OPERATION & MAINTENANCE MANUAL

For

Type HSC PUMPS

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Revision 2

SAFETY PRECAUTIONS

WARNING

Do not operate this equipment in excess of its rated speed or other than in accordance with the instructions contained in this manual.

The equipment has been found satisfactory for the conditions for which it was sold, but its operation in excess of these conditions may subject it to stresses and strains which it was not designed to withstand.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- avoid contact with rotating parts
- avoid bypassing or rendering inoperative any safeguards or protective devices
- avoid extended exposure in close proximity to machinery with high noise levels
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment
- do not modify this equipment – consult factory if modification is deemed necessary
- do not substitute for repair parts which can be provided by the equipment manufacturer.

Safe maintenance practices with qualified personnel are imperative.

Failure to heed this warning may result in an accident causing personal injury.

INITIAL INSPECTION

Upon delivery of the pumping unit verify that all items on the bill of lading are present. Also verify that the pump unit is not damaged. Immediately report any shortages or any damage to the Freight Company. List the damage or shortages on the bill of lading and the freight bill.

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SECTION I

GENERAL INFORMATION

This manual covers the installation, operation and maintenance of Patterson Pump Type HSC pumps. The pump is a centrifugal, single stage; single suction type furnished with mechanical seals. When properly installed and when given reasonable care and maintenance, centrifugal pumps should operate satisfactorily for a long period of time. Centrifugal pumps use the centrifugal force principal of accelerating the liquid within a rotating impeller, and then collecting it and converting it to pressure head in a stationary volute.

The pump consists of two assemblies:

1. Volute assembly or stationary part

2. Rotating element or moving part

The back pullout design allows for removal of the motor and integral rotating element without disturbing the suction and discharge piping. The suction and discharge nozzles are drilled and tapped for gauge connections. Pump casings are drilled and tapped for complete pump drain. Casing wear rings are provided as standard equipment.

SECTION II

STORAGE & PROTECTION

All pumps are shop serviced and ready for operation when delivered, but there are occasions when considerable time elapses between the delivery date and the time the pump is put into operation. Equipment which is not in service should be kept in a clean, dry area. If equipment is to be stored for long periods of time (six months or more), the following precautions should be taken to insure that the equipment remains in good condition.

1. Unpainted-machined surfaces, which are subject to corrosion, should be protected by some corrosive resistant coating.

2. The shaft should be rotated 10 to 15 revolutions by hand periodically in order to spread the lubricant over all the bearing surfaces. Suitable intervals are from one to three months, depending on atmospheric conditions, etc. In order to insure that the pump shaft does not begin to sag, do not leave the shaft in the same position each time.

3. Space heaters on motors and controllers should be connected and fully operable if atmospheric conditions approach those experienced in operation. Consult instruction manuals for other precautions concerning storage of individual components of pumping unit.

4. Fresh lubricant should be applied to bearings upon removal of equipment from storage.

SECTION III

INSTALLATION

3-1 Location:

Several factors should be considered when selecting a location for the pumping unit (pump and drive). The unit should be accessible for both inspection and maintenance. Headroom should be provided for the use of crane, hoist or other necessary lifting devices. The pump should be located as close as possible to the liquid supply so that the suction line is short and direct. Location should require a minimum of elbows and fittings in the discharge line to minimize friction losses. The unit should be protected against flooding.

3-2 Mounting:

Pumps can be mounted on steel bases, raised concrete pads or floor as long as the mounting surface is level. The mounting surface must be solid and rigid enough to support the pump unit without deflection or vibration. To facilitate the leveling of the pump use a spirit level and short pieces of pipe in the threaded nozzles to determine if the pump is level in all directions.

3-3 Alignment:

The pump unit has been manufactured to allow field alignment. The unit must be properly aligned at the time of installation. Reliable trouble-free and efficient operation of a unit depends upon correct alignment. Misalignment may be the cause of noisy pump operation, vibration, premature bearing failure, or excessive coupling wear. Factors that may change the alignment of the pumping unit are settling of the foundation, springing of the base plate, piping strains, a shift of the pump or drive on the foundation. When checking coupling alignment, remember flexible couplings are not intended to be used as universal joints. The purpose of a flexible coupling is to compensate for temperature changes and to permit end movement of the shafts without interference with each other.

Two types of misalignment may exist: parallel misalignment and angular misalignment. Limits of misalignments are stated in the coupling manufacturer's instructions, but should be kept to a minimum for maximum life of equipment components.

To check coupling alignment, the following procedure should be followed:

1. Set the coupling gap to the dimension shown on the coupling data sheet.

2. Check for parallel misalignment by placing a straight edge across both coupling halves at four points 90° apart. Correct alignment occurs when the straight edge is level across the coupling halves at all points.

3. Check angular misalignment with a feeler gauge at four points 90° apart. Correct alignment occurs when the same gauge just enters between the halves at all four points.

Angular and parallel misalignment are corrected by shifting the motor and adding or removing shims from under the motor feet. After each change, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustment already made in another direction.

The importance of correct alignment cannot be overemphasized. Alignment should be checked and corrected as required after:

1. Mounting
2. Piping is connected
3. Pump or driver is moved for any reason.

WARNING!!!

The importance of correct alignment cannot be overemphasized. The following procedure should be used for initial installation.

1. Mount pump assembly on steel base, concrete pad or floor and tighten bolts evenly, but not too tight..

2. At this point check alignment of the coupling. This should not be more than that recommended by the coupling manufacturer.

3. If misalignment is evident, determine which direction the coupling needs to be moved.

4. Loosen all nuts and add the shims underneath the driver to obtain final alignment.

Alignment should be checked and corrected as required after:

- Mounting
- Piping is connected
- Pump or driver is moved for any reason

3-4 Wiring and Controls:

The electric motor power supply connections must conform to national and local codes. The motor ratings stamped on the motor nameplate must match the line voltage and wire capacity**. DO NOT USE ANY OTHER VOLTAGE.**

SECTION IV

OPERATION

CAUTION:

Do not exceed the rated working pressure of the pump.

The sum of the suction pressure and the maximum pump operating head (converted to units of pressure) must be less than the pump working pressure, at all times.

CAUTION:

Do not exceed the pressure capabilities of the mechanical seals.

The pressure on the mechanical seals for this pump type is equal to the suction pressure.

The suction pressure must not exceed the rated working pressure of the mechanical seals.

4-1 Starting:

- Turn the pump shaft by hand to insure that the parts do not bind
- Open the valve in the pump suction line, if fitted
- Close discharge valve

- Prime the pump in one of the following ways:

1. If the pump operates under positive pressure, open vent valve on top of the pump casing. After all entrained air has escaped, close the vent valves. Rotate the shaft, if possible, to allow any air trapped in the impeller passages to escape.

2. If the pump operates on a suction lift and a foot valve is included in the system, fill the pump and the suction line with liquid from an outside source. Trapped air should be allowed to escape through the vent valve while filling.

3. If the pump operates on a suction lift and no foot valve is provided, use a vacuum pump or ejector operated by air, steam, water, etc. to evacuate air from the pump case and suction line by connecting the ejector to the priming connection on top of the pump case.

- Check direction of rotation before starting pump. Rotation should be the same as the direction arrow on the case.

CAUTION:

- Do not operate without liquid. Pump seals depend on the liquid being pumped for lubrication.

- Make sure pump is primed and that no air is in the suction piping and the pump case.

- Make sure all valves open or closed as required by your specific requirements.

Start driver:

Open discharge valve slowly when the pump is up to speed.

CAUTION:

Overheating and/or loss of prime will result if the pump is operated against a closed valve for more than a few minutes.

NOTE: Should the pump fail to build up pressure or discharge water when the discharge valve is opened, stop the pump and read **Section Locating Operating Difficulties**.

4-2 Shutdown:

The pump may be stopped with the discharge valve open without causing damage. However, in order to prevent water hammer effects, as a general recommendation the discharge valve should be closed first.

1. Close discharge valve.

2. Stop driver.

3. If danger of freezing exists, isolate the pump by closing a valve in the pump suction line, if fitted, and drain the pump completely.

SECTION V

MAINTENANCE

1. There should be no mechanical seal leakage except for a brief break in period. Mechanical seals should be replaced if they are leaking
3. **Refer to the motor manufacturer's instructions for periodic maintenance requirements.**
4. Check that electrical control equipment contacts are in good condition and clean.
5. Bearing relubrication requirements – refer to the table "**Pump Bearing Relubrication Requirements".** . Do not overlubricate the bearings.. Such action will cause bearings to overheat.
6. Refer to the "**General Pump Inspection and Maintenance Schedule**" for best results.

HSC Pump Bearing Relubrication Requirements					
	Pump Speed	Bearing Group Number*			
		1	2	3	4
Relubrication Interval*** (Operating Hours)	1000 RPM	20,000	20,000	19,000	15,000
	1200 RPM	19,000	18,000	15,000	12,000
	1500 RPM	15,000	14,000	12,000	9,000
	1800 RPM	12,500	11,000	9,000	7,000
	3000 RPM	7,500	6,500	5,000	3,500
	3600 RPM	5,000	5,000	4,000	2,000
Relubrication Amount of Grease	Ounces (cc)	¼ (8)	¼ (8)	3/8 (11)	3/8 (11)
	Number of Strokes**	8	8	12	12

*** The bearing group for a pump is the suffix in the model designation. For example, model S8A12A-3 uses bearing group 3.**

**** These values are for a typical grease gun having a capacity of 1 ounce (30 cc) of grease per 30 strokes. IMPORTANT - The number of strokes should be adjusted according to the actual grease gun used.**

***** These relubrication intervals are based on bearing temperatures up to 150 degrees F (65 degrees C), measured on the bearing housing. The intervals should be halved for every increase in temperature of 25 degrees F (15 degrees C), above 150 degrees F (65 degrees C), to allow for more frequent relubrication, but the maximum operating temperature for the grease used must not be exceeded. The bearings must also be relubricated more frequently when there is a risk of becoming contaminated, such as a dirty, dusty, or wet environment.**

Relubrication procedure:

1) Clean grease fitting and outside of bearing housing.

2) Remove drain plug.

3) Inject grease according to the table above.

4) Start and run the pump for a short time to allow any excess grease to purge.

5) Wipe off any excess grease that may have purged and replace drain plug.

General Pump Inspection and Maintenance Schedule
HSC Split Case Pumps

Excludes motors, VFD's, and controls.

Contact Patterson Pump Company if assistance is needed to determine the inspection and service requirements for a specific pump

Inspect (✔) or service (•) at the indicated calendar time or run time interval – whichever comes first	**4 hours**	**Routinely**	**Monthly**	**2000 hours or 3 months**	**4000 hours or 6 months**	**8000 hours or 12 months**
Unusual noise		✔				
Unusual vibration		✔				
Unusual temperature		✔				
Leaks in pump or piping		✔				
Pressure gauge readings		✔				
Visual inspection of equipment general condition		✔				
Anytime a pump is opened, inspect the running clearances and restore them to original specifications if the running clearances have doubled (install new wear rings)		✔ •				
Anytime a pump is opened, inspect the impeller for corrosion or excessive wear.		✔ •				
Mechanical seal (should be no leakage)		✔				
Drain lines are working properly		✔				
Coupling integrity		✔				
Operate the pump			✔			
Tightness of foundation and hold-down bolts				✔		
Check coupling alignment and integrity (maintain records)				✔		
Add grease to pump anti-friction bearings (maintain records)				•		
Check and flush seal water and drain piping						•
Perform a comparative field test (flow, pressures, and power) with calibrated instruments. Restore internal running clearances if results are unsatisfactory (install new wear rings).						✔ •
Perform a comparative vibration test						✔
Inspect sleeves. Replace if worn.						✔ •
Realign coupled pumps (maintain records)						•

SECTION VI

REPAIRS AND REPLACEMENT

WARNING!!!

Whenever any disassembly work is to be done on the pump, disconnect the power source to the driver to eliminate any possibility of starting unit. It is advisable that a qualified Pump service technician does the disassembly and reassembly of the pump.

6-1 To Remove Rotor:

Reference: Pump Assembly Section

1. Remove coupling guard and disconnect coupling halves.
2. Disconnect any piping from the upper half casing (1B) that will interfere with its removal.
3. Remove bolting from the casing parting flanges and bearing caps. Remove the bearing caps
4. Loosen and remove all three screws in each mechanical seal gland (17).
5. Remove alignment pins between the upper and lower casing halves (1A & 1B).
6. Remove upper casing half (1B) by lifting straight up until clear of the impeller.
7. Place slings around the shaft near the bearing locations and lift the rotating element from the lower casing (1A).
8. Place rotating element in a clean, dry work area for necessary disassembly. Case wear rings (7) will be loose on assembly.

6-2 Disassembly of Rotating Element:

1. Remove the case wear rings (7) that will be loose on the assembly.
2. Remove the screws holding the bearing housings (31 & 33) to the bearing covers (37).
3. Remove bearing housings (31 & 33), exposing bearings (16 & 18). There is a bearing spacer (78) that is a loose part in the outboard bearing housing (33). This will be needed at reassembly of the pump.
4. Remove the outboard bearing retaining ring (18A).
5. Remove the bearings (16 & 18) from the shaft (6).
6. Remove the bearing covers (37) from the shaft (6).
7. Remove the glands (17) and mechanical seals (65) from the shaft (6).
8. Remove the shaft sleeve retaining rings (14A) and shaft sleeves (14).
9. Remove the impeller (2) from the shaft (6), noting the rotation direction of the impeller vanes relative to the coupling end of the shaft, for reassembly later.

6-3 Cleaning:

WARNING!!!

Petroleum based cleaning solvents are flammable. Smoking or open flames in the vicinity of these solvents is extremely hazardous and must not be permitted. Disregarding this warning could result in grave personal injury.

Clean all metal parts with a solvent. Use a bristle brush (not metal or wire) to remove tightly adhering deposits. A fiber scraper may be used to remove the gasket and shellac from casing flange. Blow dry with clean dry compressed air.

CAUTION:

Never use hydrocarbon liquids (oil or solvent) to clean mechanical seal parts. Use of oil or solvent will deteriorate material used on the seal.
Use mild soap solution to clean seal parts. Use only your finger to remove dirt. Rinse with clean water and dry with mild air stream. Use care not to damage or scratch lapped surfaces.

6-4 Inspection:

Visually inspect parts for damage affecting serviceability. Check o-rings and gaskets for cracks, nicks, or tears; packing rings for excessive compression, fraying or shredding, and embedded particles. Replace if defective in any way. Mount shaft between lathe centers and check eccentricity for entire length of the shaft. Eccentricity should not exceed .002 inches (0.05 mm). Bearing surfaces should be smooth; shoulders square and free of nicks.

Measure OD of impeller hub and ID of pump casing. Compute diametrical clearance (ID minus OD) and compare with the original pump specifications. Surfaces must be smooth and concentric. Examine impeller passages for cracks, dents or embedded material. Examine shaft sleeves for wear.

6-5 Reassembly:

The following should prove helpful in reassembling the pump:

1. All parts, inside and out, should be clean. Dirt and grit will cause excessive wear, plus needless shutdown.

2. Install the impeller key (32) and impeller (2) onto the shaft (6). Double check for correct rotation.

3. Lubricate the O.D. of the shaft sleeve (14) and the I.D. of the opposite half of the mechanical seal (65) using **International Products P-80 Emulsion Temporary Assembly** Lubricant or equivalent (available from International Products Corporation, 201 Connecticut Dr, Burlington NJ 08016 USA, phone 609-386-8770, Fax 609-386-8438, http://www.ipcol.com, mkt@ipcol.com). Press the shaft sleeve (14) through the mechanical seal (65). Coat the interior of the shaft sleeve (14) with **Dow Corning 732 Multi Purpose Sealant or equivalent**. Repeat for other side.

4. Install the sleeves (14) onto the shaft (6) and install retaining rings.

5. Press the mechanical seal faces (65) into the glands (17) and install O-Rings. Lubricate O-rings using **International Products P-80 Emulsion Temporary Assembly Lubricant** or equivalent.

6. Assemble the glands (17) onto the shaft (6).

7. Press the lip seals (89) into the bearing covers (37) and install the covers (37) onto the shaft (6).

8. Press the bearings (16 & 18) onto the shaft (6).

9. Install the bearing spacer ring (78) into the outboard bearing cartridge (33) and the seal (89A) into the inboard bearing cartridge (31).

10. Install the cartridges (31 & 33) onto the bearings (16 & 18) and fasten them to the bearing covers (37).

11. Install the dowel pins into the case rings (7) and slide onto the impeller (2).

12. Lower the rotating element into the lower half casing (1A). Note: Align the grooves in the O.D. of the cartridges (31 & 33) with the machined side of the casing. This centers the impeller in the volute. Align the thru holes in the cartridges (31 & 33) and glands (17) with the holes in the casing (1A & 1B).

13. Start the socket head cap screws to hold the glands (17) into the casing (1A & 1B) in the hole located at bottom dead center. (There are drilled holes in the cartridges for access to these cap screws). Tighten and then back off one half round.

14. Before placing the parting flange gasket (73) into position, place a 1/8" tp 3/16" bead of **Permatex Ultra Blue RTV Silicone Product No. 77B** or equivalent sealant on the parting flange inside the perimeter of parting flange bolt locations and adjacent to the hydraulic passages.

15. Place the parting flange gasket (73) into position onto the lower casing half (1A).

16. Before placing the upper casing half (1B) into position, place a 1/8" to 3/16" (3 to 5 mm) bead of **Permatex Ultra Blue RTV Silicone Product No. 77B** or equivalent sealant on top of the parting flange gasket inside the perimeter of parting flange bolt locations and adjacent to the hydraulic passages

17. Lower the upper half casing (1B) into position. Install alignment pins at the casing parting flange joint.

18. Install and tighten all three screws in each gland (17).

19. Install case parting flange bolts and tighten.

20. Install bearing caps. Insert alignment pins into bearing cartridges (31 & 33). (Drill cartridges for pins if new.)

21. Torque all parting flange bolts, including the bearing cap bolts using the following appropriate dry torque values according to the bolt size:

    ½" – 75 to 90 ft-lbs (10 to 13 kgf-m)
    5/8" – 150 to 180 ft-lbs (21 to 25 kgf-m)
    ¾" – 260 to 300 ft-lbs (36 to 42 kgf-m)

22. Install all fittings and tubing that were removed.

23. Rotate by hand to insure that the parts do not bind.

LOCATING OPERATING DIFFICULTIES

In the majority of cases, operating difficulties are external to the pump and the following causes should be carefully investigated before undertaking repairs:

No Water Delivered

- Pump not primed – indicated by no pressure on discharge.

- Speed too low – indicated by low pressure on discharge.
- Valve closed – indicated by high discharge head.
- Impeller completely plugged up – indicated by low discharge pressure.

Abnormally Small Quantities Delivered

- Air leaks in suction pipe or stuffing boxes.
- Speed too low.
- Discharge head higher than anticipated.
- Impeller partially plugged up.
- Obstruction in suction line.
- Mechanical defects: Impeller damaged, casing or seal defective.

Insufficient Pressure

- Speed too low. Might be caused by low voltage or current characteristics different from nameplate reading on the motor.
- Air in water will cause the pump to make a cracking noise.
- Mechanical defects: worn casing rings, impeller damaged, defective casing or seal.

Intermittent Operation

- Leaky suction line.
- Water seal plugged (hence, a leaky stuffing box).
- Suction lift too high.
- Air, gas or vapor in liquid.

Pump Overloads Driver

- Speed too high.
- Head lower than rated, hence, pumping too much water. (This is valid for low specific speed pumps).
- Mechanical defects: stuffing boxes too tight, shaft bent, rotating element binds.
- Rubbing due to foreign matter in the pump between the case ring and the impeller.

Pump Vibrates

- Misalignment.
- Foundation not sufficiently rigid.
- Impeller partially clogged.
- Mechanical defects: bent shaft, rotating element binds, bearings worn, coupling defective.
- Suction and discharge pipes not anchored.
- Pump cavitating from too high a suction lift.
- Air entrainment in the pump suction due to low submergence.

RECOMMENDED SPARE PARTS FOR HVES PUMPS

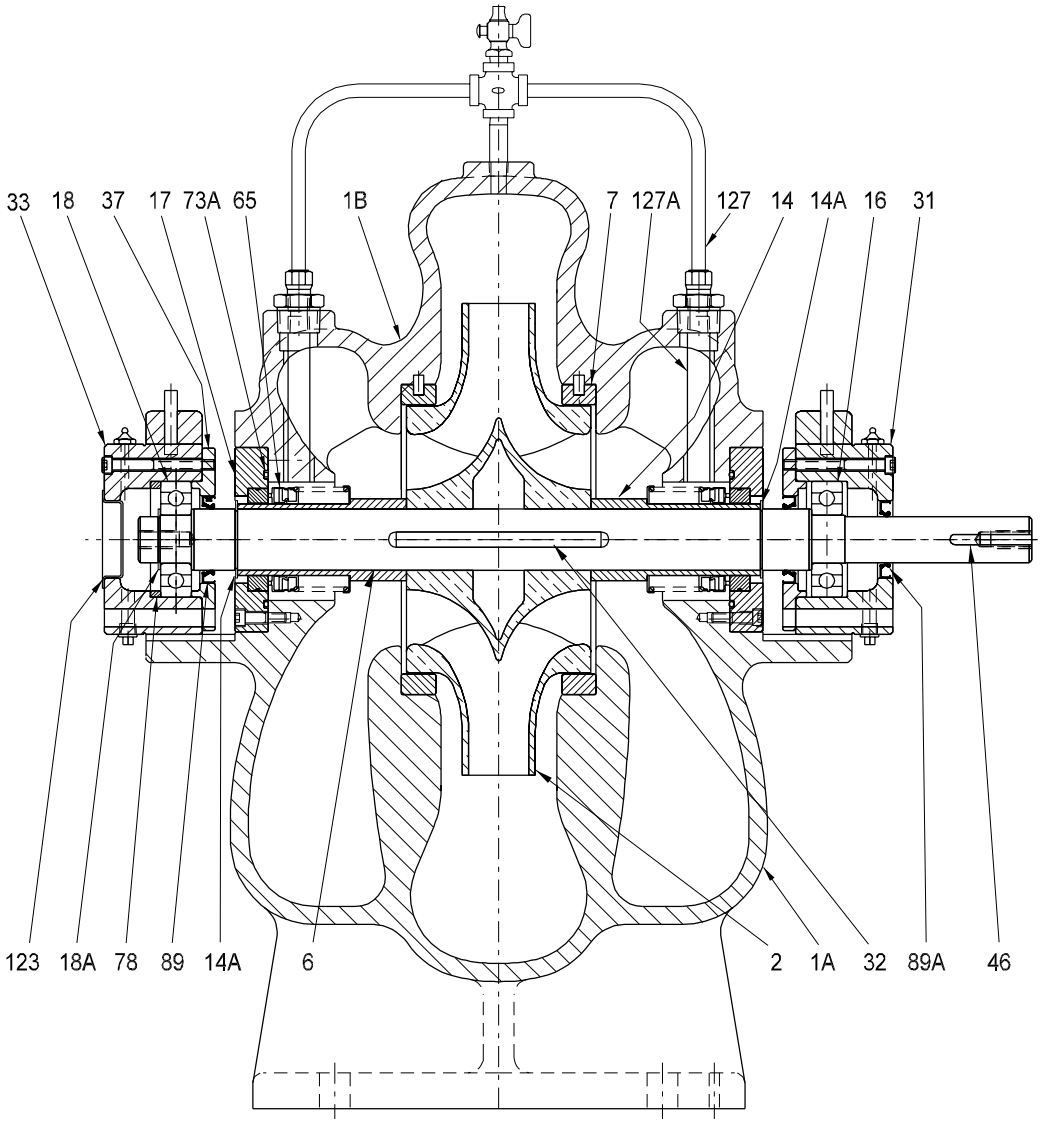
Reference: Assembly Section

INTERMITTENT DUTY

Number	Description
7	Casing Ring
14	Shaft Sleeve
65	Mechanical Seal
	Set of gaskets and O-Rings
	Coupling and its accessories (not shown)
	Permatex Ultra Blue RTV Silicone Product No. 77B or equivalent sealant
	Dow Corning 111 Valve lubricant & Sealant or equivalent
	Dow Corning 732 Multi Purpose Sealant or equivalent

CONTINUOUS DUTY

Number	Description
2	Impeller
6	Shaft
7	Casing Ring
14	Shaft Sleeves
16	Bearing (inboard)
18	Bearing (outboard)
	Bearing Retaining Rings
	Shaft Sleeve Retaining Rings
65	Mechanical Seal
	All Hardware (not shown)
	Set of gaskets and O-Rings
89 & 89A	Set of Lip Seals
	Coupling and its accessories (not shown)
	Permatex Ultra Blue RTV Silicone Product No. 77B or equivalent sealant
	Dow Corning 111 Valve lubricant & Sealant or equivalent
	Dow Corning 732 Multi Purpose Sealant or equivalent



Typical Assembly Section, Type HSC

ITEM	DESCRIPTION	MATERIAL	ITEM	DESCRIPTION	MATERIAL
1A	LOWER HALF CASING	Cast Iron - ASTM A48-CL30	31	INBOARD BEARING HOUSING	Cast Iron - ASTM A48-CL30
	LOWER HALF CASING (Opt)	Ductile Iron - ASTM A536 Grade 65-45-12	32	IMPELLER KEY	Stainless Steel - ASTM Type 304
1B	UPPER HALF CASING	Cast Iron - ASTM A48-CL30	33	OUTBOARD BEARING HOUSING	Cast Iron - ASTM A48-CL30
	UPPER HALF CASING (Opt)	Ductile Iron - ASTM A536 Grade 65-45-12	37	BEARING COVER	Cast Iron - ASTM A48-CL30
2	IMPELLER	Bronze - ASTM B584-875	46	COUPLING KEY	Steel - ASTM A108-1018
6	SHAFT	Alloy Steel - AISI 1045	65	MECHANICAL SEAL	316 S.S. / Carbon VS. Silicon Carbide
6	SHAFT (OPTIONAL)	416 S.S.	65	MECHANICAL SEAL (OPTIONAL)	316 S.S. / Tungsten Carbide VS. Tungsten Carbide
7	CASING RING	Bronze - ASTM B505-932	73	PART. FLG GSKT (Not Shown)	Vellumoid
14	SHAFT SLEEVE	Bronze - ASTM B505-932	73A	MECH SEAL GLAND O-RING	Nitrile
14	SHAFT SLEEVE (OPTIONAL)	416 S.S.	78	BEARING SPACER	Steel - ASTM A36
14A	SHAFT SLEEVE RET. RING	Steel - Mfg. Std.	89	INNER SEAL	Nitrile
16	INBOARD BEARING	Single Ball - Mfg. Std.	89A	OUTER SEAL	Nitrile
17	MECHANICAL SEAL GLAND	Cast Iron - ASTM A48-CL35	123	END COVER	Steel - ASTM A36
18	OUTBOARD BEARING	Single Ball - Mfg. Std.	127	SEAL WATER PIPING (EXTERNAL)	Polymer
18A	OUTER RETAINING RING	Steel - Mfg. Std.	127A	SEAL WATER PIPING (INTERNAL)	Brass
18B	INNER RETAINING RING	Steel - Mfg. Std.			

Notes