FLOWSERVE

USER INSTRUCTIONS

Worthington GR Series Rotary Gear Pump

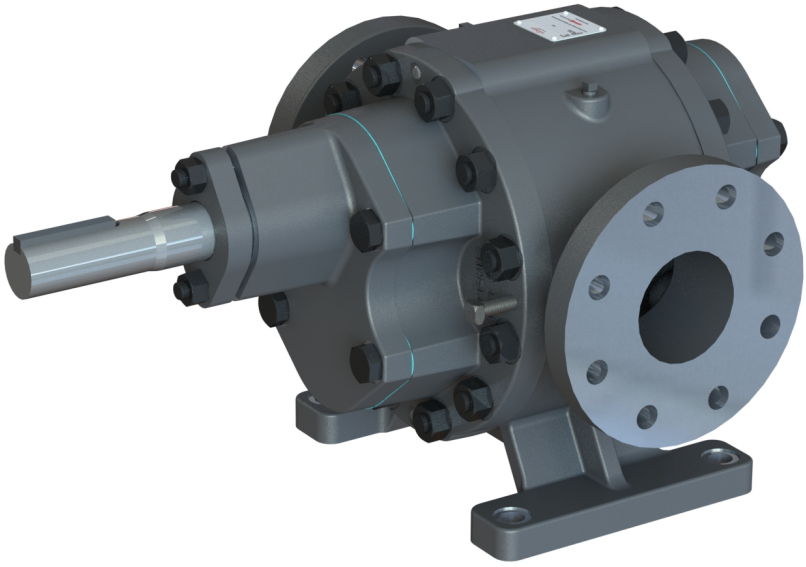
Installation
Operation
Maintenance

GR, GRM, GRMI, GRJ, GRL, GRJL, GRW, GRWM, GRWMI, GRWL, GRH, GRHM, GRHMI, GRHJ, GRHL, GRHJL

PUIOM001048, EN

Original Instructions

⚠ ***These instructions must be read prior to installing, operating, and maintaining this equipment.***



Experience In Motion

Document Version

Rev 03 Release, 26-APR-2023

CONTENTS

1 General Information

1.1 Scope of manual

These instructions must be kept close to the product's operating location or directly with the product.

These instructions must be read prior to installing, operating, using, or maintaining the equipment in any region worldwide. The equipment must not be put into service until all of the safe operating conditions noted in the instructions have been met. Failure to comply with the information provided in the User Instructions is considered to be misuse. Personal injury, product damage, delay in operation, or product failure caused by misuse are not covered by the Flowserve warranty.

Flowserve products are designed, developed and manufactured with state-of-the-art technologies in modern facilities. The unit is produced with great care and commitment to continuous quality control, utilizing sophisticated quality techniques, and safety requirements.

Flowserve is committed to continuous quality improvement and being at your service for any further information about the product in its installation and operation or about its support products, repair and diagnostic services.

The following user information covers the Flowserve, GR Rotary Pump and all of its configurations.

These instructions are intended to familiarize the reader with the product and its permitted use. Operating the product in compliance with these instructions is important to help ensure reliability in service and avoid risks. These instructions may not take into account all local regulations; ensure such regulations are observed by all, including those installing the product. Always coordinate repair activities with operations personnel and follow all plant safety requirements and applicable safety and health legislation.

Supplementary user instructions determined from the contract requirements for inclusion into User Instructions for buy-out equipment such as driver, instrumentation, controller, sub-driver, seals, seal system, mounting component etc. If required, copies of other information sent separately to the Purchaser should be obtained from the Purchaser and retained with these User Instructions.

The typical general arrangement drawing, and any specific drawings required by the contract will be sent to the Purchaser separately unless the contract specifically calls for these to be included into the User Instructions. If required, copies of other drawings sent separately to the Purchaser should be obtained from the Purchaser and retained with these User Instructions.

If any changes, agreed with Flowserve Solution group, are made to the product after it is supplied, a record of the details should be maintained with these User instructions. When requesting information or ordering replacement parts, be sure to give the pump serial number and size shown on the nameplate. When requesting information on pump performance or bearing life, full conditions of service (pressures, type of liquid, speed, etc.) should be known.

1.2 Disclaimer

Information in this User Instruction is believed to be complete and reliable. In spite of all Flowserve's efforts to provide comprehensive information and instructions, sound engineering and safety practices should always be used. Please consult with a qualified engineer.

Flowserve manufactures products to applicable International Quality Management System Standards as certified and audited by external Quality Assurance organizations. Genuine parts and accessories have been designed, tested, and incorporated into the products to help ensure continued product quality and performance in use. As Flowserve cannot test parts and accessories sourced from other vendors the incorrect incorporation of such parts and accessories may adversely affect the performance and safety features of the product. The failure to properly select, install, or use authorized Flowserve parts and accessories is considered to be misuse. Damage or failure caused by misuse is not covered by Flowserve's warranty. In addition, any modification of Flowserve products or removal of original components may impair the safety of these products in use

1.3 Certification instruction

It is a legal requirement that machinery and equipment put into service within certain regions of the world shall conform to the Marking Directives applicable to Flowserve products (i.e. Machinery Directive, Low Voltage Directive, Electromagnetic Compatibility (EMC) Directive, Pressure Equipment Directive (PED), Equipment for Potentially Explosive Atmospheres (ATEX), etc.).

Note: Certificates defined in the Contract requirements are provided with these instructions where applicable. Examples of the certificates can be found in the Annex of this document. If required, copies of other certificates sent separately to the Purchaser should be obtained from the Purchaser for retention with this User Instruction.

1.4 Units

This pump was designed with the United States customary system (USC) units. This manual also uses SI units or dual units when appropriate.

2 Safety Information

2.1 Intended use

This product has been selected to meet the specifications of your purchase order. The acknowledgement of these conditions has been sent separately to the Purchaser. A copy should be kept with these instructions.

⚠ The product/system must not be operated beyond the parameters specified for the application. If there is any doubt as to the suitability of the product/system for the application intended, contact Flowserve for advice, quoting the serial number.

- Installing, operating, or maintaining the product/system in any way that is not covered in this User Instruction could cause death, serious personal injury, or damage to the equipment. This includes any modification to the product/system or use of the parts not provided by Flowserve.
- Only operate the product/system when it has successful passed all inspection acceptance criteria
- Do not operate the product/system in a partially assembled condition.
- If the conditions of service on the customer's purchase order change (i.e. pumping fluid, temperature, or duty conditions) it is requested that the user seeks written agreement from Flowserve before start up.
- Observe equipment labels, such as arrows designating the direction of rotation, warning signs, etc., and keep them in a legible condition. Replace any damaged and/or illegible labels immediately.

2.2 Safety symbols and description

This User Instruction contains specific safety markings where non-observance of an instruction would cause a hazard. The specific safety markings are:

Table 1: Definition of safety symbols and markings

Symbol	Description
⚠ DANGER	**DANGER** This symbol indicates a hazardous situation which, if not avoided, will result in death or serious injury

WARNING	**WARNING** This symbol indicates a hazardous situation which, if not avoided, could result in death or serious injury
CAUTION	**CAUTION** This symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury
SAFETY INSTRUCTIONS	**Safety Instruction** This symbol indicates specific safety-related instruction or procedures
NOTICE	**NOTICE** This symbol is used to address practices not related to physical injury
	This is the safety alert symbol. It is used to alert you to potential physical injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Table 2: Additional symbols

Symbol	Description
	**ELECTRICAL HAZARD** This symbol indicates electrical safety instructions where non-compliance would affect personal safety and could result in loss of life
	**TOXIC HAZARD** This symbol indicates "hazardous substances and toxic fluid" safety instructions where non-compliance would affect personal safety and would damage the equipment or property
	**ATEX EXPLOSION PROTECTION** This symbol indicates explosive atmosphere marking according to ATEX. It is used in safety instructions where non-compliance in the hazardous area would cause the risk of an explosion

2.3 General hazard sources

2.3.1 Mechanical Hazards

Note: The load values mentioned in this section are Flowserve recommendations only. All lifting must be done in compliance with site safety protocol, local regulations, and related industry standards.

Many precision parts have sharp corners which require appropriate personal protective equipment during handling. Prior to any attempt to lift an item, employees must first determine the approximate weight and stability of the load.

- Large, unstable, or awkward loads should always be handled with the assistance of additional personnel or appropriate mechanical means.
- Loads in excess of 50 lb. (23 kg) should only be lifted by appropriate mechanical means and in accordance with current local legislation or with the assistance of additional personnel.

- Lifting items less than 50 lb. (23 kg) may be prohibited without assistance if the lift is repetitive and/or awkward (i.e., away from the body, above the shoulders or below the knees) thus placing excessive stress on the personnel.
- Repetitive lifting of any kind should be evaluated as part of a documented end-user safety program.

See section 4.4, Transportation for proper lifting instructions.

2.3.2 Electrical hazards

 NEVER DO MAINTENANCE WORK WHEN THE UNIT IS CONNECTED TO POWER (Lock out)

2.3.3 Additional hazards

 When the pump is handling hazardous liquids, care must be taken to avoid exposure to the liquid by appropriate siting of the pump by limiting personnel access and by operator training. If the liquid is flammable and/or explosive, strict safety procedures must be applied.

⚠CAUTION PREVENT EXCESSIVE EXTERNAL PIPE LOAD

Do not use pump as a support for piping. Do not mount piping expansion joints, unless allowed by Flowserve in writing, so that their force, due to internal pressure, acts on the pump flange. When applied on a pressure line, tie rods limiting the elongation of the joint and take the axial thrust created by the internal pressure must be used.

 **⚠CAUTION NEVER RUN THE PUMP DRY OR WITHOUT PROPER PRIME**

 **⚠CAUTION NEVER OPERATE THE PUMP WITH THE DISCHARGE VALVE CLOSED**. Unless otherwise instructed at a specific point in the User Instructions. See section 6, *Commissioning*, & Section 7, *Operation*

 **⚠CAUTION NEVER OPERATE THE PUMP WITH SUCTION VALVE CLOSED**. It should be fully opened when the pump is running

⚠CAUTION NEVER EXCEED THE MAXIMUM DESIGN PRESSURE (MDP)

See section 12.3 for operating limitations

⚠CAUTION THE PUMP SHAFT MUST TURN AS SPECIFIED WHEN VIEWED FROM THE MOTOR END

If pump is spun is opposite direction as specified on the nameplate improper lubrication to the bearing can occur without the proper modifications.

2.4 Responsibility of the operating company

To ensure personnel safety the operating company must do the following:

- Complete a risk assessment of the site where the product/system will be in operation, by observing the working conditions
- Create site specific work instructions for the operation of the product
- Ensure that the personnel have read and understand all applicable instructions
- Provide regular training to the necessary personnel in regular intervals
- Provide the required personal protective equipment

2.5 Industrial health and safety measures

Follow industry safety standards including the use of appropriate equipment in required areas.

2.6 Qualified personnel and targeted group

All personnel involved in the operation, installation and maintenance of the unit must be qualified to carry out the work involved. If the personnel in question does not already possess the necessary knowledge and skill, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to provide applicable training.

Always co-ordinate repair activities with operation and health and safety personnel and follow all plant safety requirements and applicable safety and health laws and regulations.

2.7 Potential explosive areas


Measures are required to:

- Avoid excess temperature
- Prevent build-up of explosive mixtures
- Prevent the generation of sparks
- Prevent leakages
- Maintain the pump to avoid hazard

All instructions for equipment installed in potentially explosive atmospheres must be followed to help ensure explosion protection. For ATEX, both electrical and non-electrical equipment must meet the requirements of the European Explosion Protection Directive 2014/34/EU. Always observe the regional legal Ex requirements, e.g. Ex electrical items outside the EU may be required certified to other than ATEX e.g. IECEx, UL.


Use equipment only in the zone for which it is appropriate. Always check that all equipment is suitably rated and/or certified for the classification of the specific atmosphere in which they are to be installed.

2.8 Protective equipment

Necessary protective equipment including personal protective equipment shall adhere to facility standards.

3 Product Description

3.1 General product description

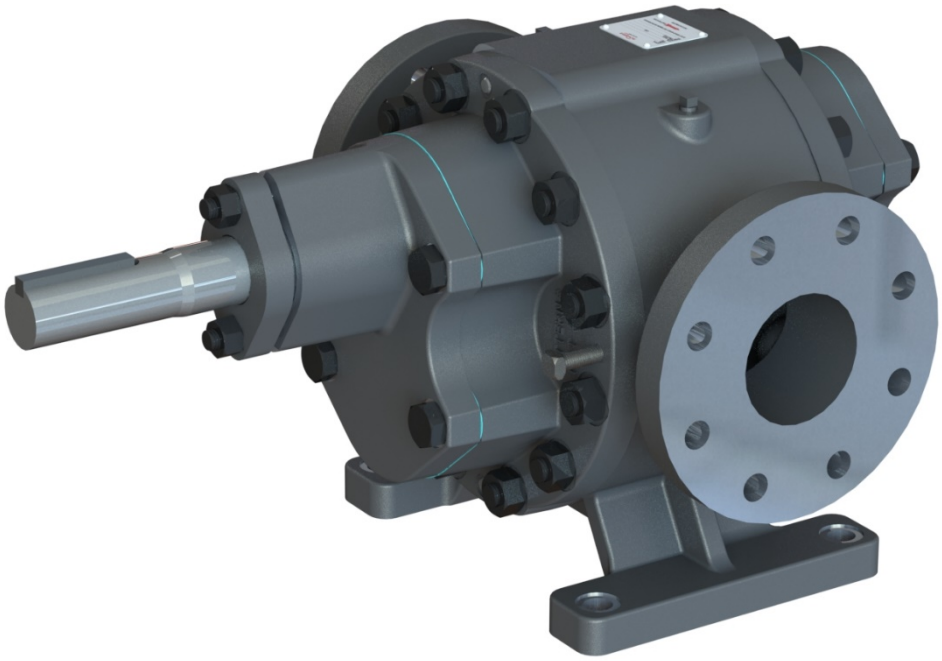


Figure 1: Isometric View of a GR Rotary Pump

The GR pump is a gear type rotary pump designed for handling viscous liquids at moderate pressures. As such, it depends upon accuracy of assembly and close internal clearances for efficient operation. Pumping action is achieved by liquid being carried around in the space between the gear teeth and the pump body and being forced out as the teeth mesh on the discharge side. It is the close clearances around the gear that prevent liquid from leaking back to the suction side. This enables the pump to build up pressure needed to force liquid through the discharge pipe. Double helical impeller gears provide smooth pulsation free flow and heavy-duty bearings support the loads that discharge pressure imposes on the impeller gears.

3.2 Design

3.2.1 Body

The pump body is designed for equal size suction and discharge flanges. For size 3GRs and below, relief valve ports are tapped in the top of the body. Refer to 3.6.3.2 for more relief valve information. This option is not available on larger sizes. Jacketed bodies are also available.

3.2.2 Sideplate

Sideplates are designed to hold the bearings in place. They are dowel pinned to the body to accurately align the bearings and rotating element. Jackscrews are provided to remove the sideplates from the body.

3.2.3 Stuffing Box

The stuffing box is designed to be for both packing and a mechanical seal. A tapped hole is accurately located to position the seal collar and set the seal working distance. If packing is used, this hole can simply be ignored. Jacketed stuffing boxes are available. Size 5 and 6 GRs have ports to switch the sideplate lubrication plugs without disassembling the pump.

3.2.4 End Cover

The end cover is bolted to the sideplate on the non-drive end. Size 5 and 6 GRs have ports to switch the sideplate lubrication plugs without disassembling the pump.

3.2.5 Rotor

GR rotors are herringbone style gears to allow for smooth, higher efficient flow. The rotors create no axial thrust.

3.2.6 Shafts

GRs have two shafts in each pump, a drive and driven shaft. The driven shaft is completely encased in the pump and the drive shaft is coupled to the motor or gear reducer.

3.2.7 Bearings/Bushings

Product-lubricated roller bearings or sleeves bearings are used in all GR pumps, depending on the operation temperature. Bearings on each side of the rotor lessen the shaft deflection and lead to a more reliable pump.

3.2.8 Driver

The driver is normally an electric motor. A speed reducer is required for a size 5GR and 6GR. A reducer may be needed on smaller sizes depending on the desired output.

3.3 Configurations

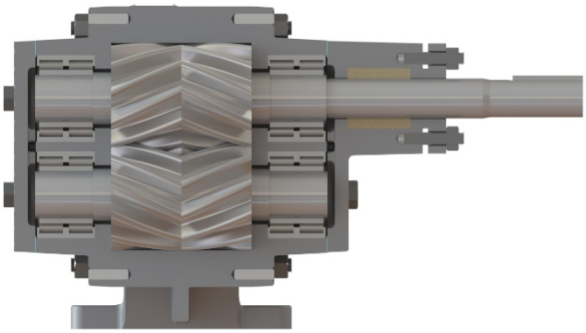
GR pumps have a variety of configurations that are spelled out in the name with different letters. The below section explains each configuration. Many configurations can be combined and some are exclusive to each other.

Table 3: GR Configurations

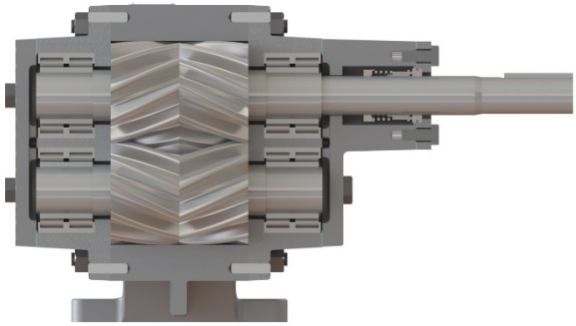
Letter	Header	Description
GR	Packed Box	This is a standard GR with packing in the stuffing box. Letters will be added to the "GR" text to spell out the other configurations.
"M"	Mechanical Seal	Standard GR except with a mechanical seal. The standard seal is a component seal.
"W"	Wide Rotor	Wide rotors provide more flow. Because of the flow increase the flange size also increases. For example, a 5GRW is a standard 4GR with wide rotors. Wide rotors cannot be combined with jacketed bodies.
"H"	High Pressure	Higher pressure is achieved by narrow rotors. Same as a standard GR except filler plates go on either side of the narrow rotors. This is only available for a size 1-1/2, 4, and 6 GR.
"J"	Jacketed Body	Body has a jacket for either heating or cooling. This is commonly paired with a jacketed stuffing box but can have a standard stuffing box as well. See connections (section 3.6.3.3) for more details.
"L"	Jacketed Stuffing Box	Stuffing box has a jacket for either heating or cooling. The L comes from the longer stuffing box that fits double the packing rings and has a lantern ring for lubrication. This is commonly paired with a jacketed body but can have a standard body as well. See connections (section 3.6.3.3) for more details.
"MI"	Inboard Bearing	There is a ball bearing on the coupling side of the pump. This is for non-direct drive arrangements that have side loads on the shaft. For this arrangement a mechanical seal is required.

"D" or "DM"	Dual Stuffing Box	Two stuffing boxes are present on either side of the pump. "D" is for dual packing and "DM" is for dual mechanical seal. The stuffing box arrangements are the same as a GR or GRM.
"S"	Special	A special GR and could be a variety of special or custom configurations.

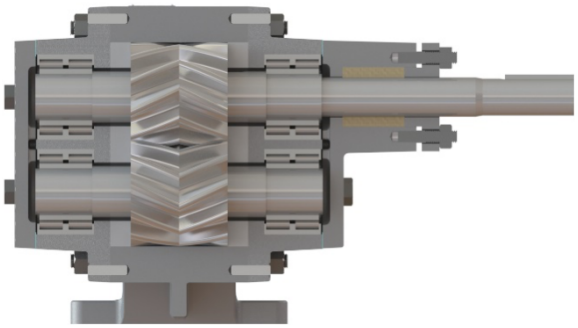
Figure 2: Cross-Sectionals for 4GR Variants



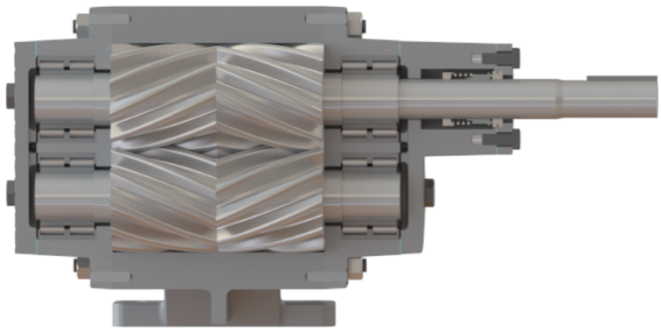
4GR



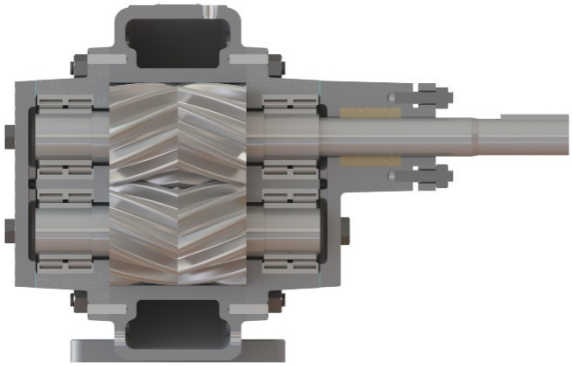
4GRM



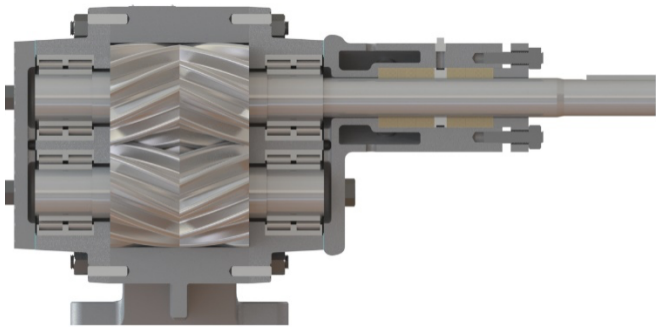
4GRH



5GRWM



4GRJ



4GRL

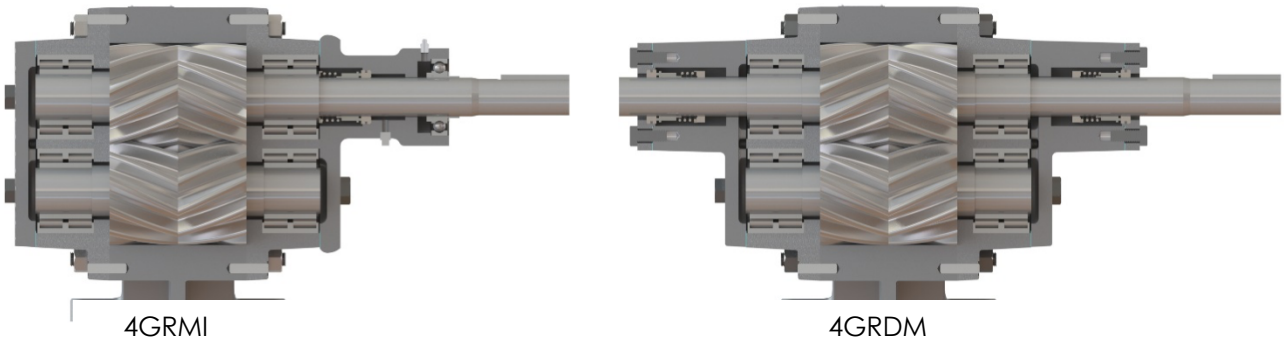
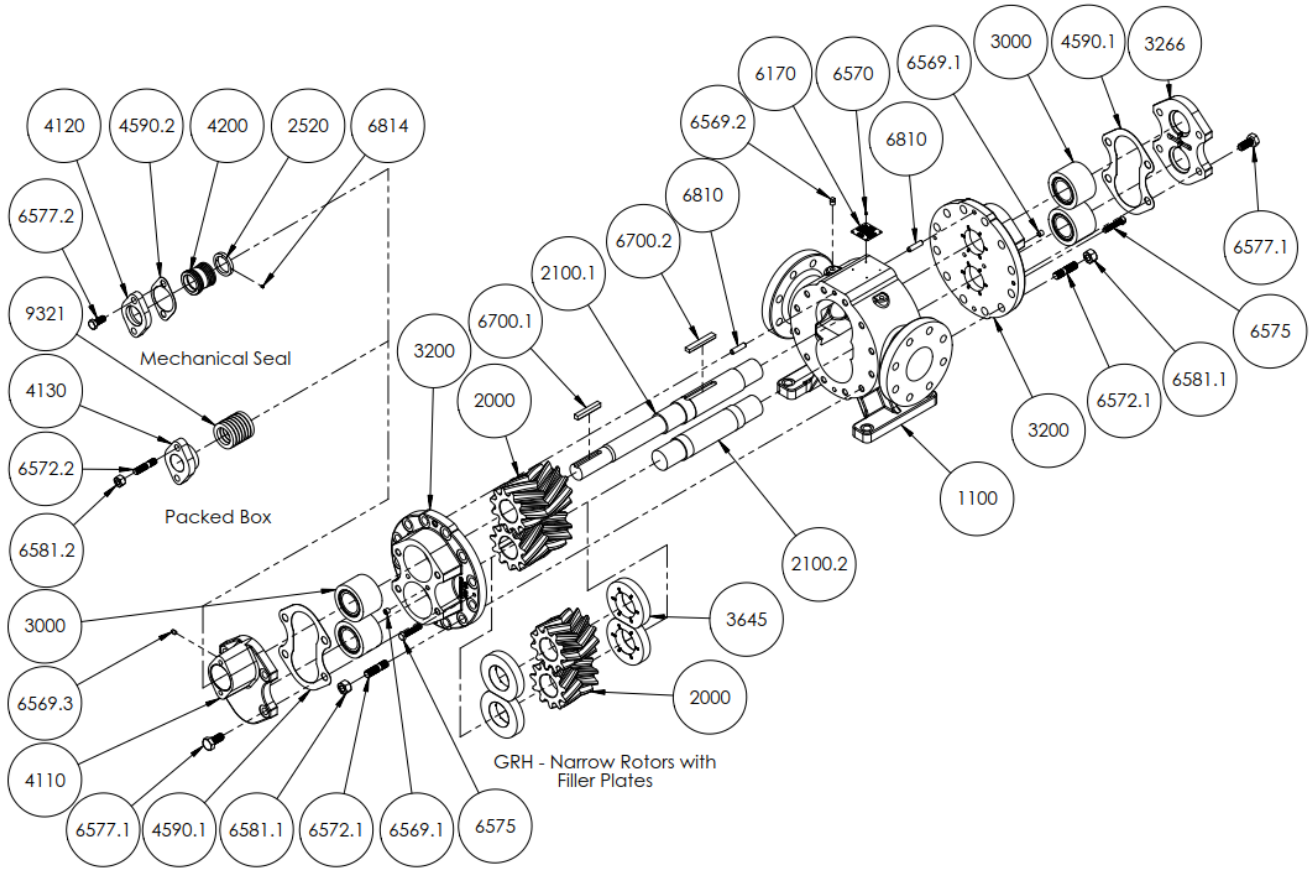


Figure 3: GR/GRW/GRH Exploded View



1100	Body
2000	Rotor
2100.1	Shaft - Driving
2100.2	Shaft - Driven
2520	Locking Collar
3000	Roller Bearing
3200	Sideplate
3266	Bearing End Cover
3645	Filler Plate
4110	Stuffing Box

6569.2	Plug - Body
6569.3	Plug - Stuffing Box
6569.4	Plug - End Cover (5 & 6 GR only)
6570	Drive Screw - Nameplate
6572.1	Stud - Body
6572.2	Stud - Gland
6575	Jacking Screw
6577.1	Capscrew - St. Box / End Cover
6577.2	Capscrew - Gland
6581.1	Nut - Body

4120	Gland - Mechanical Seal
4130	Gland - Packing
4200	Mechanical Seal
4590.1	Gasket - St. Box / End Cover
4590.2	Gasket - Gland
6170	Nameplate
6569.1	Plug - Sideplate (Countersunk)

6581.2	Nut - Gland
6700.1	Key - Coupling
6700.2	Key - Rotor
6810	Dowel Pin - Body
6814	Set Screw
9321	Packing

Figure 4: GR/GRW/GRH Sectional View

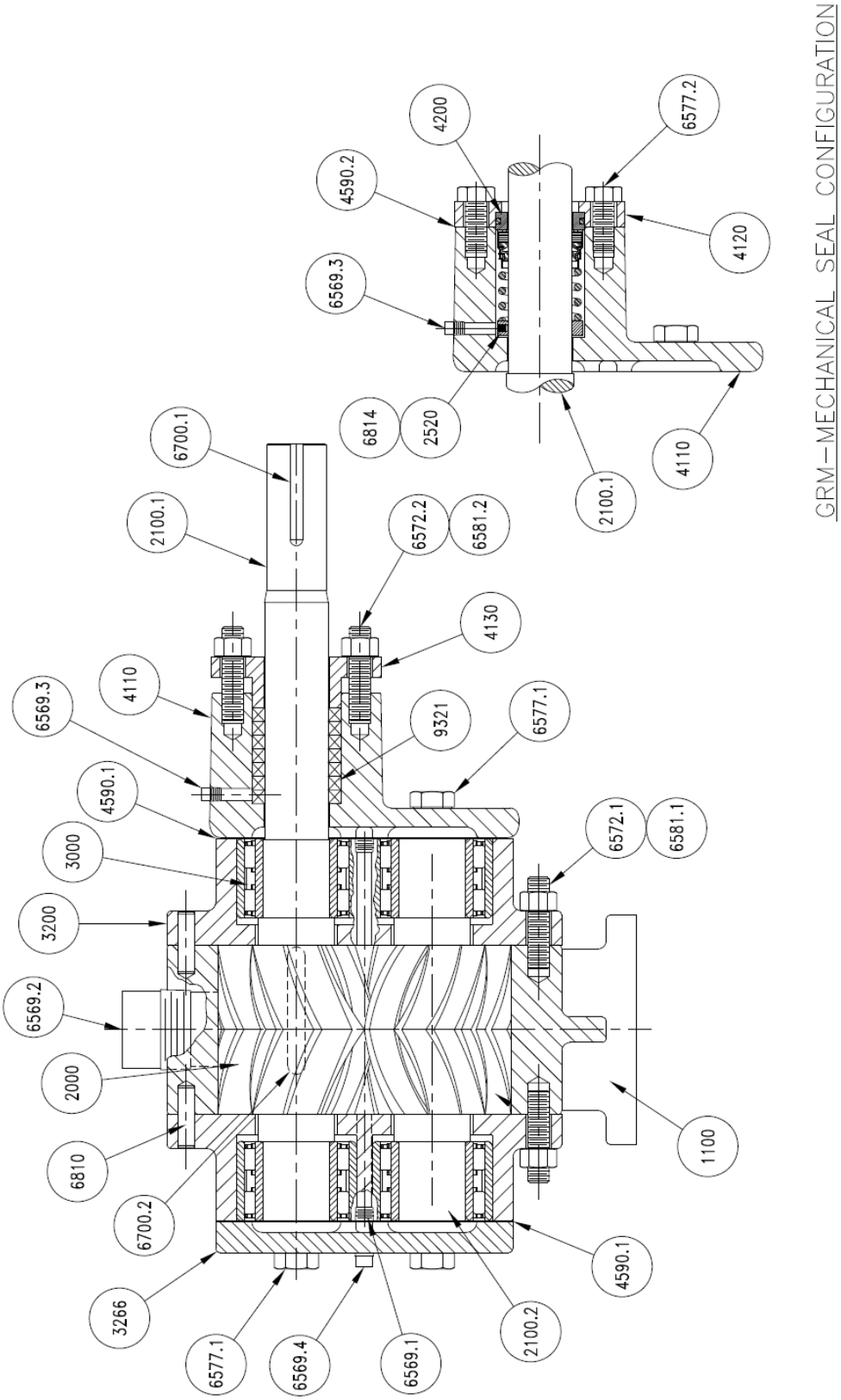
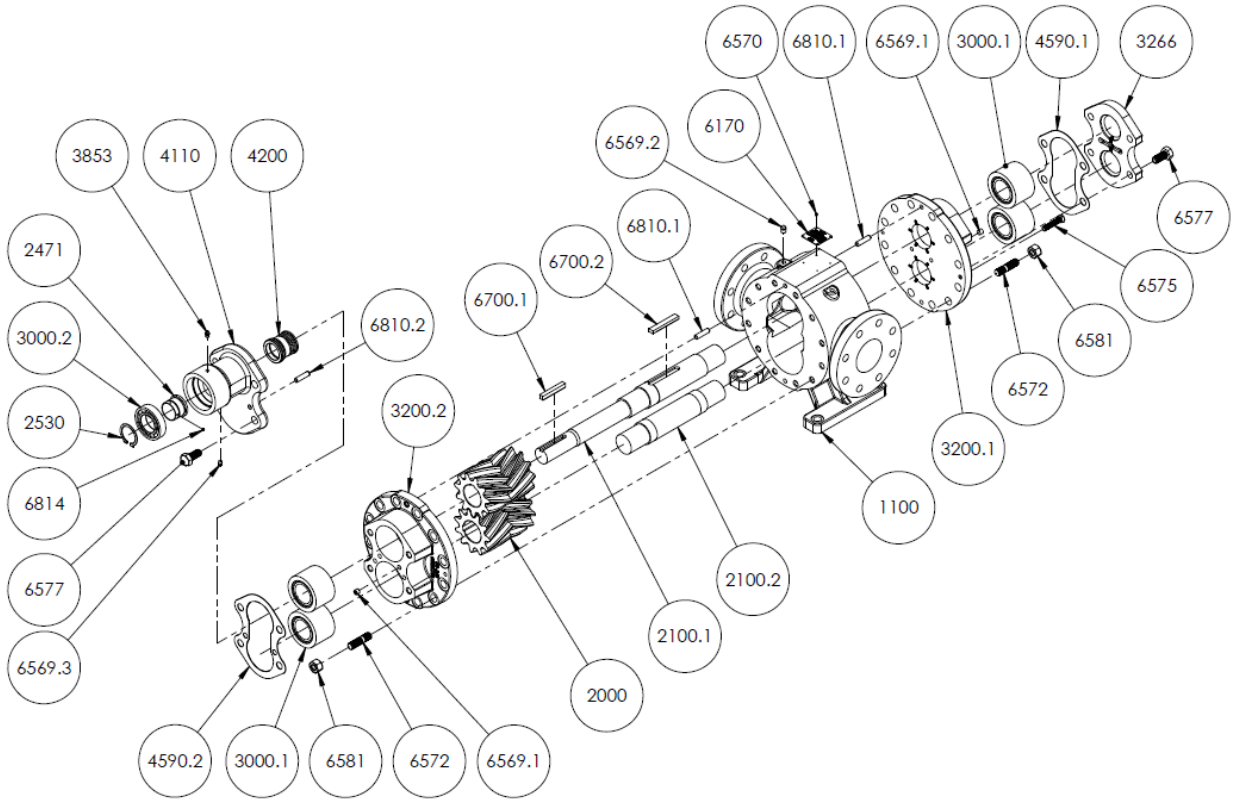


Figure 5: GRMI Exploded View



1100	Body
2000	Rotor
2100.1	Shaft - Driving
2100.2	Shaft - Driven
2471	Bearing Sleeve Adapter
2530	Retaining Ring
3000.1	Roller Bearing
3000.2	Ball Bearing
3200.1	Sideplate
3200.2	Sideplate - Dowel Pin
3266	Bearing End Cover
3853	Fitting - Grease
4110	Stuffing Box
4200	Mechanical Seal
4590.1	Gasket - End Cover
4950.2	Gasket - St. Box

6170	Nameplate
6569.1	Plug - Sideplate (Countersunk)
6569.2	Plug - Body
6569.3	Plug - Stuffing Box
6569.4	Plug - End Cover (5 & 6 GR only)
6570	Drive Screw - Nameplate
6572	Stud - Body
6575	Jacking Screw
6577	Capscrew - St. Box / End Cover
6581	Nut - Body
6700.1	Key - Coupling
6700.2	Key - Rotor
6810.1	Dowel Pin - Body
6810.2	Dowel Pin - Stuffing Box
6814	Set Screw

Figure 6: GRMI Sectional View

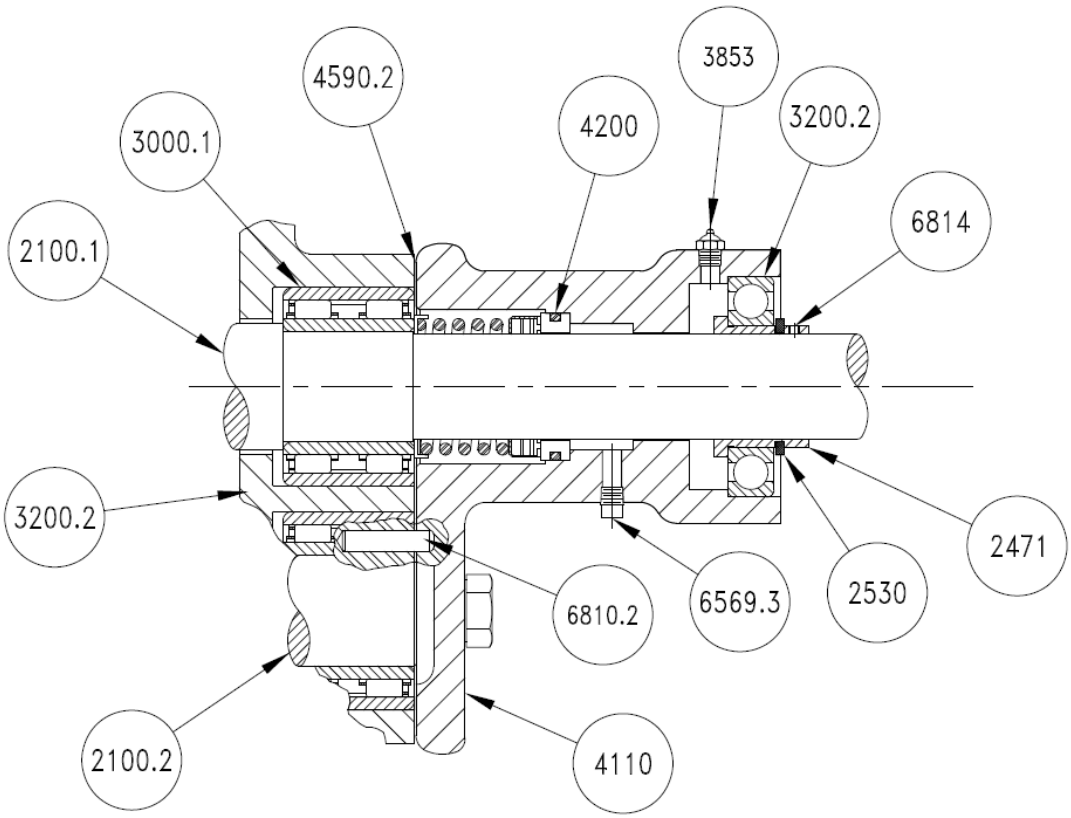
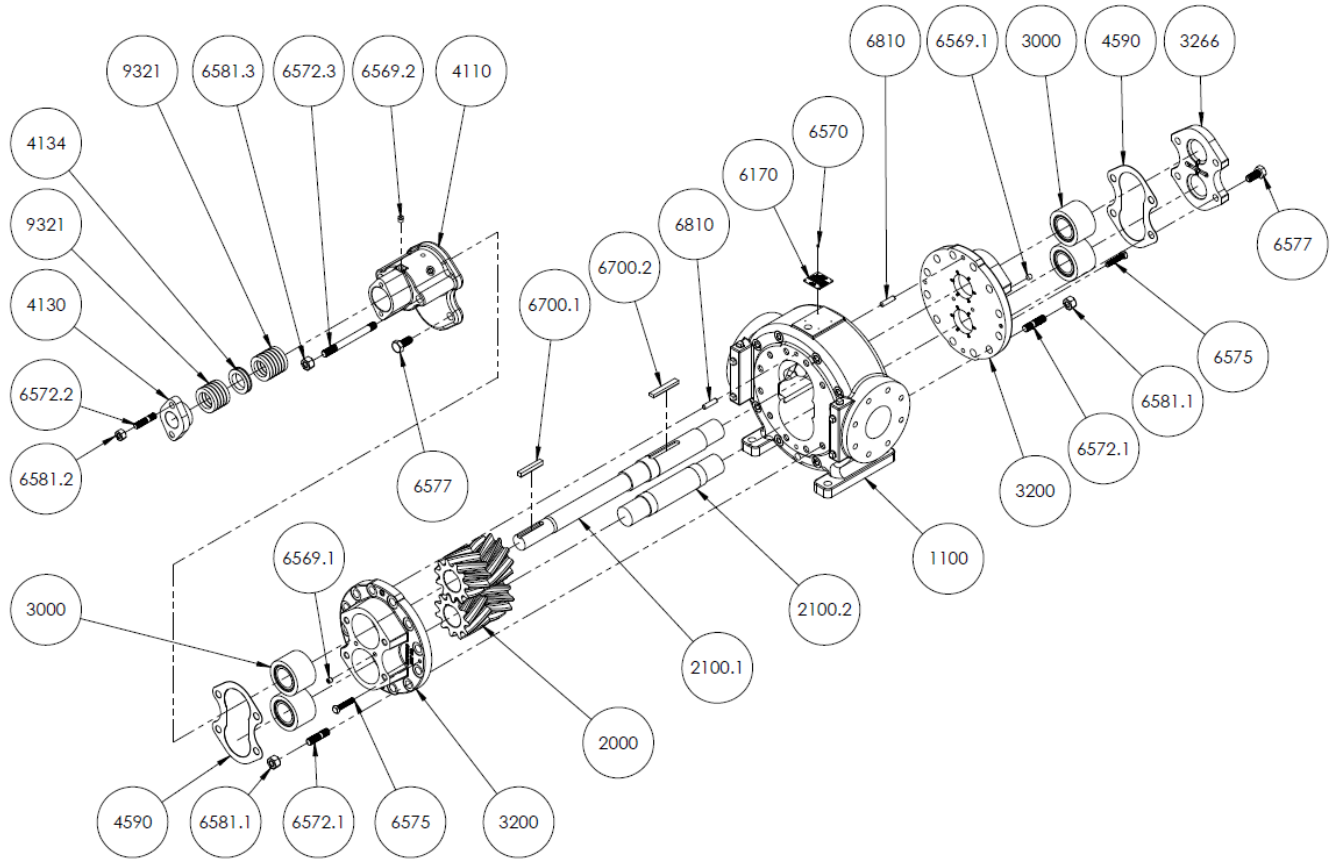


Figure 7: GRJL Exploded View



1100	Body
2000	Rotor
2100.1	Shaft - Driving
2100.2	Shaft - Driven
3000	Roller Bearing
3200	Sideplate
3266	Bearing End Cover
4110	Stuffing Box
4130	Gland - Packing
4134	Lantern Ring
4590	Gasket - St. Box / End Cover
6170	Nameplate
6569.1	Plug - Sideplate (Countersunk)
6569.2	Plug - Stuffing Box

6569.3	Plug - End Cover (5 & 6 GR only)
6570	Drive Screw - Nameplate
6572.1	Stud - Body
6572.2	Stud - Gland
6572.3	Stud - GRL Stuffing Box
6575	Jacking Screw
6577	Capscrew - St. Box / End Cover
6581.1	Nut - Body
6581.2	Nut - Gland
6581.3	Nut - GRL Stuffing Box
6700.1	Key - Coupling
6700.2	Key - Rotor
6810	Dowel Pin - Body
9321	Packing

Figure 8: GRJL Sectional View

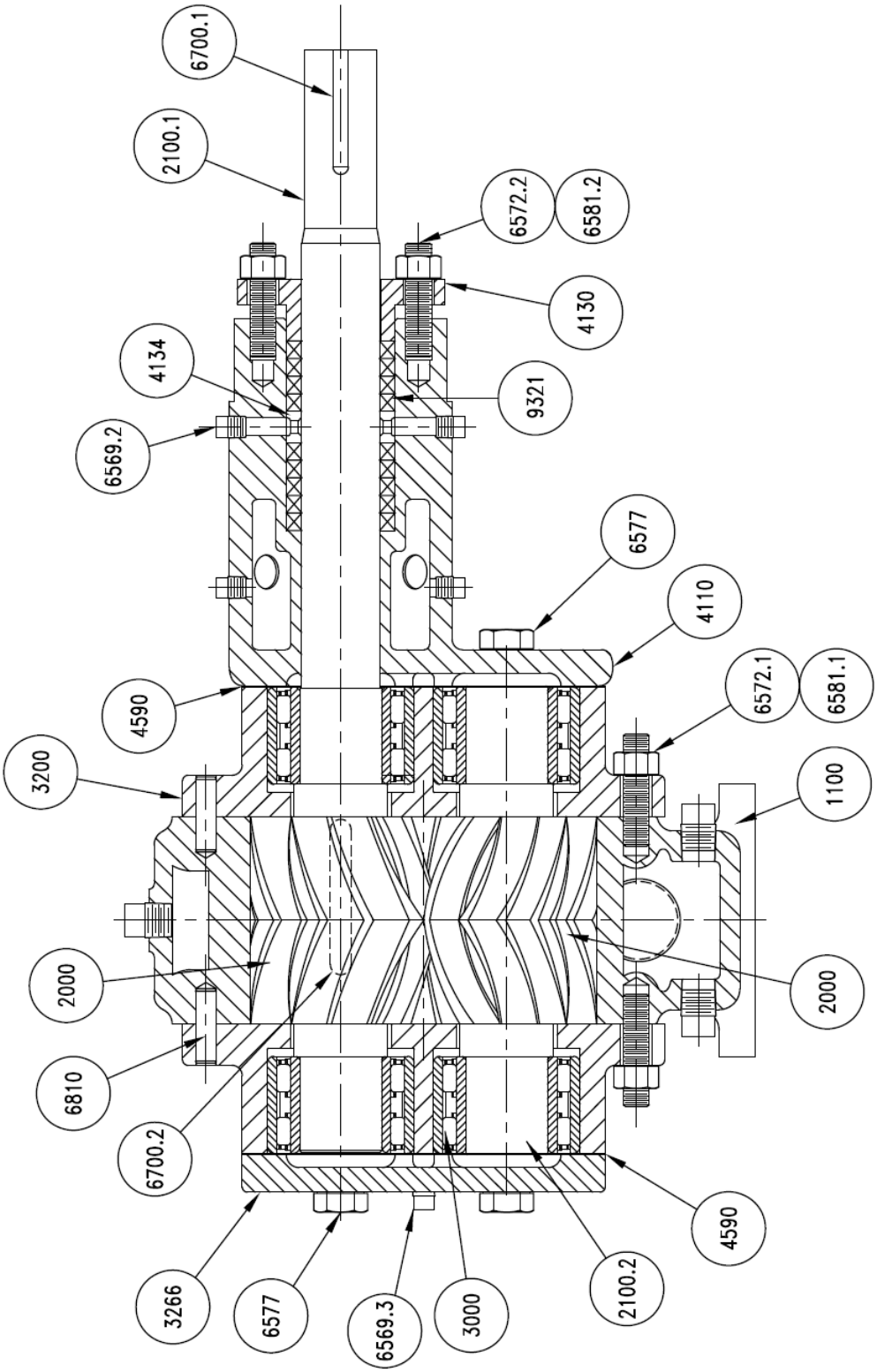
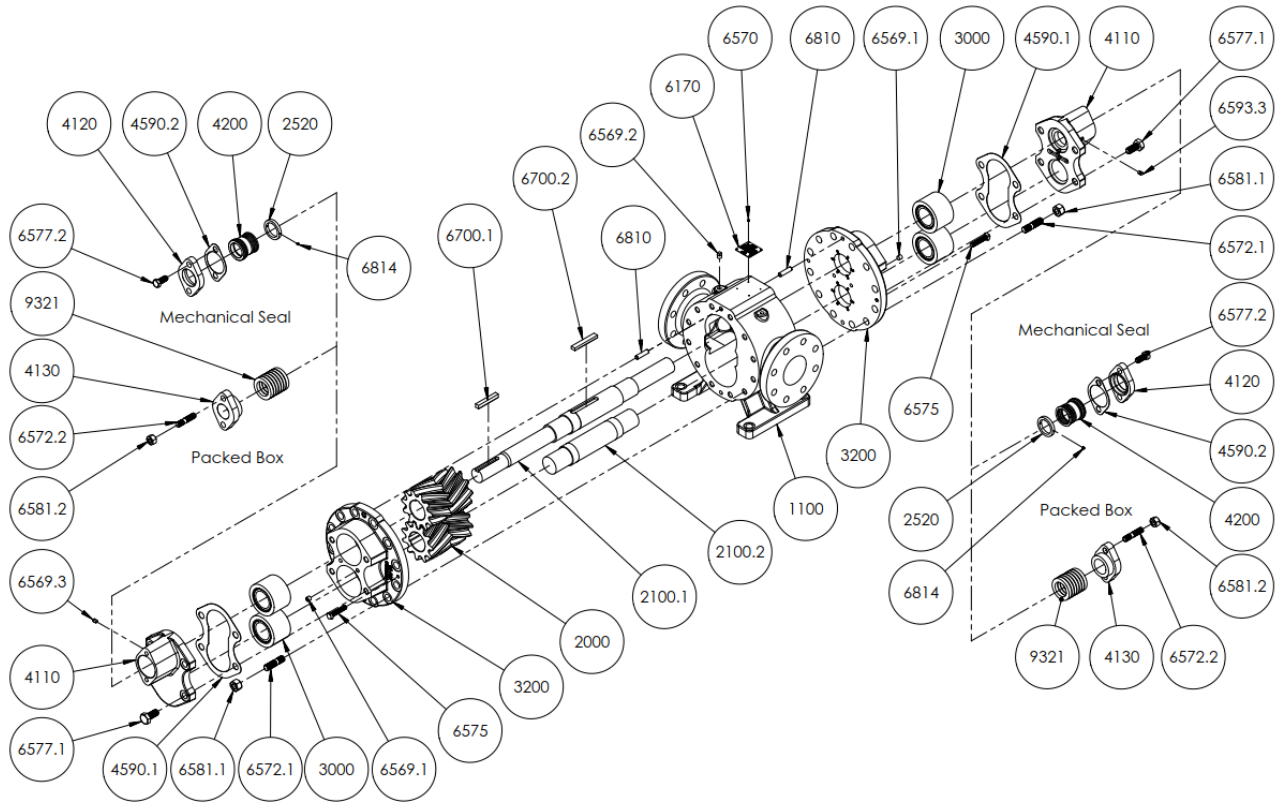


Figure 9: GRD/GRDM Exploded View



1100	Body
2000	Rotor
2100.1	Shaft - Driving
2100.2	Shaft - Driven
2520	Locking Collar
3000	Roller Bearing
3200	Sideplate
4110	Stuffing Box
4120	Gland - Mechanical Seal
4130	Gland - Packing
4200	Mechanical Seal
4590.1	Gasket - St. Box / End Cover
4590.2	Gasket - Gland
6170	Nameplate
6569.1	Plug - Sideplate (Countersunk)

6569.2	Plug - Body
6569.3	Plug - Stuffing Box
6570	Drive Screw - Nameplate
6572.1	Stud - Body
6572.2	Stud - Gland
6575	Jacking Screw
6577.1	Capscrew - St. Box / End Cover
6577.2	Capscrew - Gland
6581.1	Nut - Body
6581.2	Nut - Gland
6700.1	Key - Coupling
6700.2	Key - Rotor
6810	Dowel Pin - Body
6814	Set Screw
9321	Packing

Figure 10: GRD/GRDM Sectional View

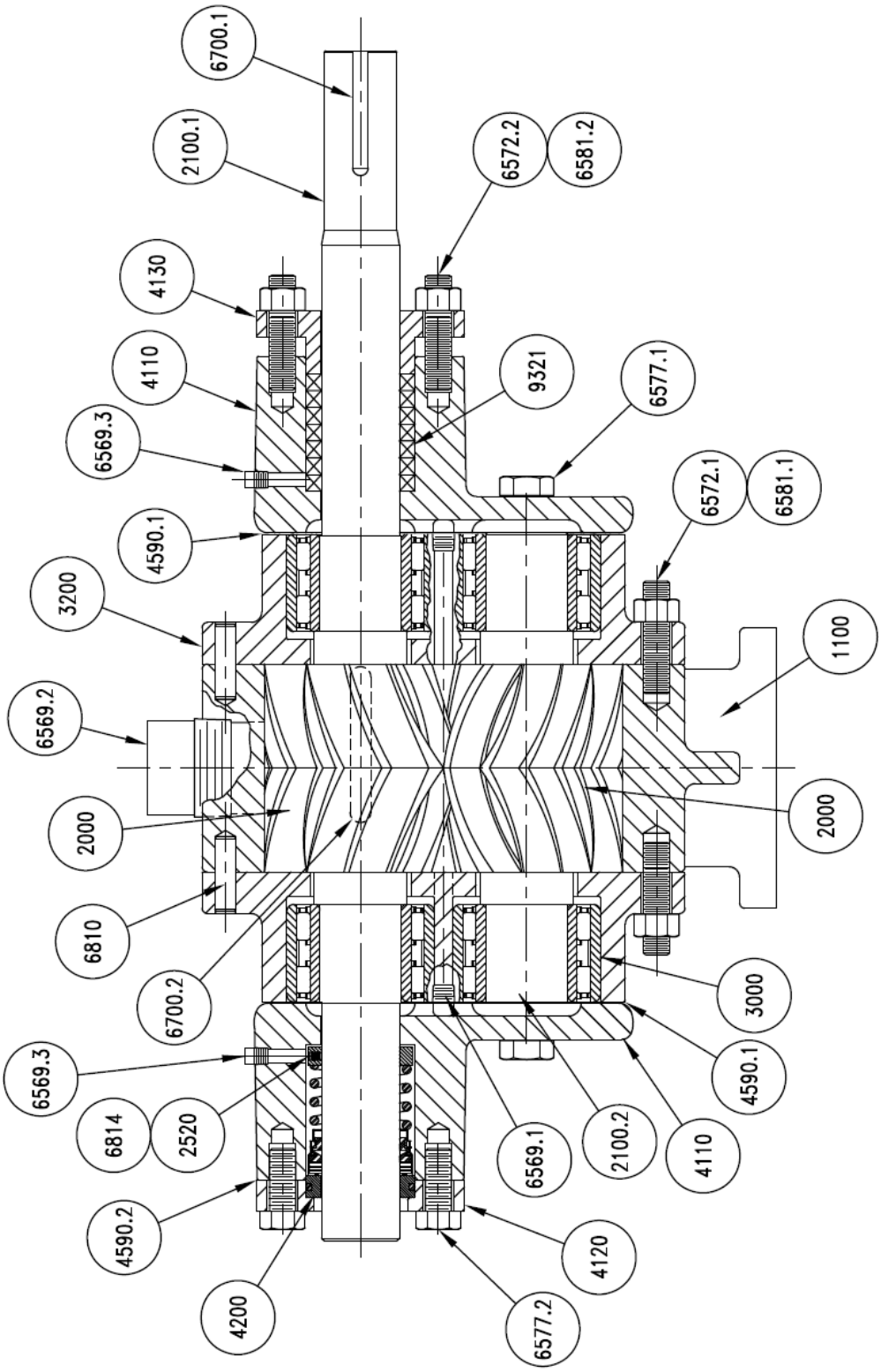
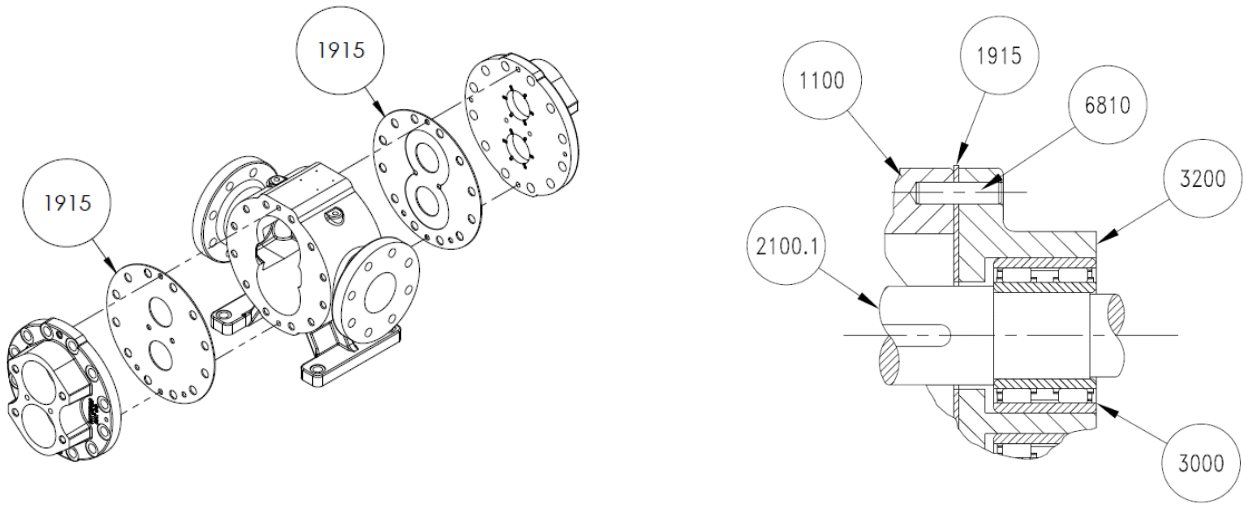
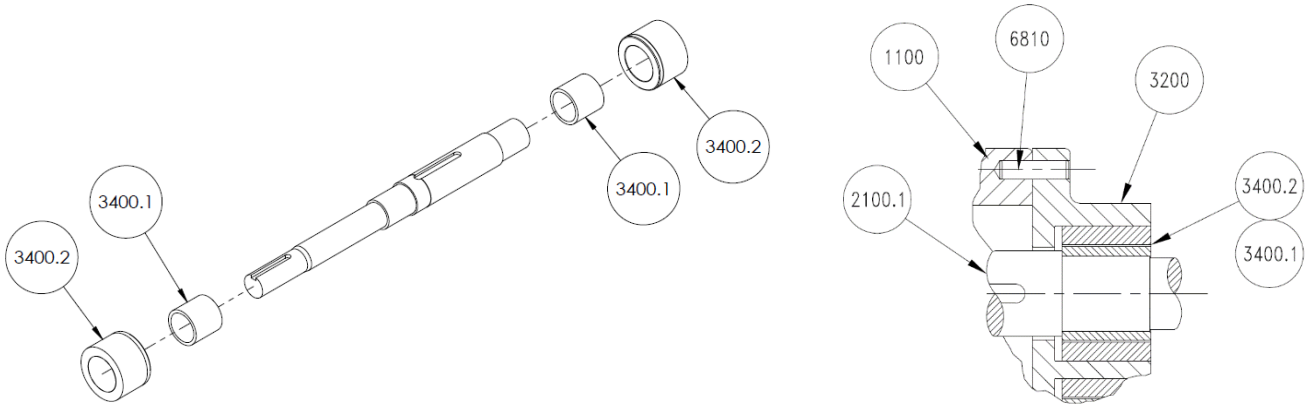


Figure 11:
Insurok Wear Plates



1915	Insurok Wear Plates

Figure 12: Sleeve Bearings



3400.1	Sleeve Bearing – Inner Race
3400.2	Sleeve Bearing – Outer Race

3.4 Scope of delivery

The exact scope of the delivery is stated in the order documentation.

3.5 Function description

The GR pump is a gear type rotary pump designed for handling viscous liquids at moderate pressures. As such, it depends upon accuracy of assembly and close internal clearances for efficient operation. Pumping action is achieved by liquid being carried around in the space between the gear teeth and the pump body and being forced out as the teeth mesh on the discharge side. It is the close clearances around the gear that prevent liquid from leaking back to the suction side. This enables the pump to build up pressure needed to force liquid through the discharge pipe. Double helical impeller gears provide smooth pulsation free flow and heavy-duty bearings support the loads that discharge pressure imposes on the impeller gears.

3.6 Connections

3.6.1 Electrical connections


Electrical connections must be made by a qualified electrician in accordance with relevant local, national, and international regulations.


It is important to be aware of the EUROPEAN DIRECTIVE on potentially explosive areas where compliance with IEC 60079-14 is an additional requirement for making electrical connections


It is important to be aware of the EUROPEAN DIRECTIVE on electromagnetic compatibility when wiring up and installing equipment on site. Attention must be paid to ensure that the techniques used during wiring/installation do not increase electromagnetic emissions or decrease the electromagnetic immunity of the equipment, wiring, or any connected devices. If in any doubt, contact Flowserve for advice.


The motor must be wired up in accordance with the motor manufacturer's instructions (normally supplied within the terminal box) including any temperature, earth leakage, current and other protective devices as appropriate. The identification nameplate should be checked to ensure the power supply is appropriate.


A device to provide emergency stopping must be fitted. If not supplied pre-wired to the pump unit, the controller/starter electrical details will also be supplied within the controller/starter. For electrical details on pump sets with controllers see the separate wiring diagram.

3.6.2 Piping connections


Protective covers are fitted to both the suction and discharge flanges of the casing and must be removed prior to connecting the pump to any pipes.

All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the dead

weight of the pipe, its contents or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fasteners diameter but that do not bottom out in the tapped holes before the joint is tight.

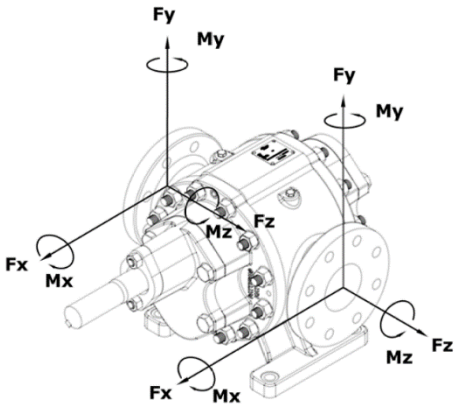


Table 4: Nozzle Forces and Moments

Cast Iron Construction, Nozzle Loads		
Pump Size	Fx, Fy, Fz (lbs.)	Mx, My, Mz (ft-lbs.)
1-1/2 GR	70	115
2 GR 2GRW	90	150
2-1/2 GR 2-1/2 GRW	115	190
3 GR 3 GRW	135	225
4 GR 4 GRW	180	300
5 GR 5 GRW	225	375
6 GR	270	450

Cast Steel Construction, Nozzle Loads		
Pump Size	Fx, Fy, Fz (lbs.)	Mx, My, Mz (ft-lbs.)
1-1/2 GR	115	190
2 GR 2GRW	150	250
2-1/2 GR 2-1/2 GRW	190	315
3 GR 3 GRW	225	375
4 GR 4 GRW	300	500
5 GR 5 GRW	375	625
6 GR	450	750

3.6.3 Auxiliary connections

3.6.3.1 Packing/Seal

GR pumps can be fitted with either packing or a seal (though it becomes a GRM with a seal). This depends on the application. If there are questions about which sealing should be used an applications engineer should be contacted.

It is Flowserve standard to ship pump with packing/seal already installed. If the seal is shipped separate or replaced the installation instructions should be shipped. Refer to section 8.6.2 when converting between packing and mechanical seals.

⚠CAUTION Failure to ensure that the packing/seal is installed may result in serious leakage of the pumped fluid.

⚠CAUTION Failure to ensure packing/seal lubrication at start-up may result in excessive heat, pump failure, thermal event (fire).

⚠CAUTION Packing gland adjustment is necessary to allow process fluids to lubricate the packing

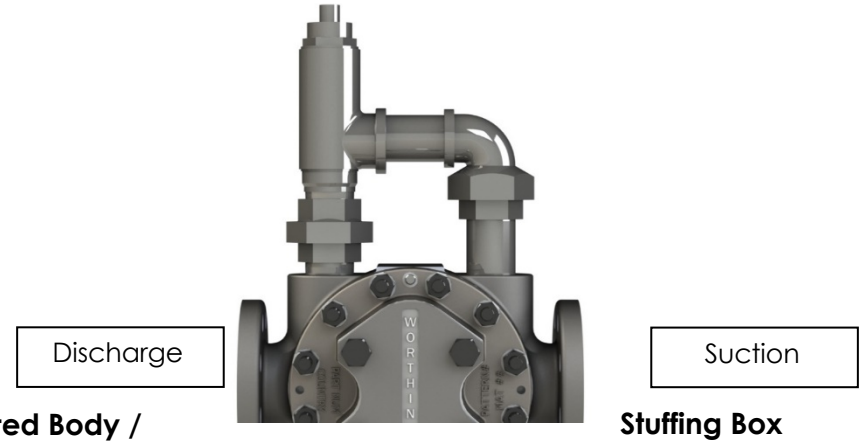
3.6.3.2 Relief Valve

A relief valve and bypass piping is an optional extra available on a type GR pump size 1 ½ -3 and GRW size 2-4 with exception of GRJ pumps.

The relief valve is set by removing the cap and adjusting the compression screw. The range of adjustment depends on the size valve. If the desired pressure is not in range, the valve should be changed. Maximum operating pressure for relief valves is 300 PSI. These relief valves are safety valves and are not recommended for continuous bypass service. Prolonged bypassing with a closed discharge line can result in excessive heating and possible pump failure.

If your pump does not have a relief valve on the pump it is required your system has one. Positive displacement pumps can generate large pressures if the discharge becomes blocked, relief valves should be present for safety reasons.

Figure 13: Integral Relief Valve

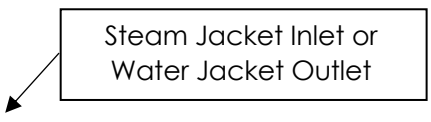


3.6.3.3 Jacketed Body / Stuffing Box

Jacketed bodies and/or stuffing boxes are available for all sizes. If it is a steam jacket the inlet is located on the top and the outlet is at the bottom. On liquid jackets, the inlet is at the bottom and the outlet at the top. Valves should be installed in the inlet lines to regulate the quantity of the jacket supply. The max pressure for the jacket is 150 PSI and the max temperature is 350°F for steam and 500°F for oil.

These parts have additional holes that are used for other reasons. These holes are not designed for jacket use and should be plugged/welded shut permanently depending on the material.

Figure 14: Jacketed Body



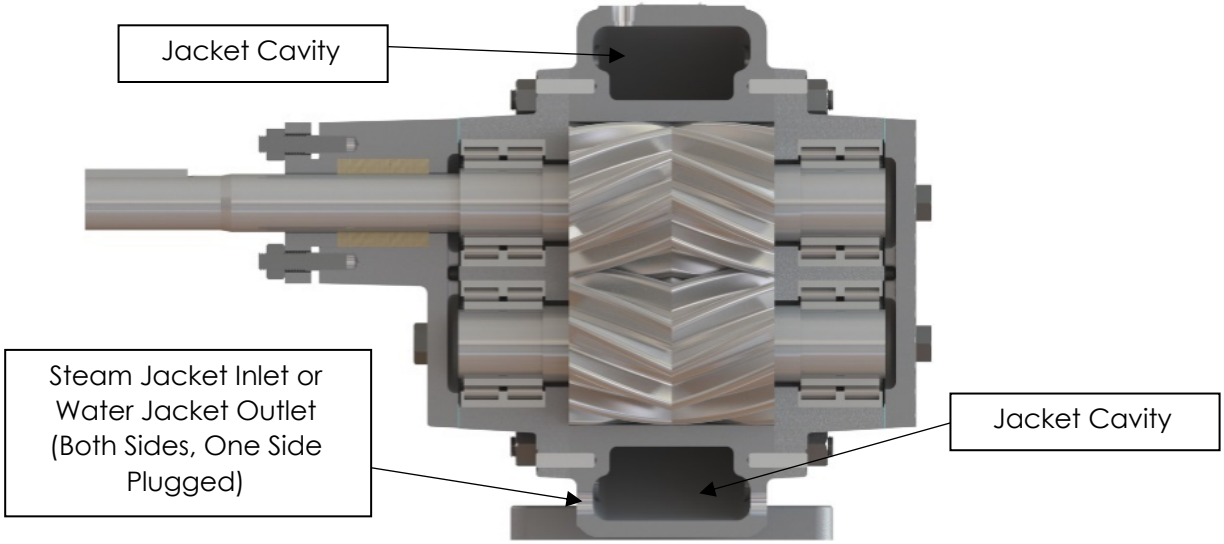
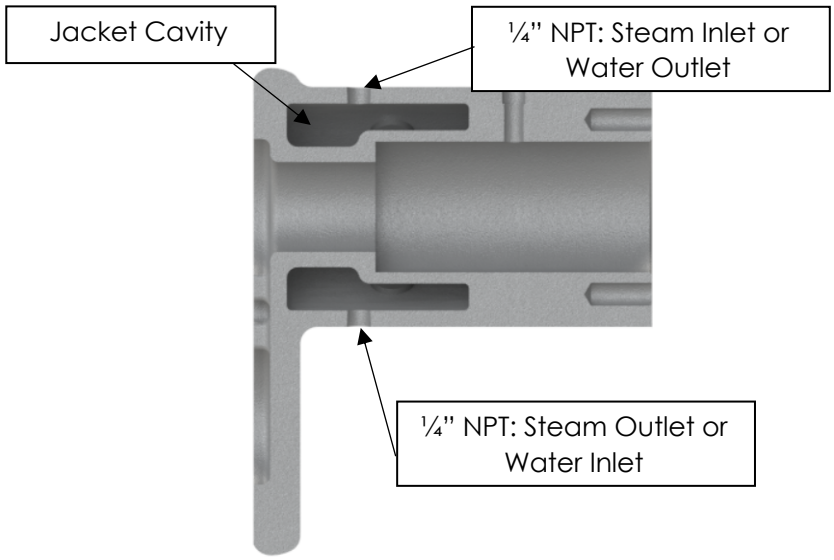


Figure 15: Jacketed Stuffing Box



3.7 Controls

3.7.1 Protection system

 The following protection systems are recommended particularly if the pump is installed in a potentially explosive area or is handling a hazardous liquid. If in doubt consult Flowserve.

If there is any possibility of the system allowing the pump to run against a closed valve or below minimum continuous safe flow a protection should be installed to ensure the temperature of the liquid does not rise to an unsafe level.

If there are any circumstances in which the system can allow the pump to run dry, or start up empty, a power monitor should be fitted to stop the pump or prevent it from being started. This is particularly relevant if the pump is handling a flammable liquid.

If leakage of product from the pump or its associated sealing system can cause a hazard it is recommended that an appropriate leakage detection system is installed.

To prevent excessive surface temperatures at bearings it is recommended that temperature or vibration monitoring is carried out.

3.8 Accessories

If you have purchased a bare shaft pump, the following items are required for operations.

1. Mechanical Seal or Packing
2. Coupling
3. Coupling Guard
4. Baseplate
5. Driver (typical a NEMA motor)

3.9 Tools, equipment, and fixtures

See Section 8.2, Special tools, for necessary tools/special tools needed for disassembly, maintenance, and reassembly.

4 Packaging, Transportation and Storage

4.1 Consignment receipt

Immediately after receipt of the product/system it must be checked against the delivery/shipping documents for its completeness and that there has been no damage in transportation. Any shortage and/or damage must be reported immediately to Flowserve and must be received in writing within one month of receipt of the equipment. Later claims cannot be accepted.

The following symbols are used to label the packaging:

	This side up		Fragile
	Keep dry		Protect from direct sunlight
	Centre of gravity		Do not use hooks
	Attachment point		

4.2 Unpacking

The pump and its associated equipment were carefully inspected at the factory prior to shipment, to ensure quality compliance. It is suggested that the equipment be inspected on arrival and that any irregularities or damage be reported to the carrier immediately.

The condition of the skid and covering is indicative of the way the shipment was handled. Broken skids, torn coverings, bent hold down bolts, broken straps, etc. indicate rough handling. The protective covers on the pump nozzles should be in place and undamaged.

In general, care is to be taken when removing crating, coverings, and strapping in order not to damage any auxiliary equipment and/or the paint finish.

Check any crate, boxes, or wrappings for any accessories or spare parts that may be packed separately with the equipment or attached to the side wall of the box or equipment.

Each product has a unique serial number. Check that this number corresponds with that advised and always quote this number in correspondence when ordering spare parts or further accessories.

Boxes, crates, pallets, or cartons may be unloaded using forklift vehicles or slings depending on their size and construction.

4.3 Packaging

The equipment has been packaged in a suitable container or transporting device that protects the material from exterior forces or impact, vibration, and environmental conditions normally encountered during transportation. Flowserve completes the following in preparation for shipment:

1. All items are inspected for cleanliness immediately before packaging. Dirt, oil residue, metal chips or other forms of contamination are removed by approved cleaning methods.
2. Checks the drive shaft spins freely either by hand or with a spanner wrench, depending on the size
3. Components which are not immediately packaged, are protected from contamination and oxidation. Package with a barrier such that water vapor, salt air, dust, dirt and other forms of contamination do not penetrate the package.
4. Items that can be damaged by condensation trapped within the package are packaged with approved desiccant inside the water vapor proof barrier or by an equivalent method.
5. Items and their containers are properly identified by markings.

It is Flowserve's responsibility to ensure that materials and products are handled, prior to shipment, in a manner that will prevent deterioration or damage to the product or personnel.

Material that has been subjected to conditions that may result in hidden damage are disassembled as required and inspected. A record of the inspection is retained in the appropriate job file or quality records.

Additional care should be taken, by all involved parties, to ensure that the quality of items being loaded/unloaded will not be damaged.

Before shipping, a packing slip is prepared and fasten it to the unit. The packing slip contain the following information:

1. Customer's Purchase Order Number.
2. Flowserve Job Number.
3. Customer's Name and Address.
4. "Ship to" Address.
5. Quantity.
6. Description.
7. Date Shipped.
8. Carrier Used.

For shipments with more than one-unit container or package for any given order, each parcel is marked as 1 of 3, 2 of 3, etc., and contain a copy of the packing list.

4.4 Transportation

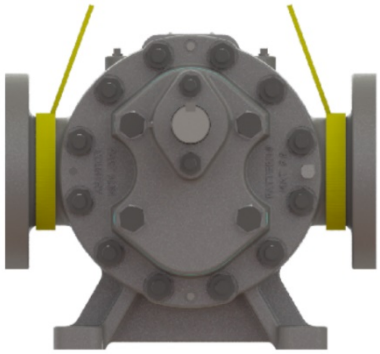
 A crane must be used for all pump sets more than 23 kg (50 lb). Fully trained personnel must carry out lifting, in accordance with local regulations.

Sling, ropes, and other lifting gear should be positioned where they cannot slip and where a balanced lift is obtained. The angle between sling or ropes used for lifting must not exceed 60˚.

Standard GR pumps are generally lifted by putting a sling around the suction nozzle and discharge nozzle. Ensure the sling is tight around both nozzles. A hand might be needed on the drive shaft to balance the pump.

For jacketed pumps with no flange necks slings can be placed underneath the sideplates. If the slings cannot firmly grip the pump from the sideplate eyebolts may be needed in the body or flange taps.

Figure 16: Lifting Plan for GR Pump



⚠CAUTION Pumps and motors often have integral lifting lugs or eye bolts. These are intended for use in only lifting the individual piece of equipment.

⚠CAUTION Do not use eye bolts or cast-in lifting lugs to lift pump, motor and baseplate assemblies.

⚠CAUTION Care must be taken to lift components or assemblies above the center of gravity to prevent the unit from flipping.

4.5 Storage

If the pumping unit is to be placed in storage, it should be inspected and stored in a dry location. Parts subject to attack from moisture should be coated with a protective material

1. Keep unit in clean, dry location. Leave piping connection covers in place to keep dirt out of inside of pump.
2. Rotate pump shaft by hand every two months to protect bearings.
3. If pump has been stored over three years, it is recommended that bearing housings be disassembled to clean bearings as appropriate. Pumps with packed stuffing boxes should have packing replaced if it has been left installed in the pump during this period. Seal faces should be reconditioned or replaced.

5 Installation

5.1 Inspection and preparation

Inspect and check shipping manifest immediately on receipt of shipment and report any damage or shortage to Flowserve

5.1.1 Location

The pump should be located to allow room for access, ventilation, maintenance, and inspection with ample headroom for lifting and should be as close as practicable to the supply of liquid to be pumped. Refer to the general arrangement drawing for the pump set.

5.1.2 Part Assemblies

The supply of motors and baseplates are optional. Equipment must be removed from the baseplate, when installed correctly. It is the responsibility of the installer to align the pump and motor set, as detailed in Section 5.3 Installation.

5.1.3 Protection of openings and threads

When the pump is shipped, all tapped connections, threads and all openings are covered or plugged. This protection/covering should not be removed until installation. If for any reason the pump is removed from service, this protection should be reinstalled. When equipment is removed from the baseplate, in a non-weather protected location, reinstall hardware with Henkel Loctite® 242 locker and sealant applied to thread. This prevents moisture and debris from entering unprotected threaded hole.

5.1.4 Suction Piping

One of the largest sources of rotary pump problems is faulty suction lines. The suction pipe should be clean, air-tight, no smaller than the pump suction opening and have a minimum of valves and fittings.

Where economically practical, the pipe should be one size larger than the suction opening and should have a continuous rise or fall from the source to eliminate air pockets. Gate valves on suction and discharge lines are recommended to facilitate future inspection and repairs.

A strainer is recommended if the liquid contains large foreign objects that might clog suction lines or jam the impeller gears. It is generally impractical to filter out fine abrasives, though they can cause rapid wear of bearings or close clearances. A strainer should have a net area and should permit easy cleaning.

5.2 Baseplate Mounting

Flowserve offers two types of standard GR baseplates, depending on the motor frame size. Channel steel bases will accommodate all motor frames up to and including 326T. Fabricated bases are for motor frames 364T and above.

The following instructions are for the standard bases. If a special/custom baseplate is used these steps below may not apply.

Figure 17: Channel Steel Baseplate

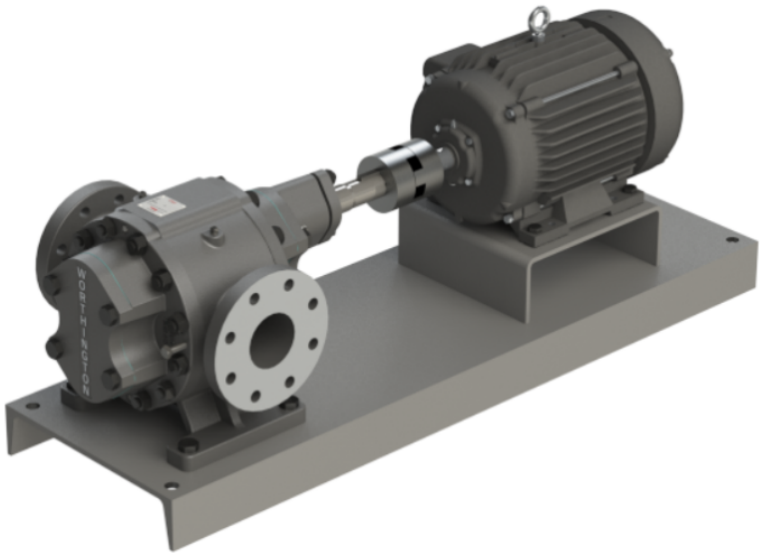
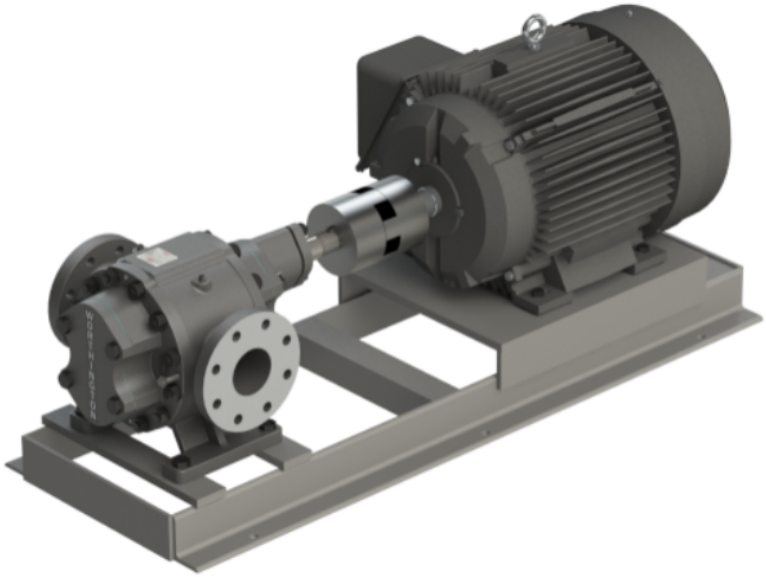


Figure 18: Fabricated Baseplate



5.2.1 Foundation

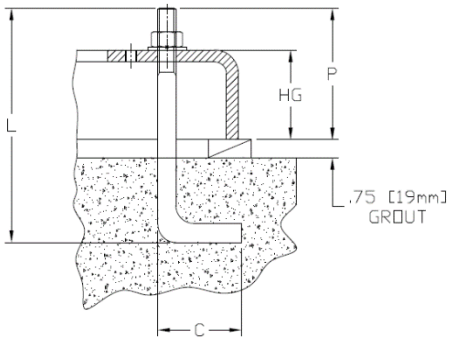
The foundation should provide permanent rigid support for the entire unit. Concrete foundations built up from solid ground will prove the most satisfactory. Ample allowance should be provided for grout in building the foundation.

Foundation bolts of the specified size should be accurately located according to drawings. Each bolt should be accurately located according to the general arrangement drawings. Each bolt should be firmly grouted in the foundation. Figures 19 and 20 show Flowserve's anchor bolt recommendation for GR pumps, depending on the type of base type and bolt size.

If more bolt flexibility is desired, each bolt can be surrounded by a pipe sleeve three or four diameters larger than the bolt. After the concrete is poured, the pipe is held solidly, while the bolts may be moved to conform to the holes in the baseplate.

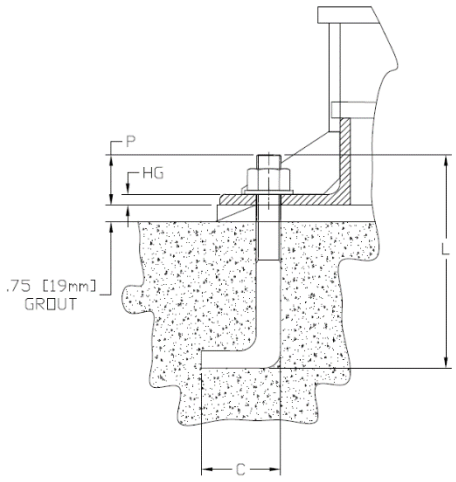
When a unit is mounted on steel work or another structure, it should be set directly over, or as close as possible to the supporting beams or walls. It should be supported that the baseplate cannot be distorted by yielding or springing of the structure.

Figure 19: Channel Steel Base Anchor Bolts



Channel Steel Baseplate				
Bolt Size	HG (Base Height)	C	L	P
5/8"	3.40	3.00	12.00	4.75
	3.95			5.38
3/4"		3.50	18.00	5.50
7/8"		4.00	24.00	5.75

Figure 20: Fabricated Base Anchor Bolts



Fabricated Steel Baseplate				
Bolt Size	HG (Base Height)	C	L	P
5/8"	0.38	3.00	12.00	1.75

5.2.2 Installation

The purpose of grouting is to prevent lateral shifting of the baseplate, not to take up irregularities in the foundation. Flowserve recommends the following procedure.

It is recommended the base is grouted 0.75" above the foundation per figures 19 and 20. The baseplate should be shimmed, if necessary, to level the baseplate. Once level and the anchor bolts are snugly tightened, the base is ready for grout

A grout mixture with sufficient strength and sufficient water should be used to cause the mixture to flow freely under the base.

The top of the rough concrete foundation should be well saturated with water before grouting. A wooden form should be built around the outside of the baseplate to contain the grout. In some cases, this form placed tightly against the lower edge of the base, and in other cases it is placed a slight distance from the edge of the baseplate. Grout is added until the entire space under the base is filled. A stiff wire should be used to work the grout and release any air pockets.

When the grout is set (about 48 hours) remove the forms and smooth the exposed surfaces, if desired. The grout should be hard in approximately 72 hours.

5.2.3 Pump and Motor Installation

The baseplate will be provided will holes already tapped in position. Motor supports are supplied with channel steel bases to align the pump and motor center line height. If the hardware is in the scope of the order, then all hardware will be provided.

The pump and motor are both mounted by four holes. Both pump and motor should be mounted after the base grout has been fully set.

The coupling should be completely removed to perform rotation check. Verify pump and motor rotate in the correct directions. See figure 22 in section 5.3.2. Operating the pump in the reverse direction can cause premature bearing failure as the bearing lubrication is dependent on rotation. If the pump rotation needs to be reversed refer to section 8.6.1.

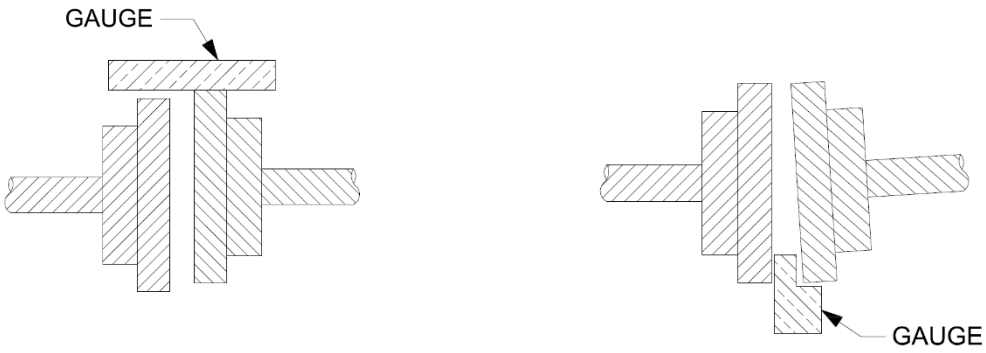
Alignment:

The procedure for checking driven and driver shaft alignment is as follows:

1. Place a straight edge across the top and side of the coupling. At the same time, check the faces of the coupling halves for parallelism by means of a tapered thickness gauge or feeler gauges, as shown in figure 21.

When the peripheries of the coupling halves are true circles and of same diameter and the faces flat, exact alignment exists when the distance between the faces is the same at all points and a straight edge will lie squarely across the rims at any point.

Figure 21: Coupling Alignment



If the faces are not parallel, the thickness gauge or feelers will show a variation at different points. If one coupling is higher than the other, the amount may be determined by the straight-edge and feeler gauges.

Maximum coupling life with a minimum of maintenance may be obtained if the coupling is aligned properly at installation. Generally, permissible angular and parallel misalignment is .005" for motors up to 75 hp and .010" for motors above 75hp. Refer to your specific coupling manufacturer information for exact guidelines.

5.3 Installation

5.3.1 Pump and shaft alignment check

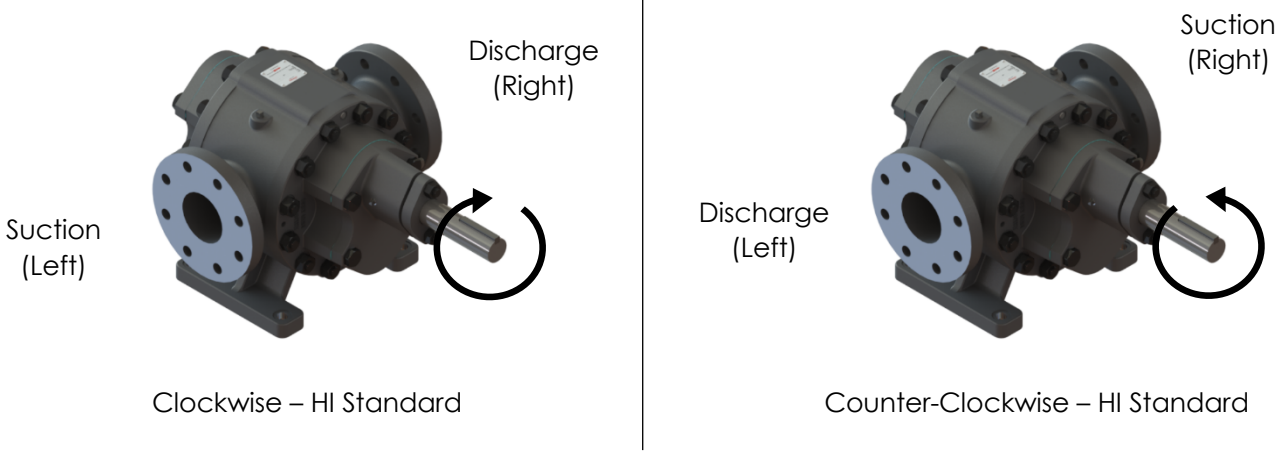
After connecting the piping rotate the pump drive shaft the appropriate rotation (viewed from motor end) by hand several complete revolutions to be sure there is no binding and that all parts are free. Recheck shaft alignment. If piping caused unit to be out of alignment, correct piping to relieve strain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

5.3.2 Direction of rotation

GR pumps can be built for either clockwise or counter-clockwise when viewed from the motor end (HI-Standard). The nameplate will show the direction, ensure the driver rotates in the same direction before assembling the coupling. To change the rotation, refer to section 8.6.1. Please

note the suction and discharge will switch if the drive shaft is on the bottom. For example, a bottom drive shaft HI-CW rotation will have the discharge on the left and suction on the right.

Figure 22: Flange Location for Rotation (Top Drive Shaft Shown)



CAUTION **It is essential that the rotation of the motor be checked before connecting the shaft coupling. Bearings may not lubricate properly and become damaged with incorrect rotation.**

5.3.3 Coupling Installation

Couplings can be either spacer or non-spacer, they are generally non-spacer though. If a spacer is present, pumps are shipped without the spacer installed. If the spacer has been installed to facilitate alignment, then it must be removed prior to checking rotation. Remove all protective material from the coupling and shaft before installing the coupling.

CAUTION **The coupling should be installed as advised by the coupling manufacturer.**

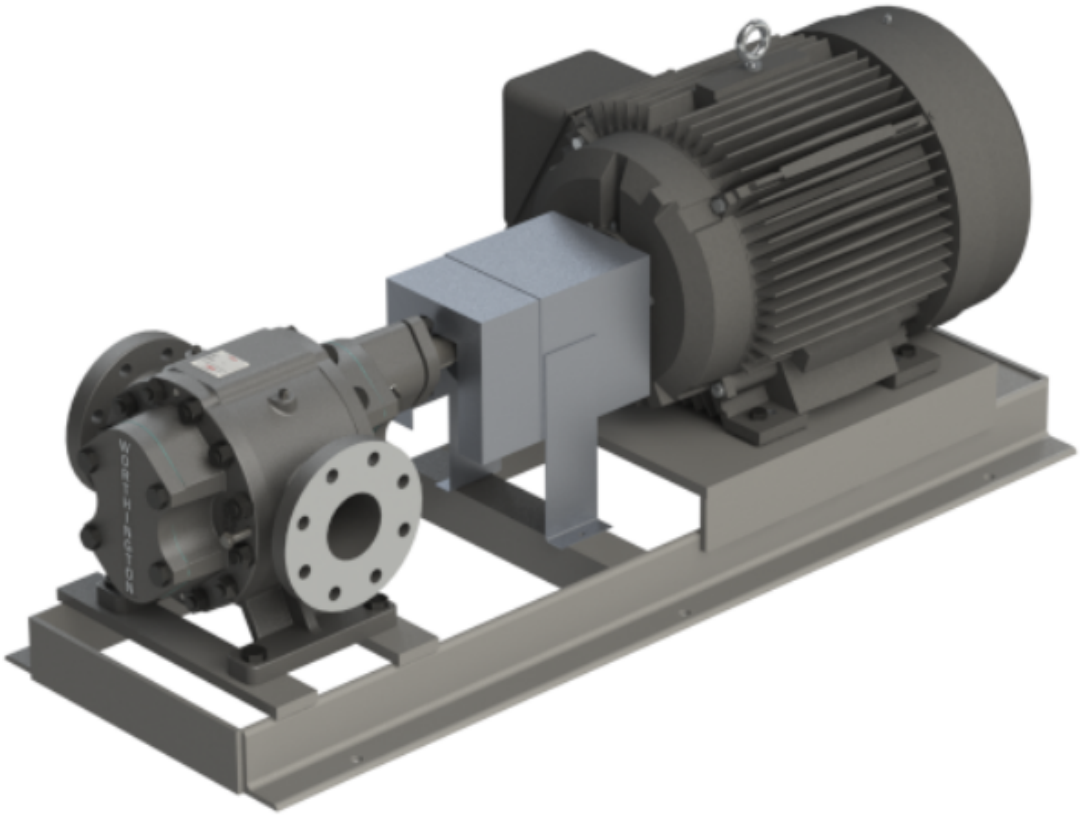
5.3.4 Coupling Guard Installation

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

Flowserve coupling guards are safety devices intended to protect workers from inherent dangers of the rotating pump shaft, motor shaft and coupling. It is intended to prevent entry of hands, fingers or other body parts into a point of hazard by reaching through, over, under or around the guard. No standard coupling guard provides complete protection from a disintegrating coupling. Flowserve cannot guarantee their guards will completely contain an exploding coupling.

Standard GR coupling guards are welded together during factory assembly to fit the specific pump. If a Flowserve guard is not provided, then guarding must be fabricated and installed before the pump is operational.

Figure 23: Standard Coupling Guard on Assembly



6 Commissioning

CAUTION **These operations must be carried out by fully qualified personnel**.

Pre-commissioning procedure

Prior to starting the pump, it is essential that the following checks be made. These checks are all described in detail in Section 8, *Maintenance*.

1. Pump and motor properly secured to the baseplate
2. All fasteners tightened to the correct torque
3. Coupling guard in place and not rubbing
4. Rotation check, see Section 5.3.2, *Direction of rotation*. **This is essential**
5. Shaft seal properly installed
6. Seal support system operational
7. Heating/cooling for jacketed body/stuffing box operational
8. Pump instrumentation is operational
9. Pump is primed

As a final step in preparation for operation, it is important to rotate the shaft by hand to be certain that all rotating parts move freely, and that there are no foreign objects in the pump casing.

WARNING Driver power must be isolated. Lockout-tagout required prior to checking for free rotation.

7 Operation

7.1 Preparatory activities

Start-up of a new pump should be preceded by several final checks:

1. Make sure any valves in the suction or discharge lines are open. Starting any rotary pump against a closed discharge line can result in extreme pressures that may damage equipment and result in injury to personnel
2. Close all drain lines.
3. Fill the pump with liquid to seal the clearances and lubricate the internal parts during initial starting.
4. Reduce torque on packing gland (when using packing) and re-tighten to finger tight to allow lubrication of the packing at start-up.

⚠CAUTION Starting or running a pump dry will inevitably cause Galling, Seizing or Destructive Wear between Gears, Sideplates, Pump Body and Mechanical Seal Faces.

7.2 Start-up and Operation

Touch the starter button for a preliminary start. During this brief period, a check should be made for extreme noise, vibration, packing/seal lubrication, or excessive pressure. If none of these are noticeable start the driver, and if the system permits, run the pump at reduced load. Check for localized heating in the bearing housings, body, and stuffing box. Check for lubrication of the packing by loosening the gland nuts to verify the presence of process fluids. Check power consumption. See if the pump is delivering liquid. If the pump is pulling a lift, a few seconds may elapse before the air is evacuated from the suction line. When the liquid is finally drawn into the impeller gears there will be a distinct change in the sound of the pump. If anything seems wrong or questionable, shut the unit down immediately. Refer to Section 9 for a guide to locating the source of trouble

7.2.1 Elevated Temperatures

Start up and operation of pumps used for elevated temperature service requires some additional precautions. Sudden introduction of hot liquid into a cold pump will cause uneven expansion of internal parts with resultant pump wear or failure. If the system in which the pump is used does not allow a gradual increase in liquid temperature, then an auxiliary means of heating is required.

Type GRJ, GRL, and GRJL pumps incorporate an integral system jacket in the pump body and stuffing box. This can be used to preheat the pump and melt any liquids such as tars and asphalt that might solidify in the pump during shut down. The steam jacket is designed for 150 PSI maximum pressure and may be used with steam or heat transfer oils. Maximum temperature for steam 350°F and for heat transfer oils 500°F. For more details refer to section 3.6.3.3.

Steam Jackets are normally used for start-up only. Once the pump is running, the liquid moves through too fast for the steam jacket to heat it any significant amount.

7.3 Cleaning, disinfecting, and sterilizing

All parts must be cleaned prior to installation. Use solvent to remove slushing compounds that have been used to protect parts in transit.

7.4 Shut down

7.4.1 Short Term

1. ⚠CAUTION Close the outlet valve but ensure that the pump runs in this condition for no more than a few seconds.
2. Stop the pump.
3. Leave the valve supplying auxiliary sealing fluid open to maintain prime while pump is idle.
4. On pumps with steam jacketed bodies and/or stuffing boxes, maintain steam flow to prevent pumping liquid from setting up in the internals of the pump.

7.4.2 Long Term

1. ⚠CAUTION Close the outlet valve but ensure that the pump runs in this condition for no more than a few seconds.
2. Stop the pump.
3. Switch off flushing and/or cooling/heating fluid supplies at a time appropriate to the process.
4. On pumps with steam jackets, shut off steam flow and allow pump to cool.
5. ⚠CAUTION For prolonged shut-downs and especially when ambient temperatures are likely to drop below freezing, the pump and any cooling and flushing arrangements must be drained or otherwise protected.

8 Maintenance

8.1 Schedule

Most type of GR Rotary Pumps are similar regarding arrangement and maintenance of impeller gears, bearings, and other internal parts. The main differences are in stuffing box or mechanical seal configurations.

A maintenance schedule that makes sense should be followed based on the application, system, and the predicted part life.

When reassembling any pumps with cast steel casings, it is recommended that impeller gears and side plates be coated with a Molybdenum disulphide-based lubricant to prevent any tendency toward galling failure on initial start-up.

8.1.1 Mechanical Seals

Mechanical seals are precision products. Great care must be used in assembling the seal parts. In handling, do not let the carbon sealing face drop and take particular care not to scratch the faces of the seal face or stationary seat.

Seals should be checked for wear on the faces. If excessive wear is found or the seal begins to leak it should be replaced with a new seal.

When a seal has been dismantled for examination, it is practically impossible to reassemble the parts into their original position. Seal faces and stationary seats must be relapped or replaced before reassembly.

Seals must never be run dry. In some instances, a short period of operation is required to clear up slight leakage.

The seal as received from the factory should be a perfectly lapped face. If the seal face is slightly marred it is possible to recondition it. The materials needed are a flat plate such as a lapping plate or a piece of plate glass and lapping paper. The lapping paper should be held flat against the lapping plate, making sure that no foreign material is under it.

Follow these steps to lap the seal face:

1. Press the seal face very lightly but firmly against the lapping paper and describe a series of about five figure eights. During the lapping process, maintain an even pressure, keep the seat flat and avoid rocking.
2. Rotate the seal face 90° and describe five more figure eights.
3. Repeat this procedure at 90° intervals until the face is cleaned up.
4. Wipe off with a clean cloth saturated in solvent.

This procedure is the same for the stationary floating seat. If the material is cast iron, more strokes will be required to obtain a lapped face.

8.1.2 Bearings

Life of GR pump bearings depends primarily upon discharge pressure, liquid viscosity, proper installation, and to a lesser extent, speed and temperature. On most applications, conditions are such that bearing life is many years. Where high discharge pressures and other factors combine to produce bearing life of only a few thousand hours, a regular preventative maintenance program should be followed. Your Flowserve Pump representative can provide bearing life information that will serve as a guide for regular bearing inspection and replacement.

Bearing clearances and the physical appearance of the bearings are a guide to their condition. Assembled internal clearance in a new bearing will vary from an average of 0.004" in a 1-1/2 GR to an average of 0.007" in a 6 GR. When a pump bearing fails due to fatigue the first stage is pitting of some of the rollers. This is followed by pitting of inner and outer races and a slight increase in clearance (on the order of 0.001"-0.002"). The internal clearance can be measured with a feeler gauge between the O.D. of the inner race and a roller on the slack side of the bearing. At this point the bearings continue to deteriorate. Wear of gears, body, and sideplate will follow.

With poor lubricants or abrasives bearing life is shorter than with good lubricants and is quite unpredictable. In this situation wear of races and rollers will progress at a steady rate and there

may be no fatigue pitting at all. Under such conditions, any development of poor performance or increased pump noise may be a sign of bearing failure. The individual user's experience in such situations should be a guide to future preventive maintenance.

Bearing clearances can be checked with a feeler gauge by removing the stuffing box or inboard bearing head and bearing cover. Visual examination of bearing races and rollers requires removal of sideplates. For disassembly/assembly steps refer to section 8.4 and 8.5.

Table 5: Bearing Clearance Guide

Pump Size	Estimated Max Total Bearing Clearance to Carry Full Load (In)	Total Clearances Between Rollers and Races (In), Recommend New Bearings when Values are exceeded
1-1/2 GR	0.004	0.010
2 GRW	0.004	0.010
2GR	0.004	0.012
2-1/2 GRW	0.004	0.012
2-1/2 GR	0.004	0.012
3 GRW	0.004	0.012
3 GR	0.005	0.014
4 GRW	0.005	0.014
4 GR	0.005	0.016
5 GRW	0.005	0.016
5 GR	0.006	0.020
6 GR	0.007	0.024

8.1.3 Rotors and other Internal Parts

Rotation in GR pumps only affects the sideplate assembly. Sideplates plugs on the discharge side assures lubrication during normal pump operation. Under normal conditions gears could be assembled into the pump with the apex pointing in either direction of rotation. The only exception to this is the high suction lift applications. Under high suction lift, if the gear is pointing in the direction of rotation, higher lifts (Lower NPSH-Required) can be reached.

In a new pump adequate clearance is provided to prevent contact between impeller gears and casing. In advanced stages of bearing failure, however, the impeller gears will contact and wear the suction side of the body and, if bearing wear is uneven, one or both sideplates. Wear of gears and sideplates will be accelerated and may precede bearing failure when liquid pumped is abrasive or a poor lubricant or when drive or piping misalignments exist. Wear of these internal surfaces will be reflected in reduced pump capacity, failure to produce desired pressure in system, excessive priming time and in some cases an increase in noise level of pump.

Service to internal parts of a GR pump consists of renewal of clearances and wearing surfaces of gears, sideplates and body. Table 6 gives maximum new pump clearances and minimum gear dimensions for each size pump. This will serve as a guide. A pump may be quite satisfactory with greater clearances if pressures are moderate.

Table 6: Internal Clearances

Pump Size	Max End Clearance	Max Diameter Clearance Around Gears	Minimum Gear Width	Minimum Gear Diameter
1-1/2 GRH	0.0045	0.0090	1.924	2.771
1-1/2 GR	0.0035	0.0090	2.748	2.771
2 GRW	0.0035	0.0090	3.498	2.771
2GR	0.0035	0.0110	2.748	3.465
2-1/2 GRW	0.0035	0.0110	3.498	3.465
2-1/2 GR	0.0050	0.0110	4.247	3.465
3 GRW	0.0060	0.0110	5.997	3.465
3 GR	0.0060	0.0120	4.996	4.621
4 GRW	0.0060	0.0120	7.621	4.621
4 GRH	0.0085	0.0125	4.897	5.556
4 GR	0.0065	0.0125	6.996	5.556
5 GRW	0.0075	0.0125	10.495	5.556
5 GR	0.0085	0.0180	9.994	6.947
6 GRH	0.0105	0.0180	7.197	9.259
6 GR	0.0085	0.0180	11.994	9.259

Impeller gears and bodies generally must be replaced when worn excessively. Remachining to new clearances is beyond the capability of most shops. Reversing the gears and running on the unworn side of the teeth will not provide any improvement in performance but may temporarily forestall deteriorating performance. Reversing a worn body may provide a slight improvement.

Sideplate wear may be corrected by resurfacing up to .060", however, the average machine shop is not equipped to do this economically with the required degree of accuracy (within .0002" per inch of sideplate diameter). If resurfacing is attempted, it will be necessary to restore the six small radial oil grooves surrounding each shaft bore to their original proportions, including the radiused edges, unless wear plates or filler plates are to be fitted.

Replaceable wear plates of a self-lubricating materials are an option available for all pumps except type GRH. These sandwich between the pump body and both sideplates and present an excellent wearing surface to the face of the impeller gears. These are easily replaced when worn and can be installed in a pump in the field not originally so equipped. Since these wear plates will flex under pressure, they must have a solid backing and should not be used over a worn side plate or reversed when worn themselves.

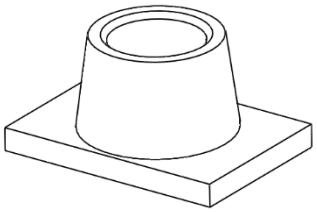
8.2 Special tools

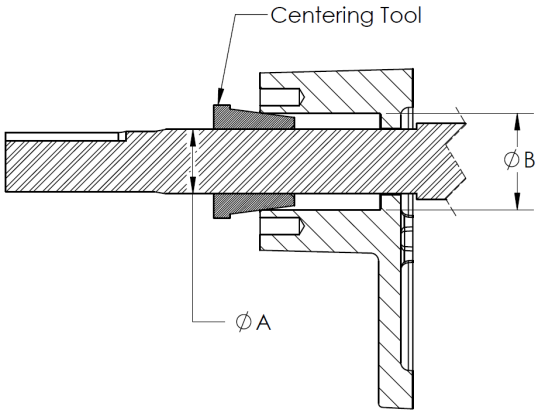
A hydraulic press is needed if work is done to the rotors or bearing inner races.

A centering tool can be used for aligning the stuffing box around the shaft. While it is possible to do it by hand this tool provides a quick and accurate method for centering. It is a cone shape on a flat plate that has the shaft bore diameter through the middle. If a lot of repairs are routine, it could be helpful to have a tool fabricated or purchased from Flowserve. See tool, required dimensions, and each tool's respective size part number below. The slope angle and tool depth aren't critical. The slope should be concentric all the way around and contact the stuffing box

bore. Verify run-out between the stuffing box ID and the shaft OD after use of the centering tool. Please refer to your packing/seal manufacturer to obtain the recommended run-out value.

Table 7: Centering Tool Dimensions





	A (in.)	B (in.)	Part Numbers
1.5GR 2GRW	0.938	1.562	GRAT015
2GR 2.5GRW	1.250	1.875	GRAT025
2.5GR 3GRW			
3GR 4GRW	1.875	2.625	GRAT030
4GR 5GRW	2.000	3.000	GRAT040
5GR	2.750	3.750	GRAT050
6GR	3.500	4.750	GRAT060

8.3 Required replacement parts for maintenance

Refer to the class 1 spare parts in section 8.8

8.4 Disassembly

Refer to section 3.3 for part number schema.

8.4.1 Standard Disassembly

1. Before performing any maintenance, lock-out and tag-out driver.

⚠CAUTION **Lock out power to driver to prevent personal injury.**

2. Close the discharge and suction valves and drain all the liquid from the pump.
3. Close all valves on auxiliary equipment and piping, then disconnect all auxiliary piping.
4. Decontaminate the pump as necessary.

⚠WARNING **If the pumps contain dangerous chemicals, it is important to follow plant safety guidelines to avoid personal injury or death.**

5. Remove the coupling guard and coupling. Remove the pump from the skid using proper lifting techniques (section 4.4).
6. Remove the rear cover bolts (6577.1) and cover (3266). (This is not applicable for the dual stuffing box configuration).
7. Remove the seal gland to expose the stuffing box (4110). If it is an "MI" configuration, refer to section 8.4.2.
8. Follow one of the steps below:
    a. Packing:
        i. It is recommended the packing rings (9321) are removed. This makes removal of the stuffing box (4110) much easier.
    b. Seal:
        i. Remove the plug (6569.3) from the stuffing box.
        ii. Loosen the set screws (6814) from the locking collar (2520) using the port in the stuffing box.
        iii. Carefully slide mechanical seal assembly and spring (4200) off the shaft.
9. Remove the stuffing box bolts (6577.1) and the stuffing box (4110).
10. Remove the sideplate nuts (6581.1).
11. Use the jacking bolts (6575) to remove the sideplates (3200)
12. Rotating elements are free to remove, and bearings can be viewed for inspection.

8.4.2 "MI" Configuration

1. Remove set screw (6814) from the bearing sleeve (2471).
2. Remove screws for stuffing box (6577).
3. Carefully tap off the stuffing box (4110). Note this part has two dowel pins to the sideplate (3200.2). The inboard bearing (3000.2) will still be inside of the stuffing box.
4. Carefully remove the mechanical seal assembly (4200)
5. Continue with step 10 in the regular GR disassembly process

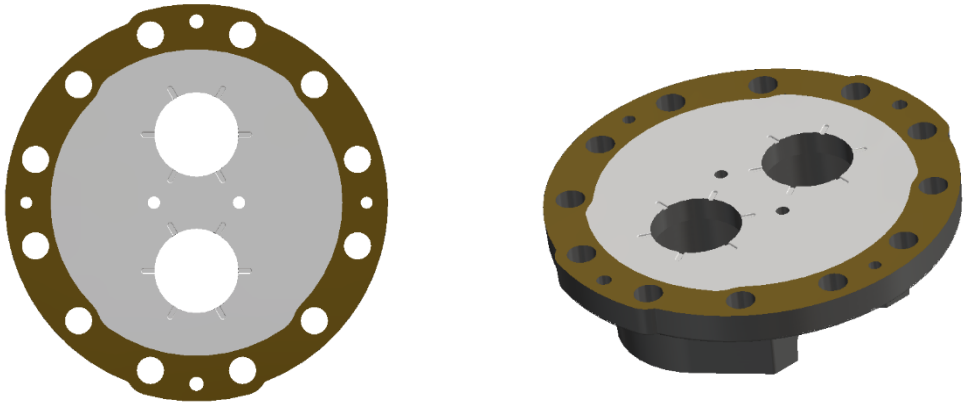
8.5 Reassembly

8.5.1 Standard Reassembly

1. Prep the sideplates (3200):
   a. Install the bearings (3000) into the sideplates (3200). Use press and tools if required.
   b. Coat the sideplate (3200) with a gasket adhesive. Coat around the bolt and dowel pin holes. Loctite 1 Gasket Sealant is recommended and this adhesive must set for 20 minutes. If another adhesive is used, then follow the manufacturer's instructions.

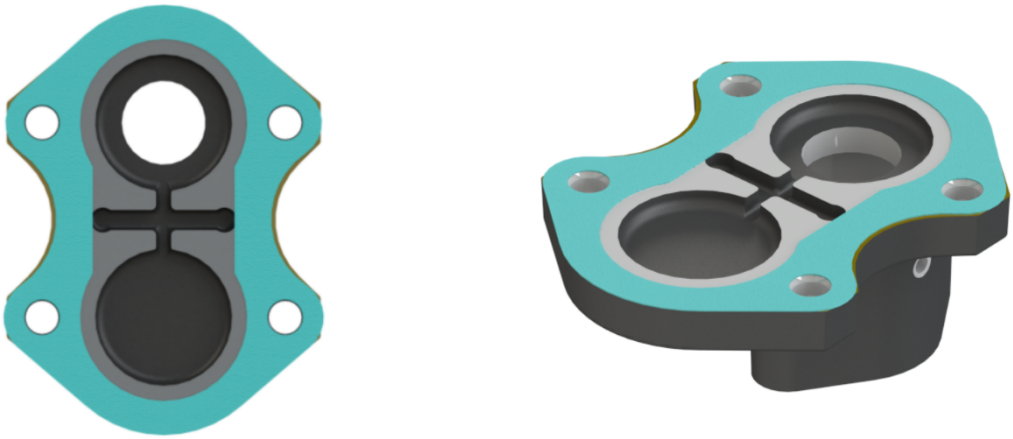
The general rule is the adhesive should be at least 1/8" inside of the bolt circle, shown in the brown area below.

Figure 24: Sideplate with Adhesive



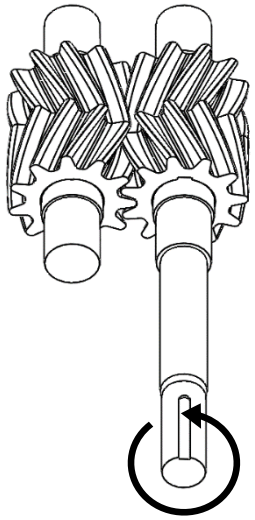
2. Install all the body studs (6572.1) and dowel pins (6810) into the body (1100).
3. Prep the stuffing box (4110) and rear cover (3266).
   a. Apply gasket adhesive to the machined mating surface.
   b. Carefully align and apply one gasket (4590.1) on top of adhesive.

Figure 25: Stuffing Box with Gasket

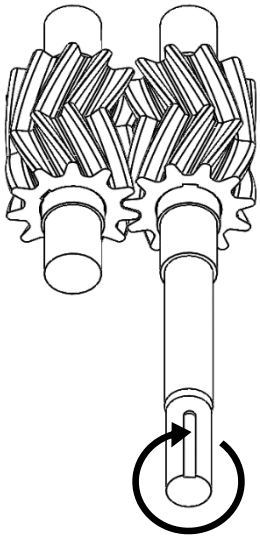


4. Press the rotors (2000) on the shafts with the key (6700.2) installed on the drive shaft (2100.1). The rotor apexes should mesh on the discharge side. While the rotors can be run either direction, the pump generates more suction lift when pressed on correctly.

Figure 26: Rotor Assembly



Counter-Clockwise



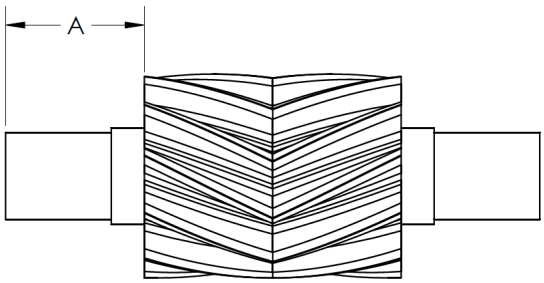
Clockwise

Check rotors are at the right distance on the shafts. Refer to table 8 below. Dim A is from the non-drive end of the shafts. The standard column applies to all configurations except for dual stuffing boxes, that is the second column. For GRH, add the rotor spacer (3645) to dimension A.

Install the filler plates (3645) with the grooves facing the rotors for the "H" configuration after the rotors are pressed on the shaft, if applicable.

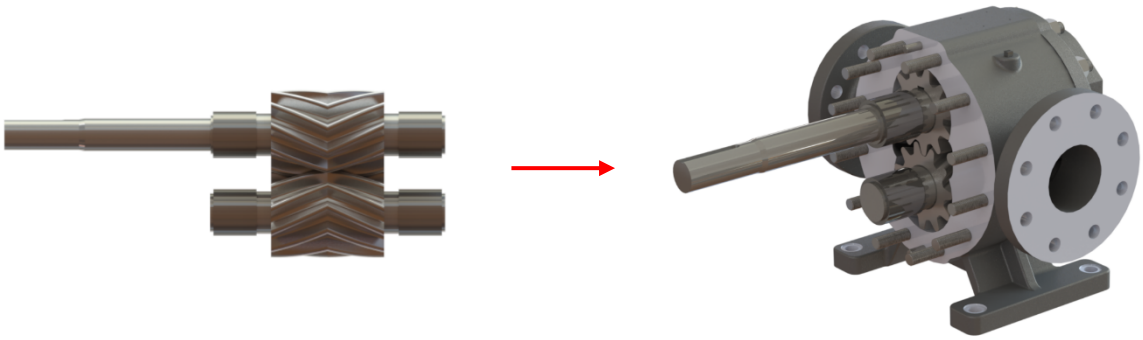
Table 8: Rotor Distance on Shaft

Size	Standard (in.)	Dual Box (in.)
1-1/2 GR	1.876	5.661
2 GRW	1.876	5.661
2 GR	2.375	6.495
2-1/2 GRW	2.375	6.495
2-1/2 GR	2.375	6.375
3 GRW	2.375	6.375
3 GR	3.158	8.878
4 GRW	3.158	8.878
4 GR	3.783	10.252
5 GRW	3.783	10.252
5 GR	4.156	10.877
6 GR	5.531	13.000



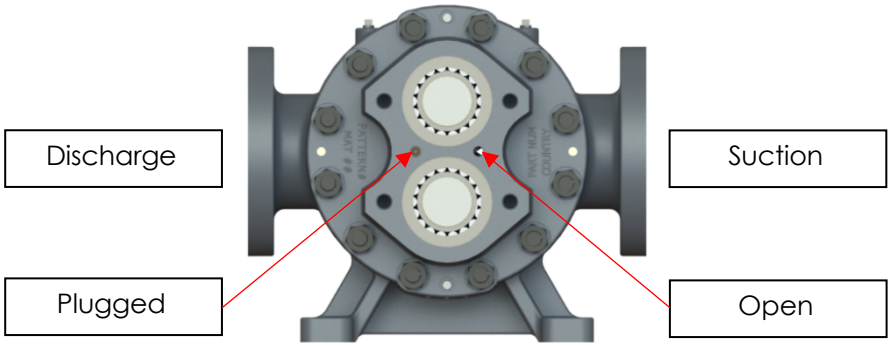
5. Heat up the inner races of the bearings (3000) to 300°F and install these on the shafts (3200.1 & 3200.2). Verify the bearing races touch the shaft shoulder.
6. If applicable, Install Insurok wear plate (1915) on the non-drive end side. Ensure the counterbores face towards the rotors.
7. Install the non-drive end sideplate (3200). Use a rubber mallet to tap sideplate onto dowel pins (6810). Torque down the nuts (6581.1) per table 9.
8. Insert the rotor assembly into the body. Mesh the rotors on a flat surface then lift rotors together. Ensure proper rigging and lifting is used since both shafts must go in simultaneously. Ensure the gears spin freely. The assembly should look like figure 27 below.

Figure 27: Rotor Set in Body



9. If applicable, Install Insurok wear plate (1915) on the drive end side. Ensure the counterbores face towards the rotors.
10. Install the drive end sideplate (3200). Use a rubber mallet to tap sideplate onto dowel pins (6810). Torque down the nuts (6581.1) per table 9.
11. Install the sideplate countersunk plug (6569.1) on the discharge side of the pump. This is a very important step for bearing lubrication.

Figure 28: Sideplate plug for Rotation (refer to section 5.3.2 to define suction and discharge)



12. Bolt end cover (3266) with gasket aligned to sideplate (3200). Torque bolts (6577.1) per table 10.
13. Clean and then Install stuffing box (4110). If inboard bearing is present, go to section 8.5.2.
    a. Slide stuffing box (4110) with gasket onto the drive shaft. Install bolts hand tight. Do not bolt down yet
    b. Slide seal centering tool (see section 8.2) on drive shaft and engage it with stuffing box bore.
    c. Tighten bolts for stuffing box to half the torque in table 10.
    d. Measure run-out between the stuffing box ID and the shaft OD per section 8.2.
14. Adjust stuffing box to shaft run-out, if necessary, by loosening the stuffing box bolts and adjusting position until proper run-out is obtained.
15. Torque stuffing box to the appropriate value listed in table 10.
16. It is recommended to finger tighten jacking bolts into sideplates to avoid losing them.

17. Install sealing, this will depend on the sealing configuration of the pump
    a. Packing – No Lantern Gland
        i. Install packing rings one at a time and press them all the way to the seat. Alternate packing end joints by 180° (90° is the minimum required).
        ii. Install gland studs.
        iii. Install gland.
        iv. Tighten to packing with a wrench, lessen to finger tight, turn one fastener hex position past finger tight. **Do not tighten the glands *too* tightly as a leakage is required to lubricate the packing.**
    b. Packing – Lantern Gland
        i. Follow previously mentioned steps but ensure that the lantern gland lines up with the inlet hole in the stuffing box.
    c. Component Seal
        i. Install the set screws (6814) in the lock collar (2520).
        ii. Slide lock collar on drive shaft (2100.1). Carefully push the collar into the stuffing box until the set screws align with the bore in the stuffing box (4110).
        iii. Tighten the set screws on the lock collar.
        iv. Prep the gland (4120).
            1. Apply gasket adhesive to the gland face.
            2. Apply the gland gasket (4590.2) on the gland (4120).
            3. Apply gasket adhesive to the stuffing box face.
        v. Install the seal spring (part of 4200) on the shaft (2100.1). It will rest on the lock collar (2520).
        vi. Apply lubricant to the seal seat OD and insert into the gland (4120). Ensure the o-ring is installed on the seat (part of 4200).
        vii. Install the seal rotor (part of 4200) onto the spring. Ensure all seal faces are clean.
        viii. Install the gland and bolt to the stuffing box. Torque per table 11.
18. If a dual stuffing box is present, repeat steps 13 through 15 for the other stuffing box.

8.5.2 Inboard Bearing Reassembly

1. Follow step 3 in 8.5.1 and prep stuffing box (4110) if not already done so.
2. Install seal rotor and seal spring (4200) onto shaft. Ensure the seal face is clean.
3. Install seal seat (4200) into stuffing box. Lubricate seat OD and insert into stuffing box body (4110).
4. Install stuffing box (4110) to the sideplate (3200.2). Align stuffing box with sideplate using dowel pins (6810.2). Install bolts and have them finger tight.
5. Install adaptor sleeve (2471) onto shaft into ball bearing bore.
6. Install the ball bearing (3000.2) into the stuffing box. Use pressing tools to seat bearing against the shoulder in the stuffing box (4110).
7. Torque down the stuffing box bolts (6577) per table 10.
8. Install the set screws (6814) into the adaptor sleeve (2471) onto the shaft (2100.1).
9. Install the snap ring (2530) onto the adaptor sleeve groove (2471), beside the bearing.
10. Install grease nipple (3853) and stuffing box plug (6569.3).
11. Install bearing grease before pump operation. Follow regular grease maintenance schedule.

8.5.3 Torque Charts

Table 9: Torque Values, Body Cover

Torque Values, Body		
Pump Size	Bolt Size	Torque (ft-lbs.)
1-1/2 GRH	1/2-13	60
1-1/2 GR	1/2-13	60
2 GRW	1/2-13	60
2 GR	5/8-11	120
2-1/2 GRW	5/8-11	120
2-1/2 GR	5/8-11	120
3 GRW	5/8-11	120
3 GR	5/8-11	120
4 GRW	5/8-11	120
4 GRH	3/4-10	200

Table 10: Torque Values, Stuffing Box/End

4 GR	3/4-10	200
5 GR	3/4-10	200
5 GRW	3/4-10	200
5 GRJ	3/4-10	200
6 GRH	1-8	490
6 GR	1-8	490

Table 11: Torque Values, Gland - **Disclaimer: These values only apply for mechanical seals**

Torque Values, Stuffing Box/End Cover		
Pump Size	Bolt Size	Torque (ft-lbs.)
1-1/2 GRH	3/8-16	24
1-1/2 GR	3/8-16	24
2 GRW	3/8-16	24
2 GR	3/8-16	24
2-1/2 GRW	3/8-16	24
2-1/2 GR	3/8-16	24
3 GRW	3/8-16	24
3 GR	5/8-11	120
4 GRW	5/8-11	120
4 GRH	5/8-11	120
4 GR	5/8-11	120
5 GR	5/8-11	120
5 GRW	3/4-10	190
5 GRJ	5/8-11	120
6 GRH	3/4-10	190
6 GR	3/4-10	190

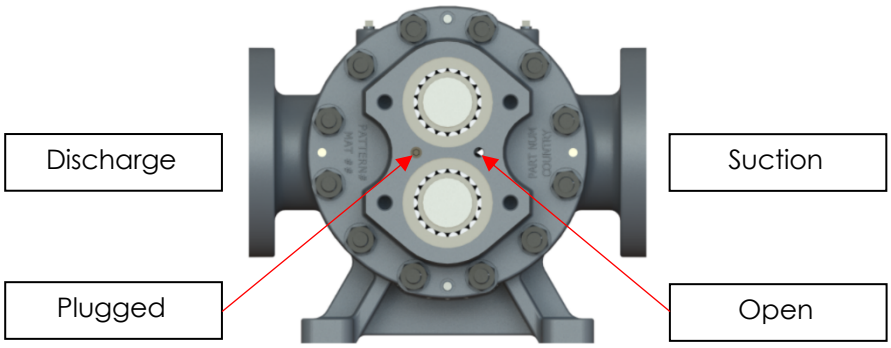
Torque Values, Gland		
Pump Size	Bolt Size	Torque (ft-lbs.)
1-1/2 GRH	1/2-13	32
1-1/2 GR	1/2-13	32
2 GRW	1/2-13	32
2 GR	5/8-11	65
2-1/2 GRW	5/8-11	65
2-1/2 GR	5/8-11	65
3 GRW	5/8-11	65
3 GR	3/4-10	110
4 GRW	3/4-10	110
4 GRH	3/4-10	110
4 GR	3/4-10	110
5 GR	3/4-10	110
5 GRW	5/8-11	65
5 GRJ	3/4-10	110
6 GRH	3/4-10	110
6 GR	3/4-10	110

8.6 Modifications

8.6.1 Reversing Rotation

It is simple to reverse the rotation of the GR pump. There are two countersunk plugs in the sideplates that need to be changed to the new discharge side. Please follow section 8.4 far enough to expose these plugs. The figure below shows the plug location.

Figure 29: Sideplate plug for Rotation



If changing the rotor direction is desired, refer to sections 8.4 & 8.5 to change rotors on shafts.

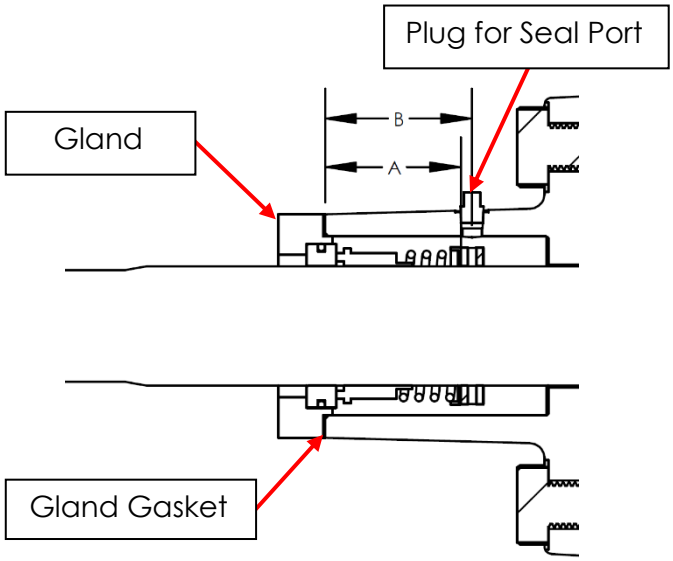
8.6.2 Changing Packing to/from Seal

GR/GRM stuffing boxes need no internal modifications to switch from packing to a seal. They are identical except one tap is located on the side for a GRM. The position of the port is pre-designed to be the correct length so a standard component seal gets enough compression. Check for or create the port with the tabulated dimensions below. Then install the correct seal kit per section 8.5.1, step 15.

If you are changing from a seal to packing simply plug the port in the side and install the packing kit per section 8.5.1, step 15. Please note the glands are not interchangeable. Packing and seals have unique glands.

Table 12: Seal Layout for GR

Size	A (in.)	B (in.)
1-1/2 GR	1.66	1.80
2 GRW	1.66	1.80
2 GR	1.56	1.75
2-1/2 GRW	1.56	1.75
2-1/2 GR	1.56	1.75
3 GRW	1.56	1.75
3 GR	2.28	2.47
4 GRW	2.28	2.47
4 GR	2.28	2.47
5 GRW	2.28	2.47
5 GR	2.78	3.03
6 GR	3.22	3.50



8.7 Post maintenance inspection

It is recommended that a maintenance plan and schedule be implemented, in accordance with these User Instructions, to include the following:

1. Any auxiliary systems installed must be monitored, if necessary, to ensure they function correctly.
2. Gland packing must be adjusted correctly to give visible leakage and concentric alignment of the gland follower to prevent excessive temperature of the packing or follower.
3. Check for any leaks from gaskets and seals. The correct functioning of the shaft seal must be checked regularly.
4. Check that the duty conditions are in the safe operating range for the pump.
5. Check vibration, noise level and surface temperature at the bearings to confirm satisfactory operation.
6. Check dirt and dust is removed from areas around close clearances and motors.
7. Check coupling alignment and re-align if necessary.

Follow section 5.3, 6, & 8.5 for proper re-assembly, installation, and start-up of pump

8.8 Spare parts stocking recommendation

Spare parts have three different classes, and those parts depend on the configuration. See the tables below for recommended spare parts. Multiple tables may be needed if multiple configurations are present.

Class 1: Normal Maintenance Items
Class 2: Major Overhaul Items
Class 3: Critical Service Items to restore pump to "as new" condition (Entire pump replacement)

Table 13: Spares for GR, GRM, GRH and GRMI with Options

GR, GRM, GRH and GRMI with Options			
Item Number	Description	Class 1	Class 2
0139	Roller Bearing	X	X
0139A	Roller Bearing - Inner Race	X	X
0139B	Sleeve Bearing	X	X
11A9A	Key - Coupling		X
11A9B	Key - Rotor		X
1273	Rotor		X
1453	Filler Plate - "H"		X
1882	Bearing Sleeve		X
2312	Insurok Wear Plate	X	X
2421	Locking Collar		X
2584A	Gasket - Gland	X	X
2584B	Gasket - Stuffing Box/End Cover	X	X
2704A	Packing	X	X
2807A	Driving Shaft		X
2807D	Driven Shaft		X
3879	Mechanical Seal Head	X	X
3880	Mechanical Seal Seat	X	X
4893	Ball Bearing	X	X

Table 14: Spares for GRJ, GRL, GRJL with Options

GRJ, GRL and GRJL with Options			
Item Number	Description	Class 1	Class 2
0139	Roller Bearing	X	X
11A9A	Key - Coupling		X

11A9B	Key - Rotor		X
1273	Rotor		X
2462	Seal Cage		X
2584B	Gasket - Stuffing Box/End Cover	X	X
2704A	Packing	X	X
2807B	Driving Shaft - "L"		X
2807D	Driven Shaft		X

Table 15: Spares for GRD with Options

GRD with Options			
Item Number	Description	Class 1	Class 2
0139	Roller Bearing	X	X
11A9A	Key - Coupling		X
11A9B	Key - Rotor		X
1273	Rotor		X
2421	Locking Collar		X
2584A	Gasket - Gland	X	X
2584B	Gasket - Stuffing Box/End Cover	X	X
2704A	Packing	X	X
2807C	Driving Shaft - "D"		X
2807D	Driven Shaft		X
3879	Mechanical Seal Head	X	X
3880	Mechanical Seal Seat	X	X

9 Troubleshooting Guide

FAULT SYMPTOM

The Pump Fails to Discharge ⇓ Pump is Noisy ⇓ Pump Wears Rapidly ⇓ Pump Not Up to Capacity ⇓ Starts, then Loses its Suction ⇓ Pump Requires Too Much Power ⇓						POSSIBLE CAUSES	POSSIBLE REMEDIES
●						**STOP PUMP IMMEDIATELY.**	
●						Not Properly Primed.	Reprime from discharge side. Keep Discharge air vent open until liquid begins to discharge.
●						Wrong direction of rotation.	Reverse wiring of motor.
●			●			Speed too slow. Entire pump capacity slips through clearances.	Change driver to increase speed. Check driver to see that it is up to rated speed.
●						Valves closed or an obstruction in suction or discharge pipe.	Open all valves. See that flange gaskets have the center cut out and that no obstruction is across end of suction pipe.
●			●			Strainer clogged.	Remove basket, clean and be sure it has ample area.
●			●	●		Suction pipe end not submerged in liquid.	Increase length of suction pipe or raise liquid level in supply tank
●						Foot valve stuck.	Check to see that suction pipe has not been screwed into foot valve far enough to hold it closed.
●			●			Suction lift too high.	Check with vacuum gauge.
●			●			Bypass open.	Examine all bypass and return lines for open valves. Close them if open. A relief valve stuck open may bypass entire pump capacity.
●	●		●	●		Air leaks in suction	Paint and tighten all suction pipe gaskets and threaded joints. Check stuffing box packing.
●						Check valve and pressure backed up by hydraulic pressure.	Install an air-release valve between the check valve and pump.
●			●			Pump badly worn. Excessive clearances will cause slip equal to pump displacement.	Replace parts.
	●	●	●	●		Insufficient liquid supply / pump runs dry.	Increase suction pipe size and reduce the length. Lower position of pump to prevent cavitation.
	●	●			●	Pump out of alignment.	Align driver with pump. Release pipe flanges to determine if they strain pump casing causing metallic contact between rotating elements and casing.
	●					High spots on rotating elements.	File or scrape down high spots that cause rotating elements to bind and produce a noise synchronized with each revolution.

FAULT SYMPTOM

The Pump Fails to Discharge	Pump is Noisy	Pump Wears Rapidly	Pump Not Up to Capacity	Starts, then Loses its Suction	Pump Requires Too Much Power	POSSIBLE CAUSES	POSSIBLE REMEDIES
	●				●	Bent drive shaft.	Replace shaft as it causes rotating elements to operate unevenly with consequent noise.
	●	●				Excessive pressure.	Check pressure. Install a relief valve.
	●	●			●	Coupling out of balance or alignment.	Align driver and pump.
	●					Relief valve chatters.	Change pressure adjustment or check size and type of relief valve.
		●				Abrasives in liquid.	Add strainer to the suction line.
		●				Corrosion that has roughened rubbing surfaces.	Replace corroded parts.
		●				Improper position of plugs in sideplates.	Ensure plugs are on the discharge side of the pump, refer to section 8.5
			●			Stuffing box improperly packed so that air is drawn in.	Repack box, tighten gland. Caution: Don't tighten enough to cause excessive packing wear and heating. If packing, ensure that it is receiving lubrication.
			●			Relief valve improperly seated or incorrectly set.	Regrind valve on its seat. Be sure valve does not open until desired pressure is reached.
				●		Liquid vaporizes in suction line.	Reduce suction lift so, as liquid approaches tank bottom, it will not vaporize.
					●	Speed to high or liquid is heavier/more viscous than specified for pump.	Reduce speed or heat liquid to reduce viscosity.
					●	Obstruction in discharge line.	May cause pump to operate above rated pressure. Check discharge line for obstructions. If this is a new installation, recalculate what the pressure should be.
					●	Stuffing box packing too tight.	Check packing. If too tight, make necessary adjustment or replace packing with correct type properly installed. Make sure packing receives lubrication.

10 Decommissioning and Recommissioning

10.1 Decommissioning

Ensure all liquids are removed from the pump as followed:

1. Drain pump

2. Drain seal systems
3. Drain oil and/or remove grease

After liquid has been drained follow long term storage procedures

10.2 Recommissioning

For products stored for 6 months follow short term storage procedures, section 4.5.1, for more than 6 months follow long term procedures, section 4.5.2.

See section 6 for commissioning & section 7 for operations

11 Returns and Disposal

11.1 Returns

The product/system shall be emptied, cleaned, and preserved before returning the equipment to the manufacturer. The manufacturer will only open the returned equipment if the contamination declaration is present.

(Note: the terms and conditions associated with returning a product/system shall be addressed within the purchasing agreement or contract, and not part of the User Instruction.)

NOTICE

Contact Flowserve for return authorization. Any goods received without prior written authorization and proper documentation upon receipt will be return to the sender.

11.2 Disposal and recycling

At the end of the equipment service life, the relevant materials and parts should be recycled or disposed of using local environmental regulation methods. If the product contains substances which are harmful to the environment, then the removal or disposal of the equipment must be in accordance with local/regional regulations. This includes any liquid and/or gas in the "seal system" or utility.


Refer to Safety Data Sheets and make sure that hazardous substances or toxic fluids are disposed of safely and that the correct personal protective equipment is used. All activities involving hazardous substances or toxic fluids must be in compliance with published safety standards.

12 Technical Data

12.1 Equipment dimensions and weights

Table 16: Cast Iron Construction, Approx. Weight in Lbs (Kgs)

	(-) Packed Box	(M) Mech. Seal	(MI) Inboard Bearing (Sealed)	(J) Jacketed Body (Packed)	(L) Jacketed Stuffing Box (Packed)	(JL) Jacketed Body / Box (Packed)	(D) Dual Packed Box	(DM) Dual Sealed Box
1-1/2 GR Threaded	95 (43)	95 (43)	97 (44)	110 (50)	100 (45)	115 (52)	125 (57)	125 (57)
1-1/2 GR Flanged	95 (43)	95 (43)	97 (44)	110 (50)	100 (45)	115 (52)	125 (57)	125 (57)
2 GRW	105 (48)	105 (48)	107 (49)	-	110 (50)	-	135 (61)	135 (61)
2 GR	150 (68)	150 (68)	153 (69)	165 (75)	155 (70)	170 (77)	166 (75)	166 (75)
2-1/2 GRW	170 (77)	170 (77)	173 (78)	-	177 (80)	-	194 (88)	194 (88)

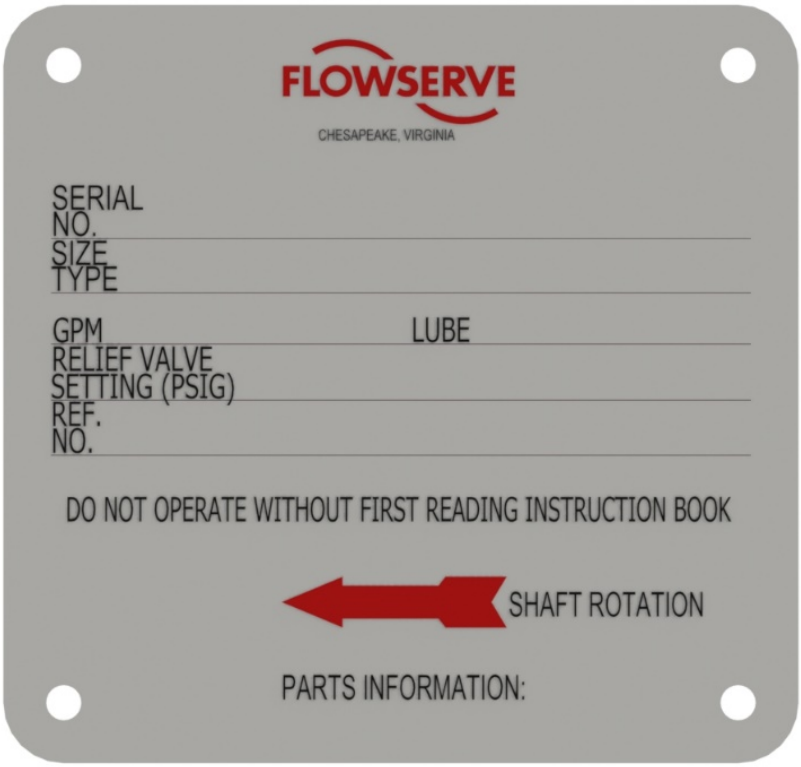
2-1/2 GR	220 (100)	220 (100)	223 (101)	240 (109)	235 (107)	255 (116)	270 (122)	270 (122)
3 GRW	266 (121)	266 (121)	270 (122)	-	282 (128)	-	302 (137)	302 (137)
3 GR	350 (159)	350 (159)	355 (161)	375 (170)	365 (166)	390 (177)	400 (181)	400 (181)
4 GRW	448 (203)	448 (203)	455 (206)	-	468 (212)	-	508 (230)	508 (230)
4 GR	525 (238)	525 (238)	532 (241)	551 (250)	545 (247)	571 (259)	596 (270)	596 (270)
5 GRW	710 (322)	710 (322)	720 (327)	-	740 (336)	-	770 (349)	770 (349)
5 GR	900 (408)	900 (408)	910 (413)	930 (422)	918 (416)	948 (430)	955 (433)	955 (433)
6 GR	1800 (816)	1800 (816)	1820 (826)	1860 (844)	1836 (833)	1896 (860)	1910 (866)	1910 (866)

Table 17: Cast Steel Construction, Approx. Weight in Lbs (Kgs)

	(-) Packed Box	(M) Mech. Seal	(MI) Inboard Bearing (Sealed)	(J) Jacketed Body (Packed)	(L) Jacketed Stuffing Box (Packed)	(JL) Jacketed Body / Box (Packed)	(D) Dual Packed Box	(DM) Dual Sealed Box
1-1/2 GR Threaded	102 (46)	102 (46)	-	112 (51)	107 (49)	117 (53)	137 (62)	137 (62)
2 GRW	112 (51)	112 (51)	-	-	118 (54)	-	142 (64)	142 (64)
2 GR	160 (73)	160 (73)	-	170 (77)	165 (75)	180 (82)	190 (86)	190 (86)
2-1/2 GRW	182 (83)	182 (83)	-	-	187 (85)	-	206 (93)	206 (93)
2-1/2 GR	235 (107)	235 (107)	-	255 (116)	250 (113)	270 (122)	285 (129)	285 (129)
3 GRW	284 (129)	284 (129)	-	-	306 (139)	-	316 (143)	316 (143)
3 GR	375 (170)	375 (170)	-	400 (181)	390 (177)	415 (188)	425 (193)	425 (193)
4 GRW	480 (218)	480 (218)	-	-	500 (227)	-	540 (245)	540 (245)
4 GR	760 (345)	760 (345)	-	786 (357)	780 (354)	810 (367)	831 (377)	831 (377)
5 GRW	965 (438)	965 (438)	-	-	995 (451)	-	1025 (465)	1025 (465)
5 GR	965 (438)	965 (438)	-	995 (451)	983 (446)	1013 (459)	1030 (467)	1030 (467)
6 GR	1925 (873)	1925 (873)	-	1985 (900)	1961 (889)	2021 (917)	2035 (923)	2035 (923)

12.2 Nameplate

Figure 30: Standard Nameplate



Serial No. : Serial Number

Size Type : Size and type, for example “3GRWM”

GPM: Gallons per minute

Lube: Lubrication of bearings, this is a product lube pump so this is the same as the process fluid

Relief Valve Setting (PSIG): Relief valve setting in PSI, only applicable if internal relief valve is provided

Ref. No. : Any reference numbers related to job/pump

12.3 Operating limits

The GR series is capable of

- Flows to 1,000 GPM
- Differential pressure of 500 PSI
- Temperatures to 650°F

- Viscosities of 50 SSU to 1,000,000 SSU
    - When the process fluid viscosity is below 50 SSU slip becomes exponential. Performance cannot be guaranteed.

Special options will be required when a pump is ran at its extreme operating limits. See some of the common options below:

- Grooved Sideplates
    - Process Fluid Viscosity is over 75,000 SSU
- Insurok Wear Plates
    - Process Fluid Viscosity is 400 SSU or less
- High Temperature Packing
    - Applications over 500°F
- Bushings (will replace roller bearings)
    - Bronze Bushing
        - Dirty Service above 100 SSU and below 350°F
    - Carbon Bushing
        - Services below 100 SSU and below 350°F
    - Impregnated Carbon Bushing
        - Dirty Services above 350°F and All Services above 500°F

Ensure the mechanical seal can endure the operating temperature.

12.4 Torque requirements

Refer to Section 8.5.2 for torque requirements.

Annex A: Declaration of Conformity

If the product/system has a declaration of conformity, then it should be added here.

Annex B: Supplementary User Instructions

Supplementary instructions such as for a driver, coupling, instrumentation, controller, seals, seal systems are provided as separate documents in their original format. If further copies of these are required, they should be obtained from the supplier for retention with these User Instructions.

Flowserve factory contacts:
Flowserve Pump Division
3900 Cook Boulevard
Chesapeake, VA 23323-2626 USA

Telephone +1 757 485 8000
Fax +1 757 485 8149

FLOWSERVE REGIONAL SALES OFFICES:

USA and Canada
Flowserve Corporation
5215 North O'Connor Blvd., Suite 300
Irving, Texas 75039-5421 USA
Telephone +1 972 443 6500
Fax +1 972 443 6800

Europe, Middle East, Africa
Flowserve FSG – Italy
Worthington S.r.l.
Via Rossini 90/92
20033 Desio (Milan) Italy
Telephone +39 0362 6121
Fax +39 0362 628 822

Asia Pacific
Flowserve Pte. Ltd
10 Tuas Loop
Singapore 637345
Telephone +64 6771 0600
Fax +65 6862 2329

Latin America and Caribbean
Flowserve Corporation
6840 Wynnwood Lane
Houston, Texas 77008 USA
Telephone +1 713 803 4434
Fax +1 713 803 4497