OPERATION & MAINTENANCE MANUAL

for

VERTICAL INLINE PUMPS

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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 of 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.

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SECTION I

GENERAL INFORMATION

This manual covers the installation, operation and maintenance of Patterson Pump vertical inline pumps. The pump is a centrifugal, single stage close-coupled type. 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 casing allows removal of the impeller and rotating element without disturbing suction and discharge piping. The suction and discharge flanges are on a common centerline 180 degrees apart. The combination motor bracket and volute configuration, machined with register fits, assures positive concentric alignment of pump volute and motor. Suction and discharge flanges are drilled and tapped for gauge connections. The volute is drilled and tapped on the underside for complete pump drain. Volute wear rings are provided to minimize internal bypassing of the liquid being pumped and to improve efficiency.

SECTION II

STORAGE & PROTECTION

All pumps are shop serviced and ready for operation when delivered, but there is 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. Be sure that the bearings are fully lubricated.

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

3. 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.

4. 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.

5. Fresh lubricant must be applied to bearings upon removal of equipment form storage. Check motor manual.

SECTION III

INSTALLATION

3-1 Location:

Several factors should be considered when selecting a location for the pumping unit (pump, base, drive, and coupling). 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:

The pump unit is designed to be installed in the pipeline. Standard piping supports on either side of the pump should be used to eliminate pipe stresses. If the pump is to be supported, the bottom of the pump case has been drilled for the following: a 1 1/2-inch flange on the 4 x 3 VIP, a 2-inch flange on the 5 x 3 VIP, a 3-inch flange on the 6 x 6 VIP, a 2-inch flange on the 4 x 3 x 11 VIP, a 3-inch flange on the 5 x 3 x 11 VIP, and a 1-inch flange on the 2 x 2 x 8 VIP.

3-3 Piping:

The suction and discharge piping should be installed with the shortest and most direct runs. Elbows should preferably be of the long radius type. Pipes must line up naturally. The piping must never be pulled into position by the flange bolts. Pipes should be supported near the pump. Suction piping, if not properly installed, is a potential source of faulty operation. Suction lines should be free of air leaks, and arranged so there are no loops or high spots in which air can be trapped. Generally, the suction line is larger than the pump suction nozzle, and eccentric reducers should be used. If the liquid supply is located below the pump centerline, the reducer should be installed with the straight side up.

Most often air enters the suction pipe entrained in the liquid. Installations with a static suction lift preferably should have the inlet of the vertical suction piping submerged in the liquid to four times the piping diameter. A large suction pipe will usually prevent the formation of vortexes or whirlpools, especially if the entrance is flared. A floating vortex breaker (raft) around the suction piping may be provided if a tendency appears for a vortex to form at the liquid surface. A stream of liquid falling into the sump near the intake pipe will churn air into the liquid. The supply line should extend down into the sump. Liquid supply entering a well perpendicular to the intake line tends to rotate the liquid, which interferes with the flow into the suction line. A baffle placed in front of the supply pipe will remedy this situation. A short elbow should never be bolted directly to the pump suction nozzle. The disturbance in the flow caused by the sharp bend so near the pump inlet may result in noisy operation, loss in efficiency, and capacity, and heavy end thrust. A long sweep or long radius elbow placed as far away from the pump as practical should be used if a bend is necessary in the suction line. If separate suction lines cannot be used for each pump, then a tapering header with Y-branches should be used. A straight branch header should never be used. Prior to installing the pump, suction piping and pump should be inspected internally, cleaned and slushed. If a strainer is installed in the suction line, the openings in the screen must be checked and cleaned periodically. The openings must be smaller than the sphere size allowed by the impeller.

Discharge piping should be installed with check valve and gate valve, with the check valve being between the pump and the gate valve. The check valve prevents reverse flow and protects the pump from excessive backpressure. The gate valve is used to isolate the pump for maintenance, priming and starting. If a diffuser is used, it should be placed between the pump and check valve.

Stuffing box seal connection is a precision drilled passage in the volute. For fire protection pumps, refer to NFPA-20 piping section.

SECTION IV

OPERATION

Pump rotation is clockwise when viewed from the driver end. Check drive rotation to see that it matches the pump rotation. For a three-phase motor, rotation may be reversed, if necessary, by interchanging any two of the three power leads. Rotation of single-phase motors is fixed by internal wiring.

WARNING!!! Prior to startup, check to see that the pump turns freely by hand.

If the pump does not turn freely, loosen the motor bolts and move slightly until rubbing stops. Misalignment will cause damage to the shaft, bearings, and wear rings.

4-1 Starting:

- When possible, turn the pump shaft by hand to insure that the parts do not bind
- Check the bearing lubricant
- Open the valve in the pump suction line, if fitted
- Close discharge valve
- Prime the pump by venting the suction and discharge piping. Vents on suction and discharge piping can be used or installed in the suction and discharge gauge connection.

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.

Adjust the packing gland until there is a slight leakage from the stuffing box. **(See Maintenance on Adjustment of Packing)**.

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, the discharge valve should be closed first.

1. Close discharge valve.
2. Stop driver.
3. Close valve in the pump suction line, if fitted. If danger of freezing exists, drain the pump completely.

4-3 Minimum Flow Limitation

All centrifugal pumps have limitations on the minimum flow at which they should be operated. The most common limitation is to avoid excessive temperature buildup in the pump because of absorption of the input power into the pumped fluid. Other less understood reasons for restrictions are:

1. Increased radial reaction at low flows in single volute casings.

Section IV – 4-3 Minimum Flow Limitation Continued

2. Increased NPSHR at low flows.

3. Noisy, rough operation and possible physical damage due to internal recirculation.

4. Increased suction and discharge pulsation levels.

The size of the pump, the energy absorbed, and the liquid pumped are among the considerations in determining these minimum flow limitations. For example, most small pumps such as domestic home circulators, service water pumps, and chemical pumps have no limitations, except for temperature buildup considerations while many large, high horsepower pumps have limitations as high as 40-50% of the best efficiency point capacity. The minimum safe flow for this pump 20 – 25 GPM.

SECTION V

MAINTENANCE

5-1 Lubrication:

Bearings: The motors are shipped from the factory with grease. Refer to the motor manufacturer's instruction manual for relubrication.

WARNING !!! Proper lubrication is essential to the pump operation. Do not operate the pump if sufficient lubricant is not present in the bearing housing of if lubricant is contaminated with excessive dirt or moisture. Operation of the unit under these conditions will lead to impaired pump performance, and possible bearing failure. Do not operate the pump with excessive amount of lubricant. Such action will cause bearings to overheat.

5-2 Stuffing Box:

The purpose of a stuffing box is to limit or eliminate leakage of the pump fluid and to prevent air from entering the suction spaces along the pump shaft. Pumps are equipped with packing (limited leakage). Normally, the pumped liquid is used to lubricate the stuffing box seal. For pumps equipped with packing, there must always be a light leakage from the glands. The amount of leakage is hard to define, but we recommend a steady dripping of liquid through the gland. Stuffing box glands should be adjusted after the pump is started. When leakage is excessive, tighten gland bolts evenly a little at a time. Allow an interval for packing to adjust to new position. Never tighten gland to be leakproof, as this will cause overheating and undue wear on shaft sleeves.

Replace stuffing box packing as follows:

1. Shutdown the pump.

2. Take precautions to prevent the driver from being inadvertently started.

3. Remove the gland bolt nuts and gland.

4. Remove and discard old packing rings – note location of lantern ring. When repacking stuffing box, lantern ring must be positioned such that the water seal connection is opposite lantern ring.

5. Clean out the stuffing box.

6. Inspect shaft sleeve for wear – if it is scored or grooved, it should be replaced.

7. Make sure the stuffing box bushing (if furnished) is set at the bottom of the box.

Section V - 5-2 Stuffing Box Continued

8. Insert rings of packing and tap lightly to seat against bushing. Be sure rings are of the proper size and length and installed with cuts staggered. Lantern ring **must** be installed opposite sealing water connection.

9. Install gland and tighten, finger tight. With the pump running, adjust gland as described previously. Care should be taken during the first hour of operation to take up on the packing gradually just enough to maintain the required amount of leakage.

If the pump is operated daily, the stuffing box packing should be renewed about every two to three months before it gets hard and scores the shaft sleeves.

5-3 Wear Ring Clearance:

Running fits between wear rings is given under the pump specifications. When these clearances are doubled, or the capacity of the pump is reduced by 5 to 10%, the rings should be renewed. The purpose of these rings is to keep internal bypassing of the liquid being pumped to a minimum. Clearances should be checked periodically and whenever the pump casing is opened. Check by direct measurement. Measure ID of case ring and OD of impeller ring, then compute clearance (ID minus OD).

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.

6-1 To Remove Impeller:

Reference: Pump Assembly Section

1. Remove bolting holding volute (1) to volute cover (11).

2. Pull motor and impeller assembly from the volute.

3. Remove impeller (2) from the motor shaft by turning the impeller screw (26) counterclockwise.

4. Loosen gland bolts and remove packing (13) and lantern ring (29).

5. Remove volute cover (11) to motor bolts and pull motor from the cover.

6. Shaft sleeve (14) and impeller key (32) can be pulled from the motor shaft.

7. Sleeve o-ring (13A) can now be removed form the motor shaft.

8. Wear rings (8 & 25) are pressed into the housings. Space has been left at the end of the wear ring to allow for the use of a puller to remove the wear rungs or they can be machined out.

Section VI - 6-1 To Remove Impeller Continued

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. Bearing surfaces should be smooth and shoulders square and free of picks.

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

6-2 Assembly:

Assembly is the reverse of the disassembly procedure. 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 downtime.

2. New o-rings and gaskets should be used when reassembling the pumps.

3. Install sleeve o-rings (13A) on the motor shaft.

4. Press fit the wear rings (8 & 25) in the volute cover (11) and volute (1). Tap in carefully until flush with the surface. There should be space behind rings for future removal.

5. Bolt the volute cover (11) to the motor. Check concentricity of wear ring to the motor shaft. Adjust by shifting volute cover as required to get concentricity with .002 to .004 thousands.

6. Install shaft sleeve (14) and impeller key (32) to the motor shaft.

7. Make sure impeller aligns with key and install with impeller screw (26).

8. Replace gasket (73) and bolt volute (1) to volute cover (11).

9. Check to see that the pump rotates freely.

10. Install packing and lantern ring.

11. Be sure packing does not block seal water inlet.

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: casing rings worn, 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, damaged impeller, 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 rings 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 VERTICAL INLINE PUMPS

Reference: Assembly Section

Number	Description
2	Impeller
8	Wear Rings
13	Packing (stuffing box)
13A	Shaft Sleeve O-Ring
14	Shaft Sleeve
24	Impeller Washer
25	Wear Rings
26	Impeller Screw
32	Impeller Key
73	Gasket

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	VOLUTE	11	VOLUTE COVER	17	PACKING GLAND	29	LANTERN RING
2	IMPELLER	13	PACKING	24	IMPELLER NUT WASHER △1	32	IMPELLER KEY
6	PUMP/MOTOR SHAFT	13A	SHAFT SLEEVE O-RING △1	25	COVER WEAR RING	73	GASKET
8	VOLUTE WEAR RING △1	14	SHAFT SLEEVE	26	IMPELLER SCREW △1		

PATTERSON PUMP COMPANY

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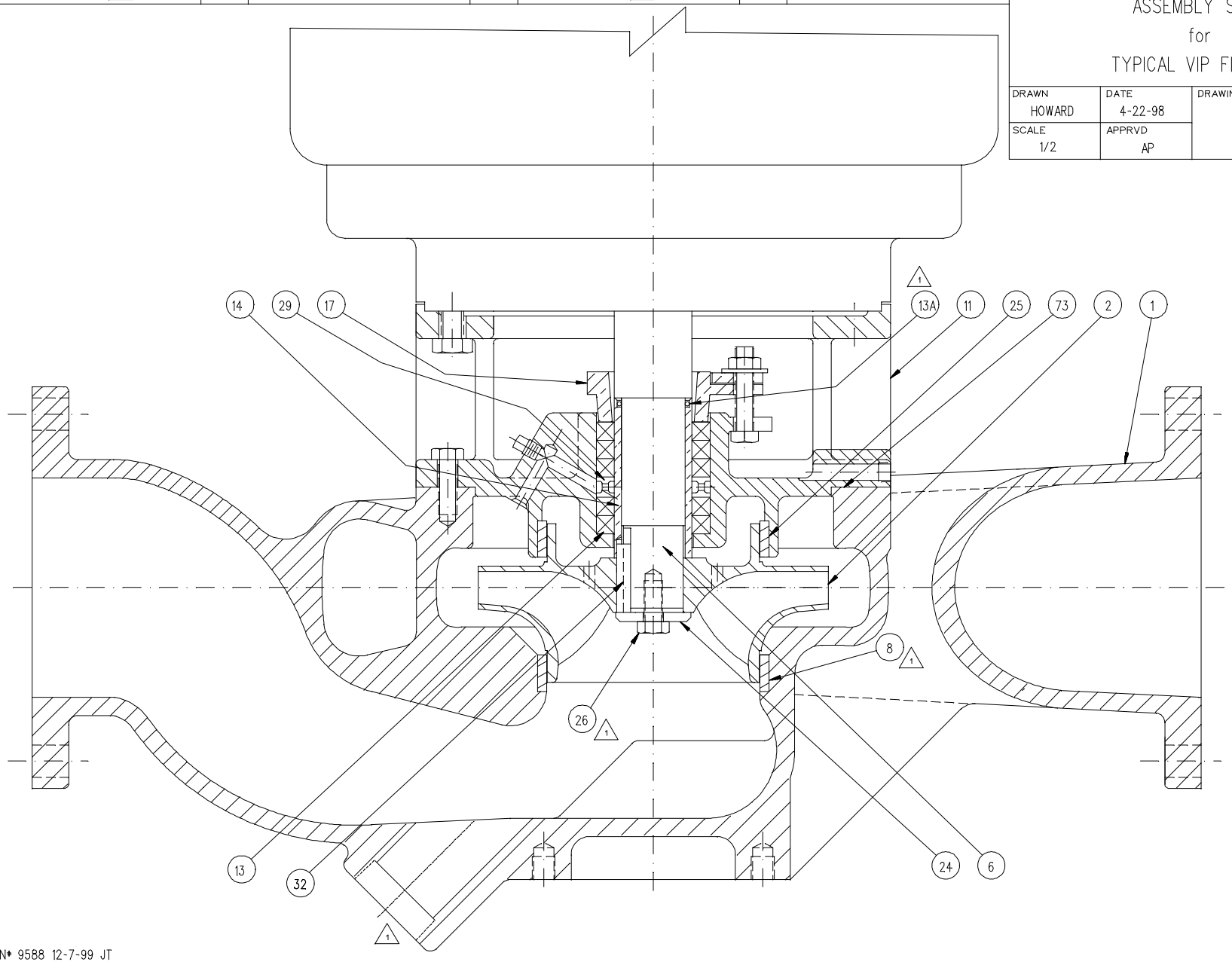
TOCCOA, GEORGIA

ASSEMBLY SECTION
for
TYPICAL VIP FIRE PUMP

DRAWN	DATE	DRAWING NO.
HOWARD	4-22-98	C05-68238-1
SCALE 1/2	APPRVD AP	



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