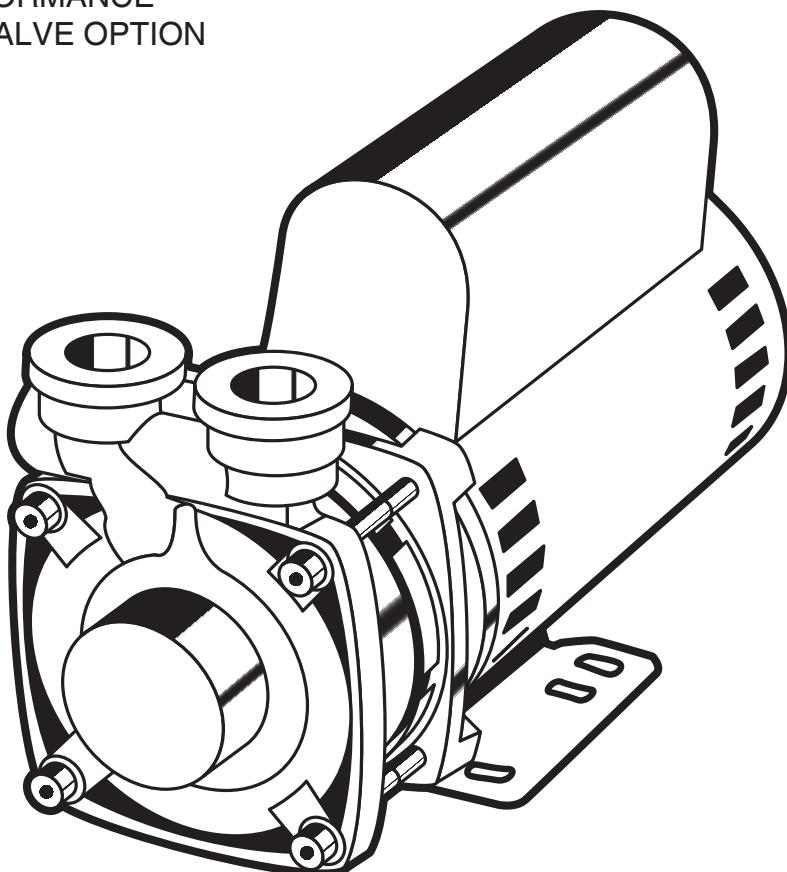


P31 SERIES

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# Pump Manual

HORIZONTAL CLOSE COUPLED  
ADJUSTABLE PERFORMANCE  
INTEGRAL RELIEF VALVE OPTION



**MTH PUMPS**

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# 1 General Instructions

## REGENERATIVE TURBINE PUMPS

- A. Inspection of Equipment
- B. Storage
- C. Placing Stored Pumps Into Service
- D. Application Considerations
- E. Recommended Spare Parts

When properly installed and given reasonable care and maintenance, regenerative turbine pumps should operate satisfactorily for many years. Because of the high differential pressures expected in a regenerative turbine pump, close running clearances are used to reduce internal losses. Abrasive particles, even microscopic ones in high enough concentrations can open up the close clearances between internal cavities. For critical services it is recommended that you keep an identical pump for stand-by use.

### 1A Inspection of Equipment

Immediately upon receipt of the shipment, inspect the equipment for damage or missing components. Check the shipping manifest and report any damage or shortage to the Transportation Company's local agent. Inspect the crate and any wrapping material before discarding. Parts or accessories are sometimes wrapped individually or fastened to the skid.

Put the instructions that came with the shipment in a safe place where they will be available to those who will be using them for installation and service.

### 1B Storage

If the pump is to be stored before use, it should be inspected as described in 1A, reboxed and stored in a dry location. Standard shipping containers are not suitable for outdoor storage. In some areas, it may be necessary to cover the pump's exterior surface with oil or other rust inhibiting coating. All units are tested at the factory with a water/corrosion inhibitor solution, some of which will remain inside the pump upon receipt. If units are flushed out prior to storage, this inhibitor will be removed

and proper care must be taken to prevent product deterioration from improper storage.

For storage beyond 30 days, a corrosion inhibiting protective fluid should be added to the internal pump cavities. Fluids used in the pump should be selected for compatibility with pump materials. This is very important when optional seal and gasket materials have been used. Protective caps on the inlet and outlets should also be used. Caps alone are not sufficient protection.

### 1C Placing Stored Pumps into Service

Special care must be taken when placing stored pumps into service. First clean the outside and flush out the inside with a process compatible fluid. Try to turn the pump using the coupling or shaft. On close coupled units, access to the shaft is between the pump and motor. A vise grip or other plier type gripping device may be used directly on the shaft. Applying torque to the motor fan blades is not recommended. If the impeller does not break loose immediately, fill the pump with a process compatible fluid and try again in a few hours.

If this fails, loosen only the pump cover thru bolts clamping the assembly together, one full turn, no more. Fill the pump with fluid. Apply torque, 50 foot pounds maximum, to the shaft. The pump should turn before 50 foot pounds is reached. If you are successful at breaking loose the unit, continue turning the pump while retightening the thru bolts to their original positions.

If the unit still won't turn over, DO NOT apply further force. Refer to the Disassembly/Reassembly Instructions in Section 5 to determine the cause of the problem.

### 1D Application Considerations

#### 1D1 Electrical Wiring

All electrical equipment and wiring should conform to Local and National Electrical Codes. Use the motor manufacturer's instructions for connecting the motor. Note the correct rotation and wiring diagrams on the

assembly. Make sure the motor rotation and speed matches that required for the pump.

### 1D2 Construction Materials

While it is reasonable to assume that good judgement has been used in selecting all the materials in the pump for compatibility with process fluids, actual conditions sometimes vary from original expectations. Also, typical material selection charts do not consider all the temperature, pressure, and fluid variables. The customer's engineer should be consulted for final judgement on the best materials for critical process applications.

### 1D3 Valves

The first valve to be considered for a regenerative turbine pumping system is often a pressure relief valve. Because this type of pump has a horsepower requirement similar to that of a positive displacement pump (constantly rising along with a pressure increase) a relief valve can be effectively used to limit horsepower. This is helpful when a non-overloading motor is specified. It can be of critical importance if the system flow rate can vary widely. There are almost no circumstances where a flow modulating valve will work successfully in a regenerative turbine pumping system. The steep pumping characteristic, typical of these pumps, produces very large pressure changes with small variations in flow rate. As a result, the modulating flow from these valves introduce sharp pressure shock waves that shorten pump life and may cause damage in other pieces of equipment in the system.

If a shutoff valve is necessary in the suction line, use a gate, ball, butterfly, or other full port valve. Globe or other flow restricting valves can in some cases reduce pump flow or increase chances of cavitation.

A swing check valve is recommended in the suction line even when the pump inlet is only slightly higher than the fluid source. It should be the

same size as the pump inlet or sized based on reasonable fluid friction losses.

A foot valve is recommended when lifting fluid from a sump. This will save wear and tear on any pump, even those equipped with self-priming equipment.

A suction strainer is recommended immediately ahead of the pump on any newly constructed system. This is advisable due to the probability that foreign material large enough to damage pump clearances may remain even though the piping has been flushed.

Valves in the outlet piping of a regenerative turbine pump should always be open as far as possible when the pump is started. This will reduce the start-up load on the pump and motor. Never start the pump with the discharge valve closed.

Inlet valving should be open when starting any pumping system. Without some fluid in the pump, it can gall and lock up impellers. Violent pump failure will result from continued operation with the inlet or discharge valve closed.

#### **1D4 Priming**

Regardless of whether self-priming equipment is used or not, always fill the pump and vent it of air for best seal and pump life. Under most circumstances, regenerative turbine pumps can be made to self-prime as long as a small amount of fluid can be recirculated through the impeller and the fluid doesn't heat up noticeably.

#### **1D5 NPSH (Net Positive Suction Head)**

The NPSH required varies with every size and capacity of pump and generally comes into consideration when the fluid being pumped approaches its vapor pressure or boiling point. The NPSH requirements of regenerative turbine pumps are different from centrifugal pumps in that there is no single specification for a given unit. The pump curve of head vs. capacity will vary according to the NPSH available, but does not have a

minimum requirement like a centrifugal. The performance of each unit at a given NPSH can be obtained from the performance curves or from your MTH representative. Understanding this, we can say that there will be a minimum NPSH required to obtain a specific performance from a unit according to its NPSH curves.

If the NPSH Available (NPSHA) is not equal to or greater than that required by the pump (NPSHR), it must be increased or a different pump selected. The usual method for increasing NPSH is to raise the static head on the pump inlet, ( $H_s$ ) by raising the source tank or lowering the pump.

By definition, NPSH means: "Net Positive Suction Head" above the vapor pressure of the pumped liquid available at the centerline of the pump. It should always be given in feet of pumped liquid. The NPSH is actually a measurement of the amount of energy available in the pumped liquid to produce the required absolute entrance velocity in the pump. If a pump requires more energy (or NPSH) than is available at a given capacity, the pressure at the inlet will fall below the vapor pressure of the pumped liquid, and loss of performance will result. The NPSH available may be calculated using the following equation.

$$\text{NPSHA} = 2.31 \left( \frac{P_s - P_{vp}}{\text{sp. gr.}} \right) + H_s - H_f$$

$P_s$  = Pressure in the suction vessel in PSIA.

$P_{vp}$  = Vapor pressure of the pumped fluid in PSIA.

$H_s$  = Static height of the pumped fluid above (+) or below (-) the centerline of the pump.

$H_f$  = All friction losses from the vessel to the pump including pipe, valve, and suction strainer friction.

For boiling liquids,  $P_s$  and  $P_{vp}$  are equal, this term then becomes zero, and can then be omitted from the equation. Please refer to the Hydraulic Institute Standards and fluid friction loss tables for more information on this subject.

#### **1D6 Noise**

While not generally considered especially noisy, regenerative turbine pumps often produce a high pitched whine that increases in intensity as the differential pressure produced in the pump increases. While high frequency sound is attenuated more easily than lower frequencies, piping structures and the fluids in them readily transmit and even amplify noise. Motors, bearings, and other rotating components add to noise and sometimes create objectionable harmonics.

Careful pump installation can contribute to noise reduction. Proper alignment of the pump and driver is essential.

Adequate supports for the inlet and discharge piping are equally important. A degree of noise reduction may be obtained when the pumping unit is supported free of building structures by the use of vibration isolators, flexible piping and conduit connections. Elastomer type couplings are the best choice to separate motor noises from the fluid and piping structure.

#### **1D7 Freezing**

When ambient temperatures drop below the freezing point of the fluid in a pump, consideration should be given to heating, insulating, or draining the pump. If you choose draining, and it will only be for a short period, first remove the drain plugs and drain the lines to and from the pump. Carefully blow out the pump with compressed air to clear all internal cavities of fluid.

DO NOT use automotive anti-freeze in pumps as the silicates present in these fluids cause damage to mechanical seals.

#### **1E Recommended Spare Parts**

FOR CRITICAL SERVICES - a duplex installation, with two identical pumping units in parallel, is the safest and many times the most cost effective choice.

FOR IMPORTANT SERVICES - a standby pump, ready for installation is advised.

**FOR ROUTINE MAINTENANCE**

- only the mechanical seals and a complete set of "O" ring gaskets are recommended. Should additional components show wear, they are available from stock at the factory.

**FOR SERVICING A PUMP THAT**

**DOES NOT PRODUCE RATED HEAD** - mechanical seals, "O" ring gaskets, impeller, motor bracket, and cover.

**FOR REBUILDING A PUMP** - all

the components required for servicing plus shaft sleeve, and drive keys should be obtained. (A factory rebuild should be considered whenever your disassembly indicates rebuilding is necessary as this is usually more economical.)

The factory recommendation for spare parts are all of those needed for rebuilding a pump and are shown on the exploded view drawings for each individual type of pump.

Special pricing and new pump warranty is offered for factory rebuilding. Turn around time can be as short as one or two days for standard models.

## P31 SERIES

## 2. Installation

### CLOSE COUPLED PUMPS

- A. Location
- B. Foundation
- C. Piping

In order to insure that pumping equipment is installed properly and to obtain reliable pump operation, it is recommended that only experienced, qualified erecting engineers undertake this task. Read the instructions thoroughly before beginning.

#### 2A Location

The first consideration for locating a pump is elevation. The lowest possible elevation using the shortest possible suction piping is usually the best. Questions regarding possible locations should be resolved by making inlet head calculations including all friction losses. The one producing the highest inlet pressure should be selected. One reason for this precaution is that, the greater the inlet pressure, the less likelihood of NPSH problems. Also a flooded suction is particularly helpful on start-up when the seals or the entire pump can be ruined because it is not properly primed and purged of air.

A dry, easily accessible location is also important. Allow ample clearance around the unit for free air circulation. If a dry location is not available, the pump can be mounted on a foundation, above the floor. Specify motor enclosure, pump materials, or coatings to suit the worst conditions expected. Place the pump so that it can be easily inspected and serviced during operation. Sufficient head room should be provided, particularly when lifting devices will be used for heavier assemblies.

#### 2B Foundation

Baseplates alone are not rigid enough to maintain alignment of

flexible-coupled units. The pump foundation is used as a support for the baseplate to maintain alignment of the unit. If the baseplate is to be grouted to the foundation, it is only necessary to embed the edges. It is unnecessary to completely fill under the baseplate. DO NOT grout the unit to the foundation until it has been properly aligned.

The foundation must be a permanent rigid installation of concrete or other material of sufficient mass to absorb all normal vibrations. Locate the foundation bolts using a layout or template in relation to the suction and discharge piping. If concrete is being used, foundation bolts of the specified size can be enclosed in a pipe sleeve two to three diameters larger than the bolts to compensate for minor variations in alignment.

Close-coupled pumps can be mounted on a steel base prior to installation or mounted directly to the foundation. Place shims under one or more of the motor feet so that strain and distortion will not result when the mounting bolts are tightened.

#### 2C Piping

##### 2C1 Piping Alignment

It is important that all piping be lined up and not forced into place. Pumps are precision pieces of equipment and are subject to damage or reduced performance if heavy forces are applied to the casing from mis-

aligned piping. It is recommended that you begin piping at the pump. If the lines are ended at the pump, particularly if the last piece is cut a little too short or long, the pump will be forced to meet the pipe and strain or distortion will result.

#### 2C2 Piping Support

Never allow the pump to support piping. Other means such as pipe hangers and pipe supports should be used to carry piping to avoid misalignment and distortion. Consideration should be given to thermally induced expansion and contraction, particularly in long runs of straight pipe.

#### 2C3 Piping Size

In general, inlet and outlet pipe sizes should be equal to or larger than those of the pump.

This should not, however, be the determining factor. Many things including installation and operating costs are involved in the decision. Careful use of the pipe and fitting friction loss tables as shown in the Hydraulic Institute manual along with the appropriate pump performance curve should be the basis for judgments.

## P31 SERIES

# 3. Operation

## P31 REGENERATIVE TURBINE PUMPS

- A. Rotation
- B. Inlet and Outlet Locations
- C. Foreign Material
- D. Electrical
- E. Adjustments
- F. Cooling Water
- G. Priming
- H. Starting
- I. Stopping

## 3A Rotation

The standard direction of rotation of the pump is right handed, or clockwise when looking at the motor end of the pump. A rotation arrow, refer to Figure 3-1, is located on the pump to indicate the correct direction of rotation.

Operating the pump in reverse will cause substantial performance variations and can damage the pump.

Always confirm correct motor rotation:

1. Jog the motor briefly.
2. Observe rotation as the unit comes to a stop.
3. Rotation should be in the direction of the arrow.

If the motor operates in the wrong direction:

1. Interchange any two leads on a three phase motor.
2. On a single phase motor,

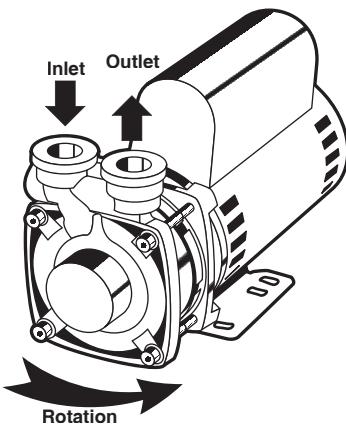


Figure 3-1

change the leads as indicated on the connection box cover. Some single phase motors may not be reversible.

## 3B Inlet and Outlet Locations (Refer to Figure 3-1)

The P31 pump suction inlet and discharge outlet are normally located on the top of the pump casing. For standard construction and operation, the inlet will be on the left and the outlet on the right when facing the pump end. Construction options and reverse rotation operation may alter this.

## 3C Foreign Material

All regenerative turbine pumps have close running clearances in order to maintain efficiency. Take extra precautions to insure that no foreign material larger than 25 microns or .001 inches is allowed to pass through the pump. Even particles of this size can damage the pump if allowed to continuously circulate through the unit. Regenerative turbine pumps are not designed for slurries.

Large particles, weld spatter, and other material found in new piping systems will bend the impeller vanes and can sometimes lock up the pump. If a new pump does not operate properly, one of the first things to check for is impeller damage from foreign material.

## 3D Electrical

It is important to be aware of and follow the appropriate local and national electrical codes. Do not make wiring alterations that can affect motor rotation without reconfirming correct rotation. Select starters and wiring for the maximum current the motor can use at full service factor loads. Regenerative turbine pumps will typically use extra power for a period until they "run-in". This can take three to four weeks depending on the duty cycle. During this period, impellers are finding their hydraulically balanced position.

## 3E Adjustments

No adjustments are required or advisable on new pumps. Because of the close fits in regenerative turbine pumps, it is not uncommon for the pump to be difficult to turn over by hand if it has been allowed to dry out inside. New pumps from the factory are tested using water based rust inhibitors to help preclude this possibility. Onsite system flushing may remove these inhibitors and subject the pump to the risk of lock up if it is allowed to dry out. In this case, do the following:

1. Fill the pump with a process compatible fluid.
2. Loosen the thru bolts exactly one turn.
3. Jog the pump momentarily using the on/off buttons if so equipped.
4. This should "break" the impeller loose without damage, unless foreign material has entered the pump.
5. If possible, spin the pump (or operate with minimal or zero discharge pressure) while the thru bolts are retightened exactly one turn.

This will flush residue from the close fitting impeller surfaces.

Because of the large areas of close fitting surfaces inside these pumps, it takes only microscopic residue to produce resistance to rotation. Once loosened, this material is quickly dispersed and the impellers will find their hydraulic center. If these procedures have been followed, no damage will have resulted from "breaking loose" the impeller.

## 3F Cooling Water

When the pump is used to pump hot fluids, consideration should be given to cooling the seals and/or selecting materials that will give satisfactory seal life. The actual temperature at the seal faces, the most critical area, will always exceed the surrounding fluid temperature. If seal flushing lines have not been installed, heat can build up in the seal faces to a

degree that may destroy the fluid film necessary to prevent rapid wear. In some cases it is necessary to cool the seal flushing fluid. Refer to the seal manufacturer's charts for guidance or to selection data in the MTH catalog anytime fluids can reach or exceed their boiling point.

### **3G Priming**

Pumps should not be operated unless they are completely filled with liquid. Damage to parts of the pump that depend on liquid for their lubrication can occur. Impellers can seize quickly when a pump is run dry. Without lubrication, seal faces can be damaged from heat buildup.

Pumps can be easily primed with a vacuum pump. An ejector or liquid ring vacuum pump is recommended for this purpose because they are not damaged if liquid enters them.

Connect the vacuum line to the discharge side of the pump, either in the discharge opening or the drain tap. A foot valve is not necessary when this kind of device is used.

When a vacuum pump is not practical, a foot valve in the suction inlet can be used to prevent liquid from running out. The pump and suction line can then be filled completely from an outside source. A vent opening will be necessary during filling to let air escape. A tight foot valve will keep the pump constantly primed so that automatic operation is possible. The valve should be inspected regularly to see that it does not develop leaks which would allow the pump to run dry.

Optional self-priming accessories are available for most MTH pumps allowing priming when a vacuum pump or foot valve is not practical. Refer to specific literature for details.

There are four components to the self-primer:

1. A check valve - necessary to maintain a vacuum in the suction line as surging occurs in the pump.
2. An air eliminator - used on the discharge side of the pump to

separate air from liquid so the liquid can be recirculated back to the suction to be used again to carry more air through the pump.

3. A recirculating line - carries liquid from the air eliminator back to the suction.
4. A fluid chamber - used on the inlet side to provide a supply of fluid to speed up priming.

Small suction lines are desirable to minimize priming time.

Using the self-priming equipment, it is only necessary to:

1. Open the plugs in both the inlet and discharge chambers.
2. Pour fluid in one until both are full.
3. Tighten both plugs.
4. Turn on the pump.

Priming time depends on lift, volume of air in the suction line, and the size of the regenerative turbine pump used. If priming time is long and the pump becomes warm, refill the priming chambers with fresh liquid. Most turbine pumps will pump twenty-six to twenty-eight inches of mercury vacuum with cold water in the pump, however, because of their low capacity, they are not usually practical for suction lifts over twenty-two feet of water.

The best way to prime a pump and keep it primed is to use a flooded suction. While this is not always practical, it does provide a number of advantages. The likelihood of pump damage from dry running is vastly reduced. Larger suction lines may be used, which also reduce line losses and minimize the potential of cavitation damage. There are no check valves or priming devices to fail or require maintenance. Whenever possible, design pumping systems with a flooded suction.

### **3H Starting**

Before starting a pump for the first time, be sure that all the preceding operations have been carried out. Proper rotation, priming, and a free

turning pump are most important.

1. Start regenerative turbine pumps with the minimum possible line restriction.
2. Open discharge and suction valves before pressing the starter.
3. Start the pump and let the system clear of air.
4. Listen for foreign material being carried through the pump.
5. Slowly close necessary valves or otherwise place the pump into service.
6. Listen for indications of undue load or other sounds indicating problems.
7. Use a clip-on ammeter to check for a steady load after approximately fifteen minutes of operation.

### **3I Stopping**

It is best to stop the pump with the least discharge head possible both for minimizing strain on components, and to be in low power mode in anticipation of restarting. If the pump will be down for more than a few weeks it is advisable to drain it. Follow the instructions for long term storage, Section 1, 1B Storage. After any prolonged stoppage, turn the pump over by hand before restarting, to be sure it is free turning.

## P31 SERIES

# 4. Maintenance

## CLOSE COUPLED PUMPS

- A. Seals
- B. Flushing Lines
- C. Lubrication

**4A Seals**

Mechanical seals are used in MTH Pumps to eliminate the maintenance that is normally associated with packing boxes. This does not, however, mean they can totally be ignored. Check a new installation for seal leakage.

Maintenance of seals consists primarily of periodic observation, looking for the first signs of failure. An occasional drip that continues to worsen is an indication that the seal has failed and must be replaced. Follow the appropriate Disassembly/Assembly instructions. Always shut down a pump with failed seals

as soon as possible. Leaky seals are usually followed by motor bearing failures and then possible pump damage as rotating parts become mis-aligned.

Where seal failures or minor fluid leaks are not tolerable, consideration should be given to switching to a sealless leak-free design. Most MTH pumps are available in a sealless canned motor design. See the SP31.

**4B Flushing Lines**

External Flushing lines are not an option on P31 pumps with mechanical seals. There is an external line available on the canned motor SP31.

**4C Lubrication**

Sealed ball bearings are standard in all MTH pumps and motors. The maximum continuous operating temperature for bearings is 375°F. While it is not advisable to routinely disassemble sealed bearings, it is possible to remove the seals during disassembly and determine their condition. Use new bearings for reassembly. While the pump is in service, listen for unusual sounds or changes in bearing noise. A screwdriver held between the bearing housing and your ear while the pump is rotated by hand is sometimes helpful if there is too much ambient noise when the system is operating.

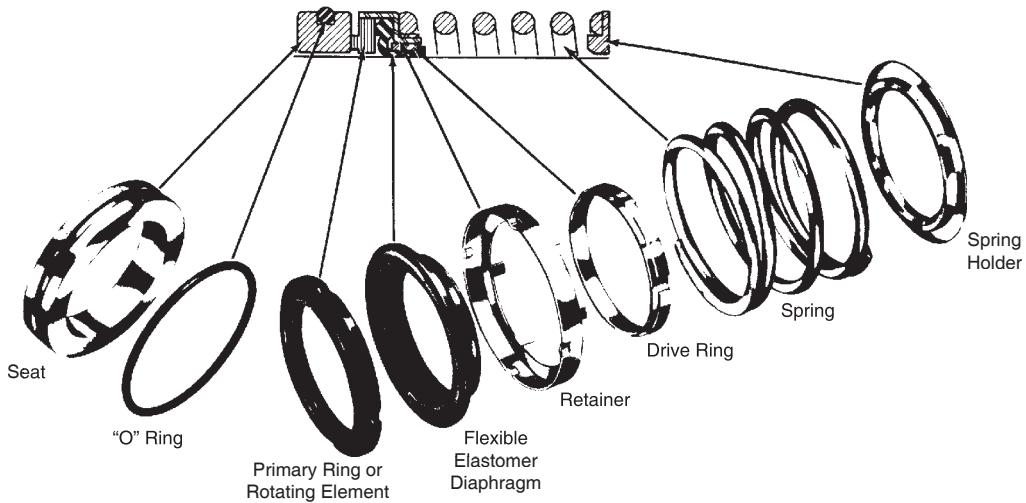


Figure 4-1

**P31 SERIES**

P31 PUMP FNDS

- A. Preliminary
  - B. Disassembly
  - C. Inspection of Components
  - D. Reassembly
  - E. Testing and Final Adjustments

## 5A Preliminary

Before attempting any service on the pump or motor, disconnect the electrical power to the pump motor. If the pump and motor are to be removed as a unit, note the wiring configuration. Use colored or numbered tape to mark the wire connections of the motor and power source, for reconnection. If the pump is being used to pump hot liquid, let the pump and liquid cool before starting disassembly.

1. Disconnect the inlet and outlet piping before unbolting the pump and motor. If the pipes are corroded, use penetrating oil on the threads to aid in removal.
  2. Unbolt the motor from the base and remove the unit. All work on the unit should be performed on an elevated workbench whenever possible.

## 5B Disassembly

The following tools and equipment are needed for disassembly/reassembly of P31 Series Pumps:

1. Soft plastic or wooden mallet.
  2. Small Punch.
  3. 5mm hex wrench.
  4. 3/16" hex wrench.
  5. Snap ring pliers.
  6. Penetrating oil.
  7. 11/16" wood dowel (Approx. 6" long.)
  8. Thin blade screwdriver.
  9. Cealube G, P-80, or glycol base lubricant compatible with the process fluid and O-ring elastomers.  
(DO NOT use petroleum products.)

To disassemble the pump:

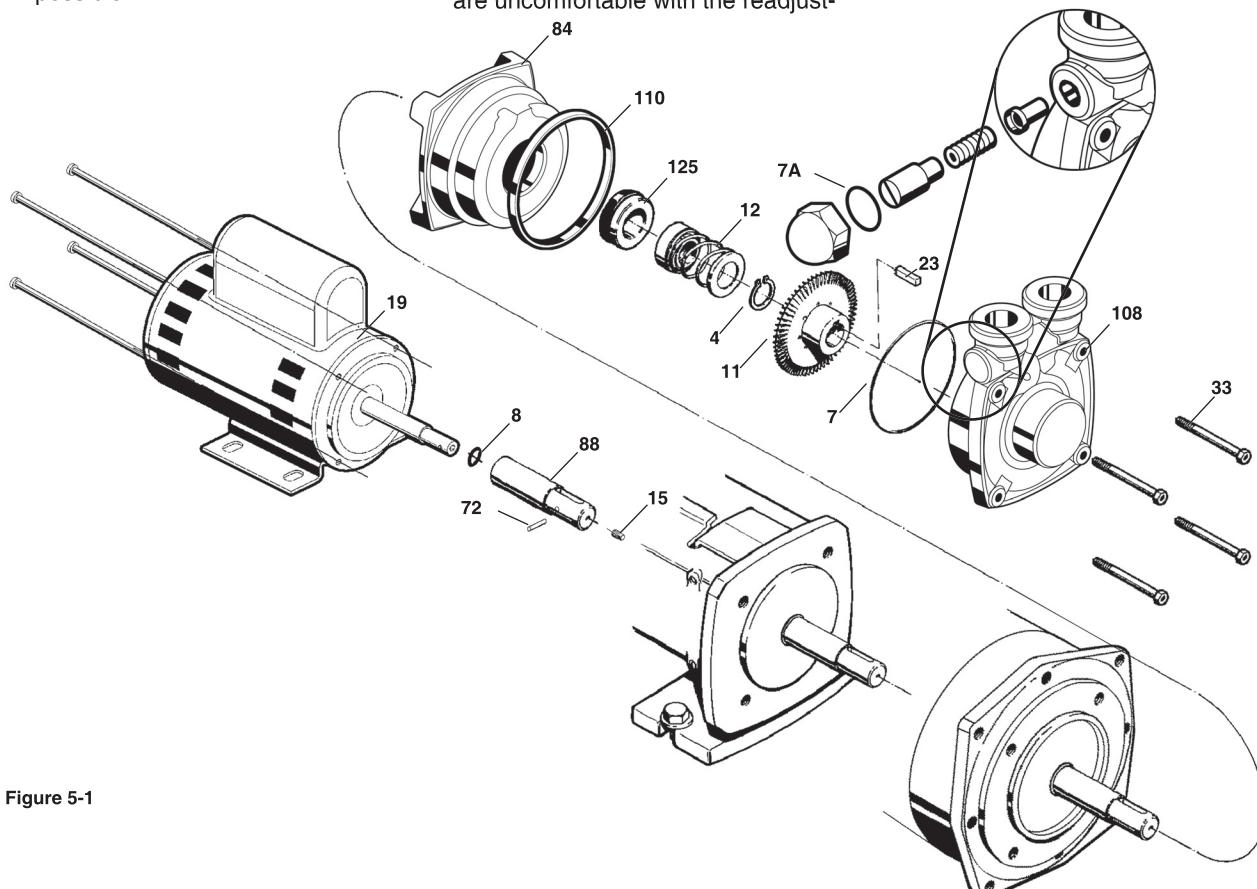
Refer to Figure 5-1 for reference to the numbered parts in the procedures below. Please note that the P31 is an adjustable performance pump. It has been preset at the factory for your particular performance needs. If you are disassembling for inspection or seal replacement only, you may wish to mark or otherwise lock the adjusting nut (#110) into place (before disassembly) especially if you are uncomfortable with the readjust-

ment procedures found in Section 5D Step 10.

1. Remove all liquid from the pump.  
Air blown through the pump will remove fluid quickly.
  2. Remove the four (4) M6-1 X 60mm bolts (#33) from the casing (#108).

P31 CLOSE-COUPLED PUMP

NAME/DESCRIPTION	PART NO.	QTY.
Motor Bracket	84	1
Casing	108	1
Adjusting Nut	110	1
"O" Ring/Casing	7	1
"O" Ring/ Relief Valve	7A	1
"O" Ring/Shaft Sleeve	8	1
Snap Ring	4	1
Impeller	11	1
Seal Rotating Element	12	1
Seal Stationary Seat	125	1
Setscrew	15	1
Thru Bolt/Casing	33	4
Thru Bolt/Motor	19	4
Shaft Sleeve	88	1
Shaft Sleeve Pin	72	1
Kev/Impeller Drive	23	1



**Figure 5-1**

3. Remove the casing. In some cases light tapping with a plastic or wooden mallet on the outside diameter of the casing may be required to loosen it from the motor bracket. Care should be taken if a screwdriver is needed to pry between the casing and motor bracket. Damage to the "O" ring (#7) and/or impeller (#11) can result.
4. Remove the impeller. The impeller is a slip fit and under normal conditions, can be removed by hand or by gently tapping on the end of the shaft with a mallet. Striking the shaft too hard will damage the seat, rotating element, and/or the motor. After removing the impeller, the impeller key (#23) needs to be removed from the shaft keyway.
5. Remove the snap ring (#4) from the shaft.
6. Unscrew the Motor Thru Bolts (#19) from the back of the motor. It is not necessary to remove the adjusting nut (#110) from the motor bracket.
7. To remove the rotating element (#12), gently slide the motor bracket (#84) forward on the shaft to push the rotating element forward enough to be removed by hand. Using tools on the rotating element will damage the rotating element or the seat. Take precautions to keep the rotating element clean if it is to be reused.
8. To remove the seat (#125). Place the motor bracket face down on a clean flat surface. Look into the opening in the center of the motor bracket, and you will see the inside edge of the seat. Insert the 11/16" dowel and, very gently, tap the seat until it drops out. Care must be taken with seal seats. They are brittle and prone to breakage from mechanical shock.

Note: It is recommended that a new replacement seal seat be installed during reassembly.

9. It is not necessary to remove the shaft sleeve (#88) unless the shaft sleeve o-ring (#7A) needs to be replaced or the motor needs to be replaced. To remove the sleeve:

- a. Remove the Setscrew (#15) from the shaft sleeve (#88).
- b. Use a small punch to push out the sleeve pin (#72). Should light tapping be required to remove the pin, support the motor shaft with a wooden block. Do not strike the shaft too hard, as it will bend.
- c. Pull the shaft sleeve (#88) off the motor shaft, exposing the shaft sleeve o-ring (#7A).

#### 5C Inspection of Components

Thoroughly clean all parts. All components should be examined for wear and corrosion. Replace any parts that show visible wear. If the pump was not producing sufficient pressure or capacity, the clearances between the casing and impeller probably exceed the maximum allowable. The P31 features an adjustable casing that may allow return to like new performance. See Section 5D for more information. If this fails, the impeller and casing will likely need replacement.

The "O" rings and other elastomeric components should be replaced if they have been deformed or cut.

If seal components must be reused, carefully inspect for microscopic cracks and nicks. Scratches that might be ignored elsewhere can produce leakage if they are on seal faces and seat wearing surfaces.

Cleanliness is imperative when working with mechanical seals. Microscopic particles between seal faces can be, and often are, the cause of early seal failures.

Check the impeller; it is designed to float. It should move easily on the shaft sleeve. As long as it can be moved on the shaft sleeve by hand, it is loose enough. If the impeller can be rocked or wobbled, it is too loose and must be replaced.

Check the shaft and sleeve for galling, pitting, and corrosion. If the motor shaft is corroded underneath the sleeve, the motor must be replaced. Surface corrosion must be removed so that seals can slide freely during assembly. The shaft sleeve diameter should be no smaller than .002" below the nominal fractional seal sizes. Remove any nicks or burrs which may have raised during disassembly. Reclean parts as necessary.

#### 5D Reassembly

All parts should be visually inspected and cleaned or replaced as outlined in 5C above.

1. Install the shaft sleeve if it has been removed from the motor.
  - a. Apply a thin coating of compatible lubricant to the motor shaft and shaft sleeve oring (#7A). Slide the o-ring over the shaft and up to the first shoulder on the shaft.
  - b. Slide the shaft sleeve (#88) over the motor shaft, aligning the holes in the sleeve with the hole in the shaft.
  - c. Insert the shaft sleeve pin (#72) through the sleeve and motor shaft, making sure the pin does not protrude from either side of the shaft sleeve.
  - d. Install the setscrew (#15) into the end of the shaft sleeve and tighten. This locks the shaft sleeve and pin into place.
2. Install the motor bracket (#84).
  - a. Lightly coat the elastomer portion of the seal seat (#125), and the seat cavity in the motor bracket with compatible lubricant. Do not get lubricant on the seal or seat faces. Insert the seal seat (shiny side up) into the motor bracket and press it firmly into position making sure that it is completely seated and absolutely square. With a soft cloth remove any skin oil or lubricant from the seat face.

- b. Make sure that both the motor face and the feet of the motor bracket are clean. Slide the motor bracket over the shaft onto the motor, making sure the water stop is at the 12 o'clock position.
  - c. Screw the motor bracket (#84) to the motor using the motor thru bolts (#19) in the back side of the motor.
  - 3. Install the rotating element (#12). Lightly lubricate I.D. of the rotating element elastomer. Place the clean rotating element on the shaft sleeve with the carbon end towards the seat. Place the spring over the shaft, with the backing plate up, and compress the spring to locate the rotating element against the seat. If this fails to seat the rotating element gently push the rotating element down with a thin blade screwdriver being careful not to damage the seat or the rotating element.
  - 4. Compress and hold the seal spring slightly below the snap ring groove and install the snap ring (#4). Make sure the snap ring is locked firmly into the groove.
  - 5. Install the impeller key (#23) into the shaft sleeve keyway.
  - 6. Install the impeller (#11). The impeller is a slip fit and should slide on firmly but easily until it stops against the impeller wearing surface. Force should not be required or used to install the impeller in the correct position. The impeller hub should be facing out away from the motor bracket. Refer to Figure 5-1.
  - 7. If the adjusting nut (#110) was moved or removed during disassembly, install it now on the motor bracket (#84) by threading it on until it bottoms out on the motor bracket.
  - 8. Apply a thin coating of compatible lubricant to the large "O" ring (#7). Place the o-ring over the motor bracket and slide it up to the shoulder where the adjusting nut is.
  - 9. Apply a thin coating of lubricant to the o-ring groove in the casing (#108). Place the casing (#108) over the motor bracket with the inlet and outlet ports in the 12 o'clock position. Install the four (4) M6-1 bolts (#33). **DO NOT torque the bolts at this time as impeller damage will result.** Lightly snug the bolts systematically, alternating diagonally across the casing until the o-ring is seated and the casing is snug against the impeller. The pump should not turn by hand at this time because the casing is physically squeezing the impeller against the motor bracket. This condition is termed the "Zero Clearance Position" and will be important to setting the final performance adjustment in the next step.
- NOTE:** If the position of the adjusting nut was previously locked down or is otherwise unchanged from the time of disassembly and does not require any adjustment, please proceed to step 10f to complete reassembly.
- 10. Adjusting pump clearance and setting performance.
    - a. Turn the adjusting nut (#110) counter-clockwise and tighten it firmly against the back of the casing (#108) to set the zero clearance position of the casing.

**NOTE:** Some early versions of the adjusting nut (#110) have 60 notches while the current model has 266. If you have a 60 notch adjusting nut, divide the notch adjustment references by five in the following procedure.

    - b. Make a reference mark on the casing next to one of the notches on the adjusting nut. This is the zero clearance starting point.
    - c. Back off the four (4) M6-1 Bolts (#33) a few turns.
    - d. Refer to the curve in Figure 5-2 to find the approximate adjustment setting for your application's performance needs.
  - e. Start turning the adjusting nut counter-clockwise the number of notches indicated in Figure 5-2. The minimum casing clearance is a total of .002" or 10 notches, (five notches equals .001"). Note that if you find the pump is over or under-performing when returned to service, you may return to this procedure and make fine adjustments to achieve the desired pump output. Generally, for a given system pressure, turn the adjusting nut clockwise if more flow is needed, counter-clockwise if less flow is needed. However, do not tighten the nut below the 10 notch minimum clearance or the pump will run the risk of seizing. Refer to Figure 5-2 and make notes on the diagram to record your adjustment results.
  - f. Tighten the bolts systematically, alternating diagonally across the cover. DO NOT exceed 7-11 ft. lbs. of torque or damage to the pump may occur.
  - g. Turn the pump by hand. If the pump turns, proceed to Section 5E Testing and Final Adjustment. If the pump will not turn, loosen bolts and turn the adjusting nut counter-clockwise five to ten more notches as described in steps 10 b through f above. If the pump still fails to turn by hand, remove the casing and impeller and inspect for burrs or foreign material. Reassemble and readjust, beginning with step 5.

## 5E Testing and Final Adjustment

The pump is now ready for installation. Final adjustments will be made with the pump in operation.

1. Connect all piping and fill the pump with fluid.
2. Reconnect the electrical connections, referring to the colored or numbered tape used to mark the wires during disassembly.
3. Make sure all valves are opened, and fluid will flow through the system.

4. Start the pump and make any final adjustments to the adjusting nut and the M6 bolts holding the casing on. These bolts must be torqued to about 7-11 ft. lbs. to obtain proper performance.
  5. Check for leaks on pump and piping. Special attention should be given to the seal area where the motor shaft enters the motor bracket.
  6. Under pressure, the impeller will find its "hydraulic" balance.
  7. Using an amprobe or similar device, check for motor overload.
  8. While the impeller is seating, it is common to experience some variance in Amp readings. After a run-in period the readings should level off.
- This completes the adjustment and testing phase. The pump is ready for service.

## P31 SERIES

# 6. Troubleshooting

## CLOSE COUPLED PUMPS

- A. Failure to Pump
- B. Reduced Capacity
- C. Reduced Pressure
- D. Pump Loses Prime After Starting
- E. Excessive Power Consumption
- F. Pump Vibrates or is Noisy
- G. Mechanical Problems
- H. Seal Leakage

### 6A Failure to Pump

1. Pump not up to speed — Use tachometer to determine actual RPM. Check voltage and wiring connections.
2. Pump not primed — Confirm that pump and all inlet piping is filled with fluid.
3. Discharge head too high — Install a pressure gauge at the pump discharge to determine the actual operating pressure. Compare readings with pump performance curve. A larger pump may be necessary.
4. Excessive suction lift — Relocate pump, supply tank, or both to minimize suction lift.
5. Wrong direction of rotation— Compare pump rotation with arrow on pump. Standard pumps rotate in a counterclockwise direction when looking at the pump end (clockwise from the motor end). Reverse two leads on a three phase motor to change rotation. Check motor nameplate for single phase.
6. Clogged suction line, strainer, or foot valve — Inspect and clean out if necessary.
7. Air pocket in suction line — Look for high spots in inlet piping system. Evacuate the system with a vacuum pump if necessary.

### 6B Reduced Capacity

1. Pump not up to speed — Use a tachometer to determine actual RPM. Check voltage and wiring connections.

2. Excessive suction lift — Relocate pump, supply tank, or both to minimize suction lift.
3. Insufficient NPSH — Lower pump, raise supply tank, or both to improve NPSH available if possible. Increase suction pressure. Reduce fluid temperature. Select a pump with lower NPSH requirements.
4. Mechanical damage — Rotate the pump by hand to determine if there are tight spots. Broken or bent impeller vanes can sometimes be noticed in this manner. If there is suspicion of damage, remove the pump from service and disassemble for inspection.
5. Air leak in the suction line — Fill the system with fluid and hydrostatically test. Tighten connections or replace leaky components.
6. Air pockets in the suction piping — Operating the system at maximum flow conditions will usually clear the lines. Evacuate the system with a vacuum pump if necessary.
7. Suction lines, strainer, or foot valve too small or clogged — Inspect and clean out as necessary. Fittings and lines should be at least equal to the pump suction size.
8. Discharge head too high — Install a pressure gauge at the pump discharge to determine the actual operating pressure. Compare readings with pump performance curve. A larger pump may be necessary.
9. Excessive wear — If a pump had previously performed satisfactorily and now gives evidence of reduced performance, it should be disassembled and examined for wear after the simpler possible problems have been pursued.

10. Pump not properly adjusted — Follow the instructions in Section 5D Step 10 for readjustment.

### 6C Reduced Pressure

1. Pump not up to speed — Use a tachometer to determine actual RPM. Check voltage and wiring connections.
2. Air or vapor in liquid — Install a separator in the suction line. Hydrostatically test the system to insure that there are no leaks.
3. Mechanical wear or damage — Rotate the pump by hand to determine if there are tight spots. Broken or bent impeller vanes can sometimes be noticed in this manner. If there is suspicion of damage or wear, remove the pump from service and disassemble for inspection. Look for wear on the impeller, suction cover, and motor bracket. If wear is the problem, consult Section 5D step 10 to attempt to readjust performance.
4. System head less than expected — Replace pump with higher capacity unit or add a valve or orifice to increase line resistance.

### 6D Pump Loses Prime After Starting

1. Leak in suction line — Fill the system with fluid and hydrostatically test. Tighten connections or replace leaky components.
2. Air entering pump through "O" rings — Hydrostatically test the pump looking for leaks. Replace faulty "O" rings.
3. Insufficient NPSH or too much suction lift — Lower pump, raise supply tank, or both to improve NPSH available if possible. Increase suction pressure. Reduce fluid temperature. Select a pump with lower NPSH requirements.

## 6E Excessive Power Consumption

1. Speed too high —  
Check RPM with tachometer.
2. Discharge head too high —  
Install a pressure gauge at the discharge to determine the actual operating pressure. Compare readings with pump performance curve. A different pump, motor or both may be necessary.
3. Specific gravity or viscosity too high —  
Check fluid involved. A different motor may be necessary.
4. Mechanical damage —  
Turn pump over by hand. After a few days run in period, all models should turn over by hand with no tight spots. An exception to this is when the pump has been idle for some time. In this case, run the pump for a few hours before checking for tight spots. If there is suspicion of damage, remove the pump from service and disassemble for inspection.
5. Pump not fully broken in —  
It is normal for new pumps to consume higher than normal current during the break-in period. If high power consumption persists beyond a few weeks, it is unlikely that further operation will reduce consumption.
6. Pump not properly adjusted —  
Loosen all nuts on pump exactly one turn. Follow the instructions in Section 5D Reassembly for repositioning fasteners.

## 6F Pump Vibrates or Is Noisy

1. Insecure mounting —  
Follow instructions in Section 2.
2. Excess piping load on pump —  
Install piping supports and check to see that there is no strain on the pump.

3. Mechanical damage —  
If mechanical damage is suspected, check first to determine if pump turns freely. Disassemble for inspection if tight spots are found.
4. Pump has a high pitched whine —  
This is typical of a regenerative turbine pump. The intensity should increase as pressure increases. Over a period of a few weeks the noise level will diminish and will be noticeably quieter as it approaches a run-in condition.

## 6G Mechanical Problems

1. Short bearing life —  
Bearings damaged due to leaky seals. Coupling misalignment. Excessive piping load on pump. RPM or pressure too high.
2. Pump locked up —  
Pump dried out and close clearances rusty. Follow installation instructions for loosening the pump. Foreign material in pump. Flush out. Disassemble if flushing is not successful.
3. Pump leaks —  
Seal or "O" rings are usually the problem. Disassembly and replacement is the solution if tightening the thru bolts has no effect.

## 6H Seal Leakage

1. Worn seat or rotating element —  
Seals will last many years operating on cold clear water or other fluids with reasonable lubricity. Particles, even microscopic, increase normal wear rates. Temperatures near the fluid's boiling point can reduce lubricity which in turn increases wear. Some chemicals will erode the seal faces or plate out on the faces producing an abrasive effect. Immediate seal replacement is recommended when leaks become evident, since bearings are quickly ruined as a result of moisture. Severe mechanical damage results when the bearings fail.

2. Improperly installed seat or rotating element —  
If a seal has recently been replaced, look for a missing "O" ring around the seat, or a seat that is cocked or in backwards. The smooth surface should face the rotating element. The rotating element may be in backward or improperly positioned. Refer to the appropriate seal diagrams and instructions to confirm the correct seal orientation. Rotating elements sometimes stick in the wrong position if left partially assembled for some time. Make sure a rotating element can be moved axially on the shaft before closing up the pump and then make the final adjustments as soon as possible.

3. Seat broken during assembly —  
Ceramic seats are particularly vulnerable to damage.  
Carefully follow reassembly instructions for seals.

4. Pitted shaft or sleeve under the seal —  
Reusing a shaft or sleeve when repairing a pump is the probable cause of this problem. The seal rotating element can produce a pitted surface underneath its elastomer portion during normal use. This is normally not a problem for the first seal assembly since the elastomer is conforming as this action occurs. A new seal can leak before it conforms if the pits are large enough. If any pits are visible to the unaided eye, shaft or sleeve replacement is advised.

## P31 SERIES

# 7. Parts and Repair Services

- A. Parts
- B. Repair Service
- C. Warranty Service
- D. Motors and Accessories

## 7A Parts

Repair parts may be obtained through your local Authorized MTH Pumps Representative or Distributor who can be found in the yellow pages, at [WWW.MTHPumps.com](http://WWW.MTHPumps.com), or by contacting the factory directly at:  
**MTH Pumps**  
 401 W. Main St. • Plano, IL 60545  
 Phone: 630-552-4115  
 Fax: 630-552-3688

## 7B Repair Services

Repair service for an MTH pump should be obtained from the company through which it was purchased.

In the event this is not possible, the name and phone number of a nearby MTH representative or distributor may be obtained by contacting

the factory. In the event that it is necessary to return the pump to the factory for repairs, remove all accessories attached to the pump. We cannot accept responsibility for their safe removal, storage, and return.

## 7C Warranty Service

All requests for warranty claims should be made through the company from which the pump was purchased or supplied. Complete details on what is wrong with the pump must be provided along with information on the system in which it is installed. Refer to the MTH Pumps Limited Warranty statement.

**NOTE: Return authorization must be obtained prior to returning any equipment. For the safety of our repair personnel, returned pumps must include an MSDS sheet for the fluid pumped if it is anything other than clean water, or ethylene glycol.**

**In this case, the MSDS sheet must be clearly attached to the outside of the box or it will be refused at our dock.**

## 7D Motors, Mechanical Seals, and Accessories

Repair service on motors, mechanical seals, relief valves, or other accessories should be obtained from the manufacturer of these components. MTH does carry replacement parts, but is not authorized to render repair service or honor manufacturer warranty on these components. Replacement mechanical seals are stocked at MTH and are always available insofar as possible for immediate shipment. Warranty service, as well as expert application information can be obtained from your local seal manufacturer's sales office.

P31 SERIES

## 8.Limited Warranty

All requests for warranty claims should be made through the company from which the product was purchased or supplied. Complete details on what is wrong with the product must be provided along with information on the system in which it is installed. Refer to the MTH Pumps Limited Warranty statement below for more information. Return authorization must be obtained prior to returning any equipment.

MTH Tool Company, Inc. / MTH Pumps, hereinafter referred to as "MTH", warrants for a period of twelve (12) months from the date of shipment ("The Warranty Period"), that the products manufactured by it will be free from defects in material and workmanship. MTH will correct defects in material or workmanship which may develop in its products under proper or normal use during the Warranty Period and under the conditions of this Warranty. This Warranty does not extend to anyone except the original consumer-purchaser. Damage to the product due to improper handling, improper storage, improper maintenance, or improper application is not covered

by this Warranty. Warranty claims for special order items or accessories not manufactured by MTH (such as motors, valves, or mechanical seals) should be directed to those who manufactured the item. MTH will repair or replace, at its option and expense, its products proved to be defective after examination by an authorized representative of MTH. The defective Product must be returned, transportation prepaid, to the factory at Plano, Illinois, USA. Disassembly of the product (especially pumps) impairs determination of reasons for failure and shall be cause for voiding this Warranty. The Product, repaired or replaced, will be shipped F.O.B. MTH's factory. **This is MTH's sole warranty. MTH makes no other warranty of any kind, express or implied, and all implied warranties of merchantability and fitness for a particular purpose which exceed MTH's aforestated obligations are hereby disclaimed by MTH and excluded from this warranty.** MTH neither assumes nor authorizes any person to assume for it, any other obligation in connection with the sale of the Product and any enlargement of

this Warranty by a purchaser shall be for its own account and its exclusive responsibility. This Warranty shall not apply to any Product or parts of Products which: (a) have been repaired, assembled, or altered outside of MTH's factory, in any manner; or (b) have been subjected to misuse, negligence or accident; or (c) have been used in a manner inconsistent with MTH's printed instructions, specifications, or the customer supplied application specification; or (d) have been damaged due to defective power supply or faulty installation. **MTH shall not be liable for incidental and consequential losses and damages under this express warranty, any applicable implied warranty, or claims for negligence, except to the extent that this limitation is found to be unenforceable under the applicable State law.** Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which vary from State to State.



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