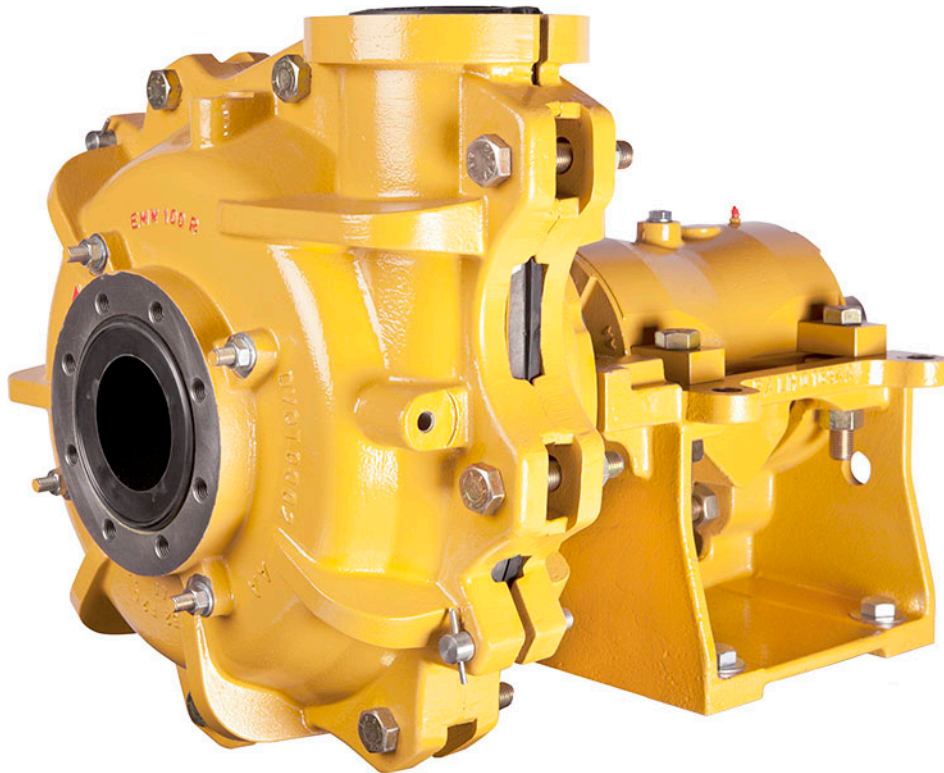


EMW® SLURRY PUMP - RUBBER

Installation, Operation, Maintenance and Storage Manual



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Forward

This manual provides instructions for the Installation, Operation, Maintenance, and Storage of the Wilfley EMW Standard Pump. The standard assembly is a grease lube pump with an expeller seal. This manual covers the standard product in addition to common options that are available. Supplemental instructions are supplied for special options. This manual must be read and understood before installation and start-up.

The design, materials, and workmanship incorporated in the construction of Wilfley EMW pumps makes them capable of providing trouble-free service. The life and satisfactory service of any mechanical unit is enhanced and extended by correct application, proper installation, periodic inspection, condition monitoring, and careful maintenance. This instruction manual was prepared to assist operators in understanding the construction and the correct methods of installation, operation, maintenance, and storage of these pumps.

A.R. Wilfley & Sons, Inc. (ARW) and Ensival-Moret shall not be liable for damage or delays caused by a failure to observe the instructions for installation, operation, maintenance, and storage contained in this manual.

Warranty is valid only when genuine EMW parts are used. Contact your local EMW representative for basic warranty information and before making any changes.

Use of the equipment on a service other than stated in the order could nullify the warranty, unless written approval is obtained in advance from ARW.

To assure proper installation, supervision from an authorized manufacturer's representative is recommended.

Additional manuals can be obtained by contacting your local EMW representative.

THIS MANUAL EXPLAINS

- Proper Storage
- Proper Installation
- Start-up Procedures
- Shutdown Procedures
- Operating Procedures
- Preventive Maintenance
- Pump Overhaul
- Spare or Repair Parts
- Pump Assembly
- Troubleshooting

1.0 Introduction

This manual contains instructions and guidelines for the installation, operation, maintenance, and storage of the EMW Standard Pumps.

There are many factors affecting the successful installation, operation, and maintenance of a pump. There are variations in these factors per individual pump; therefore, the information contained herein shall only be used as a general guideline. If detailed questions or problems arise, contact the Wilfley Sales Office, Distributors, or Representatives.

It is important that this manual be read prior to installation or start-up on the pump to understand the safety, proper performance of the pump, and maximum Mean Time Between Planned Maintenance (MTBPM).

2.0 Safety Considerations

Centrifugal pumps can be dangerous if used improperly. Any misuses may result in a pump that does not function properly. A pump that does not function properly may be a hazard and could cause damage or injury.

For maximum safety and reliability, use only factory supplied parts and follow all maintenance and operating recommendations and instructions.

The following list is meant to be provided only as a guide for some of the common types of misuse that can damage a pump and/or cause injury and will void any and all warranties.

1. Do not run a pump with the discharge valve closed.
2. Do not run a pump in the reverse direction.
3. Do not start a pump that is "wind-milling" in the reverse direction due to fluid flowing back down the discharge pipe.
4. Do not continue to operate a pump when there are indications that something is rubbing, binding, or knocking.
5. Do not continue to run a pump that gives an indication of overheating.
6. Do not operate a pump with any equipment guard removed. Make sure all equipment guards are correctly installed.
7. Do not operate a pump that is vibrating, surging, or making an abnormal noise.
8. Do not work on a pump unless the drive system is locked out and the pump is disconnected from the drive system.
9. Do not connect the pump to the drive system without verifying that the drive system is running in the correct direction.
10. Do not rely on the factory's alignment of the pump and the drive system. Alignment may have changed during shipment.
11. Do not change the pumping conditions or installation of an EMW pump without consulting ARW first to ascertain if the pump is capable of handling the new conditions and/or fluid.
12. Do not insert a cold liquid in or on a hot pump or a hot liquid in or on a cold pump.
13. Do not hit a pump with any object.
14. Do not use worn or faulty parts.
15. Do not stick hands, arms, legs, or any other object into the discharge, suction, or any other opening of a pump.
16. Do not weld attachments to the pump.
17. Do not apply external heat to the pump.
18. Do not lift the pump by only its case.
19. Do not examine a pump without using proper eye, face, and toe protection.
20. Some materials deteriorate with time. If your pump has been out of service for more than 3 months, please contact ARW for information concerning its suitability for service.

The EMW pump has been designed and manufactured for safe operation. In order to ensure safe operation, it is very important that this manual be read in its entirety prior to installation or operation of the pump. ARW shall not be liable for physical injury, damage, or delays caused by a failure to observe these instructions.

Every pump has the potential to be dangerous due to the following factors:

- Parts are rotating at high speeds.
- High pressures may be present.
- High temperatures may be present.
- Highly corrosive and/or toxic chemicals may be present.

Paying close attention to safety is always extremely important; however, there are often situations that require special attention which are indicated throughout this book by the following symbols:



DANGER – Immediate hazards that WILL result in severe personal injury or death.



WARNING – Hazards or unsafe practices that COULD result in severe personal injury or death.



CAUTION - Hazards or unsafe practices that COULD result in minor personal injury or product or property damage.

NOTE: *Always coordinate repair activity with operations personnel and follow all plant safety requirements and applicable safety and health Laws/Regulations.*

2.1 Safety Tips

2.1.1 Operator / User

- Wear insulated work gloves when handling hot bearings or using bearing heater.
- Wear heavy work gloves when handling parts with sharp edges, especially impellers.
- Wear safety glasses (with side shields) for eye protection, especially in machine shop areas.
- Wear steel toe shoes for protection when handling parts, heavy tools, etc.
- Wear other personal protective equipment to protect against hazardous/toxic fluids.
- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.
- Guards that are fitted to prevent accidental contact with moving parts must not be removed while the machine is operating.
- Leakages of hazardous material must be handled in a manner which avoids any danger to persons and the environment. Pertinent legal provisions must be followed.
- Electrical hazards must be eliminated.

2.1.2 Maintenance, Inspection, and Installation

- The operator is responsible for ensuring that all maintenance, inspection, and installation work is performed by authorized and qualified personnel who understand the manual.
- Work on the machine must only occur at standstill. The shutdown procedure described in Shutdown (Section 6) for taking the machine out of service must be followed.
- All safety/protective devices must be re-installed and/or reactivated immediately following completion of the work.
- Please observe all instructions described in Commissioning (Section 6) before returning the machine to service.
- Always lockout or tag out power.
- Ensure pump is isolated from system and pressure is relieved before disassembling pump, removing plugs, or disconnecting piping.
- Use proper lifting and supporting equipment to prevent serious injury.
- Observe proper decontamination procedures.
- Know and follow company safety regulations.

- Never apply heat to remove impeller.
- Observe all cautions and warnings highlighted in pump instruction manual.

2.2 Unauthorized Modification and Manufacture of Spare Parts

Modifications of the pump and/or pump parts are only permitted with approval from the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts can void any liability of the manufacturer for damage or warranty.

2.3 Unauthorized Operation

Any warranty of the operating reliability and safety of the pump/unit supplied is only valid if the machine is operated in accordance with its designated use. The limits stated in the data sheet must not be exceeded under any circumstances.

3.0 Transport and Storage

Following proper transport and storage practices prevents damage to pumping units.

3.1 Transport Requirements

Proper lifting and safety practices must be observed at all times. Caution when lifting the pump as the center of gravity is often located close to the stuffing box/shaft seal area and not in the physical center of the unit.

Units should be secured properly on a skid or crated box.

3.2 Handling

The following describes how to suspension lift pump components, assembled pumps, or pump, motor, baseplate assemblies.

Lifting should only be done by trained personnel. Pumps and motors often have integral lifting eyes or eye bolts. These are intended for use in lifting the individual piece of equipment.

WARNING

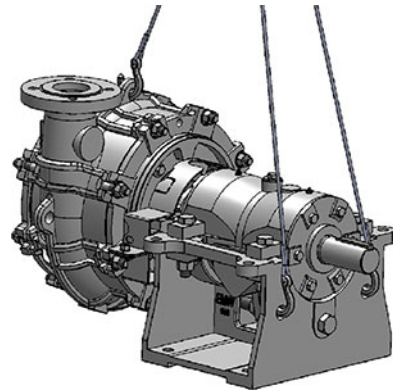
Care should be taken to ensure all lifting lines are properly installed to prevent a load shift. A load shift may result in injury, death, or property damage.

Do not lift pump using the bearing cartridge or shaft as a hoist point.

Before lifting the equipment refer to the pump data sheet for the complete assembly weight.

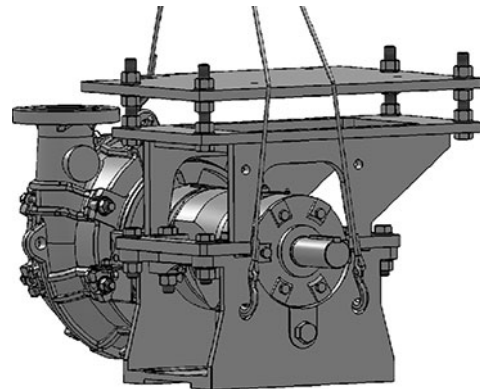
3.2.1 Bare Pump

Attach slings on pump case and pedestal. The slings form three points for lifting as shown on the next page. The sling lengths should be adjusted to balance the load before attaching the lifting hook.



3.2.2 Pump and Overhead Assembly

Do not lift pump and overhead assembly with the motor mounted on the overhead.



3.3 Storage Requirements

If the pump is inoperative for an extended of time, flush the pump thoroughly and dry to minimize corrosion. If there is a possibility of freezing, it is also recommended to drain the lines and case. If the pump is to be stored for more than 15 days, it should be rotated once a week to lubricate and prevent rusting of the bearings.

3.3.1 Short Term Pump Storage

- The pump/unit should be stored in a dry room where the atmospheric humidity is at a constant.
- If stored outdoors, the unit and crates must be covered by waterproof material to avoid any contact with humidity.
- All openings of the assembled pump/unit components are closed and must only be opened when required during installation.
- Protect all stored goods against humidity, dirt, vermin, and unauthorized access.

3.3.2 Long Term Pump Storage

Follow the guidelines when the pump or parts will be idle for a period of one month or more. Following these simple steps while in storage will help to extend the life of the bearing and related equipment reliability.

1. All machined metal surfaces should be coated with a suitable corrosion inhibitor to ensure the integrity of these surfaces at the time of installation.
2. All openings must be covered with suitable covers to protect against contaminants.
3. Components and assemblies are required to be stored indoors in a dry location. Temperature range should be between 40 degrees Fahrenheit and 100 degrees Fahrenheit.
4. When bearings are contained in equipment for storage, a few steps should be taken to ensure the preservation of bearing quality and functionality. The two main concerns that should be addressed are vibrations and moisture. Vibration causes micro movements between the bearing rolling elements and raceways. This movement can displace the

protective lubrication between the balls and raceways and lead to metal to metal cyclical impacting. This is sometimes referred to as false brinneling. Store the equipment as far as possible from the source of vibrations (i.e., motors, rotating pumps, engines, etc.). Isolating the equipment with rubber pads is also an effective means of limiting vibrational damage. Lastly, the bearings should be rotated periodically so as to prevent extended exposure to potential damage. The bearing shafts should be rotated ten full rotations at a minimum rate of once per quarter (90 days). If high vibration levels are suspected then rotating once per month is prudent. To protect the bearings from moisture and contamination, wrapping and taping the equipment in plastic is recommended. If the environment is humid (relative humidity over 70%) a suitable desiccant should be used.

3.3.3 Parts Storage

Not all parts are packaged in a suitable manner from the factory for long-term storage. To ensure a parts satisfactory performance, the part must be protected from corrosion and contamination.

3.3.4 Motor and Seal Storage

Refer to the respective manufacturer's manuals for storage instructions on the motor and seal.

4.0 Installation

4.1 Inspection upon Arrival

Your pump has been carefully inspected prior to shipment to ensure that it meets the requirements. Please inspect the pump upon arrival for any damage that may have occurred during shipment, and immediately report any damage to the carrier.

Leave all shipping covers attached to the pump unit until it is ready for installation. If installation is to be delayed more than 15 days, the pump shaft should be rotated by hand once a week to lubricate the bearings and prevent rusting.

4.2 Choosing Pump Location

1. Locate the pump as close to the liquid source as possible so the suction pipe is short and direct with a minimum of elbows, fittings, and valves.

2. Place the pump in a location that allows easy access to the unit for inspection during operation and maintenance, which involve removal and disassembly.

4.3 Foundation

The foundation should be sufficient to absorb any vibration and form a permanent, rigid support for the baseplate. A concrete foundation on a solid base is satisfactory. Foundation bolts of the proper size should be embedded in the concrete located as indicated on the outline drawing.

4.4 Alignment

The pump and motor are aligned at the factory before shipment. Realignment may be necessary after the complete unit has been leveled on the foundation and after the foundation bolts have been tightened. Procedures for checking and aligning the pump components are in section 4.0.10 and may also be found in the Hydraulic Institute Standards.

4.5 Piping

All piping must be independently supported, accurately aligned, and connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. Install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but do not bottom out in the tapped holes before the joint is tight. The customer is responsible for proper suction and discharge pipe design and layout to avoid flow induced problems.



Piping Forces: Take care during installation and operation to minimize pipe forces and/or moments on the pump casing.

4.6 Discharge Piping

An isolation valve should be installed in the discharge line to allow for pump inspection and maintenance.



A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

4.7 Suction Piping

Care should be taken in sizing and locating suction piping to prevent cavitation. A valve should be installed in the suction line to prevent fluid from flowing into the pump when it is shut down.

To avoid NPSH and suction problems, suction pipe sizes must be at least greater than the pump suction connection. **Never** use pipe or fittings on the suction that are smaller in diameter than the pump suction size.

The ideal piping configuration should have a minimum of 10 pipe diameters between the source and the pump suction. In most cases, horizontal reducers should be eccentric and mounted with the flat side on top or up with a maximum of one pipe size reduction. Never mount eccentric reducers with the flat side down. Horizontally mounted concentric reducers should not be used if there is any possibility of entrained air in the process fluid. Vertically mounted concentric reducers are acceptable. In applications where the fluid is completely de-aerated and free of any vapor or suspended solids, concentric reducers are preferable to eccentric reducers.

Avoid the use of throttling valves and strainers in the suction line. Start-up strainers must be removed shortly after start-up. When the pump is installed below the source of supply, a valve should be installed in the suction line to isolate the pump and permit pump inspection and maintenance. However, never place a valve directly on the suction nozzle of the pump. Refer to the Centrifugal Pump IOM Section of the Hydraulic Institute Standards for additional recommendations on suction piping.

4.8 Packing / Seal Flush Piping

An external connection should be made at the pump so flush flow can be varied as required by valves and the pressure can be monitored. Pipe fittings and gauges must be corrosion resistant to the fluid being pumped.

4.9 Piping Note

Refer to the Hydraulic Institute Standards for centrifugal pumps for additional piping information.

4.10 Installation and Alignment

Accurate alignment of the equipment must be obtained and sustained. Trouble-free operation can be accomplished by following the proper procedures.

A properly installed base plate will be leveled with shims, retained in place with anchor bolts, set in concrete, and grouted with a low shrinkage grout.

When a direct drive pump and motor is mounted to a common base plate at the factory, the coupling is installed and aligned at that time. However, coupling alignment must be verified before operating the pump and motor.

Proper coupling alignment can be verified by placing a straight edge axially across the coupling halves. The distance between the straight edge and the shaft should be the same within 0.1 mm (0.004 inches). Also, the angular distance between the coupling halves should be consistent within 0.1 mm (0.004 inches). At a minimum coupling alignment should be checked once every 90 degrees of shaft rotation (12:00, 3:00, 6:00 and 9:00).

When checking a v-belt motor connection, the parallel and offset alignment of the sheave(s) to each other must be within 1.0 mm (0.040 inches).

After connecting piping, rotate the pump drive shaft clockwise (viewed from motor end) by hand several complete revolutions to be sure there is no binding and that all parts are free. Recheck shaft alignment. If piping caused unit to be out of alignment, correct piping to relieve strain on the pump.

After making all piping connections verify pipe strains haven't altered alignment. If changes have occurred, alter piping to remove pipe strains on pump flanges.

Operate the pump for at least an hour or until it reaches final operating temperature. Shut the pump down and recheck alignment while the pump is hot. Piping thermal expansion may change the alignment. Realign the pump as necessary.

See the following table for possible alignment issues.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Unable to obtain horizontal (side to side) alignment, angular, or parallel.	Driver feet bolt bound.	Loosen pump hold down bolts and slide pump and driver until horizontal alignment is achieved.
	Baseplate not leveled properly, possibly twisted.	Determine which corner(s) of the baseplate are high or low and remove or add shims at the appropriate corner(s) and realign.
Unable to obtain vertical alignment, angular, or parallel.	Baseplate not leveled properly, possibly bowed.	Determine if center of baseplate should be raised or lowered and correct by evenly adding or removing shims.

5.0 Coupling and V-Belt Guard



Power must never be applied to the driver when the coupling guard is not installed.

Coupling guards are safety devices intended to protect workers from inherent dangers of the rotating pump shaft, motor shaft, and coupling. It is intended to prevent entry of hands, fingers, or other body parts into a point of hazard by reaching through, over, under, or around the guard.

No standard coupling guard provides complete protection from a disintegrating coupling. The coupling conforms to the U.S.A. standard ASME B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

6.0 Commissioning, Start-Up and Shutdown Instructions

6.1 Commissioning

Use proper eye and face protection when examining, adjusting, maintaining, or in any other way working on the pump. Read all instruction tags on the pump.

Prior to start-up, perform the following tasks:

1. Ensure the pump, suction line, and the tank are vented.
2. Make sure the unit is properly connected to the electric power supply.
3. Confirm that the direction of shaft rotation is correct. The correct direction of shaft rotation is clockwise when viewed from the motor end of the pump.
4. Ensure that all auxiliary connections are connected and functioning.
5. If the pump is oil lubricated ensure the oil level is correct. The correct amount of oil is present when the level is in the middle of the sight glass.

6.2 Start-Up

Ensure all valves are open and all auxiliaries are on. After start-up check pump for leaks and check operating conditions. Stand at a safe distance during start-up.

6.3 Shutdown

Turn off drive. Allow pump to come to a complete stop before disconnecting auxiliaries and closing valves.

7.0 General Service and Maintenance

General service and maintenance should be carried out by authorized and trained operators who are familiar with these operating instructions.



The electrical connections must be disconnected and locked out. Make sure the pump cannot be switched on accidentally.

Liquids posing health hazards must be decontaminated and disposed of ensuring that there are no risks to persons or to the environment.

7.1 Periodic Maintenance

The following table contains recommended service checks that should be performed on a periodic basis.

	Initial Start-Up	Weekly	Monthly
Flow, Pressure, Temp. (7.1.1)	X	X	
Visual (7.1.2)	X		X
Noise Vibration	X		X
Lubricate	X	X	X

7.1.1 Flow, Pressure, and Temperature Monitoring

All flow, pressure, and temperature gauges should be monitored to ensure that the pump is operating within specified limits. If the frame temperatures are monitored, this temperature generally should not exceed 71°C (160°F).

7.1.2 Visual Inspections

Periodic visual inspection should be made of the pump and its installation.

This inspection should include the following:

1. All mounting supports should be secure.
2. All external nuts, bolts, and fittings should be tight.
3. All suction and discharge piping should be secure.
4. All surfaces and joints should show no signs of leakage.

7.1.3 Pump Wash Down

Periodic maintenance can involve the use of high pressure sprays to remove excess dirt and debris. When using such equipment, in order to prevent liquid contamination which could damage the bearings, it is essential to ensure the bearing isolators are not sprayed, directly or indirectly.

7.2 Lubrication

7.2.1 Grease Lubrication

The grease base oil can be mineral or synthetic with synthetic base oil being preferred for bearing temperatures above 93°C (200°F). The consistency should be a NLGI grade 2, with a lithium or lithium complex thickener (soap).

7.2.2 Initial Bearing Grease Fill

Bearings in pumps shipped from the factory come with the bearings pre-packed with grease. When replacing bearings, pack the bearings 100% full of grease, and fill the pump housing cavity around the bearing 30% to 50% full of grease.

7.2.3 Grease Lubrication Interval

Re-lubrication intervals are difficult to determine. Once intervals are established through plant practices or experiences, regular lubrication intervals should be maintained. In the absence of pre-existing practices, refer to Appendix 1 for guidelines.

7.2.4 Oil Lubrication

Viscosity grade recommendations based on temperature are listed in the following table.

ISO Grade	Temperature	
	VG68	63°C to 76°C
VG150	77°C to 92°C	171°F to 199°F
VG220	9°C to 121°C	200°F to 250°F

In the absence of existing preventative maintenance procedures, the oil level should be checked at the time of pump installation, start-up and then once weekly thereafter, and the oil should be changed once every three months.

7.2.5 Oil Capacities

Approximate oil capacities are listed in the following table, the bearing unit should be filled until the sight glass is half full with oil:

Size	Oil Level Liters (Quarts)
50 (2x2)	0.6 (0.6)
75 (3x3)	0.7 (0.8)
100 (4x3)	1.0 (1.1)
150 (6x4)	1.3 (1.4)
200 (8x6)	2.1 (2.2)
250 (10x8)	4.6 (4.8)
300 (12x10)	5.9 (6.2)
350 (14x12)	5.6 (6.0)

7.3 Wear Adjustment



Never adjust the clearance while the pump is running.

The impeller running clearance in pumps sizes 150 (6x4) and smaller is controlled by an adjustment bolt located under the bearing cartridge.

On pumps sizes 200 (8x6) and larger two adjustment features are provided. In addition to the adjustment bolt located under the bearing cartridge, the suction cover is adjustable. This allows control of the impeller and expeller running clearance.

On all pumps, the suction cover can be rotated to compensate for uneven wear.

7.4 General Servicing Attributes

Case joint disassembly under difficult circumstances is provided for. Fasteners are located in slotted or through hole connections and can be sacrificially removed without damaging the connected components, if need be. When troublesome conditions arise with case joint separation, the joint designs allow for use of prying tools.

Seal stuffing boxes, fastened directly to the bracket, can be removed directly or if troublesome can be removed while still attached to the bracket for better accessibility to any frozen fasteners.

The bearing cartridge fork allows the bearing cartridge to be easily disassembled from the pedestal. Flats on the bearing cartridge provide accessibility to the bearing caps for application of force to aid in removal of the bearing caps.

Flanges are separate parts supplied with either ANSI 150 lb or ISO PN 16 connections. Tabs located on the case and suction cover directly behind the cone where the flange seats provide a bearing surface that aid with separation of the flange from the split ring. The flange clears the tabs while the split ring does not. With the flange assembly resting on the tabs, application of a sharp blow to the flange should separate the two pieces. With the aid of a screw driver, prying open the split ring makes it possible to slip it over the cone. Following that, the flange itself can be lifted free of the part.

7.5 Impeller Replacement

Note: Any work on non-pump equipment shall be governed by the specifications and regulations of the manufacturer. Ensure that lockout tags are in place. Do not apply heat to impeller hub or nose.

Removal of the impeller first requires removal of the suction cover. Access to the discharge nozzle on the case is also required, as it will be necessary to insert a bar into the discharge neck to contact the impeller and prevent it from rotating as it is unthreaded from the shaft.



On all but the smallest pumps, a lifting fixture to support the weight of the impeller at the impeller eye during this operation is necessary.

The impeller is tightened by running torque during normal operation. A torsional jolt is usually required to loosen the impeller. On pumps size 150 (6x4) and smaller, a shock force applied to a keyed shaft wrench located on the drive end of the shaft should provide the force necessary to break free the impeller. On pumps size 200 (8x6) and larger a sacrificial brass release collar (shown below) is provided to relieve the impeller thread load. Prying loose the pieces will relieve the impeller load and allow removal. A groove in the release collar sleeve provides a location for a screwdriver blade, lightly tapping the screw driver with a hammer to move the release collar along the shaft will aid with disassembly of the release collar.

Note: Care should be taken to prevent marring of the shaft or shaft keyway when using a shaft wrench.



Release Collar

7.6 Designation

Example: EMW 150M 6x4

Pump: EMW

Suction Nozzle (in mm): 50 through 350
(See the table below)

Hydraulic Type: Metal (M)
Rubber (R)

Imperial Size (suction x discharge):

Pump	Type	Suction mm (in)	Discharge mm (in)
50	M/R	50 (2)	50 (2)
75	M/R	75 (3)	75 (3)
100	M/R	100 (4)	75 (3)
150	M/R	150 (6)	100 (4)
200	M/R	200 (8)	150 (6)
250	M/R	250 (10)	200 (8)
300	M	300 (12)	250 (10)
350	M	350 (14)	300 (12)

7.7 Drainage / Disposal

Prior to drainage of the product from pump, review the Material Safety Data Sheet (MSDS) of the product. Wear appropriate protective clothing.

Follow relevant laws, local codes and safety procedures when disposing of product.

8.0 General Instructions for Ordering Parts

- Provide part numbers
- Provide size and model of pump
- Provide serial number if available or if a specialty pump

8.1 Design Details

Designed as a class III heavy duty end suction slurry pump, the pumping chamber, impeller and expeller are constructed with high chrome, hard iron materials.

8.1.1 Pump Casing

The extra heavy wall thickness and special volute design extends wear life. The front of the case is

open to allow inspection of or removal of the impeller from an installed pump. The casing can be rotated in 45 degree increments (90 degrees for the size 75 and 50 pumps) to accommodate a variety of discharge requirements.

8.1.2 Impeller

The impeller with its extra thick shrouds and vanes and wide open flow passages for handling large objects, maintains excellent performance characteristics throughout its wear life. A closed type impeller is used with all sizes except the size 50 (2x2) pump, which uses a semi-open type impeller.

8.1.3 Bearing Cartridge

The shaft is constructed from high strength alloy steel, mounting paired taper roller thrust bearings and a spherical roller radial bearing protected by labyrinth isolators. The bearing cartridge assembly is designed for long life in the harshest conditions and is available with either grease or oil lubrication.

8.1.4 Sealing System

The seal chamber is designed for easy maintenance, equipped with large openings for all around accessibility.

Three seal systems are available.

- Expeller with Packing Seal
- Packing Seal
- Mechanical Seal
- Diaphragm Seal with expeller
- Dynamic Seal with expeller

8.1.4.1 Expeller with Packing Seal

The expeller provides a positive hydraulic sealing arrangement when the pump is running. The packing provides a static seal when the pump is not running. The expeller will keep slurry from coming in contact with the packing when the pump is running, so abrasive wear on shaft sleeve is greatly reduced. However, the packing must be lubricated to compensate for the pumping action of the expeller, which will tend to dry out the seal chamber. Grease is the recommended lubricant for applications where the use of a liquid lubricant is undesirable. Graphite packing is standard.

Expeller seal performance is dependent upon suction pressure and pump rotational speed. Operating the pump at other than the specified conditions for which it was built can result in unsatisfactory seal performance, excessive wear, and/or premature failure of the seal and/or pump.

8.1.4.2 Packing Seal

The Packing seal provides a simple alternative solution to either an expeller seal or mechanical seal. Graphite packing is standard. A packing flush is always recommended; however, in some applications, dry running packing (packing that is lubricated solely by the liquid being pumped) will also work.

8.1.4.3 Mechanical Seal

The EMW pump seal chamber is designed to accommodate a mechanical seal. Seal envelope requirements vary from supplier to supplier and single, double, cartridge, and non-cartridge designs can work. But, before specifying a seal consult with a Wilfley Representative as engineering approval is required for such applications.

8.1.4.4 Diaphragm Seal with Expeller

The diaphragm seal is a simple flush-less dynamic seal. The expeller creates suction in the seal chamber that pulls open the diaphragm while rotating. This creates a sealing air pocket while running. Upon stopping, the diaphragm will push back against a rotating seal face using the force of the liquid in the case to create a static seal.

Expeller seal and dynamic seal performance is highly dependent upon suction pressure and pump rotational speed as well as properly adjusted internal clearances. Operating the pump at other than the specified conditions for which it was built can result in unsatisfactory seal performance, excessive wear, and/or premature failure of the seal and/or pump.

8.1.4.4 Dynamic Seal with Expeller

The dynamic seal is a flush-less proprietary sealing solution that uses an expeller to create an air pocket to seal the pump while rotating, and a specially designed static seal that can be adjusted to open and close specifically at the application speeds and pressures.

Expeller seal and dynamic seal performance is highly dependent upon suction pressure and pump rotational speed as well as properly adjusted internal

clearances. Operating the pump at other than the specified conditions for which it was built can result in unsatisfactory seal performance, excessive wear, and/or premature failure of the seal and/or pump.

9.0 General Assembly Information

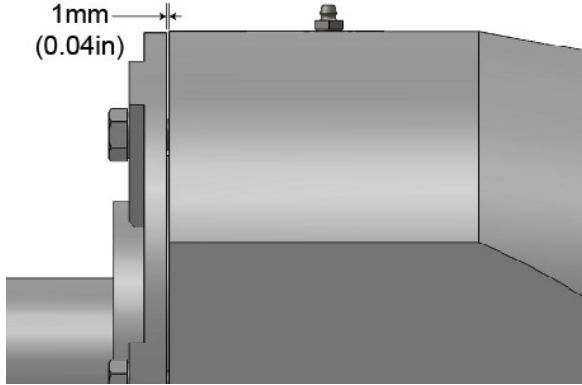
The EMW pump is metric by design. Metric fasteners are used throughout with the following exceptions. All pipe fittings use imperial National Pipe Threads (NPT). On EMW metal pumps produced in the U.S.A. the square head bolts and nuts used to assemble the case are imperial. The flat washers used with these fasteners, however, are metric. Imperial washers are too large to register correctly in the case and bracket counter bore reliefs, and should not be substituted here.

Whenever a pump is rebuilt, all o-rings and gaskets should be replaced. On pumps size 200 and larger, the release collar is a sacrificial component which must be replaced every time a pump is rebuilt.

In general, parts should be cleaned to remove such things as debris, dirt, or rust inhibitor coatings and also inspected for damage. If reconditioned or existing parts are going to be used, inspect them for wear before installing. Before using any parts, all sealing surfaces should be inspected for cleanliness and damage. Replace any damaged fasteners. All fastener threads and the impeller thread should be coated with an anti-seize lubricating compound prior to using.

On the metal pumps the discharge and suction flanges are loose parts so that either an ISO class PN16 or ANSI class 150 lb flange connection can be made. On rubber lined pumps, as a standard, the case shell suction and discharge flange connections are PN16 metric thread tapped holes. ANSI class 150 lb flange connections are available on rubber lined pumps by special request.

When bolted joints are encountered care should be taken to incrementally tighten all fasteners in a crossing pattern until metal to metal contact is achieved between the mating parts before torquing the fasteners to the final value. Exception: A gap, approximately 1 mm (0.040 inches) wide, will exist between the thrust bearing cap and the bearing cartridge when properly assembled. This bearing cap should not be over tightened.



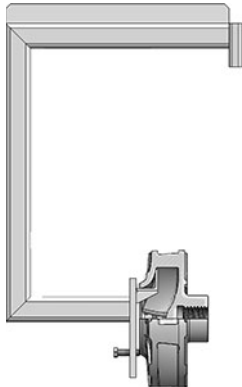
⚠ CAUTION

The tapped hole in the top of the bearing cartridge is for a lifting eye used to handle the bearing cartridge assembly. It is not to be used for lifting a pump.

9.1 Specialized Tools for Assembly and Disassembly

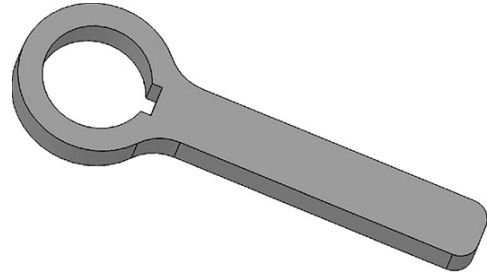
9.1.1 Impeller Tool

On all but the smallest size pumps, an impeller lifting fixture that registers in the eye of the impeller is required for inserting an impeller into or removing an impeller from a case. If a crane will be used, a "C" shaped bent frame lifting fixture with a lifting point located above the impeller center of gravity when the impeller is in a horizontal position is recommended.



9.1.2 Shaft Wrench

A shaft wrench keyed to fit the drive end of the shaft is recommended for aiding with the tightening or releasing of an impeller.

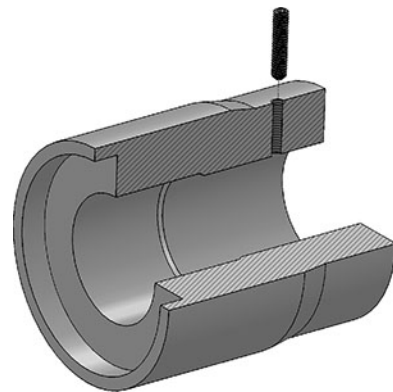


9.1.3 Shaft Handling Tool

A 12 mm tapped hole in the end of the shaft provides a location for a hoisting attachment such as an eyebolt to assist with vertical positioning of the shaft for insertion into or removal from a bearing cartridge.

9.1.4 Radial Bearing Alignment Tool

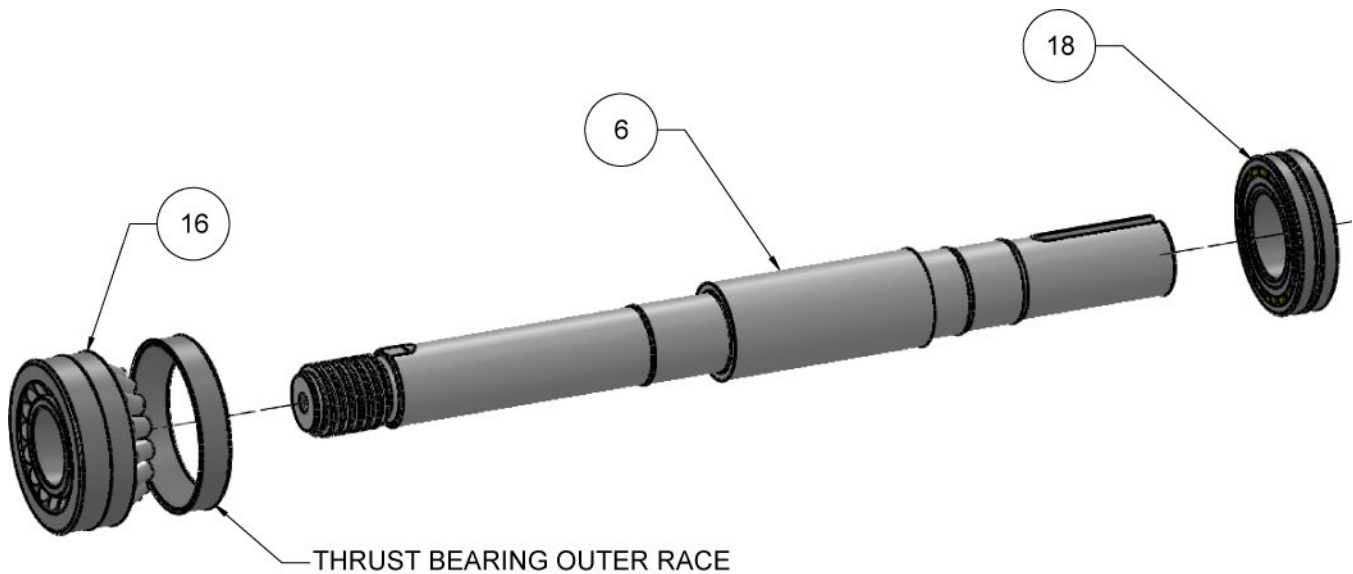
A tool to align the radial bearing outer race during vertical insertion or removal of a shaft assembly into or from a bearing cartridge is required. A tool that shoulders against the radial bearing outer race, slip fits over the drive end of the shaft and is secured in the keyway by a set screw is recommended. To avoid damaging the shaft, the set screw should only be tightened against the shaft keyway flat.



10.0 General Pump Assembly Sequence

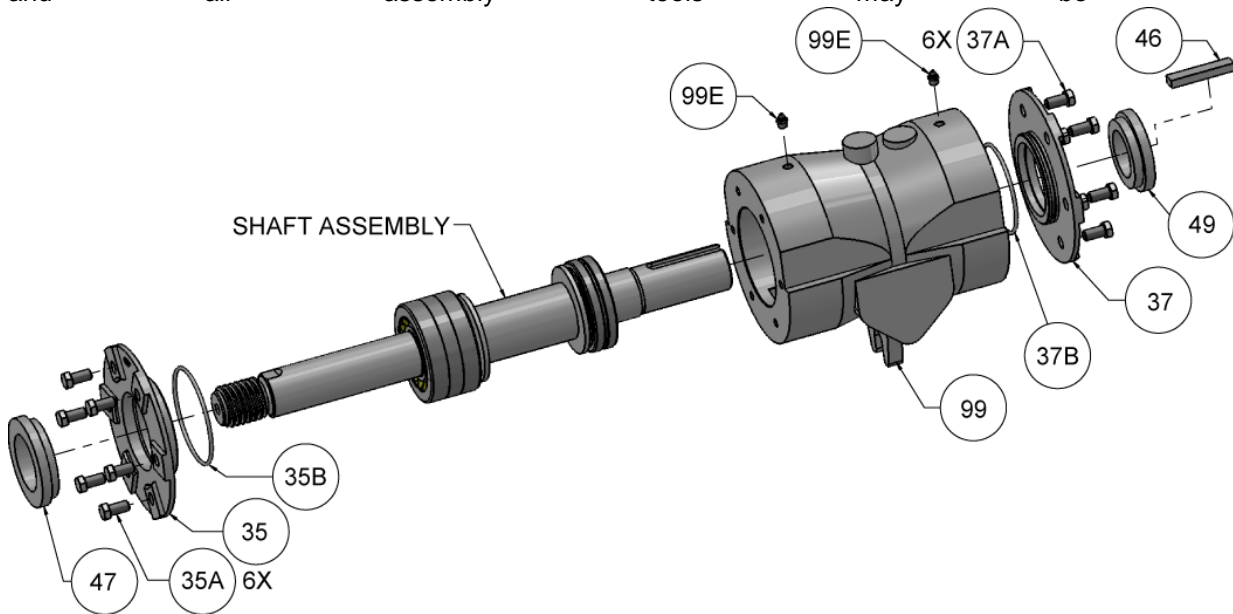
10.1 Power End Assembly

Step 1 – Shaft assembly. The thrust bearings (16) are two taper roller bearings mounted to the shaft in a face-to-face arrangement. The radial bearing (18) is a spherical roller bearing. The thrust bearings are a matched pair and cannot be assembled by mixing and matching pairs. Preheating the bearings for assembly will allow the bearings to slip onto the shaft with a butt fit of the inner race of the bearings against the appropriate shaft shoulder. Please note that the thrust bearing outer race for the inner most bearing will have to be placed on the shaft before installing the thrust bearings. The thrust bearings (16) are located on the threaded side of the shaft, and the radial bearing (18) is located on the keyed side of the shaft. Be sure that the bearings are cooled before moving on to the next step.

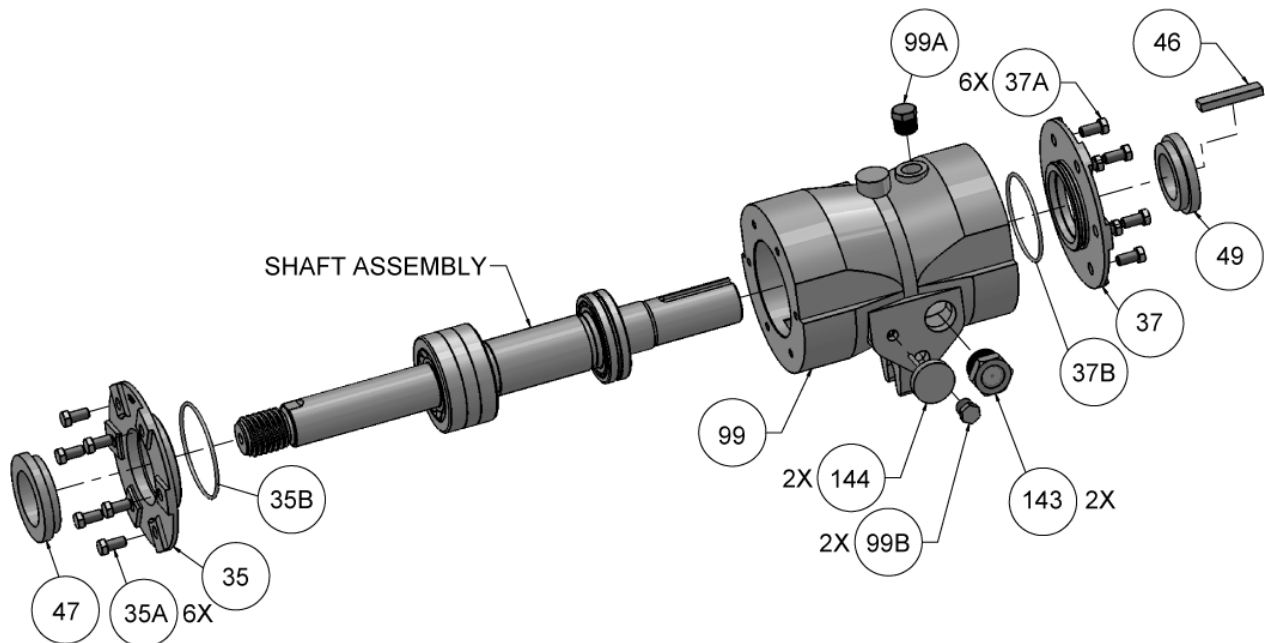


Step 1 – Shaft Assembly

Step 2 – Bearing Cartridge Assembly. To install the shaft assembly from *Step 1* into the bearing cartridge (99), the shaft should be vertically lowered, radial bearing or keyed side first, into the bearing cartridge. If unsure which side of the bearing cartridge is which, the side that has a lip in the bore is the thrust bearing side, and that side will be the side the shaft is lowered into. There is a threaded hole in the shaft (6) to allow a lifting eye for maneuvering the shaft assembly. In addition, a sleeve designed to fit around the keyed portion of the shaft and mate up against the radial bearing is needed to allow for insertion through the tight bore clearances (see figure below). If the bearings are grease lubricated the bearings and the space directly inboard from the bearings should be packed with grease before inserting the shaft assembly into the bearing cartridge. You must be careful when lowering the thrust bearing into the cartridge making sure the outer races are inserted squarely. At this point the bearing cartridge can be rested horizontally in the pedestal assembly (Step 3), or on a workbench cradle and all assembly tools may be removed.

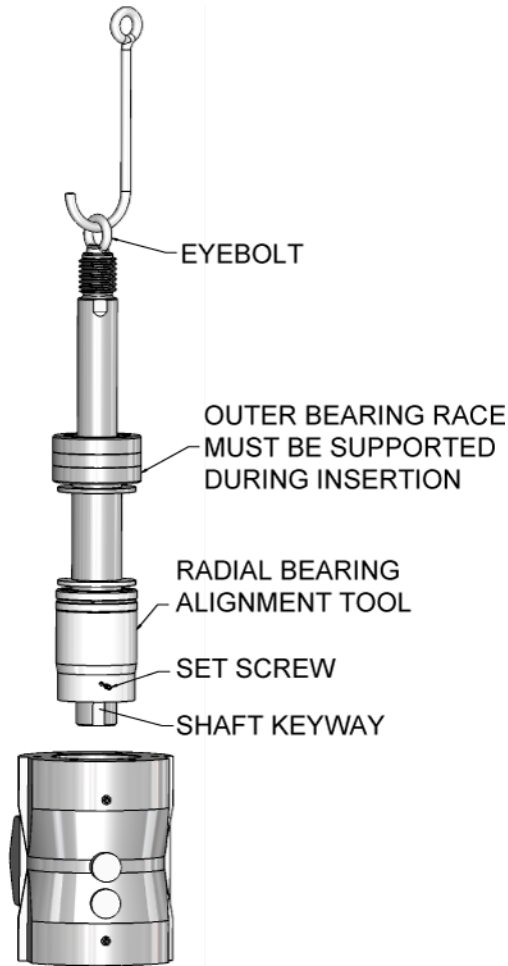


Step 2 – Bearing Cartridge Assembly (Grease Lube)



NOTE: Pumps size 75 (3x3) and smaller only require quantity 1 of items 99B, 143, and 144.

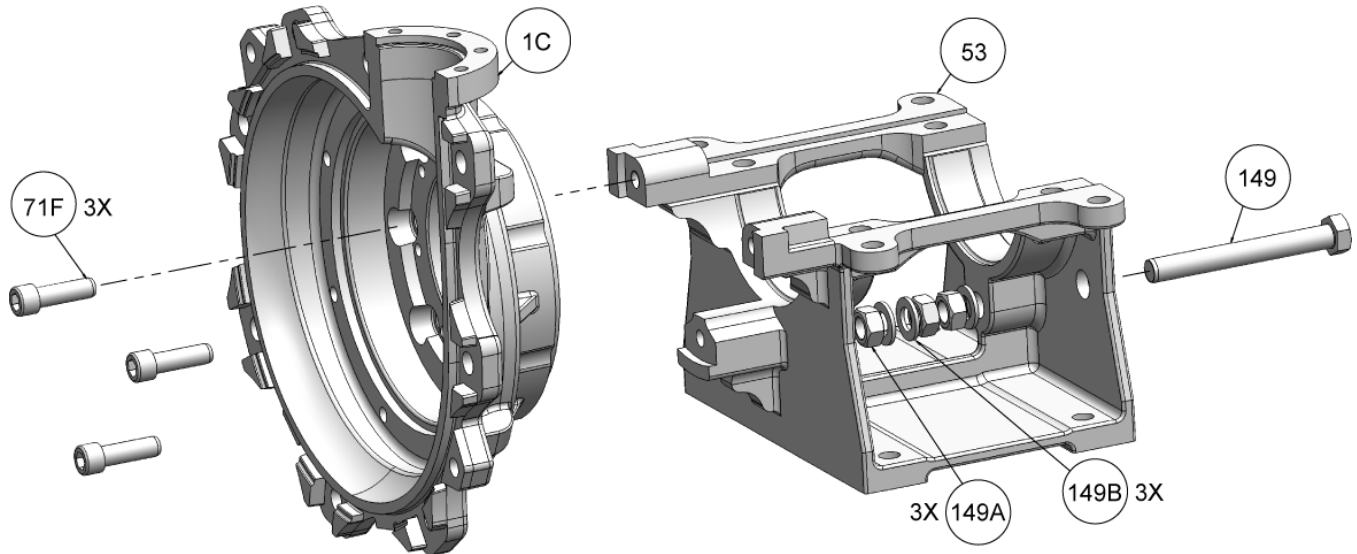
Step 2 – Bearing Cartridge Assembly (Oil Lube)



Step 2 – Lowering the shaft into the bearing cartridge

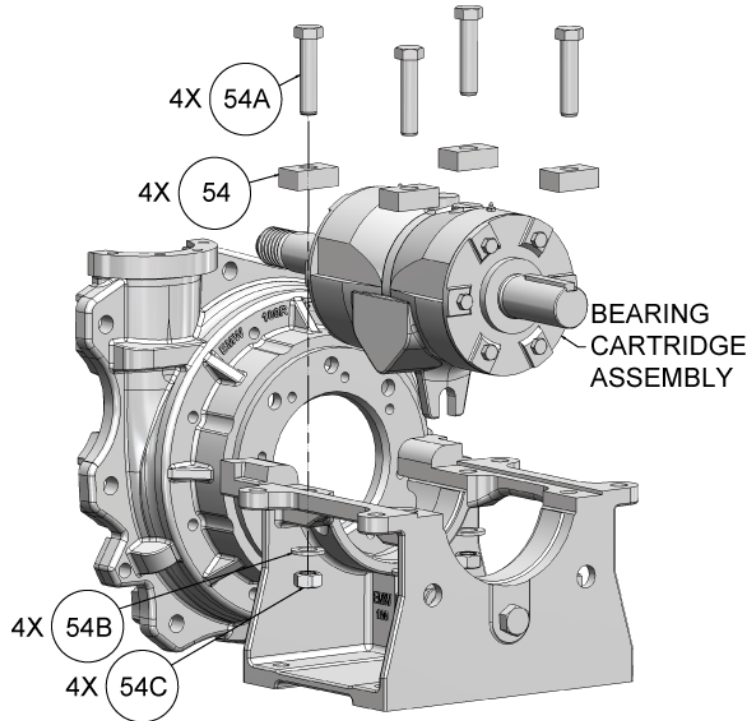
Press fit the bearing isolaters (47) and (49) into the bearing caps (35) and (37) respectively. Next install the o-rings (35B) into the thrust bearing cap (35), and (37A) into the radial bearing cap (37). If the bearings are grease lubricated, the area directly outboard from the bearings should be packed with grease prior to assembling the bearing caps. The bearing caps are assembled onto their respective sides using hardware (35A) and (37A). Please note that when installing the thrust bearing cap (35), a gap of approximately 1mm (0.040 inches) will be visible between the bearing cartridge and bearing cap. *Do not over tighten this bearing cap.* The bearing cap screws (35A) and (37A) should be tightened slowly in a star pattern and should not be over tightened as the bearing cap can deform and cause the bearing to be misaligned and seize up. When installing the bearing caps, it may be difficult to push the o-ring over the shaft shoulder, so it is recommended to use the cap screws to pull the bearing cap evenly into place. If the pump is grease lubricated, thread two grease fittings (99E) into the top of the bearing cartridge and give each bearing a shot of grease. If the pump is oil lubricated, assemble the oil drain plug (99B), oil sight glass (143), and temperature gauge (144) into the holes on the side of the cartridge, and install the oil fill plug (99A) on the top of the bearing cartridge.

Step 3 – Pedestal Assembly. Install the clearance adjustment bolt (149), nuts (149B), and washers (149C) into the pedestal (53). At this point it is recommended to bolt the pedestal to a rigid base or structure to prevent it from tipping forward when the wet end of the pump is assembled. On pumps size 100 (4x3) and smaller, assemble the gland half of the case (1C) with socket head cap screws (71F). On pumps size 150 (6x4) and larger, assemble the gland half of the case (1C) with hex-head screws (71F) and flat washers (71G).



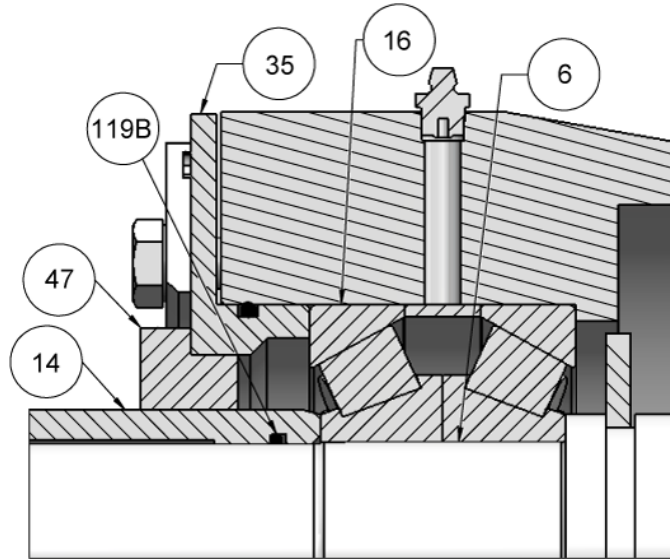
Step 3 – Pedestal Assembly

Step 4 – Power End Assembly. To complete the assembly of the power end, lower the bearing cartridge assembly from *Step 2* onto the pedestal assembly from *Step 3*, making sure the threaded side of the shaft is on the bracket side. Loosely install the bearing cartridge clamps (54) using hardware (54A), (54B), and (54C). Remove the lifting eye from the bearing cartridge and replace it with a hex cap screw and washer as this lifting eye location is not rated to lift the full pump weight.



Step 4 – Power End Assembly

Step 5 – Shaft sleeve assembly (Pump size 150 (6x4) and smaller). Install the o-ring (119B) into the ID groove in the shaft sleeve (14). Slide the shaft sleeve, chamfered end first, onto the front end of the shaft (6). The sleeve will stop on contact with the bearing isolator. Be sure to push the shaft sleeve completely on, until it seats against the thrust bearing (16). At no time should a bladed tool (like a screwdriver) be used to drive the sleeve on.



Shaft Sleeve Installation (Pumps Size 150 (6x4) and Smaller)



**Incorrectly installed shaft sleeve
(Shoulders against thrust bearing isolator o-ring)**

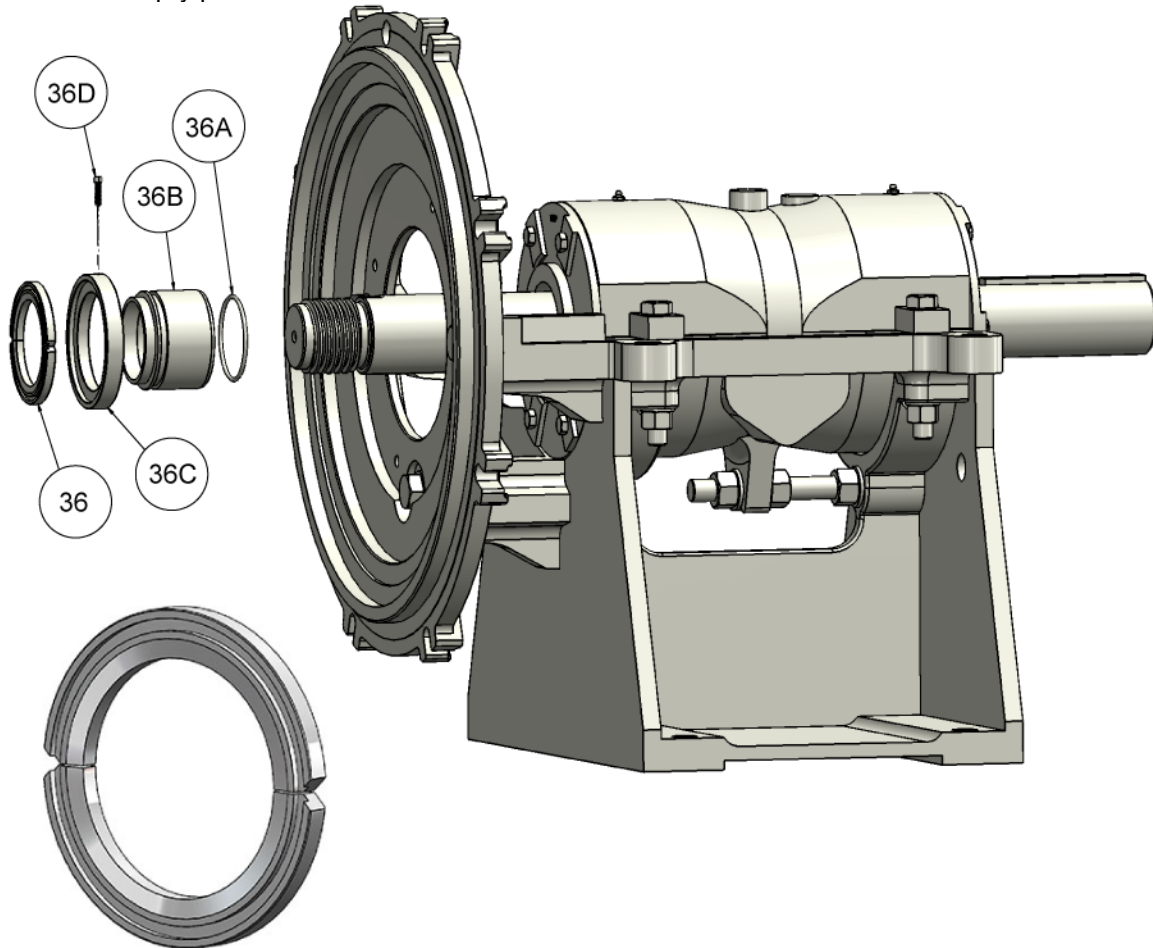


**Correctly installed shaft sleeve
(Shoulders against thrust bearing)**

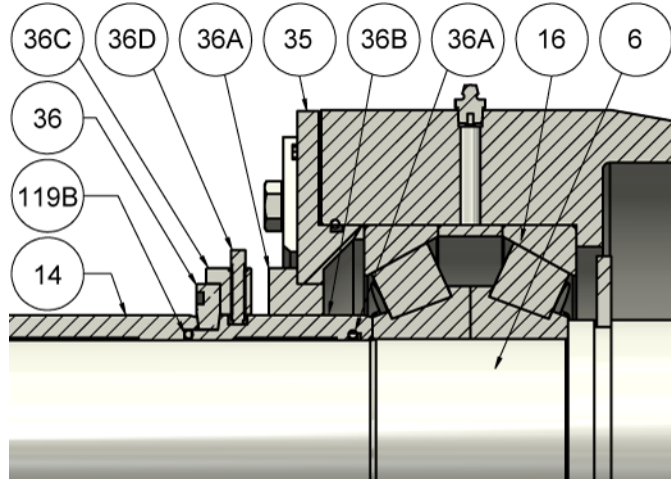
Step 5 - Release Collar Sleeve Assembly (Pump size 200 (8x6) and larger) – Install the o-ring (36A) in the ID groove in the release collar sleeve (36B). Slide the release collar sleeve, chamfered end first, onto the shaft (6). Slide the release collar cover (36C) onto the release collar shaft sleeve past the groove on the release collar shaft sleeve and loosely install the square head set screw (36D) into the cover (36C). If the release collar (36) is not already in two pieces, cut the release collar into two halves at the two scored locations and notch to 45 degrees as shown above if necessary. Orient the two halves so that the grooved faces are facing out and position on the shaft. Slide the release collar cover (36C) over the two halves of the release collar (36) and tighten the square head screw (36D) so that it bottoms out in the groove on the release collar sleeve (36B).

The release collar is split to allow removal and reinstallation on a fully assembled pump. Removing the release collar will relieve the pressure on the impeller threads so the impeller can be removed easily after use.

To remove a release collar from a fully assembled pump loosen the square head set screw (36D), slide the release collar cover (36C) towards the bearing cartridge to expose the release collar (36) and use the notches in the release collar as pry points to work the collar out.



Release Collar Sleeve Assembly (Pumps Size 200 (8x6) and Larger)



Shaft Sleeve / Release Collar Installation (Pumps Size 200 (8x6) and Larger)

10.2 Wet End Assembly

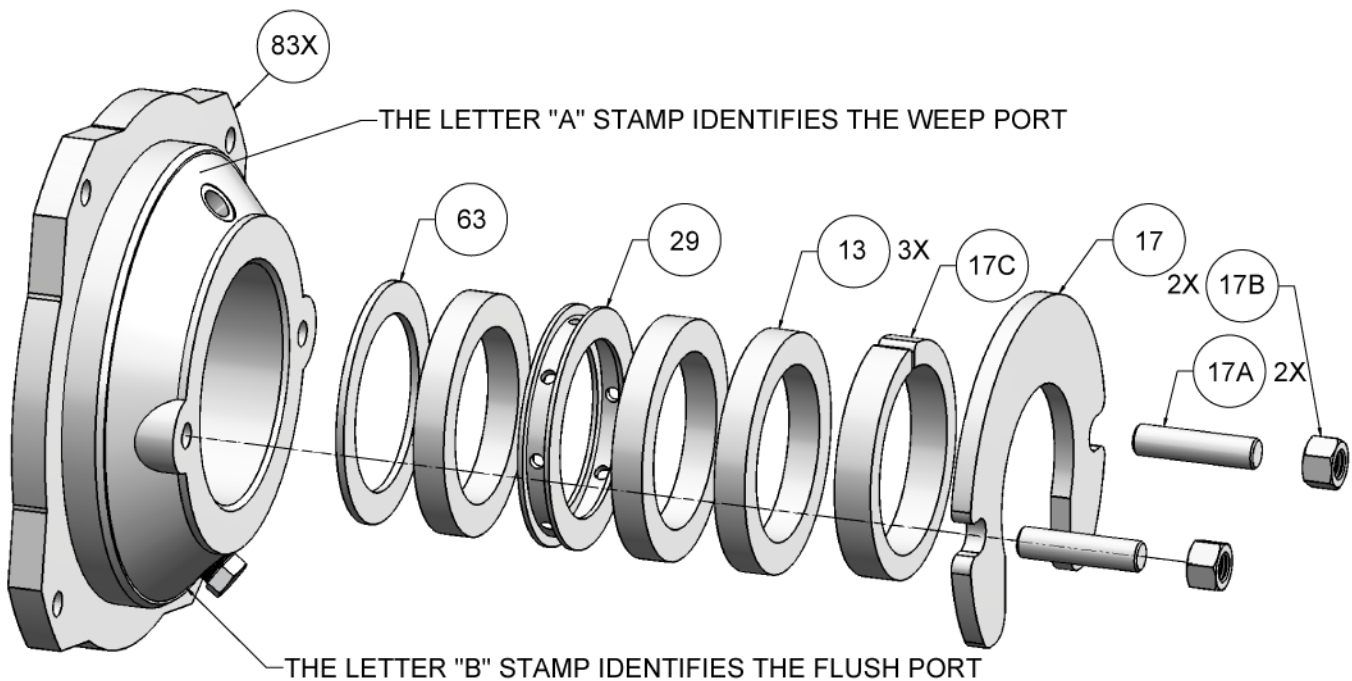
Step 6 – 7: Seal and Wet End Assembly. There are a variety of seals available for the EMW pump. Please turn to the appropriate page in table 6-1 based on which seal is installed in your pump.

Table 6-1: Seal Assemblies by Page

Seal	Section	Page
Expeller with Packing	10.2.1	23-26
Packing	10.2.2	27-30
Mechanical Seal	10.2.3	31-34
SolidLock™ Lite (Diaphragm Seal)	Contact Wilfley Representative	
SolidLock™ Dynamic Seal	Contact Wilfley Representative	

10.2.1 Expeller with Packing

Step 6-1 – Packing Seal Assembly - Expeller Seal. The expeller seal consists of an expeller (4), which creates a dynamic seal, and a packing seal, which creates a static seal. On pumps, size 100 (4x3) and larger, to prevent the expeller from slipping when pumping high density slurries, a flat section inside the expeller bore engages a flat on the shaft.



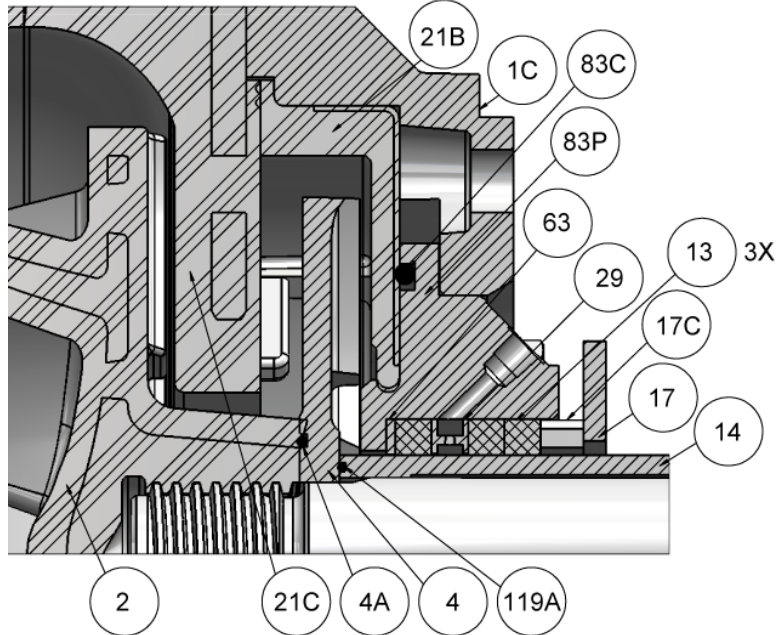
Step 6-1 Expeller with Packing Seal Components (Weep Configuration Shown)

The packing seal consists of a stuffing box (83X) three rings of packing (13), a lantern ring (29), a spacer ring (63), a gland plate (17), a gland ring (17C), two gland studs (17A) and two gland nuts (17B). When studs (17A) are being installed, coat the stud threads with a thread locking compound when assembling. Joints of successive rings should be staggered and kept at least 90° apart.

The seal housing (83X) is provided with two port configurations, weep and flush. An “A” stamp next to the port identifies the weep port while a “B” stamp next to the port identifies the flush port.

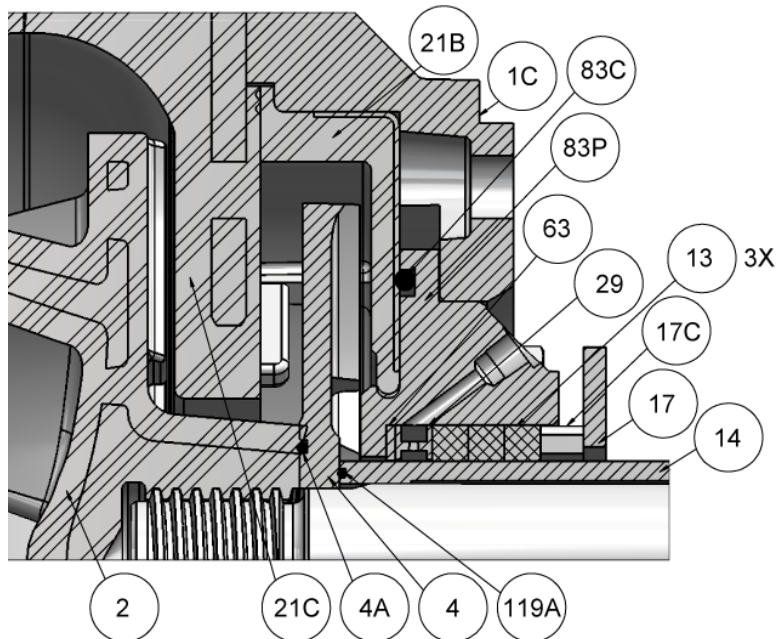
To prevent a packing seal failure the packing in all expeller sealed pumps must be lubricated during pump operation. An o-ring (71C) seals the case and expeller cover joint and another o-ring (83C) seals the expeller cover and the stuffing box joint as seen in the figures below.

Install the spacer ring (63) into the stuffing box (83X). Then depending on the flush or weep style configuration, install the packing rings (13) and lantern ring (29). Place the gland ring (17C) on the packing, install the studs (17A), and tighten down the gland plate (17) using two nuts (17B). The nuts only need to be loosely installed for initial installation. They should be tightened after the pump is fully assembled.



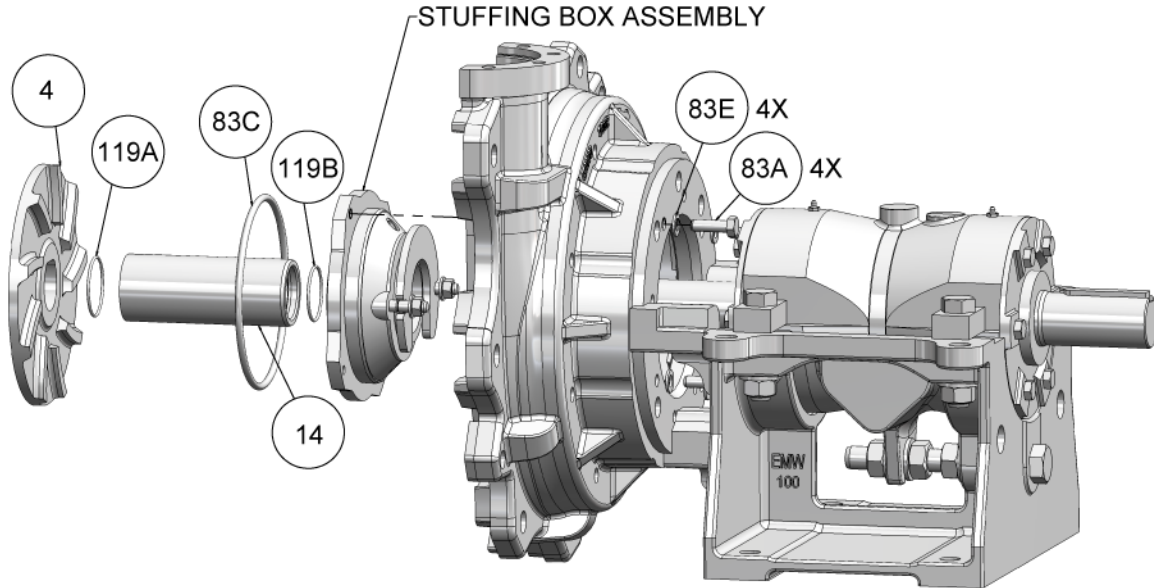
Expeller with Packing (Weep Configuration)

The weep configuration (spacer ring, packing ring, lantern ring, and two rings of packing) directs a lesser amount of coolant towards the seal chamber than a flush configuration and uses less flush water.



Expeller with Packing (Flush Configuration)

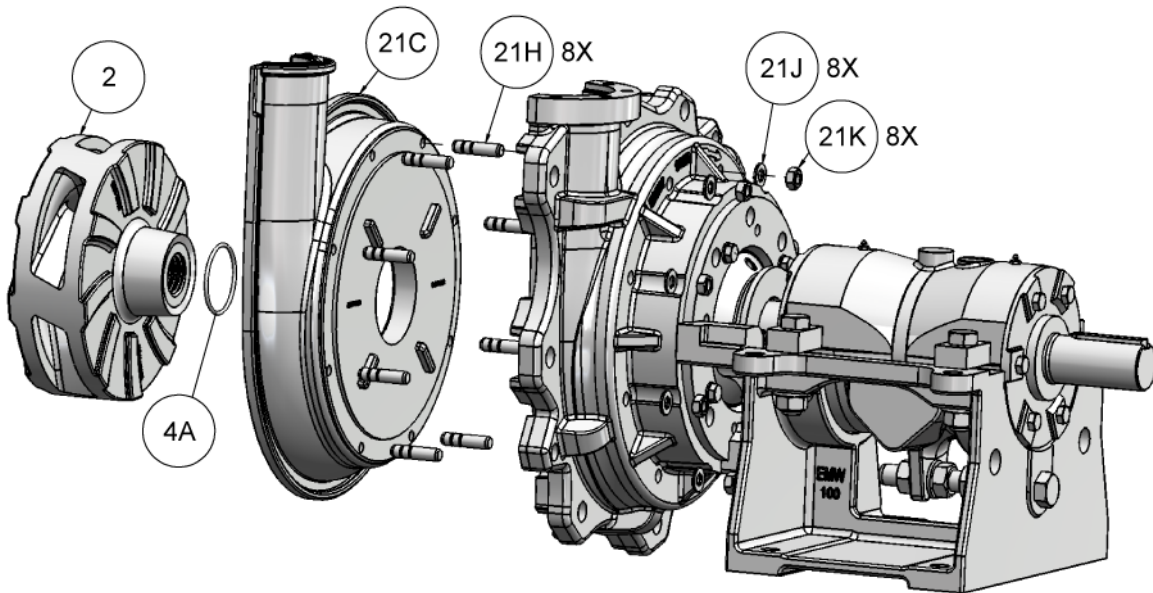
The flush configuration (spacer ring, lantern ring, and three rings of packing) directs the majority of the coolant towards the seal chamber, pushing solids away from the packing using more flush water.



Step 6-2 Expeller with Packing

Step 6-2 – Wet end assembly – Expeller/Packing Seal. Install the shaft o-ring (119B) into the shaft sleeve (14) and insert the shaft sleeve onto the shaft (6) butting it up against the release collar (36) or thrust bearing depending on your size pump. Take the stuffing box assembly (83X) and slide it onto the shaft sleeve (14). Bolt the stuffing box to the gland case half (1C) using the flat head cap screws (83A) and hex nuts (83G). Next place the stuffing box o-ring (83C) into the stuffing box groove and insert the expeller cover (21B) into the bracket. Make sure that the expeller cover (21B) ID is over the lip on the stuffing box (83X). Insert the shaft sleeve o-ring (119A) onto the end of the shaft sleeve (14) and but the expeller (4) up against it with the expeller vanes pointed towards the back of the pump. Note that the packing rings, lantern ring, and spacer ring (13), (29), and (63) can be installed and removed after the pump has been assembled, but the gland ring (17C) must be around the shaft before assembly of the wet end.

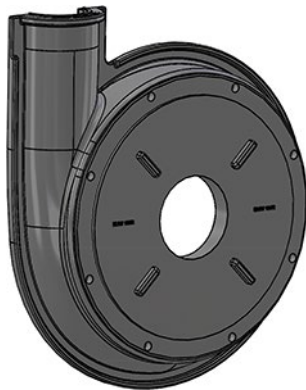
Step 7 Gland Half Case and Impeller Assembly – Expeller/Packing Seal – Assemble the gland half case liner (21C) with hardware (21H, 21J, 21K) to the case gland half. Install the expeller o-ring (4A) in the expeller (4) and thread the impeller (2) onto the shaft. Tighten the impeller.



Step 7 - Case Assembly (Expeller Seal)

The case gland half liner used with an expeller seal contains stationary vanes and a small annular opening around the shaft.

The impeller used with an expeller seal has long pump out vanes on the backside that extend almost all the way down to the hub.



Case Gland Half Liner

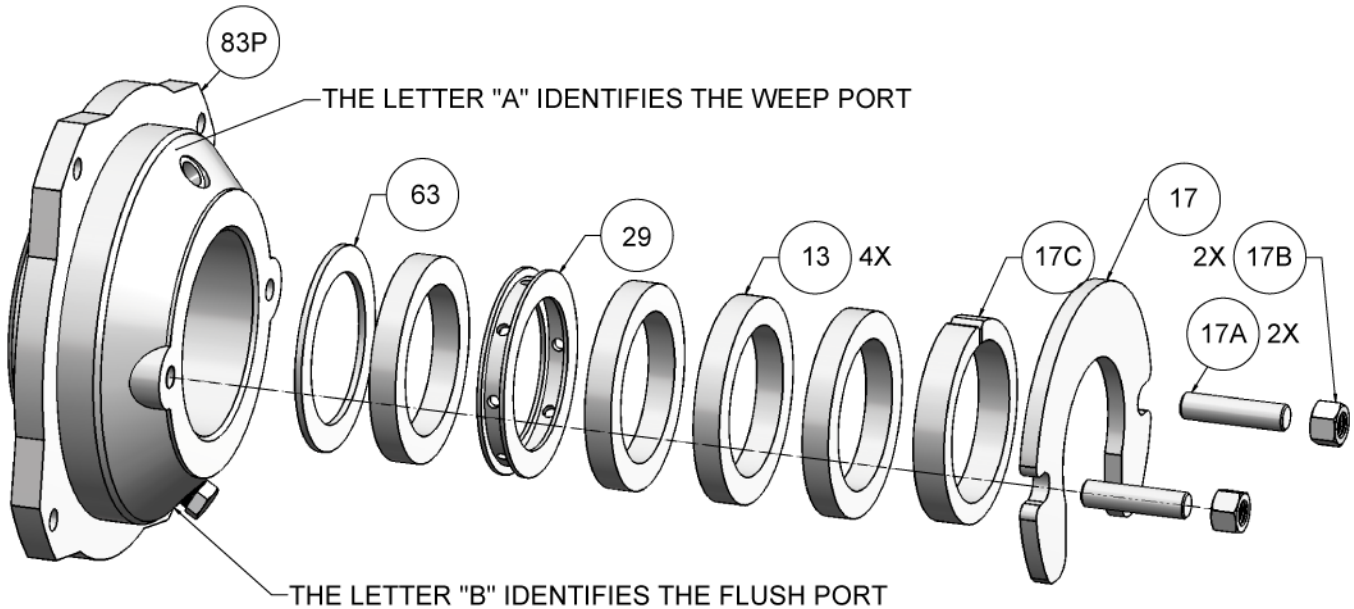


Impeller

Please proceed to Section 10.4, Step 8 on page 35 for the next assembly step.

10.2.2 Packing

Step 6-1 – Packing Seal Assembly. The packing seal creates a simple static and dynamic seal.

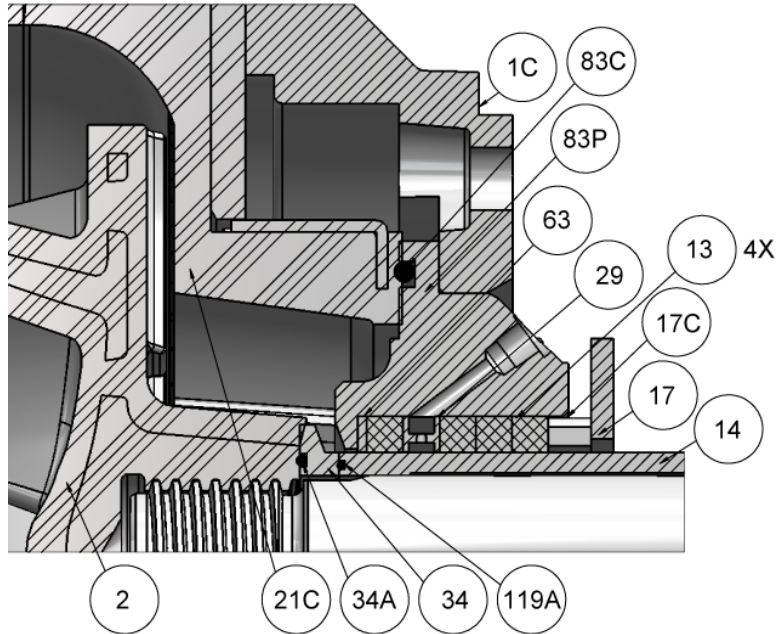


Step 6-1 - Packing Seal Components (Weep Configuration Shown)

The packing seal consists of a stuffing box (83X) four rings of packing (13), a lantern ring (29), a spacer ring (63), a gland plate (17), a gland ring (17C), two gland studs (17A) and two gland nuts (17B). When studs (17A) are being installed, coat the stud threads with a thread locking compound when assembling. Joints of successive rings should be staggered and kept at least 90° apart.

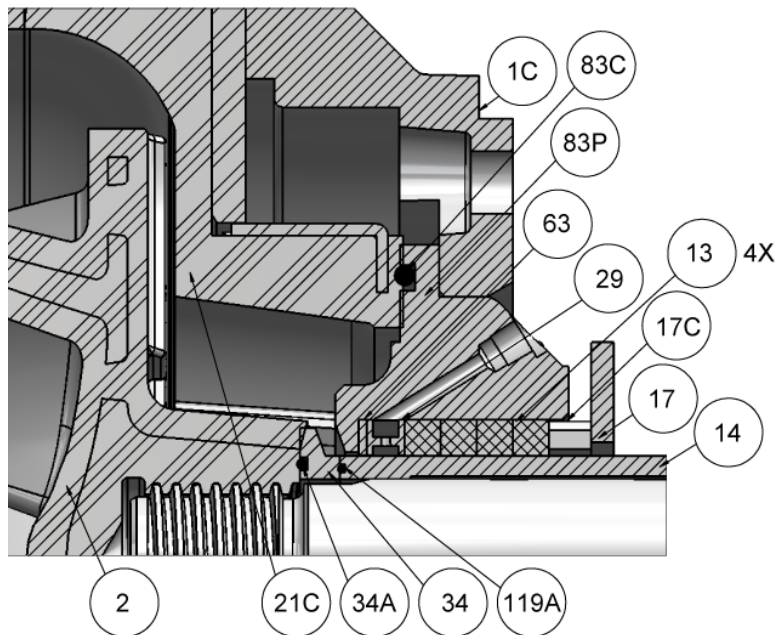
Install the spacer ring (63) into the stuffing box (83X). Then depending on the flush or weep style configuration, install the packing rings (13) and lantern ring (29). Place the gland ring (17C) on the packing, install the studs (17A), and tighten down the gland plate (17) using two nuts (17B). The nuts only need to be loosely installed for initial installation. They should be tightened after the pump is fully assembled.

The seal housing (83X) is provided with two port configurations, weep and flush. An "A" stamp next to the port identifies the weep port while a "B" stamp next to the port identifies the flush port.



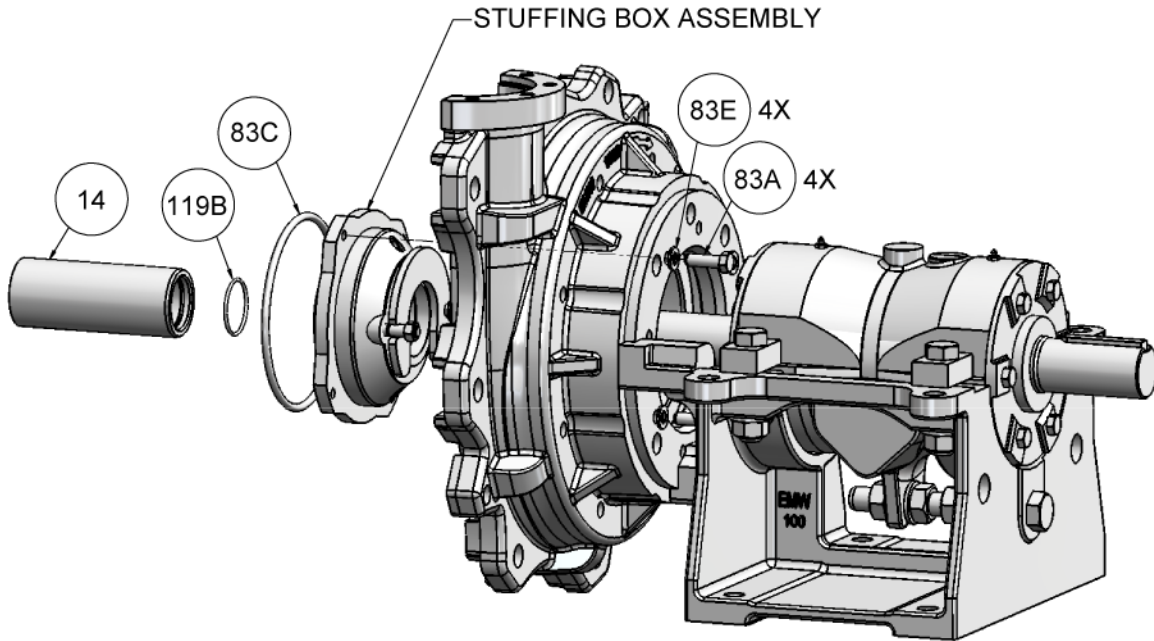
Packing Seal (Weep Configuration)

The weep configuration (spacer ring, packing ring, lantern ring, and three rings of packing) directs a lesser amount of coolant towards the seal chamber than a flush configuration and uses less flush water.



Packing Seal (Flush Configuration)

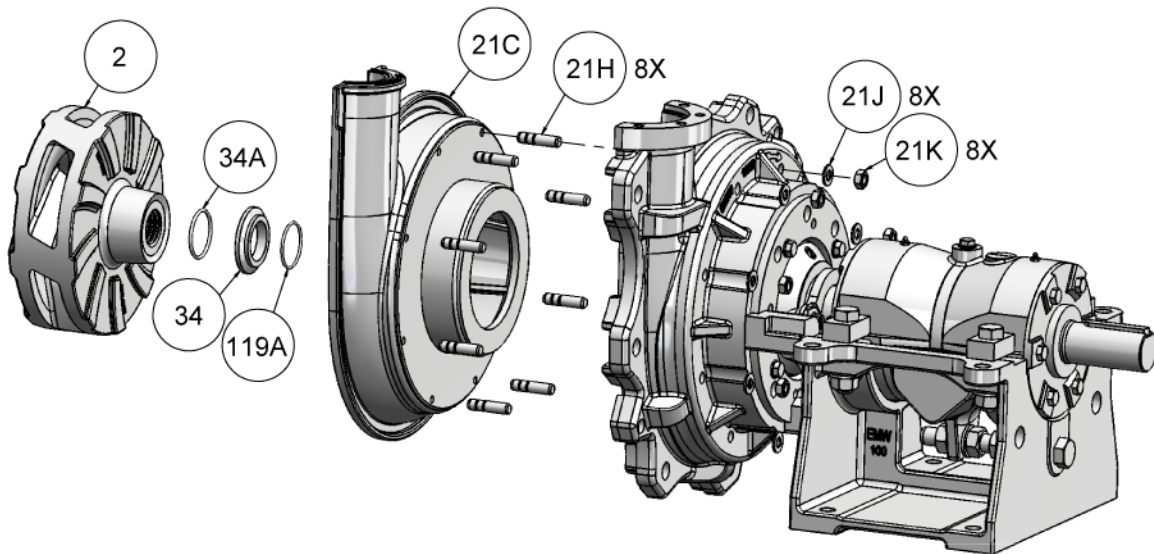
The flush configuration (spacer ring, lantern ring, and four rings of packing) directs the majority of the coolant towards the seal chamber, pushing solids away from the packing using more flush water.



Step 6-2 - Packing Seal

Step 6-2 – Wet end assembly –Packing Seal. Install the shaft o-ring (119B) into the shaft sleeve (14) and insert the shaft sleeve onto the shaft (6) butting it up against the release collar (36) or thrust bearing depending on your size pump. Take the stuffing box assembly (83X) and slide it onto the shaft sleeve (14). Bolt the stuffing box to the gland case half (1C) using the flat head cap screws (83A) and hex nuts (83G). Next place the stuffing box o-ring (83C) into the stuffing box groove. Insert the shaft sleeve o-ring (119A) onto the end of the shaft sleeve (14) and butt the spacer sleeve (34) up against it. Note that the packing rings, lantern ring, and spacer ring (13), (29), and (63) can be installed and removed after the pump has been assembled, but the gland ring (17C) must be around the shaft before assembly of the wet end.

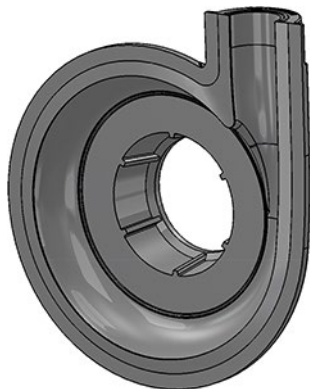
Step 7 Gland Half Casing and Impeller Assembly –Packing Seal – Assemble the gland half case liner (21C) with hardware (21H, 21J, 21K) to the case gland half. Install the spacer o-ring (4A) in the spacer sleeve (34) and thread the impeller (2) onto the shaft. Tighten the impeller.



Step 7 – Gland half assembly with impeller

A case gland half liner used with packing will always have a large bore taper box with static anti-swirl vanes and a large annular opening around the shaft.

Either impeller shown below can be used with a packing seal pump (the one with the long backside pump out vanes is standard).



Case Gland Half Liner



Impeller

A case gland half liner used with packing will always have a large bore taper box with static anti-swirl vanes and a large annular opening around the shaft.

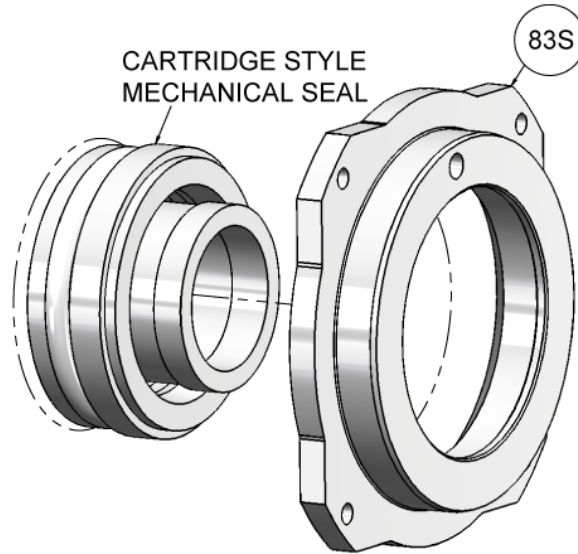
Either impeller shown below can be used with a packing seal pump (the one with the long backside pump out vanes is standard).

Please proceed to Section 10.4, Step 8 on page 35 for the next assembly step.

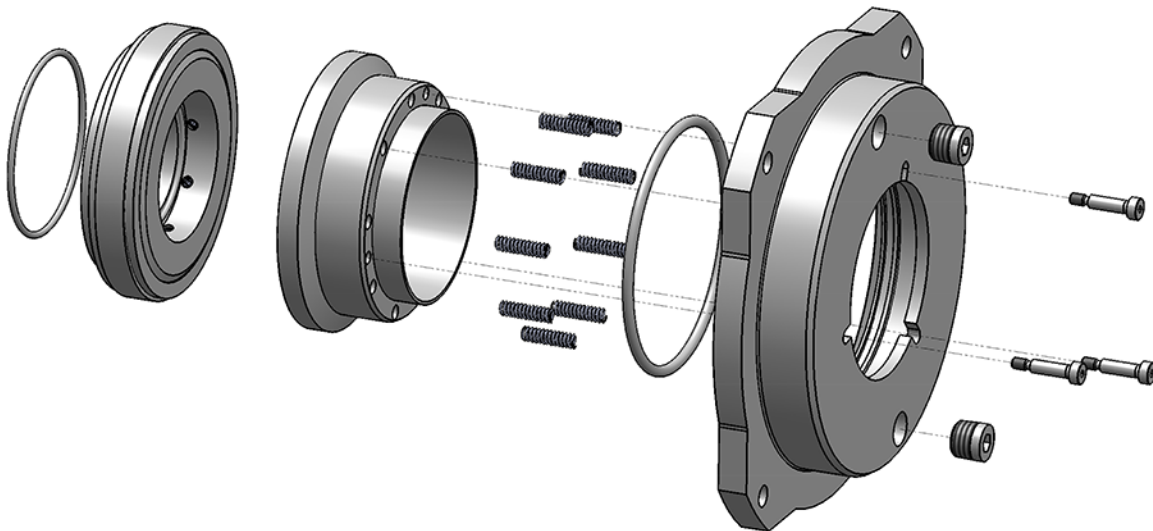
10.2.3 Mechanical Seal

Step 6 - Mechanical Seals. The seal chamber space available for mounting a mechanical seal (89S) is sufficiently large to accommodate most OEM mechanical seal products.

The case gland half liner (21C) in a mechanical seal pump is the same one used with a packing seal pump.

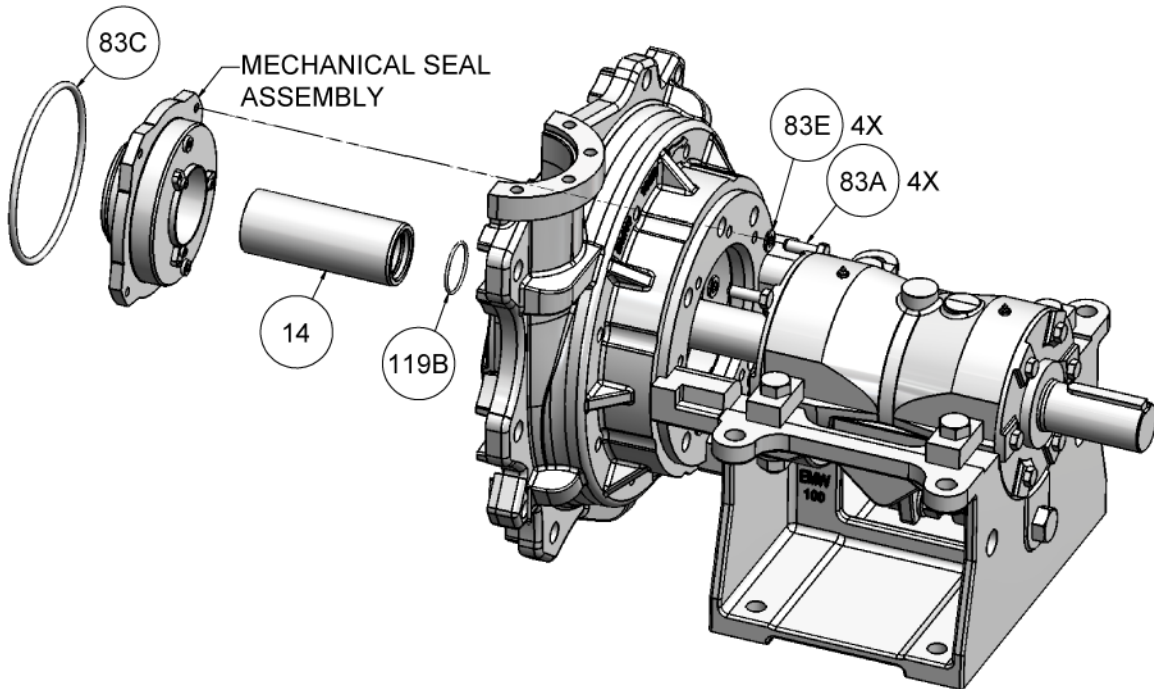


Cartridge Style Mechanical Seal



Semi-Cartridge Style Mechanical Seal

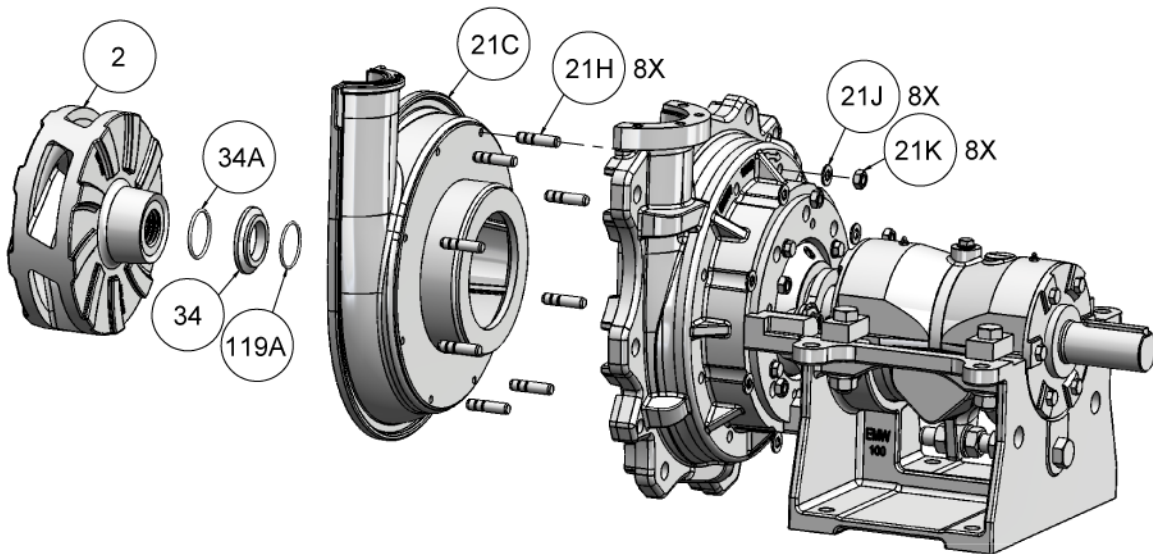
When a cartridge seal is employed, the same spacer sleeve (34) used with a packing seal is also used. Semi-cartridge style seals can also be installed. The semi-cartridge mechanical seal shown incorporates the seal gland into the stuffing box and the rotary seal face replaces the spacer sleeve. This type of seal generally requires less radial space than a cartridge style seal.



Mechanical Seal

Step 6 – Seal Assembly - Mechanical Seals – Install the seal assembly (89) into the stuffing box (83). The shaft sleeve (14) and o-ring (119B) can be installed on the shaft before installing the seal assembly or it can be inserted into the seal assembly and slid onto the shaft when the stuffing box is assembled to the bracket. Install the o-ring (83C) in the stuffing box

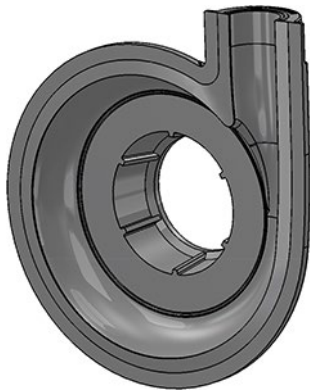
Step 7 Gland Half Casing and Impeller Assembly –Packing Seal – Assemble the gland half case liner (21C) with hardware (21H, 21J, 21K) to the case gland half. Install the spacer o-ring (4A) in the spacer sleeve (34) and thread the impeller (2) onto the shaft. Tighten the impeller.



Step 7

A case gland half liner used with a mechanical seal will always have a large bore taper box with static anti-swirl vanes and a large annular opening around the shaft.

Only an impeller with short backside pump out vanes can be used with a mechanical seal pump.



Case Gland Half Liner

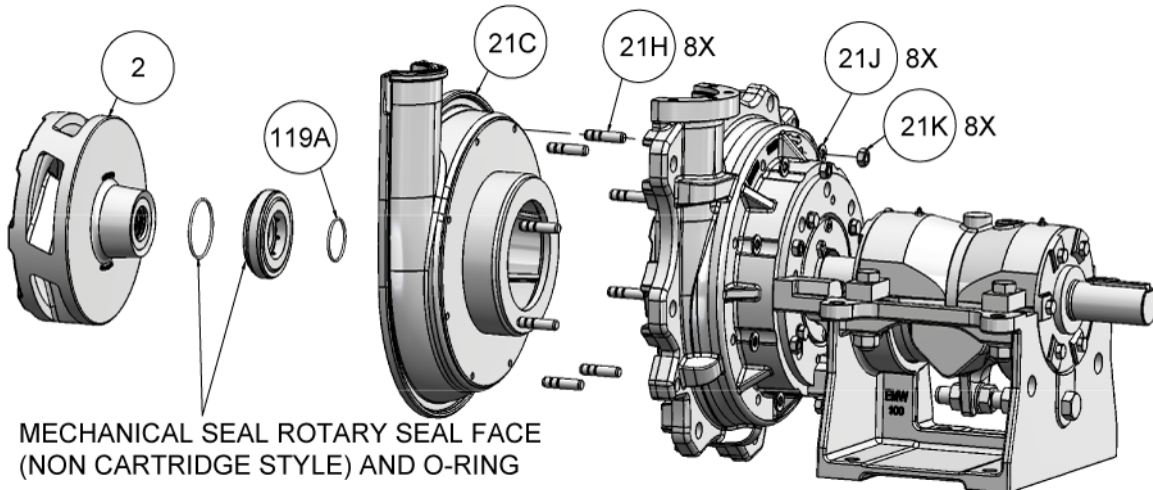


Impeller



Do not use an impeller with long backside pump out vanes in a mechanical seal pump because it can reduce the stuffing box pressure to a level low enough to damage the mechanical seal.

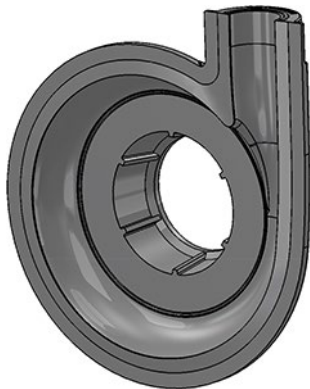
Step 7 - Semi-Cartridge Style Mechanical Seal. Assemble the case gland half liner (21C) with hardware (21H, 21J, 21K) to the case gland half. If a semi-cartridge seal of the type shown in Assembly Step 6 is used install the o-ring (119A) into the shaft sleeve (14) and slide the rotary seal face onto the shaft. Install the o-ring supplied with the mechanical seal into the mechanical seal rotary face and thread the impeller (2) onto the shaft. Tighten the impeller. Do not set the mechanical seal.



Step 7

A case gland half liner used with a mechanical seal will always have a large bore taper box with static anti-swirl vanes and a large annular opening around the shaft.

Only an impeller with short backside pump out vanes can be used with a mechanical seal pump.



Case Gland Half Liner



Impeller

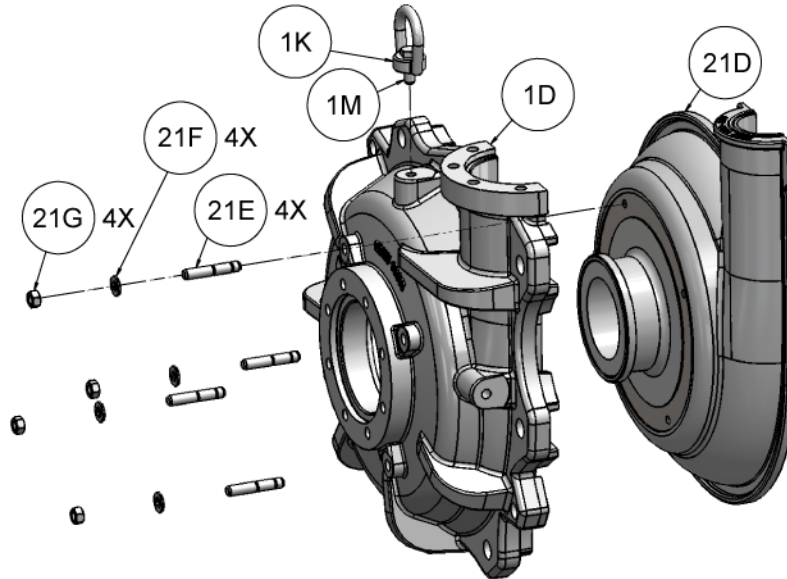


Do not use an impeller with long backside pump out vanes in a mechanical seal pump because it can reduce the stuffing box pressure to a level low enough to damage the mechanical seal.

10.4 Case (Suction Half) Assembly

10.4.1 Pumps Size 150 (6x4) and Smaller

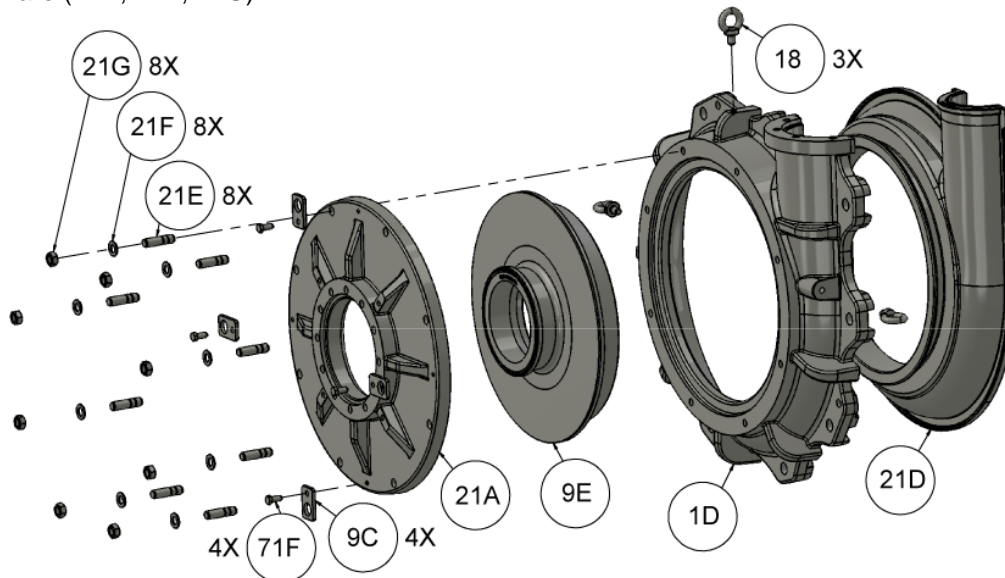
Step 8 – Suction Assembly (Pumps Size 150 (6x4) and Smaller) – Assemble the case suction half liner (21D) with hardware (21E, 21F, 21G) to the case suction half (1D). Assemble the lifting eye (1K) with hardware (1M) to the case suction half.



Step 8 – Suction Assembly

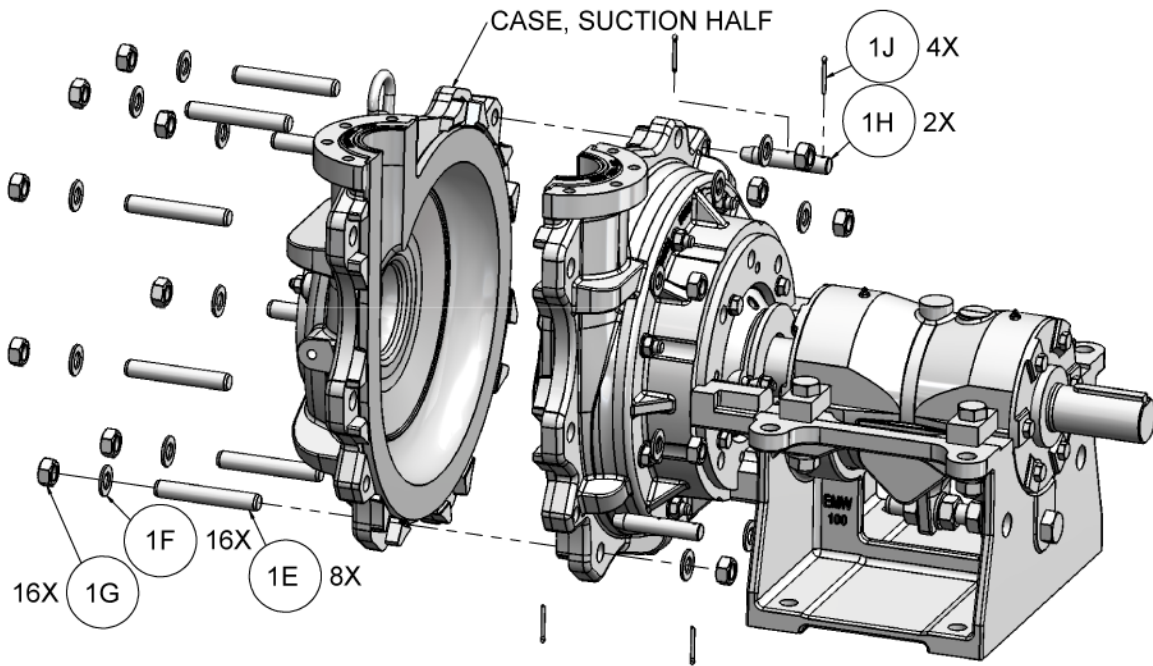
10.4.2 Pumps Size 200 (8x6) and Larger

Step 8 – Suction Assembly (Pumps Size 200 (8x6) and Larger) – Assemble the case suction half liner (21D) to the case suction half (1D). Install the suction cover liner (9E) into the suction cover (21A). Assemble the four lifting eyes (9C) with hardware (71F) to the case suction cover. Assemble the suction cover to the case suction half with hardware (21E, 21F, 21G).



Step 8 - Case Suction Half (Size 200 (8x6) Pumps and Larger)

Step 9 – Case Assembly. Insert the two alignment pins (1H) into the case gland half, taper end first, from the backside. Insert two cotter pins (1J) into each pin to hold them in place. Assemble the case suction half to the case gland half with the aid of the two alignment pins. Secure in place with hardware (1E, 1F, 1G).



Step 9 – Case Assembly

Step 10 – Seal Adjustment

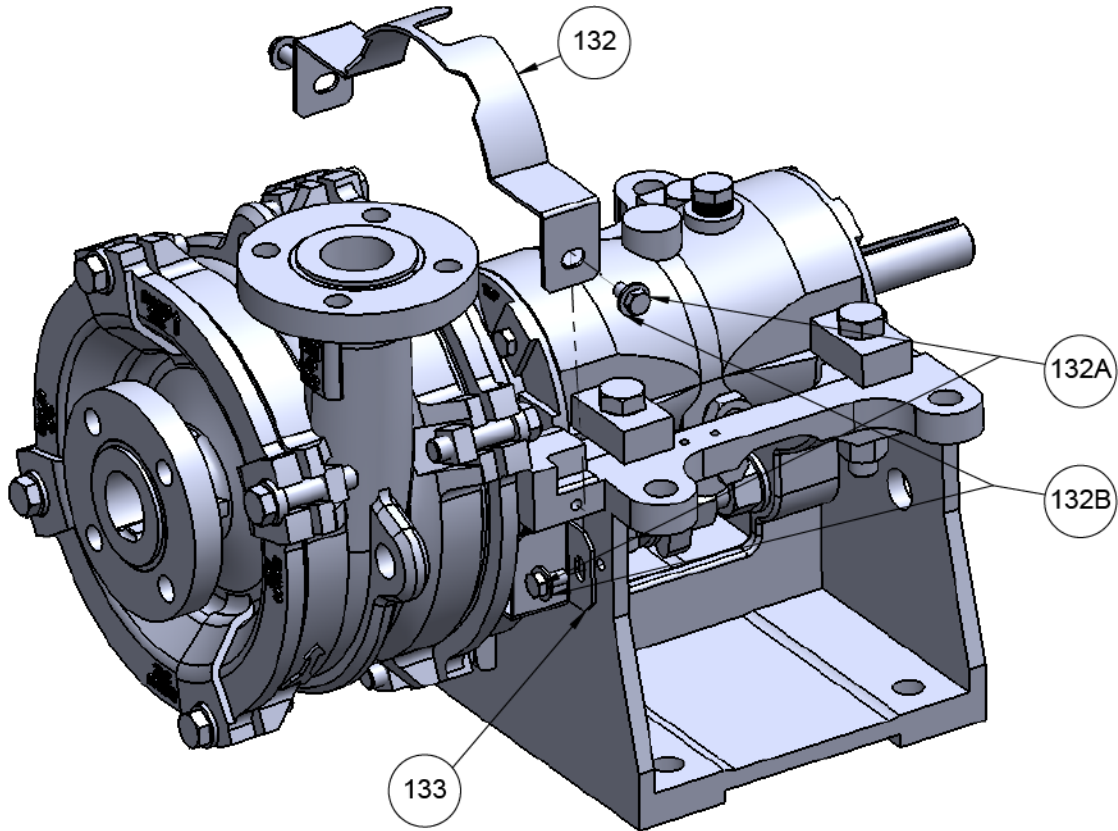
Packing with Expeller – Make sure the packing gland nuts (17B) – *shown in Step 6* - are only finger tight. (These nuts will be tightened as needed when the pump is installed and running).

Packing – Make sure the packing gland nuts (17B) *shown in step 6* - are only finger tight. (These nuts will be tightened as needed when the pump is installed and running).

Mechanical Seal - Set the mechanical seal per the manufacturer's instructions.

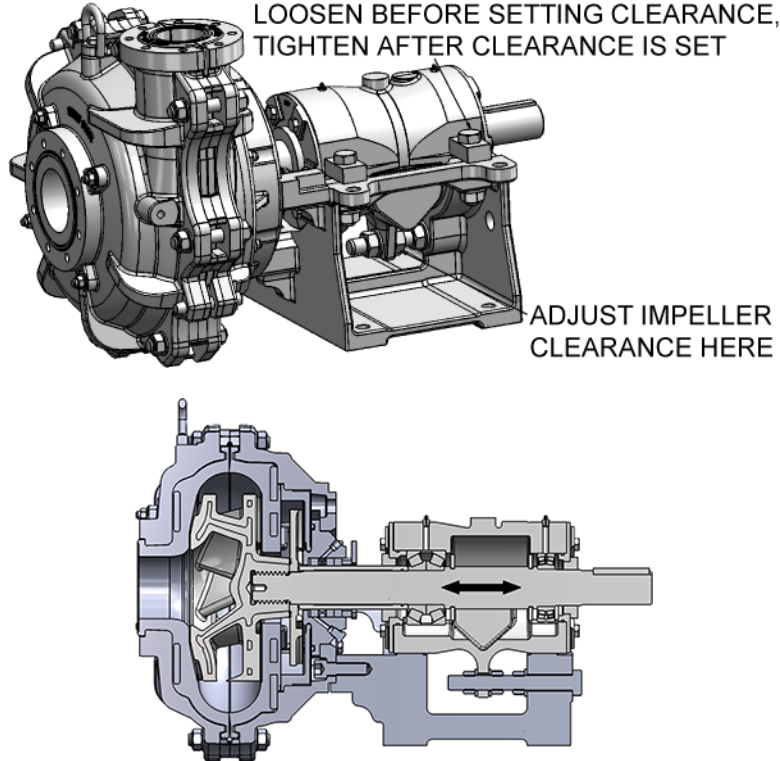
10.5 Seal Guard Assembly

Step 11 (Guard Assembly) – Assemble the upper and lower seal chamber guards (132) and (133) and hardware (132A) and (132B) to the pedestal (53).



Step 12 – Seal Guard Assembly

10.6 Setting Clearances



Step 10

Step 12 –The impeller running clearance is controlled by adjusting the bearing cartridge position in the pedestal. While this adjustment is primarily intended for controlling the impeller running clearance in an expeller sealed pump that is experiencing low expeller performance, this adjustment can be employed to move the bearing cartridge backwards, thus reducing the expeller running clearance. However, controlling the expeller running clearance in such a manner will shorten the life of the pump due to an increase in the wear rate resulting from the increase in impeller running clearance and may result in loss of performance.

To set the impeller running clearance, first ensure the bearing cartridge clamp bolts are loose, then loosen the hex nuts (149B) on the bearing cartridge adjustment screw (149) located underneath the bearing cartridge (99) in the pedestal (53). Move the bearing cartridge forward with the aid of the outboard hex nut on the bearing cartridge adjustment screw until the impeller (2) contacts the suction cover (9). While making this adjustment slowly rotate the shaft (6) in a clockwise direction, as viewed from the back of the pump. When contact occurs, back off the outboard hex nut on the adjustment screw, run up the inboard hex nut against the fork on the bearing cartridge, and tighten one hex flat (60 degrees) to set the impeller running clearance. Run the outboard hex nut up against the fork and tighten both nuts to secure the bearing cartridge in place. Tighten both hex nuts and then verify the shaft turns freely. Tighten the bearing cartridge clamp bolts. The impeller running clearance should be approximately 0.5 mm (0.02 inches). A dial indicator is recommended for a more precise setting.

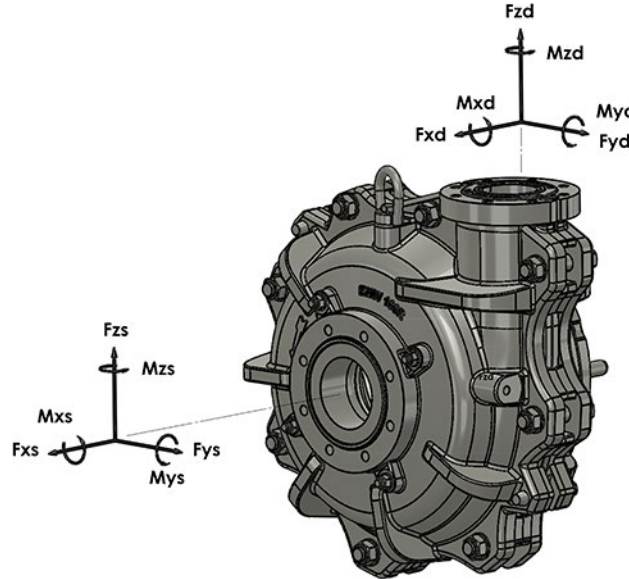
Impeller Clearance Adjustment (Rubber Lined Pump Only)

Pump Size	Number of Flats (Degrees)	Approximate Impeller Clearance
50 (2x2)	4 (240°)	2 mm
75 (3x3)	3 (180°)	1.5 mm
100 (4x3)	3 (180°)	1.5 mm
150 (6x4)	4 (240°)	2 mm
200 (8x6)	8 (540°)	4 mm
250 (10x8)	8 (540°)	4 mm

11.0 General Specifications

11.1 Forces and Moments

Forces and moments only apply to static pipelines. The values are applicable when pump is installed on a grouted and even foundation.



NOTE: Discharge nozzle coordinate system always moves with nozzle angle (Fz is always in direction of flow).

BRANCH SIZE	Discharge						Suction					
	F _{Xd} (N)	F _{Yd} (N)	F _{Zd} (N)	M _{Xd} (N-m)	M _{Yd} (N-m)	M _{Zd} (N-m)	F _{Xs} (N)	F _{Ys} (N)	F _{Zs} (N)	M _{Xs} (N-m)	M _{Ys} (N-m)	M _{Zs} (N-m)
50	7110	5690	14450	3570	3570	5420	14450	7110	5690	5420	3570	3570
75	7840	6270	15180	3930	3930	5960	15180	7840	6270	5960	3930	3930
100	8590	6890	15930	4290	4290	6500	15930	8590	6890	6500	4290	4290
150	10110	8090	17450	4990	4990	7570	17450	10110	8090	7570	4990	4990
200	11700	9340	19040	5690	5690	8620	19040	11700	9340	8620	5690	5690
250	13390	10710	20730	6380	6380	9670	20730	13390	10710	9670	6380	6380
300	15230	12180	22560	7070	7070	10710	22560	15230	12180	10710	7070	7070
350	17300	13830	24640	7740	7740	11730	24640	17300	13830	11730	7740	7740

BRANCH SIZE	Discharge						Suction					
	F _{Xd} (lb)	F _{Yd} (lb)	F _{Zd} (lb)	M _{Xd} (ft-lb)	M _{Yd} (ft-lb)	M _{Zd} (ft-lb)	F _{Xs} (lb)	F _{Ys} (lb)	F _{Zs} (lb)	M _{Xs} (ft-lb)	M _{Ys} (ft-lb)	M _{Zs} (ft-lb)
2	1600	1280	3250	2640	2640	4000	3250	1600	1280	4000	2640	2640
3	1760	1410	3410	2900	2900	4390	3410	1760	1410	4390	2900	2900
4	1930	1550	3580	3160	3160	4790	3580	1930	1550	4790	3160	3160
6	2270	1820	3920	3680	3680	5580	3920	2270	1820	5580	3680	3680
8	2630	2100	4280	4200	4200	6360	4280	2630	2100	6360	4200	4200
10	3010	2410	4660	4700	4700	7130	4660	3010	2410	7130	4700	4700
12	3420	2740	5070	5210	5210	7900	5070	3420	2740	7900	5210	5210
14	3890	3110	5540	5710	5710	8650	5540	3890	3110	8650	5710	5710

11.2 Noise Characteristics

When running the pump within the normal limits of operation and on clear liquids, the sound pressure level for the pump alone does not exceed 80 dBa.

Coarse solids, froth, or cavitation conditions can increase noise levels.

Sound pressure levels from motors, gear reducers, and belt driven units must be added.

11.3 Accessories

Couplings, sheaves, v-belts, guards, and baseplates may be provided.

11.4 Dimensions and Weights

For pump dimensions and weights, see General Arrangement Drawings.

11.5 Torque Values

METRIC Class 8.8 (N-m)			SAE Grade 5 (Lb-Ft)		
Bolt Size	Thread Pitch	Torque	Bolt Size	Thread Pitch	Torque
6	1	10	1/4	20	7
8	1.25	14	5/16	18	10
10	1.5	23	3/8	16	17
12	1.75	54	1/2	13	40
14	2	80			
16	2	108	5/8	8	80
18	2.5	128			
20	2.5	162	3/4	7	120
22	2.5	216	7/8	7	160
24	3	270	1	6	200
27	3	324	1-1/8	10	240
30	3.5	378	1-1/4	11	280
33	3.5	432	1-3/8	9	320
36	4	486	1-1/2	9	360

12.0 TROUBLESHOOTING

SYMPTOMS											POSSIBLE CAUSES	
Pump sump tank overflows	Pump overheats or seizes	Reduced bearing life	Excessive pump vibration or noise	Reduced packing life	Stuffing box leakage	Excessive motor power draw	Pump loses prime	Low discharge pressure	Low capacity	Loss of discharge pressure		Pump surges
												Pump not primed
												Pump or suction pipe not completely filled with liquid
												Suction lift too high
												Insufficient NPSH
												Air pocket in suction line
												Air leaks in suction line
												Air leaks into pump through stuffing box
												Obstructed suction line
												Suction pipe diameter too small or excessive friction losses in suction pipe
												Suction head too high for expeller
												Suction liquid velocity too high
												Pump speed too low
												Pump speed too high
												Impeller running backwards
												System head higher than design
												System head lower than design
												Material incompatible with liquid being pumped
												Liquid specific gravity different from design
												Unstable flow into pump sump tank
												Low capacity operation
												Entrained air in pump or frothy conditions
												Improperly installed piping
												Misalignment of motor to pump
												Non-rigid foundation
												Bent shaft
												Rotating parts rubbing on stationary parts
												Worn bearings
												Worn or damaged impeller
												Worn or scoured shaft sleeve
												Improperly installed packing
												Packing not suitable for operating conditions
												Faulty mechanical seal
												Excessive shaft runout
												Unbalanced impeller
												Packing gland too tight
												Obstructed impeller hydraulic passage
												Excessive thrust load
												Excessive bearing lubrication
												Insufficient bearing lubrication
												Improperly installed bearings
												Dirt in bearing housing
												Moisture in bearing housing
												Faulty bearing isolator
												Worn expeller or excessive product buildup between expeller vanes
												Excessive clearance between stuffing box and shaft sleeve
												Loose pedestal clamp screws
												Excessive V-belt tension

Appendix 1

Bearing Operating Temperature Range 63°C to 76°C (145°F to 170°F)

Pump	Lubrication Amount		Lubrication Interval Based On Pump Run Time		
	Thrust	Radial	8 hrs/day	16 hrs/day	24 hrs/day
50 (2x2)	7 g (0.2 oz)	3g (0.1 oz)	2300 hrs	1100 hrs	800 hrs
75 (3x3)	11 g (0.4 oz)	4 g (0.1 oz)	1500 hrs	700 hrs	500 hrs
100 (4x3)	15 g (0.5 oz)	6 g (0.2 oz)	1200 hrs	600 hrs	400 hrs
150 (6x4)	23 g (0.8 oz)	8 g (0.3 oz)	1700 hrs	900 hrs	600 hrs
200 (8x6)	32 g (1.1 oz)	13 g (0.5 oz)	2300 hrs	1100 hrs	800 hrs
250 (10x8)	40 g (1.4 oz)	17 g (0.6 oz)	2500 hrs	1300 hrs	800 hrs
300 (12x10)	60 g (2.1 oz)	21 g (0.8 oz)	2700 hrs	1300 hrs	900 hrs
350 (14x12)	71 g (2.5 oz)	29 g (1.0 oz)	3500 hrs	1800 hrs	1200 hrs

Bearing Operating Temperature Range 77°C to 92°C (171°F to 199°F)

Pump	Lubrication Amount		Lubrication Interval Based On Pump Run Time		
	Thrust	Radial	8 hrs/day	16 hrs/day	24 hrs/day
50 (2x2)	7 g (0.2 oz)	3g (0.1 oz)	1100 hrs	600 hrs	400 hrs
75 (3x3)	11 g (0.4 oz)	4 g (0.1 oz)	700 hrs	400 hrs	200 hrs
100 (4x3)	15 g (0.5 oz)	6 g (0.2 oz)	600 hrs	300 hrs	200 hrs
150 (6x4)	23 g (0.8 oz)	8 g (0.3 oz)	900 hrs	400 hrs	300 hrs
200 (8x6)	32 g (1.1 oz)	13 g (0.5 oz)	1100 hrs	600 hrs	400 hrs
250 (10x8)	40 g (1.4 oz)	17 g (0.6 oz)	1300 hrs	600 hrs	400 hrs
300 (12x10)	60 g (2.1 oz)	21 g (0.8 oz)	1300 hrs	700 hrs	400 hrs
350 (14x12)	71 g (2.5 oz)	29 g (1.0 oz)	1800 hrs	900 hrs	600 hrs

Bearing Operating Temperature Range 93°C to 121°C (200°F to 250°F)

Pump	Lubrication Amount		Lubrication Interval Based On Pump Run Time		
	Thrust	Radial	8 hrs/day	16 hrs/day	24 hrs/day
50 (2x2)	7 g (0.2 oz)	3g (0.1 oz)	600 hrs	300 hrs	200 hrs
75 (3x3)	11 g (0.4 oz)	4 g (0.1 oz)	400 hrs	200 hrs	100 hrs
100 (4x3)	15 g (0.5 oz)	6 g (0.2 oz)	300 hrs	200 hrs	100 hrs
150 (6x4)	23 g (0.8 oz)	8 g (0.3 oz)	400 hrs	200 hrs	100 hrs
200 (8x6)	32 g (1.1 oz)	13 g (0.5 oz)	600 hrs	300 hrs	200 hrs
250 (10x8)	40 g (1.4 oz)	17 g (0.6 oz)	600 hrs	300 hrs	200 hrs
300 (12x10)	60 g (2.1 oz)	21 g (0.8 oz)	700 hrs	300 hrs	200 hrs
350 (14x12)	71 g (2.5 oz)	29 g (1.0 oz)	900 hrs	400 hrs	200 hrs