



**ENERGY RECOVERY. INC.**



**VP-3471, ERI Part Number 50008**  
**VP-4671, ERI Part Number 50009**  
**VP-6891, ERI Part Number 50010**

**ENERGY RECOVERY, INC.**

**1908 DOOLITTLE DRIVE, SAN LEANDRO, CA 94577 USA**

**TEL: +1 510 483 7370 / FAX: +1 510 483 7371**

**[WWW.ENERGYRECOVERY.COM](http://WWW.ENERGYRECOVERY.COM) / [SALES@ENERGYRECOVERY.COM](mailto:SALES@ENERGYRECOVERY.COM)**

**ERI® DOCUMENT NUMBER 80140-01 REVISION 0**

**© ENERGY RECOVERY, INC., 2008**

**INSTALLATION, OPERATION, & MAINTENANCE MANUAL  
CIRCULATION PUMP**

**TABLE OF CONTENTS**

<b>1</b>	<b>INSTALLATION</b> .....	<b>3</b>
1.1	STORAGE.....	3
1.2	FOUNDATION .....	3
1.3	GROUTING .....	3
1.4	SETTING EQUIPMENT. RIGGING PROCEDURE, COMPONENT WEIGHT AND LIFTING DIAGRAM.....	4
1.5	ALIGNMENT .....	4
1.6	PIPING RECOMMENDATIONS.....	4
1.7	DISMANTLING CLEARANCE .....	4
1.8	THRUST BEARING.....	5
1.9	SEAL .....	5
<b>2</b>	<b>OPERATION</b> .....	<b>6</b>
2.1	START UP .....	6
2.2	ROUTINE OPERATIONAL PROCEDURE .....	7
2.3	LUBRICATION RECOMMENDATIONS.....	9
<b>3</b>	<b>DISASSEMBLY AND ASSEMBLY</b> .....	<b>10</b>
3.1	DISASSEMBLY .....	10
<b>4</b>	<b>REVISION LOG</b> .....	<b>15</b>

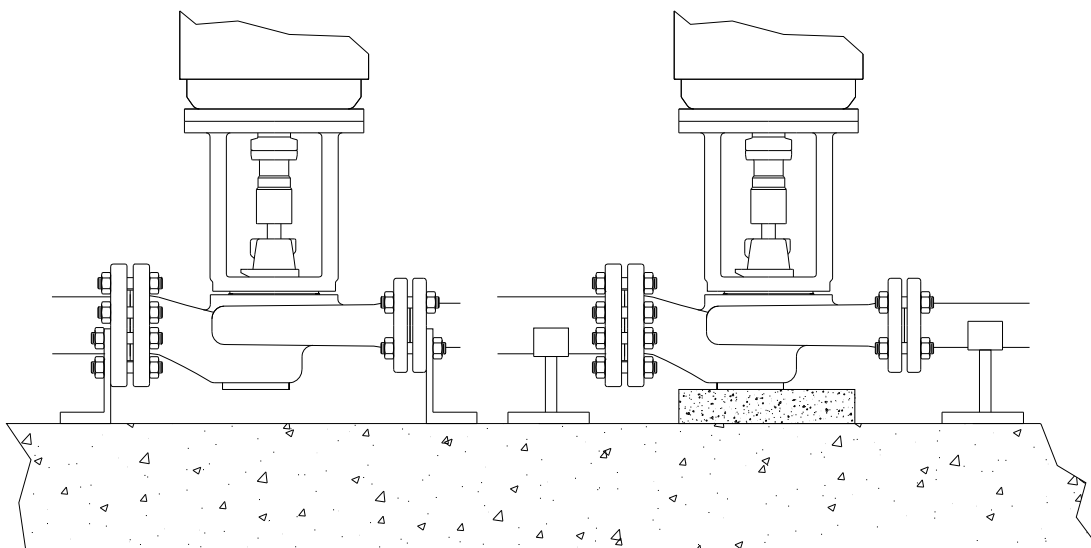
## 1 INSTALLATION

### 1.1 STORAGE

If the pump is not installed at once, find a clean dry location for storage. The unit should be stored in an approximately level position with no strains applied. Flange covers should be left in place to protect the internals from debris.

### 1.2 FOUNDATION

Normally smaller in-line pumps do not require a foundation support since the weight of the pump and driver can be carried by the suction and discharge piping. The piping must be installed in such a manner that the pump is not used as a pipe support. See sketch below.



### 1.3 GROUTING

The pumps do not require grouting.

#### **1.4 SETTING EQUIPMENT. RIGGING PROCEDURE, COMPONENT WEIGHT AND LIFTING DIAGRAM**

Use care when moving pumps. Rough handling of the pump can cause breakage or permanent misalignment. Carefully sling pumps so that the seal flush piping will not be bent or damaged when lifting.

Ensure that any equipment used to lift the pump or any of its components is capable of supporting the weights encountered. Ensure all parts are properly rigged before attempting to lift the pump.

The weight of equipment can be obtained from the pump outline drawing.

#### **1.5 ALIGNMENT**

The VPRO comes completely assembled. The motor and coupling have been aligned at the factory and the unit is ready to be put into service. Alignment is achieved through a series of spigot fits from the motor down to the pump casing. Alignment of the pump shaft to the motor shaft is taken care of through the proper assembly of the 3 piece coupling.

#### **1.6 PIPING RECOMMENDATIONS**

When designing the piping system and supports, treat the pump as a concentrated weight similar to a valve in the line.

Do not use the pump as a pipe support. All piping should be supported independently of the pump, and care should be taken when making up fittings, etc. to avoid placing a strain on the pump. Suction and discharge piping should be made direct with as few elbows as possible in order to reduce friction head losses.

For ideal conditions, straight lengths of pipe at least 5 diameters long should be attached to the pump suction before any elbows are used.

#### **1.7 DISMANTLING CLEARANCE**

Install the pump in an accessible place, as close as possible to the source of the liquid to be pumped. Allow adequate space for operation and maintenance. Head room is important, as a lift of some type is usually required for dismantling. See the outline drawing for specific recommendations.

### 1.8 THRUST BEARING

There are no thrust bearings in the pump. The thrust bearing is located in the motor.

### 1.9 SEAL

The high pressure shaft mounted seal is specifically designed for ERI in this application to minimize leakage and pump up thrust.

## 2 OPERATION

### 2.1 START UP

After performing all pre-starting checks, the pump is ready to start. Observe the following procedure to put the pump into operation.

1. Rotate the pump by hand through at least three complete revolutions to see that all parts are free of interference.
2. Prime the pump. All air must be evacuated from the system through a high point vent located on the seal gland. Failure to do so will result in mechanical seal damage and leakage past the seal faces.

**CAUTION: BEFORE STARTING OR WHILE OPERATING THE PUMP, THE CASING AND SUCTION LINE MUST BE COMPLETELY FILLED WITH THE LIQUID BEING PUMPED. THE ROTATING PARTS REQUIRE THIS LIQUID FOR LUBRICATION AND THE PUMP MAY SEIZE IF OPERATED WITHOUT LIQUID.**

3. Open the vent valve to vent the pump through the seal chamber. This will eliminate air trapped inside seal chamber and provide proper lubrication to the seal faces.
4. Investigate the source of liquid supply, and see that the line is properly arranged to handle the liquid being pumped. It is best to either start the pump against a partially open discharge valve, or if a Variable Frequency Drive (VFD) is used ramp the pump up to operating speed over a short interval. This minimizes the loading on the pump and electrical system.
5. Jog the driver to check the rotation of the pump shaft. It should correspond with the direction of the rotation arrow riveted to the motor support. If the rotation is correct, you are ready to start the unit. If incorrect, contact an electrician.
6. Start the driver.
7. As soon as the pump is operating at the rated speed, open the discharge valve slowly to avoid abrupt changes in velocity and surging in the suction line.

**CAUTION: DO NOT OPERATE THE PUMP AGAINST A CLOSED DISCHARGE VALVE FOR ANY LENGTH OF TIME OR THE LIQUID IN THE PUMP WILL BE HEATED UNTIL IT VAPORIZES. THIS WILL CAUSE THE PUMP TO SEIZE OR LOSE SUCTION.**

## 2.2 ROUTINE OPERATIONAL PROCEDURE

**WARNING: In the interest of operator safety the unit must not be operated above the nameplate conditions. Such operation could result in unit failure causing injury to operating personnel.**

Check frequently to make certain lubricating liquid flow to the mechanical seal is adequate.

Make certain that liquid is always being discharged from the pump. If not, the pump may seize. One way to check this is to check the pump casing temperature. If the pump case is more than 10 degrees F more than the pumpage, the pump may be operating below minimum flow requirements.

Check the motor bearing temperature. If bearing temperature is over 190 F, the pump should be shut down immediately and cause of overheating determined. Bearings will run at a constant temperature depending upon the ambient temperature at the location.

**WARNING: Operation of the unit without proper motor lubrication can result in overheating of the bearings, bearing failures, pump seizures and actual breakup of the equipment exposing operating personnel to injury.**

**WARNING: The unit must not be operated unless coupling guard is in place. Failure to observe this warning could result in personal injury to operating personnel.**

**IF CONDITIONS REQUIRE OPERATING THE PUMP AT REDUCED CAPACITY, THIS MUST BE DONE BY THROTTLING (OR PARTLY CLOSING) THE DISCHARGE VALVE, OR REDUCING THE OPERATING SPEED THROUGH A VFD. NEVER THROTTLE THE SUCTION LINE.**

**CAUTION: When operating for an extended time at reduced capacity, much of the pump horsepower will go into the liquid in the form of heat.**

Always maintain sufficient flow through the pump to prevent flashing of the liquid passing through the pump. At low flows, a large portion of the horsepower input is

absorbed by the liquid as heat, and the flow must be maintained at a point sufficient to keep the temperature rise through the pump within a safe limit.

**CAUTION: Damage to pump may result from prolonged operations at reduced capacities.**

In addition to heat rise considerations for minimum flow, there is also a minimum flow requirement for mechanical protection of the pump. Damage to the pump may occur at reduced capacities due to increased hydraulic thrust loads. These higher loads cause increased vibration and shaft deflection, and decreased mechanical seal and bearing life.

If a check valve is installed in the discharge line, the pump may be shut down by merely stopping the driver. If a check valve is not installed in the discharge line, shut down the pump by closing the discharge valve, after which the driver is to be stopped immediately.

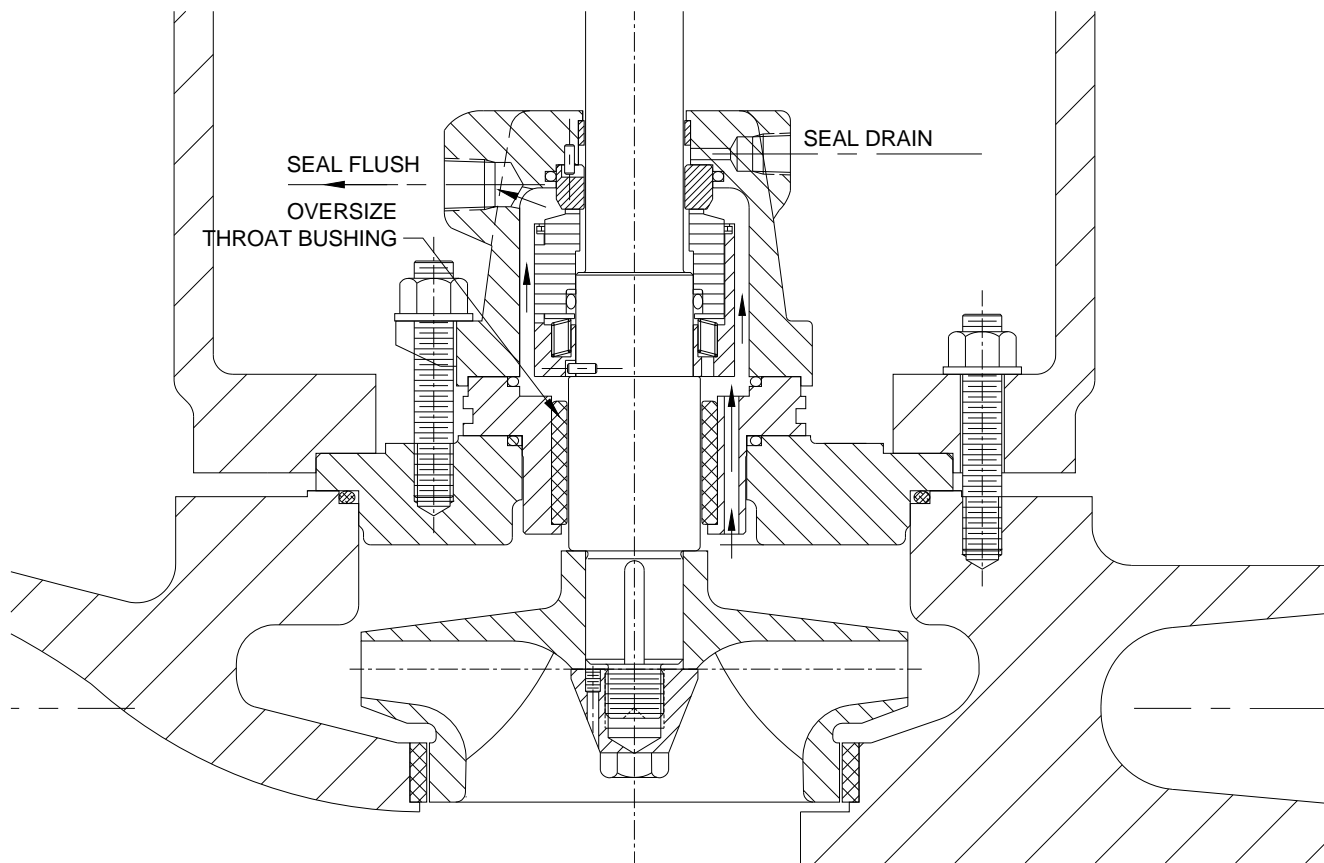
When the pump is idle and there is possibility of freezing, the casing drain plug should be removed and the casing drained.

## 2.3 LUBRICATION RECOMMENDATIONS

The pump radial bearing is self-lubricated; however, the mechanical seal is lubricated by the pumpage.

The pump radial bearing is an extra long throat bushing made of metalized carbon. This bushing is press fit into a metal holder to allow quick and easy replacement in place.

The Motor lubrication recommendations can be found in the motor IOM.



The seal lubrication comes by allowing a steady stream of pumpage to flow through the bearing and bearing retainer, out past the seal faces and out the seal gland back to the pump suction. The differential pressure generated by the pump provides the motive force.

### 3 DISASSEMBLY AND ASSEMBLY

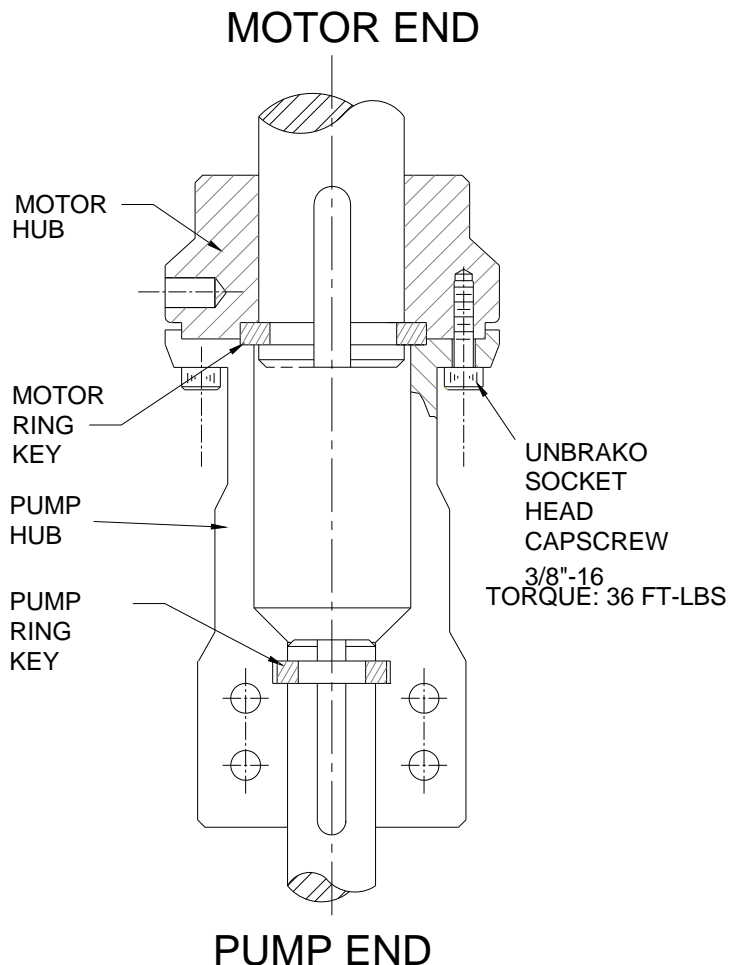
#### 3.1 DISASSEMBLY

AFTER LOCKING OUT THE DRIVER, AND ISOLATING THE UNIT, THE PUMP CAN NOW BE DISASSEMBLED – BE SURE TO FOLLOW YOUR PLANT SAFETY RULES.

It is prudent to match mark the components prior to disassembly to ensure the components are in the same position for re-assembly.

3.1.1 Remove all flush piping as required.

3.1.2 Remove the three piece coupling as follows:



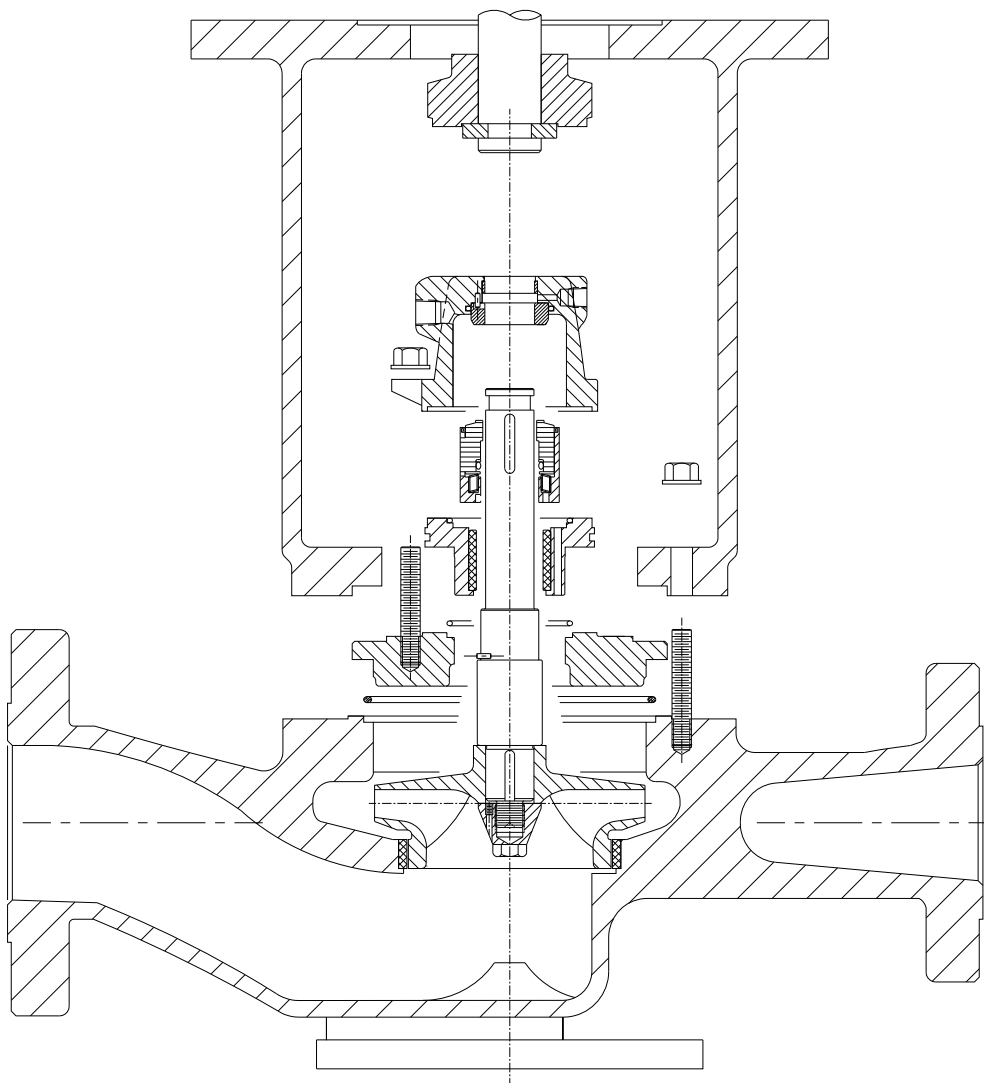
**CAUTION:** Handle coupling hubs with care. Nicks and burs are deadly enemies and will cause misalignment. The surfaces at the splits are lapped.

#### Coupling Removal

1. Loosen all axial and radial bolts (Place a bar in the hole at the side of the motor hub to stop the unit from rotating).
2. Remove all radial bolts.
3. Loosen all 6 axial bolts to lower the shaft assembly into the pump case.
4. Remove the axial bolts on one side of the coupling which will allow that half to be removed.
5. Remove the remaining 3 axial bolts and remove the coupling hub from the shaft.
6. To remove the motor hub you must use bearing puller. Removal is not recommended unless it is necessary for replacement.

3.1.3 Remove the pump coupling key and the pump ring key - the ring key is a 2 piece key that slides out from the shaft.

- 3.1.4 Unbolt the seal gland nuts and carefully lift the seal gland off the shaft between the pump and motor shaft ends. Extra care should be taken when moving past the ring key groove to avoid chipping the seal seat in the gland.
- 3.1.5 Carefully lift the seal head straight up and off the shaft
- 3.1.6 Gently pry the cartridge bearing retainer out of the cover.
- 3.1.7 Unbolt the motor support from the cover and lift the motor and support off pump. There is a spigot fit between the motor and motor support, but unless work is needed on these components, there is no need to take them apart.



- 3.1.8 Gently pry or lift the pump cover out of the case.
- 3.1.9 Lift the shaft and impeller assembly out of the pump case.

- 3.1.10 Holding the impeller from turning, loosen the impeller nut set screw, then loosen and remove the impeller nut. The impeller nut is a left hand thread on the shaft.
- 3.1.11 Pull impeller off the shaft.
- 3.1.12 Inspect the shaft over its entire length for wear.
- 3.1.13 Check the bearing inside diameter for wear.

After all parts are checked for wear and all worn parts have been replaced, the pump can be re-assembled.

#### Helpful Hints.

- Easy does it. Do not force parts - Fit Parts.
  - Remember your match marks and reassemble parts with the same orientation as the original unit.
  - The parts which fit together have very close tolerances and any dirt or debris can significantly affect the finished product in both overall quality and also in ease of assembly. – Cleanliness is the best way to assure a good assembly.
  - Always use new o-rings – nicks in o-ring are easily missed, and a damaged o-ring means a leak when the pump is back in service.
- 3.1.14 Install the impeller onto the pump shaft and install the impeller nut and set screw.
  - 3.1.15 Replace the bearing (if required) as follows:

The bearing is made from metallic impregnated carbon and is designed to have an interference fit of approximately 0.010” on diameter with the holder. The bearing can be pushed into the cover with a press. A close tolerance sliding fit is used between the bearing holder and the cover. The installed bearing should have a 0.006” to 0.009” diametral clearance with the pump shaft.
  - 3.1.16 Lower the impeller / shaft assembly into the pump case.
  - 3.1.17 Install a new case o-ring.
  - 3.1.18 Lower the pump cover over the pump shaft and into the pump case. Watch your match marks or the seal gland will be oriented incorrectly.
  - 3.1.19 Install the bearing/bearing retainer assembly into the cover with a new o-ring.
  - 3.1.20 Install the seal head onto the pump shaft – watch that the drive pin lines up with the groove in the seal head.
  - 3.1.21 Install the seal gland with a new o-ring – watch match marks.

3.1.22 Install the motor support over the cover. Use care, as there is a register fit between the motor support – watch match marks so the motor conduit box is positioned correctly.

Now that the pump assembly wet end is together, take a moment to ensure that all the bolting has been tightened, and the pump cover is fact to face with the case – no gaps. Check with a 0.0015” feeler gauge. If the faces are not metal to metal, that could be an indication that there is a burr or dirt between mating faces – this needs to be corrected before completing the assembly.

### 3.1.23 Coupling re-assembly

3.1.23.1 Check all surfaces and bores and remove every nick and burr with a hone or fine emery cloth. It is most important that all components are clean and dry. Wipe the motor hub, pump shaft and bolt threads.

3.1.23.2 The motor hub is an interference fit onto the motor shaft. Heat the motor hub to approximately 400<sup>0</sup> F then slide it over the shaft until it has passed the slot for the ring key. Position the ring key in the slot in the shaft then slide the motor hub tight against the ring key as pictured in Figure 3.

3.1.23.3 Install thrust ring assembly and coupling key. The key should fit snugly into the shaft, but must be loose in the coupling hub. Refer to Figure 5. Do not fit key to coupling hub. Break corners on key 1/32”.

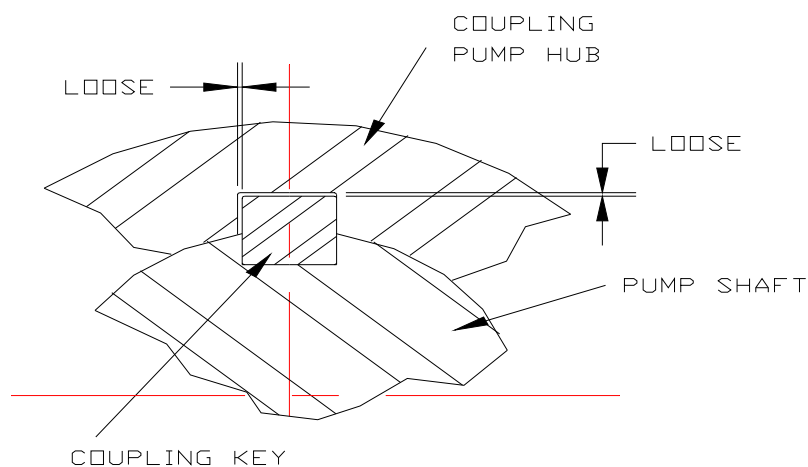


Figure 5

- 3.1.23.4 One of the coupling halves has a key way. Install this pump coupling half over the coupling key and the ring key assembly.  
- Ensure the match marks between the motor hub and pump hub line up.
- 3.1.23.5 Turn the motor shaft to line-up the axial bolt holes and match marks and install 3 axial bolts finger-tight.
- 3.1.23.6 Clean the second coupling hub again and install over the thrust ring and shaft.
- 3.1.23.7 Install the remaining 3 axial bolts.
- 3.1.23.8 Tighten all 6 axial bolts to raise the shaft assembly into place.
- 3.1.23.9 Install the radial bolts and tighten.
- 3.1.23.10 Loosen all 6 axial bolts. Re-tighten axial bolts. Check tightness of radial bolts. If you can tighten any of the radial bolts, loosen all 10 bolts (4 radial and 6 axial ) and perform steps 8 through 10 again.

**IMPORTANT: coupling pump hubs are not interchangeable. Ensure that they are kept as a unit.**

**For the coupling to provide the correct alignment between motor and the pump shaft, the axial bolts must be tightened first. Never clamp the shaft before the axial bolts are tightened.**

**4 REVISION LOG****REVISION LOG**

<b>REV</b>	<b>DESCRIPTION</b>	<b>DATE</b>	<b>APPROVAL</b>
0	INITIAL RELEASE	10/6/08	R. CLEMENTE