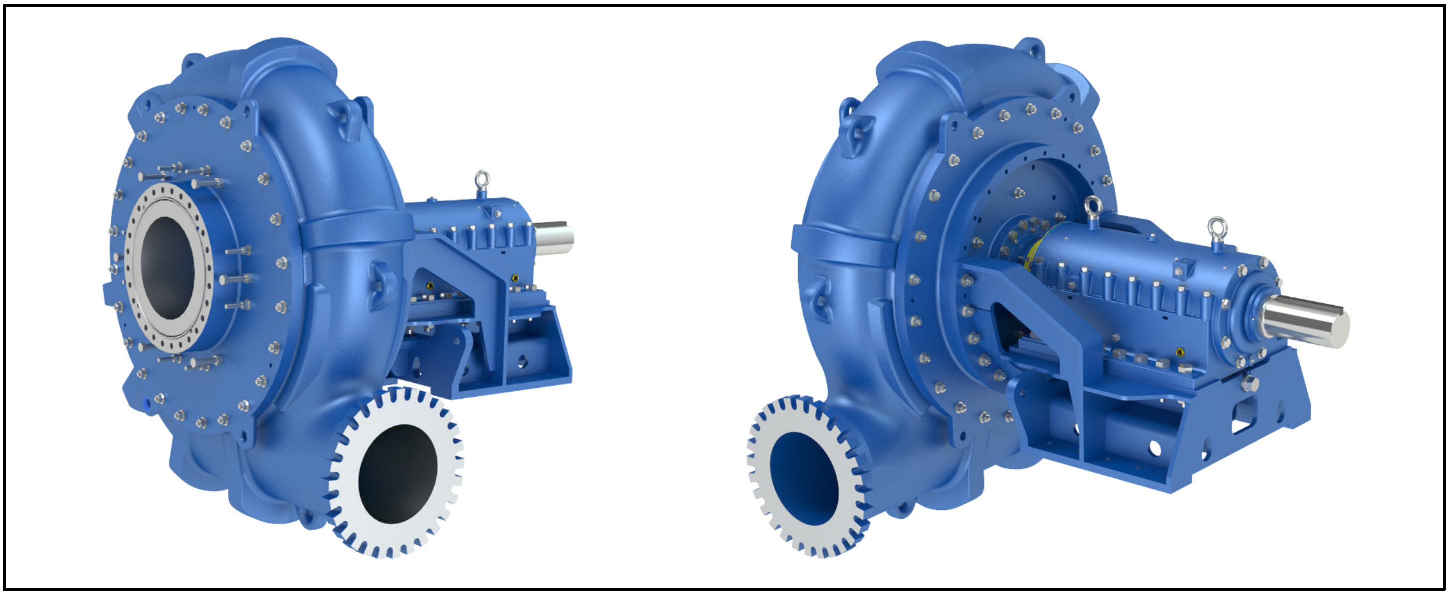
GIW® Slurry Pumps

Installation/Operating Manual

2021.8/01-US

MDX [en-us]



Pump Type: ______________________

Pump Serial Number: ______________________

Date: ______________________

Purchaser: ______________________

Purchaser's Order Number: ______________________

GIW/KSB Work Order Number: ______________________

Shipped To: ______________________

Include the pump's serial number when ordering replacement parts.

This is a standard maintenance manual provided for your convenience.

This manual may include additional documentation not applicable to your specific pump.

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1 General

1.1 Principles

This manual contains important information for operating the MDX pump reliably, properly, and efficiently. Compliance with these instructions is vital for avoiding risks and ensuring reliability and a long service life of the pump.

The nameplate indicates the type series/size, main operating data, and serial number. Quote this information in all queries, repeat orders, and orders of spare parts.

These instructions do not take local regulations into account. Operators must ensure that such regulations are strictly observed by all, including the installation personnel.

This manual may include information not applicable to your pump/unit, as your pump/unit may not have all features or auxiliary components described here. Consult your drawings and Bill of Materials (BOM) for details.

For information or instructions exceeding the scope of this manual, or in case of damage, contact your GIW/KSB representative..

WARNING

Do not operate the pump/unit beyond the limit values specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature, and motor rating. Operation must be in accordance with the instructions in this manual or the contract documentation.

1.2 Target Group

This manual is aimed at the target group of trained and qualified technical personnel. See Section 2.2, “Personnel Qualification and Training.”

1.3 Other Applicable Documents

Table 1-1: Overview of Other Applicable Documents

Document	Contents
Data sheet	Description of the technical data of the pump/set
General arrangement drawing/outline drawing[a]	Description of mating dimensions and installation dimensions for the pump (set), weights
Lifting-device manual	Guide to using lifting devices for the pump and its components. See also the lifting device testing and certificate of compliance documents.
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency, and power input
General assembly drawing	Sectional drawing of the pump
Spare parts lists[a]	Description of spare parts
List of components	Description of all pump components
Technical documents	Short, informative documents on technical topics related to information and procedures; referenced as applicable throughout the manual.

a. If agreed to be included in the scope of supply.

2 Safety

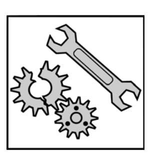
This maintenance manual must be complied with during installation, operation, and maintenance. Personnel should be familiar with this manual, and it should always be kept close to the operating location of the machine/unit for easy access.

While this section covers general safety information, individual sections throughout the manual contain more specific safety instructions that should be followed.

2.1 Safety Markings

Table 2-1 defines the safety markings that appear throughout this manual.

Table 2-1: Key to Safety Symbols/Markings

Safety Marking	Definition
DANGER	**DANGER:** Indicates a high-risk hazard that, if not avoided, will result in death or serious injury.
WARNING	**WARNING:** Indicates a medium-risk hazard that, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION:** Indicates a hazard that, if not avoided, could result in damage to the machine and its functions.
	**EXPLOSION PROTECTION:** Information about avoiding explosions in potentially explosive atmospheres in accordance with EC Directive 94/9/EC (ATEX).
	**GENERAL HAZARD:** Indicates a hazard that can result in death or serious injury; typically used with one of the signal words above.
	**ELECTRICAL HAZARD:** Indicates a hazard involving electrical voltage; provides guidelines to protect against electrical hazards that can result in death or serious injury. Typically used with one of the signal words above.
	**MACHINE DAMAGE:** Indicates a hazard for the machine and its functions; used in conjunction with the “Caution” signal word.

In addition to reading all safety messages in this manual, it is also important to comply with the following on your machine/unit:

- The arrow indicating the direction of rotation
- Markings for fluid connections (These should remain in legible condition.)

2.2 Personnel Qualification and Training

All personnel involved in operation, maintenance, inspection, and installation should be fully qualified to carry out the work involved.

The operator should clearly define personnel responsibilities, competence, and supervision. If personnel are not already qualified, they should be given appropriate training and instruction. If required, the operator may commission the manufacturer/supplier to provide such training. The operator should also ensure that personnel fully understand the instructions in this manual.

2.3 Non-compliance with Safety Instructions

Non-compliance with safety instructions and/or failure of prescribed maintenance and servicing practices can jeopardize the personnel safety, the environment, and the pump itself. Non-compliance will also lead to forfeiture of any and all rights to claims for damages available through GIW/KSB's standard warranty.

In particular, non-compliance can result in:

- Failure of important machine/unit functions
- Injury or death by electrical, mechanical, or chemical effects
- Hazard to the environment due to leakage of hazardous substances

2.4 Safety Awareness

In addition to complying with this manual's safety instructions, it is imperative to comply with the relevant national and local health and safety regulations and the operator's own internal work, operation, and safety regulations.

Note that the safety guidance in this maintenance manual applies to GIW/KSB equipment only. For safety guidance on auxiliary equipment not developed by GIW/KSB, refer to the applicable manufacturers' manuals.

2.5 Safety Instructions

2.5.1 Operators

When operating or working on or near a pump, adhere to the following safety instructions:

- Always wear appropriate personal protective equipment (PPE).
- If a component poses a potential rotational hazard, it must be equipped with a guard.
- If a guard has been fitted to prevent accidental contact with moving parts (e.g., coupling), do not remove it while the machine is operating.
- Contain leakages (e.g., at the shaft seal) of hazardous media handled (e.g., explosive, toxic, hot) to avoid danger to persons and the environment. Adhere to all pertinent legal provisions.
- Lockout/tagout (LOTO) to eliminate any electrical hazards. (Refer to the relevant national safety regulations and/or regulations issued by the local energy supply companies.)
- Be aware that mixing unsuitable media may cause a chemical reaction that can result in a pressure buildup and a potential explosion.

2.5.2 Maintenance, Inspection, and Installation Personnel

Maintenance, inspection, and installation personnel should adhere to the following safety instructions:

- Ensure that all maintenance, inspection, and installation work is performed by authorized, qualified personnel who are thoroughly familiar with this manual.
- *Unless specifically instructed in this manual*, all work on the machine should be carried out during shutdown. Adhere without fail to the shutdown procedure described in Section 6.3, “Shutdown.”
- Immediately following completion of the work, re-install and/or re-activate all safety/protective devices.
- Observe all instructions in Section 6, “Commissioning and Operation,” before returning the machine to service.

2.6 Unauthorized Modification and Manufacture of Spare Parts

Modifications or alterations of the pump equipment are only permitted after consultation with the manufacturer. To ensure safety, use only original equipment manufacturer (OEM) spare parts and accessories authorized by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for damage or warranty.

2.7 Unauthorized Modes of Operation

Never operate the pump/unit outside the limits stated in the data sheet and in this manual. The supplied warranty relating to the operating reliability and safety of the pump/unit is only valid if the machine is operated in accordance with its intended use.

2.8 Assembly and Disassembly Safety

NOTE

For sectional drawings and BOM for your specific pump and equipment, see an official copy of the documentation provided by GIW/KSB.

- Disconnect and lock out/tag out (LOTO) electrical connections before working on the unit, and ensure that the pump set cannot be switched on accidentally.
- Dismantle and reassemble the pump/unit according to the guidelines and instructions set forth in this manual and the relevant sectional drawings. Any work on the motor, gear reducer, or other non-pump equipment should be governed by the respective supplier’s specifications and regulations.
- Before assembling the pump/unit, thoroughly clean all dismantled part-mating surfaces and check for signs of wear. Replace any damaged or worn components with OEM spare parts. Ensure that the seal faces are clean and the O-rings and gaskets are properly fitted. We recommend using new sealing elements (O-rings and gaskets) whenever the pump is reassembled. Ensure that new gaskets have the same thickness as the old ones.
- Avoid using mounting aids as much as possible. If a mounting aid is necessary, use a commercially available contact adhesive. Apply it in thin layers, and only at selected points (three to four spots). Do not use cyanoacrylate adhesives (quick-setting adhe-

sives). If mounting aids or adhesives other than those described are required, contact the sealing material manufacturer.

- Drain the pump before disassembly, and secure the pump so that the pump assembly cannot be switched on accidentally. Close the shut-off elements in the suction and discharge nozzles. Once the wet end of the pump has cooled to ambient temperature, drain it and release its pressure.
- All maintenance, inspection, and installation work should be performed by authorized, duly qualified staff who are thoroughly familiar with these instructions.
- Only specially trained personnel, using OEM spare parts, should perform repair and maintenance work to the pump.
- Use a regular maintenance schedule to help avoid unexpected shutdown and ensure reliable pump operation with minimal maintenance expenditure.

WARNINGS

Decontaminate the pump if it handles liquids that pose health hazards. When draining the medium, ensure that there is no risk to persons or the environment. Adhere to all relevant laws.

Upon completion of the work: All safety-related and protective equipment must be properly refitted and/or reactivated before starting the pump assembly.

DANGER OF EXPLOSION!

Do not apply heat to the impeller hub or nose due to the sealed cavity at the impeller nose. Doing so can cause the impeller hub to explode.

2.9 Lifting and Rigging Safety

WARNINGS

Always consult your operational drawings for lifting-device details.

Always observe proper lifting, rigging, and safety practices. Do not attempt to lift heavy components by hand; this may result in personal injury and damage to equipment.

Always ensure that lifting equipment does not bind the swivel hoist ring (Figure 2-1), as binding can cause the ring to fail. When lifting a plate that contains two swivel hoist rings, do not allow the angle between the lines of tension from the rings to exceed 120° (Figure 2-2). This could cause the hoist rings to fail.

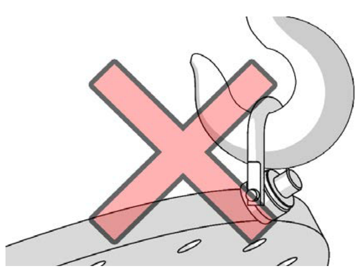


Figure 2-1: Lifting Guideline: Do not bind lifting equipment.

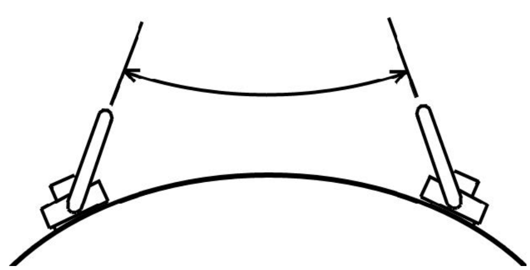


Figure 2-2: Lifting Guideline: Do not exceed 120° between lines of tension.

3 Transport and Storage

3.1 Transport

	DANGER
⚠	**Pump (set) could slip out of suspension arrangement. Danger from falling parts!** Observe proper rigging, lifting, and safety practices at all times. If the pump/unit slips out of the suspension arrangement, it may cause property damage, personal injury, or death. Anytime a lifting device is needed, consult the operational drawings for lifting device details.

Proper lifting and safety practices include verifying the equipment's lift weight and load rating and ensuring the suitability and stability of the attachment points. In addition:

- Be aware of the location of the center of gravity, which is usually *not* at the physical center of the unit. For the bare shaft pump (without motor), the center of gravity is near the shaft seal area.
- For the most stable lift, space the lifting points evenly about the center of gravity and as far apart as practical. Note that certain lifting points on the pedestal or bearing housing may be intended for handling the pedestal or bearing housing alone and are not the best balance points for the entire pump unit.

	NOTE
i	For suggested lifting methods, see Section 3.5, "Recommended Lifting." The safest lifting method will vary with pump configuration and type of lifting equipment.

- Before moving the pump, ensure that the attachments are secure. Test the lifting method for stability.
- Ensure that the unit remains in the horizontal position during lifting and cannot slip out of the suspension arrangement.
- During shipment, ensure that the pump is firmly strapped down and is protected from direct contact with the elements. Motors and gear reducers may require immediate cover. Consult the manufacturer for guidance.
- After arrival on site, consult GIW/KSB pump storage recommendations. (See Section 3.2, "Pump Storage" for further storage instructions.)
- In corrosive environments, be sure to remove all lifting eyes from the pump and store in a non-corrosive environment until needed.
- DO NOT: Use eyebolt or shackle locations on the bearing assembly, motor, or pump plates. These are intended for lifting those items alone and must not be used when lifting the entire pump.
- DO NOT: Place excessive side loads on cast lifting eyes. The side-loading angle on any lifting eye should not exceed 30°.

3.2 Pump Storage

This section lists both general cautions and further details for storing the pump for typical time periods. It also addresses storage of installed spares (idle pumps).

3.2.1 General Cautions

- In freezing environments, prevent water from collecting in the pump casing and impeller hub. Contact GIW/KSB for information on GIW/KSB foam spacer discs, which protect the impeller if left installed in sub-freezing conditions.
- If the pump is fitted with a mechanical seal, motor, sheave, bushing, coupling, gear reducer, or other piece of auxiliary equipment, consult the manufacturer's maintenance manual for additional storage instructions.
- Regularly test auxiliary systems according to manufacturer recommendations.

3.2.2 Storage Upon Receipt and Up To 3 Months

Once received, store pumps indoors and out of the weather until they are ready for installation. In construction environments where indoor storage is not available, store the pump on blocks or pallets, build a frame around it, and cover it with a tarp. Follow these guidelines for the frame, shelter, and tarp:

- The frame must be able to withstand snow and wind. It must be anchored and built to last the entire storage period.
- The shelter must be continuously maintained in a stable and leak-free condition.
- To avoid condensation, the tarp must not touch the pump, and the bottom of the tarp must be left open for ventilation. Minimum tarp requirements are as follows:
    - 610 gsm (18 oz) vinyl
    - 0.5 mm (20 mil) thick
    - Waterproof
    - UV–resistant

3.2.3 Storage Between 3 and 12 Months

The above frame requirements apply if the pump is to be exposed to the weather at any time. If storing the pump between three and twelve months, follow these additional precautions:

- **Wet end.** Drain all wet-end pump parts and isolate from reaction-vessel gases.
- **Rust inhibitor coatings.** Check the coatings on bare metal surfaces. Renew any exposed areas.
- **Painted surfaces.** Check for any signs of corrosion or breaks in the coatings. Touch up as needed.
- **Threaded holes.** Ensure that threaded holes are protected with grease and plugged.
- **Pumps with mechanical seals.** If the pump is fitted with a mechanical seal, you may need to take precautions before rotating the shaft. Refer to the seal manufacturer's maintenance manual for instructions.
- **Pumps with Inpro® or labyrinth seals:** Coat externally with white grease or petroleum jelly to seal the gap between the rotor and stator. Units equipped with a vent kit must have the vents either removed and plugged, or blocked to prevent air exchange.
- **Bearing assemblies.** See the following sections, which relate to bearing assemblies using different lubrication types.

3.2.3.1 Oil-Lubricated Bearing Assemblies with GIW/KSB Blue Oil

Oil-lubricated bearing assemblies with GIW/KSB Blue oil require shaft rotation. Begin by adding the GIW/KSB Blue oil (supplied with the pump) to the bearing housing until the level is halfway of the oil sight glass (642). Manually rotate the pump shaft *approximately* five turns each month to keep the bearings coated. Ensure that the shaft keyway is not in the same position as it was before the rotation.

Replace the oil every three months throughout the shutdown.

3.2.3.2 Oil-Lubricated Bearing Assemblies with GIW/KSB Storage Oil

Oil-lubricated bearing assemblies with GIW/KSB Storage oil do not require shaft rotation. Simply add the GIW/KSB Storage oil to the bearing housing until the level is halfway of the oil sight glass (642), and then rotate the shaft several times. **No further shaft rotation is needed.**

Keep the bearing assembly sealed in the factory-assembled condition. The oil fill plug must be securely replaced, and no breather or other vent should be added to the bearing housing.

Storage oil should be replaced every 12 months.

3.2.4 Storage Exceeding 12 Months (Long-term Storage)

The following information pertains to GIW/KSB pump assemblies only. It does *not* cover auxiliary equipment such as motors, gearboxes, lube oil systems, etc. Long-term storage for auxiliary equipment must be included in the contract and negotiated with sub-vendors at the time of order.

At 12 months of storage, and again at 24 months of storage:

- **Rust inhibitor coatings:** Check the rust inhibitor coatings on bare metal surfaces. Renew exposed areas.
- **Painted surfaces:** Check the painted surfaces for any signs of corrosion or breaks in the coatings. Touch-up as needed.
- **Oil:** Maintain the oil schedule throughout the storage period.

3.2.5 Installed Spares (Idle Pumps)

Guidelines for installed spares after being idle for one, three, and twelve months:

- **After one month.** Rotate shafts through at least five revolutions, either manually or by a short-duration start-up. If the shaft is regularly exposed to moisture (weather- or process-related), monthly oil analysis is recommended, as idle bearing assemblies are subject to breathing and internal condensation from ambient temperature fluctuations.
- **After three or more months.** Replace the oil to ensure against condensation.

3.3 Parts Storage: General Guidelines

Following are some general guidelines for parts storage. See Table 3-1 for storage of individual parts.

3.3.1 General Guidelines

For proper storage of parts:

- **Machined surfaces.** Coat with rust protector. Check monthly for visible signs of rust. Remove any rust with a wire brush. Recoat machined surfaces with a rust inhibitor as needed.
- **Casting surfaces.** Check monthly for paint breakdown. Remove any rust with a wire brush. Repaint casting surfaces as needed.
- **Drilled and threaded holes.** Grease and plug all drilled and threaded holes, and check monthly for buildup of foreign matter in drilled/threaded holes.

3.3.2 Storage Requirements for Individual Parts

With the exception of large castings (pedestals, pump casings, impellers, etc.), all pump parts should be stored indoors. Table 3-1 shows additional requirements.

Table 3-1: Storage Requirements for Pump Parts

Pump Part	Storage Requirements
Pedestal Casing Casing Half Liner Plate Impeller Sub-base	• **For these parts only,** outdoor storage is permitted. • Inspect monthly. • Lay sub-bases flat, and do not stack. •
Rubber Elastomers Urethane Neoprene	• Check the expiration date. (Shelf life is five years.) • Keep dry, away from direct sunlight or other ultraviolet (UV) sources. Keep away from heat. • Store in the box with the part covered by black plastic, low-density polyethylene bags (minimum thickness of 4mil/0.10 mm. Re-seal boxes. • Periodically inspect for deterioration, indicated by a soft, chalky layer that easily rubs off. **Note:** A darkening or discoloration of elastomer parts over time is natural and does not necessarily indicate loss of properties. •
Shaft Sleeve Lantern Ring Wear Plate	• Coat the complete part with rust protector. •
Shaft	• Coat the complete part with rust protector and wrap with 6 mil/ 0.15 mm Vapor Corrosion Inhibitor (VCI) plastic
O-rings Gasket	• Check the expiration date. (Shelf life is typically five years.) • Keep dry, out of direct sunlight, and away from heat. • Visually inspect for wear. •
Bearing Bearing Isolator Sealing Washer	• Check the expiration date. (Shelf life is typically one year.) • Refer to the manufacturer's storage guidelines. • Keep in unopened box provided by the vendor. • Keep dry and out of direct sunlight. Lay flat.
Motor Sheave Gear Reducer Coupling Bushing	• Refer to the manufacturer's storage guidelines. •

3.4 Removal from Storage

When the pump and associated parts are to be removed from storage:

- **Machined surfaces.** Use a wire brush to remove any rust.
- **Rust inhibitor.** Remove rust inhibitor from all machined surfaces prior to installation/assembly.
- **Painted surfaces.** Check for any signs of corrosion or breaks in the coatings. Touch up as needed.
- **Bearing assembly:** (Recommended) Drain before shipment and refill after relocation or installation.
- **GIW/KSB Blue oil:** If GIW/KSB Blue oil with rotation was used and the pump has been stored for less than three months, you may use the same oil for initial commissioning and break-in. Otherwise, replace the oil before commissioning to remove any moisture.
- **GIW/KSB Storage oil:** If GIW/KSB Storage oil was used, drain and replace with GIW/KSB Blue oil before start-up.
- **Stuffing box:** Check the stuffing box before start-up, and replace if necessary. Note that packing can dry out during storage and may need multiple readjustments during start-up.
- **Auxiliary equipment:** If the pump is fitted with a mechanical seal, motor, sheave, bushing, coupling, gear reducer, or other piece of auxiliary equipment, consult the manufacturer's maintenance manual for additional instructions. Refer to Chapter 6, "Commissioning and Operation," before putting the pump into service.

3.5 Recommended Lifting

The safest lifting method will vary with pump configuration and type of lifting equipment available. Refer to the pump's GA drawings and contact GIW Engineering for custom lifting recommendations.

4 Description

4.1 Technical Specification

NOTES
The MDX pump range is an international product and has been designed, in most respects, to the imperial system of units using imperial components. Most sealing elements and fasteners are imperial and require imperial tooling. Consult your arrangement drawings and BOM for details concerning your equipment.

CAUTION
Crossover between imperial and metric tools or spare parts is generally not recommended and can cause damage to equipment. Tooling used for assembly and maintenance of fasteners and other components must conform to the correct standard. Spare parts such as oil seals, O-rings, and stuffing box packing must also be purchased according to the correct standard and size. Contact your GIW/KSB representative for specific problems or questions.

The MDX is a centrifugal pump for handling highly abrasive slurries for mill circuit applications. Applications include semi-autogenous grinding (SAG) and ball-mill discharge; mill transfer; and cyclone and screen feed.

4.2 Designation

For the sample MDX pump designation below, Table 4-1 lists all associated codes. For more information, contact your GIW/KSB representative.

Example Designation: **MDX- 150X 150- 650. 5 G L B T MM**

Table 4-1: Pump Designation

Code	Description	Codes		
MDX	Pump Type			
150	Discharge Nozzle (mm)			
150	Suction Nozzle (mm)			
650	Nominal Impeller Diameter (mm)			
5	Shaft Size	**3**=3-15/16” **5**=5-7/16” **6**=6-7/16”	**7**=7-3/16” **9**=9”	**10**=10-1/4” **11**=11-1/2”
G	Plug Type	**F**=3.5S **G**=2C4.5	**J**=6.5 **K**=7.75	**L**=9.0 **M**=11.5
L	Bearing Assembly Type (	**C**=Conventional	**L**=Limited End Float	
B	Seal Type	**F**=Forward Flush **K**=KE Design **M**=Mechanical	**B**=Throat Bushing **S**=SpiralTrac™	
T	Lantern Ring Material	**T**=Teflon **M**=Metal		
M	Suction Liner Material	**M**=Metal		
M	Hub Liner Material	**M**=Metal		

4.3 Design Features

Horizontal, end suction, modified volute casing pump with heavy section thickness and 3-, 4-, or 5-vane impellers for the optimum solids passage and performance. Single-wall, heavy section, hard metal wet end, combined with robust cartridge-bearing assembly, provides maximum reliability and ease of maintenance.

4.4 Noise Characteristics

	WARNING
	Coarse solids, froth, or cavitating conditions can significantly increase the noise levels in both pump and piping. Field-testing will be necessary if accurate noise levels are required for these conditions.

If running within the normal limits of operation and with clear water, the noise level for the pump alone (with gear box and motor noises shielded) does not exceed 85 dB(A) at one meter.

Sound pressure levels from the motor and gear reducer must be added to the above in accordance with standard acoustic formulas, taking into account the distance between units. For belt-driven units, add an additional 2 dB.

4.5 Accessories

Couplings, pulleys, belts, and motor mounts and/or base plates may be provided. Refer to the BOM, data sheets, and/or other drawings for further information.

4.6 Dimensions and Weights

Dimensions and weights are listed on the pump installation plan.

4.7 Forces and Moments at Nozzles

Below are the allowable combined branch loads applicable for all GIW/KSB slurry pumps. Methods are based on ANSI/HI 12.1-12.6-2016 Slurry Pump Standard. Loads generally exceed HI/ANSI 9.6.2-2015 table 9.6.2.1.4a and API 610-2004, Table 4. Higher allowable loads may be possible depending on individual pump configuration and operating conditions. Contact GIW/KSB Engineering for more information.

NOTE: Discharge branch coordinate system always moves with the branch angle. (Fz is always along the direction of flow).

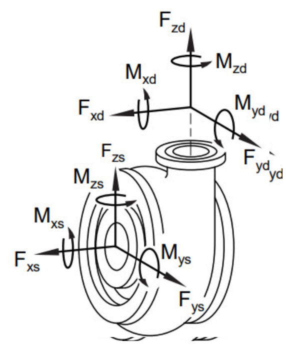


Table 4-2: Forces and Moments at Nozzles

	Flange Size		Allowable Forces						Allowable Moments					
			F_X		F_Y		F_Z		M_X		M_Y		M_Z	
	inch	mm	lbs	N	lbs	N	lbs	N	ft-lbs	N-m	ft-lbs	N-m	ft-lbs	N-m
DISCHARGE PIPE	2	50	1600	7110	1280	5690	3250	14450	2640	3570	2640	3570	4000	5420
	3	75	1760	7840	1410	6270	3410	15180	2900	3930	2900	3930	4390	5960
	4	100	1930	8590	1550	6890	3580	15930	3160	4290	3160	4290	4790	6500
	6	150	2270	10110	1820	8090	3920	17450	3680	4990	3680	4990	5580	7570
	8	200	2630	11700	2100	9340	4280	19040	4200	5690	4200	5690	6360	8620
	10	250	3010	13390	2410	10710	4660	20730	4700	6380	4700	6380	7130	9670
	12	300	3420	15230	2740	12180	5070	22560	5210	7070	5210	7070	7900	10710
	14	350	3890	17300	3110	13830	5540	24640	5710	7740	5710	7740	8650	11730
	16	400	4440	19760	3550	15790	6090	27100	6200	8410	6200	8410	9400	12750
	18	450	5110	22750	4090	18190	6760	30090	6690	9070	6690	9070	10140	13750
	20	500	5900	26240	4720	20990	7550	33580	7170	9730	7170	9730	10870	14740
	22	550	6680	29730	5350	23790	8330	37070	7650	10380	7650	10380	11600	15720
	24	600	7350	32720	5890	26190	9000	40060	8120	11020	8120	11020	12310	16700
	26	650	7900	35170	6330	28150	9550	42510	8590	11650	8590	11650	13020	17660
	30	750	8780	39090	7030	31260	10430	46430	9510	12900	9510	12900	14410	19540
	36	900	9860	43890	7890	35090	11510	51230	10850	14710	10850	14710	16440	22290
	38	950	10150	45170	8120	36150	11820	52580	11280	15300	11280	15300	17100	23190
	40	1000	10400	46270	8320	37020	12090	53810	11720	15890	11720	15890	17750	24070
SUCTION PIPE	3	75	3410	15180	1760	7840	1410	6270	4390	5960	2900	3930	2900	3930
	4	100	3580	15930	1930	8590	1550	6890	4790	6500	3160	4290	3160	4290
	6	150	3920	17450	2270	10110	1820	8090	5580	7570	3680	4990	3680	4990
	8	200	4280	19040	2630	11700	2100	9340	6360	8620	4200	5690	4200	5690
	10	250	4660	20730	3010	13390	2410	10710	7130	9670	4700	6380	4700	6380
	12	300	5070	22560	3420	15230	2740	12180	7900	10710	5210	7070	5210	7070
	14	350	5540	24640	3890	17300	3110	13830	8650	11730	5710	7740	5710	7740
	16	400	6090	27100	4440	19760	3550	15790	9400	12750	6200	8410	6200	8410
	18	450	6760	30090	5110	22750	4090	18190	10140	13750	6690	9070	6690	9070
	20	500	7550	33580	5900	26240	4720	20990	10870	14740	7170	9730	7170	9730
	22	550	8330	37070	6680	29730	5350	23790	11600	15720	7650	10380	7650	10380
	24	600	9000	40060	7350	32720	5890	26190	12310	16700	8120	11020	8120	11020
	26	650	9550	42510	7900	35170	6330	28150	13020	17660	8590	11650	8590	11650
	28	700	10020	44590	8370	37250	6700	29800	13720	18600	9050	12280	9050	12280
	30	750	10430	46430	8780	39090	7030	31260	14410	19540	9510	12900	9510	12900
	34	850	11170	49710	9520	42370	7620	33890	15770	21390	10410	14110	10410	14110
	36	900	11510	51230	9860	43890	7890	35090	16440	22290	10850	14710	10850	14710
	38	950	11820	52580	10150	45170	8120	36150	17100	23190	11280	15300	11280	15300
	40	1000	12090	53810	10400	46270	8320	37020	17750	24070	11720	15890	11720	15890

5 Installation at Site

5.1 Safety Regulations

WARNING

Risk of explosion when operating electrical equipment in hazardous conditions.
Equipment must comply with the applicable explosion-protection regulations, as indicated on the motor rating plate. For equipment installed in a hazardous location, observe and comply with the applicable local explosion-protection regulations and the regulations of the test certificate supplied with the equipment and issued by the responsible approval authorities. Keep the test certificate in an area that is easy to access.

5.2 Foundation

WARNING

Risk of injury from contact with materials. Wear appropriate PPE when handling concrete and grouting materials.

All structural work required must be prepared in accordance with the dimensions stated in the dimension table/installation plan.

The concrete foundation must have sufficient strength for the pump and be completely cured before installation. The mounting surface must be flat and level. Anchor bolts must be located according to the installation plan. This can be done when the concrete is poured, or by drilling holes in existing foundations and grouting the bolts in place.

5.3 Installing the Baseplate and Pump

WARNING

Potential for injury from vibration or shifting equipment. Do not install the baseplate and pump on unpaved or unsupported foundations.

5.3.1 Aligning the Pump/Drive Train

CAUTION

Improper alignment can result in damage to the pump and related equipment.

- Keep all components level during system operation unless special provisions for bearing lubrication and oil sealing have been made.
- After attaching the unit to the foundation and connecting the piping, thoroughly check the pump and drive train, and realign as necessary. Improper alignment of the unit can cause damage to both the coupling and the unit itself.

WARNINGS

Risk of instability with mounting bolts. GIW/KSB does not recommend using mounting bolts to close gaps between motor feet and the mounting plate (in place of shimming), as this may result in twisting of the motor frame, "soft foot" mounting, and excessive vibration.

Components may be hot. When removing drive components, take care to avoid personal injury or damage to the equipment. Avoid contact with hot surfaces such as couplings, which may heat up during normal operation and cause injury.

Guidelines for aligning the pump/drive train are as follows:

Related articles are "Baseplate Installation," "Baseplate Design," and "Anchor Bolt Template/ Anchor Installation."

- Take proper alignment into consideration when using an overhead motor mount accessory. Motor feet must be firmly supported at each mounting bolt location before the bolts are tightened. Use shims to fill any gaps, ensure solid mounting, and prevent vibration.
- For optimum performance, the pump should be mounted directly to the baseplate without shims, with the rest of the drive train aligned to the pump. For this reason, GIW/KSB baseplate designs generally allow space for shimming under the gear reducer and motor, but not under the pump itself. The only exception occurs when regular removal and replacement of the entire pump is stipulated during the equipment-design stage. In these cases, special instructions for alignment and shimming of the pump may be given on the pump assembly and/or general arrangement drawings.
- Perform coupling checks and realignment even if the pump and motor are supplied completely assembled and aligned on a common base plate. Observe the correct distance between the coupling halves and shaft ends and the pulleys, as specified in the installation plan.
- Verify the pump set alignment using laser alignment tools. If laser alignment tools are not available, use a dial indicator to verify proper alignment.
- The radial and axial deviation (tolerance) between the two coupling halves should not exceed the values shown in Table 5-1.

Table 5-1: Typical Industry Standard for Coupling Alignment

	Angular Misalignment 		Offset Misalignment 	
RPM	**Excellent**	**Acceptable**	**Excellent**	**Acceptable**
≤ 900	1.0 µm/mm	1.5µm/mm	100 µm	200 µm
≤ 1200	0.7 µm/mm	1.0 µm/mm	75 µm	150 µm
≤ 1800	0.5 µm/mm	0.7 µm/mm	50 µm	100 µm

- Ensure that coupling gaps are properly set in the case of motors with sleeve bearings.
- For V-belt installations, the pulleys are correctly aligned if a straight edge, placed vertically, shows a deviation of no more than 1.0 mm (0.04 inch). Both pulleys must be parallel.

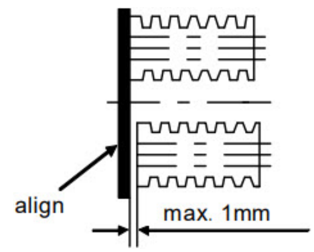


Figure 5-1: Pulley Alignment for V-Belt Installations

5.3.2 Place of Installation

WARNING

Danger of mild burns to personnel and adjacent equipment. Be aware of the following, and take the necessary precautions to avoid burns to personnel and adjacent equipment:

- The volute casing and the shaft seal take on roughly the same temperature as the medium handled.
- The shaft seal, bearing assembly, and bearing housing must not be insulated.

5.4 Connecting the Piping

DANGER

Contact with toxic or hot media can result in injury or death.

CAUTION

Impermissible loads acting on pump nozzles can cause leaks of the medium handled, burns from contact with the medium handled, and damage to the pump.

- Never use the pump itself as an anchorage point for the piping.
- Observe permissible forces and moments, compensating for any thermal expansions and contractions of the pipelines that could cause extra loads on the pump and exceed the permissible pipeline forces and moments. (See Section 4.7, “Forces and Moments at Nozzles.”)

Before installing the piping, remove the flange covers on the pump suction and discharge nozzles.

Under no circumstances should the pipe system be equipped with a check valve or other device that can rapidly decelerate the flow rate.

5.4.1 Auxiliary Connections

Auxiliary connections (cooling, heating, sealing liquid, flushing liquid, etc.) may be required per the installation plan or piping layout. Consult the installation plan or piping layout for dimensions and locations of auxiliary connections.

To ease maintenance, refer to the installation plan for spool piece recommendations.

5.5 Safety Guards

WARNING

Contact with dangerous machine parts can cause injury. In compliance with accident-prevention regulations, do not operate the pump without coupling and drive guards. If the customer specifically requests not to include guards in the delivery, the operator must supply them. In addition, follow all local safety regulations.

5.6 Oil Temperature Monitoring

RTD (resistance temperature detector) units are usually shipped separately, along with the fittings needed to install them. See your RTD documentation for more details.

Before installing the RTD units, assemble and install any fittings (not already included on the RTD) in the bearing housing. Take care not to drop or damage the unit. Use an oil-compatible sealer on the threads during installation. Inspect the assembly for leaks.

After the entire assembly is complete, the bearing assembly can be put back into service.

5.7 Final Check

Verify the alignment as described in Section 5.3.1, “Aligning the Pump/Drive Train.” At the drive end, the pump must be able to rotate 360° freely (without motor power). If resistance is observed, the nose gap may need to be reset per Section 10.4, “Setting the Nose Gap.”

5.8 Connection to Power Supply

WARNING

Risk of electrical shock and damage to pump. A trained electrician should make the connection to the power supply. Check available main voltage against the data on the motor rating plate and select the appropriate start-up method. The use of a motor protection device is strongly recommended.

Risk of injury or pump damage. An emergency shut-off switch should be installed to prevent damage to the personnel and environment in the event of hazardous pump operation.

6 Commissioning and Operation

CAUTION

Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance shall not be covered by the scope of warranty. This manual applies to single-stage pumps. Contact the GIW/KSB sales office for procedures for multi-stage pumps.

6.1 Commissioning/Return to Service

6.1.1 Checklist: Before Starting the Pump

- If a pump has been in long-term storage (more than three months), follow proper procedures for both storage and removal from storage. (See contract documents and/or contact your GIW/KSB representative). Failure to follow proper storage procedures will void your warranty. See Section 3.2, “Pump Storage.”
- The impeller nose clearance must be properly set. See Section 10.4, “Setting the Nose Gap.”
- Final alignment of the pump/drive train must be complete. See Section 5.3.1, “Aligning the Pump/Drive Train.”
- Final torquing of all bolts must be complete. See Section 11.1.1, “Special Torque Requirements.”
- All electrical and power supply connections must be in order, including fuses and overload protection devices. See Section 5.1, “Safety Regulations.”
- All required auxiliary connections (shaft seal water, oil coolers, etc.) must be made, tested, and ready to function. See Section 5.4.1, “Auxiliary Connections.”
- All safety guards and equipment must be in place. See Section 5.5, “Safety Guards.”
- Any required instrumentation must be properly installed. See Section 5.6, “Oil Temperature Monitoring.”
- Lubrication of the bearing assembly must be complete. See Section 6.1.2, “Bearing Lubrication.”
- The shaft seal must be ready for operation. See Section 6.1.3, “Shaft Seal Commissioning.”
- The drive-train direction of rotation at the pump must be correct. See Section 6.1.4, “Checking the Direction of Rotation.”
- The pump set must be primed. Section 6.2.1, “Priming the Pump.”
- The desired operating conditions must not exceed those allowed by the pump. See Section 6.4, “Operating Limits.”

6.1.2 Bearing Lubrication

CAUTION

Failure to lubricate the bearings will result in damage to the pump. Note that pump bearing units are shipped empty of oil. Before starting the pump, fill them to the center of the oil level sight gauge using the GIW/KSB Blue 150 synthetic bearing oil supplied with the unit.

- **Recommended oil:** If locally obtained oil is desired, use an equivalent synthetic or a high-quality ISO 220 or 320 mineral oil suitable for use with heavy industrial equipment, anti-friction bearings, and oil-circulating systems. Such oil typically has high temperature stability, resists oxidation and foaming, and inhibits rust, corrosion, and formation of deposits. Do not use oils with EP (Extreme Pressure) additives. Detailed bearing oil specifications and GIW/KSB Blue replacement oil are available from GIW/KSB. See Table 6-1 for ISO viscosity grades; GIW/KSB Blue oil may be used for the temperatures listed.

Table 6-1: Recommended ISO Viscosity Grades

Slurry Temperature		ISO Viscosity Grade
0°C – 20°C	32°F – 70°F)	100
20°C – 30°C	(70°F – 85°F)	150
> 30°C	(> 85°F)	220

- **Oil operating temperatures:** Oil operating temperatures for GIW/KSB bearing assemblies will depend on pump size, speed, and ambient conditions. Under typical conditions, temperatures will run from 50°C to 85°C (125°F to 185°F). For oil temperatures above 85 °C (185°F) or for severe load conditions, use a high-quality synthetic lubricant (such as GIW/KSB Blue). At higher speeds or in hotter ambient conditions temperatures can rise to 100°C (210°F). Slightly higher temperatures may occur briefly when breaking in new bearings.

WARNING

High temperatures can cause damage to bearings and the pump. Shut down the unit immediately if temperatures rise to 120°C (250°F).

- **Filling the bearing assembly:** When filling the bearing housing, ensure that the oil level is at the centerline of the oil-level sight glass when the shaft is not turning. This is the “cold level,” and it will change as the pump runs and the oil is suspended in the bearings. See Table 6-2 for recommended approximate oil capacities.

Table 6-2: Approximate Oil Capacities (liters)

Bearing Assembly	Approximate Oil Capacity (liters)
3-15/16	2
4-7/16	3
5-7/16	5
6-7/16	9
7-3/16	9
9	18
10-1/4	34
11-1/2	34

NOTE
Overfilling the bearing assembly will result in leaking.

- **Draining the oil:** Drain the oil after the first 50 to 100 hours of operation. Before refilling, flush the bearings by filling the bearing housing with a lightweight oil, turning the pump shaft several rotations, and then draining. Repeat until the flushed oil appears clean.

6.1.3 Shaft Seal Commissioning

6.1.3.1 Mechanical Seals

CAUTION
Prior to start-up, mechanical seals require safety checks such as removing seal assembly fixtures, checking axial alignment, checking torques, etc. Refer to the mechanical seal operating manual for all required safety checks.

Mechanical seals are precision devices that require special care for their proper operation. Consult the mechanical seal's instruction manual for special storage, start-up, and maintenance requirements.

6.1.3.2 Stuffing Box Commissioning

Prior to commissioning, adjust the gland packing supplied with the pump. Pre-formed packing-ring sets from GIW/KSB are recommended. For alternate brands, see the packing manufacturer's instructions regarding installation and use.

For gland flush supply, use suitable, non-aggressive, clean water that is not liable to form deposits and does not contain suspended solids. Hardness should average 5 with a neutral pH. Water should be conditioned and neutral with regard to mechanical corrosion.

An inlet temperature of 10°C – 30°C (50°F – 85°F) should produce a maximum outlet temperature of 45°C (115°F) when the gland is properly adjusted.

6.1.4 Checking the Direction of Rotation

The impeller must rotate in the correct direction of rotation. Verify the direction by briefly running the motor with the coupling or belt drive disconnected. If the motor runs in the wrong direction of rotation, have it corrected and verify the direction of rotation again before reconnecting the coupling or belts.

If a variable-frequency drive (VFD) or other controller is used, GIW/KSB recommends permanently disabling the REVERSE and BRAKE functions during controller set up.

WARNING

Risk of impeller unscrewing and damage to unit. If power is applied to the pump and the pump is run in the wrong direction of rotation, even momentarily, the impeller may unscrew, causing extensive damage to the entire unit. This is a particular risk during initial start-up, as the impeller may not be fully torqued onto the pump shaft.

6.1.5 Cleaning the Plant Piping

WARNING

Cleaning operations for flushing and pickling service must be matched to the casing and seal materials used. Any chemicals or high temperatures used must be compatible with all pump parts.

6.2 Startup

WARNING

Start-up, shutdown, filling, and draining procedures must be designed to prevent any possibility of the pump shaft experiencing negative torque. Negative torque can cause the impeller to unscrew, leading to severe damage throughout the rotating assembly and drive train. In particular, avoid the following practices:

- **Any flow through an idle pump,** in any direction, in excess of 5% of the normal operating flow rate before the impeller has been tightened by running under normal loads. This includes flow due to filling or draining of the system and/or flow caused by the equalization of different levels between the sump and discharge line after the opening of any valves in the piping.
- Any attempt to **restrict the flow after shutdown**, by either manual or automatic systems, until the pump comes to a complete standstill.
- Any **braking or re-energizing of the drive train after shutdown** until the system has reached a complete static condition.

Risk of water hammer. Start-up and shutdown procedures must also be designed to prevent any possibility of water hammer, which can place excessive loads on the piping and damage the pump flanges. The pressure waves generated by water hammer can also damage the pump's pressure-containing components, the mechanical end, and/or the mechanical seal.

DANGER OF EXPLOSION!

Danger of steam generation and explosion. Prolonged operation at zero or low flow, typically due to closed valve or unintended pipeline blockage, is not permitted.

CAUTION

At some point during initial commissioning, the pump and bearing assembly will stabilize at normal operating temperature. When this happens:

- Stop the unit and re-tighten all bolts.
- Check the coupling alignment and re-align if necessary.

These actions should also be taken in the event of system leaks.

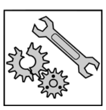
- Before starting the pump, verify that the shut-off element in the suction line is fully open.
- The pump may be started up against a closed discharge suction valve. Once the pump has reached full rotational speed, open the discharge valve slowly and adjust to the duty point.
- When starting up against an open discharge-side shut-off element, take the resulting increase in input power requirements into account.

6.2.1 Priming the Pump

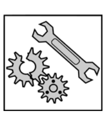
	**WARNING** **Risks of shaft seal failure.** The pump should never be run dry. Minimize air intake using proper sump design to prevent excess temperatures, airlock, and escape of medium into the atmosphere due to shaft seal failure.

Before start-up, the pump, suction line, and (if applicable) tank must be vented and primed with the liquid to be pumped. Any valve in the suction line must be fully open. Check the through-flow for all auxiliary connections.

6.3 Shutdown

	**CAUTION** Pipe system design and pump operation should prevent damage to the pump during a scheduled or emergency shutdown. In the event of a shutdown where a significant static discharge head exists in the system, the impeller can begin to run backwards as the flow reverses in the pipeline. This creates a positive torque on the shaft so the impeller connection will not unscrew. Until the flow stops, do not close any main line valves. A change in fluid velocity can create a negative torque on the impeller and unscrew it from the shaft, which can damage wet-end pump parts as well as bearings, seals, and other components.

- Switch off the drive, ensuring that the unit runs smoothly down to a complete stop. VFD and other controllers must not use any braking function to slow the pump. Diesel power trains should disengage the clutch and allow the pump to coast to a stop.
- Close any auxiliary connections. Pressurized bearing-lubrication systems must remain running until all rotation has stopped. If any part of the system uses a cooling liquid supply, turn that off only after the pump has cooled down.

	**CAUTION** **Risk of pump damage due to below-freezing temperatures.** Where temperatures may drop below freezing, the pump and system must be drained or otherwise protected against freezing.

6.3.1 Measures to be Taken for Prolonged Shutdown

6.3.1.1 If Pump Remains Installed

To ensure that the pump is always ready for instant start-up, and to prevent the formation of deposits within the pump and the pump-intake area, start up the pump set regularly once a month for a short time (about five minutes) during prolonged shutdown periods. Prior to an operation check run, ensure that there is sufficient liquid available for operating the pump.

6.3.1.2 If Pump is Dismantled and Stored

Before putting the pump into storage, carry out all checks specified in Section 3.2, “Pump Storage.” GIW/KSB recommends closing the nozzles (for example, with plastic caps or similar).

6.4 Operating Limits

WARNING

The pump/unit application limits (speed, minimum and maximum flow, head, fluid density, particle size, temperature, pH, chloride content, etc.), as stated on the data sheet, must be observed. Failure to do so may result in power overload, excessive vibration, overheating, and/or excessive corrosion or wear. If a data sheet is not available, contact your GIW/KSB representative.

CAUTION

Any make-up water or outside water supply for the system must be installed so that the GIW/KSB pump is never exposed to pressure exceeding its maximum allowable operating pressure.

6.4.1 Temperature Limits

CAUTION

Do not operate the pump at temperatures exceeding those specified on the data sheet or the nameplate unless the manufacturer’s written permission has been obtained. If this caution is disregarded, any damage that results will not be covered by the manufacturer’s warranty.

Observe bearing temperatures. Excessive bearing temperature could indicate misalignment or another technical problem.

6.4.2 Startup Frequency

DANGER

Excessive surface temperature of the motor can result in explosion hazard and damage to the motor. Observe the frequency-of-startup limits as specified in the motor and drive equipment manufacturer’s product literature.

6.4.3 Density of Medium Handled

The pump’s power input will increase in proportion to the density of the medium handled. To avoid overloading the motor, pump, and coupling, ensure that the density of the medium complies with the data specified on the purchase order.

7 Maintenance

CAUTION

Follow all safety guidelines. Before working on the pump, consult Section 2.8, “Assembly and Disassembly Safety,” and ensure that all relevant safety guidelines are followed.

7.1 Supervision of Operation

DANGER OF EXPLOSION!

Danger of explosion with closed shut-off element. Do not operate the pump against a closed shut-off element for a prolonged time. If running the pump against a closed discharge-side shut-off element for a short time, do not allow the permissible pressure and temperature values to be exceeded.

CAUTION

Risk related to water hammer. Avoid operational procedures that may cause system water hammer. Water hammer can cause sudden and catastrophic failure of the pump casing and plates.

Risk of part failure due to maintenance neglect. Neglecting maintenance procedures and monitoring can result in failure and leakage of the shaft seal, bearing seals, and wear components.

Risk of part failure due to worn coupling elements. Replace any flexible coupling elements that begin to show signs of wear.

Be aware of unusual noise or vibration. The pump should run quietly and be free from excessive vibrations at all times. Unusual noise or vibration should be investigated and corrected immediately.

7.2 Drainage/Disposal

WARNING

If the pump was used for handling liquids that pose health hazards, ensure that there is no risk to persons or the environment when draining the medium. Heed all relevant laws, local codes, and safety procedures. If required, wear all applicable PPE.

Flush and thoroughly neutralize the unit if the media handled:

- leaves residues that could lead to corrosion when coming into contact with atmospheric humidity, or
- could ignite when coming into contact with oxygen.

Properly collect and dispose of the flushing liquid used, along with any liquid residues in the pump, without posing any risk to persons or the environment.

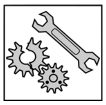
7.3 Lubrication and Lubricant Change

Under severe operating conditions, the intervals for checking, replenishing, and replacing the lubricant should be shortened. Severe operating conditions include high ambient temperature, high humidity, dust-laden air, and aggressive industrial atmosphere.

Drain and replace the oil every three to four months, or sooner if it is suspected of being dirty or contaminated.

See Section 6.1.2, “Bearing Lubrication,” for further instructions, specifications, and capacities.

7.4 Procedures for Maximum Wear Life of Parts



CAUTIONS

Risk of localized gouging. To prevent localized gouging of the suction liner and impeller, adjust the nose gap (impeller-to-suction-liner clearance) forward regularly during its life cycle. We recommend maintaining a schedule based on pump performance and adjusting it as needed. See Section 10.4, “Setting the Nose Gap.”

Risk of further part damage. Never attempt to use welding to repair white-iron Gasite wear parts.

Many factors influence the wear of slurry pump parts. The following procedures are designed to help you get the most out of your wet-end wear parts. If problems occur, contact your GIW/KSB representative for a review of your application.

7.4.1 Suction Liner

If localized wear occurs, rotate the suction liner 180° at approximately half life. If localized wear is severe, repair as recommended by GIW/KSB before rotation.

If applicable, a new snap-ring gasket or O-ring should always be used with a new suction liner or new pump casing.

7.4.2 Impeller

Impellers are sometimes changed too soon based on appearance. In general, however, an impeller does not require replacement until it fails to produce sufficient head for the application.

It is rare but possible that vibration may be caused by an impeller wearing out of balance. If this occurs, the impeller may be statically balanced by hand grinding on the back shroud.

The impeller should never be repaired by welding.

7.4.3 Pump Casing

If wear is localized with a deep gouge, repair or replace as recommended by GIW/KSB. Excessive wear problems usually indicate that the pump is not operating at the flow and head conditions originally specified for the design.

7.5 Operational Problems and Solutions

Many pump wear problems are caused by unstable system operation or by operating at conditions other than those for which they were designed. Although the dynamics of slurry-piping systems cannot be fully addressed in this manual, the following items should be considered. See Chapter 12, “Troubleshooting,” for additional information.

7.5.1 Sump Design/Supply Tank

There should be a minimum sump capacity of one minute at the expected flow conditions. Sump design should prevent any uneven flow of the solids to the suction. Often, a flat-bottom sump is best, as it will allow the solids to assume a natural slope of repose. Observe the sump during operation to ensure that solids are not building up and sloughing off.

Sump design should prevent the formation of a vortex, or other means of introducing air into the pump. Where a submerged suction is available, the depth of water level above the pump suction is more important than the cross-sectional area of the sump. Eliminate frothing of the sump by installing baffles, a submerged inlet pipe, or other methods to prevent air from becoming entrained in the slurry. If unavoidable, frothing must be accounted for in the system design and operation.

If the sump runs dry, the system will surge, causing accelerated pump wear. Decrease the pump speed or the impeller diameter, or increase the make-up water. If the flow variations are too great, a variable speed motor may be required.

7.5.2 Cavitation/NPSH Performance

The Net Positive Suction Head (NPSH) available ($NPSH_A$) must always be greater than the NPSH required ($NPSH_R$) by the pump, or cavitation will occur, which will result in head loss (drop in discharge pressure), increased wear rate of the pump parts, and shock loading of the pump bearing assembly. If in doubt, consult your GIW/KSB representative for your pump's NPSH requirements.

To maximize the NPSH available to the pump, ensure that the suction line is as short and straight as possible and the sump level is as high as possible. (If the pump is located above the water level, the suction lift should be as small as possible.) Minimizing the number of valves or short radius fittings and attaching a suction inlet bell will also reduce entrance losses. A larger-diameter suction pipe may help, but be careful not to reduce the flow velocity below safe carrying levels. Otherwise, bedding of the slurry will occur, resulting in increased wear of the suction liner and impeller.

7.5.3 Piping System Design

With coarse settling slurries, the pipelines should be vertical or horizontal. Inclined pipelines may surge due to a backward drift or buildup of solids. Also, an increase in slurry friction loss may be experienced in these sloped lines, further reducing performance.

Piping diameters must be properly sized to maintain sufficient carrying velocity. Oversized pipelines may result in the formation of a sliding bed of slurry, which can greatly accelerate the wear of pumps and pipelines.

7.5.4 Operating Conditions of Flow and Head

Note that the pump always operates at the intersection of the pump curve and the pipeline "system" curve.

During the initial stages of operation, check the motor load on the pump. If the pump is drawing an excess amount of power, this may be due to the system total dynamic head (TDH) being lower than predicted, resulting in higher flow rates and power consumption. This sometimes happens when a safety factor is applied to the head during the design of the system. Cavitation may also occur under these high-flow conditions. Slow down the pump speed to reduce flow, or increase the total discharge head against the pump to achieve reduced flow and power consumption.

Variable flow rates are especially common in applications with a high proportion of static head, such as mill discharge and cyclone feed. It can be further aggravated by operation well below the best efficiency flow rate of the pump where the pump head curve is relatively flat. Under these conditions, minor fluctuations in the system resistance caused by normal variations in solids concentration or size can result in surging flow rates.

Whenever possible, avoid prolonged operation at flows well below the optimum flow rate to prevent both recirculation of slurry within the pump and localized wear.

	NOTE
i	A useful reference and textbook has been published by GIW/KSB: *Slurry Transport Using Centrifugal Pumps*, by Wilson, Addie, Sellgren, & Clift.

8 Mechanical End

8.1 Mechanical End Overview

The bearing assembly is a cartridge design mounted on a fabricated pedestal with an adjustment mechanism for setting the impeller axial clearance.

The Limited End Float (LEF) bearing assembly (Figure 8-1) is used for mechanical seal applications or operations where tight impeller nose clearances are needed. The drive-end radial bearing is converted to a taper roller bearing to greatly reduce shaft end play.

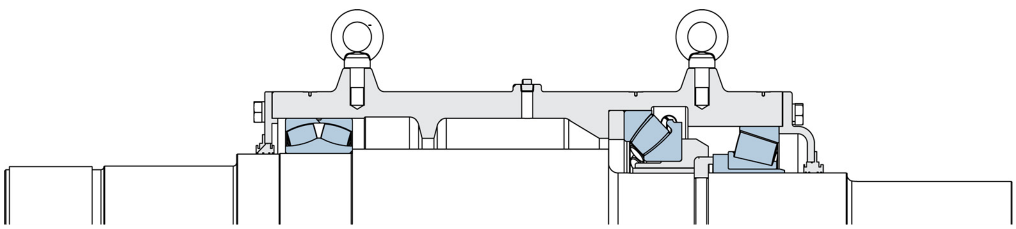


Figure 8-1: Limited End Float Bearing Assembly with Standard Stiffened Shaft

Standard lubrication is oil bath. See Section 6.1.2, “Bearing Lubrication,” for lubrication quality and quantity. For bearing part numbers, see assembly drawing and BOM.

8.2 Mechanical End Disassembly

NOTE

KSB SupremeServ Service Centers re-manufacture bearing assemblies and refurbish pumps. GIW/KSB will rebuild your assembly and return it to its original specifications using genuine OEM replacement parts. Contact your GIW/KSB sales representative for details.

CAUTION

Follow all safety guidelines. Before working on the pump, consult Section 2.8, “Assembly and Disassembly Safety,” and ensure that all relevant safety guidelines are followed.

CAUTION

Avoid excessive lifting force. Excessive lifting force may cause the top half to suddenly break free and bounce against the bearings or injure maintenance personnel. Do not use flexible lifting equipment such as nylon slings, which may stretch and exaggerate bouncing. Failure to use a lifting bar or chain spreader could result in damage to the housing. See Figure 8-2.

Use the lifting eyes for the cartridge bearing assembly only. The lifting eyes are specifically designed for the cartridge bearing assembly. Using them to lift the entire pump could result in damage to the pump and related equipment. See Figure 8-2.

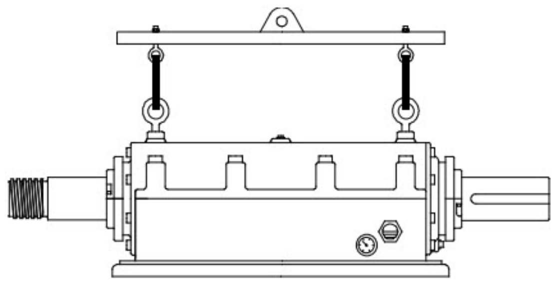


Figure 8-2: Recommended Lifting Device for Bearing Assembly

To disassemble the mechanical end of the pump:

1. Drain the oil by removing the drain plug in the end cover at either end.
2. Remove the throwers and bearing housing end covers.
3. Inspect the shaft seals, gaskets, and O-rings. Replace if broken or worn.
4. Remove the bolts holding the bearing housing halves together. Note that the housing halves are tightly doweled together to ensure that the bearings are aligned, and it may be difficult to remove the upper half.
5. Install the eyebolts and jam nuts. Use a lifting bar or chain spreader to apply a vertical force to the eyebolts when lifting. If necessary, insert a pry bar between the halves and lift evenly, taking care not to damage the sealing surfaces.
6. Remove the shaft and bearings from the housing. Different methods may be needed to remove the bearings from the shaft:

See also Section 8.3.3, which applies to some LEF–type bearing assemblies.

- **LEF Bearing Assemblies:** The drive-end radial bearing is a single-row taper roller bearing. These bearings are hot when installed and are press-fitted to the shaft. They are difficult to remove from the shaft undamaged; remove them only if a bearing must be replaced. Bearings are normally removed by pressing or heating. Take care to avoid damaging the shaft, particularly the bearing seat and shaft oil seal areas.

  The thrust bearing is a spherical roller bearing located between the radial bearings near the drive end. It is seated on a split ring that is clamped to a thrust groove in the shaft. A one-piece thrust collar is used between the bearing and the split ring. A small amount of heat on the back of the bearing is typically enough to allow it to be pushed off the split ring and removed from the shaft.

- **Bearing Assemblies with Impeller Release Rings:** As with some LEF–type bearing assemblies, the impeller and radial bearing may also be press-fitted to the shaft. Follow the same procedure specified for LEF–type assemblies.

8.3 Mechanical End Assembly

⚠	**CAUTION**
	Follow all safety guidelines. Before working on the pump, consult Section 2.8, “Assembly and Disassembly Safety,” and ensure that all relevant safety guidelines are followed.

CAUTION

Components and assembly environment must be clean and in good condition. Assemble the mechanical end in a clean, pressure-positive room. Before assembly, thoroughly clean all shaft, housing-bore, and end-cover surfaces with a suitable solvent to remove old grease and any water, dust, or grit. Clean all dismantled components, checking for signs of wear, and replace any damaged or worn components with OEM spare parts. Ensure that seal faces are clean and O-rings and gaskets are properly fitted.

8.3.1 Mounting the Bearings

CAUTION

Risk of oil leakage and seal failure. If using hand glued O-rings between the seals and the housing, note that their joints must be capable of preventing oil leakage and seal failure. Place the O-ring joint at the 12 o'clock position.

WARNING

Risk of burns. Wear the proper PPE and take needed precautions, both when heating components and when handling heated components.

To mount the bearings:

1. Place the thrust bearing on the shaft.
2. Bolt the split thrust collar (or split ring plus thrust collar in larger sizes) into place at the mating groove on the shaft. Figures 8-3 and 8-4 show the placement of both types of collars.

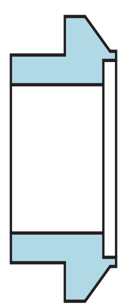


Figure 8-3: Split Thrust Collar, Sizes 4-7/16 and Smaller

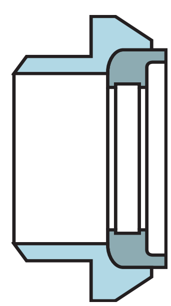


Figure 8-4: Split Ring and Thrust Collar, Sizes 5-7/16 and Larger

3. The thrust bearing is a drive fit on the thrust collar. Apply heat with an induction bearing heater to aid in seating. Press the bearing fully against the thrust collar shoulder.
4. Mount the drive-end radial bearing (next to the thrust bearing) with its inner race in direct contact with the split ring (or split thrust collar). If the bearing is a taper-lock type, first position it on the shaft while it is loosely mounted on its adapter.
5. Tighten the locknut.
6. Lock the locknut into position by bending one tab of the lock washer into one of the recesses on the locknut. Be sure that the radial bearing inner race is still in contact with the split ring (or split thrust collar).

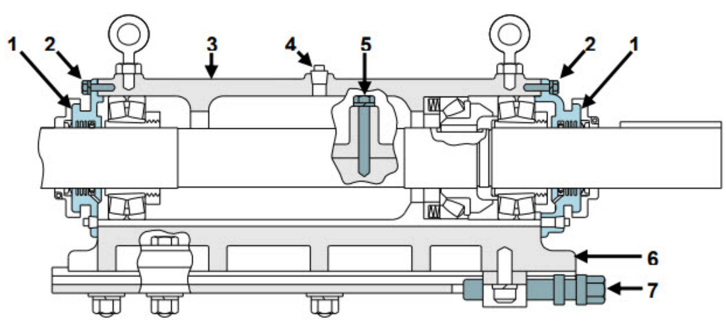
7. Loosely place the spring-retainer ring on the shaft from the threaded end of the shaft with the spring holes facing the thrust bearing.
8. Mount the remaining pump-end radial bearing last. If it is of the taper-lock type, ensure that its position after assembly is 1/4” to 5/16” (6 to 8 mm) from the housing end cover.
9. Wait for the shaft and bearing temperatures to return to room temperature.

8.3.2 LEF Bearing Assembly: Additional Shimming Procedure

LEF bearing assemblies require an additional shimming procedure to ensure proper operation. Before closing the housing and installing the end covers, use the following procedure to determine the correct number of shims. See Figure 8-7 for a drawing of the bearing assembly.

1. Install the shaft with mounted bearings and spring retainer ring (472) into the housing base (351), but without the springs (950.71) installed.
2. With the bearing housing cap (351) off and without the shims (89-4.71/.72), install the bearing end cover (361.70) and tighten the lower bolts (901.70) until all internal bearing clearance is eliminated and the end cover contacts the taper roller bearing. A gap should remain between the end cover and the housing.
3. Dowel and bolt the housing cap to the base and install the remaining end cover bolts.
4. Using a feeler gauge, measure the maximum gap between the end cover and the housing.
5. Select enough 0.010” (0.25 mm) shims (and 0.005” (0.13 mm)) if included in your BOM) to fill this gap, plus 0.002” to 0.008” (0.05 mm to 0.20 mm) extra interference for sealant. These will be used when installing the bearing end cover.
6. Unbolt the end cover and housing cap from the base. Remove the shaft with mounted bearings and spring retainer ring from the base and re-assemble using remaining steps.

8.3.3 Closing the Housing



1 – End Cover
2 – End Cover Fasteners
3 – Upper Housing
4 – Oil Fill Port
5 – Upper Housing Fasteners
6 – Lower Housing
7 – Adjustment Screw

Figure 8-5: Closing the Housing: LEF Bearing Assembly

To close the housing:

1. Insert the thrust bearing springs into the retainer ring. A small amount of grease can be used to hold the springs in place.
2. Place the shaft and bearings into the housing’s lower half. Be sure that the thrust bearing’s outer race and springs are held in their proper place.

3. Place the lock washers on the bolts and lightly coat the threads with anti-seize.
4. Apply a 1/8” (3 mm) bead of Loctite 518 sealant along the parting line of the bearing housing, between the inside edge and the bolt holes and around each hole.In addition, add a bead between each shim.

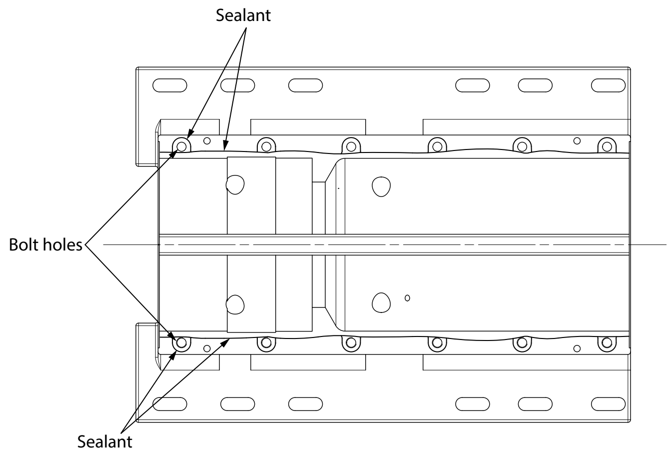


Figure 8-6: Sealant Application

	CAUTION
	Risk of oil-bath contamination with RTV. Room-temperature vulcanizing (RTV) silicone should only be used as an alternative to Loctite 518. RTV expands and can also dry into clumps that break off and contaminate the oil bath. For this reason, GIW/KSB recommends using Loctite 518.

5. Lower the top half and install the dowel pins.
6. Working from the center outward and alternating side to side, tighten the housing bolts. Final torque should be verified as 75% of yield for lubricated Grade 5 or Metric 8.8 fasteners.
7. Where a dowel pin has internal threads for removal, protect the threads with Loctite 518 sealant or install a matching screw.

8.3.4 Installing End Covers and Seals

	CAUTION
	Verify all thrower and labyrinth seal clearances. Failure to do so may result in overheating, damage to the seals, and damage to the bearings. See Figures 8-8 and 8-9.

To install the end covers and seals:

1. Begin by carefully inspecting the labyrinth oil seal grooves for any grease residue, chips, burrs, or other debris, and clean if necessary. *This step is essential to proper operation and must be done before installing the end covers,*
2. Slip the split internal thrower onto the shaft, and verify that there is a small gap between the ends.

3. Stretch the extension spring over the top of the internal thrower, and hook the ends together.

4. Slip both items off the shaft together and lay them inside the large groove at the end cover's internal diameter. Later, when the end covers are installed onto the shaft, a flat-head screwdriver may be needed to start the internal thrower on the shaft.

To determine the correct number of shims, see Section 8.3.2, "LEF Bearing Assembly: Additional Shimming Procedure."

5. Special sealing is required for end-cover shims that are used on LEF seal units. After determining the correct number of shims, apply a 1/8" (3 mm) diameter bead of Loctite 518 sealant to the end-cover face (in the corner just above the lip that fits into the housing (Figure 8-7), 360° around), and to each shim.

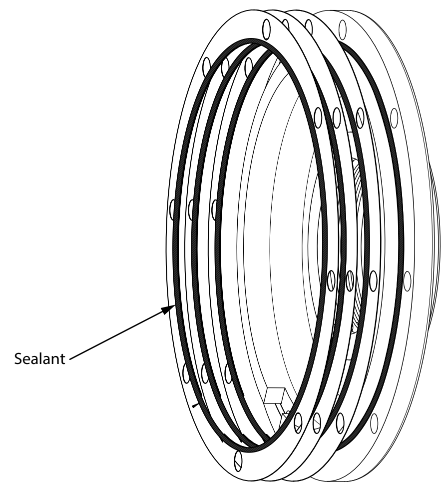


Figure 8-7: Sealant Application, 360° Around

6. Remove any excess sealant from the inside of the cover. Install and torque the end cover bolts immediately. If the sealant begins to cure, it will be necessary to remove it and start over.

7. Before installing the end cover nearest the pump, measure to ensure that a 1/4" to 5/16" (6 mm to 8 mm) clearance between the end cover and bearing races will be obtained after assembly. A 0.020" (0.5 mm) gasket is also used with this end cover.

8. After installing both end covers, use a feeler gauge to measure the gap between the shaft and the inner diameter of each labyrinth seal. A minimum gap of 0.005" (0.13 mm) is required all the way around, or shaft damage may occur. If necessary to maintain the minimum seal gap, shift the end cover within the clearance at the housing bore before tightening.

9. Apply a thin coating of grease to the end-cover faces where the V-ring contact is made.

10. Install the V-rings.

11. Install the throwers so that their outer face is flush with the back of the seal-face flange. This will ensure correct V-ring compression. The split throwers clamp tightly to the shaft when bolted together;, so take care to ensure that the thrower does not cock during tightening, or it will run out against the end cover. The best method is to bolt the halves together directly in position rather than sliding over the shaft after bolting. Gently tapping the thrower at intervals while tightening will also help ensure that it is properly seated.

12. After tightening the throwers, check their radial clearance with the seal flange by running a wire gauge around the gap. There should be a minimum gap of 0.020” (0.5 mm).

13. As a final check, rotate the bearing assembly by hand. Check the alignment of the throwers, and listen or feel for any rubbing.

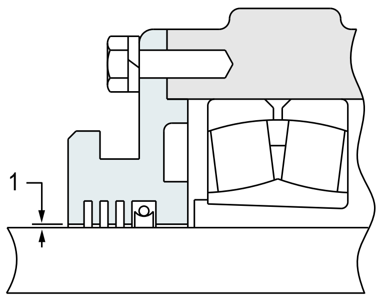


Figure 8-8: Labyrinth Seal Clearance

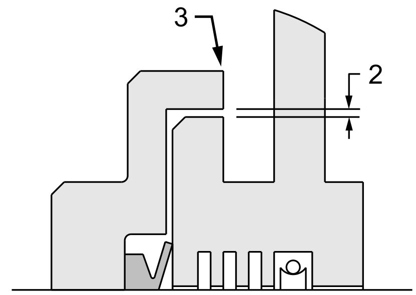


Figure 8-9: Thrower Clearance

Key: 1 = 0.005” min.; **2** = 0.020” wire; **3** = Flush back faces of the thrower and labyrinth flange

8.4 Mounting the Bearing Assembly

	WARNING
⚠	**Risk of equipment damage and personal injury.** Failure to install the bearing-housing hold-down bolts at this time may result in tipping of the bearing assembly and possible personal injury when the impeller is screwed onto the shaft.

To mount the bearing assembly:

1. Mount the bearing-housing adjustment nut with the adjusting screw onto the bottom of the housing. When placing the bearing assembly onto the pedestal, ensure that the slotted tab on the pedestal fits into the slot of the adjusting screw.

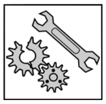
2. Ensure that the pedestal and bearing housing saddles are clean, dry, and free from oil or grease. If corrosion of the saddles is a problem, apply a thin film of preservative. Take special care in the axial adjustment procedure to ensure that no movement occurs.

3. Install the bearing-housing hold-down bolts, but keep them slightly loose until the axial adjustment of the bearing housing is complete.

	NOTE
i	The assembly design locates the bearing assembly in machined ways and uses hex head cap screws to clamp the housing down against the pedestal surface. An adjusting bolt is used to set the impeller nose clearance. This bolt should not be considered part of the locking mechanism.

4. Remove any paint, dirt, rust, or lubricants from both the housing and the pedestal to provide solid metal-to-metal contact. All mating surfaces must be clean and dry.

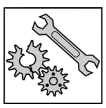
5. Use a heavy hex nut that meets or exceeds the requirements of ASTM A194-2H. When properly torqued, these fasteners will provide the clamping force required to hold the housing in place.



CAUTION

Never replace any fastener with a fastener of another grade. Doing so will risk damage to the equipment.

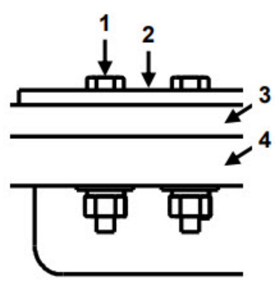
6. Prepare the fastener by cleaning the bolt and nut, checking the threads, and replacing any parts that show signs of damage, wear, or galling.
7. Obtain the correct torque by properly lubricating the threads. Note that various lubricants have different values. GIW/KSB recommends coating the threads with either copper- or nickel-based anti-seize, which will provide thread lubrication for correct clamp load at a lower applied torque and assist in routine fastener removal for future maintenance. If using an alternate lubricant such as heavy oil, adjust the torque values accordingly.



CAUTION

GIW does not recommend using Moly lube, as bolts can easily be over-torqued.

8. Install the bearing-assembly hold-down bolts from the top. While this approach is not ideal for torque, it makes assembly much easier. The flat strap is used to help distribute the bolt forces along the cast bearing housing. Ensure that this junction also has clean metal-to-metal contact. Flat washers and lock washers are used under the nut to distribute load. The nut should be held with a box wrench while the bolt is tightened. As with any high-torque bolted joint, fasteners should be brought up to the required specification in two or three stages.



1	Bolt
2	Strap
3	Bearing Housing
4	Pedestal

Figure 8-10: Bearing Assembly Hold-Down Bolts

9. Verify the size of the bolts, and use Table 8-1 (English) or Table 8-2 (metric) to determine the tightening torque. Bolts should be SAE Grade 8 or Metric Class 10.9.

	NOTE
	Fastener torque must be accurately measured to achieve the proper clamping force. Air impact wrenches rarely deliver the correct torque due to variations in air pressure and tool condition. They can be used to tighten the bolts, but a calibrated torque wrench should be used to obtain the final torque values. GIW/KSB recommends a hydraulic torque wrench for larger fasteners. These tools must be calibrated to ensure accuracy.

Table 8-1: Torque Requirements – Bearing Assembly Clamp Bolts – ENGLISH

Bearing Assembly Clamp Bolts – English Fasteners (Grade 8)				
Size	Anti-Seize		Lubricated/Oiled	
	ft-lbs	N-m	ft-lbs	N-m
3/4”	225	305	280	380
1”	550	750	680	920
1⅛”	800	1,085	960	1,300
1¼”	1,150	1,560	1,360	1,840
1½”	1,900	2,575	2,660	3,600
1¾”	3,000	4,060	4,600	6,200
2”	4,500	6,100	6,500	8,800

Table 8-2: Torque Requirements – Bearing Assembly Clamp Bolts – METRIC

Bearing Assembly Clamp Bolts – Metric Fasteners (Class 10.9)				
Size	Anti-Seize		Lubricated/Oiled	
	ft-lbs	N-m	ft-lbs	N-m
M20	275	375	300	400
M24	450	610	500	700
M27	650	880	800	1,075
M30	915	1,250	1,175	1,600
M36	1,630	2,200	2,250	3,025
M42	2,590	3,500	3,700	5,025
M48	3,800	5,150	5,575	7,550
M52	4,740	6,425	7,040	9,450

9 Shaft Seal

GIW/KSB pumps typically use a stuffing box for the shaft seal, though a mechanical seal can be used (upon customer request) on some smaller, lighter-duty pumps. (See Section 9.2, “Mechanical Seal.”)

9.1 Stuffing Box

GIW offers four interchangeable stuffing box designs. In general more flush water will result in less wear on the packing and sleeve. The best design for a pump depends on the severity of the service, the quality of the seal water, and the relative importance of seal life in reference to water-supply costs.

- **Throat Bushing**: (Figure 9-1; **1** is the packing, and **2** is the throat bushing.) Standard for GIW/KSB’s LSA–style pumps (including MDX), this design produces a throttling effect that restricts seal water flow in the pump while maintaining pressure and flow at the packing rings. This design reduces the amount of water that enters the process flow while providing an easy-to-maintain stuffing box assembly.

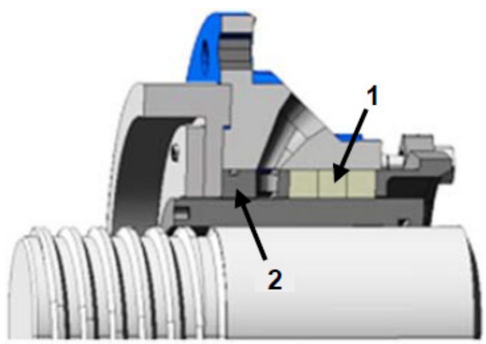


Figure 9-1: Throat Bushing Design

- **SpiralTrac™ Option:** (Figure 9-2.) With SpiralTrac™ technology, available with the throat bushing design, flow rates can be reduced by more than 50% (compared to throat bushing without SpiralTrac™) while still maintaining acceptable packing life and shaft sleeve wear.

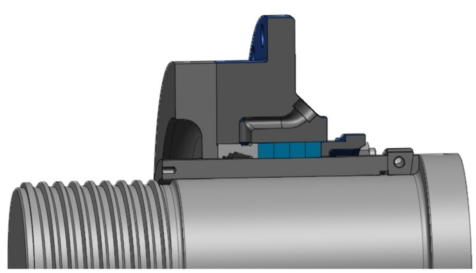


Figure 9-2: Throat Bushing with SpiralTrac™

- **KE:** (Figure 9-3; **1** is the packing and **3** is the lantern ring.) The KE design is used where minimum water usage is desired. One or two rings of packing are located between the lantern ring and the wear plate to restrict seal water flow into the pump cavity, while the packing rings behind the lantern ring seal to the atmosphere. Because this design is the most sensitive design to variable operating conditions and abrasive wear, it requires more careful maintenance.

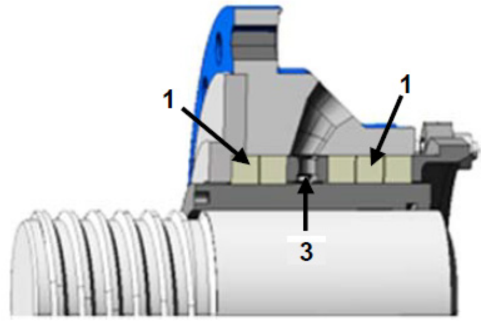


Figure 9-3: KE Design

- **Forward Flush:** (Figure 9-4; **1** is the packing and **3** is the lantern ring.) This design has historically been used where gland water supply is plentiful and the addition of water to the process flow is not problematic; however, note that GIW/KSB is phasing out this design due to global water conservation initiatives. This stuffing box is no longer available on GIW/KSB's standard pumps.

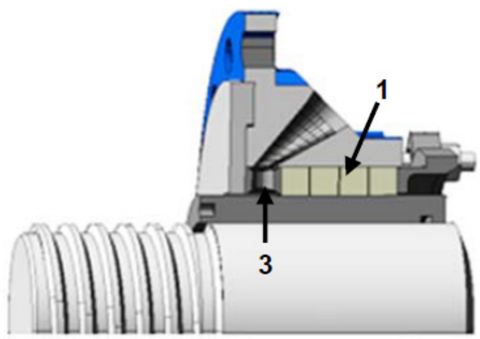


Figure 9-4: Forward Flush Design

9.1.1 Stuffing Box Packing

CAUTION

Use proper maintenance procedures for a longer packing life. Such procedures are essential to avoid premature failure, wear, and corrosion to nearby parts; contamination to the mechanical end; and unnecessary downtime.

Stuffing box packing (the sealing element in most stuffing box assemblies) experiences considerable friction and has a limited lifespan. Packing must be replaced periodically.

Although the packing may have an expiration date listed, the packing should be changed based on a visual inspection rather than on age or amount of time used. Be aware that the replacement packing type must be compatible with your pumping application. Factors to consider include pressure, temperature, pH, solids content, and seal water quality.

Refer to your BOM for the packing type supplied with your pump, or contact your GIW/KSB representative or packing supplier if a change in packing type is needed.

For more on packing types offered, see the technical article, "Stuffing Box Design."

9.1.2 Stuffing Box Assembly

To assemble the stuffing box:

1. Mount the stuffing box so that the seal water tap is on or near the horizontal centerline. This will position the gland studs at nine o’clock and three o’clock for easy access.
2. Provide clearance between the stuffing-box rabbet fit and the pedestal to allow centering of the stuffing box to the shaft sleeve.
3. Center the stuffing-box assembly between the shaft sleeve and the packing. Center to within 0.25 mm (.010") at all locations.

CAUTION

Failure to center the stuffing box may greatly reduce service life for the packing and shaft sleeve.

4. Fully tighten the stuffing-box flange bolts.
5. Fasten the stuffing-box wear plate into place with a gasket.

9.1.3 Stuffing Box Maintenance

The stuffing box has NPT tapped holes, located 180° apart, for sealing water, Either tap can be used, but normal practice is to pipe sealing water to both taps.

Use these guidelines to ensure that the stuffing box remains in good working condition:

- **Keep the stuffing box free of abrasive particles.** To do so, adjust the seal water pressure and gland (452) tightness to maintain a small flow of cool or lukewarm leakage out of the stuffing box. If the leakage becomes hot, loosen the gland to allow greater flow. If the leakage is cloudy, increase the water pressure.
- **Keep the gland flush supply clean and neutral.** Use suitable, non-aggressive clean water that is not liable to form deposits and does not contain suspended solids. Hardness should average 5, pH should be neutral, and water should be conditioned to prevent mechanical corrosion.
- **Assess inlet and outlet temperatures.** An inlet temperature of 10°C – 30°C (50°F – 85°F) should produce a maximum outlet temperature of 45°C (115°F) when the gland is properly adjusted.
- **Adjust seal-water pressure as needed.** The needed pressure varies with operating pressure, slurry properties, and the packing condition, but there should be a supply pressure of 10 psi (0.7 bar) over the pump’s stuffing box pressure. In most cases, you can adjust the supply pressure with the manual valve and gauge near the stuffing box.

NOTE

If stuffing box pressure cannot be measured, alternatively use the discharge pressure. As with stuffing box pressure, there should be a supply pressure of 10psi (0.7 bar) over the discharge pressure.

9.1.3.1 Flow Control Option

NOTE

The KE stuffing box is a low-flow design and must be pressure-controlled. Flow control can result in burning or jamming the packing. Actual flow in a properly maintained and adjusted stuffing box is considerably lower than shown in Table 9-1.

The throat bushing, throat bushing with SpiralTrac®, and forward flush designs are generally pressure-controlled, but flow control is an option. Seal water requirements listed in Table 9-1 show potential flow with worn packing.

Flow control may be achieved in different ways.

- A positive-displacement pump that delivers the correct volume can be used with a safety or "pop-off" valve so the purge pressure can never exceed 10 psi (0.7 bar) above the maximum working pressure of the pump.
- Where water supply is adequate, install a flow meter and regulating valves in the line. Should the pump pressure exceed supply pressure, a back-flow preventer will help prevent reverse flow. All components must have adequate pressure ratings. Verify that components will work with the volume, pressure, and water quality supplied to the stuffing box.

For best performance, adjust each pump for minimum water consumption while still providing an adequate drip rate. As water volume is reduced, loosen the gland slightly to maintain the proper drip rate to ensure adequate flush while limiting water use. The temperature of the water exiting the stuffing box can be a better indicator than "drip rate" or volume. It should be at a temperature that would be comfortable for hand washing, indicating that the packing is not overheated. The gland to the stuffing-box housing fasteners should only be hand-tightened.

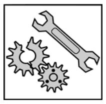
9.1.3.2 Maximum Seal Water Requirements

For hot, high-pressure, or otherwise severe service conditions, an optional combination of lantern ring/throat bushing is recommended in place of the standard lantern ring and first ring of packing.

Table 9-1: Stuffing Box Maximum Seal Water Requirements

Shaft Size	Stuffing Box Type							
	Throat Bushing		KE Design		Forward Flush		SpiralTrac™	
	L/sec	gpm	L/sec	gpm	L/sec	gpm	L/sec	gpm
3-15/16	0.63	10	0.25	4	1.26	20	0.32	5
4-7/16	0.82	13	0.32	5	1.58	25	0.41	6.5
5-7/16	0.95	15	0.38	6	1.89	30	0.48	7.5
6-7/16	1.70	27	0.69	11	3.47	55	0.85	13.5
7-3/16	1.77	28	0.69	11	3.47	55	0.89	14
9	2.71	43	1.07	17	5.36	85	1.36	21.5
10-1/4	3.47	55	1.39	22	6.94	110	1.74	27.5
11-1/2	4.73	75	1.89	30	9.46	150	2.37	37.5

9.2 Mechanical Seal

	**CAUTION**
	Before start-up, see the mechanical seal operating manual for all required safety checks. Safety checks include removing seal assembly fixtures, checking axial alignment, and checking torques.

Mechanical seals are precision devices that require special care for their proper operation. Consult the seal's instruction manual for special storage, start-up, and maintenance requirements, and any further information.

For guidance on general maintenance and troubleshooting, contact the mechanical-seal vendor.

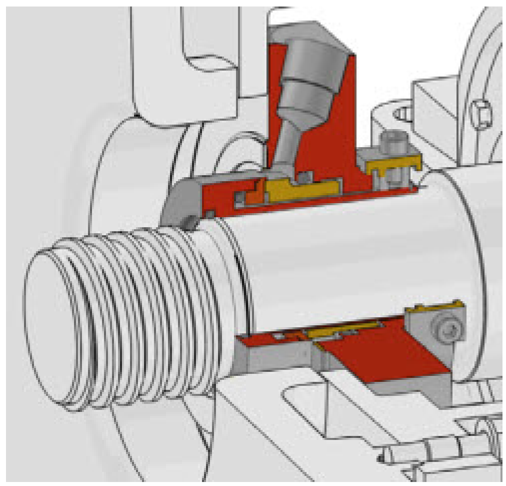


Figure 9-5: Mechanical Seal Cross-Section

9.2.1 Mechanical Seal Assembly and Disassembly

Review the mechanical seal arrangement and determine the layout of the mechanical seal assembly. Some mechanical seals have an adapter that must be placed on the shaft before the hub plate and/or casing is installed. Other mechanical seals can be installed after the casing is installed.

Always refer to the mechanical seal's maintenance manual for assembly and disassembly procedures.

10 Wet End

10.1 Wet End Overview

Listed below is general information about the major parts of the MDX pump. Refer to the location numbers on the pump assembly drawings and BOMs for part numbers, descriptions, quantities, and materials.

- **Pump Casing:** The pump casing is cast as a single piece and is made of a high-chrome white iron for hardness, abrasion, and corrosion resistance. Custom materials are available for highly corrosive applications.
- **Impeller Form:** All standard impellers are double-shrouded five-vane designs.

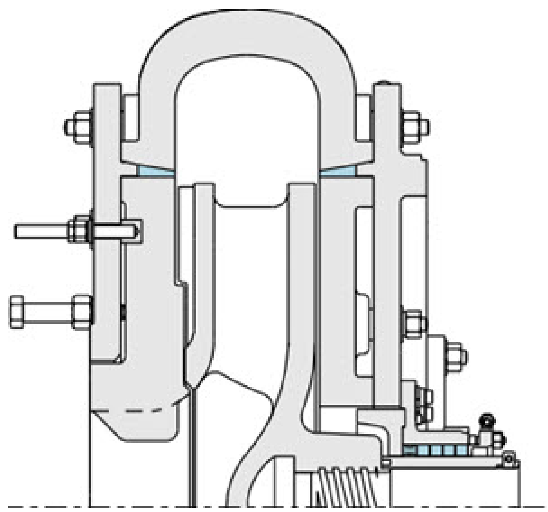


Figure 10-1: MDX Standard Wet End Construction

10.2 Wet End Disassembly

	CAUTION
	Follow all safety guidelines. Before working on the pump, consult Section 2.8, “Assembly and Disassembly Safety,” and ensure that all relevant safety guidelines are followed.

10.2.1 Removing the Adjustable Suction Liner

To remove the adjustable suction liner:

1. Loosen the adjustment bolts (see Figure 10-2) to back off from the suction liner. Unscrew them far enough to ensure that the suction liner can be retracted fully.
2. Pull the suction liner toward the suction plate using the crosswise torque technique, tightening the nuts on the adjustment studs no more than 0.2 inches (5 mm) at a time.

3. Repeat the crosswise torque pattern until the suction liner is flush with the suction plate, if possible.

	NOTE
	If the suction liner does not fully retract, it may be due to the build-up of solids behind the liner and the shifting of the snap-ring gasket. In this case, retract the suction liner as far as possible using nuts on the adjustment studs until the liner is well seated.

4. Tighten the nuts onto the fully threaded studs to contact the suction liner and prevent any axial shifting of the suction liner during disassembly.
5. Remove the suction plate assembly from the casing per standard procedure.

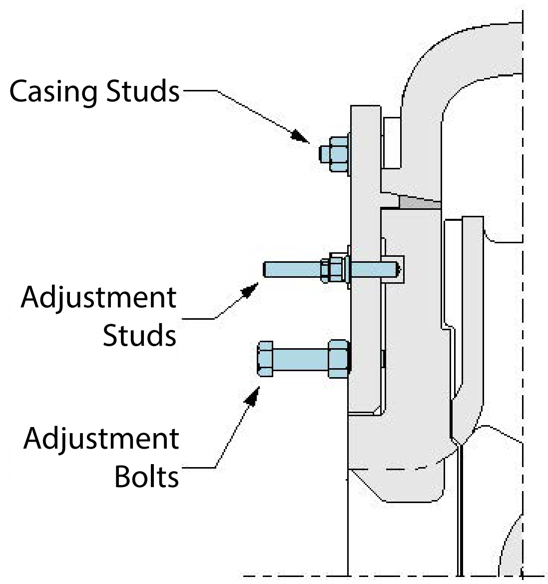


Figure 10-2: Adjustable Suction Liner

6. Remove the suction plate assembly from the casing per standard procedure.

	DANGER OF EXPLOSION!
	Risk of explosion. Do not apply heat to the impeller hub or nose due to the sealed cavity at the impeller nose.

10.2.2 Removing the Impeller—Release Ring Assemblies

	WARNING
	Energy can be released when a tightened impeller is disassembled. Break-loose devices, lifting devices, and impeller release rings can spring suddenly and injure nearby personnel.

Push-off holes are drilled and tapped in the segmented ring so bolts can be used to push the ring segment away from the shaft to remove the segment. The impeller release rings also come with nylon set screws in push-off bolt locations to protect the threads.

To remove the release ring:

1. Loosen and remove the three-socket head-cap screws that hold the three segmented pieces together (the parting-line cap screws).
2. Check to see that the threaded holes are clean. If necessary, use a tap to clean out the threads.
3. Install the push-off bolts into the clean threads (Figure 10-3), and turn the first push-off bolt with a wrench, 1/8 turn.

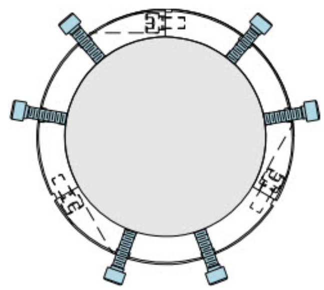


Figure 10-3: Push-Off Bolts

4. Continue with the next push-off bolt in the adjacent segment, proceeding around the shaft multiple times until the segments fall out.

	WARNING
⚠	**Risk of injury from segments becoming projectiles.** Never leave push-off bolts in the release ring segments during pump operation, as they could work loose and become projectiles that cause equipment damage or personal injury. If the bolts are turned in too far in their respective segment, the ring may not fit properly against the shaft.

10.2.3 Removing the Impeller—Release Ring Tool

	WARNING
⚠	**Risk of injury from release ring tool or other devices.** Energy can be released during disassembly of the tightened impeller. Break-loose devices, lifting devices, and impeller release rings could spring suddenly and injure nearby personnel.

To order an IRR tool (GIW/KSB part #2009B), contact your GIW/KSB representative.

An optional impeller release ring (IRR) tool is effective for large, highly loaded pumps in corrosive environments. Use Figure 10-4 as a reference when reading the following procedure.

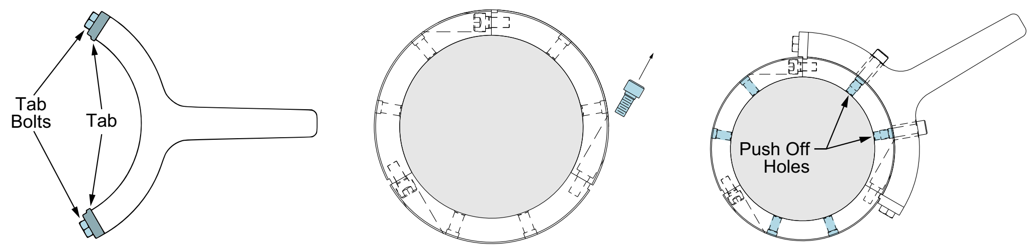


Figure 10-4: Impeller Release Ring with Optional Tool

To remove an impeller using the IRR tool:

1. Remove the stuffing box gland (if clearance is required for the IRR tool).
2. Remove one IRR parting-line socket head cap screw (SHCS).
3. Loosen the tool tab bolts just enough that the tab can move a little.
4. Lay the tool on top of the IRR segment in which the IRR parting-line SHCS was removed.
5. Position the tool such that the tool tabs fit into the grooves at each end of the IRR segment. Verify that the slots in the tool align with the push-off holes in the IRR. (Note that the tool only fits in one direction).
6. Screw the two SHCSs that come with the tool into the push-off holes, finger-tight.
7. Tighten the tab bolts with a wrench while pushing the tabs into the IRR grooves.
8. Tighten the SHCSs that hold the tool to the IRR.
9. Screw four lifting eyes (finger-tight) into the push-off holes in the remaining IRR segments until they bottom against the shaft.
10. Screw a lifting eye in the tool. Note that some tools already have an eye welded to the tool, so this step may not be required.
11. Thread one chain through the four lifting eyes and around the shaft. Remove the slack in the chain, and connect the ends of the chain with a carabiner.
12. Thread a second chain through the tool lifting eye and around the shaft.

	NOTE
	The chains are required as a safety precaution and must be used to prevent injury.

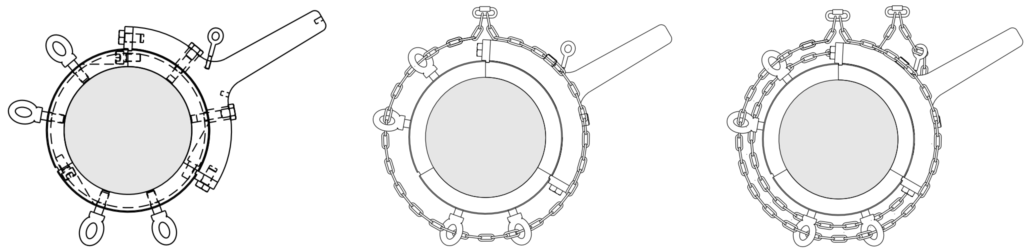


Figure 10-5: Using Chains with the IRR

13. Remove the slack in the chain and connect the ends of the chain with a carabiner.
14. Remove the remaining two IRR parting-line SHCSs. Note that you may need to move the nearby lifting eye first.
15. Hit the tool with a sledgehammer until the IRR segment breaks free. After each hammer blow, re-tighten any loose fasteners, and verify that the tabs fit snugly into the IRR groove.

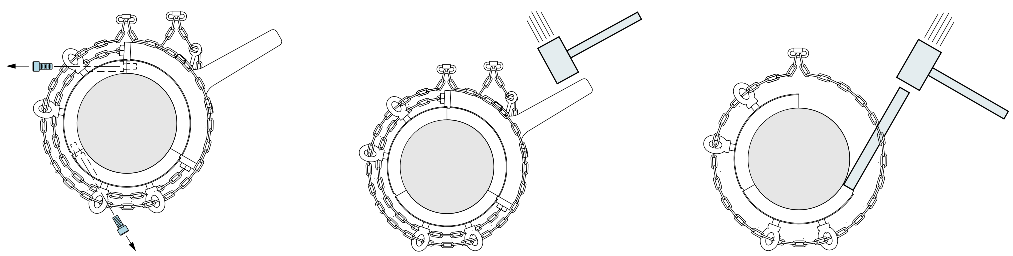


Figure 10-6: Breaking IRR Segments Loose with a Hammer

If all three IRR segments break loose, the removal job is complete.

If they do not all break loose:

1. Remove the tool, the loose IRR segment, and the chain.
2. While the other two IRR segments are still chained to the shaft, seat a solid-steel bar on the parting-line face of either of the two remaining segments.
3. Tap with a hammer until the remaining segments break free.

10.2.4 Removing the Impeller—Break-Loose Device

	WARNING
⚠	**Risk of injury from break-loose device or other tools.** Energy can be released during disassembly of the tightened impeller. Break-loose devices, lifting devices, and impeller release rings could spring suddenly and injure nearby personnel.

To remove the impeller using a break-loose device:

1. Rotate the impeller until the tip of one blade faces the pump discharge.

2. Insert the break-loose device through the eye of the impeller, and attach it to the trailing edge of the blade facing discharge.

1	Impeller
2	Break-Loose Device

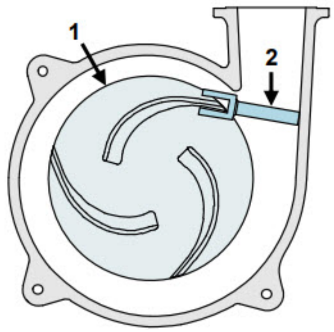


Figure 10-7: Impeller Break-Loose Device

3. Rotate the shaft in the direction opposite to normal, using the pump pulley or a spanner wrench.
4. For ease of impeller removal, heavily coat the shaft threads with anti-seize compound during re-assembly. Two aramid paper gaskets should be used between the shaft sleeve and the impeller.

10.2.5 Removing the Impeller—Lifting Device

WARNING

Do not remove, lift, move, or reinstall an impeller without properly using a recommended impeller-lifting device.

CAUTION

Risk of damage to lifting device when used for anything other than lifting. Never use the lifting device as a break-loose device. Even if it is just installed into the impeller while the impeller is rotated to break it loose from the shaft, there is a possibility of damaging the lifting device, rendering it unusable. **Only use the lifting device for lifting.**

See operational drawings and lifting device manual for more details regarding this procedure.

To use a lifting device to remove (or install) an impeller:

1. Grasp the impeller at the suction eye. The impeller can be leveled by turning the adjusting bolt that bears against the impeller nose. (Note that this step is especially useful when re-installing the impeller).
2. Ensure that the lifting line is tight prior to thread disengagement.

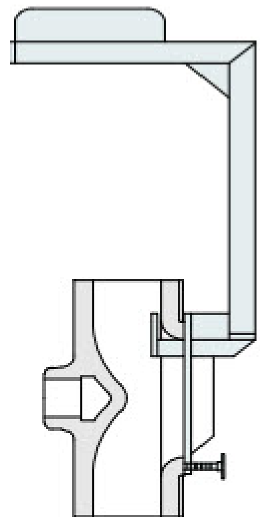


Figure 10-8: Impeller Lifting Device

10.2.6 Removing the Casing

For greater safety and control of the component, GIW/KSB procedure requires using at least two lifting points for the casing. Where applicable, GIW/KSB pump casings are supplied with cast lifting eyes for this purpose. Note that if the chain hook does not fit the lifting eye, an appropriate clevis should be installed. Another acceptable lifting point is a chain secured around the discharge neck below the flange. (Take care not to damage the casing flange ears.)

10.3 Wet End Assembly

WARNING

The stuffing box assembly *must* be completed before starting the wet end assembly.

There are many safety risks involved in assembling the wet end of a pump. See Section 2.9, “Assembly & Disassembly Safety,” before working on the pump.

10.3.1 Mounting the Shaft Sleeve

The process for pumps with an impeller release ring differs from the process for pumps without one. See individual subsections below for details.

10.3.1.1 Pumps with Impeller Release Ring

CAUTION

The anti-seize *must not* contact the faces of the release ring, shaft sleeve, impeller-contacting face, or shaft shoulder. Lubrication at any these faces could result in overloading and breakage of the shaft.

NOTE

Replace the taper ring and the segmented release ring if either show signs of damage. To ensure quality of materials, obtain replacement parts from GIW/KSB. Mechanical properties of release ring bolts are as follows:

- **Material Specification**: ASTM A286 (FF-S-86E)/AISI Type 660
- **Yield Strength**: 120,000 psi (830 Mpa)
- **Tensile Strength**: 160,000 psi (1,100 Mpa)
- **Elongation**: 12% minimum in a 2” (50 mm) specimen for all diameters
- **Reduction in Area**: 45% minimum for all diameters

Use of alternative materials, including standard black or coated socket head cap screws is not recommended due to the possibility of corrosion and/or stress-corrosion cracking, which could lead to sudden failure of the release ring in service.

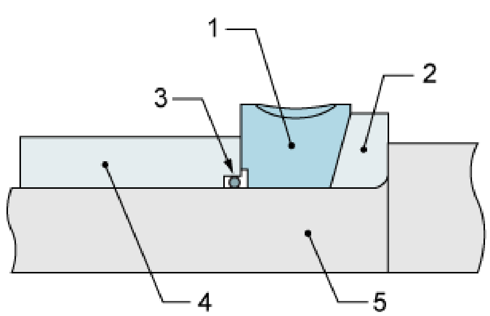
To mount the shaft sleeve for a pump with an impeller-release ring:

1. Carefully inspect the segmented release-ring fasteners for damage or cracking, and replace if not in good condition.
2. Clean the shaft with industrial degreaser.
3. Slide the taper ring into place by mating its radius to the radius of the shaft. The tapered side of the taper ring should face the shaft plug.
4. Slide the release ring onto the shaft, making sure that the tapered surface on the release ring mates against the tapered surface on the tapered ring to provide complete surface contact of the taper ring on the side facing the release ring.
5. Place the O-ring on the shaft.

NOTE

The angles on the release ring and taper ring must match. Always replace the release ring and the taper ring in pairs to ensure a correct fit.

6. Apply a light coat of anti-seize inside the shaft sleeve as needed.
7. Push the shaft sleeve into position. This action will completely force the O-ring into the sleeve recess.



1 = Impeller release ring
2 = Taper ring
3 = O-ring
4 = Shaft sleeve
5 = Shaft

Figure 10-9: Impeller Release Ring Components

NOTES

When installing the shaft sleeve, stop when the release-ring face and the shaft-sleeve face are approximately 25 mm (1 inch) apart. Inspect the faces to ensure they are still clean and free from grease. If grease is present, clean the faces before sliding the sleeve into place.

Fasteners must be installed with Loctite Threadlocker 242. Use a new, untorqued fastener each time a new release ring is installed. See Table 10-1 for applicable torques.

Table 10-1: English and Metric Fasteners

	Bolt Size	Stress Area	Torque with Loctite 242 on Fastener	Hex Key Size
ENGLISH	3/8”-16NC	0.078 inch²	40 ft-lbs	5/16 inch
	1/2”-13NC	0.142 inch²	105 ft-lbs	3/8 inch
	5/8”-11NC	0.226 inch²	210 ft-lbs	1/2 inch
	3/4”-10NC	0.334 inch²	375 ft-lbs	5/8 inch
	1"- 8NC	0.606 inch²	910 ft-lbs	3/4 inch
METRIC	M10 x 1.50	58 mm²	70 N-m	8 mm
	M12 x 1.75	84 mm²	125 N-m	10 mm
	M16 x 2.00	157 mm²	310 N-m	14 mm
	M20 x 2.50	245 mm²	605 N-m	17 mm
	M24 x 3.00	353 mm²	1,000 N-m	19 mm

10.3.1.2 Pumps without Impeller Release Ring

To mount the shaft sleeve for a pump without an impeller-release ring, be aware of the following guidelines:

- A light coat of lubricant can be applied inside the shaft sleeve. Apply just enough lubricant to be able to slide the sleeve on. If force is needed, lightly tap the shaft sleeve with a block and hammer. Do not over-lubricate.
- Lubricant must *not* come into contact with any of the shaft sleeve’s axial faces, including the impeller-contacting face and the face in contact with the shaft shoulder.
- When installing the shaft sleeve, stop when the sleeve face and shaft face are approximately 1 inch (25 mm) apart. Inspect the faces to ensure they are still clean and free from grease. If grease is present, clean the faces before sliding the sleeve into place.
- In many cases, an O-ring must be placed on the shaft first. As the shaft sleeve is pushed into position, this O-ring should be completely forced into the shaft sleeve recess.

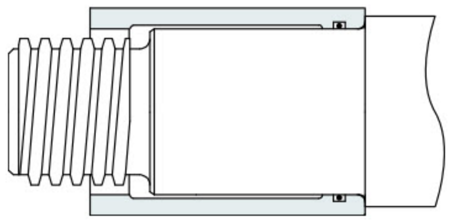


Figure 10-10: Conventional Type Shaft Sleeve Arrangement

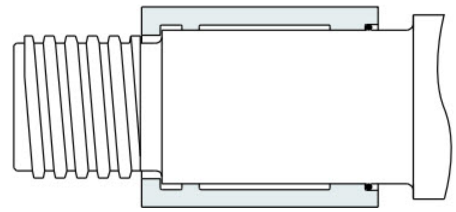


Figure 10-11: Hook Type Shaft Sleeve Arrangement

10.3.2 Hub Plate (With Liner)

To assemble the hub subassembly:

1. Inspect and clean the sealing areas on both the hub liner and the casing. Smooth any burred or rough surfaces manually.
2. Place the hub liner with the wear side down.
3. Insert the fasteners that hold the hub liner to the hub plate into the hub liner.
4. Lift the hub plate and install it onto the hub liner.
5. Tighten using a crosswise torque bolting pattern.
6. Install the studs that hold the hub plate to the pedestal into the hub plate.
7. Mount to the pedestal using a crosswise-torque bolting pattern.
8. Apply lubricant or mild liquid soap to the snap-ring gasket to prevent friction during assembly, and place the O-ring or snap-ring gasket around the hub liner.

CAUTION

Avoid leakage and damage to equipment. The snap-ring gasket must be installed with the tapered end facing the wear side of the liner. Ensure that the Teflon lining is in contact with the hub liner.

10.3.3 Hub Plate (Without Liner)

To mount the hub plate:

1. Place the hub plate with the threaded holes facing up.
2. Install the studs that hold the hub plate to the pedestal into the hub plate.
3. Mount to the pedestal using a crosswise torque bolting pattern.

10.3.4 Mounting the Casing

NOTE

With an open-back construction, it may be more convenient to mount the impeller before mounting the casing. See Section 10.3.5, “Installing the Impeller.”

To mount the casing:

1. Alignment of the pump casing with the mechanical end is obtained through a rabbet fit machined into the hub plate. For the best wear and efficiency performance, the casing must be fully seated in this fit.
2. Before installing, ensure that the proper gasket is fitted between the casing and the pedestal.
3. Thread the studs that hold the casing to the pedestal or hub plate, and mount using a crosswise torque bolting pattern.

10.3.5 Installing the Impeller

To install the impeller:

1. Begin by coating the shaft threads heavily with anti-seize compound.

CAUTION

Coat only the shaft threads. Do not coat the shaft- sleeve faces that contact the impeller and the step in the shaft.

2. Place two gaskets (400.10) between the shaft sleeve and the impeller hub face. These gaskets will prevent galling and ensure ease of impeller removal. Stagger the gaskets so they are not in alignment (Figure 10-12). Install them dry, without grease.

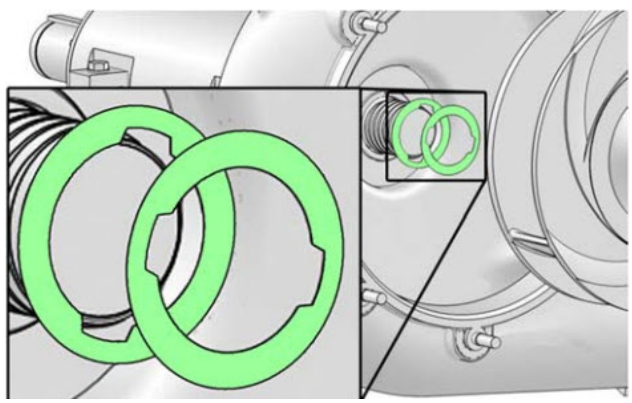


Figure 10-12: Staggered Impeller Gasket Installation

3. Move the shaft/bearing housing completely forward.
4. Ensure that the hub face of the impeller is free from nicks and burrs, and that the impeller threads are clean.
5. Thread the impeller by holding it stationary while turning the shaft.

NOTE

The impeller should be lifted in a secure way so that it cannot shift. Impeller lifting devices are available to assist in this operation.

	WARNING
⚠	**Use of chains can cause risk to equipment and personnel.** Never use chains to lift the impeller. Not only can they cause the vane tips or shrouds to chip, but an improperly mounted impeller can fall and cause equipment damage, injury, or loss of life.

6. When assembly of the pump is complete, check the impeller-to-suction-liner clearance and adjust if necessary. (See Section 10.4, “Setting the Nose Gap.”)

10.3.5.1 Open-Hub Casings

For open-hub casings:

- Lift the impeller in a secure way so it cannot shift.
- Do not hook chains on the vane tips or shrouds, as they could cause the tips of the impeller to chip.
- Secure the impeller so that it cannot turn.
- Turn the shaft to thread the impeller.

10.3.5.2 Closed-Hub Casings

For closed-hub casings:

- Before installing the impeller, run the bearing housing completely forward.
- Install the lifting device into the impeller. The impeller must hang level.
- Turn the shaft to thread the impeller.

10.3.6 Mounting the Suction Plate/Liner

Refer to the pump assembly drawing for details of your specific application. Suction plate/liner assembly instructions are for general assembly procedures. Read all instructions before beginning assembly.

To mount the suction plate/liner:

1. Lay liner 13-19 on a flat, level surface. Use shims to level if necessary.
2. Apply Loctite Threadlocker to the stud threads that will be installed into the liner.
3. Install the studs (902.02) into the liner (Figure 10-13), and apply light oil or anti-seize to the exposed end of the stud.

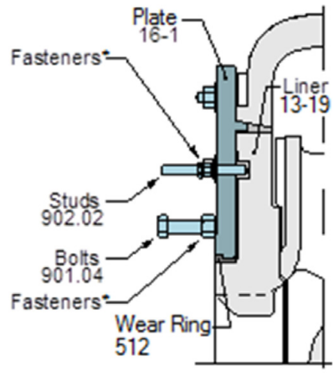


Figure 10-13: Installing Studs into the Liner

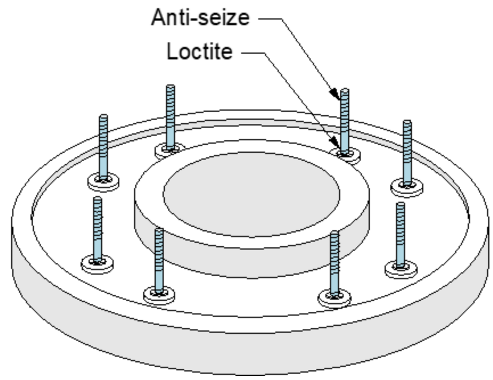


Figure 10-14: Applying Loctite Threadlocker and Anti-seize

*All or some may be present. See pump drawing for actual configuration and location suffixes.

4. Lay plate 16-1 onto the liner, ensuring that the rabbet fit is aligned. Install the wear ring (512), if present, with the O-rings (412.01/02) and supporting hardware (914.06 and 550.06), ensuring that the wear ring is fully seated and flush with the suction plate sealing surface (Figure 10-15). Install and then tighten the washers, gaskets, and nuts (550.02, 920.02, 920.03/05 in Figures 10-15 and 10-16; 400.02, 50-7.02, 543.02 in Figure 10-16 only) to the studs using a crosswise torque technique.

Figure 10-15: Representative Fastener Orientation (With Wear Ring)

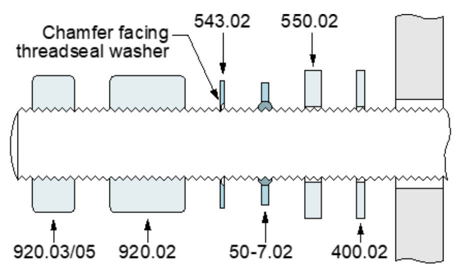
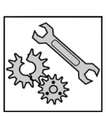


Figure 10-16: Representative Fastener Orientation (Without Wear Ring)

5. To secure the liner and eliminate leakage around the washers, torque all nuts and jam nuts (if included) to 100–300 ft-lbs (135–405 N-m) on the adjustment studs (920.02 and 920.03/05).



CAUTION

Do not over-tighten! Excessive torque may damage the sealing gasket (400.02).

6. Ensure that suction-plate sealing and gasket surfaces are clean and free of dirt and grease. If necessary, clean the areas around the fasteners, the suction-flange face, and the liner face using a wire brush and/or solvent.

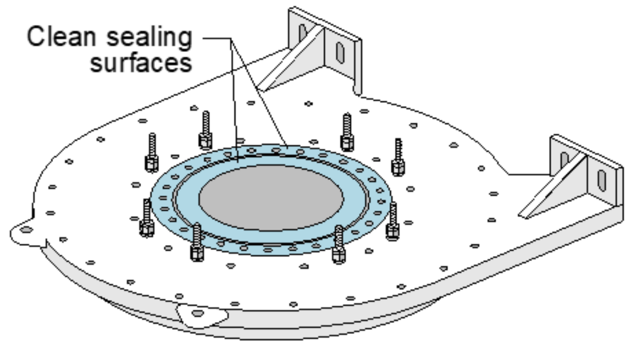


Figure 10-17: Sealing Surfaces

7. Coat the adjustment bolt threads with light oil or anti-seize.
8. Install the adjustment bolts (901.04) with nuts and washers (50-7.04*, 543.04*, and 920.04) into the corresponding taps (Figure 10-18).

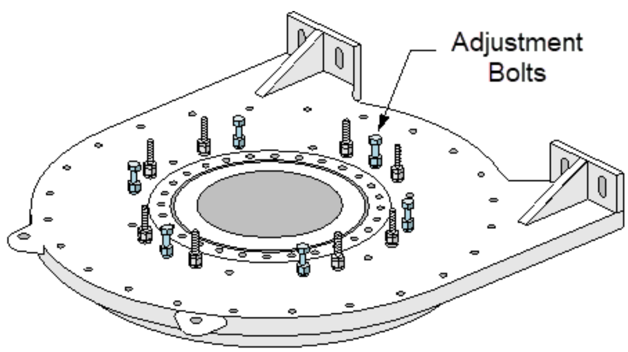


Figure 10-18: Adjustment Bolts

9. Tighten the adjustment bolts until snug, and then tighten the nuts (920.04) to 100–300 ft-lbs (135–405 N-m) to eliminate leakage around the washers.

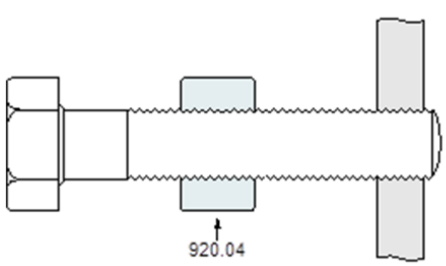


Figure 10-19: Representative Fastener Orientation (With Wear Ring)

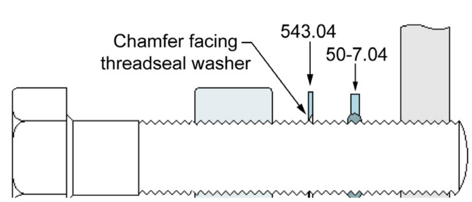


Figure 10-20: Representative Fastener Orientation (Without Wear Ring)

10. To simplify the liner adjustment, mark the head of the adjustment bolts at the 12 o'clock position with the adjustment bolts tight (Figure 10-21). Mark the plate at the 2 o'clock and 6 o'clock positions, or at the desired adjustment interval. For adjustment procedure, see Section 10.3.9, "Adjusting the Suction Liner: Procedure."
11. If applicable, install plugs (hex-head cap screw and Stat-O-Seal washer at locations 901.05/50-7.05, or NPT pipe plugs at location 903.07/08) into the remaining taps. Note that not all kits require plugs; see BOM for plug details.

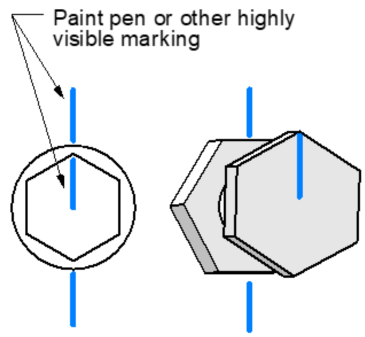


Figure 10-21: 12 o'clock Position – Head of Adjustment Bolts

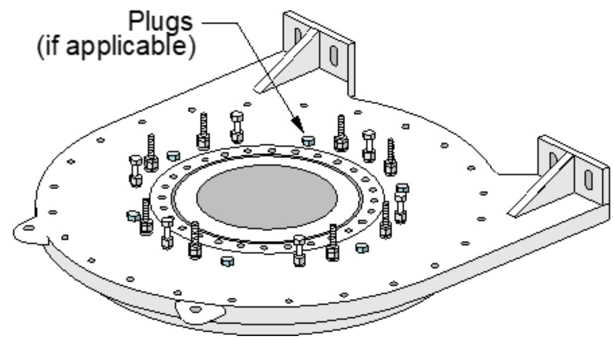


Figure 10-22: Example Plug Location

12. Apply a general-purpose, lithium-based grease to the liner surface to be in contact with the gasket.
13. Install a snap-ring gasket (40-2 or 40-2.01) over the liner (13-19).
14. Install the gasket over the greased surface of the liner (13-19).
15. Install the suction-plate assembly onto the pump casing per standard procedure.
16. If present, install gaskets 400.06 (not used with wear ring). The purpose of these gaskets is to protect the suction plate after the liner is adjusted. Take the actions below to install the gaskets. (If using a wear ring, skip the following steps.)
    - Apply a coating of RTV (room-temperature vulcanizing) silicone sealant to one side of each gasket, and then to the suction-plate flange face, suction-liner face, and pipe-flange face.
    - Attach the coated side of the 400.02 gaskets to the suction pipe and suction flange. DO NOT apply RTV sealant to the surface between the two 400.06 gaskets.
    - Install the suction piping. Allow the RTV sealant to fully cure before adjusting the liner.

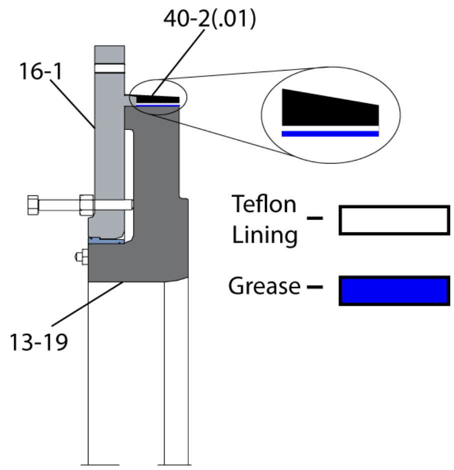


Figure 10-23: Snap-Ring Gasket Installed Over Liner

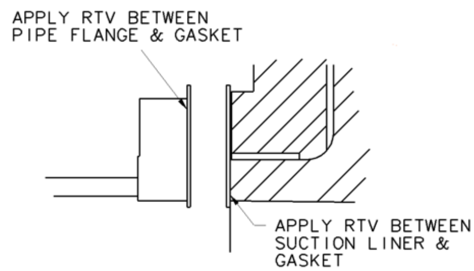


Figure 10-24: RTV Coating Application

After mounting, the suction liner should protrude approximately 1/32” to 3/32” (0.8 to 2.4 mm) from the suction plate at the suction flange connection. This protrusion is normal and provides the sealing surface for the suction piping. Pumps with a wear ring will not feature any liner protrusion. It is important that excessive force is not placed on the liner by using a raised-face flange or a gasket that covers the liner protrusion only. In general, we recommend using a full-face flange and a full-face gasket to connect the suction piping.

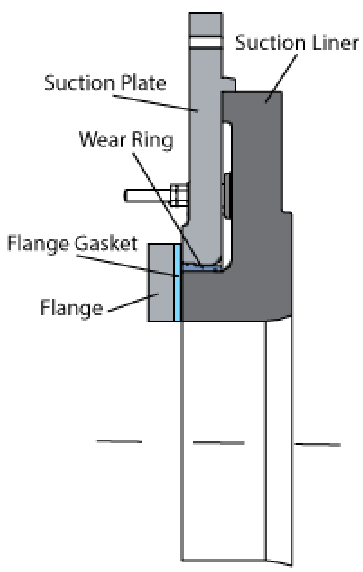


Figure 10-25: Correct Placement of Gasket

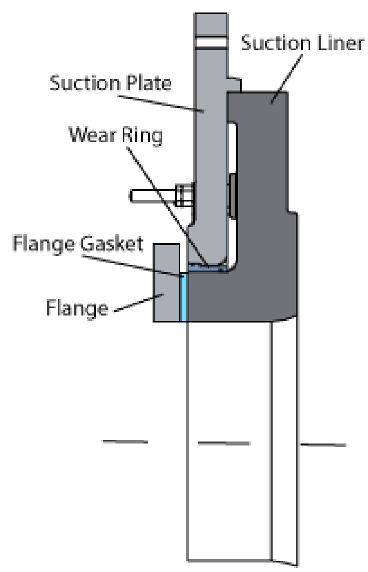


Figure 10-26: Incorrect Placement of Gasket

10.3.7 Installing the Snap-Ring Gasket

Guidelines for installing snap-ring gaskets are as follows:

- Always check to ensure that there is a gap behind the back vertical surface of the gasket. If this is not the case, remove the gasket and turn it inside out. The back vertical surface of the gasket should taper forward 10° to form this gap.

- The pump casing side opening is tapered at 10°. As you tighten the nuts, tighten the opposite nuts in an alternating pattern to maintain alignment as parts are pulled into place. Visual accuracy of alignment is sufficient.
- For longer life, rotate the suction liner 180° at approximately half-life. It is best to replace the snap-ring gasket at this point, or when parts are changed. This replacement will ensure better parts life, as a partially worn snap-ring gasket will not adequately protect the adjoining metal parts.

If a snap-ring gasket is not badly worn, you may be able to continue using it by placing something behind its back vertical surface so that after installation, the gasket protrudes into the casing. The protruding gasket should wear off, leaving a smooth joint. If the snap-ring gasket does not protrude, the resulting gap between metal parts will cause turbulence and result in accelerated wear.

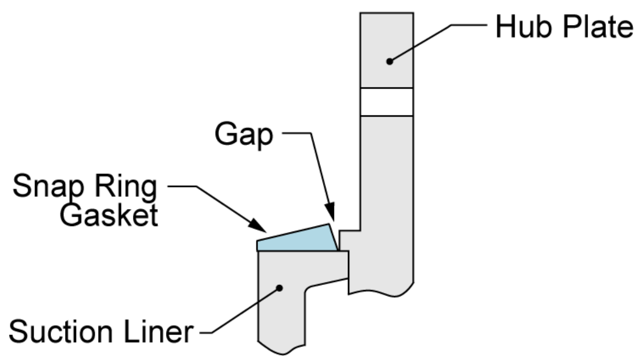


Figure 10-27: Snap-Ring Gasket Installation

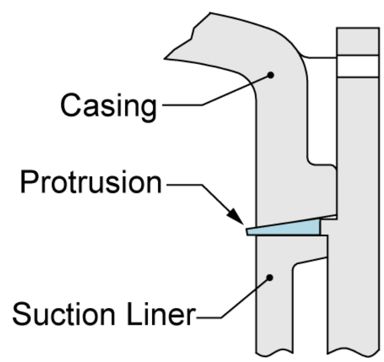


Figure 10-28: Snap-Ring Gasket Protrusion

10.3.8 Adjusting the Suction Liner: General Guidelines

The suction liner, and sometimes the impeller, are often among the first parts of a pump to wear out in a typical maintenance cycle. The wear performance of both is affected by the adjustment of the impeller-to-liner running clearance (often referred to as the “impeller nose gap”). As a result, regular adjustments are key to extending the maintenance cycle and can increase wear life by up to 50%.

NOTE

Adjustments do not necessarily reduce overall wear, but rather prevent “3D gouging” wear, which bores through the liner in localized areas and leads to early failure.

10.3.8.1 General Usage Guidelines

- Optimum adjustment occurs when the parts are brought just to the point of touching, as this provides the tightest clearance and leads to the most even liner wear and the longest parts life.
- GIW/KSB recommends 12 to 25 adjustments during the life of the part (for example, one to two times per week for a three-month maintenance cycle.
- Although pumps should be shut down for the adjustment process whenever possible, it may sometimes be necessary to make adjustments while the pumps are running, since stopping them once or twice a week for adjustments may not be possible.

	NOTE
	If possible, flush with clear water when making adjustments on a running pump. This will help reduce the possibility that noise from the solids or fluctuations in power due to changing slurry concentration will interfere with the identification of rubbing.

- The pump hardware designs have been validated to operation discharge pressures specific to each pump. Based on the torque limitations of the assemblies' pusher bolts, note that a lower functional limit for making adjustments during operation may be reached before this upper limit.

	CAUTION
	Do not increase the length of the liner pusher bolts or otherwise modify the pump to increase adjustment distance. Exceeding the maximum adjustment distance can result in pump leakage, suction liner failure, and/or dislodging of the suction liner.

- Perform adjustments at a fixed speed only. Disable any variable speed capabilities.
- Adjustments can also be performed on idle pumps. Adjusting the pump while idle reduces the chance of excessive rubbing due to over-adjustment. If adjusting an idle pump, note that the shaft must be turned by hand to detect the point of rubbing.
- Perform adjustments at a constant slurry specific gravity (SG). If fluctuations cannot be controlled to within +/-5%, make adjustments on clear water for reliable indication of rubbing during adjustment.
- Adjust the pusher bolts in multiple passes using a crosswise torque pattern (Figure 10-29). We recommend adjusting in small increments; see below for more detailed guidance on selecting an adjustment increment. This will help minimize stress per bolt and the torque requirement and will improve the ability to detect when the liner contacts the impeller.

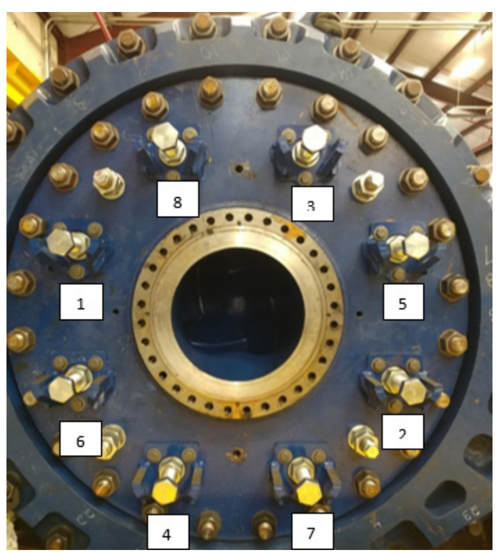


Figure 10-29: Pusher-Bolt Adjustment Torque Pattern

	WARNING
	Do not adjust any single pusher bolt more than three flats per pass in any situation. This can cause the suction liner to become misaligned with reference to the suction plate and not allow further adjustment.

- Do *not* exceed the torque limit on the pusher bolts.
- To minimize friction and increase pushing force, use a light oil or an anti-seize compound on all pusher bolts and exposed installation studs.

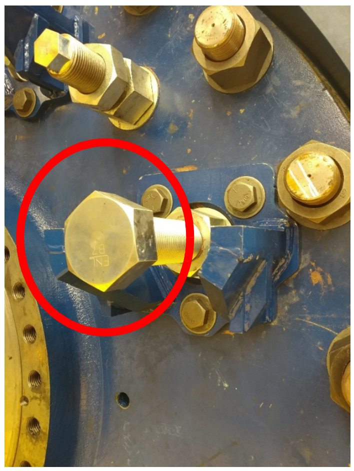


Figure 10-30: Pusher Bolt

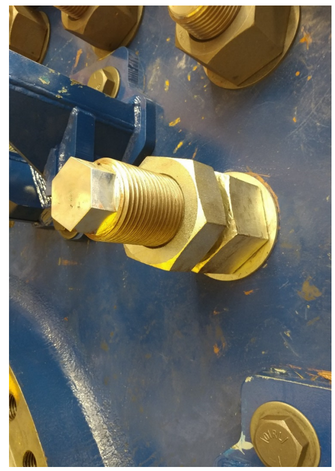


Figure 10-31: Installation Stud

- Use hand tools only with 300 ft-lb (407 N-m) of torque on the pusher-bolt lock nuts.
- Use a torque multiplier and a manual torque wrench, or a hydraulic torque wrench, to provide accurate, sufficient torque for the adjustment. If adjusting during shutdown, a torque multiplier or hydraulic torque wrench should not be necessary.
- The pump's hardware design has been evaluated for use with specific hydraulic torque wrenches. Similar hydraulic torque wrenches may also be suitable; evaluate on a case-by-case basis.
- Run-time adjustments require careful and methodical procedures to minimize the risk of over-adjustment. Over-adjustment of a running pump can lead to rubbing damage in the impeller-to-liner clearance zone.
- Adjustments should be made in small increments. Best practice is to limit the axial movement of the suction liner during each adjustment increment to a value between 0.5 mm and 0.25 mm (0.020" – 0.010"). The larger value is a good general-purpose value and can be used if the expected gap is large. The smaller value may be desirable if the expected gap is small.

10.3.8.2 Calculation Guidelines: Bolt Rotation per Liner Movement

For practical convenience, the desired amount of axial movement should be converted into one of the following:

- the amount of rotation of the adjustment (pusher) bolt in degrees

- an equivalent number of “flats” of the hex head of the adjustment bolt, where one flat equals 1/6 turn of the adjustment bolt.

To calculate these values, first determine the size of your adjustment bolt from the pump assembly drawing or Bill of Material, or measure it directly. The degrees of percent rotation or equivalent hex head “flat” values can be calculated using the equations given here. Note that values for some typical adjustment bolt sizes are provided in Table 10-2.

For a 0.5 mm (0.020") movement:

degrees of rotation = 180 / thread lead (mm)

= 7.2 x thread pitch (threads/inch)

hex head flats = 3 / thread lead (mm)

= 0.12 x thread pitch (threads per inch)

For a 0.25 mm (0.010") movement:

degrees of rotation = 90 / thread lead (mm)

= 3.6 x thread pitch (threads per inch)

hex head flats = 1.5 / thread lead (mm)

= 0.06 x thread pitch (threads per inch)

Table 10-2: Degrees of Rotation & Hex Head Flats: 0.5mm (0.020”) & 0.25mm (0.010”) Adjustments

Common Adjustment Bolt Sizes	for a 0.5 mm (0.020”) adjustment		for a 0.25 mm (0.010”) adjustment	
	degrees of rotation	hex head flats	degrees of rotation	hex head flats
1 – 8 NC	60°	1	30°	1/2
1¼ – 7 NC	50°	7/8	25°	1/2
1½ – 6 NC	45°	3/4	20°	3/8
1¾ – 5 NC	35°	5/8	18°	3/8
M42 x 4.5	40°	3/4	20°	3/8
M48 x 5	35°	1/2	18°	1/4
M56 x 5.5	30°	1/2	15°	1/4

10.3.8.3 Calculation Guidelines: Liner Movement per Bolt Rotation

As an alternative to calculating the axial movement (Section 10.3.8.2), it may be more convenient to calculate the liner movement per one of the following:

- each 45° rotation
- each hex head flat

One of these (or a fraction of one of these) can then be chosen as your standard adjustment interval.

This calculation has the advantage of providing the exact amount of movement associated with each adjustment interval while using convenient turning increments. Values for some typical adjustment bolt sizes are provided in Table 10-3.

Liner movement (mm):

per 45° rotation = thread lead (mm) / 8

per hex head flat = thread lead (mm) / 6

Liner movement (inches):

per 45° rotation = 0.125 / thread pitch (threads per inch)

per hex head flat = 0.167 / thread pitch (threads per inch)

Table 10-3: Degrees of Rotation & Hex Head Flats: 0.5mm (0.020") & 0.25mm (0.010") Adjustments

Common Adjustment Bolt Sizes	Liner Movement (mm)		Liner Movement (inches)	
	per 45° rotation	per hex head flat	per 45° rotation	per hex head flat
1 – 8 NC	0.40 mm	0.52 mm	0.016"	0.021"
1¼ – 7 NC	0.45 mm	0.61 mm	0.018"	0.024"
1½ – 6 NC	0.53 mm	0.71 mm	0.021"	0.028"
1¾ – 5 NC	0.64 mm	0.85 mm	0.025"	0.033"
M42 x 4.5	0.56 mm	0.75 mm	0.022"	0.030"
M48 x 5	0.63 mm	0.83 mm	0.025"	0.033"
M56 x 5.5	0.69 mm	0.92 mm	0.027"	0.036"

10.3.8.4 Calculating Total Movement

After following the calculation guidelines described previously, calculate the total movement based on the total degrees of turning or the total flats, as shown below. This amount should be recorded as the total movement for the adjustment.

Total liner movement (mm):

= total degrees of rotation x thread lead (mm) / 360

= total number of flats x thread lead (mm) / 6

Total liner movement (inches):

= total degrees of rotation / thread pitch (threads per inch) / 360

= total number of flats / thread pitch (threads per inch) / 6

10.3.8.5 Detecting Contact (Rubbing)

During each adjustment increment, it is essential to monitor continuously for the onset of rubbing, as rubbing will often begin partway through an adjustment increment. If a full adjustment increment is made without monitoring, the onset of rubbing may be missed, and the pump may be placed into a heavy rubbing condition, leading to parts damage.

It may be difficult to determine, based on a single factor, when the suction liner contacts the impeller and rubbing occurs. The following proven methods have been used to monitor suction liner adjustments in the field. To most reliably detect rubbing, we strongly recommend using all three methods in tandem during suction liner adjustments.

NOTE

To a lesser extent than the three methods presented here, an increase in bearing temperature can also indicate contact. However, this is a more delayed indicator, and it should not be used as the primary means of detecting a rubbing contact.

10.3.8.5.1 Sound Levels

Sound usually provides the first indication of rubbing, but it is also the most subjective measure and should not be used alone.

To monitor sound levels, use a quality microphone or stethoscope designed for monitoring heavy equipment and provided with headphones to shield the user from ambient noise. A stethoscope is best for audibly detecting intermittent or light contact. We recommend using the microphone or stethoscope at the end of the liner installation studs. Listen continuously while the liner is being moved, as it is essential to be listening closely when first contact is made. Keep the following in mind:

- The onset of rubbing is often easily identified by experienced users but can be missed by the novice, especially if it begins mid-adjustment and the user is not listening.
- The intermittent contact sound that is typical of first contact may become audible after only a few adjustment bolts have been advanced.
- If the liner is advanced beyond first contact, a more constant rubbing sound may be established that cannot be easily distinguished from normal pumping noise.

Rubbing typically starts as a repeated “knocking” noise due to the presence of clearing vanes. A change in the character of the noise can also be heard and has been compared to the sound of a train (distant vs. close as the gap between liner and impeller is closed).

Terminate the adjustment as soon as rubbing is identified by the monitoring of sound. If there is any doubt about the detection of rubbing, reduce the adjustment increment to the minimum (0.25 mm) and monitor the driver power carefully as the adjustment continues. (See Section 10.3.8.5.3.)

10.3.8.5.2 Vibration Levels

An increase in vibration levels can indicate rubbing, but the usefulness of vibration monitoring varies with the installation, as it can be affected by background vibration levels. Still, vibration monitoring provides an important and objective backup for the more subjective monitoring of audible sound. Rubbing detected by vibration monitoring should be confirmed with other methods.

Use a quality, portable vibration analyzer with frequency spectrum analysis capability to measure the amplitude of pump vibration throughout the adjustment. For most direct monitoring, we recommend attaching the sensor to the end of a liner installation stud. Filter the vibration output to the frequencies of interest.

Rubbing will usually appear at frequencies equal to:

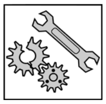
- the rotational frequency of the pump (1x)
- the clearing vane pass frequency (This is equal to the rotational frequency multiplied by the number of clearing vanes on the outer suction side of the impeller.)

Occasionally, rubbing will show at 2x the rotational frequency.

Do not allow vibration to exceed 0.4 in/s (10 mm/s) RMS at any point during adjustment, as this can indicate severe rubbing contact.

10.3.8.5.3 Drive Power (Amps)

This method of detection is the least sensitive of the three, but an increase in driver power (or amps) is the most direct indication of rubbing and provides an essential safety backup. This monitoring should always occur continuously during a suction liner adjustment.



CAUTION

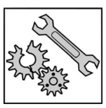
Adjustments made where only power is monitored will likely experience some rubbing damage and cracking that could reduce parts life. Therefore, power monitoring should always be combined with sound and vibration monitoring.

During adjustment, avoid changes to the pump operation that may affect driver power independent of rubbing. In particular:

- Lock the pump speed.
- Stabilize, as much as possible, the process slurry density and flow rate.

For a pump at fixed speed, power will increase directly (linearly) with both flow and slurry density. (For example, a 2% increase in flow together with a 3% increase in slurry density will result in a 5% increase in pump power.)

Generally, pump efficiency will increase as the nose gap is reduced but will decrease once contact is made. A spike in amps of 3% or more while adjusting (at a constant speed and SG) would indicate contact.



CAUTION

An increase in driver power in excess of 5% due to rubbing may cause visible signs of heat damage to the liner and impeller. If allowed to continue for an extended period, parts breakage may result. An increase in driver power of 10% or more due to rubbing can lead to cracking and breakage of the parts within minutes.

10.3.8.6 Recommendations

If contact is detected using any of the methods listed previously, no further adjustments are needed. Terminate the adjustment increment, and reverse any movement made during that increment to obtain the final suction liner position.

If vibration or amperage limits are exceeded, this can indicate heavy contact. Stop the adjustment and retract the liner until baseline levels are re-established, confirming that contact has ceased.

If heavy contact cannot be remedied, shut down the pump to avoid damage to the pump components.

Once a successful adjustment is complete within the specified parameters, back off the liner by loosening the pusher bolts one adjustment increment to prevent contact during operation and shutdown. This requirement applies for second-stage pumps and beyond. First-stage pumps, however, do not require the liner to be backed off.

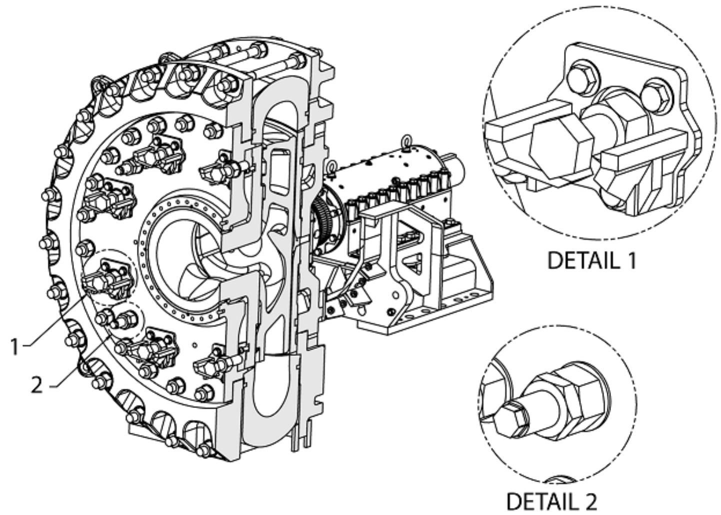


Figure 10-32: Installation Studs and Pusher Bolts

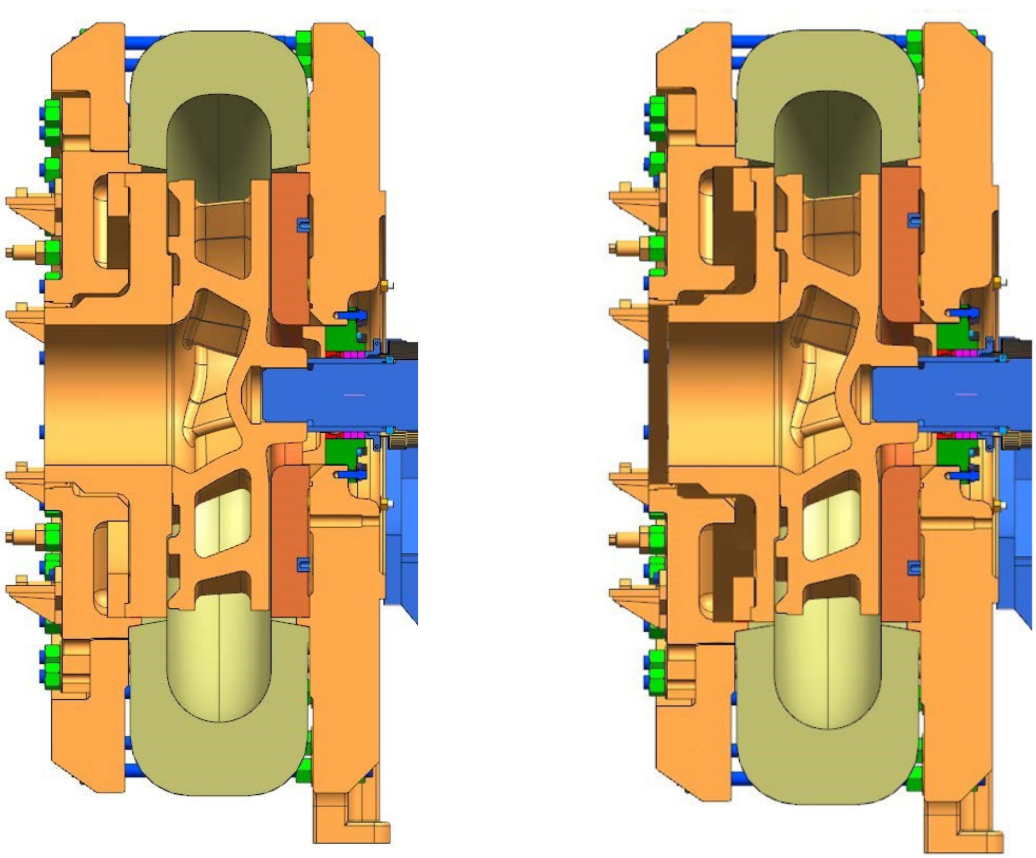


Figure 10-33: Visual Representation of Suction Liner Maximum Axial Travel

10.3.9 Adjusting the Suction Liner: Procedure

WARNINGS

- Pay close attention to the process and avoid distractions, taking note of any unusual sounds, vibration, or other conditions.
- Do not multi-task during a pump adjustment. If the adjustment must be interrupted, back off the last adjustment, lock down and close out the process, and return at a later date.
- Damage to both the impeller and the liner will occur if the pump operates with severe contact between them.
- To ensure that only small adjustments are made to the pusher bolts, adjust them with hand tools or controlled torque input devices only.
- DO NOT use an impact wrench to adjust the pusher bolts. Pusher bolts should only be turned a fixed/measured amount. (See Figure 10-32.)
- Spikes in power consumption or bearing temperature can indicate rubbing between impeller and liner. If these occur, immediately stop the forward adjustment and back off the pusher bolts.
- The nose gap should initially be set per guidance in Section 10.4 by adjusting the CBA forward. Suction liner adjustment should only be used to adjust forward after the pump is in operation.
- Suction plate damage can result from prolonged operation once the liner has worn through. Typical wear is uneven, and localized wear-out may occur before complete wear-out.
- Initial adjustment requirements after a pump rebuild can vary significantly due to tightening of the impeller upon initial startup. Take special care when adjusting a liner for the first time, before established wear rates have been determined. Once you know the pump's wear performance and have made regular adjustments, you can more accurately predict how much adjustment is required. Also note that pump wear should not be extrapolated between pumps in different locations or applications, even if they are the "same pump" by design.

10.3.9.1 Adjustment Team Roles

Because it is difficult for one person to accomplish an adjustment, best practice is to define these primary roles within the maintenance team:

- **Adjustment Supervisor**—Oversees the adjustment, audits the procedure, and records measurement information in the adjustment log; is usually assisted by at least one **Maintenance Technician**.

NOTE

The duties of this position can be performed by a Maintenance Technician if they are experienced in making adjustments and the pump is well-marked. (See Section 10.3.9.2.1.)

- **Monitoring Superintendent**—Monitors the pump for indications of rubbing whenever the adjustment bolts are being moved; sole focus is on detecting any rubbing; should not be responsible for turning adjustment bolts or filling out the adjustment log; is the team's decision-maker regarding:
  - when the pump is ready for an adjustment increment to begin
  - what amount of movement will be made during each increment
  - when rubbing has occurred
  - whether to back off any adjustments
  - when to terminate the adjustment process
  - final check after liner is properly locked and the adjustment has been successfully completed

10.3.9.2 Adjusting While the Pump Is Running

	WARNING
	• If the suction liner is being adjusted while the pump is running, the adjustment must be performed at a fixed pump speed. • Exceeding the maximum single-bolt adjustment limit may result in failure to detect intermittent contact, which can lead to severe contact and damage to parts. • In the event of a pump shutdown after a running adjustment has been completed, impeller-to-liner contact may occur due to relaxation of the pump components as internal pressure is lost.

	NOTE
	Internal pressure during operation results in deflection of the pump components, which, in turn, increases the nose gap. This deflection is more significant when pumps are operated in series, due to higher suction and discharge pressures.

10.3.9.2.1 Prior to Adjustment

Before making the adjustment:

1. Arrange a pre-job safety meeting with operations, maintenance, reliability, and (if available) the pump specialist.
2. Number the pusher bolts following a crosswise torque pattern. (See Figure 10-29 on page 65.) We recommend using a magnetic "dealer" chip and magnetic numbers (Figure 10-34) to keep track of what bolts have been adjusted. Move the chip to the next number immediately after each bolt has been turned, and stop when the chip reaches bolt #1.

Figure 10-34: Use of "Dealer" Chip and Magnetic Numbers

3. Mark the heads of the pusher bolts at the 12 o'clock position, and mark the plate at the desired adjustment intervals. Figure 10-35 shows an example. Values will differ based on bolt-specific threads.

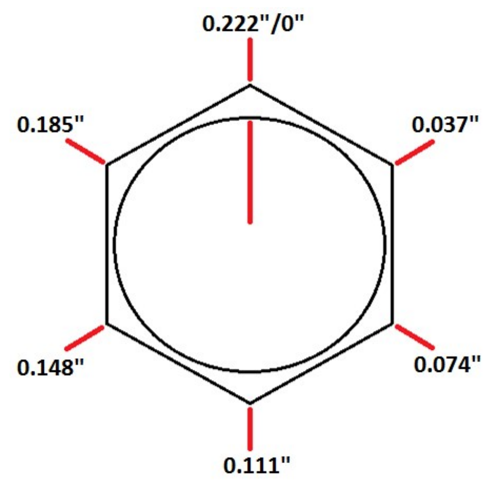


Figure 10-35: Example of Bolt Marking for Linear Travel Measurement

	NOTE
	Prior to marking, ensure that all pusher bolts are in contact with the liner.

4. Liner axial movement will be measured based on the marked rotation of the pusher bolts; however, these are subject to being disturbed during the adjustment, so bolt rotation should always be tracked. Travel distance per bolt flat can be determined by using bolt dimensions. See Sections 10.3.8.2 and 10.3.8.3 for calculation guidelines.
5. All pumps in the train must be set to a fixed speed throughout the entire adjustment process. Contact the control room operator to verify that the VFD is locked out.
6. Prepare an adjustment log for recording important data at intervals throughout the adjustment. This data should include time, distance (mm), power (A), speed (% rated or RPM), flow (m^3/hr), vibration (mm/s RMS), and any ancillary readings. Also include space to record changes in sound characteristics as outlined in Section 10.3.8.5.
7. Determine baseline readings for the items listed in step 6, and then calculate and record the 3% amperage value as applicable. (A 3% increase in motor amps will indicate a high likelihood of rubbing.)

You are now ready to begin making the adjustment.

10.3.9.2.2 Adjusting the Suction Liner

To adjust the suction liner:

1. Loosen the nuts on the installation studs by at least 0.25 inches (6.4 mm) to allow liner movement. Ensure that a gap is maintained throughout the adjustment process to prevent the binding of pusher bolts.
2. Before making the adjustment pass, log data as described in step 6 of Section 10.3.9.2.1. Note the sound characteristics, motor amps, and vibration amplitude as outlined in Section 10.3.8.5.

	NOTE
	If technician experience is lacking, we recommend having an experienced GIW field representative on hand to guide the adjustment process and train local technicians in proper monitoring methods. See Section 10.3.9.1 for details on adjustment team roles.

3. Following a crosswise torque pattern, tighten the pusher bolts no more than the maximum single adjustment distance at a time (one flat). If contact is detected while tightening any single pusher bolt, cease the adjustment and return the pusher bolts to their positions at beginning of adjustment pass, ensuring that all bolt heads indicate the same position.
4. Check the dial indicators to ensure that the suction liner axial travel is even.
5. After the adjustment pass, log data as described in step 6 of Section 10.3.9.2.1. Note the sound characteristics, motor amps, and vibration amplitude as outlined in Section 10.3.8.5.
6. Repeat steps 1 through 5 until there is light contact between the suction liner and the impeller, or until the intended suction liner axial travel is achieved.

	WARNING
	To minimize the risk of equipment damage in the event of a shutdown, retract the liner after adjustment to ensure a small running nose gap. Failure to retract the liner after detecting contact may result in liner contact in the event of a shutdown or loss of system pressure.

7. Once light contact is made, back off each pusher bolt 0.5 mm for second-stage and beyond.
8. After completing the adjustment and backing off the liner, confirm that all contact indications have subsided. Continue monitoring at a fixed speed for 10 minutes.

10.3.9.2.3 After the Adjustment

Once the adjustment is complete and you have monitored at a fixed speed for 10 minutes:

1. Ensure that all bolt heads indicate the same position.
2. Re-tighten the pusher-bolt nuts to 300 ft-lb (407 N-m) to lock the pusher bolts into place.
3. Re-tighten the nuts and jam nuts on the installation studs to 300 ft-lb (407 N-m) to lock the suction liner into place.
4. Log data as described in step 6 of Section 10.3.9.2.1. Note the sound characteristics, motor amps, and vibration amplitude as outlined in Section 10.3.8.5.

10.3.9.3 Adjusting During Shutdown

	NOTE
i	**First adjustment only:** While holding the pusher bolts in place, loosen the nuts on the pusher bolts by at least 0.25 inches (6.35 mm). Individually back off all pusher bolts no more than 1/6 of a turn (one flat), and hand-tighten them until snug. Ensure that the suction liner is fully retracted and all pusher bolts are in contact with the liner.

To adjust the suction liner during shutdown:

1. Number the pusher bolts following a crosswise torque pattern. (See Figure 10-29 on page 65.)
2. Mark the heads of the pusher bolts at the 12 o'clock position, and mark the plate at the desired adjustment intervals. Figure 10-35 on page 74 shows an example. Values differ based on bolt-specific threads. See also Sections 10.3.8.2 and 10.3.8.3 for calculation guidelines.
3. Liner axial movement will be measured based on the marked rotation of the pusher bolts. Dial indicators on the installation studs may be used as a secondary method to confirm liner movement and pusher-bolt seating.
4. Loosen the nuts on the installation studs by at least 0.25 inches (6.35 mm) to allow liner movement.
5. Throughout the adjustment, manually rotate the impeller in the direction of rotation to verify clearance. If the suction pipe is removed, also check the nose gap using feeler gauges to estimate the remaining adjustment distance.
6. Tighten the pusher bolts according to calculations, following a crosswise torque pattern.
7. Check the dial indicators to ensure that the suction liner axial travel is even.
8. Repeat steps 5 through 7 until either of the following occurs:
    - There is light contact between the suction liner and the impeller (where the impeller can no longer be freely rotated 360° and/or there is audible rubbing noise).
    - The intended suction liner axial travel has been achieved.
9. Loosen the pusher bolts and set the values to the nose gap specified in Section 10.4.
10. Re-tighten the pusher-bolt nuts to 300 ft-lb (407 N-m) to lock the pusher bolts into place.
11. Re-tighten the nuts and jam nuts on the installation studs to 300 ft-lb (407 N-m) to lock the suction liner into place.
12. Confirm that the impeller rotates freely over 360° with no rubbing noise.

10.4 Setting the Nose Gap

To maximize the pump's performance, set the nose gap (the clearance between the suction face of the impeller and the suction liner) to an allowed minimum. Clearance depends on the size and type of bearing assembly. To set the nose gap, move the bearing housing assembly with the adjusting screw.

Before you can set the nose gap:

- Ensure that the pump's wet end has been completely assembled.

- Torque the wet-end bolts.
- Slightly loosen all of the bearing housing hold-down bolts.

It is not necessary to install the suction spool piece or suction piping before setting the nose gap. This can be done before or after the following steps.

To set the nose gap:

1. Move the bearing assembly toward the impeller end by means of the adjusting screw. Stop when the impeller first begins to rub the suction liner. It is helpful to slowly rotate the impeller during this step.

NOTES

Each rotation of the adjusting bolt will move the bearing assembly. See Table 10-4 for distances per full turn of adjustment bolts of various sizes.

Never apply more than 500 ft-lbs (678 N-m) to the adjusting bolt. If the bearing assembly does not move when this much torque is applied, it may be because the bearing assembly is stuck to the pedestal, possibly from rust. If this is the case, take the following steps in the order listed:

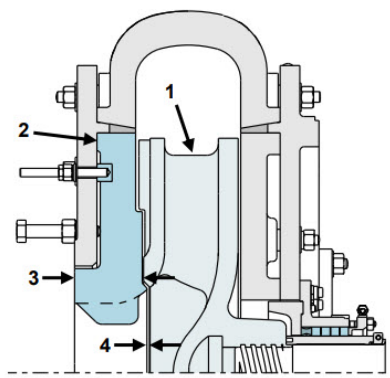
- Support the shaft in the stuffing-box area with a wooden block.
- Loosen the bearing hold-down bolts until there is a 3.3-mm (0.13”) gap between the flat washer and the pedestal.
- Place a hydraulic jack in any one of three places on the pedestal to push up the bearing assembly. (See drawing 1763SK for details.)
- Break the seal with the pedestal.

Table 10-4: Distance per Full Turn of Adjustment Bolt

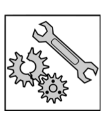
Bolt Size (English)	Distance per Full Turn of Adjustment Bolt			Bolt Size (Metric)	Distance per Full Turn of Adjustment Bolt	
	inch	mm			inch	mm
3/4” – 10 NC	0.100	2.54		M20 – 2.5	0.098	2.5
1" – 8 NC	0.125	3.18		M24 – 3.0	0.118	3
1 1/8” – 7 NC	0.143	3.63		M27 – 3.0	0.118	3
1 1/4” – 7 NC	0.143	3.63		M30 – 3.5	0.138	3.5
1 3/8” – 6 NC	0.167	4.23		M33 – 3.5	0.138	3.5
1 1/2” – 6 NC	0.167	4.23		M36 – 4.0	0.157	4
1 3/4” – 5 NC	0.200	5.08		M42 – 4.5	0.177	4.5
2” – 4 1/2 NC	0.222	5.64		M48 – 5.0	0.197	5.00
2 1/4” – 4 1/2” NC	0.222	5.64		n/a	n/a	n/a

2. Reverse the adjusting screw until the clearance between the impeller and the suction liner is brought to the recommended values shown in Table 10-5.

Table 10-5: MDX Nose Gap Specifications

Shaft Size	Minimum Nose Gap				Minimum Nose Gap for Urethane Liners	Example Cross Section
	Conventional		Limited End Float			
	in	mm	in	mm		
3 - 15/16	0.07	1.78	0.016	0.41	0.0001 x Urethane Thickness x ΔT(°F) + Minimum Nose Gap 0.00018 x Urethane Thickness x ΔT(°C) + Minimum Nose Gap	 Example Cross-Section Shown 1 Impeller 2 Suction Liner 3 Urethane Thickness 4 Nose Gap
5 - 7/16	0.09	2.29	0.016	0.41		
6 - 7/16	0.09	2.29	0.016	0.46		
7 - 3/16	0.09	2.29	0.016	0.46		
9	0.11	2.79	0.016	0.46		
10 - 1/4	0.12	3.05	0.023	0.58		
11 - 1/2	0.13	3.30	0.025	0.64		

3. Once the clearance is correct, tighten the bearing housing hold-down bolts according to the requirements of Section 8.4, “Mounting the Bearing Assembly.”
4. Recheck the clearance with a feeler gauge.
5. Firmly lock the adjusting screw and nut together against the bearing housing tab, and again confirm that the shaft can rotate freely 360° by hand.



CAUTIONS

Listen for rubbing sounds when tightening adjustment bolts! If a spike in power consumption (motor current draw) occurs, this can indicate that the impeller is rubbing against the liner.

During operation, monitor the suction liner’s condition for wear. Typical wear is uneven, and localized wear-out is possible before complete wear-out occurs. Prolonged operation of pump after liner wear-out can lead to suction plate damage.

The final movement of the bearing housing during adjustment should always be *away* from the impeller end. This ensures that the threads of the adjusting screw will contain no backlash against the forward-directed thrust-loading that the pump will generate during operation. This convention is especially important if a mechanical seal is being used, or if a preservative has been applied to the bearing housing and pedestal mounting saddles.

11 Tooling

11.1 Torque Requirements

Torque requirements listed below and in previous sections are for lubricated bolting. All bolts must be lubricated to ease pump assembly and disassembly. Anti-seize compound is preferred, but well-oiled is also acceptable.

11.1.1 Special Torque Requirements

You must accurately measure fastener torque to achieve the proper clamping force as defined either on the assembly drawing or in the manual sections listed below. GIW/KSB recommends using a hydraulic torque wrench, as this tool can be calibrated to produce the necessary accuracy.

- For bearing housing hold-down bolt torque, refer to Section 8.4, “Mounting the Bearing Assembly.”
- If the pump is equipped with an impeller release ring, refer to Section 10.3, “Wet End Assembly,” for torque requirements.If the pump is equipped with a mechanical seal, refer to the mechanical seal manual for torque requirements.

11.1.2 Non-Critical Torque Requirements

No special torque requirements exist for the remaining nuts and bolts unless specifically called for on the assembly drawing. Nuts and bolts with unspecified torques should be tightened enough to ensure a firm mating between parts in accordance with good maintenance practice. Where possible, an air-driven impact wrench is recommended for bolts over 25 mm (1 inch) in diameter.

Table 11-1: Non-critical Torque Requirements (English Fasteners)

Diameter	Tensile Area (in^2)	Anti-Seize				Lubricated/Oiled				Proof Strength (psi)
		Pump Assembly Fasteners		Mounting Equipment to Sub-Base		Pump Assembly Fasteners		Mounting Equipment to Sub-Base		
		ft-lb	N-m	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m	
1/4”	0.0318	3	5	5	6	5	7	7	10	85,000
3/8”	0.0775	12	17	17	23	19	25	26	35	
1/2”	0.142	30	41	42	57	45	61	63	86	
5/8”	0.226	60	81	84	114	90	122	126	171	
3/4”	0.334	106	144	149	202	160	217	224	303	
7/8”	0.462	172	233	241	326	258	349	361	489	
1"	0.606	258	349	361	489	386	524	541	733	
1 1/8”	0.763	318	431	445	603	476	646	667	904	74,000
1 1/4”	0.969	448	608	627	851	672	911	941	1,276	
1 3/8”	1.16	590	800	826	1,120	885	1,200	1,239	1,680	
1 1/2”	1.41	783	1,061	1,096	1,485	1,174	1,591	1,643	2,228	
1 5/8”	1.78	795	1,078	1,114	1,510	1,193	1,618	1,670	2,265	55,000
1 3/4”	1.9	914	1,240	1,280	1,736	1,372	1,860	1,920	2,603	
1 7/8”	2.41	1,243	1,685	1,740	2,359	1,864	2,527	2,610	3,538	
2"	2.5	1,375	1,864	1,925	2,610	2,063	2,796	2,888	3,915	
2 1/4”	3.25	2,011	2,726	2,815	3,817	3,016	4,090	4,223	5,726	
2 1/2”	4	2,750	3,728	3,850	5,220	4,125	5,593	5,775	7,830	
2 3/4”	4.93	3,728	5,055	5,220	7,077	5,592	7,582	7,829	10,615	
3”	5.97	4,925	6,678	6,895	9,349	7,388	10,017	10,343	14,023	
3 1/4”	7.1	7,874	10,676	11,024	14,947	11,812	16,014	16,536	22.420	68,250
3 1/2”	8.33	9,949	13,489	13,929	18,885	14,924	20,234	20,893	28,327	
3 3/4”	9.66	12,362	16,760	17,306	23,464	18,543	25,140	25,960	35,197	
4”	11.08	15,124	20,506	21.174	28,708	22,686	30.758	31,761	43,062	

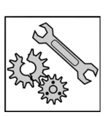
Notes on Table 11-1:
Values 1/4” – 1 1/2” – Based on SAE J429 Grade 5 Fasteners
Values 1 5/8” – 3" – Based on ASTM A449 Fasteners
Values 3 1/4” – 4” – Based on ASTM A193 Grade B7 Fasteners
Torque values taken at 50% proof strength for pump assembly fasteners
Torque values taken at 70% proof strength for mounting equipment to sub-base
K-Factors = 0.120 for anti-seize; 0.180 for lubricated/oiled

Table 11-2: Non-critical Torque Requirements (Metric Fasteners)

Diameter	Tensile Area (mm^2)	Anti-Seize				Lubricated/Oiled				Proof Strength (MPa)
		Pump Assembly Fasteners		Mounting Equipment to Sub-Base		Pump Assembly Fasteners		Mounting Equipment to Sub-Base		
		ft-lb	N-m	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m	
M8	36.6	8	10	11	14	11	15	16	21	580
M10	58	15	20	21	28	22	30	31	42	
M12	84.3	26	35	36	49	39	53	55	74	
M14	115	41	56	58	78	62	84	87	118	
M16	157	64	87	90	122	97	131	135	184	
M20	245	130	176	182	247	195	265	273	370	600
M22	303	177	240	248	336	265	360	372	504	
M24	353	225	305	315	427	337	457	472	640	
M27	459	329	446	461	625	494	669	691	937	
M30	561	447	606	626	848	670	909	938	1,272	
M36	817	781	1,059	1,093	1,482	1,171	1,588	1,640	2,224	
M42	1,120	1,249	1,693	1,749	2,371	1,874	2,540	2,623	3,556	
M48	1,470	1,874	2,540	2,623	3,556	2,810	3,810	3,934	5,334	
M56	2,030	3,018	4,092	4,226	5,729	4,528	6,139	6,339	8,594	
M64	2,680	4,554	6,175	6,376	8,645	6,831	9,262	9,564	12,967	
M72	3,460	6,615	8,968	9,261	12,556	9,922	13,452	13,891	18,833	

Notes on Table 11-2:
All strengths are based on Class 8.8 bolts.
Torque values taken at 50% proof strength for pump assembly fasteners
Torque values taken at 70% proof strength for mounting equipment to sub-base
K-Factors = 0.120 for anti-seize; 0.180 for lubricated/oiled

11.2 Spare Parts Stock



CAUTION

After installation of spare parts, it is important that the steps outlined in Section 6.1, "Commissioning/Return to Service," are followed prior to start-up.

Due to the erosive action of the slurry, many of the wet-end components of the pump may require replacement during normal maintenance. Inspection or overhaul of the mechanical components may also require the replacement of certain parts.

The following are recommended lists of parts (whenever applicable) to have on hand for normal maintenance and inspection. The quantities of parts kept in store will depend upon the severity of the slurry duty and the number of units operating. Maintenance practices may also favor keeping fully built sub-assemblies or complete pumps on hand in some cases. Previous experience in similar duties often provides the best guidance. If in doubt, contact your GIW/KSB representative for specific recommendations.

Commissioning Spares

Gaskets for all equipment

Wet end fasteners

Shaft sleeve with gaskets and O-rings

Impeller release ring assembly

Impeller release ring hardware

Bearing Assembly

Bearings

Bearing assembly gasket kit

Bearing lubricant

Operational Spares

Additional set of gaskets for all equipment

Pump casing

Impeller

Side liners

Shaft Seal

Shaft sleeve

Shaft seal wear plate

Stuffing box packing

Lantern ring

SpiralTrac™

12 Troubleshooting

If you encounter problems that are not described here, consult your GIW/KSB representative, and have the needed information available. See Section 12.2 for details.

12.1 Troubleshooting Key and Chart

Table 12-1: Troubleshooting Key

Letter	Issue	Letter	Issue
A	Pump delivers insufficient flow rate	**E**	Leakage at the pump
B	Motor is overloaded	**F**	Excessive leakage at the shaft seal
C	Excessive discharge pressure	**G**	Vibration during pump operation
D	Increase in bearing temperature	**H**	Excessive temperature rise in the pump

Table 12-2: Troubleshooting Chart

A	B	C	D	E	F	G	H	Possible Cause	Remedy
■		■	■		■	■	■	Blocked discharge or suction piping **WARNING**: Pump must not be run with blocked piping. Danger of explosion due to heating of liquid and overpressure of pump.	Remove blockage or open valve. If piping cannot be unblocked immediately, pump must be shut down without delay.
■		■						System head is higher than expected.	Check for unexpected clogging, collapsed line, or partially closed valve. Check system calculations. Adjustment may be needed to system design and/or pump operating conditions.
			■			■	■	Low flow operation.	Increase flow rate. In general, operation below 30% of best efficiency flow rate is not recommended.
	■					■		System head is lower than expected, leading to excessive flow rate.	Adjustment may be needed to system design and/or pump operating conditions. Contact your GIW/KSB rep for further advice.
■						■	■	Pump and piping are not completely vented or primed.	Vent and/or prime.
■						■		Excess air entrained in liquid.	Improve sump design and venting to prevent air from reaching the pump. Consider a froth pump design if air cannot be avoided.
■					■	■	■	Partial clogging of impeller.	Remove blockage. Be aware that blockage may drain back into sump after shutdown.
			■		■	■		Resonance vibrations in the piping.	Check the pipeline connections and pump mounting. If required, reduce the distances between, or otherwise modify pipe supports.
■					■	■	■	Insufficient suction head (NPSH available).	Check sump level. Raise if necessary. Fully open any valves in the suction line. Check suction line friction loss calculations. Alter design if necessary. Contact your GIW/KSB rep for further advice.
	■							Density or viscosity of the fluid pumped is higher than expected.	Adjustment may be needed to system design and/or pump operating conditions.
	■	■						Speed is too high.	Reduce the speed.

Table 12-2: Troubleshooting Chart (Continued)

A	B	C	D	E	F	G	H	Possible Cause	Remedy
				■	■	■		Worn parts. Loose bolts, seals, or gaskets.	Check for worn parts. Replace as needed. Tighten the bolts and/or fit new seals and gaskets if needed.
					■			Incorrect packing material or adjustment, or incorrect seal water pressure (too high or low).	Correct adjustment. Replace parts as needed. (See KSB/GIW technical article on this subject.)
			■		■	■		The unit is misaligned.	Check the coupling. Re-align if required.
			■			■		Bearing failure.	Replace bearings. Check lubricant for contamination. Inspect and repair bearing seals as needed. Contact a GIW/KSB service center for factory rebuild services.
			■					Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Correct according to maintenance manual recommendations.
			■					Insulating or hot ambient conditions	Remove insulation and/or dirt from bearing assembly. Improve ventilation around pump.
	■							Operating voltage is too low.	Increase the voltage.

12.2 Checklist: Reporting Problems to GIW/KSB

For problems not covered in this section, contact your GIW/KSB representative, and have the following information at hand:

- Pump serial number (from the nameplate on the pedestal or bearing housing), customer location, and the approximate startup date
- Pumped fluid specific gravity (SG) and slurry information (SG and particle size, liquid temperature, etc.)
- Approximate flow rate desired and the actual minimum and maximum flow rates of the system (if known)
- System static head (the difference in elevation between the water level on the suction side of the pump and the point of discharge)
- Length and size of suction and discharge lines, including a description of the general arrangement, including fittings, bends, and valves
- Pressure (e.g., cyclone back-pressure), if the discharge point is not to atmosphere
- If suction is taken from a sump: general arrangement, including size dimensions and minimum and maximum sump levels referenced to the suction centerline of the pump
- Available driver horsepower, speed of motor and pump, or description of the ratio device between the pump and motor
- Impeller diameter (if different from that supplied with the pump)

This information is especially important if the pump has been transferred from the duty for which it was selected to some other application.

In many instances, you may find that unusual wear in the pump or low efficiencies are caused by a mismatch between the pump and the system application and can be corrected once the operating conditions are known.

Contact your GIW/KSB rep for further specific recommendations on system design.

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