

PWV

**API 610
Vertical Turbine Pump
VS6 (Can Type)
VS1 (Sump Type)**





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**INSTRUCTION MANUAL FOR INSTALLATION,
OPERATION, MAINTENANCE AND SPARE PARTS
API 610 VERTICAL TURBINE PUMP
VS6 (CAN TYPE) VS1 (SUMP TYPE)**



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SECTION 1 – INTRODUCTION

The design, material, and workmanship incorporated in the construction of PW610 Pumps makes them capable of giving long, trouble-free service. The life and satisfactory service of any mechanical unit, however, is enhanced and extended by correct application, proper installation, periodic inspection and careful maintenance.

This instruction manual was prepared to assist operators in understanding the construction and the correct methods of installing, operating and maintaining these pumps. It is advisable that rotating components of the pump assembly be covered with a suitable rigid guard to prevent injury to personnel.

Study thoroughly Sections 1 thru 11 and carefully follow the instructions for installing and operating. Sections 12 thru 14 are answers to trouble and maintenance questions. Keep this instruction manual readily available for reference.

RECEIVING AND CHECKING

The pump shall be carefully supported prior unloading from the carrier. Handle all components carefully. Inspection for damage of the shipping crate shall be made prior to unpacking the pump. After unpacking, visually inspect the pump and check the following:

1. Contents of the pump assembly against shipping list.
2. All components against damage.
3. Shafting for straightness and damage.

Any shortages or damages should be immediately called to the attention of the local freight agent of the carrier by which the shipment arrived and proper notation made on the bill. This shall prevent any controversy when a claim is made and facilitate prompt and satisfactory adjustment.

MATERIALS AND EQUIPMENT REQUIRED

The material and equipment necessary for installation of the pump will vary with the size of the pump and the type of installation.

The following list of standard tools and supplies is offered only as a guide:

1. BULK MATERIAL: Anti-Galling Lubricant, Thread Compound, Lubrication Oil, Turbine Oil, Grease, and solvent (petroleum-base, kerosene, distillate or unleaded gasoline)
2. RIGGING EQUIPMENT: Mobile power hoist, dragline and blocks, elevator clamps, Clevises-for use with eyebolts, timbers (size, length and quantity as required to support long pump parts on the floor), and I-Beams or timbers to support pump over barrel.
3. HAND TOOLS: Pipe wrenches, clean rags, feeler gages, and set of mechanic's tools (including: files, wire brush, pliers, wire cutters, pocket knife, and pipe wrenches).



4. OPTIONAL TOOLS TO FACILITATE PUMP ASSEMBLY AND DISASSEMBLY: Dial indicator (to assist in motor end shaft adjustment) and Collet driver (to assist in bowl assembly and disassembly when required).

SECTION 2 – STORAGE

STORAGE

PW610 carefully preserves and protects its products for shipment. However, the effective life of the preservatives applied at the factory can vary 3 to 18 months depending on the severity of the environment where the equipment is stored. This section provides procedures for preparation prior to storage and maintenance during storage of PW610 Pumps. These procedures are necessary to protect the precision parts of the pumps. Specific procedures for storing motors, gear-heads and engines, should be obtained from the equipment manufacturer. This section is intended to be of general assistance to users of PW610 Pumps. It shall not modify, amend and/or otherwise alter the scope of PW610 Pumps warranty responsibilities to the purchaser in any way whatsoever.

STORAGE PREPARATION

PW610 vertical pumps require proper preparation for storage and regular maintenance during storage. The pump shall be considered in storage when it has been delivered to the job site and is waiting installation.

RECOMMENDED STORAGE PROCEDURES

Controlled storage facilities should be maintained at an even temperature 10°F or more above the dew point with relative humidity less than 50% and little or no dust. If these requirements cannot be met the pump is to be considered in uncontrolled storage. For uncontrolled storage periods of 6 months or less, the pump is to be inspected periodically to insure that all preservatives are intact.

All pipe threads and flanged pipe covers are to be sealed with tape, plastic covers or blind flanges and gaskets if available. The pump must not be stored closer than 6 inches from the ground.

PREPARATIONS FOR UNCONTROLLED LONG TERM STORAGE

When applicable to the pump, storage periods over 6 months require the preceding uncontrolled storage procedure plus the following:

1. Inspect the lube oil and seal flush piping, and either fill the piping with rust preventative oil, or recoat the piping periodically to prevent corrosion.
2. Place 10 pounds of moisture absorbing desiccant or 5 pounds of vapor phase inhibitor crystals near the center of the pump. If the pump is assembled, place an additional one pound in the discharge nozzle securely fastened to the discharge elbow.
3. Install a moisture indicator near the perimeter of the pump. Cover the pump with 6 mil minimum thickness black polyethylene or equal and seal it with tape. Provide a small ventilation hole approximately 1/2 inch diameter.

4. Provide a roof or a shed shelter to protect from direct exposure to the elements.

SECTION 3 – GENERAL DESCRIPTION

GENERAL DESCRIPTION

The model PWV pumps are either vertically suspended can pump (VS6) or vertical suspended sump/wet pit type pumps (VS1) designed to meet wide ranges of process injection and transfer requirements in the petroleum and petrochemical industries. The PWV pumps also feature capacities to 7000 GPM, heads to 3500 feet and pressures to 3000 PSIG. Special applications are also available to meet cryogenics, high temperature or corrosive applications. *See Annex A for Cross Sections.*

DRIVERS

The most common type drivers supplied are solid shaft electric motors with rigid adjustable type couplings that permit removal of the complete mechanical seal without removing the driver. Occasionally right angle gear drives with solid shafts are also provided.

DISCHARGE HEAD

The discharge head may be a fabricated "T" type or "F" type head depending on design requirements. Ports are provided for connecting suction gage, discharge gage. Flanges are provided for stuffing box or mechanical seal bypass return and barrel vent piping. The discharge head is designed with large hand holes for easy mechanical seal or stuffing box adjustment. All discharge heads are designed and fabricated under ASME section VIII and hydro-tested to 1.5MAWP.

COLUMN

Flanged column construction provides positive shaft and bearing alignment, ease of assembly and disassembly. Bearings are spaced to provide vibration free operation below shaft first critical speed to insure long bearing life and reduced shaft wear. The line shaft is supported within the column by use of integral bearing retainers in the column assembly. Each column flange connection is sealed an O-ring or gasket depending on temperature and pressure requirements.

BOWL ASSEMBLY

The bowls are generally flanged construction for accurate alignment and ease of assembly and disassembly. Impellers are enclosed for API compliance; however, open impeller are available depending on design requirements. Impellers are keyed to the shaft. A special first stage low NPSH impeller may be provided in certain applications. Each bowl flange connection is sealed an O-ring or gasket depending on temperature and pressure requirements.

THRUST POT

A thrust pot is utilized when the electric motor or gearbox is not designed to carry the pump down thrust.



BARREL (VS6 ONLY)

The barrel may be fabricated with a below base suction flange or it may be a plain cylinder, for above base suction, depending on design requirements. The barrel flange to pump head will be sealed by either an O-ring or gasket depending on temperature and pressure requirements. All barrels are designed and fabricated under ASME section VIII and hydro-tested to 1.5MAWP.

SECTION 4 – BARREL INSTALLATION

PREPARING THE FOUNDATION

The foundation must be rigid, level and of adequate strength to support the complete weight of the pump plus the weight of the liquid passing through it. Concrete foundation shall have bolts sized and located in accordance with the dimensions given on the Pump Certified General Arrangement Drawing or established by actual measurement of barrel mounting holes.

When the pump is mounted directly on a structural steel frame, pumps shall be located directly over, or as near as possible to the main building members, beams, or walls. Barrel mounting flange shall be bolted to the supports to avoid distortion, prevent vibration, and retain proper alignment.

BARREL INSTALLATION

Install the barrel as follows:

1. Position a suitable lifting device over concrete foundation or steel structure opening.
2. Thread two eyebolts diametrically opposite in the barrel flange. Attach a sling to eyebolts and to hoist hook.
3. Hoist barrel and position over opening. Orient suction flange in the required position (if below base suction).
4. In the case the barrel is not grouted, complete the barrel installation by following instructions in Step 5. If barrel is grouted continue with Step 6.
5. If a barrel is being bolted to a structural foundation or the barrel is not grouted to the concrete foundation, use shims for leveling the barrel mounting plate. Continue to lower the barrel until the flange rests firmly on the shims.
6. The barrel mounting plate should not be grouted.
7. Grouting the sole plate. Place round metal discs under the soleplate level bolts. Check the level of the sole palte, utilizing a spirit level across the flange. Use a non-shrinking grout following manufacturer's recommendations. Pour the grout into the foundation and force it between the soleplate and the dammed-in area. Level off the grout flush with the top of the dam. Allow ample time for the grout to cure before installing the barrel to foundation and installing the pump.
8. Intall barrel mounting plate bolting and gradually and uniformly connect the barrel mounting flange to the sole plate Install nuts on foundation bolts, tighten them gradually and uniformly. Check to see that barrel has remained level in all directions after final tightening.



CAUTION: Do not drop any foreign object into the barrel. Such an object can cause serious damage to the pump and any downstream components. Any foreign object dropped into the barrel must be retrieved prior to continuing installation of the pump or components.

SECTION 5 – STANDARD PUMP INSTALLATION

PUMP INSTALLATION

Pumps 20 feet or less in length are usually shipped assembled, with the exception of the barrel, driver, packing, mechanical seal and coupling assembly, spacer or nonspacer type. When provided, refer to the Certified Pump General Arrangement Drawing for the applicable base plate plan for locating anchor bolt holes.

INSTALLING A TYPICAL PUMPWORKS 610PWV ASSEMBLED PUMP

1. Install barrel as described in Section 4.
2. Clean the barrel mounting flange and annular groove and install O-ring or gasket as provided. Clean bottom surface of discharge head mounting flange.
3. Use lifting eyes provided on the driver stand as connected to the discharge head and thread two eyebolts through bolt holes or use a strap thru the driver stand hand holes and hoist unit into position over the barrel.
4. Lower the unit and carefully guide it so that unit does not strike sides of the barrel. Continue to lower unit until discharge head flange engages and rests firmly on the barrel and hangs plumb in the barrel, then secure with cap screws.
5. Refer to Section 10 through 14 for remaining assembly, startup, maintenance, disassembly and recommended lubricants for the pump. Refer to job data package for recommended spare parts.

SECTION 6 – INSTALLING THE BOWL ASSEMBLY (SECTION 6 THRU 9 DISCUSS INSTALLATION BY COMPONENTS)

BOWL ASSEMBLY INSTALLATION

The following bowl installation instructions apply to pumps shipped disassembled.

WARNING: Do not work under a heavy suspended object unless there is a positive support under it, which will protect personnel should a hoist or sling fall.

CAUTION: Do not attempt to lift bowl assembly by the pump shaft. This will result in damaging the pump shaft.

Prior to installing bowl assembly check that all cap screws are tight and all required piping is installed. Remove all accumulated dust, oil or other foreign materials from external surfaces. Install bowl assembly as follows:

1. Position a suitable lifting device over the barrel opening. Place two I-beams supports across the barrel opening strong enough to safely support the weight of the entire pump assembly.
2. Place an elevator clamp just below the discharge bowl flange, or thread two eyebolts through bolt holes in the flange, and hoist into position over the barrel.
3. Lower bowl assembly and carefully guide it so that unit does not strike sides of the barrel. Continue to lower bowl assembly until elevator clamps or bowl flange rests firmly on the supports.
4. Place a cover over bowl assembly to prevent entrance of dirt or other foreign matter.
5. Shaft threads are left hand.
6. When threaded coupling is not installed on the pump shaft, proceed as follows: (1) Install threaded coupling onto pump shaft screwing it on for one-half its length (2) A fine wire inserted in the drilled hole at the center of the coupling can be used as a gage to determine when the coupling is correctly positioned on the pump shaft. (3) Remove the wire after installing the coupling.

CAUTION: Do not drop any foreign object into the bowl assembly. Such an object can cause serious damage to the pump and any downstream components. Any foreign object dropped into the bowl assembly must be retrieved prior to continuing assembly.

SECTION 7 – INSTALLING THE COLUMN

When provided, see the Certified Pump General Arrangement Drawing for the required number of column and shaft sections required.

1. Check the bowl-shaft and line-shaft for straightness. Average total runout shall not exceed 0.003" T.I.R. over the shaft or 0.0005"/ft.
2. Apply a thin film of oil to line-shaft and coupling (29) threads (if non-galling material). Start thread manually until resistance is felt. Complete the joint utilizing a pair of pipe wrenches. Butting the bottom of line-shaft against the top of pump shaft (30). Use care not to apply wrenches on bearing journal surfaces.
3. Install two eyebolts diametrically opposite in the upper flange of column (25). Attach a sling to the eyebolts and to hoist hook. Hoist column section over bowl assembly. Lower column over line-shaft until column flange engages the discharge bowl flange register. Insert cap screws through both flanges as possible. Tighten cap screws gradually in diametrically opposite pairs.
4. Lift bowl and column assembly high enough to allow rotation of the I-beam supports. Install and tighten remaining cap screws.
5. Lift assembly and remove supports. Slowly lower the bowl and column assembly into the barrel. Place supports on barrel and continue to lower the assembly until the column flange comes to rest on the supports.
6. Assemble remaining column and line shaft sections.

NOTE: On most column sizes, the bearing retainer is integral with the column.

7. Install threaded coupling (29) on protruding end of the line-shaft (13), if required.
8. Assemble next column section, intermediate, or top column as required, and make certain bearing retainer engages the column register, and secure with cap screws



provided until all columns and line-shaft sections required for the proper pump setting have been assembled. Tighten cap screws gradually and uniformly.

NOTE: If non-integral bearing retainers are used on column sections do not over-tighten flange bolts in order to make flange faces meet. Flange faces will be designed to be separated by bearing retainer.

SECTION 8 – INSTALLING THE DISCHARGE HEAD

PW610 pumps are provided with an "F" type head for below grade suction or a "T" type head for above grade suction, depending on installation requirements. Install discharge head as follows:

1. If the stuffing box is assembled to the head, remove it and all attached piping.
2. When a mechanical seal is provided, it is usually shipped separately. In case the seal is assembled to the discharge head, remove seal prior to installing the head.
3. Remove coupling guard if provided. Thread two eyebolts in the head driver stand connection holes diametrically opposite and hoist discharge head over the protruding line-shaft.
4. Install O-ring or gasket as provided on the barrel groove.

CAUTION: Do not bump or scrape the shaft protruding above the column. This could result in bending or damaging the shaft.

5. Orient the discharge head in the required position and lower head aligning the vertical hole with the line-shaft protruding above the column until the discharge head engages the column (25) register. Install cap screws and secure discharge head to the column. Tighten cap screws gradually in diametrically opposite pairs.
6. Lift pump assembly high enough to allow rotation of the supports. Realign and lower assembly. Install and tighten remaining cap screws. Repeat rotation and tightening procedure until all cap screws are uniformly tight.
7. Hoist bowl column, head assembly, and remove supports from barrel (47) opening.
8. Lower bowl, column and head assembly until discharge head flange engages barrel flange. Install cap screws and secure discharge head to barrel. Tighten cap screws gradually in diametrically opposite pairs.

SECTION 9 – DRIVER STAND INSTALLATION

PW610 pumps are provided with a driver stand that connects to the discharge head. The driver stand acts as the mounting surface for the motor. Install the driver stand as follows:

1. Lift the driver either using the windows (hand holes) with a strap or attach bolting to the lifting eyes and orient the stand such that the windows are perpendicular to the nozzles of the discharge head.
2. Lower the driver stand flush with the top of the discharge head and install connection bolting.



SECTION 10 – MECHANICAL SEAL INSTALLATION

Instructions for installing mechanical seals are provided by the seal manufacturer. Consult the seal manufacturer's instructions (furnished with the seal) for information on the type of seal used. Additionally, refer to factory furnished outline drawing and seal piping schematic for seal piping arrangements.

SECTION 11 – DRIVER AND COUPLING INSTALLATION AND INSTALLATION

INSTALLATION OF SOLID SHAFT DRIVER

NOTE: When pump is provided with a thrust pot, secure driver to discharge head and indicate line up before installing the thrust pot and flexible coupling are installed.

WARNING: Do not work under a heavy suspended object unless there is a positive support under it, which will protect personnel should a hoist or sling fail.

The coupling between the driver-shaft and line-shaft may be a nonspacer or a spacer type. The latter is used on pumps furnished with a mechanical seal to permit servicing the seal without lifting the driver.

Proceed with installation of the driver as follows:

1. Attach a sling to the lifting lugs of driver. Hoist motor, inspect the mounting surface, register, and shaft extension, and clean these surfaces thoroughly. If any burrs are found, remove burrs with a smooth mill file, cleaning thoroughly afterward.
2. Orient the motor conduit box in the required position and align the mounting holes with the hating tapped holes in the discharge head. Lower the motor until the registers engage and motor rests on the discharge head. Secure motor with cap screws provided.
3. Check assembly run-outs. Bore Max T.I.R 0.005" – Face Max T.I.R 0.002.
4. On drivers having a non-reverse ratchet or pins manually turn the driver shaft clockwise viewed from above until the non-reverse ratchet or pins fully engage.
5. Lubricate motor bearings in accordance with instructions given on the lubrication plate attached to the motor case.

WARNING: The motor must not be tested for direction of rotation when coupled to the pump. If pump should rotate in the wrong direction, serious damage to the pump and driver and serious injury to nearby personnel could result.

6. Make temporary electrical connections according to tagged leads or diagram attached to the motor. Motor must rotate counterclockwise when viewed from above. See arrow on pump name plate, if driver does not rotate counterclockwise, change motor rotation by interchanging any two leads, for three phase only. For single phase, see motor manufacturer's instructions.
7. MOTOR SHAFT END PLAY ADJUSTMENT: Motor shaft end play if required shall be checked with a dial indicator prior to connecting pump coupling to solid shaft motor. Consult the applicable motor manufacturer's instruction manual for detailed information on motor shaft end play.

8. Coupling Installation:

- Apply thin film of oil on line-shaft key (11) and insert key into line-shaft keyseat.
- Gently lower pump hub over head-shaft
- Thread adjusting nut (6) flush with top of head-shaft.
- Apply a thin film of oil to key and insert it into the driver shaft keyseat. Place the driver hub (4) over the driveshaft and key sliding it up the shaft until annular groove is exposed. Install split ring (12) in the groove and slide driver hub down over the split ring to capture it.
- Install spacer (5) and secure to driver hub (4) with cap screws (8) and nuts (9)

IMPELLER ADJUSTMENT. Impeller adjustment is identical for motors and right angle gear drives. Adjustment is accomplished by turning adjusting plate (6).

NOTES:

- 1. Mechanical seal, when provided must not be secured to the shaft prior to impeller adjustment (open or enclosed impellers). Shaft must move up or down within the seal assembly.**
- 2. For pumps handling liquids between -50 to 200°F, impeller adjustment can be made under ambient conditions. For liquid temperatures in excess of this range, it is recommended that impeller adjustment be made after the pump surface temperature has reached an equilibrium when charged with the pumpage. In those cases, where this is not feasible due to safety considerations or impossible due to external ice buildup in cryogenic applications, refer to factory for specific instructions.**
- 3. When a thrust pot is used, impeller adjustment is accomplished with the pot's adjusting nut and a dial indicator.**

A. OPEN IMPELLERS

1. With the impellers at the bottom, turn adjusting nut (6) towards driver hub or spacer (4). Obtain 0.015 inch clearance between adjusting plate and driver hub or spacer for the first 10 feet of column. Add 0.010 for each additional 10 feet of column. EXAMPLE: Total pump length 50 feet-set impellers at 0.055 inch.
2. After impeller adjustment, align adjusting plate (6) with pump hub (7), and tightly draw coupling flanges together. This raises impellers amount of clearance between flanges.
3. Set seal after impeller adjustment. Securely tighten all setscrews in the collar. Remove spacer between the gland plate and collar. Retain spacer for future resetting of seal.

NOTE: When impellers are reset, the seal must also be reset.

B. ENCLOSED IMPELLERS

1. The lifting setting for the pump will be found marked with a lifting tag below the namplate for the pump. It can also be found on the Certified General Arrangement Drawing. This setting should be 1/8 to 3/16 clearance between the adjusting nut and the shaft. Shaft elongation will be compensated on pumps longer than 20ft.
2. After impeller adjustment, align adjusting nut (6) with pump hub (7) and spacer (5). Insert cap screws (8) and tightly draw coupling flanges together.
3. To set seal, follow step A3, open impellers.



SECTION 12 – PUMP STARTUP AND OPERATION

PRE-START PROCEDURE: Consult the applicable manufacturer's instructions for detailed information for the prime mover (engine or steam turbine) coupling, driveshaft, electric driver, gearhead or mechanical seal. When applicable to the pump and prior to startup, check the following:

1. Make sure mechanical seal is properly lubricated and all piping to seal connected. Also, check that all cooling, heating and flushing lines are operating and regulated.
2. Check alignment between pump and driver.
3. Wiring of driver is counterclockwise when viewed from above.
4. All connections to driver and starting device with wiring diagram.
5. Voltage, phase, and frequency on motor nameplate with line circuit.
6. Impeller adjustment.
7. Rotate shaft manually to ensure impellers are not binding.
8. Check that driver bearings are properly lubricated and check oil level in housing.
9. Check that Barrel and auxiliary seal components are properly vented.

NOTE: Particularly on pumping fluids that are near their vapor pressure, adequate venting is a must for reliable pump operation. The barrel should be continuously vented back to the vapor side of the suction vessel with liberal size piping. Additionally, on systems where the suction pressure is below atmospheric pressure and a standby pump is not isolated from the system, precautions must be taken, to prevent the entrance of air. This is generally handled by pressurizing the standby pump from the system's discharge pressure side, through the pump stuffing box or seal housing.

10. Check Discharge piping and pressure gages for proper operation.

PRIMING

The first stage must always be completely submerged. Pump must not run dry, the rotating parts within the pump may gall and seize to the stationary parts. The parts must be lubricated by the liquid being pumped.

PUMP STARTUP

1. Partially close valve in discharge line.
2. Fully open suction side valves on pressurized systems.
3. Vent system when the pump surface temperature has reached an equilibrium.
4. Start pump.
5. When pump is operating at full speed, slowly open discharge valve. If driver overheats or there is excessive vibration, stop the pump.

NOTE: If the Impellers have not been final adjusted, due to extreme liquid temperature, they should be adjusted prior to start-up and after pump surface temperatures have reached an equilibrium.



MECHANICAL SEAL

If seal leaks slightly at startup, allow a reasonable amount of time for seal to adjust itself. Liquids with good lubricating qualities normally take longer to wear in the seal than liquid with lesser qualities. When a seal starts out with a slight leak and gets progressively less with running, it is indicative of leakage across the seal faces and that continued running will eliminate leakage. Where leakage occurs immediately and remains constant, unaffected by running, it usually indicates secondary seal (shaft packing) damage, or seal faces are warped out of flat.

SECTION 13 – MAINTENANCE

Preventive maintenance includes periodic inspection, re-lubrication of electric motors, gear drives and prime mover. Systematic inspection of the pump and its components shall be made at regular intervals. The frequency required depends upon the operating conditions of the pump and its environment. Consult the applicable manufacturer's instructions for detailed information on maintenance for the prime mover, driveshaft, electric motors and gear drives. Any deviation in performance or operation from what is expected can be traced to some specific cause. Variances from initial performance will indicate changing system conditions, wear, or impending breakdown of the unit.

WARNING: Before initiating maintenance procedures disconnect all power sources to the equipment and accessories and completely discharge all parts and accessories which may retain electric charge. Failure to comply may result in severe personal injury or death.

SECTION 14 – TROUBLESHOOTING

Corrective maintenance procedures include functions of the pump and its components during troubleshooting for isolating and remedying bad operation. Before pulling the pump bowl from the well, the Installation and Operation Manual should be reviewed for causes of reduced performance not related to the condition of the bowl assembly. Some of the possible causes of reduced performance could be:

1. Incorrect lateral adjustment. (This is especially critical with units utilizing semi-open impellers).
2. Well conditions such as gas or air in the water.
3. Change in operating conditions such as increased pumping water level or increased discharge head requirements.
4. Slow motor speed due to overload, low voltage or low frequency.
5. Incorrect direction of rotation.
6. Strainer clogged or suction "sanded in".
7. Inadequate submergence of pump suction.

After the pump bowls have been pulled but before sending to the shop for repairs, check the bottom impeller for foreign material such as rocks or wood chips. Also check the strainer for obstructions.



SECTION 15 – PUMP DISASSEMBLY AND REASSEMBLY

PUMP DISASSEMBLY

NOTE: Pump components should be match marked prior to disassembly

Clear a large area adjacent to the pump as a storage space for pump parts as they are disassembled. If the pump has a long column, arrange parallel timbers on the ground to support the pump column and shaft sections horizontally. After disassembly for repair or replacement of pump components, reassemble in all cases.

WARNING: Do not attempt to lift the entire pump by the lifting lugs of the driver. These lugs and bolts cannot support the weight of the entire pump.

CAUTION: When lifting the pump use the appropriate lifting eyes located on the driver stand. In the case where the pump exceeds 20,000 lbs, consider disassembly by components.

It is recommended that maintenance personnel become thoroughly familiar with the PW610 pump before performing any removal of the components. Consult the manufacturer's instructions for detailed disassembly information for the prime mover, driveshaft, gear drive, motor and mechanical seal, as applicable.

1. On pumps which are driven through a gear drive remove driveshaft between the gear drive and prime mover on. Pumps equipped with an electric motor drive, remove the electrical connection at the conduit box and tag electrical leads at the motor.

WARNING: Before opening the conduit box of an electrical motor, be sure that the current to the motor is shut off. Severe injury to personnel could result if contact with live motor leads is made.

2. Match mark parts in sequence of disassembly to aid in the reassembly procedure.
3. Disconnect the discharge piping from discharge head. If driver is equipped with an oil-cooling system, remove the external tubing or piping as required.

SOLID SHAFT DRIVER REMOVAL

1. Remove nuts (9) and cap screws (8) and disconnect spacer or nonspacer coupling as applicable. *See Annex A for Cross Sections.*
2. Remove cap screws that secure driver to discharge head or driver support (1) and lift driver off the discharge head, or driver support.
3. Remove nuts (9), cap screws (8), spacer (5), unscrew adjusting plate (6), pump hub (7), driver hub (4), remove keys (10 and 11) and split ring (12).

WARNING: Do not work under a heavy suspended object unless there is a positive support under it which will protect personnel should a hoist or sling fail.

4. DRIVER SHAFT END PLAY. When the driver, solid shaft motor or gear drive is disassembled, shaft end play shall be checked with dial indicator prior to connecting



pump coupling to the applicable driver. Consult the applicable driver manufacturer's instruction manual for detailed information on shaft end play adjustment.

MECHANICAL SEAL REMOVAL

Instructions for each seal are provided with the seal, if instructions are not available, the following information applies for most seals furnished:

1. **INSIDE MOUNTED SEAL**-If seal is provided with eccentric washers, swing them into the slot in the sleeve and lock them into position before loosening setscrews, so that seal may be reset. If the seal does not have eccentric washers or a spacer, mark position of seal using a flat scribing tool; before loosening setscrews. Remove gland cap screws, and slide seal off the shaft.
2. **DOUBLE SEAL**-If seal is provided with eccentric washers swing them into the slot in the sleeve and lock them into position before loosening setscrews. Remove cap screws that secure gland. Carefully slide gland, rotating unit and stationary seat, to ensure not to damage gaskets and O-rings.
3. **TANDEM SEAL**-If seal is provided with eccentric washers, swing them into the slot in the sleeve and lock them into position before loosening setscrews, so that seal may be reset, If the seal does not have eccentric washers or a spacer, mark position of seal using a flat scribing tool, before loosening setscrews. Remove gland cap screws, and slide seal off the shaft.

DISCHARGE HEAD AND COLUMN REMOVAL

1. Remove cap screws (46) that secure discharge head to barrel.
2. If pump is provided with a driver support (1) remove cap screws (2) and hoist off the discharge head.
3. Pass two slings through hand holes on discharge head or place an elevator clamp just below the discharge head flange, if discharge does not have hand holes and hoist entire pump straight upward to a comfortable working height. Fasten an elevator clamp approximately two feet below the column (25). Place two I-beams across the barrel opening. Lower pump until the elevator clamp rests on the I-beams.
4. Remove cap screws (26) and hoist discharge head off the top column (25). Remove bearing retainer if applicable.
5. Attach the sling to the elevator clamp and raise pump until the next column flange is above the barrel flange. Fasten another elevator clamp below the next column flange and lower the pump until elevator clamp rests on the I-beams and remove the sling.
6. Disconnect line-shaft from threaded coupling and remove from lineshaft (13). Remove coupling and remove bearing retainer.

NOTE: Shaft threads are left hand. CAUTION: If threaded coupling will not readily unscrew, apply heat to coupling (not to shaft), for approximately 30 seconds, at the same time applying torque to the shaft.



7. Disconnect additional lengths of column and lineshafts as required until top bowl (31) is reached.
8. Install two eyebolts diametrically opposite in bowl assembly. Attach a sling to eyebolts and to hoist hook. Hoist bowl assembly and place horizontally on blocks.

BOWL DISASSEMBLY. The bowl assembly is composed of a suction bell, intermediate bowl, top bowl, enclosed impellers with taper collets, enclosed impellers with thrust collars, bearings and a barrel.

NOTE: Match mark bowl assembly in sequence of disassembly to aid in the reassembly procedure.

TURBINE BOWLS. Turbine bowl impellers are secured to the shaft by either a taper collet or by standard key construction.

TURBINE BOWL-WEAR RINGS REMOVAL

1. Utilizing a diamond point chisel, cut two "V" shape grooves on the bowl wear ring approximately 180 degrees apart. Use extreme care not to damage the wear ring seat.
2. With a chisel or equal, knock the end of one half of the ring in and pry ring out.
3. On special materials, such as chrome steel, set up the bowl in a lathe and machine the wear ring off. Use extreme care not to machine or damage the ring seat.

TURBINE BOWL-IMPELLER WEAR RING REMOVAL

Set up impeller in a lathe and machine wear ring off. Use extreme care not to machine or damage ring seat or impeller hub.

BOWL, SUCTION BELL AND RETAINER BEARING REMOVAL

1. Utilizing an arbor press and a piece of pipe or sleeve with outside diameter slightly smaller than bowl and retainer bearing housing, press the bearing off.
2. Remove suction bell bearing by setting suction bell on a lathe and machine bearing off. Suction bell bearing may also be removed by using bearing pullers and pulling bearing out.

NOTE: Bowl bearings are press fit. Do not remove unless replacement is necessary.

INSPECTION AND REPLACEMENT

1. Clean all pump parts thoroughly with a suitable cleaner.
2. Check bearing retainers for deformation and wear.
3. Check shafts for straightness and excessive wear on bearing surfaces. Check deflection of shafts; average total runout shall not exceed 0.003" T.I.R

4. On pumps equipped with a mechanical seal, check that shaft or sleeve is free of pits, burrs or sharp edges to prevent cutting or improper sealing of O-ring. Remove burrs and sharp edges by polishing with a fine crocus cloth.
5. Visually check impellers and bowls for cracks and pitting. Check all bowl bearings for excessive wear and corrosion.
6. Replace all badly worn or damaged parts with new parts. In addition, replace all gaskets, o-rings and packing as required.

TURBINE BOWL AND IMPELLER WEAR RING INSTALLATION

Place the bowl on a flat surface with the flange side facing up. Use liquid nitrogen or other method to shrink wear rings and drop in. Press until the wear ring face is even with the bowl bore face. Cast Iron or materials that are not easily fused should be secured with installation pins. 400 series stainless or other materials that can be fused should be welded in place to secure them.

Impellers should be placed on a flat surface with the eye side facing up. Heat impeller wear rings until they expand and then drop them on impeller (certain materials should not be heated or heated too long, especially wear rings with coatings). Press until flush. As before, use installation pins where appropriate or fuse wear rings where appropriate.

BOWL, SUCTION BELL, AND RETAINER BEARING INSTALLATION

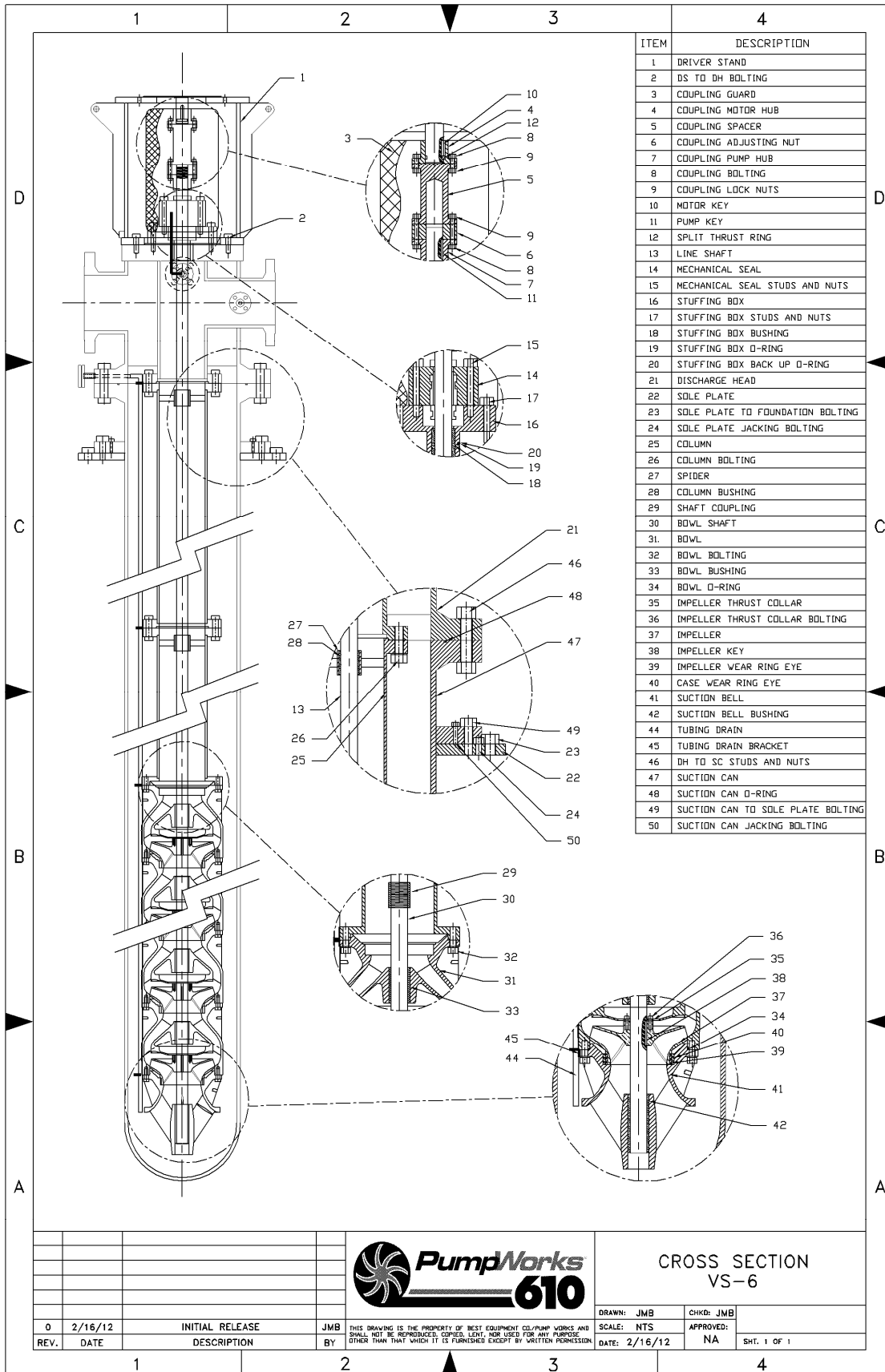
1. Press bearing (28) into spider using an arbor press or equal. *See Annex A for Cross Sections.*
2. Press bearing (42) into suction bell (41) using an arbor press or equal.
3. Press bearings (33) into bowl (31). Place the bowl with the flange downward and press bearing through chamfered side of bowl hub until bearing is flush with hub, use an arbor press or equal.
4. For running-installed clearances see Annex "B"



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ANNEX "A"

VS-6 & VS-1 CROSS SECTIONS

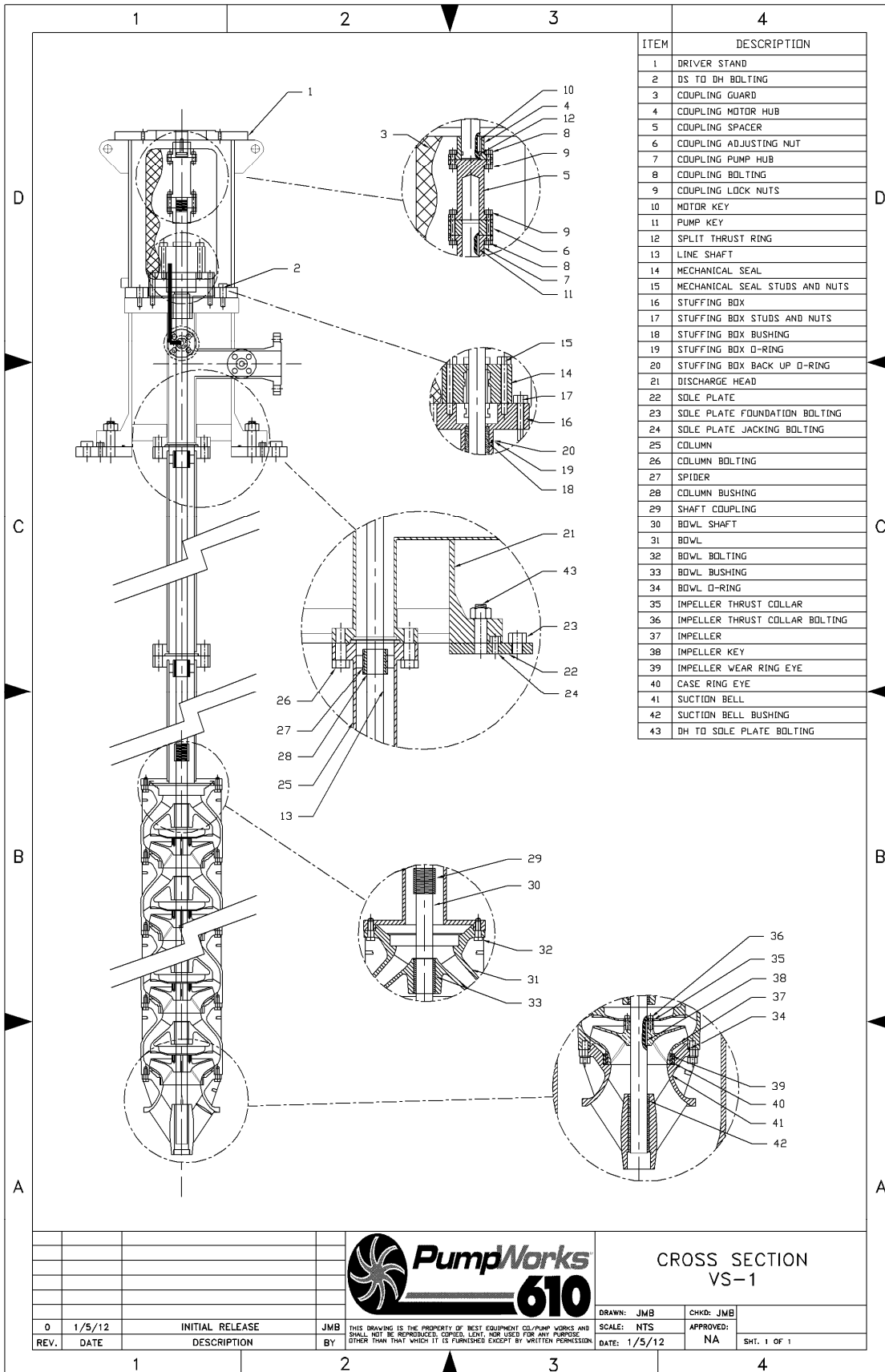


CROSS SECTION
VS-6

REV.	DATE	DESCRIPTION	BY
0	2/16/12	INITIAL RELEASE	JMB

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SCALE: NTS	APPROVED: NA
DATE: 2/16/12	SHT. 1 OF 1



CROSS SECTION
VS-1

0	1/5/12	INITIAL RELEASE	JMB	THIS DRAWING IS THE PROPERTY OF BEST EQUIPMENT CO./PUMP WORKS AND SHALL NOT BE REPRODUCED, COPIED, LENT, NOR USED FOR ANY PURPOSE OTHER THAN THAT WHICH IT IS FURNISHED EXCEPT BY WRITTEN PERMISSION	DRAWN: JMB	CHKD: JMB
REV.	DATE	DESCRIPTION	BY		SCALE: NTS	APPROVED: NA
					DATE: 1/5/12	SHT. 1 OF 1



ANNEX “B”

PWV RUNNING-INSTALLED CLARENCES

PUMP SIZE	SHAFT DIA.	NOMINAL DIAMETRICAL CLEARNACE – SHAFT TO BEARING	NOMINAL DIAMETRICAL CLEARANCE – IMPELLER WEAR RING TO BOWL WEAR RING	AXIAL CLEARANCE END PLAY
6LK	1	0.006-0.008	0.011-0.013	1/4
6JO	1	0.006-0.008	0.011-0.013	7/16
6JK	1	0.006-0.008	0.011-0.013	3/8
7YK	1	0.006-0.008	0.014-0.016	3/8
8FK	1 3/16	0.006-0.008	0.014-0.016	3/8
8JK	1 3/16	0.006-0.008	0.014-0.016	9/16
8JO	1 3/16	0.006-0.008	0.014-0.016	9/16
8LK	1 3/16	0.006-0.008	0.014-0.016	7/15
8XK	1 3/16	0.006-0.008	0.014-0.016	7/16
10LK	1 1/2	0.007-0.009	0.015-0.017	1/2
10JK	1 1/2	0.007-0.009	0.015-0.017	1/2
10XK	1 1/2	0.007-0.009	0.015-0.017	1/2
10DO	1 1/2	0.007-0.009	0.015-0.017	1/2
10DK	1 1/2	0.007-0.009	0.015-0.017	9/16
10HK	1 1/2	0.007-0.009	0.015-0.017	7/8
10FK	1 11/16	0.007-0.009	0.015-0.017	9/16
11JK	1 11/16	0.007-0.009	0.016-0.018	9/16
12LK	1 11/16	0.007-0.009	0.016-0.018	1/2
12DO	1 11/16	0.007-0.009	0.016-0.018	5/8
12DK	1 11/16	0.007-0.009	0.016-0.018	5/8
12FK	1 11/16	0.007-0.009	0.016-0.018	1/2
14LK	1 15/16	0.007-0.009	0.017-0.019	5/8
14JK	1 15/16	0.007-0.009	0.017-0.019	5/8
14DO	1 15/16	0.007-0.009	0.017-0.019	3/4
14DK	1 15/16	0.007-0.009	0.017-0.019	7/8
14FK	1 15/16	0.007-0.009	0.017-0.019	1
15DK	2 1/4	0.010-0.012	0.018-0.020	7/8
16MK	2 1/4	0.010-0.012	0.019-0.021	9/16
18MK	2 1/4	0.010-0.012	0.020-0.022	5/8
20MK	2 7/16	0.011-0.013	0.021-0.023	3/4
22BK	2 7/16	0.011-0.013	0.022-0.024	11/4

Note: All dimensions in inches