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PWH

API 610
SINGLE STAGE OH2

PumpWorks™ 610

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INSTALLATION OPERATION AND MAINTENANCE MANUAL

OVERHUNG SINGLE STAGE

PWH SERIES

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Table of Contents

Figures

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
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Section 1 – PWH Pump Description

The PumpWorks 610 11th Edition Upgrade (PWH) is a bearing bracketed Horizontal Single Stage Centrifugal pump. It is manufactured in accordance with the American Petroleum Institute Standard 610.
The PumpWorks 610 pump features short impeller overhang, and can be combined with single, double, and triple volute casings in various sizes. The back pull-out design, in most cases, allows the complete rotating assembly of the pump to be removed without removing or disrupting the driver as well as the suction and discharge piping.

Section 2 - Installation & Handling

Inspection

Upon receipt, carefully inspect the pump for damage and check against the bill of lading. Report any damage or shortage to the carrier's local representative and send a copy to PumpWorks. When uncrating, be careful not to discard any small accessories that may be attached to the crate.

Handling

Lift the complete unit using proper lifting techniques.

CAUTION: *Lifting eyes may be provided on the casing cover. These are designed for lifting the casing cover only. Never lift the pump assembly using these lifting eyes. The pump assembly may not be balanced when lifting. Always provide proper support so that the pump cannot tip.*

Storage - Short Term

When it is necessary to store the pump for a short time (less than 6 months) before it can be installed, place it on a skid in a dry location. Protect it thoroughly from moisture, sand, grit and other contaminants. Do not remove the protective covers on the suction and discharge flanges.

Storage - Long Term

More thorough precautions are required if the pump is to be stored for greater than 6 months. The pump must be covered or stored indoors. Prior to storage, remove the oil vent plug and fill the bearing housing with one quart of vapor emitting oil. Reinstall vent plug. Perform the following at 6 month intervals:

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Phone: (713) 956-2002
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1. Coat all unpainted exterior machined surfaces liberally with a light petroleum grease or equivalent rust preventative.
2. Remove bearing housing vent and drain plugs and drain oil. Reinstall drain plug and refill bearing housing with one quart of new vapor emitting oil. Reinstall vent plug.
3. Rotate pump shaft 3-1/2 turns (180° from original position).
4. Remove the protective covers on the suction and discharge flanges. Remove any visible rust on internal surfaces and coat with rust preventative. Replace protective covers on the flanges.

NOTE: *Accumulation of condensation in the pump must be avoided. Store the equipment away from climatic extremes. Do not store the pump in areas of high ambient vibration, as damage to bearings may occur.*

When auxiliary equipment such as drivers, mechanical seals and instrumentation is provided, it may require additional preparation for long term storage. Refer to the manufacturer's literature for specific instructions.

Location
The pump should be positioned as close to the suction source as practical, in an effort to optimize suction conditions. Ensure sufficient clearance around the pump to allow for cooling and maintenance accessibility.

Section 3 – Foundation

General
A proper foundation and grouting can mean the difference between a unit that gives many years of trouble-free service and one that requires constant realignment. It should therefore be everyone’s concern that only the best of materials, together with proper design, be used when performing this important function.

The foundation (4” to 6” longer and wider than base plate) shall be sufficiently substantial to absorb any vibration and to form a permanent rigid support for the base plate; this is important in maintaining the alignment of the units. A concrete foundation on a solid base should be satisfactory. The foundation bolts should be installed as shown in Figure 1, and must be located according to the certified outline drawing.

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Phone: (713) 956-2002
Fax(713) 956-2141

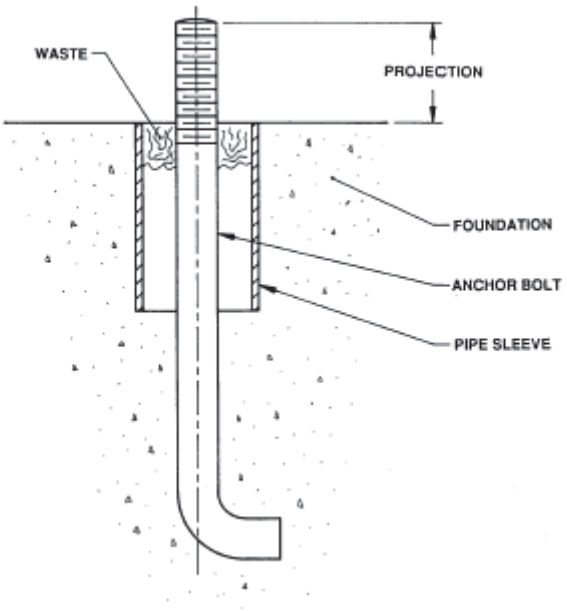

Figure No. 1

Leveling of the Unit

1. Before the machine is set on the foundation, chip away defective concrete, leveling the entire surface of the foundation leaving it rough but level. The surface must be free of oil, grease, loose particles and the waste material stuffed around the foundation bolts must be removed.

2. Clean the bolts and underside of the base plate of oil, grease, dirt and other coatings that may interfere with complete bearing or react with cement. Check base plate and proposed method of placing the grout to avoid trapping air beneath the base plate. Air vent holes are provided in the base plate deck to help fill all pockets.

3. Place the unit on the foundation with the coupling halves disconnected. The coupling should not be reconnected until the alignment operations have been completed. Follow the proper alignment procedure for your equipment. The base

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Fax(713) 956-2141

plate should be supported on round metal steel plate discs and shims or on metal wedges having a small taper. These support pieces should be placed close to the foundation bolts (Figure 2). Adjust the metal supports or wedges until pump and driver shafts are level. Check the coupling faces and the suction and discharge flanges of the pump for vertical position with a level. Correct the positions if necessary by adjusting the supports under the base plate as required. (See section on Field Installation of Motor and Coupling Alignment.)

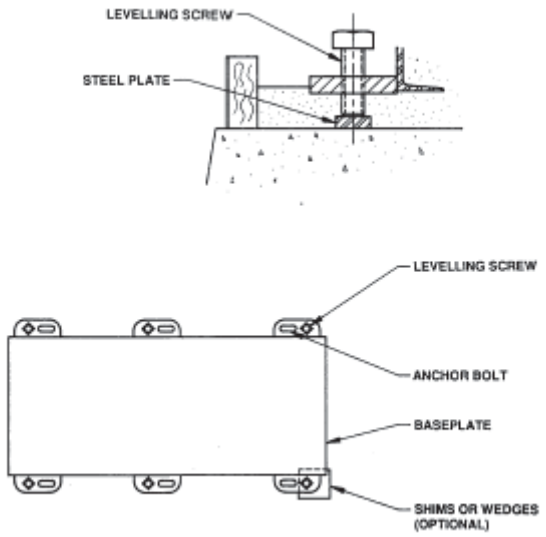

Figure No. 2

Grouting

When the alignment is correct the foundation bolts should be tightened evenly, but not too firmly. The unit then is grouted to the foundation. The base plate must be completely filled with oil and water-resisting non-shrink grout. Grout must not have an exothermic temperature greater than ASTM D2471 or 45° C.

The following suggestions, highlighting generally accepted successful field procedures, are not mandatory but should be followed, modified, or rejected by the engineer, owner, or contractor since they, and not PumpWorks 610, are responsible for planning and executing procedures for the job.

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1. Read API 610 10th Edition Appendix L.

2. Build wooden forms around foundation and saturate the top surface of the foundation with water for at least 6 hours prior to grouting. Remove free water with hose or rags just before placing grout. Remove water from anchor bolts with rags or a siphon.

3. The method of forming is dependent on the contractor's selection of a grout placing procedure that affords rapid and complete filling of the spaces to be grouted, and that keeps the grout in full contact with the underside of the base plate until the grout has hardened. (Figure 3).

4. Vibrations from machines operating nearby is often transmitted into the foundation of the machine being grouted. Such machines should be shut down until the grout takes its initial set, otherwise the bond of the grout may be affected. Observing the surface of water in a shallow pan sitting on the pump base plate indicates whether or not vibrations are present.

5. Puddle, vibrate grout continuously as it is poured to expel all air and completely fill all cavities under the base plate to the level of the grout holes.

6. After 48 hours, shims, wedges, and jack bolts, used to level base plate shall be removed, and the resulting void filled with grout.

7. The exposed edge of the grout can now be finished as shown in Figure 4.

8. Only after grout is hard (72 hours or more) should the foundation bolts be tightened and the pump and driver aligned.

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Phone: (713) 956-2002
Fax(713) 956-2141

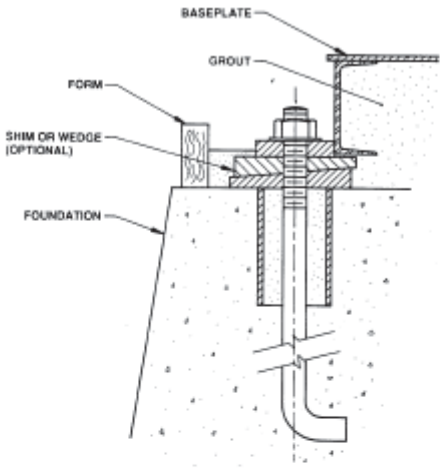

Figure No. 3

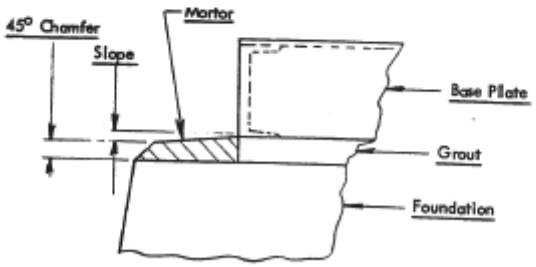

Figure No. 4

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Section 4 - Piping

General

Support and anchor suction and discharge piping independently near the pump so that when flange bolts are tightened strain will not be transmitted to the pump casing. Piping must align with the pump flanges. Never force piping into place at suction or discharge flanges.

If an expansion joint or non-rigid pipe coupling is used, install a pipe anchor between the fitting and the pump. Proper installation of the pipe anchor will eliminate any objectionable forces on the pump.

It is good practice to increase the size of suction and discharge piping leading to the pump nozzles in order to decrease the head loss due to friction. Arrange piping with as few bends and fittings as possible. Use large radius elbows wherever possible. See Figure 8 Piping Diagram.
Flush all piping thoroughly to remove any foreign matter before connecting to the pump.

Suction Piping

1. The nominal suction pipe diameter must be as large, or larger than the nominal suction size. Suction piping should be as short and direct as possible. At least 5 pipe diameters of straight pipe must be connected to the pump suction flange.

2. Ensure that suction lines are sealed to avoid leakage and air pockets.

3. Reducers, if used, must be eccentric and installed with the sloping side down. The reducer or elbow must be located at least five pipe diameters from the pump suction flange.

4. Start up cone type suction strainers should be used and must have a net free area of at least three times the suction pipe area.

5. When working under suction head or flooded suction, install a gate valve in the suction line to permit closing the line for pump inspection and maintenance.

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Fax(713) 956-2141

CAUTION: *Never throttle the pump with the suction valve*.

Discharge Piping

1. A check valve and gate valve should be installed in the discharge line.
The check valve, placed between the pump and gate valve, prevents pumpage from running back through the pump in the event of driver failure. The gate valve is used in priming, starting and shutdown of the pump.

2. If increasers are used on the discharge, they should be located between the check valve and the pump.

Section 5 - Preparing for Operation

Driver Lubrication
Motor bearings should be serviced and lubricated as outlined in the motor manufacturer's instructions.

Pump Lubrication
OIL SUMP LUBRICATED PUMPS: Bearing housing incorporates an oil ring or oil flinger to circulate oil to the bearings. Fill the bearing housing to the proper level (Centerline of the bull's eye) with ISO/ASTM VG 32 oil.
For lubrication changing intervals, refer to Section 8 Operational Checks.

The constant level oiler bottle will be found in the box of fittings shipped with the pump. Adjustment should be made as detailed below.

Fill the bearing housing with proper grade of oil through the constant level oiler cup to 1/4" (6.35 millimeters) below the level mark. Then fill the oiler bottle with oil and place it in the oiler cup. The housing is filled when oil remains in the oiler bottle.
If the oil level is not at the proper level, remove bottle and reset level adjuster (See Figure 5). Replace bottle (repeat operation until proper level is obtained). Thereafter, it is only necessary to keep bottle filled with oil.

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Phone: (713) 956-2002
Fax(713) 956-2141

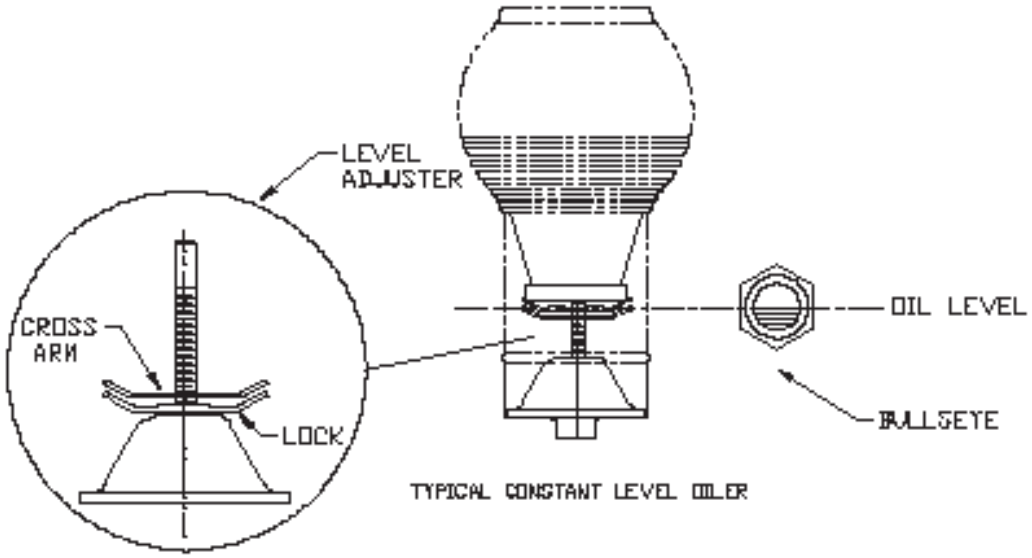

Figure No. 5

Mechanical Seals

As a standard, the PWH pump is fitted with a cartridge type mechanical seal which complies with the service requirements outlined on the pump data sheet. The seals are factory installed and no adjustment is required. Seal installation details are provided in the final data package.

NOTE: *Seal locating devices must be disengaged before start-up.*

Seal Flush Piping

Seal flush piping should be installed in accordance with the service requirements outlined in the pump data sheet and the seal manufacturer's recommendations. Vent seal cavity and flush piping prior to start up. Refer to the Outline Drawing provided in the final data package for specific seal flush piping details. If the pump is fitted with an auxiliary seal flush reservoir, perform the following before operating the pump:

1. Connect a vent line to the flange or union at the top of the reservoir.
2. Fill the reservoir and piping through the filler hole.
3. Pipe the gauge connection to a gauge or pressure relay.

NOTE: *Be sure that the liquid level in the reservoir is located in the approximate center of the level gauge.*

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Fax(713) 956-2141

Shaft Alignment

If a new base is purchased, the driver and pump shafts have been aligned at the factory, however, it is recommended that alignment be re-checked before operating the pump.
Remove the coupling guard and coupling spacer (if required for your tooling). Verify that coupling hub runout measured between the flange rims is within .005 inch (.127 mm) TIR. Verify that coupling hub flange faces are parallel within .003 inch (.076 mm).
NOTE: *If the pump is to operate above 300°F (150°C), it is important to perform the alignment with the pump at operating temperature.*

WARNING: *Be sure that power to the motor is off and locked out before removing or installing the coupling or coupling guard.*

General

When pumps and drivers are received from the factory with both machines mounted on a common base plate, they have been accurately aligned before shipment. All base plates are flexible to some extent, and therefore must not be relied up on to maintain the factory alignment.
Realignment is necessary after the complete unit has been leveled on the foundation and again after the grout has set, any final pressure grouting done, foundation bolts have been tightened. The final pump to motor alignment must be checked after the unit is piped and rechecked periodically as outlined.

Field Mounting of Driver

When the driver is to be mounted on the base plate in the field, it is necessary to place the base plate with pump on the foundation, to level the pump shaft, to check the coupling faces including parallelism and angular misalignment, the suction and discharge flanges for horizontal or vertical position, and to make any necessary corrective adjustments.

The driver pads on the base plate can now be coated with chalk to facilitate marking the hold-down bolt holes. Place the driver on the base plate so that the distance between the coupling halves is as indicated on the outline drawing.

Adjust the height of the driver by placing shims under the driver feet. After the alignment of the coupling halves is correct including parallelism and angular misalignment, center punch with transfer tooling or scribe on the base plate pads the circumference of the bolt holes in the driver feet. Remove the driver, determine size of hold-down bolts, and drill and tap base plate. Replace driver on

the base plate, insert the bolts and align the driver before tightening. The subsequent procedures are the same as for factory aligned units.

RECOMMENDED HOLD-DOWN BOLTS FOR DRIVERS

Hole Size	Bolt Size	Hole Size	Bolt Size
11/32	1/4"	21/32	1/2"
13/32	5/16"	13/16	5/8"
17/32	3/8"	15/16	3/4"

Flexible Couplings

The primary functions of all flexible couplings are:

1. To Transmit power from one shaft to another, efficiently and effectively.

2. To accommodate the slight shaft misalignments which develop in service.

The secondary functions of flexible couplings are:

1. To absorb shock loads and pulsations.
2. To dampen vibration.
3. To accommodate load reversals.
4. To minimize initial backlash.
5. To provide ease of installation and maintenance.
6. To decrease wear on shaft bearings and driven equipment.

Shafts become misaligned during operation because of settling foundations, the effects of heat, vibration, worn bearings, etc. These misalignments take place in the form of angular misalignment, parallel misalignment, or axial movement of the shafts (end float). Therefore, to get full service life from any flexible coupling, it is necessary to:

1. Assure proper shaft alignment during initial installation.
2. Occasionally check for and correct shaft misalignments during service.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

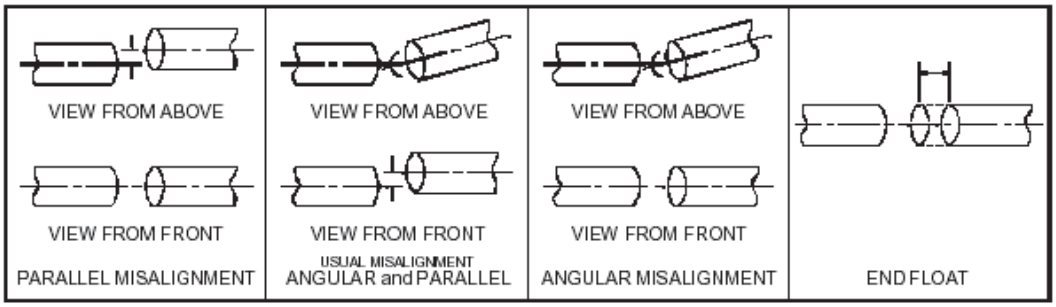

Figure No. 6

Misaligned shafts not properly coupled are subject to severe stresses and damage at bearings and seals. Any or all of the misalignments shown in the above diagrams are present in all connected drives.

There are so many factors entering into the probable life of a coupling that it is impossible to tabulate the misalignment capacities for every application.

Any coupling which is stressed heavily with torque will have little reserve left for misalignment stresses. Conversely, if a coupling is lightly torqued, it will have a larger reserve for misalignment conditions.

It should also be pointed out that a coupling traveling at a slow speed such as used in conjunction with the slow speed side of a gear reducer can take relatively large misalignments over a long period of time. On the other hand, a coupling rotating at high speeds must be aligned with great care to make sure that it will give continuous trouble-free service.

Alignment of Spacer Type Couplings Driver to Pump

Prior to alignment, remove shims and check driver for soft foot. Correct as required.

A spacer type coupling is used between the pump and driver. To align the spacer coupling, remove the spacer between the pump and driver. Make a bracket, as shown in Figure 7, which can be fastened to one of the coupling halves and which is long enough to reach the other coupling half.

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Phone: (713) 956-2002
Fax(713) 956-2141

Fasten this bracket to one coupling half and a dial-type indicator to the bracket arm so that the indicator is in contact with the rim of the other coupling half as shown at “A”, Figure 7. Revolve one coupling half by hand so that the indicator moves around the other coupling half.

After alignment on the coupling rim has been obtained, change the indicator so it bears against the face of the same coupling half and make any necessary adjustments. If the shafts have end play, it is preferable to make this check of face alignment by using inside micrometers as shown at “B”, Figure 7.

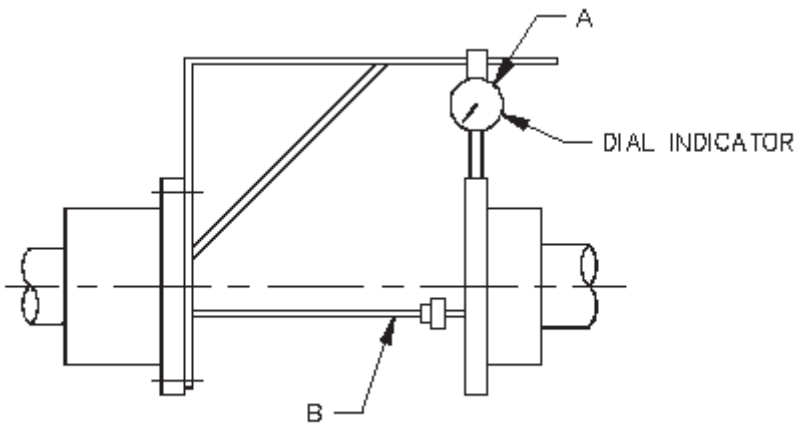

Figure No. 7

Maximum total runout at “A” shall be per coupling manufacturer recommendation and not exceed, .005 T.I.R. Maximum variation in parallelism at “B” shall be per coupling manufacturer recommendation and not exceed .003”.
Recommended hub spacing must be maintained.

NOTE: *Gear type couplings are aligned in the same manner as outlined in Figure 7. However, the coupling covers must be moved back out of the way and measurements made on the coupling hubs.*

Change the bracket, fastening it to the other coupling half, and use the indicator, as described above, against the face and rim of opposite coupling half.

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Phone: (713) 956-2002
Fax(713) 956-2141

It is impossible to align any equipment perfectly. We, therefore, recommend that on the vertical misalignment you set the equipment with the largest dimension between the bottom of its mounting feet and its shaft centerline low. EXAMPLE: The shaft of a foot-mounted motor or gear would sit lower than the shaft on the centerline-mounted pump.

When a turbine driver is used to drive the pump, this variation in the shaft elevation must be rechecked after the driver has been allowed to come up to the operating temperature. An approximate cold setting can be obtained from the driver manufacturer.

Final Check of Alignment

After the grout has set, pressure grouting to fill voids has also set, and the foundation bolts have been properly tightened, the unit should be checked for parallel and angular alignment and if necessary, corrective measures taken.

Machinery must be free of strain or distortion. Loosen and then tighten the hold-down bolts of the pump and motor sequentially, using the dial indicator on the coupling as a monitor to assure that units are uniformly supported. After the piping of the unit has been connected, the alignment should again be checked while tightening the connection bolts.

The direction of rotation of the driver should be checked to make certain that it matches that of the pump.

The coupling halves can then be reconnected. With the pump properly primed, the unit then should be operated under normal operating conditions until temperatures have stabilized. It then should be shut down and immediately checked again for alignment of the coupling.

It should be emphasized that attempts to correct alignment in one direction may alter the alignment in the other direction; therefore, it is necessary to check in all directions after making any adjustments. Pumps should be level to .005 inches per foot at operating temperature when measured at the shaft extension.

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Phone: (713) 956-2002
Fax(713) 956-2141

Doweling

After the unit has been running for about one week, the coupling halves should be given a final check for misalignment caused by pipe strains or temperature strains. If the alignment is correct, both pump and driver should be doweled to the baseplate. For locations of the dowels, see certified outline drawing.

Factors That May Disturb Alignment

The unit should be hot checked periodically for alignment. If the unit does not stay in line after being properly installed, the following are possible causes:

1. Settling, seasoning or springing of the foundation.
2. Pipe strains distorting or shifting the machine.
3. Wear of the bearings.
4. Springing of the base plate by heat from adjacent steam pipe, etc.
5. Shifting of the building structure due to variable loading or other causes.

It may be necessary to slightly readjust the alignment, from time to time, while the unit and foundation are new.

Rotation

The driver rotation for all PWH pumps must be verified prior to coupling the pump. To check rotation, remove the coupling guard and coupling spacer. Make momentary contact with the motor starter to verify correct rotation.

WARNING: *Keep clear of rotating components when checking motor rotation. Be sure that tools and loose hardware are clear before starting motor*

.

High Temperature Operation

Pumps handling liquids at temperatures above 300° F (150º C) should be brought up to operating temperature before start-up. This can be accomplished by circulating hot pumpage through the pump. Control the circulation so that the pump casing temperature rise does not exceed 150° F (37.8º C) per hour. The pump casing temperature must be within 75 ° F (24º C) of the pumpage before start-up and operation.

WARNING: *Bring pump up to operating temperature slowly before start up. Severe thermal shock can damage the pump and cause injury*.

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Fax(713) 956-2141

Section 6 - Starting the Pump

Start-up Checklist

Before starting the pump, check the following:

1. Pump rotation is correct
2. Seal locking plates removed
3. Seal flush connected
4. Vent and drain lines installed
5. Motor and pump bearings lubricated
6. Pipe connections and plugs tight
7. Coupling spacer installed and pump and driver aligned
8. Pump shaft rotates freely
9. Coupling guard installed
10. Suction valve open
11. Discharge side in start-up position
12. Instrumentation connections made
13. Everyone standing clear

Priming

NOTE: *The pump casing, suction line and seal flush must be filled with liquid BEFORE the pump is started.* When the pump is located above the pumpage source, it must be primed to evacuate all air from the pump case.

Starting

A centrifugal pump usually requires less power to operate with the discharge valve closed than with the discharge valve open. For this reason, it is often an advantage to have this valve partially closed when starting. Open the valve to achieve approximately minimum stable flow upon start up.

Start the pump and bring it immediately to operating speed. Slowly open the discharge valve further as soon as there is a discharge pressure indication. Continue opening the discharge valve until rated capacity and discharge pressure are obtained. If the rated conditions cannot be obtained, refer to the Trouble Checklist in Section 9.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Section 7 – Operation

Operating Capacity

Centrifugal pumps should not be operated at greatly reduced capacity or with a closed discharge valve because the energy required to drive the pump is converted to heat and the temperature of the liquid may reach its boiling point. If this occurs, the rotating parts are exposed to vapor with no lubrication and damage to internal parts will occur.

There are several means to protect the pump from such possible damage:

1. Liquid temperature sensor to shut the pump down if the Pumpage temperature exceeds a predetermined level.

2. Constant open by-pass between the pump discharge and the suction source.

3. Suction pressure sensor to shut the pump down if the suction pressure drops below a predetermined level.

4. Vibration sensor to shut the pump down if the vibration level exceeds a predetermined value.

NOTE: *Never throttle pump on suction side.*

Freezing

During cold weather when the pump is not in operation, the pump should be drained to prevent the liquid inside from freezing.

WARNING: *If the pumpage is toxic, flammable, or corrosive, take proper precautions for handling pumpage before draining the pump.*

Shut-Down

To avoid water hammer, it is recommended that the discharge valve be partially closed to the minimum flow point just prior to shut-down of the pump.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Section 8 - Operational Checks

First 60 Minutes

It is recommended that the following parameters be recorded at 10 minute intervals during the first 60 minutes of operation and periodically thereafter:

1. Suction and discharge pressures
2. Bearing housing temperature
3. Pumpage temperature
4. Vibration levels
5. Leakage

Satisfactory operation is indicated by correct capacity and discharge pressure and stable bearing housing temperature. Keep records for future troubleshooting reference and performance trend analysis.

Periodic check of the items listed below will ensure the pump is maintained in its best operating condition.

Mechanical Seal

Check mechanical seals for leakage during the first hours of operation. Minor leakage through the seal usually stops after a short run-in period but if it continues shut down the pump and investigate the cause. Excessive leakage past the seal generally indicates worn or broken parts requiring replacement.

Lubrication

Driver Lubrication

Driver bearings should be serviced and lubricated according to the motor manufacturer's instructions. Consult lubrication directions on nameplate and literature provided in the final data package.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Pump Lubrication

Great care should be exercised to keep the housing clean and only clean lubricants should be used. Foreign solids or liquids within the bearing housing can completely ruin the bearings in a short time. Keep the oiler bottle filled with the correct grade of oil. Under normal conditions the oiler will maintain proper oil level. A routine check of the oil level will verify proper working order of the oiler.

At initial start-up, change oil after 24 hours of running time. Thereafter, change oil at the following intervals:

Service	Change	Check Level
Continuous	Every 3 Months	Weekly
Intermittent	Every 6 Months	Monthly
High Temp.	Monthly	Daily

When changing the oil, flush the inside of the housing with clean oil to remove any accumulated contaminants.

Due to rolling friction and drag of the race, heat is generated within bearings and unless cooled they will operate at temperatures above that of the surrounding atmosphere. Oil lubricated ball bearings can safely be operated up to 180° F (82.2° C) and bearing temperatures of 160° F (71.1°C) are normal. Do not use the human hand as a thermometer. Determine the temperatures accurately by placing a contact type thermometer against the bearing housing. Record this temperature on a regular basis and maintain a log of the reading. A stable temperature indicates normal operation.

Sudden increases in temperature or an excessively high temperature are indications of operational problems or a pending bearing failure.

Check to see that oil is of proper viscosity and the oil level is neither too high nor too low. The unit should also be checked for unstable hydraulic operation and unnecessary mechanical loads, such as shaft misalignment.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Bearing Housing

Periodically check bearing housing surface temperature. Normal bearing housing operating temperature is 125° - 180° F (50º - 80º C).

NOTE: *Stop the pump immediately if bearing housing temperature exceeds 190° F (88° C). Inspect for possible problems such as those stated above before restarting the pump.*

NOTE: *Bearing housings equipped with water cooling coils are to be adjusted to operate so as to maintain an oil temperature no less than 25°F above the surrounding ambient temperature to prevent condensation.*

Section 9 - Trouble Checklist

No Liquid - No liquid discharge from the pump may be caused by:

1. Pump not primed.
2. Speed too low--check to see if motor receiving full voltage.
3. Suction lift too high or insufficient NPSH available.
4. Impeller or piping plugged.
5. Wrong rotation.
6. Air leaks or pockets in suction line.

Insufficient Liquid - Insufficient liquid discharge may be caused by:

1. Speed too low.
2. Discharge head higher than anticipated.
3. Suction lift too high or insufficient NPSH available.
4. Impeller or piping partially plugged.
5. Wrong rotation.
6. Air leaks or pockets in suction line.
7. Mechanical defects (worn wear rings or impeller damage).

Insufficient Pressure - Insufficient pressure may be caused by:

1. Speed too low.
2. Air or gases in liquid.
3. Impeller diameter too small.
4. Capacity too great.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

5. Mechanical defects (worn wear rings or damaged impeller).
6. Wrong rotation.

Surges in Performance - Surges in performance may be caused by:

1. Air leak in suction line.
2. Air pocket in suction line.
3. Not enough NPSH available.
4. Air or gases in liquid.
5. Impeller plugged.

Excessive Power - Excessive power consumption may be caused by:

1. Speed too high.
2. Head too low (causing excessive capacity).
3. Specific gravity or viscosity of liquid pumped is too high.
4. Mechanical defects (bent shaft, worn wear rings, etc.).

Section 10 - Maintenance

General

The procedures given below are general and apply to all PWH pumps. For procedures specific to your particular pump, refer to the drawings and instructions supplied in the final data package with your pump.

WARNING: *Be sure that power to the motor is off and locked out before starting maintenance procedures.*

Pump Disassembly

The disassembly procedure is not specific to any pump but is general to the PWH series supplied with a cartridge type seal. Refer to the specific drawings supplied with your pump to augment this procedure. The numbers in parentheses after certain steps refer to component parts as identified on the typical pump sectional drawing Figure 9.

NOTE: *Typical sectional drawings are for disassembly and assembly purposes only and should not be used for specific detailed dimensions.*

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

1. Turn power off and lock in off position.
WARNING: *Be sure the power to the motor is turned off and locked in the off position before beginning disassembly.*

2. Close suction and discharge gate valves and any auxiliary valves.
NOTE: *The back pull-out design of this pump allows the complete Back Pull-Out unit to be removed without disturbing the suction and discharge piping or the driver.*

3. Drain the pump by opening the case drain.
WARNING: *If the pumpage is toxic, flammable or corrosive take proper precautions for handling pumpage before draining the pump.*

4. Disconnect and remove all seal flush piping after the pump is completely drained.

5. If the pump is equipped with an auxiliary seal flush reservoir, drain the reservoir and disconnect the seal flush piping.
NOTE: *Always cap off open ports and lines to prevent dirt from entering.*

6. Remove coupling guard. Disassemble and remove drive coupling spacer.
CAUTION: *The back pull-out unit is heavy. Proper lifting equipment must be used to avoid injury*.

7. Unbolt casing cover (802) from pump casing (800). Screw jack bolts into tapped holes in casing cover (802) and evenly tighten bolts to facilitate removal of the rotating assembly. [Impeller, casing cover, bearing bracket and shaft (805, 802, 849, 820)]. Remove casing gasket (815-1).
NOTE: *The pump back pull-out unit should now be moved to a repair shop where proper equipment and facilities are available.*

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Disassembly of Back Pull-Out Unit

After the complete back pull-out unit has been taken to a clean work area, the unit can be fully dismantled by following the instructions given below and referring frequently to the pump sectional drawing Figure 9.

1. Remove impeller locknut setscrew and impeller locknut (821-1). NOTE: *The impeller locknut loosens in a clockwise direction. It has a left hand thread.*

2. Remove impeller and impeller key. The impeller is a slip fit but may require the use of a puller for removal. (805, 811-1)
CAUTION: *Do not bend or damage the impeller when removing with a puller.*

3. Remove inboard heat sink guards.

4. Engage seal locating devices. Loosen cartridged seal drive collar set screws. Refer to seal drawing in final data package.

5. Unscrew capscrews holding bearing bracket (849) to casing cover (802) and pull casing cover and seal from remaining rotating assembly.
CAUTION: *When separating the casing cover from the bearing bracket, be careful not to damage the mechanical seal.*

6. Unbolt and remove cartridged seal assembly and seal chamber gasket from casing cover. Refer to the manufacturers instructions for seal maintenance.

7. To disassemble casing/cover wear rings (808-1,2) remove set screws holding the wear ring. Remove the wear ring. NOTE: *Some Wear Rings Are Fuse Welded In Place.*

8. To remove the throat bushing (847) grind off welds between cover and bushing and remove bushing.

9. For disassembly of bearing bracket see following instructions.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Bearing Bracket Disassembly

After dismantling the casing cover, the bearing bracket can be disassembled.

1. Remove pump coupling hub and drive key.

2. Remove the fan guard (812), inboard heat sink (829-2), and fan (853) as applicable.

3. Remove the two oil ring retainers.

4. Loosen capscrews and remove outboard end cap/bearing seal assembly (813-2, 829-2), and plastic shims (815-3).

5. Slide shaft assembly out of bearing bracket.

6. Remove ball bearing locknut and lockwasher (821-2 and 831) from fan shaft.

7. Using an arbor press with appropriate fixturing, remove thrust bearings (881-2) and radial bearing (881-1) from the pump shaft.

8. Remove oil rings (817) from shaft or loosen set screws and remove oil flinger.

Inspection of Pump Parts

Clean all parts in appropriate cleaning solution and inspect for wear or damage. Closely inspect bushings, sleeves, wear rings, and shaft keyways and keys. Replace any part that shows signs of wear or damage.

Impeller

Inspect impeller passages and vane surfaces for evidence of erosion. Replace if excessively worn or corroded. The impeller is dynamically balanced at the factory, and balance must be maintained for proper operation of the pump.

Case & Impeller Wear Rings

Case and impeller rings are normally provided for both sides of the impeller. These rings allow a small clearance to be maintained between the rotating impeller and the stationary casing rings. For proper hydraulic performance these

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

clearances should be as listed below. Rings should be replaced when clearances have increased to a point where hydraulic performance cannot be met.

Standard Material Minimum Running Clearances (API 610)

Wear Ring Diameter (Inches)	Min. Diametral Clearance	
	Inches	Micrometers
3.500 - 3.999	0.016	406
4.000 - 4.499	0.016	406
4.500 - 4.999	0.016	406
5.000 - 5.999	0.017	432
6.000 - 6.999	0.018	457
7.000 - 7.999	0.019	483
8.000 - 8.999	0.020	508
9.000 - 9.999	0.021	533
10.000 - 10.999	0.022	559
11.000 - 11.999	0.023	584
12.000 - 12.999	0.024	610
13.000 - 13.999	0.025	635

NOTE: *For materials with known galling tendencies and for all materials operating at temperatures above 500 deg. F, add 0.005"(127 micrometers) to the above diametrical clearances. Pumps utilizing special non-galling wear materials may run tighter clearances.*

Ball Bearings

Replace both Radial and Thrust Bearings Each Time Bearing Housing is repaired.

CAUTION: *New bearings should not be unwrapped until ready for use. Whenever in doubt about the condition of a bearing replace it.*

Seals

Inspect all seals for irregularities or damage. Consult the seal manufacturer's data for seal reconditioning and service. Seal faces, "O" rings and seal sleeve must be in perfect condition. Replace all worn parts.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Shaft

Inspect the shaft for damage and straightness. Dress minor damage and polish areas where the shaft contacts a seal. Support the shaft in rollers or V-blocks at the bearing locations and check runout. Runout must not exceed .002 inch TIR on all diameters.

General

All parts should be cleaned before assembly. This is especially important at "O" ring grooves, threads, cylindrical fits and gasket surfaces. Any burred edge must be removed before part is installed into the pump. Coat all parts with light oil and cover with protective cloth if the pump is not immediately reassembled.

Assembly

When assembling this pump it is recommended that only genuine PumpWorks 610 parts be used. Always use new O-rings, gaskets and lock washers. Assembled parts must be clean and free of dust or dirt.

Bearing Bracket Assembly

The bearing bracket can be reassembled by following the instructions given below and by referring to the pump drawing Figure 9.
NOTE: The bearing bracket is common for both the mechanical seal and Seal Reservoir arrangements.

CAUTION: Ensure that the bearing housing internals are checked for cleanliness.

1. Press inboard bearing seal (829-1) and firmly seat into bearing bracket (849) if removed during disassembly.

NOTE: *Bearing seal oil return slot must be located such that it faces down with the bearing bracket in its normally mounted position.*

2. Assemble oil rings, if applicable, (817) on shaft (820), installing each in the groove in the shaft.

3. Assemble oil flinger, if applicable, (817) on shaft (820) against the shoulder and lock in place with set screws.

4. Lubricate bearing seat on shaft. Slide thrust bearing (881-2) on shaft (820) as far as possible by hand. Place sleeve over shaft, being sure it

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

rests against inner race only. Press sleeve evenly until bearing is seated firmly against shaft shoulder.
Note: *Install thrust bearings back to back. Generally this means that the markings on the outer race are installed together. Bearings must always be replaced in pairs. New bearings are normally packaged in the correct back to back orientation for installation.*

5. Assemble thrust bearing lockwasher (831) and locknut (821-2). Crimp tab of lockwasher into bearing locknut slot.

6. Lubricate bearing seat on shaft. Slide radial bearing (881-1) on shaft (820) as far as possible by hand. Place sleeve over shaft, being sure it rests against inner race only. Press sleeve evenly until bearing is firmly seated against shaft shoulder.
NOTE: *Heating the bearings using an induction bearing heater or hot oil bath can be used to obtain a slip fit assembly. Be sure the bearing is not magnetized if induction heating is used. Do not heat bearings above 250°F.*

7. Install shaft and bearing subassembly into bearing bracket.

8. Install outboard bearing end cap/bearing seal assembly (813-2,829-2), and plastic shims (815-3) onto bearing bracket.

9. Check axial end play of shaft. End play should be adjusted to .003 to .005 by adding or removing shims.

10. Install inboard bearing seal by pressing or lightly tapping into bearing bracket. Rotate shaft to check for possible rubs on inpro seals and adjust if necessary.

11. Install oil ring retainers.

12. Install inboard heat sink (829-2), outboard fan (817), and fan shroud (812) as required.

13. Install pump coupling hub and drive key (811-2).

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Assembly of Back Pull-out Unit

The back pull-out unit can be reassembled by following the instructions given below and referring to the pump sectional drawing Figure 9.

CAUTION: Ensure that all parts are checked for cleanliness prior to installing them.

1. For assembly of bearing bracket see preceding instructions.

2. If removed during disassembly press throat bushing (847) into casing cover (802), and tack welds in two places equally spaced.

3. If removed during disassembly press casing or cover wear rings (808-1,2) into casing or cover and set screw in three places. Check rings for proper clearance to the impeller rings.

4. Lubricate pump shaft and slide cartridge seal assembly and if part of your unit, the inboard heat sink (829-2), onto shaft.
CAUTION: *Care must be taken not to damage seal sleeve gasket or seal face.*

5. Place gland gasket (815-2) on pilot or in groove of gland plate.

6. Slide casing cover (802) over pump shaft (820) and seal. Insert and tighten cap screws between bearing bracket (849) and cover.

7. Draw gland nuts up evenly until metal to metal contact is realized between gland and cover.

8. Install impeller key (811-1) and impeller (805). The impeller is a very snug slip fit, therefore the use of gentle force may be required to fully seat it to the shaft shoulder.

9. Tighten the seal drive collar set screws and packing sleeve follower if applicable. Disengage seal locating devices and check rotation.

10. Check shaft and make sure it is free to rotate. Re-engage seal locating device prior to storing or installing back pull-out unit in casing.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Assembly of Back Pull-Out Unit to Pump Casing

The pump back pull-out unit which includes the impeller (805), the casing cover (802), the bearing bracket (849), and the shaft (820) is now ready for reassembly to the pump in the field. Follow the instructions given below and refer to the pump sectional drawing Figure 9.

CAUTION: Ensure that all parts are checked for cleanliness prior to installing them.

1. Return complete Back Pull-Out unit to pump.

2. Slide casing gasket (815-1) over cover.

3. Slide Back Pull-Out unit into casing (800) and tighten casing stud nuts evenly.

CAUTION: *Check shaft that it is free to rotate and does not bind.*

4. Check coupling alignment. Refer to Preparation For Start-Up.

5. Install coupling spacer and lubricate if required.

6. Install coupling guard.

7. Replace all previously removed piping.

8. Refer to preparation for start-up Section.

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Section 11 – Torque Values

Recommended Stud Torque

Nominal Dia. (in)	Threads Per Inch	Recommended Torque (ft-lb)
3/4	10	195
7/8	9	315
1	8	475
1 1/8	8	695
1 1/4	8	980
1 3/8	8	1,330
1 1/2	8	1,760
1 5/8	8	2,265
1 3/4	8	2,865
2	8	4,350
2 1/2	8	8,735

Material: ASTM A193 Grade B7
Lubricant: Nickel based Anti-Seize μ=.13
Rev 4

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

Section 12 - Spare Parts

Save time and money by maintaining one complete set of the essential wearing parts for each pump. Do not wait until breakdown occurs. Recommended spare parts for the PWH are tabulated below.

PART NO.	DESCRIPTION	START-UP	PUMP RECONDITION	CRITICAL SERVICE
815-1	Casing Gasket	1	1	2
823	Cartridge Seal	1	1	1
805	Impeller	-	1	1
821-1	Impeller Nut	-	1	1
820	Shaft	-	1	1
806-1, -2	Impeller Wear Rings	-	2	2
808-1, -2	Casing Wear Rings	-	2	2
815-3	Shim Assembly	-	1	-
829-1	Bearing Seal	-	1	1
829-2	Bearing Seal	-	1	1
881-1	Radial Bearing	-	1	-
881-2	Thrust Bearing	-	1	-

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

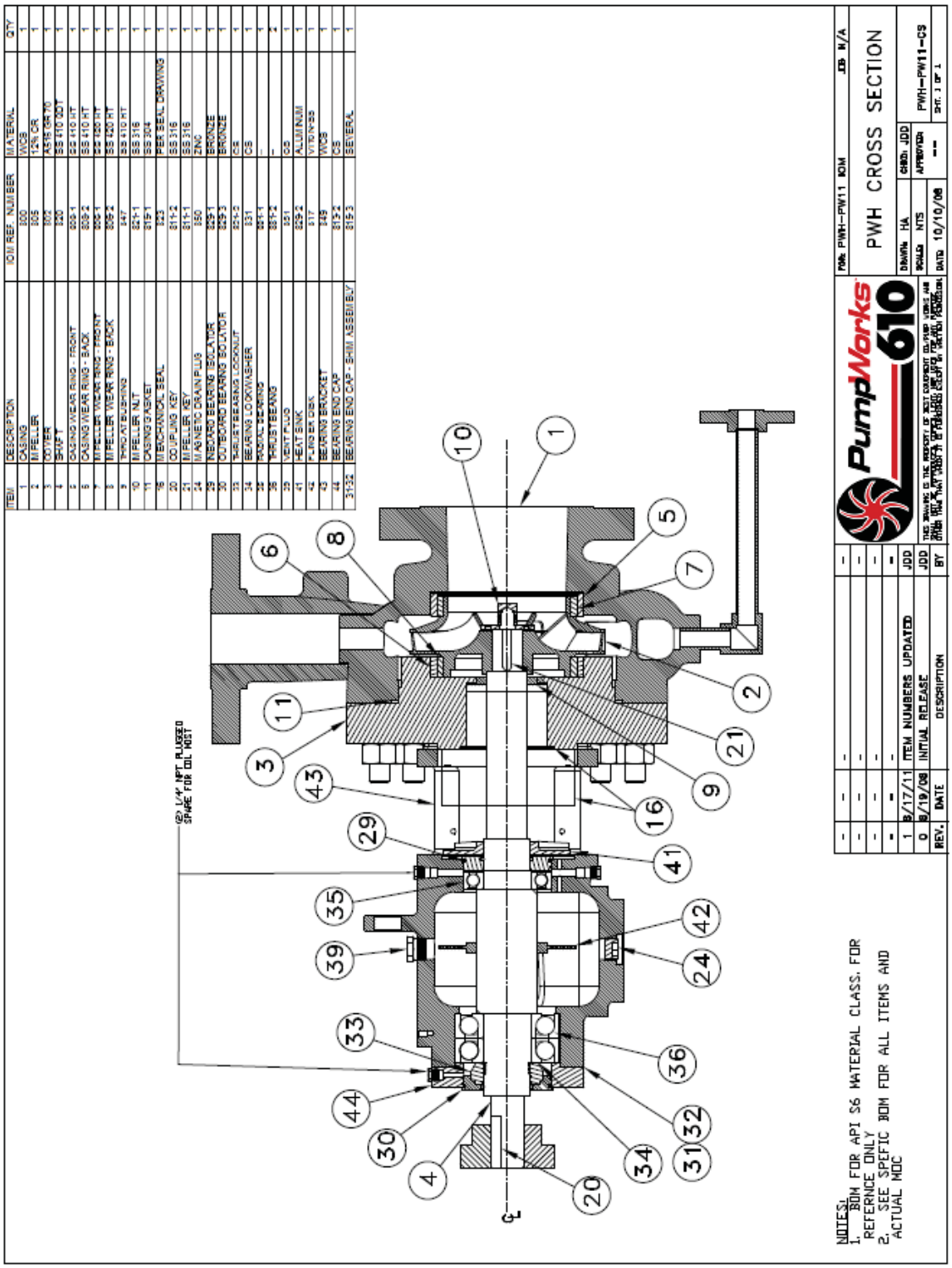

FIGURE 8

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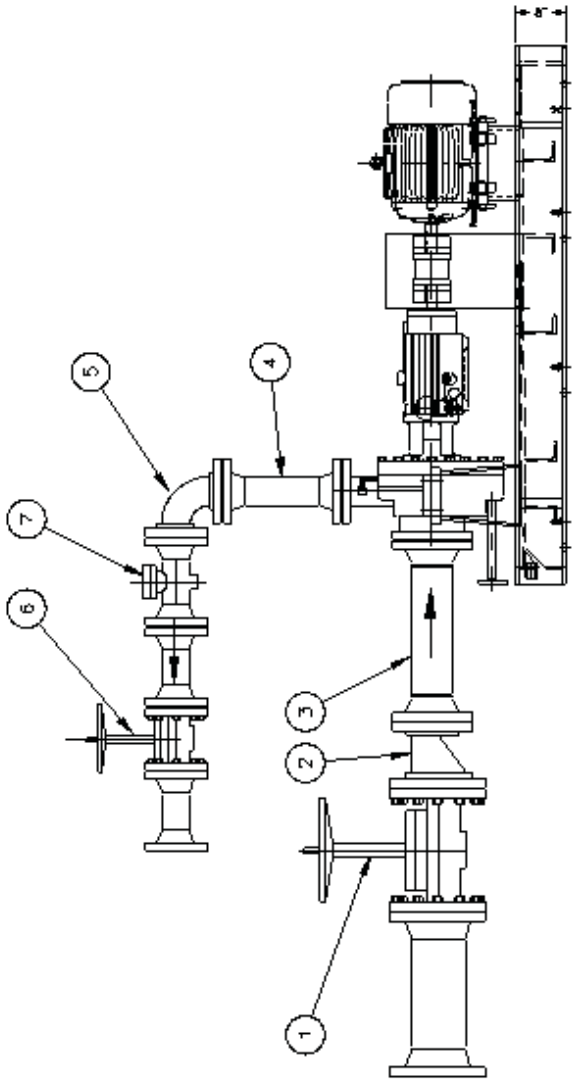
Phone: (713) 956-2002
Fax(713) 956-2141



TYPICAL HORIZONTAL PIPING DIAGRAM

IRECTION OF FLOW

1. SUCTION VALVE
2. ECCENTRIC REDUCER
3. MAKE-UP PIECE (LENGTH MAT'L. BY DIM.)
4. MAKE-UP PIECE
5. ELBOW
6. DISCHARGE VALVE
7. CHECK VALVE

Figure 9