INSTALLATION OPERATION AND MAINTENANCE MANUAL FOR IRONMOUNTAIN MODELS SPL AND SPH SLURRY PUMPS © ATLAS EQ. CO.

IRON MOUNTAIN

SEVERE DUTY SLURRY PUMPS

Model SPL and SPH

Warning: Do not operate this equipment in excess of its rated capacity, speed, pressure, temperature or other than in accordance with the instructions contained in this Manual. A prototype of this equipment has been shop-tested and found satisfactory for the conditions for which it was sold, but its operation in excess of these conditions will subject it to stresses and strains which it was not designed to withstand. Failure to heed this warning may result in an accident causing personal injury, loss of life, and property damage.

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OPERATIONS, INSTRUCTION AND MAINTENANCE MANUAL

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SAFETY:

DEFINITIONS

This pump has been designed for reliable and safe operation. Pumps are pressure containing vessels with rotating parts that could be hazardous. Operators and maintenance personnel must follow the necessary safety measures. Atlas Machinery Inc. shall not be liable for damage or delays caused by a failure to observe the instructions in this manual.

Throughout this manual the words **WARNING, CAUTION,** and **Note** are used to indicate procedures and areas of maintenance and operations which require special operator attention and focus:

WARNING — An operating procedure or practice which, if not followed could result in personal injury or loss of life.

CAUTION
An operating procedure or practice which if not correctly followed, could result in damage or destruction of equipment and property.

Note: Operating procedure, condition which is essential to observe.

WARNING — **Example:** Pump shall never be operated without a coupling or belt guard correctly installed.

CAUTION
Example: Never valve down the suction line to control the pump flow. This can cause significant damage to the pump.

Note:
Example: Proper alignment of pulleys and/or couplings is essential for long equipment life.

GENERAL PRECAUTIONS:

WARNING — Injuries to personnel will result if the procedures outlined in the manual are not followed.

- Never operate pump without drive guard installed correctly
- Never operate pump beyond its rated conditions to which the pump was sold.
- Never run pump below the recommended minimum flow or run the pump dry.
- Never run pump with discharge valve closed.
- Always lock out power to driver when performing pump maintenance.
- Never operate pump without all safety devices installed and in good operating condition.
- Never use heat to disassemble pumps due to risk of explosion from trapped liquid. Be especially cautious with removal of impeller.
- Check rotation of pump with the pump disconnected from the driver. Incorrect motor rotation can cause the impeller to back off its threads and destroy parts and possibly cause severe personal injury.

SECTION I – GENERAL

Introduction
This instruction manual is to be used to assist those involved with installation, operation, and maintenance of IronMountain Model SPL and SPH slurry pumps. It is recommended that this manual be reviewed in detail prior to installing, operating, or performing any work on the pump or driver.

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The IronMountain "SPL" and "SPH" (Hard Metal) pumps are heavy duty, end suction centrifugal pumps, designed for pumping abrasive and corrosive slurries. They are widely used in mining, power, coal and other industrial pumping applications.

The SPL and SPH pumps are single-stage, single-suction, frame mounted, overhung designed horizontal centrifugal pumps. The outer casing is made of carbon steel and the inner casing and all wear plates are constructed of abrasion resistant metals.

Model designation is as follows:
EXAMPLE:

Model **8SPH-60G**
8 indicates the discharge size for this pump is **8**"
SP indicates a slurry pump
H indicates a **H**igh head pump while **L** indicates **L**ow head pump.
60 indicates a **nominal maximum impeller diameter** of 60 cm. or 23.62 in.
G indicates the bearing frame size.

Importance of Instructions

IronMountain pumps are designed for trouble-free service. The life expectancy and satisfactory service of this and any mechanical device is enhanced by periodic inspection and a carefully designed preventive maintenance process. This manual has been prepared to assist operators in understanding the construction and correct methods of installing, operating, and maintaining these pumps.

Study this manual thoroughly, and follow the instructions carefully for installation, operations and maintenance. Keep this manual for reference in a place accessible by all.

Special Warning

Atlas Machinery Company, Inc. will not be liable for any damages or delay caused by failure to comply with the provisions of this instruction manual. This pump is not to be operated at speeds, working pressures, discharge pressures, or temperatures higher than, nor used with liquids other than, stated in the original order acknowledgement without written permission of Atlas Machinery Company, Inc.

Receiving and Inspection-Shortages

All pumps are inspected and documented prior to leaving the assembly plant. Check that the pump is the correct model and size in accordance to what has been ordered. If all is correct, then install the pump in accordance to this manual and all other technical and safety requirements.

Thoroughly inspect all cartons and wrapping for parts prior to discarding. Parts are sometimes wrapped individually or fastened to the crate. Match all items to the packing documents provided with the shipment. If all parts are there installation can proceed. After comparison of the parts on hand with the packing documents there seem to be parts missing or damaged report the deviations to the transportation company's local agent immediately.

Preservation and Storage

If corrosion resistant coating is ordered and provided from the factory; Kerosene is recommended as the best solvent for removal. Care must be taken to ensure that all trace of rust preventative is removed from the discharge and suction flange faces, the exposed shafting, and all coupling surfaces.

Short Term Storage

When it is necessary to store a pump for a short time before it can be installed, place it in a dry location. Protect it thoroughly from moisture and physical damage. Any protection provided by the factory should not be removed.

Protect the bearings and couplings against sand, grit and any other foreign matter. To prevent rusting-in or seizing, lubricate the unit (refer to Section III Lubrication) and rotate the shaft by hand at least once a week.

Long Term Storage

The following procedure is necessary if the equipment needs to be stored for an extended period of time before installation:

In addition to the Short Term Storage requirements, check the stuffing box to insure that it contains no packing which could cause corrosion of internal parts as a result of condensation.

The internal surfaces of the pump should be coated with protective fluid. All other parts such as bearings and couplings should be flushed, dried and coated with Vaseline or acid-free heavy oil, after which they should be stored. Wrap and box these parts or assemblies in order to avoid metal to metal contact.

NOTE: All pumps and associated parts should be stored inside in a warm dry environment, and not be stored outside in cold weather covered by plastic covers. Condensation most likely will occur and corrosion will result.

SECTION II - INSTALLATION INSTRUCTIONS
All pumps are inspected and hydrostatically tested prior to shipment.

Pump Handling

SAFETY is always the prime consideration when moving or lifting a pump.

WARNING

Do not use the lifting eyes on the casing or bearing frame to lift the pump. These eyes are designed to assist removal of casing halves or parts for the bearing assembly only and are not designed to lift the entire pump

To lift a pump or a bare pump with a sole plate:

- Locate the rectangular hole in the bearing frame just below the stuffing box cover. This hole approximates the center of gravity of the bare pump.
- Place wire rope or chain capable of handling the weight through the hole and join both ends.
- To balance, auxiliary wire ropes should be added between the lift hook and the casing lift screws.

WARNING

Care must be taken to pump is not dropped. Any sharp blows to the pump, positioning the casing on a sharp object, or allowing the pump to topple can cause harm to the pump and a safety hazard for personnel.

When lifting horizontal pump with an overhead mount motor, direct connected pump, or base mounted units with either speed reduction or a direct coupled; the assembly should be lifted as a complete unit from underneath. Always utilize the square hole in the pump bearing frame underneath the stuffing box area as a best means to lift the bare pump.

CAUTION: Cushions should be added between wire rope and pump to prevent damaging the appearance of pump and the possibility of cutting the wire rope.

Site location of Pump Assembly
The pump should be placed so that it is easily accessible for inspection during operation, while giving due attention to the desirability of simplifying the suction and discharge piping layout.

The pump should always be located as near as possible to the suction supply to keep suction losses to a minimum. The suction and discharge pipes and valves should be designed and laid out so that one section (Minimum length 3X pipe diameter spool piece) may be readily removed to allow quick and easy access to the pump liquid end for installation and maintenance.

There should be ample head room to allow the use of an overhead crane or lifting device with sufficient capacity to lift the heaviest part of the unit.

Foundation
The foundation may consist of any material that will afford permanent rigid support to the full area of the pump or driver supports and that will absorb expected strains and vibrations that may be encountered in service.

Concrete foundations built on solid ground are preferred. Foundation bolts of the adequate sizes should be selected and located according to elevation drawings. Each bolt should be surrounded by a pipe sleeve two or three times the diameter of the bolt. The sleeves should be held rigidly yet allowing the bolts to be moved to conform to the holes in the baseplate.

The pump should be located directly over or as near as possible to the main load carrying members, beams or walls when it is mounted directly to structural steel framing. The baseplate should be bolted to the steel supports to avoid distortion, prevent vibration and retain proper alignment.

Leveling

Pumps are generally shipped together with the baseplate. It is usually unnecessary to remove the pump or driver from its baseplate when leveling with units of moderate size. The unit should be placed on the foundation supported by shims and wedges close to the foundation bolts to allow for grouting from three quarters to two inches between the bottom of the baseplate and the top of the foundation.

If the unit is direct connected to a motor; disconnect the coupling halves before leveling the unit and alignment of coupling halves.

Level the pump and base with a spirit level. Where possible, place the level on some exposed part of the pump shaft, sleeve or planed surface of the casing. Adjust the wedges under baseplate until the pump shaft is level and flanges of both the suction and discharge nozzles are at the specified height, and location.

After leveling of the pump and base, align the coupling halves between the pump and driver shafts by an acceptable method. (See Instructions below)

Grouting

The pump needs to be grouted into place. The purpose of grouting is to prevent lateral shifting of the baseplate, not to take up irregularities in the foundation. The following procedure is recommended:

A typical mixture for grout is one part pure Portland Cement and two parts building sand, with sufficient water to cause the mixture to flow freely. The top of the rough concrete foundation should be cleaned and saturated with water prior to starting the grouting process. A wood form is usually constructed around the outside of the baseplate to contain the grout. In some cases this form is placed tightly against the edge of the baseplate. After grouting in the baseplate fill the base with concrete and add concrete until the entire space under the base is filled including the space between the pump and motor supports and between the pump and driver mounts. A stiff wire can be used to work the grout and release any air pockets.

After the grout and concrete is poured, cover the exposed surfaces with wet burlap to slow the hardening process. This will help prevent cracking.

Suction, Discharge and Stuffing Box Piping

Satisfactory operation cannot be maintained when piping loads are applied to the pump flanges. Pumps can be sprung and pulled out of position by connecting the pump to located pipe flanges. Flanges must be correctly aligned **prior to** tightening the flange bolts.

Suction and discharge piping and associated equipment must be supported and anchored near but independent of the pump such that no strain will be transferred to the pump casing. Pipe strains are a common cause of misalignment, hot bearings, worn couplings and vibration. **Never force suction or discharge piping onto the pump flanges.**

The selection of the pipe size is determined by pipe friction tables, critical sedimentation velocity, and other related issues specific to the application. The velocity of slurry is determined by the critical sedimentation velocity is normally between 5 and 10 FT/Second (1.5 ~3 Meters/Second).

Where pipe diameters change, tapered sections of pipe are preferred to sudden changes of section. This can provide smoother operation and reduce wear. Valve inside diameters should never be less than that of the pipe. A check valve should be utilized in cases where the pumpage is pumped vertically.

Suction Pipe

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Experience has shown that the major source of problems in centrifugal pump installations is a faulty suction line. The utmost attention must be given to this portion of the installation. The suction piping should be as direct as possible and its length kept to a minimum. If a long suction line is required, increase the pipe size to reduce friction losses.

A straight short removable flanged spool piece (not less than 3 times the pipe diameter) should be installed between the suction pipe and the pump suction flange to facilitate casing removal and improving suction conditions to the pump.

As a rule of thumb, the diameter of the suction pipe should be one size larger than the pump suction diameter to minimize the potential cavitation and allow the correct velocity to transport the product. If the suction length is short it **may be possible** to use the same diameter suction line as the pump suction. In all cases, **sufficient pipe velocity must be maintained in the pipe to prevent settling.**

For most slurry applications it will be necessary to gravity feed product into the pump. Normally a sloping intake pipe from the feedbox to the pump is desirable, particularly when handling materials that settle quickly.

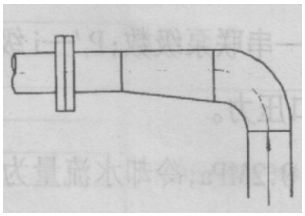


Fig: 1: Eccentric Suction reducer

The piping should be straight run without high spots and have a continual slope downward into the pump. This will prevent air pockets. Use only eccentric reducers installed with the straight side on top (see Fig. 1). The suction piping should be checked before initial startup to insure that there are no air leaks into the pipeline.

A suction valve is desirable so that the pump can be isolated while repairs are being made and for ease of priming in the case of a self priming application.

It is always preferable for the pump to operate with a positive suction head.

CAUTION: The suction valve must never be used to control the pump capacity.

Net Positive Suction Head

The Net Positive Suction Head required (NPSHr) by the pump is the amount of energy at the pump suction required for the pump to operate with properly without damaging cavitation. The NPSHr varies with every size of pump and for any given pump it varies with capacity. The NPSHr by your unit can be obtained for the performance curves available form your IRONMOUNTAIN representative.

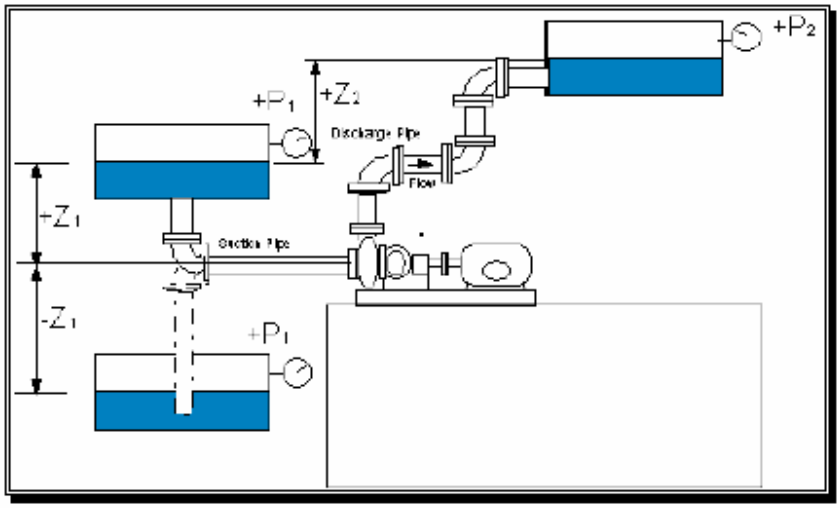


Fig. 2: NPSH Calculation diagram

To determine the NPSH available in your system refer to Fig. 2 and the following equation:

If available NPSH is not equal to, or greater than, that required by the pump, it must be increased or the pump will not operate correctly and significant failures will occur. The increase of NPSHa by the system is usually accomplished by increasing the static head Z.

NPSHa = +/- Z + (((P-Pv) x 2.31)/ SP. GR.) – Hf –He

Where: Z = Static Head
P = Pressure on surface of liquid in PSIa (PSI absolute = Pressure of gage + 14.7)
Pv = Vapor pressure of liquid at pumping temperature PSIa
Hf = Suction line friction losses in feet
He = Entrance losses from tank to pipe in feet of head.

NOTE: For boiling liquids, P equals Pv and this item can be omitted from the equation.

Discharge Piping

Diameter: The diameter of discharge pipeline is normally larger than the discharge size of pump, and sized to the flow, properties of slurry, and sedimentation rate. A discharge valve should be installed to provide flow control of the pump and isolate the pump (in conjunction with the suction valve) from the piping system. A discharge gauge must be installed in a vertical section of pipe between the pump discharge nozzle and the first valve on the discharge line. This gage will be an indicator of the pump performance. Without this gage it is difficult to determine how the pump is performing under load.

Stuffing Box Cover

Two different stuffing box covers can be provided. One version is for packing and expeller applications and the second version is provided for mechanical seal applications. Both stuffing box covers have ½ inch NTP ports to facilitate seal water in and out connections. A pressure gage and piping is provided to measure the sealing box pressure.

Stuffing Box – Packing Installation

IronMountain Model SPL and SPH pumps are packed at the factory. The packing gland is set at the factory finger-tight and may require adjustment during startup. Refer to section IV for stuffing box adjustment.

Connect pump with a supply of grit free clean water for packing lubrication. Shaft sleeve scoring, packing destruction, and mechanical seal face damage will result from contaminated lubricant. See section IV for the gland water supply requirements.

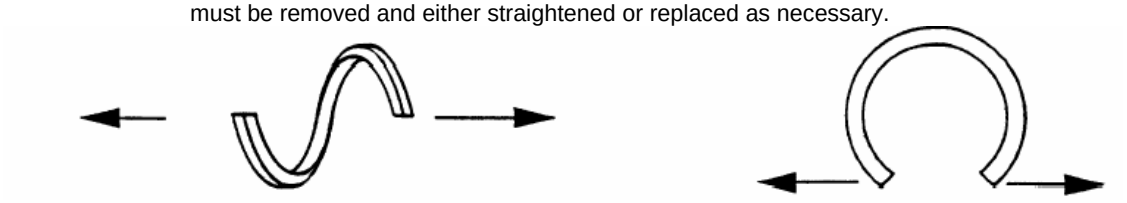
Packing Type

Original equipment packing is a suitable grade for the service intended.

Packing Procedure

- Stuffing box and shaft sleeve must be clean and free of grit and contaminates.
- Form packing over shaft of mandrel of same diameter. Carefully cut to packing length. Discard rings cut too short.
- Pre-form each ring by coiling 1.5 turns
- To install packing rings, expand the coil as a coil spring. See Fig 12A and 12B for the correct and incorrect method of installing packing. Note the location of the lantern ring prior to packing installation. The lantern ring and packing locations are different for the weep and flush arrangements. See sectional view Fig 3
- Expand the first coil as shown and insert into the stuffing box. Tamp packing into stuffing box shoulder firmly with the gland (See Fig. 5).
- NOTE: NOTE THE POSITION OF THE Packing Split.
- Install the second and third coil as required by the assembly drawing, staggering the cut between 90 and 120 degrees.
- Insert the lantern ring into the stuffing box carefully noting its proper position on the assembly drawing. **CAUTION**: Failure to properly locate the seal cage will result in insufficient packing lubrication. Packing and shaft sleeve damage may result. (See Table 5 for No. Rings & Packing size)
- After packing and lantern ring are properly installed, insert the gland into the stuffing box. Tighten gland nuts finger tight only. The shaft should turn freely.
- Turn lubricant supply on, start the pump and adjust the gland as described in the pump start-up procedure.

- Periodic maintenance is absolutely required for all packed pumps including pumps furnished with expellers. Normal shaft run out should be under 0.005 inches to avoid premature failure of stuffing box packing. If there is excessive shaft run out; the shaft must be removed and either straightened or replaced as necessary.



Correct Incorrect

Figure 5: Packing forming

Pump Model	1.5-SPL-19A	2-SPL-46B 3.5 SPL-36D 4-SPL-42F	2.5-SPH-39C	3.5-SPH-48E 4-SPH-50E	6-SPL-60G 6-SPH-74H 8-SPL-60G 8-SPH-74H	10-SPL-65J	10-SPH-74K 12-SPH-76K	12-SPL-56L 12-SPL-65M
Size X Length (in)	5/16-7.40	1/2X13.74		5/8-16.46	3/4-20.40	3/4-20.91	7/8-26.97	3/4-22.22
Size X Length (mm)	8x188	13x13x349		16x16x418	19x19x518	19x19x518	20x20x685	19x19x518
No. Pkg Rings w/Expeller	N/A	4		4	4	4	4	4
No. Pkg Rings w/o Expeller	4	5		5	5	5	5	5

Table 5: Packing size and Number of Rings

Packed Box or Expeller Installations:

Packed Box Seal Water Piping

The stuffing box is supplied with water connections for two packing configurations. The attached illustration shows these two alternative configurations. Verify that the lantern ring is properly positioned to accept the flush water.

Do not over tighten the gland nuts. Over tightening packing causes excessive friction between the packing and the sleeve and will result in damaged components

The flush water requirements and packing dimensions are listed in Table 5 for all packing arrangements.

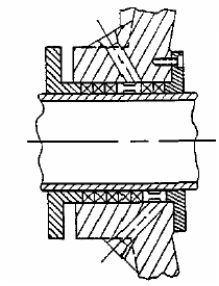


Fig 3: Weep &

Model	Flush Water GPM
1.5SPL-19A	7.56
2.5SPH-39C	7.93
2SPL-46B	7.93
3.5SPH-48E	11.1
3.5SPL-36D	7.93
4SPH-50E	11.1
4SPL-42F	7.93
6SPH-74H	19.02
6SPL-60G	19.02
8SPH-74H	19.02
8SPL-60G	19.02
10SPH-74K	19.02
10SPL-65J	19.02
12SPH-76K	19.02
12SPL-56L	19.02
12SPL-65M	19.02

To cover all possible situations, the gland water source should be capable of supplying water at a pressure approximately equal to the pump discharge pressure. Depending on the conditions of service, the required box pressure may be somewhat less. A valve should be installed in the gland water line to limit pressure to the optimum for the actual conditions of service. Excessive pressure will increase water consumption, gland water leakage and shaft sleeve wear.

Full Flow Seal Water

A full flush box will yield the best protection for abrasive applications.
The flush water should be turned on before pump is started and left on for 3 minutes after pump is stopped to flush out solids from the packing box.

Some units may be supplied with an expeller and grease packed stuffing box. For these situations, the weep style arrangement is normally used in conjunction with a grease cup or weight loaded greaser. Periodic maintenance is absolutely required for all packed pumps

Table 1: Flush Water Requirements

Pipe plugs are installed in the stuffing box water connections when the pump is shipped from the factory. Remove the plugs, install piping and supply fluid at a minimum 15 PSI above discharge pressure to the stuffing box water inlet port.

The higher pressure sealing water prevents ingress of abrasive pumpage into the stuffing box. If abrasive pumpage is allowed in the stuffing box it will cause premature failure of the shaft sleeve and packing. Therefore, even when the pump is shut down, the sealing water must be left on unless the pump isolated from the suction and discharge lines.

Carbon fiber with Teflon penetrated packing is recommended. When packing the pump the packing dimensions must be consistent with the space between the sleeve and the stuffing box bore and sized per the Table 1 below. Packing should be cut at a 120 degree angle between the adjacent surfaces.

Mechanical Seal Installations: Figure 3 shows a typical double seal installation with the mechanical seal stuffing box cover. For the mechanical seal installation, the stuffing box in and out connections at the box are plugged at the factory. Remove the pipe plugs, install piping and supply fluid to the stuffing box—minimum 15 Psig above discharge pressure.

Pressure and flow rate of the seal water are shown in the table below:

		Sealing Fluid Flow (GPM)			
Sealing Method	**Sealing Water Pressure**	**1/4" NTP**	**3/8" NTP**	**1/2" NTP**	**5/8" NTP**
Expeller with Packing (Single Stage) (GPM)	Pi = 0.5 *P	4 to 6	6 to 8	8 to 12	12 to 20
Packed Box (GPM)	Pi = (NS-1/3)*P	4 to 6	6 to 8	8 to 12	12 to 20
Packed Box (Full Flow) GPM)					
Mechanical Seal (GPM)	Pi = (NS-1/3)*P	4 to 6	6 to 8	8 to 12	12 to 20

Table 2: Seal Water Pressure and flow rate

Fig 4: Typical Double Mech Seal Installation: P = Discharge pressure of single-stage pump
NS = Number of stages
Pi = Shaft seal pressure of 1st stage pump

Do not start pump without seal water for all mechanical seal applications. Seal failure will occur is less than 10 seconds. Mechanical Seal startup instructions need to be followed carefully:

- Double mechanical seals stuffing box covers have two NTP tapped ports. Standing at the shaft end of the pump; the port on the left is the seal cooling water inlet, and the one on the right (the same side with discharge of pump) is the seal water outlet port. Connect the ports to a clean grit free water supply. Shaft sleeve scoring, packing destruction, and mechanical seal face damage will result from contaminated water lubricant.
- The seal water must be turned on prior to starting a pump with a double mechanical seal installed and the seal water must continue to run for 3 minutes after the pump has been stopped. This is to allow proper cooling to the seal faces. Seal failure can and probably will occur if this procedure is not followed.
- Should a pump with a mechanical seal be not operated for a long period of time, the stuffing box between the seal faces should be filled with No. 46 oil to help protect the mechanical seal from damage.

Drain Piping: All drain connections should be piped to the suction well or other means of disposal so that the flush water will carry away from the installation site.

ALIGNMENT:

V – Belt Drive – Alignment

WARNING

UNITS MUST NOT BE OPERATED WITHOUT PROPER DRIVE GUARDS IN PLACE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN PERSONAL INJURY TO OPERATING PERSONNEL.

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CAUTION: Prior to installing belts check motor rotation is correct. This is imperative due to possible severe damage to equipment if the rotation is incorrect.

Overhead Mount Configuration CV: The electric motor is frequently bolted to an overhead motor support for belt driven pumps. The support is constructed of fabricated steel, with four jacking bolts to change the center distance between the motor and pump sheaves. This configuration is utilized for space saving considerations as it has the smallest footprint.

Base Mounted Belt Drive Z: The motor is bolted to a common baseplate and the motor shaft is offset either horizontally or vertically from the pump shaft to allow for installation of a belt drive.

In either case similar methods are utilized for installing the belt drive.
Care must be exercised in the assembly of the drive arrangement. Sheave misalignment can cause excessive heat premature bearing failure and belt wear.

The following installation process is required for a reliable and efficient drive installation:

1. WARNING — **Disconnect and "Lock Out"** the power from the pump drive using **safety procedures** set up at the installation site. **DO NOT INSTALL BELTS PRIOR TO ROTATION CHECK**
2. Bolt the drive motor to the slide base.
3. Using the four jacking bolts, move the slide base into its bottom position.
4. Install sheaves on shafts and align sheaves faces using a straight edge—see Fig 5
5. **Connect the power to the motor and check motor rotation to insure it conforms to the arrow located on the front of the pump casing.**
6. Install belts and set belt tension by adjusting slide base with jack bolts. Recheck the sheave face alignment.
7. Lock the four jack bolts with the adjustable lock nuts.
8. Rotate the sheaves by hand to ensure that the pump impeller is free to move in the pump casing.
9. Install sheave/belt guard
10. Check belt tension after the pump is shut down. (See Figs. 6-7)

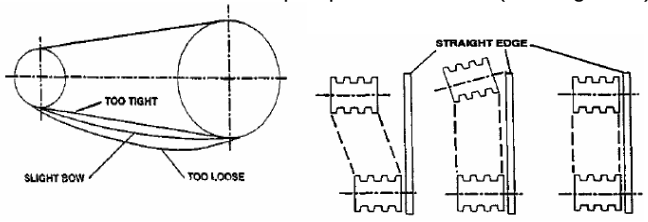


Fig 6 &7:
Belt Tension Sheave Align **Wrong** **Wrong** **Correct**

Direct Connect Drive – Alignment

If the pump assembly is provided as direct connected then the coupling has been shipped unassembled to prevent starting the pump until rotation has been checked.

Important: The motor must be bumped and checked for the correct rotation, the piping connected to the pump, and the pump mounted on the foundation prior to aligning the couplings and connecting the pump with the motor. The correct pump rotation arrow is cast into the front casing.

If the rotation is incorrect and the pump is started the impeller can come off the shaft possibly causing catastrophic failure of the unit. The motor rotation must be reversed prior to connection of the coupling.

Alignment:
The preferred procedure when aligning couplings is to use a laser alignment device.

Other procedures in order of accuracy are as follows:
Fig. 6: Alignment with Dial Indicator

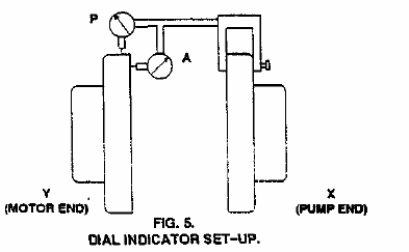


FIG. 5.
DIAL INDICATOR SET-UP.

Dial Indicator Procedure: A good method for final alignment of the coupling halves is with a dial indicator. The following is the procedure.

1. Move the driver as required, including shimming front or back until the coupling faces are parallel.
2. Bolt the indicator to the pump half of the coupling. With the button resting on the other coupling periphery, set the dial to zero and chalk mark the coupling half at the point where the button rests. For any check, top or bottom or sides, rotate both shafts by the same amount. i.e. all readings on the dial must be made with its button on the chalk mark.

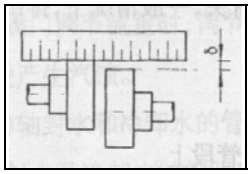
The dial readings will indicate whether the driver has to be raised or lowered or moved to either side. After any movement, check that the coupling faces remain parallel to one another.
EXAMPLE: If the dial reading at the starting point is set to zero and the diametrically opposite reading at the bottom or sides shows a plus or minus .020 inches, then the driver has to be raised or lowered by shimming or moved to one side or the other by half of this reading.

NOTE: for all checks including that for parallelism of coupling faces, keep both shafts pressed hard over to one side when taking the readings.

Straight Edge Procedure: The procedure followed when checking driver and driver shaft alignment is as follows:

1. Place a straight edge across the top and side of the coupling, and at the same time check the faces of the coupling halves for parallelism by means of a tapered thickness gauge or feeler gauges.

2. Assuming the peripheries of the coupling halves are true circles and of same diameter and the faces are flat; exact alignment exists when the distance between the faces is the same at all points and the straight-edge will lie squarely across the rims at any point. If the faces are not parallel, the thickness gauge or feeler gages will show a variation at different points. If one coupling is higher than the other, the amount may be determined by the straight-edge and feeler gauges.



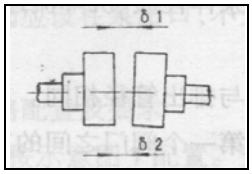


Fig 7 & 8: Alignment with Straight Edge method:

Maximum coupling life with a minimum of maintenance may be obtained if the coupling is aligned properly at installation. Generally, permissible angular and parallel misalignment is .005 inches for motors up to 75 BHP and .010 for motors above 75 BHP.

Spaces between faces of couplings and the ends of shafts should be set that they cannot touch, rub or exert a pull on either pump or driver. The amount of this clearance may vary with the size and type of coupling used. The best rule to follow is to allow sufficient clearance for unhampered endwise movement to the limit of its gearing clearance. On motor driven units, the magnetic center of the motor will determine the running position of the motor half coupling. It is recommended that the magnetic center position be checked by operating the motor while disconnected from the pump. At this time, check also the direction of rotation of the motor. If current is not available, move motor shaft in both directions as far ass the bearings will permit then adjust shafts centrally between these limits, thereafter assembling the unit with the correct gap between coupling halves.

When the unit is accurately leveled and aligned the holding down bolts should be gently and evenly tightened prior to grouting.

IMPORTANT: Alignment must be rechecked, after suction and discharge piping have been bolted to the pump, to test the effect of piping strains. When handling hot liquids, the nozzle flanges, after the unit has been in service, should be disconnected to check in which direction the expansion of the piping is acting, correct for the effect of strains as required.

Accurate alignment of the pump shaft and driving unit shaft or pulley is essential for satisfactory operation. A flexible coupling will not compensate for misalignment of pump and drive shafts. Misaligned pulleys will cause excessive V-belt wear.

TABLE 2
ALIGNMENT TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
Cannot obtain horizontal (Side-to-Side) alignment, angular or parallel.	Driver feet bolt bound.	Loosen pump hold down bolts and slide pump and driver until horizontal alignment is achieved.
	Baseplate not leveled properly, probably twisted.	Determine which corner(s) of the baseplate are high or low and remove or add shims at the appropriate corner(s) and realign.
Cannot obtain vertical (Top-to-Bottom) alignment, angular or parallel.	Baseplate not leveled properly, probably bowed.	Determine if center of baseplate should be raised or lowered and correct by evenly adding or removing shims at the center of the baseplate.

Table 6: Troubleshooting Alignment

SECTION III – PUMP PREPARATION FOR START-UP

Pump Support

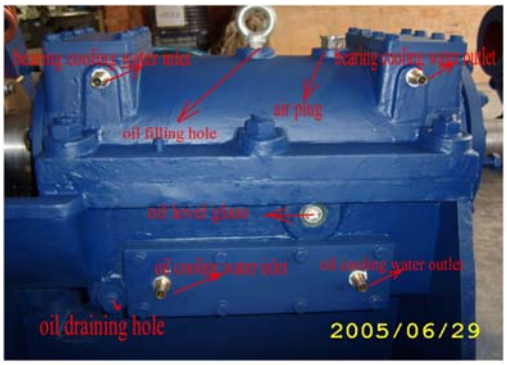
Prior to starting a new pump, check the pump foundation and piping to be certain that the installation conform to the specifications in Section II Installation Instructions.

Bearing Lubrication

Turn pump shafts to fill bearings and all reservoirs in the bearing housing. Check oil level indicator and add oil accordingly. Oil level indicator is a bull's eye located on the left side of the bearing housing when viewed from the shaft end. **CAUTION**: **Do not over fill above the center of the bull's eye type oil level indicator.** Monitor oil level indicator for the first 24 hours of operation and maintain fill level.

Both Bearing Cooling and Oil Sump Cooling are provided as standard for the 6 inch discharge and larger SPL & SPH pumps.

- Cooling water can be provided to both the line and thrust bearings. Connections are ½" NTP and can either be piped in place by the customer or flexible hoses can be used. See Fig 10.



- Oil sump cooling provisions are also provided with ½ inch NTP connections. See Fig 10.

Fig. 10 Bearing frame accessories 6" discharge and larger

Bearing Cooling Water Bearing & Oil Cooling water pressure: (7-30 PSIG)
Quantity of Bearing & Oil Cooling Water: (4-12 GPM)

WARNING

OPERATION OF THE UNIT WITHOUT PROPER LUBRICATION CAN RESULT IN OVERHEATING OF BEARINGS, BEARING FAILURES, PUMP SEIZURES, AND ACTUAL BREAKUP OF EQUIPMENT, EXPOSING OPERATIONAL PERSONNEL TO POSSIBLE INJURY.

The viscosity of the oil should be 150 SSU at the operating temperature to prevent accelerated bearing wear.
For the best results, the minimum oil viscosity should be maintained as shown in Table 7 below.

MINIMUM MAINTAINED OIL VISCOSITY

Operating Temperature	Suggested Turbine Oil	Suggested Lubricating Oil
0-160 F	No. 32 Winter and Cold Weather	SAE 40
161-180 F		SAE 50 or 90
181- 210 F	No. 48 Summer and Hot Weather	SAE 140

Table 7: Oil Viscosity

Industrial type petroleum based rust and oxidation inhibited oil or synthetic lubricants are recommended. Use of oil with extreme pressure additive is optional.

Oil level must be checked and filled prior to starting pump. The oil level bull eye sight glass is located on the left side of the bearing frame as viewed from the shaft end. The oil should be filled through the oil fill plug which is located at the top of the bearing frame. Unscrew the lifting eye. This is also a good time to check that the vent is clear of foreign materials. Fill the oil up to but not over the red line. (See Figure 10)

Shaft Rotation

CAUTION: Be sure to check motor rotation is correct prior to installing belts or connecting couplings. This is imperative due to possible severe damage to equipment if it is started up backwards. **Correct pump rotation is indicated with arrow cast into the front of the pump casing.**

WARNING

UNITS MUST NOT BE OPERATED WITHOUT PROPER DRIVE GUARDS IN PLACE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN PERSONAL INJURY TO OPERATING PERSONNEL

Impeller Adjustment Procedure (Fig. 11)

The pump flow and discharge head will decrease as wear occurs between the impeller and the front wear plate. To maintain optimum pump performance and minimize the effects of wear, the impeller clearance should be adjusted periodically as indicated by pump performance.

The Clearance between the impeller and front liner must be adjusted in time to maintain **.03 -.06 in** (0.75 to 1.5mm) for the pump to operate at its best efficiency. The following is the procedure for impeller adjustment:

Fig. 11 Impeller adjustment

WARNING

Do not attempt to adjust the impeller with the pump running. **Stop the pump and lock out the motor** before adjusting impeller clearance.

SPL:

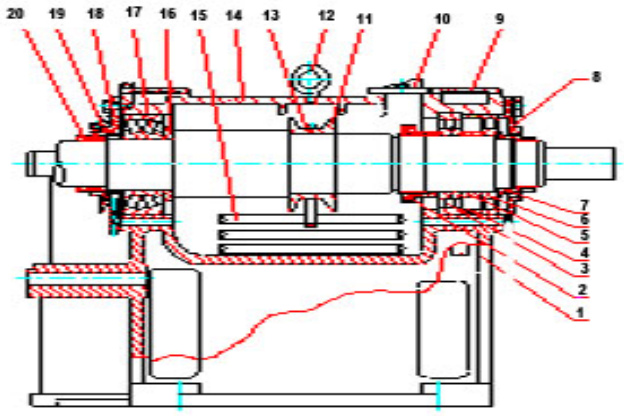
To reduce the clearance between impeller front wear plate:

1. Loosen all adjusting bolts on the rear bearing cover.
2. Tighten all adjusting nuts, this allows the impeller to move forward until proper clearance is attained.
3. Tighten all adjusting bolts to maintain clearance.
4. Rotate shaft to insure all parts turn freely.
5. Restart the pump.

To increase the clearance between the impeller and front wear plate:

1. Loosen all adjusting nuts.
2. Tighten all adjusting bolts, this allows the impeller to move backward until the proper clearance is attained.

3. Tighten all adjusting nuts to maintain clearance.
4. Rotate shaft to insure all parts turn freely.
5. Restart the pump.



1. Bearing Frame
2. Bearing Locknut A
3. Radial Bearing
4. Oil Inlet Washer
5. Bearing Washer
6. Bearing
7. Bearing Locknut B
8. Bearing Cover, Drive End
9. Cooling Chamber Cover
10. Service Gate Cover
11. Oil Slinger
12. Lifting Eye-Oil Fill
13. Oil Ring
14. Frame Cover
15. Oil Cooler
16. Bearing Release collar
17. Thrust Bearing
18. Bearing Cover, Gland End
19. Water-Proof plate
20. Long Collar

SPH :

To reduce the clearance between impeller front wear plate:

1. Loosen adjusting nut B (7) by rotating it counter-clockwise.
2. remove the service gate cover (10)
3. Tighten adjusting nut A (2) to allow the shaft forward until the correct clearance is attained.
4. Tighten the adjusting nut B (7), and again tighten the adjusting nut A (2).
5. Replace the service gate cover (10).
6. Rotate shaft to insure all parts turn freely.
7. Restart the pump.

To increase the clearance between the impeller and front wear plate:

1. Open the service gate cover (10).
2. Loosen adjusting nut A (2) by turning counter-clockwise.
3. Tighten adjusting nut B (7) to allow the shaft to move back until the gap is correct.
4. Tighten the adjusting nut A (2), and again tighten the adjusting nut B (7).
5. Replace the service gate cover (10).
4. Rotate shaft to insure all parts turn freely.
5. Restart the pump.

Single stage Startup and Stop Procedure

1. After all other instructions in this manual have been completed the pump is ready to start.
2. Rotate shaft by hand to insure that impeller and shaft rotate freely. If necessary adjust impeller clearance.

3. Re-check suction pipe for length (should be as short as possible). The diameter of suction pipe should not be less than the pump suction diameter. No air leaks in line and minimum number of bends.
4. Inspect shaft seal area.
   a. Expeller
      i. If oil Cup is fitted on box be sure it is filled with grease. Calcium-sodium base grease seems to work well.
      ii. If water sealed be sure water is connected and water is flowing at the correct pressure and capacity.
   b. Packed Box
      i. Be sure the water is turned on and it is the correct pressure and flow.
      ii. Be sure the water seal is connected to the connection best suited for the application. Pump can either be set up for full flow or weep options.
      iii. Adjust the bolts on the packing gland to be finger tight or just tight enough to restrict the flow of water. After run-in the leak rate should not be less than 1 drop per second to maintain proper sleeve lubrication.
5. Initially start the pump on clean water if possible.
6. Open the Suction valve all the way open.
7. Open the discharge valve to ¼ open.
8. Start the motor. Be sure it is running in the direction indicated by the arrow on the pump casing. Stop the pump immediately should it be running incorrectly.
9. Open the discharge valve until the design flow is reached.
10. Check the suction and discharge pressures, flow rate and motor amperage as well as leakage at packing gland. If packing is hot, loosen the gland bolts to increase the water flow out of the packing area.
11. During operation periodically check the motor amperage, suction and discharge pressure and quantity of sealing water coming out of the stuffing box. Continually adjust packing gland over the first two days of operation to get to around 1 drop/second.
12. Periodically check bearing temperatures while pump is in operation. An infrared temperature indicator works well for this application. If bearing becomes hot when pump shortly after the pump starts; stop the pump until the bearing cools then restart it. If the bearing continues to heat up, then the bearing assembly should be inspected.
13. In general, bearing heating is caused by contaminated lubrication. The bearing lubricant should be clean and filled only to the fill line. Do not overfill as it will also cause overheating. Lubricant quantity should be checked daily especially at first.
14. Pump performance and efficiency will reduce as the clearance between impeller and liner increases. Therefore, the clearance between impeller and liner should be adjusted in time in order to keep the pump operating at maximum efficiency. Wearing parts should be replaced when the pump performance can not meet the requirement.

Procedure for Single Stage Pump shutdown:

1. If possible clean water should be flushed through the pump 30 minutes prior to shutdown to clear the slurry out of the pump and line which will prevent settling and possible blockage of the line.
2. Turn off motor.
3. Close discharge valve
4. Close suction valve. This isolates the pump from the system and if pump was flushed with fresh water insures clean water inside the pump and stuffing box.
5. Turn off seal water and cooling water.
6. Disconnect power from pump if necessary.

Multistage Startup and Stop Procedure

IronMountain pumps are capable of 4 stage series operation. These pumps are special construction and are specifically designed for the application. The following procedure must be followed in addition to the procedure outlined above in the single pump startup instructions.

WARNING **Do not use in Pumps in series unless approved by IronMountain engineering. Do not stop all staged pumps at one time with the discharge valve open.**

The discharge head of the pump is based on the pump operating in steady state with the pipeline full. If the pipeline is long and the discharge valves are opened full then the pump will initially see a

very low discharge pressure. This can cause large flows which can bring on cavitation and severe vibration which can cause catastrophic failure of the pump. Since operating a pump system in series normally involves very long pipelines the following startup procedure is recommended.

The maximum number of pumps that can be staged is 4. The actual number of pumps in the system is N

WARNING

Insure that all instructions contained in this manual and all other pertinent installation and other regulations regarding the complete system including piping have been met.

1. Close the suction valve on the first stage pump
2. Open all suction valves on remaining stage pumps
3. Completely open all discharge valves except the valve on the final stage pump.
4. Check to see packing adjustment is proper for the application. Do not over tighten.
5. Turn on the shaft seal water and cooling water to all pumps and make sure the seal water pressures are adjusted correctly for each pump.
6. Open the suction valve to the first stage pump.
7. Start the first stage pump. Open the discharge pump gradually to approximately $1/N^{th}$ of the design flow
8. When you estimate that the slurry has filled the pipeline to approximately $1/N^{th}$ of the length of the total discharge line start the second pump.
9. Open the discharge valve further to approximately 2/Nth.
10. When you estimate that the slurry the pipeline is 2/Nth full start the third pump and open the discharge valve up to 3/N.
11. Continue in this order until the pipeline is filled with slurry and the pumps are running normally.
12. Adjust discharge valve to design flow.
13. After pumps are running confirm that the differential pressure for each pump is consistent with the design
14. Confirm that the motor amperage is equal to design conditions.
15. Check for abnormal sounds or vibrations.
16. Seal water consumption and leakage is stabilized to about 1 drop per second after run-in.
17. Bearing temperature is between 95-167 deg F (35-75 Deg C).
18. To stop pumps reverse the instructions.
19. Turn off seal water and cooling water as application dictates.

CAUTION: Water hammer can cause severe damage to pumps. Do not let conditions happen that can cause this phenomenon happen.

SECTION IV –ASSEMBLY AND DISASSEMBLY

Assembly of Pump Unit:

Shaft Assembly

1. Preheat Thrust bearings to approximate 80-100 deg C.
2. Install Thrust Bearing on shaft.
3. Install bearing spacer and locknut to fix bearing in place. Examine parallelism and roughness and two faces. Check up flexibility of rotation, rust, stain, and so on. Check up the end play for angle joint bearing and double self-aligning bearings. After finding the center of ball track, determine whether to add a washer to guarantee the standard end play of bearing.
4. Insure bearing rotates freely after locknut is in place.
5. Let bearing cool in room temperature only.
6. Warm Bearing housing to 80-100 deg C and install with oil seal.
7. Preheat Radial Bearing to approximate 80-100 deg C
8. Install Radial Bearing on Shaft.
9. Assemble O-Rings on bearing cartridge.

Bearing Frame Assembly for SPL

1. Clean and inspect all parts to the Bearing Frame.
2. After thoroughly cleaning the surface between the bearing frame cover and frame, add a gasket of the proper thickness to guarantee a +/- .015mm bearing holes fit.
3. Install the hexagonal oil drain plug.
4. Mark a red line through the center of the oil sight glass to indicate the fill line and install the sight glass.
5. For 6" and larger of SPL and all of SPH, install the cooler unit and chamber covers.
6. Lift the shaft assembly and install in the bearing frame. Install frame cover. Install two taper pins, studs and nuts to secure the bearing cover.
7. Add washer between the front radial bearing cover and bearing frame face. Install oil seal and tighten bolts
8. Measure the distance between the back bearing cover and bearing housing to insure spacing of 0.05-0.10 mm.
9. Install the oil seal in the cover and tighten bolts after adding the spacer between the bearing cover and bearing frame surface.
10. Install the water-proof plate and the impeller release collar. Be sure to use Grease or Never Seize on all threads for ease of disassembly.
11. Install impeller adjustment bolts and nuts in bearing housing.
12. Use a dial indicator with magnetic base to check TIR of .025mm maximum between the shaft centerline and bearing frame faces.

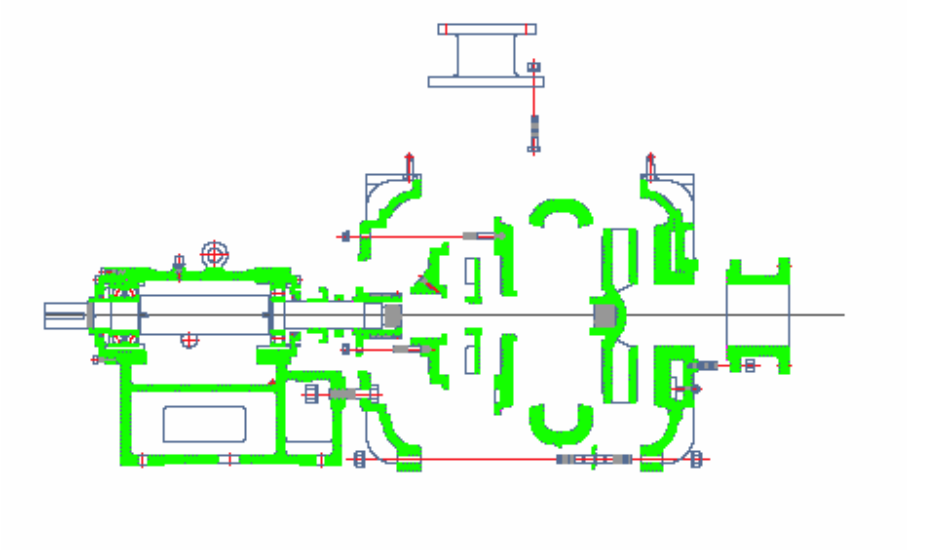
Bearing Frame Assembly for SPH

(see the drawing above for bearing assembly)

1. All elements and parts need to be cleaned and inspected for wear, corrosion and fitness for duty prior to assembly. Replace all bearings if any signs of wear or deficiencies are detected.
2. Install oil collar (15) in the frame and then cooling chamber cover (10) and lifting eye (12).
3. Put a gasket 0.2mm thick on the contact face between the frame and frame cover. Install the shaft with its belongings in the frame (1) **[** note: oil ring (13) must not slip out of the slinger (11) **]**. Install the frame cover and tighten.
4. Install front and read bearing covers (18 & 8)and their washers and tighten.
5. Install the long collar (20) on the shaft, then the water-proof plate (19) on the long collar (20), then fix them with 2 screws. (Note: These screws will be loosened when adjusting the impeller. After adjusting, tighten again)
6. Turn the adjusting nuts (2 & 7) to adjusting the shaft backward and forward till the shaft rests on the good location. Tighten the nuts.
7. Turn the shaft to insure it rotates freely.
8. Install the hexagonal oil drain plug.
9. Mark a red line through the center of the oil sight glass to indicate the fill line and install the sight glass.
10. The 6 inch discharge and larger pumps have oil coolers. Install the cooler unit and chamber covers.
11. Lift the shaft assembly and install in the bearing frame. Install the top half of the bearing frame cover.
12. Install two taper pins and install studs and nuts to secure the bearing housing cover.
13. Add washer between the front radial bearing cover and bearing frame face.
14. Install oil seal and tighten bolts
15. Measure the distance between the back bearing cover and bearing housing to insure spacing of 0.05-0.10 mm.
16. Repairs can be made to the depth of the cover to insure the spacing is correct.
17. Install the oil seal in the cover and tighten bolts after adding the spacer between the bearing cover and bearing frame surface.
18. Install the slinger and the impeller removal ring. Be sure to use Grease or Never Seize on all threads for ease of disassembly.
13. Install impeller adjustment bolts and nuts in bearing housing.
14. Use a dial indicator with magnetic base to check TIR of .025mm maximum between the shaft centerline and bearing frame faces.

Assembly outer casing and rear wear plate.

1. Position back casing onto the bearing frame and install bolts
2. Install o-ring on shaft sleeve and install shaft sleeve on shaft
3. Install Gland and lantern ring if required
4. Position stuffing box and install o-ring in slot.
5. Install expeller in front of stuffing box.
6. Install stuffing box o-ring.
7. Install studs in rear wear plate and lift with sling onto the rear casing by tightening fasteners.
8. Inspect the interval between the hole in the rear wear plate and impeller hub to insure clearance.



Assembly of Wet End

1. Using lubricating oil or never seize lubricate both the impeller threads on the shaft and impeller.
2. Mount the Expeller and Impeller on the shaft
3. Assemble Seal O-ring on rear wear plate.
4. Lift the volute onto the back liner being careful not to displace the Seal O-ring. Then tighten to finger tight 2 studs with locating plates. This will hold the impeller in place while the rest of the liquid end is assembled.
5. Center the top of the volute inside the inner casing so as there is equal spacing between the OD of the volute and the ID of the outer casing. Then tighten the locating plates to fix the position of the volute.

Assembly of the front outer casing and front wear plate:

1. Position the front outer casing on the floor in a horizontal position. Make sure the studs in the wear plate are tight. Locate the front liner in the front outer casing and tighten stud nuts.
2. Lubricate the Seal O-ring with heavy grease to help hold it in position and install the O-ring in the front wear plate.
3. Lift the assembled outer front casing and wear plate with the eyebolt provided at the top of the casing.
4. Position the casing, install the through bolts and tighten. Be certain that the volute is centered between the two outer casings.
5. Adjust the impeller clearance as described in this manual.

Installation of the Suction and Discharge Spool Pieces:

1. Position the 3mm thick gasket between the volute and the spool pieces. This gasket is used as a seal. Should the gasket thickness not be adequate provide a thicker gasket.
2. Tighten the Bolts.

3. In addition to the standard spool pieces provided with the pump it is suggested that a longer spool piece be installed in the suction piping to facilitate disassembly of the pump.

Assembly of additional components:

1. Install motor on base, connect power and check for proper rotation
2. Assemble coupling or sheaves and belts. All must have approved guards installed.
3. Install packing per instructions in this manual

Disassembly of Bearing Housing and Shaft Assembly

Disassembly is accomplished by following the assembly instructions in reverse.

SECTION V – CHECKLIST FOR TROUBLESHOOTING

Table 8: Troubleshooting Pump Performance

Symptom	Possible Cause	Remedy
Failure to Prime	Air leak at suction or stuffing box gland. Incorrect rotation of pump or impeller Suction pipe blockage	Seal air leak. Confirm direct of rotation Remove blockage
Excessive Power Consumption	Packing too tight. Packing damaged. Mechanical defects: Misalignment or unparallel shafts Speed too high Total system head lower than pump rating Pumpage has higher Sp. Gr. than rated	Loosen gland bolts to finger tight to start Remove burned packing Adjust impeller clearance, check for bent shaft, impeller rub, worn bearings, worn impeller and other wet end parts. Replace bearings and properly tighten belts Re-align motor and pump shafts Measure rotation speed and modify drive Control flow with discharge valve Recalculate total system head Measure Sp. Gr.
High Bearing Temperatures	Lubricant level too high or low Impurities in the lubrication Worn Bearings Misaligned or unparallel shafts Rubbing in pump ,impeller unbalance Improper bearing assembly Shaft seal water too high	Adding grease(oil) as requirement Replace with clean new lubricant Replace bearings Realign motor and pump shaft Remove rubbing ,balance impeller Replace bearing or refitting the bearing Reducing the pressure of shaft seal water
Excessive Stuffing Box leakage	Worn Packing Shaft sleeve worn Dirty sealing water	Replace packing with new Replace shaft sleeve Find source of clean seal water
Insufficient Capacity	Pump Not Primed Speed too low Total piping system head higher than pump rating Suction lift too great or insufficient NPSHa Impeller passages partially blocked Suction line partially blocked Wrong Direction of Rotation Mechanical defects: impeller worn or damaged Defective gasket causing leakage on suction side Pumpage viscosity too high	Check for Air leaks in suction line Measure actual pump speed Recalculate total system head & adjust discharge flow Recalculate NPSHa and compare to NPSHr of pump. Visually inspect impeller Measure suction pressure Visually Inspect and compare to arrow on pump Inspect impeller Utilize water to seal areas of concern Check viscosity of pumpage

Excessive vibration & noise	Worn Bearings Impeller imbalance Air or blockage in suction line Impeller is partially blocked or worn Foundation not sufficiently rigid Misalignment Bent Shaft Worn Bearings Insufficient NPSHa	Replace bearings Replace impeller or repair Bleed air out of line and/or remove blockage Remove blockage.

SECTION VI – REPLACEMENT PARTS

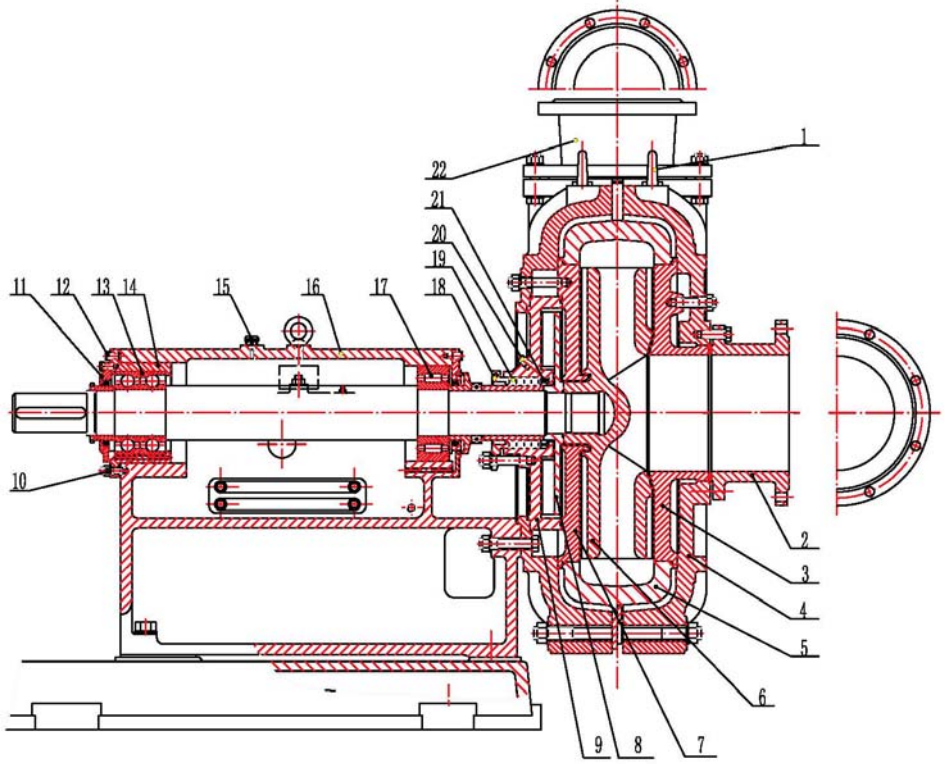
Ordering Replacement Parts

When ordering spare parts call 1-866-808-2950 or your local IronMountain representative. Repair orders will be handled with a minimum of delay if the following directions are followed

1. Provide the Model number, pump size and serial number at the time of order. This information can be obtained from the nameplate on the pump.
2. Write plainly the name and item number of each part required. These names and numbers should agree with those on the sectional drawing
3. Provide the quantity of parts required
4. Provide complete shipping and billing instructions

IRON MOUNTAIN

Sectional Drawing for SPL and SPH Slurry Pumps



1. lifting ring screw
2. suction spool piece
3. front wear plate
4. front casing
5. volute liner
6. impeller
7. rear wear plate
8. expeller
9. stuffing box
10. adjusting nut for impeller gap
11. front bearing cover
12. adjusting scew for impeller gap
13. bearing
14. bearing housing
15. air plug
16. frame cover
17. bearing
18. stuffing gland
19. packing
20. shaft seal water joint
21. lantern ring
22. discharge spool piece

SECTION VII – RECOMMENDED SPARE PARTS

To ensure against possible long and costly downtime periods, especially on critical services, it is advisable to carry in the user's inventory some spare parts. IronMountain suggests the following spare parts be kept on site by the customer

QTY	ITEM NO.	ITEM DESCRIPTION
1		Casing
1		Suction Side Wear Plate
1		Discharge Side Wear Plate
1		Impeller
1		Gasket (Impeller to Sleeve
1		Gasket Outer Casing to
1		Gasket Inner casing
1		Inboard Bearing
1		Outboard Bearing
1		Inboard Seal Outside
1		Inboard Seal iInside
1		Outboard Seal Outside
1		Outboard Seal Inside
1		Shaft
1		Misc

If pump is equipped with an expeller, additional recommended parts are:

QTY	ITEM NO.	ITEM DESCRIPTION
1		Gasket (Expeller to Impeller)
1		Stuffing Box Cover
1		Expeller

In place of the individual items, a complete bearing housing and shaft assembly may be substituted

SPECIAL NOTE: IN CASES WHERE PUMPS ARE FURNISHED WITH SPECIAL MATALS, DELIVERIES ARE QUITE LENGTHLY, IT IS THEREFORE ADVISABLE TO ANTICIPATE YOUR REQUIREMENTS SEVERAL MONTHS IN ADVANCE SO THAT POSSIBLE LONG DELIVERIES WILL NOT HANDICAP YOUR OPERATION

SECTION VIII – MAINTENANCE TIPS

Impeller Removal
Sleeve Removal
Bearing Housing Assembly

SECTION IX – SPECIAL TOOLS

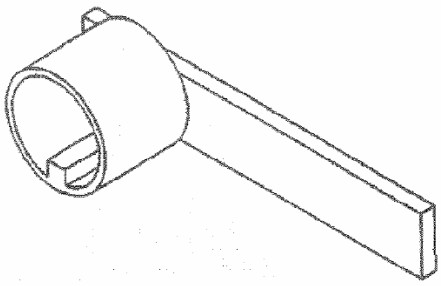


FIG. 11
SHAFT ROTATOR
(to install & remove impeller from casing)