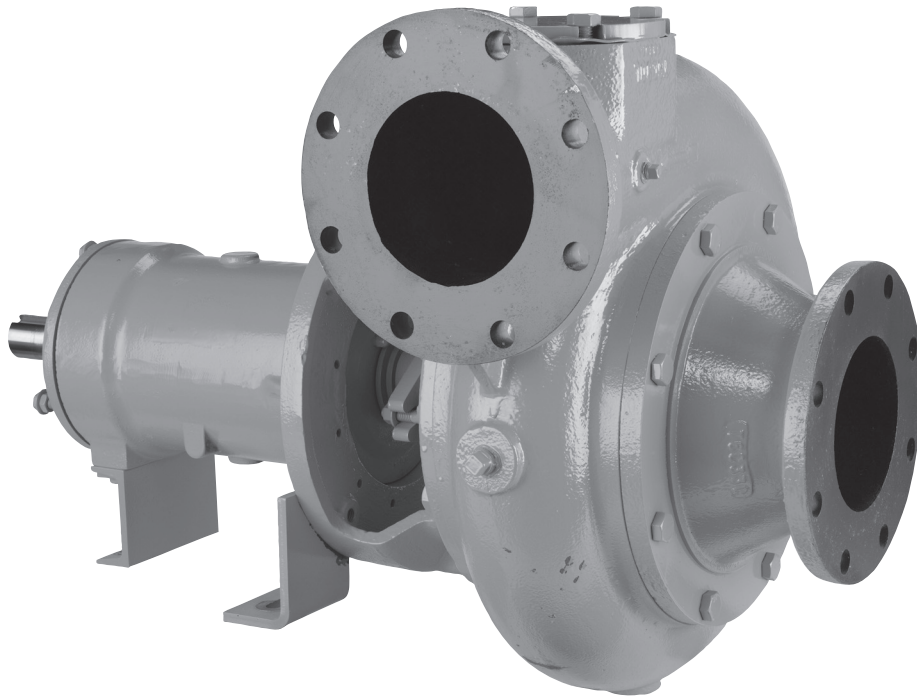




OWNERS MANUAL

INSTALLATION AND OPERATING INSTRUCTIONS
REPAIR PARTS LIST

4BSD, 5BSD, 6BSD, and 8BSD End-Suction Solids-Handling Pumps



Berkeley Pumps / 293 Wright Street / Delavan, WI 53115

LOSS OR DAMAGE IN TRANSIT

Immediately upon receipt, a complete inspection and accounting against the packing list should be made of all major components, and accompanying boxes or pallets. All material is shipped F.O.B. our factory, or our vendor's shipping point unless optional contractual arrangements are made. Under these terms, any claims for loss or damage in transit should be immediately directed to the delivering

freight carrier. Berkeley will assist the customer in receiving fair compensation, but assumes no responsibility to mediate such claims. This policy includes shipments wherein Berkeley pays freight costs as part of the sales terms.

If there is any indication of oil leakage from the motor oil chamber, advise the factory immediately and request instructions for proper handling.

PUMP/MOTOR IDENTIFICATION

Carefully record all of the following data from your pump/motor nameplate. It will aid in obtaining the correct replacement parts for your pump. In addition to the nameplate, the pump serial number is also stamped on the discharge flange.

Pump:

Serial Number _____

Size _____ Model # _____

GPM _____ Head _____ (feet)

BHP: _____ RPM: _____

Pump _____ Weight _____ (lbs.)

Motor:

Horsepower _____

Serial Number _____

Motor Frame _____

Full Load Speed _____

Full Load Amps _____

Phase/Hz/Volts _____ / _____ / _____

Motor Weight _____

Motor Identification Number _____

Date Placed in Service _____

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Congratulations! You are the new owner of the finest pump commercially available. If you give it the proper care as outlined and recommended by this manual, it will provide you with reliable service and long life.

NOTICE: Read this complete manual and manuals for all component equipment before assembly or installation is started. These manuals supply adequate instructions for the installation, operation and maintenance of your pump. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or damage to the pump. Keep the manuals near the pump for future reference.

This manual supplies general guidance ONLY for Berkeley Pump BSD Series solids-handling pumps. If your operating conditions ever change, always consult with the factory for reapplication. Always refer to the manuals provided by manufacturers of the accessory equipment for their separate instructions. Variations exist in both the equipment used with these pumps and in the particular installation of the pump and driver. If there are questions regarding the pump or its application which are not covered in this manual, please contact the factory as follows:

Berkeley
293 Wright Street
Delavan, WI 53115

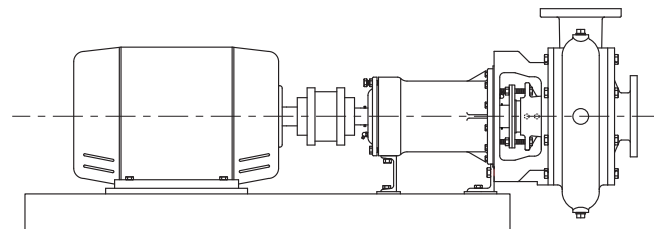


Figure 1: Typical Installation

To obtain additional data on hydraulics and pump selection and operation, we suggest you purchase "Hydraulic Institute Standards" from the Hydraulic Institute, 9 Sylvan Way, Parsippany, NJ 07054-3802.

LIMITED WARRANTY

BERKELEY warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

Product	Warranty Period
Water Systems:	
Water Systems Products — jet pumps, small centrifugal pumps, submersible pumps and related accessories	<i>whichever occurs first:</i> 12 months from date of original installation, or 18 months from date of manufacture
Pro-Source™ Composite Tanks	5 years from date of original installation
Pro-Source™ Steel Pressure Tanks	5 years from date of original installation
Pro-Source™ Epoxy-Lined Tanks	3 years from date of original installation
Sump/Sewage/Effluent Products	12 months from date of original installation, or 18 months from date of manufacture
Agricultural/Commercial:	
Centrifugals – close-coupled motor drive, frame mount, SAE mount, engine drive, VMS, SSCX, SSHM, solids handling, submersible solids handling	12 months from date of original installation, or 24 months from date of manufacture
Submersible Turbines, 6" diameter and larger	12 months from date of original installation, or 24 months from date of manufacture

Our limited warranty will not apply to any product that, in our sole judgement, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and BERKELEY's only duty, is that BERKELEY repair or replace defective products (at BERKELEY's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

BERKELEY SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE FOREGOING WARRANTIES SHALL NOT EXTEND BEYOND THE DURATION EXPRESSLY PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on the duration of an implied warranty, so the above limitations or exclusions may not apply to You. This warranty gives You specific legal rights and You may also have other rights which vary from state to state.

This warranty supersedes and replaces all previous warranty publications.

In the U.S.: BERKELEY, 293 Wright St., Delavan, WI 53115

In Canada: 269 Trillium Dr., Kitchener, Ontario N2G 4W5

PUMP/MOTOR PRESTART-UP AND START-UP CHECKLIST

Contractor _____ Pump Serial Number _____


Project Name _____ Pump Model Number _____


Date of Shipment _____ Motor Serial Number _____


Procedure	Yes	No	N/A	Comments
1. Shipment				
Was there any damage in transit? (List)				_____
Were all items received? (List)				_____
2. Storage				
Has equipment been protected from the elements?				_____
Was equipment subject to flooding?				_____
Have storage instructions been followed?				_____
3. Installation				
Were retaining fasteners, used in shipping, removed prior to installation?				_____
Is grouting under base or properly compacted?				_____
Is grouting of the non-shrink type?				_____
Have proper anchor bolts been used?				_____
Have the bolts been properly tightened?				_____
Have both the suction and discharge been checked for pipe strain?				_____
Are lube lines and seal water lines properly installed?				_____
Are accessory items, RTD's, bearing temp detectors, vibration sensors, etc. mounted and properly installed?				_____
Are lube lines purged of air and lubricant added (pump and driver)?				_____
Are all safety guards in place?				_____
Have impellers been checked for proper clearance?				_____
4. Alignment				
Has the alignment of driver to pump been checked?				_____
Have indicator readings been taken? (List)				_____
5. Rotation				
Has the rotation of the drives been checked for correctness?				_____
Has the coupling been turned to assure free rotation of pump and motor?				_____
6. System				
Has the system been checked to insure that it is free of foreign matter and purged of air which could be damaging to the pump?				_____
Is liquid available to the pump?				_____
Has assurance been obtained from responsible parties that all piping is secure and that the routing of flow has been established and is correct?				_____
7. Start-Up				
Has flow been established? Flow rate: _____ GPM				_____
Have gauge readings been taken? Suction pressure: _____ PSI				_____
Discharge pressure: _____ PSI				_____
Is excessive vibration present?				_____
Is bearing operating temperature excessive?				_____
8. Safety				
Have all safety labels been read and understood?				_____


Name _____ Date _____

READ AND FOLLOW SAFETY INSTRUCTIONS!


 **This is the safety alert symbol.** When you see this symbol on your pump or in this manual, look for one of the following signal words and be alert to the potential for personal injury.


 **DANGER** warns about hazards that **will** cause serious personal injury, death or major property damage if not avoided.

 **WARNING** warns about hazards that **could** cause serious personal injury, death or major property damage if not avoided.


 **CAUTION** warns about hazards that **could** cause minor personal injury or property damage if not avoided.

NOTICE addresses practices not related to personal injury. The installation, use and operation of this type of equipment is affected by various Federal, State and Local Laws, and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of equipment is the responsibility of the equipment Owner and all necessary steps should be taken by the Owner to assure compliance with such laws before operating the equipment.

 **Risk of serious eye injury from flying chips, foreign matter on the pump, etc.** Wear protective eye glasses while working on this equipment.

 **Risk of sudden and unexpected starts. Disconnect power and verify that pump cannot start before servicing or working on equipment.** If your installation uses automatic starting equipment, the pump unit may start at any time without warning. Proper precautions should be taken to avoid injury as a result of automatic starting of the equipment.


NOTICE: This product has been designed specifically for operation in water or sewage. Consult the factory before using it with other liquids.


 **Risk of puncture wounds and health hazards from sharp objects. Do not try to clean the pump with bare hands.** Always wear heavy puncture resistant gloves when cleaning the pump. The pumped material may contain items that may present health hazards such as needles and other sharp objects.


Before attempting to service this pump:

1. Familiarize yourself with this manual.
2. Disconnect or lock out the power source to ensure the pump will not start. Confirm power source disconnection with appropriate electrical test equipment.
3. Close the discharge valve, and if present, the suction valve.

After the pump has been installed, make certain that the pump and all piping connections are tight and are properly supported prior to start-up and operation.

 **Burn hazard.** Certain procedures in disassembly and assembly require that parts be heated to high temperatures. Heated parts can cause severe burns. Wear heat resistant gloves when handling heated parts.

 **Risk of crush injuries if pump is dropped. The pump is heavy; use appropriate lifting gear if you must raise the pump. Take all normal precautions for the weights involved (400 – 1700 lbs.).**

 **Risk of electrical shock and unexpected starts.** Do not attempt to clean the pump until electrical power has been disconnected (and locked out, if possible) and it has been verified that the pump cannot start.

INTRODUCTION

General

The Berkeley BSD Series pumps consist of several components. The following is a list of those major parts (or component assemblies) and a brief description of their design and function.

Impeller

The impeller is a solids-handling type of one piece construction, single suction, enclosed radial flow design with well-rounded leading vanes and tapered toward the trailing edge for a circular flow pattern. Waterways through the impeller have extremely smooth contours, free of sharp corners, so as to minimize rags or stringy, fibrous material from catching or clogging. The impeller is balanced and secured to the shaft by means of a bolt, impeller washer and key. The arrangement is such that the impeller cannot be loosened from torque in either forward or reverse rotation.

Volute

The volute is matched to the impeller and made of close-grained cast iron. The volute is of one-piece circular constant flow, equalizing pressure design with smooth fluid passages large enough to pass any size solid that can pass through the impeller and has a flanged suction and discharge.

Fronthead

The pump fronthead bolts to the volute and forms the inlet to the pump.

Backhead

Cast as a separate piece, the backhead houses the sealing box which is designed to accept standard mechanical seals without requiring re-machining.

Frame/Bearing/Shaft

Bearing frame is machined for accurate and permanent bearing alignment and houses the bearing/shaft assembly. The shaft is accurately machined along its entire length and precision ground at bearing locations. A renewable shaft sleeve protects the shaft where it passes through the sealing box area.

Base

Fabricated steel base supports the pump and driver and is designed with large access openings to facilitate grouting.

Coupling Guards

All pumps are furnished with coupling guards.

Location and Handling

The pump should be installed as near to the fluid as possible so a short direct suction pipe can be used to keep suction losses to a minimum. If possible, locate the pump so fluid will flow to the suction opening by gravity. Discharge piping should be direct and with as few elbows and fittings as possible.

Pump and driver should be located in an area that will permit periodic inspection and maintenance. Head and access room should be provided and all units should be installed in a dry location with adequate drainage.

Foundation

Pump foundations should have a level surface and be of sufficient mass to prevent vibration and form a permanent rigid support. The most satisfactory foundations are concrete with anchor bolts of adequate size imbedded in the foundation in pipe sleeves with an inside diameter 2-1/2 times larger than the bolt diameter which will allow for final accurate positioning of the unit. Recommended anchor bolt design is available from the factory.

INSTALLATION

General

▲ WARNING **Crushing hazard if pump drops.** Use appropriate lifting equipment to raise the pump. Do not try to pick up the complete unit by the driver eye bolts or a pump shaft eyebolt. The bolts may fail and drop the pump.

NOTICE: Pump and driver alignment should be checked throughout the piping and grouting procedures. Once piping connections have been made and grouting completed, alignment corrections are difficult.

Grouting

When alignment is correct, the unit should be grouted using a high grade non-shrinking grout. The base is designed to be completely filled with grout.

NOTICE: Damaging vibration may result if the baseplate is not solidly in contact with the grout bed.

Do not fill the anchor bolt pipe sleeves with grout.

If leveling devices are used, make sure they are not imbedded in grout. Provide access in the grout to the leveling devices (if used) so that they can be backed off or removed after the grout has cured.

Allow the grout to fully cure. Back off leveling nuts (if used) and remove shims and/or wedges. Firmly tighten the foundation bolts so the base is solidly against the grout bed. All pockets and/or holes left by removal of leveling devices are to be filled with grout. Recheck alignment before connecting the piping.

Piping

NOTICE: All piping connections must be made with the pipe in a free supported state, and without the need to apply vertical or side pressure to obtain alignment of the piping with the pump flange.

All piping should be independently supported near the pump so the pipe strain will not be transmitted to the pump casing. Weight of the pipe and contained liquid must be considered in support design. Suction and discharge piping should be one or two sizes larger than the pump suction and discharge sizes, especially where piping is of considerable length. Flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust.

Suction pipe must be airtight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. Discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line and a closing valve in the suction line. The

check valve, between the pump and closing valve, protects the pump from water hammer and prevents reverse rotation in the event of power failure. Closing valves are used in priming, starting and when the pump is shut down. Pumps must never be throttled by use of a valve in the suction line.

Auxiliary Piping Connections

In addition to primary piping connections, your pump may require connections to the baseplate drain, discharge pressure gauges or mechanical seals. All these connections should now be installed. (Refer to Mechanical Seal section of this manual.)

NOTICE: For satisfactory pump operation and life, auxiliary pipe lines must be kept clean.

Rotation

Before connecting the motor to the pump, bump start the motor and verify that rotation is in the proper direction. Correct pump rotation is indicated by a directional arrow on the pump casing.

Vibration and Noise Levels

After installation is complete and the pump is put into normal service, a baseline measurement of noise and vibration levels should be made for future reference. Periodic checks should be made, as changes in either of these could indicate problems. Early detection can save expensive repairs and downtime. Refer to "Troubleshooting" for simple causes and remedies.

Vibration and noise level measurements should be made with the equipment in its normal operating mode, with no unusual background noise present.

Leveling of the Pump

Lower the unit onto the foundation and position the base so the anchor bolts are aligned in the middle of the holes in the base. Disconnect the coupling halves.

Set the base on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability.

Adjust the metal shims or wedges until the shaft of the pump and driver are level. Make sure that all shims or wedges fit firmly between the foundation and the base.

If leveling nuts are installed on the anchor bolts and are used for alignment, follow the same procedure as with shims or wedges. Support the base with additional shims or wedges if necessary. Make sure that all nuts and shims are in firm contact with the base.

Tighten the foundation bolts snugly, but not too firmly, and recheck the shafts for being level before grouting. Motor and pump shafts should also be in close alignment prior to grouting. If not in close alignment, determine the cause for misalignment and correct. Refer to the Grouting section.

NOTICE: Pump and driver alignment should be checked throughout the piping and grouting procedures. Once piping connections have been made and grouting completed, alignment corrections are difficult.

Coarse Coupling Alignment

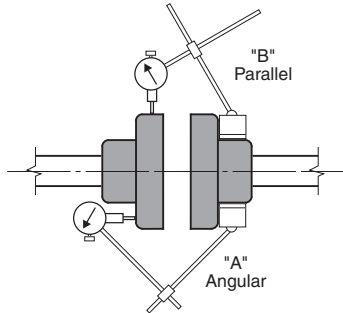
▲ WARNING **Risk of entrapment by rotating couplings.** **Install guards before starting the pump.** Check safety codes, and always install protective guard or shield as required by the various federal, state and local laws and the regulations concerning OSHA.

The final coupling alignment must be made after the piping has been connected. Realign as required. If sufficient adjustment is not achieved, piping may have to be disconnected to properly align the coupling. Reconnect the piping and recheck coupling alignment.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

Pumps may be supplied with one of several different types of commercial couplings. Refer to coupling drawings and alignment tables in this manual and/or the coupling manufacturer's installation and alignment instructions which may be supplied with the pump.

Fine Alignment



Distance from Centerline	Maximum Allowable T.I.R.
1.00 inch	0.035 inches
2.00 inches	0.070 inches
3.00 inches	0.105 inches
4.00 inches	0.140 inches

- Angular and parallel misalignment of the coupling may be corrected simultaneously. Maintain a separation between coupling halves, per manufacturer's specifications, to avoid preloading of pump and motor bearings.
- Check and account for indicator sag.
- Clamp dial indicators to the pump and motor shaft as shown above.
- Start with angular alignment and finish check with parallel alignment.
- Rotate both the shaft and coupling together by hand. Note the total indicated runout shown on indicator "A". The maximum allowable angular misalignment is 1 degree. Limits of reading on indicator "A" at various distances from shaft centerline are shown in Table (above).
- Continue to rotate both shafts by hand and note the runout shown on indicator "B". The maximum allowable total indicated runout is .005 inches. Should either angular or parallel misalignment exceed the value shown, shift or shim the motor until mis-alignment is within the allowable limits shown. Do not move pump unless absolutely necessary. When shimming, be sure that all feet on the pump and motor are equally supported to avoid strains on the castings when the hold down bolts are tightened.

Periodic Alignment Check

Coupling misalignment can occur because of shifts in grouting and/or foundations, or because of large objects going through the pump causing shock loading conditions. Coupling alignment should be checked periodically for changes. Coupling misalignment can lead to or cause bearing failure, coupling failure, shaft breakage and high power consumption.

Refer to the coupling alignment tolerances found in this manual or the coupling manufacturer's alignment instructions that may have been supplied with the pump.

V-Belt Drive

A pump coupled to its driver by means of V-belts and sheaves may have been shipped separately from the drive components. Refer to the driver manufacturer's literature for installation, operation and maintenance instructions.

OPERATION

General

This section contains applicable start-up and break-in procedures for operation. Because variations may exist in a particular installation between pumps, drivers and accessory equipment, specific operating instructions are not within the scope of this manual.

NOTICE: Before starting or operating the pump, read this entire manual and especially comply with the following instructions:

- Before starting the pump:
 - Rotate the shaft by hand to assure all moving parts are free.
 - Install guards around all exposed rotating parts.
 - Fill the casing and suction line with liquid. The pump may be primed by using a priming system.
- Observe all caution or danger tags attached to the equipment.
- Never run the pump dry as the close running fits within the pump are lubricated by the liquid. Running dry may result in pump seizure.
- If excessive vibration or noise occurs during operation, shut the pump down and consult the Troubleshooting Guide or a Berkeley representative.

Wet Well Design

It is required that an evenly distributed flow of non-aerated water be supplied to the pump suction. Improper wet well or sump design, or insufficient suction pipe submergence can result in vortexing which reduces the pump's performance and can cause severe damage to the pump.

Normal Operating Procedures

Monitor the following during running cycles:

- Unit vibration or noise.
- Driver lubrication.
- Pump lubrication.

Check the following before normal start-up:

- Driver lubrication (refer to driver operating manual)
- General condition of all equipment.

Priming

The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

- Positive suction head.**
 - Open the vent on the highest point of the pump casing.
 - Open all suction valves.
 - Allow liquid to flow from the vent hole until all air bubbles are vented, then close the vent.
 - Pump is now primed.
- Negative suction head.**
 - Install the priming system on the vent at the highest point of the pump casing.
 - Close the discharge valve.

3. Open the suction valve.
4. Start the priming system.
5. Run the priming system until a continuous stream flows through the suction line, then close the vent valve.
6. The pump is now primed.

Starting the Pump

- A. After the pump is primed, the discharge valve closed, and the suction valve open, start the driver according to the driver manufacturer's instruction.
- B. Open the discharge valve slowly to prevent water hammer.
- C. Immediately after the pump has been started, check bearing temperature and pump noise level. Continue to monitor these values for the first several hours of operation.

Bearing Operating Temperature

These pumps are designed to operate over a wide ambient temperature. The temperature, when measured on the outside surface of the bearing housing, should not exceed 190° F (88° C). Temperatures in excess of 190° F (88° C) may indicate a lack of lubricant, or bearing problems. If temperatures exceed this limit, the pump should be stopped and the cause investigated and corrected.

Regulating/Control Procedure

Pumping stations are usually designed to have the pumps started and stopped automatically using a controller. Since this is a function of station design, the operators should be thoroughly familiar with the system's operating parameters and the use of the controller.

Stopping the Pump

- A. Disconnect the electrical power and lock out the power to the driver.
- B. Check power source with appropriate electrical test equipment to ensure driver cannot accidentally start.

Emergency Procedures

Many installations are equipped with emergency shutoff switches near the pump location. These locations should be plainly marked and be readily accessible at all times.

The control panel (if used) may be equipped with an emergency stop button or switch.

NOTICE: The operator or persons working around the equipment should be familiar with the locations of emergency shutoff points.

- A. Emergency Start-Up.
 1. Open the suction valve.
 2. Start the Driver.
 3. Open the discharge valve.
- B. Emergency Shut-Down.
 1. Shut off the power at the nearest switch.
 2. Close discharge valve.

Operating at Reduced Capacity

Typical applications cover a wide range of flow rates, and a variable speed driver is often used to adjust the pump capacity, which is taken into consideration by Berkeley when selecting the pump and impeller trim. Although these pumps are applicable over a wide range of operating conditions, care should be exercised when doing so, especially when actual conditions differ from sold conditions. Always contact your nearest Berkeley distributor or the factory before operating the pump at any condition other than that for which it was sold.

Generally, these pumps can be operated continuously at a capacity equal to 25% of the pump capacity at the best efficiency point (BEP), and at higher capacities. For capacities less than 25% of BEP, it is recommended that the pumps be operated for intermittent periods of time only.

Seasonal Operating Instructions

If the pump is located in an area that is subject to below freezing temperatures for extended periods of time and will not be operated enough to prevent freezing, it should be drained to prevent damage to the casing.

TROUBLESHOOTING

If you have followed the installation and start up procedures outlined in this manual, your pump should provide reliable service and long life. However, if operating problems occur, significant time and expense can be saved if you use the following checklist to eliminate the most common causes of those problems. Common problems are listed below with suggested remedies shown.

Symptom	Probable Cause	Corrective Actions
Insufficient Discharge	<p>Pump not primed. Speed too low. System discharge head too high.</p> <p>Suction lift too high.</p> <p>Wrong direction of rotation.</p> <p>Air leaks into suction piping, stuffing box or gaskets. Impeller passage partially plugged. Impeller damaged. Impeller diameter too small.</p> <p>Insufficient suction line submergence. Air in liquid. Insufficient net positive suction head.</p> <p>Worn parts.</p>	<p>Prime pump. Evacuate all the air. Check drive speed and voltage. Change system. Raise wet well level. Install larger impeller and driver. Increase submergence. Lower pump. Change system. Reverse any two motor lead connections. Check driver O&M. Check flange connections for proper seal. Tighten connections. Clean impeller passages. Check and repair or replace. Replace impeller with larger diameter. Check driver HP. Increase submergence. Increase submergence to prevent vortexing. Increase submergence. Lower pump. Change system. Rebuild pump.</p>
Loss of Suction	<p>Suction line leaks. Suction lift too high.</p> <p>Air or gases in liquid. Air leaks into suction piping, stuffing box or gasket. Wrong direction of rotation.</p>	<p>Tighten flange connections and check to be sure they are sealed. Increase submergence. Lower pump. Reduce suction line losses. Increase submergence to prevent vortexing. Check connections and tighten.</p> <p>Reverse any two motor lead connections. Check driver O&M.</p>
Excessive Power Consumption	<p>Speed too high. System head lower than rating – pumps too much liquid. Specific gravity or viscosity of liquid is too high. Mechanical defects. a. Shaft bent. b. Rotating element binds. Misalignment.</p> <p>System head lower than design. Incorrect impeller diameter.</p>	<p>Check driver speed and voltage. Change system. Reduce pump speed. Trim impeller.</p> <p>Reduce pump capacity.</p> <p>Replace shaft. Determine cause and correct. Check motor/pump to base connections. Realign coupling. Change system. Reduce pump speed. Trim impeller. Determine correct impeller diameter and replace or trim impeller.</p>
Vibration or Noise	<p>Misalignment between drive and pump. Foundation bolts loose or defect in grouting. Mechanical defects. a. Shaft bent. b. Rotating element binds. Head lower than rating–pumps too much liquid. Pipe strain. Cavitation.</p>	<p>Realign driver and pump. Tighten foundation bolts and/or regrout.</p> <p>Replace shaft. Determine cause and correct. Increase system head. Reduce pump speed. Trim impeller. Improperly supported or aligned. Check pipe supports and adjust or realign. Increase suction head.</p>

TROUBLESHOOTING (continued)

Symptom	Probable Cause	Corrective Actions
	Pump running at shut-off condition. Insufficient suction line submergence. Air in liquid. Impeller passages plugged.	Open discharge valve. Check for obstructions. Increase submergence. Increase submergence to prevent vortexing. Clean impeller passages.
Bearing Overheating	Excessive lubricant. Shaft bent. Rotating element binds. Pipe strain. Insufficient bearing lubrication. Incorrect type of lubricant.	Drain lubricant as necessary. Replace shaft. Determine cause and correct. Check pipe supports. Add lubricant. Check the lubricant used. Refer to Maintenance section for recommended lubricants.

Net Positive Suction Head (NPSH)

NPSH can be defined as the head (energy) that causes liquid to flow through the suction pipe and enter the eye of the impeller. NPSH is expressed in two values:

1. NPSH required (NPSHR)
2. NPSH available (NPSHA)

It is essential that NPSHA always be greater than NPSHR to prevent cavitation, vibration, wear and unstable operation.

NPSHR is a function of pump design and therefore varies with the make, size, capacity and speed of the pump. The value for your pump can be obtained from your pump performance curve.

NPSHA is a function of your system and may be calculated as follows:

1. When the source of liquid is above the pump: $NPSHA = \text{barometric pressure (feet)} + \text{static suction head (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$.
2. When the source of liquid is below the pump: $NPSHA = \text{barometric pressure (feet)} - \text{static suction lift (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$.

NOTICE: Suction head or suction lift on horizontal pumps is measured from the datum elevation plane which is the horizontal plane that passes through the centerline of the pump shaft.

PREVENTIVE MAINTENANCE

NOTICE: Carefully read this section before attempting any maintenance procedure. Refer to accessory equipment manuals that may have been included.

To assure satisfactory operation of the pumps, routine inspection and periodic maintenance are required. It is suggested that an inspection and maintenance log be kept and the inspector immediately report any problems. A guide for preventive maintenance for normal applications is shown below. Usual application with abnormal heat, moisture, dust, etc. may require more frequent inspection and service.

Item	Action Required
Seal Box	Check every 150 hours for proper operation. Replace mechanical seal.
Bearings	Lubricate every 2000 hours or at least once a year.
Pump Alignment	Check for changes on an annual basis.
Pump Vibration Level	Check for changes on an annual basis.
Pump Noise Level	Check for changes on an annual basis.

Stuffing Box

The stuffing box is equipped with a mechanical seal. Generally, pumps should be checked for leakage every 150 hours of operation.

External Flush

The Berkeley Dry-run Seal requires one gallon of food-grade hydraulic oil (FGHO). Viscosity should be 150 SSU at 100° F. The upper port is always the return port to the reservoir. Periodically check the oil level through the sight glass in the reservoir. When inspecting the pump, inspect the dry-run system for oil leaks or signs of wear and tear or damage to hoses, fittings, etc.

Mechanical Seal Replacement

Refer to the Mechanical Seal section of this manual for general information, including removal and installation procedures.

Bearing Lubrication

Under normal operating conditions, the bearings must be lubricated every 2000 hours of running time, or at least once a year regardless of total operating hours.

NOTICE: Any application with abnormal heat, moisture, dust, etc. may require a change in this schedule and you should refer to a lubrication engineer or the factory for specific instructions.

Grease recommendations in this manual will provide satisfactory lubrication over a wide temperature range. There is, however, a practical limit. Operation of the pump should be discontinued and the factory consulted if temperatures measured on the outside of the bearing housing exceed 190° F (88° C).

Grease Recommendations

Recommended grease is an N.L.G.I. No. 2 lithium based multi-purpose grease with a mineral oil viscosity of 950 - 1250 SUS at 100 degrees F, and 80 - 82 SUS at 210 degrees F. Suggested greases meeting this specification are:

Manufacturer	Brand Name
Atlantic Richfield	ARCO M/P #2
Chevron	Dura-Lith
Exxon	Ronex or MP #2
Gulf	Gulf Crown #2
Sinclair	Litholine MP #2
Texaco	Marfak 958 or MP #2

Proceed as follows during lubrication:

▲ WARNING Risk of severe hand injuries from sudden and unexpected starts. Take extreme care to make sure that the driver cannot be accidentally started. Keep hands, fingers, clothing and any tools away from the coupling.

- A. Stop the unit, remove the grease drain plug and connect a grease gun to the lubrication fitting.
- B. Start the unit and inject grease until the old grease is relieved through the drain opening.
 1. If the grease does not relieve at the drain, check for blockage with a mechanical probe.
 2. Immediately after lubrication, bearing temperatures may rise above normal level.
- C. Continue running the unit until bearing temperatures stabilize at the normal level and grease stops seeping at the grease drain opening.
- D. Stop the unit, remove the grease gun, wipe off the relieved grease and replace the plug.
- E. Resume normal operation.

Impeller Running Clearance (See Table 1)

▲ WARNING Risk of electrical shock and sudden and unexpected starts. Disconnect (and lock out, if possible) the electrical power before servicing the pump.

As the impeller and fronthead wear, the clearance increases causing internal leakage, decreasing pump performance.

The clearance can be adjusted to compensate for wear. Refer to the data section of this manual for nominal impeller clearances. If the desired clearance cannot be obtained, it may be necessary to rebuild the pump.

The clearance may be checked by removing the suction handhole cover and placing a feeler (thickness) gauge between the impeller and the fronthead. (Refer to the impeller adjustment drawing illustrations, Figure 11, and Table 1.)

▲ WARNING Risk of puncture wounds and health hazards from sharp objects. Do not try to measure impeller clearance with bare hands. Always wear heavy puncture resistant gloves when cleaning the pump. The pumped material may contain items that may present health hazards such as needles and other sharp objects.

T20, T30, and T40 Frame Pumps:

Back off the jackscrews and tighten the capscrews at the bearing housing until the impeller just contacts the fronthead.

Measure the gap between the housing and frame.

Loosen the capscrews and tighten each jackscrew in a criss-cross method, 1/8 of a turn at a time until the gap between bearing housing and frame is increased by the amount of required impeller distance (see Table 1).

NOTICE: If the gap is not as specified, repeat this entire procedure until the proper clearance is achieved.

Tighten the locknuts to insure that the jackscrews will remain in the proper position.

T60 Frame Pumps:

Back off the stud locknuts and capscrews holding the thrust bearing cover (140) and thrust bearing housing (139) to the frame (90).

Measure the gap between the thrust bearing housing (139) and the frame (90).

Adjust the shim pack (AL, AM) thickness between the thrust bearing housing (139) and the frame (90) to achieve the correct impeller clearance specified in Table 1.

Tighten the stud nuts and capscrews against the O-rings. Do not compress the O-rings by more than 50%. Recheck the impeller clearance.

NOTICE: If the gap is not as specified, repeat this entire procedure until the proper clearance is achieved.

Tighten the locknuts to the stud nuts to make sure that the housing will remain in proper position.

Cleaning the Pump

If the pump becomes clogged, it will be necessary to stop the pump and clean out the impeller and volute area.

▲ WARNING Risk of puncture wounds and health hazards from sharp objects. Do not try to clean the pump with bare hands. Always wear heavy puncture resistant gloves when cleaning the pump. The pumped material may contain items that may present health hazards such as needles and other sharp objects.

Proceed according to the following instruction:

▲ WARNING Risk of electrical shock and sudden and unexpected starts. Disconnect (and lock out, if possible) the electrical power to the pump before servicing the unit.

- A. Stop the pump and lock out the controls so that the pump cannot accidentally start.
- B. Unbolt and remove the cleanout covers in the volute and elbow (if so equipped). Use a hose or long handle to loosen and remove debris. If the material cannot be loosened by a hose, use a scraper to loosen it and then flush it with a hose.
- C. Install new gaskets and replace the cleanout covers.
- D. Return to normal operating cycle.

CORRECTIVE MAINTENANCE:

Major corrective maintenance will require disassembly of the pump. The following are step-by-step instructions:

Time Requirements

Mechanical seal replacement time is approximately four (4) man hours. Complete disassembly and reassembly of the pump is estimated at 6 - 8 hours.

Maintenance Qualifications

The pump described by this manual is designed to be maintained by a mechanic experienced with rotating machinery, using normal mechanics tools.

Pump Disassembly

NOTICE: Read this entire disassembly procedure and refer to the sectional drawings in this manual before proceeding.

- A. Prepare the pump for disassembly according to the following procedure:

1. Lock out the power to the driver.

▲ WARNING Risk of electrical shock and sudden and unexpected starts. Disconnect (and lock out, if possible) the electrical power to the pump before servicing the unit. Check the power source with appropriate electrical test equipment to make sure that the driver cannot accidentally start.

2. Close suction and discharge valves.
3. Drain the pump
4. Remove the coupling guard and coupling.
5. Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication lines, grease lines, etc.)
6. If the volute (30) or fronthead (33) must be removed for any reason, disconnect the suction and discharge piping. Remove the capscrews holding the pump to the base.
7. Remove the pump less the base to a convenient work area.

▲ WARNING Risk of crush injuries if pump is dropped. The pump is heavy; use appropriate lifting gear if you must raise the pump. Take all normal precautions for the weights involved (400 – 1700 lbs.).

- B. Remove the capscrews holding the backhead (34) to the volute (30) but leave in the capscrews that hold the backhead (34) to the frame (90). Remove the capscrews which hold the mounting feet (A28 and B28) to the pump.
- C. Install an eyebolt of adequate strength in the tapped (coupling) end of the shaft (4). Remove the frame (90) and rotating assembly from the volute (30).
- D. Support the frame and rotating assembly in a horizontal position.
 1. Remove the impeller capscrew (9) and impeller washer (9A).
 2. Because the impeller capscrew (9) is installed with ¹Loctite®, it will be necessary to heat the cap screw to approximately 450 degrees F to break the bond.

▲ WARNING Burn hazard. Heated parts can cause severe burns. Wear heat resistant gloves when handling heated parts.

- E. Remove the impeller (1) from the shaft (4). Impeller and shaft have a close tolerance, so it will be necessary to use a pulling device.

NOTICE: Take care not to damage the impeller when using a puller or similar device. Attach the puller or other equipment at the reinforced impeller vane area only. Do not pull against the unsupported impeller shroud.

Because the impeller is installed with Loctite®, it will be necessary to heat the impeller (1) hub to approximately 450° F to break the bond.

▲ WARNING Burn hazard. Heated parts can cause severe burns. Wear heat resistant gloves when handling heated parts.

- F. Refer to the Mechanical Seal section of this manual.
- G. Remove the capscrews that secure the backhead (34) to the frame (90). Remove the mechanical seal (refer to

Mechanical Seal section of this manual), gland (31) and radial bearing deflector (B126).

H. Remove the thrust bearing deflector (A126).

I. Shaft Assembly:

T20 and T30 Frame Construction:

Remove the capscrews and jackscrews that secure the thrust bearing housing (139) to the frame (90). Remove the shaft assembly from the frame (90), using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Remove the radial bearing (163) from the shaft (4) using a bearing puller.

Remove the thrust bearing snap ring (168A) and the thrust bearing housing (139).

Remove the thrust bearing locknut (161) and lock-washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller.

T40 Frame Construction:

Remove the capscrews and jackscrews that secure the thrust bearing housing cover (140) and thrust bearing housing (139) to the frame (90).

Remove the thrust bearing housing cover (140) and remove the shaft assembly from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Remove the radial bearing (163) from the shaft (4) using a bearing puller.

Remove the thrust bearing housing (139).

Remove the thrust bearing locknut (161) and lock-washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller.

Remove the thrust bearing grease retainer (A206).

T60 Frame Construction:

Remove the capscrews that secure the thrust bearing housing cover (140), capscrew O-rings and thrust bearing housing (139) to the frame (90). Remove the thrust bearing housing cover and shims (140, AL, AM).

Remove the shaft assembly and impeller adjustment shims (AL, AM) from the frame (90) using the eyebolt installed in the tapped (coupling) end of the shaft (4).

Remove the radial bearing (163) from the shaft (4) using a bearing puller. Remove the radial bearing grease retainer (B206).

Remove the thrust bearing housing (140) from the shaft (4).

Remove the thrust bearing locknut (161) and lock-washer (162) and then remove the thrust bearing (168) from the shaft (4) using a bearing puller.

Remove the thrust bearing grease retainer (A206).

▲ CAUTION Risk of hand injury and damage to bearing. Pull on the inner race only to avoid pulling the bearing apart.

NOTICE: Because of possible damage or contamination during removal, bearings and grease retainers should not be reused and new bearings and grease retainers should always be installed.

J. The shaft sleeve (14) is secured with Loctite® and needs to be heated to approximately 450 degrees F to break the bond. Remove the shaft sleeve (14) from the shaft (4).

▲ WARNING Burn hazard. Heated parts can cause severe burns. Wear heat resistant gloves when handling heated parts.

K. Remove the lip seal (139A) from the thrust bearing housing (139) on T20 and T30 frames.

Remove lip seal (139A) from the thrust bearing cover (140) on T40 and T60 frames.

Remove lip seal (140A) from the frame (90) on T20, T30, T40 and T60 frames.

NOTICE: Because of possible damage during disassembly, lip seals should not be reused and new lip seals should always be installed.

L. Remove the volute (30) by removing the capscrews holding it to the fronthead (33).

M. Pump disassembly is now complete. All parts should be thoroughly cleaned and inspected for wear or damage and replaced if required.

Pump Assembly

NOTICE: Read this entire assembly procedure and refer to the sectional drawings in this manual before proceeding.

The following step-by-step instructions for assembly of the pump are essentially the reverse order of the instructions for disassembly. All new or cleaned parts should be moved to a dust-free location for assembly. Gaskets, lip seals, and bearings should not be reused and should always be replaced with genuine Berkeley® replacement parts.

Using a new volute gasket (156) between the volute (30) and fronthead (33), secure the volute with capscrews.

Connect the discharge piping to the volute (30).

Using a new cleanout cover gasket (203), install the volute cleanout cover (202) securing with capscrews.

B. Install lip seal (139A) on the thrust bearing housing (139) for T20 and T30 frames.

Install lip seal (139A) on the thrust bearing cover (140) for T40 and T60 frames.

Install lip seal (140A) on the frame (90) for T20, T30, T40 and T60 frames.

C. Install the shaft sleeve (14) onto the shaft (4):

NOTICE: To ensure proper bonding, thoroughly clean all mating surfaces with solvent to remove all grease, oil, dirt, etc.

1. Apply a bead of Loctite® No. 609 completely around the shaft (4) on the impeller end of the shaft/sleeve fit.

2. Slide the shaft sleeve (14) part way onto the shaft (4) while rotating it at least one full revolution to evenly spread the Loctite®.

3. Continue sliding the sleeve over the shaft until it butts firmly against the shaft shoulder.

NOTICE: Allow the Loctite® to cure for two (2) hours prior to operating the pump.

D. Shaft Assembly:

Preheat thrust bearings (168) and radial bearings (163) in an oil bath or oven.

▲ WARNING Burn hazard. Heated parts can cause severe burns. Wear heat resistant gloves when handling heated parts.

NOTICE: When heating bearings, do not exceed 250 degrees F.

After the parts have cooled, pack the radial bearing (163) and thrust bearing (168) half full of grease. Refer to the bearing lubricating instruction in the maintenance section of the manual for specific grease recommendations.

NOTICE: Pressure should be applied to the inner bearing race only, to prevent damage.

T20 and T30 Frame Construction:

Slide the thrust bearing (168) onto the shaft (4) and secure with the lock-washer (162) and locknut (161).

Fill the upper portion of the thrust bearing housing (139) with grease and slide it over the thrust bearing (168). Install the thrust bearing snap ring (168A) in the thrust bearing housing.

Slide the radial bearing (163) onto the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly into the frame (90).

Secure the thrust bearing housing (139) to the frame with capscrews. Install the jackscrews but do not tighten until the assembly is completed.

Go to "All Frames", below.

T40 Frame Construction:

Install the thrust bearing grease retainer (A206) on the thrust bearing (168) and slide it on the shaft (4) securing it with lock-washer (162) and locknut (161).

Install the thrust bearing housing (139) over the thrust bearing (168).

Slide the radial bearing (163) over the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4), install the shaft assembly in the frame (90).

Fill the thrust bearing housing cover (140) with grease and slide it over the shaft and secure to the frame with capscrews. Install the jackscrews but do not tighten until the assembly is completed.

Go to "All Frames", below.

T60 Frame Construction:

Install the thrust bearing grease retainer (A206) on the thrust bearing (168) and slide it on the shaft (4) securing it with lock-washer (162) and locknut (161).

Slide the thrust bearing housing (139) over the impeller end of the shaft and up over the thrust bearing (168).

Install the radial bearing grease retainer (B206) on the radial bearing (163) and slide it on the shaft (4).

Using the eyebolt installed in the tapped (coupling) end of the shaft (4) install the shaft assembly into the frame (90).

Install impeller adjustment shims between the frame (90) and the thrust bearing housing (139) (required for correct impeller clearance. Refer to Impeller Running Clearance section of this manual). Fill the thrust bearing housing cover (139A) with grease and slide it over the shaft and secure to the frame with capscrews.

Go to "All Frames", below.

All Frames:

After the clearance is set, remove the capscrews securing the thrust bearing housing (139) and cover (139A) to the frame (90), install O-rings on the capscrews, and reinstall.

- A. Install the thrust bearing deflector (A126) and radial bearing deflector (B126) on the shaft (4).

- B. Install the backhead (34) to the frame (90) and secure with capscrews.
- C. Refer to the Mechanical Seal section of this manual for seal installation.
- D. Install the gland (31) and hand tighten the gland bolts.
- E. Install the impeller (1), impeller washer (9A) and impeller capscrew (9) according to the following procedure:

1. Thoroughly clean the impeller bore, the end of the shaft, shaft threads and capscrew threads to ensure they are free from oil, dirt or any foreign matter.
2. Inspect and measure the impeller bore, shaft fit diameter, key and keyway for wear. Measure in several locations along the length of the fit. If the clearance between the shaft and impeller exceed 0.003" anywhere along the lengths of the impeller bore, contact the factory for instructions for rework or replacement of components.
3. Apply a sufficient amount of Loctite® No. 609 to shaft and impeller bore to cover the entire impeller fit area.
4. Install the impeller key (102) in the shaft (4).
5. Slide the impeller (1) over the shaft, making sure it butts firmly against the shaft sleeve.
6. Apply three of four drops of Loctite® No. 609 to the impeller capscrew threads and install on shaft with the impeller washer (9A) in place. Impeller fastener torque values are shown in Table #3 in the technical data section of this manual. (Torque values are for SAE grade 8 steel only. If other materials are used, consult the factory for proper torque values.)

NOTICE: To prevent the impeller from turning, use a board wedged in the vanes using care not to damage the vanes in any way.

- F. If the mounting feet were removed, install them at this time.
- G. Install a new volute gasket (156) on the volute (30) and assemble the complete frame/rotating assembly onto the volute, securing with capscrews.
- H. Install all gauges and auxiliary piping such as stuffing box lubrication lines, grease lines, etc.
- I. Refer to the Impeller Running Clearance section of this manual for instruction on adjustment and set the proper clearance.
- J. Install the coupling key (272) and pump coupling half on the shaft (4). Reconnect to drive coupling half on flexible drive shaft.
- K. Install all shaft and coupling guards.
- L. The pump assembly is now complete. Refer to Operation section of this manual.

WEAR RINGS

Replacing Existing Rings

A fronthead wear ring (16) has been supplied with your pump. If it requires replacement due to wear, the following procedures should be followed:

Wear Ring Removal

- A. If the wear ring requires replacement, it can be removed by heating it to 350 - 400 degrees F to break the Loctite™ bond.

▲ WARNING **Burn hazard. Heated parts can cause severe burns.** Wear heat resistant gloves when handling heated parts.

- B. The ring may also be ground off if heating fails to affect removal.

NOTICE: Care should be used to avoid damage to the ring set.

Wear Ring Installation

Because of the required close tolerances, replacement wear rings should be obtained from Berkeley or their authorized representative.

NOTICE: To insure proper bonding, thoroughly clean all mating parts with solvent to remove all grease, oil, dirt, etc.

Apply a bead of Loctite® No. 504 to the fronthead completely around the middle of the wear ring fit, and press the wear ring into place.

NOTICE: To avoid distortion and ensure proper installation, be careful to press the wear rings evenly and completely into place. They should be firmly butted against the corresponding fronthead shoulder at the bottom of the wear ring fit.

Adding Wear Rings

It is possible to add either or both impeller or fronthead wear rings to pumps which were not so originally equipped from the factory. This work should be done by a qualified machinist experienced in similar machining work. Contact the factory for parts, instructions and correct matching dimensions.

COUPLING REMOVAL AND INSTALLATION

Refer to the coupling manufacturer's literature supplied with the pump.

MECHANICAL SEALS

Mechanical seals covered by these instructions, when properly installed, will give satisfactory performance. To ensure proper installation, these instructions should be read carefully.

Double Mechanical Seal

Standard double mechanical seals consist of two stationary seats with O-ring seals and a single spring rotating assembly with O-ring sealing and drive, or O-ring sealing and elastomer drive ring.

Removal

By this time the frame assembly with backhead should have been removed to a clean work area.

- A. Remove the capscrews that secure the backhead (34) to the frame (90) and carefully slide it off the shaft sleeve.
- B. Remove the solid gland bolts and remove the gland (31).
- C. Remove the seal rotating element (45).
- D. Inspect all components for damage prior to reassembly. This should include the shaft sleeve. Replace the damaged part(s) or replace with a complete new seal.

Installation

- A. Remove any burrs or nicks on the sleeve (14) and apply a light coat of liquid soap or liquid detergent.
NOTICE: Seal faces are lapped and polished to a mirror finish. It is imperative that sealing faces be handled with care and kept perfectly clean. DO NOT touch the sealing faces.
- B. Slide the solid gland (31) over the shaft sleeve (14) being careful not to damage the mechanical seal faces.
NOTICE: The gland, stationary seat and rotating element must be far enough onto the shaft (4) so as not to interfere with the installation of the backhead (34).
- C. Thoroughly clean the sealing box and install the mechanical seal (45). Use even pressure to install the seal.
- D. Carefully, so as not to damage the seal (45), slide the backhead (34) over the shaft (4) and shaft sleeve (14) and secure to the frame (90) with capscrews.
- E. Without touching the seal faces and using a slight twisting action, push the seal and rotating element into the backhead (34) sealing box.
- F. When the seal spring can easily be compressed by hand into the sealing box, secure the gland (31) with capscrews to the backhead.

Operation

Special operating techniques are not required when using pumps equipped with mechanical seals. However, there are certain precautions that should be taken.

- A. Pumps should never be operated, even to test electrical connections, until the operator knows that there is oil in the sealing box. In order to check for oil in the sealing box, loosen the dry run connections at the box. Tighten the connections only after oil has started flowing.
Running the seal with an air bound sealing box is the same as running it without fluid.
- B. Some seals will leak slightly when first run. This leakage should cease within a very short period of time.

Routine Maintenance

Required maintenance at a very minimum as follows:

- A. Periodically (150 hours of operation) check to see that the pumped liquid is going through the sealing box out to the wet well or drain.
- B. Check that the gland bolts have not loosened and that the gland is flush with the sealing box.

TECHNICAL DATA

Table 1: Pump Nominal Impeller Clearance

Discharge Size	Model Number	Frame Size	Nominal Impeller Clearance
4"	4BSD1	T20	.010 - .020
4"	4BSD2		
4"	4BSD3	T30	.015 - .025
6"	6BSD3		
4"	4BSD4	T40	.010 - .020
4"	4BSD5		.008 - .015
5"	5BSD6		.020 - .030
6"	6BSD6	T60	.020 - .030
8"	8BSD6		

Table 2: Impeller Fasteners and Torque

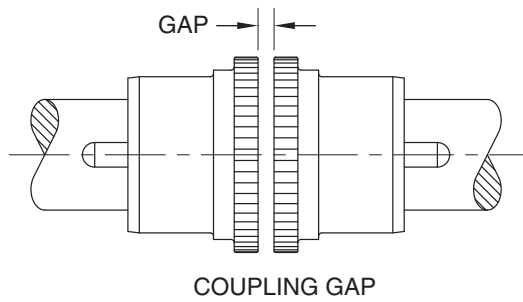
Pump Size & Model	Pump Frame	Impeller Fastener Size	Tightening Torque (lb. - ft.)
4BSD1	T20	1/2 - 13	80
4BSD2	T20	1/2 - 13	80
4BSD3	T30	5/8 - 11	120
6BSD3	T30	5/8 - 11	120
4BSD4	T40	3/4 - 10	200
4BSD5	T40	7/8 - 9	240
5BSD6	T40	7/8 - 9	240
6BSD6	T60	1-1/4 - 7	240
8BSD6	T60	1-1/4 - 7	240

Table 3: Falk Coupling Alignment Data

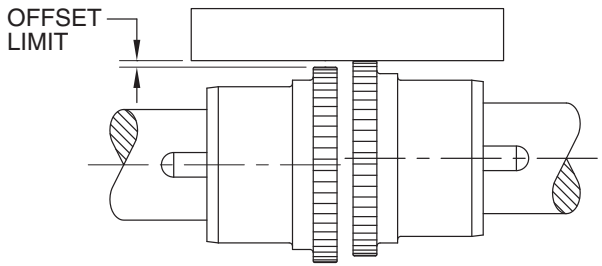
Size	Gap (Inches)	Installation Alignment Limits		Fastener Torque (lb.-in.)
		Offset (Maximum) (Inches)	Angular (Maximum min./max. in Inches)	
1030T	.125	.006	.003	100
1040T	.125	.006	.003	100
1050T	.125	.008	.004	200
1060T	.125	.008	.005	200
1070T	.125	.008	.005	200
1080T	.125	.008	.006	200
1090T	.125	.008	.007	200

Table 4: Woods Coupling Alignment Data

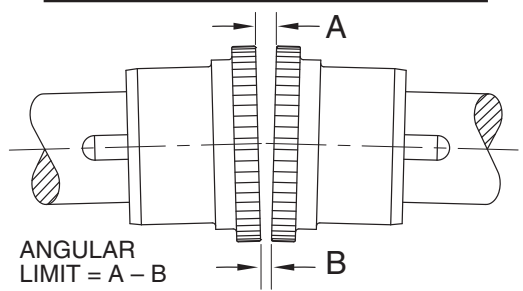
Size	Sleeve Type	Maximum Gap (Inches)	Installation Alignment Limits		Fastener Torque (lb.-in.)
			Offset (Maximum) (Inches)	Angular (Maximum min./max. in Inches)	
6S	JES	.875	.015	.070	155
7S	JES	1.000	.020	.081	155
8S	JES	1.125	.020	.094	275
9S	JES	1.437	.025	.109	275
10S	JES	1.625	.025	.128	275
11S	E	1.875	.032	.151	275



COUPLING GAP



OFFSET ALIGNMENT

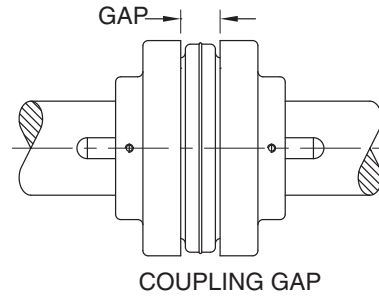


ANGULAR ALIGNMENT

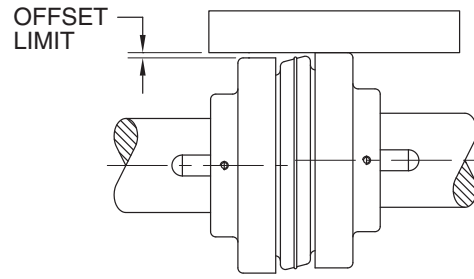
5400M003

6151 0210

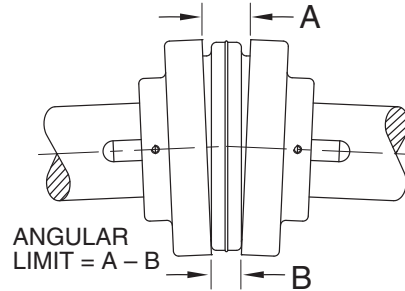
Figure 2: Falk Coupling Alignment



COUPLING GAP



OFFSET ALIGNMENT



ANGULAR ALIGNMENT

5400M001

6152 0210

Figure 3: Woods Coupling Alignment

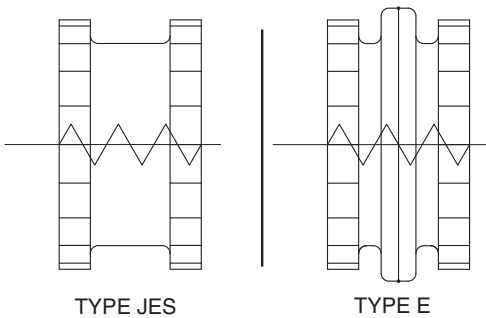


Figure 4: Coupling Sleeves—TYPE JES Sleeves are one-piece split construction moulded EPDM rubber. TYPE E Sleeves are two-piece molded EPDM rubber secured by a retaining ring.

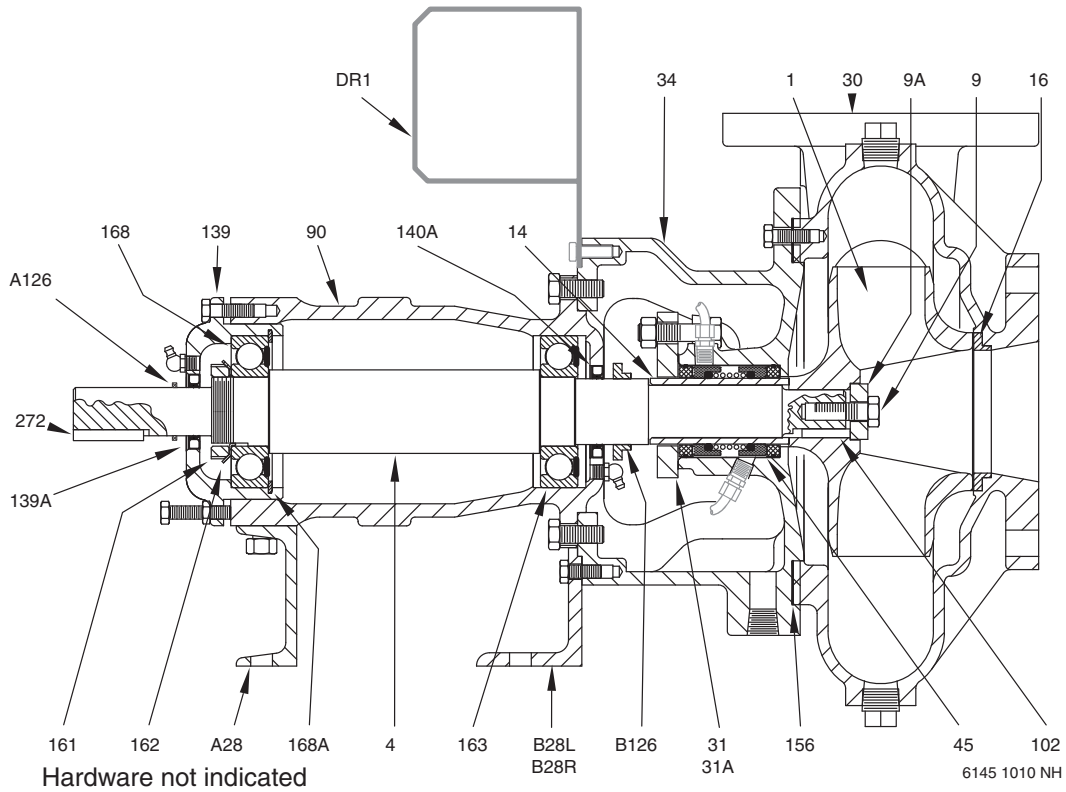


Figure 5A: Assembly with Integral Fronthead (4BSD1, T20 Frame), product shown with volute oriented in T1 position

Parts List – B85622

Item	Description	Part Number
1	Impeller	T4A1FG
1	Impeller	T4A1FG
4	Shaft	T20B4A 4180 F
9	Impeller Capscrew	11FM7A0113 0003 F
9A	Impeller Washer	CP5855AN 9660 F
14	Shaft Sleeve	T20B14A 9630 F
16	Wear Ring	T4A16A 9630 F
A28	Mounting Foot, Frame	T20B28A 4080 F
B28L	Mounting Foot, Left	T20B28C 4080 F
B28R	Mounting Foot, Right	T20B28D 4080 F
30	Volute	T4A30Y 0220 F
31	Solid Gland	W175A31A 0220 F
31A	Gasket	T20B325A 8180 F
34	Backhead	T20B34A 0220 F
45	Mechanical Seal	HYD1DE1 9906 F
90	Frame	T20B90B 0220 F
102	Impeller Key	16FM104S0194 4780 F
A126	Deflector	HYD6F2 9906 F

Item	Description	Part Number
B126	Deflector	HYD6F3 9906 F
139	Bearing Housing	T20B139A 0220 F
139A	Lipseal	HYD2Q6 9906 F
140A	Lipseal	HYD2Q18 9906 F
156	Volute Gasket	T3A155A 8380 F
161	Bearing Locknut	11FM61AN10 0006 F
162	Bearing Lockwasher	11FM1JAW10 0006 F
163	Thrust Bearing	HYD38M11 9906 F
168	Radial Bearing	HYD38M11 9906 F
168A	Snap Ring	HYD37B11 9906 F
272	Coupling Key	16FM104S0331 4780 F
DR1	Dry-Run Tank Assembly (See Figure 10)	B85725
	Mechanical Seal Kit (Includes 31A, 45, AH, AJ, AK); Dry-pit Solids handling, T20 (Includes Items 31A, 45, AH, AJ, AK)	B85783

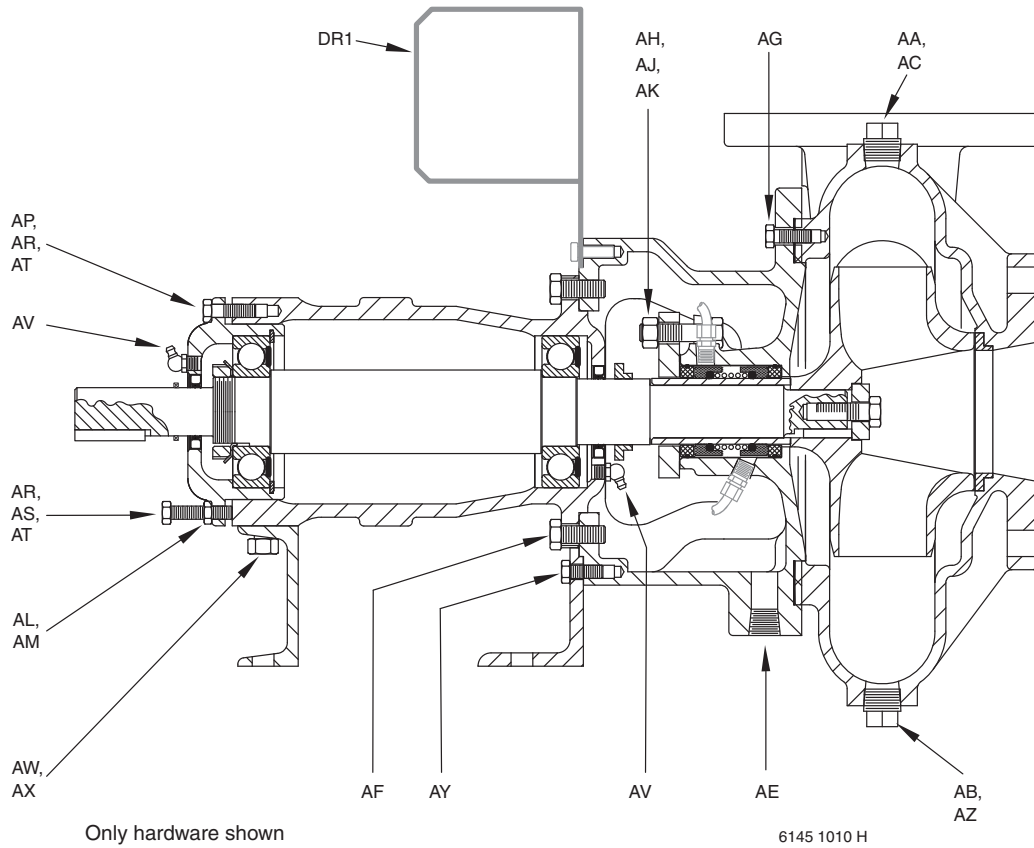


Figure 5B: Assembly Hardware (4BSD1, T20 Frame)

Parts List – B85622

Item	Description	Part Number
AA	Pipe Plug	20FM7D0002 0008 F
AB	Pipe Plug	20FM7A0006 0008 F
AC	Pipe Plug	20FM7D0004 0008 F
AE	Pipe Plug	20FM7D0002 0008 F
AF	Cap Screws	11FM7A0112 0001 F
AG	Cap Screws	11FM7A0056 0001 F
AH	Gland Bolts	11FM4A0103 0006 F
AJ	Gland Bolt Nuts	11FM25A10005 0006 F
AK	Gland Bolt Washers	11FM25A10005 0006 F
AL	Jam Nuts	11FM27A0003 0006 F

Item	Description	Part Number
AM	Washers	11FM1N0009 0006 F
AP	Cap Screws	11FM7A0056 0001 F
AR	Cap Screws	11FM7G0058 0001 F
AS	Jam Nuts	11FM27A0003 0006 F
AT	Washers	11FM1N0009 0006 F
AV	Lube Fitting	20FM23E0003 0013 F
AW	Cap Screws	11FM7A0112 0001 F
AX	Washers	11FM1MB0003 0006 F
AY	Cap Screws	11FM7A0055 0001 F
AZ	Pipe Plug	20FM7A0002 0008 F

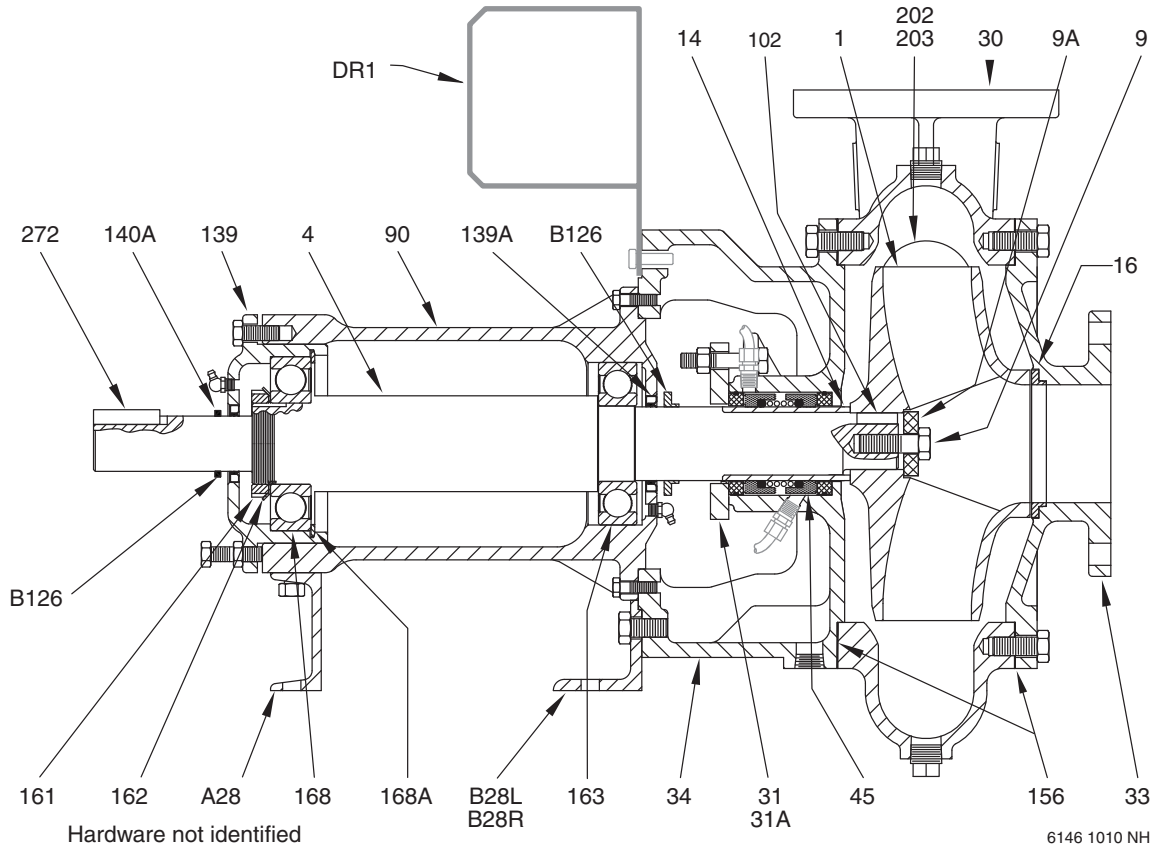


Figure 6A: Assembly (4BSD2, T20 Frame, and 4BSD3, 6BSD3, T30 Frame), product shown with volute oriented in T1 position

Parts List – B85626, B85632, B85633

Item	Description	B85626	B85632	B85633
1	Impeller	T4B1MG	T4C1KH	T6C1EP
4	Shaft	T20B4A 4180 F	T30C4A 4180 F	T30C4A 4180 F
9	Impeller Capscrew	11FM7A0114 0003 F	11FM7A0173 0003 F	11FM7A0177 0003 F
9A	Impeller Washer	CP5855AN 9660 F	CP5855AR 9660 F	CP5855AS 9660 F
14	Shaft Sleeve	T20B14A 9630 F	T30C14A 9610 F	T30C14A 9610 F
16	Wear Ring	T4C16AF 9630 F	T4C16AF 9630 F	T6C16P 9630 F
A28	Mounting Foot, Frame	T20B28A 4080 F	T40D28A 4080 F	T40D28A 4080 F
B28L	Mounting Foot, Left	T20B28C 4080 F	T30C28D 4080 F	T30C28D 4080 F
B28R	Mounting Foot, Right	T20B28D 4080 F	T30C28E 4080 F	T30C28E 4080 F
30	Volute	T4B30AK 0220 F	T4C30AD 0220 F	T6C30L 0220 F
31	Solid Gland	W175A31A 0220 F	T30C31A 3980 F	T30C31A 3980 F
31A	Gasket	T20B325A 8180 F	N/A	N/A
33	Fronthead	T4B33AZ 0220 F	T4C33AH 0220 F	T6C33S 0220 F
34	Backhead	T20B34B 0220 F	T30C34A 0220 F	T30C34A 0220 F
45	Mechanical Seal	HYD1DE1 9906 F	HYD1DE2 9906 F	HYD1DE2 9906 F
90	Frame	T20B90B 0220 F	T30C90C 0220 F	T30C90C 0220 F
102	Impeller Key	16FM104S0194 4780 F	16FM104S2138 4780 F	16FM104S2138 4780 F
A126	Deflector	HYD6F2 9906 F	HYD6F3 9906 F	HYD6F3 9906 F
B126	Deflector	HYD6F3 9906 F	HYD67A2 9923 F	HYD67A2 9923 F
139	Bearing Housing	T20B139A 0220 F	T30C139A 0220 F	T30C139A 0220 F
139A	Lipseal	HYD2Q6 9906 F	HYD2Q18 9906 F	HYD2Q18 9906 F
140A	Lipseal	HYD2Q18 9906 F	HYD2Q29 9906 F	HYD2Q29 9906 F
156	Volute Gasket	CP2930 8380 F	CP2928 8380 F	CP2928 8380 F
161	Bearing Locknut	11FM61AN10 0006 F	11FM61AN14 0006 F	11FM61AN14 0006 F
162	Bearing Lockwasher	11FM1JAW10 0006 F	11FM1JAW14 0006 F	11FM1JAW14 0006 F
163	Thrust Bearing	HYD38M11 9906 F	HYD38M15 9906 F	HYD38M15 9906 F
168	Radial Bearing	HYD38M11 9906 F	HYD38M14 9906 F	HYD38M14 9906 F
168A	Snap Ring	HYD37B11 9906 F	HYD37B12 9906 F	HYD37B12 9906 F
202	HH Cover	T4C202A 3980 F	T4C202A 3980 F	T5C202A 3980 F
203	HH Cover Gasket	TBGA467A 7880 F	TBGA467A 7880 F	T6C203A 7880 F
272	Coupling Key	16FM104S0331 4780 F	16FM104S0639 4780 F	16FM104S0639 4780 F
DR1	Dry-Run Tank Assembly (See Figure 10)	B85725	B85726	B85726
	Mechanical Seal Kit (Includes 31A, 45, AH, AJ, AK)	B85783	B85784	B85784

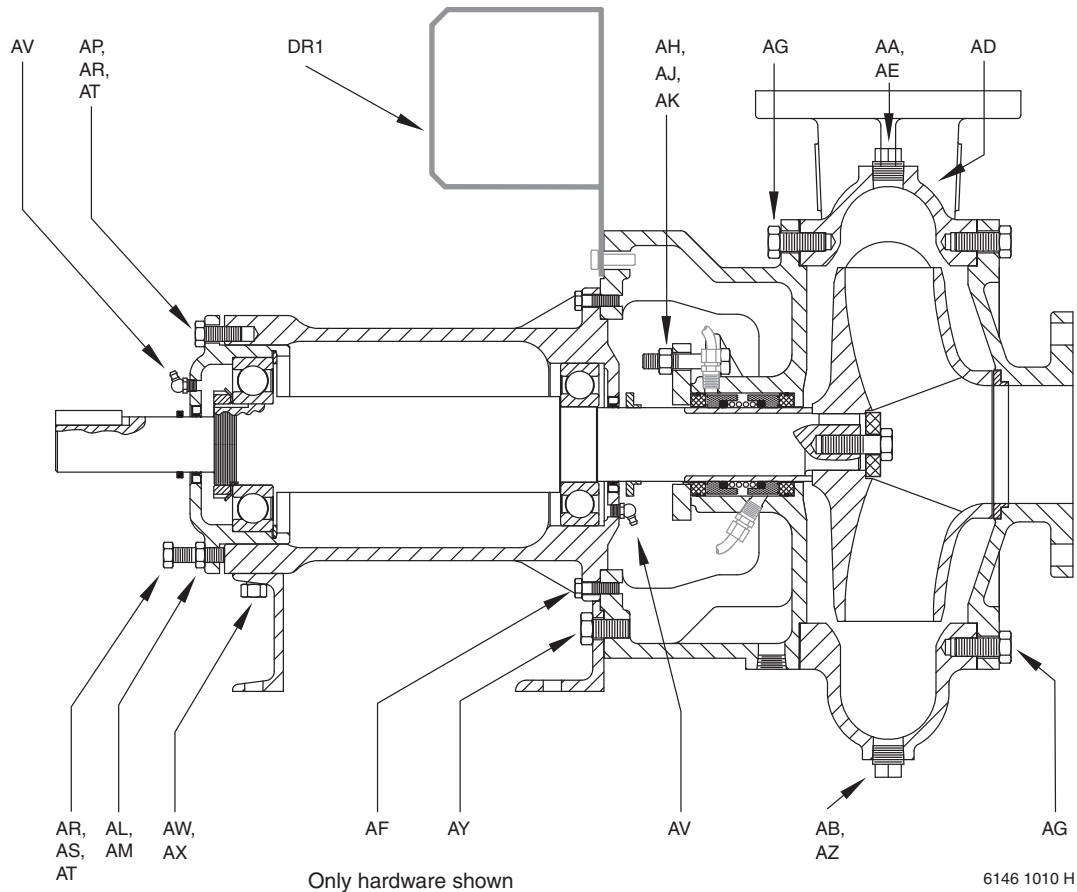


Figure 6B: Assembly Hardware (4BSD2, T20 Frame, and 4BSD3, 6BSD3, T30 Frame)

Parts List – B85626, B85632, B85633

Item	Description	Part Number		
		B85626	B85632	B85633
AA	Pipe Plug	20FM7D0004 0008 F	20FM7D0004 0006 F	20FM7D0004 0006 F
AB	Pipe Plug	N/A	20FM7D0002 0008 F	20FM7D0002 0008 F
AD	HH Cover Capscrews	11FM7A0112 0001 F	11FM7A0112 0001 F	11FM7A0170 0001 F
AE	Pipe Plug	20FM7D0002 0008 F	20FM7D0002 0008 F	20FM7D0002 0008 F
AF	Cap Screws	11FM7A0112 0001 F	11FM7A0056 0001 F	11FM7A0056 0001 F
AG	Cap Screws	11FM7A0112 0001 F	11FM7A0171 0001 F	11FM7A0171 0001 F
AH	Gland Bolts	11FM4A0103 0006 F	11FM4A0102 0006 F	11FM4A0102 0006 F
AJ	Gland Bolt Nuts	11FM25A10005 0006 F	11FM25A10005 0006 F	11FM25A10005 0006 F
AK	Gland Bolt Washers	11FM1N0011 0006 F	11FM1N0011 0006 F	11FM1N0011 0006 F
AL	Jam Nuts	11FM27A0003 0006 F	11FM27A0005 0006 F	11FM27A0005 0006 F
AM	Washers	11FM1N0009 0006 F	11FM1N0011 0006 F	11FM1N0011 0006 F
AP	Cap Screws	11FM7A0056 0001 F	11FM7A0113 0001 F	11FM7A0113 0001 F
AR	Cap Screws	11FM7G0058 0001 F	11FM7G0114 0001 F	11FM7G0114 0001 F
AS	Jam Nuts	11FM27A0003 0006 F	11FM27A0005 0006 F	11FM27A0005 0006 F
AT	Washers	11FM1N0009 0006 F	11FM1N0011 0006 F	11FM1N0011 0006 F
AV	Lube Fitting	20FM23E0003 0013 F	20FM23E0003 0013 F	20FM23E0003 0013 F
AW	Cap Screws	11FM7A0112 0001 F	11FM7A0112 0001 F	11FM7A0112 0001 F
AX	Washers	11FM1MB0003 0006 F	11FM1MB0003 0006 F	11FM1MB0003 0006 F
AY	Cap Screws	11FM7A0055 0001 F	11FM7A0169 0001 F	11FM7A0169 0001 F
AZ	Pipe Plug	20FM7A0002 0008 F	N/A	N/A

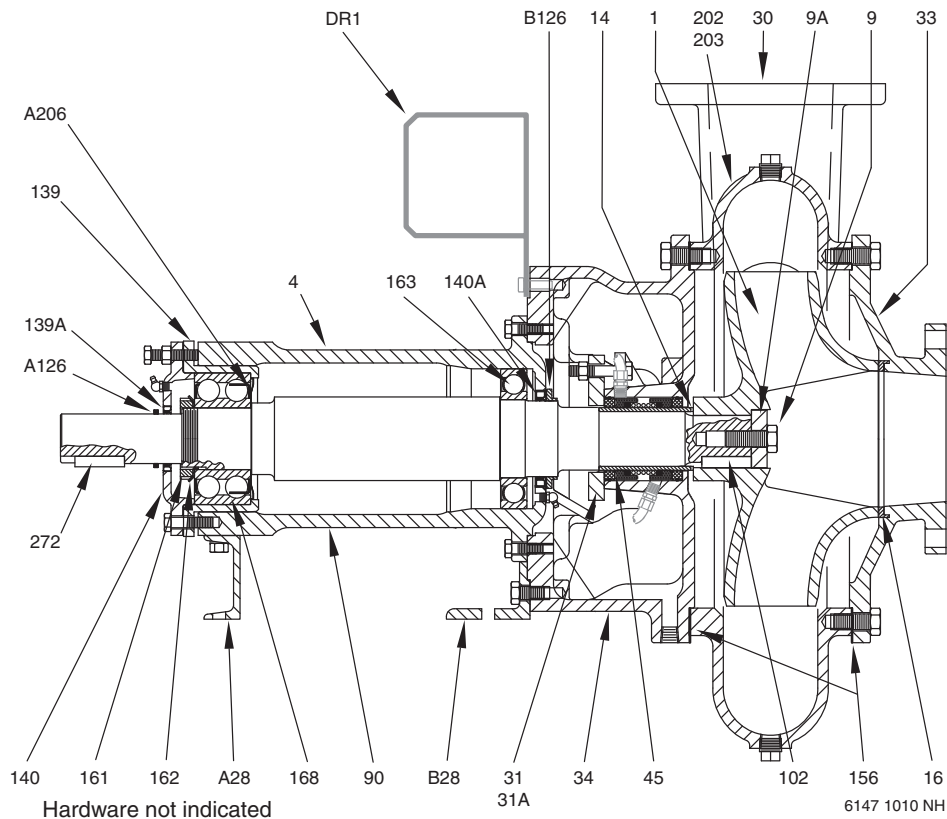


Figure 7A: Assembly (4BSD4, T40 Frame), product shown with volute oriented in T1 position

Parts List – B85649

Item	Description	Part Number
1	Impeller	T4D1AR
4	Shaft	T40D4A 4180 F
9	Impeller Capscrew	11FM7A0202 0003 F
9A	Impeller Washer	CP5855AT 9660 F
14	Shaft Sleeve	T40D14A 9610 F
16	Wear Ring	T5C16AA 9630 F
A28	Mounting Foot, Frame	T40D28F 4080 F
B28	Mounting Foot, Backhead	T40D28E 4080 F
30	Volute	T4D30G 0870 F
31	Solid Gland	W300A31A 0220 F
31A	Gasket	T40D325C 8180 F
33	Fronthead	T4D33G 0220 F
34	Backhead	T40D34A 0220 F
45	Mechanical Seal	HYD1DE3 9906 F
90	Frame	T40D90C 0220 F
102	Impeller Key	16FM104S0640 4780 F
A126	Deflector	HYD6F4 9906 F
B126	Deflector	HYD67A3 9923 F

Item	Description	Part Number
139	Bearing Housing	T40D139A 0220 F
139A	Lipseal	HYD2Q150 9906 F
140	Bearing Housing Cover	T40D159A 0220 F
140A	Lipseal	HYD2Q44 9906 F
156	Volute Gasket	TAJC33B 8380 F
161	Bearing Locknut	11FM61AAN15 0006 F
162	Bearing Lockwasher	11FM1JAW15 0006 F
163	Thrust Bearing	HYD38B9 9906 F
168	Radial Bearing	HYD38AD2 9906 F
202	HH Cover	T4D202A 0220 F
203	HH Cover Gasket	TBGA467A 7880 F
A206	Bearing Shield	HYD50A23 9906 F
272	Coupling Key	16FM104S0804 4780 F
DR1	Dry-Run Tank Assembly (See Figure 10)	B85727
	Mechanical Seal Kit (Includes 31A, 45, AH, AJ, AK)	B85785

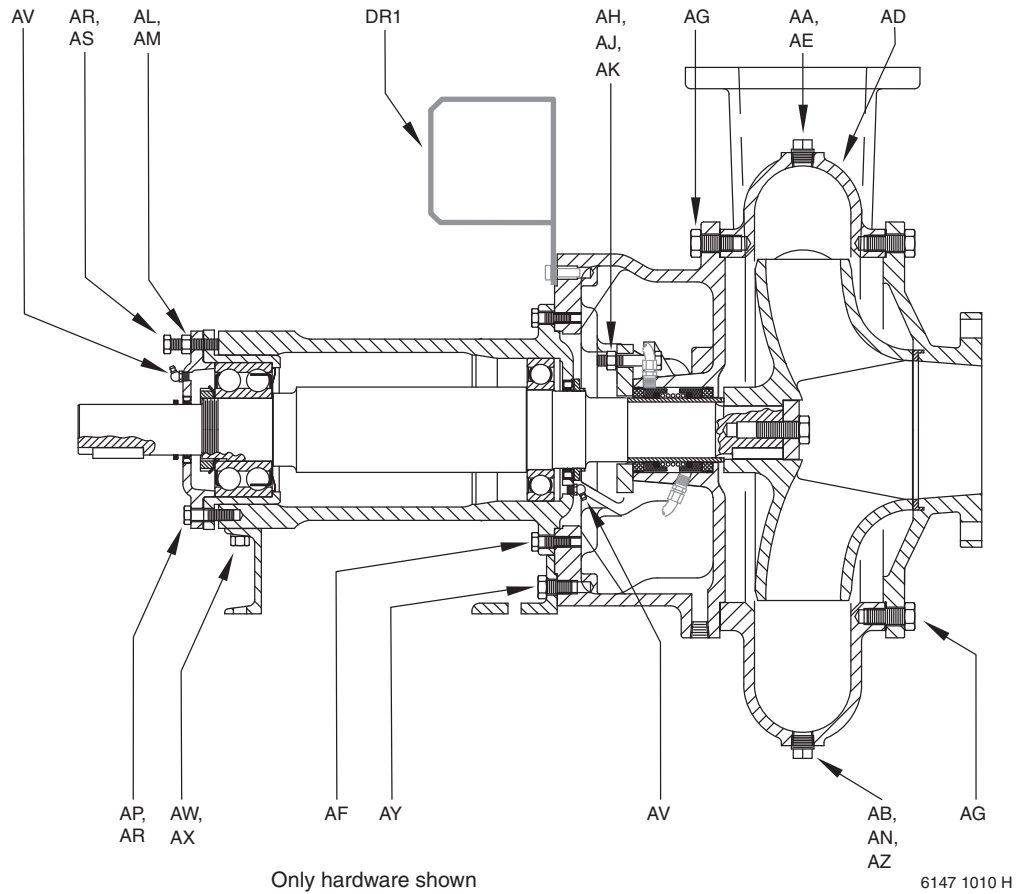


Figure 7B: Assembly Hardware (4BSD4, T40 Frame)

Parts List – B85649

Item	Description	Part Number
AA	Pipe Plug	20FM7D0004 0006 F
AB	Pipe Plug	20FM7A0002 0008 F
AD	HH Cover Capscrews	11FM7A0112 0001 F
AE	Pipe Plug	20FM7D0002 0008 F
AF	Cap Screws	11FM7A0113 0001 F
AG	Cap Screws	11FM7A0201 0001 F
AH	Gland Bolts	11FM4A0102 0006 F
AJ	Gland Bolt Nuts	11FM25A10005 0006 F
AK	Gland Bolt Washers	11FM1N0011 0006 F
AL	Jam Nuts	11FM27A0005 0006 F

Item	Description	Part Number
AM	Washers	11FM1N0011 0006 F
AN	Pipe Plug	20FM7D0001 0006 F
AP	Cap Screws	11FM7A0115 0001 F
AR	Cap Screws	11FM7G0117 0001 F
AS	Jam Nuts	11FM27A0005 0006 F
AV	Lube Fitting	20FM23E0003 0013 F
AW	Cap Screws	11FM7A0113 0001 F
AX	Washers	11FM1MB0003 0006 F
AY	Cap Screws	11FM7A0170 0001 F
AZ	Pipe Plug	20FM7A0002 0008 F

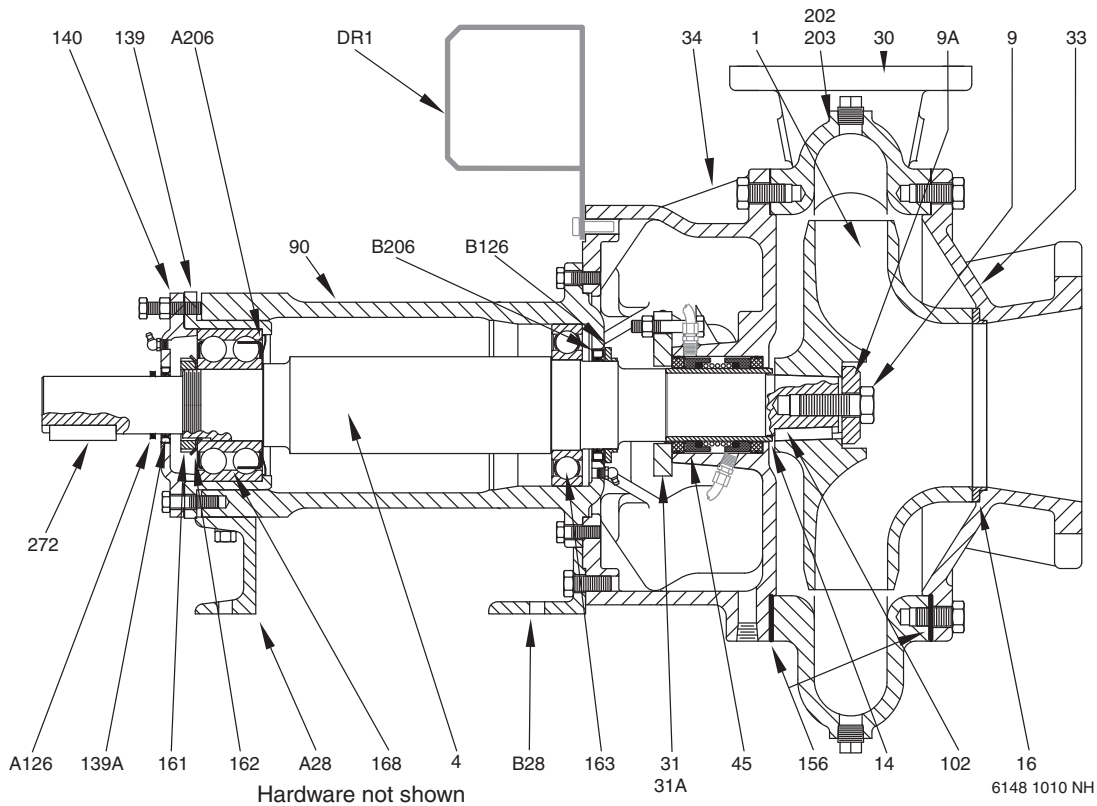


Figure 8A: T40 Assembly (4BSD5 and 5BSD6, T40 Frame), product shown with volute oriented in T1 position

Parts List – B85650, B85651

Item	Description	Part Number	
		B85650	B85651
1	Impeller	T4E1E	T5D1DC
4	Shaft	T40D4K 4180 F	T40D4K 4180 F
9	Impeller Capscrew	11FM7A0231 0003 F	11FM7A0231 0003 F
9A	Impeller Washer	CP8844J 9660 F	CP8844B 9660 F
14	Shaft Sleeve	T40D14J 9610 F	T40D14J 9610 F
16	Wear Ring	T4C16AM 9630 F	T5D16G 9630 F
A28	Mounting Foot, Frame	T40D28F 4080 F	T40D28F 4080 F
B28	Mounting Foot, Backhead	T40D28E 4080 F	T40D28E 4080 F
30	Volute	T4E30A 0220 F	T5D30C 0220 F
31	Solid Gland	W300A31A 0220 F	W300A31A 0220 F
31A	Gasket	T40D325C 8180 F	T40D325C 8180 F
33	Fronthead	T4E33G 0220 F	T5D33V 0220 F
34	Backhead	T40D34F 0220 F	T40D34F 0220 F
45	Mechanical Seal	HYD1DE3 9906 F	HYD1DE3 9906 F
90	Frame	T40D90C 0220 F	T40D90C 0220 F
102	Impeller Key	16FM104S0640 4780 F	16FM104S0640 4780 F
A126	Deflector	HYD6F4 9906 F	HYD6F4 9906 F
B126	Deflector	HYD67A3 9923 F	HYD67A3 9923 F
139	Bearing Housing	T40D139A 0220 F	T40D139A 0220 F
139A	Lipseal	HYD2Q150 9906 F	HYD2Q150 9906 F
140	Bearing Housing Cover	T40D159A 0220 F	T40D159A 0220 F
140A	Lipseal	HYD2Q44 9906 F	HYD2Q44 9906 F
156	Volute Gasket	T5D156A 8380 F	T5D156A 8380 F
161	Bearing Locknut	11FM61AAN15 0006 F	11FM61AAN15 0006 F
162	Bearing Lockwasher	11FM1JAW15 0006 F	11FM1JAW15 0006 F
163	Thrust Bearing	HYD38B9 9906 F	HYD38B9 9906 F
168	Radial Bearing	HYD38AD2 9906 F	HYD38AD2 9906 F
202	HH Cover	T4C202A 3980 F	T5D202A 0220 F
203	HH Cover Gasket	TBGA467A 7880 F	TBIA467B 7880 F
A206	Bearing Shield	HYD50A23 9906 F	HYD50A23 9906 F
272	Coupling Key	16FM104S0804 4780 F	16FM104S0804 4780 F
DR1	Dry-Run Tank Assembly (See Figure 10)	B85727	B85727
	Mechanical Seal Kit (Includes 31A, 45, AH, AJ, AK)	B85785	B85785

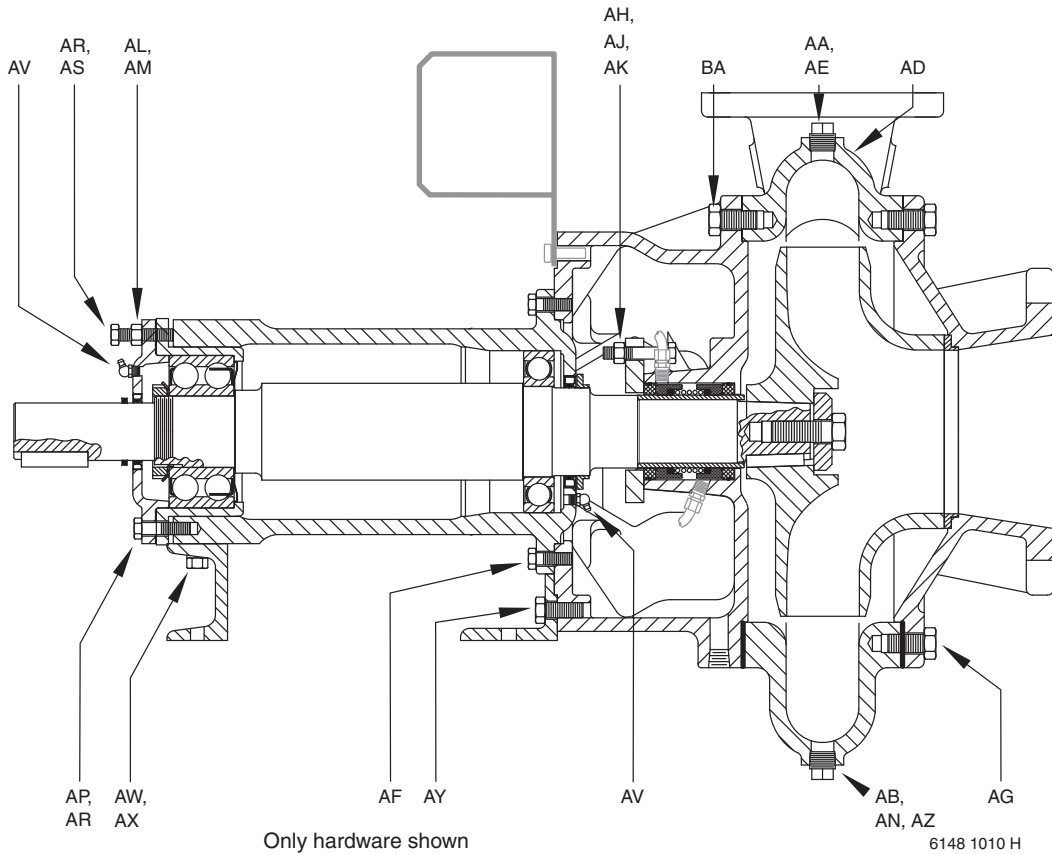


Figure 8B: Assembly Hardware (4BSD5 and 5BSD6, T40 Frame)

Parts List – B85650, B85651

Item	Description	Part Number	
		B85650	B85651
AA	Pipe Plug	20FM7D0004 0006 F	20FM7D0004 0008 F
AB	Pipe Plug	20FM7A0002 0008 F	20FM7A0002 0008 F
AD	HH Cover Capscrews	11FM7A0112 0001 F	11FM7A0171 0001 F
AE	Pipe Plug	20FM7D0002 0008 F	20FM7D0002 0008 F
AF	Cap Screws	11FM7A0113 0001 F	11FM7A0113 0001 F
AG	Cap Screws	11FM7A0201 0001 F	11FM7A0201 0001 F
AH	Gland Bolts	11FM4A0102 0006 F	11FM4A0102 0006 F
AJ	Gland Bolt Nuts	11FM25A10005 0006 F	11FM25A10005 0006 F
AK	Gland Bolt Washers	11FM1N0011 0006 F	11FM1N0011 0006 F
AL	Jam Nuts	11FM27A0005 0006 F	11FM27A0005 0006 F
AM	Washers	11FM1N0011 0006 F	11FM1N0011 0006 F
AN	Pipe Plug	20FM7D0001 0006 F	20FM7D0001 0006 F
AP	Cap Screws	11FM7A0115 0001 F	11FM7A0115 0001 F
AR	Cap Screws	11FM7G0117 0001 F	11FM7G0117 0001 F
AS	Jam Nuts	11FM27A0005 0006 F	11FM27A0005 0006 F
AV	Lube Fitting	20FM23E0003 0013 F	20FM23E0003 0013 F
AW	Cap Screws	11FM7A0113 0001 F	11FM7A0113 0001 F
AX	Washers	11FM1MB0003 0006 F	11FM1MB0003 0006 F
AY	Cap Screws	11FM7A0170 0001 F	11FM7A0170 0001 F
AZ	Pipe Plug	20FM7A0002 0008 F	20FM7A0002 0008 F
BA	Capscrews	11FM7A0201 0001 F	11FM7A0201 0001 F

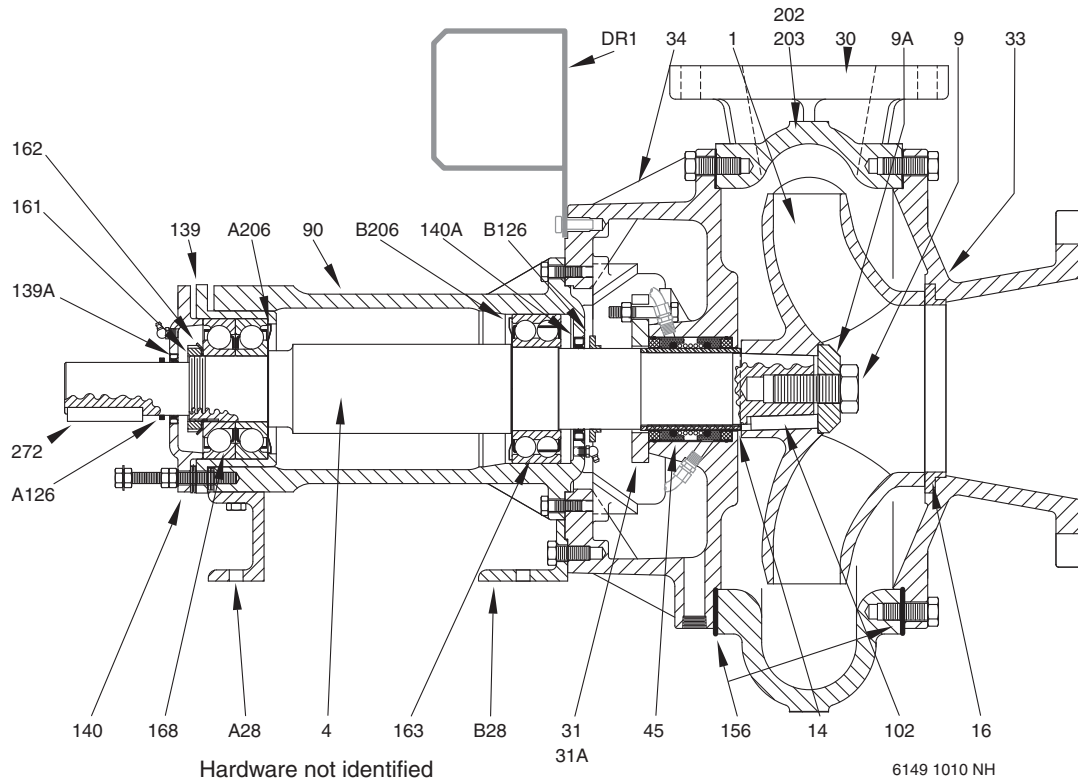


Figure 9A: Assembly (6BSD6 and 8BSD6, T60 Frame), product shown with volute oriented in T1 position

Parts List – B85652, B85653

Item	Description	Part Number	
		B85652	B85653
1	Impeller	T6E1BA	T8F1N
4	Shaft	T60E4F 4180 F	T60E4F 4180 F
9	Impeller Capscrew	11FM7A0312 0003 F	11FM7A0312 0003 F
9A	Impeller Washer	CP8844A 9660 F	CP8844A 9660 F
14	Shaft Sleeve	T60E14H 9610 F	T60E14H 9610 F
16	Wear Ring	T6E16K 9630 F	T6F16A 9630 F
A28	Mounting Foot, Frame	T40D28F 4080 F	T40D28F 4080 F
B28	Mounting Foot, Backhead	T40D28E 4080 F	T40D28E 4080 F
30	Volute	T6E30H 0220 F	T8F30A 0220 F
31	Solid Gland	W350A31A 0220 F	W350A31A 0220 F
31A	Gasket	T60E325B 8180 F	T60E325B 8180 F
33	Fronthead	T6E33J 0220 F	T6E33R 0220 F
34	Backhead	T60E34A 0220 F	T60E34B 0220 F
45	Mechanical Seal	HYD1CW4 9906 F	HYD1CW4 9906 F
90	Frame	T40D90C 0220 F	T40D90C 0220 F
102	Impeller Key	16FM104S0805 4780 F	16FM104S0805 4780 F
A126	Deflector	HYD6F4 9906 F	HYD6F4 9906 F
B126	Deflector	HYD67A3 9923 F	HYD67A3 9923 F
139	Bearing Housing	T40D139A 0220 F	T40D139A 0220 F
139A	Lipseal	HYD2Q150 9906 F	HYD2Q150 9906 F
140	Bearing Housing Cover	T40D159A 0220 F	T40D159A 0220 F
140A	Lipseal	HYD2Q44 9906 F	HYD2Q44 9906 F
156	Volute Gasket	T6E156A 8380 F	T6E156A 8380 F
161	Bearing Locknut	11FM61AAN15 0006 F	11FM61AAN15 0006 F
162	Bearing Lockwasher	11FM1JAW15 0006 F	11FM1JAW15 0006 F
163	Thrust Bearing	HYD38K5 9906 F	HYD38K5 9906 F
168	Radial Bearing	HYD38A4 9906 F	HYD38A4 9906 F
202	HH Cover	T6E202A 0220 F	TBIA2296AB 0220 F
203	HH Cover Gasket	TAJE203A 7880 F	TAJE203A 7880 F
A206	Bearing Shield	HYD50A23 9906 F	HYD50A23 9906 F
B206	Bearing Shield	HYD50A9 9906 F	HYD50A9 9906 F
272	Coupling Key	16FM104S0808 4780 F	16FM104S0808 4780 F
DR1	Dry-Run Tank Assembly (See Figure 10)	B85727	B85727
	Mechanical Seal Kit (Includes 31A, 45, AH, AJ, AK)	B85786	B85786

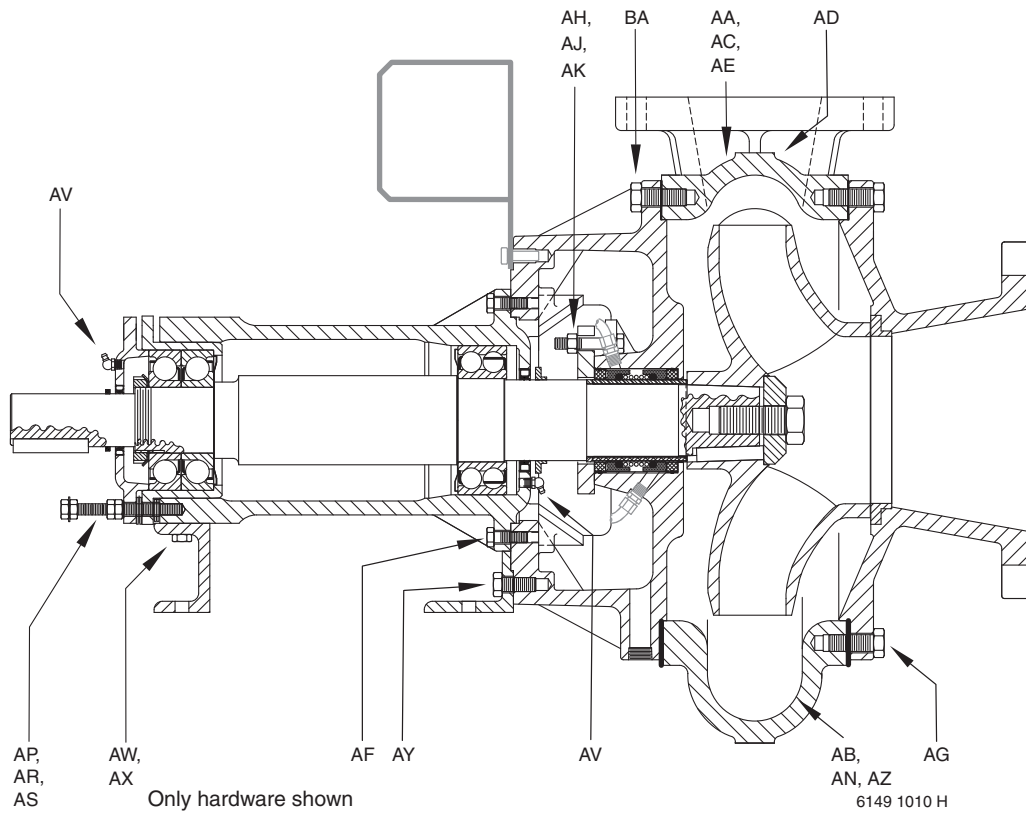


Figure 9B: Assembly Hardware (6BSD6 and 8BSD6, T60 Frame)

Parts List – B85652, B85653

Item	Description	Part Number	
		B85652	B85653
AA	Pipe Plug	20FM7D0004 0008 F	20FM7D0004 0008 F
AB	Pipe Plug	20FM7A0003 0008 F	20FM7A0003 0008 F
AC	Pipe Plug	20FM7A0002 0008 F	20FM7A0002 0008 F
AD	HH Cover Capscrews	11FM7A0171 0001 F	11FM7A0171 0001 F
AE	Pipe Plug	20FM7D0002 0008 F	20FM7D0002 0008 F
AF	Cap Screws	11FM7A0113 0001 F	11FM7A0113 0001 F
AG	Cap Screws	11FM7A0202 0001 F	11FM7A0229 0001 F
AH	Gland Bolts	11FM4A0102 0006 F	11FM4A0102 0006 F
AJ	Gland Bolt Nuts	11FM25A10005 0006 F	11FM25A10005 0006 F
AK	Gland Bolt Washers	11FM1N0011 0006 F	11FM1N0011 0006 F
AN	Pipe Plug	20FM7D0001 0006 F	20FM7D0001 0006 F
AP	Cap Screws	11FM7G0116 0001 F	11FM7G0116 0001 F
AR	Cap Screws	11FM7G0116 0001 F	11FM7G0116 0001 F
AS	Jam Nuts	11FM27A0005 0006 F	11FM27A0005 0006 F
AU	Shims	HYD102A19 5180 F	HYD102A19 5180 F
AU	Shims	HYD102A20 5180 F	HYD102A20 5180 F
AU	Shims	HYD102A21 5180 F	HYD102A21 5180 F
AV	Lube Fitting	20FM23E0003 0013 F	20FM23E0003 0013 F
AW	Cap Screws	11FM7A0113 0001 F	11FM7A0113 0001 F
AX	Washers	11FM1MB0003 0006 F	11FM1MB0003 0006 F
AY	Cap Screws	11FM7A0170 0001 F	11FM7A0170 0001 F
AZ	Pipe Plug	20FM7A0002 0008 F	20FM7A0002 0008 F
BA	Capscrews	11FM7A0202 0001 F	11FM7A0229 0001 F

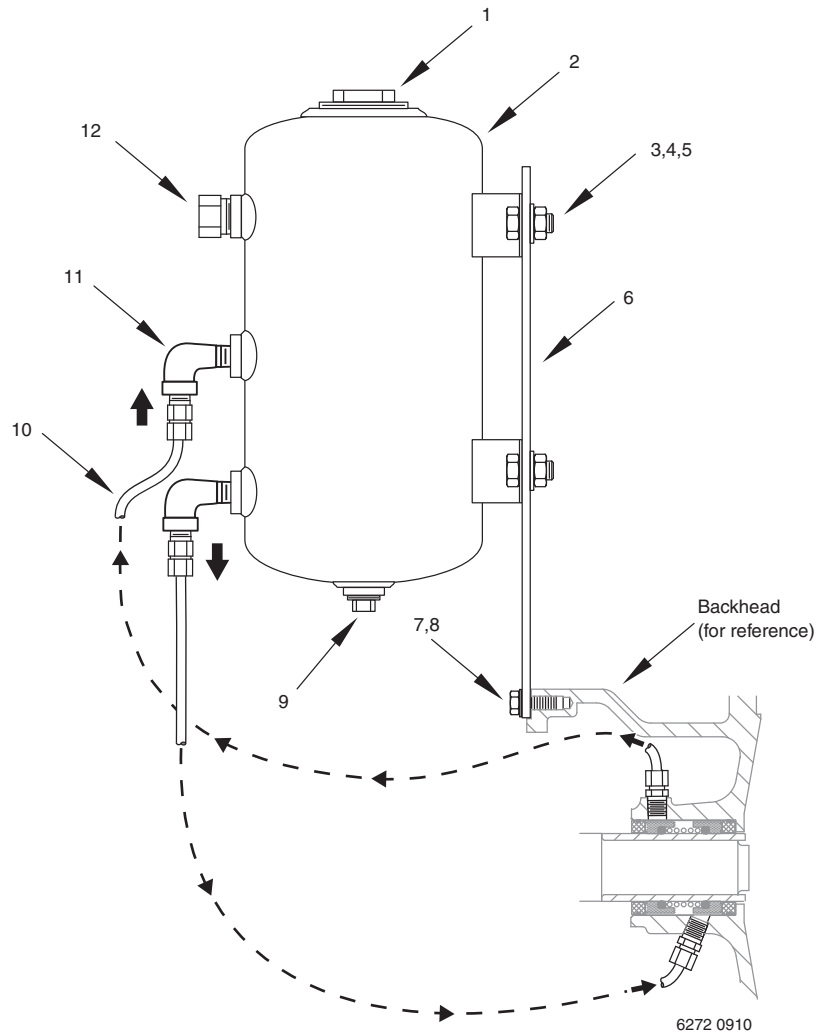
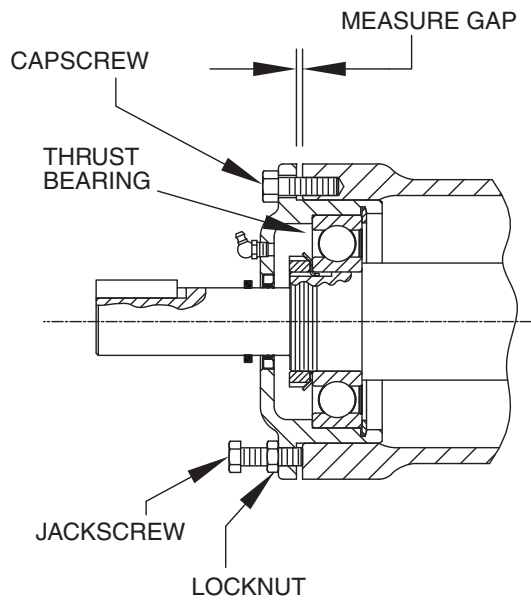
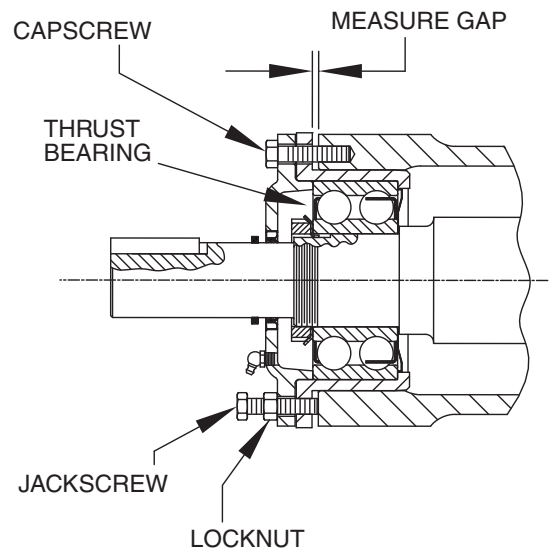


Figure 10: DR1 – Dry Run Tank Assembly

Item	Description	Quantity	T20 FRAME	T30 FRAME	T60 FRAME
			Part Number	Part Number	Part Number
1	Pipe Plug	1	20FM7A0006 0008 F	20FM7A0006 0008 F	20FM7A0006 0008 F
2	Reservoir	1	M14961	M14961	M14961
3	Cap Screw	4	11FM7A0055 0001 F	11FM7A0055 0001 F	11FM7A0055 0001 F
4	Hex Nut	4	11FM25A10003 0006 F	11FM25A10003 0006 F	11FM25A10003 0006 F
5	Lockwasher	4	11FM1A0011 0016 F	11FM1A0011 0016 F	11FM1A0011 0016 F
6	Bracket	2	M15206	M15207	M15208
7	Cap Screw	2	11FM7A0056 0001 F	11FM7A0170 0001 F	11FM7A0171 0001 F
8	Lockwasher	2	11FM1A0011 0006 F	11FM1A0015 0006 F	11FM1A0015 0006 F
9	Pipe Plug	1	20FM7D0002 0008 F	20FM7D0002 0008 F	20FM7D0002 0008 F
10	Hose	2	M14983	M14983	M14983
11	Elbow	2	20FM3C0002 0008 F	20FM3C0002 0008 F	20FM3C0002 0008 F
12	Sightglass	1	HYD7S2 9906 F	HYD7S2 9906 F	HYD7S2 9906 F
DR1	Dry Pit Tank Assembly	-	B85725	B85726	B85727

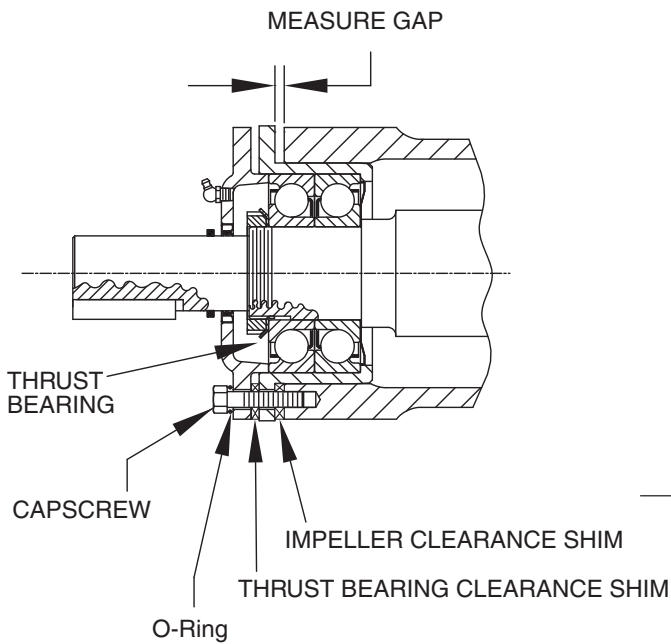


T20 AND T30 FRAME

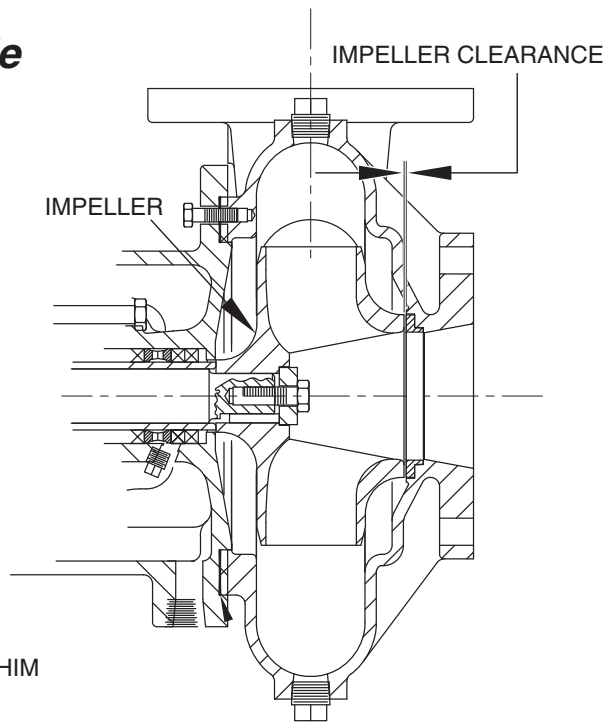


T40 FRAME

*Not
to
Scale*



T60 FRAME



TYPICAL VOLUTE

IMPELLER ADJUSTMENT

5400M021

6150 0210

Figure 11: Impeller Adjustment