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PWI-BB

API 610
VERTICAL IN-LINE
SINGLE STAGE OH3

PumpWorks™ 610

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

INSTALLATION OPERATION AND MAINTENANCE MANUAL

VERTICAL INLINE SINGLE STAGE PWI-BB SERIES

8885. Monroe St. Houston, Texas USA 77061
Phone: (713) 956-2002
Fax(713) 956-2141

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Section 1 – PWI Pump Description

The Pump Works 610 PWIBB pump is a single stage, vertical in-line centrifugal pump manufactured in accordance with the American Petroleum Institute (API) Standard 610.

Our PWI-BB (OH3) design features a vertical bearing housing system to take the radial and axial forces exerted upon the pump and connects the pump and driver with a flexible spacer coupling. These systems allow for the removal of the mechanical seal without removing the driver or suction and discharge piping.

NOTE: *All reference part numbers (provided in parentheses) in this manual refer to the typical sectional drawing, Figure 3, Figure 4, and Figure 5.*

Section 2 - Handling & Storage

Inspection

Upon receipt, carefully inspect the unit for damage and validate against the bill of lading. Report any damaged or missing items to the carrier's local representative and submit a copy of the report to PumpWorks 610. While removing packaging do not discard any small accessories that may be attached.

Handling

Lift the complete unit using the provided lifting lugs on the pump driver stand (4300) with proper lifting techniques.

Storage - Short Term

When storing the unit for less than 6 months prior to installation, store on a skid in a dry location to protect the unit from moisture, sand, grit, and other contaminants. Do not remove the provided protective covers on the suction and discharge flanges.

Storage - Long Term

When storing the unit more than 6 months prior to installation, the pump must be covered or stored indoors. Perform the following upon receipt and at 6-month intervals:

1. Prior to storage, remove the oil vent plug (5300.5) and fill the bearing housing with one quarter of vapor emitting oil. Reinstall vent plug.

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2. Coat all unpainted exterior machined surfaces liberally with a light petroleum grease or equivalent rust preventative.

3. Rotate pump shaft (3560) 3.5 turns (180º from original position).

4. Remove the protective covers on the suction and discharge flanges. Remove any visible rust on internal surfaces and coat with a light petroleum grease or equivalent rust preventative. Replace protective covers on the flanges.

NOTE: *Accumulation of condensation in the unit must be avoided. Store the unit away from climatic extremes.*

When auxiliary equipment such as drivers, mechanical seals (6600.1), or instrumentation is provided, additional preparation for long term storage may be required. Refer to the appropriate manufacturer's literature for specific instructions.

Section 3 - Installation

General

Support and anchor suction and discharge piping independently near the pump so strain will not be transmitted to the pump casing when flange bolting is tightened. Piping must independently align with the pump flanges; never force piping into place at suction or discharge flanges.

If an expansion joint or non-rigid pipe coupling is used, install a pipe anchor as near to the suction and/or discharge flanges as possible. Proper installation of the pipe anchor will eliminate any undesirable forces on the pump. Use large-radius elbows wherever possible. Flush all piping thoroughly to remove any foreign matter before connecting to the pump. Per the Hydraulic Institute, there should be at least five to ten pipe diameters of straight pipe length coming into the suction before the first fitting, strainer, or valve is installed, and it is preferable to have the same conditions after the discharge.

Location

The unit should be positioned as close to the suction source as practical, to optimize suction conditions, while ensuring sufficient clearance around the unit to allow for cooling and maintenance accessibility.

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Suction Piping

1. The nominal suction pipe diameter must be the same size as the nominal suction flange size.

2. Ensure that suction lines are sealed to avoid leakage and air pockets.

3. Per the Hydraulic Institute, reducers, if used, should be of the conical type and sufficiently long to prevent fluid turbulence. Contour type reducers are not recommended. Eccentric or concentric reducers may be used when the liquid source is above the pump and the suction piping is sloping upwards toward the source.

4. Start-up, cone-type suction strainers should be used and must have a net free area of at least three times the suction pipe area; they should point upstream into oncoming flow.

5. Installing a gate valve in the suction line permits closing the line for pump inspection and maintenance.

CAUTION: *Never throttle the pump with the suction valve; while pump is in operation, this valve should always be fully open.*

Discharge Piping

1. A check valve and gate valve should be installed in the discharge piping. The check valve, placed between the unit and gate valve, prevents pumpage from running back through the unit. The gate valve is used in priming, starting, and shutdown of the unit and to control discharge flow.

2. If increasers are used in the discharge piping, they should be located between the check valve and the unit.

Section 4 - Preparing for Operation

General

When pumps and drivers are received from the factory with the motor installed on the pump driver stand, they have been accurately aligned before shipment. Realignment is necessary after the suction and discharge piping have been installed.

Alignment should be checked after working on the mechanical seal or removing the driver to ensure minimal repair and maintenance of the unit after re-assembly.

Driver Lubrication

Motor bearings should be serviced and lubricated as outlined in the motor manufacturer's instructions.

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Bearing Housing Lubrication

The bearing housing incorporates an oil flinger (3660) and pumping ring (lube screw pump, (3800)) to circulate oil to the bearings . Fill the bearing housing through the closed system oiler (6650.1) with ISO/ASTM VG 32 oil. For lubrication changing intervals, refer to Section 7 Operational Checks.

Prior to installing the closed system oiler level, shaft rotation direction must be determined, typically indicated by an arrow on the casting of the equipment. Install oiler on the side of the equipment facing the direction of shaft rotation to prevent misfeeding of the oiler

Verify that there are no contaminants or noticeable particles in the closed system or bearing housing.

Fill the bearing housing through the main body of the closed system until oil reaches to ¼” below the level mark. Then fill the oiler bottle with oil until optimum fluid level visible through the sight glass. With 5/32” Allen key, adjust the collar to desired levels as indicated in fig 1.

Then fill the oiler reservoir with oil and place it in the oiler cup. The housing is filled when oil remains in the oiler bottle. It is recommended to fill oil through the oiler slowly in increments of few ounces ensuring the oil levels does not go above 13/16” the bottom level of sight glass shown in fig. 1. Oil can also be poured in through ½” port (5300.6).

If the oil level is not visible at the proper level, remove reservoir and reset level using set screws. Replace bottle (repeat operation until proper level is obtained). Refer fig # 1 for looking at the correct oil running levels in the bearing housing. The running oil level should surface at around 3/8” above the bottom line of the oiler 6650.1.

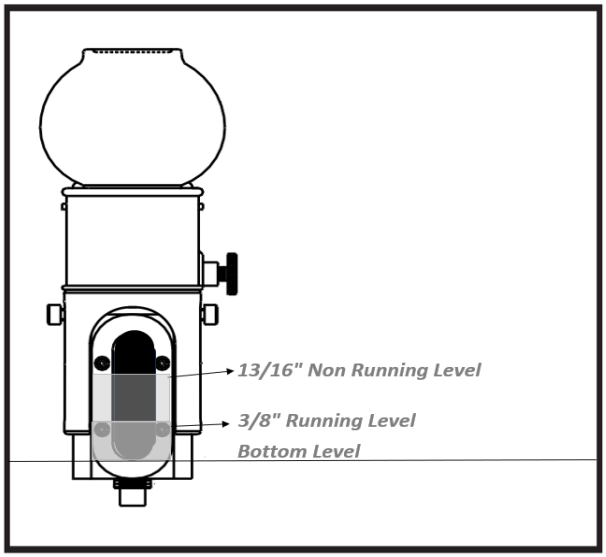

Figure 1: Proper Indications of Oil Levels

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After the bearing housing is filled with the oil, start up machine and verify proper oil level is being maintained.

Refer to figure # 2 for parts designation for Trico Oiler Level utilized in Pumpworks' PWIBB Pumps

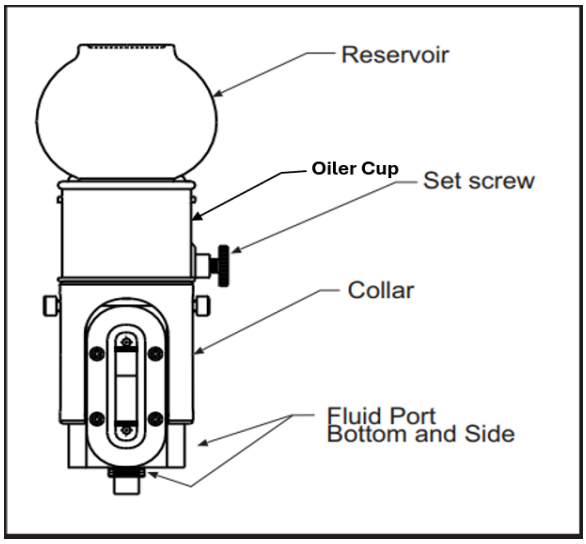

Figure 2: Oiler Level Assembly

Mechanical Seals

As a standard, the PWI-BB pump is equipped with a cartridge-type mechanical seal (6600.1), which complies with the service requirements outlined on the pump data sheet. The seals are factory-installed, and no adjustment is required.

NOTE: *Seal setting devices must be disengaged prior to start-up.*

Seal Flush Piping

Seal flush piping should be installed in accordance with the service requirements outlined in the pump data sheet and the seal manufacturer's recommendations. Vent seal cavity to prime seal and piping prior to start up. Refer to the general arrangement drawing and auxiliary system IOM details, as necessary, provided in the final data package.

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Rotation

The driver rotation must be verified prior to start-up. To check rotation, remove the coupling guard and coupling spacer to disengage the pump from the driver. Make momentary contact with the motor starter, also known as a “bump test”, to verify correct rotation.

WARNING: *Keep clear of rotating components when checking the motor rotation. Be sure that tools and loose hardware are clear before starting motor.*

High Temperature Operation

Pumps handling liquids at temperatures above 300º F (150º C) should be gradually brought to operating temperature prior to start-up. This can be accomplished by circulating hot pumpage through the pump and controlling the circulation so that the pump casing temperature rise does not exceed 150º F (37.8º C) per hour. The pump casing temperature must be within 75º F (24º C) of the pumpage before start-up and operation.

WARNING: *Bring the pump up to the operating temperature slowly before starting up. Severe thermal shock can damage the pump and cause injury*.

Section 5 – Operation

Operating Capacity

Centrifugal pumps should not be operated at greatly reduced capacity or with a closed discharge valve because the energy required to drive the pump is converted to heat and the temperature of the liquid may reach its bubble point. If this occurs, the rotating parts are exposed to vapor with no lubrication and damage to internal parts will occur.

There are several ways to protect the pump from damage:

1. Add a liquid temperature sensor to shut the pump down if the pumpage temperature exceeds a predetermined level. See the High Temperature Operation Passage of Section 4 for some guidelines.
2. Add a flow meter to the discharge with an alarm level set for the minimum continuous safe flow (MCSF) ability of the pump, which can be found on the pump data sheet. Operating below the MCSF increases the radial loading on the system, which can lead to shortened bearing life, decreases the NPSH of the pump, and can lead to internal cavitation.
3. Installing a constant open minimum-flow by-pass between the pump discharge and the suction source should unexpected blockage occur in the pipeline.
4. Adding a suction pressure sensor upstream from the pump to shut the pump down if the suction pressure drops below a predetermined level.

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5. Adding a vibration sensor to shut the pump down if the vibration level exceeds a predetermined value.

NOTE: *Never throttle pump on suction side. The suction valve should always be fully open during pump operation.*

Freezing

During cold weather when the pump is not in operation, the pump should be drained to prevent the liquid inside from freezing. Proper storage procedures should be followed while the pump is not in use.

WARNING: *If the pumpage is toxic, flammable, or corrosive, take proper precautions for handling pumpage before draining the pump.*

Shut-Down

To avoid water hammer, it is recommended that the discharge valve be partially closed to the minimum flow point just prior to shutting down the pump.

Section 6 - Starting the Pump

Start-up Checklist

Before starting the pump, check the following:

_ Pump rotation direction matches motor rotation direction (bump test)
_ Seal setting devices removed per seal manufacturer's recommendations
_ Seal flush piping is properly installed
_ Pump vent and drain lines installed, and any vent and drain valves closed after pump is primed.
_ Motor bearings lubricated per motor manufacturer's recommendations
_ Pump bearing housing has the appropriate level of oil to lubricate the pump bearings.
_ Pipe connections and plugs tightened and sealed
_ Coupling spacer installed and pump and driver aligned
_ Pump shaft rotates 360º freely
_ Coupling guards installed
_ Pump and all auxiliary systems are fully vented
_ Suction valve fully open
_ Discharge valve in start-up position

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_ Instrumentation connections made
_ All personnel clear of equipment

Priming

NOTE: *The pump casing, suction line and seal flush must be filled with liquid and fully vented BEFORE the pump is started.*

Starting

A centrifugal pump usually requires less power to operate with the discharge valve closed than with the discharge valve open. For this reason, it is recommended that this valve be partially closed when starting. However, **ensure the pump is not operating below the minimum stable flow conditions at any time**.

Start the pump and immediately bring to operating speed. Slowly open the discharge valve as soon as there is a discharge pressure indication. Continue opening the discharge valve until rated capacity and discharge pressure are obtained. If the rated conditions cannot be obtained, refer to the Trouble Checklist in Section 8.

Section 7 - Operational Checks

First 60 Minutes

It is recommended that the following parameters be recorded at 10-minute intervals during the first 60 minutes of operation and periodically thereafter:

1. Suction and discharge pressures
2. Pumpage temperature
3. Vibration levels
4. Leakage
5. Bearing housing temperature

Satisfactory operation is indicated by correct capacity, discharge pressure, and low vibration levels. Keep records for future troubleshooting reference and performance trend analysis.

A periodic check of the items listed above will ensure the pump is maintained in its best operating condition.

Mechanical Seal

Check mechanical seals for leakage during the first hours of operation. Minor leakage through the seal usually stops after a short operation period, but, if leakage continues, shut down the pump and investigate the cause. Excessive leakage past the seal generally indicates worn or broken parts requiring replacement.

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Lubrication

Driver Lubrication

Driver bearings should be serviced and lubricated according to the motor manufacturer's instructions. Consult lubrication directions on nameplate and literature provided in the final data package.

Pump Lubrication

Great care should be exercised to keep the housing clean and only clean lubricants should be used. Foreign solids or liquids within the bearing housing can completely ruin the bearings in a short time. Keep the oiler bottle filled with the correct grade of oil (See Section 4). Under normal conditions the oiler will maintain proper oil level. A routine check of the oil level will verify proper working order of the oiler.

After the initial start-up, change the oil after 24 hours of running time. Thereafter, change the oil at the following intervals:

Table 1: Oil Change Intervals

Service	Change	Check Level
High Temp	Monthly	Daily
Continuous	Every 3 Months	Weekly
Intermittent	Every 6 Months	Monthly

When changing the oil, flush the inside of the housing with clean oil to remove any accumulated contaminants.

Due to rolling friction and drag of the bearing races, heat is generated within the bearings, and they will operate at temperatures above the surrounding atmosphere unless cooled. Oil lubricated ball bearings can safely be operated up to 180°F (82.2°C) and bearing temperatures of 160°F (71.1°C) are normal. **Do not use the human hand as a thermometer.** Determine the temperatures accurately by placing a contact type thermometer against the bearing housing. Record this temperature on a regular basis and maintain a log of the reading. A stable temperature indicates normal operation.

Sudden increases in temperature or excessively high temperature are indications of operational problems or a pending bearing failure.

Check to see that oil is of proper viscosity and the oil level is neither too high nor too low.

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The unit should also be checked for unstable hydraulic operation and unnecessary mechanical loads, such as shaft misalignment.

Bearing Housing Temperatures

Periodically check bearing housing surface temperature. Normal bearing housing operating temperature is 125° - 180° F (50º - 80º C).

NOTE: *Stop the pump immediately if bearing housing temperature exceeds 190° F (88° C). Inspect for possible problems such as those stated above before restarting the pump.*

NOTE: ***Bearing housings equipped with water cooling coils are to be adjusted to operate to maintain an oil temperature no less than 25°F above the surrounding ambient temperature to prevent condensation.***

Section 8 - Trouble Checklist

No Liquid - No liquid discharge from the pump may be caused by:

1. Pump not primed.
2. Speed too low--check to see if motor receiving full voltage.
3. Insufficient NPSH available.
4. Impeller or piping plugged.
5. Wrong rotation.
6. Air leaks or pockets in suction line.

Insufficient Liquid - Insufficient liquid discharge may be caused by:

1. Speed too low.
2. Suction lift too high or insufficient NPSH available.
3. Impeller or piping partially plugged.
4. Wrong rotation.
5. Air leaks or pockets in suction line.
6. Mechanical defects (worn wear rings or impeller damage).

Insufficient Pressure - Insufficient pressure may be caused by:

1. Speed too low.
2. Air or gases in liquid.
3. Capacity too great.
4. Mechanical defects (worn wear rings or damaged impeller).
5. Wrong rotation.

Surges in Performance - Surges in performance may be caused by:

1. Air leak in suction line.
2. Air pocket in suction line.
3. Not enough NPSH available.

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4. Air or gases in liquid.
5. Impeller plugged, or unplugged, by debris.
6. Unstable current to the motor.

Excessive Power - Excessive power consumption may be caused by:

1. Improper operational speed.
2. Head too low (causing excessive capacity).
3. Specific gravity or viscosity of liquid pumped has been modified from its originally rated condition.
4. Mechanical defects (bent shaft, worn wear rings, etc.).
5. System resistance is too low, causing excessive pump flow.

Section 9 - Maintenance

General

Follow procedure below for PWIBB pumps. For procedures specific to a particular unit, refer to the drawings and instructions supplied in the final data package with that unit.

WARNING: *Be sure that power to the motor is off and locked out before starting maintenance procedures.*

Pump Disassembly

The disassembly procedure applies generally to all PWIBB pumps supplied with a cartridge-type seal. Refer to the specific drawings supplied with your unit to augment this procedure.

NOTE: *Typical sectional drawings are for disassembly and assembly purposes only and should not be used for specific detailed dimensions.*

1. Turn power off and lock in off position.

   WARNING: *Be sure the power to the motor is turned off and locked in the off position before beginning disassembly.*

2. Close suction and discharge gate valves and any auxiliary valves.

   NOTE: *The back pull-out design of this pump allows the complete Back Pull-Out unit to be removed without disturbing the suction and discharge piping or the driver.*

3. Drain the pump by opening the case drain.

   WARNING: *If the pumpage is toxic, flammable or corrosive take proper precautions for handling pumpage before draining the pump.*

4. Disconnect and remove all seal flush piping after the pump is completely drained.

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5. If the pump is equipped with an auxiliary seal flush reservoir, drain the reservoir and disconnect the seal flush piping.

NOTE: *Always cap off open ports and lines to prevent dirt from entering.*

6. Remove coupling guard.

7. Remove oiler bulb guard (6650.2) from the bearing housing

8. Disassemble and remove coupling spacer (4500). Remove pump coupling hub and coupling key (8160.2).

9. Remove cap screws (7000.3) that secure driver stand (4300) to pump casing (2400.2) or casing cover (3640) and lift driver standoff of pump casing or casing cover with a lifting strap or hook attached to driver stand lifting lug slots.

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.*

10. Remove nuts (7600.2) attaching casing cover (3640) to pump casing (2400.2) and remove casing cover by tightening jack bolts in the tapped holes in casing cover to facilitate removal of the rotating assembly.

11. Safely lift the back pull-out unit comprising case cover (3640), Impeller (3800), and bearing housing power frame and put it on a clean area. Remove casing gasket (6800.1).

CAUTION: *The back pull out unit with the bearing housing is very heavy. Proper lifting equipment must be used to avoid injury.*

Disassembly of Back Pull-Out Unit

After the complete back pull-out unit has been taken to a clean work area, the unit can be fully dismantled by following the instructions given below and referring frequently to the pump sectional drawing Figure 5.

1. Remove impeller lockbolt set screw (7200), if installed, and impeller lockbolt (3620).

   NOTE: *The impeller lockbolt loosens in a clockwise direction. It has a left-hand thread.*

2. Remove impeller (3800) and impeller key (8160.1). The impeller is a slip fit but may require the use of a puller for removal.

CAUTION: *Do not bend or damage the impeller when removing with a puller.*

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3. Unscrew cap screws (7100.2) holding bearing bracket (3900) to casing cover (3640) and pull casing cover and seal from bearing housing assembly.

CAUTION: *When separating the casing cover from the bearing bracket, be careful not to damage the mechanical seal. Be careful while handling bearing housing assembly since its very heavy and could cause injuries*

4. Loosen seal stud nuts (7600.1) securing mechanical seal (6600.1) to case cover (3640).

5. Replace seal setting devices per seal manufacturer's recommendation. Engage seal locating devices then loosen set screws fastening seal drive collar to shaft (3560).

6. Remove nuts (7600.1) attaching seal (6600.1) to casing cover (3640).

7. Unbolt and remove the cartridge seal assembly (6600.1) and seal chamber gasket from casing cover. Refer to the manufacturer's instructions for seal maintenance.

8. To disassemble casing/cover wear rings (3600.3, 3600.4), remove set screws holding the wear ring if any. Remove the wear ring. NOTE: *Some Wear Rings Are Fuse Welded in Place.*

9. To remove the throat bushing (3750), grind off welds between cover and bushing and remove bushing.

10. For disassembly of bearing housing see following instructions.

Bearing Housing Disassembly

After dismantling the casing cover, the bearing bracket can be disassembled.

1. Remove pump coupling hub and drive key (8160.2)

2. Unscrew fan set screw(7200.3) and remove the fan guard (4600), inboard heat sink (3580.1), and fan (3580.2) as applicable.

3. Loosen cap screws (7100.3) and remove outboard end cap/bearing seal assembly (3640.1, 6550.1), and plastic shims (7900.1, 7900.2).

4. Slide shaft assembly out of bearing bracket.

5. Remove lube screw pump (3800) off the shaft by pulling it out gently

6. Remove ball bearing locknut and lock washer (6100, 6120) from fan shaft.

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7. Using a press with appropriate fixturing, remove thrust bearings (6050.2) and radial bearing (6050.1) from the pump shaft.

8. Remove oil rings (6050.1) from shaft or loosen set screws and remove oil flinger (3660) by loosening set screws.

11. Remove inboard heat sink (3580.1) and oil reservoir cover (3640.2) out of the bearing housings from the inboard side.

Inspection of Pump Parts

Clean all parts with an appropriate cleaning solvent and inspect for wear or damage. Closely inspect sleeve bearings, wear rings, and shaft keyways and keys. Replace any part that shows signs of wear or damage.

Impeller

Inspect impeller (3800) passages and vane surfaces for evidence of erosion. Replace if excessively worn or corroded. The impeller is dynamically balanced at the factory, and balance must be maintained for proper operation of the pump.

Case & Impeller Wear Rings

Impeller wear rings allow a small clearance to be maintained between the rotating impeller and the stationary casing. For proper hydraulic performance, rings should be replaced when excessive increase in clearance begins to affect performance. The Hydraulic Institute recommends 40% increase in running clearance before the impeller wear rings should be replaced. Refer Table 2 for running and replacement clearances.

Table 2: Standard Running and Replacement Clearance

Wear Ring Diameter (in)	Min. Diametrical Clearance		Replacement Clearance	
	(in)	*(µm)*	*(in)*	*(µm)*
3.500 - 3.999	0.014	356	0.020	498
4.000 - 4.499	0.015	381	0.021	533
4.500 - 4.999	0.016	406	0.022	568
5.000 - 5.999	0.017	432	0.024	605
6.000 - 6.999	0.018	457	0.025	640
7.000 - 7.999	0.019	483	0.027	676
8.000 - 8.999	0.02	508	0.028	711
9.000 - 9.999	0.021	533	0.029	746
10.000 - 10.999	0.022	559	0.031	783

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Wear Ring Diameter (in)	Min. Diametrical Clearance		Replacement Clearance	
	(in)	*(µm)*	*(in)*	*(µm)*
11.000 - 11.999	0.023	584	0.032	818
12.000 - 12.999	0.024	610	0.034	854
13.000 - 13.999	0.025	635	0.035	889

NOTE: *Refer PWIBB Open face Impeller Addendum for clearance check between Impeller and Case if open face impeller is used in the pump. For materials with known galling tendencies, and for all materials operating at temperatures above 500º F, add 0.005"(127 micrometers) to the above diametrical clearances. Pumps utilizing special non-galling wear materials may use smaller wear ring clearances. The clearances referenced above act as a guideline, with the final clearances determined by PumpWorks 610 for each process condition like conditions where vespel and graphalloy bushings are utilized for wear rings.*

Seals

Inspect all mechanical seals (6600.1) for irregularities or damage. Consult the seal manufacturer's data for seal reconditioning and service. Seal faces, "O" rings and the seal sleeve must be in perfect condition. Replace all worn parts.

Shaft and Throat Bushing

Inspect the shaft (3560) for damage and straightness. Dress minor damage and polish areas where the shaft contacts a seal. Support the shaft in rollers or V-blocks about ¼ of the overall length from each end and check run-out. Run-out must not exceed .002-inch TIR on all diameters. The clearance between shaft and throat bushing must be maintained to 0.030”. If excessive clearance rises to 40% of the original design clearance, its time to replace throat bushing as well.

General

All parts should be cleaned before assembly. This is especially important at "O" ring grooves, threads, cylindrical fits, and gasket surfaces. Any burred edge must be removed before part is installed into the pump. Coat all parts with light oil and cover with protective cloth if the pump is not immediately reassembled.

Assembly

When assembling these PWIBB pumps, it is recommended that only genuine PumpWorks 610 parts be used. Always use new O-rings, gaskets, (oil new bulbs, sight gauge if applicable) and lock washers. Assembled parts must be clean and free of dust or dirt.

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Bearing Housing Assembly

The bearing bracket can be reassembled by following the instructions given below and by referring to the pump drawing Figure 3 and Figure 4.

NOTE: The bearing bracket is common for both the mechanical seal and Seal Reservoir arrangements.

1. Assemble oil flinger, if applicable, (3660) on shaft (3560) against the shoulder and lock in place with set screws.

2. Press inboard bearing seal (6550.2) and firmly seat into bearing housing (3900) if removed during disassembly.

NOTE: Bearing housing should be positioned upside down to install inboard bearing seal. Ensure it firmly rests against the bearing housing shoulder.

3. Gently insert the oil reservoir cover (3800) into the bearing housing as well.

4. Lubricate thrust bearing seat on shaft. Slide thrust bearing (6050.2) on shaft (3560) as far as possible by hand to rest against the shoulder. Let thrust bearing heat-soak in an induction bearing heater or oil bath up to 250F. (note: this should be applied to both radial bearings as well as thrust bearings. Also refer SKF's catalogue for more guidance on Bearings Installation for Deep Groove Ball Bearings and Angular Contact Ball Bearings).

NOTE: Install thrust bearings back-to-back. Generally, this means that the markings on the outer race are installed together. Bearings must always be replaced in pairs.

5. Assemble thrust bearing lockwasher (6120) and locknut (6100). Crimp tab of lockwasher into bearing locknut slot.

6. Apply step number 4 for placing radial bearing against the shaft shoulder.

7. Install lube screw pump (3800) into the shaft

8. Slide shaft along with lube screw pump, radial and thrust bearings, and oil flingers into the bearing housing (3900).

9. Install outboard bearing end cap/bearing seal assembly (3640.1, 6550.1), and plastic shims (7900.1, 7900.2) onto bearing housing.

10. Check axial end play of shaft. End play should be adjusted to 0.003" to 0.005" by adding or removing shims between bearing housing end cover and bearing housing.

11. After making sure inboard bearing seal is firmly pressed into the bearing housing and shaft, rotate shaft to check for possible rubs on Isomag seals and adjust if necessary.

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11. Install oil ring retainers, if applicable.

12. Install inboard heat sink (3580.1), outboard fan (3580.2), and fan shroud (4600) as required.

13. Install pump coupling hub and drive key (8160.2).

Assembly of Back Pull-out Unit

The back pull-out unit can be reassembled by following the instructions given below and referring to the appropriate pump sectional drawing Figure 5.

1. For assembly of bearing bracket see preceding instructions.

2. If removed during disassembly press throat bushing (3750) into casing cover (3640).

3. If removed during disassembly, press casing and / or cover wear rings (3600.3, 3600.4) into casing and / or cover and fusion weld in four locations, equispaced. Check rings for proper clearance to the impeller rings by referring Table 1.

4. Lubricate pump shaft and slide cartridge seal assembly onto the shaft.

CAUTION: *Care must be taken not to damage seal sleeve gasket or seal face.*

5. Place gland gasket (6800.2) on pilot or in groove of gland plate.

6. Slide casing cover (3640) over pump shaft (3560) and seal.

7. Draw gland nuts up evenly until metal-to-metal contact is realized between seal gland and cover. Put the bearing housing in a vertical position with outer flange facing upwards and secure bearing housing mounting screws (7100.2) and insert and tighten them into the case cover (3640) by sliding the pump shaft into the bearing housing.

8. After completing above steps, install impeller key (8160.1) and impeller (3800) by locking those two components with a lockbolt (or locknut, 3620). Mount two set screws (7200) into the lockbolt. The impeller is a very snug slip fit; therefore, the use of gentle force may be required to fully seat it to the shaft shoulder. Remember to press fit the Impeller wear rings before locking impeller with the pump shaft.

9. Tighten the seal drive collar set screws and packing sleeve if applicable.

10. Check shaft and make sure it is free to rotate. Re-engage seal locating device prior to storing or installing back pull-out unit in casing.

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Note: Comply with Seal OEM Manual for proper installation and maintenance protocols.

Assembly of Back Pull-Out Unit to Pump Casing

The pump back pull-out unit which includes the impeller (3800), the casing cover (3640), the bearing bracket (4300), and the shaft (3560) is now ready for reassembly to the pump in the field. Follow the instructions given below and refer to the pump sectional drawing Figure 5.

1. Return complete Back Pull-Out unit to pump.
2. Put casing gasket (6800.1) over cover pilot groove and slide Back Pull-Out unit into casing (2400.2) and tighten casing stud nuts evenly.
3. Attach a lifting strap or hook to the lifting lugs of the driver stand (4300) and bring the driver stand on the top of casing cover (3640).

CAUTION: *Check shaft that it is free to rotate and does not bind.*

4. Put motor stand bolts (7000.4) down on the bottom plate protruding into the casing cover (3640) and secure them tightly.
5. Install coupling spacer and lubricate if required.
6. Check coupling alignment. Refer to Preparation for Start-Up.
7. Install coupling guard.
8. Replace all previously removed piping.
9. Refer to the Preparation for Start-Up section.

Section 10 – Torque Values

Recommended Stud Torque Values

Table 3: Recommended Stud Torque Values

Material		A193 GR B6/B6M	A193 GR B7 / A193 GR B7M	A193 GR B8 /A193 B8M CLASS 1	SAE CARBON STEEL GRADE 1 GRADE 2
Nominal Dia. (in)	Threads per Inch	Recommended Torque (ft-lb)			
3/4	10	175	216	62	63
7/8	9	282	349	100	101
1	8	423	522	149	151

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Material		A193 GR B6/B6M	A193 GR B7 / A193 GR B7M	A193 GR B8 /A193 B8M CLASS 1	SAE CARBON STEEL GRADE 1 GRADE 2
Nominal Dia. (in)	Threads per Inch	Recommended Torque (ft-lb)			
1-1/8	8	619	766	219	222
1-1/4	8	870	1074	307	312
1-3/8	8	1179	1457	416	423
1-1/2	8	1555	1922	549	557
1-5/8	8	2003	2475	707	718
1-3/4	8	2530	3126	893	907
2	8	3846	4750	1357	1378
2-1/2	8	7698	9510	2717	2759

Material: ASTM A193 GR B7
Lubricant: Nickel-based Anti-sieze (μ = .13)

Section 11 - Spare Parts

Save time and money by maintaining one complete set of the essential wearing parts for each pump. Do not wait until breakdown occurs. Recommended spare parts for the PWIBB are tabulated below.

Table 4: Spare Parts

SECTIONAL REFERENCE NUMBER	DESCRIPTION	START-UP	PUMP RECONDITION	CRITICAL SERVICE
6800.1	Casing Gasket	1	1	2
6600.1	Cartridge Seal	1	1	1
3800	Impeller	-	1	1
3620	Impeller Locknut	-	1	1
3560	Shaft	-	1	1
3600.1 3600.2	Impeller Wear Rings	-	2	2
3600.3 3600.4	Casing Wear Rings	-	2	2
6050.1	Radial Bearing	-	1	2
6050.2	Thrust Bearing	-	2	2
3800	Oil Pump	-	1	1
3660	Oil Flinger Disc	-	1	1
6550.2	Bearing Isolator Inboard	-	1	1
6550.1	Bearing Isolator Outboard	-	1	1

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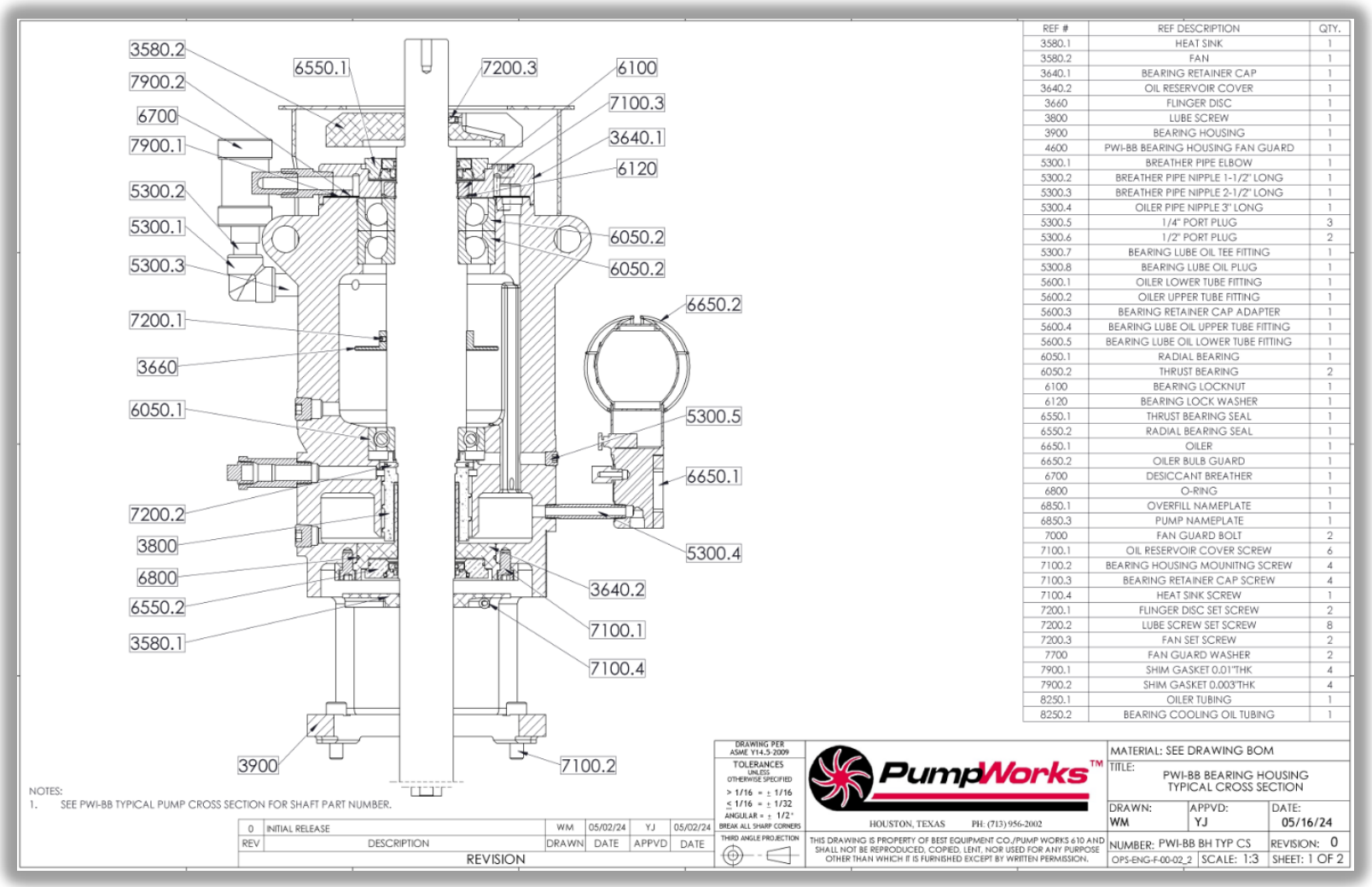

REF #	REF DESCRIPTION	QTY.
3580.1	HEAT SINK	1
3580.2	FAN	1
3640.1	BEARING RETAINER CAP	1
3640.2	OIL RESERVOIR COVER	1
3660	FLINGER DISC	1
3800	LUBE SCREW	1
3900	BEARING HOUSING	1
4600	PWI-BB BEARING HOUSING FAN GUARD	1
5300.1	BREATHER PIPE ELBOW	1
5300.2	BREATHER PIPE NIPPLE 1-1/2" LONG	1
5300.3	BREATHER PIPE NIPPLE 2-1/2" LONG	1
5300.4	OILER PIPE NIPPLE 3" LONG	1
5300.5	1/4" PORT PLUG	3
5300.6	1/2" PORT PLUG	2
5300.7	BEARING LUBE OIL TEE FITTING	1
5300.8	BEARING LUBE OIL PLUG	1
5600.1	OILER LOWER TUBE FITTING	1
5600.2	OILER UPPER TUBE FITTING	1
5600.3	BEARING RETAINER CAP ADAPTER	1
5600.4	BEARING LUBE OIL UPPER TUBE FITTING	1
5600.5	BEARING LUBE OIL LOWER TUBE FITTING	1
6050.1	RADIAL BEARING	1
6050.2	THRUST BEARING	2
6100	BEARING LOCKNUT	1
6120	BEARING LOCK WASHER	1
6550.1	THRUST BEARING SEAL	1
6550.2	RADIAL BEARING SEAL	1
6650.1	OILER	1
6650.2	OILER BULB GUARD	1
6700	DESICCANT BREATHER	1
6800	O-RING	1
6850.1	OVERFILL NAMEPLATE	1
6850.3	PUMP NAMEPLATE	1
7000	FAN GUARD BOLT	2
7100.1	OIL RESERVOIR COVER SCREW	6
7100.2	BEARING HOUSING MOUNITNG SCREW	4
7100.3	BEARING RETAINER CAP SCREW	4
7100.4	HEAT SINK SCREW	1
7200.1	FLINGER DISC SET SCREW	2
7200.2	LUBE SCREW SET SCREW	8
7200.3	FAN SET SCREW	2
7700	FAN GUARD WASHER	2
7900.1	SHIM GASKET 0.01"THK	4
7900.2	SHIM GASKET 0.003"THK	4
8250.1	OILER TUBING	1
8250.2	BEARING COOLING OIL TUBING	1

Figure 3: Typical PWIBB Bearing Housing Cross Section 1

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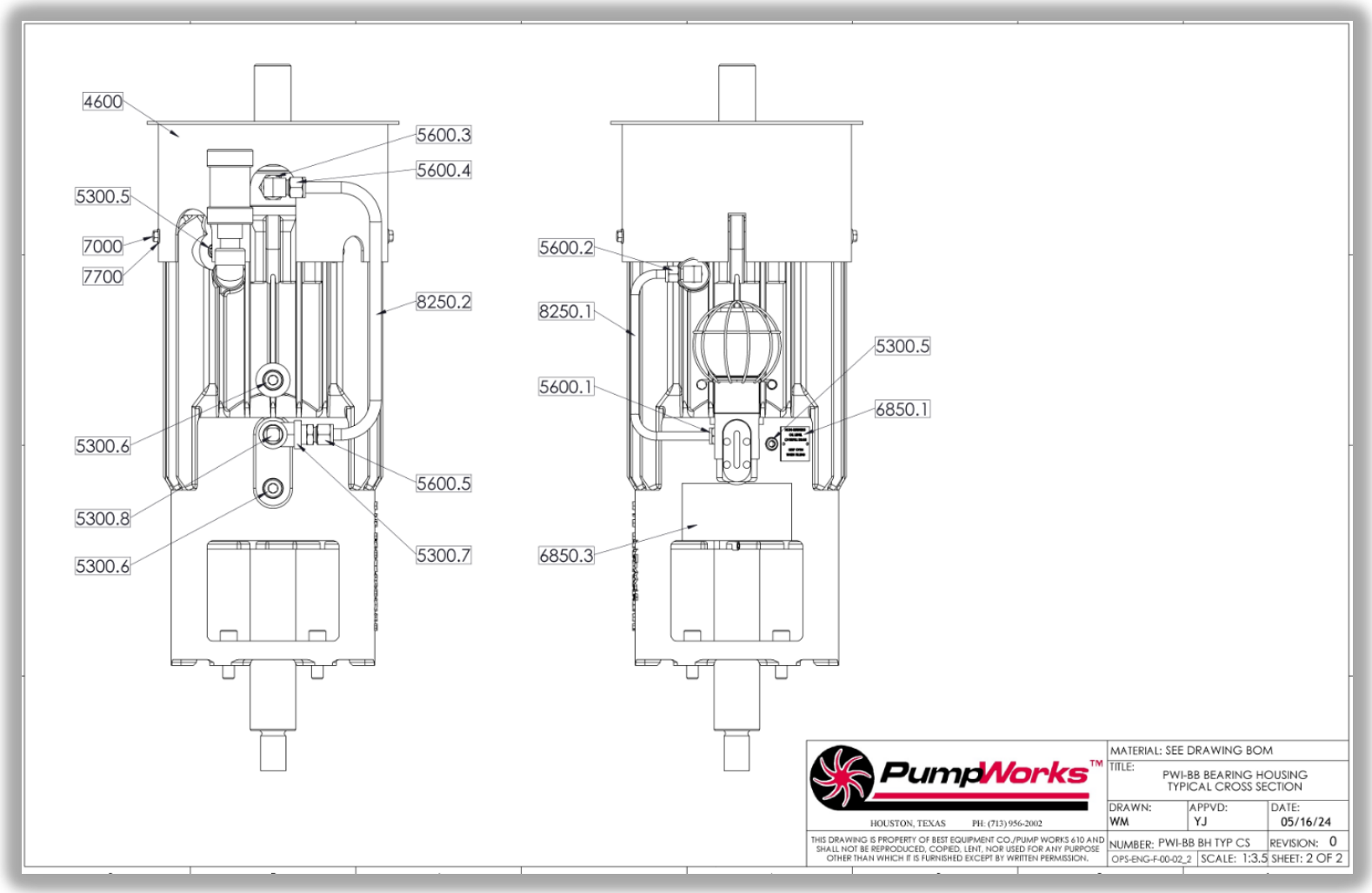

Figure 4: PWIBB Cross Section 2

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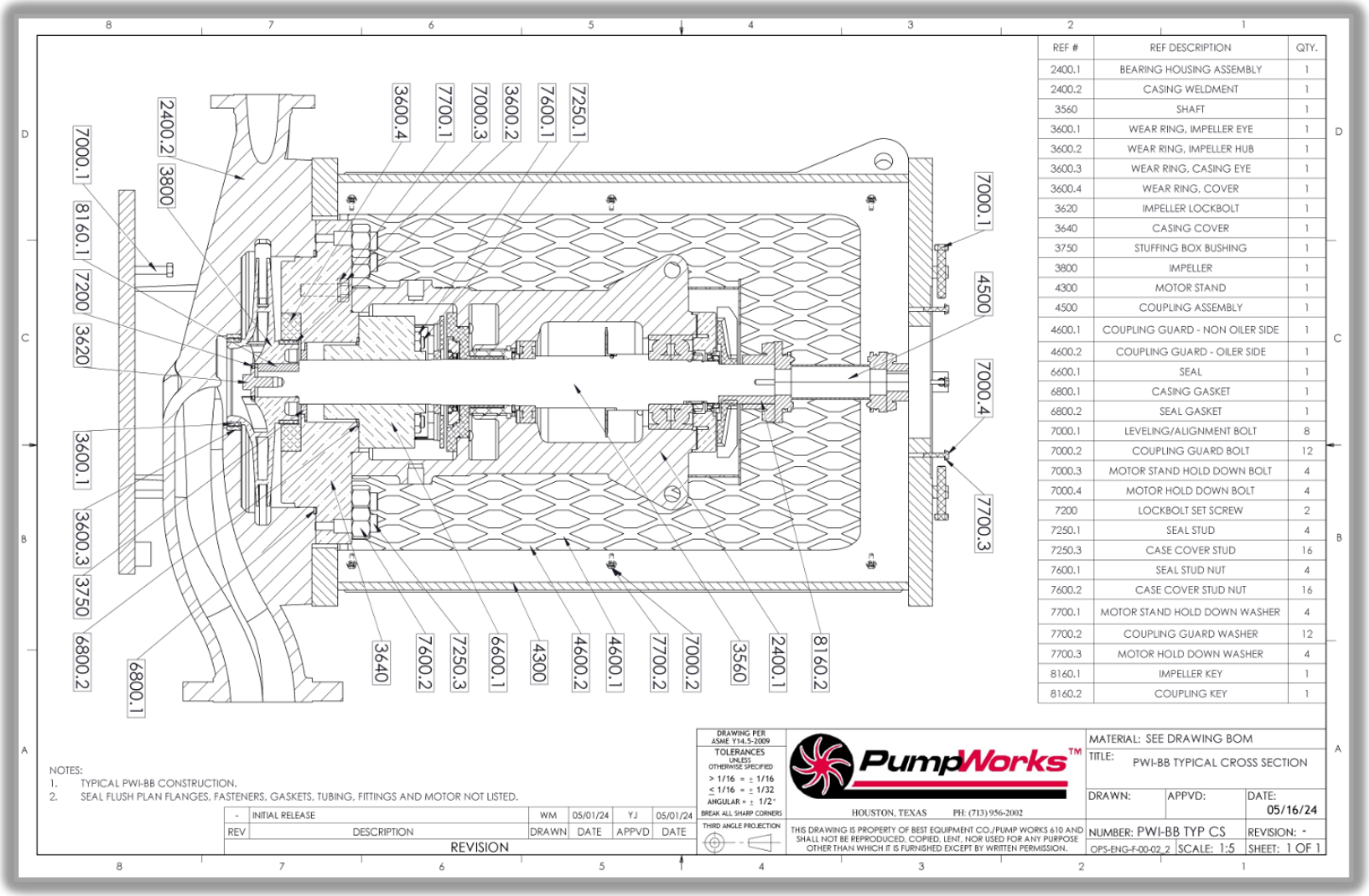

REF #	REF DESCRIPTION	QTY.
2400.1	BEARING HOUSING ASSEMBLY	1
2400.2	CASING WELDMENT	1
3560	SHAFT	1
3600.1	WEAR RING, IMPELLER EYE	1
3600.2	WEAR RING, IMPELLER HUB	1
3600.3	WEAR RING, CASING EYE	1
3600.4	WEAR RING, COVER	1
3620	IMPELLER LOCKBOLT	1
3640	CASING COVER	1
3750	STUFFING BOX BUSHING	1
3800	IMPELLER	1
4300	MOTOR STAND	1
4500	COUPLING ASSEMBLY	1
4600.1	COUPLING GUARD - NON OILER SIDE	1
4600.2	COUPLING GUARD - OILER SIDE	1
6600.1	SEAL	1
6800.1	CASING GASKET	1
6800.2	SEAL GASKET	1
7000.1	LEVELING/ALIGNMENT BOLT	8
7000.2	COUPLING GUARD BOLT	12
7000.3	MOTOR STAND HOLD DOWN BOLT	4
7000.4	MOTOR HOLD DOWN BOLT	4
7200	LOCKBOLT SET SCREW	2
7250.1	SEAL STUD	4
7250.3	CASE COVER STUD	16
7600.1	SEAL STUD NUT	4
7600.2	CASE COVER STUD NUT	16
7700.1	MOTOR STAND HOLD DOWN WASHER	4
7700.2	COUPLING GUARD WASHER	12
7700.3	MOTOR HOLD DOWN WASHER	4
8160.1	IMPELLER KEY	1
8160.2	COUPLING KEY	1

NOTES:
1. TYPICAL PWI-BB CONSTRUCTION.
2. SEAL FLUSH PLAN FLANGES, FASTENERS, GASKETS, TUBING, FITTINGS AND MOTOR NOT LISTED.

REV	DESCRIPTION	DRAWN	DATE	APPVD	DATE
-	INITIAL RELEASE	WM	05/01/24	YJ	05/01/24

REVISION

DRAWING PER ASME Y14.5-2009
TOLERANCES UNLESS OTHERWISE SPECIFIED
> 1/16 = ± 1/16
≤ 1/16 = ± 1/32
ANGULAR = ± 1/2°
BREAK ALL SHARP CORNERS
THIRD ANGLE PROJECTION

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MATERIAL: SEE DRAWING BOM
TITLE: PWI-BB TYPICAL CROSS SECTION
DRAWN: | APPVD: | DATE: 05/16/24
NUMBER: PWI-BB TYP CS | REVISION: -
OPS-ENG-F-00-02_2 | SCALE: 1:5 | SHEET: 1 OF 1

Figure 5: Typical PWIBB Pump Cross Section