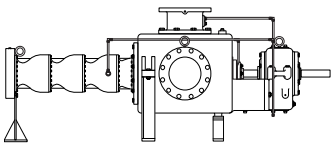


INSTALLATION, OPERATION &
MAINTENANCE MANUAL
FOR
SERIES 380
HT HORIZONTAL TURBINE

9 September 2011
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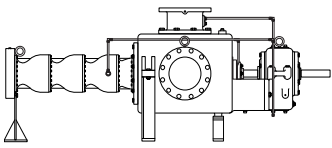
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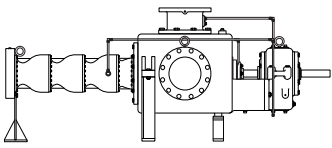
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SAFETY CONSIDERATIONS

The American-Marsh HT horizontal turbine pump has been designed and manufactured for safe operation. In order to ensure safe operation, it is very important that this manual be read in its entirety prior to installing or operating the pump. American-Marsh Pumps shall not be liable for physical injury, damage or delays caused by a failure to observe the instructions for installation, operation and maintenance contained in this manual.

Remember that every pump has the potential to be dangerous, because of the following factors:

- parts are rotating at high speeds
- high pressures may be present
- high temperatures may be present
- highly corrosive and/or toxic chemicals may be present

Paying constant attention to safety is always extremely important. However, there are often situations that require special attention. These situations are indicated throughout this book by the following symbols:

DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

WARNING

WARNING – Hazards or unsafe practices which COULD result in severe personal injury or death.

CAUTION

CAUTION – Hazards or unsafe practices which COULD result in minor personal injury or product or property damage.

Maximum Lifting Speed: 15 feet/second.

If in a climate where the fluid in the casing could freeze, never leave liquid in the pump casing. Drain the casing completely. During winter months and cold weather, the liquid could freeze and damage the pump casing.

Do not run the equipment dry or start the pump without the proper prime (casing flooded).

Never operate the pump for more than a short interval with the discharge valve closed. The length of the ENGINEERED PROCESS GROUP

interval depends on several factors including the nature of the fluid pumped and its temperature. Contact American-Marsh Engineering for additional support if required.

Never operate the pump with a closed suction valve.

Excessive pump noise or vibration may indicate a dangerous operating condition. The pump must be shutdown immediately.

Do not operate the pump for an extended period of time below the recommended minimum flow. See Figure 6, page 14.

If the liquid is hazardous, take all necessary precautions to avoid damage and injury before emptying the pump casing.

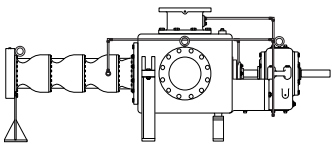
Residual liquid may be found in the pump casing, head and suction line. Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

Always lockout power to the driver before performing pump maintenance.

Never operate the pump without the coupling guard and all other safety devices correctly installed.

Do not apply heat to disassemble the pump or to remove the impeller. Entrapped liquid could cause an explosion.

If any external leaks are found while pumping hazardous product, immediately stop operations and repair.



PUMP IDENTIFICATION

MANUFACTURER

American-Marsh Pumps
185 Progress Road
Collierville, TN 38017
United States of America

TYPE OF PUMP

The American-Marsh HT horizontal turbine pump is a horizontal, francis impeller, radially split, centrifugal pump.

NAMEPLATE INFORMATION

DATE OF MANUFACTURE

The date of manufacture is indicated on the pump data plate.

INSTALLATION, OPERATION & MAINTENANCE MANUAL IDENTIFICATION

Prepared: August, 2011
Revision: 01

Edition: 01
Date of Revision: 08/23/11

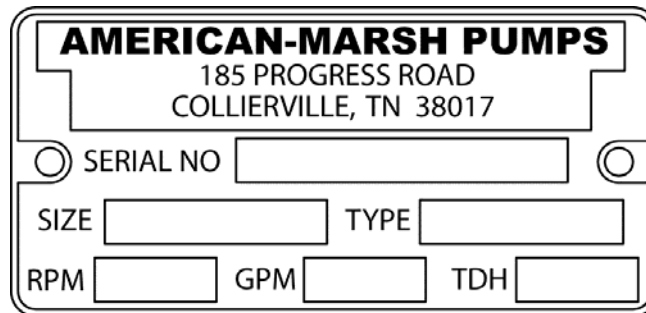


FIGURE 1A – Pump Data Plate (Powerframe and Suction Head)

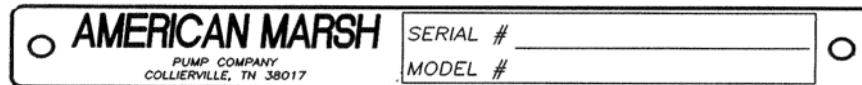
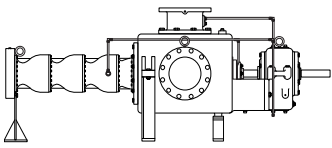


FIGURE 1B – Pump Data Plate (For Bowl Assembly)

- SERIAL NUMBER : Serial Number of pump unit (issued by Production Control).
- SIZE : Size designation of pump (8HC-2 Stage)
- MODEL # : Size designation of pump (8HC-2 Stage)
- TYPE : Pump type (HT).
- RPM : Speed of pump.
- GPM : Rated capacity of pump.
- TDH : Rated Total Dynamic Head of pump.



In case of doubt, contact the manufacturer.

WARRANTY

American-Marsh Pumps guarantees that only high quality materials are used in the construction of our pumps and that machining and assembly are carried out to high standards.

The pumps are guaranteed against defective materials and/or faulty craftsmanship for a period of one year from the date of shipment unless specifically stated otherwise.

Replacement of parts or of the pump itself can only be carried out after careful examination of the pump by qualified personnel.

The warranty is not valid if third parties have tampered with the pump, or is the warranty seal has been broken or tampered with.

This warranty does not cover parts subject to deterioration or wear and tear (mechanical seals, pressure and vacuum gauges, rubber or plastic items, bearings, etc.) or damage caused by misuse or improper handling of the pump by the end user.

Parts replaced under warranty become the property of American-Marsh Pumps.

Contact the American-Marsh Pumps' factory:

American-Marsh Pumps
185 Progress Road
Collierville, TN 38017
United States Of America

Phone: (901) 860-2300
Fax: (901) 860-2323
www.american-marsh.com

GENERAL INSTRUCTIONS

The pump and motor unit must be examined upon arrival to ascertain any damage caused during shipment. If damaged immediately notify the carrier and/or the sender. Check that the goods correspond exactly to the description on the shipping documents and report any differences as soon as possible to the sender. Always quote the pump type and serial number stamped on the data plate.

The pumps must be used only for applications for which the manufacturers have specified:

- ❖ **The construction materials**
- ❖ **The operating conditions (flow, pressure, temperature, etc.)**
- ❖ **The field of application**

HANDLING AND TRANSPORT

METHOD OF TRANSPORT

The pump must be transported in the horizontal position

INSTALLATION

During installation and maintenance, all components must be handled and transported securely by using suitable slings. Handling must be carried out by specialized personnel to avoid damage to the pump and persons. The lifting rings attached to various components should be used exclusively to lift the components for which they have been supplied. Lift the pump only by the lifting rings attached to the pump. Lift the motor only by the lifting rings attached to the motor. DO NOT lift the complete assembly (base, motor and pump together) by the lifting rings attached to the pump or motor. The assembly must be lifted by the baseplate.

! CAUTION

Maximum lifting speed: 15 feet/second

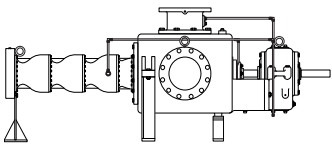
STORAGE

SHORT-TERM STORAGE

Normal packaging is designed to protect the pump during shipment and for dry, indoor storage for up to two months or less. The procedure followed for this short-term storage is summarized below:

Standard Protection for Shipment :

- a. Loose unmounted items, including, but not limited to, oilers, packing, coupling spacers, stilts, and mechanical seals are packaged in a water proof plastic bag and placed under the coupling guard. Larger items are cartoned and metal banded to the base plate. For pumps not mounted on a base plate, the bag and/or carton is placed inside the shipping carton. All parts bags and cartons are identified with the American-Marsh sales order number, the customer purchase order number, and the pump item number (if applicable).
- b. Inner surfaces of the bearing housing, shaft (area through bearing housing), and bearings are coated with Cortec VCI-329 rust inhibitor, or equal.
Note: Bearing housings are not filled with oil prior to shipment.
- c. After a performance test, if required, the pump is tipped on the suction flange for drainage (some



residual water may remain in the casing). Then, internal surfaces of ferrous casings, covers, flange faces, and the impeller surface are sprayed with Calgon Vestal Labs RP-743m, or equal. Exposed shafts are taped with Polywrap.

- d. Flange faces are protected with plastic covers secured with plastic drive bolts. 3/16 in (7.8 mm) steel or 1/4 in (6.3 mm) wood covers with rubber gaskets, steel bolts, and nuts are available at extra cost.
- e. All assemblies are bolted to a wood skid which confines the assembly within the perimeter of the skid.
- f. Assemblies with special paint are protected with a plastic wrap.
- g. Bare pumps, when not mounted on base plates, are bolted to wood skids.
- h. All assemblies having external piping (seal flush and cooling water plans), etc. are packaged and braced to withstand normal handling during shipment. In some cases components may be disassembled for shipment. The pump must be stored in a covered, dry location.

LONG-TERM STORAGE

Long-term storage is defined as more than two months, but less than 12 months. The procedure American-Marsh follows for long-term storage of pumps is given below. These procedures are in addition to the short-term procedure.

Solid wood skids are utilized. Holes are drilled in the skid to accommodate the anchor bolt holes in the base plate, or the casing and bearing housing feet holes on assemblies less base plate. Tackwrap sheeting is then placed on top of the skid and the pump assembly is placed on top of the Tackwrap. Metal bolts with washers and rubber bushings are inserted through the skid, the Tackwrap, and the assembly from the bottom of the skid and are then secured with hex nuts. When the nuts are “snugged” down to the top of the base plate or casing and bearing housing feet, the rubber bushing is expanded, sealing the hole from the atmosphere. Desiccant bags are placed on the Tackwrap. The Tackwrap is drawn up around the assembly and hermetically (heat) sealed across the top. The assembly is completely sealed from the atmosphere and the desiccant will absorb any entrapped moisture. A solid wood box is then used to cover the assembly to provide protection from the elements and handling. This packaging will provide protection up to twelve months without damage to mechanical seals, bearings, lip seals, etc. due to humidity, salt laden air, dust, etc. After unpacking, protection will be the responsibility of the user. Addition of oil to the bearing housing will remove the inhibitor. If units are to be idle for extended periods after addition of lubricants, inhibitor oils and greases should be used.

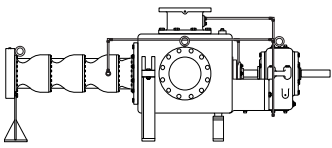
Every three months, the shaft should be rotated approximately 10 revolutions.

INSTALLATION & ALIGNMENT

FACTORY AND PRELIMINARY ALIGNMENT PROCEDURE

The purpose of factory alignment is to ensure that the user will have full utilization of the clearance in the motor holes for final job-site alignment. To achieve this, the factory and preliminary alignment procedure specifies that the pump be aligned in the horizontal plane to the motor, with the motor foot bolts centered in the motor holes. This procedure ensures that there is sufficient clearance in the motor holes for the customer to field align the motor to the pump, to zero tolerance. This philosophy requires that the customer be able to place the base in the same condition as the factory. Thus the factory alignment will be done with the base sitting in an unrestrained condition on a flat and level surface. This standard also emphasizes the need to ensure the shaft spacing is adequate to accept the specified coupling spacer. The factory alignment procedure is summarized below:

1. The base plate is placed on a flat and level work bench in a free and unstressed position.
2. The base plate is leveled as necessary. Leveling is accomplished by placing shims under the rails (or, feet) of the base at the appropriate anchor bolt hole locations. Levelness is checked in both the longitudinal and lateral directions.
3. The motor and appropriate motor mounting hardware is placed on the base plate and the motor is checked for any planar soft-foot condition. If any is present it is eliminated by shimming.
4. The motor feet holes are centered around the motor mounting fasteners.
5. The motor is fastened in place by tightening the nuts on two diagonal motor mounting studs.
6. The pump is put onto the base plate and leveled. If an adjustment is necessary, we add or delete shims between the pump foot and the base plate.
7. The spacer coupling gap is verified.
8. The parallel and angular *vertical* alignment is made by shimming under the motor.
9. All four motor feet are tightened down.
10. The pump and motor shafts are then aligned *horizontally*, both parallel and angular, by *moving the pump* to the fixed motor. The pump feet are tightened down.



- Both horizontal and vertical alignment are again final checked as is the coupling spacer gap.

RECOMMENDED PROCEDURE FOR BASE PLATE INSTALLATION & FINAL FIELD ALIGNMENT

PRELIMINARY ALIGNMENT CHECKS

If the pump is shipped with a baseplate and motor, a preliminary alignment check is needed. If the pump and motor is not properly aligned follow the factory and preliminary alignment procedures on the previous page.

NEW GROUDED BASE PLATES

- The pump foundation should be located as close to the source of the fluid to be pumped as practical. There should be adequate space for workers to install, operate, and maintain the pump. The foundation should be sufficient to absorb any vibration and should provide a rigid support for the pump and motor. Recommended mass of a concrete foundation should be three times that of the pump, motor and base. Note that foundation bolts are imbedded in the concrete inside a sleeve to allow some movement of the bolt.
- Level the pump base plate assembly. Record your leveling measurements on the baseplate leveling worksheet in Appendix B. If the base plate has machined coplanar mounting surfaces, these machined surfaces are to be referenced when leveling the base plate. This may require that the pump and motor be removed from the base plate in order to reference the machined faces. If the base plate is without machined coplanar mounting surfaces, the pump and motor are to be left on the base plate. The proper surfaces to reference when leveling the pump base plate assembly are the pump suction and discharge flanges. **DO NOT** stress the base plate. **DO NOT** bolt the suction or discharge flanges of the pump to the piping until the base plate foundation is completely installed. If equipped, use leveling jackscrews to level the base plate. If jackscrews are not provided, shims and wedges should be used. See Figure 2. Check for levelness in both the longitudinal and lateral directions. Shims should be placed at all base anchor bolt locations, and in the middle edge of the base if the base is more than five feet long. Do not rely on the

bottom of the base plate to be flat. Standard base plate bottoms are not machined, and it is not likely that the field mounting surface is flat.

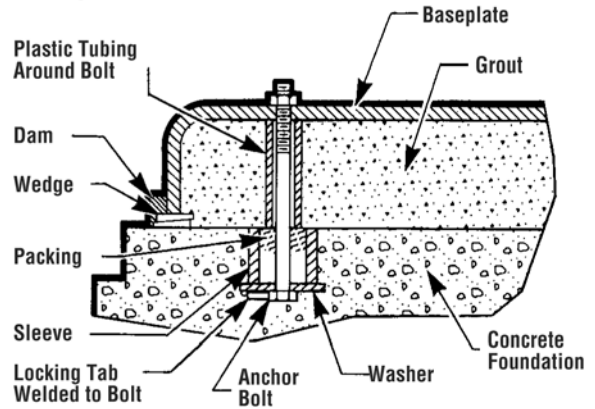
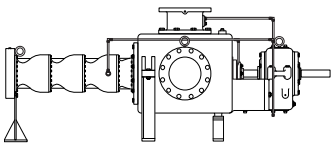


FIGURE 2 – Base Plate Foundation

- After leveling the base plate, tighten the anchor bolts. If shims were used, make sure that the base plate was shimmed near each anchor bolt before tightening. Failure to do this may result in a twist of the base plate, which could make it impossible to obtain final alignment. Check the level of the base plate to make sure that tightening the anchor bolts did not disturb the level of the base plate. If the anchor bolts did change the level, adjust the jackscrews or shims as needed to level the base plate. Continue adjusting the jackscrews or shims and tightening the anchor bolts until the base plate is level.
- Check initial alignment. If the pump and motor were removed from the base plate proceed with step 5 first, then the pump and motor should be reinstalled onto the base plate using American-Marsh's Factory Preliminary Alignment Procedure, and then continue with the following. As described above, pumps are given a preliminary alignment at the factory. This preliminary alignment is done in a way that ensures that, if the installer duplicates the factory conditions, there will be sufficient clearance between the motor hold down bolts and motor foot holes to move the motor into final alignment. If the pump and motor were properly reinstalled to the base plate or if they were not removed from the base plate and there has been no transit damage, and also if the above steps were done properly, the pump and driver should be within 0.015 in (0.38 mm) FIM (Full Indicator Movement)



parallel, and 0.0025 in/in (0.0025 mm/mm) FIM angular. If this is not the case first check to see if the driver mounting fasteners are centered in the driver feet holes. If not, re-center the fasteners and perform a preliminary alignment to the above tolerances by shimming under the motor for vertical alignment, and by moving the pump for horizontal alignment.

5. **Grout the base plate.** A non-shrinking grout should be used. Grout compensates for uneven foundation, distributes weight of unit, and prevents shifting. Use an approved, non-shrinking grout, after setting and leveling unit.
 - a. Build a strong form around the foundation to contain grout.
 - b. Soak the top of the concrete foundation thoroughly, then remove surface water.
 - c. Under the base should be completely filled with grout.
 - d. After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary.
 - e. Approximately 14 days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

Make sure that the grout fills the area under the base plate. After the grout has cured, check for voids and repair them.

Jackscrews, shims and wedges should be removed from under the base plate at this time. If they were to be left in place, they could rust, swell, and cause distortion in the base plate.

6. Run piping to the suction and discharge of the pump. There should be no piping loads transmitted to the pump after connection is made. Recheck the alignment to verify that there are no significant loads.
7. Perform final alignment. Check for soft-foot under the driver. An indicator placed on the coupling, reading in the vertical direction, should not indicate more than 0.002 in (0.05 mm) movement when any driver fastener is loosened. Align the driver first in the vertical direction by shimming underneath its feet. When satisfactory alignment is obtained the number of shims in the pack should be minimized. It is recommended that no more than five shims be used under any foot. Final horizontal alignment is made by moving the driver. Maximum pump reliability

is obtained by having near perfect alignment. American-Marsh recommends no more than 0.002 in (0.05mm) parallel, and 0.0005 in/in (0.0005 mm/mm) angular misalignment.

8. Operate the pump for at least an hour or until it reaches final operating temperature. Shut the pump down and recheck alignment while the pump is hot. Piping thermal expansion may change the alignment. Realign pump as necessary.

EXISTING GROUDED BASE PLATES

When a pump is being installed on an existing grouted base plate, the procedure is somewhat different from the previous section "New Grouted Base Plates."

1. Mount the pump on the existing base plate.
2. Level the pump by putting a level on the discharge flange. If not level, add or delete shims between the pump foot and the base plate.
3. Check initial alignment. (Step 4 above)
4. Run piping to the suction and discharge flanges of the pump. (Step 6 above)
5. Perform final alignment. (Step 7 above)
6. Recheck alignment after pump is hot. (Step 8 above)

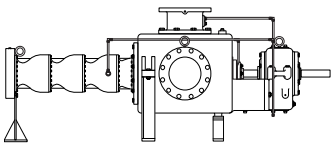
All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but that do not bottom out in the tapped holes before the joint is tight.

PIPING CONNECTION – SUCTION & DISCHARGE

When installing the pump piping, be sure to observe the following precautions:

Piping should always be run to the pump. Do not move pump to pipe. This could make final alignment impossible.

Both the suction and discharge piping should be supported independently near the pump and properly aligned, so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at necessary intervals to provide support. When expansion joints are used in the piping system, they must be installed beyond the piping



supports closest to the pump. Tie bolts should be used with expansion joints to prevent pipe strain. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes. It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction.

WARNING

Piping Forces: Take care during installation and operation to minimize pipe forces and/or moments on the pump casing.

Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45-degree or long sweep 90-degree fitting to decrease friction losses.

Make sure that all piping joints are air-tight. Where flanged joints are used, assure that inside diameters match properly. Remove burrs and sharp edges when making up joints. Do not “spring” piping when making any connections. Provide for pipe expansion when hot fluids are to be pumped.

SUCTION PIPING

The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimized and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be attributed directly to improper suction piping systems.

Friction losses caused by undersized suction piping can increase the fluid’s velocity into the pump. As recommended by the Hydraulic Institute Standard ANSI/HI 1.1-1.5-1994, suction pipe velocity should not exceed the velocity in the pump suction nozzle. In some situations pipe velocity may need to be further reduced to satisfy pump NPSH requirements and to control suction line losses. Pipe friction can be reduced by using pipes that are one to two sizes larger than the pump suction nozzle in order to maintain pipe velocities less than 5 feet/second.

Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening.

If the suction pipe is short, the pipe diameter can be the same size as the suction opening. If longer suction pipe

is required, pipes should be one or two sizes larger than the opening, depending on piping length.

A suction pipe of the same size as the suction nozzle, approaching at any angle other than straight up or straight down, must have the elbow located 10 pipe diameters from the suction flange of the pump. Vertical mounted pumps and other space limitations require special piping.

When operating on a suction lift, the suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe will become filled with air and thus prevent proper operation on the pump. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

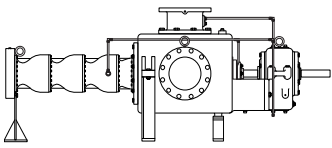
NOTE: When operating on suction lift, never use a straight taper reducer in a horizontal suction line, as it tends to form an air pocket in the top of the reducer and the pipe.

To facilitate cleaning pump liquid passage without dismantling pump, a short section of pipe (Dutchman or spool piece), so designed that it can be readily dropped out of the line, can be installed adjacent to the suction flange. With this arrangement, any matter clogging the impeller is accessible by removing the nozzle (or pipe section).

Valves in Suction Piping

When installing valves in the suction piping, observe the following precautions:

- a. If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type, rather than the multiple spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line (See “Valves in Discharge Piping” below).
- b. When foot valves are used, or where there are other possibilities of “water hammer,” close the discharge valve slowly before shutting down the pump.
- c. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets. Globe valves should not be used, particularly where NPSH is critical.
- d. The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump for maintenance



purposes, and should always be installed in positions to avoid air pockets.

e. A pump drain valve should be installed in the suction piping between the isolation valve and the pump.

Discharge Piping

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain as even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

Valves in Discharge Piping

A triple duty valve should be installed in the discharge. The triple duty valve placed on the pump protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure.

WARNING

When fluid velocity in the pipe is high, for example, 10 ft/s (3 m/s) or higher, a rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

Pressure Gauges

Properly sized pressure gauges should be installed in both the suction and discharge nozzles in the gauge taps (which are provided on request). The gauges will enable the operator to easily observe the operation of the pump, and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapor binding, or other unstable operation should occur, widely fluctuating discharge pressure will be noted.

Pump Insulation

On chilled water applications most pumps are insulated. As part of this practice, the pump bearing housings should not be insulated since this would tend to “trap” heat inside the housing. This could lead to increased bearing temperatures and premature bearing failures.

Pump and Shaft Alignment Check

After connecting piping, rotate the pump drive shaft clockwise (view from motor end) by hand several complete revolutions to be sure there is no binding and that all parts are free. Recheck shaft alignment. If piping caused unit to be out of alignment, correct piping to relieve strain on the pump.

MECHANICAL SEAL

When the pump is intended to be equipped with a mechanical seal, it is American-Marsh’s standard ENGINEERED PROCESS GROUP

practice to install the mechanical seal in the pump prior to shipment. Specific order requirements may specify that the seal be shipped separately, or none be supplied. It is the pump installer’s responsibility to determine if a seal was installed. If a seal was supplied but not installed, the seal and installation instructions will be shipped with the pump.

WARNING

Failure to ensure that a seal is installed may result in serious leakage of the pumped fluid.

Seal and seal support system must be installed and operational as specified by the seal manufacturer.

Mechanical seals are preferred over packing on some applications because of better sealing qualities and longer serviceability.

Leakage is eliminated when a seal is properly installed, and normal life is much greater than that of packing on similar applications.

Pumps containing single mechanical seals normally utilize the pumped liquid to lubricate the seal faces. This method is preferred when the pumped liquid is neither abrasive nor corrosive.

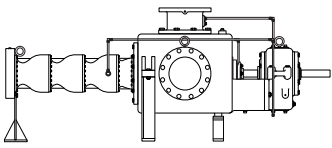
On HT pumps an API Flush Plan 11 is standard. The flush lines connect the first stage water pressure to the mechanical seal with a ½” flush line. If the liquid pumped is not clean or cool an external water supply will need to be used, and the flush line disconnected.

PACKING

When the pump is intended to be equipped with shaft packing, it is American-Marsh’s standard practice to install the packing in the stuffing box prior to shipment.

WARNING

Failure to ensure that packing is installed may result in serious leakage of the pumped fluid.



PIPING CONNECTION –SEAL/PACKING SUPPORT SYSTEM

WARNING

If the pump has a seal support system, it is mandatory that this system be fully installed and operational before the pump is started.

If packing is used:

Packing Lubrication – Water, when compatible with the pumpage, should be introduced into the packing box at pressure 10 to 15 lbf/in² (69 to 103 kPa) above the stuffing box pressure.

The gland should be adjusted to give a flow rate of 20 to 30 drops per minute for clean fluid. For abrasive applications, the regulated flow rate should be 1-2 gpm (0.06-0.13 l/s).

Grease lubrication, when compatible with the pumpage, may be used. In non-abrasive applications the pumpage itself may be sufficient to lubricate the packing without need for external lines. The internal flush line should be plugged.

Abrasive Packing Arrangement – The installation procedures are the same as the standard packing with some exceptions. A special lip seal is installed first, followed by two lantern ring assemblies, then two of the packing rings provided.

A flush line from a clean external source should be connected to the top of the stuffing box.

On HT pumps an API Flush Plan 11 is standard. The flush lines connect the first stage water pressure to the stuffing box with a ½” flush line. If the liquid pumped is not clean or cool an external water supply will need to be used, and the flush line disconnected.

BEARING LUBRICATION

Oil lubricated pumps are shipped from the factory without oil in the bearing housings. Before the pump is started the oil reservoirs must be filled with a high quality ISO 100 grade oil with anti-wear additives. The oil should be drained and replaced every 3 to 6 months depending on operating conditions as shown in Figure 4.

Oil lubricated pumps have an internal water cooled bearings. Cool clean water can be used to flow around the bearing through the internal cooling jacket by pumping water from the ¾” connection on the bottom of the bearing housing and exiting out the ¾” connection on

the top. On HT pumps a flush line is standard. The flush line connects the first stage water pressure to the internal bearing cooling jacket. If the liquid pumped is not clean or cool an external water supply will need to be used, and the flush line disconnected.

WARNING

The bearing cooling jacket connection is the connection closest to the pump end. The connection next to it that is closest to the motor is the oil fill port for the bearing housing. DO NOT fill the oil fill port with water. The oil fill port will have an observation hole where you can see the oil ring and insure the ring is turning with the shaft.

The Oil lubricated bearings are standard. (Grease lubrication is optional)

Grease lubricated ball bearings are packed with grease at the factory and ordinarily will require no attention before starting, provided the pump has been stored in a clean, dry place prior to its first operation.

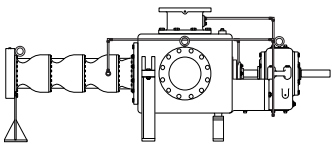
The bearings should be watched the first hour or so after the pump has been started to see that they are operating properly. See Figure 3 for recommended lubricants. Do not allow the bearings to exceed temperatures listed in Figures 4 or 5.

The importance of proper lubrication cannot be over emphasized. It is difficult to say how often a bearing should be greased, since that depends on the conditions of operation. It is well to add one ounce of grease at regular intervals, but it is equally important to avoid adding too much grease. For average operating conditions, it is recommended that 1 oz. of grease be added at intervals of three to six months, and only clean grease be used. It is always best if unit can be stopped while grease is added to avoid overloading.

CAUTION

Excess grease is the most common cause of overheating.

A lithium based NLGI-2 grade grease should be used for lubricating bearings where the ambient temperature is above -20°F. Grease lubricated bearings are packed at the factory with Royal Purple NLGI #2. Other recommended greases are Texaco Multifak 2, Shell Alvania 2 and Mobilux No. 2 grease. Greases made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Do



not use graphite. Use of an ISO VG 100 mineral base oil with rust and oxidation inhibitors is recommended. The maximum desirable operating temperature for ball bearings is 260°F. The bearings are allowed to run up to 310°F for a few hours at a time. Should the temperature of the bearing frame rise above 310°F, the pump should be shut down to determine the cause.

Mineral Oil	Quality mineral oil with rust and oxidation inhibitors. Mobil DTE Heavy/Medium ISO VG 68 or equivalent.
Synthetic	Royal Purple SynFilm 68, Conoco SYNCON 68 or equivalent. Some synthetic lubricants require Viton O-rings.
Grease	Royal Purple NLGI #2, Chevron SRI #2 (or compatible)

FIGURE 3 – Recommended Lubricants

Maximum Oil Temperature	ISO Viscosity Grade	Minimum Viscosity Index
Up to 160°F (71°C)	46	95
160-175°F (71-80°C)	68	95
175-200°F (80-94°C)	100	95

FIGURE 4 – Oil Viscosity Grades

Grease Lubricant	Weeks	Hours
Under 160°F (71°C)	22	3750
161-176°F (72-80°C)	13	2250
177-194°F (81-90°C)	8	1417
195-212°F (91-100°C)	7	1190
213-230°F (101-110°C)	3	562
231-248°F (111-120°C)	2	352
249-266°F (121-130°C)	1.5	225

FIGURE 5 – Re-lubrication Intervals for Grease

COUPLING

A direction arrow is cast on the casing. Make sure the motor rotates in the same direction before coupling the motor to the Pump.



It is absolutely essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time, can dislodge the shaft sleeves which may cause serious damage to the pump.

The coupling should be installed as advised by the coupling manufacturer. Pumps are shipped without the spacer installed. If the spacer has been installed to facilitate alignment, then it must be removed prior to checking rotation. Remove protective material from the coupling and any exposed portions of the shaft before installing the coupling.

PUMP OPERATION

ROTATION CHECK



It is absolutely essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time, can dislodge and damage the shaft sleeves, impeller, casing, shaft and shaft seal.

HT pumps can turn clockwise or counter-clockwise and therefore rotation must be specified at time of order.

PRE START-UP CHECKS

Prior to starting the pump it is essential that the following checks are made. These checks are all described in detail in the Maintenance Section of this booklet.

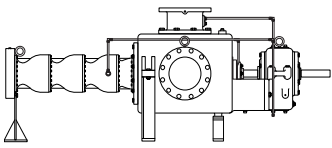
- Pump and Motor properly secured to the base plate
- Check alignment of pump and motor
- Coupling guard in place and not rubbing
- Rotation check, see above
- THIS IS ABSOLUTELY ESSENTIAL.**
- Shaft seal and/or packing properly installed
- Seal support system operational
- Bearing lubrication
- Pump instrumentation is operational
- Pump is primed
- Rotation of shaft by hand

As a final step in preparation for operation, it is important to rotate the shaft by hand to be certain that all rotating parts move freely, and that there are no foreign objects in the pump.

Fill out the Procedure Checklist for Prestart-Up from Appendix C.

PRIMING

If the pump is installed with a positive head on the suction, it can be primed by opening the suction and vent valve and allowing the liquid to enter the casing. If the pump is installed with a suction lift, priming must be



done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

ENSURING PROPER NPSH_A

Net Positive Suction Head – Available (NPSH_A) is the measure of the energy in a liquid above the vapor pressure. It is used to determine the likelihood that a fluid will vaporize in the pump. It is critical because a centrifugal pump is designed to pump a liquid, not a vapor. Vaporization in a pump will result in damage to the pump, deterioration of the Total Differential Head (TDH), and possibly a complete stopping of pumping. Net Positive Suction Head – Required (NPSH_R) is the decrease of fluid energy between the inlet of the pump, and the point of lowest pressure in the pump. This decrease occurs because of friction losses and fluid accelerations in the inlet region of the pump, and particularly accelerations as the fluid enters the impeller vanes. The value for NPSH_R for the specific pump purchased is given in the pump data sheet, and on the pump performance curve.

For a pump to operate properly the NPSH_A must be greater than the NPSH_R. Good practice dictates that this margin should be at least 5 ft (1.5 m) or 20%, whichever is greater.

CAUTION

Ensuring that NPSH_A is larger than NPSH_R by the suggested margin will greatly enhance pump performance and reliability. It will also reduce the likelihood of cavitation, which can severely damage the pump.

MINIMUM FLOW

Minimum continuous stable flow is the lowest flow at which the pump can operate and still conform to the bearing life, shaft deflection and bearing housing vibration limits of the ASME standard. Pumps may be operated at lower flows, but it must be recognized that the pump may not conform to one or more of these limits. For example, vibration may exceed the limit set by the ASME standard. The size of the pump, the energy absorbed, and the liquid pumped are some of the considerations in determining the minimum flow.

Typically, limitations of 20% of the capacity at the best efficiency point (BEP) should be specified as the minimum flow. However, American-Marsh has determined that several pumps must be limited to higher minimum flows to provide optimum service. The following are the recommended minimum flows for these specific pumps:

Pump Size	60 Hz		50 Hz	
	RPM	Minimum Flow (% of BEP)	RPM	Minimum Flow (% of BEP)
ALL MODELS	3500	60%	2900	50%

FIGURE 6 – Minimum Continuous Safe Flow

Note: “Minimum intermittent flow” value of 50% of the “minimum continuous flow” as long as that flow is greater than the “minimum thermal flow.”

All HT pumps also have a “Minimum Thermal Flow.” This is defined as the minimum flow that will not cause an excessive temperature rise. Minimum Thermal Flow is application dependent.

WARNING

Do not operate the pump below Minimum Thermal Flow, as this could cause an excessive temperature rise. Contact an American-Marsh Sales Engineer for determination of Minimum Thermal flow.

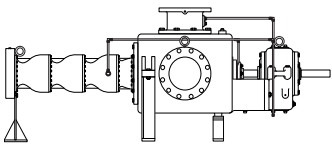
STARTING THE PUMP AND ADJUSTING FLOW

1. Open the suction valve to full open position. It is very important to leave the suction valve open while the pump is operating. Any throttling or adjusting of flow must be done through the discharge valve. Partially closing the suction valve can create serious NPSH and pump performance problems.

DANGER

Never operate pump with both the suction and discharge valves closed. This could cause an explosion.

2. A standard centrifugal pump will not move liquid unless the pump is primed. A pump is said to be “primed” when the casing and the suction piping are completely filled with liquid. Open discharge valve a slight amount. This will allow any entrapped air to escape and will normally allow the pump to prime, if the suction source is above the pump. When a condition exists where the suction pressure may drop below the pump’s capability, it is advisable to add a low pressure control device to shut the pump down when the pressure drops below a predetermined minimum.



3. All cooling, heating and flush lines must be started and regulated.
4. Start the driver (typically, the electric motor).
5. Slowly open the discharge valve until the desired flow is reached, keeping in mind the minimum flow restrictions listed above.

SHUTDOWN CONSIDERATIONS

When the pump is being shutdown, the procedure should be the reverse of the start-up procedure. First, slowly close the discharge valve, shutdown the driver, then close the suction valve. Remember, closing the suction valve while the pump is running is a safety hazard and could seriously damage the pump and other equipment.

TROUBLESHOOTING

The following is a guide to troubleshooting problems with American-Marsh pumps. Common problems are analyzed and solutions are offered. Obviously, it is impossible to cover every possible scenario. If a problem exists that is not covered by one of the examples, then contact a local American-Marsh Sales Engineer or Distributor/Representative for assistance.

! DANGER

It is important that the discharge valve be opened within a short interval after starting the driver. Failure to do this could cause a dangerous buildup of heat, and possibly an explosion.

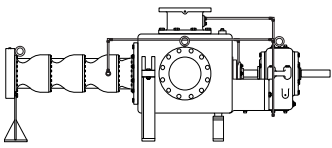
6. **Reduced capacity**
Avoid running a centrifugal pump at drastically reduced capacities or with discharge valve closed for extended periods of time. This can cause severe temperature rise and the liquid in the pump may reach its boiling point. If this occurs, the mechanical seal will be exposed to vapor, with no lubrication, and may score or seize to the stationary parts. Continued running under these conditions when the suction valve is also closed, can create an explosive condition due to the confined vapor at high pressure and temperature. Thermostats may be used to safeguard against over heating by shutting down the pump at a predetermined temperature.

Safeguards should also be taken against possible operation with a closed discharge valve, such as installing a bypass back to the suction source. The size of the bypass line and the required bypass flow rate is a function of the input horsepower and the allowable temperature rise.

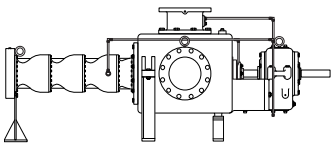
7. **Reduced Head**
Note that when discharge head drops, the pump's flow rate usually increases rapidly. Check motor for temperature rise as this may cause overload. If overloading occurs, throttle the discharge.
8. **Surging Condition**
A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

OPERATION IN SUB-FREEZING CONDITIONS

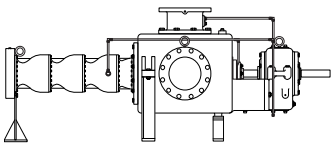
When using the pump in sub-freezing conditions where the pump is periodically idle, the pump should be properly drained or protected with thermal devices which will keep the liquid in the pump from freezing.



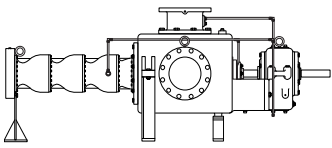
PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Problem #1 Pump not reaching design flow rate.	1.1 Insufficient NPSH _A . (Noise may not be present)	Recalculate NPSH available. It must be greater than the NPSH required by pump at desired flow. If not, redesign suction piping, holding number of elbows and number of planes to a minimum to avoid adverse flow rotation as it approaches the impeller.
	1.2 System head greater than anticipated.	Reduce system head by increasing pipe size and/ than or reducing number of fittings. Increase impeller diameter. NOTE: Increasing impeller diameter may require use of a larger motor.
	1.3 Entrained air. Air leak from atmosphere on suction side.	1. Check suction line gaskets and threads for tightness. 2. If vortex formation is observed in suction tank, install vortex breaker. 3. Check for minimum submergence.
	1.4 Entrained gas from process.	Process generated gases may require larger pumps.
	1.5 Speed too low.	Check motor speed against design speed.
	1.6 Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three phase motor. The pump should be disassembled and inspected before it is restarted.
	1.7 Impeller too small.	Replace with proper diameter impeller. NOTE: Increasing impeller diameter may require use of a larger motor.
	1.8 Impeller clearance too large.	Replace impeller and/or case wear rings.
	1.9 Plugged impeller, suction line or casing which may be due to a product or large solids.	1. Reduce length of fiber when possible. 2. Reduce solids in the process fluid when possible. 3. Consider larger pump.
	1.10 Wet end parts (casing, impeller) worn, corroded or missing.	Replace part or parts.
Problem #2.0 Pump not reaching design head (TDH).	2.1 Refer to possible causes under Problem #1.0.	Refer to remedies listed under Problem #1.0 and #3.0.
Problem #3.0 No discharge or flow	3.1 Not properly primed.	Repeat priming operation, recheck instructions. If pump has run dry, disassemble and inspect the pump before operation.
	3.2 Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three phase motor. The pump should be disassembled and inspected before operation.



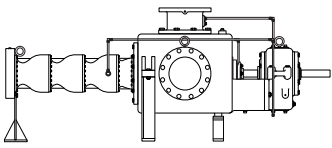
PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Cont. Problem #3.0 No discharge or flow	3.3 Entrained air. Air leak from atmosphere on suction side.	Refer to recommended remedy under Problem #1.0, Item #1.3.
	3.4 Plugged impeller, suction line or casing which may be due to a fibrous product or large solids.	Refer to recommended remedy under Problem #1.0, Item #1.9.
	3.5 Damaged pump shaft, impeller.	Replace damaged parts.
Problem #4.0 Pump operates for short period, then loses prime.	4.1 Insufficient NPSH.	Refer to recommended remedy under Problem #1.0, Item #1.1.
	4.2 Entrained air. Air leak from atmosphere on suction side.	Refer to recommended remedy under Problem #1.0, Item #1.3.
Problem #5.0 Excessive noise from wet end.	5.1 Cavitation - insufficient NPSH available.	Refer to recommended remedy under Problem #1.0, Item #1.1.
	5.2 Abnormal fluid rotation due to complex suction piping.	Redesign suction piping, holder number of elbows and number of planes to a minimum to avoid adverse fluid rotation as it approaches the impeller.
	5.3 Impeller rubbing.	1. Replace impeller and/or case wear rings. 2. Check outboard bearing assembly for axial end play.
Problem #6.0 Excessive noise from bearings.	6.1 Bearing contamination appearing on the raceways as scoring, pitting, scratching, or rusting caused by adverse environment and entrance of abrasive contaminants from atmosphere.	1. Work with clean tools in clean surroundings. 2. Remove all outside dirt from housing before exposing bearings. 3. Handle with clean dry hands. 4. Treat a used bearing as carefully as a new one. 5. Use clean solvent and flushing oil. 6. Protect disassembled bearing from dirt and moisture. 7. Keep bearings wrapped in paper or clean cloth while not in use. 8. Clean inside of housing before replacing bearings. 9. Check oil seals and replace as required. 10. Check all plugs and tapped openings to make sure that they are tight.
	6.2 Brinelling of bearing identified by indentation on the ball races, usually caused by incorrectly applied forces in assembling the bearing or by shock loading such as hitting the bearing or drive shaft with a hammer.	When mounting the bearing on the outboard end use a proper size ring and apply the pressure against the inner ring only. Be sure when mounting a bearing to apply the mounting pressure slowly and evenly.



PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
<p>Cont. Problem #6.0 Excessive noise from power end.</p>	<p>6.3 False brinelling of bearing identified again by either axial or circumferential indentations usually caused by vibration of the balls between the races in a stationary bearing.</p>	<p>1. Correct the source of vibration. 2. Where bearings are oil lubricated and employed in units that may be out of service for extended periods, the drive shaft should be turned over periodically to re-lubricate all bearing surfaces at intervals of one-to three months.</p>
	<p>6.4 Thrust overload on bearing identified by flaking ball path on one side of the outer race or in the case of maximum capacity bearings, may appear as a spalling of the races in the vicinity of the loading slot. (Please note: maximum capacity bearings are not recommended in HT pumps.) These thrust failures are caused by improper mounting of the bearing or excessive thrust loads.</p>	<p>1. Follow correct mounting procedures for bearings.</p>
	<p>6.5 Misalignment identified by fracture of ball retainer or a wide ball path on the inner race and a narrower cocked ball path on the outer race. Misalignment is caused by poor mounting practices or defective drive shaft. For example bearing not square with the centerline or possibly a bent shaft due to improper handling.</p>	<p>Handle parts carefully and follow recommended mounting procedures. Check all parts for proper fit and alignment.</p>
	<p>6.6 Bearing damaged by electric arcing identified as electro-etching of both inner and outer ring as a pitting or cratering. Electrical arcing is caused by a static electrical charge emanating from belt drives, electrical leakage or short circuiting.</p>	<p>1. Where current shunting through the bearing cannot be corrected, a shunt in the form of a slip ring assembly should be incorporated. 2. Check all wiring, insulation and rotor windings to be sure that they are sound and all connections are properly made. 3. Where pumps are belt driven, consider the elimination of static charges by proper grounding or consider belt material that is less generative.</p>



PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Cont.: Problem #6.0 Excessive noise from power end.	6.7 Bearing damage due to improper lubrication, identified by one or more of the following: 1. Abnormal bearing temperature rise. 2. A stiff cracked grease appearance. 3. A brown or bluish discoloration of the bearing races.	1. Be sure the lubricant is clean. 2. Be sure proper amount of lubricant is used. The constant level oiler supplied with HT pumps will maintain the proper oil level if it is installed and operating properly. In the case of greased lubricated bearings, be sure that there is space adjacent to the bearing into which it can rid itself of excessive lubricant, otherwise the bearing may overheat and fail prematurely. 3. Be sure the proper grade of lubricant is used.



MAINTENANCE

PREVENTIVE MAINTENANCE

The following sections of this manual give instructions on how to perform a complete maintenance overhaul. However, it is also important to periodically repeat the "Pre start-up checks" listed on page 13. These checks will help extend pump life as well as the length of time between major overhauls.

NEED FOR MAINTENANCE RECORDS

A procedure for keeping accurate maintenance records is a critical part of any program to improve pump reliability. There are many variables that can contribute to pump failures. Often long term and repetitive problems can only be solved by analyzing these variables through pump maintenance records.

NEED FOR CLEANLINESS

One of the major causes of pump failure is the presence of contaminants in the bearing housing. This contamination can be in the form of moisture, dust, dirt and other solid particles such as metal chips. Contamination can also be harmful to the mechanical seal (especially the seal faces) as well as other parts of the pumps. For example, dirt in the shaft threads could cause the impeller to not be seated properly against the shaft sleeve. This, in turn, could cause a series of other problems. For these reasons, it is very important that proper cleanliness be maintained. Some guidelines are listed below.

If it is contaminated, determine the cause and correct. The work area should be clean and free from dust, dirt, oil, grease, etc. Hands and gloves should be clean. Only clean towels, rags, and tools should be used.

MAINTENANCE OF PUMP DUE TO FLOOD DAMAGE

The servicing of centrifugal pumps after a flooded condition is a comparatively simple matter under normal conditions.

Bearings are a primary concern on pumping units. First, dismantle the bearings; clean and inspect them for any rusted or badly worn surfaces. If bearings are free from rust and wear, re-assemble and re-lubricate them with one of the recommend-ed pump lubricants. Depending on the length of time the pump has remained in the flooded area, it is unlikely that bearing replacement is necessary; however, in the event that rust or worn surfaces appear, it may be necessary to replace the bearings.

Next, inspect the stuffing box, and clean out any foreign matter that might clog the box. Mechanical seals should be cleaned and thoroughly flushed.

Couplings should be dismantled and thoroughly cleaned. Any pump that is properly sealed at all joints and connected to both the suction and discharge should exclude outside liquid. Therefore, it should not be necessary to go beyond the bearings, stuffing box, and coupling when servicing the pump.

ROUTINE MAINTENANCE CHART	
Every Week	Visually check for leaks Check for lubrication Adjust glands as necessary to maintain proper leakage in packing Hand test bearing housing for any sign of temperature rise
Every Month	Check bearing temperature with a thermometer
Every 6 Months	Check the packing and replace if necessary Check alignment of the pump and motor Check holding down bolts for tightness Check coupling for wear
Every Year	Check rotating element for wear Check wear ring clearances Check and regrease bearings Measure total dynamic suction and discharge head

FIGURE 7 – Routine Maintenance Chart

DISASSEMBLY

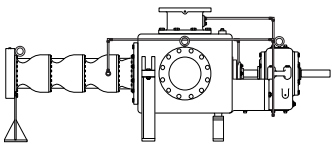
Refer to the parts list shown in Figure 11 for item number references used throughout this section.

1. Before performing any maintenance, disconnect the driver from its power supply and lock it off line.



Lock out power to driver to prevent personal injury.

2. Close the discharge and suction valves, and drain all liquid from the pump.
3. Close all valves on auxiliary equipment and piping, then disconnect all auxiliary piping.
4. Decontaminate the pump as necessary. *If American-Marsh pumps contain dangerous*



chemicals, it is important to follow plant safety guidelines to avoid personal injury or death.

5. Remove the coupling guard.
6. Remove the coupling and drive key. (if a spacer coupling is used)
7. Drain the pump.
8. Disconnect and drain the flush lines running from the bearing stage (#41) to the mechanical seal (#331B) and the bearing housing's (#82M) cooling jacket connection.
9. Disconnect the return flush line from the bearing housing (#82M) to the suction nozzle (#40).
10. Drain all the oil from the bearing housing (#82M).
11. Remove the two blind flange access plate (#20) from the suction head (#2B).
12. Through the access of the suction head disconnect the keyed coupling assembly (#31) that connects the bowl shaft (#41A) with the power frame shaft (#41B).

DISASSEMBLY OF BOWL ASSEMBLY

13. Remove the bearing stage (#41) from the bearing stage adapter (#47B).
14. Now the bowl assembly can be taken to a work bench for disassembly and repair.
15. Remove the discharge flange (#54) from the last stage of the pump bowl assembly.

! WARNING

Take great care in protecting the shaft assemblies (#41A,41B) during the entire disassembly process. Parts must be slid down the shaft for removal.

16. Remove all bolts from the bowl assembly (#1A) and remove the bowl. Remove and replace the bowl assembly o-ring.
17. Remove the impeller (#11A) and collet (or key assembly (#24A) by using a collet hammer.
18. Repeat this process until all of the bowls (#1A), impellers (#11A) and collets have been removed. Remove and replace all o-rings.
19. Inspect all bowl bearings (#35) for wear or damage. Replace bowl bearings (#35) if worn or damaged.
20. Remove and replace the bearing stage o-rings.
21. Inspect the bearing stage bearing (#47A) for wear or damage. Replace bearing stage bearing (#47A) if worn or damaged.

DISASSEMBLY OF BEARING HOUSING

22. Remove capscrews (#384B) securing bearing straps (#82M). Lift off bearing straps (#82M).

23. If packed loosen and remove nuts, washers, and clamps, securing split halves of the packing gland. (#71A) and remove the gland (#71A).
24. If sealed loosen the mechanical seal set screws that hold the seal sleeve to the shaft (#41B).
25. Loosen the nuts (#387E/F) that hold on the bearing housing (#82M). Remove the bearing housing (#82M).
26. Remove the entire shaft assembly (#41B) from the suction head (#2B).
27. Assuming that further work required on the shaft assembly, use properly secured rope slings and hoist or crane as required lifting it from the suction head (#2B) and placing it on suitable bench or work surface. Take care not to dent or damage any parts. Use of a supporting cradle or work stand is recommended.
28. Slide the pump half of flexible coupling off shaft (41B) and remove coupling key (#125A). Pry up on end of coupling key so as not to damage shaft. If preferred, key may be removed by carefully tapping from outer end with a brass drift or similar non-marring tool, using a small hammer.
29. The thrust bearing (#81P) is press fitted onto the bearing adapter (#92N). To remove it, you must first remove the bearing housing capscrews, bearing cap (#85P), bearing housing gasket (#359A), bearing locknut (#89N) and bearing lockwasher (#359A), inboard bearing cap (#108P), and bearing isolator (#104P) off of shaft (#41B).

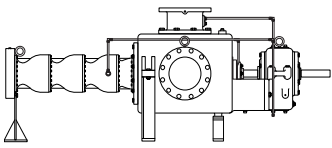
DISASSEMBLY OF STUFFING BOX

30. Unbolt and remove the stuffing box assembly (#17A) from the suction head (#2B).

! CAUTION

Mechanical seal faces can be extremely fragile and brittle in nature. Extreme care should be taken when handling these parts.

31. If packed remove and discard rings of packing (#331A), since replacement with new packing is recommended whenever pump is disassembled, and remove and replace if damaged the lantern ring (#73A).
32. If sealed replace the mechanical seal if damaged (#331B).
33. Press out the stuffing box bearing (#17B).



RE-ASSEMBLY

BEARING INSTALLATION

Mounting of bearings on shafts must be done in a clean environment. Bearing and power end life can be drastically reduced if even very small foreign particles work their way into the bearings.

Bearings should be removed from their protective packaging only immediately before assembly to limit exposure to possible contamination. After removing the packaging they should only come in contact with clean hands, fixtures, tools and work surfaces.

RE-ASSEMBLY OF BEARING HOUSING AND STUFFING BOX

1. Wipe over the shaft (#41B) with clean light oil.

CAUTION

Be sure that the register on the suction head (#2B), bearing stage adapter (#47B), bearing stage (#41) and bowl assemblies (#1A) are in good condition and are not damaged.

2. Press stuffing box bearing (#17B) into the stuffing box (#17A).
3. If sealed, bolt the mechanical seal gland to the stuffing box (#17A).
4. Mount the lower half of each bearing housing (#82M) to the suction head (#2B). There are two alignment pins at bearing housing location.

WARNING

It is EXTREMELY important that the bearing housings be aligned PRIOR to tightening the four capscrews that hold the bearing housing (#82M) to the suction head (#2B). Catastrophic damage can occur if either bearing housing is out of alignment.

5. Install the inboard bearing isolator (#104P), manifold cap (108P) and manifold cap gasket (#359A) onto shaft (#41B).
6. Heat the thrust bearing (#81P) to approximately 212°F (100°C) using a bearing hot plate or lubricating oil bath.

WARNING

Do not exceed 248°F (120°C). Temperatures in excess of this will permanently damage ball bearing.

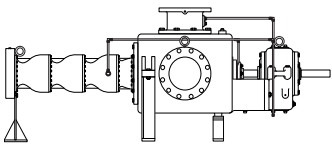
7. Slide the thrust bearings (#81P) onto the bearing adapter (#92N). Slide the bearing adapter (#92N) (with bearings) onto shaft shoulder. Install oil ring spacer (#109P), oil ring (#88M), lockwasher (#91N) and locknut (#89N). Tighten locknut (#89N) and bend lockwasher (#91N) over to lock into place.
8. Slide shaft (41B) through stuffing box (#17A) and suction head (#2B).
9. Install the outboard bearing isolator (#104N), manifold cap (85P) and manifold cap gasket (#359A) onto shaft (#41B).
10. Install upper bearing housing (#82M). Install the inboard bearing housing cap gasket (#359B) and cap (#108P). Be sure that the bearing housing cap (#108P) tightens flush against the bearing housing (#82M). Be sure to tighten the capscrews located on the manifold cap (108P).
11. If packed, install new packing (#331A) and lantern ring (#73A). Due to the low cost of packing always install new packing when the stuffing box (#17A) has been removed, and install the packing gland assembly (#71A).
12. If sealed, tighten mechanical seal set screws to the shaft (#41B).

CAUTION

Be sure that when tightening all bolts on the bearing stage (#2), bowl assemblies (#1A) and discharge flange (#1E) that an alternating tightening sequence is used to ensure that the part is securely and uniformly tightened to the complete pump assembly. See the torque chart in Figure 9 on the next page.

RE-ASSEMBLY OF BOWL ASSEMBLY

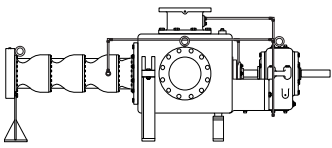
13. Install the impeller (#11A) and collet (or key assembly) and secure into position.
14. Install the bowl assembly o-ring and bowl assembly (#1A) to the bearing stage (#41). Repeat this process until all bowls and impellers have been installed in pump.
15. Install discharge flange (#54) and foot (#2C) to last bowl assembly.
16. Connect the bowl shaft (#41A) and the power frame shaft (#41B) using the keyed coupling (#31).
17. Install the two blind flange access plate (#20) to the suction head (#2B).



18. Connect the flush lines running from the bearing stage (#41) to the mechanical seal (#331B) and the bearing housing's (#82M) cooling jacket connection.
19. Connect the return flush line from the bearing housing (#82M) to the suction nozzle (#40).
20. Rotate the shaft by hand to assure smooth turning and that it is free from rubbing or binding.

BOLT SIZE		TIGHTENING TORQUE	
Metric	Standard	Lbf ft	Nm
4 mm	5/32"	2.7	3.6
5 mm	3/16"	5.2	7.0
6 mm	1/4"	8.9	12.0
7 mm	9/32"	14.6	19.8
8 mm	5/16"	21.8	29.6
9 mm	11/32"	28.0	38.0
10 mm	3/8"	38.7	52.5
12 mm	1/2"	65.6	89.0
14 mm	9/16"	99.6	135
16 mm	5/8"	151	205
18 mm	11/16"	190	257
20 mm	3/4"	264	358
22 mm	7/8"	321	435
24 mm	15/16"	411	557

FIGURE 9 – Capscrew Torque Values



APPENDIX A

AMERICAN-MARSH HT MAINTENANCE INSTRUCTIONS BEARING HOUSING OIL SEALS (LABYRINTH TYPE) INPRO/SEAL® VBXX BEARING ISOLATORS

INTRODUCTION

American-Marsh Pumps provides pumps fitted with a variety of labyrinth oil seals. While these instructions are written specifically for the Inpro/Seal VBXX labyrinth, they also apply to seals of other manufacturers. Specific installation instructions included with the seal, regardless of manufacturer, should be observed.

The Inpro “VBXX” Bearing Isolator is a labyrinth type seal which isolates the bearings from the environment (uncontaminated), and retains the oil in the bearing housing. The bearing isolator consists of a rotor and a stator. The rotor revolves with the shaft, driven by a close fitted drive ring that rotates with the shaft. The stator is a stationary component that fits into the housing bore with a press fit (nominal 0.002 in (0.05 mm) interference) and with an “O” ring gasket seal. The two pieces are assembled as a single unit, and are axially locked together by an “O” ring. There is no mechanical contact between the rotor and stator when the isolator is running.

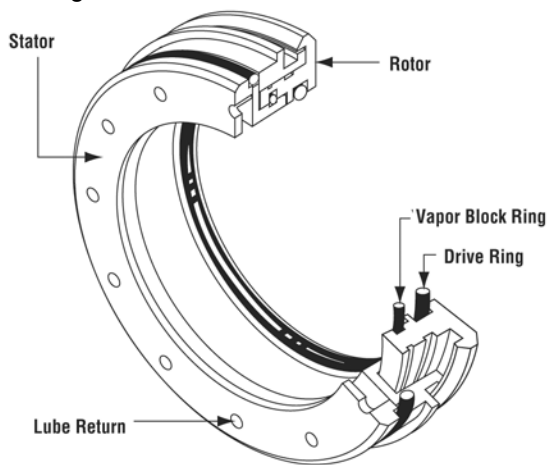


FIGURE 10 – Bearing Isolator

The VBXX is *not intended to be separated* from the bearing arm unless being replaced.

1. If the VBXX is removed from the housing, for any reason, it must be replaced with a new

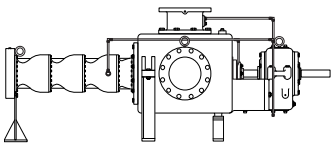
VBXX to ensure a perfect seal with the housing bore.

2. Repair or replacement of the seals is only necessary when excessive oil leakage is evident. However, if for any other reason, the bearing housing is to be disassembled or the pump shaft removed, it is recommended that the rotor “O” rings (which seal on the shaft) be replaced. Spare or replacement “O” rings may be obtained from “Inpro” distributors.

The “Inpro” VBXX bearing isolator is a one piece assembly. The rotor must not pull out of the stator. If the rotor can be removed, the complete seal assembly must be replaced.

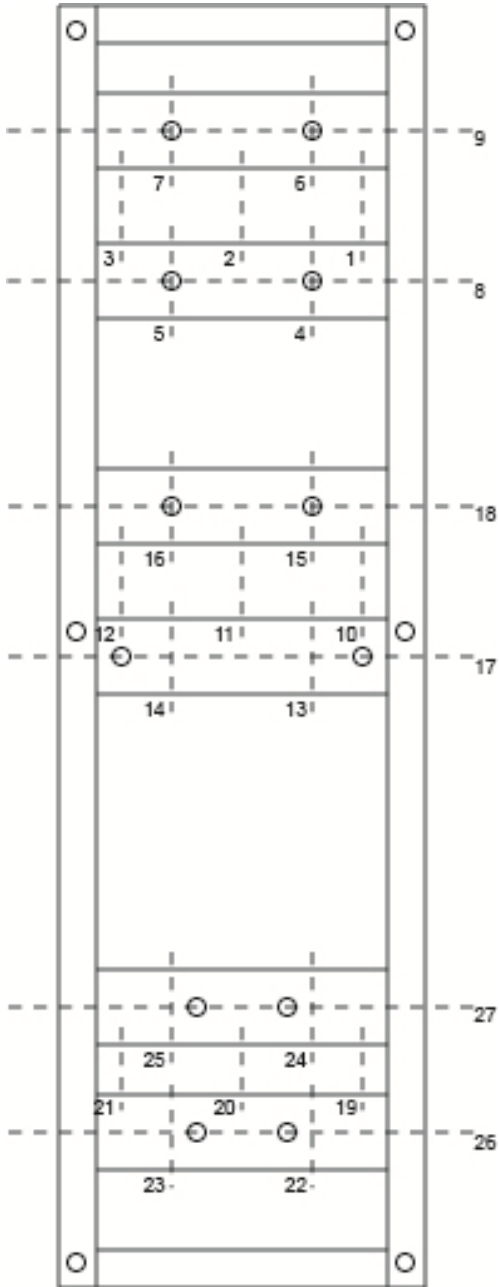
3. If the bearing arm with bronze VBXX seals is washed or cleaned using a caustic type bath, the bronze material may discolor (turn black). If this happens, the complete seal assembly must be replaced. **Note:** This may occur if the housing is left in a caustic bath over a long period of time (more than 8 hours).
4. To remove the VBXX bearing isolator:
 - A. Remove the pump shaft as described in the pump disassembly instructions.
 - B. From the inside of the bearing arm (#86N & 86P), place a bar (made from a soft material such as wood or plastic) against the inside face of the seal. Push the seal out by tapping the bar with a soft mallet or an arbor press.
5. To install a new VBXX bearing isolator, in the outboard or inboard bearing arm:
 - A. Position the outboard seal in the bore of the bearing arm (#86N & 86P) with the **single expulsion port at the 6 o’clock position**, (carefully keep aligned with the bore).
 - B. The seal stator O.D. press fits into the bore. Use an arbor press. Place a block or bar (large enough to protect the rotor flange) between the arbor press ram and seal face. Press the seal down into the bore stopping at the shoulder on the stator O.D.

The elastomer “O” ring acts as a gasket to ensure damming up of small imperfections in the housing bore. The “O” ring is designed to be compressed to the point of overfilling its groove. The overfilled material is sheared off during assembly. Remove any sheared “O” ring material which may extrude from the bore.



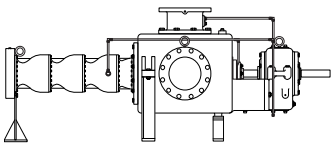
APPENDIX B

BASEPLATE LEVELING WORKSHEET



LEVELING MEASUREMENTS

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____



APPENDIX C

PROCEDURE CHECKLIST FOR PRESTART-UP

AMP Representative _____
 Contractor _____
 Project Engineer _____
 Project Name _____

Representative Phone Number _____
 Contractor Phone Number _____
 Project Engineer Phone Number _____
 Pump Location _____

Equipment Information

Pump Model _____
 Motor Model _____
 Engine Model _____
 Gear Drive Model _____

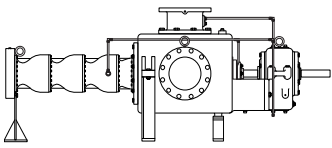
Pump Serial Number _____
 Motor Serial Number _____
 Engine Serial Number _____
 Gear Drive Serial Number _____

Procedure	Yes	No	N/A	Comments
1. Shipment Was there any damage in shipping? Were all items received?	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	
2. Storage Has equipment been protected from weather? Was equipment subject to damage in storage? Have all bearings been protected from moisture?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
3. Installation Were fasteners used in shipping and removed prior to installation? Is grouting under base properly compacted? Is grouting of the non-shrink type? Have proper anchor bolts been used? Have both the suction and discharge been checked for pipe strain? Are lube lines, cooling jacket lines, and seal water lines properly installed? Are accessory items mounted and properly installed? Are lube lines purged of air and lubricant added to the pump and motor? Are all safety guard in place? Have impellers been checked for proper clearance? Is all wiring connection to motor completed and checked for proper voltage, phase, frequency, etc. VFD (if installed) is installed and operable?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
4. Alignment Has the alignment of driver to pump been checked? Have indicator readings been taken?	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	
5. Rotation Has the rotation of the drives been checked for correctness? Has the coupling been turned to assure free rotation of pump and motor?	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	
6. System Has the system been checked to insure that it is free of foreign material? Is liquid available to the pump? Has assurance been obtained from responsible parties that all piping is secure and that the routing of flow has been established and is correct? Are pumps and controls accessible and unlocked?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

The above listed items are completed, and the listed pumps are ready to for start-up by an AMP representative.

Name _____

Date _____



APPENDIX D

PROCEDURE CHECKLIST FOR START-UP

AMP Representative _____ Representative Phone Number _____
 Contractor _____ Contractor Phone Number _____
 Project Engineer _____ Project Engineer Phone Number _____
 Project Name _____ Pump Location _____

Equipment Information

Pump Model _____ Pump Serial Number _____
 Motor: Mfg _____ Model _____ Serial Number _____
 Engine: Mfg _____ Model _____ Serial Number _____
 Gear Drive: Mfg _____ Model _____ Serial Number _____

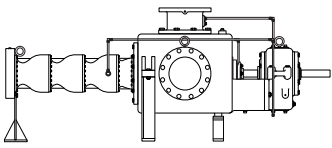
Design Conditions

Flow _____ TDH _____ Drive RPM _____ Drive HP _____ Voltage _____ Phase _____

Procedure	Yes	No	N/A	Comments
1. Prestart-Up Has the procedure checklist for prestart-up been completed? Verify motor rotation <input type="checkbox"/> CW <input type="checkbox"/> CCW	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Impeller Setting Has impeller been properly adjusted? Lateral impeller setting for vertical turbine pump - _____ Inches Impeller setting for end suction pump - _____ Inches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Lubrication Have the bearing been properly lubricated? Oil lubricated vertical turbine pump - _____ Drips per minute Water flush vertical turbine pump - _____ Minutes solenoid open Type of pump ball bearing lubrication <input type="checkbox"/> Oil <input type="checkbox"/> Grease Has the coupling been properly lubricated? Have the motors been properly lubricated? Type of pump ball bearing lubrication <input type="checkbox"/> Oil <input type="checkbox"/> Grease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. System Has flow been established? Have gauge readings been taken? Is excessive vibration present? Is bearing operating temperature excessive?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Sealing Device <input type="checkbox"/> Mechanical Sealed <input type="checkbox"/> Packed <input type="checkbox"/> Other Mechanical seal Mfg./Model _____ Is the API flush plan operable? Is seal lubricant pressure a constant 10 psi above discharge pressure? Has packing been adjusted to insure proper lubrication of packing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Installation of American-Marsh supplied equipment is acceptable.
 Responsibility for operation and maintenance of the pump station by owner.

Customer's Representative Witnessing Start-Up _____ American-Marsh Pumps Representative Conducting Start-Up _____
 Name _____ Date _____ Name _____ Date _____



APPENDIX E

FIELD TEST REPORT

AMP Representative _____ Representative Phone Number _____
 Contractor _____ Contractor Phone Number _____
 Project Engineer _____ Project Engineer Phone Number _____
 Project Name _____ Pump Location _____

Equipment Information

Pump Model _____ Pump Serial Number _____
 Motor: Mfg _____ Model _____ Serial Number _____
 Engine: Mfg _____ Model _____ Serial Number _____
 Gear Drive: Mfg _____ Model _____ Serial Number _____

Design Conditions

Flow _____ TDH _____ Drive RPM _____ Drive HP _____ Voltage _____ Phase _____

Procedure

	Yes	No	N/A	Comments
1. Prestart-Up Has the procedure checklist for prestart-up been completed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Start-Up Has the procedure checklist for start-up been completed? Is all measuring equipment calibrated and in good condition?	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	
3. System Is the suction valve checked open? Is the proper level of product in the sump / barrel / tank? Is the sump condition clean and free of debris? Are all system valves checked to be in the correct positions? Is all piping is secure and proper routing of flow is established?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

4. Recorded Data

	Condition 1	Condition 2	Condition 3
Speed (rpm)			
Flow (gpm)			
Discharge Pressure (psig)			
Suction Pressure (psig)			
Lift (water level to discharge center line) – (ft)			
Input Power (hp / KW)			
Current (amps)			
Voltage (volts)			
Estimated friction loss to discharge gauge (ft)			
Motor Efficiency			

5. Calculated Data

	Condition 1	Condition 2	Condition 3
TDH (ft)			
Pump BHP (KW x Motor Eff. / 0.746)			
Pump Eff. (TDH x SG x GPM) / (BHP x 3960)			

Customer's Representative Witnessing Start-Up _____ American-Marsh Pumps Representative Conducting Start-Up _____
 Name _____ Date _____ Name _____ Date _____

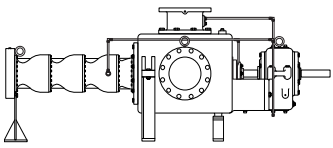
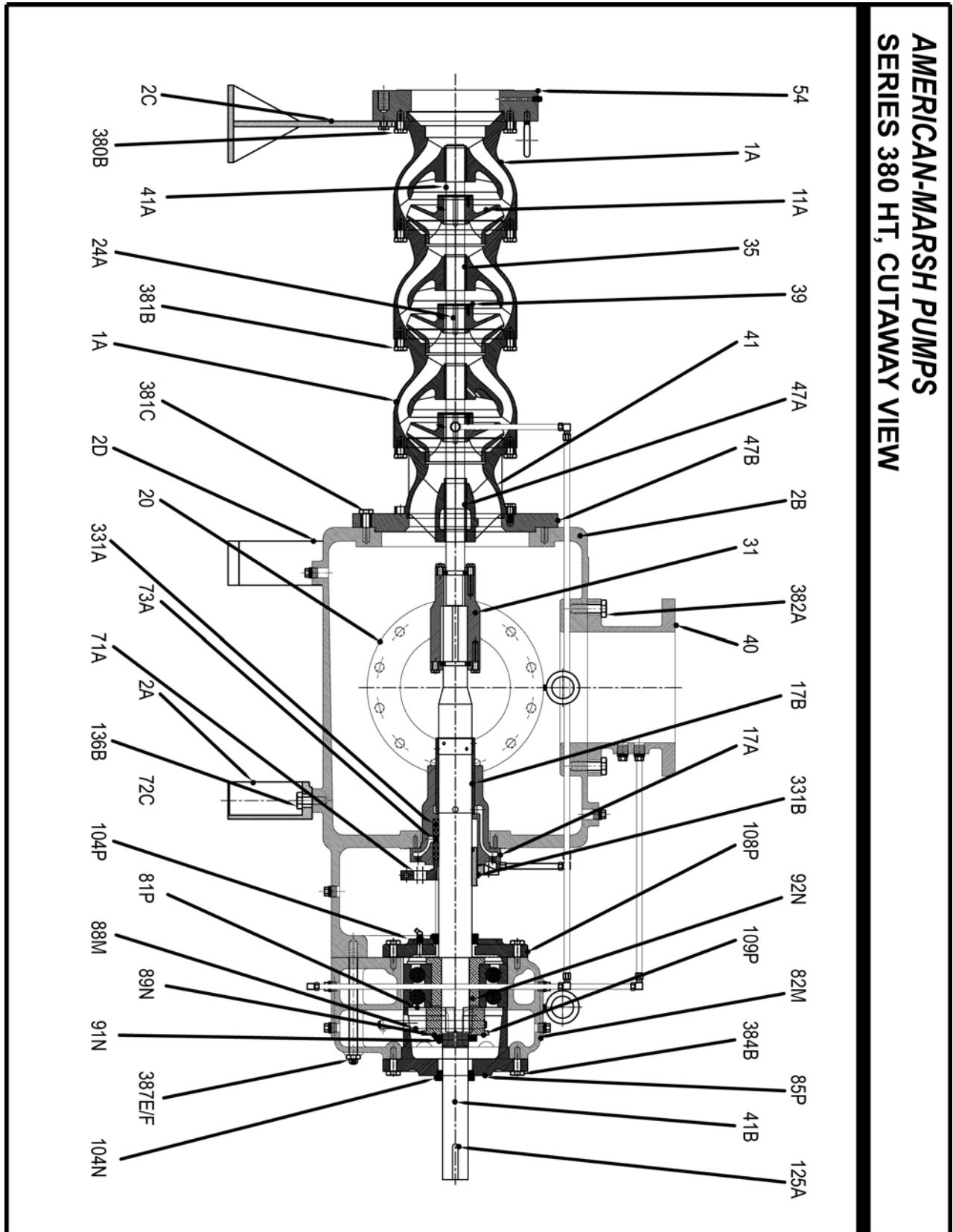
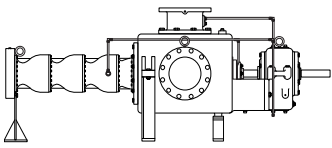


FIGURE 11 – HT Sectional Drawing





HT Parts List

Item Number	Item Description	Num. Req.
1A	Bowl	Varies
2A	Foot, Bearing Housing	1
2B	Suction Head	1
2C	Bracket, Discharge Support	Varies
2D	Bracket, Suction Head	2
11A	Impeller	Varies
17A	Stuffing Box	1
17B	Bearing, Stuffing Box	1
20	Blind Flange	2
24A	Key, Impeller	Varies
31	Coupling Assembly	1
35	Bearing, Bowl	Varies
39	Split Ring, Impeller	Varies
40	Suction Nozzle	1
41	Bearing Stage	1
41A	Shaft, Bowl	1
41B	Shaft, Bearing Housing	1
47A	Bearing, Bearing Stage	1
47B	Adapter, Bearing Stage	1
54	Discharge Flange	1
71A	Packing Gland	1
72C	Bolts, Packing Gland	2

Item Number	Item Description	Num. Req.
73A	Lantern Ring	1
81P	Thrust Bearing	1
82M	Bearing Housing	1
85P	Cap Outboard	1
88M	Ring, Bearing Oil	1
89N	Locknut, Bearing	1
91N	Lockwasher, Bearing	1
92N	Adapter, Bearing	1
104N	Bearing Isolator, Outboard	1
104P	Bearing Isolator, Inboard	1
108P	Cap, Inboard	1
109P	Collar, Oil Ring	1
125A	Key, Motor Coupling	1
136B	Bolt, Bearing Housing Foot	1
331A	Mechanical Seal	1
331B	Packing Set	1
380B	Capscrew, Dis. Support Bracket	Varies
381B	Capscrew, Bowl	Varies
381C	Capscrew, Bearing Stage Aprt.	Varies
382A	Capscrew, Suction Nozzle	Varies
384B	Capscrew, Bearing Housing Cap	8
387E/F	Stud and Nut, Bearing Housing	4

* Not shown in sectional.

Recommended spare parts are in **BOLD**.