



**OPERATION & MAINTENANCE
MANUAL**

FOR

HVES PUMPS

PATTERSON PUMP COMPANY
A GORMAN-RUPP COMPANY
PO Box 790
2129 Ayersville Road
Toccoa, Georgia 30577 USA
Telephone: 706-886-2101

SAFETY TERMINOLOGY AND SYMBOLS



This symbol indicates electrical safety instructions where noncompliance will involve a high risk to personal safety or the loss of life.



This symbol indicates safety instructions where noncompliance would affect personal safety and could result in loss of life.



This symbol indicates safety instructions where noncompliance will involve some risk to safe operation and personal safety and/ or would damage the equipment or property.

INTRODUCTION

Patterson pumps, when properly installed and operated, and when given reasonable care and maintenance, will operate satisfactorily for a long period of time. This manual outlines the general principles that should be considered to ensure trouble-free pump operation.

Patterson pumps are built in a wide variety of designs and for many different services. This instruction manual should be studied carefully and followed, as there may be specific requirements for this unit and application that cannot be covered in a general discussion. These special instructions included within should be read thoroughly before operating the equipment.

GENERAL GUIDELINES



These instructions must always be kept close to the product's operating location or directly with the product.

These instructions are intended to facilitate familiarization with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. The instructions may not reflect all current legal requirements and local regulations; ensure that such requirements and regulations are observed by all, including those installing the product. Always coordinate repair activity with operations personnel, and follow all plant safety requirements and applicable safety and health laws/regulations.

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.

TABLE OF CONTENTS

SECTION 1	General Information.....	1
SECTION 2	Storage & Protection	1
SECTION 3	Installation	
	3-1 Location.....	2
	3-2 Mounting.....	2
	3-3 Alignment	2
	3-4 Wiring and Controls	3
SECTION 4	Operation	
	4-1 Starting	4
	4-2 Shutdown	5
SECTION 5	Maintenance	5
SECTION 6	Repairs & Replacement	
	6-1 To Remove Rotor	8
	6-2 Disassembly of Rotating Element.....	8
	6-3 Cleaning	8
	6-4 Inspection	9
	6-5 Assembly	9
	Locating Operation Difficulties.....	10
	Recommended Spare Parts	13
	Typical Assembly Section.....	14
	Notes.....	15

SECTION 1

GENERAL INFORMATION

This manual covers the installation, operation and maintenance of Patterson Pump HVES 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 2

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 3

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 is 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.



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 4

OPERATION



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.

Do not exceed the pressure capabilities of the mechanical seals.

The maximum pressure on the mechanical seal for this pump type is equal to the suction pressure plus 10% of the maximum pump operating head (converted to units of pressure) for a new pump.

For a pump with worn internal ring clearance, the maximum pressure on the mechanical seal is equal to the suction pressure plus 15% of the maximum pump operating head (converted to units of pressure).

This 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 3 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.



- 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.



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 5

MAINTENANCE

1. There should be no mechanical seal leakage except for a brief break in period.

2. 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 over lubricate the bearings. Such action will cause bearings to overheat.
6. Refer to the “**General Pump Inspection and Maintenance Schedule**” for best results.

Pump Bearing Relubrication Requirements				
Relubrication Interval*** (Operating Hours)	Pump Speed	Bearing Group Number*		
		1	2	3
	1000 RPM	20,000	20,000	15,000
	1200 RPM	19,000	16,000	12,000
	1500 RPM	15,000	13,000	9,000
	1800 RPM	12,500	10,000	7,000
	3000 RPM	7,500	5,500	3,500
	3600 RPM	5,000	4,000	2,000
Relubrication Amount of Grease	Ounces (cc)	¼ (8)	3/8 (11)	¾ (22)
	Number of Strokes**	8	12	22

* The bearing group for a pump is the suffix in the model designation. For example, model E2B13A-2 uses bearing group 2.

** 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.

General Pump Inspection and Maintenance Schedule HVES Pumps

Excludes drivers, 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	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.	✓ •				
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		✓			
Check coupling alignment and integrity (maintain records)			✓		
Add grease to pump anti-friction bearings (maintain records)	Refer to Table "Pump Bearing Relubrication Requirements"				
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 sleeve. Replace if worn.					✓ •
Realign coupled pumps (maintain records)					✓

SECTION 6

REPAIRS AND REPLACEMENT



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 and Bearing Housing:

Reference: Pump Assembly Section

1. Remove coupling guard and disconnect coupling halves.
2. Remove bolts holding the motor to base or floor, then remove the motor.
3. Remove bolts from bearing housing support (99A) to base, bolts holding the volute cover (11) to the casing (1).
4. Pull entire rotating assembly and volute cover (11) from the casing (1). The assembly should be pulled straight out until impeller (2) is clear of the casing.

6-2 Disassembly of Rotating Element:

1. Remove the impeller screw (26) and washer (69).
2. Remove impeller (2). Do not loosen impeller key (32).
3. Remove Bolts from between volute (11) and bearing housing (99).
4. Separate volute (11) from bearing housing (99) assembly.
5. Remove mechanical seal (65) and shaft sleeve (14).
6. Remove deflector (40).
7. Remove pump coupling half.
8. Remove bolts from bearing cover (37), remove bearing cover, outer retaining ring (18A) and outboard seal (89A).
9. Remove shaft (6) and bearings (16 & 18) from bearing housing (99).
10. Remove inner retaining ring (18B).
11. Remove bearing (16 & 18) from shaft

6-3 Cleaning:



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.



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 Assembly:

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. Press bearings (16 & 18) onto the shaft (6) and install retaining ring (18B).
3. Install seals (89 & 89A) into bearing housing (99) and cover (37).
4. Insert the shaft assembly into the housing (99). Install retaining ring (18A), cover (37), and deflector (40).
5. Install O-ring (73) and mechanical seal (65) into the volute cover (11). Coat the O-ring and O.D. of the seal with **Dow Corning Molykote 111 Compound** or equivalent (available from Motion Industries, 545 Olympic Drive, Athens, GA

30601, USA, Phone: 706-353-7780, Fax: 706-546-1427) prior to assembly.

6. Lubricate the O.D. of the shaft sleeve (14) and the I.D. of the opposite half of the mechanical seal using **Dow Corning Molykote 111 Compound** or equivalent. Press the shaft sleeve (14) through the seal. Coat the interior of the shaft sleeve (14) with Dow Corning 732 Multi-Purpose Sealant or equivalent.

Steps 6 thru 13 are best preformed in the vertical position, if possible.

7. Place the volute cover (11) over the shaft (6) onto the bearing housing (99).
8. Press the shaft sleeve (14) onto the shaft (6) and install seal spring.
9. Insert the impeller key (32) into the shaft keyway. Install the impeller (2) onto the shaft (6).
10. Coat the impeller bolt (26) with **Loctite 262 Threadlocker** or equivalent. Install the impeller washer (69) and bolt (26).
11. Install the casing ring (7) into the casing (1).
12. Install the spacer ring (73A) and lower the rotating assembly down into the casing (1).
13. Install and tighten casing bolts.
14. Install bearing support stand (99A).
15. Install all NPT fittings and tubing.
16. 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

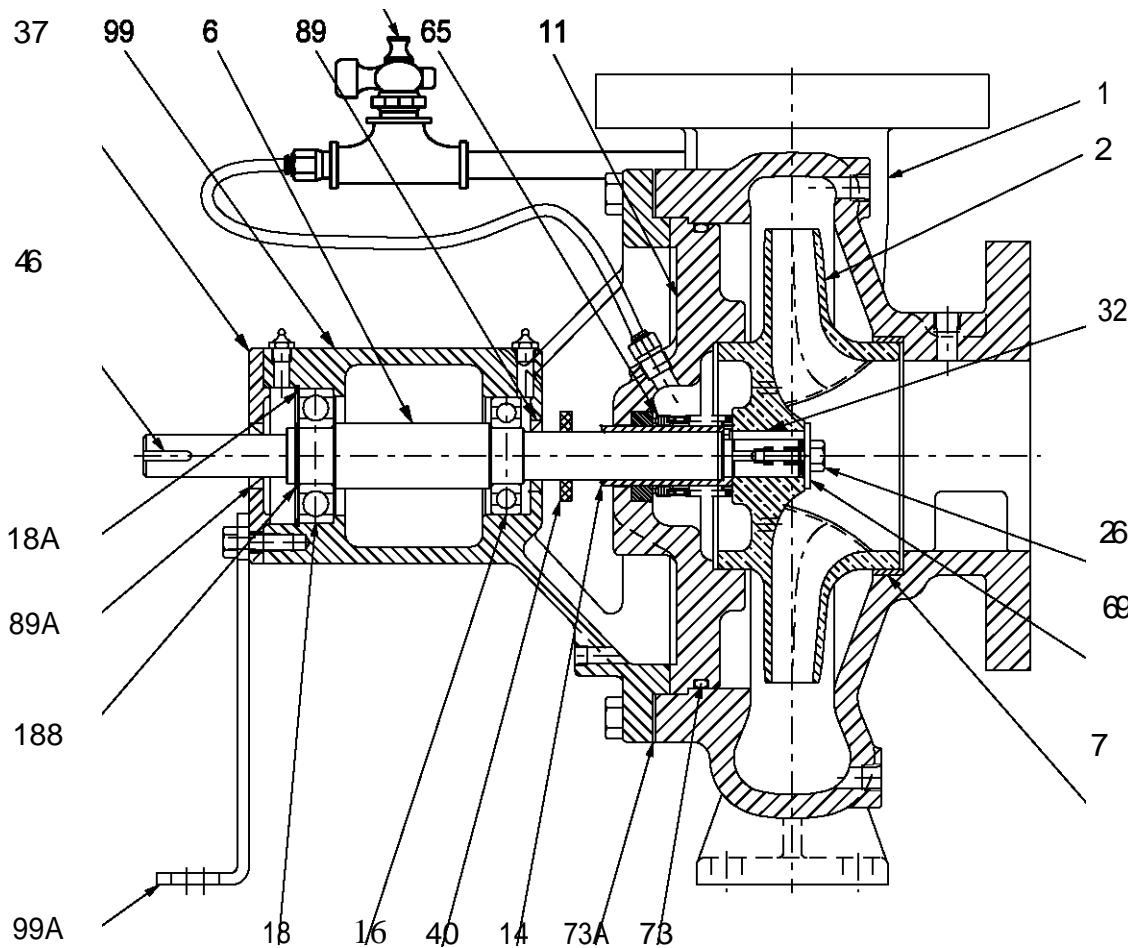
INTERMITTENT DUTY

Number	Description
7	Casing Ring
14	Shaft Sleeve
65	Mechanical Seal
73A	O-Ring (casing)
	Coupling and its accessories (not shown)

CONTINUOUS DUTY

Number	Description
2	Impeller
6	Shaft
7	Casing Ring
14	Shaft Sleeve
16	Bearing (inboard)
18	Bearing (outboard)
18A	Outer Retaining Ring
18B	Inner Retaining Ring
26	Impeller Screw
40	Deflector
65	Mechanical Seal
	All Hardware (not shown)
73A	O-Ring (casing)
89	Lip Seal
89A	Lip Seal

PET COCK
FOR
VENTING



Typical Assembly Section, Type HVES

ITEM	DESCRIPTION	MATERIAL	ITEM	DESCRIPTION	MATERIAL
1	CASING	Cast Iron - ASTM MB-CL30	32	IMPELLER KEY	Stainless Steel - ASTM Type 304
2	IMPELLER	Bronze - ASTM B584-B75	37	BEARING COVER	Cast Iron - ASTM M8-CL30
6	SHAFT	Alloy Steel - AISI 1045	40	DEFLECTOR	Nitrile
6	SHAFT (OPTIONAL)	416 S.S.	46	COUPLING KEY	Steel - ASTM A106-101B
7	CASING RING	Vesconite	65	MECHANICAL SEAL	316 S.S. / Carbon VS. Silicon Carbide
11	VOLUTE COVER	Cast Iron - ASTM MBCL30	65	MECHANICAL SEAL	316 S.S./Tungsten Carbide VS. Tungsten
14	SHAFT SLEEVE	Bronze - ASTM BSOS-932	69	IMPELLER WASHER	Stainless Steel AISI 416
14	SHAFT SLEEVE (OPTIONAL)	416 S.S.	73	O-RING	Nitrile
16	INBOARD BEARING	Single Ball - Mfg. Std.	73A	SPACER	Polymer
18	OUTBOARD BEARING	Single Ball - Mfg. Std.	69	INBOARD SEAL	Nitrile
1BA	OUTER RETAINING RING	Steel - Mfg. Std.	BBA	OUTBOARD SEAL	Nitrile
1BB	INNER RETAINING RING	Steel - Mfg. Std.	99	BEARING HOUSING	Cast Iron - ASTM M6-CL30
26	IMPELLER SCREW	Stainless Steel - Type 304	9BA	BRG. HOUSING SUPPORT	Steel - Mfg. Std.

Notes