing oil to flow to pump through lower oil line/tube only. Keep upper oil line open to atmosphere to allow for purging of air.
- d. Once oil enclosing tube is confirmed full, purge remaining air from upper lip seal (with use of feeler gauge or other suitable method). Great care should be taken to protect lip seal from damage during purging of air.
- e. Fill pump oil reservoir to a level approx. 1 inch below upper oil line/tube level.

RECOMMENDED LUBRICATING OIL TYPE : **ISO Viscosity Grade 46**

Ambient Temp. (50-125°F), (10 to 52°C)

Examples: Chevron Rando HD 46, Coastal Premium AW 46, Shell Omala 46, Tellus Premium 46  
List of Brand names is for purpose of identifying types and is not to be construed as exclusive.

APPROX. QUANTITY OF OIL REQUIRED PER PUMP: **10 quarts**

## 2.9b FINAL INSTALLATION PROCEDURES (VOS/VOM)

Variations in installations exist; therefore, these procedures are to be used as general guidelines as final checklist or verification that your Morrison Pump has been properly installed. Please understand your specific installation, review all drawings, and perform per the following procedural verifications:

- a. Verify the following pump fasteners, if applicable, for tightness (verify proper torque):
  - Pump baseplate (support plates) to pump station (e.g. sole plate, beams, concrete, etc).
  - Gear or vertical electric motor to pump gear/motor stand fasteners.
  - Pump discharge flange fasteners.
  - Pump discharge harnessed pipe coupling fasteners.
  - Head shaft coupling fasteners.
- b. Verify gear (speed reducer) or vertical electric motor lubricating oil levels. See manufacturer's instructions. Fill as required. Do not overfill.
- c. Verify pump oil reservoir is full. See Section 2.6a.
- d. If applicable, install engine driver per manufacturer's instructions and drawings provided.
- e. If applicable, install drive coupling or drive shaft, per manufacturer's instructions. See drawings for proper distances between input and output shafts.
- f. Install all protective guards. Caution: Pump driver shall not be operated without guards properly installed.

### **3.0 PUMP OPERATION & SHUTDOWN**

Please review Section 1.0 Introduction including General Information and Safety Precautions. Please follow procedures in Section 2.0 for proper handling and installation of your Morrison Pump.

#### **3.1a OPERATOR REQUIREMENTS**

Prior to operating pump equipment, personnel must read and understand the Morrison Pump and pump driver manuals in its entirety. It is the responsibility of the owner and/or operator of the pump equipment to understand the pump equipment, entire pumping system, and the pump operating limits. All service and operating personnel must be experienced in the service and operation of large pump systems, and qualified per applicable local law/requirements. Said personnel should be trained by the manufacturer or manufacturer's authorized representative.

All procedures should be performed utilizing standard safety procedures and practices, and performed by qualified personnel.

### **3.2b PUMP PRE-OPERATIONAL CHECKS – VOS/VOM**

Prior to pump start-up, the following pre-operational checks must be completed:

- a. Verify Pump and all associated pump equipment have been properly installation and all required adjustments are complete.
- b. Verify correct driver rotation was confirm (motor drive)
- c. Check pump for any visible damage.
- d. Verify pump is properly anchored in place.
- e. Verify gear or motor, if applicable, is properly installed and fastened to Pump. Check fasteners for tightness.
- f. Verify pump oil level.
- g. Verify gear or motor oil levels.
- h. Verify pump discharge connection.
- i. Verify drive shaft (if applicable) and guard are properly installed.
- j. Verify sufficient water level in sump. Pump Suction Bell and Impeller must be fully submerged. Reference drawings if unsure.
- k. Verify sufficient water supply is available (intake canals, etc.).
- l. Verify sump low water level pump shutdown is active.
- m. Verify all instrumentation and emergency shutoffs, if applicable, are active.
- n. Verify ok to operate pump driver (electric motor, engine, etc.).

### 3.3b PUMP START-UP PROCEDURES – VOS/VOM ELECTRIC DRIVE

Once pump equipment has been properly installed, Pump Start-Up can be performed by qualified personnel. Personnel must be familiar with electric motor manufacturer's manuals, electric motor control panel, all emergency shutoff procedures, and must follow all safety protocol. Initial start-up procedure is as follows:

- a. Verify installation of all pump equipment is complete.
- b. Verify Pump Pre-Operational Checks are complete.
- c. Confirm that there are no obstructions in the pump intake, and that the pump may be safely operated.
- d. Confirm OK to operate electric motor.
- e. If the phase sequencing of the incoming motor cables are not positively known, motor should be "bumped" to verify motor rotation matches proper pump rotation (arrow indications on pump).
- f. Start Pump/Motor per driver manufacturer's directions. Note if any unusual noise or vibration.
- g. Allow pump operation to stabilize.
- h. Check for flange leaks along pump column and discharge. Walk down entire system (from water intake to water discharge) confirming system piping integrity.
- i. For oil lubricated pumps, verify oil reservoir level. Fill if required. During initial pump operation, trapped air may be expelled from oil enclosing tube, requiring a small amount of oil to be added.
- j. Record data, as applicable for future reference:
  - Initial pump start-up date & time
  - Pump intake water elevation
  - Discharge water elevation
  - Pump discharge pressure
  - Electric motor operating voltage and amperage
  - Vibration data
- k. For Morrison Pumps with threaded shaft couplings, Pump Impeller Adjustments (Section 2.4) will need to be reperformed after first shutdown.

### **3.7b PUMP POST START UP PROCEDURES – VOS/VOM**

The supplied pumps have been fitted with a mechanical seal sealing system. The Mechanical seal located at the base of the enclosing tube will prevent the pump lubrication oil from contamination and/or leakage.

Once energized and allowed to operate for a short moment (1 – 2 minutes) impeller position must be reset due to possible system self adjusting or settling that may change impeller/mechanical seal clearance.

#### Impeller adjustment

- a. Turn off motor and pump. Disconnect and lock out power supply.
- b. Return to Section 2.4b and reset the impeller position as indicated.
- c. Reconfirm oil level and reinstall reservoir cover.

### **3.8a ENVIRONMENTAL CONDITIONS**

Prior to operation of pump system (pump, gear, motor, engine) confirm that pumping equipment area is free from trash and debris. Excessive amounts of trash and debris can effect proper pump operation and may create a safety hazard to personnel.

Inspect and confirm installation of all protective guards.

Pump should not be placed in operation or be permitted to operate at sump water levels below those agreed to by Morrison Pump and as specified in project bid specifications.

### **3.9a PUMP STANDARD SHUTDOWN**

The standard Morrison Pump is designed for a standard automatic shutdown and/or manual shutdown; however, since this is a function of the pump station design, the operator must be familiar with the system design and operating parameters. In general, at time of required shut down (whether at design speed or reduced speed), simply de-energize motor via motor MCC or shutdown the engine via engine panel. Engine panels may have an engine shutdown sequence.

If the pump/gear/motor has been fitted with a non-reverse ratchet (NRR), it will generate some mechanical noise prior to NRR engagement. The mechanical noise as the driver (motor or engine) comes to a halt is only temporary and will only last for a few seconds until NRR has engaged. Once NRR has engaged, the pump/motor will not rotate in the counter direction.

When the pumps are shut down for maintenance or service, motors must be disconnected and tagged "DO NOT START" per standard electrical protocol/procedures. If engine-driven pump, PTO should be disengaged, E-stop engaged, and engine start panel should be tagged "DO NOT START," per standard safety procedures.

### **3.9b EMERGENCY SHUTDOWN**

Many installations are equipped with emergency shut-off switches near the pump location. These locations should be clearly marked and easily accessible to the pump operator. Motor and engine control panels should have been fitted with emergency "OFF" buttons or switches. The operator and/or pump equipment service personnel working around pump equipment should be familiar with locations and operation of emergency start/stop button or switches.

If there is any pending risk of injury to personnel or damage to equipment, simply Press "OFF" button or switch to individual unit or all units for an immediate halt of pump machinery operation. Do not restart pump equipment without complete understanding that all is clear to operate.

## **4.0 MAINTENANCE AND SERVICE – GENERAL INFORMATION**

It is important that your Morrison Pump is properly maintained and serviced to retain your pump's operating efficiencies, increase equipment longevity, and to ensure the reliability of your overall pumping system. Preventative maintenance must be performed per the recommended schedule found within this section. For gears, motors, engines, etc. please refer to the manufacturer's maintenance manuals.

All maintenance and service must be performed by a knowledgeable and qualified pump technician, who has adequately familiarized themselves with the Morrison Pump. All work shall be performed with the pump OFF (not in operation, and properly tagged out). Any guards or safety devices removed for pump servicing must be reinstalled.

In requesting parts for your Morrison Pump, please reference the Morrison Pump serial number, and the item name and reference number found on the Parts Detail Drawing. To maintain satisfactory long-term operation of your pump, only Morrison Pump Company factory parts should be utilized to maintain design specifications.

We strongly recommend that maintenance and service logs be maintained for proper record-keeping.

## 4.1b PUMP MAINTENANCE SCHEDULE VOS/VOM

Every installation requires its own special procedures which may vary slightly from those described below. We recommend that the following steps not be deleted but added to your standard operating procedures. The following is for the pump only. Other accessories such as the gear, drive coupling and driver will have additional requirements.

### Daily - Prior to starting the unit

- a. Inspect pump, motor, couplings, electrical wiring, and other components that may have come loose. (i.e. flange bolts, couplings, anchors)
- b. Verify Pump lubrication reservoir oil level is correct.
- c. Inspect flanges for signs of leaks.
- d. Verify pump and driver lubricating oil levels and condition.

### After first 50 hours of operation

- a. Inspect and re-torque all column flange fasteners.

### Every 200 hours of operation and prior to starting the unit

- a. Inspect and clean suction screen (if installed)
- b. Inspect and clean Zinc Anodes (if installed)
- c. Inspect drive coupling element wear or other possible damages.

### Every 1,000 hours of operation-prior to starting the unit

- a. If possible, clean and inspect discharge pipe for fouling.
- b. If possible, calculate pump flow for possible early detection of potential problem.
- c. Inspect and correct damages to pump, gear driver and pipe coatings. The earlier corrected the less wear from corrosion.
- d. Measure and record pump vibration levels and study history for signs of pump wear or damage

## 4.2b REMOVAL AND REINSTALLATION (VOS/VOM)

Variations in installations exist; therefore, these procedures are to be used as general guidelines for the handling and placement of your Morrison Pump. Please understand your specific installation, review all drawings, and perform per the following procedural guidelines:

**Note: Inspect and confirm all lifting hardware and apparatus for condition and certified lift values.**

**Note: Prior to initiating removal process be sure to study the station dimensions along with pump drawing dimensions to understand size and weight limitations of the pumps handling.**

### Removal

- a. Disconnect pump discharge from discharge pipe. For harnessed pipe couplings be sure coupling has been positioned to not interfere with extraction of pump.
- b. Install a non-marking clamp on pump shaft immediately above upper seal carrier housing (mechanical marking of shaft will damage lip seal and cause oil leaks). This will maintain mechanical seal position during handling to prevent loss of lubricating oil through mechanical seal.
- c. Remove driver cover and propeller adjustment nut.
- d. With great care remove driver in a vertical fashion that does not apply any force (side load) on the shaft.
- e. Remove head shaft from upper pump shaft.
- f. Remove pump foundation anchors. If anchors are of the embedded type wrap or install a guard over anchor threads.
- g. If pump is oil lubricated remove oil reservoir and plug oil lines.
- h. With use of the four (4) upper lifting eyes raise pump vertically until it is free from the station floor.
- i. Carefully rotate to its horizontal position and carefully set it on wood blocks or other suitable and stable setting.

### Reinstallation

Please proceed to section 2.2a Placement of Pump and subsequent section for reinstallation process

## **4.9z PUMP LONG TERM STORAGE**

For long term storage (greater than 1 month), store pump in a clean, dry, secure location away from vibration. Equipment stored in a horizontal position must be placed upon wood blocks to prevent contact with ground and surface contaminants. At a minimum, the following precautions should be taken to ensure the pump equipment remains in good condition:

1. Machined mating surfaces should be coated to prevent corrosion. Periodic application of grease/wax anticorrosion products (Cosmoline, Linebacker or similar) are best suited and will not require much labor to prepare for eventual assembly.
2. To preserve the pump coating, touch up the areas that may have been chipped or scraped.
3. The shaft should be rotated periodically (approx. once per month), in order to ensure that the pump shaft does not begin to sag. Mark shaft position prior to each movement to ensure reset position is approximately 180 degrees out of phase with previously stored position.
4. Space heaters on motors and controllers should be connected and fully operable if atmospheric conditions approach those experienced in operation. Review manufacturer's manuals of other pumping equipment being stored.

For longer storage periods, contact Morrison Pump Company.

## 4.9x PUMP SHORT TERM STORAGE

For short term storage (3 months or less), the pumps may be stored outside (in the weather). The pumps have been design and manufactured for aquatic immersion and adequately coated and finished to resist a wet tropical environment. All un-coated steels are of a marine grade stainless steel and will not suffer from exposure to the outdoor environment.

The pumps should be stored in a horizontal position while placed/set on wood blocks/dunnage to prevent contact with ground and surface contaminants. At a minimum, the following precautions should be taken to ensure the pump equipment remains in good condition:

1. Machined mating surfaces have been coated at factory with a rust inhibitor and should be coated as periodically as needed to prevent corrosion. A coating/dressing of grease/wax anticorrosion products (Cosmoline, Linebacker or similar) are best suited and will not require much labor to prepare for eventual assembly.
2. Prior to shipment all pump openings have been covered to prevent collection of debris or unwarranted physical access.
3. To preserve the pumps epoxy coating, touch up the areas that may have been chipped or scraped.
4. The shaft should be rotated periodically (approx. once per month), in order to ensure that the pump shaft does not begin to sag. Mark shaft position prior to each movement to ensure reset position is approximately 180 degrees out of phase with previously stored position.

For Pump Long Term Storage please refer to 4.9z

## Pump Trouble Shooting Guide

Morrison Pump Model VOM



	Symptom	Possible Causes	Corrective Action
I	Insufficient Discharge Volume	<ul style="list-style-type: none"> <li>Speed too low</li> <li>Low sump water level</li> <li>Insufficient feed water to sump</li> <li>Impeller fouled or clogged</li> <li>Diffuser or straightening vanes fouled</li> <li>Flow loss due to leaks</li> <li>Incorrect impeller clearance setting</li> <li>Worn impeller</li> <li>Discharge valve malfunctioning</li> </ul>	<ul style="list-style-type: none"> <li>Confirm power supply for voltage and frequency</li> <li>Verify pump minimum submergence satisfied</li> <li>Clean station intake bar screens</li> <li>Clean impeller</li> <li>Clean diffuser</li> <li>Inspect pump bowl, column and flanges for damage or leaks and repair</li> <li>Review pump manual and re-establish impeller clearance</li> <li>Inspect impeller and wear ring for excessive wear and replace if necessary</li> <li>Inspect and service discharge valve for proper operation</li> </ul>
II	Excessive Power Consumption	<ul style="list-style-type: none"> <li>Incorrect impeller clearance setting</li> <li>Worn impeller</li> <li>Discharge valve malfunctioning</li> <li>Power supply</li> <li>Low sump water level</li>   <li>Impeller fouled or clogged</li> <li>Shaft lubricant too viscous</li> </ul>	<ul style="list-style-type: none"> <li>Review pump manual and re-establish impeller clearance</li> <li>Inspect impeller and wear ring for excessive wear and replace if necessary</li> <li>Inspect and service discharge valve for proper operation</li> <li>Confirm power supply for voltage and frequency</li> <li>Verify pump minimum submergence satisfied</li> <li>Clean station intake bar screens</li> <li>Clean impeller</li> <li>Replace pump lubrication oil to manufacturer's specifications</li> </ul>
III	Excessive Vibration	<ul style="list-style-type: none"> <li>Worn pump bearings</li> <li>Damaged motor bearings</li> <li>Motor electrical imbalance</li> <li>Bent pump shaft</li> <li>Damaged impeller</li> <li>Propeller fouled or clogged</li> <li>Diffuser or straightening vanes fouled</li> <li>Incorrect impeller clearance setting</li> <li>Large or excessive solids in pumpage</li> <li>Sump vortexing</li> </ul>	<ul style="list-style-type: none"> <li>Replace bearings as per manufacturers specifications</li> <li>Review manufacturers service guidelines</li> <li>Analyze power quality</li> <li>Repair or replace</li> <li>Repair/dynamic balance or replace</li> <li>Clean propeller</li> <li>Clean diffuser</li> <li>Review pump manual and re-establish impeller clearance</li> <li>Improve bar screening</li> <li>Inspect sump for possible causes</li> </ul>




**Pump Trouble Shooting Guide (continued)**  
**Morrison Pump Model VOM**



	Symptom	Possible Causes	Corrective Action
IV	Excessive Noise	<ul style="list-style-type: none"> <li>Incorrect impeller clearance setting</li> <li>Cavitation</li> <li>Large or excessive solids in pumpage</li> <li>Sump vortexing</li> <li>Worn pump bearings</li> <li>Damaged motor bearings</li> <li>Motor electrical imbalance</li> <li>Bent pump shaft</li> </ul>	<ul style="list-style-type: none"> <li>Review pump manual and re-establish impeller clearance</li> <li>Pump suction blocked, remove obstruction</li> <li>Improve bar screening</li> <li>Inspect sump for possible causes</li> <li>Replace bearings as per manufacturers specifications</li> <li>Review manufacturers service guidelines</li> <li>Analyze power quality</li> <li>Repair or replace</li> </ul>
V	Premature Mechanical Seal Failure	<ul style="list-style-type: none"> <li>Pumping excessive abrasives</li> <li>Incorrect impeller clearance setting</li> <li>Excessive vibration</li> <li>Insufficient lubrication</li> </ul>	<ul style="list-style-type: none"> <li>Contact manufacturer for possible options</li> <li>Review pump manual and re-establish impeller clearance</li> <li>Review excessive vibration troubleshooting</li> <li>Replace pump lubrication oil to manufacturers specifications</li> </ul>

## Bolt Grade Markings and Strength Chart

**NOTE: Bolt torque values for reference only.**

Head Marking	Grade and Material	Nominal Size Range (inches)	Mechanical Properties		
			Proof Load (psi)	Min. Yield Strength (psi)	Min. Tensile Strength (psi)
 No Markings	<b>Grade 2</b> Low or medium carbon steel	1/4 thru 3/4	55,000	57,000	74,000
		Over 3/4 thru 1-1/2	33,000	36,000	60,000
 3 Radial Lines	<b>Grade 5</b> Medium Carbon Steel, Quenched and Tempered	1/4 thru 1	85,000	92,000	120,000
		Over 1 thru 1-1/2	74,000	81,000	105,000
 6 Radial Lines	<b>Grade 8</b> Medium Carbon Alloy Steel, Quenched and Tempered	1/4 thru 1-1/2	120,000	130,000	150,000
Stainless markings vary. Most stainless is non-magnetic	<b>18-8 Stainless</b>  <b>(304/316SS)</b>  Steel alloy with 17-19% Chromium and 8-13% Nickel	1/4 thru 5/8		40,000	100,000 – 125,000 Typical
		3/4 thru 1			100,000 Typical
		Above 1		40,000	80,000 – 90,000 Typical

Recommended Bolts Torque Values								
Bolt Size	TPI	Tightening Torque (ft lbs)						
		Grade 2		Grade 5		Grade 8		304/316 SS
		Waxed	Plain	Waxed	Plain	Waxed	Plain	Plain (Loctite)
1/4	20	3	5	4	8	4	8	6
5/16	18	6	11	9	17	9	17	11
3/8	16	10	20	15	31	15	31	19
7/16	14	16	32	25	49	25	49	30
1/2	13	24	49	38	75	38	75	44
9/16	12	35	70	54	109	54	109	63
5/8	11	48	97	75	150	75	150	87
3/4	10	86	173	133	266	133	266	150
7/8	9	83	166	215	429	215	429	238
1	8	125	250	322	644	322	644	356
1 1/8	7	177	354	397	794	397	794	507
1 1/4	7	250	500	560	1120	560	1120	695
1 3/8	6	327	655	734	1469	734	1469	935
1 1/2	6	435	870	975	1950	975	1950	1201







**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**



**MORRISON PUMP COMPANY**  
VERTICAL MIXED FLOW PUMPS

**TABLE OF CONTENTS:**

1. COVER PAGE
2. PUMP GENERAL DIMENSIONS
3. PUMP PARTS DETAIL

**PUMP DATA:**  
PUMP MODEL(S): VOM-16-13



2514 Hollywood Blvd.  
Hollywood, FL USA  
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Project: INDUSTRIAL PROCESS SYSTEMS  
WICHITA, KANSAS WASTEWATER TREATMENT PLANT  
NO. 2, RAS PUMPS  
MORRISON PROJECT NO. J56178

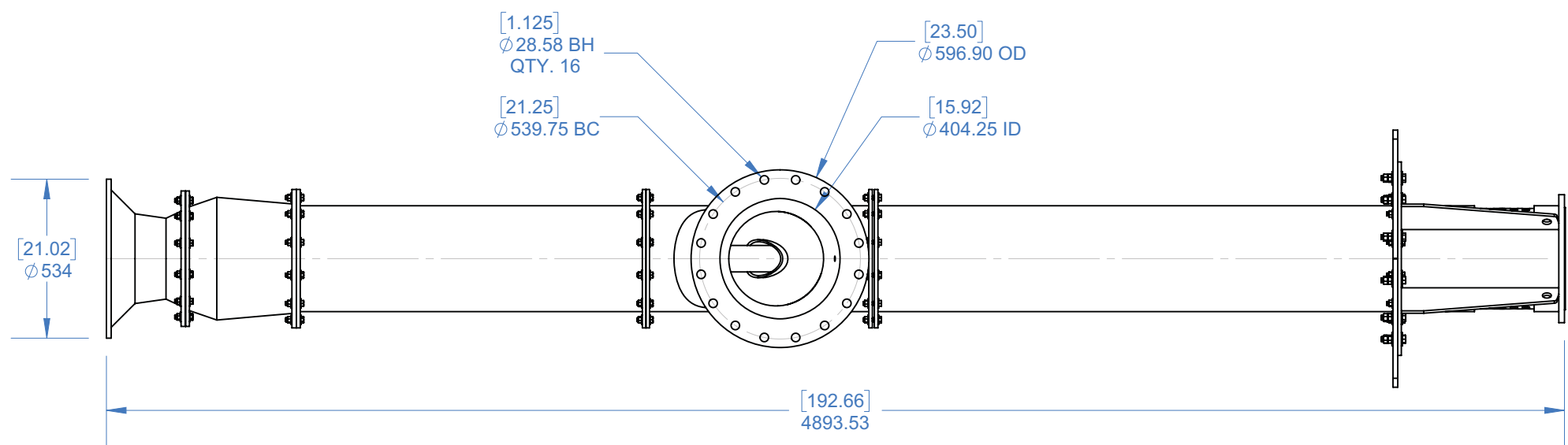
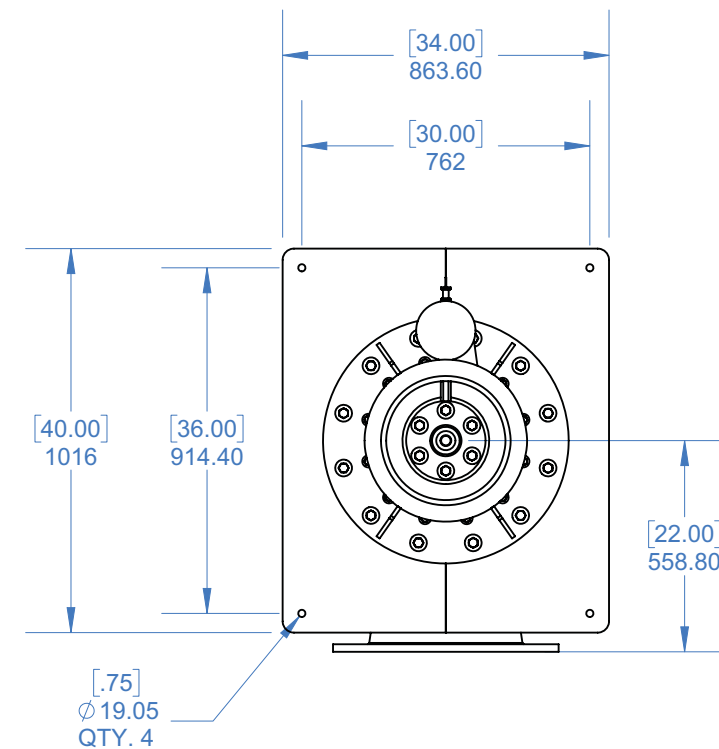
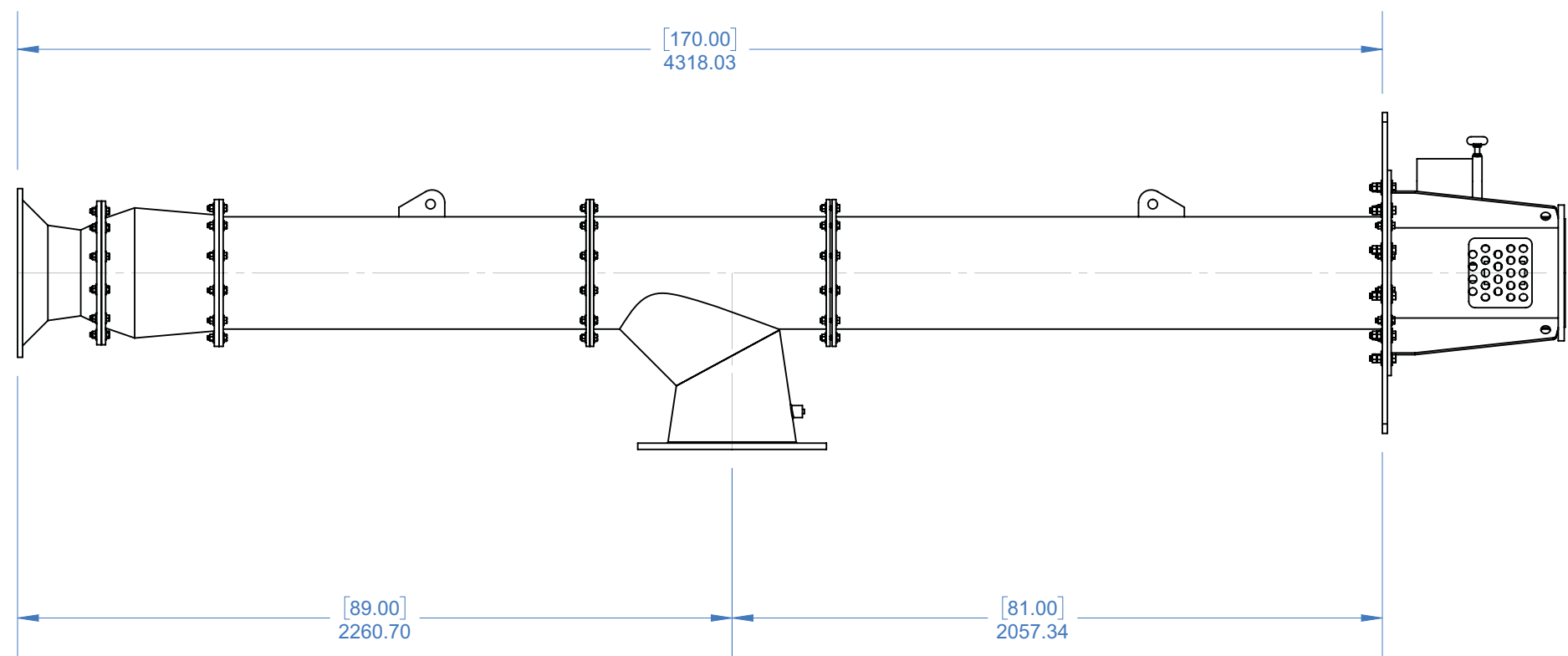
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Units: N/A

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Rev: -

Drawn by: D.J.H.  
Checked by: J.M.C.

Date: 16-MAY-2017  
File: J56178-COVER



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Dwg Title:

PUMP GENERAL DIMENSIONS  
MORRISON PUMP MODEL VOM-16-13

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Units:

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MILLIMETERS

Sheet:

1 of 1

Rev:

-

Drawn by:

D.J.H.

Checked by:

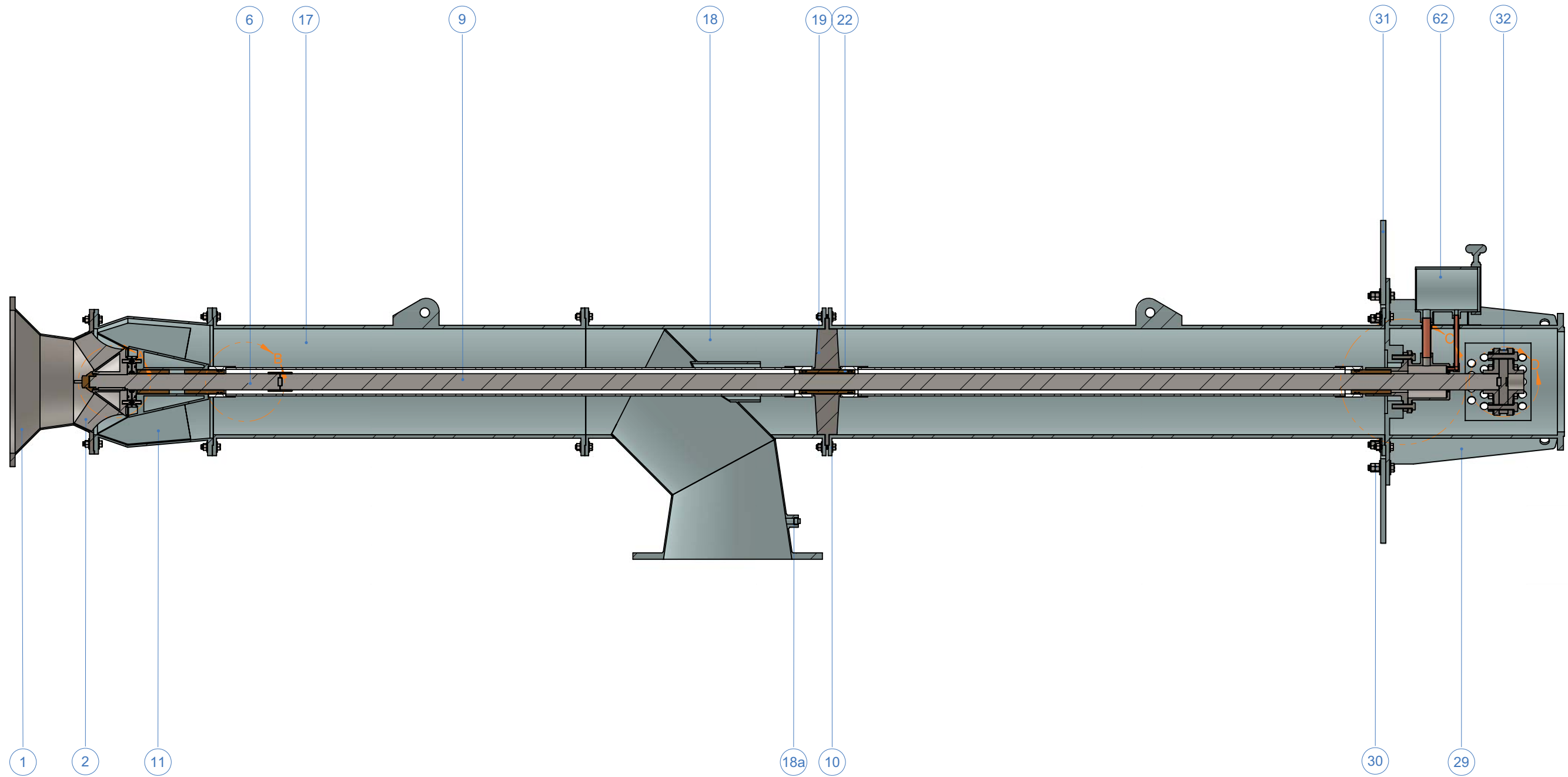
J.M.C.

Date:

19-MAY-2017

File:

J56178-GENDIMS-IOM



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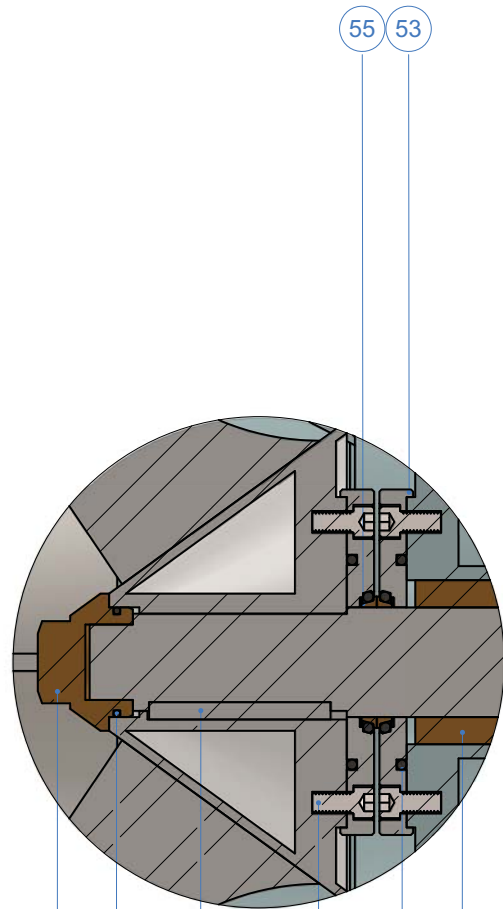
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MORRISON PUMP MODEL VOM-16-13

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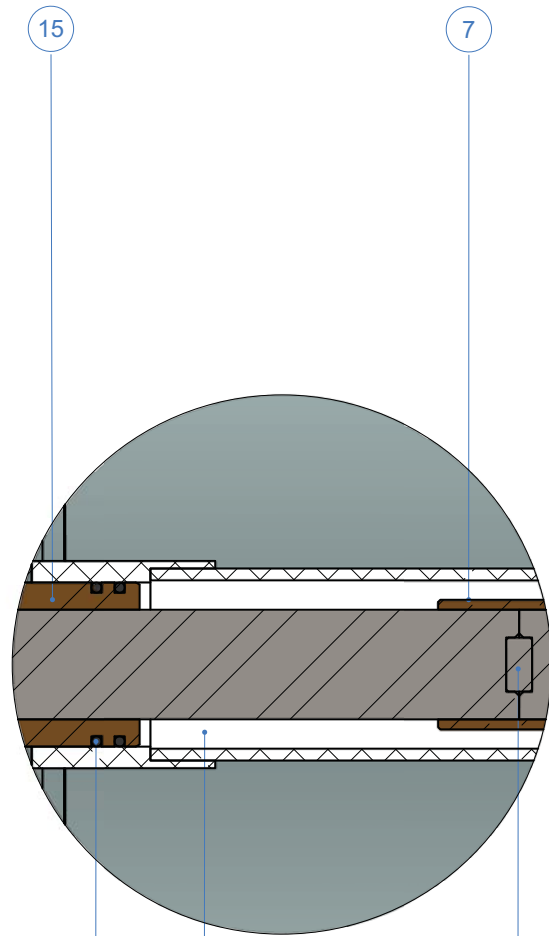
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Checked by:  
J.M.C.

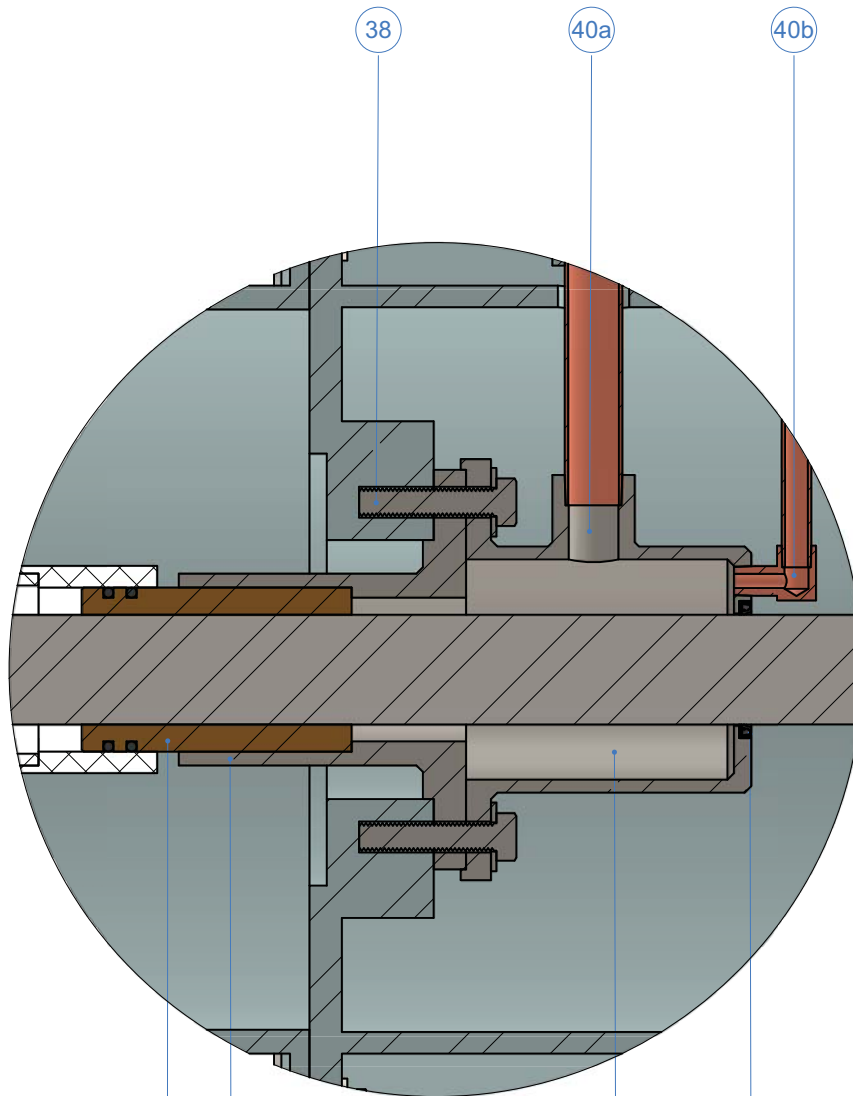
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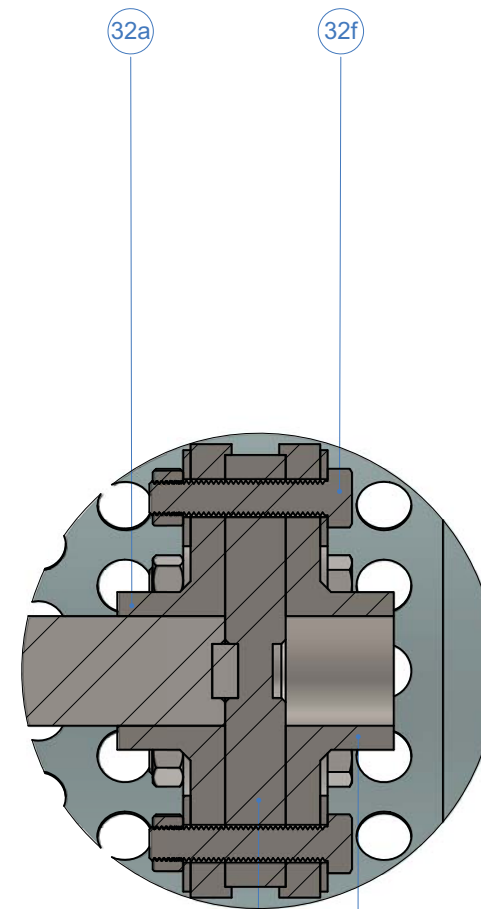
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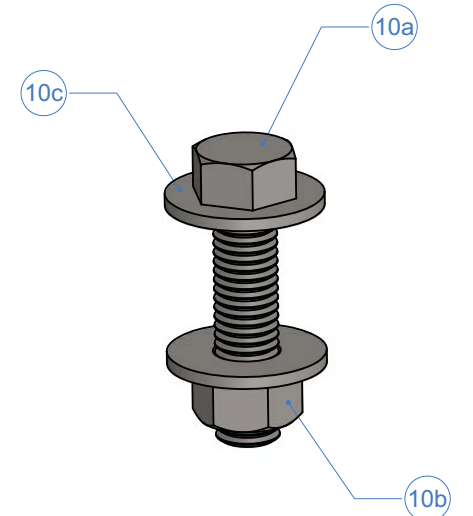
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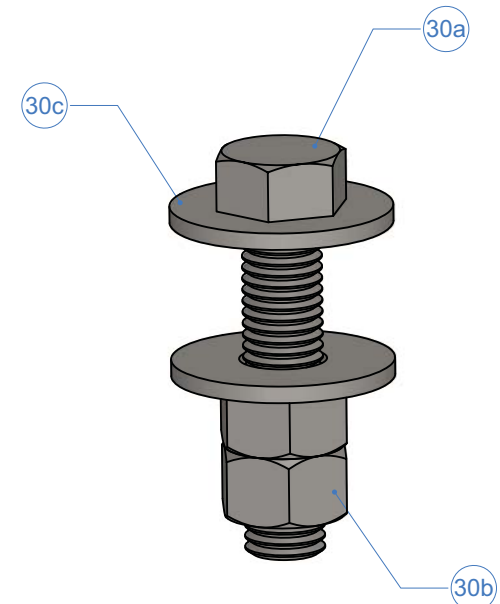
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SCALE 1 : 3.5



**DETAIL D**  
SCALE 1 : 3.5



**10. COLUMN FLANGE  
BOLT ASSEMBLY**  
SCALE 2:3



**30. BASEPLATE TO MOTOR STAND  
BOLT ASSEMBLY**  
SCALE 1:1



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2 of 3  
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File:  
J56178-PARTS DETAIL-IOM

REF NO.	DESCRIPTION	QTY.	MATERIAL	REMARKS
1	SUCTION BELL	1	STAINLESS STEEL 304	REGISTERED FLANGE
2	IMPELLER	1	STAINLESS STEEL ASTM A 240 (TYPE 304L)	MIXED FLOW MODEL MP-13-MD
3	IMPELLER KEY	1	STAINLESS STEEL ASTM A 240 (TYPE 304L)	
4	IMPELLER RETAINING NUT	1	BRONZE	
4a	IMPELLER RETAINING NUT O-RING		BUNA-N	
6	IMPELLER BOWL SHAFT	1	STAINLESS STEEL ASTM A311 (GRADE 1045)	Ø 50 MM NOMINAL - IN OIL BATH
7	IMPELLER BOWL SHAFT COUPLING	1	ALUMINUM BRONZE	
9	LINE SHAFT	1	STAINLESS STEEL ASTM A311 (GRADE 1045)	Ø 2 IN. NOMINAL, 2-PIECE (UPPER & LOWER) - IN OIL BATH
10	COLUMN FLANGE BOLT ASSEMBLY	60		INCLUDES 10a, 10b, & (2) x 10d
10a	BOLT		STAINLESS STEEL ASTM A 593 (TYPE 304)	1/2" UNC
10b	NUT		STAINLESS STEEL ASTM A 593 (TYPE 304)	1/2" UNC
10c	WASHER		STAINLESS STEEL ASTM A 593 (TYPE 304)	1/2" UNC
11	DIFFUSER BOWL SEGMENT	1	STAINLESS STEEL 304	REGISTERED FLANGE
14	DIFFUSER BEARING (LOWER)	1	BRONZE	Ø 50MM ID x Ø 3.0" OD x 100MM LENGTH
15	DIFFUSER BEARING (UPPER)	1	BRONZE	Ø 50MM ID x Ø 3.0" OD x 125MM LENGTH
17	COLUMN SEGMENT	2	A36 CARBON STEEL	WELDED LIFTING EYE, REGISTERED FLANGE
18	ELBOW SEGMENT	1	A36 CARBON STEEL	WELDED LIFTING EYE, REGISTERED FLANGE
18a	DISCHARGE PRESSURE PORT	1	A36 CARBON STEEL	Ø 3/4 IN. NPT
19	INTERMEDIATE BEARING CARRIER	1	A36 CARBON STEEL	FLANGED
22	INTERMEDIATE BEARING	1	BRONZE	Ø 2.0" ID x Ø 3.0" OD x 225MM LENGTH
23	SHAFT ENCLOSING TUBE	2	ASTM D1785 NON-METALLIC	Ø 3.0 IN.
24	ENCLOSING TUBE O-RING	8	BUNA-A	PARKER #2-334 Ø 2.60" ID x 3/16"
25	SHAFT CENTERING DISC	2	ASTM A311 (GRADE 1045)	
29	MOTOR STAND	1	A36 CARBON STEEL	REGISTERED FLANGE
30	BASEPLATE TO MOTOR STAND BOLT ASSEMBLY	12		INCLUDES 10a & (2) x 10b,10d
30a	BOLT	1	STAINLESS STEEL ASTM A 593 (TYPE 304)	5/8" UNC
30b	NUT	2	STAINLESS STEEL ASTM A 593 (TYPE 304)	5/8" UNC
30c	WASHER	2	STAINLESS STEEL ASTM A 593 (TYPE 304)	5/8" UNC
31	BASEPLATE	1	SPLIT	
32	HEAD SHAFT FLANGED COUPLING ASSEMBLY	1		
32a	HEAD SHAFT FLANGED COUPLING (LOWER)	1	A36 CARBON STEEL	
32b	HEAD SHAFT FLANGED COUPLING (UPPER)	1	A36 CARBON STEEL	
32c	HEAD SHAFT FLANGED COUPLING REGISTER	1	A36 CARBON STEEL	
36	UPPER BEARING	1	BRONZE	Ø 2.0" ID x Ø 3.0" OD x 175MM LENGTH
37	UPPER BEARING CARRIER	1	A36 CARBON STEEL	FLANGED
38	UPPER BEARING CARRIER FASTENER	4	STAINLESS STEEL ASTM A 593 (TYPE 304)	INCLUDES 10a, 10b
40	UPPER LIP SEAL CARRIER	1	A36 CARBON STEEL	FLANGED
40a	BEARING OIL FEED PORT	1	A36 CARBON STEEL	3/4 IN. FEMALE NPT, SUPPLY
40b	BEARING OIL RETURN PORT FITTING	1	BRASS	1/4 IN. FEMALE NPT, RETURN / VENT
41	UPPER LIP SEAL	1	NITRILE RUBBER	Ø 2 IN. ID x Ø 2 1/2 IN. OD x 1/4 IN.
52	MECHANICAL SEAL CARRIER FASTENER	6	STAINLESS STEEL ASTM A 593 (TYPE 304)	Ø 3/8" x 3/4" ALLEN
53	MECHANICAL SEAL CARRIER	2	STAINLESS STEEL ASTM A 240 (TYPE 304L)	REGISTERED FLANGED
55	MECHANICAL SEAL	1	N/A	MPC-287
57	MECHANICAL SEAL CARRIER O-RING	2	BUNA-N	Ø 3.85" ID x 3/16"
62	LUBRICATING OIL RESERVOIR	1	A36 CARBON STEEL	



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MORRISON PUMP MODEL VOM-16-13

Scale:  
N/A  
Units:  
N/A

Sheet:  
3 of 3  
Rev:  
-

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D.J.H.  
Checked by:  
J.M.C.

Date:  
16-MAY-2017  
File:  
J56178-PARTS DETAIL-IOM

**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**



**NIDEC MOTOR CORPORATION**

8050 WEST FLORISSANT AVE.  
ST. LOUIS, MO 63136



**DATE:** 8/9/2017

**P.O. NO.:** 403833  
**Order/Line NO.:** 17700282 SO 100

**TO:** Patterson Pump Co  
Subsidiary Gorman-Rupp Co  
Attn: Accts Payable  
PO Box 790  
Toccoa, GA, 30577

**ATTN:** CLIFF PORTER

**Model Number:** NA

**Catalog Number:**  
VHS TEFC Configuration  
CONF,MOTOR,VHS TEFC

**REVISIONS:**  
A)P' BASE CHANGE  
FROM TP TO TPH (10"  
TO 16.5").

**MARKS:** 71000280-0825

**ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.  
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.**

**Features:**

Horsepower ..... 00015.00~00000.00 ~ KW: 11.19  
Enclosure ..... TEFC  
Poles ..... 08~00 ~ RPM: 900~0  
Frame Size ..... 286~TPH  
Phase/Frequency/Voltage.. 3~060~460 ~ Random Wound  
Service Factor ..... 1.15  
Insulation Class ..... Class "F" ~ Insulife 2000  
Altitude In Feet (Max) .. 3300 Ft.(1000 M) ~ +40 C  
Efficiency Class ..... Premium Efficiency  
Application ..... Centrifugal Pump  
Inverter Duty NEMA MG1 Part 31  
Customer Part Number .... 71000280-0825  
16.5" Base ~ Coupling Size: 1-1/4" Bore, 3/8" Key  
Non-Reverse Ratchet ~ Steady Bushing Not Requested  
Pricebook Thrust Value (lbs).. 4200  
Customer Down Thrust (lbs) ... 4200  
Customer Shutoff Thrust (lbs).  
Up Thrust (lbs): ~  
Inverter Duty Rating Details:  
Load Type (Base Hz & Below) .. Variable Torque  
Speed Range (Base Hz & Below). 10:1  
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)  
Starting Method ..... Direct-On-Line Start  
Duty Cycle ..... Continuous Duty  
Efficiency Value ..... 89.5 % ~ Typical  
Load Inertia (lb-ft<sup>2</sup>): NEMA ~ NEMA Inertia: 400.00 ~ 1.00  
Number Of Starts Per Hour: NEMA  
Motor Type Code ..... TUI  
Rotor Inertia (LB-FT<sup>2</sup>) 4.45 LB-FT<sup>2</sup>  
Qty. of Bearings PE (Shaft) 1  
Qty. of Bearings SE (OPP) 1  
Bearing Number PE (Shaft) 7310 BEP  
Bearing Number SE (OPP) 6210-2Z-J/C3

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# NIDEC MOTOR CORPORATION

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**Accessories:**

Counter CW Rotation FODE  
Shaft Ground Ring  
Special Balance  
Thermostats - Normally Closed

**USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT**

<b>Horsepower</b>	15
<b>Pole(s)</b>	08
<b>Voltage(s)</b>	460
<b>Frame Size</b>	286TPH
<b>Outlet Box AF</b>	4.44
<b>Outlet Box AA</b>	1.50

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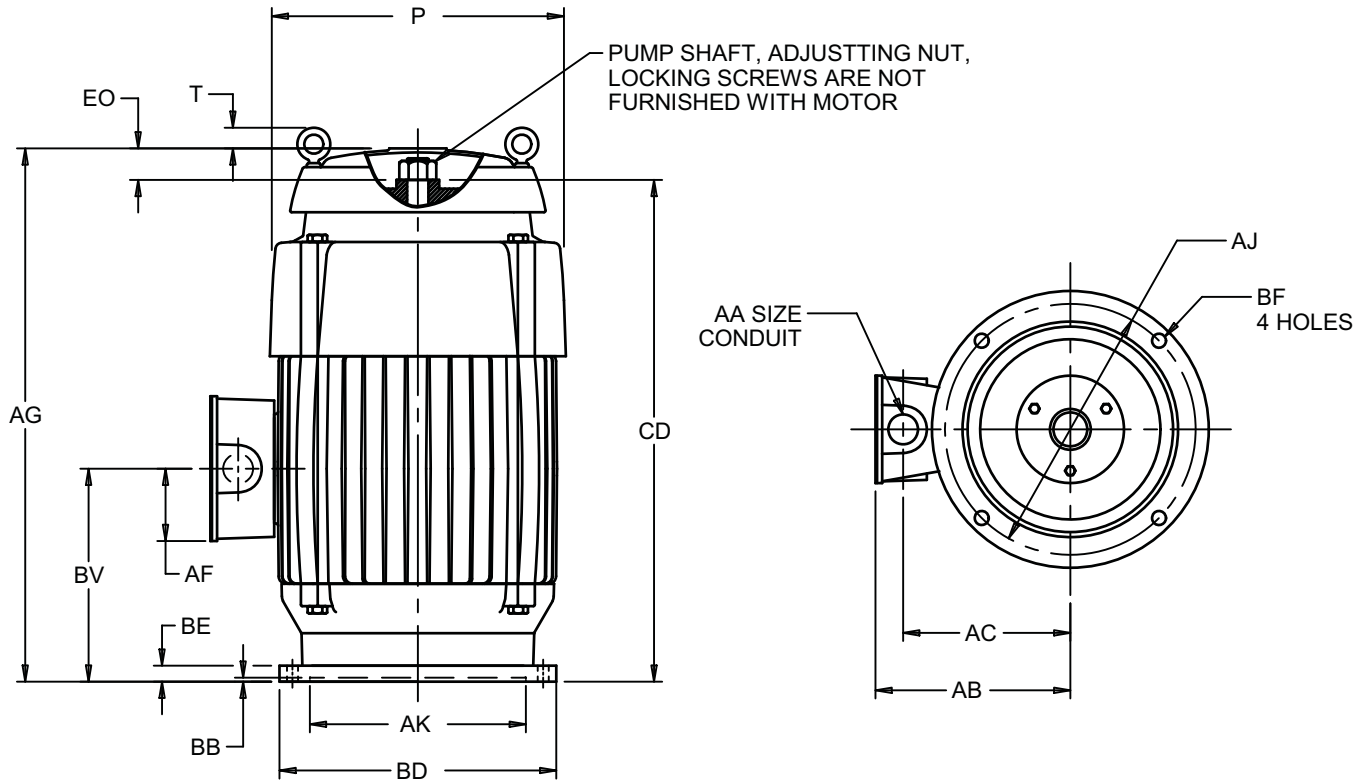
EFFECTIVE:  
**22-AUG-12**

SUPERSEDES:  
**28-FEB-11**

**VERTICAL MOTORS**  
TOTALLY ENCLOSED FAN COOLED  
FRAME: 284, 286TP, TPA, TPH  
BASIC TYPE: TU

PRINT:  
**09-2298**

SHEET:  
**1 OF 1**



ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS	P <sup>2</sup>	T	AA	AB	AC	AF	AG	BE	BV	CD	EO
IN	14.44	1.13	1.50	11.09	8.32	4.44	29.88	1.00	13.44	26.56	2.94
MM	367	29		282	211	113	759	25	341	675	75

FRAME	UNITS	AJ	AK +.003	BB MIN	BF
284, 286TP, TPA	IN	9.125	8.250	.19	.44
	MM	231.78	209.55	5	11
284, 286TPH	IN	14.750	13.500	.25	.69
	MM	374.65	342.90	6	18

FRAME	UNITS	BD MAX
284, 286TP	IN	10.00
	MM	254
284, 286TPA	IN	12.00
	MM	305
284, 286TPH	IN	16.50
	MM	419

- 1: ALL ROUGH DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
- 2: LARGEST MOTOR WIDTH.
- 3: CONDUIT OPENINGS MAY BE LOCATED IN STEPS OF 90 DEGREES REGARDLESS OF LOCATION. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
- 4: TOLERANCES SHOWN ARE IN INCHES ONLY.

TOLERANCES	8.250 AK	13.500 AK
"AK" DIMENSION	-.000;+.003	-.000;+.005
FACE RUNOUT	.004 T.I.R.	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.004 T.I.R.	.007 T.I.R.

09-2298/C

**Nidec Motor Corporation**  
St. Louis, Missouri

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ISSUED BY  
**R. KING**  
APPROVED BY  
**J. O'BRIEN**

IHP\_DP\_NMCA (MAR-2011) SOLIDEDGE

# NAMEPLATE DATA

CATALOG NUMBER: _____		NAMEPLATE PART #: <span style="border: 1px solid black; padding: 2px;">422707-005</span>	
MODEL: _____	FR: <span style="border: 1px solid black; padding: 2px;">286TPH</span>	TYPE: <span style="border: 1px solid black; padding: 2px;">TUI</span>	ENCL: <span style="border: 1px solid black; padding: 2px;">TEFC</span>
SHAFT END BRG: <span style="border: 1px solid black; padding: 2px;">7310 BEP - QTY 1</span>		OPP END BRG: <span style="border: 1px solid black; padding: 2px;">6210-2Z-J/C3 - QTY 1</span>	
PH: <span style="border: 1px solid black; padding: 2px;">3</span>	MAX AMB: <span style="border: 1px solid black; padding: 2px;">40 C</span>	ID#: <span style="border: 1px solid black; padding: 2px;">(ref: Order#: 17700282, Type: SO, Line#: 100)</span>	
INSUL CLASS: <span style="border: 1px solid black; padding: 2px;">F</span>	Asm. Pos: _____	DUTY: <span style="border: 1px solid black; padding: 2px;">CONT</span>	
HP: <span style="border: 1px solid black; padding: 2px;">15</span>	RPM: <span style="border: 1px solid black; padding: 2px;">875</span>	HP: _____	RPM: _____
VOLTS: <span style="border: 1px solid black; padding: 2px;">460</span>	_____	VOLTS: _____	_____
FL AMPS: <span style="border: 1px solid black; padding: 2px;">21.6</span>	_____	FL AMPS: _____	_____
SF AMPS: <span style="border: 1px solid black; padding: 2px;">24.5</span>	_____	SF AMPS: _____	_____
SF: <span style="border: 1px solid black; padding: 2px;">1.15</span>	DESIGN: <span style="border: 1px solid black; padding: 2px;">B</span>	CODE: <span style="border: 1px solid black; padding: 2px;">E</span>	_____
NEMA NOM EFFICIENCY: <span style="border: 1px solid black; padding: 2px;">89.5</span>	NOM PF: <span style="border: 1px solid black; padding: 2px;">73.4</span>	KiloWatt: <span style="border: 1px solid black; padding: 2px;">11.2</span>	_____
GUARANTEED EFFICIENCY: <span style="border: 1px solid black; padding: 2px;">87.5</span>	MAX KVAR: _____	HZ: <span style="border: 1px solid black; padding: 2px;">60</span>	_____

**HAZARDOUS LOCATION DATA (IF APPLICABLE):**

DIVISION: _____	CLASS I: _____	GROUP I: _____
TEMP CODE: _____	CLASS II: _____	GROUP II: _____

**VFD DATA (IF APPLICABLE):**

VOLTS: <span style="border: 1px solid black; padding: 2px;">460</span>	_____
AMPS: <span style="border: 1px solid black; padding: 2px;">22.7</span>	_____
TORQUE 1: <span style="border: 1px solid black; padding: 2px;">89.9LB-FT</span>	TORQUE 2: _____
VFD LOAD TYPE 1: <span style="border: 1px solid black; padding: 2px;">VT/PWM</span>	VFD LOAD TYPE 2: _____
VFD HERTZ RANGE 1: <span style="border: 1px solid black; padding: 2px;">6-60</span>	VFD HERTZ RANGE 2: _____
VFD SPEED RANGE 1: <span style="border: 1px solid black; padding: 2px;">90-900</span>	VFD SPEED RANGE 2: _____
SERVICE FACTOR: <span style="border: 1px solid black; padding: 2px;">1.00</span>	FL SLIP: _____
NO. POLES: _____	MAGNETIZING AMPS: _____
VECTOR MAX RPM: _____	Encoder PPR: _____
Radians / Seconds: _____	Encoder Volts: _____

**TEAO DATA (IF APPLICABLE):**

HP (AIR OVER): _____	HP (AIR OVER M/S): _____	RPM (AIR OVER): _____	RPM (AIR OVER M/S): _____
FPM AIR VELOCITY: _____	FPM AIR VELOCITY M/S: _____	FPM AIR VELOCITY SEC: _____	

**ADDITIONAL NAMEPLATE DATA:**

Decal / Plate	WD=499495	Customer PN	71000280-0825
Notes		Non Rev Ratchet	NRR
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude			
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.06 IN/SEC	Arctic Duty	
3/4 Load Eff.	90.6	Inrush Limit	
Motor Weight (LBS)	330	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	4200	Special Note 2	
Thrust Percentage	100% HT	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3			

**NIDEC MOTOR CORPORATION  
ST. LOUIS, MO**



TYPICAL NAMEPLATE DATA  
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY  
SOME FIELDS MAY BE OMITTED

Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

## MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	TUI	286TPH

ORDER NO.	LINE NO.	100
17700282		

MPI:		230738
HP:		15
POLES:		8
VOLTS:		460
HZ:		60
SERVICE FACTOR:		1.15
EFFICIENCY (%):		
	S.F.	87.6
	FULL	88.5
	3/4	90.6
	1/2	90.6
	1/4	86.5
POWER FACTOR (%):		
	S.F.	75.2
	FULL	73.4
	3/4	67.9
	1/2	56.7
	1/4	36.2
	NOLOAD	4
	LOCKED ROTOR	38.8
AMPS:		
	S.F.	24.5
	FULL	21.6
	3/4	17.1
	1/2	13.7
	1/4	11.2
	NOLOAD	10.6
	LOCKED ROTOR	86.5
NEMA CODE LETTER		E
NEMA DESIGN LETTER		B
FULL LOAD RPM		875
NEMA NOMINAL / EFFICIENCY (%)		89.5
GUARANTEED EFFICIENCY (%)		87.5
MAX KVAR		7.2
AMBIENT (°C)		40
ALTITUDE (FASL)		3300
SAFE STALL TIME-HOT (SEC)		30
SOUND PRESSURE (DBA @ 1M)		65
TORQUES:		
	BREAKDOWN{% F.L.}	205
	LOCKED ROTOR{% F.L.}	145
	FULL LOAD{LB-FT}	89.9

NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

**NIDEC MOTOR CORPORATION**  
ST. LOUIS, MO

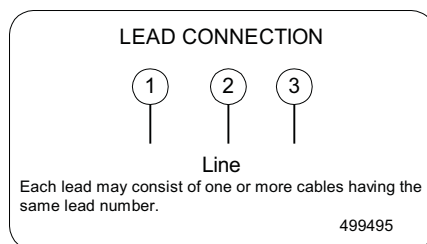
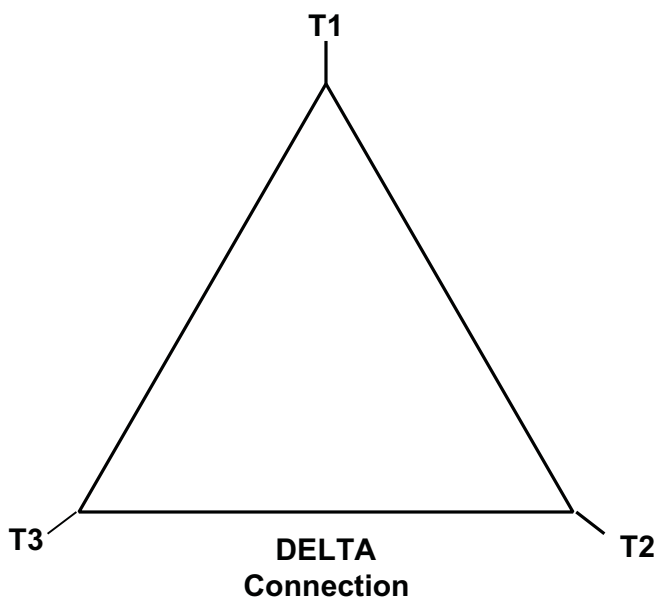


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499495

### Motor Wiring Diagram

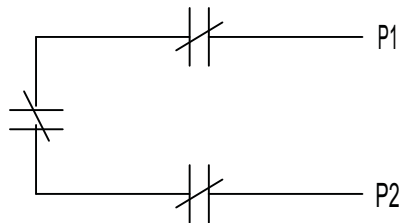


To reverse direction of rotation interchange connections L1 and L2.  
Each lead may be comprised of one or more cables.  
Each cable will be marked with the appropriate lead number.

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.
2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



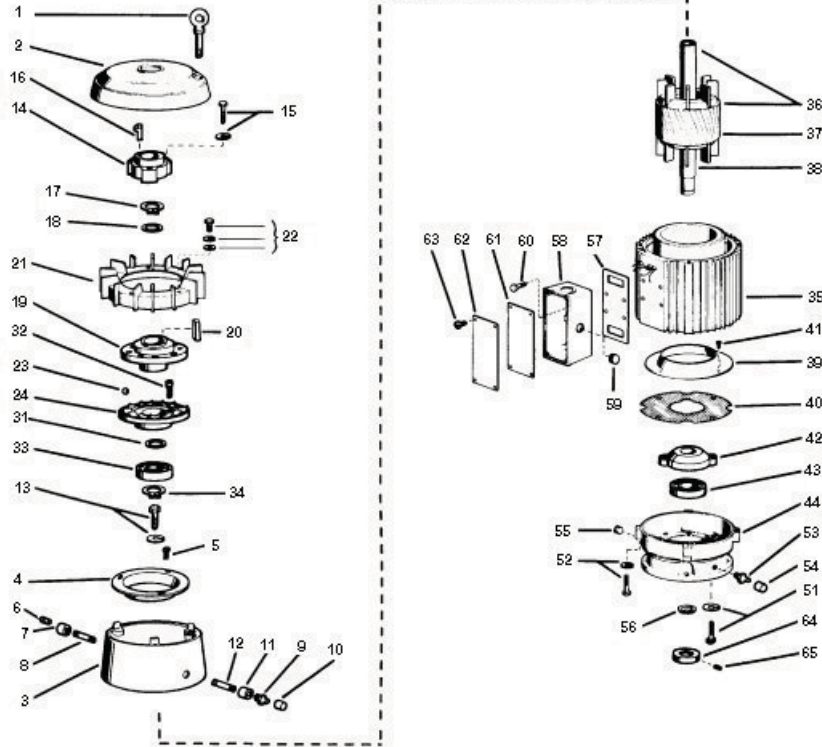
NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: <b>MISC</b>	SCALE	UNITS	TITLE		<b>NIDEC MOTOR CORPORATION</b>
<b>STL0211 - UPDATED FORMAT .</b>	<b>NONE</b>	<b>IN</b>	<b>CUSTOMER CONNECTION DIAGRAM</b>		
	TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)		ISSUED BY	APPROVED BY	REVISION DATE
MATERIAL:	<u>INCHES</u>	<u>mm</u>	<b>R. KING</b>	<b>C. CADE</b>	<b>24-FEB-11</b>
---	ANGLES X° = ±1°		CODE	DWG NO.	REV
				<b>0834066</b>	<b>G</b>
					SHEET NUMBER
					<b>1 OF 1</b>
					DWG SIZE
					<b>A</b>

## RENEWAL PARTS

FRAMES 182 THRU 215 - OPEN DRIPPROOF  
 FRAMES 182 THRU 286 - TOTALLY ENCLOSED  
 TYPES: AU, AUE, AJI, JU, LU, LUCS, LUS, TU, TUC, TUCI, TUCS, TUE, TUI, TUS  
 HIGH THRUST HOLLOSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	2	Eyebolt
2	1	Canopy Cap
3	1	Upper Bracket
4	1	Air Deflector (Upper)
5	3	Screw (Air Deflector)
6	1	Flpe Plug
7	1	Flpe Coupling
8	1	Nipple Fitting
9	1	Grease Fitting
10	1	Plastic Cap

**WARNING:**

Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

**BEARINGS:**

Refer to motor nameplate for the bearing numbers.

**PRICES:**

Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 145 & 146

## RENEWAL PARTS

FRAMES 182 THRU 215 - OPEN DRIPPROOF  
 FRAMES 182 THRU 286 - TOTALLY ENCLOSED  
 TYPES: AU, AUE, AJI, JU, LU, LUCS, LUS, TU, TUC, TUCI, TUCS, TUE, TUI, TUS

### HIGH THRUST HOLLOSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
11	1	Pipe Coupling
12	1	Nipple Fitting
13	4	Screw & Lockwasher (Bracket to Stator)
14	1	Drive Coupling
15	3	Screw & Lockwasher (Drive Coupling)
16	1	Gib Key
17	1	Snap Ring
18	As Req	Shims
19	1	Rotating Ratchet
20	1	Square Key
21	1	Fan
22	5	Screw, Washer & Lockwasher (Fan to Ratchet)
23	10	Steel Ball
24	1	Stationary Ratchet
25-30	-	NOT USED THIS ASSEMBLY
31	As Req	Shims
32	3	Screw (Stationary Ratchet)
33	1	Ball Bearing (Upper) (Refer to Section 775)
34	1	Snap Ring
35	1	Wound Stator Assembly
36	1	Rotor Assembly (Includes items 37 & 38)
37	1	Rotor Core
38	1	Rotor Shaft

ITEM NO.	QTY	NAME OF PART
39	1	Air Deflector (Lower)
40	1	Bracket Screen (AU Only)
41	4	Screw (Air Deflector)
42	1	Bearing Cap (Lower)
43	1	Ball Bearing (Lower) (Refer to Section 775)
44	1	Lower Bracket
45-50	-	NOT USED THIS ASSEMBLY
51	2	Screw & Lockwasher (Bearing Cap)
52	4	Screw & Lockwasher (Bracket to Stator)
53	1	Grease Fitting
54	1	Plastic Cap (Not Illustrated)
55	1	Pipe Plug
56	1	Water Deflector
57	1	Gasket (Outlet Box Base)
58	1	Outlet Box Base
59	1	Pipe Plug
60	4	Screw
61	1	Gasket (Outlet Box Cover)
62	1	Outlet Box Cover
63	4	Screw
64*	1	Stabilizer Bushing (Optional)
65*	2	Screw (Optional)

\* With optional Stabilizer Bushing, delete Item No. 56 and add Items 64 & 65

**WARNING:**

Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

**BEARINGS:**

Refer to motor nameplate for the bearing numbers.

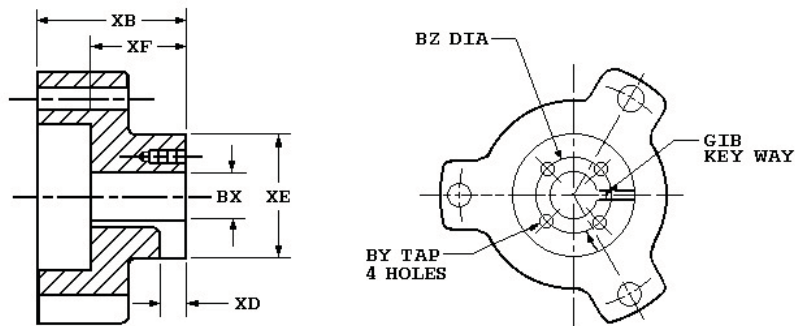
**PRICES:**

Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

reference: Renewal Parts Section 700, Pages 145 & 146

# Vertical HOLLOSHAFT Coupling Dimensions

## Standard Coupling Dimensions



Coupling Part Number	366983
BX Nominal	1 1/4
Actual Bore	1.251
BY	1/4-20
BZ	1 3/4
XB	2 9/16
XD	17/32
XE	2 1/4
XF	1 5/8
SQ. KEY	3/8

### Notes:

1. All Rough casting dimensions may vary by 0.25" due to casting variations.
2. All tapped holes are Unified National Course, Right Hand thread.
3. Coupling bore dimension "BX" is machined with a tolerance of  $-.000$ ",  $+.001$ " up to 1.50" bore inclusive. Larger bores:  $-.000$ ",  $+.002$ ".



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## TYPICAL REED CRITICAL FREQUENCY DATA

Note: Motor RCF Test Data can be provided at time of motor shipment through special test.  
Please contact your Nidec Motor Corporation representative for more information.

MODEL NO: NA  
CATALOG NO: NA

Frame: 286TPH Type: TUI

REED CRITICAL FREQUENCY:	75	HZ
CENTER OF GRAVITY:	11.7	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0017	IN
UNIT WEIGHT:	330	LBS
BASE DIAMETER:	ALL	IN
TOLERANCE ON RCF VALUE:	20%	
DATE:	8/9/2017	



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# General Information for Integral Horsepower (IHP) Motors on Variable Frequency Drives (VFDs)

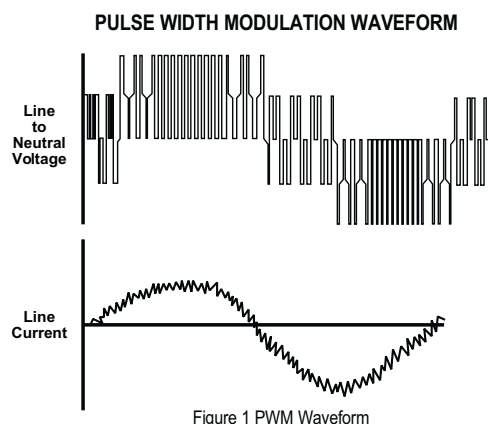
## Variable Frequency Drives (VFD)

A VFD is a type of controller used to vary the speed of an electric motor. The VFD takes a fixed AC voltage and frequency and allows it to be adjusted in order to get different speeds from the motor. Motor speed can be varied by changing the frequency of the input power waveform. The equation below shows how the frequency affects the speed of a three phase induction motor.

$$\text{Speed} = \frac{120 * \text{Fundamental Input Frequency}}{\text{Number of Motor Poles}}$$

## How does a VFD work?

A VFD takes the fixed frequency and voltage sine wave from the power grid or power station and puts it through a few steps in order to allow the VFD user to vary the frequency and in turn control the motor speed. First it rectifies the AC power into DC Power. Because of this step, a term commonly used instead of VFD is inverter. This only describes one step of what the VFD does to the power waveform. Once rectified into a DC voltage the drive sends the power through a set of transistors or switches. These switches can take the DC waveform and by opening and closing at certain speeds and durations can create an output waveform that mimics the sine wave that is required to drive a three phase electric motor. The output wave form is known as a Pulse Width Modulation (PWM) waveform because the waveform is created by multiple pulses of the switches at short intervals.



## What variables should be considered when deciding whether to power a motor with a VFD?

VFD compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of a particular motor for use with a VFD. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line / System Voltage
- Cable length between the VFD and the motor
- Drive switching (carrier) frequency
- Motor construction

- VFD dv/dt
- High temperatures or high humidity
- Grounding system

Wider speed ranges, higher voltages, higher switching frequencies, insufficient grounding and increased cable lengths all add to the severity of the application and, therefore, the potential for premature motor failure.

## How does a VFD affect the motor?

There are many things to consider when a motor is powered using a VFD or PWM power. When a motor is powered by a PWM waveform the motor windings very often see a large differential voltage, either from phase to phase or turn to turn. When the voltage differential becomes large enough it creates a reaction at the molecular level that converts available oxygen into O<sub>3</sub>. This phenomenon is called partial discharge or corona. This reaction creates energy in the form of light and heat. This energy has a corrosive effect on the varnish used to protect the motor windings. PWM waveforms can also magnify shaft voltages which lead to arcing across the bearing and causing premature bearing failure. Corrective action must be taken to mitigate these issues that arise when using an electric motor with a VFD.

## How do I protect the motor?

Nidec Motor Corporation (NMC) has developed specific motor designs to decrease the harmful affects that a VFD can have on a motor. NMC's INVERTER GRADE<sup>®</sup> insulation system is the first line of defense against corona and phase to phase faults that can be common when a motor is powered using a PWM waveform. The INVERTER GRADE<sup>®</sup> insulation system is standard on all of NMC's Inverter Duty products. Along with the INVERTER GRADE<sup>®</sup> insulation, thermostats are installed as a minimum protection against over heating the motor. Special consideration must also be given to bearings in motors powered by VFD's. In order to create a low resistance path to ground for built up shaft voltages a shaft grounding device can be used. On larger horsepower motors an insulated bearing system should be used in conjunction with the shaft grounding device when installed, to force the stray shaft voltages to ground. The bearing failures are more prominent on motors with thrust handling bearings. NMC has created an Inverter Duty vertical motor line that not only uses the INVERTER GRADE<sup>®</sup> insulation system, but that also comes standard with a shaft grounding device. On motors that are 100 HP and greater the thrust bearing is also insulated for additional protection.

## What does "Inverter Duty" mean?

An Inverter Duty motor should describe a motor that helps mitigate potential failure modes of a motor that is powered by a VFD. Inverter duty motor windings should be able to withstand the voltage spikes per NEMA MG1 Part 31.4.4.2 and protect against overheating when the motor is run at slow speeds. On thrust handling bearings it is apparent that the bearings require additional protection. Inverter Duty vertical motors should have a shaft grounding device to protect the motor bearings from fluting due to voltage discharge through the bearing. On larger motors (100HP and larger) the shaft should also be electrically isolated from the frame in order to aid the shaft grounding ring in discharging the shaft voltages to ground.

\*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL<sup>®</sup> & CSA<sup>®</sup> listings where indicated.

† All marks shown within this document are properties of their respective owners.



# Motor / Inverter Compatibility

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## Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (consult codes for installation requirements)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA<sup>®†</sup> 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask an Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

## Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%) mismatch impedance.

## 690V Applications

Motors that are rated for 690VAC and that will be powered by 690VAC PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an INVERTER GRADE<sup>®</sup> motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

## Low Voltage TITAN<sup>®</sup> Motors

When using 449 frame and larger motors on PWM type VFDs consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

## Bearing Currents Related to PWM Waveforms

Due to the uniqueness of this condition occurring in the field, protection of the motor bearings from shaft currents caused by common mode voltages is not a standard feature on sine wave or Inverter Duty motor products, unless explicitly noted. Some installations may be prone to a voltage discharge condition through the motor bearings called Electrical Discharge Machining (EDM) or fluting.

EDM damage is related to characteristics of the PWM waveform, and the VFD programming, and installation factors.

Bearing EDM as a result of VFD waveform characteristics may be prevented by the installation of a shaft grounding device such as a brush or ring and/or correction of the installation characteristics causing the shaft voltage condition. Insulated bearing(s) may be required. VFD filters may be used if bearing fluting is to be mitigated.

## Bearing Protection on Inverter Duty Vertical Motors

All U.S. MOTORS<sup>®</sup> brand "Inverter Duty" vertical products have a shaft grounding system that allows damaging shaft currents a low resistance path to ground. **Bearings on vertical motors fed by VFD power without this bearing protection are not covered under any warranty.** All other bearing failure is covered per NMC's standard warranty. An electric motor repair shop approved to service U.S. MOTORS<sup>®</sup> brand motors must verify that the cause of the bearing failure was not due to EDM damage.

## Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

## Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

## Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Locked rotor and drive tripping caused by non-reversing-ratchet operation at low motor speeds. It is not recommended to operate motors at less than 1/4 of synchronous speed. If slow speeds are required contact NMC engineering.
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/ deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

## Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the resistance of the motor winding to ground, and lower the Corona Inception Voltage (CIV) level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the common methods for drying out a winding that has low resistance readings. **Damage caused by these factors are not covered by the limited warranty provided for the motor unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.**

**NEMA<sup>®†</sup> Application Guide for AC Adjustable Speed Drive Systems:**  
<http://www.nema.org/stds/acadjustable.cfm#download>

\* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL<sup>®†</sup> & CSA<sup>®†</sup> listings where indicated.

† All marks shown within this document are properties of their respective owners.



# Warranty Guidelines for Integral Horsepower (IHP)\* Motors on Variable Frequency Drives

## Warranty Guidelines

The information in the following section refers to the motor and drive application guidelines and limitations for warranty.

## Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. **No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive.** If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

## 575 Volt Motors

575 volt motors can be applied on Inverters when output filters are used. Contact the drive manufacturer for filter selection and installation requirements.

## Applying INVERTER GRADE® Insulated Motors on Variable Frequency Drives (2, 4, 6 pole)

The products within this catalog labeled “Inverter Duty” or “Vector Duty” are considered INVERTER GRADE® insulated motors. INVERTER GRADE® motors exceed the NEMA® MG-1 Part 31 standard. Nidec Motor Corporation provides a three-year limited warranty on all NEMA® frame INVERTER GRADE® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). Cable distance can be further limited by hot and humid environments and VFD manufacturers cable limits. These motors may be appropriate for certain severe inverter applications or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation’s U.S. Motors® brand is available in the following INVERTER GRADE® insulated motors:

- Inverter Duty NEMA® frame motors good for 10:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI
- Inverter Duty motors rated for 10:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed
- 841 Plus® NEMA® Frame Motors

## Applying Premium Efficient motors (that do not have INVERTER GRADE® insulation) on Variable Frequency Drives (2, 4, 6 pole)

Premium efficient motors without INVERTER GRADE insulation meet minimum NEMA® MG-1, Section IV, Part 31.4.4.2. These motors can be used with Variable Frequency Drives (with a reduced warranty period) under the following parameters:

- On NEMA® frame motors, 10:1 speed rating on variable torque loads & 4:1 speed range on constant torque loads.
- On TITAN® frame motors, 10:1 speed rating on variable torque loads.
- On TITAN® frame motors, inquiry required for suitability on constant torque loads.

Cable distances are for reference only and can be further limited by hot and humid environments (refer to Table 1). Refer to specific VFD manufacturers cable limits. Refer to the Motor/ Inverter Compatibility page for special consideration of vertical motor bearings.

Table 1 - Cable Distances			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	127 ft	400 ft	218 ft
6 Khz	90 ft	307 ft	154 ft
9 Khz	73 ft	251 ft	126 ft
12 Khz	64 ft	217 ft	109 ft
15 Khz	57 ft	194 ft	98 ft
20 Khz	49 ft	168 ft	85 ft

## Warranty Period Clarifications and Exceptions

### Standard Energy Efficient Exclusion

Applying Standard & Energy Efficient Motors on Variable Frequency Drives is not recommended. VFD related failures on standard and energy efficient motors will not be covered under warranty.

### Vertical Motor Windings

Premium efficient vertical motors without INVERTER GRADE® insulation that are installed using the criteria described in this document and applied in the correct applications shall have a warranty while powered by a VFD for 12 months from date of installation or 18 months from date of manufacturing whichever comes first. See limited warranty page for horizontal motor warranty periods.

### Bearing Exclusion for Thrust Handling Bearings

Bearings used in premium efficient vertical motors, and all thrust handling bearings, that are powered by VFDs without shaft grounding devices or insulated bearings (when required) will not be covered under any warranty for damages caused from being powered by a VFD. All other bearing failure is covered per NMC’s standard warranty. An electric motor repair shop approved to service U.S. MOTORS® brand motors must verify that the cause of the bearing failure was not due to Electrical Discharge Machining.

### Medium Voltage and Slow Speed Considerations

Motors that are rated above 700 VAC or that are eight pole and slower require special consideration and installation and are not covered under the warranty guidelines in this document. Motors that are rated above 700VAC have special cable length and voltage differential issues that are specific to the VFD type and manufacture. The motor construction and cost may vary dramatically depending on the VFD topology and construction. Contact your NMC representative with VFD manufacturer name and model type for application and motor construction considerations. Motors that are designed eight pole and slower also require special installation and filters per the drive manufacturer.

\* This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL® & CSA® listings where indicated.

† All marks shown within this document are properties of their respective owners.



# Vertical High Thrust Motors



INSTALLATION, OPERATION  
AND MAINTENANCE MANUAL



## Safety First

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High voltage and rotating parts can cause serious injury or loss of life. Installation, operation, and maintenance must be performed by qualified personnel. Familiarization with and adherence to NEMA MG2<sup>†</sup>, the National Electrical Code, and local codes is recommended. It is important to observe safety precautions to protect personnel from possible injury. Personnel should be instructed to:

1. Disconnect all power to motor and accessories prior to initiating any installation, maintenance, or repairs. Also ensure that driven equipment connected to the motor shaft will not cause the motor to rotate (wind milling of fans, water flowing back through pump, etc.).
2. Avoid contact with rotating parts.
3. Act with care in accordance with this manual's prescribed procedures in handling and installing this equipment.
4. Be sure unit and accessories are electrically grounded and proper electrical installation wiring and controls are used in accordance with local and national electrical codes. Refer to "National Electrical Code Handbook" - NFPA No. 70. Employ qualified electricians.
5. Be sure equipment is properly enclosed to prevent access by children or other unauthorized personnel in order to prevent possible accidents.
6. Be sure shaft key is fully captive before unit is energized.
7. Provide proper safeguards for personnel against rotating parts and applications involving high inertia loads which can cause over speed.
8. Avoid extended exposure to equipment with high noise levels.
9. Observe good safety habits at all times and use care to avoid injury to yourself or damage to equipment.
10. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.
11. Observe all special instructions attached to the equipment. Remove shipping fixtures if so equipped before energizing unit.
12. Check motor and driven equipment for proper rotation and phase sequence prior to coupling. Also check if a unidirectional motor is supplied and note proper rotation.
13. Electric motors can retain a lethal charge even after being shut off. Certain accessories (space heaters, etc.) are normally energized when the motor is turned off. Other accessories such as power factor correction capacitors, surge capacitors, etc. can retain an electrical charge after being shut off and disconnected.
14. Do not apply power correction capacitors to motors rated for operation with variable frequency drives. Serious damage to the drive will result if capacitors are placed between the motor and drive. Consult drive supplier for further information.

<sup>†</sup> All marks shown within this document are properties of their respective owners.

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## I. Shipment

Prior to shipment, all motors undergo extensive mechanical and electrical testing, and are thoroughly inspected. Upon receipt of the motor, carefully inspect the unit for any signs of damage that may have occurred during shipment. Should such damage be evident, unpack the motor at once in the presence of a claims adjuster and immediately report all damage and breakage to the transportation company.

When contacting Nidec Motor Corporation (NMC) concerning the motor, be sure to include the complete motor identification number, frame, and type which appear on the nameplate.

## II. Handling

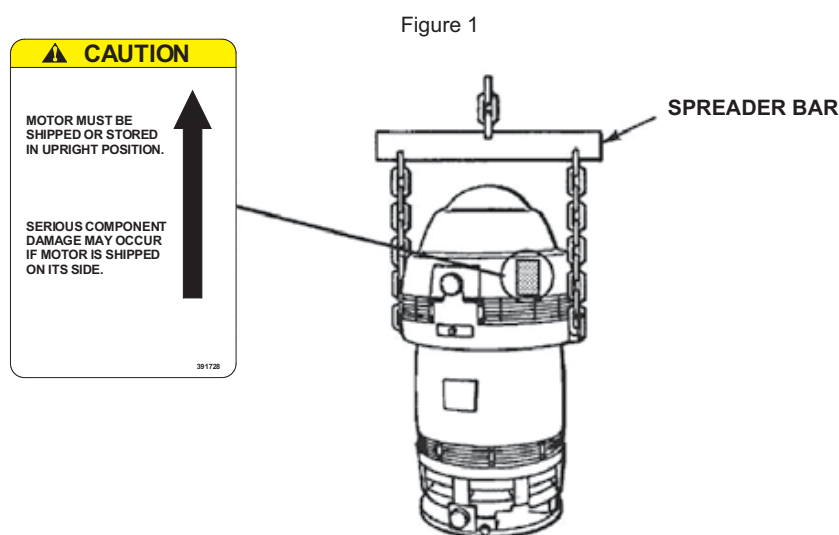
The equipment needed to handle the motor includes a hoist and spreader bar arrangement (see Figure 1) of sufficient strength to lift the motor safely. The spreader bar should have the lifting rings or hooks positioned to equal the span of the lifting lugs or eyebolts. The lifting lugs or eyebolts are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

### ⚠ WARNING

*Lifting the motor by other means can result in damage to the motor or injury to personnel.*

### ⚠ CAUTION

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



### III. Storage

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#### 1) When To Put A Motor In Storage

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

- A. Out of service or in storage less than one month - no special precautions except that space heaters, if supplied, must be energized at any time the motor is not running.
- B. Out of service or in storage for more than one month but less than six months - store per items 2A, B, C, D, E, F(2), and G, items 3A, B, and C, and item 4.
- C. Out of service or in storage for six months or more - all recommendations.

#### 2) Storage Preparation

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

### NOTICE

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

- C. Whether indoors or out, the area of storage should be free from excessive ambient vibration which can cause bearing damage.
- D. Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must be taken to prevent insects, such as dauber wasps, from gaining access to the interior of the motor.
- E. Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. If necessary, re-coat the surfaces with a rust preventative material, such as Rust Veto<sup>®†</sup> No. 342 (manufactured by E.F. Houghton Co.) or an equivalent. The condition of the coating should be checked periodically and surfaces re-coated as needed.
- F. Bearings:
  - 1) When storage time is 6 months or more, grease lubricated cavities must be completely filled with lubricant. Remove the drain plug and fill cavity with grease until grease begins to purge from drain opening. Refer to section IX. “LUBRICATION” and/or review motor’s lubrication nameplate for correct lubricant.

### CAUTION

*Do not re-grease bearings with drain closed or with unit running.*

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

**NOTE:** Motor must not be moved with oil in reservoir. Drain oil before moving to prevent sloshing and possible damage. With a clean cloth, wipe any excess oil from the threads of the drain plug and the inside of the drain hole. Apply Gasoila<sup>®†</sup> P/N SS08 or equivalent thread sealant to the threads of the drain plug and replace the plug in the oil drain hole. Refill oil when motor has been moved to the new location.

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

### 3) Periodic Maintenance

- A. Oil should be inspected monthly for evidence of moisture or oxidation. The oil must be replaced whenever contamination is noted or every twelve months, whichever occurs first. It is important to wipe excess oil from the threads of the drain plug and the drain hole and to coat the plug threads with Gasoila<sup>®†</sup> P/N SS08 or equivalent thread sealant before replacing the drain plug.
- B. Grease lubricated bearings must be inspected once a month for moisture and oxidation by purging a small quantity of grease through the drain. If any contamination is present, the grease must be completely removed and replaced.
- C. All motors must have the shaft rotated once a month to maintain a lubricant film on the bearing races and journals.

#### D. Insulation Testing:

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

1. The recommended procedure for the  $IR_1$  test is as follows:

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

 **WARNING**

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

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

<u>Rated Motor Voltage</u>	<u>Recommended DC Test Voltage</u>
UP to 1000 (inclusive)	500 VDC
1001 to 2500 (inclusive)	500 to 1000 VDC
2501 to 5000 (inclusive)	500 to 2500 VDC
5001 and up	500 to 5000 VDC

 **WARNING**

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

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

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

Where:

$R_{40C}$  = insulation resistance (in megohms) corrected to 40°C

$K_T$  = insulation resistance temperature coefficient at temperature T°C

$R_T$  = measured insulation resistance (in megohms) at temperature T°C

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

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

Where:

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

The recommended procedure for the PI test is as follows:

- (1) Perform steps 1 and 2 from the  $IR_1$  test procedure. Heed the safety warnings given in the  $IR_1$  test procedure.
- (2) With DC voltage still being applied by the megohmmeter, taken an additional reading of insulation resistance between the motor leads and ground 10 minutes after the DC voltage was initially applied. To minimize measurement errors, the variation in winding temperature between the 1 minute and 10 minute readings should be kept to a minimum.
- (3) Obtain the polarization index by taking the ratio of the 10 minute resistance reading to the 1 minute resistance reading.

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

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

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

<b><u>Rated Motor Voltage</u></b>	<b><u>Minimum Insulation Resistance</u></b>
Up to 999 (inclusive)	5 Megohms
1000 and up	100 Megohms

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

Refer any question to the Nidec Motor Corporation Product Service Department.

For more information, refer to the IEEE 43™ Standard.

#### 4. Start-up Preparations After Storage

- A. Motor should be thoroughly inspected and cleaned to restore to an “As Shipped” condition.
- B. Motor which has been subjected to vibration must be disassembled and each bearing inspected for damage.
- C. When storage time has been six (6) months or more, oil and/or grease must be completely changed using lubricants and methods recommended on the motor's lubrication plate, or in **Section IX - “LUBRICATION”**
- D. The winding must be tested to obtain insulation resistance and dielectric absorption ratio as described in **Section III., item 3.**
- E. Contact Nidec Motor Corporation Product Service Department prior to start-up if storage time has exceeded one year.

### IV. Installation Location

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

- 1) The location should be clean, dry, well-ventilated, properly drained, and provide accessibility for inspection, lubrication, and maintenance. Ambient vibration should be kept to a minimum. Outdoor installations on open dripproof motors require protection from the elements.
- 2) The location should provide adequate space for motor removal without shifting the driven unit.
- 3) Temperature rise of a standard motor is based upon operation at an altitude not exceeding 3300 feet (1000 meters) above sea level, and a maximum ambient temperature of 40°C unless specified otherwise on nameplate. See NEMA<sup>®†</sup> MG-1 20.28 for usual service conditions.
- 4) To avoid condensation inside the motor, it should not be stored or operated in areas subject to rapid temperature changes unless it is energized or protected by space heaters.
- 5) The motor should not be installed in close proximity to any combustible material or where flammable gases maybe present, unless it is specifically built for that environment and is U.L. labeled accordingly.
- 6) Oil lubricated motors must be mounted within one degree of true vertical. Failure to do so will result in oil leakage and possibly bearing failure.

## 7) Recommended Minimum Installation Clearances

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

Speed	Distance to Wall	Distance to Another Motor
3600 RPM	2 x motor width	2 x motor width
1800 RPM or Less	1 x motor width	

## V. Initial Installation

### CAUTION

*Any rotating component removed to facilitate installation of motor should be witness marked to assist in reassembly as not to affect the overall motor balance. All loosened or removed parts must be reassembled and tightened to original specifications.*

### 1. General

Reliable, trouble free operation of a motor and driven unit depends on a properly designed foundation and base plus good alignment. If the motor and driven unit are not installed properly, the following may result:

- \* Noisy Operation
- \* Excessive vibration
- \* Bearing damage or failure
- \* Motor failure

### 2. Shaft Alignment

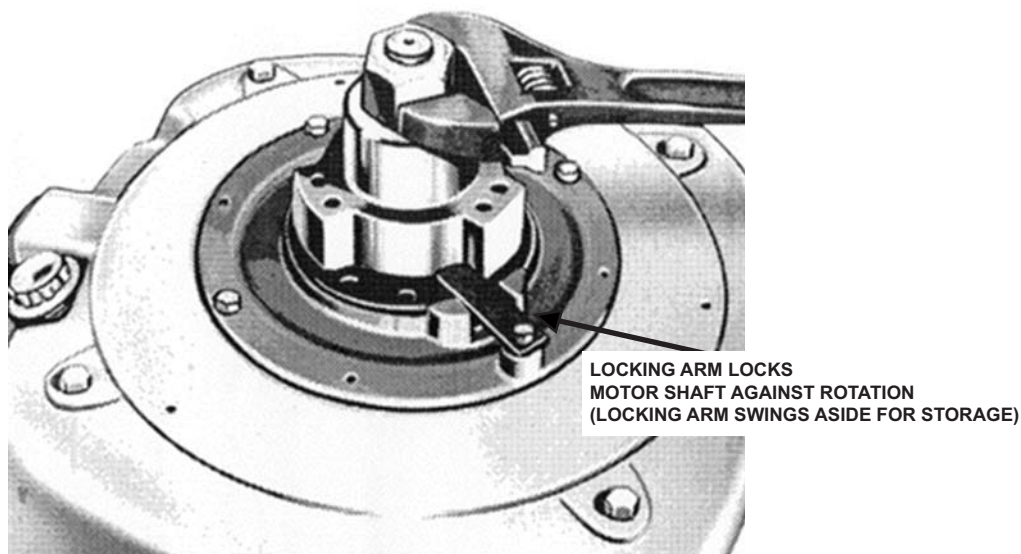
On HOLLOSHAFT® motors, the pump shaft and motor coupling must be aligned within .003" TIR. On solid shaft motors, the motor and pump shafts must be aligned within .002" TIR.

### 3. Pump Shaft Adjustment (HOLLOSHAFT® motors only)

To facilitate axial pump shaft adjustment, a locking feature is provided to lock the motor shaft against rotation. The two types of locking features are as follows:

- A. Locking arm (Figure 2) - The locking arm is bolted to a stationary part and is pinned (for best results use arm in tension) or interferes with a rotating part (when locking arm is not in use it should be moved out of the way and bolted in place). A non-reverse ratchet functions as a locking device. Motors supplied with a non-reverse ratchet are not equipped with a locking arm.
- B. Pinning through mating holes - Holes are provided in both a stationary and rotating part which line up allowing insertion of a pin.

Figure 2



**⚠ WARNING**

*Locking device must be disengaged prior to starting motor or motor damage and/or injury to personnel can result.*

**⚠ CAUTION**

*Care should be exercised when lowering the motor over the pump shaft so that the oil retaining tube in the lower bracket is not damaged (applies only to motors with oil lubricated lower bearing).*

4. Drive Coupling (HOLLOSHAFT® units only).

The drive coupling may be utilized in one of two ways:

- A. Bolted type (Figure 3) - Hold down bolts are installed (some motors require removal of driving pins to allow installation of hold down bolts) in the drive coupling to prevent upward movement of the pump shaft. This will allow momentary upthrust from the pump to be taken by the motor's guide bearing.

**⚠ WARNING**

*Failure to tighten coupling and non-reverse ratchet bolts to required torque values can cause bolts to break, resulting in equipment damage or injury to personnel.*

**⚠ WARNING**

*Failure to tighten coupling and non-reverse ratchet bolts to the required torque values shall cause bolts to break, resulting in equipment damage or injury to personnel.*

Figure 3  
Bolted Coupling

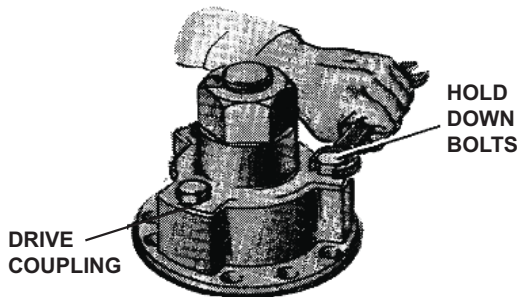
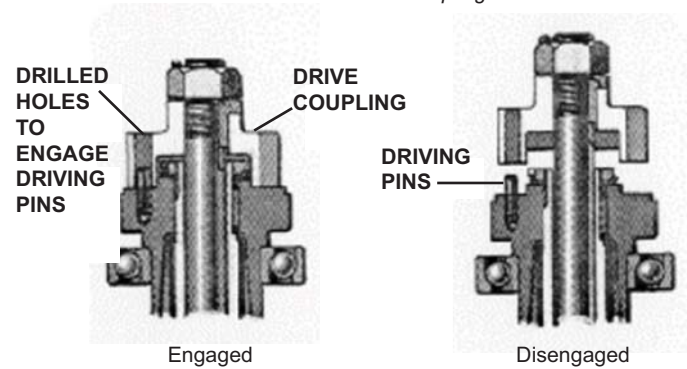


Figure 4  
Self Release Coupling



Adjusting Nut Locking Screw

B. Self-release type (Figure 4) - Driving pins are used to engage the drive coupling with the rotor. A power reversal may unscrew the joints of the pump shafting, causing the shafting to lengthen and buckle or break if the shafting is restrained. The self-release coupling will lift out of engagement with partial unscrewing of the shafting, thus stopping further rotation of the pump. The following items must be followed for proper functioning of the self-release coupling:

- The pump shaft adjusting nut must be properly secured to the drive coupling with a locking screw
- The drive coupling should not bind on the driving pins
- The drive coupling must not be bolted down
- The pump shaft must be concentric to the motor shaft to prevent rubbing of the pump shaft inside the motor shaft
- There must be no potential for upthrust in the application
- Do not use the self-release feature in conjunction with a lower steady bushing, as friction between the parts can damage the line shafting and/or bushing
- Due to the possibility of sparking as the parts separate, the self-release feature must not be used in an environment where explosive gases or dust may be present

**⚠ WARNING**

*Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.*

## 5. Water Cooling For Bearing Oil Reservoir.

If the motor is equipped with cooling coils in the oil reservoir, a minimum water supply of 4 GPM must be maintained at a maximum of 125 PSI with a 32°C (90°F) maximum inlet temperature. External water connections must be self draining to prevent cooling coil rupture at freezing temperatures. Use clean, noncorrosive water only. If corrosive conditions exist and are specified at time of motor order, special corrosion resistant fittings can be supplied.

## 6. Electrical Connection

Refer to the motor nameplate for power supply requirements and to the connection diagram on the motor. Be sure connections are tight. Check carefully and assure that they agree with the connection diagram, then insulate all connections to be sure that they will not short against each other to ground. Be sure the motor is grounded to guard against possible electrical shock. Refer to the National Electrical Code Handbook (NFPA No. 70) and to local electrical codes for proper wiring, protection, and wire sizing. Be sure proper starting equipment and protective devices are used for every motor. For assistance, contact the motor starter manufacturer.

**Part Winding Starters:** Part winding starters used with part winding start motors should have the timer set at a minimum time consistent with the power company requirements. The recommended maximum time on part winding is two seconds. Setting the timer for longer periods can cause permanent damage to the motor and may void the warranty. Note that motor may or may not start on part winding start connection.

## 7. Direction Of Rotation

As a standard, motors that are equipped with a non-reverse ratchet are designed to operate in a counterclockwise direction as viewed from the top of the motor. Also, some high speed motors have unidirectional ventilating fans. When the motor has a unidirectional ventilating fan, the direction of rotation is indicated by an arrow mounted on the motor and by a warning plate mounted near the main nameplate.

### CAUTION

*Apply power **momentarily** to observe the direction of rotation for which the leads are connected. Motor damage may occur if power is applied for more than ten seconds while rotation is locked against the non-reverse ratchet. The motor should be uncoupled from the driven equipment during this procedure to assure driven equipment is not damaged by reverse rotation. Couplings (if installed) should be properly secured.*

*For a 3 phase motor, to reverse the direction of rotation (if the motor is not operating in the correct direction), interchange any two of the three power leads on the motor. For a 1 phase motor, if the motor is not operating in the correct direction, follow the instructions on the connection plate attached to the motor in order to reverse the direction of rotation. For both 1 and 3 phase motors, be sure that the power is off and steps are taken to prevent accidental starting of the motor before attempting to change electrical connection.*

## 8. Spring-Preloaded Thrust Bearings

Motors built with spherical roller thrust bearings (bearing number 29xxx) at any speed or tandem angular contact thrust bearings (bearing number 7xxx) on large 3600 or 3000 RPM (2-pole) motors have preload springs which maintain a minimum thrust load at all times to prevent bearing skidding. These motors require a minimum external thrust load sufficient to compress the springs to properly seat the thrust bearing and to relieve the lower guide bearing of axial spring thrust. Refer to motor's minimum thrust nameplate for required thrust.

### CAUTION

*Do not run a motor which has bearing preload springs without thrust load for more than fifteen (15) minutes as bearing damage can result.*

## 9. Initial Start

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

- A. Ensure that motor and control device connections agree with wiring diagrams.
- B. Ensure that voltage, phase, and frequency of line circuit (power supply) agree with motor nameplate.
- C. Check insulation resistance according to Section III "STORAGE" item 3.
- D. Check all foundation, base, non-reverse ratchet (if applicable), and coupling bolts (if applicable) to ensure they are tight.
- E. If motor has been in storage, either before or after installation, refer to Section III "STORAGE" Item 4 for preparations.
- F. Motors are tested with oil at our manufacturing facility then drained prior to shipment.

Note: A small amount of residual oil and rust inhibitor will remain in the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation. Check oil lubricated units to be certain that bearing housings have been filled to between the "MAX" and "MIN" levels on the sight gauge windows with the correct lubricant. Refer to Section IX "LUBRICATION" for proper oils.

- G. Check for proper or desired rotation. See item 7 of this section for details.
- H. Ensure that all protective devices are connected and operating properly, and that all outlet accessory, and access covers have been returned to their original intended position.
- I. Start motor at lowest possible load and monitor to be sure that no unusual condition develops.

### WARNING

*All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.*

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

## VI. Normal Operation

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Start the motor in accordance with standard instructions for the starting equipment used.

### 1. General Maintenance

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

- A. Trained personnel who have a working knowledge of rotational equipment and have read this manual.
- B. Systematic records which contain at least the following:
  - 1. Complete nameplate data
  - 2. Prints (wiring diagrams, certified outline dimensions)
  - 3. Alignment data
  - 4. Results of regular inspection, including vibration and bearing temperature data, as applicable
  - 5. Documentation of any repairs
  - 6. Lubrication data:
    - Method of application
    - Types of lubricants for wet, dry, hot, or adverse locations
    - Maintenance cycle by location (some require more frequent lubrication)

### 2. Inspection and Cleaning

Stop the motor before cleaning. **CAUTION: Assure against accidental starting of the motor.** Clean the motor inside and out regularly. The frequency of cleaning depends upon actual conditions existing around the motor. Use the following procedures as they apply:

- A. Wipe off dirt, dust, oil, water, or other liquids from external surfaces of motor. These materials can work into or be carried into the motor windings and may cause overheating or insulation breakdown.
- B. Remove dirt, dust, or debris from ventilating air inlets. Never allow dirt to accumulate near air inlets. Never operate motor with air passages blocked.
- C. Clean motors internally by blowing with clean, dry, compressed air at 40 to 60 PSI. If conditions warrant, use a vacuum cleaner.



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

- D. When dirt and dust are solidly packed, or windings are coated with oil or greasy grime, disassemble the motor and clean with solvent. Use only high-flash naphtha, mineral spirits, or Stoddard solvent. Wipe with solvent dampened cloth, or use suitable soft bristled brush. DO NOT SOAK. Oven dry (150 - 175°F) solvent cleaned windings thoroughly before reassembly.
- E. After cleaning and drying the windings, check the Insulation resistance per Section III, Item 3.

## VII. Non-Reverse Ratchet

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Units featuring non-reverse ratchets are refine-balanced by attaching weights to the rotating ratchet. If the ratchet is removed, it should be marked and reassembled in the same position to retain proper balance.

## VIII. Endplay Adjustment

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The term endplay is defined as the total axial float of the rotor. Should the motor be disassembled for any reason, the rotor endplay must be adjusted. Care must be taken to ensure that end play is within the proper range. Use one of the following procedures, depending upon the type of thrust bearing to set and play:

### CAUTION

*Excessive endplay can allow the thrust bearing to separate when units are run with zero thrust or momentary up thrust, resulting in thrust bearing failure. Insufficient endplay may cause the bearings to load against each other, resulting in extreme heat and rapid failure of both the guide and thrust bearings.*

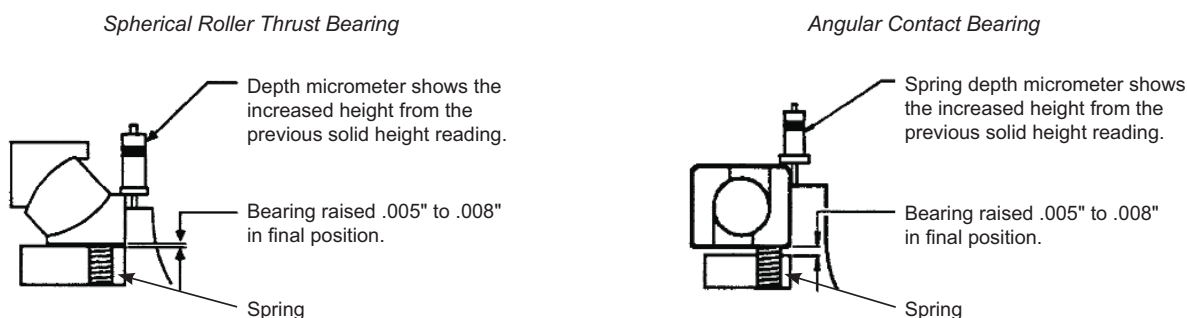
#### 1. Spherical Roller Thrust Bearings and Angular Contact Bearings (With Springs).

Setting the correct end play on units with spring-preloaded spherical roller or angular contact thrust bearings requires a controlled assembly method, due to various deflections internal to the motor and friction of locknut threads from spring force. An end play setting of .005 to .008 inches is required to allow the lower guide bearing to return to an unloaded position when external thrust is applied to the motor (see Figure 5). End play can be properly adjusted by the following recommended procedure:

- A. Place spring retainer (without springs) and lower thrust washer of bearing into upper bearing bore.
- B. Using a depth micrometer, measure the distance between the top and lower thrust washer and the faced surface on top of the bearing housing (see Figure 5). Record dimension to three decimals.
- C. Add .005 to .008 inches to the recorded dimension to obtain the correct endplay range for the unit.
- D. Reassemble bearing with springs. Motor is now ready to set and play. Several acceptable methods for setting endplay are following.

**NOTE:** Certain motor builds require removal of the fabricated steel or cast aluminum oil baffle to provide access for depth micrometer measurements.

Figure 5



## 2. Angular Contact Ball Bearings (Without Springs)

- A. No preliminary measurements are required to set and play. End play may be set by any of the following methods described in this section.
- B. To correctly adjust the endplay setting, a dial indicator should be positioned to read the shaft axial movement. (See figure 7 for location and dial indicator). The rotor adjusting locknut should be turned until no further upward movement of the shaft is indicated. The locknut is then loosened until .005 to .008" endplay is obtained. Lock the locknut with lock washer.

### **CAUTION**

*Care should be taken to ensure that the locknut is not over-tightened, as this can lead to an erroneous end play setting (due to deflection of parts) and bearing damage may result.*

- C. Motors that have two opposed angular contact bearings that are locked for up and downthrust do not require endplay adjustment. The shaft, however, should be set to the original 'AH' (shaft extension length) to prevent the guide bearing from taking thrust.

## END PLAY ADJUSTMENT METHODS

### 1. Method 1 (refer to Figures 6 & 7)

This method requires the user to install a bolted chain from the bearing mount back to a lifting lug. Rotate the locknut with a spanner wrench (and bar extension) until dial indicator shows no movement on end of shaft. The locknut should then be loosened until proper endplay is obtained, lock the locknut with lock washer. (See Figure 7 for location of dial indicator.)

**NOTE:** This is the lowest cost of the three methods and requires the least amount of equipment. This method, however, may be less desirable than Method 2 as considerable locknut torque may be encountered on units with bearing preload springs.

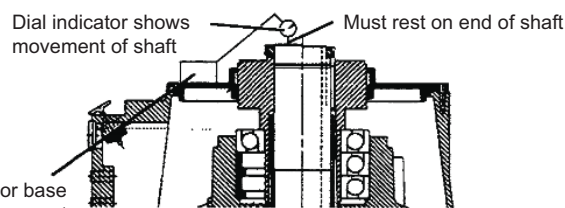
- Special equipment required:
- Locking bolts
  - 3/4" chain
  - Spanner wrench with extension
  - Dial indicator
  - Depth micrometer

Figure 6 (Method 1)



Mounting springs are compressed and rotor is lifted by locknut

Figure 7 (Method 1 &amp; 3)



Dial indicator shows movement of shaft  
Dial indicator base must rest on a stationary part as close as possible to shaft.

## 2. Method 2 (refer to Figure 8 - Utilized on spring Loaded Bearings Only)

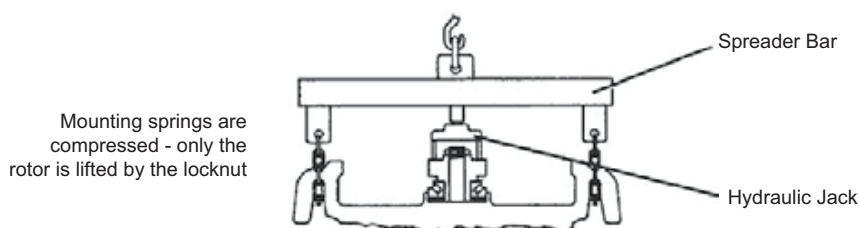
This method utilizes a spreader bar and chains to wrap around lifting lugs, a hydraulic jack (five ton), and crane to lift the spreader bar. The hydraulic jack is supported by two steel blocks of equal thickness on top of the bearing mounting with the jack pushing against the spreader bar. On large motors, the rotor can be lifted by placing a second jack below the motor shaft to allow the locknut to be turned easily.

**NOTE:** This method utilizes typical shop equipment and tools. Endplay settings can be checked quickly on larger vertical motor products. The locknut lifts rotor weight only.

Equipment required:

- Large spreader bar with chains and locking bolts
- Overhead crane
- Spanner wrench
- 5-ton hydraulic jack
- Depth micrometer
- Metal blocks
- Dial indicator

Figure 8 (Method 2)



Mounting springs are compressed - only the rotor is lifted by the locknut

## 3. Method 3 (refer to Figure 9)

This method uses a one inch thick steel disc with a center hole for the shaft end bolt and two threaded hydraulic jacks connected to a single pump. Apply load to hydraulic jacks until dial indicator shows no movement on end of shaft. (See Figure 7 for location of dial indicator). The shaft locknut should be positioned and the pressure from hydraulic jack relieved until proper endplay is obtained.



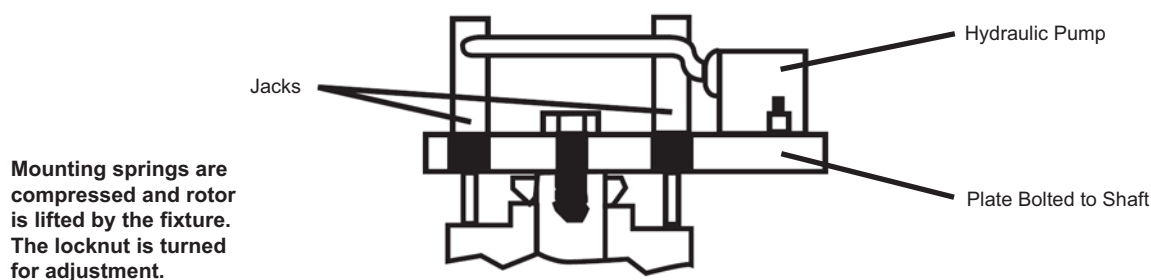
*Use of excessive hydraulic pressure can damage bearings.*

**NOTE:** This method is directly usable on solid shaft motors and can be used on most HOLLOSHAFT® motors with the use of a long threaded rod and plate. It is easy to apply and settings can be checked quickly, especially in field service. The locknut does not see any force and can be turned easily.

Equipment required:

- Fixture with hydraulic jacks
- Dial indicator
- Spanner wrench

Figure 9 (Method 3)



**⚠ CAUTION**

*After setting endplay, run unit for three to five minutes, then stop and verify the endplay setting. Readjust as necessary. All loosened or removed parts must be reassembled and tightened to original specifications. Keep all tools, chains, equipment, etc. clear of unit before energizing motor.*

## IX. Lubrication

Motor must be at rest and electrical controls should be locked open to prevent energizing while being serviced. If motor is being taken out of storage, refer to **Section III “STORAGE”, item 4** for instructions.

### 1. Oil lubricated bearings

Motors are tested with oil at our manufacturing facility then drained prior to shipment. A small amount of residual oil and rust inhibitor will remain on the oil sump. This residual oil and rust inhibitor is compatible with Turbine Type Mineral Oils and Synthetic, PAO (Poly Alpha Olefin) based oils listed in this manual. It is not necessary to drain this residual oil when adding new oil for operation.

Change oil once per year with normal service conditions. Frequent starting and stopping, damp or dusty environment, extreme temperature, or any other severe service conditions will warrant more frequent oil changes. If there is any question, consult Nidec Motor Corporation Product Service Department for recommended oil change intervals regarding your particular situation.

Determine required oil ISO Viscosity Grade (VG) and base oil type from Table 3, then see Table 4 for approved oils. Add oil into oil fill hole at each bearing housing until the oil level reaches between minimum and maximum marks located on the sight of the gauge window. It is important to wipe excess oil from the threads of the drain hole and to coat the plug threads with Gasoila<sup>®†</sup> P/N SS08, manufactured by Federal Process Corporation or equivalent thread sealant before replacing the drain plug. Plug should be tightened to a minimum of 20 lb.-ft. using a torque wrench. See the motor nameplate or Table 5 for the approximate quantity of oil required.

### 2. Grease Lubricated Bearings

#### A. Relubrication of Units In Service

Grease lubricated bearings are pre-lubricated at the factory and normally do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 or suggested regreasing intervals and quantities. Note that operating environment and application may dictate more frequent lubrication. To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage (caked grease or foreign particles) with a mechanical probe, taking care not to damage bearing.

#### **WARNING**

*Should a motor supplied with a self-release coupling become uncoupled, the motor and pump must be stationary and all power locked out before manually re-coupling.*

Add new grease at the grease inlet. New grease must be compatible with the grease already in the motor (refer to table 2 for compatible greases).

#### **WARNING**

*Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. Prevent such intermixing by disassembling motor, removing all old grease and repacking with new grease per item B of this section. Refer to Table 2 for recommended greases.*

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

**⚠ WARNING**

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

### B. Change of Lubricant

Motor must be disassembled as necessary to gain full access to bearing housing(s).

Remove all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings both inboard and outboard of bearing approximately 30 percent full of new grease. Grease fill ports must be completely charged with new grease. Inject new grease into bearing between rolling elements to fill bearing. Remove excess grease extending beyond the edges of the bearing races and retainers.

Table 1  
Recommended Grease Replenishment Quantities & Lubrication Intervals

Bearing Number		Grease Replenishment Quantity (Fl. Oz.)	Lubrication Interval		
62xx, 72xx	63xx, 73xx		1801 thru 3600 RPM	1201 thru 1800 RPM	1200 RPM and slower
03 thru 07	03 thru 06	0.2	1 Year	2 Years	2 Years
08 thru 12	07 thru 09	0.4	6 Months	1 Year	1 Year
13 thru 15	10 thru 11	0.6	6 Months	1 Year	1 Year
16 thru 20	12 thru 15	1.0	3 Months	6 Months	6 Months
21 thru 28	16 thru 20	1.8	3 Months	6 Months	6 Months

Refer to motor nameplate for bearings provided on a specific motor. For bearings not listed in Table 1, the amount of grease required may be calculated by the formula:

$$G = 0.11 \times D \times B$$

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

Table 2  
Recommended Greases

Motor Frame Size	Motor Enclosure	Grease Manufacturer	Grease (NLGI Grade 2)
All Thru 447	All	Exxon Mobil	Polyrex-EM
449 and Up	Open Dripproof		
449 and Up	TEFC and Explosionproof		Mobilith SHC-100

The above greases are interchangeable with the grease provided in units supplied from the factory (unless stated otherwise on motor lubrication nameplate).

Table 3  
Nidec Motor Corporation Recommended Oil Viscosities

Use chart below when "no" special lubrication plate is attached to the motor

Angular Contact Thrust Bearing (7XXX Series) (ABMA BT-Series)						
Motor Enclosure	Frame Size	Speed (RPM)	Ambient Temperature	ISO VG	Base Oil Type	
Open Dripproof or Weather Protected	324 and larger	All	-15°C thru 40°C (5-104°F)	32	Mineral or Synthetic	
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
-15°C thru 40°C (5-104°F)	404 thru 447		32	Mineral or Synthetic		
			41°C thru 50°C (105-122°F)	68	Synthetic Only	
Totally Enclosed or Explosion proof	449 thru 5811		1801-3600	-15°C thru 40°C (104°F)	32	Synthetic Only
			1800 & below		68	Synthetic Only
		All	41°C thru 50°C (105-122°F)	Refer to Office		

Spherical Roller Thrust Bearing (29XXX Series) (ABMA TS-Series)					
Motor Enclosure	Frame Size	Speed (RPM)	Ambient Temperature	ISO VG	Base Oil Type
Open Dripproof or Weather Protected	444 and larger	1800 and below	-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	
			41°C thru 50°C (105-122°F)		
Totally Enclosed or Explosion proof	449 and larger		-15°C thru 25°C (5-77°F)	68	Mineral or Synthetic
			6°C thru 40°C (42-104°F)	150	Synthetic Only
			41°C thru 50°C (105-122°F)	Refer to Office	

Notes:

1. If lower guide bearing is oil lubricated, it should use the same oil as the thrust bearing.
2. If lower guide bearing is grease-lubricated, refer to TABLE 2 for recommended greases.
3. Refer to Nidec Motor Corporation for ambient temperatures other than those listed.

Table 4  
Nidec Motor Corporation Approved Oil Specifications For Use with Anti-Friction Bearings

Oil Manufacturer	ISO VG 32		ISO VG 68		ISO VG 150	
	Viscosity: 130-165 SSU @ 100F		Viscosity: 284-347 SSU @100F		Viscosity: 620-765 SSU @ 100F	
	Mineral Base Oil	Synthetic Base Oil	Mineral Base Oil	Synthetic Base Oil	Mineral Base Oil	Synthetic Base Oil
Chevron USA, Inc.	GST Turbine Oil 32	Cetus 32 Hipersyn	GST Turbine Oil 68	Cetus 32 Hipersyn	R & O Machine Oil 150	Cetus 32 Hipersyn
Conoco Oil Co.	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear Turbine Oil 32	Syncon 32	Hydroclear AW Hyd. Fluid 150	N/A
ExxonMobil	DTE Oil Light, Teresstic 32	SHC 624	DTE Oil Heavy Medium, Teresstic 68	SHC 626	DTE Oil Extra Heavy, Teresstic 150	SHC 629
Phillips Petroleum Co.	Magnus 32	Syndustrial "E" 32	Magnus 68	Syndustrial "E" 68	Magnus 150	N/A
Shell Oil Co.	Tellus S2 MX 32	Tellus HD Oil AW SHF 32	Tellus S2 MX 68	Tellus HD Oil AW SHF 68	Morlina S3 BA 150	N/A
Texaco Lubricants Co.	Regal 32	Cetus PAO 32	Regal 68	Cetus PAO 68	Regal 150	N/A

Table 5  
Approximate Oil Sump Capacities

Frame Size	Motor Type Designation (See Motor Nameplate)	Oil Capacity (Quarts)	
		Upper Bearing	Lower Bearing
180 - 280	AU, AV-4	Grease	Grease
180 - 280	AV		
320 - 440	RV		
320 - 360	RV-4, RU	3	
400	RV-4, RU	5	
440	RV-4 (2 pole)	17	
	RV-4, RU (4 pole & slower)	6	
180 - 440	TV-9, TV, LV-9, LV	Grease	
180 - 360	TV-4, TU, LV-4, LU		
400	TV-4, TU, LV-4, LU	6	
440	TV-4, TU, LV-4, LU	5	
449	JU, JV-4	22	
	HU, HV-4	12	
	JV-3, JV, HV	Grease	
HV, EV, JV, RV			
5000	RU, RV-4	30	
	HU, HV-4 (4 pole & slower)	12	
	HV-4 (2 pole only)	20	
	EU, JU, EV-4, JV-4	22	5
5808-5810	HU, HV-4	24	3
5807-5811	EU, JU, EV-4, JV-4	37	4
5812	JU, JV4	41	4
5813	RU, RV-4	48	4
6808-6810	HU, HV-4	70	3
6808-6810	HV (Bow Thruster)	Grease	Grease
6808-6810	HV (Other Than Bow Thruster)	70	3
6812	JU, JV4	48	7
6813	RU, RV4	45	7
8000	RU, RV-4	70	6
	RV	Grease	Grease
9600	RU, RV-4	95	13
	RV	Grease	Grease
6812	JU, JV4	48	7
6813	RU, RV4	41	7

## X. Fundamental Troubleshooting - Problem Analysis

This chart can reduce work and time spent on motor analysis. Always check the chart first before starting motor disassembly, as what appears to be a motor problem may often be located elsewhere. For additional information, consult our website at [www.usmotors.com](http://www.usmotors.com).

SYMPTOM	POSSIBLE CAUSE	ANALYSIS
Motor fails to start	Defective power supply	Check voltage across all phases above disconnection switch
	Blown or defective primary fuses	
	Blown or defective secondary fuses	Check voltage below fuses (all phases) with disconnect closed
	Open control circuit	Push reset button
	Overload trips are open	
	Defective holding coil in magnetic switch	Push start button and allow sufficient time for operation of time and delay, if used, the check voltage across magnetic holding coil. If correct voltage is measured, coil is defective. If no voltage is measured, control circuit is open
	Loose or poor connections in control circuits	Make visual inspection of all connections in control switch
	Magnetic switch closes	Open manual disconnect switch, close magnetic by hand, and examine contractors and springs
	Poor switch closes	
	Opens circuit in control panel	Check voltage at T1, T2, & T3
	Open circuit leads to motor	Check voltage at leads in outlet box
Leads improperly connected	Check lead numbers and connections	
Motor fails to come up to speed	Low or incorrect voltage	Check voltage at T1, T2, & T3 in control panel and at motor leads in outlet box
	Incorrect connection at motor	Check for proper lead connections at motor and compare with connection diagram on motor
	Overload - Mechanical	Check impeller setting. Check for a tight or locked shaft
	Overload - Hydraulic	Check impeller setting. Check GPM against pump capacity and head
Motor Vibrates	Headshaft misaligned	Remove top drive coupling and check alignment of motor to pump
	Worn line shaft bearings or bent line shaft	Disconnect motor from pump and run motor only to determine source of vibration
	Hydraulic disturbance in discharge piping	Check isolation joint in discharge piping near pump head
	Ambient Vibration	Check base vibration level with motor stopped
	System Natural Frequency (Resonance)	Revise rigidity of support structure
Motor Noisy	Worn thrust bearing	Remove dust cover, rotate rotor by hand, and make visual examination of balls and races. Bearing noise is commonly accompanied by a high frequency vibration and/or increased temperature
	Electrical noise	Most motors are electrically noisy during the starting period. This noise should diminish as motor reaches full speed

SYMPTOM	POSSIBLE CAUSE	ANALYSIS
<p>Motor overheating (Check with thermocouple or by resistance methods. Do not depend on hand.)</p>	Overload	<p>Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.</p>
	Motor intake or exhaust blocked or clogged	<p>Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped</p>
	Unbalanced voltage	<p>Check voltage to all phases. Refer to Appendix A</p>
	Open stator windings	<p>Disconnect motor from load. Check idle amps for balance in all three phases. Check stator resistance in all three phases</p>
	Over / Under Voltage	<p>Check voltage and compare to nameplate voltage</p>
	Ground	<p>Locate with test lamp or insulation tester and repair</p>
	Improper connections	<p>Re-check connections</p>
<p>Bearing Overheating</p> <p>Generally, bearing temperatures (as measured by a tipsensitive RTD or thermocouple touching the bearing outer race) should not exceed 90°C when using mineral-based lubricants or 120°C when using synthetic-based lubricants</p>	Misalignment	<p>Check alignment</p>
	Incorrect oil, or oil level too high or too low	<p>Refill with proper oil. Verify oil level is correct</p>
	Excessive thrust	<p>Reduce thrust from driven machine</p>
	Bearing over-greased	<p>Relieve bearing cavity of grease to level specified in lubrication section</p>
	Motor overloaded	<p>Measure load and compare to nameplate rating. Check for excessive friction in motor or in complete drive. Reduce load or replace motor with greater capacity motor. Refer to Appendix C.</p>
	Motor intake or exhaust blocked or clogged	<p>Clean motor intake and exhaust areas. Clean filters or screens if motor is so equipped</p>
<p>Bearing oil leaking around the drain plug</p>	<p>Insufficient sealant applied to drain plug threads</p>	<p>Remove drain plug and drain existing oil from sump. With a clean cloth, wipe excess oil from the plug threads and the threads in the drain hole. Apply Gasolia Thread Sealant P/N SS08 to the threads of the plug and replace. Fill sump with new oil to the proper level.</p>

## XI. Spare Parts

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A parts list is available for your unit and will be furnished upon request. Parts may be obtained from local Nidec Motor Corporation distributors and authorized service shops, or through Nidec Motor Corporation distribution center.

**Nidec Motor Corporation**  
710 Venture Drive  
Suite 100  
Southaven, MS 38672  
Phone (662) 342-6910  
Fax (662) 342-7350

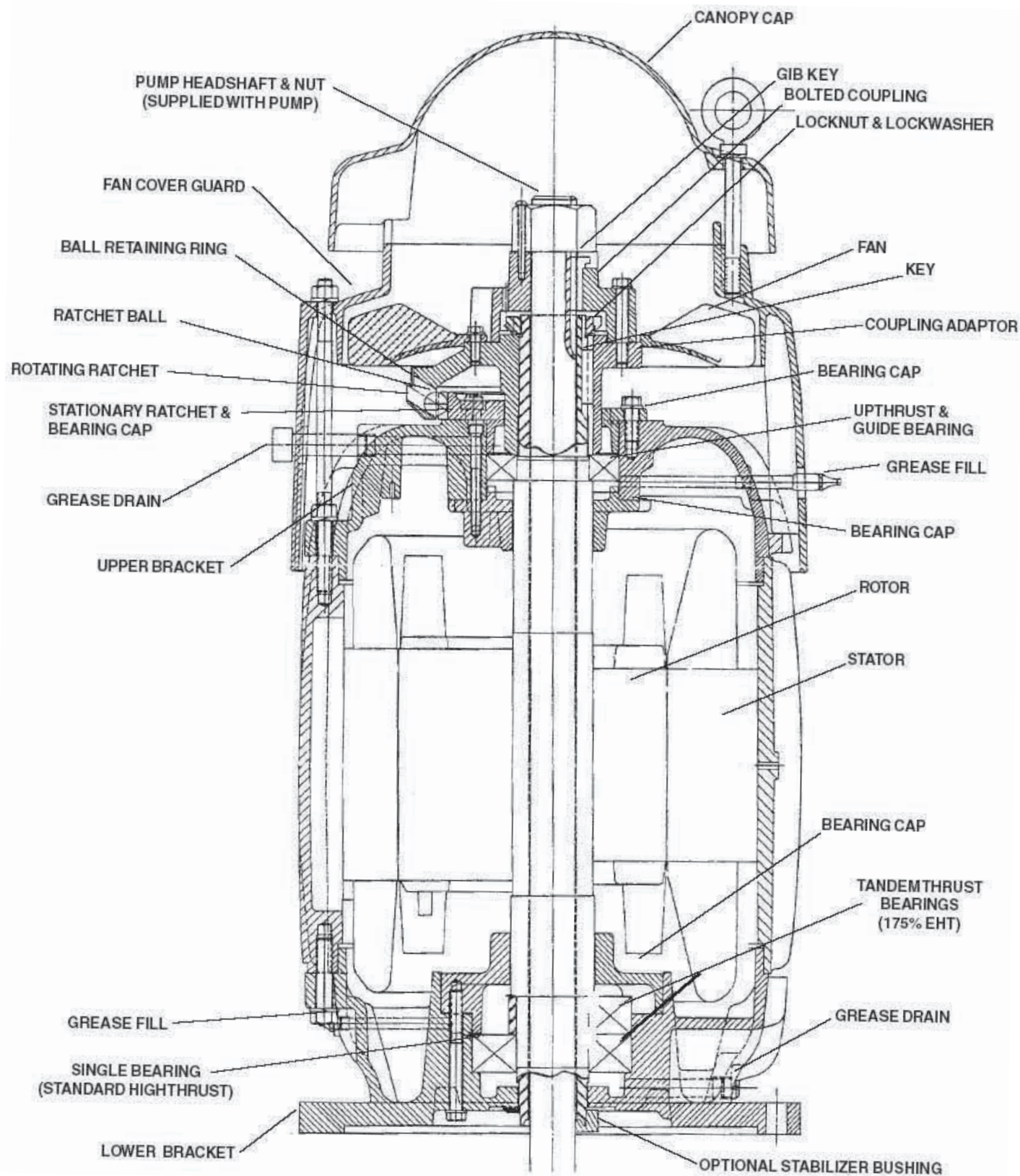
Drawings for many standard designs are supplied on the following pages. Most of the parts should be easy to identify. If however, there is some deviation from your machine, consult Nidec Motor Corporation Product Service Department.

## XII. Index Cut Away Views and Explosion Views

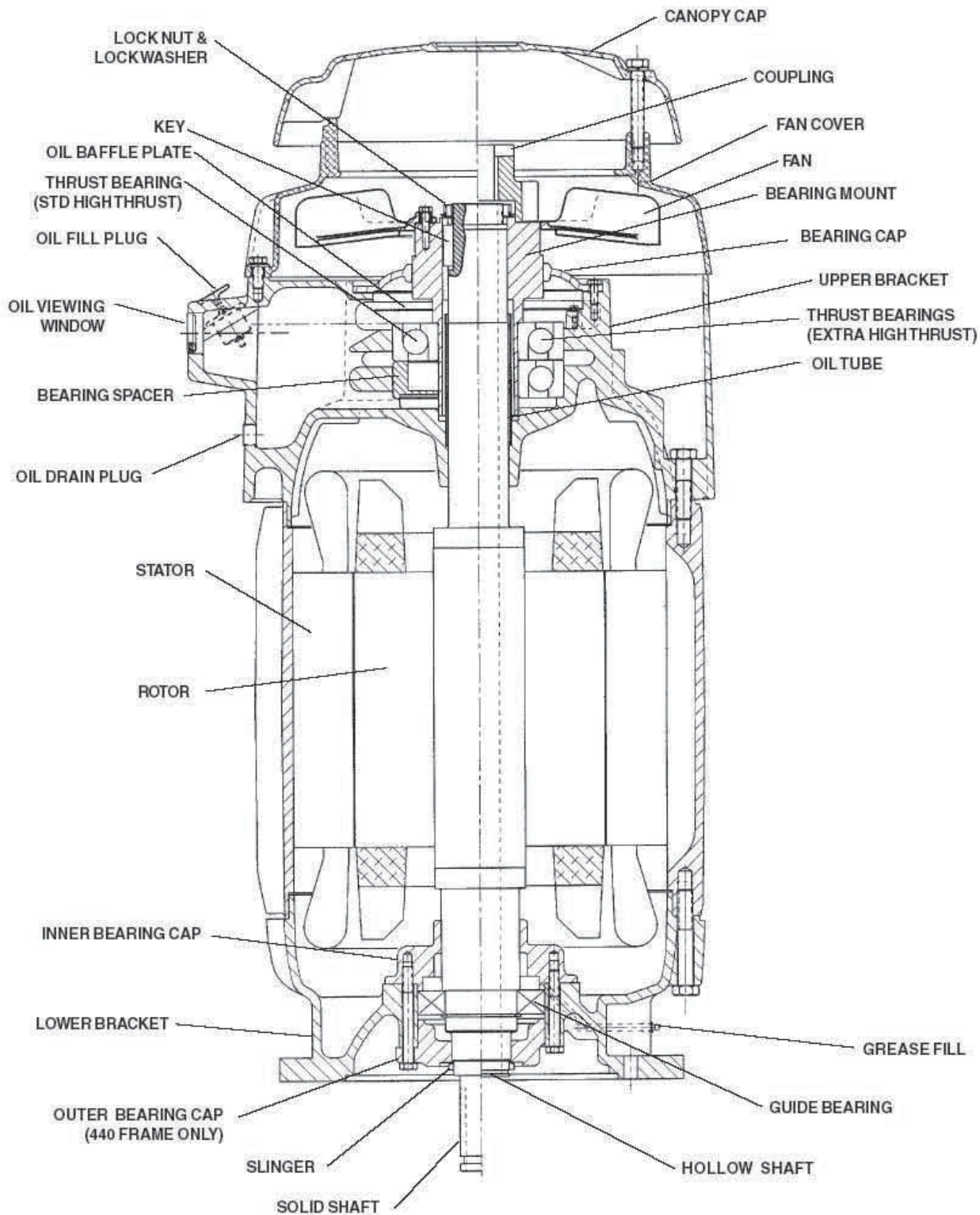
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<b>Frame</b>	<b>Type</b>	<b>Page Number(s)</b>
280, 320, 360	LU, TU .....	25
400 thru 440	LU, TU, TV-4, LV4 High Thrust .....	26
449	JV, JV3 .....	27
449 (2 Pole)	JV4 .....	28
449 (4 Pole and Slower)	JU and JV4 .....	29
5800 (2 Pole)	JV4 and EV4 .....	30
5807 thru 5811 (4 Pole and Slower)	JU, JV4, EU, EV4 .....	31
5812	JU, JV4 .....	32, 33
6812	JU, JV4 (6812) .....	34, 35, 36
250 thru 280	AU High Thrust .....	37
320 thru 440	RU, High Thrust .....	38
440 (2 Pole)	RV-4 .....	39
5000-6800, 8000	HU, HV4 (5000, 6800, RU, RV4 8000) .....	40
5000 and 5800	RU, RV4 .....	41, 42
6813	RU, RV4 .....	43, 44, 45
9600	RU, RV4 .....	46

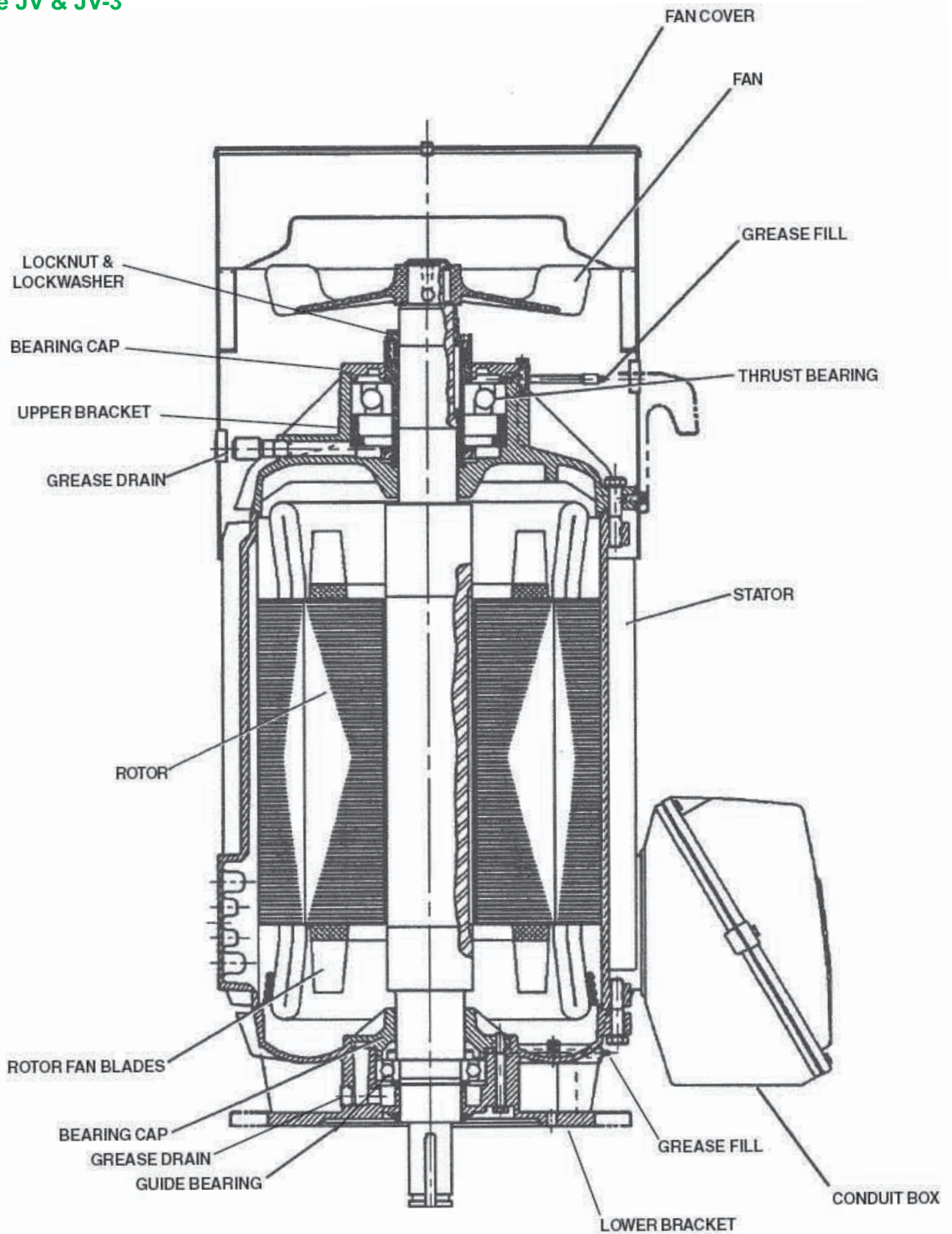
280, 320, 360 Frames, Type LU  
320, 360 Frames, Type TU



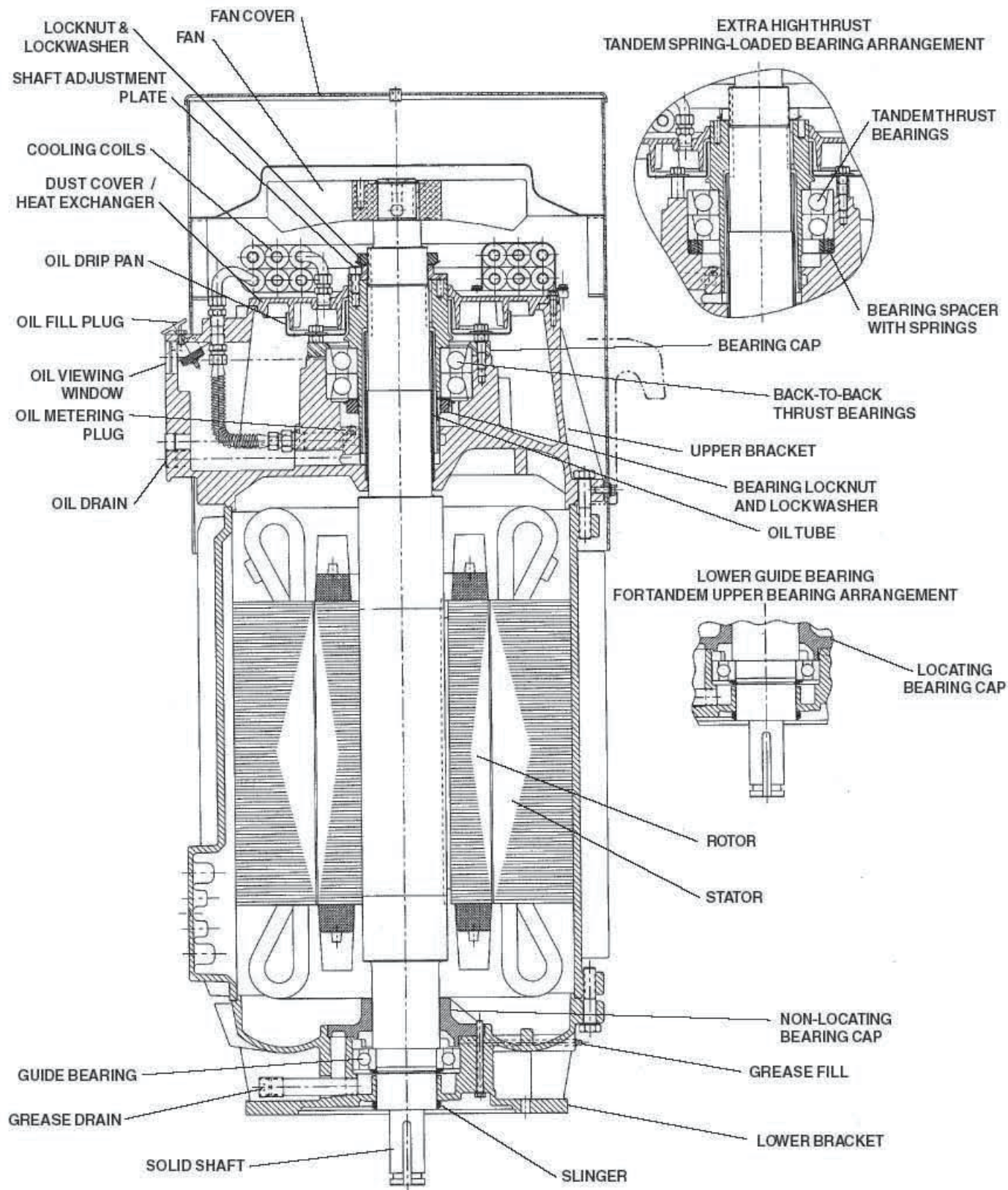
## 400 Thru 440 Frame Types TU, LU, TV-4 and LV-4 High Thrust



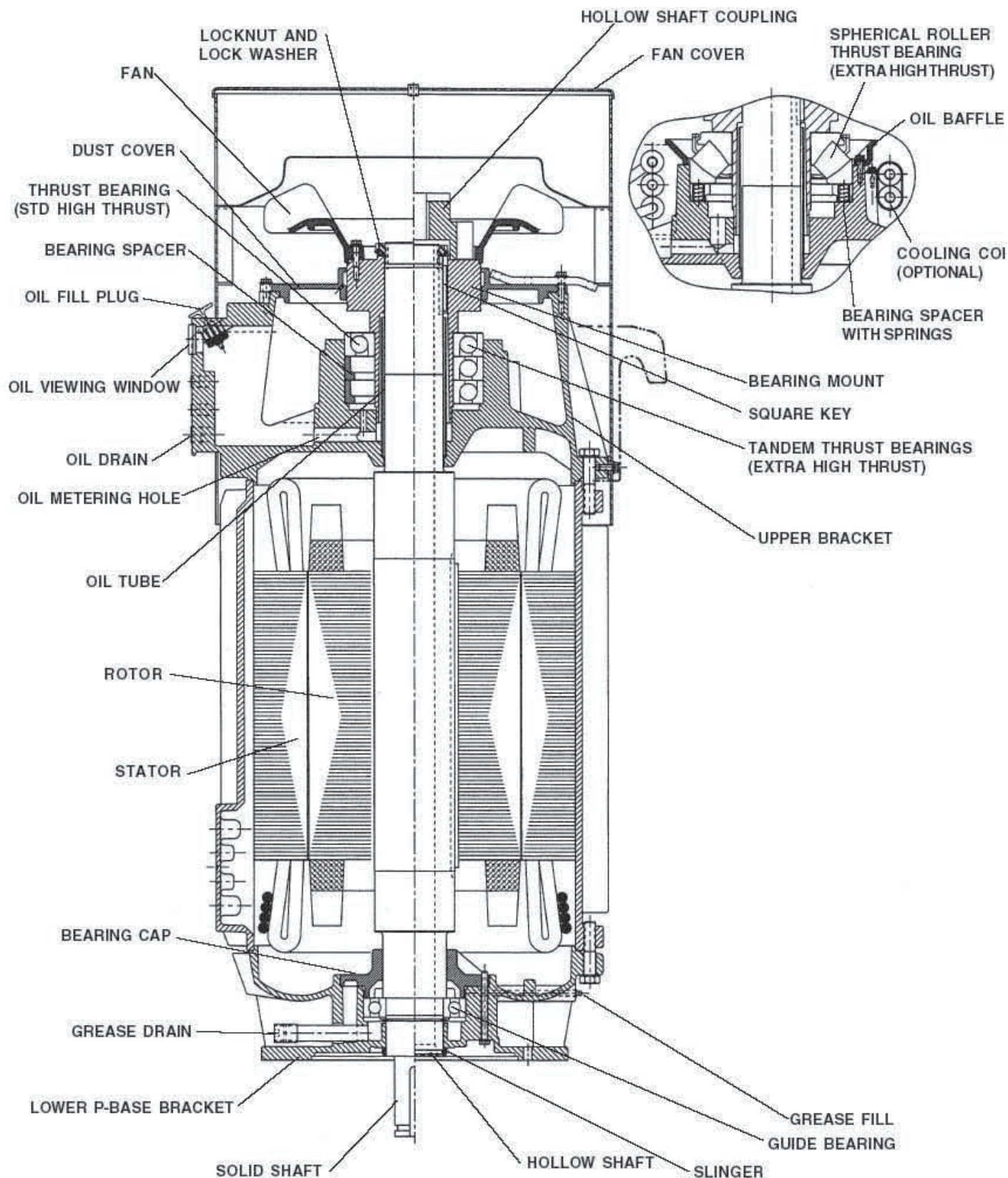
## 449 Frame Type JV & JV-3



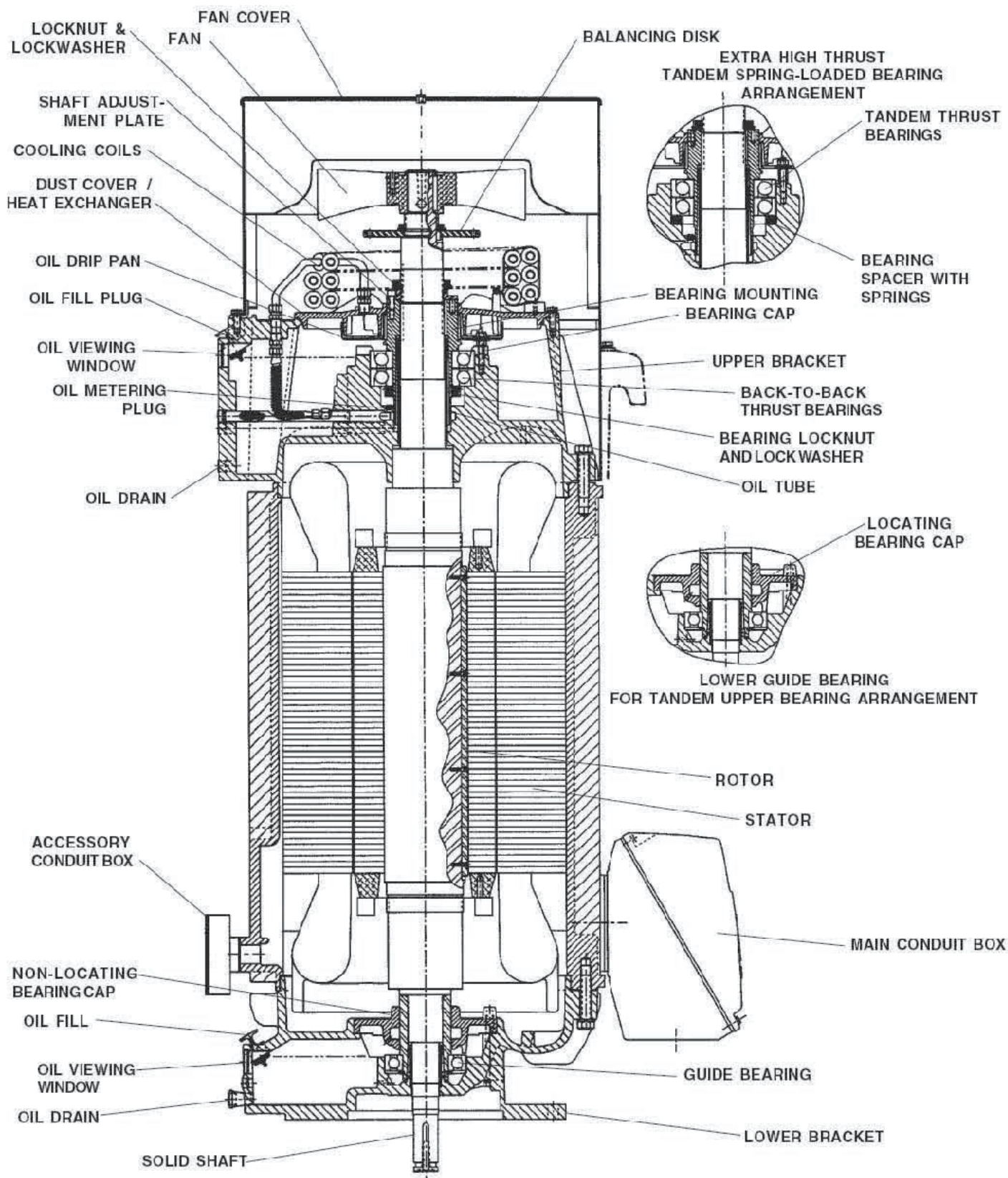
### 449 Frame Type JV-4 (2 Pole)



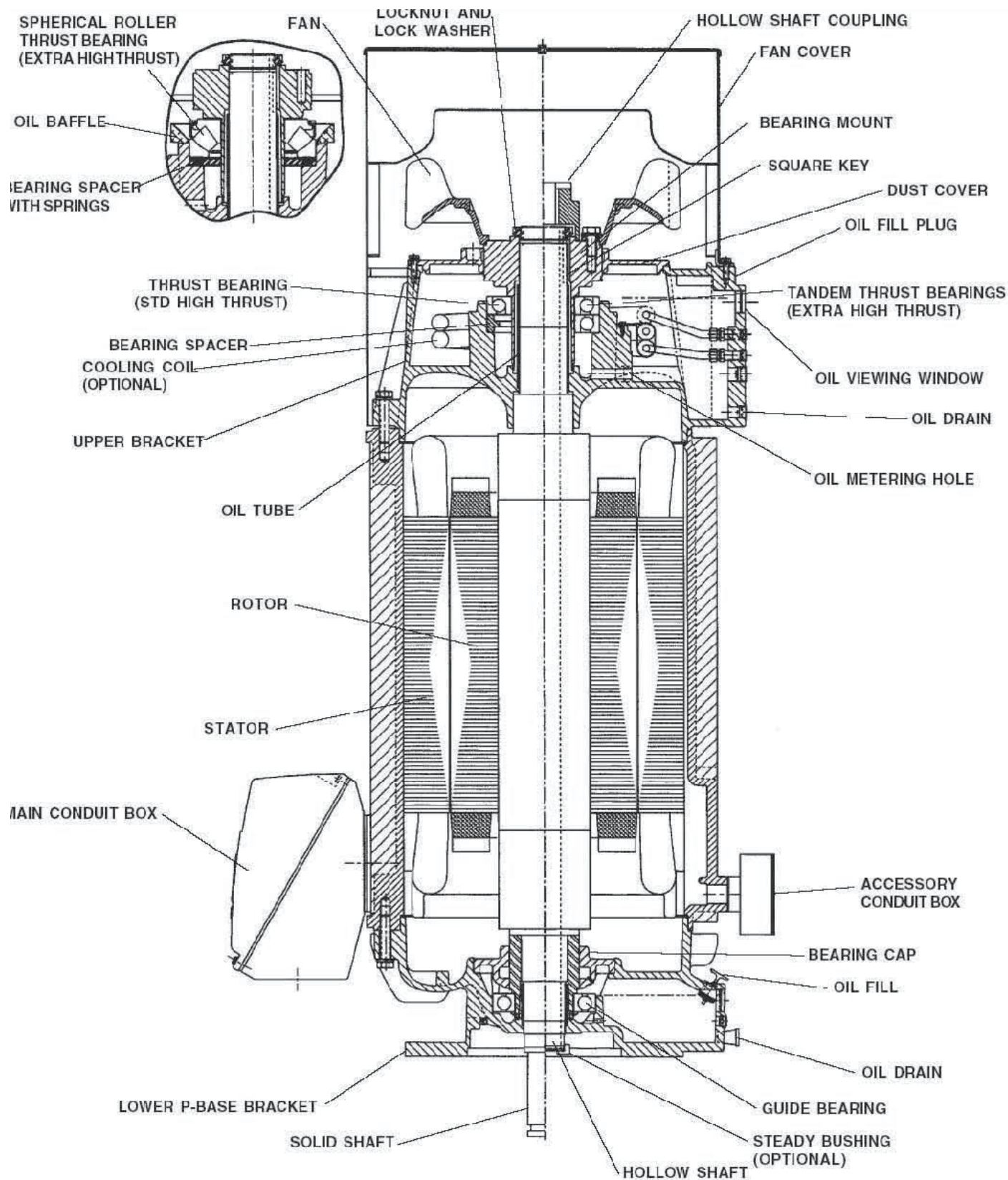
## 449 Frame Type JU and JV-4 (4 Pole & Slower)



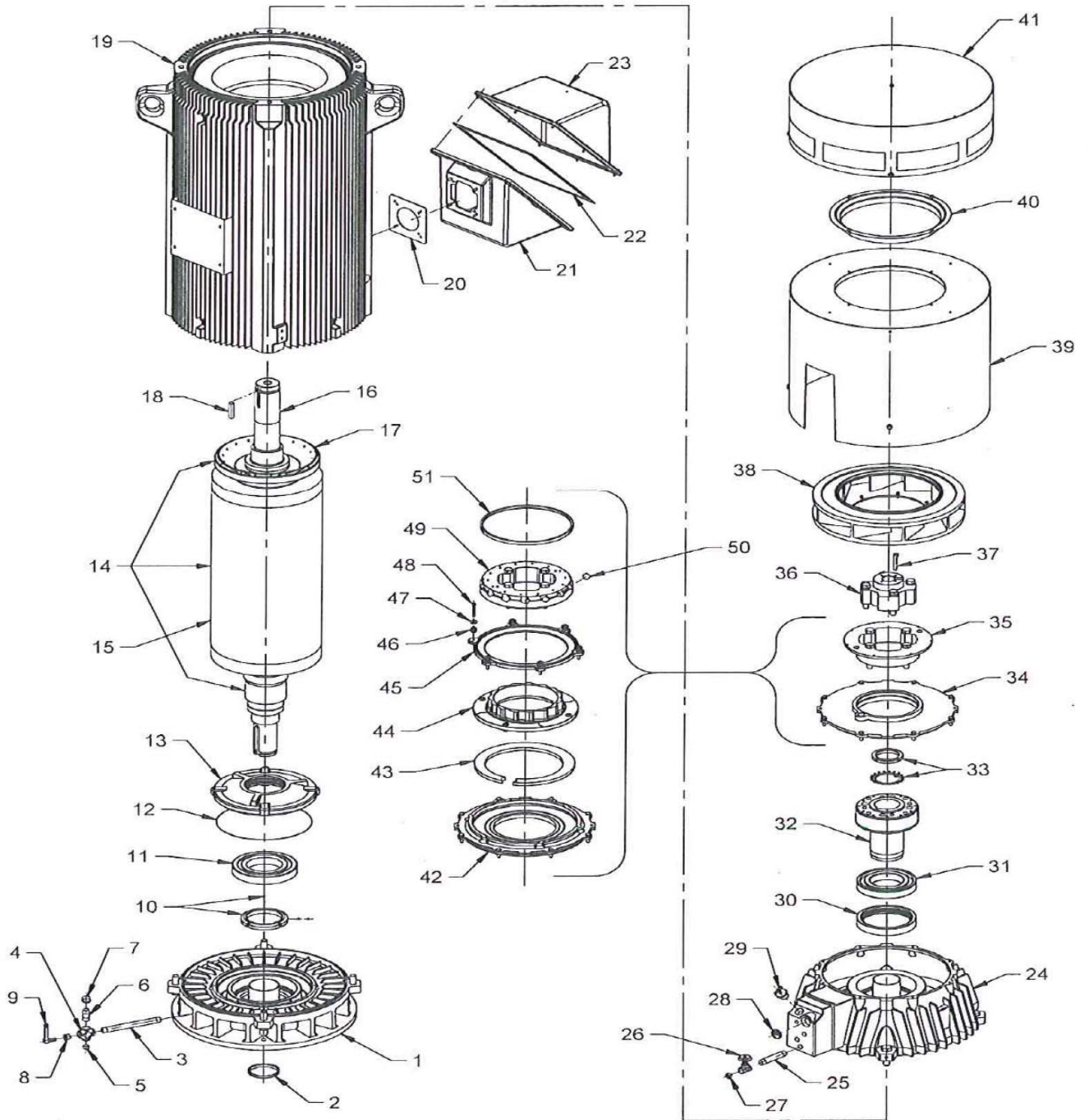
### 5800 Frame JV-4 & EV-4 (2 Pole)



**5807 - 5811 Frame**  
**Type JU, and JV-4, EU, EV-4 (4 Pole & Slower)**



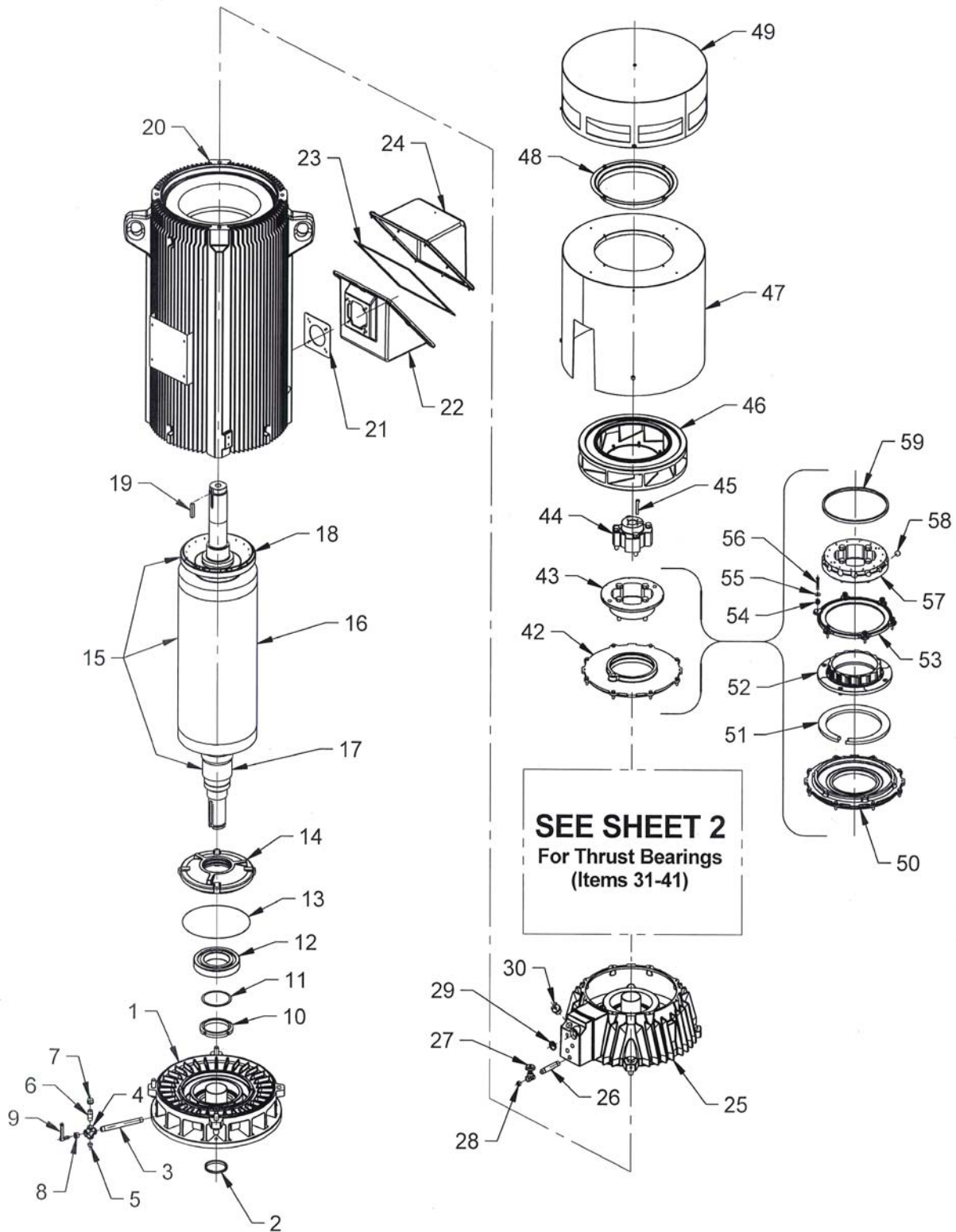
5812 Frame  
Type JU, JV4



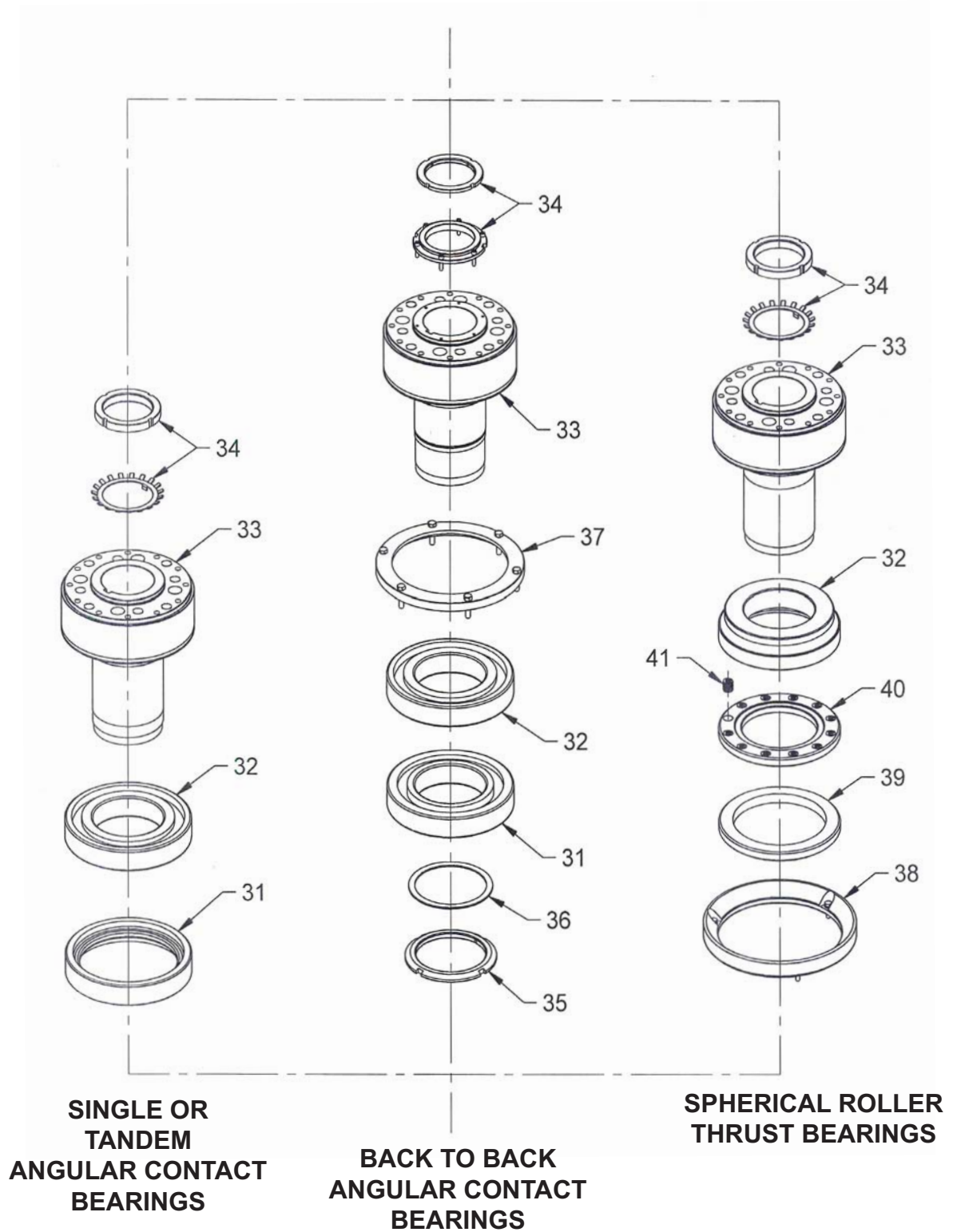
## 5812 Frame Type JU, JV4

ITEM NO.	QTY	NAME OF PART	ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket	28	1	Oil Sight Gauge Window
2	1	Shaft Water Slinger	29	1	Oil Fill Plug (Expanding)
3	1	Pipe Nipple (Lower Oil Drain)	30	1	Bearing Spacer (or Tandem Thrust Bearing)
4	1	Pipe Tee (Lower Oil Drain)	31	1	Upper Thrust Bearing
5	1	Pipe Plug (Lower Oil Drain)	32	1	Bearing Mounting
6	1	Pipe Nipple (Lower Oil Fill)	33	1	Locknut and Lockwasher (Brg Mtg to Shaft)
7	1	Pipe Cap (Lower Oil Fill)	34	1	Dust Cover (Only on Units Without Ratchet)
8	1	Reducer Bushing	35	1	Fan Adaptor (Only on Units Without Ratchet)
9	1	Oil Sight Gauge Window	36	1	Thrust Coupling (Only on Hollowshaft)
10	1	Locknut and Set Screws	37	1	Gib Key (Only on Hollowshaft)
11	1	Lower Bearing	38	1	Fan
12	1	O-Ring	39	1	Fan Cover
13	1	Lower Bearing Cap	40	1	Air Deflector
14	1	Rotor Assembly	41	1	Canopy Cap
15	1	Rotor Core	42	1	Ratchet Adaptor (Only on Units With Ratchet)
16	1	Rotor Shaft	43	1	Connection Spring (Only on Units With Ratchet)
17	1	Rotor Fan	44	1	Stationary Ratchet (Only on Units With Ratchet)
18	1	Square Key (Bearing Mounting to Shaft)	45	1	Pressure Plate (Only on Units With Ratchet)
19	1	Stator Assembly	46	6	Die Spring (Only on Units With Ratchet)
20	1	Gasket (Outlet Box Base to Stator)	47	6	Plain Washer (Only on Units With Ratchet)
21	1	Outlet Box Base	48	6	Screw (Only on Units With Ratchet)
22	1	Gasket (Outlet Box Cover to Base)	49	1	Rotating Ratchet (Only on Units With Ratchet)
23	1	Outlet Box Cover	50	14	Ratchet Ball (Only on Units With Ratchet)
24	1	Upper Bracket	51	1	Ball Retaining Ring (Only on Units With Ratchet)
25	1	Pipe Nipple (Upper Oil Drain)			
26	1	Gate Valve (Upper Oil Drain)			
27	1	Pipe Plug (Upper Oil Drain)			

## 6812 Frame Type JU and JV4



## 5812 and 6812 Frame Type JU and JV4

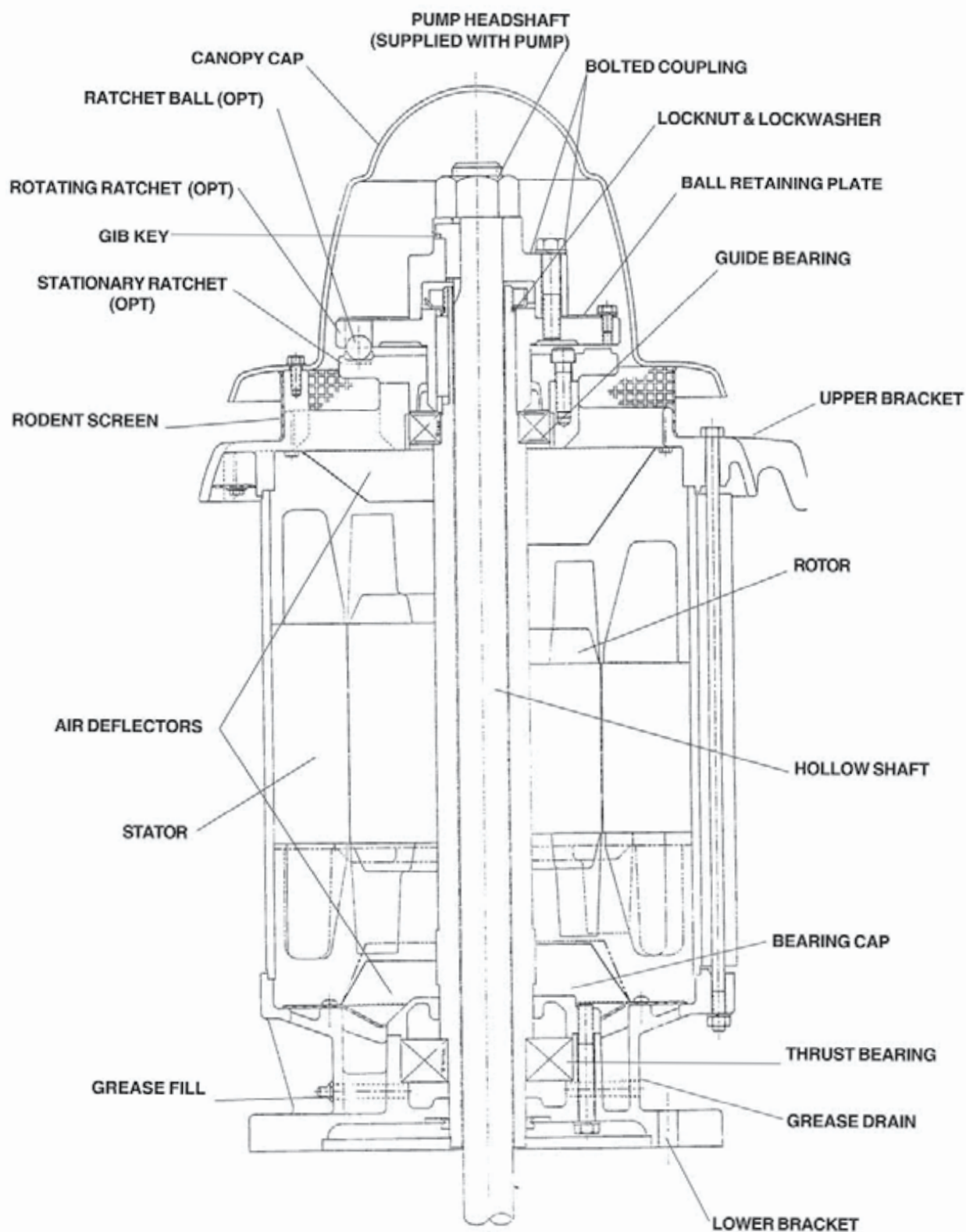
**THRUST BEARING DETAILS**

## 5812 Frame Type JU, and JV4 6812 Frame Type JU and JV4

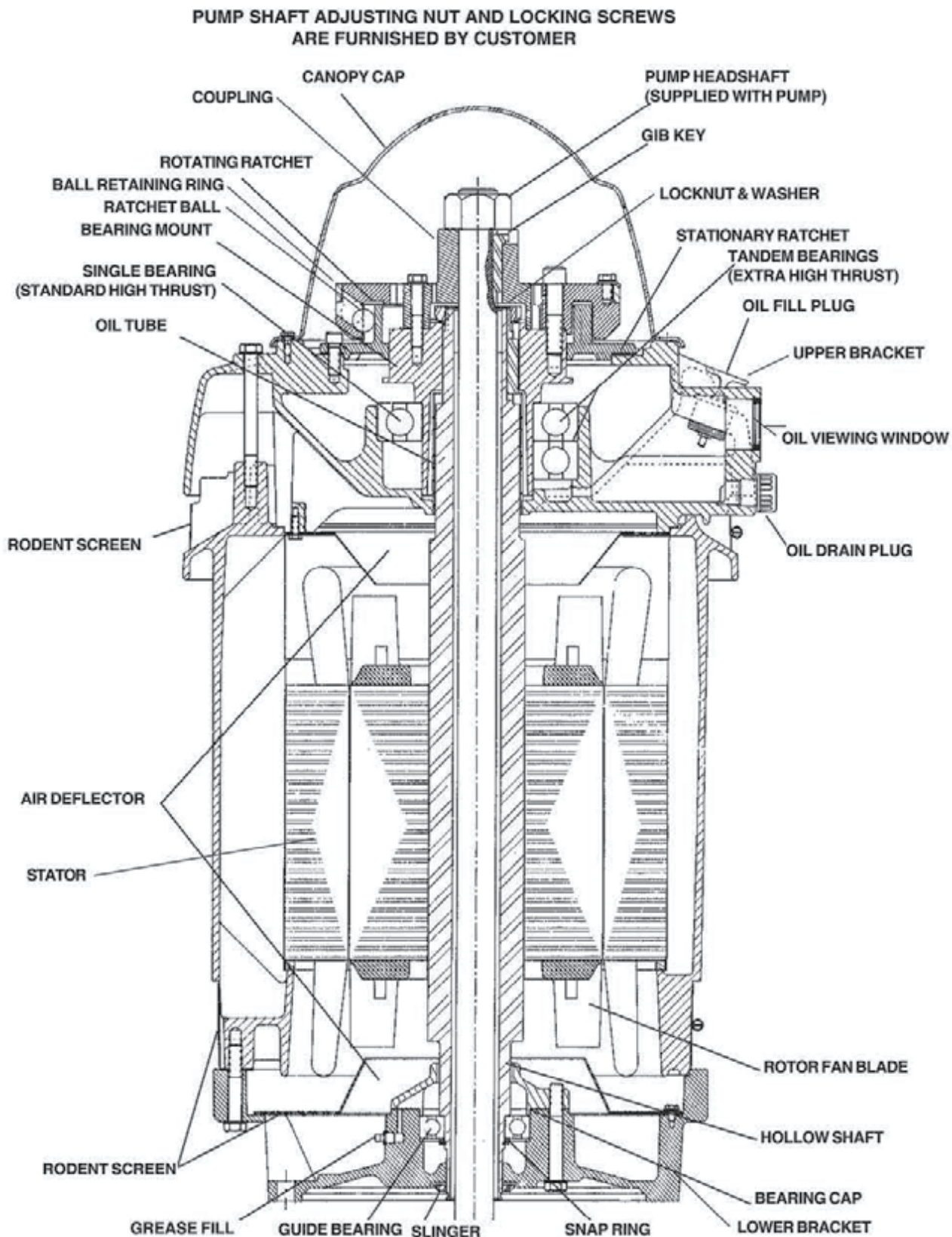
ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket
2	1	Shaft Water Slinger
3	1	Pipe Nipple (Lower Oil Drain)
4	1	Pipe Tee (Lower Oil Drain)
5	1	Pipe Plug (Lower Oil Drain)
6	1	Pipe Nipple (Lower Oil Fill)
7	1	Pipe Cap (Lower Oil Fill)
8	1	Reducer Bushing
9	1	Oil Sight Gauge Window
10	1	Locknut and Set Screws
11	1	Insulated Washer (When Supplied)
12	1	Lower Bearing
13	1	O-Ring
14	1	Lower Bearing Cap
15	1	Rotor Assembly
16	1	Rotor Core
17	1	Rotor Shaft
18	1	Rotor Fan
19	1	Square Key (Bearing Mounting to Shaft)
20	1	Stator Assembly
21	1	Gasket (Outlet Box Base to Stator)
22	1	Outlet Box Base
23	1	Gasket (Outlet Box Cover to Base)
24	1	Outlet Box Cover
25	1	Upper Bracket
26	1	Pipe Nipple (Upper Oil Drain)
27	1	Gate Valve (Upper Oil Drain)
28	1	Pipe Plug (Upper Oil Drain)
29	1	Oil Sight Gauge Window
30	1	Oil Fill Plug (Expanding)

ITEM NO.	QTY	NAME OF PART
31	1	Bearing Spacer (or Tandem Thrust Bearing)
32	1	Upper Thrust Bearing
33	1	Bearing Mounting
34	1	Locknut and Lockwasher (Brg Mtg to Shaft)
35	1	Locknut and Set Screws (Back-to-Back Brgs.)
36	1	Bearing Spacer (Insul.)(Back-to-Back Brgs.)
37	1	Bearing Cap (Clamping)(Back-to-Back Brgs.)
38	1	Oil Baffle (EHT Bearing)
39	1	Bearing Support (EHT Bearing)(When Supplied)
40	1	Bearing Spacer (EHT Bearing)
41	As Req'd	Die Spring (EHT Bearing)
42	1	Dust Cover (Only on Units Without Ratchet)
43	1	Fan Adaptor (Only on Units Without Ratchet)
44	1	Thrust Coupling (Only on Hollowshaft)
45	1	Gib Key (Only on Hollowshaft)
46	1	Fan
47	1	Fan Cover
48	1	Air Deflector
49	1	Canopy Cap
50	1	Ratchet Adaptor (Only on Units With Ratchet)
51	1	Connection Spring (Only on Units With Ratchet)
52	1	Stationary Ratchet (Only on Units With Ratchet)
53	1	Pressure Plate (Only on Units With Ratchet)
54	6	Die Spring (Only on Units With Ratchet)
55	6	Plain Washer (Only on Units With Ratchet)
56	6	Screw (Only on Units With Ratchet)
57	1	Rotating Ratchet (Only on Units With Ratchet)
58	As Req'd	Ratchet Ball (Only on Units With Ratchet)
59	1	Ball Retaining Ring (Only on Units With Ratchet)

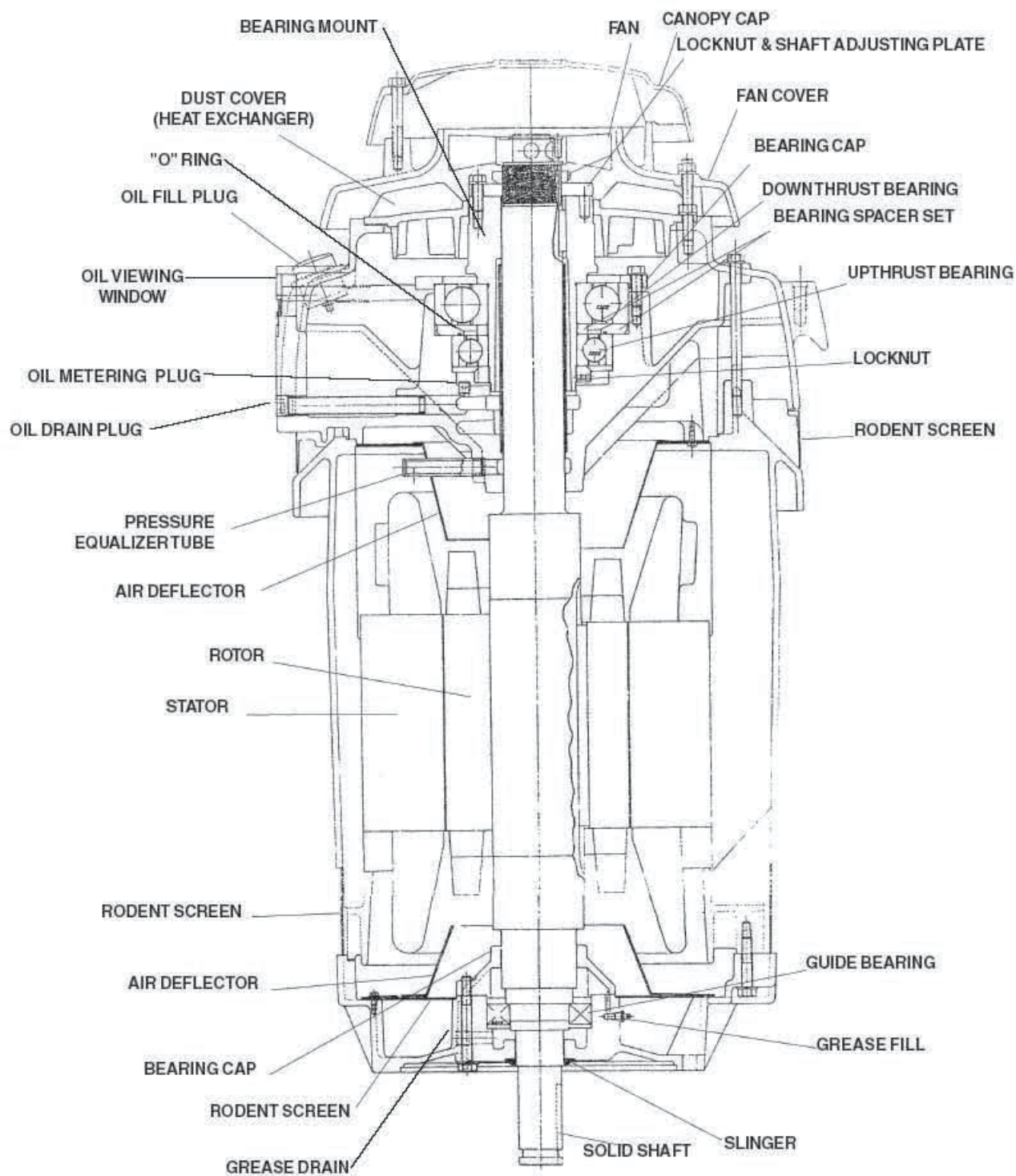
## 250 and 280 Frames Type AU High Thrust



320 Thru 440 Frames  
Type RU - High Thrust

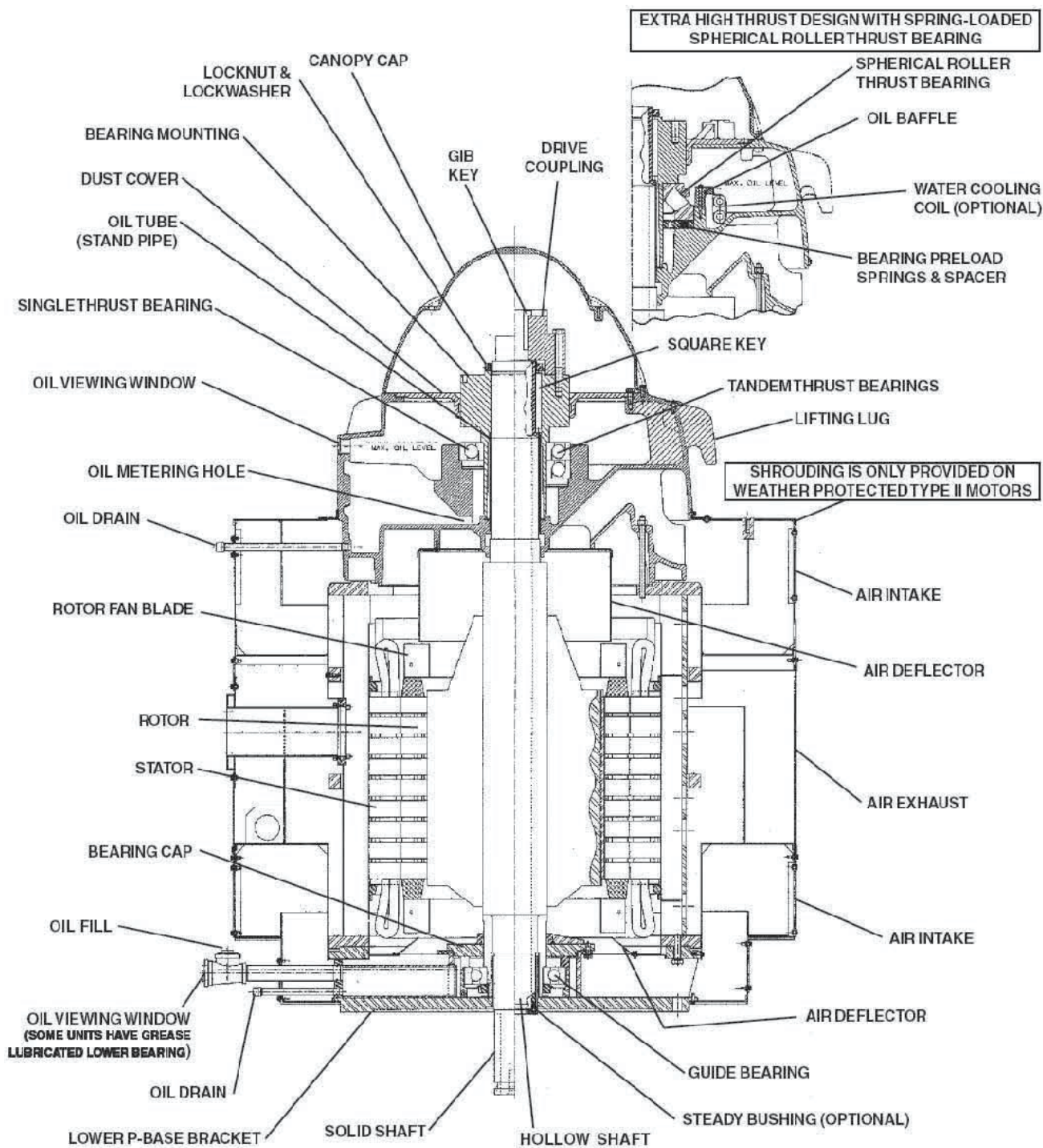


## 440 Frame, Type RV-4 (2 Pole)

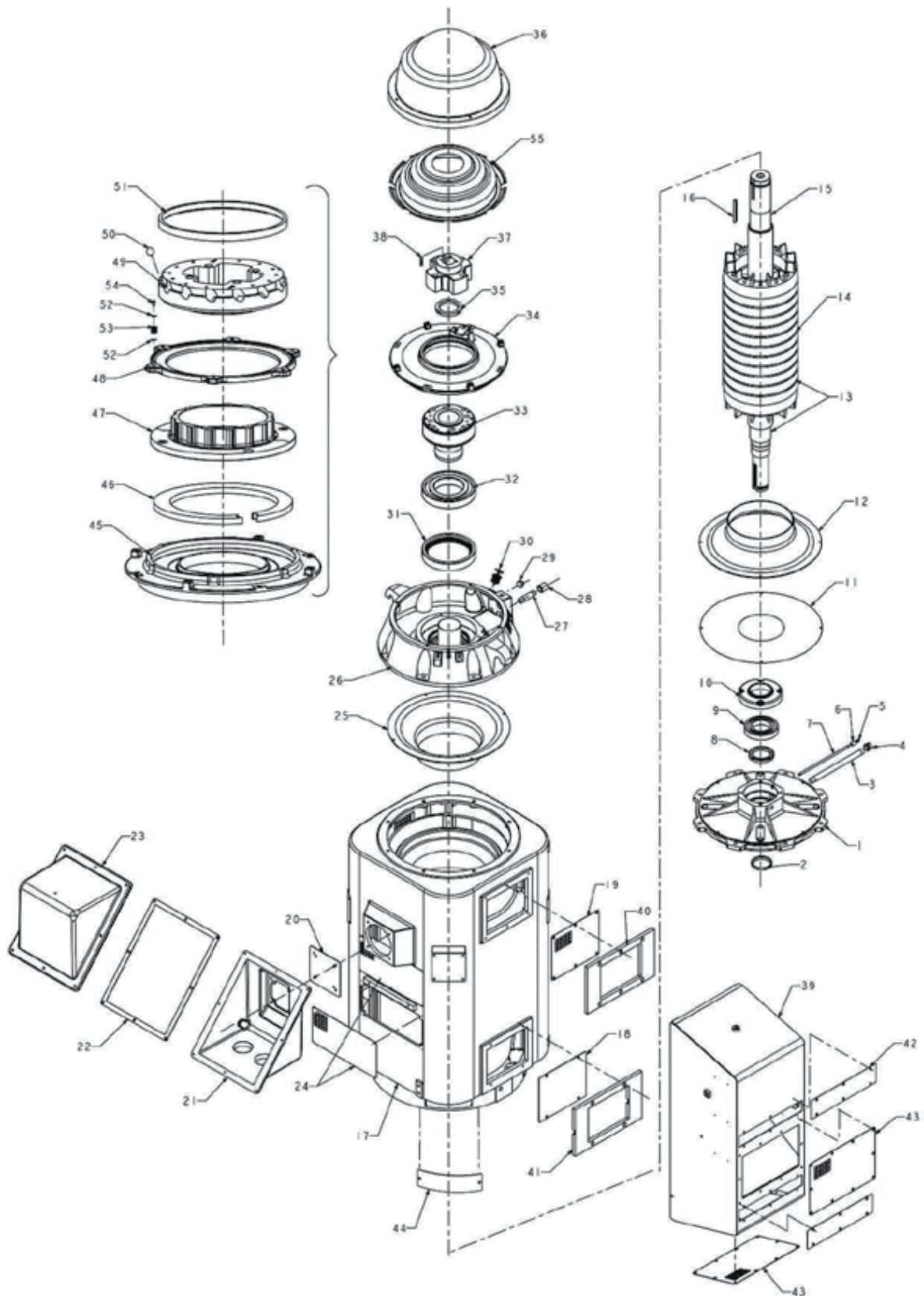


**5000 - 6800 Frame, Type HU & HV4**  
**8000 Frame, Type RU & RV (4 Pole and Slower)**

PUMP SHAFT, ADJUSTING NUT, AND LOCKING SCREWS  
 ARE FURNISHED BY CUSTOMER



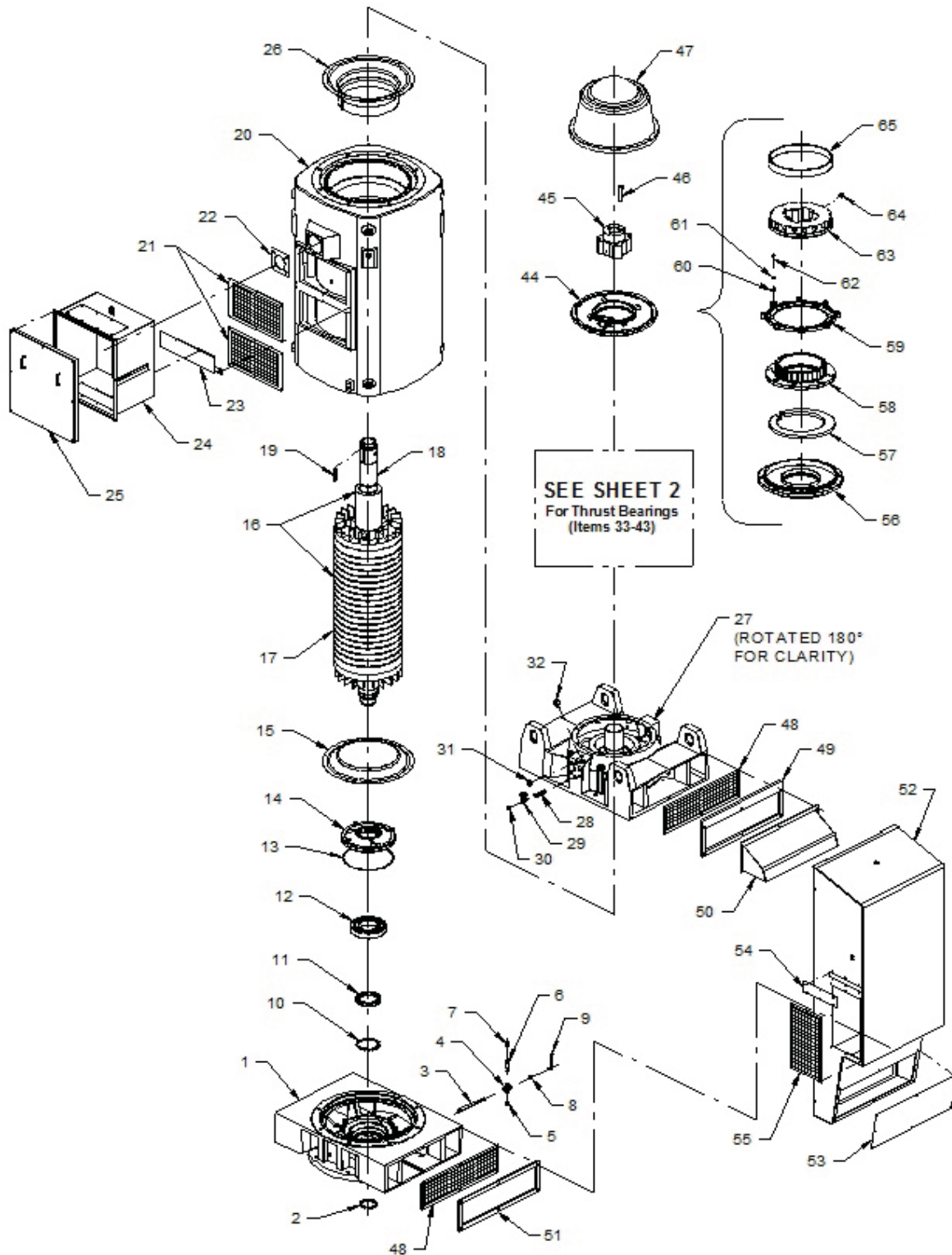
## 5000 and 5800 Frame Type RU and RV-4



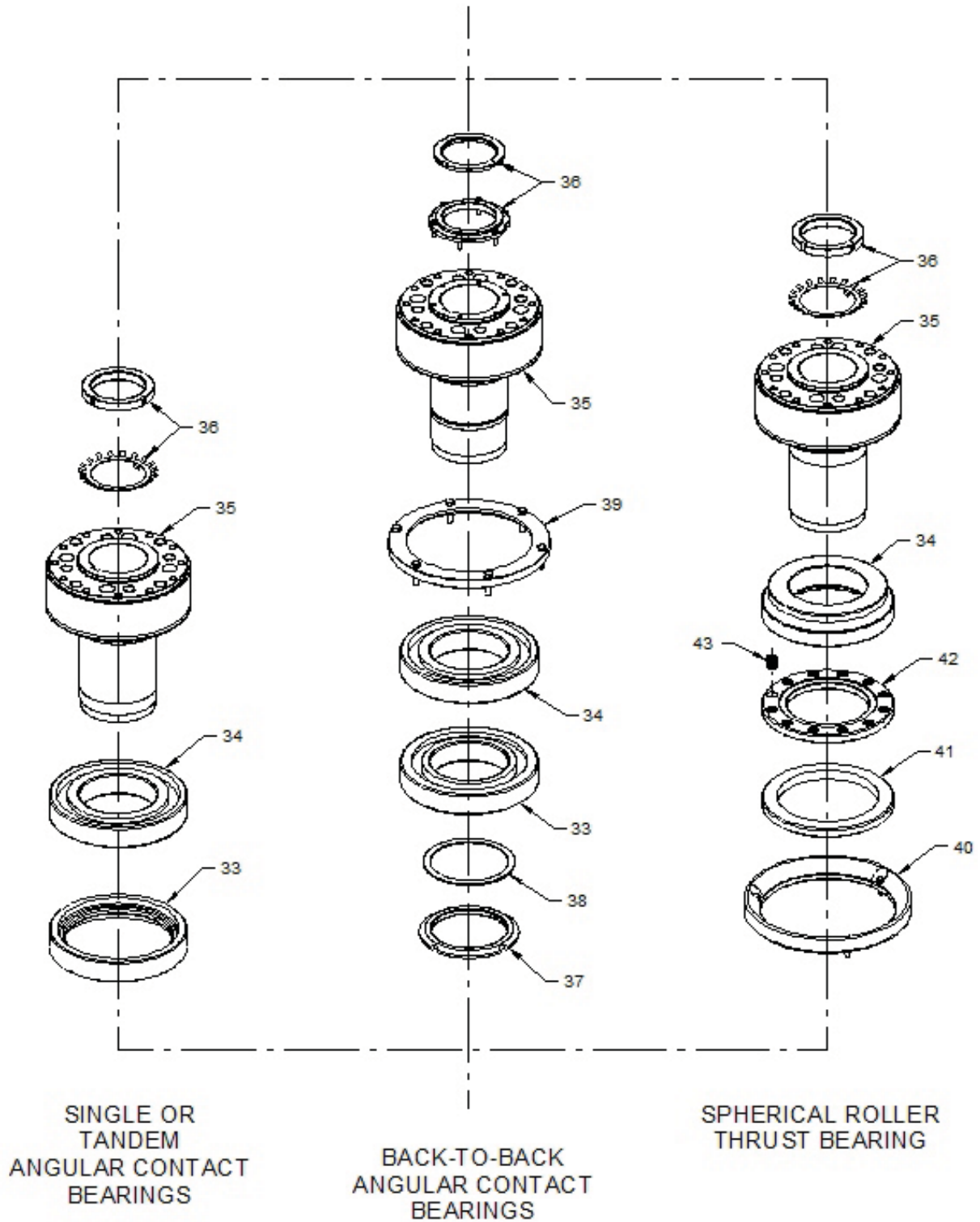
## 5000 and 5800 Frame Type RU and RV-4

ITEM NO.	QTY	NAME OF PART	ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket	32	1	Upper Thrust Bearing
2	1	Shaft Water Slinger	33	1	Bearing Mounting
3	1	Pipe Nipple (Lower Grease Drain)	34	1	Dust Cover (Only on Units Without Ratchet)
4	1	Pipe Cap (Lower Grease Drain)	35	1	Locknut and Lockwasher (Brg Mtg to Shaft)
5	1	Grease Zerk Fitting	36	1	Canopy Cap
6	1	Pipe Coupling (Lower Grease Fill)	37	1	Thrust Coupling (Only on Hollowshaft)
7	1	Pipe Nipple (Lower Grease Fill)	38	1	Gib Key (Only on Hollowshaft)
8	1	Locknut and Lockwasher (Lower Bearing)	39	2	WP2 Intake Box (Only on WP-2)
9	1	Lower Bearing	40	2	Upper Adapter Flange (Only on WP-2)
10	1	Lower Bearing Cap	41	2	Lower Adapter Flange (Only on WP-2)
11	1	Lower Intake Screen (Only on WP-1)	42	4	Filter Access Cover (Only on WP-2)
12	1	Lower Air Deflector	43	4	Intake Screen (Only on WP-2)
13	1	Rotor Assembly	44	4	Cover (Flange Access) (Only on WP-2)
14	1	Rotor Core	45	1	Ratchet Adaptor (Only on Units With Ratchet)
15	1	Rotor Shaft	46	1	Connection Spring (Only on Units With Ratchet)
16	1	Square Key (Bearing Mounting to Shaft)	47	1	Stationary Ratchet (Only on Units With Ratchet)
17	1	Stator Assembly	48	1	Pressure Plate (Only on Units With Ratchet)
18	1	Lower Air Intake Cover (Only on WP-1)	49	1	Rotating Ratchet (Only on Units With Ratchet)
19	1	Upper Air Intake Screen (Only on WP-1)	50	12-(5008) 14-(5012) 16-(5813)	Ratchet Ball (Only on Units With Ratchet)
20	1	Gasket (Outlet Box Base to Stator)	51	1	Ball Retaining Ring (Only on Units With Ratchet)
21	1	Outlet Box Base	52	4-(5008) 12-(5012) 8-(5813)	Plain Washer (Only on Units With Ratchet)
22	1	Gasket (Outlet Box Cover to Base)	53	4-(5008) 6-(5012) 8-(5813)	Die Spring (Only on Units With Ratchet)
23	1	Outlet Box Cover	54	4-(5008) 6-(5012) 8-(5813)	Screw (Only on Units With Ratchet)
24	2-(5008) 4-(5012) 4-(5813)	Exhaust Screen	55	1	Pressurization Baffle (5000 Frame Only)
25	1	Upper Air Deflector			
26	1	Upper Bracket			
27	1	Pipe Nipple (Oil Drain)			
28	1	Pipe Cap (Oil Drain)			
29	1	Oil Sight Gauge Window			
30	1	Oil Fill Plug (Expanding)			
31	1	Bearing Spacer (or Tandem Thrust Bearing)			

## 6813 Frame Type RU, RV-4



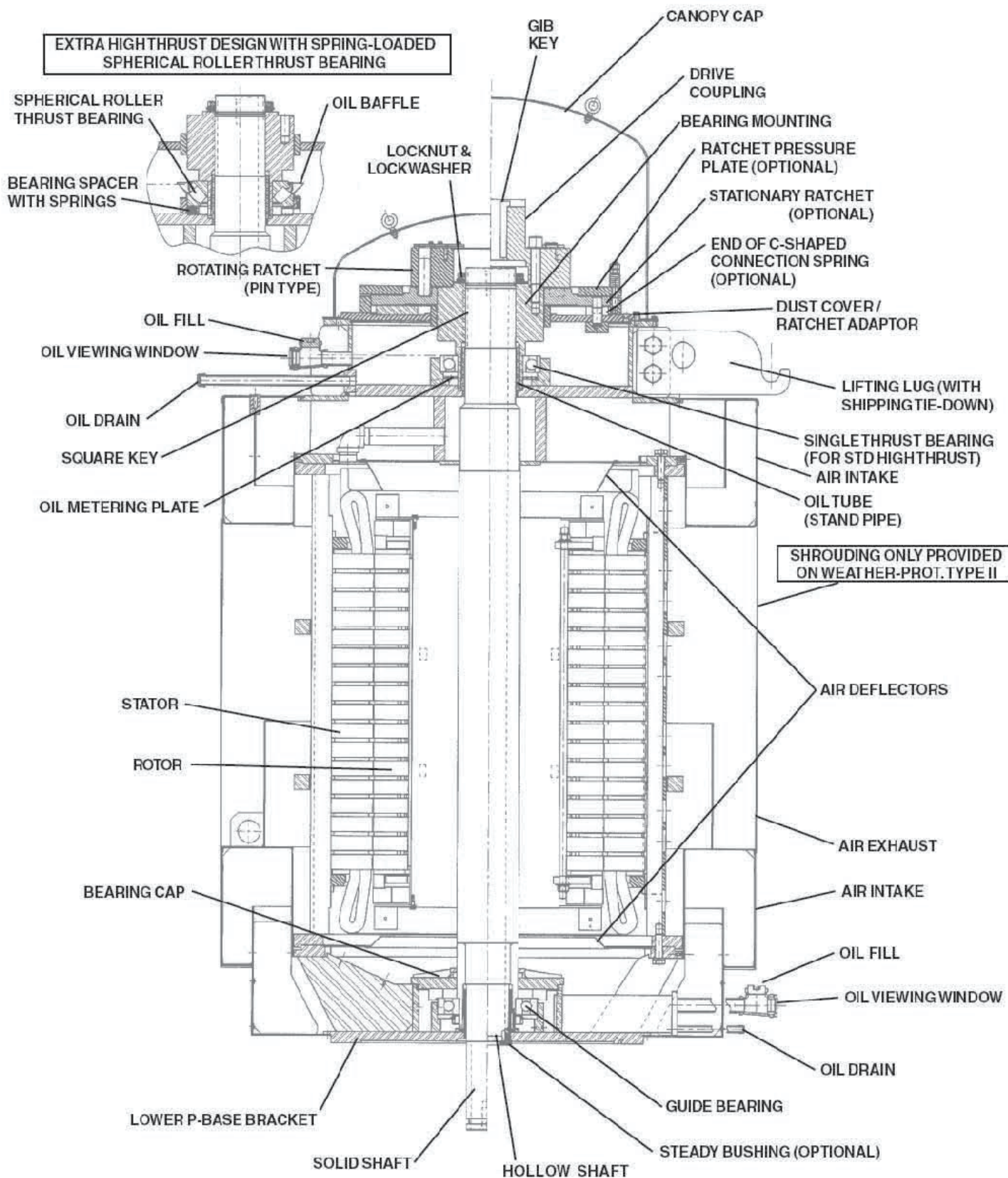
## 6813 Frame Type RU, RV-4

**THRUST BEARING DETAILS**

## 6813 Frame Type RU and RV-4

ITEM NO.	QTY	NAME OF PART	ITEM NO.	QTY	NAME OF PART
1	1	Lower Bracket	34	1	Upper Thrust Bearing
2	1	Shaft Water Slinger	35	1	Bearing Mounting
3	1	Pipe Nipple (Lower Oil Drain)	36	1	Locknut and Lockwasher (Brg Mtg to Shaft)
4	1	Pipe Tee (Lower Oil Drain)	37	1	Locknut and Set Screws (Back-to-Back Brgs.)
5	1	Pipe Plug (Lower Oil Drain)	38	1	Bearing Spacer (Insul.)(Back-to-Back Brgs.)
6	1	Pipe Nipple (Lower Oil Fill)	39	1	Bearing Cap (Clamping)(Back-to-Back Brgs.)
7	1	Pipe Cap (Lower Oil Fill)	40	1	Oil Baffle (EHT Bearing)
8	1	Reducer Bushing	41	1	Bearing Support (EHT Bearing)(When Supplied)
9	1	Oil Sight Gauge Window	42	1	Bearing Spacer (EHT Bearing)
10	1	Lockwasher (Lower Bearing)	43	As Req'd	Die Spring (EHT Bearing)
11	1	Locknut (Lower Bearing)	44	1	Dust Cover (Only on Units Without Ratchet)
12	1	Lower Bearing	45	1	Thrust Coupling (Only on Hollowshaft)
13	1	O-Ring	46	1	Gib Key (Only on Hollowshaft)
14	1	Lower Bearing Cap	47	1	Fan Cover
15	1	Lower Air Deflector	48	4	Bracket Screen (Upper and Lower)
16	1	Rotor Assembly	49	2	Upper Flange Adaptor (Only On WP-2)
17	1	Rotor Core	50	2	Upper Air Scoop (Only On WP-1)
18	1	Rotor Shaft	51	2	Lower Flange Adaptor (Only On WP-2)
19	1	Square Key (Bearing Mounting to Shaft)	52	2	WP-2 Intake Box (Only On WP-2)
20	1	Stator Assembly	53	2	Access Cover (Only On WP-2)
21	4	Exhaust Screens	54	4	Filter Access Cover (Only On WP-2)
22	1	Gasket (Outlet Box Base to Stator)	55	4	Intake Screen (Only On WP-2)
23	1	Mounting Bracket (Outlet Box To Stator)	56	1	Ratchet Adaptor (Only on Units With Ratchet)
24	1	Outlet Box Base	57	1	Connection Spring (Only on Units With Ratchet)
25	1	Outlet Box Cover	58	1	Stationary Ratchet (Only on Units With Ratchet)
26	1	Upper Air Deflector	59	1	Pressure Plate (Only on Units With Ratchet)
27	1	Upper Bracket	60	6	Die Spring (Only on Units With Ratchet)
28	1	Pipe Nipple (Upper Oil Drain)	61	6	Plain Washer (Only on Units With Ratchet)
29	1	Gate Valve (Upper Oil Drain)	62	6	Screw (Only on Units With Ratchet)
30	1	Pipe Plug (Upper Oil Drain)	63	1	Rotating Ratchet (Only on Units With Ratchet)
31	1	Oil Sight Gauge Window	64	As Req'd	Ratchet Ball (Only on Units With Ratchet)
32	1	Oil Fill Plug (Expanding)	65	1	Ball Retaining Ring (Only on Units With Ratchet)
33	1	Bearing Spacer (or Tandem Thrust Bearing)			

9600 Frame  
Types RU and RV-4





**Table 6: Threaded Fastener Torque Requirements**

All threaded fasteners used for rigid joints (cast iron and low carbon steel) in products of Nidec Motor Corporation, are to be tightened to the torque values listed in the following tabulation. Values are based upon dry assembly.

Diameter of Fastener	Number of Threads Per Inch	Grade 5 Fasteners	Grade 2 Fasteners
#6	32	16 lb-in	10 lb-in
	40	18	12
#8	32	30	19
	36	31	20
#10	24	43	27
	32	49	31
#12	24	66	37
	28	72	40
1/4"	20	96	66
	28	120	76
5/16"	18	16 lb-ft	11 lb-ft
	24	18	12
3/8"	16	29	20
	24	34	23
7/16"	14	46	30
	20	52	35
1/2"	13	70	50
	20	71	55
9/16"	12	102	
	18	117	
5/8"	11	140	
	18	165	
3/4"	10	249	
	16	284	
7/8"	9	401	
	14	446	
1"	8	601	
	14	666	
1-1/8"	7	742	
	12	860	
1-1/4"	7	1046	
	12	1196	
1-3/8"	6	1371	
	12	1611	
1-1/2"	6	1820	
	12	2110	

The above torque limits are not to be used when a drawing or specification lists a specific torque.

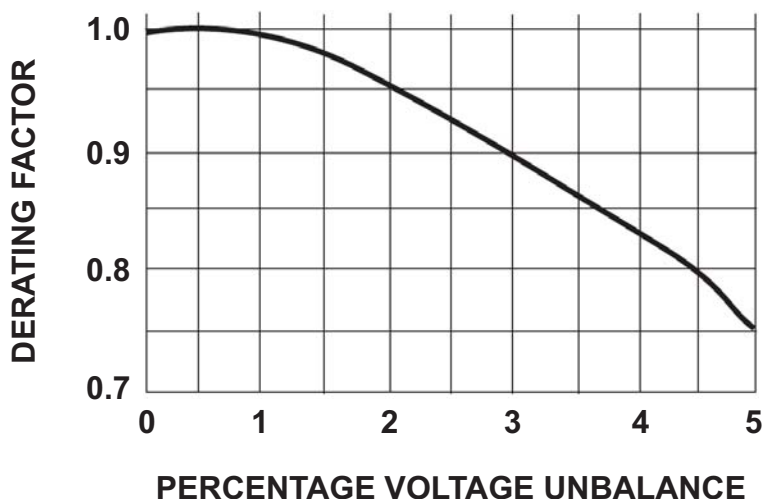
## Appendices

### Effects of Unbalanced Line Voltage

A potential cause of premature motor failure is unbalanced line (supply) voltage. Three phase motors produce useful work when they efficiently convert electrical energy into mechanical energy. This is accomplished when each phase of the supply voltage is of equal strength and works in harmony to produce a rotating magnetic field within the motor.

When the value of supply voltage leg to leg is not equal (e.g. 460-460-460), the risk of unbalanced line voltage is present. If this voltage unbalance exceeds about 1%, excessive temperature rise will result. Unless the motor HP capacity is derated to compensate, the motor will run hot resulting in degradation of the insulation system and bearing lubricant.

From NEMA<sup>®†</sup> MG-1, 14.36: Derating factors due to unbalanced line voltage



#### **EXAMPLE: Field ratings of Phase A - 480 v, Phase B = 460 v, Phase C = 450 v**

As a rule of thumb, the percentage increase in temperature rise will be about two times the square of the percentage voltage unbalance. In this case, the average voltage (480+460+450) is equal to 463 volts. The maximum deviation between legs is 17 volts (480-463 volts).

The Percentage voltage unbalance is determined as follows:  $17 / 463 \times 100 = 3.7\%$ . The temperature rise will then increase  $(3.7)^2 \times 2 = 27\%$ . This condition will reduce the typical life of your motor to less than 25% of its design life. Should this condition be present, call your electric utility and resolve your unbalanced supply condition.

Other areas of motor performance will also be affected - e.g., loss of torque capacity, change in full load RPM, greatly unbalanced current draw at normal operating speed. Refer to NEMA<sup>®†</sup> MG-1 section 14.36 for details.

## Motors Applied to Variable Frequency Drives (VFD's)

Electrical motors can be detrimentally affected when applied with variable frequency drives (VFD's). The non-sinusoidal waveforms of VFD's have harmonic content which causes additional motor heating; and high voltage peaks and short rise times, which result in increased insulation stress, especially when long power cable lengths are used. Standard motors utilized with VFD's must be limited to those application considerations defined in **NEMA MG-1 Part 30**.

**NEMA MG-1 Part 31** defines performance and application considerations for Definite-Purpose Inverter Fed motors. To insure satisfactory performance and reliability, Nidec Motor Corporation offers and recommends nameplated inverter duty motor products which meet the requirements of NEMA MG-1 Part 1. The use of non-inverter duty motors may result in unsatisfactory performance or premature failure, which may not be warrantable under the Terms and Conditions of Sale. Contact your Nidec Motor Corporation Field Sales Engineer for technical assistance in motor selection, application and warranty details.

## Electric Motor Load Test Using the Watt Hour Meter

In the analysis of electric motors, it is desirable to conduct an accurate load check on a particular installation to determine whether the motor is operating within the rating and horsepower for which it was designed. Since most pumps installations have their own watt hour meters, accurate readings will permit a load check via the following formula:

**K** = Disc constant (watts per revolution of disc per hour). This is typically found on the meter face.

**R** = Revolutions of disc in watt meter within the time of the test.

**T** = Time of test, in seconds.

**Transformer Ratio** = Stated on meter face. Must be included where current transformers are used with watt meters.

To obtain input kilowatts:

$$\text{Input KW} = \frac{K \times R \times 3.6}{T}$$

To obtain input horsepower:

$$\text{Input HP} = \frac{K \times R \times 4.83 \times \text{Transformer Ratio}}{T}$$

The watt hour meter measures power consumed over a period of time. It is necessary to establish the rate at which power is being consumed by the work being done. We establish this rate by counting the revolutions of the disc in a given time. Here is the typical example of a load check:

### GIVEN

- Pump motor to be load checked is rated 100 HP, 1800 HP, 3-Phase, 60 Hz, 1.15 service factor, 91.0 Percent Efficiency
- Disc constant (K) found on face of meter = 40
- Transformer ratio found on face of meter = 3

### DATA FOUND FROM TESTS

With stop watch, disc was observed to revolve 10 times in exactly 49 seconds. Therefore, R=10; T=49.

### THUS

$$\text{Input HP} = \frac{40 \times 10 \times 4.83 \times 3}{49} = 118.29$$

$$\text{Output HP} = \text{Input HP} \times \text{Motor Efficiency}$$

$$\text{Output HP} = 118.29 \times 91\% = 107.54$$

### CONCLUSION

The output HP (107.54) is greater than output HP shown on nameplate (100 HP) but is well within the 1.15 service factor which applies to this motor.

Member of the following:



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NIDEC MOTOR CORPORATION

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Phone: 800-566-1418 | Fax: 314-595-8922  
[www.usmotors.com](http://www.usmotors.com)

**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**



# Technical Data

## Jotamastic 87 Aluminium



### Product description

A two component surface tolerant, abrasion resistant, high solids polyamine cured epoxy mastic coating which may be applied in high film thickness. Available with different hardeners for varying substrate temperatures, Standard (Std) and Wintergrade (WG). This product is a part of a complete system which is certified not to spread flames.

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### Recommended use

Steel where blast cleaning may not be possible, and on hydrojetted surfaces still being moist where gloss retention is of minor importance. Suitable for use as a dielectric shield around impressed current cathodic protection (ICCP) anodes on ships. Can be used alone or in combination with various systems of primers and topcoats. Gives excellent corrosion protection both in salt and fresh water. If exposed to sunlight chalking may occur.

For application in water ballast tanks at newbuilding stage in accordance with PSPC (IMO Res. MSC 82/W), see the "Application procedure for water ballast tanks - Jotamastic 87".

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### Film thickness and spreading rate

Std Comp. B	Minimum	Maximum	Typical
Film thickness, dry mils (µm)	6,0(150)	12,0(300)	8,0(200)
Film thickness, wet mils (µm)	6,8(170)	13,8(345)	9,2(230)
Theoretical spreading rate ft <sup>2</sup> /gl (m <sup>2</sup> /l)	233(5,8)	116(2,9)	176(4,4)

WG Comp. B	Minimum	Maximum	Typical
Film thickness, dry mils (µm)	6,0(150)	10,0(250)	8,0(200)
Film thickness, wet mils (µm)	7,8(195)	13,0(325)	10,4(260)
Theoretical spreading rate ft <sup>2</sup> /gl (m <sup>2</sup> /l)	205(5,1)	124(3,1)	156(3,9)

### Comments

Hong Kong rules:

Category of paints - Other vessel coatings; VOC 250 gms/ltr HK EPD method (Ready to use); Exempt compound - N/A; Specific gravity: 1.43 (A+B); Both VOC and Specific gravity values provided are typical values, subject to changes when different color involved.

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### Approvals

APAS approved to specification 2973, 2973F and 2977.

Approved for PSPC water ballast tanks according to IMO resolution MSC.215(82).

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## Physical properties

<b>Color</b>	Aluminium, Aluminium Red toned
<b>Solids (vol %)*</b>	87 ± 2 Std Comp. B 77 ± 2 CC/WG Comp. B
<b>Flash point</b>	<b>Std Comp. B:</b> 104°F ± 4 (40°C ± 2) (Setaflash) <b>CC/WG Comp. B:</b> 88°F ± 4 (31°C ± 2) (Setaflash)
<b>VOC</b>	<b>Std Comp. B</b> 2,09 lbs/gal (250 gms./ltr.) USA-EPA Method 24 110 gms/ltr UK-PG6/23(97). Appendix 3 <b>CC/WG Comp. B</b> 180 gms/ltr UK-PG6/23(97). Appendix 3
<b>Gloss</b>	Semigloss
<b>Gloss retention</b>	Fair
<b>Water resistance</b>	Excellent
<b>Abrasion resistance</b>	Very good
<b>Solvent resistance</b>	Good
<b>Chemical resistance</b>	Good
<b>Flexibility</b>	Good

\*Measured according to ISO 3233:1998 (E)

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## Surface preparation

All surfaces should be clean and free from contamination. The surface should be assessed and treated in accordance with ISO 8504.

### Bare steel

Cleanliness: Power tool cleaning to min. SSPC-SP2 "Hand Tool Clean" or St 2, mill scale free (ISO 8501-1:2007). Improved surface treatment (blast cleaning to SSPC-SP10 "Near White Blast" or Sa 2½) will improve the performance. In case of waterjetting the flash rust degree shall not exceed (M) moderate in SSPC and NACE standards for waterjetted surfaces.

### Shopprimed steel

Clean, dry and undamaged approved shopprimer.

### Coated surfaces

Clean, dry and undamaged compatible primer. Contact your local Jotun office for more information. For maintenance UHPWJ to WJ2 (NACE No.5/SSPC-SP 12) or Power tool cleaning to min. SSPC-SP2 "Hand Tool Clean" or St 2 for rusted areas

### Other surfaces

The coating may be used on other substrates. Please contact your local Jotun office for more information.

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## Condition during application

The temperature of the substrate should be minimum 50°F (10°C) (Std), 23°F (-5°C) in CC and at least 5°F (3°C) above the dew point of the air, temperature and relative humidity measured in the vicinity of the substrate. Good ventilation is required in confined areas to ensure proper drying.

Hydrojetting of steel surface makes a wet surface. The surrounding air must have a relative humidity not exceeding 85 %. Before painting the surface shall not be glossy with moisture, but can have a patchy appearance.

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## Application methods

<b>Spray</b>	Use airless spray (thin 10%)
<b>Brush</b>	Recommended for stripe coating and small areas, care must be taken to achieve the specified dry film thickness.
<b>Roller</b>	May be used for small areas but not recommended for first primer coat, however when using roller application care must be taken to apply sufficient material in order to achieve the specified dry film thickness.

---

## Application data

<b>Mixing ratio (volume)</b>	<b>Std Comp. B:</b> 5.5 parts Comp. A ( base) to be mixed thoroughly with 1 part Jotamastic 87 Std Comp. B (curing agent) <b>WG Comp. B:</b> 3.7 parts Comp. A (base) to be mixed thoroughly with 1 part Jotamastic 87 WG Comp. B (curing agent)
<b>Induction time</b>	10 minutes.
<b>Pot life 73°F (23°C)</b>	<b>Std Comp. B:</b> 1½ hours <b>CC/WG Comp. B:</b> 1 hour
<b>Thinner/Cleaner</b>	Jotun Thinner No. 17
<b>Guiding data airless spray</b>	
<b>Pressure at nozzle</b>	15 MPa (150 kp/cm <sup>2</sup> , 2100 psi).
<b>Nozzle tip</b>	0.53 - 0.79 mm (0.021-0.031")
<b>Spray angle</b>	65-80°
<b>Filter</b>	Check to ensure that filters are clean.

<b>Note</b>	* The temperature of the mixture of base and curing agent is recommended to be at least 59°F (15°C), otherwise extra solvent may be required to obtain correct viscosity. * Too much solvent results in lower sag resistance and slower cure. * If extra solvent is necessary, this should be added after mixing of the two components.
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## Drying time

Drying times are generally related to air circulation, temperature, film thickness and number of coats, and will be affected correspondingly. The figures given in the table are typical with:

- \* Good ventilation (Outdoor exposure or free circulation of air)
- \* Typical film thickness
- \* One coat on top of inert substrate

<b>Std Comp. B</b>			
<b>Substrate temperature</b>	<b>50°F(10°C)</b>	<b>73°F(23°C)</b>	<b>104°F(40°C)</b>
<b>Surface dry</b>	8 h	4 h	2 h
<b>Through dry</b>	24 h	10 h	4 h
<b>Cured</b>	14 d	7 d	2 d
<b>Dry to recoat, minimum</b>	24 h	10 h	4 h
<b>Dry to recoat, maximum <sup>1</sup></b>			

**WG Comp. B**

<b>Substrate temperature</b>	<b>23°F(-5°C)</b>	<b>32°F(0°C)</b>	<b>41°F(5°C)</b>	<b>50°F(10°C)</b>	<b>73°F(23°C)</b>
<b>Surface dry</b>	24 h	18 h	12 h	6 h	2,5 h
<b>Through dry</b>	80 h	44 h	26 h	16 h	6 h
<b>Cured</b>	21	14 d	7 d	3 d	2 d
<b>Dry to recoat, minimum</b>	80 h	44 h	26 h	16 h	6 h
<b>Dry to recoat, maximum <sup>1</sup></b>					

1. Provided the surface is free from chalking and other contamination prior to application, there is normally no overcoating time limit. Best intercoat adhesion occurs, however, when the subsequent coat is applied before preceding coat has cured. If the coating has been exposed to direct sunlight for some time, special attention must be paid to surface cleaning and mattening/removal of the surface layer in order to obtain good adhesion.

The given data must be considered as guidelines only. The actual drying time/times before recoating may be shorter or longer, depending on film thickness, ventilation, humidity, underlying paint system, requirement for early handling and mechanical strength etc. A complete system can be described on a system sheet, where all parameters and special conditions could be included.

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## Typical paint system

<b>Jotamastic 87 Aluminium</b>	<b>1 x 8 mils (200 µm)</b>	<b>(Dry Film Thickness)</b>
Jotamastic 87	1 x 8 mils (200 µm)	(Dry Film Thickness)
Hardtop II	1 x 2 mils (50 µm)	(Dry Film Thickness)

Other systems may be specified, depending on area of use

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## Storage

The product must be stored in accordance with national regulations. Storage conditions are to keep the containers in a dry, cool, well ventilated space and away from source of heat and ignition. Containers must be kept tightly closed.

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## Handling

Handle with care. Stir well before use.

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## Packing size

14.7 liters (3.88 gallons) Comp. A (base) in a 20 liter container and 2.7 liters (0.71 gallons) Jotamastic 87, Std Comp. B in a 3 liter container  
14.7 liters (3.88 gallons) Comp. A (base) in a 20 liter container and 4 liters (1.05 gallons) Jotamastic 87, WG Comp. B in a 5 liter container

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## Health and safety

Please observe the precautionary notices displayed on the container. Use under well ventilated conditions. Do not breathe or inhale mist. Avoid skin contact. Spillage on the skin should immediately be removed with suitable cleanser, soap and water. Eyes should be well flushed with water and medical attention sought immediately.

**For detailed information on the health and safety hazards and precautions for use of this product, we refer to the Material Safety Data Sheet.**

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## DISCLAIMER

The information in this data sheet is given to the best of our knowledge based on laboratory testing and practical experience. However, as the product can be used under conditions beyond our control, we can only guarantee the quality of the product itself. We also reserve the right to change the given data without notice. Minor product variations may be implemented in order to comply with local requirements.

If there is any inconsistency in the text the English (UK) version will prevail.

Jotun is a World Wide company with factories, sales offices and stocks in more than 50 countries. For your nearest local Jotun address please contact the nearest regional office or visit our website at [www.jotun.com](http://www.jotun.com)

ISSUED 10 JANUARY 2013 BY JOTUN  
THIS DATA SHEET SUPERSEDES THOSE PREVIOUSLY ISSUED

## Jotamastic 87 Aluminium Comp A

### 1. Product and company identification

<b>Trade name</b>	: Jotamastic 87 Aluminium Comp A
<b>Code</b>	: 523
<b>Material uses</b>	: Coatings: Solvent-borne.
<b>Manufacturer</b>	: Jotun Paints, Inc. 9203 Highway 23 Belle Chasse, LA 70037 Telephone: (800) 229-3538 or (504) 394-3538 SDSJotun@jotun.com
<b>In case of emergency</b>	: 1-800-424-9300

### 2. Hazards identification

<b>Physical state</b>	: Liquid.
<b>Odor</b>	: Characteristic.
<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200). CAUTION! COMBUSTIBLE LIQUID AND VAPOR. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA. POSSIBLE CANCER HAZARD - CONTAINS MATERIAL WHICH MAY CAUSE CANCER, BASED ON ANIMAL DATA. Combustible liquid. Keep away from heat, sparks and flame. Avoid exposure - obtain special instructions before use. Do not breathe vapor or mist. Avoid contact with skin and clothing. Contains material that may cause target organ damage, based on animal data. Contains material which may cause cancer, based on animal data. Risk of cancer depends on duration and level of exposure. Use only with adequate ventilation.
<b>Eyes</b>	: May cause eye irritation.
<b>Skin</b>	: May cause skin irritation.
<b>Inhalation</b>	: No known significant effects or critical hazards.
<b>Ingestion</b>	: No known significant effects or critical hazards.
<b>Potential chronic health effects</b>	: <b>CARCINOGENIC EFFECTS:</b> Classified A4 (Not classifiable for humans or animals.) by ACGIH, 3 (Not classifiable for humans.) by IARC [xylene]. Classified A4 (Not classifiable for humans or animals.) by ACGIH [aluminium stabilized]. Classified A3 (Proven for animals.) by ACGIH, 2B (Possible for humans.) by IARC [ethylbenzene]. <b>MUTAGENIC EFFECTS:</b> Not available. <b>TERATOGENIC EFFECTS:</b> Not available.
<b>Medical conditions aggravated by over-exposure</b>	: Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

### 3. Composition/information on ingredients

<u>Name</u>	<u>CAS number</u>	<u>% by weight</u>
talca (non-asbestos form)	14807-96-6	2.5 - 10
xylene	1330-20-7	2.5 - 10
magnesite	546-93-0	2.5 - 10
aluminium stabilized	7429-90-5	2.5 - 10
benzyl alcohol	100-51-6	1 - 2.5
Naphtha (petroleum), hydrodesulfurized heavy	64742-82-1	1 - 2.5
2-methylpropan-1-ol	78-83-1	1 - 2.5
ethylbenzene	100-41-4	1 - 2.5

Components not listed are not physical or health hazards as defined in 29 CFR 1910.1200 (Hazard Communication Standard).

### 4. First aid measures

- Eye contact** : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.
- Skin contact** : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.
- Inhalation** : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
- Ingestion** : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

### 5. Fire-fighting measures

- Flammability of the product** : Flammable.
- Products of combustion** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide  
halogenated compounds  
metal oxide/oxides
- Suitable** : Use dry chemical, CO<sub>2</sub>, water spray (fog) or foam.
- Not suitable** : Do not use water jet.
- Special exposure hazards** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- Combustible liquid. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## 6 . Accidental release measures

- Personal precautions** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Methods for cleaning up** : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

## 7 . Handling and storage

- Handling** : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Do not get in eyes or on skin or clothing. Do not ingest. Avoid breathing vapor or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.
- Storage** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

## 8 . Exposure controls/personal protection

### Product name

talc (non-asbestos form)

### Exposure limits

**ACGIH TLV (United States, 1/2011).**

TWA: 0,1 f/cc 8 hour(s). Form:

**OSHA PEL Z3 (United States, 9/2005).**

TWA: 0,1 f/cc 8 hour(s).

STEL: 1 f/cc 30 minute(s).

: 1 f/cc 30 minute(s). Form: not containing asbestos

TWA: 20 mppcf 8 hour(s). Form: not containing asbestos

**OSHA PEL 1989 (United States, 3/1989).**

TWA: 2 mg/m<sup>3</sup> 8 hour(s). Form: Respirable dust

**NIOSH REL (United States, 6/2009).**

## 8 . Exposure controls/personal protection

xylene	<p>TWA: 2 mg/m<sup>3</sup> 10 hour(s). Form: Respirable fraction  <b>ACGIH TLV (United States, 1/2011).</b>          STEL: 651 mg/m<sup>3</sup> 15 minute(s).          STEL: 150 ppm 15 minute(s).          TWA: 434 mg/m<sup>3</sup> 8 hour(s).          TWA: 100 ppm 8 hour(s).  <b>OSHA PEL (United States, 6/2010).</b>          TWA: 435 mg/m<sup>3</sup> 8 hour(s).          TWA: 100 ppm 8 hour(s).  <b>OSHA PEL 1989 (United States, 3/1989).</b>          STEL: 655 mg/m<sup>3</sup> 15 minute(s).          STEL: 150 ppm 15 minute(s).          TWA: 435 mg/m<sup>3</sup> 8 hour(s).          TWA: 100 ppm 8 hour(s).</p>
magnesite	<p><b>OSHA PEL 1989 (United States, 3/1989).</b>          TWA: 5 mg/m<sup>3</sup> 8 hour(s). Form: Respirable fraction          TWA: 15 mg/m<sup>3</sup> 8 hour(s). Form: Total dust  <b>NIOSH REL (United States, 6/2009).</b>          TWA: 5 mg/m<sup>3</sup> 10 hour(s). Form: Respirable fraction          TWA: 10 mg/m<sup>3</sup> 10 hour(s). Form: Total  <b>OSHA PEL (United States, 6/2010).</b>          TWA: 5 mg/m<sup>3</sup> 8 hour(s). Form: Respirable fraction          TWA: 15 mg/m<sup>3</sup> 8 hour(s). Form: Total dust</p>
aluminium stabilized	<p><b>OSHA PEL 1989 (United States, 3/1989). Notes: as Al</b>          TWA: 15 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Dust          TWA: 5 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Pyrophoric          TWA: 5 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Respirable fraction          TWA: 5 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Welding fume  <b>OSHA PEL (United States, 6/2010). Notes: as Al</b>          TWA: 5 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Respirable fraction          TWA: 15 mg/m<sup>3</sup>, (as Al) 8 hour(s). Form: Total dust  <b>NIOSH REL (United States, 6/2009).</b>          TWA: 5 mg/m<sup>3</sup> 10 hour(s). Form: Respirable fraction          TWA: 10 mg/m<sup>3</sup> 10 hour(s). Form: Total  <b>ACGIH TLV (United States, 2/2010).</b>          TWA: 1 mg/m<sup>3</sup> 8 hour(s). Form: Respirable fraction; see Appendix C</p>
benzyl alcohol	<p><b>AIHA WEEL (United States, 10/2011).</b>          TWA: 10 ppm 8 hour(s).</p>
Naphtha (petroleum), hydrodesulfurized heavy	<p><b>ACGIH TLV (United States, 1/2005). Notes: Substances for which the TLV is higher than the OSHA Permissible Exposure Limit (PEL) and/or the NIOSH Recommended Exposure Limit (REL). See CFR 58(124) :36338-33351, June 30, 1993, for revised OSHA PEL.</b>          TWA: 525 mg/m<sup>3</sup> 8 hour(s). Form: All forms          TWA: 100 ppm 8 hour(s). Form: All forms  <b>NIOSH REL (United States, 12/2001).</b>          CEIL: 1800 mg/m<sup>3</sup> 15 minute(s). Form: All forms          TWA: 350 mg/m<sup>3</sup> 10 hour(s). Form: All forms  <b>OSHA PEL (United States, 8/1997).</b>          TWA: 2900 mg/m<sup>3</sup> 8 hour(s). Form: All forms          TWA: 500 ppm 8 hour(s). Form: All forms  <b>OSHA PEL 1989 (United States, 3/1989).</b>          TWA: 525 mg/m<sup>3</sup> 8 hour(s). Form: All forms          TWA: 100 ppm 8 hour(s). Form: All forms</p>
2-methylpropan-1-ol	<p><b>ACGIH TLV (United States, 1/2011).</b>          TWA: 152 mg/m<sup>3</sup> 8 hour(s).          TWA: 50 ppm 8 hour(s).  <b>NIOSH REL (United States, 6/2009).</b>          TWA: 150 mg/m<sup>3</sup> 10 hour(s).          TWA: 50 ppm 10 hour(s).</p>

## 8 . Exposure controls/personal protection

ethylbenzene

### OSHA PEL (United States, 6/2010).

TWA: 300 mg/m<sup>3</sup> 8 hour(s).

TWA: 100 ppm 8 hour(s).

### OSHA PEL 1989 (United States, 3/1989).

TWA: 150 mg/m<sup>3</sup> 8 hour(s).

TWA: 50 ppm 8 hour(s).

### OSHA PEL 1989 (United States, 3/1989).

TWA: 100 ppm 8 hour(s).

TWA: 435 mg/m<sup>3</sup> 8 hour(s).

STEL: 125 ppm 15 minute(s).

STEL: 545 mg/m<sup>3</sup> 15 minute(s).

### NIOSH REL (United States, 6/2009).

TWA: 100 ppm 10 hour(s).

TWA: 435 mg/m<sup>3</sup> 10 hour(s).

STEL: 125 ppm 15 minute(s).

STEL: 545 mg/m<sup>3</sup> 15 minute(s).

### OSHA PEL (United States, 6/2010).

TWA: 100 ppm 8 hour(s).

TWA: 435 mg/m<sup>3</sup> 8 hour(s).

### ACGIH TLV (United States, 1/2011). Notes: K

TWA: 20 ppm 8 hour(s). Form:

- Engineering measures** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
- Eyes** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
- Skin** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory** : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard (NIOSH-approved P95) if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
- Hands** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
- Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

## 9 . Physical and chemical properties

- Physical state** : Liquid.
- Flash point** : Closed cup: 40°C (104°F)
- Color** : Various colors.
- Odor** : Characteristic.
- Relative density** : 1.5 g/cm<sup>3</sup> 12.52 pounds/gallon
- VOC** : 1.36 pounds/gallon (US) 248 % (w/w) [ISO % 11890-2]
- Solubility** : Insoluble in the following materials: cold water and hot water.

## 10 . Stability and reactivity

- Stability and reactivity** : The product is stable.
- Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.
- Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

## 11 . Toxicological information

- Chronic effects on humans** : **CARCINOGENIC EFFECTS:** Classified A4 (Not classifiable for humans or animals.) by ACGIH, 3 (Not classifiable for humans.) by IARC [xylene]. Classified A4 (Not classifiable for humans or animals.) by ACGIH [aluminium stabilized]. Classified A3 (Proven for animals.) by ACGIH, 2B (Possible for humans.) by IARC [ethylbenzene].  
Contains material which may cause damage to the following organs: upper respiratory tract, skin, eyes.

- Other toxic effects on humans** : Exposure to component solvent vapor concentrations in excess of the stated occupational exposure limit may result in adverse health effects such as mucous membrane and respiratory system irritation and adverse effects on the kidneys, liver and central nervous system. Solvents may cause some of the above effects by absorption through the skin. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness and, in extreme cases, loss of consciousness. Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin, resulting in non-allergic contact dermatitis and absorption through the skin. If splashed in the eyes, the liquid may cause irritation and reversible damage. Swallowing may cause nausea, diarrhea, vomiting, gastrointestinal irritation and chemical pneumonia.

Based on the properties of the epoxy constituent(s) and considering toxicological data on similar preparations, this preparation may be a skin sensitizer and an irritant. It contains low-molecular weight epoxy constituents which are irritating to eyes, mucous membranes and skin. Repeated skin contact may lead to irritation and to sensitization, possibly with cross-sensitization to other epoxies. Skin contact with the preparation and exposure to spray, mist and vapors should be avoided.

Contains reaction product: bisphenol-A-(epichlorhydrin); epoxy resin (number average molecular weight  $\leq$  700), hydrocarbons, c9-unsatd., polyimd., epoxy resin (MW 700-1200). May produce an allergic reaction.

### Specific effects

- Carcinogenic effects** : Contains material which may cause cancer, based on animal data. Risk of cancer depends on duration and level of exposure.
- Mutagenic effects** : No known significant effects or critical hazards.
- Reproduction toxicity** : No known significant effects or critical hazards.
- Chronic effects** : Contains material that may cause target organ damage, based on animal data.
- Target organs** : Contains material which may cause damage to the following organs: upper respiratory tract, skin, eyes.

## 12 . Ecological information

### Ecotoxicity data

<u>Product/ingredient name</u>	<u>Species</u>	<u>Period</u>	<u>Result</u>
xylene	Oncorhynchus mykiss (LC50)	96 hour(s)	3.3 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	8.2 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	8.6 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	12 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	13.3 mg/l
	Pimephales promelas (LC50)	96 hour(s)	13.4 mg/l
aluminium stabilized	Oncorhynchus mykiss (LC50)	96 hour(s)	0.12 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	0.16 mg/l

Continued on next page

## 12 . Ecological information

benzyl alcohol	Oncorhynchus mykiss (LC50)	96 hour(s)	0.31 mg/l
	Lepomis macrochirus (LC50)	96 hour(s)	10 mg/l
	Pimephales promelas (LC50)	96 hour(s)	460 mg/l
Naphtha (petroleum), hydrodesulfurized heavy	Fish (LC50)	96 hour(s)	<10 mg/l
	Daphnia (EC50)	48 hour(s)	<10 mg/l
	Algae (IC50)	72 hour(s)	<10 mg/l
2-methylpropan-1-ol	Scenedesmus subspicatus (EC50)	48 hour(s)	230 mg/l
	Daphnia pulex (EC50)	48 hour(s)	1100 mg/l
	Scenedesmus subspicatus (EC50)	48 hour(s)	1250 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	1330 mg/l
	Pimephales promelas (LC50)	96 hour(s)	1430 mg/l
	Pimephales promelas (LC50)	96 hour(s)	1510 mg/l
ethylbenzene	Daphnia magna (EC50)	48 hour(s)	2.93 mg/l
	Daphnia magna (EC50)	48 hour(s)	2.97 mg/l
	Selenastrum capricornutum (EC50)	48 hour(s)	7.2 mg/l
	Oncorhynchus mykiss (LC50)	96 hour(s)	4.2 mg/l
	Pimephales promelas (LC50)	96 hour(s)	9.09 mg/l
	Poecilia reticulata (LC50)	96 hour(s)	9.6 mg/l

**Environmental precautions** : Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

**Products of degradation** : Products of degradation: carbon oxides (CO, CO<sub>2</sub>) and water, halogenated compounds. Some metallic oxides.

## 13 . Disposal considerations






**Waste disposal** : The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

**Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.**

**The information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.**

**Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.**

## 14 . Transport information

Regulatory information	UN number	Proper shipping name	Class	PG*	Label	Additional information
DOT Classification	1263	Paint.	3	III		-
TDG Classification	1263	Paint.	3	III		-
ADR/RID Class	1263	Paint.	3	III		Tunnel restriction code: (D/E) Hazard identification number: 30 Special provisions: 640E
IMDG Class	1263	Paint.	3	III		Emergency schedules (EmS): F-E, <u>S-E</u> Marine pollutant: No.
IATA-DGR Class	1263	Paint.	3	III		-

PG\* : Packing group

ADR/RID: Viscous substance. Not restricted, ref. chapter 2.2.3.1.5 (applicable to receptacles < 450 litre capacity). IMDG Viscous substance. Transport in accordance with paragraph 2.3.2.5 (applicable to receptacles < 30 litre capacity)

## 15 . Regulatory information

**HCS Classification** : Combustible liquid  
Carcinogen  
Target organ effects

**U.S. Federal regulations** : **TSCA 8(a) IUR Exempt/Partial exemption:** Not determined  
**United States inventory (TSCA 8b):** Not determined.

**SARA 302/304/311/312 extremely hazardous substances:** No products were found.

**SARA 302/304 emergency planning and notification:** No products were found.

**SARA 302/304/311/312 hazardous chemicals:** ethylbenzene; xylene; reaction product: bisphenol-A-(epichlorhydrin); epoxy resin; aluminium stabilized; talc (non-asbestos form); 2-methylpropan-1-ol; benzyl alcohol

**SARA 311/312 MSDS distribution - chemical inventory - hazard identification:**  
ethylbenzene: Fire hazard, Immediate (acute) health hazard, Delayed (chronic) health hazard; xylene: Fire hazard, Immediate (acute) health hazard, Delayed (chronic) health hazard; reaction product: bisphenol-A-(epichlorhydrin); epoxy resin: Immediate (acute) health hazard; aluminium stabilized: Fire hazard, reactive; talc (non-asbestos form): Immediate (acute) health hazard; 2-methylpropan-1-ol: Fire hazard, Immediate (acute) health hazard, Delayed (chronic) health hazard; benzyl alcohol: Immediate (acute) health hazard, Delayed (chronic) health hazard

**Clean Air Act (CAA) 112 accidental release prevention:** No products were found.

### SARA 313

Product name

CAS number

Concentration

Continued on next page

## 15 . Regulatory information

<b>Form R - Reporting requirements</b>	:	xylene	1330-20-7	2.5 - 10
		aluminium stabilized	7429-90-5	2.5 - 10
		ethylbenzene	100-41-4	1 - 2.5
<b>Supplier notification</b>	:	xylene	1330-20-7	2.5 - 10
		aluminium stabilized	7429-90-5	2.5 - 10
		ethylbenzene	100-41-4	1 - 2.5

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

**State regulations**

- : **Connecticut Carcinogen Reporting:** None of the components are listed.
- : **Connecticut Hazardous Material Survey:** None of the components are listed.
- : **Florida substances:** None of the components are listed.
- : **Illinois Chemical Safety Act:** None of the components are listed.
- : **Illinois Toxic Substances Disclosure to Employee Act:** None of the components are listed.
- : **Louisiana Reporting:** None of the components are listed.
- : **Louisiana Spill:** None of the components are listed.
- : **Massachusetts Spill:** None of the components are listed.
- : **Massachusetts Substances:** The following components are listed: BENZYL ALCOHOL; ISOBUTYL ALCOHOL; MAGNESITE DUST; TALC; ALUMINUM; XYLENE; ethylbenzene
- : **Michigan Critical Material:** None of the components are listed.
- : **Minnesota Hazardous Substances:** None of the components are listed.
- : **New Jersey Hazardous Substances:** The following components are listed: ISOBUTYL ALCOHOL; 1-PROPANOL, 2-METHYL-; MAGNESITE; CARBONIC ACID, MAGNESIUM SALT (1:1); TALC; ALUMINUM; XYLENES; BENZENE, DIMETHYL-; ethylbenzene
- : **New Jersey Spill:** None of the components are listed.
- : **New Jersey Toxic Catastrophe Prevention Act:** None of the components are listed.
- : **New York Acutely Hazardous Substances:** The following components are listed: Isobutanol; Xylene (mixed); Ethylbenzene
- : **New York Toxic Chemical Release Reporting:** None of the components are listed.
- : **Pennsylvania RTK Hazardous Substances:** The following components are listed: BENZENEMETHANOL; 1-PROPANOL, 2-METHYL-; SOAPSTONE DUST; ALUMINUM; BENZENE, DIMETHYL-; ethylbenzene
- : **Rhode Island Hazardous Substances:** None of the components are listed.

**WARNING:** This product contains a chemical known to the State of California to cause cancer.

<u>Ingredient name</u>	<u>Cancer</u>	<u>Reproductive</u>	<u>No significant risk level</u>	<u>Maximum acceptable dosage level</u>
ethylbenzene	Yes.	No.	No.	No.

### EU regulations

**Hazard symbol or symbols :**



Irritant

**Risk phrases**

- : R10- Flammable.
- : R36/38- Irritating to eyes and skin.
- : R43- May cause sensitization by skin contact.
- : R52/53- Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

**Safety phrases**

- : S24- Avoid contact with skin.
- : S37- Wear suitable gloves.

## 16 . Other information

**Label requirements** : COMBUSTIBLE LIQUID AND VAPOR. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA. POSSIBLE CANCER HAZARD - CONTAINS MATERIAL WHICH MAY CAUSE CANCER, BASED ON ANIMAL DATA.

**Hazardous Material Information System (U.S.A.)** :

Health	0
Flammability	0
Physical hazards	0
PERSONAL PROTECTION	



**Date of issue** : 04.06.2013.

**Version** : 1.02

**Notice to reader**

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▣ Indicates information that has changed from previously issued version.

# Material Safety Data Sheet



## Jotamastic 87 Standard - Comp. B

### 1. Product and company identification

**Trade name** : Jotamastic 87 Standard - Comp. B  
**Code** : MM00000527  
**Material uses** : Coatings: Hardener.  
**Manufacturer** : Jotun Paints, Inc.  
9203 Highway 23  
Belle Chasse, LA 70037  
Telephone: (800) 229-3538 or  
(504) 394-3538  
SDSJotun@jotun.com  
**In case of emergency** : 1-800-424-9300

### 2. Hazards identification

**Physical state** : Liquid.  
**Odor** : Characteristic.  
**OSHA/HCS status** : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).  
DANGER!  
CAUSES SKIN BURNS. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.  
Corrosive to the skin. Causes burns. Do not breathe vapor or mist. Do not get in eyes or on skin or clothing. Contains material that may cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container tightly closed and sealed until ready for use. Wash thoroughly after handling.  
**Eyes** : No known significant effects or critical hazards.  
**Skin** : Corrosive to the skin. Causes burns.  
**Inhalation** : May give off gas, vapor or dust that is very irritating or corrosive to the respiratory system. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.  
**Ingestion** : May cause burns to mouth, throat and stomach.  
**Potential chronic health effects** : **CARCINOGENIC EFFECTS:** Not available.  
**MUTAGENIC EFFECTS:** Not available.  
**TERATOGENIC EFFECTS:** Not available.  
**Medical conditions aggravated by over-exposure** : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

### 3. Composition/information on ingredients

<u>Name</u>	<u>CAS number</u>	<u>% by weight</u>
benzyl alcohol	100-51-6	10 - 25
3-aminomethyl-3,5,5-trimethylcyclohexylamine	2855-13-2	10 - 25

Components not listed are not physical or health hazards as defined in 29 CFR 1910.1200 (Hazard Communication Standard).

### 4. First aid measures

**Eye contact** : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.  
**Skin contact** : In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Continued on next page

## 4 . First aid measures

- Inhalation** : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
- Ingestion** : Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

## 5 . Fire-fighting measures

- Flammability of the product** : Non-flammable.
- Products of combustion** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide  
nitrogen oxides
- Suitable** : Use an extinguishing agent suitable for the surrounding fire.
- Not suitable** : None known.
- Special exposure hazards** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.  
  
In a fire or if heated, a pressure increase will occur and the container may burst.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

## 6 . Accidental release measures

- Personal precautions** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Do not breathe vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment (see Section 8).
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).
- Methods for cleaning up** : Stop leak if without risk. Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

## 7 . Handling and storage

- Handling** : Put on appropriate personal protective equipment (see Section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. If during normal use the material presents a respiratory hazard, use only with adequate ventilation or wear appropriate respirator. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous. Do not reuse container.



## 11 . Toxicological information

**Other toxic effects on humans** : Exposure to component solvent vapor concentrations in excess of the stated occupational exposure limit may result in adverse health effects such as mucous membrane and respiratory system irritation and adverse effects on the kidneys, liver and central nervous system. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness and, in extreme cases, loss of consciousness. Solvents may cause some of the above effects by absorption through the skin. Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin, resulting in non-allergic contact dermatitis and absorption through the skin. If splashed in the eyes, the liquid may cause irritation and reversible damage. Swallowing may cause nausea, diarrhea and vomiting.

Contains 3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexane-1,6-diamine. May produce an allergic reaction.

### Specific effects

**Carcinogenic effects** : No known significant effects or critical hazards.

**Mutagenic effects** : No known significant effects or critical hazards.

**Reproduction toxicity** : No known significant effects or critical hazards.

**Chronic effects** : Contains material that may cause target organ damage, based on animal data.

**Target organs** : Contains material which may cause damage to the following organs: skin, eyes.

## 12 . Ecological information

### Ecotoxicity data

<u>Product/ingredient name</u>	<u>Species</u>	<u>Period</u>	<u>Result</u>
benzyl alcohol	Lepomis macrochirus (LC50)	96 hour(s)	10 mg/l
	Pimephales promelas (LC50)	96 hour(s)	460 mg/l
3-aminomethyl-3,5,5-trimethylcyclohexylamine	Daphnia magna (EC50)	48 hour(s)	17.4 mg/l
	Daphnia (EC50)	24 hour(s)	44 mg/l
	Algae (IC50)	72 hour(s)	37 mg/l

**Environmental precautions** : No known significant effects or critical hazards.

**Products of degradation** : Products of degradation: carbon oxides (CO, CO<sub>2</sub>) and water, nitrogen oxides (NO, NO<sub>2</sub> etc.).

## 13 . Disposal considerations






**Waste disposal** : The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

**Disposal should be in accordance with applicable regional, national and local laws and regulations. Local regulations may be more stringent than regional or national requirements.**

**The information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.**

**Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION for additional handling information and protection of employees.**

## 14 . Transport information

Regulatory information	UN number	Proper shipping name	Class	PG*	Label	Additional information
<b>DOT Classification</b>	2735	Polyamines, liquid, corrosive, n.o.s. (3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexamethylenediamine)	8	III		-
<b>TDG Classification</b>	2735	Polyamines, liquid, corrosive, n.o.s. (3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexamethylenediamine)	8	III		-
<b>ADR/RID Class</b>	2735	Polyamines, liquid, corrosive, n.o.s. (3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexamethylenediamine)	8	III		Tunnel restriction code: (E) Hazard identification number: 80
<b>IMDG Class</b>	2735	Polyamines, liquid, corrosive, n.o.s. (3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexamethylenediamine)	8	III		Emergency schedules (EmS): F-A, S-B Marine pollutant: No.
<b>IATA-DGR Class</b>	2735	Polyamines, liquid, corrosive, n.o.s. (3-aminomethyl-3,5,5-trimethylcyclohexylamine, trimethylhexamethylenediamine)	8	III		-

PG\* : Packing group

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## 15 . Regulatory information

- HCS Classification** : Corrosive material  
Target organ effects
- U.S. Federal regulations** : **TSCA 8(a) IUR Exempt/Partial exemption:** Not determined  
**United States inventory (TSCA 8b):** Not determined.  
**SARA 302/304/311/312 extremely hazardous substances:** No products were found.  
**SARA 302/304 emergency planning and notification:** No products were found.  
**SARA 302/304/311/312 hazardous chemicals:** 3-aminomethyl-3,5,5-trimethylcyclohexylamine; benzyl alcohol  
**SARA 311/312 MSDS distribution - chemical inventory - hazard identification:** 3-aminomethyl-3,5,5-trimethylcyclohexylamine: Immediate (acute) health hazard; benzyl alcohol: Immediate (acute) health hazard, Delayed (chronic) health hazard  
**Clean Air Act (CAA) 112 accidental release prevention:** No products were found.
- State regulations** : **Connecticut Carcinogen Reporting:** None of the components are listed.  
**Connecticut Hazardous Material Survey:** None of the components are listed.  
**Florida substances:** None of the components are listed.  
**Illinois Chemical Safety Act:** None of the components are listed.  
**Illinois Toxic Substances Disclosure to Employee Act:** None of the components are listed.  
**Louisiana Reporting:** None of the components are listed.  
**Louisiana Spill:** None of the components are listed.  
**Massachusetts Spill:** None of the components are listed.  
**Massachusetts Substances:** The following components are listed: BENZYL ALCOHOL  
**Michigan Critical Material:** None of the components are listed.  
**Minnesota Hazardous Substances:** None of the components are listed.  
**New Jersey Hazardous Substances:** The following components are listed: ISOPHORONEDIAMINE; CYCLOHEXANEMETHANAMINE, 5-AMINO-1,3,3-TRIMETHYL-; TRIMETHYLHEXAMETHYLENEDIAMINE; 1,6-HEXANEDIAMINE, C,C,C-TRIMETHYL-

Continued on next page

## 15 . Regulatory information

**New Jersey Spill:** None of the components are listed.

**New Jersey Toxic Catastrophe Prevention Act:** None of the components are listed.

**New York Acutely Hazardous Substances:** None of the components are listed.

**New York Toxic Chemical Release Reporting:** None of the components are listed.

**Pennsylvania RTK Hazardous Substances:** The following components are listed:  
BENZENEMETHANOL

**Rhode Island Hazardous Substances:** None of the components are listed.

### EU regulations

Hazard symbol or symbols :



Corrosive

**Risk phrases** : R22- Harmful if swallowed.  
R34- Causes burns.  
R43- May cause sensitization by skin contact.

**Safety phrases** : S23- Do not breathe vapor / spray.  
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.  
S36/37/39- Wear suitable protective clothing, gloves and eye/face protection.  
S38- In case of insufficient ventilation, wear suitable respiratory equipment.  
S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

## 16 . Other information

**Label requirements** : CAUSES SKIN BURNS. CONTAINS MATERIAL THAT MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.

**Hazardous Material Information System (U.S.A.)** :

Health	3
Flammability	2
Physical hazards	0
PERSONAL PROTECTION	G

**National Fire Protection Association (U.S.A.)** :



**Date of issue** : 16.10.2012.

**Version** : 1.01

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**Pump Reference &  
Performance Data**

**Pump IOM Instructions**

**Pump Drawings**

**Electric Motor**

**Pump Coating**

**Warranty**





# MORRISON

PUMP COMPANY

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**A BUSINESS UNIT OF PATTERSON**

Patterson Pump Company and Divisions of Patterson Pump Company ("Patterson") warrants, to the extent hereinafter set forth, each new piece of Patterson equipment to be free from defects in material and workmanship under the normal use and service for which it was intended if, and only if, it has been properly installed and operated.

Patterson's obligation under the warranty is limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part or parts of the equipment that were manufactured by Patterson and which are returned to Patterson at Toccoa, Georgia, provided that such part or parts are received at the Patterson factory not later than twelve (12) months after installation or eighteen (18) months after shipment whichever occurs first.

As to a part or parts such as engines, motors and accessories which are furnished by Patterson, but not manufactured by it, same will carry only the warranty of the manufacturer of such part or parts, and this shall be the limit of Patterson's liability with respect to such part or parts.

Purchaser must notify Patterson by registered or certified mail, return receipt requested, of a claimed breach of warranty within thirty (30) days after discovery thereof, but not later than the termination of the guarantee period hereinabove provided; otherwise, such claim shall be deemed waived.

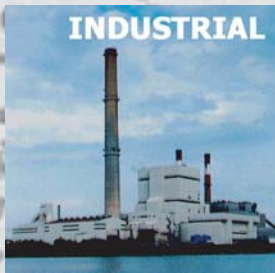
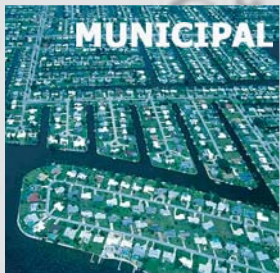
Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other equipment or machinery.

This warranty shall not apply to any Patterson Equipment, or parts thereof, which have been repaired or altered without Patterson's written consent, outside Patterson's factory, or which have been altered in any way so as in the judgement of Patterson, to affect adversely the performance or reliability of the Patterson equipment, or which have been subject to misuse, negligence or accident, or which have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such equipment.

**THIS WARRANTY IS FURNISHED EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT OTHERWISE SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OF PATTERSON.**

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