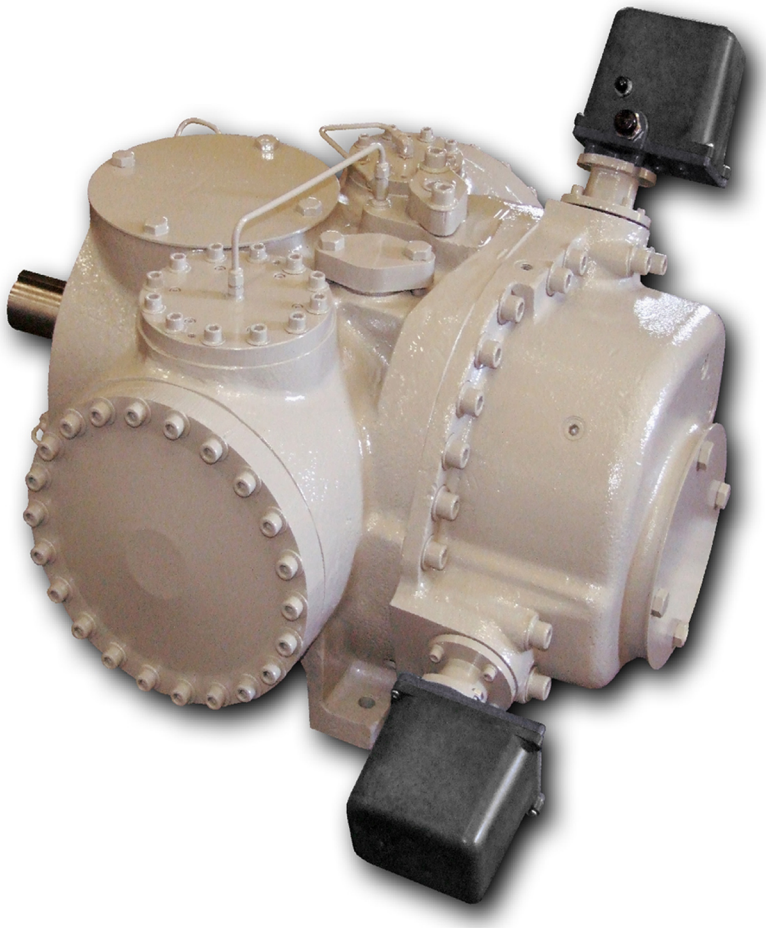
VSG & VSSG Single Screw Bare Shaft Compressor

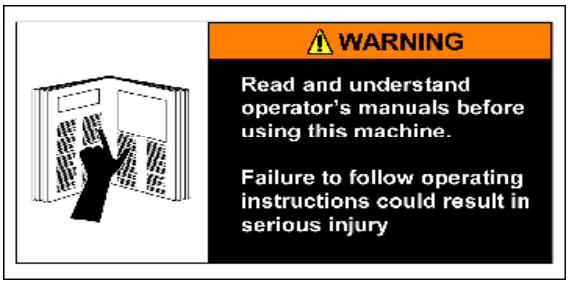
Installation, Operation and Service Manual



The World's Best Compressors™
For Gas Compression

VILTER
by COPELAND

Important Message



READ CAREFULLY BEFORE INSTALLING AND STARTING YOUR COMPRESSOR.

The following instructions have been prepared to assist in installation, operation and removal of Vilter™ Single Screw Compressors. Following these instructions will result in a long life of the compressor with satisfactory operation.

The entire manual should be reviewed before attempting to install, operate, service or repair the compressor.

Only qualified personnel shall operate, install and maintain the equipment.

Qualified personnel shall be accredited by a local regulatory agency, which requires that they are continually scrutinized by an organization whose sole mission is to establish, maintain and assure that the highest industry standards are set and met in a continuous and ongoing basis. The credentials shall address topics ranging from plant safety, operating concepts and principles and operations through the basics of gas compression compliance and PSM (Process Safety Management) requirements.

Follow local workplace occupational safety and health regulations.

A compressor is a positive displacement machine. It is designed to compress gas. The compressor must not be subjected to liquid carry over. Care must be exercised in properly designing and maintaining the system to prevent conditions that could lead to liquid carry over. Vilter™ Manufacturing is not responsible for the system or the controls needed to prevent liquid carry over and as such Vilter™ Manufacturing cannot warrant equipment damaged by improperly protected or operating systems.

Vilter™ screw compressor components are thoroughly inspected at the factory. However, damage can occur in shipment. For this reason, the equipment should be thoroughly inspected upon arrival. Any damage noted should be reported immediately to the Transportation Company. This way, an authorized agent can examine the unit, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter™ representative or the home office should be notified of any claim made.

All inquires should include the Vilter™ sales order number, compressor serial and model number. These can be found on the compressor name plate on the compressor.

All requests for information, services or parts should be directed to:

Copeland Industrial LP (Vilter)
Customer Service Department
5555 South Packard Ave
Cudahy, WI 53110-8904 USA
Telephone: 1-414-373-7615, Fax:1-414-744-3483
E-mail: info.vilter@copeland.com, Website: Copeland.com/Vilter

Equipment Identification Numbers:
Vilter Order Number: _____Compressor Serial Number: _____
Vilter Order Number: _____Compressor Serial Number: _____

Standard VILTER™ Warranty Statement

It is now on the web site. You can access it here:
Go to www.Copeland.com/Vilter ,then scroll down to find Lifecycle Services -> Warranty Information
Or click directly:
Warranty Information | Copeland US

The EC Declaration of Incorporation

It is now on the web site. You can access it here:
Go to www.Copeland.com/Vilter ,then scroll down to find Lifecycle Services -> Compliance -> Legal & Compliance
Or click below directly:
EC Declaration of Incorporation - Single Screw Compressor

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How To Use This Manual

This manual contains instructions for VSG & VSSG bare shaft compressors. It has been divided into eight sections and Appendices:

Section 1: General Information

Section 2: Theory of Operation

Section 3: Installation

Section 4: Operation

Section 5: Maintenance & Service

Section 6: Troubleshooting

Section 7: Warranty and Parts

Section 8: Spare Parts List

Appendices

Appendix A - Torque Specifications

Appendix B - Vilter Oil

Appendix C - Vibration Measurements - Single Screw Compressor

It is highly recommended that the manual be reviewed prior to servicing system parts.

Figures and tables are included to illustrate key concepts.

NOTE:

The symbol ⟨ at the bottom of every page:

Click the symbol ⟨ . It will take you back to your previous page.

Safety precautions are shown throughout the manual. They are defined as the following:

NOTICE - Notice statements are shown when there are important information that shall be followed. Not following such notices may result in void of warranty, serious fines, serious injury and/or death.

WARNING - Warning statements are shown when there are hazardous situations, if not avoided, will result in serious injury and/or death.

CAUTION - Caution statements are shown when there are potentially hazardous situations, if not avoided, will result in damage to equipment.

NOTE - Notes are shown when there are additional information pertaining to the instructions explained.

Additional Important Notes

- Installation, operation and maintenance instructions can be found in the associated software manual.
- Due to continuing changes and unit updates, always refer to the website Copeland.com/Vilter or Vilter.com to make sure you have the latest manual.
- Any suggestions of manual improvements can be made to Vilter™ Manufacturing at the contact information on page i.

Bare Shaft Gas Compressor Model Designations

The compressor bare shaft model designation can be found on the nameplate.

Compressor Model
GVSG - Gear Driven Vilter™ Single Screw Compressor
VSG - Vilter™ Single Screw Compressor
VSSG - Vilter™ Single Screw Compressor (Compressor models 291, 341, 451 & 601 - with High Pressure)
VRSG - Vilter™ Twin Screw Compressor

VSG –1801–HPH

Size
CFM - Nominal CFM displacement of the compressor at 3600 rpm

Compressor Type
CIH - Standard Cast Iron Material w/ Discharge Connection Horizontal
CID - Standard Cast Iron Material w/ Discharge Connection Down
STH - Steel Compressor Material w/ Discharge Horizontal
HPH - High Pressure Cast Iron Option w/Discharge Connection Horizontal (This currently exists on only the VSG-1501/1801)
DIH - Ductile Iron(750MAWP) w/ Discharge Connection Horizontal
DID - Ductile Iron Material w/ Discharge Connection Down

System Unit Identification

To keep definitions of units simple and consistent, Vilter™ has defined the following three:

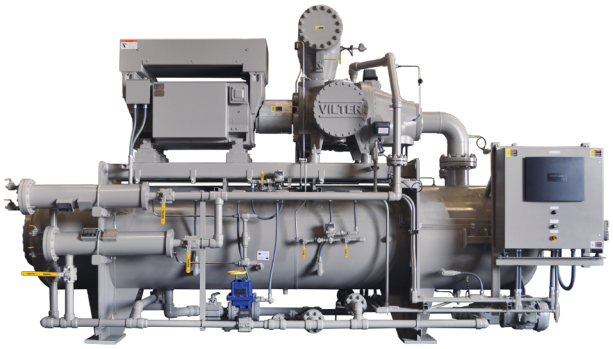
- Bare Shaft Compressor
- Compressor Unit
- Package Unit

Bare Shaft Compressor

A bare shaft compressor is just the compressor with no coupling and motor nor foundation.

Compressor Unit

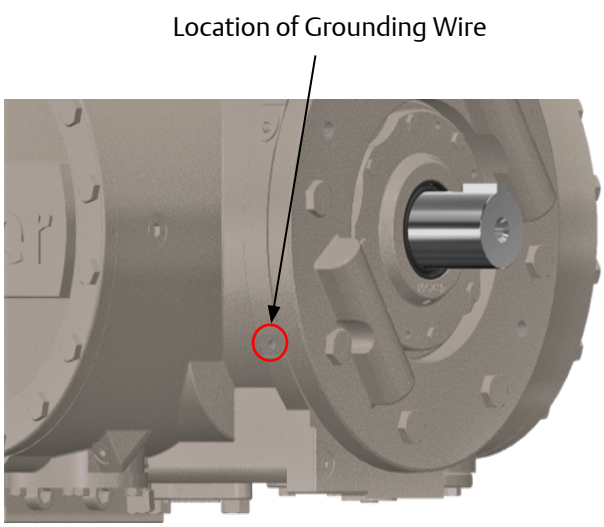
A compressor unit consists of the bare shaft compressor with the coupling, motor, oil separator, frame, micro-controller system and oil system. A compressor unit typically a single screw compressor unit, is not mounted on a structural steel base.



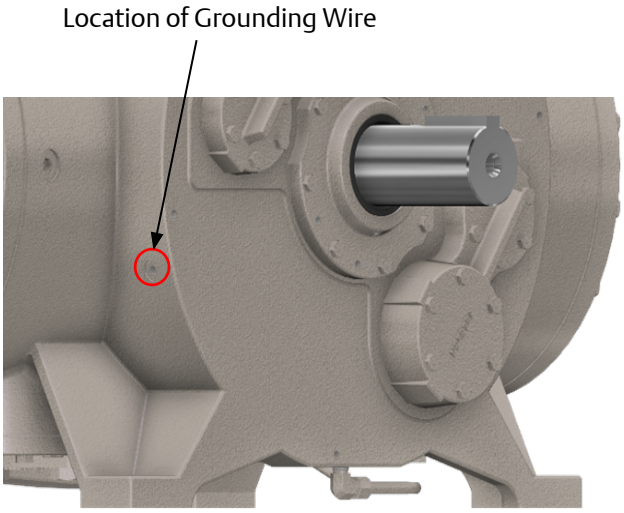
Package Unit

A package unit is a complete system mounted on a structural steel base with interconnecting piping.

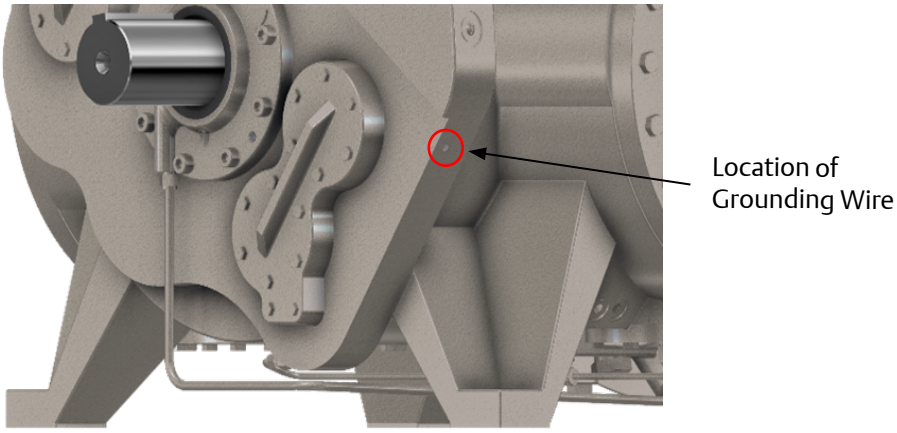
Grounding Wire Location



(a) VSG 501, 601, 701 (240mm) &
VSG 301, 361, 401 (205mm)



(b) VSG 751 & 901 (280mm)
VSSG 291, 341, 451, 601 (240mm)
VSG 791, 891, 1051, 1201, 1301 (310mm)
VSG 2401, 2601, 2801, 3001 (401mm)



(c) VSG 1551, 1851, & 2101 (350mm)

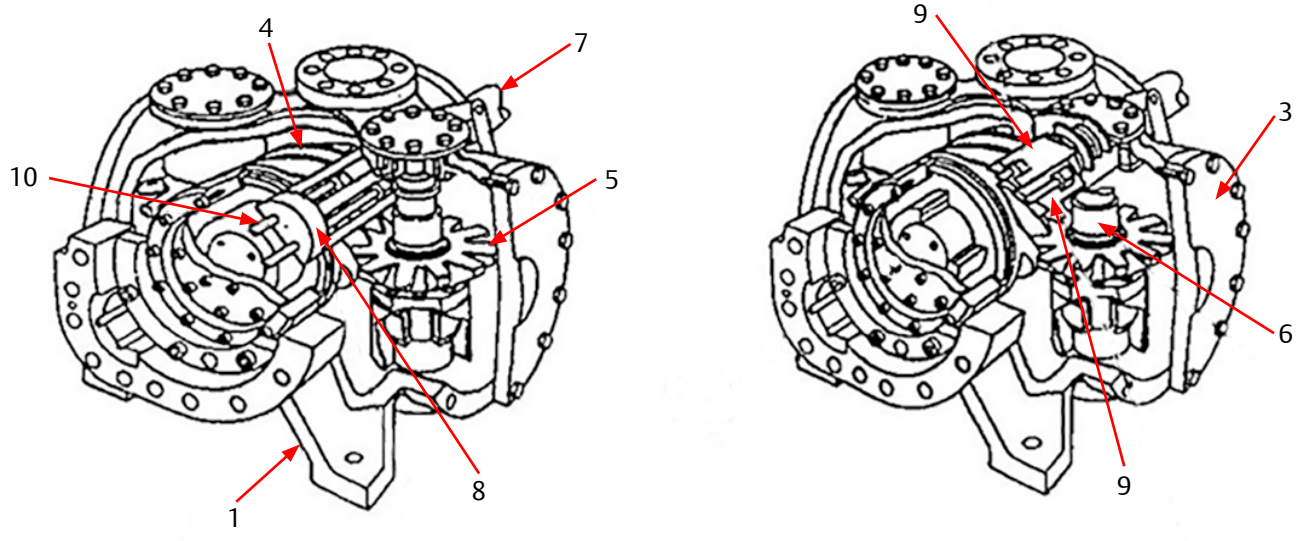
Figure 1-1. The Grounding-Wire Hole Location on Housing for Various Screw Compressor Models

VSG Standard Materials of Construction

Table 1-1. VSG Standard Materials of Construction

Tag No.	Component Description	Material Type	Typical Specification Data
1	Compressor Frame	Cast Grey Iron	ASTM A-126
2*	Discharge Manifold	Cast Ductile Iron	ASTM A-536
3	Gaterotor Covers	Cast Ductile Iron	ASTM A-536
4	Main Rotor	Cast Grey Iron	Vilter Specification
5	Gaterotors	PPS	Ryton
6	Gaterotor Supports	Cast Ductile Iron	ASTM A-536
7	Main Drive Shaft	Steel	AISI 1045 or 1144
8	Slide Carriages	Cast Grey Iron	ASTM A-126
9	Volume / Capacity Slides	Cast Grey Iron	ASTM A-126
10	Slide Valve Drive Shafts	Steel	ASTM A-108
11*	Bearings*		Cylindrical Roller Type
12*	Bearings*		Angular Contact Ball
13*	Bearing Cages*		Steel & Polyamide

Note: *: The component is not shown in the illustration.



Compressor

The Vilter™ Single Screw Compressor is a positive displacement, capacity and volume controlled, oil flooded, rotary compressor which uses a single main screw intermeshed by two opposing Gaterotors. Gas compression occurs when the individual teeth of each Gaterotor sweep through the grooves, or flutes, of the main screw as the screw rotates. Compression occurs from the time the screw flute is first closed off by the Gaterotor finger, until the time when the screw flute has rotated to the point of lining up with the discharge port in the compressor housing. A labyrinth type seal is used to prevent gas at discharge pressure from leaking past the end of the screw. Any discharge gas leakage past the labyrinth seal is vented back to suction via four longitudinal holes drilled through the body of the screw.

By venting the discharge end of the main screw back to suction, forces on each end of the screw are equal. This results in zero net axial forces on the main bearings. With twin opposing Gaterotors, all radial forces are cancelled out also. Main shaft bearings have no net forces except the weight of the screw and the shaft assembly.

The VSG compressors are comprised of three rotating assemblies: the main screw assembly and the two Gaterotor assemblies. Each of these rotating assemblies use a common bearing configuration consisting of a single, cylindrical rolling element bearing at one end, and a pair of angular contact ball bearings at the other end. The pair of angular contact ball bearings are used to axially fix one end of the rotating shafts, and to absorb the small amount of thrust loads on the shafts. The inner races of the ball bearings are securely clamped to the rotating shafts, while the outer races are securely held in the bearing housing, thus fixing the axial position of the shaft in relation to the bearing housings. The cylindrical roller bearings at the opposite end of the shafts allow for axial growth of the shafts while supporting the radial loads from the shafts.

The suction gas enters the compressor housing through the top inlet flange, at the driven end of the unit. The driven end of the compressor housing is flooded with gas at suction pressure. The gas enters the open end of the main screw flutes at the driven end, and becomes trapped in the screw flute as the screw rotates and the Gaterotor tooth enters the end of the flute. At this point, the compression process begins. Directly after the screw flute is closed off by the Gaterotor tooth, oil is injected into the groove.

The oil enters the compressor through a connection at the top of the compressor. The purpose of the injected oil is to absorb the heat of compression, to seal the Gaterotor tooth in the groove, and to lubricate the moving parts.

Additional internal oiling ports are provided at the main and Gaterotor bearings to cool and lubricate the bearings. The mechanical shaft seal housing also contains oiling ports to lubricate, cool and provide a sealing film of oil for the mechanical shafts seal. Excess oil flows through the check valves on the sealing baffle plate. This oil is directed at the main rotor roller bearing, which cools and lubricates the front roller bearing.

As the main screw rotates, the Gaterotor is also driven, causing the Gaterotor tooth to sweep the groove in the main screw. This sweeping action reduces the volume of the groove ahead of the Gaterotor tooth and causes the trapped gas and oil to be compressed in the reduced volume. As the main screw continues to rotate, the Gaterotor tooth continues to reduce the groove volume to a minimum, thus compressing the trapped gas to a maximum pressure. A labyrinth seal arrangement prevents the compressed gas from leaking past the end of the screw. As the Gaterotor tooth reaches the end of the groove, the groove rotates to a position that lines up with the discharge port in the compressor housing and the gas/oil mixture is discharged from the screw at high pressure. This completes the compression cycle for a single flute of the main screw.

Once the gas is swept from the main screw flute through the discharge port, it passes into the discharge manifold of the compressor. From the discharge manifold, the gas/oil exits the compressor housing.

Capacity and Volume Control

The Vilter™ VSG compressors feature the exclusive Parallex™ Slide System, which consists of a pair of slides for each Gaterotor assembly. These two independently operated slides are referred to as the capacity slide and the volume ratio slide. On the suction end of the screw, the capacity slide moves to vary the timing of the beginning of the compression process. With the slide moved all the way out to the suction end of the screw (the 100% position), the compression process begins immediately after the Gaterotor tooth enters the screw flute and closes off the end of the groove. In this situation, the maximum volume of gas is trapped in the screw flute at the start of the compression process. As the slide is pulled back away from the suction end of the screw, the start of the compression process is delayed as some of the suction gas is allowed to spill back out of the screw flute until the screw rotates far enough to pass the end of the capacity slide and begin compressing. This causes a reduced volume of gas to be trapped in the screw flute when the compression process begins. In this way, the capacity of the compressor is reduced from 100% down to as low as 10% of the full rated capacity.

The capacity slide provides the means for controlling specific process set points. By continuously adjusting the flow of gas through the compressor, either suction or discharge pressure in a particular process can be controlled. When coupled with a microprocessor controller, the adjustable capacity slide allows for precise and continuous automatic control of any parameter in the process to a chosen set point.

The second slide for each Gaterotor is the volume ratio slide. The purpose of the volume ratio slide is to maximize the efficiency of the compressor by matching the gas pressure within the screw flute at the point of discharge to the downstream process requirements. The volume ratio slide operates at the discharge end of the screw, and acts to vary the position of the discharge port. When the slide is extended fully to the discharge end of the screw (the 100% position), the compression process within the screw flute continues until the screw rotates far enough for the flute to pass the end of the volume ratio slide. At this point, the screw flute lines up with the discharge port and the compressed gas is expelled from the screw flute. As the volume ratio slide is pulled back away from the discharge end of the screw, the position of the discharge port is changed and the gas is allowed to escape the screw flute earlier in the compression process, at a reduced pressure.

The overall volume ratio within the compressor is determined by the distance between the front of the capacity slide (the start of compression) and the back of the volume ratio slide (the completion of compression). Therefore, the volume ratio slide must respond to changes in the downstream pressure measured in the oil separator and position itself for the required compression ratio based on the position of the capacity slide. By only compressing the gas within the screw as far as required to match the pressure in the downstream receiver, the compressor efficiency is maximized. Proper positioning of the volume ratio slide prevents either over compressing or under compressing of the gas within the screw flute. This allows the single screw compressor to efficiently handle a range of volume ratios from as low as 1.2 up to 7.0.

Description of a Gas System for a Standard Compressor Set

The gas passes through a stop valve and a check valve and then through a mesh strainer mounted directly to the inlet flange. The check valve is necessary to prevent reverse rotation and potential damage or oil loss at shut down. The suction gas enters the compressor housing through the top inlet flange, at the driven end of the unit.

After compression the gas is discharged from the discharge manifold directly into a oil separator tank. On the discharge of the oil separator tank another check valve is positioned to prevent the entry of gas or liquid refrigerant in to the separator when the compressor is shut down. The separator should be allowed to equalize slowly to suction pressure through a small bypass line around the suction check or combination stop/check valve. This will allow the compressor to start without a pressure differential across it, reducing the starting power requirements.

From the discharge manifold, the gas/oil exits the compressor housing and passes into the oil separator through a pipe elbow. The separator vessel serves to separate the oil from the gas as the gas stream moves from one end of the separator to the other. The majority of the oil is separated from the gas in the primary chamber of the vessel due to changes in direction and velocity reduction. Any remaining oil mist is separated from the gas stream as the stream passes through the coalescing elements and into the secondary chamber of the vessel. The gas at discharge pressure then exits at the far end of the separator.

Oil collected in the bottom of the separator is drained off to be recirculated in the oil injection system. The injection oil temperature is controlled by several means the first of which is a three-way mixing valve, which mixes hot oil directly from the separator with oil which has passed through the oil cooler to obtain oil at the desired temperature. This oil then passes through a filter to remove any contaminants, which may have been picked up from the process gas, and is injected back into the compressor.

Description of an Oil System for a Standard Compressor Set

At start oil is drawn from the oil separator tank by the oil pump, and passes through an oil cooler and micronic filters to the oil supply inlet on the compressor frame. From there it internally lubricates all points internal to the compressor. After start-up when the compressor develops sufficient differential pressure the oil pump can be shut down and the oiling can take place without the use of the oil pump. On units with low pressure differentials such as booster and low pressure differential high stage compressors, the oil pump must remain on whenever the unit is running to maintain sufficient oil flow.

Critical Applications Guidelines

To ensure the successful operation of the VSG compressor, the guidelines described below should be followed.

1. Proper lubrication is critical to the operation of the VSG compressor. The compressor relies on the injected oil to absorb and remove the heat of compression, to seal the compression chambers formed in the flutes of the screw, and to lubricate all moving parts. For this reason, it is imperative that the oil chosen be of correct viscosity, and that sufficient oil flow be provided at all times, using an auxiliary oil pump when necessary. The oil chosen must be compatible with the process gas as well, to prevent absorption of the gas into the oil, which would dilute the oil and reduce the viscosity. Also, oil filtration to 25 micron nominal particle size is required to ensure that only clean oil is injected into the compressor. For assistance in choosing the correct oil for the application and in sizing an auxiliary oil pump, consult a Vilter™ representative.
2. Injection oil temperature must be closely controlled for optimum performance. Oil temperature must be maintained a minimum of 15 - 20°F above the gas mixture dewpoint at anytime to prevent condensation or liquid knockout from occurring within the compressor.
3. Gas composition plays a role in the performance of the VSG compressor as well. While the VSG is capable of handling a wide variety of gases, it is required that the concentration of H_2S in the process gas not exceed 100 PPM. If H_2S is present in the process gas in any concentration, special oil additives are required to protect the compressor from corrosion.

Notice on using Non-Vilter Oils

Oil and its additives are crucial in gas compression system performance. Vilter™ Manufacturing will **NOT APPROVE** non-Vilter oils for use with Vilter™ compressors. Due to the innumerable choices available it is not possible for us to test all oils offered in the market place, and their effects on our equipment, as we can with our own lubricants.

We realize that customers may choose compressor lubricants other than Vilter™ branded oil. This is certainly within the customers' right as owners of the equipment. When this choice is made, however, Vilter™ is unable to accept responsibility for any detrimental affects those lubricants may have on the equipment or system performance and durability.

Should a lubrication related system issue occur with the use of non-Vilter oils, Vilter™ may deny warranty upon evaluation of the issue. This includes any parts' failure caused by inadequate lubrication.

Certainly, there are many good lubricants in the market place. The choice of a lubricant for a particular application involves consideration of many aspects of the lubricant and how it and its additive package, will react in the various parts of the entire gas compression system. It is a complex choice that depends on a combination of field experience, lab and field-testing, and knowledge of lubricant chosen. Vilter™ will not accept those risks other than for our own compressor lubricants.

Alarm and Shutdown Readings

The control system for the VSG compressor must protect the machine from damage caused by running outside of normal operating conditions by providing operators with alarms when operating parameters have reached an abnormal condition, and by automatically stopping the compressor before these conditions can cause a unit failure. Pressures and temperatures of the process gas and the oil, as well as motor amperage and slide positions must all be continuously monitored to ensure the compressor is operating properly.

1. Low Gas Suction Temperature - This point protects the compressor from suction gas entering the compressor at too low of a temperature, and is activated by a direct reading from the suction temperature RTD located in the suction "T".

2. High Gas Discharge Temperature - This point protects the compressor against high gas temperature at the discharge of the unit, and is activated by a direct reading from the RTD located in the compressor discharge manifold.

3. Low Oil Separator Start Temperature - This point protects the compressor from starting with low oil temperature in the separator, and is activated by a direct reading from the RTD located in the bottom of the oil separator.

4. Low Oil Separator Run Temperature - Similar to the Low Oil Separator Start Temperature described above, however this point only becomes active after a predetermined warm up time, and uses a higher setpoint.

5. Low Oil Injection Temperature - This point protects the compressor from running with cold oil being injected into the screw housing, and is activated by a direct reading from the RTD located in the oil injection line. This point is bypassed for a predetermined period of time after starting to allow the unit time to start and warm up.

6. High Oil Injection Temperature - This point protects the compressor from running with hot oil being injected into the screw housing, and is activated by a direct reading from the RTD located in the oil injection line.

7. Low Suction Pressure - This point protects the compressor from drawing low suction pressure and is activated by a direct reading from the suction pressure transducer, which reads the pressure from a tap located in the suction stop/check valve housing.

8. High Discharge Pressure - This point protects the compressor from developing high discharge pressure and is activated by a direct reading from the discharge pressure transducer, which reads the pressure from a tap located in the oil separator. In addition to this alarm and shutdown, the compressor package is ultimately protected from damage due to over pressurization by at least one discharge pressure relief valve located on the oil separator. The purpose of this safety setpoint is to allow for a lower setpoint to conform to a process requirement, and to prevent the relief valve from opening.

9. Prelube Oil Pressure - This point acts as a permissive to start the compressor, and protects against the compressor starting with no oil lubrication. If, during a start sequence, the prelube oil pressure fails to rise above 4.0 PSID, the compressor will fail to start. The prelube oil pressure is a calculated value obtained by subtracting the discharge pressure reading from the oil manifold pressure (oil filter outlet pressure) reading.

10. Low Oil Pressure - This point protects the compressor from running with insufficient lubrication pressure, and becomes active after a predetermined period of running, usually sixty seconds. The oil pressure is a calculated value obtained by subtracting the suction pressure from the oil manifold pressure (oil filter outlet pressure) reading, which results in the actual pressure under which the oil is entering the screw housing.

11. High Running Oil Filter Differential Pressure - This point alerts operators to clogging oil filters. When the oil filters develop a high differential pressure while running at normal operating temperatures, it is an indication that they are becoming dirty and must be changed. An alarm initially warns of dirty filters; if the situation worsens before the filters are changed a shutdown will stop the compressor.

In most cases, the safety setpoints described above will have settings which are dictated by process requirements, and not necessarily mechanical constraints of the compressor. Process pressures and temperatures may vary considerably depending on the application of the compressor, and the VSG compressor is designed to work well in a broad range of applications. For this reason, it is impractical to suggest “initial” setpoints to fit all applications. Instead, minimum and maximum values for each safety setpoint are provided, while precise settings for the safety setpoints must be derived for each installation.

VSG Package Requirements

Process Gas Circuit

1. Suction Gas Stop/Check Valve - The VSG compressor requires a manually operated stop valve on the suction line to the compressor to allow for isolating the compressor package from process gas. Also, a check valve is required in the suction line to limit reverse rotation of the compressor on shutdown.

2. Suction Line Strainer - Vilter™ strongly recommends the use of an inline suction gas strainer to protect the VSG compressor from foreign material which may enter the compressor with the suction gas. This strainer is generally of stainless steel mesh construction. Vilter™ can provide assistance in designing a strainer housing specifically suited to VSG applications.

3. Process Gas/Oil Separator - A separator vessel capable of removing the oil from the discharge gas stream with an efficiency down to at least 5 PPM oil carryover is required. Vilter's own available horizontal separator is an ASME-coded vessel which uses five stages of separation to achieve an oil loss of as little as 3 to 4 PPM.

4. Discharge Gas Relief Valve - To protect the compressor package from damage due to over pressurization, a relief valve must be installed inside of any discharge line hand block valves. The relief valve must be set to open at a pressure lower than the Maximum Allowable Working Pressure (MAWP) of the separator.

5. Oil Prelube Pump - Usually a direct driven gear type pump, the oil pump is required to prelube the compressor prior to starting and to maintain oil pressure during any periods of low compression ratio operation.

6. Oil Cooler/ Temperature Control Valve - An oil cooler, either air or water cooled, must be used to remove the heat of compression from the oil stream. A temperature control valve is used to maintain constant oil injection temperature to the compressor.

7. Oil Filtration - Large capacity micronic oil filters are required to filter the oil before injection into the VSG compressor. Filtration down to 25 microns nominal or less is generally acceptable. Dual filters are recommended to allow replacement of one cartridge while the compressor continues running with the other cartridge in service.

8. Oil Heater - An oil heater is generally required and must be sized to maintain oil temperature of at least 90°F when the compressor is not running. For outdoor installations, low ambient temperatures and winds must be considered when sizing the oil heater. Also, insulating the separator and oil piping may be required in low temperature ambient conditions.

NOTE

Because the oil system on the VSG compressor utilizes discharge gas pressure as the means to move the injection oil through the system, it must be remembered that all components of the oil system are exposed to full discharge pressure and must be pressure rated accordingly.

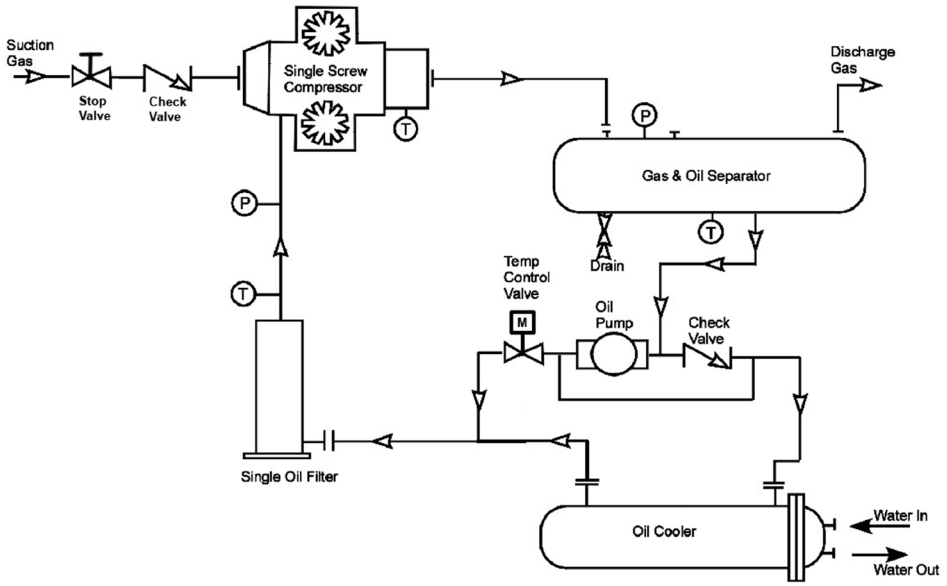


Figure 2-1. Basic Single Screw Compressor System

WARNING

When working with LFG, NG or other dangerous/ flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

NOTICE

Vilter compressors are to be installed and connected to the customer-provided piping. Vilter expects this piping to be designed and built following ASME B31.3 Process Piping Guide, plus any other local applicable codes, and that the installation will be performed by qualified personnel only.

Delivery Inspection

Every equipment supplied by Vilter is thoroughly inspected at the factory. However, damage can occur in shipment. For this reason, the compressor should be thoroughly inspected upon arrival, prior to off-loading. Any damage noted should be photographed and reported immediately to the transportation company. This way, an authorized agent can examine the compressor, determine the extent of damage and take necessary steps to rectify the claim with no serious or costly delays. At the same time, the local Vilter representative or the home office should be notified of any claims made within ten (10) days after its discovery. Refer to Compressor Inspections Prior to Installation and Storage for additional recommendations.

Rigging and Lifting of the Compressor

WARNING

When rigging and lifting a compressor unit, use proper lifting device capable of lifting and maneuvering the weight and size of the compressor unit. Use only qualifi ed personnel and additional personnel and lifting equipment (i.e. spreader bar) as required. Failure to comply may result in death, serious injury and/or damage to equipment.

Only qualified personnel shall operate rigging and lifting equipment. Ensure that the lifting device is capable of lifting the weight of the compressor, refer to the supplied Vilter General Assembly (GA) drawing, and to Table 3-3 for weights of bare shaft compressors.

To lift the compressor, use lifting points on compressor frame to attach the lifting device, see Table 3-1 and Figure 3-1 to 3-6. There are a few points to consider prior to moving it:

- Ensure that the weight is evenly distributed amongst the lifting device (i.e. lifting chains and spreader bar) prior to lifting.
- Ensure that the lifting device is not obstructed by any parts of the compressor to prevent damage to components.
- Use additional personnel as needed to spot and aid in maneuvering the compressor.
- Ensure there is plenty of space to maneuver the compressor, and a clear path to its location.

Bare Shaft Compressor Lifting Points and Weights

Table 3-1. Bare Shaft Compressor Component Weights

Models	Component Weights				
	Gaterotor Bearing Housing	Gaterotor Bearing Housing Cover	Discharge Manifold	Main Compressor Assembly ONLY	Gaterotor Cover
128-243	14 lbs (6.35 kg)	9 lbs (4.08 kg)	160 lbs (72.57 kg)	1095 lbs (498 kg)	26 lbs (11.79 kg)
291-601	19 lbs (9 kg)	11 lbs (5 kg)	125 lbs (57 kg)	1105 lbs (502 kg)	46 lbs (21 kg)
751-901	28 lbs (13 kg)	11 lbs (5 kg)	177 lbs (80 kg)	1450 lbs (658 kg)	33 lbs (15 kg)
791-1301	37 lbs (17 kg)	13 lbs (6 kg)	274 lbs (125 kg)	2006 lbs (910 kg)	42 lbs (19 kg)
1551-2101	54 lbs (24 kg)	19 lbs (9 kg)	349 lbs (158 kg)	3151 lbs (1429 kg)	70 lbs (32 kg)
2401-3001	58 lbs (27 kg)	32 lbs (15 kg)	788 lbs (358 kg)	4152 lbs (1883 kg)	150 lbs (68 kg)

Table 3-2. Bare Shaft Compressor Component Lifting Hole Sizes

Models	Component Lifting Hole Sizes				
	A	B	C	D	E
	Discharge Manifold (Side)	Discharge Manifold (Top)	Main Compressor Assembly ONLY (Discharge)	Main Compressor Assembly ONLY (Suction)	Gaterotor Cover
128-243	-	1/2-13 UNC -2B	1/2-13 UNC -2B	1/2-13 UNC -2B	-
291-601	5/8-11 UNC - 2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC -2B
751-901	5/8-11 UNC - 2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	-
791-1301	5/8-11 UNC - 2B	5/8-11 UNC -2B	3/4-10 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC -2B
1551-2101	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/8-16 UNC -2B
2401-3001	5/8-11 UNC -2B	5/8-11 UNC -2B	5/8-11 UNC -2B	3/4-10 UNC -2B	5/8-11 UNC -2B

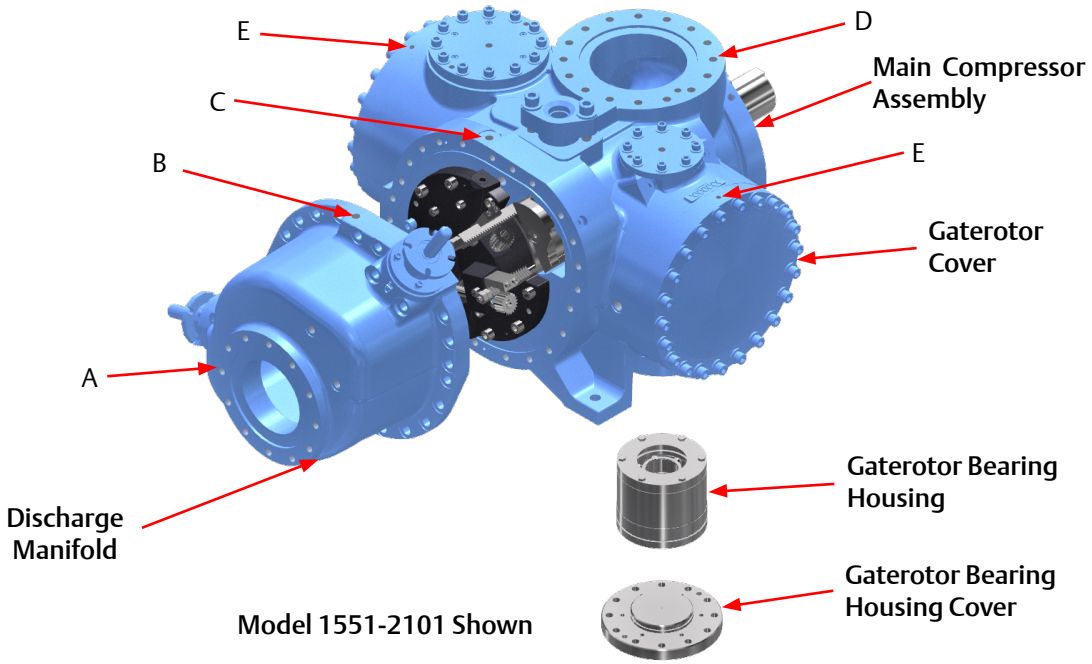


Figure 3-1. Bare Shaft Compressor Lifting Points and Component Weights

Bare Shaft Compressor Center of Gravity (Models 128-243)

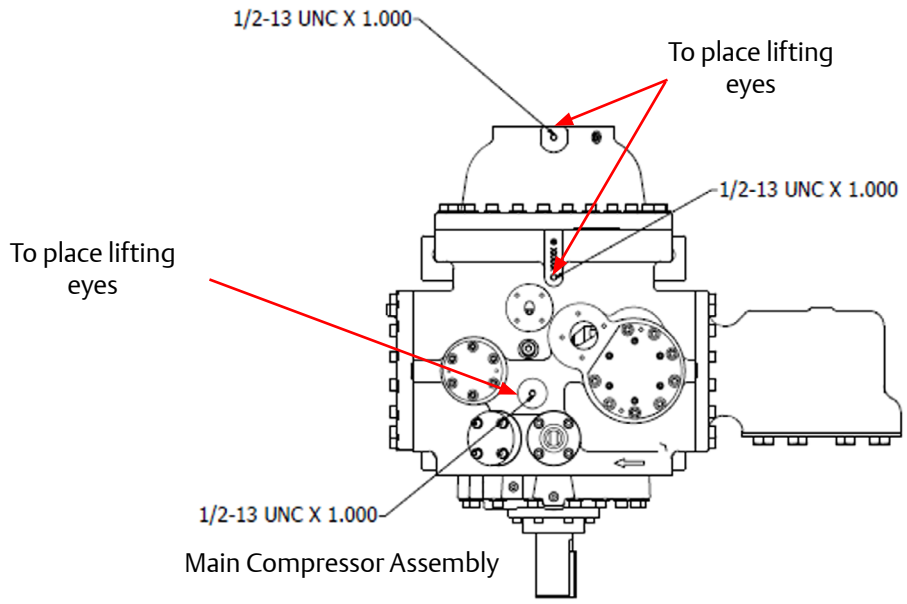


Figure 3-2. Bare Shaft Compressor Assembly Center of Gravity (Models 128-243)

Table 3-3. Bare Shaft Compressor Weights

COMPRESSOR MODEL	VSG128	VSG145	VSG160	VSG180	VSG204	VSG222	VSG243
Weight	1095 LBS	1095 LBS	1095 LBS	1090 LBS	1090 LBS	1090 LBS	1090 LBS

Bare Shaft Compressor Center of Gravity (Models 291-2101)

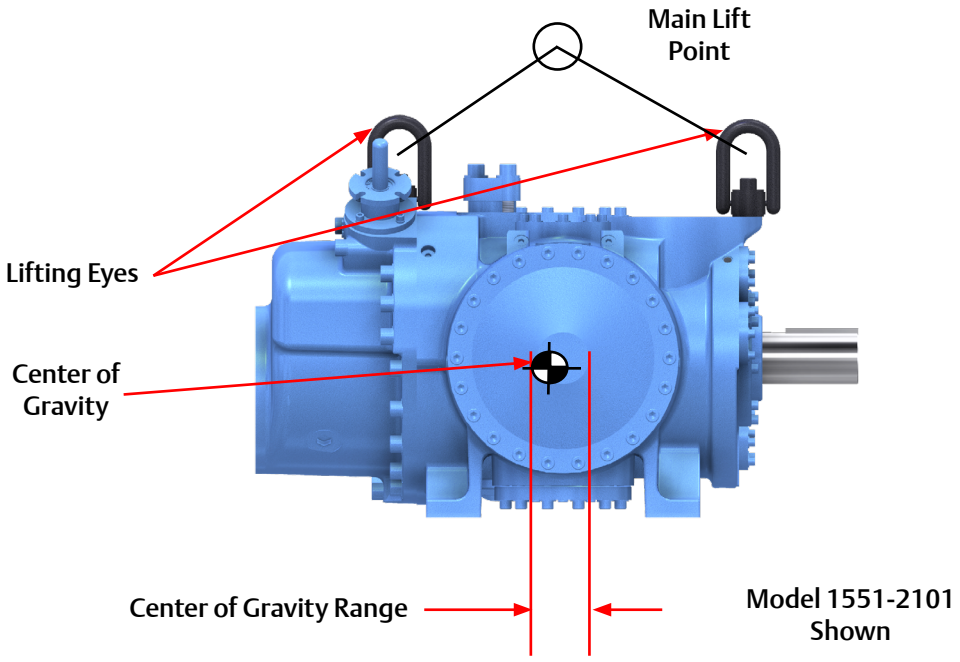


Figure 3-3. Bare Shaft Compressor Assembly Center of Gravity (Models 291-2101)

Center of gravity may differ slightly between models 291-2101. Adjust main lift point within the range to keep bareshaft compressor as leveled as possible when lifting.

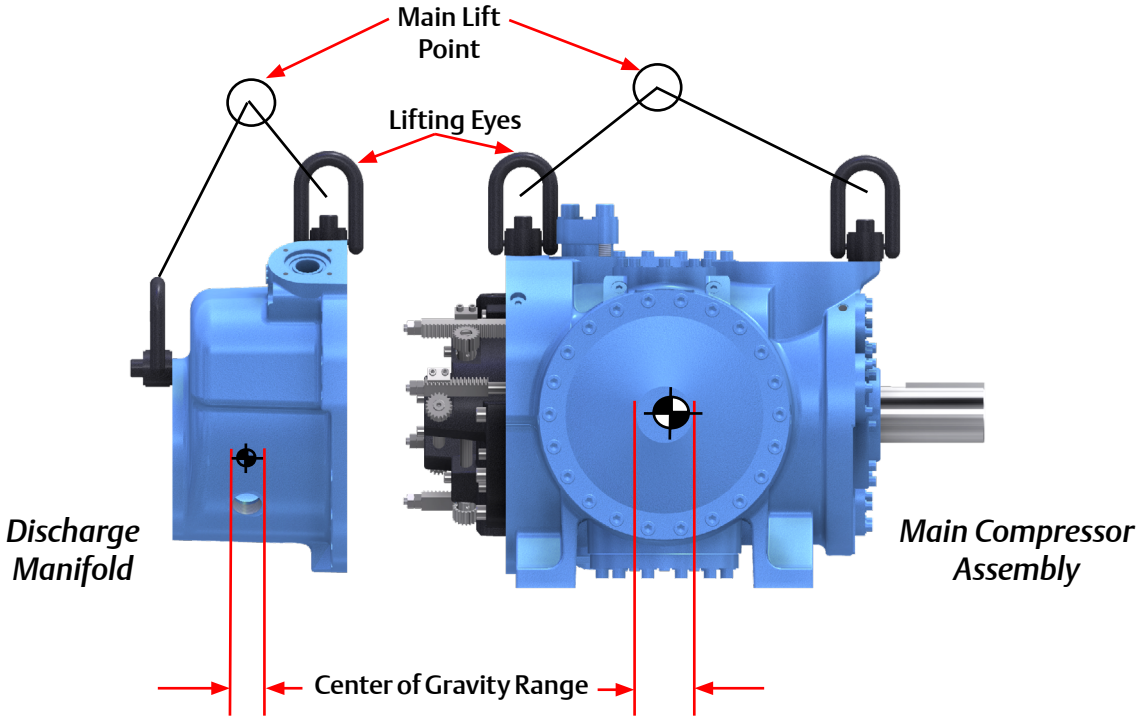


Figure 3-4. Bare Shaft Compressor Center of Gravity - Discharge Manifold and Main Compressor Assembly (Models 291-2101)

Bare Shaft Compressor Center of Gravity (Models 2401-3001)

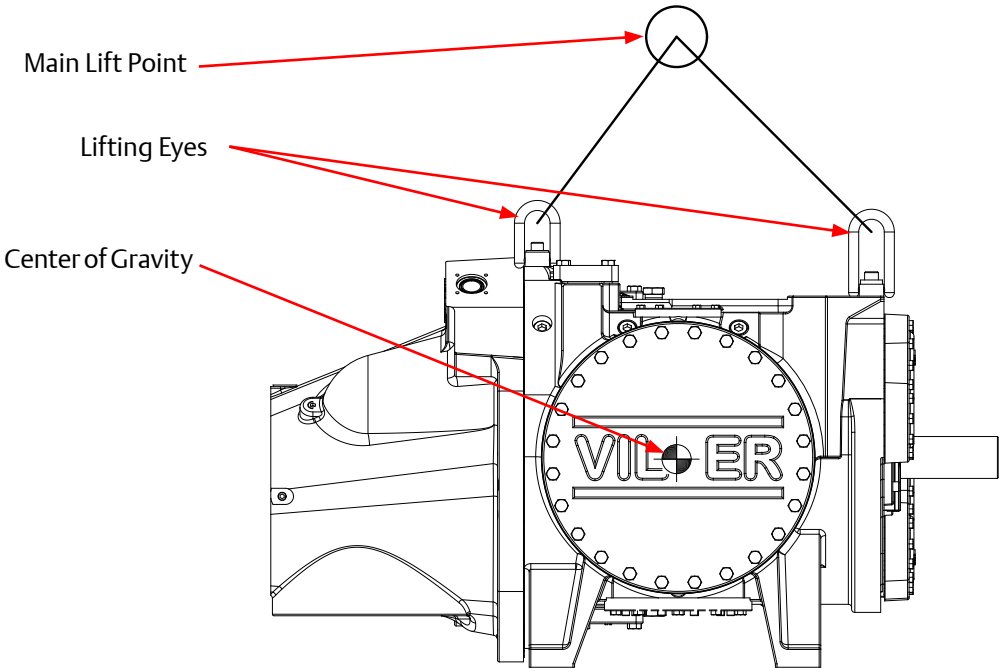


Figure 3-5. Bare Shaft Compressor Assembly Center of Gravity (Models 2401-3001)

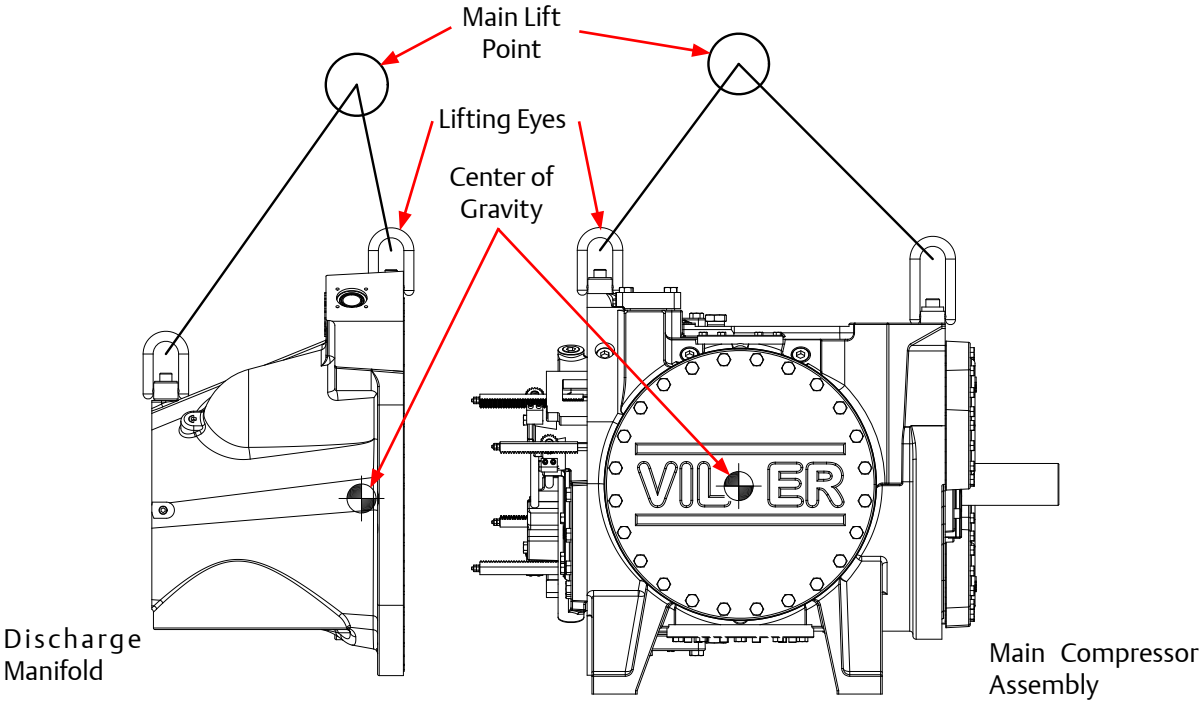


Figure 3-6. Bare Shaft Compressor Center of Gravity - Discharge Manifold and Main Compressor Assembly (Models 2401-3001)

Compressor Inspections Prior to Installation and Storage

The compressor must be inspected prior to installation since components could have come loose and/or damaged during shipment or moving.

- Check for loose bolts, particularly the compressor mounting nuts.
- Look into the suction and discharge connections and inspect for any signs of corrosion on parts.
- Check for bent or damaged components. The compressor should have also been inspected prior to offloading, see Delivery Inspection.
- Check that the nitrogen pressure is still holding pressure. Any leaks must be fixed and the system purged and re-charged with dry nitrogen.
- Prelube the compressor with the main oil pump and rotate by hand several revolutions prior to start.
- Notify Vilter™ Service and Warranty Department when the compressor is started.

NOTE

For Pre Start-Up and Start-Up checklists, please contact Vilter Service and Warranty Department.

CAUTION

Before installation, follow the proper procedures to depressurize the compressor.

Recommended On-site Tools

The tools recommended to have on site are important for troubleshooting, inspections and compressor unit operation. Besides general mechanic tools, these tools are recommended:

- Oil Pump (maximum of 2-3 GPM with motor approved for Division 1 or Division 2 and with ability to overcome suction pressure) (VPN A40849A)
- Infrared Heat Gun
- Torque Wrenches (with ranges from 0 to 600 ft-lbs)
- Sockets and wrenches up to 2-1/2" (63.5 mm)
- Voltmeter

Compressor Mounting

The Vilter single screw compressor should be firmly mounted to the package. Isolation dampers should not be used between the compressor and the package.

See Compressor Replacement in Section 5 for more installation details.

Notice on Using Non-Vilter Oils

CAUTION

Do not mix oils. Failure to comply may result in damage to equipment.

NOTICE

Vilter does not approve non-Vilter oils for use with Vilter compressors. Use of oils not specified or supplied by Vilter will void the compressor warranty.

Due to the need for adequate lubrication, Vilter recommends only the use of Vilter lubricants, designed specifically for Vilter compressors. With extensive research that has been performed, we are able to offer gas compression lubricating oils. Use of oil not specified or supplied by Vilter will void the compressor warranty.

Please contact your local Vilter representative or the Home Office for further information.

Long Term Storage Requirements

The procedure described is a general recommendation for long term storage (over one month of no operation) of Vilter compressor units. It is the responsibility of the installation firm and end user to address any unusual conditions. Use the supplied Long Term Storage Log sheet to help with record keeping, see section Page 3-8.

Warranty of the system remains in effect as described at the beginning of this manual, on page i.

NOTE

The compressor must be inspected prior to long term storage since components could have come loose and/or damaged during shipment or moving. See previous section for inspection details.

NOTE

At the time of purchase Vilter™ Manufacturing must be notified.

The following are recommendations regarding long term storage:

1. The compressor(s) must be stored in a heated building, preferably air conditioned to control moisture, to prevent corrosion of the main rotor shaft and for the compressor, and the slide valve(volume ratio& capacity) motors and gears.
2. The main rotor shaft must be coated with light grease to prevent rusting.
3. (For Screw Compressors) The volume and capacity slide valve motor enclosures should have corrosion inhibitors installed in them and the enclosures should be sealed. On a six month basis (depending on relative humidity), check and replace inhibitors as necessary, and check for signs of corrosion.
4. Before leaving Vilter™ Manufacturing the compressor is evacuated and pressurized, with dry nitrogen, to 5 psig (5 psi above atmospheric pressure). Pressure must be monitored with the gauge (provided by Vilter™) and checked on a regular basis (at least monthly).
5. The rotor shaft must be rotated every 3 months to prevent flat spots from developing on the bearing surfaces and to keep the shaft seal lubricated.
6. A log should be maintained indicating that the above procedures have been completed.

When the compressor is installed, please do the following before starting the compressor:

1. Look into the suction and discharge connections and inspect for any signs of corrosion on parts.
2. Prelube the compressor with the main oil pump and rotate by hand several revolutions prior to start.
3. Notify the Vilter™ Warranty Department when the compressor is started.

NOTE

The Long Term Storage Log (on Page 3-8) is an interactive form. You can fill it electronically and print the page as your records.

Long Term Storage Log

Company: _____

Serial Number: _____ Sales Order Number: _____

Name (Please Print): _____ Initial: _____

Date (M/D/Y): _____

☐ PSIG Nitrogen Pressure - Current

☐ PSIG Nitrogen Pressure - Recharged (If pressure is low, identify and fix leak prior to recharging, see Compressor Unit Leak Check procedure in Section 5 of the compressor manual)

Nitrogen Leak Location (Briefly explain nature of leak):

☐ Compressor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Bearings Greased

☐ Air Cooled Oil Cooler Fan Rotated

☐ Bare Metal Surfaces (Check all bare metal surfaces for rust and ensure they are covered with rust inhibitor)

☐ Desiccants (Are desiccants still effective? If not, replace. Check control panel, motor, pneumatic controllers and valves)

☐ Cover Bags/Tarp (Ensure bags and tarps are not torn and are sealed over components correctly, replace if damaged)

☐ Valves (Stop valves are in closed position so the compressor unit is isolated. All other valves, except those venting and draining to atmosphere are to be open)

☐ Space Heater & Panel Components (Ensure space heater is energized and panel components are rust-free)

Name (Please Print): _____ Initial: _____

Date (M/D/Y): _____

☐ PSIG Nitrogen Pressure - Current

☐ PSIG Nitrogen Pressure - Recharged (If pressure is low, identify and fix leak prior to recharging, see Compressor Unit Leak Check procedure in Section 5 of the compressor manual)

Nitrogen Leak Location (Briefly explain nature of leak):

☐ Compressor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Shaft (Rotate shafts at least 6 revolutions)

☐ Motor Bearings Greased

☐ Air Cooled Oil Cooler Fan Rotated

☐ Bare Metal Surfaces (Check all bare metal surfaces for rust and ensure they are covered with rust inhibitor)

☐ Desiccants (Are desiccants still effective? If not, replace. Check control panel, motor, pneumatic controllers and valves)

☐ Cover Bags/Tarp (Ensure bags and tarps are not torn and are sealed over components correctly, replace if damaged)

☐ Valves (Stop valves are in closed position so the compressor unit is isolated. All other valves, except those venting and draining to atmosphere are to be open)

☐ Space Heater & Panel Components (Ensure space heater is energized and panel components are rust-free)

Clear Form

Instrumentation Requirements

Pressure

There are four pressure transducers required to read system pressures as listed below.

1. **Suction pressure transducer**

   Measures the gas suction pressure into the compressor housing, which provides the permissive to start for minimum suction pressure, and is used for annunciation of low suction pressure while running and in the capacity control logic.

2. **Discharge pressure transducer**

   Measures the discharge pressure of the process gas in the separator, which provides annunciation for high discharge pressure, and may also be used for capacity control logic.

3. **Oil Filter Inlet pressure transducer**

   Measures the oil pressure as it enters the oil filter canisters and is used to calculate oil filter differential pressure to provide annunciation of high filter differential pressure.

4. **Oil Manifold pressure transducer**

   Measures the oil pressure downstream of the oil filter as the oil is injected into the compressor, and provides annunciation protection for low prelube oil pressure, and low running oil injection pressure.

Additional pressure transducers may be required and installed by the customer for pressure readings at customer specified points such as process gas discharge pressure from the package boundary, cooling water pressure to and/or from the oil cooler, etc.

Temperature

There are four temperature readings required for processor control, as listed below.

1. **Suction temperature RTD** measures the temperature of the incoming suction gas, and is used to provide annunciation for low suction temperature when the unit is running.
2. **Discharge temperature RTD** measures the temperature of the gas/oil mixture as it is discharged from the compressor housing, and provides annunciation for high running discharge temperature.
3. **Oil Separator temperature RTD** measures the temperature of the oil in the separator sump, and gives the oil temperature start permissive and low running separator temperature annunciation.
4. **Oil Injection temperature RTD** measures the temperature of the oil as it is injected into the compressor, which provides annunciation for either high or low running oil injection temperature.

** Additional RTD's may be required and installed by the customer for temperature readings at customer specified points such as discharge gas temperature from the package boundary, cooling water temperature to and/or from the oil cooler, gas aftercooler temperature, etc.*

Miscellaneous

Additional instrumentation devices required are a current transformer mounted around one phase of the drive motor leads to measure main motor amperage, and two rotary potentiometers to read the position of the slides. The amperage signal provides annunciation for high motor amperage, and is used in the capacity control logic. The rotary potentiometers indicate the position of the slides, which is used as a starting permissive and in the capacity control logic. Also, additional input points may be required for customer connection of remote signals such as Start and Stop commands, and capacity setpoint control.

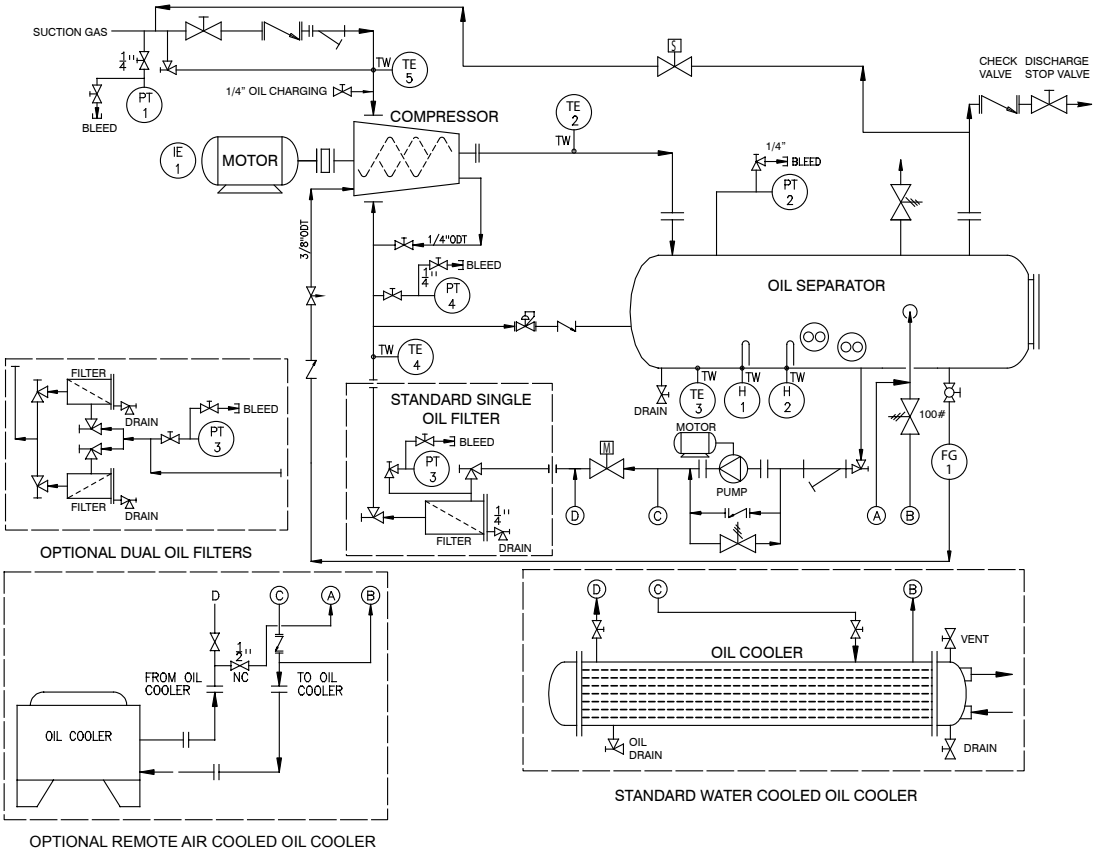


Figure 3-7. Additional Instruments

Piping

Before installing piping, the compressor inlet and outlet x Piping should be supported so that no piping loads are transmitted to the compressor casings.

All piping should be inspected for cleanliness before installation. As each pipe is connected to the compressor, the coupling alignment should be checked to ensure that no alteration has taken place.

If alignment has altered, the compressor is being strained and the piping supports must be adjusted.

It is not sufficient merely to re-align the drive coupling, as this will not correct the cause of the strain.

Compressors must have an inlet strainer permanently fitted to the compressor inlet.

Care must be taken to avoid trapping the lines except for specific purposes. When traps are used, the horizontal dimensions should be as short as possible to avoid excessive oil trapping.

Steel pipe is generally used in large installations when joints are welded.

In making up joints for steel pipe, the following procedures should be followed:

For threaded connections, all threads on the pipe and fitting should be carefully cleaned to remove all traces of grease or oil. Threads should then be wiped dry with a lintless cloth. Only thread filling compounds suitable for service should be used for making steel pipe joints. These compounds should be used sparingly, and on the pipe only. Do not put any on the first two threads to prevent any of the thread sealing compound from entering the piping system. Acetylene or arc welding is frequently used in making steel pipe joints. However, only a skilled welder should attempt this kind of work. Take care to see no foreign materials are left in the pipes and remove all burrs formed when cutting pipe.

For halocarbon piping, only wrought copper fittings should be used. Cast fittings as used for water service are porous and will allow the refrigerant to escape. Note this exception: In larger pipe sizes, wrought fittings are not available. However, specially tested cast fittings are available and these may be used with complete safety.

It is important to avoid short, rigid pipe lines that do not allow any degree of flexibility. This must be done to prevent vibration being transmitted through the pipe lines to the buildings. One method of providing the needed flexibility to absorb the vibration is to provide long lines that are broken by 90° Ells in three directions.

A second method would be to install flexible pipe couplings as close to the compressor unit as possible with connections run in two different directions, 90° apart. These flexible connections should be installed on both the high and low side lines of the compressor unit.

Hangers and supports for coils and pipe lines should receive careful attention. During prolonged operation of the coils, they may become coated with ice and frost, adding extra weight to the coil. The hangers must have ample strength and be securely anchored to withstand the vibration from the compressor and adequately support the pipe lines.

This information is taken from ASME B31.3 codes. The installing contractor should be thoroughly familiar with these codes, as well as any local codes.

Recommended Header Piping

The following would be the recommended configurations for the compressor's piping.

Compressor Suction Piping

Whenever possible, follow these guidelines:

- Pitch the main back to the scrubber for proper drainage of header.
- To keep pressure drop low, change direction only when necessary, and use long radius elbows.
- Take branch line to the compressors off the top of the main (with the first horizontal leg perpendicular to the main). This will prevent any liquid in the main from entering the compressor suction.
- Drains on the suction header, between each compressor and at the end of the header, should be used for daily routine PM procedures to prevent liquid build up in the header where it can be swept into compressors as a liquid slug and damage the compressor.
- Where possible use several 90-degree long radius elbows between the header and then drop to the equipment in each branch line. This can provide flexibility to accommodate thermal expansion or contraction and avoid stresses on the equipment. Two horizontal legs in the branch line, approximately 3 feet each, will normally be adequate. Other arrangements also work well.
- Avoid excessive piping loads when piping to equipment, see Table 3-4.

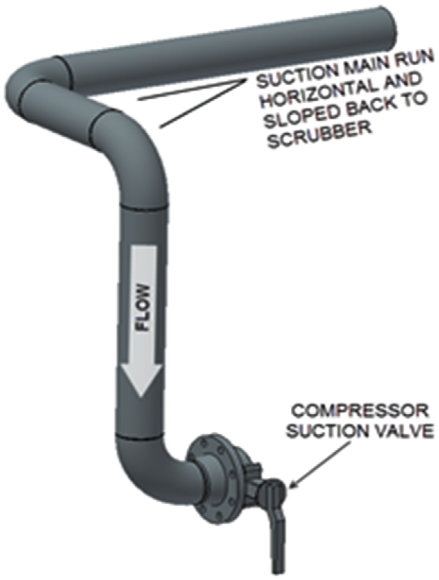


Figure 3-8. Single Compressor Suction Piping

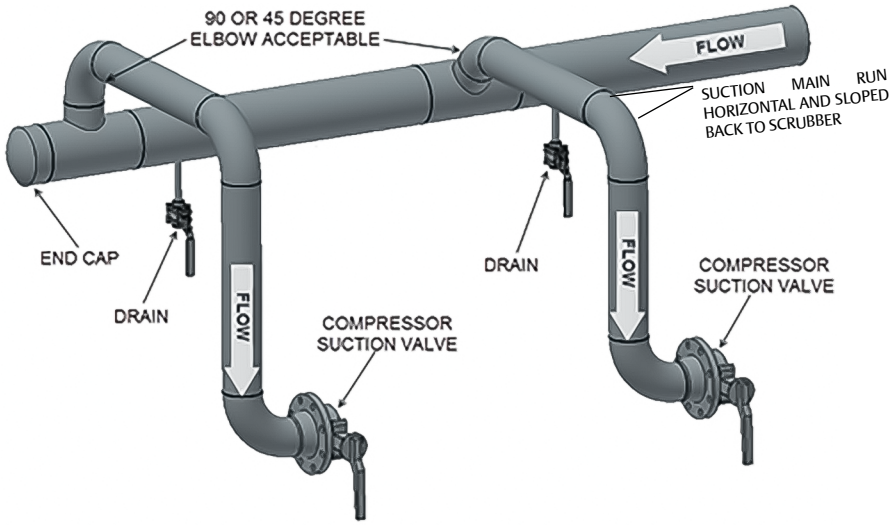


Figure 3-9. Multiple Compressor Suction Piping

Compressor Discharge Piping

Whenever possible, follow these guidelines:

- Install discharge mains so all branch lines can enter from the top.
- Where permitted, individual compressor discharge branches should enter the discharge main via a lateral connection in the flow direction. If your local codes prohibit laterals, tees or saddled connections are acceptable entrances.
- Avoid bull heading discharge lines due to the creation of excessive pressure drop. Where the equipment room design and layout requires the riser to the aftercooler to be located between compressors, a lateral entering the riser in the direction of flow is preferable. The mixing of flows minimizes the pressure drop on those compressors entering the side branch.
- Avoid excessive piping loads when piping to equipment, see Table 3-4.

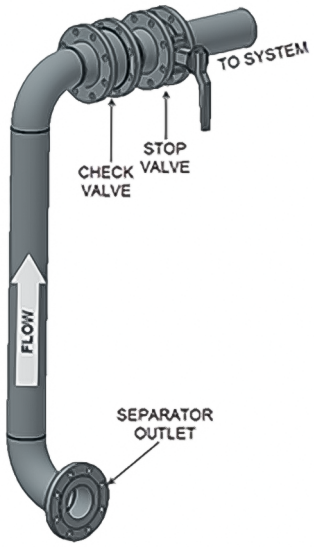


Figure 3-11. Single Compressor Discharge Piping

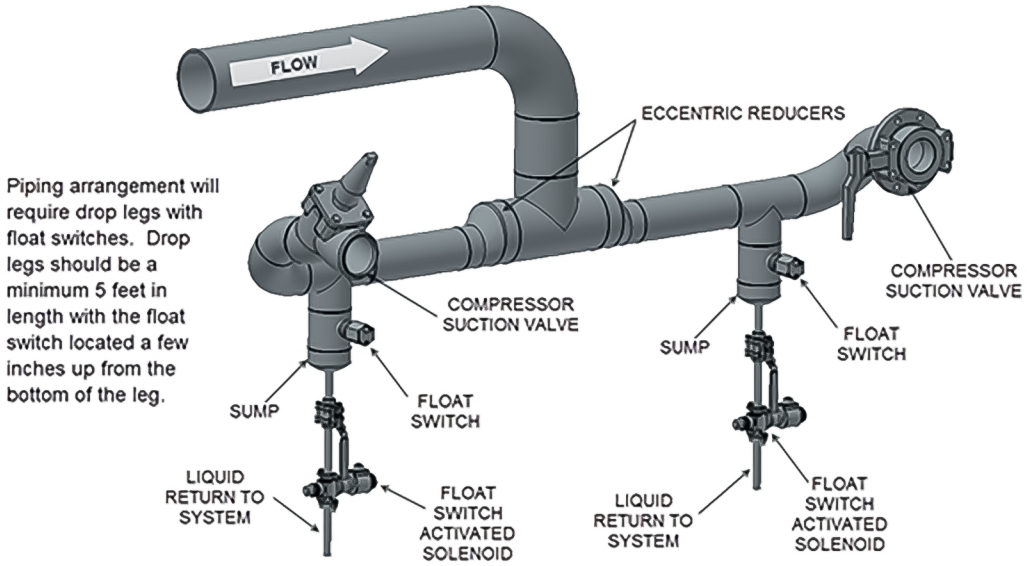


Figure 3-10. Multiple Compressor Suction Piping

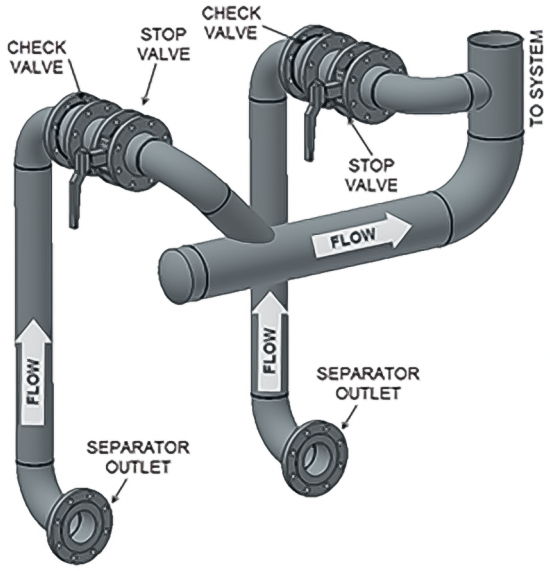


Figure 3-12. Multiple Compressor Discharge Piping, Vertical To System

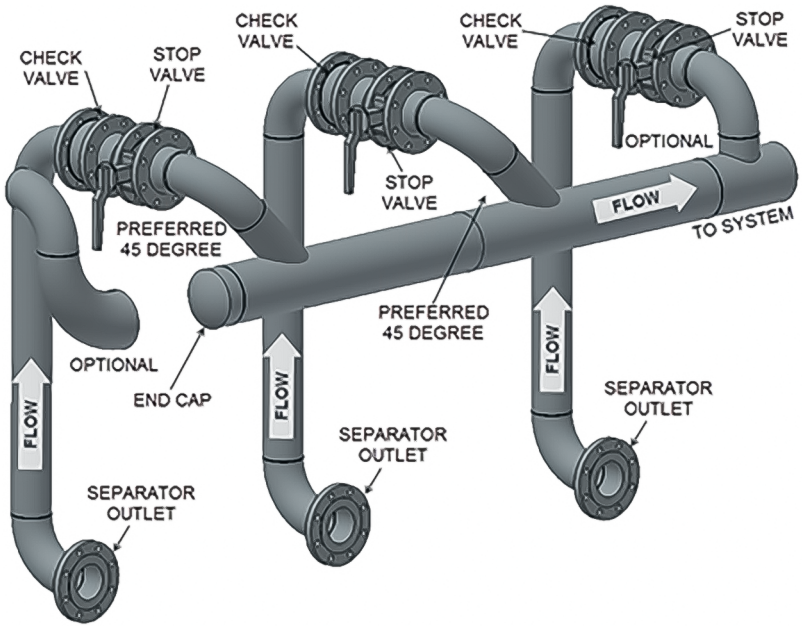


Figure 3-13. Multiple Compressor Discharge Piping, Horizontal to System With Options

Oil Line and Aftercooler Piping

Whenever possible, follow these guidelines:

- Vertical drops should be no higher than 8 to 10 feet.
- In the event that the vertical drop needs to be higher than 13 feet, an electronic service valve is to be installed in the return line to the compressor (consult factory).
- Install optional service drain valves on field oil lines from compressor to remote oil cooler if oil lines cannot be drained by the equipment service valves.
- With ambient temperatures below 50°F, heat trace and insulation on oil lines and oil cooler heads must be installed.
- The maximum pressure drop on oil lines to and from the oil cooler and compressor must not exceed 5 to 10 psi.
- Avoid excessive piping loads when piping to equipment, see Table 3-4.

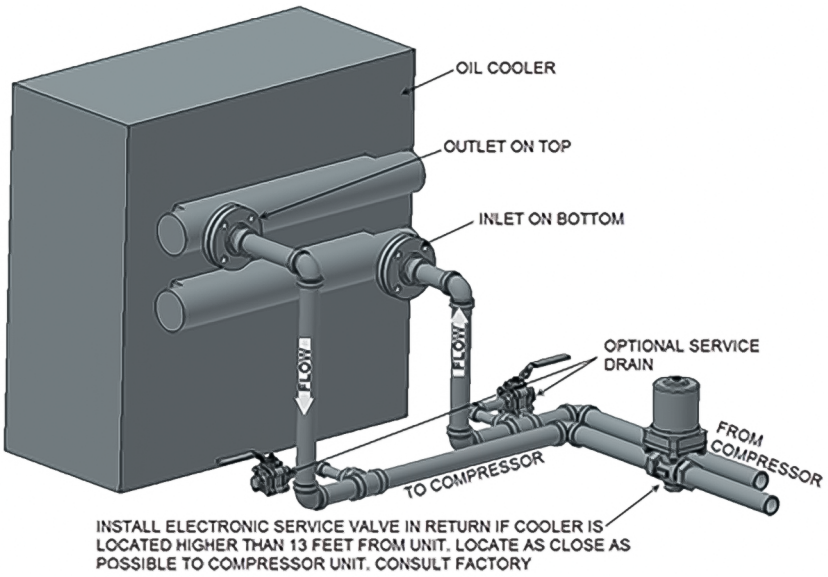


Figure 3-14. Compressor Oil Line Piping to Air-Cooled Oil Cooler

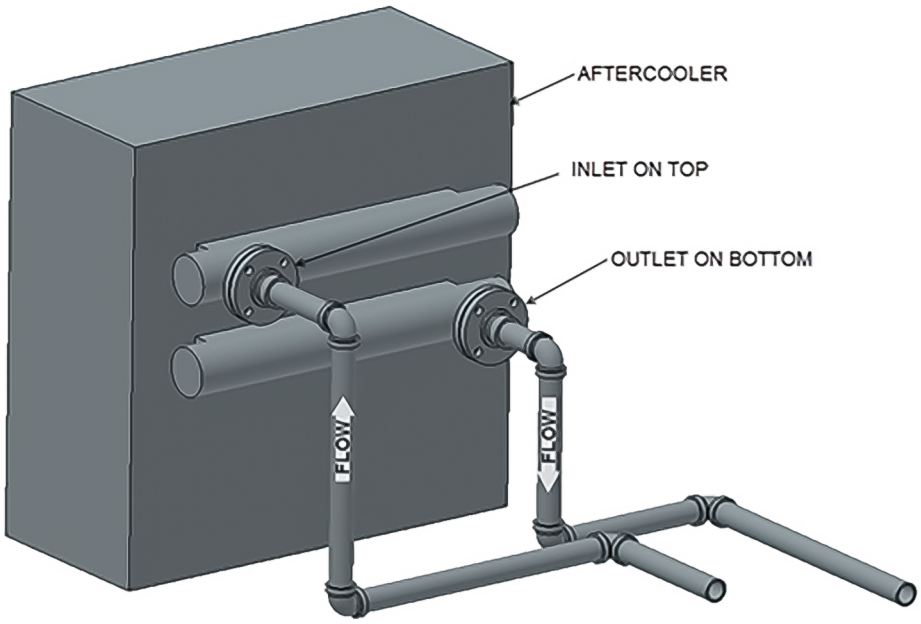


Figure 3-15. Aftercooler Piping

Allowable Flange Loads

While ideally the flanges of a Vilter compressor should not be strained with any loads, thermal, dead, live, wind & seismic loads applied to unit connections must be considered & even tolerated on the field. Even well supported external piping connected to the compressor will result in some loads applying forces and moments to flanges in three axes.

The most important issue is the motor/compressor misalignment caused by external forces and moments imposed by plant piping. Table 3-4 lists the maximum allowable forces and moments that can be applied to Vilter compressor flanges when the compressor is mounted on an Oil Separator. Vilter defines this arrangement as a “Compressor Unit” as opposed to a “Bare Shaft Compressor” mounted to a foundation.

It must be noted that it is necessary to check for compressor shaft movement when the job is complete. In no case shall the attached piping be allowed to cause more than 0.002" movement at the compressor shaft. If more than 0.002" movement is detected the piping must be adjusted to reduce the compressor shaft movement to less than 0.002". E.g. compressor shaft should not move more than 0.002" when piping is removed or connected to the compressor.

IMPORTANT – Piping elements shall be supported per the requirements of ASME B31.3 as applicable. See guidelines below, particularly with concern to minimizing loads on check valves.

Table 3-4. Maximum Allowable Flange Loads

Nozzle Dia [in]	Fz (lbf)	Fy (lbf)	Fx (lbf)	Mzz (ft-lbf)	Myy (ft-lbf)	Mxx (ft-lbf)
4	400	400	400	300	300	300
6	600	600	600	500	500	500
8	900	900	900	1000	1000	1000
10	1200	1200	1200	1200	1200	1200
12	1500	1500	1500	1500	1500	1500
14	2000	2000	2000	2000	2000	2000

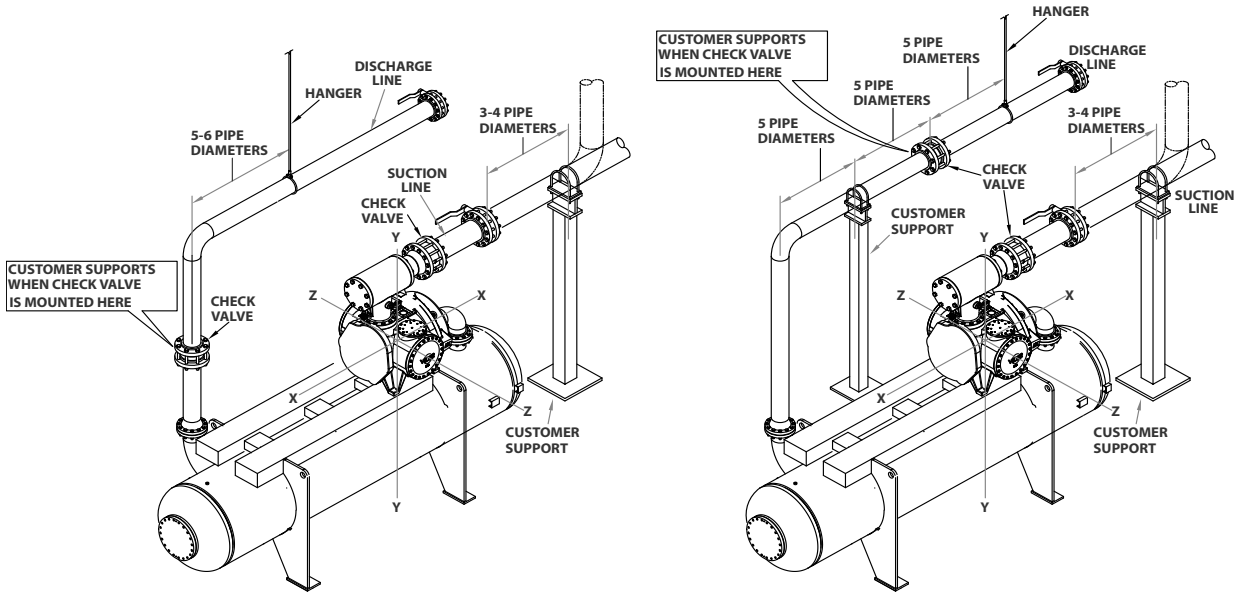


Figure 3-16. Piping Elements Support

Testing Compressor System For Leaks

CAUTION

Do not hydro test compressor unit. Failure to comply may result in damage to equipment.

CAUTION

The compressor unit along with other system units contain many components with various pressure ratings. Pressure relief protection provided considers the design pressure of a system components. Before replacing a pressure relief valve with a relief valve having a higher pressure setting, all system components must be evaluated for acceptability.

Vilter™ equipment is tested for leaks at the factory. One the most important steps in putting a refrigeration system into operation is field testing for leaks. This must be done to assure a tight system that will operate without any appreciable loss of gas. To test for leaks, the system pressure must be built up. Test pressures per ASME B31.3 codes.

Before testing may proceed, several things must be done.

First, if test pressures exceed the settings of the system, relief valves or safety devices, they must be removed and the connection plugged during the test.

Secondly, all valves should be opened except those leading to the atmosphere. Then, open all solenoids and pressure regulators by the manual lifting stems. All bypass arrangements must also be opened.

Leak Testing Procedure

Dry nitrogen, or anhydrous CO_2 in this order of preference may be used to raise the pressure to the proper level for testing.

After the system is thoroughly tested, open all valves on the lowest part of the system so the gas will float away from the compressor. This prevents any dirt or foreign particles from entering the compressor and contaminating the working parts.

Step 1: Test The System At A Test Pressure

Only dry nitrogen or anhydrous CO_2 may be used to raise the pressure in the gas compression system to the proper level for the test. The gas may be put into the system through the charging valve or any other suitable opening.

Adjust the pressure regulator on the bottle to prevent over-pressurization. Do not exceed the pressure rating on the vessel with the lowest pressure rating. When the proper pressure is attained, test for leaks with a soap mixture described as below.

A mixture of four parts water to one part liquid soap, with a few drops of glycerin added, makes a good solution. Apply this mixture with a one-inch round brush at all flanges, threaded joints, and welds.

After all leaks are found and marked, relieve the system pressure and repair the leaks. The pressure should be bled off in 10 – 15 psig increments from the lowest part of the system to help expel any residual water in the compressor system.

Never attempt to repair welded joints while the system is under pressure. Repair all visible leaks and recheck the system.

If possible, leave the pressure on overnight. A small pressure drop of 5 lbs over this period indicates a very tight system. Remember to note the ambient temperature, as a change in temperature will cause a change in pressure.

Step 2: Test The System At The Design Pressure If Needed

Charge a small amount gas into the system and pressurize the system to its respective design pressure. Use a leak detection spray or leak detector around all joints and connections.

If any leaks are observed during this test, they must be repaired and rechecked before the system can be considered tight and ready for evacuation.

After the system is thoroughly tested, the pressure should be bled off in 10 – 15 psi increments from the lowest part of the system to help expel any residual water, dirt, or foreign particles in the compressor system.

Notice on Using Non-Vilter Oils

Oil and its additives are crucial in system performance. Vilter™ Manufacturing will **NOT APPROVE** non-Vilter™ oils for use with Vilter™ compressors. Due to the innumerable choices available it is not possible for us to test all oils offered in the market place, and their effects on our equipment.

We realize that customers may choose lubricants other than Vilter™ branded oil. This is certainly within the customers' right as owners of the equipment. When this choice is made, however, Vilter™ is unable to accept responsibility for any detrimental affects those lubricants may have on the equipment or system performance and durability.

Should a lubrication related system issue occur with the use of non-Vilter™ oils, Vilter™ may deny warranty upon evaluation of the issue. This includes any parts' failure caused by inadequate lubrication.

Certainly, there are many good lubricants in the market place. The choice of a lubricant for a particular application involves consideration of many aspects of the lubricant and how it and its additive package will react in the various parts of the entire system. It is a complex choice that depends on a combination of field experience, lab and field-testing, and knowledge of lubricant chosen. Vilter™ will not accept those risks other than for our own lubricants.

Safety Setpoints

A detailed explanation of all safety setpoints can be found in the Compact Logix PLC manual, p/n 35391CL.

1. Oil Pressure

Low oil pressure differential stops the compressor unit when there is an insufficient difference in pressure between the oil manifold and suction.

2. Discharge Pressure

High discharge pressure cutout stops the compressor unit, when the discharge pressure in the oil separator exceeds the setpoint.

3. Suction Pressure

Low suction pressure cutout stops the compressor unit when the suction pressure drops below the setpoint.

4. Oil Filter Differential

High oil filter differential cutout stops the compressor unit when the difference between the outlet and inlet of the filter exceeds the setpoint.

5. Oil Temperature

The oil temperature cutout stops the compressor unit when the oil temperature is too high or too low.

6. Discharge Temperature

The high discharge temperature cutout stops the compressor unit when the discharge temperature exceeds the setpoint.

Control System

Calibration

Equipped for automatic operation, the screw compressor unit has safety controls to protect it from irregular operating conditions, an automatic starting and stopping sequence, capacity and volume ratio control systems.

Check all pressure controls to assure that all safety and operating control limits operate at the point indicated on the microprocessor.

The unit is equipped with block and bleed valves that are used to recalibrate the pressure transducers. To use the block and bleed valves to recalibrate the pressure transducers, the block valve is shut off at the unit and the pressure is allowed to bleed off by opening the bleed valve near the pressure transducer enclosure. The transducer can then be calibrated at atmospheric pressure (0 psig), or an external pressure source with an accurate gauge may be attached at the bleed valve.

Recheck the transducers periodically for any drift of calibration, refer to Maintenance/Service Interval table in Section 5.

Starting, Stopping and Restarting The Compressor

Starting

Before the screw compressor unit can start, certain conditions must be met. All of the safety setpoints must be set appropriately, and differential pressure setpoint between suction and discharge should be accomplish. When “Unit Start” button in the start menu is pressed, the oil pump will start first. When sufficient oil pressure has built up and the compressor capacity control and volume ratio slide valves are at or below 5%, the compressor unit will start.

NOTE

The amount of oil pressure that needs to be achieved before compressor start is at least the minimum prelube pressure above setpoint set in the HMI. For additional information on Low Oil Pressure at Start, see Troubleshooting Guide - General Problems and Solutions in Section 6.

If the compressor is in the automatic mode, it will now load and unload in response to the system demands.

Stopping/Restarting

Stopping the compressor unit can be accomplished in a number of ways. Any of the safety setpoints will stop the compressor unit if an abnormal operating condition exists. The compressor unit stop button will turn the compressor unit off. If any condition turns the compressor unit off, the slide valve motors will drive the slide valves back to 5% or below. If the auto start option is selected (see Compact Logix PLC manual), the compressor unit will start up after a waiting period. With both options, the compressor slide valves must return below their respective 5% limits before the compressor unit can be restarted.

NOTE

An anti recycle timer will be activated for 20 minutes (to allow the compressor unit to equalize to suction pressure) between pre-lubing or pushing the start button.

Emergency Shutdown

Emergency shutdown is initiated by the following:

1. A shutdown or trip condition of a process variable while the system is in operation. If a process variable reaches a high-high or low-low shutdown setpoint, the compressor unit will automatically stop. A shutdown alarm is also generated on the control panel HMI screen annunciating the specific process variable trip condition.
2. The emergency stop button is located on the front of the PLC control panel enclosure. When the emergency stop button is pushed, the compressor shuts down and energy to the PLC outputs are removed. The compressor capacity and volume slide-valves will stay in their last position until the unit is powered back up. Once appropriate, the emergency shut down push button must be pulled back out, and the “Compressor Control Power” button on the front of the panel must be pushed. The unit can then be restarted.

Slide Valve Actuator Calibration (25972XP)

The slide calibration screen allows the user to calibrate slide valve actuators.

Slide Calibration Screen Overview

- Must be logged in as "MGR" to calibrate slides.
- Press "Enter Slide Calibration" To Activate Slide Calibration Mode, see Figure 4-1 and Figure 4-2. (Machine MUST be stopped to enter slide calibration mode. Machine will not be allowed to start if slide calibration is active.)
- Up/down push-buttons move slide actuators.
- The screen indicates the correct rotation of the slide valve command shaft.

Both the capacity and volume slide actuators should be calibrated when one or more of these have occurred:

- Compressor unit starting up for the first time.
- A new actuator motor has been installed.
- There is an error code flashing on the actuator's circuit board - an attempt to recalibrate should be made.
- The range of travel is not correct, and the command shaft travel is physically correct.
- The compressor is pulling high amperage, the calibration of the volume slide should be checked.
- An actuator does not unload below 5%, or an actuator that doesn't move.

Calibrate Slide Valve Actuators (25972XP)

Slide valve actuators must be installed prior to calibration. Refer to Slide Valve Actuator Installation procedure in VSG/VSSG Compressor Unit manual (35391STG). The following steps pertain to calibrating one slide valve actuator. Repeat procedure to calibrate the other slide valve actuator.

WARNING

After stopping the compressor, allow the compressor and surrounding components to cool down prior to servicing. Failure to comply may result in serious injury.

To calibrate actuators, proceed with the following steps.

1. Stop compressor unit and allow to cool.
2. Remove screws securing actuator cover to actuator assembly. As a reference see Figure 4-3.
3. Carefully lift actuator cover from actuator assembly.
4. From main screen:
   - Press Main Menu > Instrument Calibration > Calibrate Slides.
5. Check that dip switches are in the right position according to what is showed in the calibration screen.
6. Logging on with high-level access (MGR or SUPER) will prompt the Calibrate button to appear on Instrument Calibration Overview screen.
7. Enter Calibration mode in the screen by pressing the button "Enter Slide Calibration Mode". Figure 4-2.
8. In the calibration screen press the button labeled "Auto Calibrate Capacity" or "Auto Calibrate Volume, depending on which slide valve you want to calibrate, this, places the actuator in calibration mode. The red LED will begin flashing.

Calibration can also be done alternative by pressing the blue push button on the actuator for more than 2.5 seconds and then release it.

NOTE

Now the current "Capacity" or the current "Volume" value will be displayed on the Main screen and Slide Calibration screen.

NOTE

When automatic calibration is initiated, the actuator determines the span by moving CCW and then CW until the calibration torque thresholds are reached and then backing off from these limits by three degrees.

CAUTION

The actuator will not respond to set point input until it is calibrated. When the actuator is not calibrated the status LED displays the not calibrated blink code.

The actuator cannot be brought into automatic calibration mode if it has shut down on over-temperature. Once the actuator has cooled to where its temperature is below the threshold, then it can be calibrated.

9. Gently install the cover over the top of the actuator to where it contacts the base and O-ring seal.

CAUTION

Do not over tighten screws. Failure to comply may result in damage to equipment.

10. Check and make sure the cover is seated properly, then gently tighten the screws.

11. Repeat procedure to calibrate other slide valve actuator.
12. Once you finish calibration, press “Slide Calibration Mode Active” button to complete calibration and exit the slide calibration mode. Once you exit calibration mode, the screen should look as in figure 4-1.

The controller will automatically energize the actuator and drive it back to its minimum position (5% or below) for pre-start-up.

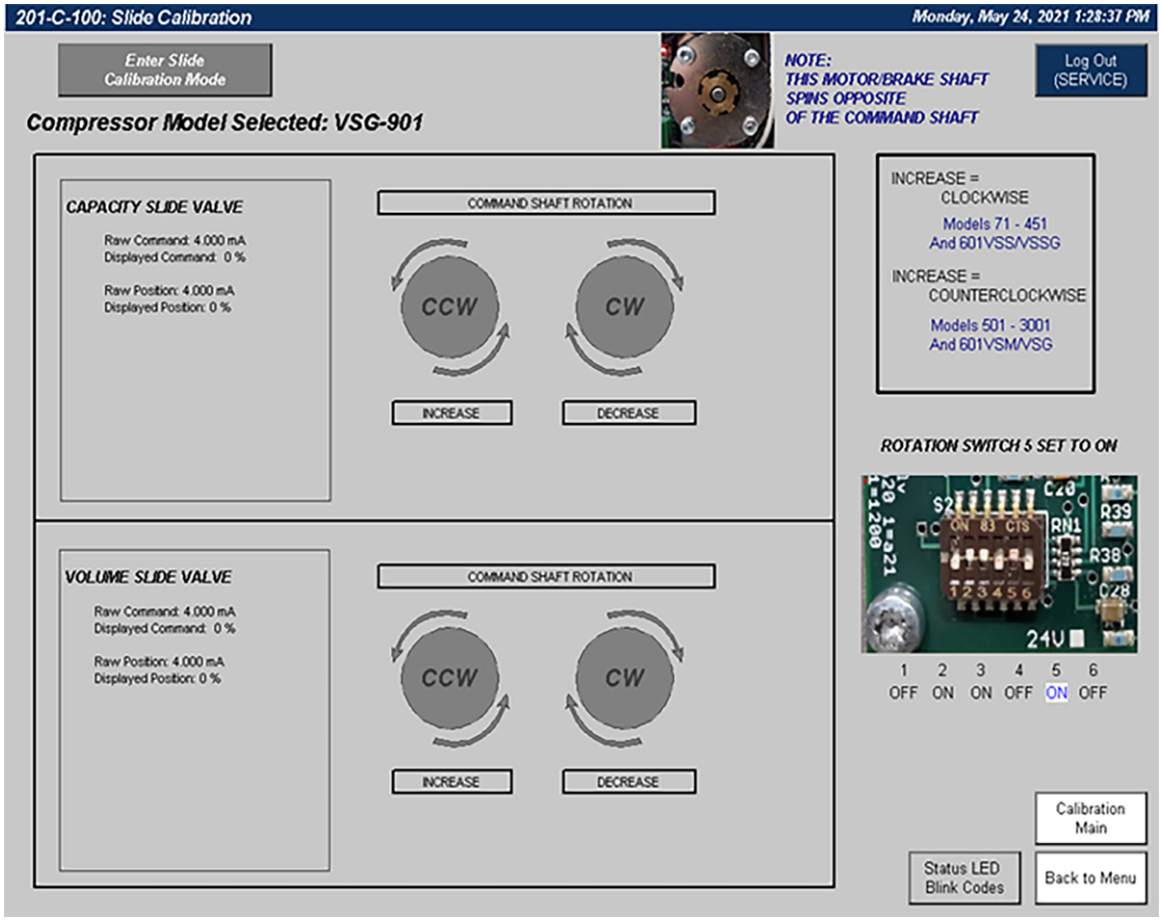


Figure 4-1. Slide Calibration Screen (Not in Calibration Mode)

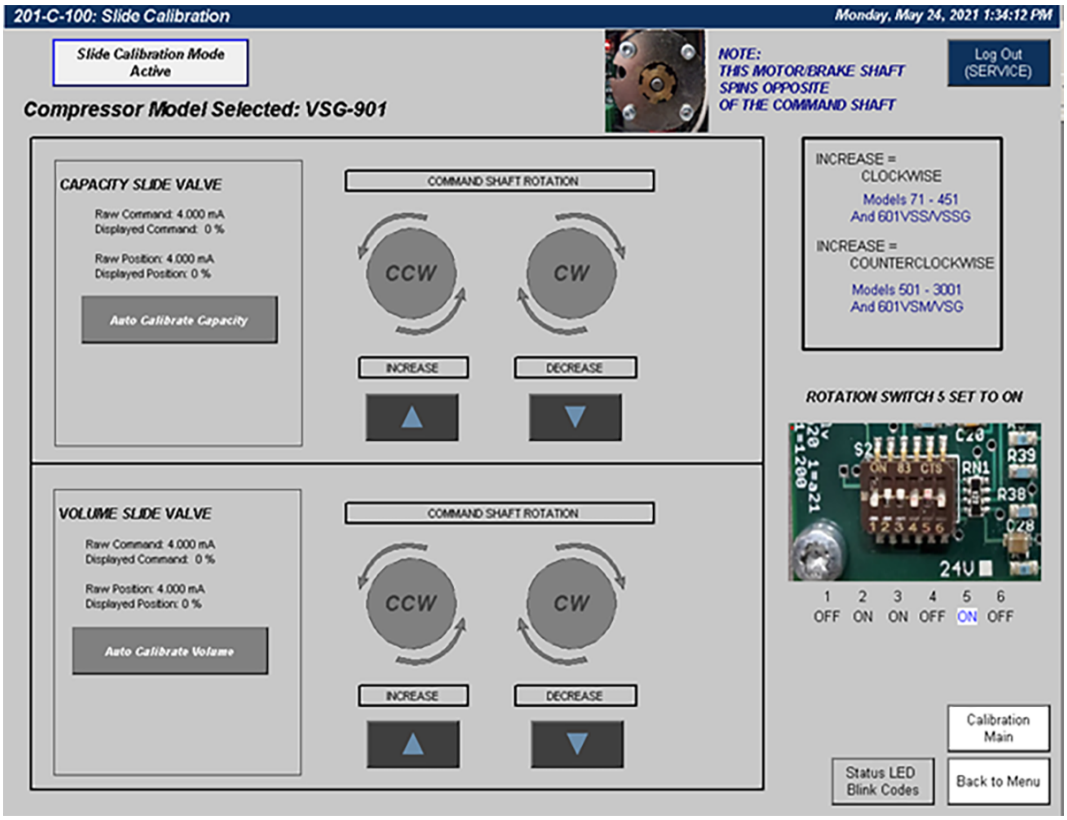


Figure 4-2. Slide Calibration Screen (In Calibration Mode)

Figure 4-3. Actuator Inside

Look Gear Visible Inside to Check Rotation

Figure 4-4. Rotation Check. Motor/Brake Shaft Spins Opposite of the Command Shaft

Slide Valve Actuators Calibration (For VPN 25972D Only)

Slide valve actuators must be installed prior to calibration. Refer to Slide Valve Actuator Installation procedure. The following steps pertain to calibrating one slide valve actuator. Repeat procedure to calibrate other slide valve actuator.

WARNING

After stopping the compressor, allow the compressor and surrounding components to cool down prior to servicing. Failure to comply may result in serious injury.

CAUTION

Do not calibrate in direct sunlight. Failure to comply may result in damage to equipment.

Both the capacity and volume slide actuators should be calibrated when one or more of these have occurred:

- Compressor unit starting up for the first time.
- A new actuator motor has been installed.
- There is an error code flashing on the actuator's circuit board - an attempt to recalibrate should be made.
- The range of travel is not correct and the command shaft travel is physically correct.
- The compressor is pulling high amperage, the calibration of the volume slide should be checked.
- An actuator does not unload below 5%, or an actuator that doesn't move.

To calibrate optical actuators, continue with the following steps:

CAUTION

If the compressor unit is starting up for the first time or a new actuator motor has been installed, leave the power cable and position transmitter cable disconnected until step 7.

1. Stop compressor unit and allow to cool.
2. Remove screws securing actuator cover to actuator assembly. As a reference see Figure 4-5.

CAUTION

Wires are attached to the connector on the actuator cover. Handle actuator cover with care to prevent damage to wires. Failure to comply may result in damage to equipment.

3. Carefully lift actuator cover from actuator assembly and tilt towards Turck connectors. Raise cover high enough to be able to press the blue calibration button and be able to see the red LED on the top of assembly.
4. On the main screen of the PLC, press "Menu", then "Instrument Calibration" button to enter the instrument calibration overview screen, then press "Calibrate Slides" button to enter the slide calibration screen, see Figure 4-6.
5. Logging on with high-level access will prompt the "Enter Slide Calibration Mode" button to appear.
6. Press "Enter Slide Calibration Mode" button to initiate calibration mode. The Slide Calibration button turns green and Set Max and Set Min buttons appear, see Figure 4-7.

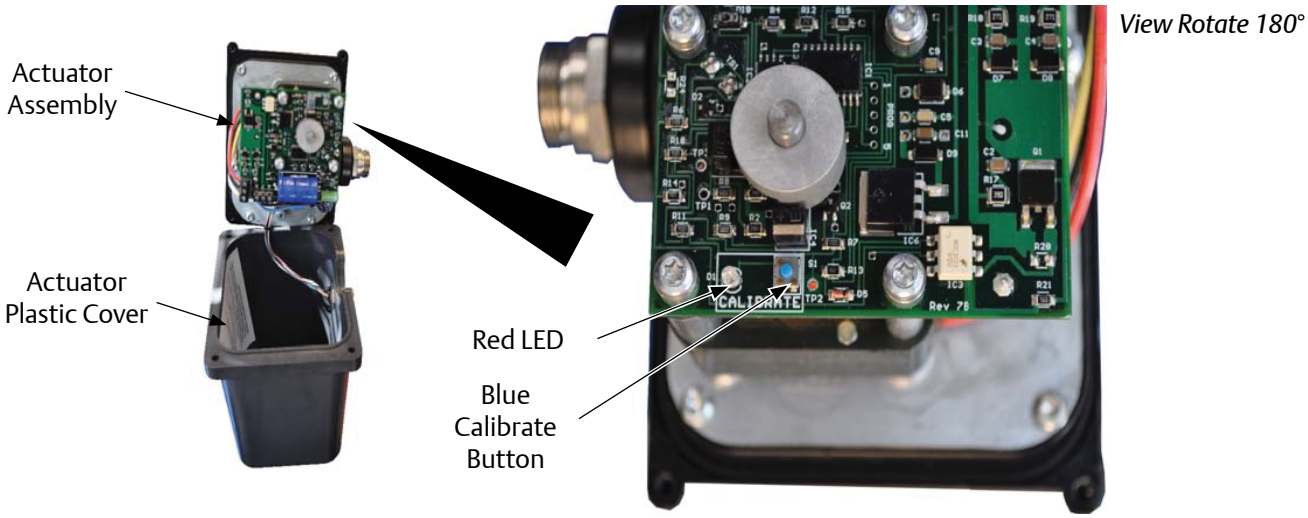


Figure 4-5. Actuator Assembly

7. If the compressor unit is starting for the first time or a new actuator was installed, connect connectors of power cable and position transmitter cable to new actuator.

NOTE

If the UP (increase) and DOWN (decrease) buttons do not correspond to increase (INC) or decrease (DEC) shaft rotation, swap the blue and brown wires of the "power cable" in the control panel. This will reverse the rotation of the actuator/command shaft.

8. Press UP or DOWN to move the slide valve and check for the correct rotation, see Table 4-1.

NOTE

When the actuator is in calibration mode, it outputs 0V when the actuator is running and 5V when it is still. Thus, as stated earlier, the actuator voltage will fluctuate during calibration. After the actuator has been calibrated, 0V output will correspond to the minimum position and 5V to the maximum position.

9. Quickly press and release the blue push button on the actuator one time. This places the actuator in calibration mode. The red LED will begin flashing rapidly.

CAUTION

DO NOT CONTINUE TO ENERGIZE THE ACTUATOR MOTOR AFTER THE SLIDE HAS REACHED THE MECHANICAL STOP. Doing so may cause mechanical damage to the motor or shear the motor shaft key. When the slide has reached the mechanical stop position, press down on the photo-chopper to release the brake, and thereby release the tension on the actuator motor.

NOTE

The "Slide calibration" screen on the Control Panel has a "Current" window, which displays twice the actuator output voltage. This value, (the % volume and the % capacity) displayed in the "Current Vol" and Current Cap" Windows are meaningless until calibration has been completed.

10. Use the DOWN button on the control panel to drive the slide valve to its minimum "mechanical stop" position. Release the DOWN button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.

11. Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount, see Figure 4-8. Hold the UP button for no more than 3 seconds to pulse the actuator to where the slide is just off of the mechanical stop and there is no tension on the motor shaft.

12. Quickly press and release the blue button on the actuator again. The red LED will now flash at a slower rate, indication that the minimum slide valve position (zero position) has been set.

NOTE

Now the actuator is ready for calibrating to maximum position.

13. Use the UP button on the control panel to drive the slide to its maximum "mechanical stop" position. Release the UP button when the slowing of the motor rotation and a winding sound from the actuator motor is noted.

14. Press down on the photo-chopper shaft to disengage the brake, releasing tension from the motor mount. Hold the DOWN arrow button for no more than 3 seconds to pulse the actuator to where the slide is just off of its mechanical stop and there is no tension on the motor shaft.

15. Quickly press and release the blue button on the actuator one more time. The red LED will stop flashing. The actuator is now calibrated and knows the minimum and maximum positions of the slide valve it controls.

16. Gently lower the plastic cover over the top of the actuator to where it contacts the base and O-ring seal.

CAUTION

Do not over tighten screws. Failure to comply may result in damage to equipment.

17. Check and make sure the cover is seated properly, then gently tighten the four #10 screws.

18. Press the Slide Calibration button to complete calibration. The controller will automatically energize the actuator and drive it back to its minimum position (below 5%) for pre-start-up.

NOTE

Now the "Current Cap" or the "Current Vol" value will be displayed in the window on the "Main" screen and the "Slide Calibration" screen.

19. Repeat procedure to calibrate other slide valve actuator.

NOTE

The default settings for minimum millivolts is 200 mV and maximum is 4800 mV. See Figure 4-7.

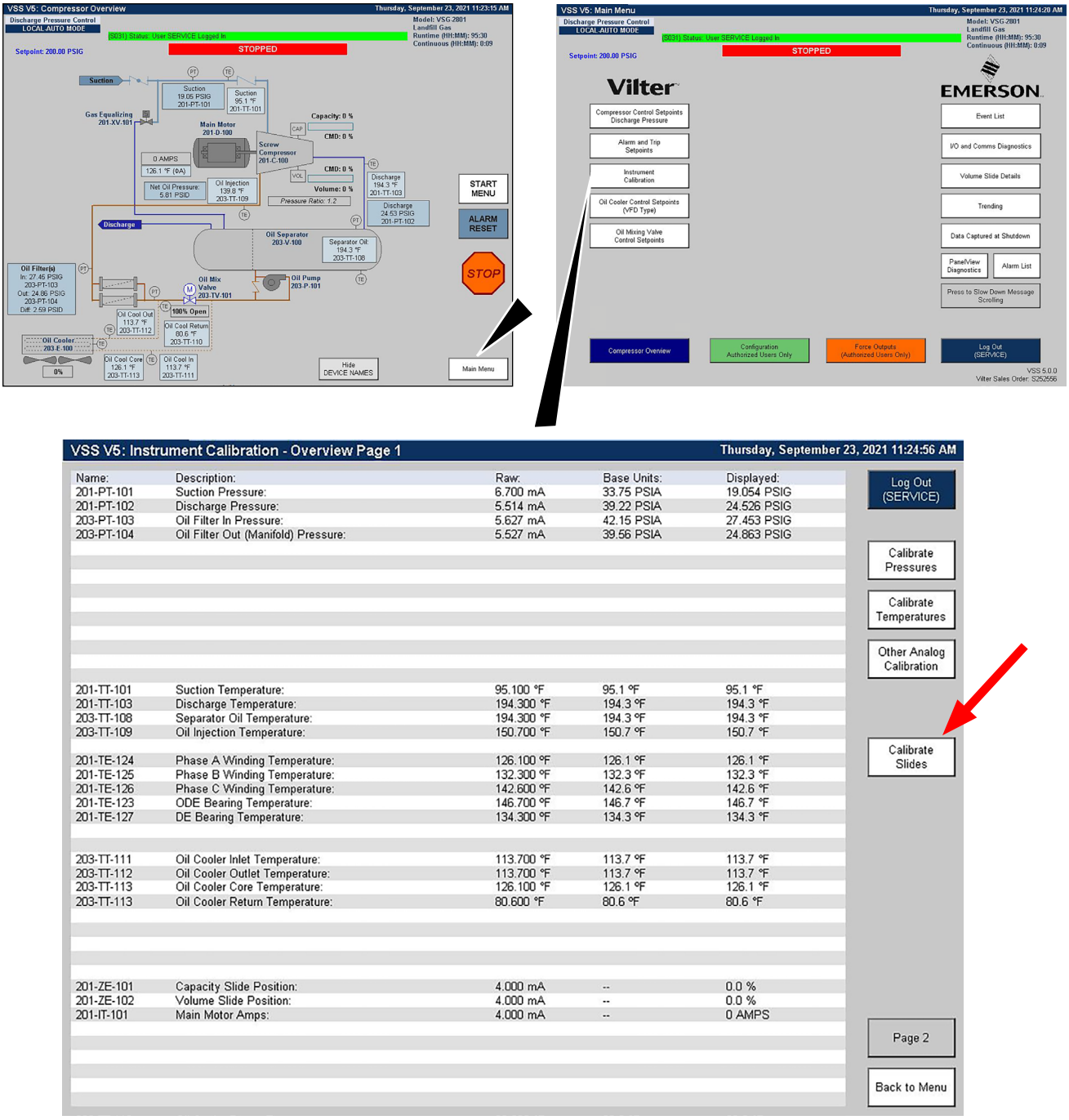
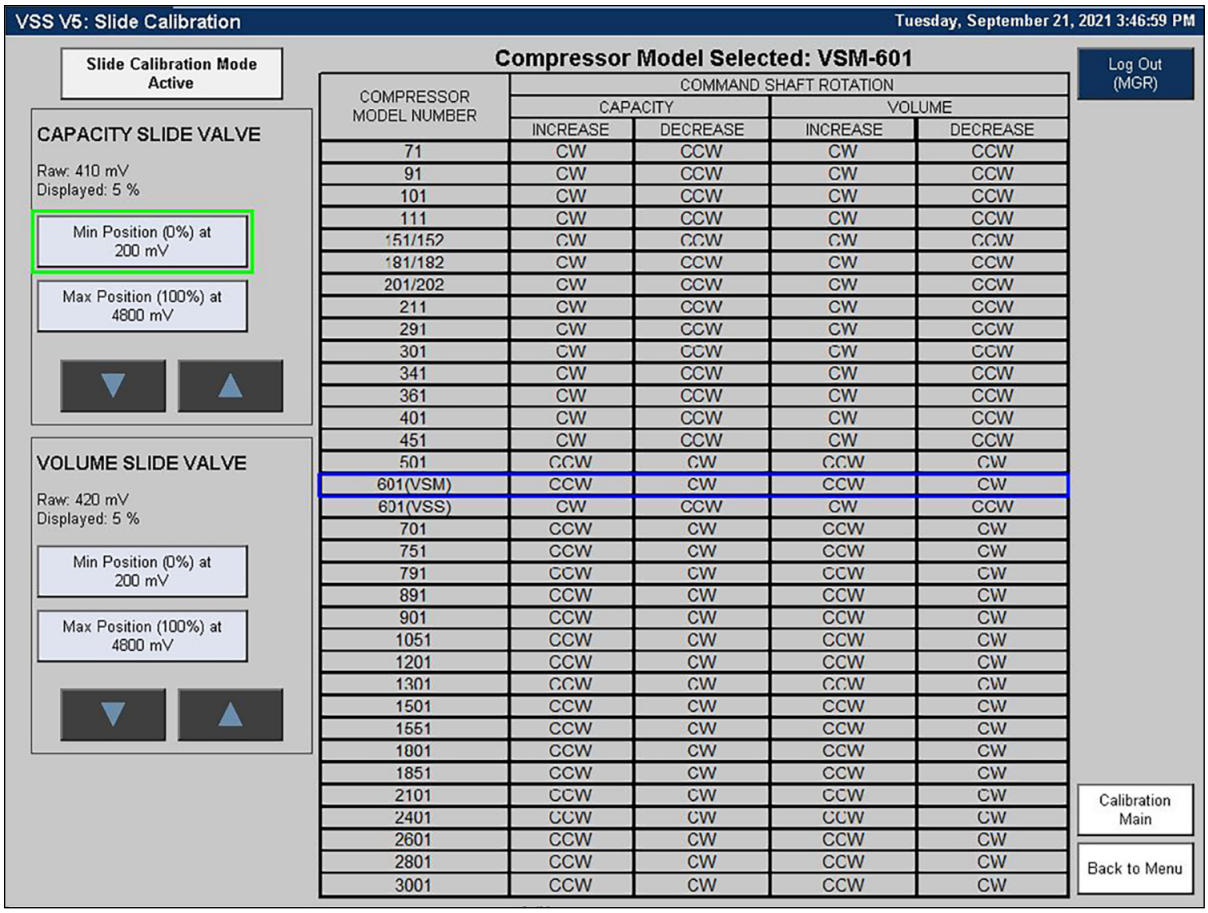


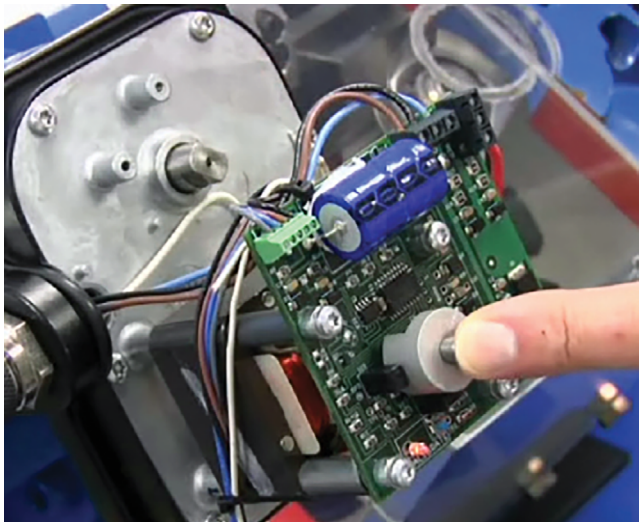
Figure 4-6. Overview, Main Menu and Instrument Calibration Screens (Compact Logix PLC)



COMPRESSOR MODEL NUMBER	COMMAND SHAFT ROTATION			
	CAPACITY		VOLUME	
	INCREASE	DECREASE	INCREASE	DECREASE
71	CW	CCW	CW	CCW
91	CW	CCW	CW	CCW
101	CW	CCW	CW	CCW
111	CW	CCW	CW	CCW
151/152	CW	CCW	CW	CCW
181/182	CW	CCW	CW	CCW
201/202	CW	CCW	CW	CCW
211	CW	CCW	CW	CCW
291	CW	CCW	CW	CCW
301	CW	CCW	CW	CCW
341	CW	CCW	CW	CCW
361	CW	CCW	CW	CCW
401	CW	CCW	CW	CCW
451	CW	CCW	CW	CCW
501	CCW	CW	CCW	CW
601(VSM)	CCW	CW	CCW	CW
601(VSS)	CW	CCW	CW	CCW
701	CCW	CW	CCW	CW
751	CCW	CW	CCW	CW
791	CCW	CW	CCW	CW
891	CCW	CW	CCW	CW
901	CCW	CW	CCW	CW
1051	CCW	CW	CCW	CW
1201	CCW	CW	CCW	CW
1301	CCW	CW	CCW	CW
1501	CCW	CW	CCW	CW
1551	CCW	CW	CCW	CW
1801	CCW	CW	CCW	CW
1851	CCW	CW	CCW	CW
2101	CCW	CW	CCW	CW
2401	CCW	CW	CCW	CW
2601	CCW	CW	CCW	CW
2801	CCW	CW	CCW	CW
3001	CCW	CW	CCW	CW

Screen colors inverted for ease of reading.

Figure 4-7. Slide Calibration Screen (Compact Logix PLC)



Press down on Photo-chopper to release tension from motor shaft.

Figure 4-8. Photo-chopper

Table 4-1. Command Shaft Rotation Specifications*

Compressor Model	Command Shaft Rotation				No. of Turns/Rotation			Angle/Slide Travel		
	Capacity		Volume		Capacity			Volume		
	INC	DEC	INC	DEC	Turns	Degrees	Travel	Turns	Degrees	Travel
VSSG 291 VSSG 341 VSSG 451 VSSG 601	CW	CCW	CW	CCW	0.91	328	3.568"	0.52	187	2.045"
VSG 301 VSG361 VSG 401	CW	CCW	CW	CCW	0.80	288	3.141"	0.45	162	1.767"
VSG 501 VSG 601 VSG 701	CCW	CW	CCW	CW	0.91	328	3.568"	0.52	187	2.045"
VSG 751 VSG 901	CCW	CW	CCW	CW	1.09	392	4.283"	0.63	227	2.473"
VSG 791 VSG 891 VSG 1051 VSG 1201 VSG 1301	CCW	CW	CCW	CW	1.22	439	4.777"	0.74	266	2.889"
VSG 1551 VSG 1851 VSG 2101	CCW	CW	CCW	CW	1.48	533	5.823"	0.87	313	3.433"
VSG 2401 VSG 2601 VSG 2801 VSG 3001	CCW	CW	CCW	CW	1.80	648	7.072"	1.36	490	5.341"

*The large gear on the command shaft has 50 teeth. The teeth are counted when moving the command shaft from the minimum stop position to the maximum stop position.

The manual operating shaft on the gear motor should be turned the opposite direction of the desired command shaft rotation.

The capacity and volume control motors are equipped with a brake, if it is necessary to operate the control motors manually, the brake must be disengaged. The brake can be disengaged by pushing on the motor shaft on the cone end. The shaft should be centered in its travel. Do not use excessive force manually operating the motor or damage may result.

Maintenance and Service Schedule for Gas Compression Applications

Follow this table for maintaining and servicing the single screw compressor at hourly intervals, for applications of gas compression.

Table 5-1. Maintenance/Service Schedule For Gas Compression Application

Group	Inspection/ Maintenance	Service Interval (Hours) Based on **WET SATURATED GAS**										Service Interval (Hours) Based on **DRY CLEAN GAS**													
		200	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	To 120,000	200	5,000	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000
Oil Circuit	Oil Change	Replace oil based on oil analysis report or visual contamination.										-	R	-	R	-	R	-	R	-	R	-	R	-	R
	Oil Analysis(1)	-	S	S	S	S	S	S	S	S	*	-	S	S	S	S	S	S	S	S	S	S	S	S	S
	Oil Filters	Prepare to replace when the pressure drop reaches the given limits.										R	R	R	R	R	R	R	R	R	R	R	R	R	R
	Oil Strainer	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I
Package	Coalescing Elements	-	I	R	-	I	-	R	-	I		-	-	-	-	R	-	-	R	-	-	R	-	-	R
	Coalescing Drain Line	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Suction Screen	I	I	I	I	I	I	I	I	I	*	I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Liquid Line Strainers	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Hot Alignment after Initial Start Up	-	I	I	I	I	I	I	I	I		-	I	I	I	I	I	I	I	I	I	I	I	I	I
Control Calibration	Transducers	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I
	RTDs / TTs	I	I	I	I	I	I	I	I	I		I	I	I	I	I	I	I	I	I	I	I	I	I	I
	Slide Valve Motors(3) If Applicable	Slide valve calibration should be inspected monthly. Inspections can be performed through the control panel. If a Non-Movement Alarm appears, calibrate immediately.																							
Compressor(2)	Main Motors	See Motor Manual for proper lubrication procedures and service intervals.																							
	Inspect for Back Spin(4)	Inspect Every 5,000 Hours or As Needed 10,000 hours for the clean																							
	Inspect for Leaks	Check Monthly																							
	Shaft Seal Replacement	When oil leakage above 15 drops per hour																							
	Inspect Compressor **	-	I	I	-	I	-	I	-	I	-	-	I	I	I	I	I	I	I	I	I	I	I	I	I

I – Inspect /Calibrate S – Sampling R – Replace

Notes: *: Based on previous inspection findings extrapolate balance of service intervals or at least once a year.
**: Inspections include: gaterotor inspection (backlash measurement, shelf clearance and gaterotor float), end play measurement (main rotor & gaterotor), slide valve inspection (if applicable).

For Additional Notes, please see the next page.

Additional Notes

1. Oil Analysis/Sampling is based on the gas stream. For the first year, sample the oil once a month to determine a base line of the longevity of the oil. It is the customer's discretion to increase the time period between oil sampling if oil contamination is unlikely or decrease the time period if there is a reason to believe the oil was contaminated during operation. In landfill applications (where gas mixtures change overtime) and/or corrosive or wet gas conditions exist, an oil sample must be taken every 2 to 3 months (quarterly) as a minimum.

   Proper separation of any liquids must be accomplished to prevent droplets of liquid at the com pressor suction. The discharge temperature must be kept a minimum of 30° F above the discharge gas dew point to prevent the condensing of liquids in the oil separator. The oil shell and legs must be insulated when the gas stream has a high probability of having condensables. Replace the oil at the 6 month and 12-month intervals unless the oil sampling shows otherwise.
2. The life of the compressor will be extended if the compressor unit is purged with nitrogen or sweet dry natural gas at shutdown. If there is more than one compressor at the site, the recommendations are to keep both operating unloaded (the compressors are efficient while unloaded) to prevent any H2S corrosion of the bearings due to any moisture condensing forming an acidic solution. If a compressor has to be shut down for more than 16 hours, flush the compressor out with fresh clean oil and drain the oil in addition to purging the compressor. Turn the compressor over by hand or use the drive motor to bump the compressor over monthly until operation is resumed.
3. Slide Valve Calibration should be inspected monthly. This can be done via Control Panel - if a non movement alarm appears on the Control Panel, calibrate immediately (by pressing the call/stop button on explosion proof actuator 25972XP, or for older models, using the controller, or calibration tool 75002).
4. When shutting off the compressor, normally there is a back spin of the compressor motor shaft in the opposite direction. 4 or 5 revolutions are normal to fill the suction cavity with high pressure gas from the Oil Separator. More than this will reflect a faulty Suction Check Valve or Open Bleed line around the Suction Check Valve, which should be closed during operation.
5. Daily records should be kept on suction, discharge, oil pressures & temperatures, along with ensuring Temp Leaving Oil Separator is above Dew Point.
6. Suction Header and drop leg should be checked and drained for moisture build up.

Maintaining Proper Operation

To ensure proper operation, the following items should be checked:

- Calibrate all transducer and RTDs.
- Check capacity and volume actuator calibration.
- Check fuses in the PLC panel.
- Check for loose wiring connections in the PLC panel.
- Check relay and contact operation for relays in the PLC panel.
- Verify the operation of the suction and discharge check valves.
- Check for correct rotation of all motors on the package (compressor, oil pump, and fan motors).
- Check that the piping to the oil cooler is correct.
- Check setup of soft starts and VFDs.
- Verify set points in the PLC.
- Check oil heater operation.
- Check for loose bolts on the compressor unit. Tighten any loose bolts.

Recommendations When Servicing

When working on the compressor, care must be taken to ensure that contaminants (i.e. water from melting ice, dirt and dust) do not enter the compressor while it is being serviced. It is essential that all dust, oil or ice that has accumulated on the outside of the compressor be removed before servicing the compressor. When servicing the compressor, all gaskets, O-rings, roll pins and lock washers must be replaced when reassembling the compressor.

Compressor Unit Isolation For Maintenance/Service (Compressors with Slide Valves)

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

WARNING

At shutdown, open valves that may trap gas or liquid to prevent rotation of the compressor and serious injury and/or damage to equipment.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

The compressor unit must be isolated and depressurized to atmosphere prior to servicing.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. If equipped with equalizing solenoid to control suction by-pass, allow solenoid to remain open until pressures equalize, see Figure 5-1 (2 of 2)
3. Turn motor and oil pump starter disconnect switches into the OFF position. Lock-out/tag-out disconnect switches.
4. If equipped with manual suction by-pass valve and it is not open, open suction by-pass valve to allow oil separator pressure to vent to low-side system pressure, see Figure 5-1 (1 of 2). Close suction by-pass valve when complete.
5. Isolate the compressor unit by closing all valves to the house system. Lock-out/tag-out valves.

NOTE

If drain valves are installed on suction and discharge headers, open these valves too to remove build up of liquid during shut-down periods.

6. Open any other valves that may trap gas or liquid. Lock-out/tag-out valves.
7. Recover and/or transfer all vapors per local/state codes and policies.
8. Open discharge pressure bleed valve at block and bleed assembly and allow remaining pressure in oil separator to equalize to atmospheric pressure.
9. Servicing the compressor unit can proceed at this point. After servicing, ensure to perform a leak check, see Compressor Unit Leak Check procedure.

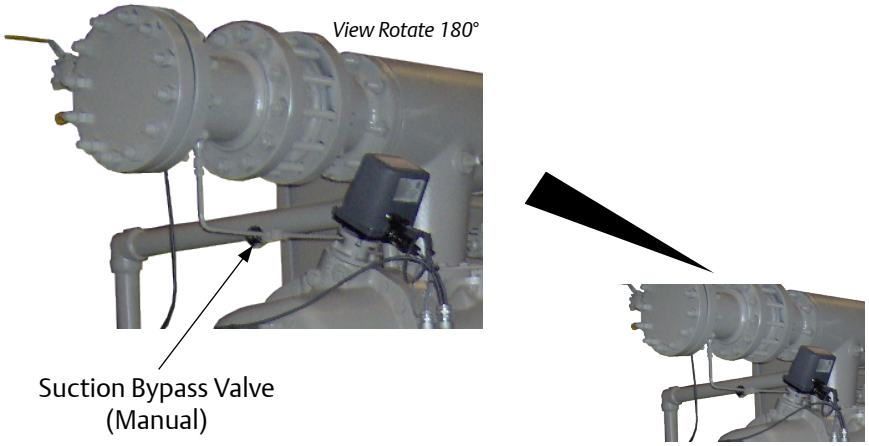


Figure 5-1. Suction By-Pass Valve Location (Manual) (1 of 2)

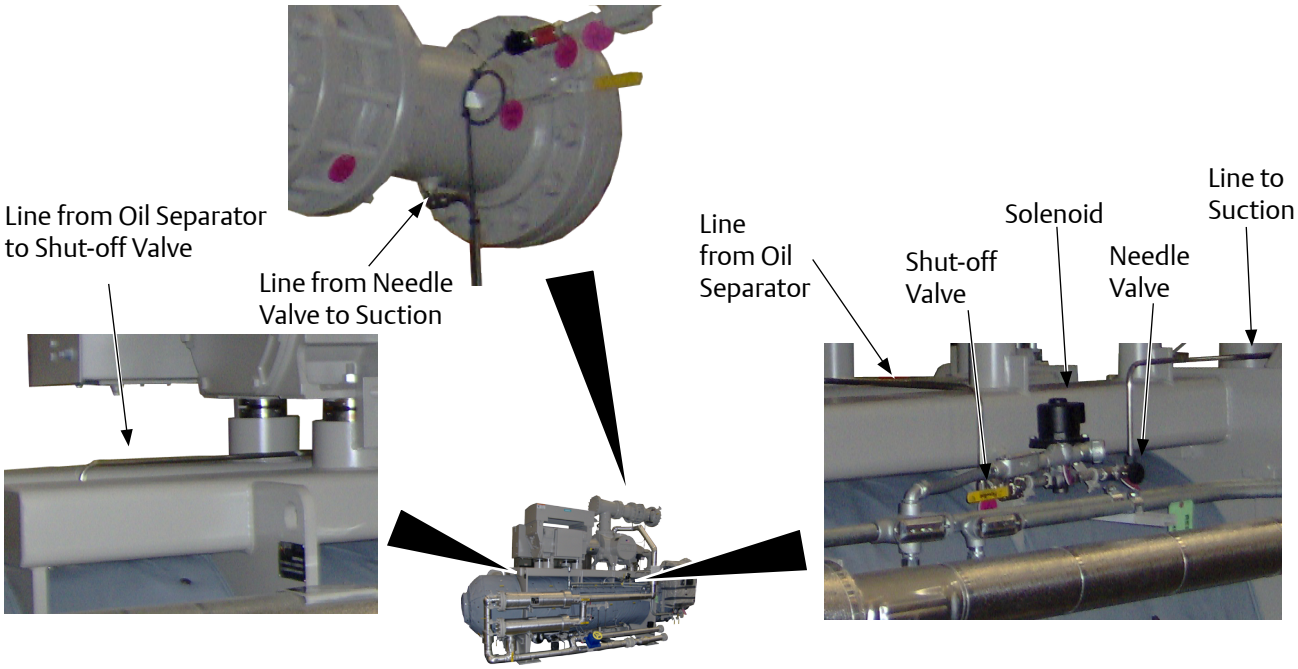


Figure 5-1. Suction By-Pass Valve Location (Equalizing Solenoid) (2 of 2)

Recommendations when Servicing (Compressors Without Slide Valves)

When working on the compressor, care must be taken to ensure that contaminants (i.e. water from melting ice, dirt and dust) do not enter the compressor while it is being serviced. It is essential that all dust, oil or ice that has accumulated on the outside of the compressor be removed before servicing the compressor.

After servicing the compressor, all gaskets, O-rings, roll pins and lock washers must be replaced when reassembling the compressor.

Preparation of Unit For Servicing

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

A) Shut down the unit, open the electrical disconnect switch and pull the fuses for the compressor motor to prevent the unit from starting. Put a lock on the disconnect switch and tag the switch to indicate that maintenance is being performed.

WARNING

Be cautious when isolating sections of CO_2 piping. CO_2 has a very steep pressure curve, and as sections containing CO_2 warm up, pressures can rise dramatically & well beyond system design.

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

B) Isolate the unit by manually closing the discharge Stop valve. Allow the unit to equalize to suction pressure before closing the Suction Bypass. After the unit has equalized to suction pressure and suction valve closed, use an acceptable means to depressurize the unit that complies with all Local, State and Federal Ordinances.

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

NOTICE

Recover or transfer all gas vapor in accordance with local ordinances before opening the compressor unit to the atmosphere.

C) Remove drain plugs from the bottom of compressor housing and the discharge manifold. Drain the oil into appropriate containers.

Compressor Unit Leak Check After Servicing

The compressor unit must be checked for leaks after servicing to ensure a tight system. For additional leak testing information, refer to Chapter VI of ASME B31.3 Process Piping Code.

CAUTION

Do not hydro test compressor unit. Failure to comply may result in damage to equipment.

1. If servicing the compressor unit was completed, proceed to Step 2. Otherwise, isolate the compressor unit from the house system, see Compressor Unit Isolation procedure.
2. Open all shut-off valves, check valves, control valves and solenoid valves in the system to be tested.
3. Slowly pressurize compressor unit through suction oil charging port with dry nitrogen.
4. Using appropriate soap solution, check for leaks on joints and connections of the serviced component.
5. If leaks are found, depressurize system and fix leaks. Repeat steps 3 and 4 until all leaks are fixed.
6. Typically, no evacuation is required for open loop systems. If evacuation is required, evacuate from suction oil charging port. Otherwise, bleed nitrogen to atmosphere.
7. Close all valves previously opened in the system. Open suction and discharge shut-off valves. Remove tags as per the local lock-out/tag-out procedure.
8. Turn the motor and oil pump disconnect switches to the ON position.
9. The compressor unit can now be started, refer to Start-Up procedure in Section 4.

Oil Sampling

WARNING

Improper selection or application of fluid diagnostic products can cause serious injury or damage. The user is solely responsible for making the final selection of products to ensure that the overall system performance and safety requirements are met. These include reviewing fluid compatibility with materials and seals.

WARNING

Avoid skin contact with any condensate or oil. Wear rubber gloves and a face shield when working with condensate or oil. Failure to comply may result in serious injury or death.

DANGER

Sampling often releases hot fluid under high velocity/pressure.

1. **Hot fluid can cause severe burn injuries.**
2. **Skin penetration from high-pressure fluid can occur, causing severe injury, gangrene and/or death. If this happens, immediate ly contact an experienced medical practi tioner.**
3. **Hot fluid escaping to the atmosphere can ignite if it comes into contact with an igni tion source. This can lead to severe property damage.**

Recommendations

1. Make sure you´re aware of the risks associated with the fluid being sampled or worked with. Check with the manufacturer.
2. If you have not been trained to sample, service, repair, or troubleshoot a pressurized fluid system, especially a hydraulic system, you are at risk of suffering an accident. Seek the proper training before proceeding.

Installation of The Oil Sampler Valve

WARNING

When working with LFG, NG or other dangerous or flammable gases, ensure there are adequate ventilation and vapor detectors. Refer to national fire and building codes. Failure to comply may result in serious injury or death.

1. Lubricate the threads (1/4"-18 NPT) with Teflon tape.
2. Tighten to the max. torque 25 ft-lbs (34 N-m). Use 11/16" open wrench. Avoid over tightening.

Pre-Sampling

Use the Vilter Oil Analysis Kit (VPN 3097A) to collect an oil sample for analysis, see Figure 5-2.

Once the sample has been taken, the label must be filled out and pasted on the bottle, and both must be placed inside the mailing tube and sealed with the pre-addressed mailing label.

Below are a few points to remember when taking a sample:

- Sample running compressor units, not cold units. Sample after minimum 30 minutes of compressor operating time.
- Sample after the oil filter.
- Sample according to the sampling procedure below.

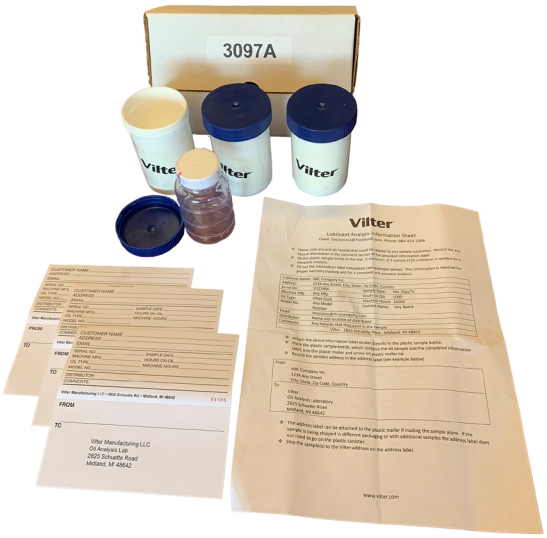


Figure 5-2. Oil Analysis Kit (VPN 3097A)

- Ensure sampling valves and devices are thoroughly flushed prior to taking a sample.
- Ensure samples are taken as scheduled in the Maintenance and Service Schedule.
- Send samples to the oil analysis lab immediately after sampling, do not wait 24 hours.

Sampling Procedure

THE SAMPLING PRESSURE RANGE IS LIMITED BETWEEN 5 TO 750 PSI (0.03 – 5.17 MPa). IF THE OPERATING PRESSURE IS ABOVE 750 PSI (5.17 MPa), THE OIL SAMPLING MUST BE DONE WHEN THE COMPRESSOR IS NOT RUNNING AND ENSURE THE SYSTEM PRESSURE IS WITHIN THE 5 TO 750 PSI (0.03 – 5.17 MPa) SAMPLING RANGE.

A 1/4" NPT oil sampling valve is provided either in the oil filter canister cover or in the piping after the filter (See Figure 5-3).

1. Unthread the oil sampling valve cap.

NOTE

DO NOT remove the valve from the piping or filter housing.

2. Remove the cap of the oil analysis bottle and position it carefully under the valve spout. (Make sure the valve spout is rotated to the downward position) **SLOWLY AND VERY CAREFULLY** press the "PUSH BUTTON with your finger to open the valve, and release the button close it, see Figure 5-5.

WARNING

If the valve is opened too rapidly, a foamy pressurized jet of oil will gush out and splash outside the container.

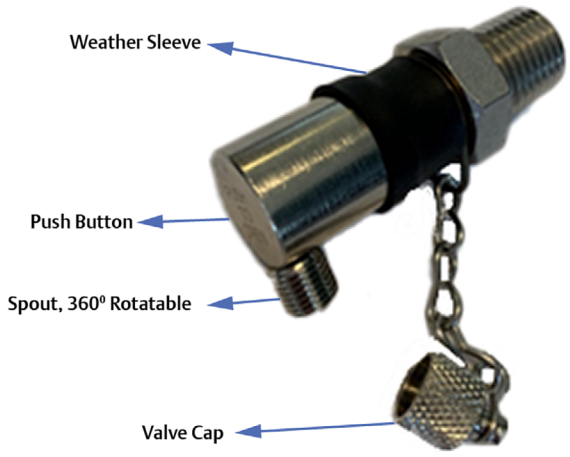


Figure 5-3. Oil Sampler Valve (VPN #3708A) For Gas Compression Applications

3. In most cases there will be foam in the oil, so you must fill the bottle up to the top and then wait for the foam to dissipate. Repeat this step as many times as necessary (around 4 to 6 times) until the clear oil level reaches ¾ full, see sequence in Figure 5-5.
4. After all the foam dissipates, tighten the sample bottle cap.
5. Tighten the oil sampling valve cap.
6. Attach the filled sampling information label to the bottle and mail the sample out to the oil analysis lab immediately.

NOTE

Missing information from the sampling label may result in longer turnaround time as the laboratory will need to request the info before the sample can be tested.

Oil Sample Analysis Report

NOTE

A copy of the oil analysis report is also sent to Vilter. See Appendix B for a sample of the oil analysis report.

An oil analysis report will show the physical properties of the oil, such as:

- Water content
- Viscosity
- Acid number
- Particle count
- Antioxidant level
- Wear metals
- Contaminating/additive metals

Button being pressed, valve open

Button released, valve closed

Figure 5-4. Operating the Oil Sampling Valve

Figure 5-5. Stages of the Oil Sample Taking Process

Compressor Replacement

Notify Vilter prior to performing a compressor replacement. See Warranty instructions in Section 7.

Removal

To replace a compressor on a unit, proceed with the following steps:

NOTICE

Dispose of used oil in an appropriate manner following all Local, State and Federal laws and ordinances.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

1. Shut down and isolate the compressor unit, see Compressor Unit Isolation for Maintenance and Service procedure.

   NOTE

   Note location of cables to aid in installation.

2. Disconnect all cables from sensors on compressor and actuators.
3. Remove drive coupling, see appropriate Drive Coupling Replacement procedure.
4. If equipped with C-flange, remove bolts securing C-flange to compressor.
5. Remove center member, see Drive Coupling Removal procedure.
6. Using appropriate drain pan, drain oil by removing drain plugs from under compressor housing and discharge manifold. Allow oil to completely drain.
7. Remove all oil lines from the compressor.
8. Support suction line with appropriate supporting equipment.
9. Remove nuts and bolts securing suction strainer/check valve assembly to suction stop valve and compressor.
10. Using appropriate lifting device, remove suction strainer/check valve assembly from compressor.
11. Remove nuts and bolts securing discharge pipe to compressor and oil separator, see Figure 5-6.
12. Remove discharge pipe and gaskets from compressor and oil separator.
13. Remove nuts, flat washers, lock washers and studs securing compressor to frame.
14. Remove any additional lines and/or components to allow removal of compressor as required.

WARNING

When rigging and lifting a bare shaft compressor, use proper lifting device capable of lifting and maneuvering the weight and size of the compressor. Use only qualified personnel and additional personnel and lifting equipment (i.e. spreader bar) as required. Failure to comply may result in death, serious injury and/or damage to equipment.

NOTE

Refer to Bare Shaft Compressor Lifting Points and Weights of Section 3 for appropriate lifting hole sizes, weights and lifting points.

15. Install appropriate lifting eyes on top of compressor.
16. Using appropriate lifting device and additional personnel, remove compressor from frame.
17. Remove shims and spherical washers from compressor mounting locations.
18. Inspect shims and spherical washers for damage, replace as required.

Installation

1. Install shims and spherical washers on compressor mounting locations, see Figure 5-6.
2. Install appropriate lifting eyes on top of compressor.
3. Using appropriate lifting device, position compressor on compressor mounting locations on frame.
4. Loosely install studs, lock washers, flat washers and nuts to secure compressor to frame until alignment is correct.
5. Check compressor for soft foot. Add or remove shims as required until measurements are within +/- 0.002".
6. Tighten nuts to secure compressor to frame, refer to Appendix A.
7. If equipped with C-flange, install bolts to secure C-flange to compressor. Tighten bolts, see Appendix A.
8. If equipped with C-flange, install C-flange coupling, refer to C-flange Coupling Replacement procedure.
9. Install coupling, see Drive Coupling Installation and Alignment procedure .
10. Install coupling guard.
11. Install nuts and bolts to secure discharge pipe to oil separator and compressor.
12. Tighten nuts on 'discharge pipe-to-compressor flange' first, then tighten nuts on 'discharge pipe-to-oil separator flange', see Appendix A.
13. Install nuts to secure suction strainer/check valve assembly to compressor and suction stop valve.
14. Tighten nuts on 'suction strainer/check valve assembly-to-compressor' first, then tighten nuts on 'suction strainer/check valve assembly-to-suction stop valve', refer to Appendix A.
15. Install all lines to compressor.
16. Install all cables to sensors on compressor and actuator.
17. Perform leak check, see Compressor Unit Leak Check procedure.

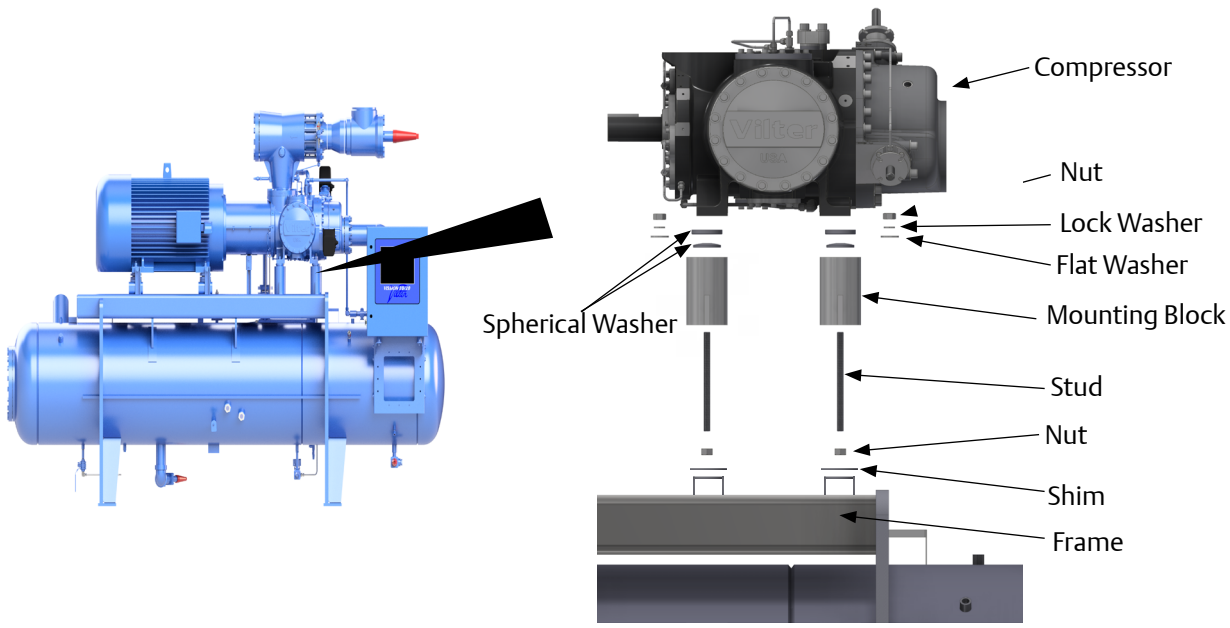


Figure 5-6. Compressor Replacement and Hardware Assembly (Models 2401-3001 Shown)

Compressor Inspection

Vilter™ Single Screw VSG Compressors are designed for long periods of trouble free operation with a minimum of maintenance. However, a yearly inspection is recommended so any irregular wear is noted and rectified. At this time, the bearing clearance is measured for the main rotor and gaterotors, and gaterotor backlash and float should also be inspected.

The following procedures are used when measuring the main rotor and gaterotor bearing clearance, gaterotor backlash and float.

Compressor Shaft Bearing Clearance Inspections

If clearance measurements are out of tolerance, contact Vilter™ Technical Support for further assistance.

CAUTION

When taking the measurements, do not exceed 300 to 500 lbs of force at point of contact or damage may result to the bearings.

Determine Maximum Applied Force

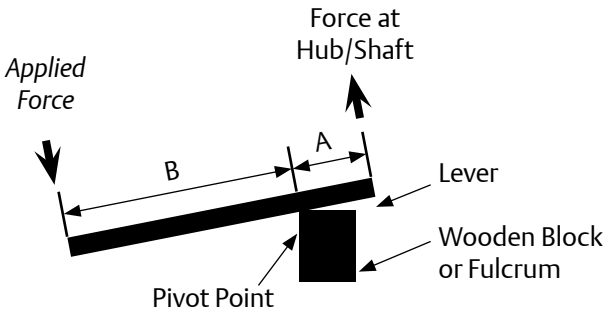
To determine maximum applied force, take maximum applied force at hub/shaft multiplied by length of A and divide by length B. This is the maximum force that should be applied on the lever.

(Applied Force x A)/B = Applied Force (Maximum)

So, using a 36" (or 1 m) lever with pivot space of 6" (or 15 cm) would make the maximum applied force to be 60 lbf (or 235 N). Calculation is as follows:

(300 lbf x 6")/30" = 60 lbf (Max. *Applied Force*)

(1335 N x 15 cm)/85 cm = 235 N (Max. *Applied Force*)



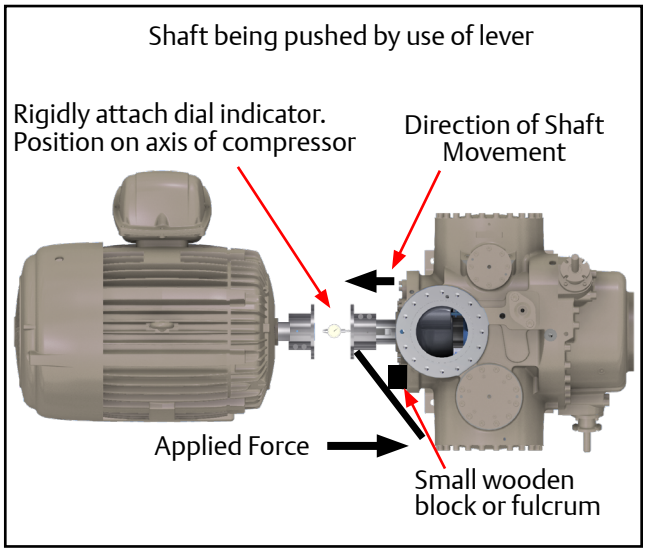
As a quick reference, Table 5-2 shows maximum applied forces for 36" lever with 6" pivot for all compressor models.

Main Rotor Bearing Axial Clearance Inspection

To inspect bearing axial clearance, proceed with the following steps:

1. Install dial indicator to the compressor frame and zero indicator, see Figure 5-7.
2. Place lever arm and fulcrum behind compressor coupling half and push the coupling towards the motor. Record measurement.
3. Re-zero indicator, now position the fulcrum on the motor and use the lever arm to push the input shaft towards the compressor. Record measurement

Top View



Top View

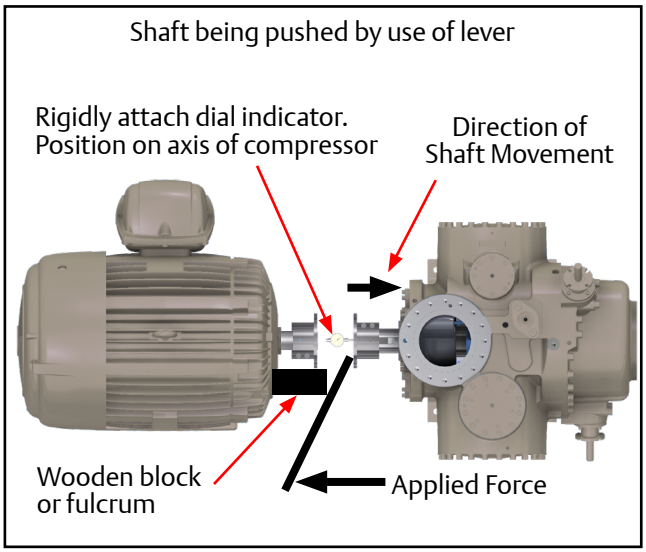


Figure 5-7. Bearing Axial Clearance Inspection

4. Add both measurements. If measurement is out of allowable tolerance shown in Table 5-2, the bearing may need to be replaced. Contact Vilter™ Technical Support.

Main Rotor Bearing Radial Clearance Inspection

5. Install dial indicator to the compressor frame and zero indicator, see Figure 5-8.

NOTE

Do not exceed maximum applied force. For maximum applied forces of all compressor models, see Table 5-2.

6. Place lever arm and fulcrum underneath hub and push hub upwards. Record measurement.
7. If measurement is out of allowable tolerance shown in Table 5-2, the bearing may need to be replaced. Contact Vilter™ Technical Support.

Figure 5-8. Bearing Radial Clearance Inspection

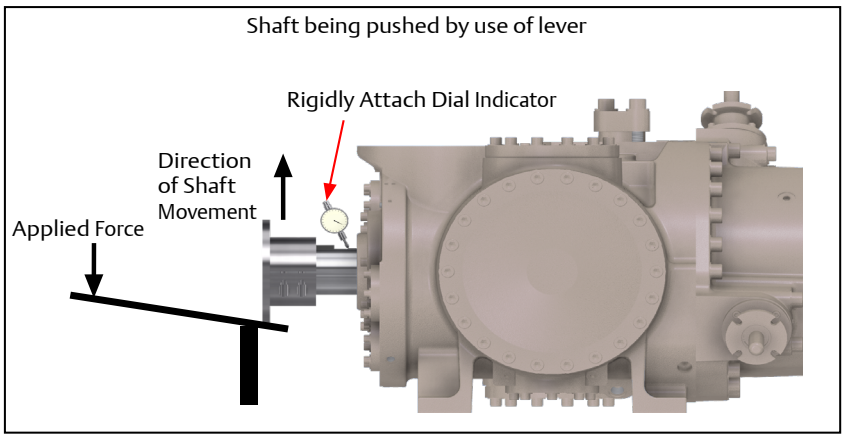


Table 5-2. Maximum Rotor Bearing Clearance

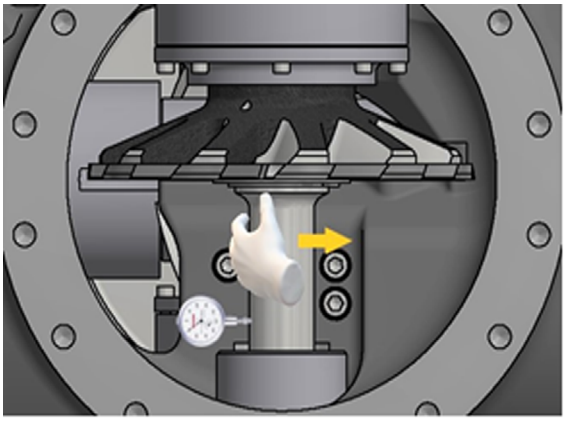
Compressor Model	Max. Axial Clearance in. (mm)	Max. Radial Clearance in. (mm)	Max. Force at Hub/Shaft lbf (N)	Max. Applied Force (36 Lever, 6 Pivot) lbf (N)
128, 145, 160, 180, 204, 222, 243	0.002 (0.051)	0.006 (0.152)	100 (444)	20 (89)
151, 181, 201, 152, 182, 202, 301, 361, 401		0.006 (0.152)	100 (444)	20 (89)
501, 601, 701		0.007 (0.178)	150 (667)	30 (133)
291, 341, 451, 601		0.007 (0.178)	150 (667)	30 (133)
751, 901		0.006 (0.152)	200 (890)	40 (178)
791, 891, 1051, 1201, 1301		0.006 (0.152)	300 (1335)	60 (267)
1501, 1551, 1801, 1851, 2101		0.007 (0.178)	400 (1780)	80 (356)
2401, 2601, 2801, 3001		0.006 (0.152)	600 (2670)	120 (534)

Gaterotor Bearing Inspection

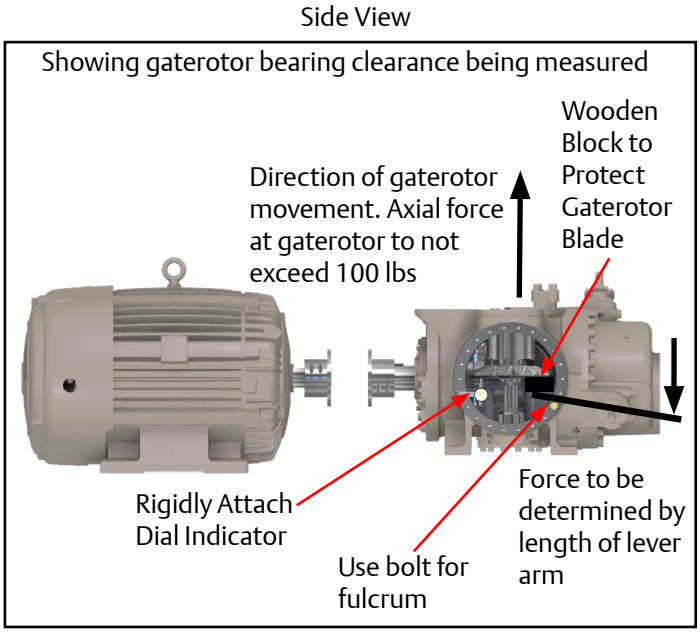
1. Position a one gallon (at least) plastic oil collection bin beneath the side cover. Carefully pry open the side cover to allow the oil to drain before finally removing the side cover.
2. To measure the gaterotor radial bearing clearance, position a dial indicator to the gaterotor shaft as shown in Figure 5-9 (a) and zero the indicator. Put a hand as shown and firmly move the shaft in the direction shown in Figure 5-9 (a). Record the measurement. See Table 5-3 for the maximum radial clearance value.
3. To measure the gaterotor axial bearing clearance, position a dial indicator on the gaterotor, as shown in Figure 5-9 (b).
4. To check axial bearing clearance use a lever arm pivoting on a bolt with a small block of wood against the gaterotor to protect it, as shown in Figure 5-9 (b). Record the measurement. See Table 5-3 for the maximum axial clearance value.

Table 5-3. Maximum Gaterotor Bearing Clearance

Compressor Models	Max. Axial Clearance in (mm)	Max. Radial Clearance in (mm)
All Sizes	0.002" (0.051 mm)	0.004" (0.102 mm)



(a): Radial



(b): Axial

Figure 5-9. Gaterotor Bearing Clearance

Gaterotor Inspection

A) Gaterotor - Main Housing Shelf Clearance

Follow these steps to check the clearance between the gaterotor and the shelf, which should be between 0.003" – 0.004", see Figure 5-10.

1. Place a 0.003" feeler gauge between the gaterotor teeth, as shown in Figure 5-11 (a) and (b).

NOTE

Make sure the feeler gauge stays in the opening between the two teeth until it is on top of the shelf.

2. Without moving the feeler gauge, slowly rotate the gaterotor so that the feeler gauge tip stays between the gaterotor and the shelf. See Figure 5-11 (c).

CAUTION

Do not over rotate. If the rotor catches the feeler gauge, a piece can break and fall into the rotor

3. Gently pull the feeler gauge out in the direction shown in Figure 5-11 (d).

Check for 0.003"-0.004" (0.076 - 0.102 mm) clearance between gaterotor blade and shelf.

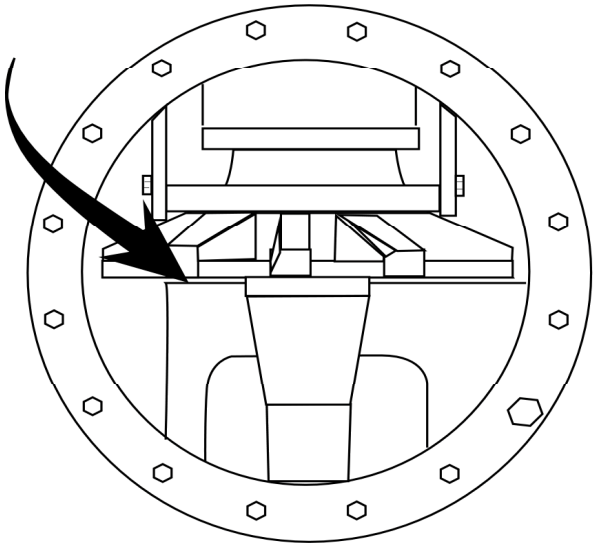
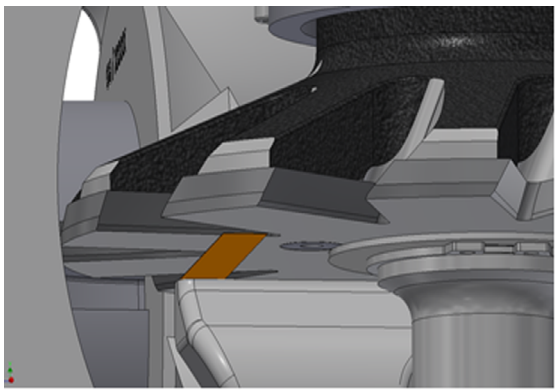
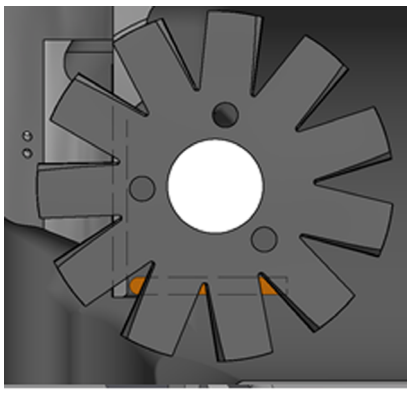


Figure 5-10. Gaterotor and Shelf Clearance

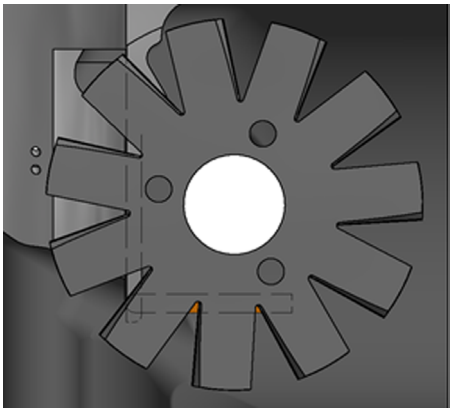
(a) Feeler Gauge Placement (Side View)

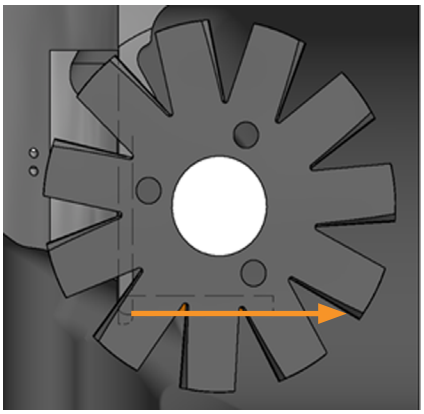




(b) Feeler Gauge Placement (Top View)

(c) Tip Of The Feeler Gauge Stays Between Gaterotor and Shelf While Rotating





(d) Feeler Gauge Must Be Pulled Out In This Direction

Figure 5-11. Gaterotor and Shelf Clearance Measurement Steps

4. If it is easy to pull out the feeler gauge, then increase the feeler gauge thickness by 0.001" and repeat above steps 1-3. If it is slightly tight to pull it out, then the clearance corresponds to the feeler gauge thickness.

NOTE

Replacement gaterotors are the same dimensionally as the gaterotors installed at the factory. Therefore, the same shims can be reused when replacement is needed to preserve the 0.003" – 0.004" clearance.

Clearance and Shims

Under 0.003"	0.003" – 0.004"	Over 0.004"
Remove shims (103 in Figure 5-37, 106 in Figure 5-22 & 5-24) to achieve 0.003" – 0.004"	Perfect!	Add shims (103 in Figure 5-37, 106 in Figure 5-22) to achieve 0.003" – 0.004"

B) Gaterotor Float Measurement

1. Before doing any measurements, first conduct a visual check to see if there is any noticeable clearance between the gaterotor and its bushing, see Figure 5-12. If there is noticeable clearance, please contact Vilter Service Department.

NOTE

The number of bushings on a gaterotor can be anywhere from one to three.

2. To measure the float between the gaterotor bushing and the support damper pin (see Figure 5-14), position a dial indicator at the tip of the support as shown in Figure 5-13. Hold the gaterotor in place, then gently move the support teeth back and forth with two fingers (and record measurement). Refer to Table 5-4 to find the maximum float value.

NOTICE

If clearance measurements are out of tolerance, contact Vilter Service Department for further assistance.

Table 5-4. Gaterotor Float

Model	Max. Float in. (mm)
VSSG 291 - 601	0.045 (1.143)
VSG 128 - 243	0.065 (1.651)
VSG 301 - 401	0.045 (1.143)
VSG 501 - 701	0.045 (1.143)
VSG 751 - 901	0.055 (1.397)
VSG 791 - 1301	0.060 (1.524)
VSG 1551 - 2101	0.060 (1.524)
VSG 2401-3001	0.060 (1.524)

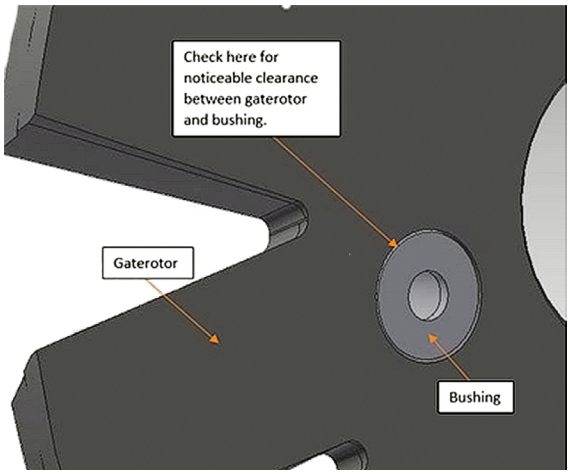


Figure 5-12. Visual Inspection Between Gaterotor and Bushing

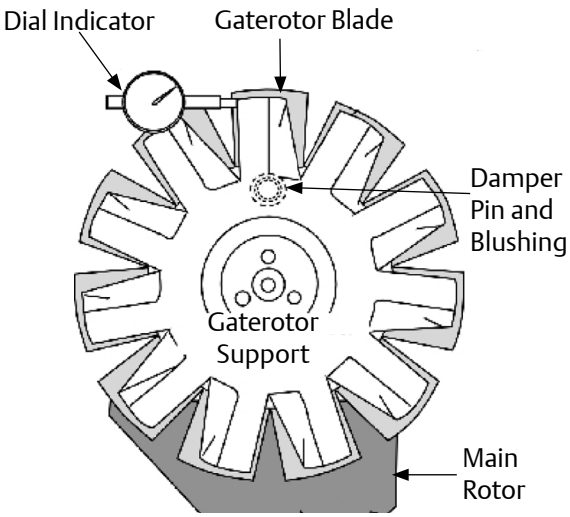


Figure 5-13. Gaterotor Float Dial Location

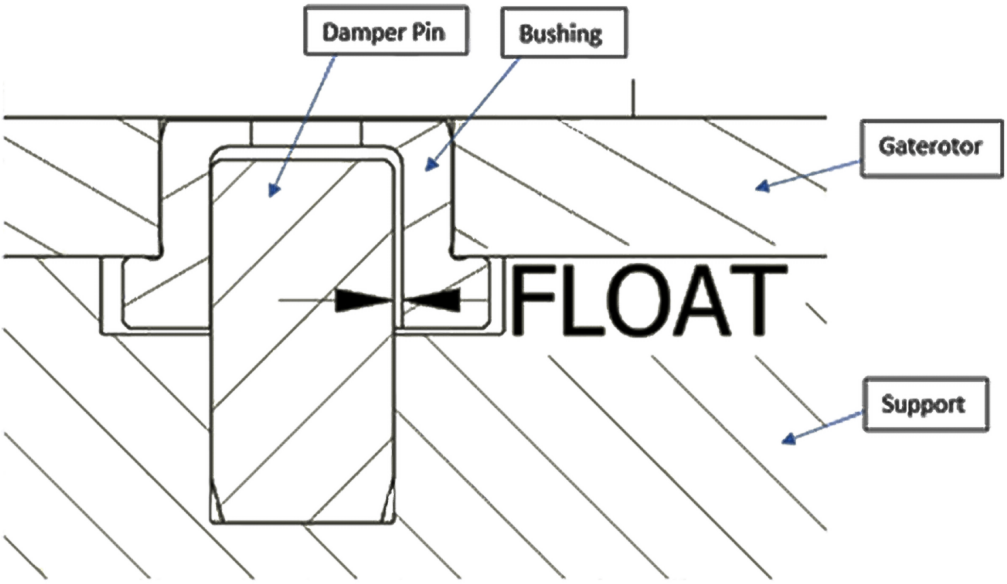


Figure 5-14. Gaterotor Float

C) Gaterotor Backlash Inspection

Gaterotor Backlash is the clearance between the gaterotor teeth width and the main rotor groove.

Follow these steps to perform the gaterotor backlash inspection:

1. The Gaterotor should be aligned so that a tooth in the rotor is perpendicular to the Main Axis as shown in Figure 5-15. The tooth should be in the center axis of the housing.
2. A dial indicator with magnetic base can be used (Vilter part numbers 9994ARE or 9994ARJ for the dial indicator, and 9994ARD for the magnetic base). See Figure 5-16 for location.
3. Place the Dial Indicator as square as possible on the Gaterotor tooth as shown on Figure 5-17.

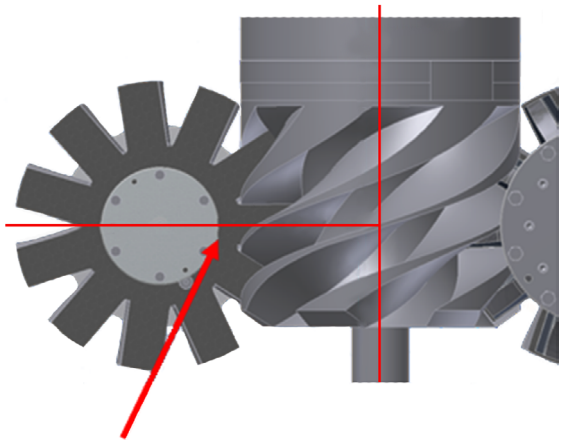


Figure 5-15. Alignment of Gaterotor

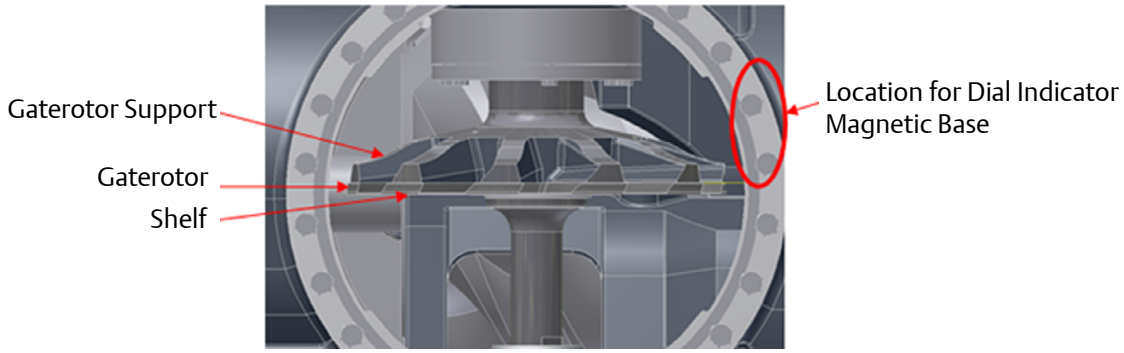


Figure 5-16. Location of Dial Indicator Magnetic Base

4. To measure the backlash (see Figure 5-18), move the gaterotor with two fingers back and forth rapidly several times while reading the dial indicator to see what the displacement range is. This displacement range will be the total backlash.

Contact Vilter Service Department if the measurement is above the ranges shown in Table 5-5.

Table 5-5. Backlash Range

Compressor Model	Normal Backlash
VSG 128-1301	0.008" to 0.012"
VSG 1501-3001	0.008" to 0.015"

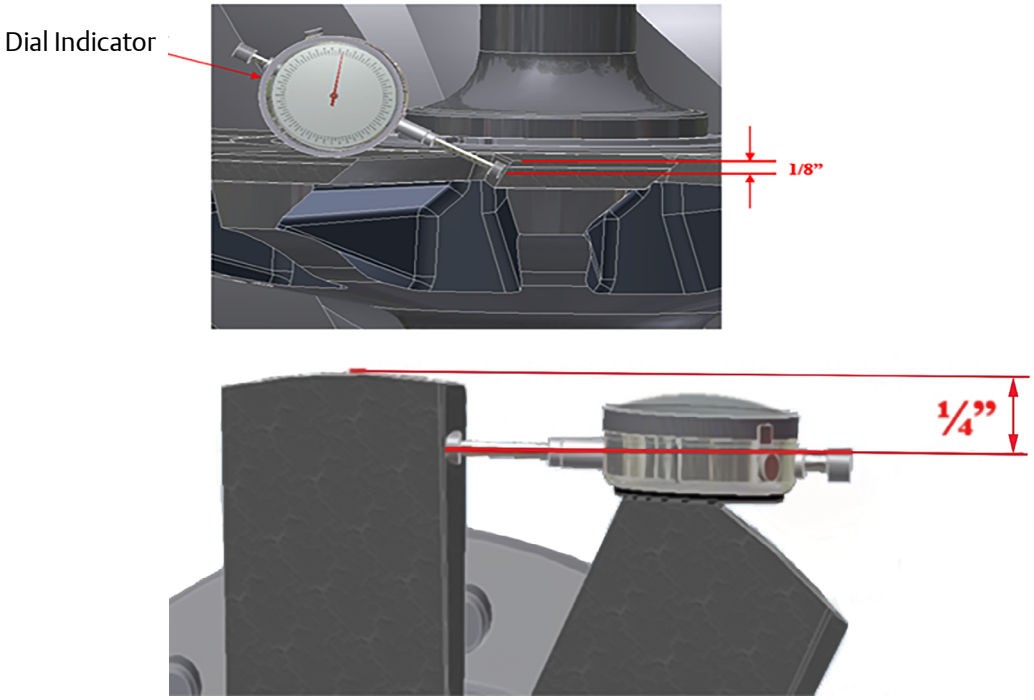


Figure 5-17. Placement of Dial Indicator

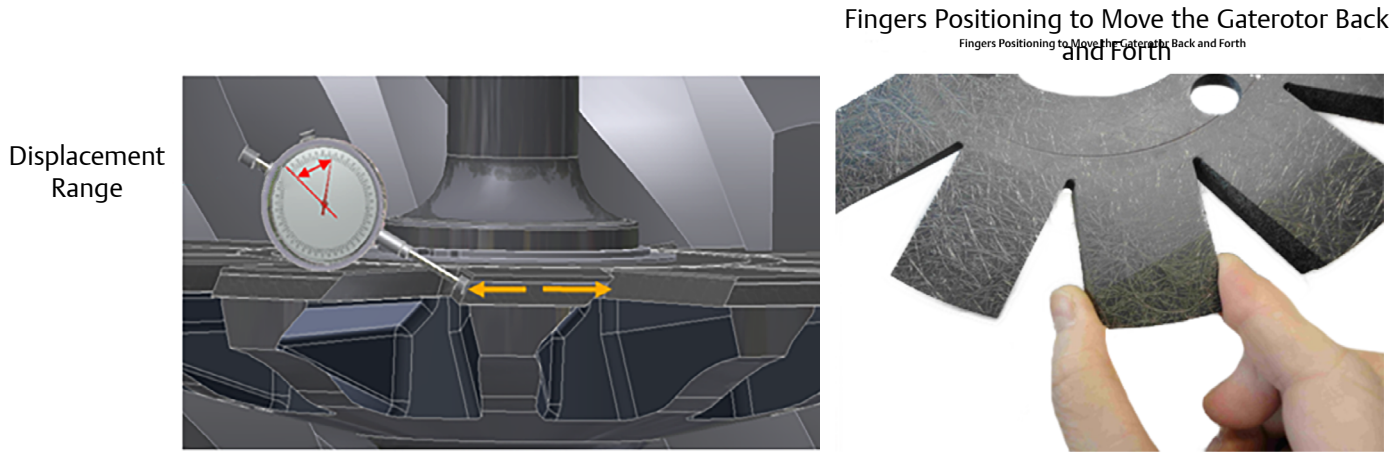


Figure 5-18. Measuring Backlash

Important Notes

1. Backlash cannot be checked if:

- The gaterotor is damaged in any way.
- The clearance between the gaterotor and the shelf is too tight.

2. Make sure you check the backlash, not the float:

- The backlash is the clearance between the gaterotor teeth width and the rotor groove.
- The float is the amount of play between the gaterotor bushing and the damper pins.

Additional Inspections

In addition, visually inspect the main rotor and gaterotors for signs of abnormal wear due to dirt or other contaminants.

If some chipping is present on the edges of the gaterotor, this will not influence the compressor performance. If chipping is more than what´s shown on Figure 5-19, take pictures and contact Vilter Service Department.

Post Inspection

After all the inspections are complete, the gaterotor cover, suction tee, coupling center member and coupling guard can be reinstalled and the unit can be evacuated and leak checked before starting.

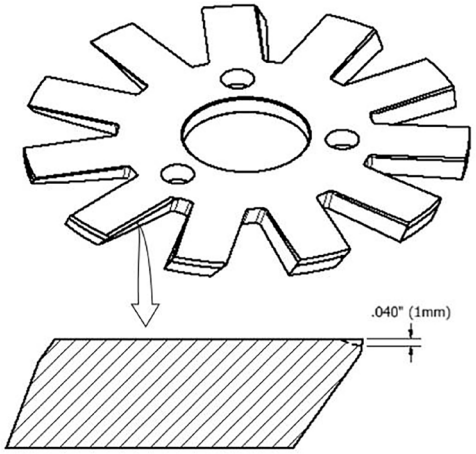


Figure 5-19. Chipped Edge of Gaterotor

Gaterotor Assembly Replacement (All VSG & VSSG Compressors Except VSG 301-701 and VSG 128 - 243 Compressors)

The following table lists the gaterotor tool sets needed to remove and install gaterotor assemblies.

Table 5-6. Gaterotor Tool Sets

Model	Tool Set VPN
VSSG 291 - 601	A25205B
VSG 128 - 243	A25205G
VSG 301 - 401	N/A
VSG 501 - 701	A25205B
VSG 751 - 1301	A2520 5C
VSG 1551 - 2101	A25205E
VSG 2401-3001	A25205F

Removal

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

1. Remove center member, see appropriate Drive Coupling Replacement procedure.

NOTE

All parts must be kept with their appropriate side and not mixed when the compressor is reassembled.

2. Remove two upper bolts from side cover
3. Install guide studs in holes.

NOTE

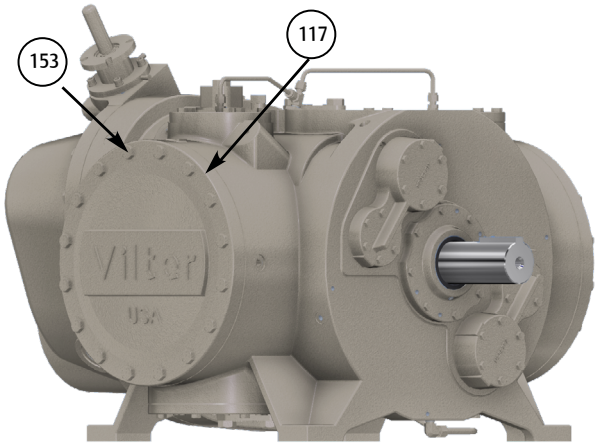
There will be some oil drainage when the cover is removed.

4. Remove remaining bolts and side cover.
5. Turn main rotor so a driving edge of any one of the main rotor grooves is even with the back of the gaterotor support.

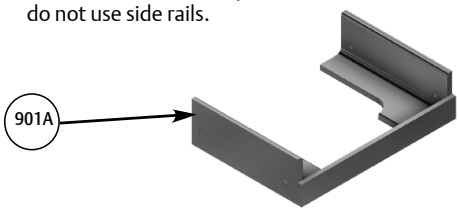
NOTE

The gaterotor stabilizer is designed to hold the gaterotor support in place and prevent damage to the gaterotor blade as the thrust bearings and housing is being removed.

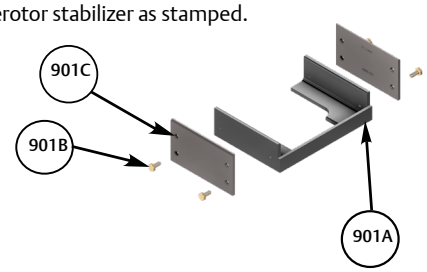
6. Insert gaterotor stabilizer. The side rails are not required on VSSG 291 thru 601. For the VSG 751 thru 901 and VSG 1051 thru 1301 compressors, use the side rails and assemble to the gaterotor stabilizer as stamped. For the VSG 1551 thru 3001, use the side rails and assemble to the gaterotor stabilizer. See Figure 5-20.
7. Remove hex head bolts and socket head bolts from thrust bearing cover.
8. Re-install two bolts into the threaded jacking holes to assist in removing thrust bearing cover. Retain the shim pack.
9. Hold gaterotor support with a suitable wrench on the flats provided near the roller bearing housing. See Figure 5-21.
10. Remove the inner retainer bolts and retainer.
11. To remove the thrust bearing housing, install thrust bearing removal and installation tool with smaller puller shoe. Turn the jacking screw clockwise. The thrust bearings and housing assembly will be pulled off the shaft and out of the frame.
12. Remove bolts from roller bearing housing.
13. Re-install two bolts into jack bolt holes provided in housing to aid in removal.
14. To remove the gaterotor support, carefully move support in the opposite direction of rotation and tilt roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gaterotor support. On dual gate compressor units, repeat the procedure for the remaining gaterotor support assembly.



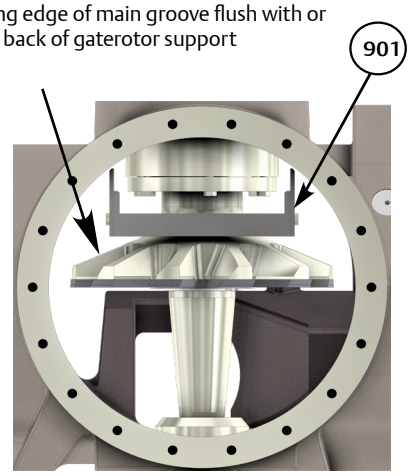
For VSSG 291-601 compressors, do not use side rails.



For VSG 751/901 and 1051-1301 compressors, use side rails and assemble gaterotor stabilizer as stamped.



Position leading edge of main groove flush with or slightly below back of gaterotor support



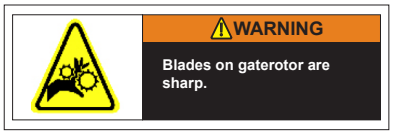
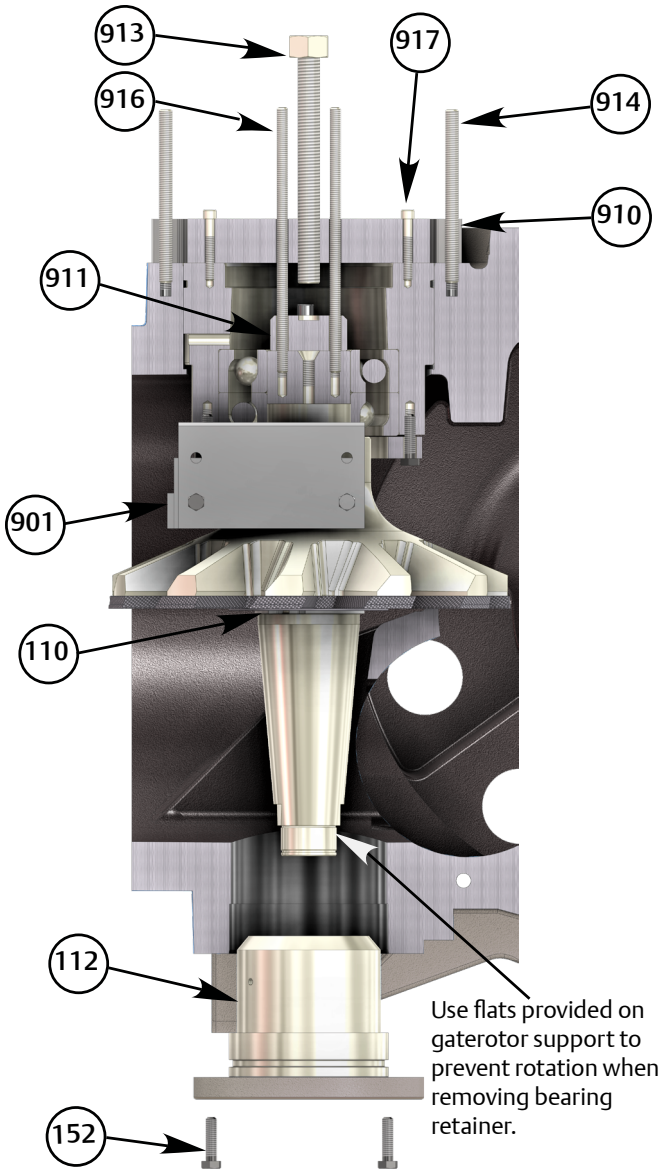


Figure 5-20. Gaterotor Assembly Removal and Tools



Use flats provided on gaterotor support to prevent rotation when removing bearing retainer.

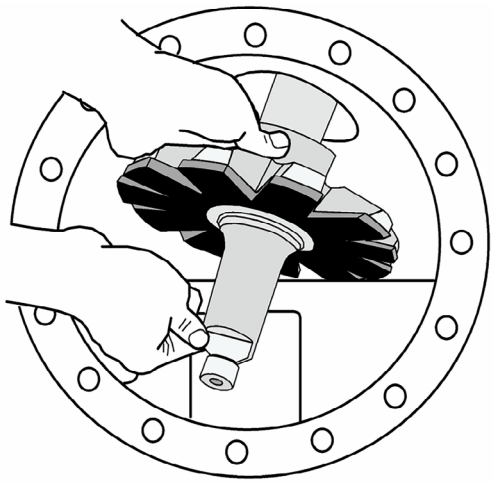
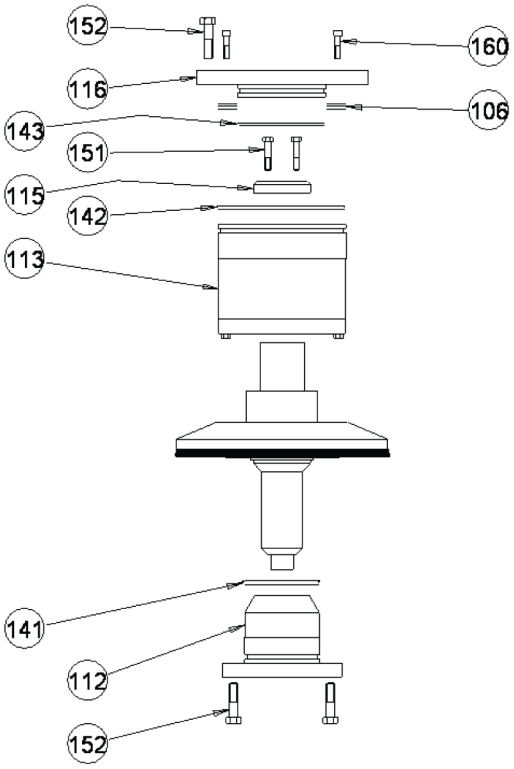


Figure 5-21. Gaterotor Assembly Removal



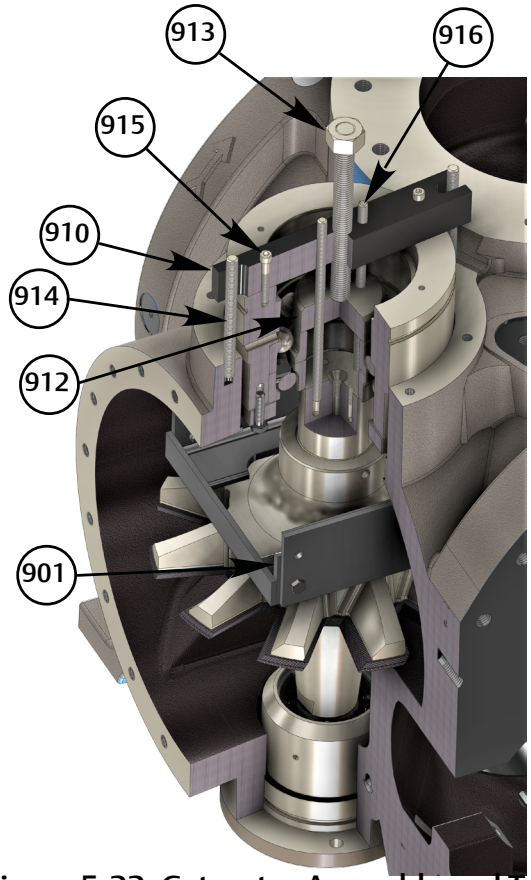
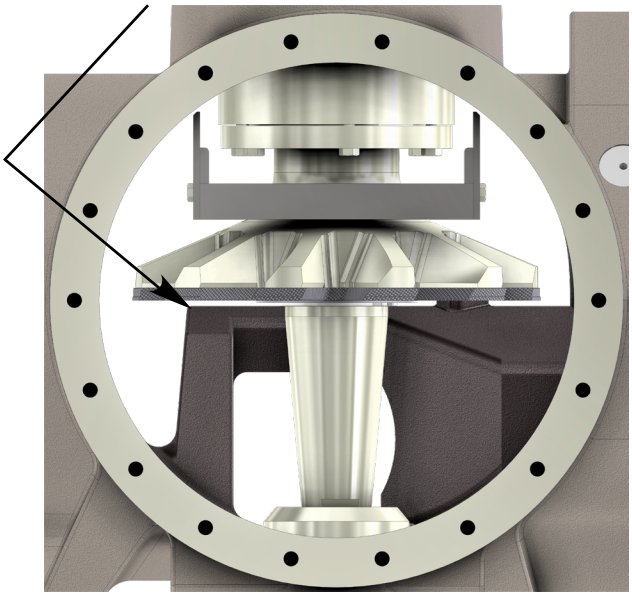


Figure 5-22. Gaterotor Assembly and Tools

Installation

1. Install gaterotor support by carefully tilting the roller bearing end of the gaterotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support. Install gaterotor stabilizer. The gaterotor stabilizer (901) will hold the gaterotor support in place as the thrust bearing housing is being installed. If the gaterotor support is not restricted from moving, the gaterotor blade may be damaged. See Figure 5-22.
2. Install the roller bearing housing (112) with a new O-ring (141). See Figure 5-22.
3. Tighten bolts (152), see Appendix A.

Check for 0.003"-0.004" (0.076- 0.102 mm) clearance between gaterotor blade and partition.



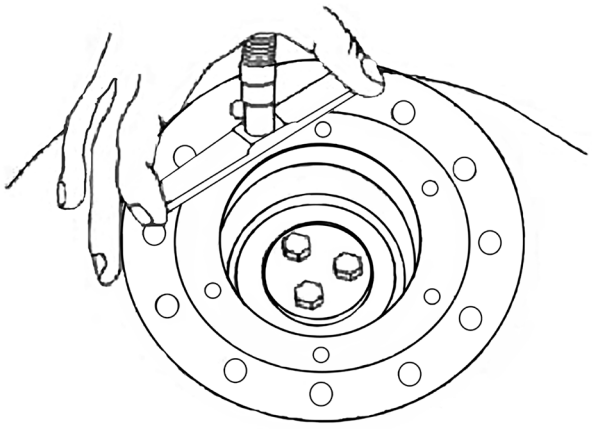


Figure 5-23. Gaterotor and Shelf Clearance

4. When installing the thrust bearing housing (113), a new O-ring (142) must be used when the housing is installed, see Figure 5-22. Lubricate the outside of the housing and bearings with clean compressor oil to aid in the installation. Due to the fit of the bearings on the gaterotor shaft, the thrust bearing removal and installation tool with the pusher shoe must be used. Turn the jacking screw clockwise. This will push the thrust bearings onto the shaft and push the housing assembly into the frame. Install the inner retainer (115) and bolts (151) using Loctite® 242 thread locker. Tighten bolts, see Appendix A.
5. Set clearance between gaterotor blade and shelf.
6. Place a piece of 0.003"-0.004" shim stock between gaterotor blade and shelf.

NOTE

This measurement determines the amount of shims needed for the correct clearance.

7. Measure depth from top of compressor case to top of thrust bearing housing.
8. Use factory installed shim pack (106) and bearing housing cover (116) without the O-ring (143).

NOTE

Replacement blades are precisely the same dimensionally as blades installed originally at factory: Therefore, the same amount of shims will be required for replacement blades.

9. Check the clearance between the entire gaterotor blade and the shelf, rotate the gaterotor to find the tightest spot. It should be between 0.003"-0.004" (0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf, see Figure 5-23.
10. After clearance has been set install a new O-ring (143) on bearing housing cover, install cover and tighten the bolts to the recommended torque value. See Figure 5-22.
11. Install side cover with a new gasket. Tighten the bolts to the recommended torque value. The unit can then be evacuated and leak checked.

Gaterotor Assembly Replacement (VSG 301-701 Compressors ONLY)

Removal

The removal of the gaterotor assembly for the VSG 301-701 compressors is similar for the VSG 901 - 2101 compressors except that the inner races are secured to the stationary bearing spindle. See Figure 5-24.

1. Remove center member, see Appropriate Drive Coupling Replacement procedure.
2. Remove the upper bolt from the side cover and install a guide stud in the hole.
3. Remove remaining bolts and side cover. There will be some oil drainage when the cover is removed.

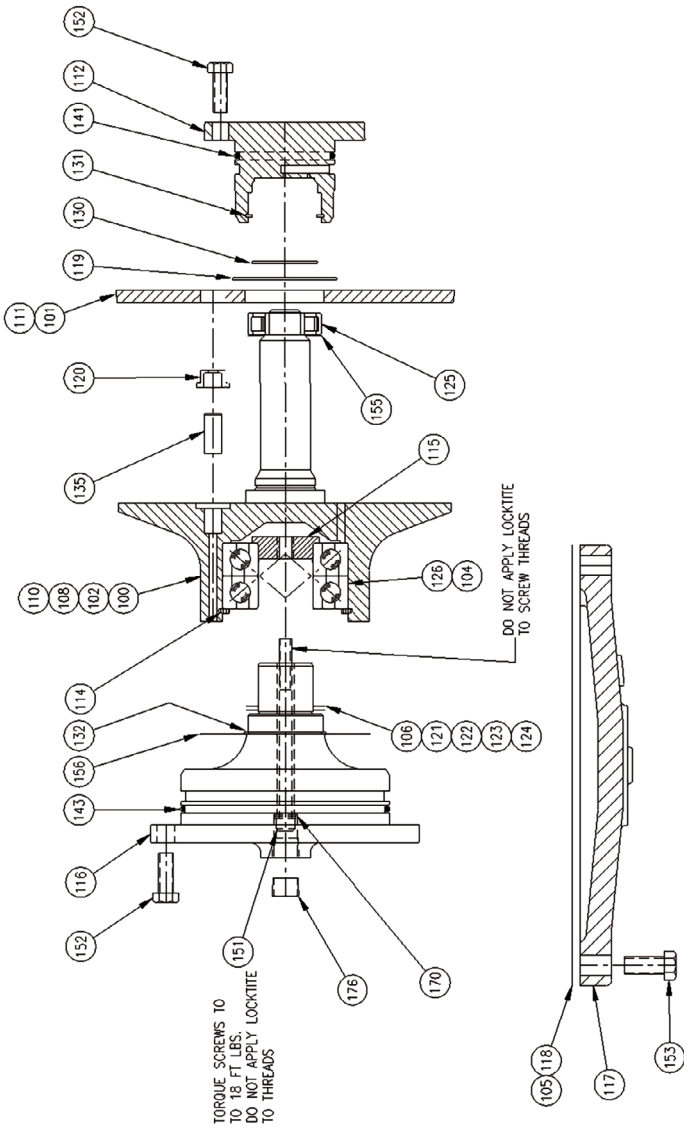


Figure 5-24. Gaterotor Assembly Breakdown

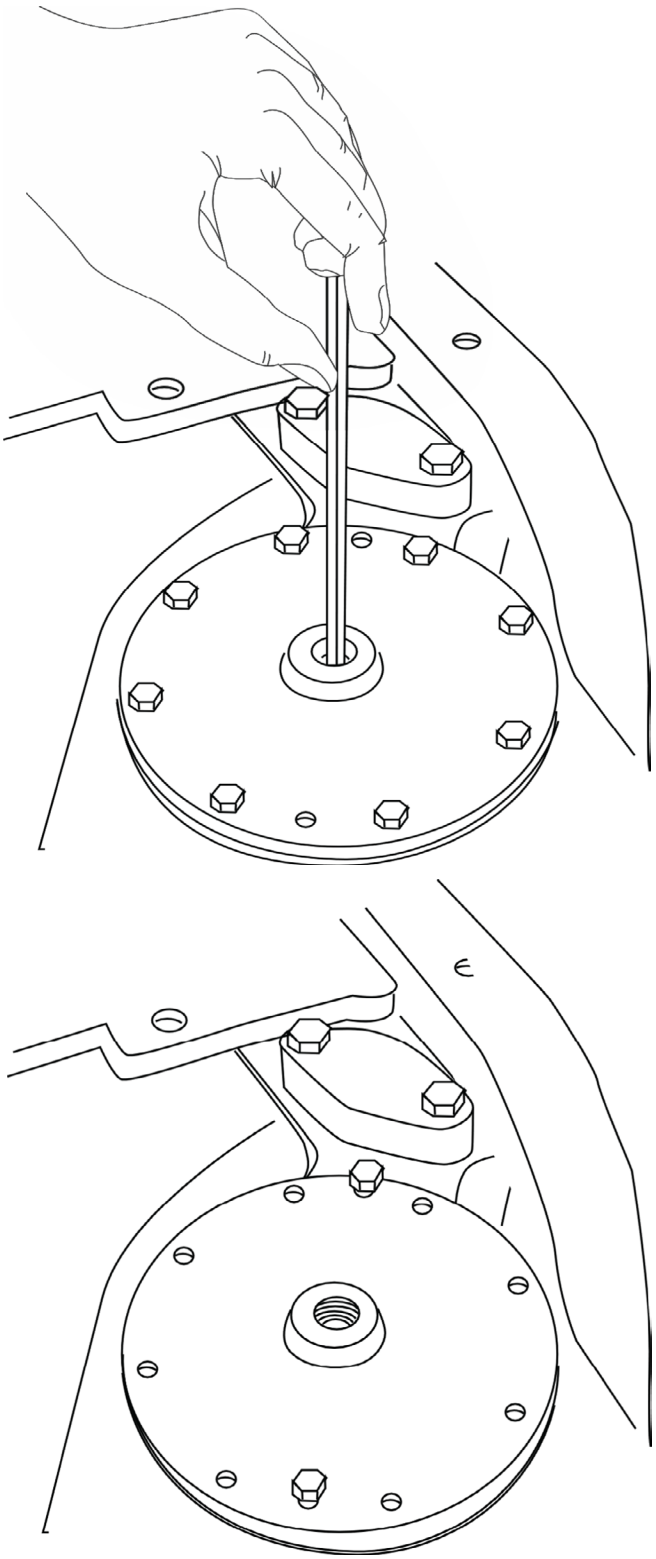
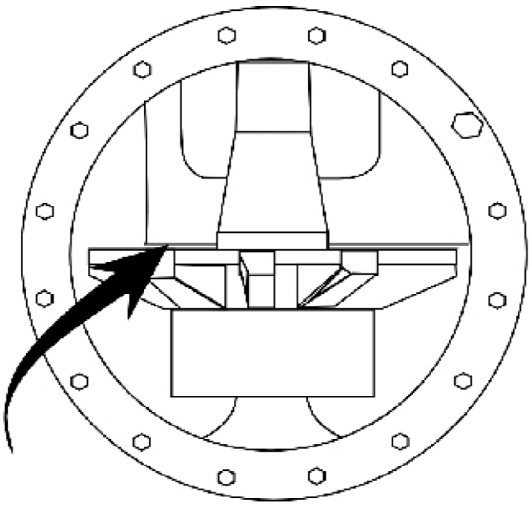


Figure 5-25. Gaterotor Thrust Bearing

4. The side cover that contains the suction strainer should have the suction line properly supported before the bolts securing the line to the cover can be removed. After the line is removed, the cover can be removed per paragraph 2.
5. Turn the main rotor so the driving edge of the groove is between the top of the shelf or slightly below the back of the gaterotor support. At this point install the gaterotor stabilizing tool.
6. Remove plug on the thrust bearing housing. Loosen the socket head cap screw that is located underneath the plug. This secures the inner races of the thrust bearings to the spindle.
7. Remove bolts that hold the thrust bearing housing to the compressor. Insert two of the bolts into the threaded jacking holes to assist in removing the bearing housing from the compressor. See Figure 5-25. When the housing is removed, there will be shims between the spindle and thrust bearings. These control the clearance between the shelf and gaterotor blades. These must be kept with their respective parts for that side of the compressor. See Figure 5-26.
8. Remove the bolts from the roller bearing housing. After the bolts have been removed, the housing can be removed from the compressor.
9. To remove the gaterotor support, carefully move the support opposite the direction of rotation and tilt the roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gaterotor support. On dual gate versions, repeat the procedure for the remaining gaterotor support assembly.



Check for 0.003"-0.004" (0.076 - 0.102 mm) clearance between gaterotor blade and partition.

Figure 5-26. Gaterotor and Shelf Clearance

Installation

1. Install the gaterotor support. Carefully tilt the roller bearing end of the gaterotor support towards the suction end of the compressor. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support.
2. Install the roller bearing housing with a new O-ring. Tighten the bolts to the recommended torque value.
3. Install the spindle with shims and O-ring, tighten bolts, see Appendix A. Measure the clearance between the shelf and blade.
4. Check the clearance between the entire gaterotor blade and the shelf, rotate the gaterotor to find the tightest spot. It should be between 0.003"-0.004" (0.076mm-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf.
5. Once the clearance is set remove the spindle. Install new O-ring, apply Loctite 242 thread locker to the socket head cap screw clamping the thrust bearings to the spindle. Torque all bolts, see Appendix A.
6. Install side covers with new gaskets. Tighten bolts, see Appendix A. The unit can now be evacuated and leak checked.

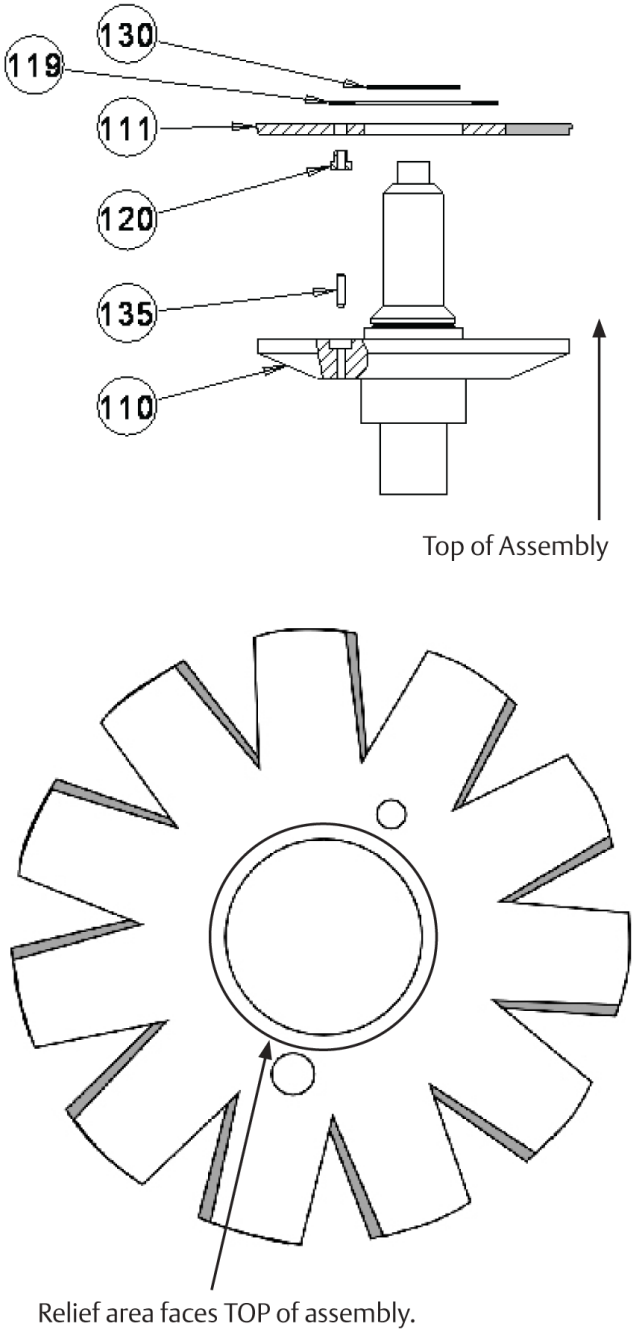


Figure 5-27. Gaterotor Blade Assembly

Gaterotor Disassembly

To perform gaterotor disassembly, remove gaterotor from compressor, see Gaterotor Assembly Replacement procedure (All VSG-VSSG Compressors Except VSG 301-701 Compressors) or Gaterotor Assembly procedure (VSG 301-701 Compressors ONLY).

Gaterotor Blade Removal

1. Remove the snap ring and washer from the gaterotor assembly. Lift gaterotor blade assembly off the gaterotor support, see Figure 5-27.
2. Check damper pin and bushing for excessive wear. Replace if required.

Gaterotor Blade Installation

1. Install damper pin bushing (120) in gaterotor blade (111) from the back side of the blade. Be sure bushing is fully seated.
2. Place blade assembly on gaterotor support. Locating damper over pin.
3. Install washer (119) and snap ring (130) on gaterotor assembly. The bevel on the snap ring must face away from the gaterotor blade. After the gaterotor blade and support are assembled, there should be a small amount of rotational movement between the gaterotor and support.

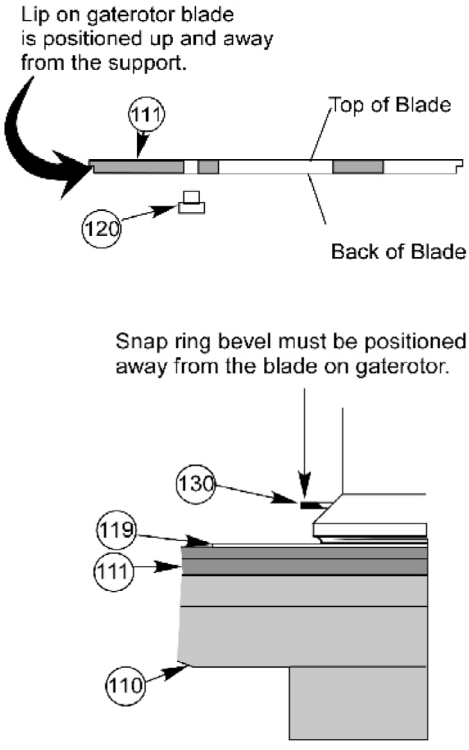


Figure 5-28. Gaterotor Blade Installation

Gaterotor Thrust Bearing Removal

For removal of thrust bearings on VSG units:

1. Remove bolts (150) from the clamping ring (114), see Figure 5-29.
2. Remove thrust bearing clamping ring.
3. Remove thrust bearings (126) from housing (113).

For removal of thrust bearings on VSSG units:

4. Remove retaining ring from gaterotor support.
5. Remove bearings from support.
6. Remove bearing retainer from inner race.

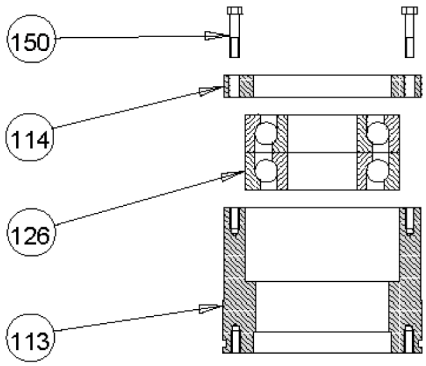


Figure 5-29. Gaterotor Thrust Bearing

Gaterotor Thrust Bearing Installation

For installation of thrust bearings on VSG and VSSG units:

1. Install thrust bearings (126) in the housing so the bearings are face to face. The larger sides of the inner races are placed together. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the housing.
2. Center the bearing retainer ring on housing, use Loctite® 242-thread locker and evenly tighten the bolts to the recommended torque value, see Figure 5-26.

For installation of thrust bearings on VSG 301 - 701 units:

1. Install retainer in the back of the inner race of one of the thrust bearings. The back of the inner race is the narrower of the two sides.

2. The bearing with the retainer should be placed in the housing first, retainer towards the support. Install the second bearing. The bearings should be positioned face to face. This means that the larger sides of the inner races are placed together. A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the gaterotor support.
3. Install the bearing retaining snap ring.

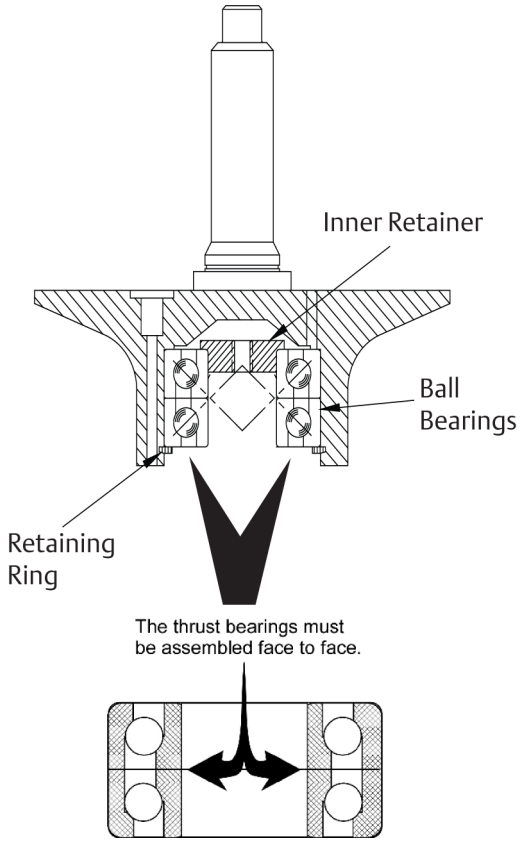


Figure 5-30. Thrust Bearing Installation

Gaterotor Roller Bearing Removal

1. Remove the snap ring (131), which retains the roller bearing in the bearing housing, see Figure 5-31.
2. Remove the roller bearing (125) from the bearing housing (112).
3. Use a bearing puller to remove the roller bearing race (125) from the gaterotor support (110).

Gaterotor Roller Bearing Installation

1. Match up the part numbers on the inner race to the part numbers on the outer race. Press the bearing race (numbers visible) onto the gaterotor support.
2. Install the outer bearing into the bearing housing so the numbers match the numbers on the inner race. Install the snap ring retainer in the housing. The bevel on the snap ring must face away from the roller bearing.

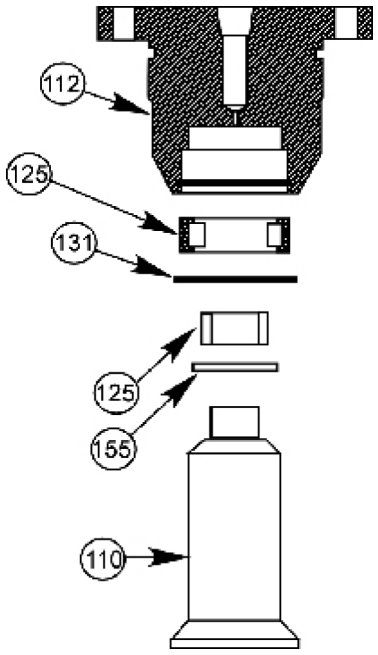


Figure 5-31. Rotor Bearing Assembly

Gaterotor Removal and Installation (VSG 128 - 243 Compressors ONLY) Use gaterotor tool set: A25205G

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

Removal

1. Prepare the compressor for servicing (please see Compressor Unit Isolation for Maintenance/Service on Page 5-3 for procedure details).

NOTE

Each gaterotor assembly must be reassembled on the same side that it is disassembled from.

2. Position at least a one gallon plastic oil collection bin beneath the side cover. Carefully pry open the side cover to allow the oil to drain before finally removing the side cover.
3. Rotate the main rotor to the position indicated in Figure 5-32.

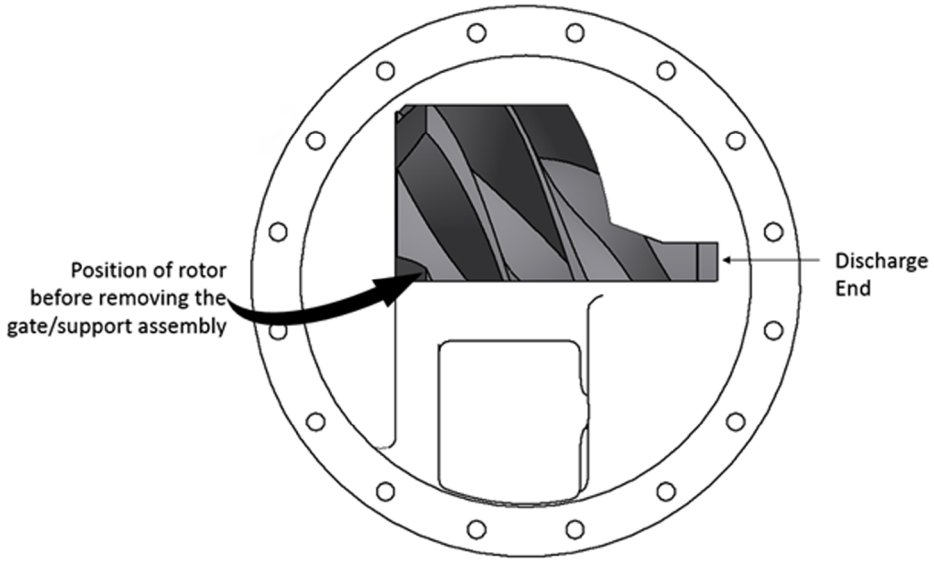


Figure 5-32. Rotor Position for Gaterotor/Support Assembly Removal

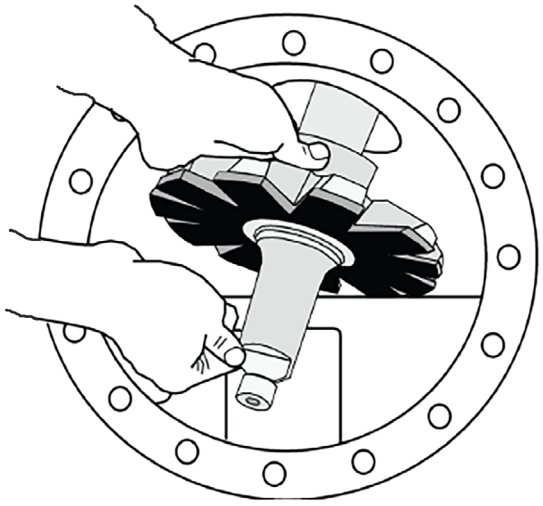


Figure 5-33. Gaterotor/Support Assembly Removal

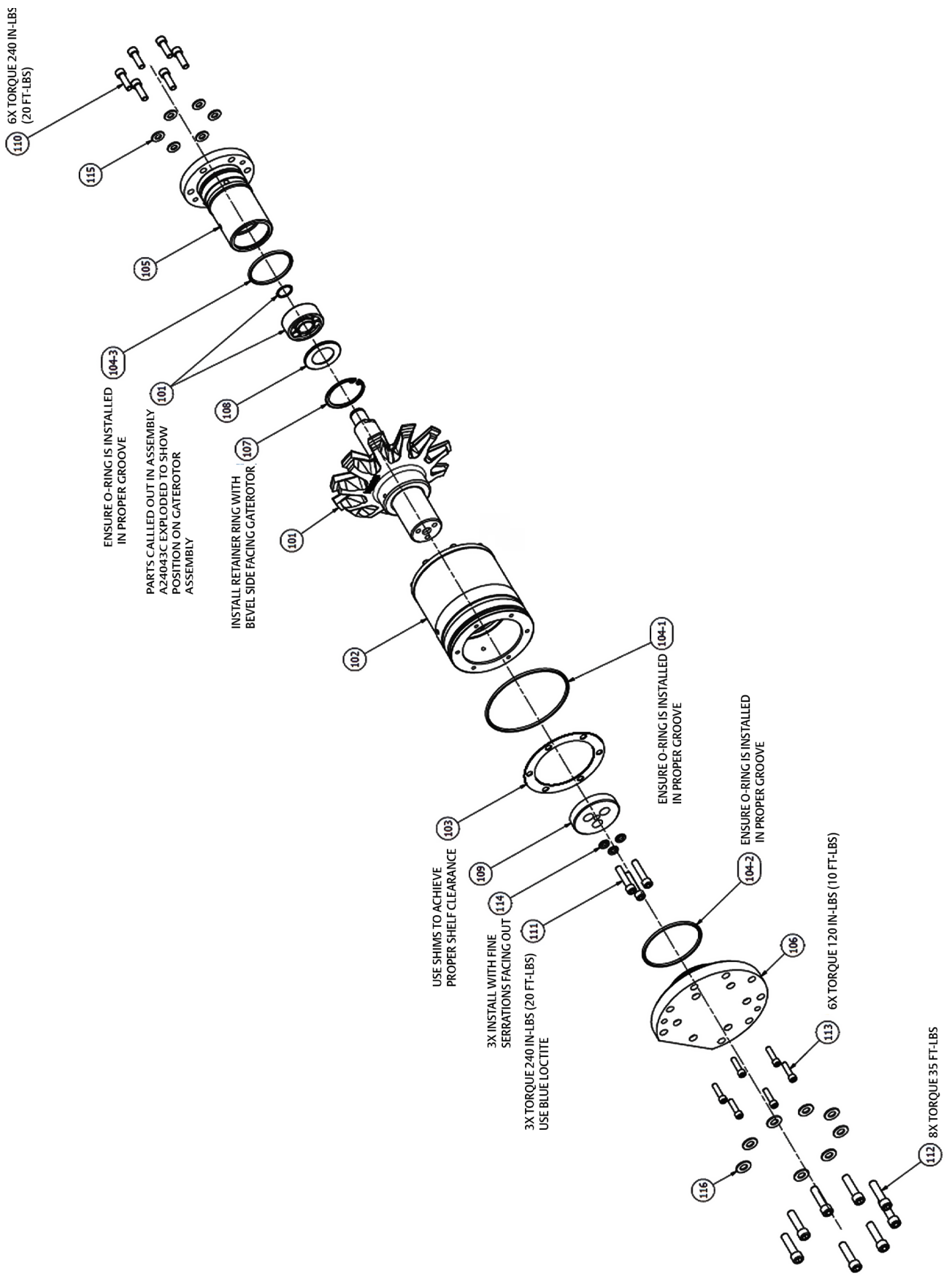


Figure 5-34. Gaterotor Assembly

4. Using Figure 5-34 as a guide, remove the screws (110), and the washers (115).
5. Remove ball bearing housing cover screws (112 & 113), washers (116) and cover (106).
6. Remove ball bearing retainer screws (111), washer (114), and retainer (109).
7. Remove shim pack (103) and O-ring (104-2).
8. Remove roller bearing housing (105).
9. Remove O-ring (104-3).
10. Use the tool set A25205G (shown in Figure 5-35) to remove ball bearing housing (102 in Figure 5-34): Install the tool set as shown in Figure 5-36 by hand tightening the bolt (109) - this will hold the gaterotor support in place. Turn the jacking screw (105 in Figure 5-35) clockwise. The ball bearing housing assembly will be pulled off the gaterotor support. Remove entire tool set.

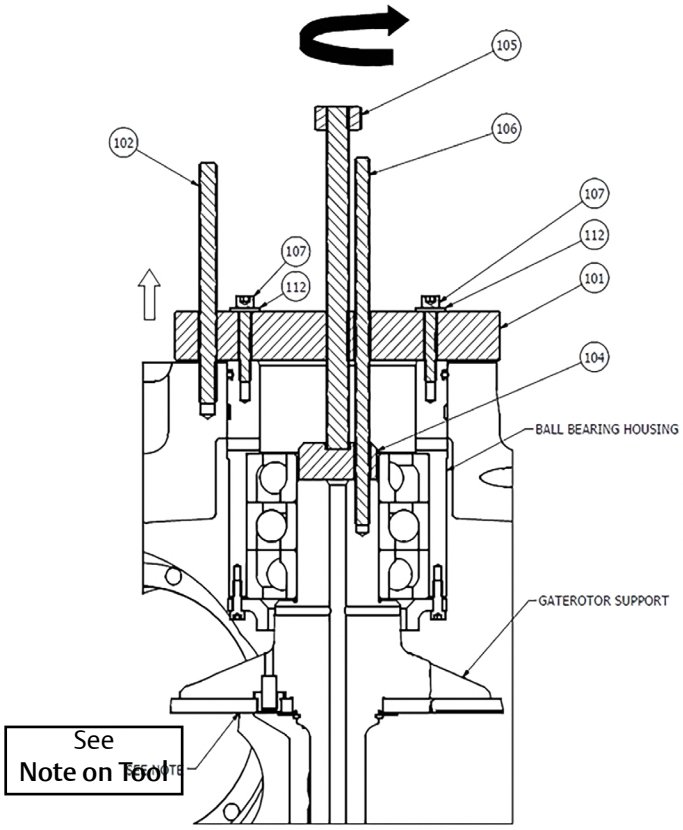


Figure 5-35. Tool To Remove Bearing Housing Assembly

11. Remove O-ring (104-1 in Figure 5-34).
12. Make sure the rotor is in position as shown in Figure 5-32. Remove support assembly (101 in Figure 5-34) as shown in Figure 5-33.

NOTE

O-rings and Nord-Lock washers (114 in Figure 5-34) will need to be replaced each time.

Note on Tool

Make sure that gaterotor is not in contact with the housing shelf while installing and removing the bearing housing assembly.

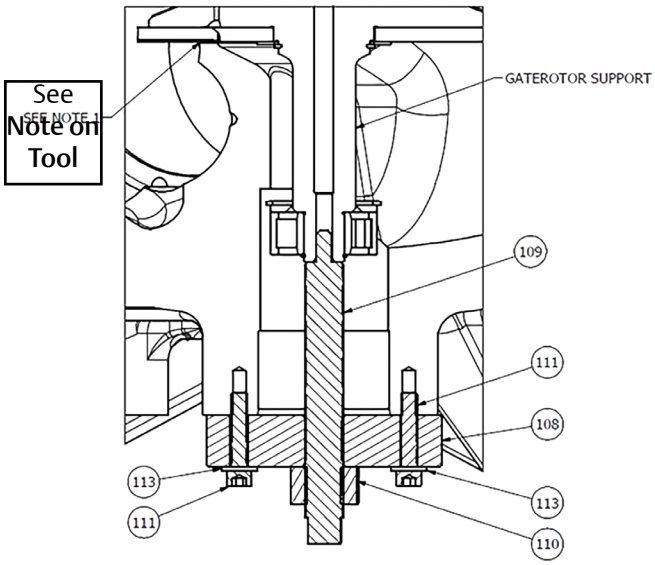


Figure 5-36. Tool To Install and Remove Bearing Housing Assembly

Installation

(Refer to Figure 5-34)

Torque values for screws:
- 110: 20 ft-lbs
- 112: 35 ft-lbs
- 113: 10 ft-lbs
- 111: 20 ft-lbs (use blue Loctite)

- The beveled side of the retaining ring (101.14) must face away from gaterotor, see Figure 5-40.
- Make sure O-rings are placed in the proper grooves, see Figure 5-35.
- Washer 114 has fine and coarse serrations, and those fine serrations must be facing out. See "NORD-LOCK Washers" on Page 5-55 for more details.

1. Install gaterotor support by carefully tilting the roller bearing end of the gaterotor support towards the suction end of the compressor, see Figure 5-34. The compressor input shaft may have to be rotated to facilitate the installation of the gaterotor support, see Figure 5-33.
2. When installing the ball bearing housing (102), a new O-ring (104-1) must be used when the housing is installed, see Figure 5-35. Lubricate the outside of the housing and bearings with clean compressor oil to aid in the installation. Due to the way the bearings fit on the gaterotor support, the gaterotor tool set (A25205G) must be used. Assemble the tool set according to Figure 5-38 and 5-33 by hand tightening the bolt (109) - this will hold the gaterotor support in place. Evenly turn the jacking studs (102) clockwise. This will push the ball bearing housing onto the gaterotor support. Remove entire tool set.
3. Install the inner retainer (109), washers (114) and bolts (111) using Loctite® 242 thread locker. Tighten bolts to 20 ft-lbs.
4. Install the roller bearing housing (105) with a new O-ring (104-3).
5. Tighten bolts (110) to 20 ft-lbs.
6. Set clearance between gaterotor blade and shelf.
7. Place a piece of 0.003"-0.004" shim stock between gaterotor blade and shelf.

NOTE

This measurement determines the number of shims needed for the correct clearance.

8. Measure depth from top of compressor case to top of ball bearing housing.
9. Use factory installed shim pack (103) and ball bearing housing cover (106) without the O-ring (104-2).

NOTE

Replacement blades are precisely the same dimensionally as blades installed originally at factory. Therefore, the same number of shims will be required for replacement blades.

Note on Tool

Make sure that gaterotor is not in contact with the housing shelf while installing and removing the bearing housing assembly.

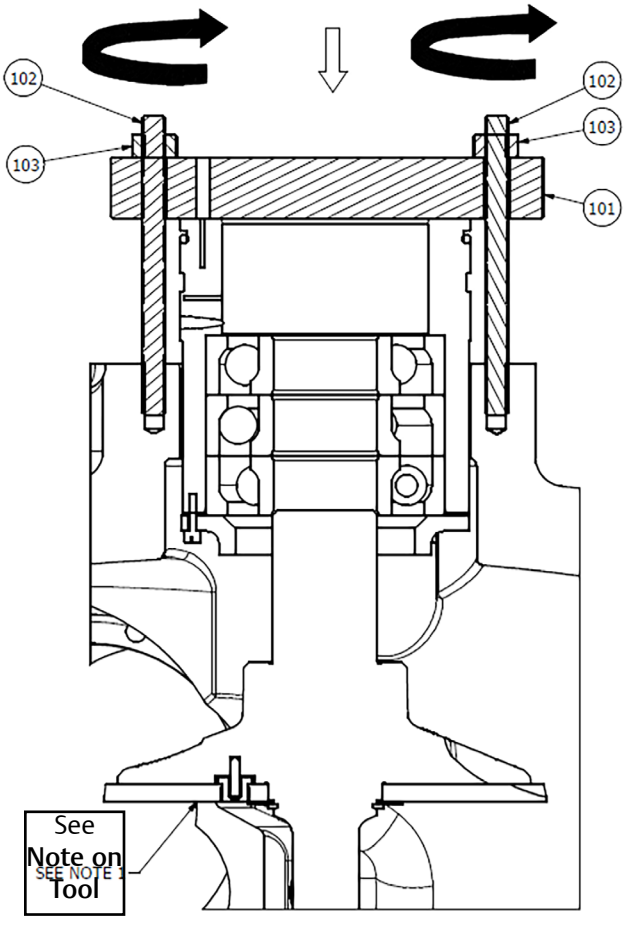


Figure 5-37. Tool To Install Bearing Housing Assembly

10. Check the clearance between the entire gaterotor blade and the shelf, rotate the gaterotor to find the tightest spot. It should be between 0.003"-0.004" (0.076-0.102 mm). Make adjustments, if necessary. It is preferable to shim the gaterotor blade looser rather than tighter against the shelf, see Figure 5-39.
11. After clearance has been set install a new O-ring (104-2) on ball bearing housing cover, install cover (106), and tighten the bolts (112 and 113) to the recommended torque values.
12. Install side cover with a new gasket. Tighten the bolts to the recommended torque value. The unit can then be evacuated, and leak checked.

Torque values for screws:
- 110: 20 ft-lbs
- 112: 35 ft-lbs
- 113: 10 ft-lbs
- 111: 20 ft-lbs (use blue Loctite)

Check for 0.003"-0.004" (0.076 - 0.102 mm) clearance between gaterotor blade and partition.

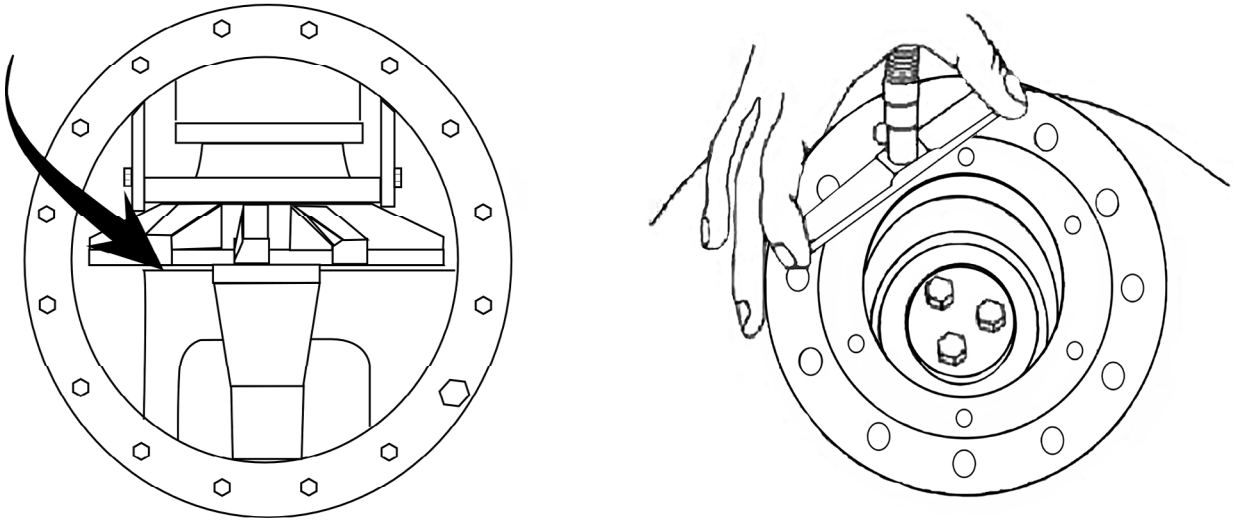


Figure 5-38. Check the Clearance Between the Gaterotor and Shelf

Gaterotor Blade Removal

1. Remove the retaining ring (101.14) and washer (101.13) from the assembly, see Figure 5-39.
2. Lift gaterotor blade assembly (101.12) off the gaterotor support (101.11).
3. Check damper pin and bushing for excessive wear. Replace if required (see Page 5-17 for gaterotor float details.)

Gaterotor Blade Installation

1. Install bushings (101.12b) in gaterotor blade (101.12a) from the back side of the blade. Be sure bushing is fully seated and torqued to 5 ft-lbs. using red Loctite, see Figure 5-40.
2. Place blade assembly (101.12) on gaterotor support (101.11). Locate bushing over pin, see Figure 5-39.
3. After the gaterotor and support are assembled, there should be a small amount of rotational movement between the gaterotor and support.
4. Install washer (101.13) and retaining ring (101.14).

NOTE

Retaining ring (101.14) must be installed with bevel side facing away from the gaterotor, see Figure 5-39.

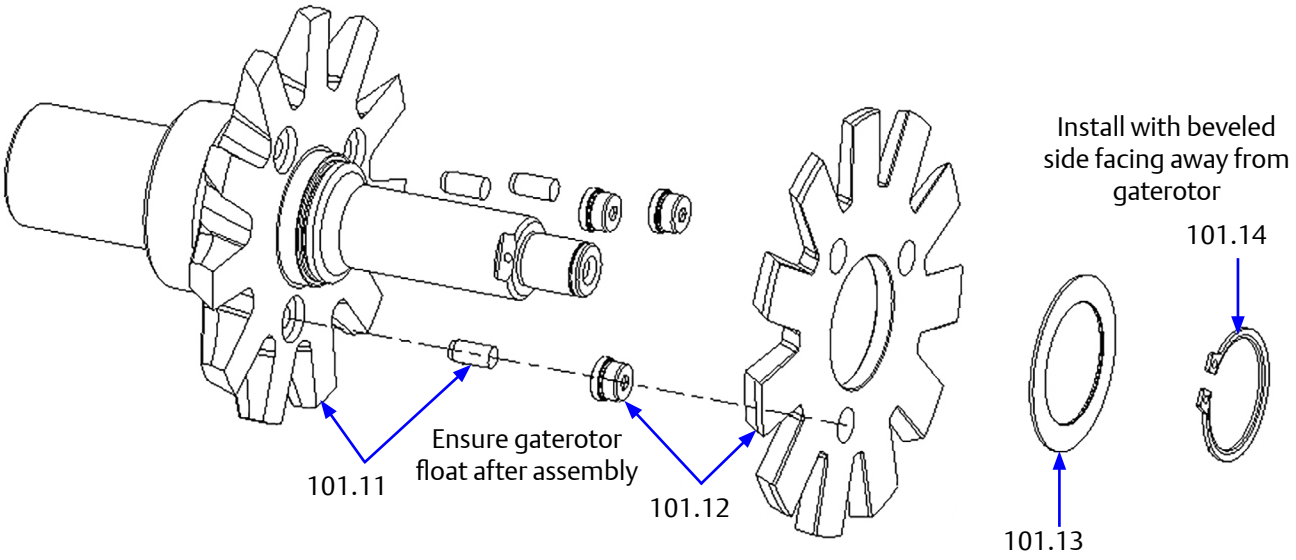


Figure 5-39. Gaterotor and Support Assembly

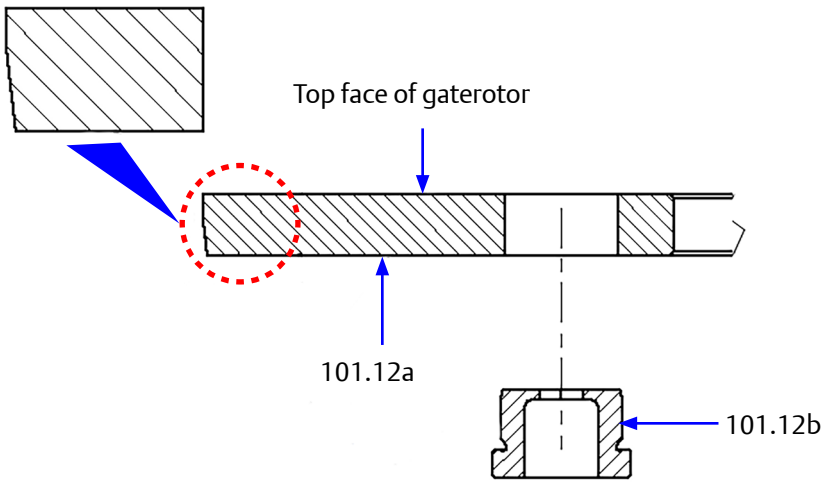


Figure 5-40. Gaterotor Top Face Identification

Gaterotor Ball Bearing Removal

1. Remove bolts (102.4) from the outer retainer (102.3), see Figure 5-41.
2. Remove ball bearing outer retainer (102.3).
3. Using a press, remove ball bearings (102.2) from housing (102.1).

Gaterotor Ball Bearing Installation

1. Install three ball bearings (102.2) in the housing (102.1) so the first two bearings are back to back, and the second and third bearings are face to face (the larger sides of the inner races are placed together, as shown in Figure 5-41). A light application of clean compressor lubricating oil should be used to ease the installation of the bearings into the housing.
2. Center the bearing outer retainer (102.3) on housing (102.1), use Loctite® 242-thread locker and evenly tighten the bolts (102.4) to the recommended torque value (4 lb-ft), see Figure 5-41.

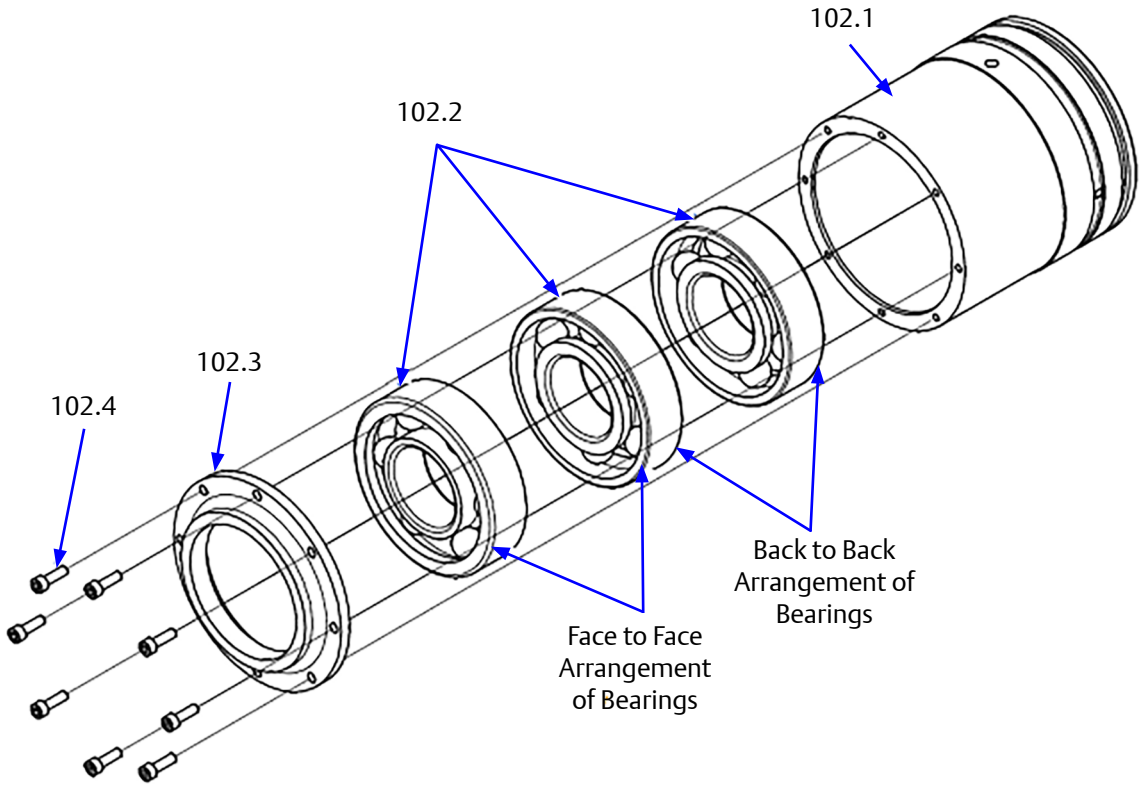


Figure 5-41. Gaterotor Ball Bearing

Gaterotor Roller Bearing Removal

1. Remove the snap ring (107), which retains the roller bearing in the bearing housing, see Figure 5-42.
2. Remove the baffle washer (108) and the roller bearing (101.3b) from the bearing housing (105).
3. Remove the retaining ring (101.2) from the gaterotor support (101.1). Use a bearing puller to remove the roller bearing inner race (101.3a) from the gaterotor support (101.1).

Gaterotor Roller Bearing Installation

1. Match up the part numbers on the inner race and outer race of the bearing (101.3a & 101.3b).
2. Install the outer race (101.3b) into the bearing housing (105). Install baffle washer (108) with inner bevel facing the bearing rollers (101.3b). Install the snap ring retainer (107) in the housing. The bevel on the snap ring must face away from the roller bearing.
3. Heat Roller bearing inner race (101.3a) to 250 °F, then quickly install on gaterotor support (101.1). Once cool, install retaining ring (101.2).

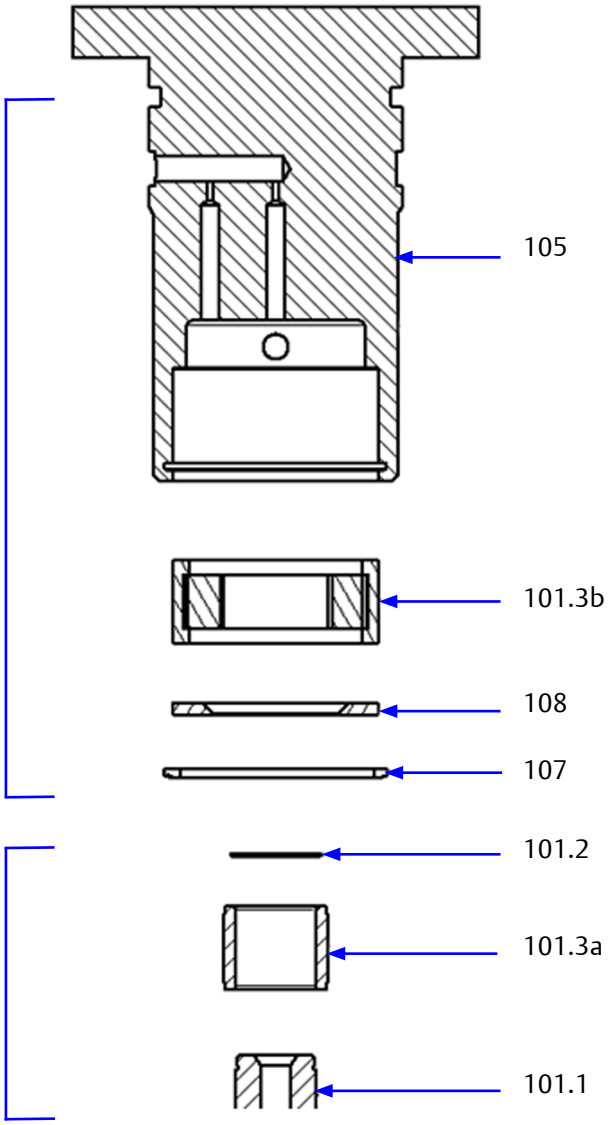


Figure 5-42. Gaterotor Roller Bearing Assembly

Gaterotor Removal (VSG 301-701 Models)

The removal of the gaterotor assembly for the VSG 301-701 compressors is similar for the VSG 901-2101 compressors. The inner races are secured to the stationary bearing spindle.

1. Prepare the compressor for servicing.
2. Remove the upper bolt from the side cover and install a guide stud in the hole. Remove the remaining bolts and side cover. There will be some oil drainage when the cover is removed.
3. The side cover that contains the suction strainer should have the suction line properly supported before the bolts securing the line to the cover can be removed. After the line is removed, the cover can be removed according to Step 2.
4. Turn the main rotor so the driving edge of the groove is between the top of the shelf or slightly below the back of the gaterotor support. At this point install the gaterotor stabilizing tool.
5. Remove plug on the thrust bearing housing. Loosen the socket head cap screw that is located underneath the plug. This secures the inner races of the thrust bearings to the spindle.
6. Remove bolts that hold the thrust bearing housing to the compressor. Insert two of the bolts into the threaded jacking holes to assist in removing the bearing housing from the compressor. When the housing is removed, there will be shims between the spindle and thrust bearings. These control the clearance between the shelf and gaterotor blades. These must be kept with their respective parts for that side of the compressor.
7. Remove the bolts from the roller bearing housing. After the bolts have been removed, the housing can be removed from the compressor.

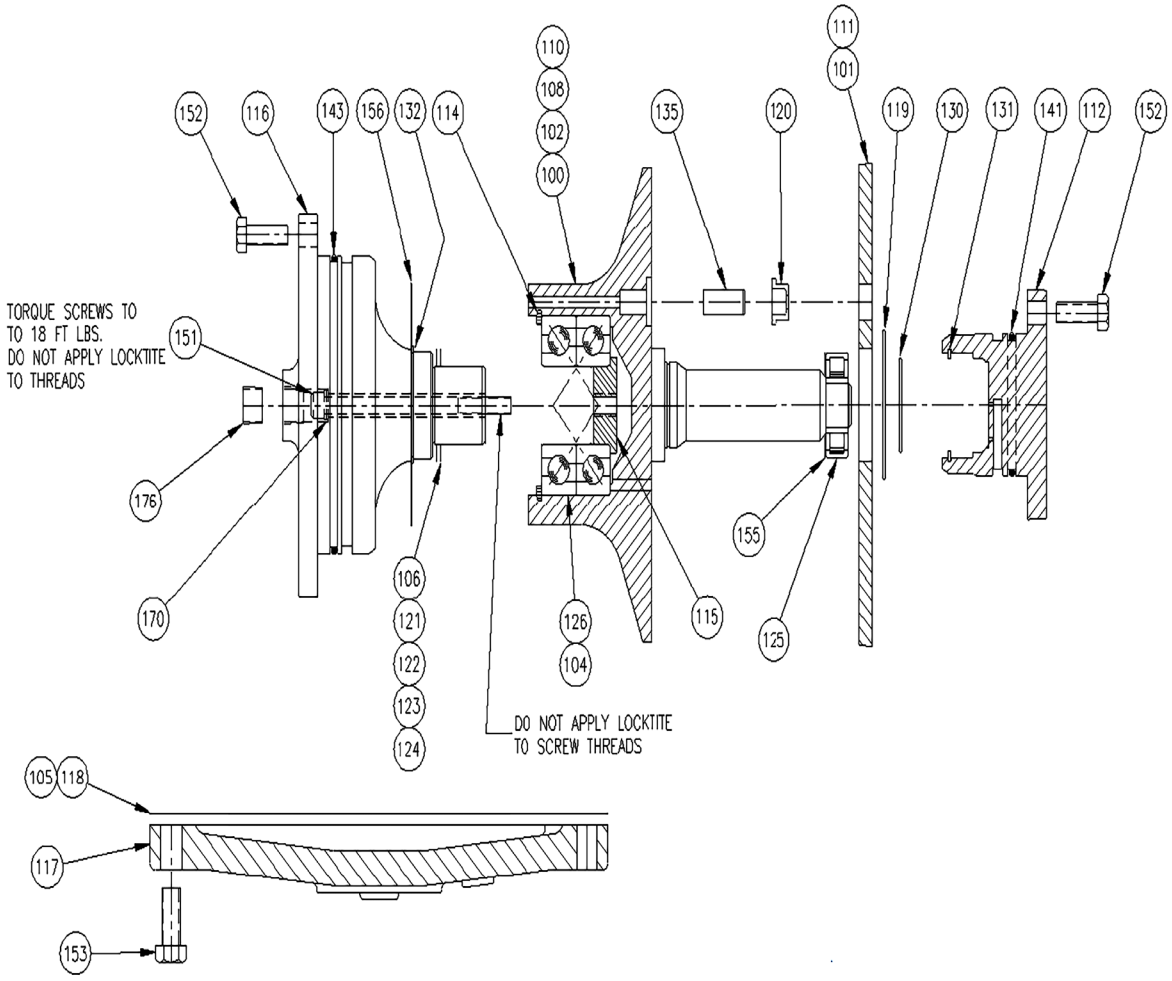


Figure 5-43. Gaterotor Removal (VSG 301-701 Models)

8. To remove the gaterotor support, carefully move the support opposite the direction of rotation and tilt the roller bearing end towards the suction end of the compressor. The compressor input shaft may have to be turned to facilitate the removal of the gaterotor support. On dual gate versions, repeat the procedure for the remaining gaterotor support assembly.

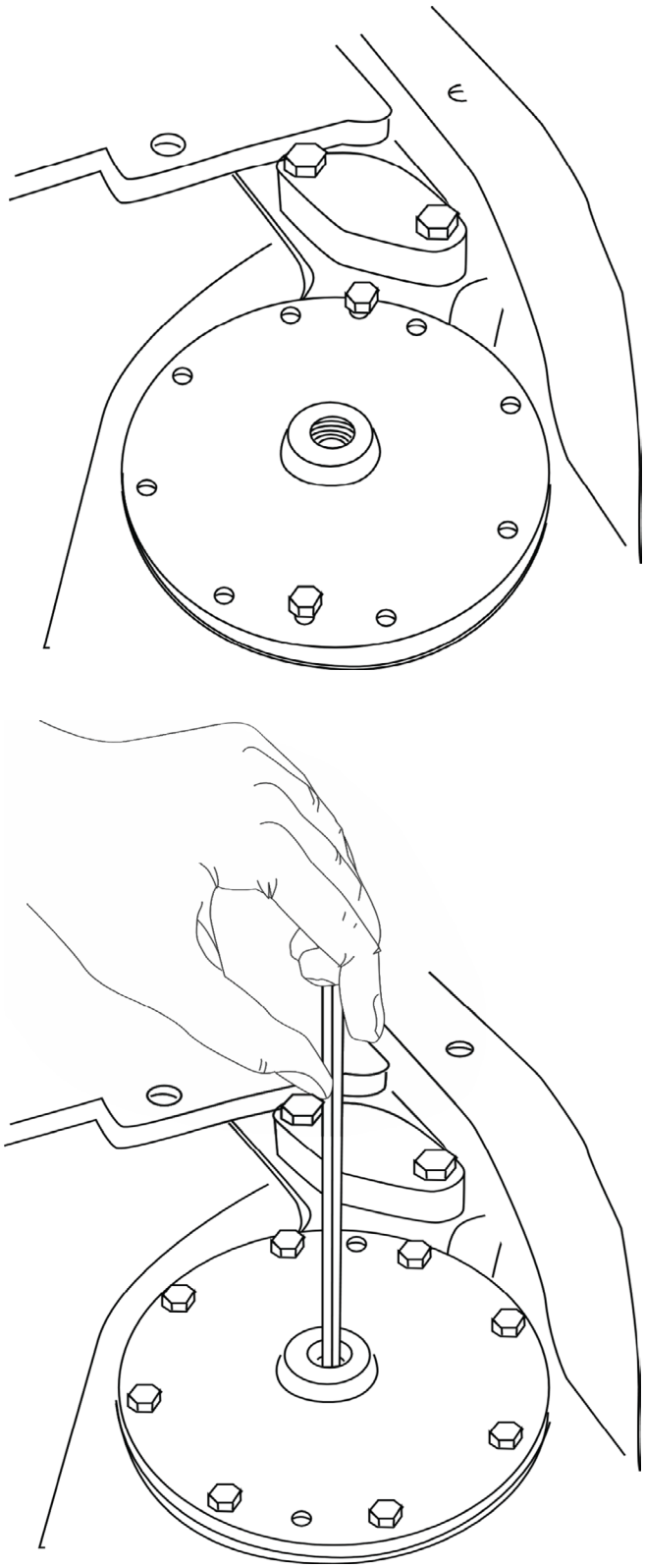


Figure 5-44. Gaterotor Thrust Bearing (VSG 301-701 Models)

Slide Valve Actuator Assembly Replacement

To replace slide valve actuator assembly, proceed with the following steps:

Removal

WARNING

At shutdown, open any other valves that may trap liquids to prevent serious injury and/or damage to equipment.

WARNING

Follow local lock-out/tag-out procedure.

NOTE

This procedure is applicable to both capacity and volume slide valve actuator assemblies.

1. Shut down the compressor unit, refer to Stopping/Restarting procedure in Section 4.
2. Turn disconnect switches to the OFF position for the compressor unit and oil pump motor starter, if equipped.
3. Allow compressor, motor and surrounding components to cool prior to servicing.
4. Disconnect connectors from actuator.

NOTE

Note orientation of components to aid in installation.

5. First remove E-clips, then remove Locking Retainers, next loosen and remove Grooved Bolts and Washer that secure actuator assembly to actuator mount. See Figure 5-45 for parts details.
6. Remove actuator assembly from actuator mount.

Installation

CAUTION

When installing the slide valve actuator assembly, loosen locking collar down the shaft. Do not use a screwdriver to pry locking collar into position.

7. Position actuator assembly on mount as noted in removal.
8. Install washers and grooved bolts to secure actuator assembly to actuator mount, torque them to 6 lb-ft. Then install locking retainers. Last push E-clips into grooved bolt heads. Refer to Actuator Installation Using Anti-Rotation Bolts (see next page) for details.
9. Tighten screws, see Appendix A.

CAUTION

If installing new actuator, do not connect connectors of power cable or position transmitter cable to new actuator once installed. Connecting connectors to new actuator will occur during calibration procedure. Failure to comply may result in damage to equipment.

10. Leave connectors disconnected to actuator assembly.
11. Calibrate actuator assembly, see Slide Valve Calibration procedure in Section 4.

Actuator Installation Using Anti-Rotation Bolts

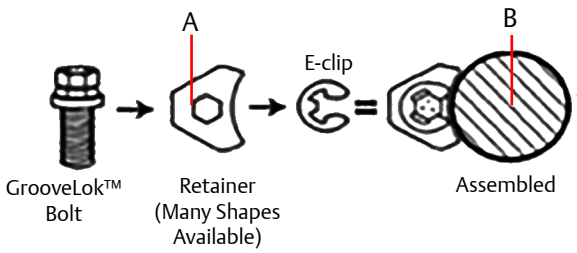
Tools Needed: A 7/16 open wrench or torque wrench with 7/16 crowfoot wrench adapter.

Part #: The parts come with the actuator. Retrofit kit # is 25972R (Includes 4 sets of bolts, washers, retainers & E-clips).

1. Install the Grooved Bolt and Washer and torque them to 6 lb-ft. See Figure 5-45 (a).

NOTE

It may be necessary to adjust the bolt position so that one of the bolt edges is parallel to line A and B, then the retainer will drop-on easily. If required, tighten bolt further for this alignment.

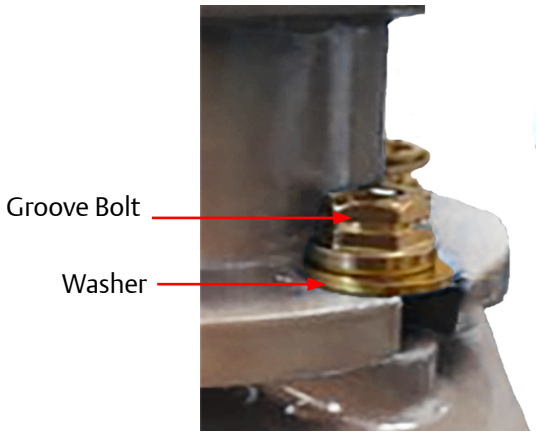


2. Position Locking Retainer over Grooved Bolt, with the shallow curved edge toward the center of the command shaft housing. See Figure 5-45 (b).

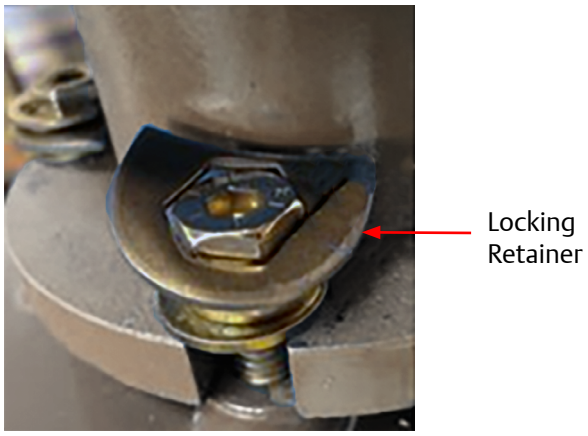
NOTE

The locking retainer hex hole is offset 3° so flipping it over gives it new positioning.

3. Push E-Clip into Grooved Bolt Head. Once E-clip is on make sure it rotates back and forth freely. This will ensure E-Clip is completely seated. See Figure 5-45 (c).



(a) Groove bolt and washer



(b) Locking Retainer

(C) E-clip

Figure 5-45. Actuator Installation Using Anti-Rotation Bolts

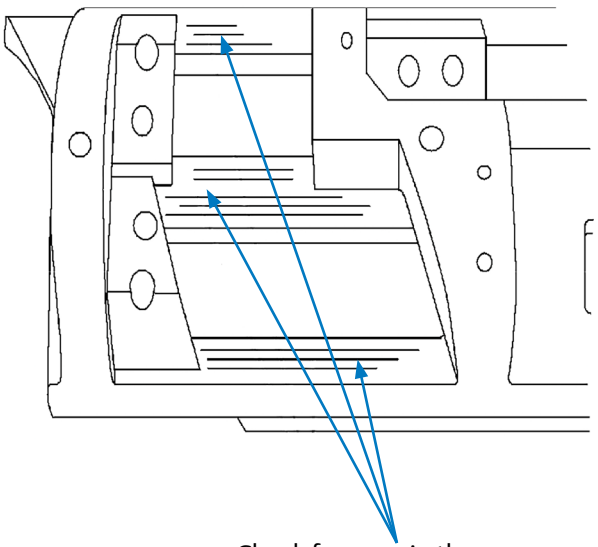
Inspection of Slide Valve Assemblies In The Compressor

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

Prepare The Compressor For Servicing

1. Remove the gaterotor access covers. Using a mirror and flashlight, visually inspect the slide valve carriage through the gas bypass opening. Look for any significant signs of wear on the slide valve carriage
2. To check the clearance of the slide valve clamps, the gaterotor support must be removed. Refer to removal of the gaterotor support.
3. Using a feeler gauge, inspect the clearance between capacity and volume slide valve clamps and slide valve carriage through the gas bypass opening. The clearance should be less than 0.002".
4. If the slide valves are worn in excess of the tolerances, the Vilter factory should be contacted.



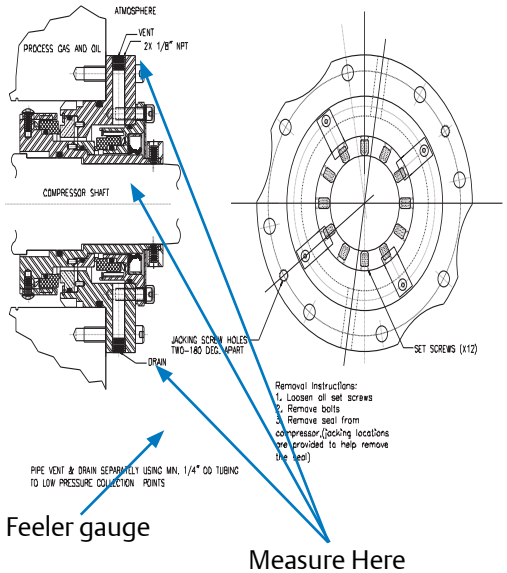
Check for wear in these areas.

Removal of Slide Valve Carriage Assemblies

1. Prepare the compressor for servicing.
2. If only one of the slide valve carriages is removed, only the corresponding gaterotor support needs to be removed. If both carriages are removed, both gaterotors must be removed. Remove the gaterotor assemblies.
3. Remove the capacity and volume actuators. Remove the discharge manifold, capacity and volume cross shafts and the slide valve racks.
4. Locate and remove the socket head plugs above the slide valve carriage attachment bolts. Remove the bolts located under the plugs.
5. The slide valve carriage may now be removed. On newer carriages there is a threaded hole in the back of the slide valve carriage to aid in its removal. Use a threaded tip slide hammer to aid in the removal of the carriage.

NOTE

Slide Valves may be re-positioned to aid in removal of assembly.



Feeler gauge

Measure Here

Installation of Slide Valve Carriage Assemblies

1. Position the slide valves to the center of the carriage. Place the slide valve assembly in the bore of frame and use the slide hammer to slowly tap the carriage into position. Re-positioning slide valves once inside bore may aid installation. Adjust the carriage so that the 3-holes line up.
2. Install the 3 socket head cap screws with new Nord-Lock washers beneath the heads, but do not tighten them.
3. Work a piece of 0.005 shim stock between the slide valves and the main rotor to help position the carriage. See Figure 5-46.
4. Tighten, to the correct torque, the hold down bolts to secure the carriage in the frame. The edges of the slide valves themselves should be at or slightly below the main rotor bore.
5. Re- Install the capacity and volume slide valve cross shafts, slide valve racks and discharge manifold.
6. Re-install the gaterotor assemblies.

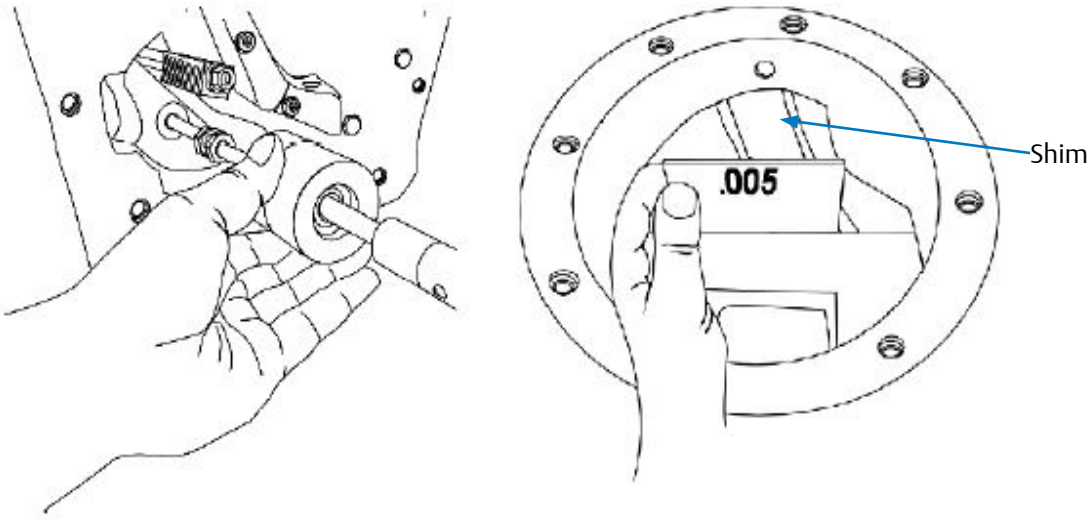


Figure 5-46. Installation of Slide Valve Carriage Assembly

Slide Valve Command Shaft Assembly Replacement

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

Removal

NOTE

The following steps can be used to remove or install either the capacity or volume command shaft assemblies.

1. Shut down and isolate compressor unit, see Compressor Unit Shutdown and Isolation procedure.
2. Remove actuator, see Actuator Assembly Replacement procedure.
3. Remove four socket head cap screws (457) and Nord-Lock washers (477) securing the command shaft assembly to the discharge manifold.
4. The command shaft and mounting plate may now be removed from the compressor.

Installation

5. Install a new O-ring (446) into the groove on the compressor discharge manifold. You may use clean compressor lubricating oil on the O-ring.
6. Install the command shaft onto the compressor discharge manifold. Ensure that the command shaft tongue is engaged in the cross-shaft slot inside the compressor discharge manifold. Rotate the command shaft assembly so that the vent holes point downward. This will prevent water and dust from entering the vent.
7. Secure the command shaft assembly to the discharge manifold using the four socket head cap screws and Nord-Lock washers and apply the proper torque.
8. Perform leak check, see Compressor Unit Leak Check procedure.

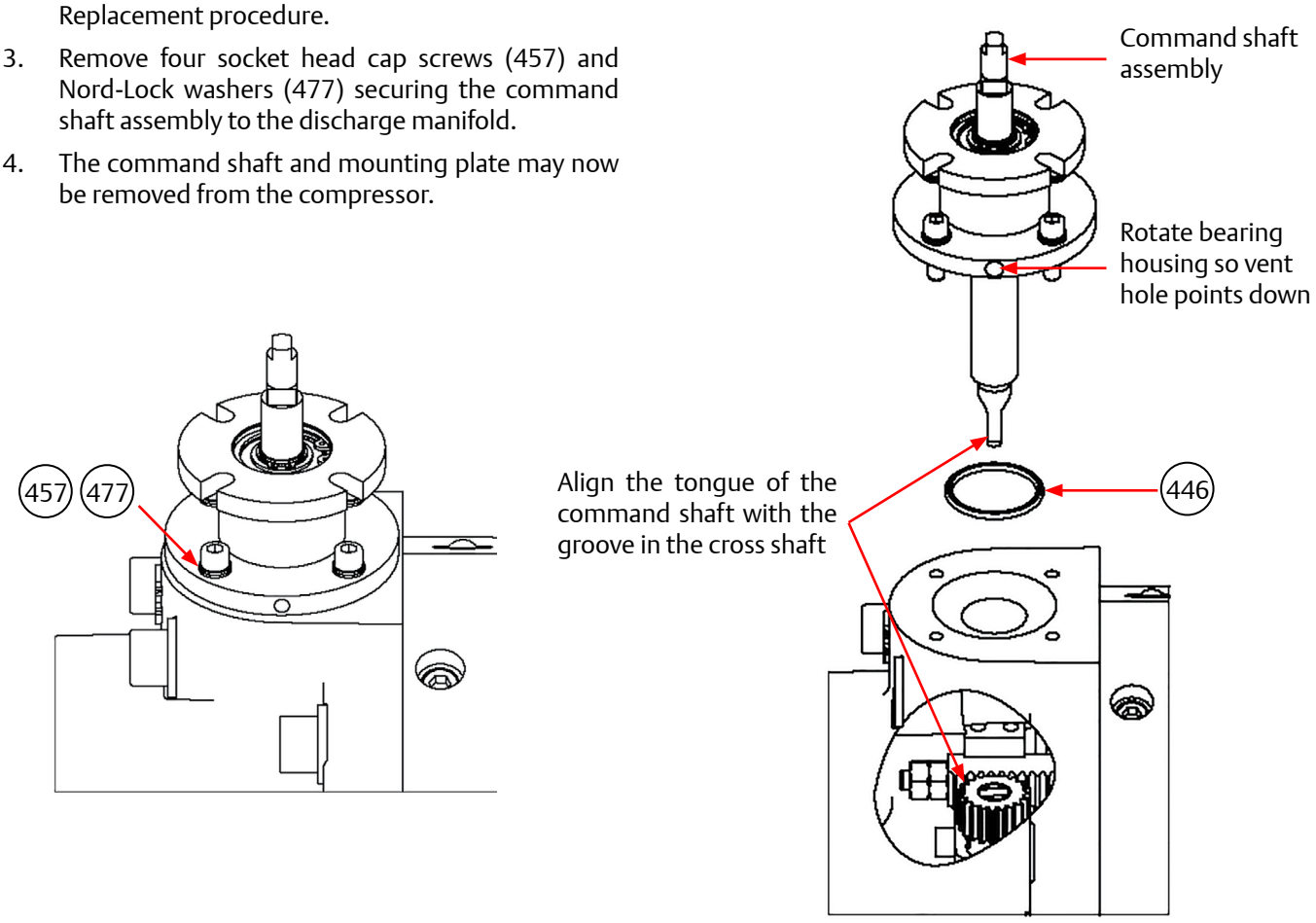


Figure 5-47. Command Shaft Assembly Replacement

Discharge Manifold Removal

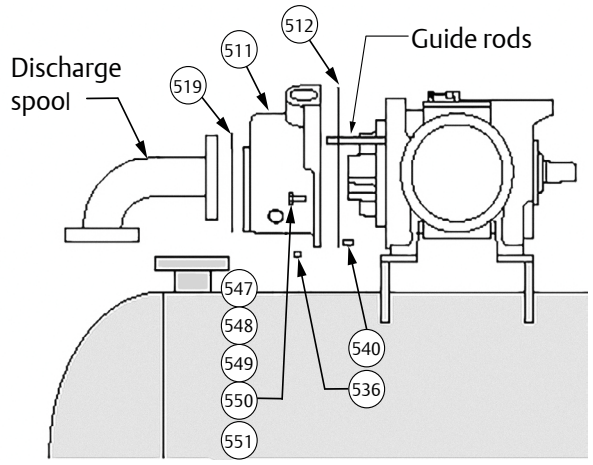
WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

1. Remove both control actuators and command shaft assemblies.
2. On VSG 751-2101 and VSSG 291-601 compressors, remove the discharge spool between the manifold and separator. Remove one bolt from each side of the discharge manifold and install (2) guide rods approximately 6" long, to support the manifold. Remove the remaining bolts (note length and location of bolts) and take off the discharge manifold.

NOTE

The manifold has dowel pins to locate it on the compressor housing. Therefore, remove manifold straight back approximately 1" as not to break dowel pins.



NOTE

When removing the discharge manifold on VSG 301-701 compressor the compressor must be properly supported to keep the compressor from moving when the manifold is removed.

3. On VSG 301-701 compressors, unbolt the discharge flange from the discharge manifold.
4. Remove one bolt from each side of the discharge manifold and install (2) guide rods approximately 6" long, to support the manifold. Remove the remaining bolts (note length and location of bolts) and take off the discharge manifold.

Discharge Manifold Installation

5. Install (2) guide rods to position the discharge manifold. Install a new manifold gasket and the discharge manifold. Install the dowel pins and bolts, tighten manifold bolts to the recommended torque value.
6. On VSG 751-2101 and VSSG 291-601 compressors, install the discharge spool or elbow between the discharge manifold and oil separator with new gaskets. When installing the discharge elbow tighten the bolts to the correct torque on the manifold flange first before tightening the separator flange bolts. Install the drain plug in the bottom of the discharge manifold.
7. On VSG 301-701 compressors install the bolts in the discharge flange. Install the drain plug in the bottom of the discharge manifold.
8. Install both command shaft assemblies and control actuators.

Compressor Shaft Seal Replacement

Shaft Seal Assembly

The shaft seal is made up of a mating ring and a carbon or silicon carbide (SC) component.

The mating ring is the rotating part of the seal and is installed against the shaft shoulder. It has a drive notch on one end which aligns with the drive pin inserted in the shaft.

Carbon or SC component is the stationary part of the seal and is installed into the shaft seal housing using an O-ring.

The shaft seal housing with the stationary part is assembled in the compressor main housing using an O-ring, see Figure 5-48.

The shaft seal needs to be carefully handled and installed to function properly. See Figure 5-49 for details.

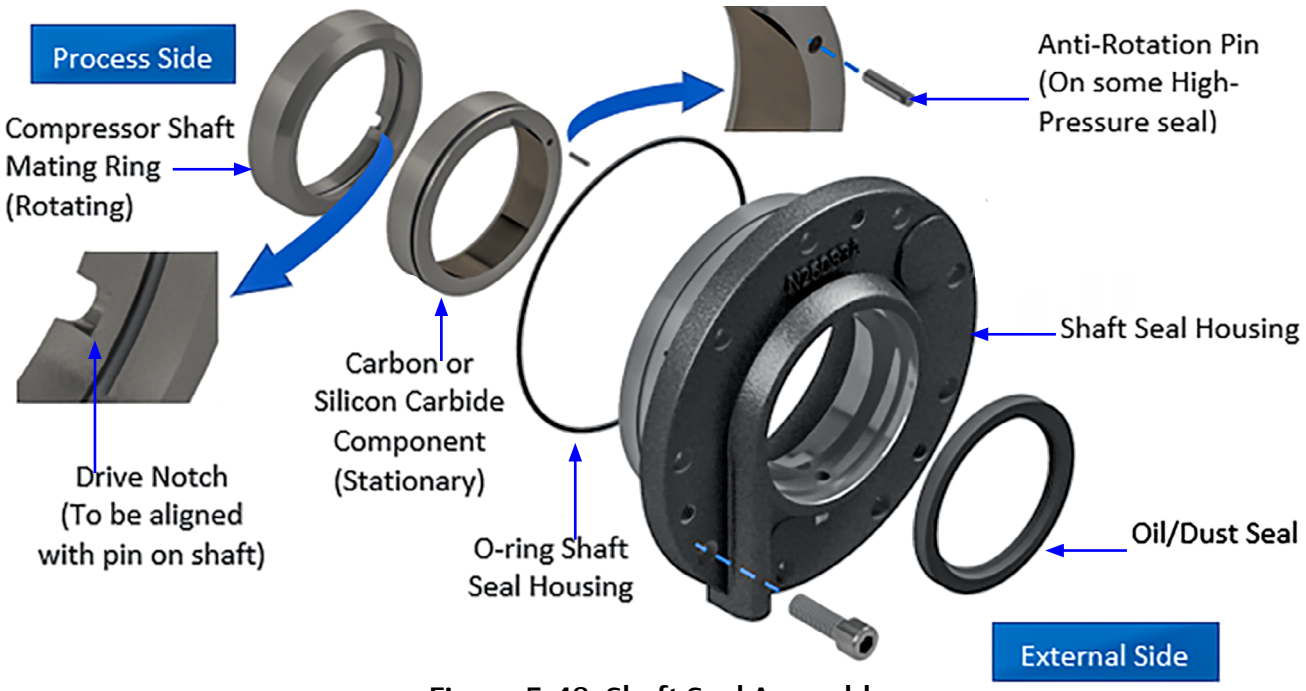


Figure 5-48. Shaft Seal Assembly

Handling Seal Face with Care

- Avoid touching seal faces as much as possible during installation.
- Be sure to always keep seal faces face-up, rather than face-down, see image on the right.

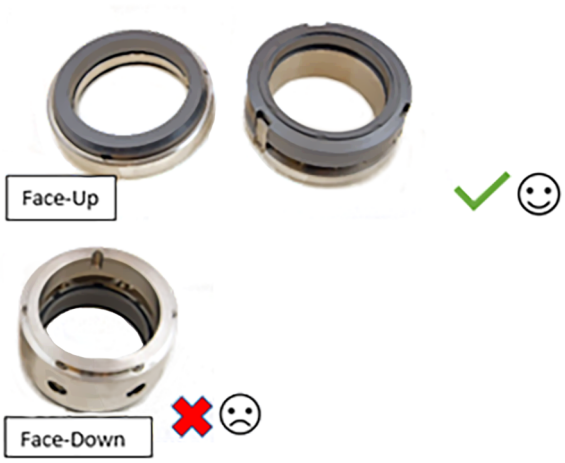


Figure 5-49. Handling Seal Face with Care

Compressor Shaft Seal Replacement (All VSG Models Except VSG 128 - 243)

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

Removal

1. Remove bolts (281) securing shaft seal housing (218) to compressor (see Figure 5-50).

NOTE

There will be a small amount of oil drainage as the shaft seal housing is removed.

2. Insert two bolts (281) into threaded jacking holes to assist in removing shaft seal housing (218).
3. Remove mating ring (219C) from compressor shaft.
4. Remove oil seal (230) from shaft seal housing (218).
5. Using a brass drift and hammer, tap out cup assembly (219B) from the back side of shaft seal housing (218).
6. Remove O-ring (260).

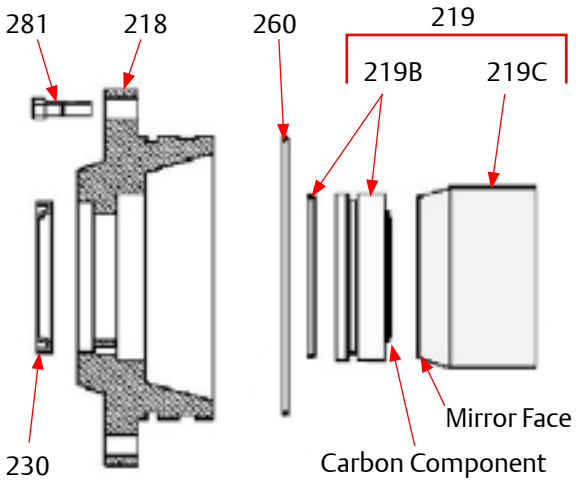


Figure 5-50. Compressor Shaft Seal Assembly

Installation

CAUTION

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-49 for handling seal faces with care. Do not touch the carbon component of the cup assembly or mirror face on the mating ring as body oil and sweat will cause corrosion.

NOTE

On VSSG 291-601 and VSG 128-243 compressors equipped with a Anti-rotation pin in the shaft seal housing, when replacing the cup assembly (219B) the Anti-rotation pin in the housing must be removed. See Figure 5-53.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

1. Install new oil seal (230) in housing (218).
2. To install the carbon cartridge part of the seal in the seal housing: clean inside shaft seal housing (218) where cup assembly (219B) meets inside shaft seal housing.
3. If applicable, remove protective plastic from cup assembly (219B). **DO NOT** wipe or touch carbon component of cup assembly.
4. If carbon component of cup assembly (219B) needs cleaning, use alcohol and a lint-free cloth to clean.
5. Apply clean compressor lubricating oil to O-ring on cup assembly (219B).
6. If applicable, align the hole on the back of the carbon cartridge with the Anti-rotation in the seal housing. Using shaft seal tool or similar, install cup assembly (219B) in shaft seal housing (218).

Follow these steps to verify the integrity of a shaft seal:

7. Check lead chamfer and outer diameter of shaft for deep scratches that may potentially damage the O-ring on the inner diameter of the shaft seal, see Figure 5-52.

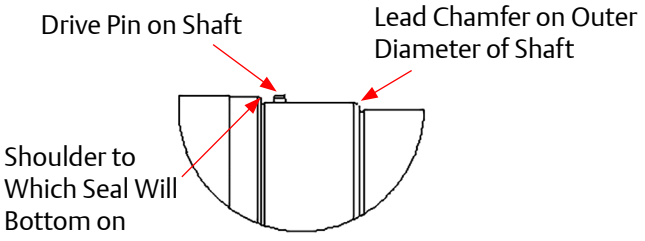


Figure 5-51. Shaft with Pin

8. Check lead chamfer and inner diameter of shaft seal housing for burrs and/or deep scratches that may potentially damage the O-ring on the outer diameter of the shaft seal, see Figure 5-53.
9. For shaft seal 25985R and 25985T, shim 24022A needs to be assembled in shaft seal housing before shaft seal. To assemble the shim, align the slot on it with the anti-rotation pin during installation. Visually verify that the back of the shim is abutted against the shaft seal housing, see Figure 5-53.
10. Clean compressor shaft and shaft seal cavity in compressor housing.
11. Apply clean compressor lubricating oil to mating ring (219C) seating area on compressor shaft.
12. Apply clean compressor lubricating oil to inside area of mating ring (219C). See Figure 5-53.

IMPORTANT

DO NOT wipe or touch the face of the mating ring (219C) where face meets the carbon component of the cup assembly (219B).

Table 5-7. Shaft Seals with Anti-Rotation Pins

Shaft Seal	Pressure (PSI)		O-ring Material
	Static	Dynamic	
25985Y	1800	1350	Aflas
25985T	1200	600	Viton
25985R	1200	600	Aflas
25985W	1800	1350	Fluoroelastomer

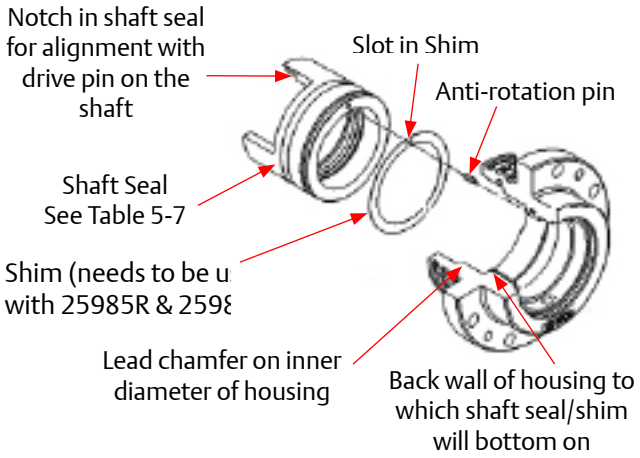


Figure 5-52. Shaft Seal and Its Housing

CAUTION

Ensure the mating ring (219C) is fully seated against the shoulder of the compressor shaft. If the mating ring is not fully seated against the shoulder, the carbon component of the cup assembly (219B) will be damaged when the shaft seal housing (218) is installed. See Figure 5-54.

13. Align slot in mating ring (219C) with drive pin on compressor shaft. Carefully push mating ring on while holding onto outside area of mating ring until mating ring is fully seated against shoulder on compressor shaft. See Figure 5-54.
14. Install a new O-ring (260) on the seal housing (218), making sure the O-ring is placed in the O-ring groove and not the oil gallery groove. Lubricate both seal faces with clean compressor lubricating oil. See Figure 5-53.
15. Carefully install the seal housing (218) on the compressor shaft, evenly tightening the bolts to the recommended torque values.
16. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

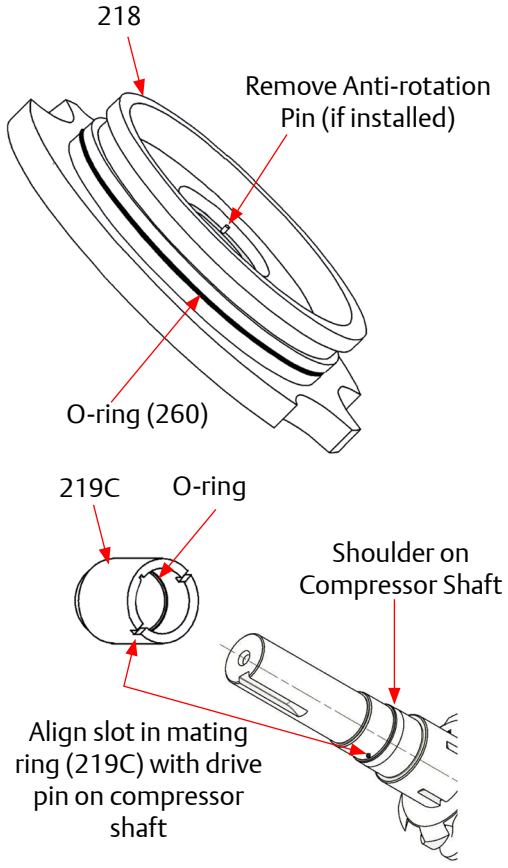


Figure 5-53. Compressor Shaft Seal Installation

Shaft Seal Removal - For Model 25985Y

(See Table 5-7 and Figure 5-54)

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

There will be a small amount of oil drainage as the shaft seal housing is removed.

1. Remove bolts (281) securing shaft seal housing (218) to compressor.
2. Insert two bolts (281) into threaded jacking holes to assist in removing shaft seal housing (218).
3. Remove silicon carbide rotating face (219.6) & O-ring (219.7) from shaft.
4. Remove spring holder (219.8) from shaft.
5. Remove oil seal (230) from shaft seal housing (218).
6. Remove retaining ring (219.5) from seal housing.
7. Flip the seal housing over and carefully tap the stationary silicon carbide piece (219.3), retainer (219.4), and O-ring (219.2) out of the seal housing using brass drift and hammer.
8. Remove O-ring (260).

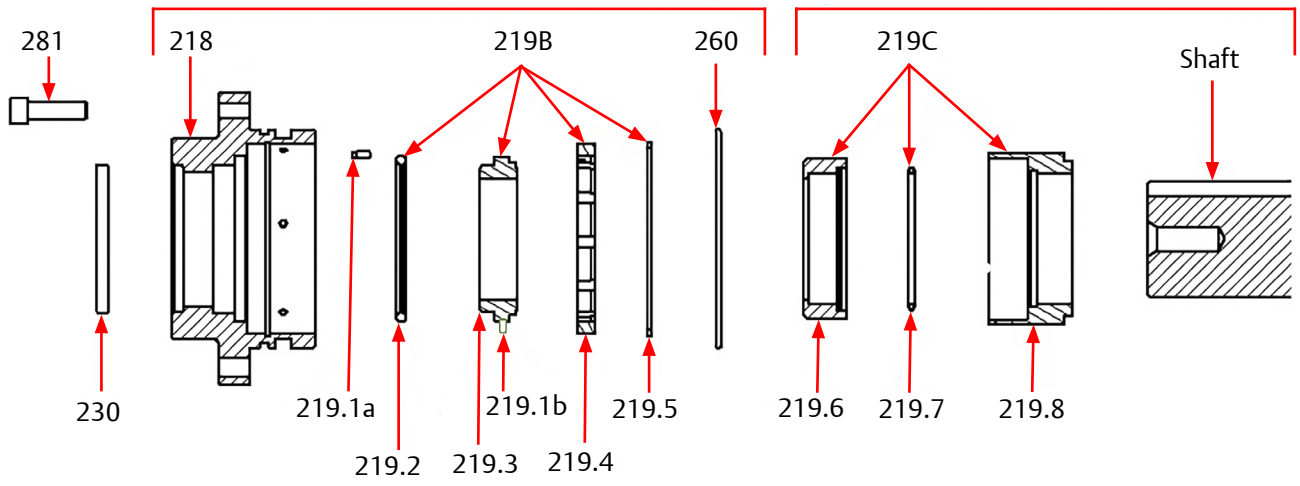


Figure 5-54. Shaft Seal Breakdown (25985Y Model)

Shaft Seal Removal – For Part# 25985W

(See Table 5-7 and Figure 5-55)

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

There will be a small amount of oil drainage as the shaft seal housing is removed.

1. Prepare compressor for disassembly (standard nomenclature from other area of manual.
2. Loosen and remove screws (281) mounting shaft seal housing (218) to main compressor housing.
3. Carefully thread three screws (281) into the jacking holes in the shaft seal housing (218) to push it out of the main compressor housing. Do not go more than one-half turn on any screw at a time.
4. Once the shaft seal housing (218) has been removed from the compressor housing, loosen the 4 small socket cap screws (303) holding the shaft seal retainer (304) to the shaft seal housing (218).
5. Using a hammer and punch, carefully tap the seal cartridge (305) out of the shaft seal housing (218).
6. Remove oil seal (230) from shaft seal housing (218).
7. Remove the O-ring (260) from the shaft seal housing (218).
8. The rotating assembly (219C) can be firmly pulled off the compressor shaft as one assembly. Be sure to note the location of the drive pin in the main compressor shaft for re-assembly. See Figure 5-53.

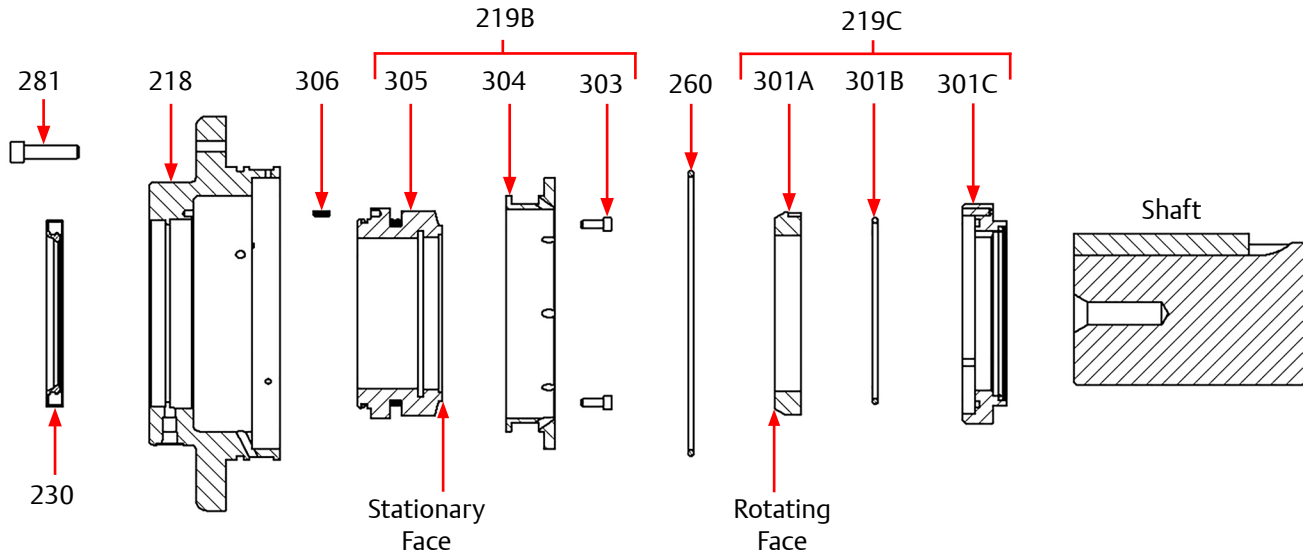


Figure 5-55. Shaft Seal Breakdown (25985W Only)

Prior To Shaft Seal Installation (For 25985Y and 25985W Shaft Seal Models)

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-49 for Handling Seal Face with Care.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

Follow these steps to verify the integrity of a shaft seal:

1. Check lead chamfer and outer diameter of shaft for deep scratches that may potentially damage the O-ring on the inner diameter of the shaft seal, see Figure 5-51.
2. Check lead chamfer and inner diameter of shaft seal housing for burrs and/or deep scratches that may potentially damage the O-ring on the outer diameter of the shaft seal, see Figure 5-56.
3. For shaft seals 25985R and 25985T, shim 24022A needs to be assembled in shaft seal housing before shaft seal. To assemble the shim, align the slot on it with the anti-rotation pin during installation. Visually verify that the back of the shim is abutted against the shaft seal housing, see Figure 5-56.
4. Clean compressor shaft and shaft seal cavity in compressor housing.
5. Apply clean compressor lubricating oil to the compressor shaft in mating ring seating area, see Figure 5-57.

Once these steps have been performed, the installation procedure will depend on the shaft seal model of the compressor, so check the Section relevant to yours.

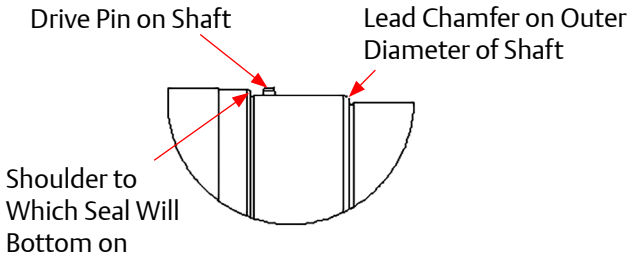


Figure 5-51. Shaft with Pin

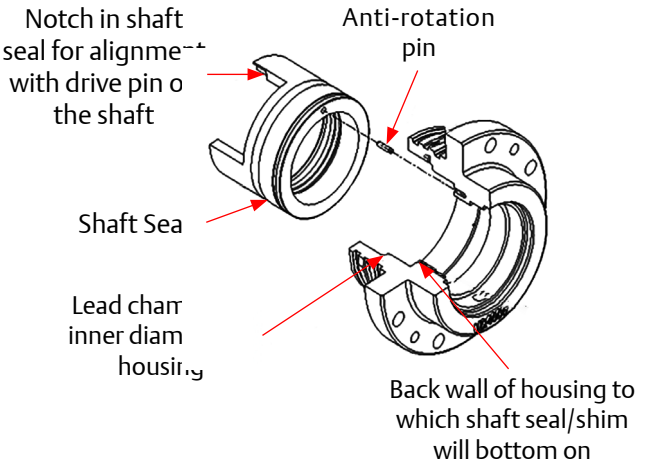


Figure 5-56. Shaft Seal Housing

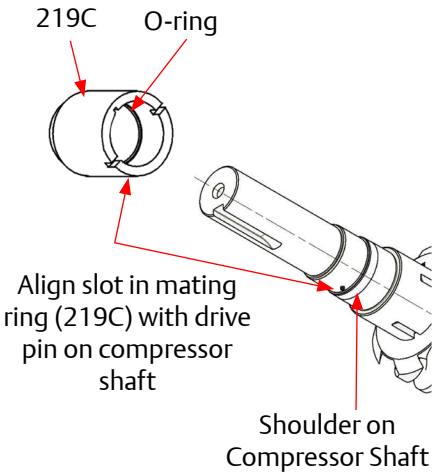


Figure 5-57. The Alignment of Compressor Shaft and Mating Ring

Shaft Seal Installation - For Model 25985Y

(See Table 5-7 and Figure 5-54)

NOTE

Follow the "Prior to Shaft Seal Installation" steps before starting this procedure.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-49 for Handling Seal Face with Care.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

CAUTION

Do not wipe or touch the face of the mating ring (219C) where the face meets the carbon component of the stationary assembly (219B).

1. Apply clean compressor lubricating oil to inside area of spring holder (219.8), rotating Silicon carbide piece (219.6) and O-ring (219.7).
2. Carefully fit spring holder (219.8) onto shaft until it is fully seated against shoulder on compressor shaft. Be sure to align slot in spring holder (219.8) with drive pin on compressor shaft, see Figure 5-53.

CAUTION

Ensure the spring holder (219.8) is fully seated against the shoulder of the compressor shaft. If the spring holder (219.8) is not fully seated against the shoulder, the carbon component of the stationary assembly (219B) will be damaged when the shaft seal housing (218) is installed.

3. Place O-ring (219.7) inside rotating silicon carbide piece (219.6) and carefully assemble onto shaft. You should feel some resistance in sliding this onto the shaft shoulder.
4. Install a new oil seal (230) in seal housing (218).
5. If necessary, Install anti-rotation pin (219.1a) in hole in shaft seal housing (218).
6. Install O-ring (219.2) into shaft seal housing.
7. Install stationary silicon carbide piece (219.3) in shaft seal housing with anti-rotation pin (219.1b) aligned 180 degrees away from the pin (219.1a) in Step 4. You should feel some resistance to fit the stationary piece into the O-ring.
8. Fit the retainer (219.4) over the stationary piece while aligning the slots on the anti-rotation pins.
9. Install retaining ring (219.5) into groove in shaft seal housing.
10. Install a new O-ring (260) on the seal housing (218), making sure the O-ring is placed in the O-ring groove and not the oil gallery groove. Lubricate both seal faces with clean compressor lubricating oil.
11. Carefully install the seal housing (218) on the compressor shaft, evenly tightening the bolts (281) to the recommended torque values (36 ft-lbs.).
12. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

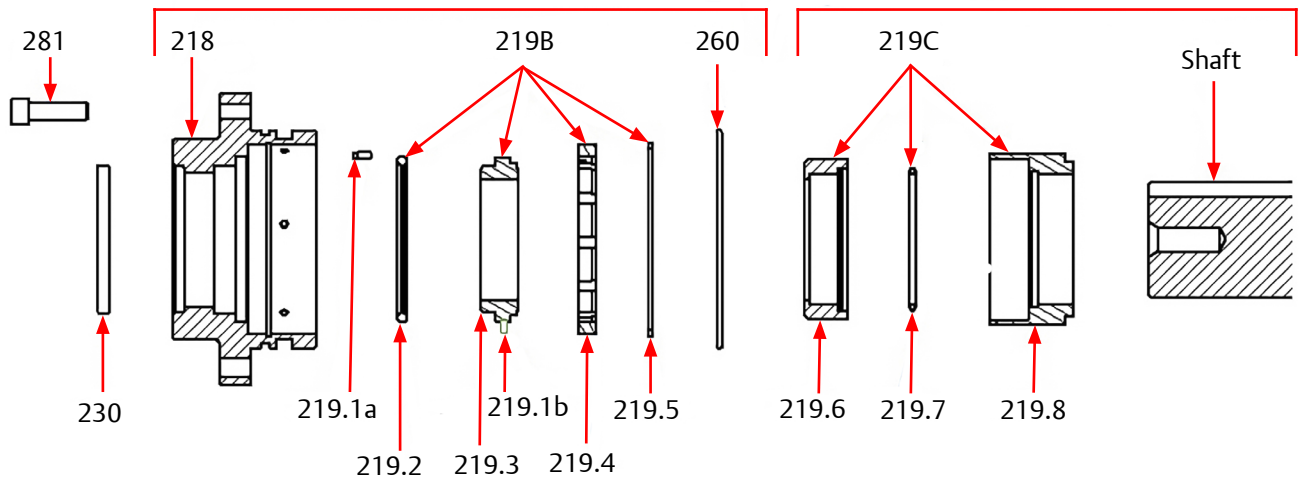


Figure 5-54. Shaft Seal Breakdown (25985Y Model)

Shaft Seal Installation – For Part# 25985W

(See Table 5-7 and Figure 5-55)

NOTE

Follow the "Prior to Shaft Seal Installation" steps before starting this procedure.

WARNING

Follow local lock-out/tag-out procedure. Compressors must be depressurized before attempting to do any work on them. Failure to comply may result in serious injury, death and/or damage to equipment.

NOTE

Care must be taken when handling the cup assembly and mating ring when installing. See Figure 5-49 for Handling Seal Face with Care.

Suggestion

A spray bottle filled with clean compressor oil may be used to lubricate the faces of the seals without touching the seal.

CAUTION

Do not wipe or touch the face of the mating ring (219C) where the face meets the carbon component of the stationary assembly (219B).

1. Install a new oil seal (230) in seal housing (218).
2. Ensure compressor shaft is clean and free from marks and scratches.
3. Remove seal rotating face (301A) and O-ring (301B) from rotating assembly portion of the seal (assembly 219C).
4. Apply clean compressor lubricating oil to seal seating area on the compressor shaft and inside area of rotating face support (301C).
5. Gently assemble the rotating face support (301C) onto main compressor shaft, taking care to align the drive pin in the main shaft with the keyway on the rotating face support (301C).
6. Using a small amount of Flowserve supplied grease, carefully re-assemble O-ring (301B) and rotating face (301A) over the compressor shaft, onto the rotating face support (301C).
7. Moving onto the stationary portion of the seal (219B), gently press the stationary face (305), into the seal housing (218) ensuring it is fully seated. Make sure to align the hole on the back of the stationary face (305) with the Anti-rotation pin (306) in the seal housing (218). See Figure 5-56.
8. Assemble retaining ring (304) over the seal into the shaft seal housing (218), aligning the mounting holes with the threaded holes in the shaft seal housing.
9. Apply blue Loctite 242 to the bolts (303) and tighten them down evenly in a star pattern until snug, then torqueing each to 48 in-lbs (6 N-m).
10. Apply clean compressor lubricating oil to both seal faces (305 and 219C).
11. Ensure a new O-ring (260) is installed in proper groove of shaft seal housing (218).
12. Carefully assemble shaft seal housing (218) onto main compressor shaft into main compressor housing, evenly tightening the bolts (281) and torqueing to their appropriate value as specified by compressor specific drawing.
13. Install the coupling and coupling guard. The unit can then be evacuated and leak checked.

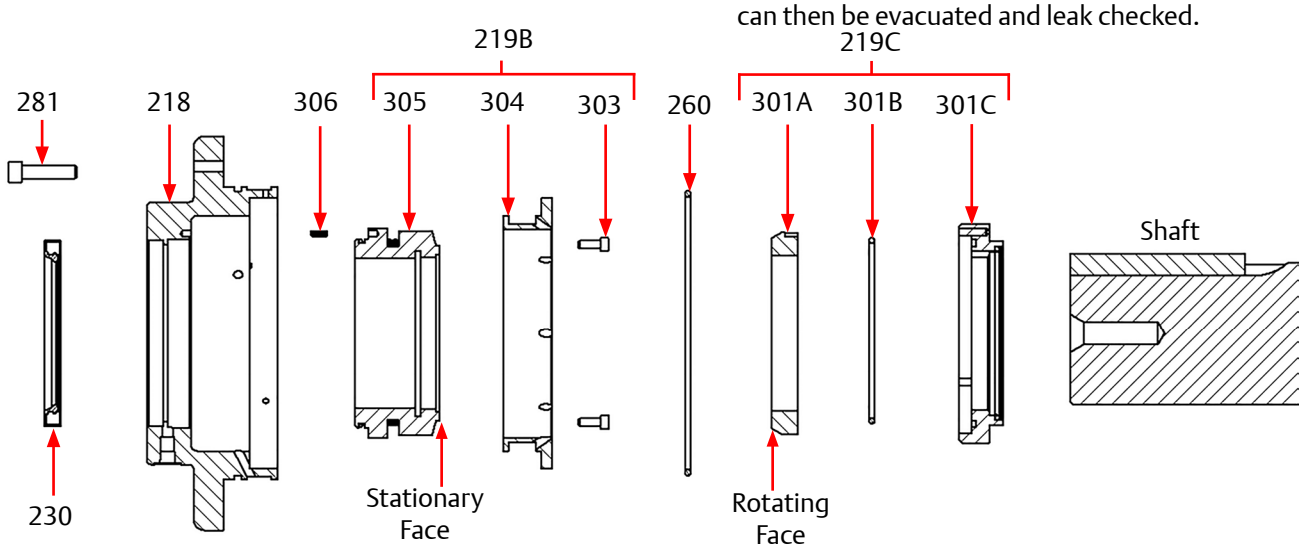


Figure 5-55. Shaft Seal Breakdown (25985W Only)

Installation of Slide Valve Carriage Assemblies

1. Position the slide valves to the center of the carriage. Place the slide valve assembly in the bore of frame and use the slide hammer to slowly tap the carriage into position. Re-positioning slide valves once inside bore may aid installation. Adjust the carriage so that the 3-holes line up.
2. Install the 3 socket head cap screws with new Nord-Lock washers beneath the heads, but do not tighten them.
3. Work a piece of 0.005" shim stock between the slide valves and the main rotor to help position the carriage.
4. Tighten, to the correct torque the hold down bolts to secure the carriage in the frame. The edges of the slide valves themselves should be at or slightly below the main rotor bore.
5. Re-install the capacity and volume slide valve cross shafts, slide valve racks and discharge manifold.
6. Re-install the gaterotor assemblies.

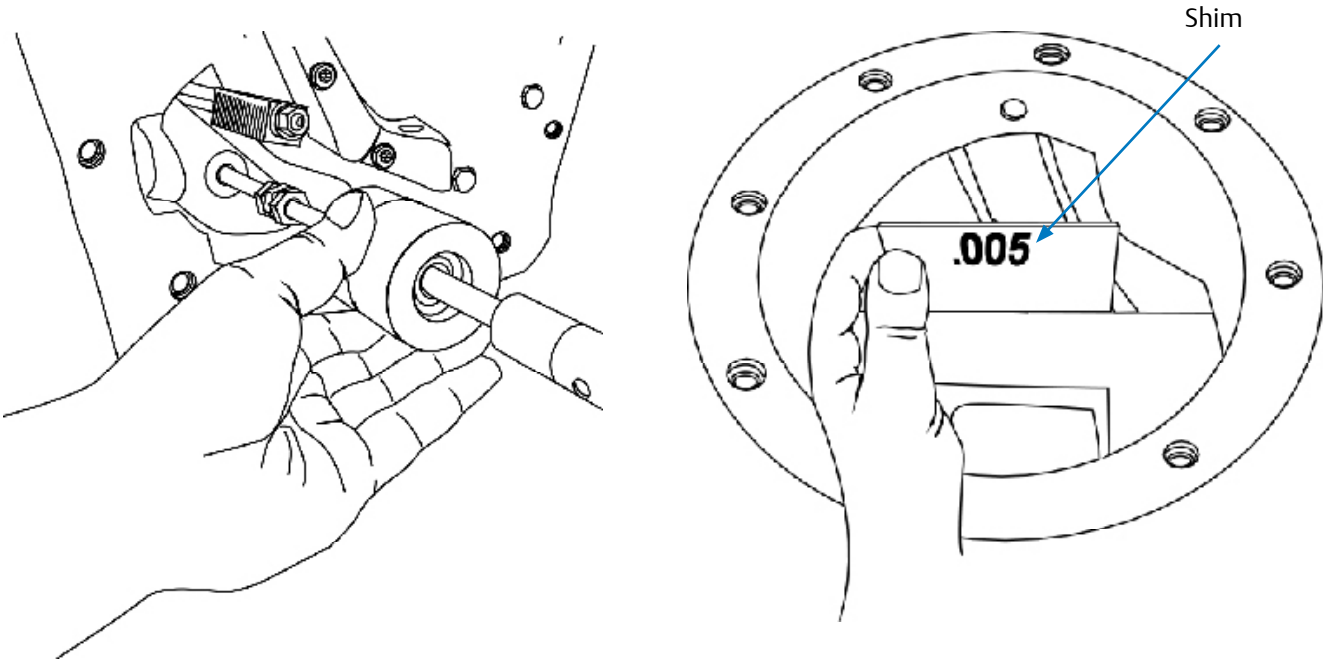


Figure 5-46. Installation of Slide Valve Carriage Assembly

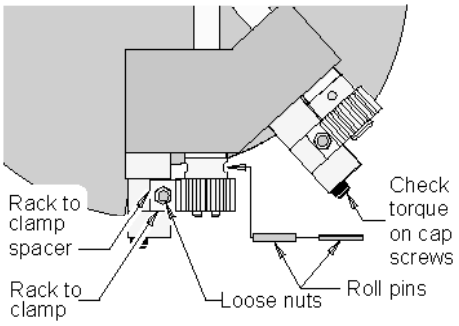
Slide Valve Gear and Rack Inspection

1. Remove the discharge manifold.
2. Check rack to rack clamp and rack clamp spacer clearance on all four slide valves.

Table 5-8. Rack Clearance Values

Measurement	Clearance
Rack to clamp	0.005" to 0.010"
Rack to clamp spacer	0.003" to 0.005"

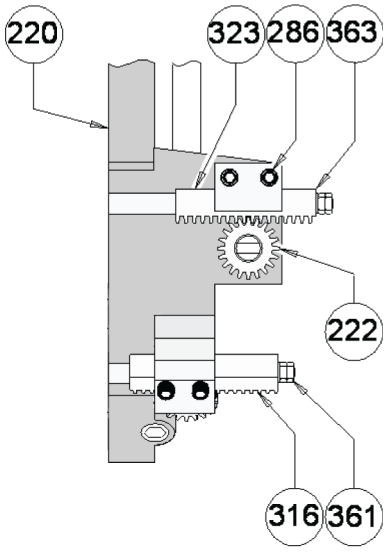
3. Check torque of socket heat cap screws.
4. Check for excessive movement between the slide valve rack shafts and the rack. The jam nuts on the end of the slide valve rack shaft should be tight.
5. Check for loose or broken roll pins in gears.



6. Look for any excessive wear on all moving parts and replace the worn parts.
7. Reassemble the manifold and discharge elbow.

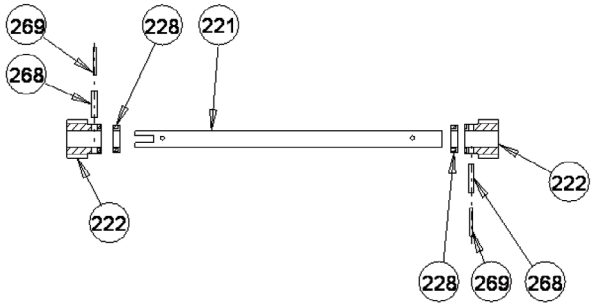
Removal of Capacity or Volume Cross Shafts

1. Remove the discharge manifold.
2. To remove the capacity or volume ratio slide valve racks, remove the two jam nuts and lock washers (361) securing the rack (316) to the slide valve shafts. The racks can now be pulled off the slide valve shafts. Repeat the procedure for the remaining pair of slide valve racks.

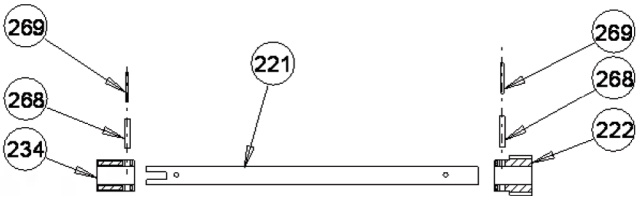


3. To remove the cross shafts, remove socket head bolts, clamp and spacers from both sides.

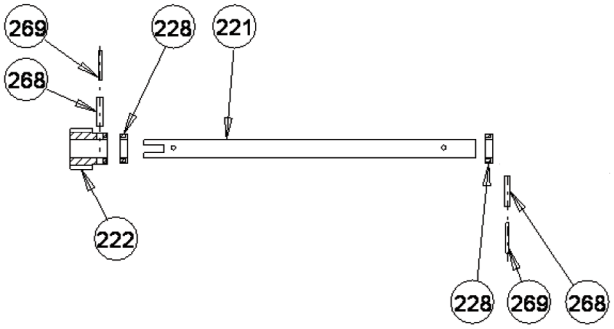
VSG 751-2101 Compressors Cross Shafts



VSSG 291-601 Compressors Cross Shafts
Volume Control Cross Shaft



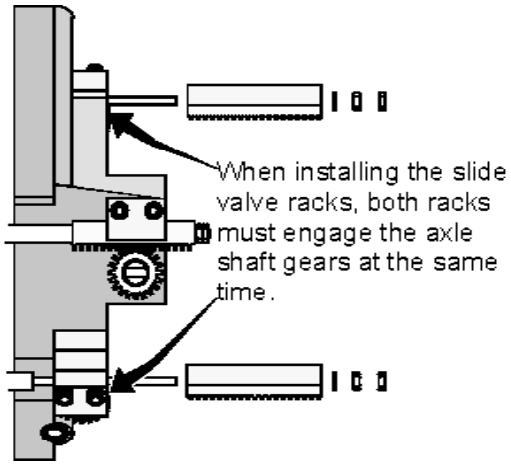
Capacity Control Cross Shaft



4. Drive the roll pins from pinion gear from one side. Remove pinion gear. Slide the cross shaft with the remaining pinion gear or spacers out of the opposite side. Repeat the procedure for the remaining cross shaft.

Installation of Capacity or Volume Cross Shafts

1. To reassemble either set of capacity or volume ratio slide valve racks, install the cross shaft with the pinion gear onto the back plate, place the remaining pinion gear on the shaft and drive in the roll pins. Install clamps, spacers and bolts on both sides. Tighten the bolts to the recommended torque values.
2. The slide valve sets must be synchronized on VSG 751-2101 and dual gate VSG 301-701 units. Both slide valve racks for either the volume ratio or capacity slide valves must engage the cross shaft gears at the same time. Push the racks all the way towards the suction end of the compressor until they stop. Install washers and jam nuts on the slide valve shafts. Repeat the procedure for the remaining set of slide valve racks.



3. Install (2) guide rods to position the discharge manifold. Install a new manifold gasket and the discharge manifold. Install the dowel pins and bolts, tighten manifold bolts to the recommended torque value.
4. On VSG 751-2101 and VSSG 291-601 and VSG 301-701 compressors install the discharge.

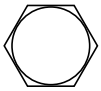
Main Rotor Assembly

Due to the procedures and tools involved in the disassembly and reassembly, the main rotor assembly must be performed by qualified individuals. Please consult the factory if maintenance is required.

Torque Specifications

Refer to the following table for torque specifications.

Table 5-9. Torque Specifications (All units, Ft.-Lbs)

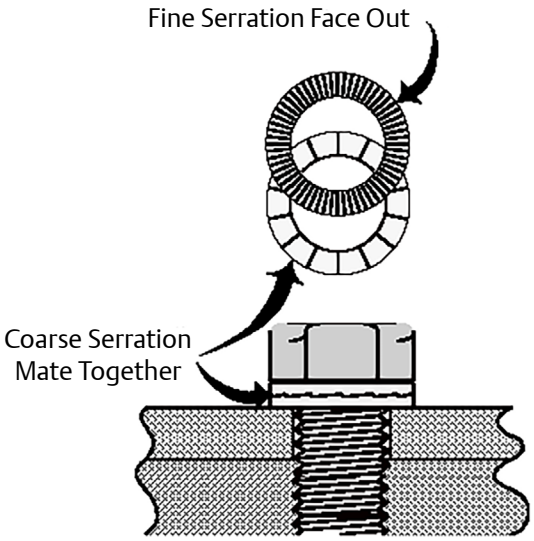
TYPE BOLT	HEAD MARKINGS	NOMINAL SIZE NUMBERS OR INCHES									
		#10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8
SAE GRADE 2 COARSE (UNC)			5	10	18	29	44	63	87	155	150*
SAE GRADE 5 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 8 COARSE (UNC)			11	22	39	63	96	138	191	338	546
SOCKET HEAD CAP SCREW (ASTM A574) COARSE (UNC)		5	13	26	46	73	112	155	215	380	614
NOTES:	1) Torque values on this sheet are not to override those given on the individual drawings.										
	2) When using loctite, the torque value on this sheet are only accurate if bolts are tightened immediately after loctite is applied.										
	* The proof strength of Grade 2 bolts is less for sizes 7/8 and above and therefore the torque values are less than smaller sizes of the same grade.										

Using A Torque Wrench Correctly

Torque Wrenches

Using A Torque Wrench Correctly Involves Four Primary Concerns:

1. A smooth even pull to the break point is required. Jerking the wrench can cause the pivot point to break early leaving the bolt at a torque value lower then required. Not stopping when the break point is reached results in an over torque condition.
2. When more than one bolt holds two surfaces together there is normally a sequence that should be used to bring the surfaces together in an even manner. Generally bolting is tightened incrementally in a diametrically staggered pattern. Some maintenance manuals specify a tightening scheme. If so, the manual scheme shall be followed. Just starting on one side and tightening in a circle can cause the part to warp, crack, or leak.
3. In some cases threads are required to be lubricated prior to tightening the bolt/nut. Whether a lubricant is used or not has considerable impact on the amount of torque required to achieve the proper preload in the bolt/stud. Use a lubricant, if required, or not if so specified.
4. Unlike a ratchet wrench a torque wrench is a calibrated instrument that requires care. Recalibration is required periodically to maintain accuracy. If you need to remove a bolt/nut do not use the torque wrench. The clockwise/counterclockwise switch is for tightening right hand or left hand threads not for loosening a fastener. Store the torque wrench in a location where it will not be bumped around.



Nord-Lock® Washers

1. The Nord-Lock® lock washer sets are used in many areas in VSG screw compressors that require a vibration proof lock washer.
2. The lock washer set is assembled so the course serrations that resemble ramps are mated together.
3. Once the lock washer set is tightened down, it takes more force to loosen the bolt that it did to tighten it. This is caused by the washers riding up the opposing ramps.

Slide Valve Actuator 25972XP Troubleshooting Guide

Table 6-1. Slide Valve Actuator 25972XP Troubleshooting Guide (1 of 2)

Problem	Reason	Solution
The actuator fails to calibrate or calibrate correctly	An over-torque condition is causing the span to be too small	Test slide travel or balance piston.
	The actuator is too hot	Allow it to cool.
	The span is greater than 8 turns of the output shaft	Defect in slide travel.
	The input voltage is too low	Test power supply in controller.
	The actuator is not actually driving the command shaft	Inspect compressor slides.
	There are damaged or broken gears	Replace the actuator.
	The position sensor magnets are not rotating with the shaft	Replace the actuator.
	Circuit board failure	Replace the actuator.
The actuator only works intermittently. See Note 2.	Bad signal wire connection	Inspect and/or replace cabling between controller and actuator.
	The supply voltage is too low	Increase controller Power supply output or replace .
	Input position signal problems	Inspect and/or replace cabling between controller and actuator.
	Intermittent over-torque condition	See Note 1.
	The actuator is too hot	Allow it to cool.
	The position sensor magnets are not rotating with the shafts.	Replace actuator.
The actuator does not respond to the input position signal	The configuration switch is not set correctly	Refer to actuator manual for proper configuration.
	Something is causing an over-torque condition	See Note 1.
	The actuator is too hot	Allow it to cool.
	Bad signal wire connection	Inspect and/or replace cabling between controller and actuator.
	Low supply voltage	Test and/or replace controller power supply.
	Actuator mechanical problems	Replace actuator.
	Circuit board failure	Replace actuator.

Table 6-1. Slide Valve Actuator 25972XP Troubleshooting Guide (2 of 2)

Problem	Reason	Solution
The actuator runs continuously back and forth independent of the input position signal	Over-voltage has blown the DAC on the circuit board	Replace actuator.
Modbus LEDs	If Modbus is not used, these light(s) can stay on indefinitely or turn on and off randomly	No Action needed.
Bad or no output signal	The configuration switch is not set correctly	Refer to actuator manual for proper configuration.
	Bad signal wire connection	Inspect and/or replace cabling between controller and actuator.
	The output circuit protection in blown on the circuit board	Replace actuator.

Notes 1 : Possible High Torque testing procedure

If you notice the commanded position does not match the actuate position while the compressor is running, the actuator my be encountering a high torque condition. The actuators a limited to 75lbs torque in order to prevent damage to the internal slide mechanism. To test if high torque occurring, please follow the steps below:

1. Turn off the compressor
   a. If the slide returns to approximately 0%; Then move on to Step 2.
   b. If the slide DOES NOT return to 0%; The actuator is likely faulty and should be replaced
2. Go to the calibration screen
3. Using the "+" button, move the slide to its Max position
   a. If max position can be reached, then the actuator is likely to be ok, proceed to Step 4.
   b. If the actuator fails to reach max position; remove the actuator and manually move the command shaft using a wrench
      I. If the slide can be move with wrench easily, the actuator is likely faulty and should be replaced
      II. If the slide can not be moved any further in the increase direction, than the slide is either stuck or it is at is max position. Please contact customer service.
4. If the actuator can move through its full range freely while the compressor is off, then the actuator is mostly likely working as expected. The mostly likely reason the actuator is failing to reach its commanded position while running is because it is requiring more than the allow amount of torque to move the slides. There could be a number of reasons for this high torque so please contact customer service for additional trouble shooting steps.

Notes 2 : Intermittent Actuator Signal

If while operation the actuators, you notice the large jump in the position in a very short amount of time then the cabling to the actuator is probably damages and should be replaced. The actuator is a slow-moving motor and a position jump of 10% or more in less than a second is physically impossible. A common source of this connectivity issue is the connector that connects to the actuator. If this connector was over tightened, the connector can break and will fail to maintain a solid connection. Please inspect this connection for damage.

Slide Valve Actuator (25972XP) Status LED Blink Codes

The actuator communicates status information to the operator by blink codes through the status LED. In the blink codes **1 = LED** on and **0 = LED** off. Time increases from left to right and the pattern repeats once the end of a sequence is reached.

Table 6-2. Slide Valve Actuator 25972XP Status LED Blink Codes

Blink Code	Meaning
‘0011001100110011 (uniform blink)	The actuator is in the process of auto calibrating.
‘0000000000000001	The actuator is not calibrated. Possible causes: 1. Automatic calibration failed because the span was too small. This can be caused by a sticking valve. 2. Automatic calibration was stopped before it was completed. 3. EEPROM memory failure is preventing stored calibration data from being read.
‘1111111111111111 (steady glow)	Hardware error. Possible causes: 1. Excessive backlash from worn or broken gears. 2. Shaft magnets are too close or too far from position sensor chips. 3. Position sensor chip failure.
‘0000000000010101	The actuator temperature exceeds 100°C. Normal operation resumes after it cools.
‘0000000000000101	The actuator torque limit has been exceeded. The actuator will pause 6 seconds and then try to move again.
‘1111111111111110	An emergency stop command has been issued through either Modbus or the CAL/STOP push button.

Slide Valve Actuator 25972D Troubleshooting Guide

Refer to the following tables for Slide Valve Actuator Troubleshooting Guide.

Table 6-3. Slide Valve Actuator 25972D Troubleshooting Guide (1 of 2)

Problem	Reason	Solution
The actuator cannot be calibrated or exit calibration mode	Dirt or debris is blocking one or both optocoupler slots	Clean the optocoupler slots with a Q-Tip and rubbing alcohol.
	The photochopper fence extends less than about half way into the optocoupler slots	Adjust the photochopper so that the fence extends further into the optocoupler slots. Make sure the motor brake operates freely and the photochopper will not contact the optocouplers when the shaft is pressed down.
	The white calibrate wire in the grey Turck cable is grounded	Tape the end of the white wire in the panel and make sure that it cannot touch metal
	Dirt and/or condensation on the position sensor boards are causing it to malfunction	Clean the boards with an electronics cleaner or compressed air.
	The calibrate button is stuck down	Try to free the stuck button.
	The position sensor has failed	Replace the actuator.
	Push button is being held down for more that ¾ second when going through the calibration procedure	Depress the button quickly and then let go. Each ¾ second the button is held down counts as another press.
The actuator goes into calibration mode spontaneously	The white calibrate wire in the grey Turck cable is grounding intermittently	Tape the end of the white wire in the panel and make sure that it cannot touch metal.
	A very strong source of electromagnetic interference (EMI), such as a contactor, is in the vicinity of the actuator or grey cable	Increase the distance between the EMI source and the actuator. OR Install additional metal shielding material between the EMI source and the actuator or cable.
	There is an intermittent failure of the position sensor	Replace the actuator.
The actuator goes into calibration mode every time power is restored after a power loss	The motor brake is not working properly (See theory section above).	Get the motor brake to where it operates freely and recalibrate.

Table 6-3. Slide Valve Actuator 25972D Troubleshooting Guide (2 of 2)

Problem	Reason	Solution
The actuator does not transmit the correct position after a power loss	The motor was manually moved while the position sensor was not powered.	Recalibrate.
	The motor brake is not working properly	Get the motor brake to where it operates freely and then recalibrate.
	The position sensor's EEPROM memory has failed	Replace the actuator.
There is a rapid clicking noise when the motor is operating	The photochopper is misaligned with the slotted optocouplers	Try to realign or replace the actuator.
	The photochopper is positioned too low on the motor shaft.	Adjust the photochopper so that the fence extends further into the optocoupler slots.
	A motor bearing has failed	Replace the actuator.
The motor operates in one direction only	There is a loose connection in the screw terminal blocks	Tighten.
	There is a loose or dirty connection in the yellow Turck cable	Clean and tighten.
	The position sensor has failed	Replace the actuator.
	There is a broken motor lead or winding	Replace the actuator.
The motor will not move in either direction	The thermal switch has tripped because the motor is overheated	The motor will resume operation when it cools. This could be caused by a malfunctioning control panel. Consult the factory.
	Any of the reasons listed in "The motor operates in one direction only"	See above.
	The command shaft is jammed	Free the command shaft.
	Broken gears in the gearmotor	Replace the actuator.
	Blown relay or fuse.	Check and replace blown relay and/or fuse.
The motor runs intermittently, several minutes on, several minutes off	Motor is overheating and the thermal switch is tripping	This could be caused by a malfunctioning control panel. Consult the factory.
The motor runs sporadically	Bad thermal switch	Replace the actuator.
	Any of the reasons listed in "The motor will not move in either direction"	See above.
The motor runs but output shaft will not turn	Stripped gears inside the gear motor or the armature has come unpressed from the armature shaft	Replace the actuator.

Slide Valve Actuator 25972D LED Blink Codes

Slide Valve Actuators communicate problems discovered by internal diagnostics via LED blink codes. Only one blink code is displayed, even though it is possible that more than one problem has been detected.

Table 6-4. Slide Valve Actuator 25972D LED Blink Codes* (1 of 2)

Flash Pattern	Meaning
*=ON _=OFF	
*_*_*_*_*_*_*_*_*_*_*_*_*	Calibration Step 1
*___*___*___*___*___	Calibration Step 2
*__*_____	This indicates a zero span. This error can only occur during calibration. The typical cause is forgetting to move the actuator when setting the upper limit of the span. If this is the case, press the blue button to restart the calibration procedure. This error can also occur if either or both of the slotted optocouplers are not working. If this is the case, the slide valve actuator will have to be replaced. The operation of the slotted optocouplers is tested as follows: 1. Manually rotate the motor shaft until the aluminum photochopper fence is not blocking either of the optocoupler slots. 2. Using a digital multi-meter, measure the DC voltage between terminal 3 of the small terminal block and TP1 on the circuit board.(1) You should measure between 0.1 and 0.2 Volts. 3. Next, measure the DC voltage between terminal 3 and TP2 on the circuit board. You should measure between 0.1 and 0.2 Volts.
*_____	This indicates a skipped state in the patterns generated by the optocouplers as the motor moves. This error means that the slide valve actuator is no longer transmitting accurate position information. The actuator should be recalibrated as soon as possible. This code will not clear until the actuator is recalibrated. This code can be caused by: 1. The motor speed exceeding the position sensors ability to measure it at some time during operation. A non-functioning motor brake is usually to blame. 2. The actuator is being operated where strong infrared light can falsely trigger the slotted optocouplers, such as direct sunlight. Shade the actuator when the cover is off for service and calibration. Do not operate the actuator with the cover off.

Note:

*There are two versions of slide valve actuators, version A and B. Only version B is able to display LED blink codes. Slide valve actuator version B can be distinguished by only having a single circuit board as supposed to two circuit boards in version A.

(1) TP1 and TP2 are plated-thru holes located close to the slotted optocouplers on the board. They are clearly marked on the board silkscreen legend.

Table 6-4. Slide Valve Actuator 25972D LED Blink Codes* (2 of 2)

Flash Pattern	Meaning
*__*__*_____	The motor has overheated. The actuator motor will not run until it cools. Once the motor cools, the actuator will resume normal operation. Motor overheating is sometimes a problem in hot and humid environments when process conditions demand that the slide valve reposition often. Solutions are available; consult your Vilter authorized distributor for details. Another possible cause for this error is a stuck motor thermal switch. The thermal switch can be tested by measuring the DC voltage with a digital multi-meter between the two TS1 wire pads(2). If the switch is closed (normal operation) you will measure 0 Volts.
**********	The 24V supply is voltage is low. This will occur momentarily when the actuator is powered up and on power down. If the problem persists, measure the voltage using a digital multi-meter between terminals 3 and 4 of the small terminal block. If the voltage is >= 24V, replace the actuator.
_**********	The EEPROM data is bad. This is usually caused by loss of 24V power before the calibration procedure was completed. The actuator will not move while this error code is displayed. To clear the error, calibrate the actuator. If this error has occurred and the cause was not the loss of 24V power during calibration, possible causes are: 1. The EEPROM memory in the micro-controller is bad. 2. The large blue capacitor is bad or has a cracked lead.
*****___*_____	Micro-controller program failure. Replace the actuator.

*There are two versions of slide valve actuators, version A and B. Only version B is able to display LED blink codes. Slide valve actuator version B can be distinguished by only having a single circuit board as supposed to two circuit boards in version A.

(2) The TS1 wire pads are where the motor thermal switch leads solder into the circuit board. They are clearly marked on the board silkscreen legend and are oriented at a 45 degree angle.

Troubleshooting Guide - General Problems and Solutions

Refer to the following tables for Troubleshooting Guide - General Problems and Solutions.

Table 6-5. Troubleshooting Guide - General Problems and Solutions (1 of 3)

Problem	Solution
Low Oil Pressure at Start	• After failing to start compressor with "Prelube Oil Pump Inhibit", first allow Discharge pressure, Oil Filter In pressure and Out pressure to equalize. Then restart compressor. If compressor fails to start due to low oil pressure, continue trouble-shooting with items below. • Reset Prelube Oil Pressure Setpoint in Alarms and Trip Setpoints screen to lowest recommended setpoints. • Check calibration of oil manifold transducer, discharge pressure transducer, and suction transducer. • Check for correct oil pump motor rotation and operation. • Ensure transducer isolation valves are open. • Verify that the correct transducer ranges are selected. • Check to see all oil line valves are open except the oil dump valve used to fill the lines and oil cooler. • Check oil strainer for dirt. • Check oil filter pressure drop. • Check "Prelube Oil Pump Time Limit" setpoint is sufficient in Compressor Timer Setpoints screen. • Prelube pressure is manifold pressure minus discharge pressure.
Low Run Oil Pressure	• Check solutions in "Low Oil Pressure at Start". • Check that there is proper discharge pressure ratio to create differential pressure, otherwise oil pressure can't be maintained. Oil pressure is manifold oil pressure minus the suction pressure. It is a net pressure. • If the oil pump is selected to be a part time oil pump in the "Setup" menu, then ensure that it only shuts off at an appropriate pressure ration that takes into account pressure drops through the oil cooler. This is a set point in the "Compressor Control Setpoints" menu called "Oil Pump Restart." It is a pressure ratio. (discharge pressure in PSIA/suction pressure in PSIA) Default ratio is a pressure ratio of 3.00:1 that stops the pump and 2.80:1 that restarts the pump. This ratio can be increased. Do not decrease without consulting Vilter.
Oil flow or oil pressure problems	• Clean oil strainer screen. • Change oil filter, maybe plugged or collapsed. • Oil pump gears worn internally, excessive end-clearance. • Oil priming valve used on air-cooled cooler units is open. • Relief in-line check valve stuck open. • Pressure ratio too low, oil pump should be on.
Faulty pressure or temperature readings	• Check that the correct pressure or temperature range is selected in the Instrument Calibration menu. • Check cable connections at device, terminal strips, and PLC input card for correct wiring and shielding (RF noise). • Check calibration of RTDs and transducers.

Table 6-5. Troubleshooting Guide - General Problems and Solutions (2 of 3)

Problem	Solution
Oil Loss Issues	• Oil return line from coalescing side of oil separator to suction is closed, not open enough (0.75 turns should be sufficient), or plugged with debris • The check valve in the oil return line could be stuck closed or the flow is in the wrong direction • There may be water in the oil affecting the coalescing elements • Coalescent elements in need of replacement due to age or damage (water contamination) • The operating conditions are not correct (too high of suction and/or too low discharge pressure) This creates increased gas flow which could make the oil separator too small • The suction or discharge check valve is not working correctly causing oil to escape when the unit stops • Viscosity of oil incorrect; send sample for testing • There is an oil leak somewhere in the system
High oil temperature (liquid injection)	• Check for correct setting of all manual values. • Check for correct operation of 2-way automatic oil mixing valve. • In the “Vilter Only” menu, ensure that you select “Yes this unit has the oil mixing valve” to enable it. • If your are controlling a step type oil cooler or a VFD oil cooler, verify the correct one is selected in the “Vilter Only” menu and the amount of steps are entered in the menu screen “Oil Cooler Step Control” menu. • Check the oil cooler and associated piping to make sure it is full of oil before starting. • Check the oil strainer for debris and clean if necessary. • Verify that the volume slide actuator is functioning correctly and that the correct compressor size (type) is selected in the “Vilter Only” menu. • Check that all fans are working. • Check for correct fan rotation on the oil cooler. • Check that your operating conditions are within the “As Sold” design conditions.
Capacity/Volume Slide Actuator Alarms/Trips/ Symptoms:	• Calibration method not correct • Actuator or Gear motor not working, or off on overload • Slide valve carriage assembly out of position, slides binding • Cross-shaft gears, broken pins • Command shaft broken • Slide valve rack or rack shaft damaged • Check balance piston movement • Reference Slide Valve Actuator Troubleshooting Guide • Check I/O fusing
High Amp Draw	• Check Main Motor Amps scaling and PLC.

Table 6-5. Troubleshooting Guide - General Problems and Solutions (3 of 3)

Problem	Solution
Vibration	• Check that unit is leveled and secured to mounting pad or floor. • Check supported pipes (i.e. suction and discharge pipe) and make sure they are adequately supported. • Check for loose bolts and nuts. • Check condition of compressor and motor (i.e. alignments)
Excessive Motor Backspin	• If there is more than normal motor backspin at shutdown, check suction check valve for proper operation.

Warranty Claim Processing

This section explains how the warranty claim is processed and to help clear any questions that may arise prior to contacting customer service. For additional warranty information, refer to the Terms and Conditions of your order. Vilter™ contact information can be found on page iii.

1. The warranty process starts with contacting a Vilter Service and Warranty (S&W) department representative. *Ensure to have the original Vilter sales order number for the equipment available to better assist you.*
2. Our Vilter S&W representative will confirm if the equipment is within the warranty time frame as described in the warranty statement..

If the equipment (Part/Compressor/Compressor Motor) is within the warranty time frame, proceed to the following section regarding the type of equipment:

Process For Returning Products Covered By the Warranty

STEP 1. To return a product or part for warranty consideration, you will need to provide the original Copeland Industrial LP sales order number on all submitted documents.

For a parts warranty request, you will also need:

- To provide Copeland Industrial LP a detailed and accurate description of the issue.
- To provide Copeland Industrial LP a valid purchase order for the new part(s)—you must pay the freight.
- One copy of Return Merchandise Authorization (RMA) sent to you for your records.
- One copy of RMA sent to you to include in the return shipment of parts back to Copeland Industrial LP for warranty consideration.

STEP 2. Return the parts (freight prepaid) to:

COPELAND INDUSTRIAL LP
5555 South Packard Avenue
Cudahy, WI 53110-8904

STEP 3. Upon receipt of the returned part(s), Copeland Industrial LP will complete a timely evaluation of the part(s).

STEP 4. You will be contacted with Copeland Industrial LP decision once the final report is completed.

STEP 5. If approved, the warranty will be credited (excluding freight) to your account. Copeland Industrial LP will retain the returned part(s) for final disposition. If a warranty request is not approved, you will be provided with a written response and the parts will be held for 30 days from the date of the response. After such time, Copeland Industrial LP reserves the right to dispose of the parts. If you wish to have the part(s) returned within the 30 days, you will need to contact Vilter™ and the part(s) will be returned freight collect.

Procedure For Parts Not Manufactured By Vilter™

Although Copeland Industrial LP does not provide any warranty for parts and products that are not manufactured by Copeland Industrial LP, Copeland Industrial LP does pass through any manufacturer's warranty to you (to the maximum extent permitted by the manufacturer). Copeland Industrial LP will work with you in facilitating your warranty claim with the manufacturer.

To facilitate your warranty claim for a third party, please follow the following four steps:

STEP 2. If the part or product is not a motor, send a description containing the specifications of the part/product and the alleged defect to:

Service.Vilter@Copeland.com

If the part or product is a motor or starter, please complete the following form and return it to:

Service.Vilter@Copeland.com.

STEP 3. Copeland Industrial LP will communicate with you, if necessary, to ascertain additional information and will reasonably assist with the OEM to determine the part/product's warranty status.

VILTER
by COPELAND

Motor Warranty Procedure

Step 1: Determine if the part of product is within the original equipment manufacturer's warranty.

Step 2: If the part or product is not a motor, send a description containing the specifications of the part/product and the alleged defect to Service.Vilter@Copeland.com.

If the part or product is a motor or starter, please complete the following form and return it to Service.Vilter@Copeland.com.

Step 3: Copeland Industrial LP will communicate with you, if necessary, to ascertain additional information and will reasonably assist with the OEM to determine the part/product's warranty status.

Step 4: For motor or starter claims, if the motor or starter falls within the OEM's warranty time frame:

- The motor or starter will need to be taken to a manufacturer approved shop for diagnosis. Copeland Industrial LP can help you locate motor shops in your area that are manufacturer approved. The shop will diagnose the root cause, submit a report to the OEM, and the motor OEM will make the determination of warranty coverage.
- If a warranty claim is approved, the OEM will either have the motor or starter repaired by the motor shop or send a new replacement motor to the site, depending on the OEM's warranty terms.

Model: _____ Serial Number: _____ Manufacturer: _____

Starter Type Run Hours _____ Start Date: _____

☐ Soft Start	Alignment Data Available:	☐ Yes, please include	☐ No
☐ Cross the Line	Lubrication Records Available:	☐ Yes, please include	☐ No
☐ VFD	Vibration Report Available:	☐ Yes, please include	☐ No
	Grease Type: _____		

Describe Motor Symptoms:

STEP 4. For motor or starter claims, if the motor or starter falls within the OEM's warranty time frame:

- The motor or starter will need to be taken to a manufacturer approved shop for diagnosis. Copeland Industrial LP can help you locate motor shops in your area that are manufacturer approved. The shop will diagnose the root cause, submit a report to the OEM, and the motor OEM will make the determination of warranty coverage.
- If a warranty claim is approved, the OEM will either have the motor or starter repaired by the motor shop or send a new replacement motor to the site, depending on the OEM's warranty terms.

On-Site Service Support

If on site support is required, contact a Vilter S&W department representative to start this process.

Warranty does not cover labor or expenses.

1. A quote, a service rate sheet, and the service terms and conditions will be provided.
2. Submit a PO.
3. Schedule the service visit.

Remanufactured Gas Bare Shaft Single Screw Compressor Process

These instructions are an overview of how the process works when a bare shaft compressor is in need of being remanufactured. This is to help clear any questions that may arise prior to contacting customer service.

The process begins by contacting Vilter's Customer Service Department. Vilter contact information can be found on page iii.

- Request a "VSS/VSM Single Screw Compressor Rebuild Form".
- Submit the Rebuild Form and a Purchase Order (PO) for the inspection. A fee is required for the initial inspection and tear down report; contact Vilter Customer Service representative for the latest fee.
- A Return Material Authorization (RMA) number will be provided.
- Send the compressor to Vilter in the condition as stated on the Rebuild Form (i.e. no oil in the compressor). Charges may apply if conditions are not met.
- A report will be sent to you after the inspection has been completed explaining what level of rebuild is necessary along with the cost.

NOTE

Inspection and rebuild times will vary, contact Vilter Customer Service representative for further details.

- Submit a new PO for the amount that will be needed for the rebuild. The inspection cost will be waived upon receipt of the new PO. Make sure to provide your "Ship to Address" and "Billing Address".

Explanation of Rebuild Levels

Level 1

Compressor is in good condition. Replace bearings, gaskets, shaft seal and O-rings. All hardware is intended to be re-used (when possible). Parts are organized in part kit form.

Level 2

Compressor is in good condition, but requires new gate rotor blades. Replace all items in Level 1 plus new gate rotor blades and bushings.

Level 3

Current Reman Compressor requires complete rebuilding and re-conditioning to "as-new" condition. All the components listed in Level 2 are replaced plus all hardware, slide assemblies, pistons, and a main rotor (if damaged) and/or gate rotor supports.

NOTE

A Level 1 and Level 2 rebuild will include washing the housing and repainting over the current paint. A Level 3 rebuild will include blasting all the current paint off before repainting.

Bare Shaft Compressor Description

Single Screw Bare Shaft Compressor features include:

- Cast grey iron frame with cast ductile iron discharge manifold and gate rotor covers with discharge connection horizontal.
- Standard drive shaft is straight.
- Standard slide assembly.
- Viton shaft seal O-rings.
- Crating with Purge & Gauge.
- Does not include hand wheels or slide valve motors.

How to Read a Parts List and Illustration

A parts list consist of the following information:

Item Number

Item number associated with the number shown in the parts illustration.

Description

A description of an item.

Model Number

Compressor type and size.

VPN

VPN stands for Vilter™ Part Number.

Quantity

A quantity used for respective model or series of models.

Assembly and Kit Information

For assembly and kit, included items are added in parenthesis after part description.

Example-

ITEM	DESCRIPTION	MODEL NUMBER	
		VSSG 451	
		QTY	VPN
100	SUPPORT ASSEMBLY (110 and 135B)	2	A25159BB
110	SUPPORT	2	25606A
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910A

VPN A25159BB - SUPPORT ASSEMBLY includes items (110 and 135B).

Terms and Abbreviation Used

Term	Description
SM	Small
LG	Large
O.D.	Outer Diameter
BRG	Bearing
HSG	Housing
VOL.	Volume
CAP.	Capacity
AR	As Required
QTY	Quantity
W/O	Without
W/	With

Important Notes

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor.

Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Additional note/information of part/item/quantity shown at the bottom of parts table.

Vilter™ Aftermarket Parts Contact Information

Phone: 1-800-862-2677

Fax: 1-800-862-7788

E-mail: Parts.Vilter@Copeland.com

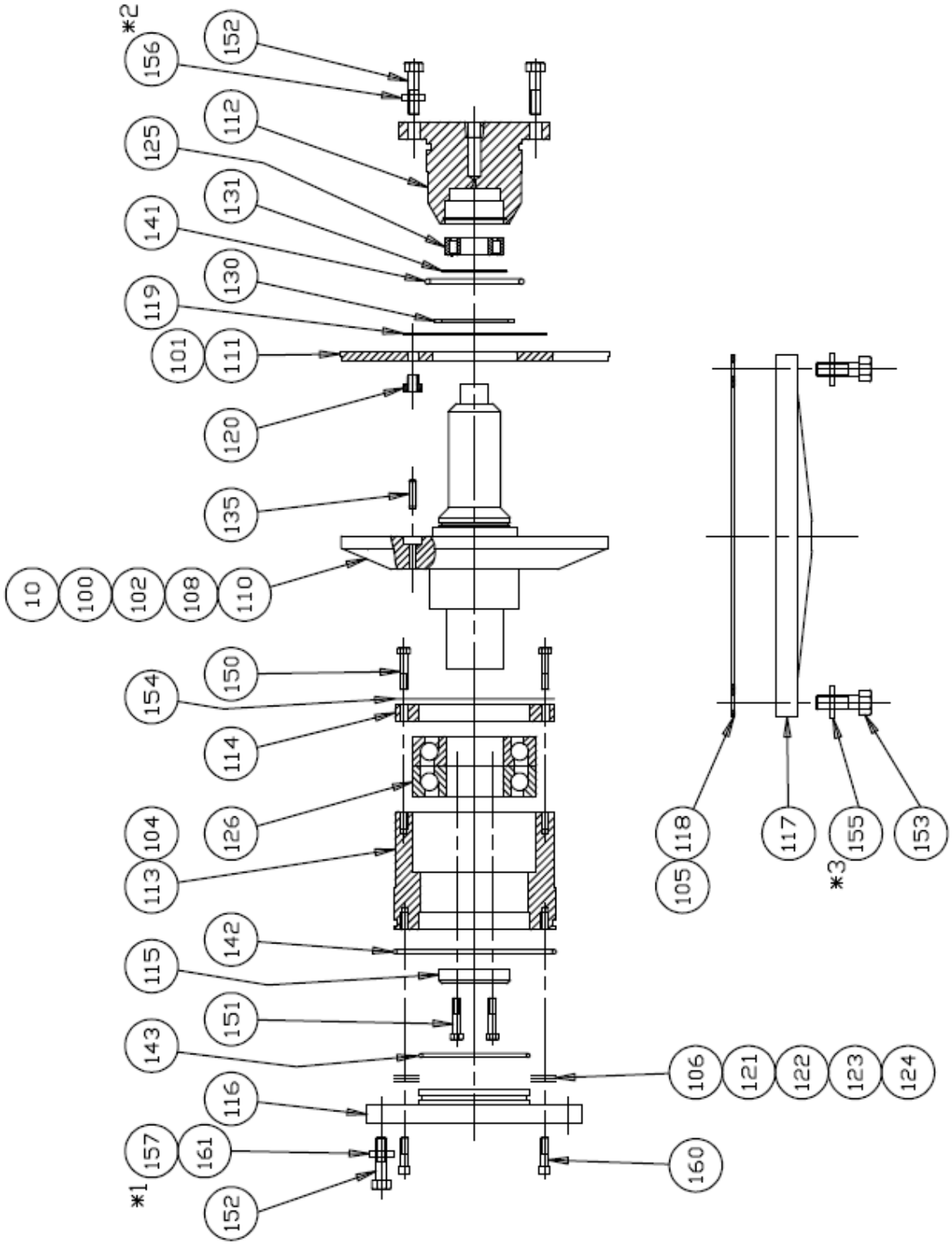
Website: Copeland.com/Vilter or VIlter.com

VSSG 291 - 601 and VSG 751 - 3001
Recommended Spare Parts List

Refer to the Custom Manual
Spare Parts Section for Specific Applications

NOTE
Please have your Model # and Sales Order # available when ordering.
These are found on the compressor's Name Plate.

Gaterotor (VSSG 291 - VSG 2101)



*For VSG Models from 291 to 2101

Gaterotor (VSSG 291 - VSSG 601)
(1 of 2)

ITEM No	ITEM DESCRIPTION	MODEL NUMBER							
		VSSG 291		VSSG 341		VSSG 451		VSSG 601	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712ZAF[2] KT712ZV[1,2] KT712ZNAF[2,4]	AR	KT712TAF KT712SV[1,2] KT712SAF[2] KT712TNAF[2,4]	AR	KT712AAF KT712AV[1] KT712W[1,2,4] KT712WSAF[2] KT712WAF[2,4]	AR	KT712X[1,2,4] KT712BDAF[3] KT712XSAF[2] KT712BNAF[2,4] KT712BAF[2,3]
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713KAAF KT713KAF[2]	AR	KT713NAAF KT713NV[1,2] KT713NAF[2]	AR	KT713AAF KT713W[1,2] KT713WAF[2]	AR	KT713X[1,2] KT713XAF[2] KT713BAF[2,3]
100	SUPPORT ASSEMBLY (110 & 135B)	2	A25159BD	2	A25159BC	2	A25159BB	2	A25159BA
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161BD	2	A25161BC	2	A25161BB	2	A25161BA
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164BAF	2	A25164BAF	2	A25164BAF	2	A25164BAF
1052	GATEROTOR GASKET SET (1182, 141, 142, 143)	2	A25164BDAF	2	A25164BDAF	2	A25164BDAF	2	A25164BDAF
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124) 2 A25165B 2	2	A25165B	2	A25165B	2	A25165B	2	A25165B
110	SUPPORT	2	27970C	2	27970B	2	27970D	2	27970A
111	GATEROTOR	2	25557D	2	25557C	2	25557A	2	25534A
112	SMALL BEARING HOUSING	2	25518D	2	25518D	2	25518D	2	25518D
113	LARGE BEARING HOUSING	2	25517A	2	25517A	2	25517A	2	25517A
114	RETAINER	2	25008A	2	25008A	2	25008A	2	25008A
115	RETAINER	2	25009A	2	25009A	2	25009A	2	25009A
116	BALL BEARING COVER	2	25258A	2	25258A	2	25258A	2	25258A

Note:

Default standard design condition: Cast Iron housing with Aflas O-rings

AR: As Required.

(1): Viton O-Rings

(2): Steel housing

(3): DI housing

(4): Large bearing

Gaterotor (VSSG 291 - VSSG 601, 2 of 2)

ITEM No	ITEM DESCRIPTION	MODEL NUMBER							
		VSSG 291		VSSG 341		VSSG 451		VSSG 601	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
117	GATEROTOR COVER	2	25519A	2	25519A	2	25519A	2	25519A
118	GATEROTOR COVER GASKET	2	25259A	2	25259A	2	25259A	2	25259A
1182	GATEROTOR COVER O-RING 10.484 X 10.726 AFLAS VP101	2	3547R	2	3547R	2	3547R	2	3547R
119	WASHER	2	25007A	2	25007A	2	25007A	2	25007A
120A	BUSHING, SMALL DOWEL PIN	2	25006A	2	25006A	2	25006A	2	25006A
120B	BUSHING, LARGE DOWEL PIN	2	25760A	2	25760A	2	25760A	2	25760A
121	SHIM 0.002”	AR	25010AA	AR	25010AA	AR	25010AA	AR	25010AA
122	SHIM 0.003”	AR	25010AB	AR	25010AB	AR	25010AB	AR	25010AB
123	SHIM 0.005”	AR	25010AC	AR	25010AC	AR	25010AC	AR	25010AC
124	SHIM 0.010”	AR	25010AD	AR	25010AD	AR	25010AD	AR	25010AD
125	ROLLER BEARING	2	2864B	2	2864B	2	2864B	2	2864B
126	BALL BEARING	4	2865BP	4	2865BP	4	2865BP	4	2865BP
130	RETAINING RING	2	2866A	2	2866A	2	2866A	2	2866A
131	RETAINING RING	2	2867A	2	2867A	2	2867A	2	2867A
135A	DOWEL PIN, SM, 0.250” O.D.	2	2868B	2	2868B	2	2868B	2	2868B
135B	DOWEL PIN, LG, 0.4375” O.D.	2	25910A	2	25910A	2	25910A	2	25910A
141	141 O-RING ROLLER BEARING HOUSING	2	3547B	2	3547B	2	3547B	2	3547B
142	142 O-RING BALL BEARING HOUSING	2	3547D	2	3547D	2	3547D	2	3547D
143	143 O-RING BRG HSG COVER	2	3547C	2	3547C	2	3547C	2	3547C
150	HEX HEAD CAP SCREW (1/4-20 NC X 1)	12	2796AG	12	2796AG	12	2796AG	12	2796AG
151	151 HEX HEAD CAP SCREW (5/16-18 NC X 1-1/4)	6	2796B	6	2796B	6	2796B	6	2796B
152	152 HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	40	2796CJ	40	2796CJ	40	2796CJ	40	2796CJ
153	153 HEX HEAD CAP SCREW (1/2-13 NC X 1-1/2)	32	2796E	32	2796E	32	2796E	32	2796E
160	160 SOCKET HEAD CAP SCREW	12	2795H	12	2795H	12	2795H	12	2795H

Gaterotor (VSG 1051 - 1301)

ITEM	DESCRIPTION	MODEL NUMBER					
		VSG 1051		VSG 1201		VSG 1301	
		QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712EAF	AR	KT712FAF KT712FV[1]	AR	KT712Y[2]
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT713EAF	AR	KT713FAF	AR	KT713Y[2]
100	SUPPORT ASSEMBLY 110 & 135B.	2	A25159DB	2	A25159DA		
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161DB	2	A25161DA	2	A25161DH
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164DAF	2	A25164DAF	2	A25164DAF
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165C	2	A25165C	2	A25165C
110	SUPPORT	2	25614A	2	25587A	2	25587A
111	GATEROTOR	2	25610A	2	25588A	2	25588F
118	GATEROTOR COVER GASKET	2	25132A	2	25132A	2	25132A
119	WASHER	2	25086A	2	25086A	2	25086A
120A	BUSHING, SMALL DOWEL PIN	2	25104A	2	25104A	2	25104A
120B	BUSHING, LARGE DOWEL PIN	2	25760B	2	25760B	2	25760B
121	SHIM 0.002"	AR	25089AA	AR	25089AA	AR	25089AA
122	SHIM 0.003"	AR	25089AB	AR	25089AB	AR	25089AB
123	SHIM 0.005"	AR	25089AC	AR	25089AC	AR	25089AC
124	SHIM 0.010"	AR	25089AD	AR	25089AD	AR	25089AD
125	ROLLER BEARING	2	2864G	2	2864G	2	2864G
126	BALL BEARING	4	2865A	4	2865A	4	2865A
130	RETAINING RING	2	2866B	2	2866B	2	2866B
131	RETAINING RING	2	2867L	2	2867L	2	2867L
135A	DOWEL PIN, SM, 0.250" O.D.	2	2868H	2	2868H	2	2868H
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910B	2	25910B	2	25910B
141	O-RING ROLLER BEARING HOUSING	2	3547G	2	3547G	2	3547G
142	O-RING BALL BEARING HOUSING	2	3547H	2	3547H	2	3547H
143	O-RING BRG HSG COVER	2	3547E	2	3547E	2	3547E

Notes:

Default standard design condition: Cast Iron housing with Aflas O-Rings

AR: As Required.

(1): Viton O-Rings

(2): Neoprene O-Rings

Gaterotor (VSG 1551 - 2101)
(1 of 2)

ITEM	DESCRIPTION	MODEL NUMBER					
		VSG 1551		VSG 1851		VSG 2101	
		QTY	VPN	QTY	VPN	QTY	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 125, 126, 130, 131, 141, 142, 143)	AR	KT712LV* KT712LAF* KT712LNV** KT712LNAF**	AR	KT712MV* KT712MAF* KT712MNV** KT712MNAF**	AR	KT712KNV** KT712KNAF**
-	GATEROTOR BLADE REPLACEMENT KIT (111, 118, 120A, 120B, 121, 122, 123, 124, 130, 141, 142, 143)	AR	KT712TV* KT712TAF* KT712TNV** KT712TNAF**	AR	KT713UV* KT713UAF** KT713UNV** KT713UNAF**	AR	KT713LNV** KT713LNAF**
101	GATEROTOR ASSEMBLY (111, 120)	2	A25160EB	2	A25160EA	2	A25160EA
102	GATEROTOR SUPPORT ASSEMBLY (100, 111, 120B, 119, 130)	2	A25161EB	2	A25161EA	2	A25161EC
104	SHIM 350MM GATEROTOR BALL BRG VSS	2	25977U	2	25977U	2	25977U
105	GATEROTOR GASKET SET (118, 141, 142, 143)	2	A25164EGAF	2	A25164EGAF	2	A25164EGAF
106	SHIM PACK SET ((2) 121, (2) 122, (1) 123, (1) 124)	2	A25165E	2	A25165E	2	A25165E
110	SUPPORT	2	25665C	2	25665E	2	25665D
111	GATEROTOR	2	25647A	2	25645A	2	25744D
112	SMALL BEARING HOUSING	2	26507A	2	26507A	2	26507A
113	LARGE BEARING HOUSING	2	26506A	2	26506A	2	26506A
114	RETAINER	2	25141A	2	25141A	2	25141A
115	RETAINER	2	25789A	2	25789A	2	25789A
116	BALL BEARING COVER	2	25351A	2	25351A	2	25351A
117	GATEROTOR COVER	2	26508B	2	26508B	2	26508B
118	GATEROTOR COVER GASKET	2	26509A	2	26509A	2	26509A
119	WASHER	2	25788A	2	25788A	2	25788A
120A	BUSHING, SMALL DOWEL PIN	-	N/A	-	N/A	-	N/A
120B	BUSHING, LARGE DOWEL PIN	2	25760C	2	25760C	2	25760C
121	SHIM 0.002"	AR	25791AA	AR	25791AA	AR	25791AA
122	SHIM 0.003"	AR	25791AB	AR	25791AB	AR	25791AB
123	SHIM 0.005"	AR	25791AC	AR	25791AC	AR	25791AC
124	SHIM 0.010"	AR	25791AD	AR	25791AD	AR	25791AD
125	ROLLER BEARING	2	2864K	2	2864K	2	2864K
126	BALL BEARING	4	2865K	4	2865K	4	2865K
130	RETAINING RING	2	2866G	2	2866G	2	2866G

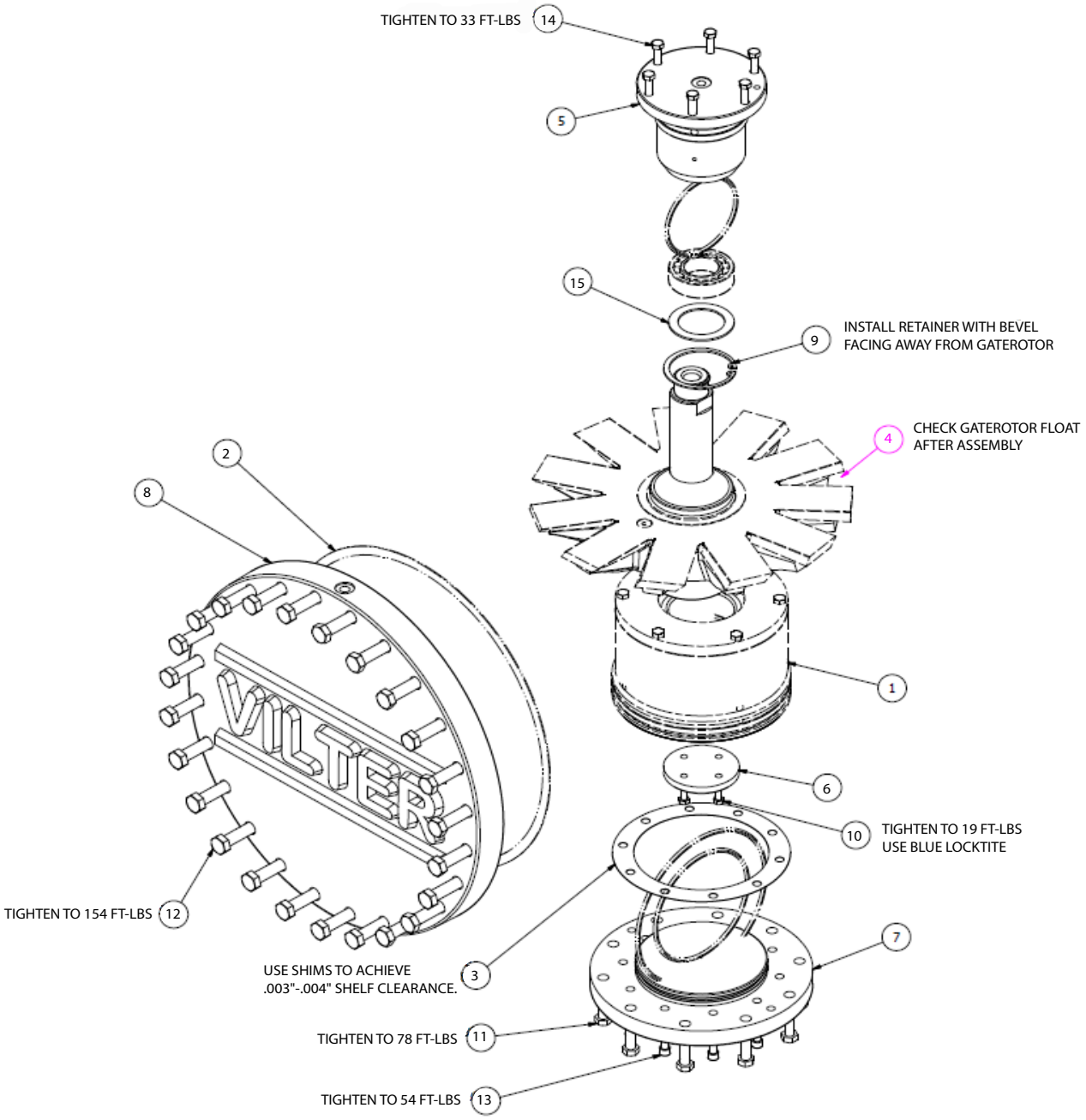
Gaterotor (VSG 1551 - 2101)
(2 of 2)

ITEM	DESCRIPTION	MODEL NUMBER					
		VSG 1551		VSG 1851		VSG 2101	
		QTY	VPN	QTY	VPN	QTY	VPN
131	RETAINING RING	2	2867R	2	2867R	2	2867R
135A	DOWEL PIN, SM, 0.250" O.D.	-	N/A	-	N/A	-	N/A
135B	DOWEL PIN, LG, 0.4375" O.D.	2	25910C	2	25910C	2	25910C
141	O-RING ROLLER BEARING HOUSING	2	3547E	2	3547E	2	3547E
142	O-RING BALL BEARING HOUSING	2	3547AJ	2	3547AJ	2	3547AJ
143	O-RING BRG HSG COVER	2	3547AH	2	3547AH	2	3547AH
150	HEX HEAD CAP SCREW (1/4-20 NC X 1-1/4)	12	2796CJ	12	2796CJ	12	2796CJ
151	HEX HEAD CAP SCREW (5/16-18 NC X 1-1/4)	8	2796N	8	2796N	8	2796N
152	HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	32	2796CJ	32	2796CJ	32	2796CJ
153	HEX HEAD CAP SCREW (1/4-20 NC X 1)	44	2796R	44	2796R	44	2796R
160	SOCKET HEAD CAP SCREW	16	2795G	16	2795G	16	2795G

Notes: AR: As Required. *: For Serial Numbers Before 5580. **: For Serial Numbers After 5580.

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Gaterotor (VSG 2401 - 3001)



*VSG 2401 - 3001 Only

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Gaterotor (VSG 2401 - 3001)

ITEM	DESCRIPTION	QTY	MODEL NUMBER			
			VSG 2401	VSG 2601	VSG 2801	VSG 3001
			VPN	VPN	VPN	VPN
-	GATEROTOR BLADE AND BEARING REPLACEMENT KIT	AR	KT712NV[1]	KT712PAF	KT712QAF*	KT712RAF KT712RV[1]
-	GATEROTOR BLADE REPLACEMENT KIT	AR	KT713PAF	KT713QAF	KT713RAF*	KT713SAF KT713SV[1]
001	BALL BEARING	1	A25163G	A25163G	A25163G	A25163G
002	SEAL GATEROTOR	1	A25164FAF	A25164FAF	A25164FAF	A25164FAF
003	SHIM	1	A25165F	A25165F	A25165F	A25165F
004	SUPPORT	1	A25222FH	A25222FG	A25222FF	A25222FE
005	BEARING HOUSING	1	26089B	26089B	26089B	26089B
006	GATEROTOR BEARING HOUSING COVER	1	25789B	25789B	25789B	25789B
007	GATEROTOR COVER	1	26087B	26087B	26087B	26087B
008	RETAINING RING (3.346 X 0.109) BEVELED	1	26132C	26132C	26132C	26132C
009	HEX HEAD CAP SCREW (5/16 -18 NC X 1-1/4)	1	2867R	2867R	2867R	2867R
010	HEX HEAD CAP SCREW (1/2-13 NC X1-3/4)	4	2796B	2796B	2796B	2796B
011	HEX HEAD CAP SCREW (5/8-11 NC X 2-3/4)	10	2796EL	2796EL	2796EL	2796EL
012	HEX HEAD CAP SCREW (3/8-16 NC X 1-3/4)	24	2796GQ	2796GQ	2796GQ	2796GQ
013	HEX HEAD CAP SCREW (3/8-16 NC X 1-1/4)	10	2795AH	2795AH	2795AH	2795AH
014	ROLLER BEARING SHIM	6	2796CJ	2796CJ	2796CJ	2796CJ
015	BEARING RETAINER	1	25977Z	25977Z	25977Z	25977Z

Notes: Default standard design condition: Cast Iron housing with Aflas O-Rings

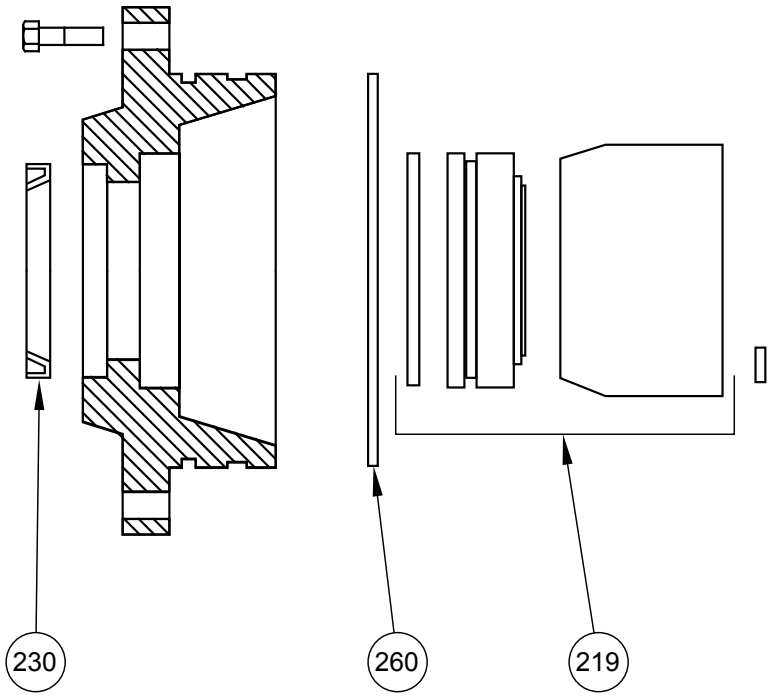
AR: As Required.

(1): Viton O-Rings

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Shaft Seal

Shaft Seal With Stationary Carbon Face



ITEM	DESCRIPTION	QTY	MODEL NUMBER			
			VSSG 291 thru VSSG 601 VSG 501 - 701	VSG 751-1301	VSG 1501 VSG 1801 VSG 1551- 2101	VSG 2401 - 3001
			VPN	VPN	VPN	VPN
	SHAFT SEAL AMM KIT (219, 260, 230)	1	KT709AG	KT709BG	KT709CG	KT709EG
219	SEAL SHAFT	1	25916B	25917B	25914B	25985P
230	OIL SEAL	1	25040A	2930F	2930B	2930E
260	O-RING	1	2825F	2825AR	2825W	2825X

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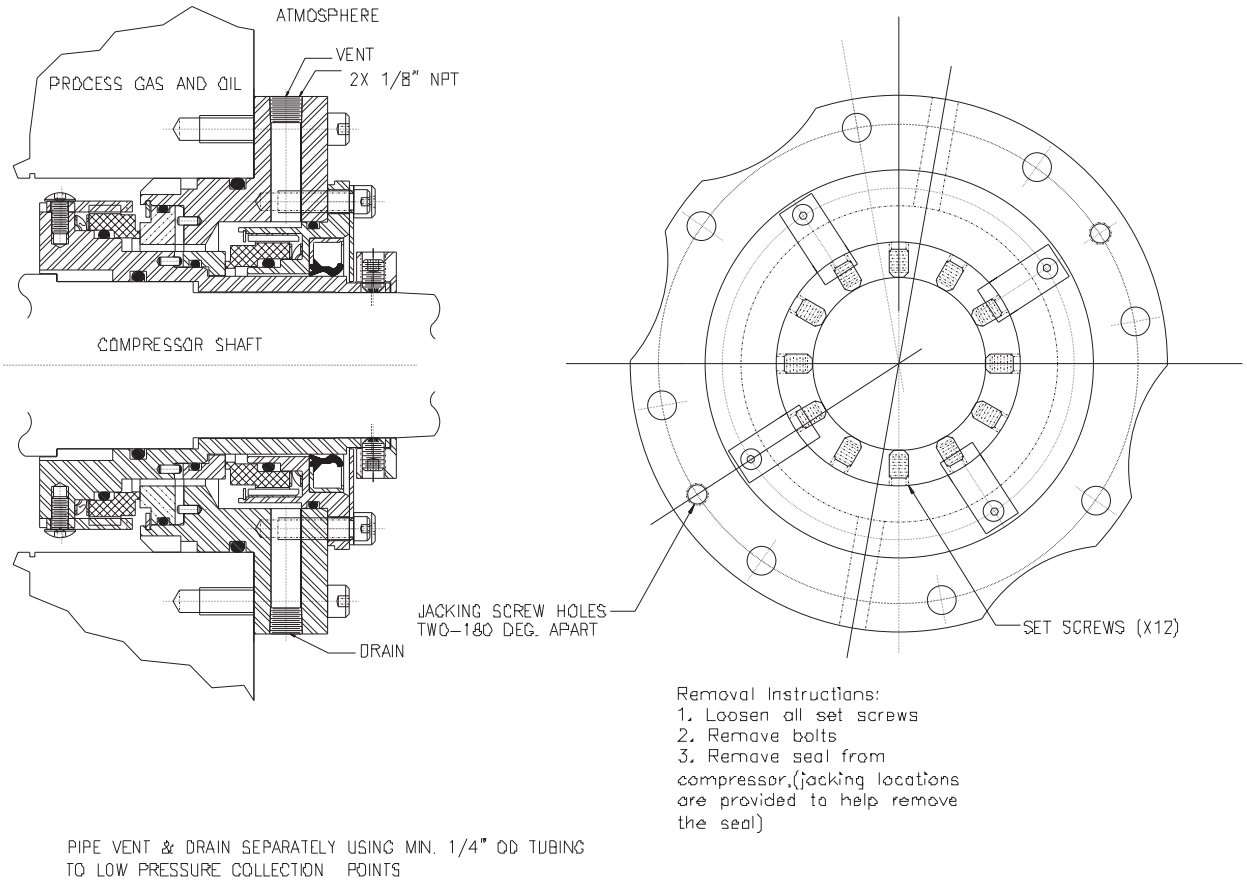
Tandem Shaft Seal



ITEM	DESCRIPTION	SHAFT DIAMETER			
		2.25"		2.875"	
		QTY	VPN	QTY	VPN
-	TANDEM SHAFT SEAL	1	25713A*	1	26380A***
		1	25713B**		

Notes- * - W/ Neoprene O-Rings. ** - W/ Viton O-Rings. *** - FEPM O-Rings.

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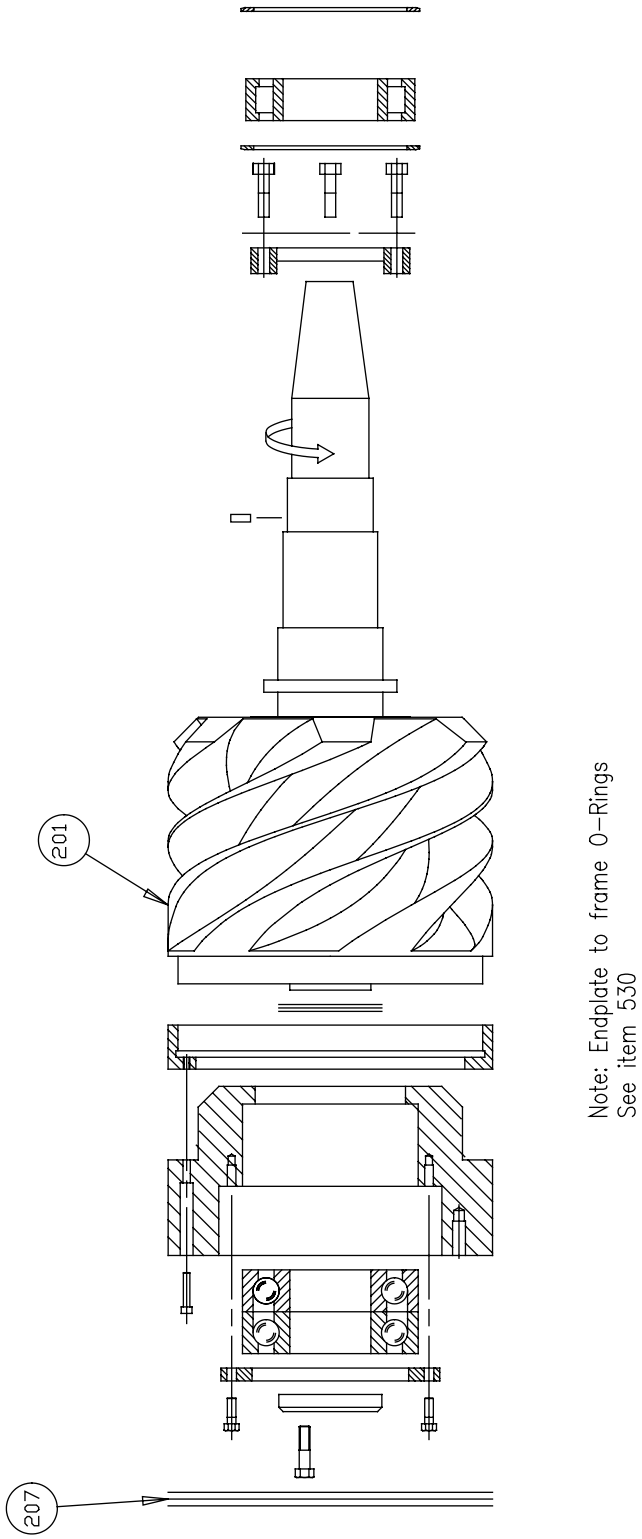
Main Rotor

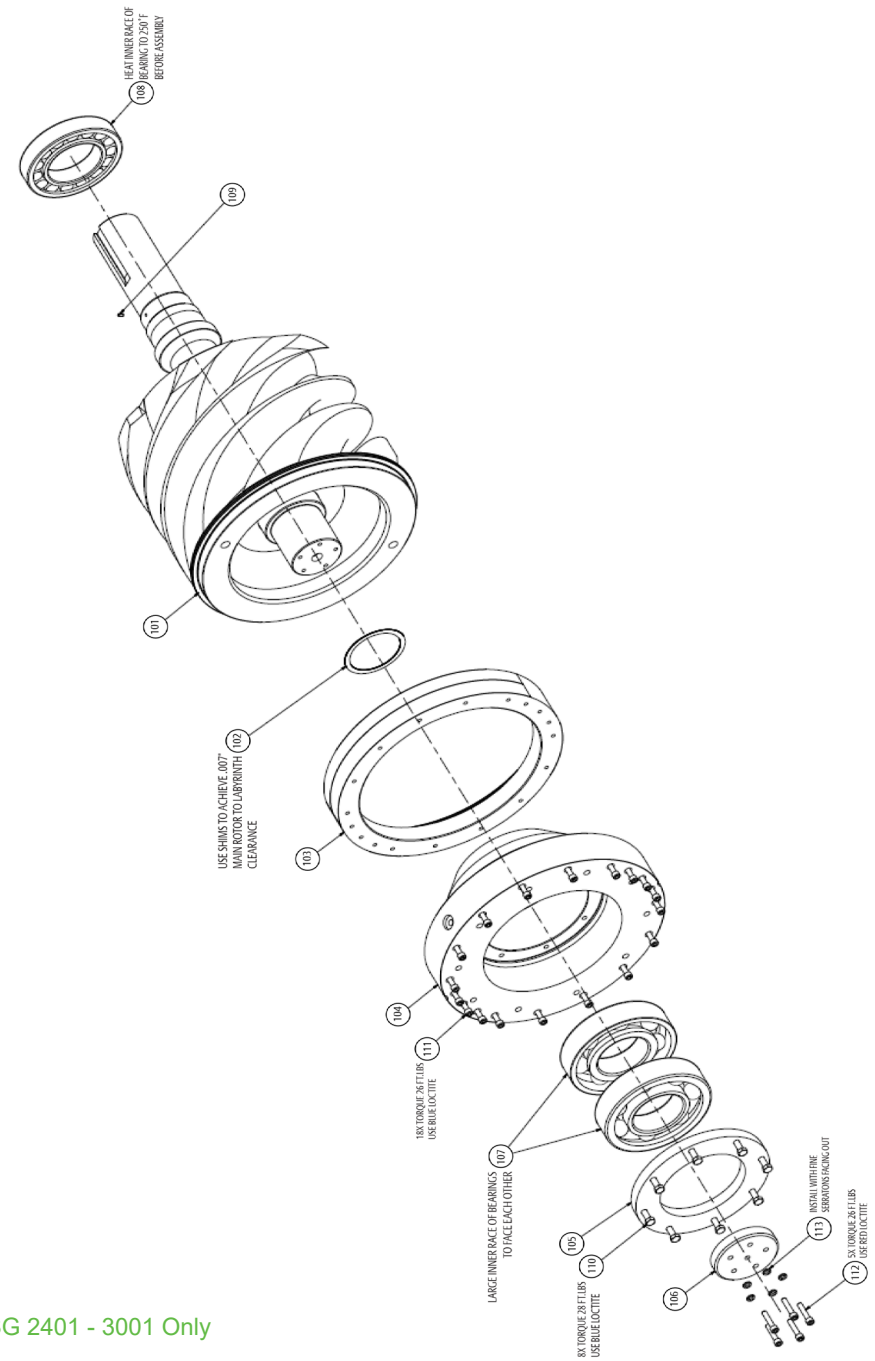
ITEM		207	201
MODEL NUMBER	QTY	DESCRIPTION	
		SHIM PACK	ROTOR ASSEMBLY
VSSG 291	1	A25177B	A25226BL
VSSG 341	1	A25177B	A25226BE
VSSG 451	1	A25177B	A25226BB
VSSG 601	1	A25177B	A25226BA
VSG 751	1	A25177C	A25226CB
VSG 901	1	A25177C	A25226CA
VSG 1051	1	A25177D	A25226DB
VSG 1201	1	A25177D	A25226DA
VSG 1301	1	A25177D	A25752HA
VSG 1501	1	A25177E	A25226EB
VSG 1551	1	A25177E	A25226EC
VSG 1801	1	A25177E	A25226EA
VSG 1851	1	A25177E	A25226ED
VSG 2101	1	A25177E	A25226EE



*For VSSG/VSG Models from 291 to 2101

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

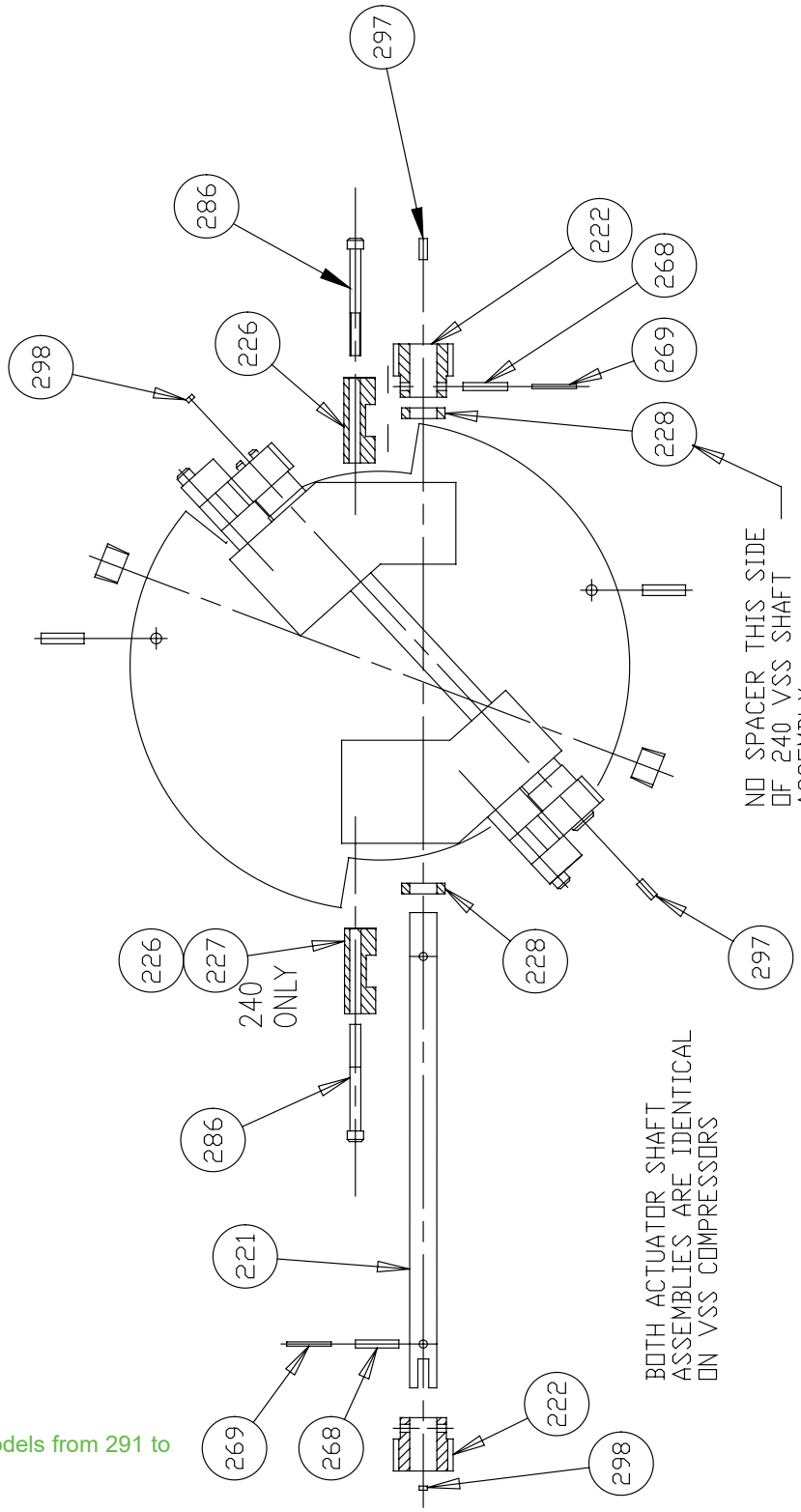
Main Rotor



*VSG 2401 - 3001 Only

ITEM	DESCRIPTION	QTY	MODEL NUMBER			
			VSG 2401	VSG 2601	VSG 2801	VSG 3001
			VPN	VPN	VPN	VPN
	ROTOR ASSEMBLY	1	A25226AN	A25226AM	A25226AL	A25226AK
102	SHIM PACK	1	A25177G	A25177G	A25177G	A25177G

Slide Valve Cross Shafts and End Plate



*For VSSG/VSG Models from 291 to 2101

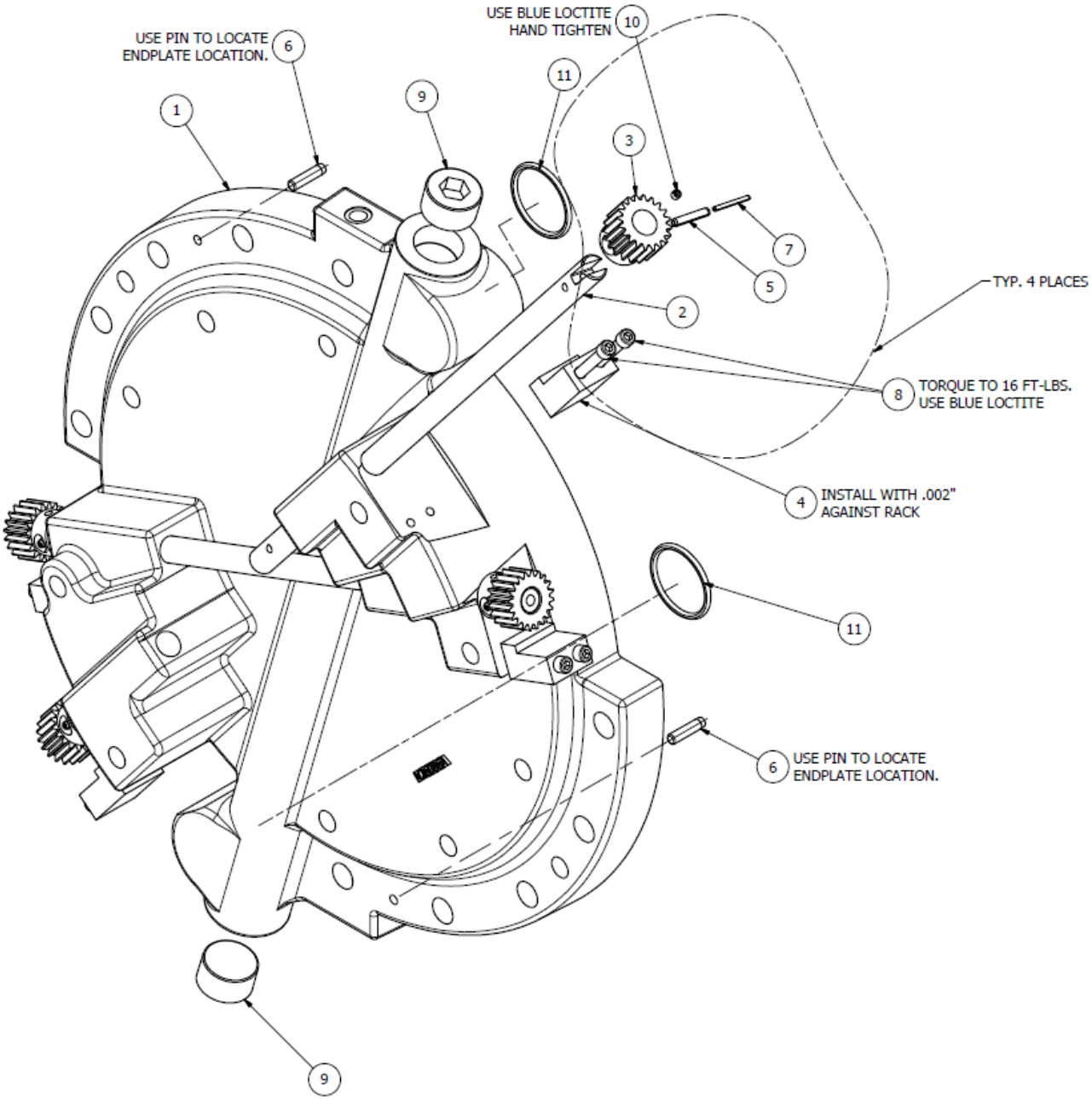
Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Slide Valve Cross Shafts and End Plate

ITEM	DESCRIPTION	MODEL NUMBER									
		VSSG 291 thru 601		VSG 751 - 901		VSG 1051 VSG 1201 VSG 1301		VSG 1501 VSG 1801		VSG 1551 - 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
220	END PLATE	-	N/A	1	25543A	1	25593A	1	25661A	1	25661A
221	SHAFT	2	25843A	2	25844A	2	25845A	2	25793A	2	25793A
222	GEAR	4	25027A	4	25027A	4	25027A	4	25027A	4	25027A
226	RACK CLAMP	2	25913A	4	25913C	4	25913C	4	25913C	4	25913C
227	RACK CLAMP	2	25913B	-	N/A	-	N/A	-	N/A	-	N/A
228	SPACER	2	25847A	4	25033C	4	25033C	4	25033C	4	25033C
267	DOWEL PIN	-	N/A	2	2868B	2	2868B	2	2868B	2	2868B
268	EXPANSION PIN	4	1193D	4	1193D	4	1193D	2	1193D	4	1193D
269	EXPANSION PIN	4	2981AA	4	2981AA	4	2981AA	2	2981AA	4	2981AA
270	PIPE PLUG	-	N/A	2	2606E	2	2606E	2	2606E	2	2606A
286	SOCKET HEAD CAP SCREW	8	2795F	8	2795F	8	2795F	8	2795F	8	2795F
297	SET SCREW	2	2060J	2	2060J	2	2060J	2	2060J	2	2060J
298	SET SCREW	2	2060H	2	2060H	2	2060H	2	2060H	2	2060H

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

End Plate (VSG 2401 - 3001 Only)



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End Plate (VSG 2401 - 3001 Only)

ITEM	DESCRIPTION	MODEL NUMBER	
		VSG 2401 - 3001	
		QTY	VPN
018	PIPE PLUG SOCKET HEX	2	13163F
019	O-RING (1.609 X 1.887) VITON	2	2825C
270	FLUSH SEAL PLUG 3/4-14 NPTF SOCKET HEAD	2	2606A
269	ROLL PIN (M2.5 X 26) STEEL	4	2981AA
286	SCREW (1/4-20 NC X 2) CAP SOCKET HEAD ASTM A574	8	2795Q
226	RACK CLAMP	4	25913E
298	SET SCREW (10-32 NF X 3/16) CUP PNT HEX	4	2060H
222	GEAR	4	25027A
220	END PLATE ASSEMBLY	1	A25849FAAF* A25849FAV**
221	COMMAND SHAFT	1	A25994FAF* A25994FV**
268	ROLL PIN (.187 X 1)	4	1193D
267	DOWEL PIN (1/4 X 1) STEEL	2	2868B

Notes: *: AFLAS. **: VITON.

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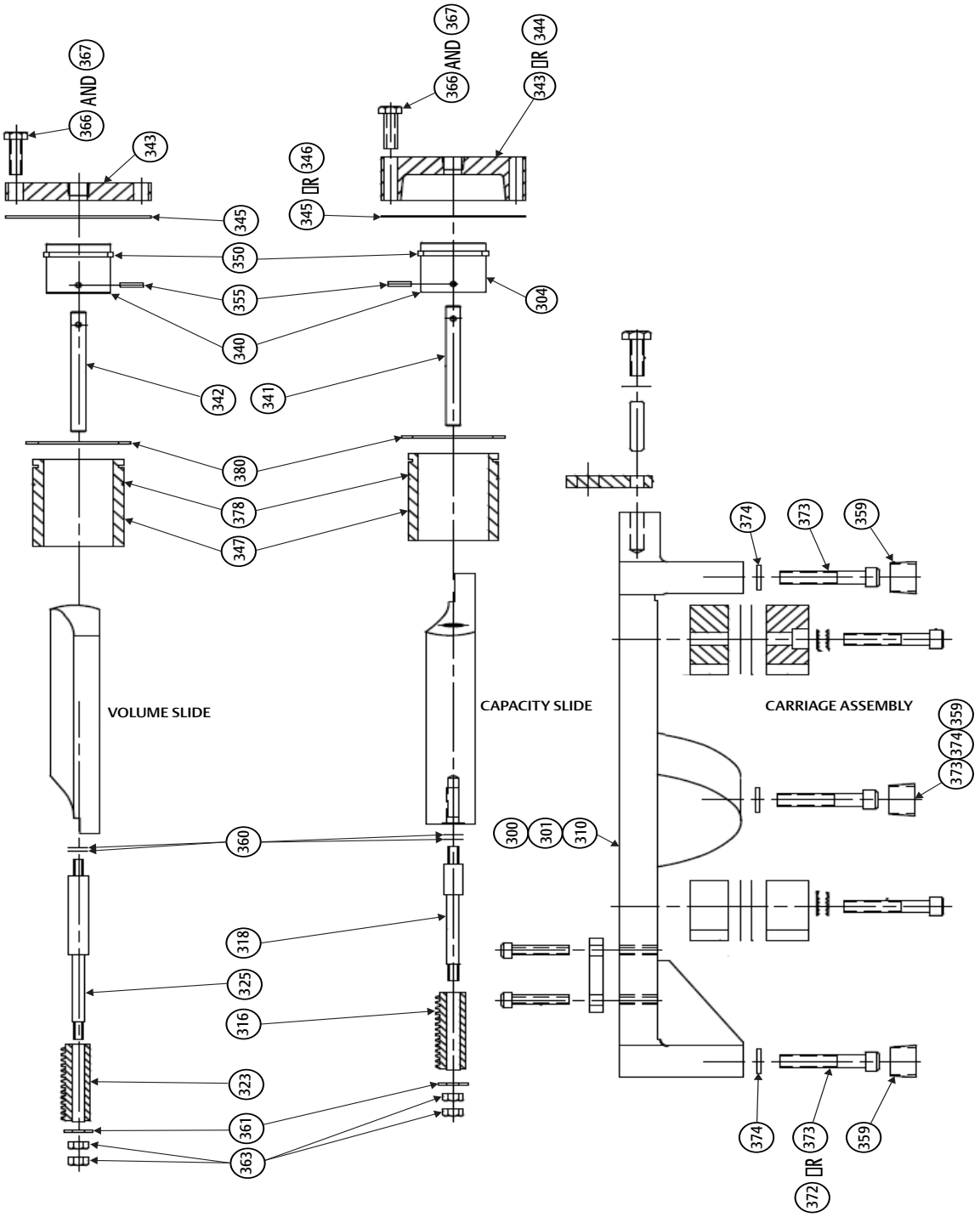
Slide Valve Carriage Assembly



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Slide Valve Carriage Assembly

ITEM	DESCRIPTION	MODEL NUMBER							
		VSSG 291 thru VSSG 601		VSG 751 thru VSG 901		VSG 1051 VSG 1201		VSG 1501 thru VSG 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
300	CARRIAGE ASSEMBLY	2	A25179B	2	A25179C	2	A25179D	2	A25179E
304	CAPACITY PISTON (340, 341, 350, 355)	2	A25183B	2	A25183C	2	A25183D	2	A25183E
305	VOLUME PISTON (340, 342, 350, 355)	2	A25184B	2	A25184C	2	A25184D	2	A25184E
307A	GASKET (345)	2	25900A	-	N/A	-	N/A	2	A25200E
307B	GASKET SET (345, 378)	-	N/A	2	A25200C	2	A25200D	-	N/A
316	RACK	2	25024AH	2	25080AH	2	25080CH	2	25779AH
323	RACK	2	25023AH	2	25080BH	2	25080DH	2	25080DH
325	SHAFT	-	N/A	-	N/A	-	N/A	2	25778A
340	PISTON	-	N/A	4	25076A	4	25138A	4	25782A
341	CAPACITY PISTON SHAFT	-	N/A	2	25078A	2	25078E	2	25784A
342	VOLUME PISTON SHAFT	-	N/A	2	25078B	2	25078F	2	25783A
343A	COVER, SEPARATE VOL. & CAP.	4	25022A	2	25123B	4	25123D	-	N/A
343B	COVER, ONE PIECE CAST	2	25399D	2	25279A	2	25401A	2	25690A
344	COVER, SEPARATE VOL. & CAP.	-	N/A	2	25123A	-	N/A	-	N/A
345A	GASKET, SEPARATE VOL. & n/a CAP COVERS.	4	25021A	2	25124B	4	25124C	-	N/A
345B	GASKET, ONE PIECE CAST COVER	2	25900A	2	25902A	2	25901A	2	25384A
346	GASKET, ONE PIECE CAST COVER	-	N/A	2	25124A	-	N/A	-	N/A
347	PISTON SLEEVE	-	N/A	2	25079A	-	N/A	4	25786A
350	PISTON RING SET	4	2953AA	4	2953AB	4	2953AC	4	2953AD
355	EXPANSION PIN	4	1193PP	4	1193PP	4	1193PP	4	1193PP
359	PIPE PLUG	6	2606D	6	2606D	6	2606D	6	2606E
360	LOCK WASHER (PAIR)	4	3004C	4	3004C	4	3004C	4	3004C
361	WASHER	4	13265B	4	13265B	4	13265B	4	13265B
363	NUT	8	2797A	8	2797A	8	2797A	8	2797A
366A	HEX HEAD CAP SCREW, SEPARATE VOL. & CAP COVERS.	24	2796N	12	2796B	24	2796B	-	N/A
366B	HEX HEAD CAP SCREW, ONE PIECE CAST COVER.	24	2796B	12	2796P	24	2796P	28	3796BL
367	HEX HEAD CAP SCREW	-	N/A	12	2796BN	-	N/A	-	N/A
373	SOCKET HEAD CAP SCREW	-	N/A	6	2795N	6	2795P	6	2795AG
374	LOCK WASHER (PAIR)	-	N/A	6	3004C	6	3004D	6	3004D
378	O-RING	-	N/A	2	2825AN	-	N/A	4	2825U
380	RETAINER RING	-	N/A	2	2866C	-	N/A	4	2866G

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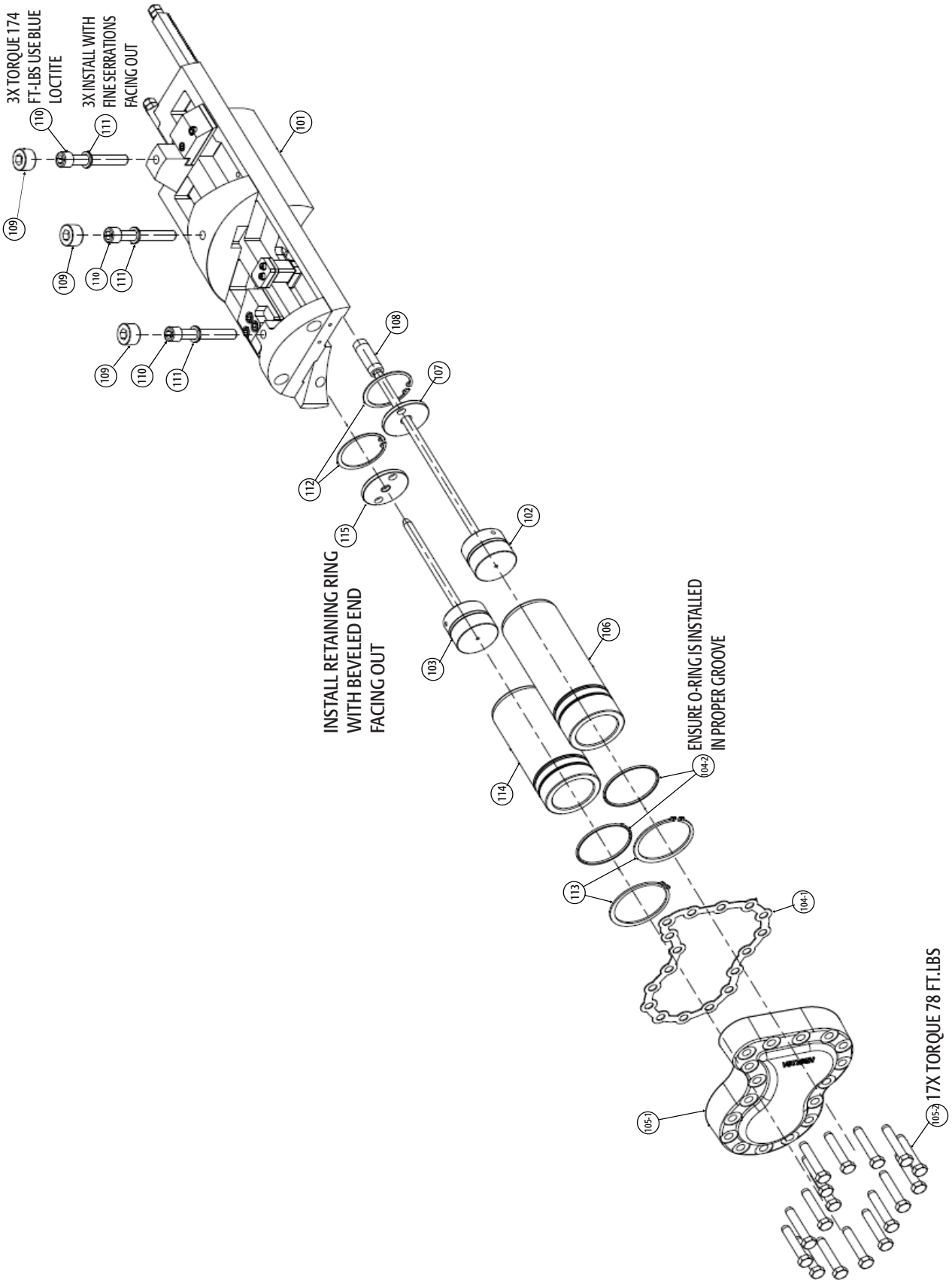
Slide Valve Carriage Assembly (VSG 2401 - 3001 Only)



Slide Valve Carriage Assembly (VSG 2401 - 3001 Only)

ITEM	DESCRIPTION	MODEL NUMBER	
		VSG 2401 thru VSG 3001	
		QTY	VPN
101	CARRIAGE ASSEMBLY	1	A25179K
102	CAPACITY PISTON	1	A25183GS
103	VOLUME PISTON	1	A25184GS
104	SMALL PISTON SEAL	1	A25200FS
105	PISTON COVER	1	A25220F
106	SMALL CAPACITY PISTON SLEEVE	1	26113E
107	PISTON SHAFT GUIDE WASHER CAP SM	1	26115D
108	PIPE NIPPLE (1/2 X 2-1/2)	1	13189D
109	PIPE SOCKET PLUG HEX	3	13163F
110	SCREW (5/8-16 NC X 4) CAP SOCKET	3	2795BE
111	NORD LOCK WASHER (.625) PERMANENTLY TIGHT	3	3004H
112	RETAINING RING (2.875 X 0.093) INT BEVELED	2	2867AQ
113	RETAINING RING (3.500) EXTERNAL BASIC	2	2866AC
114	VOLUME PISTON SLEEVE	1	26114E
115	PISTON SHAFT GUIDE WASHER	1	26115C

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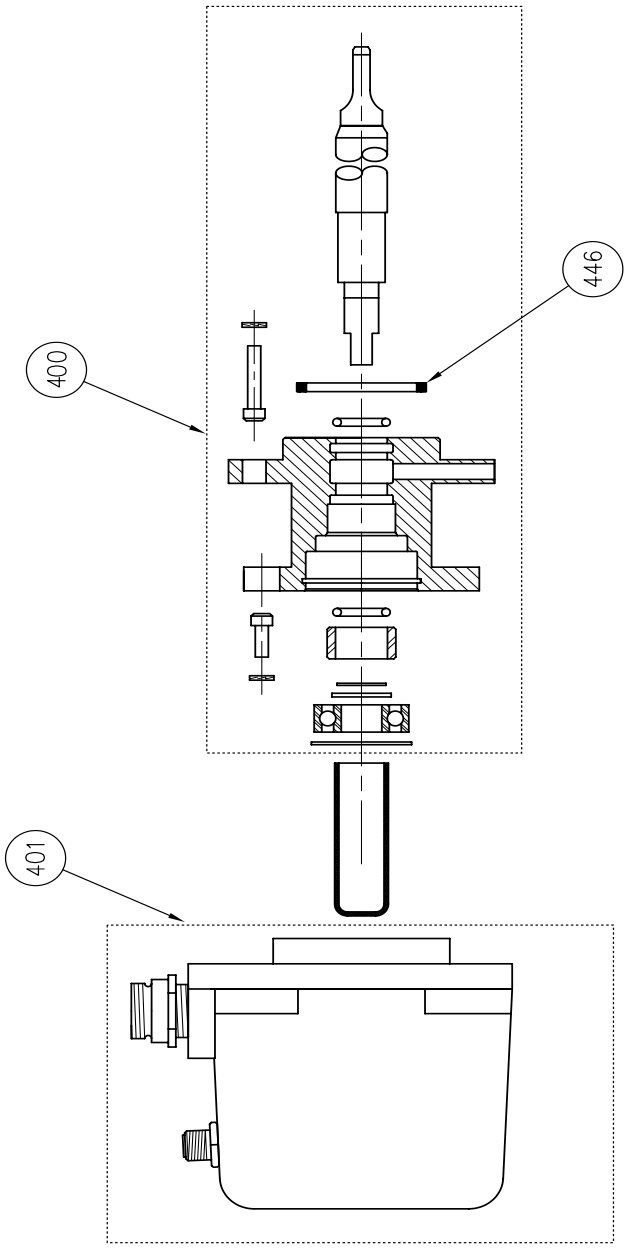
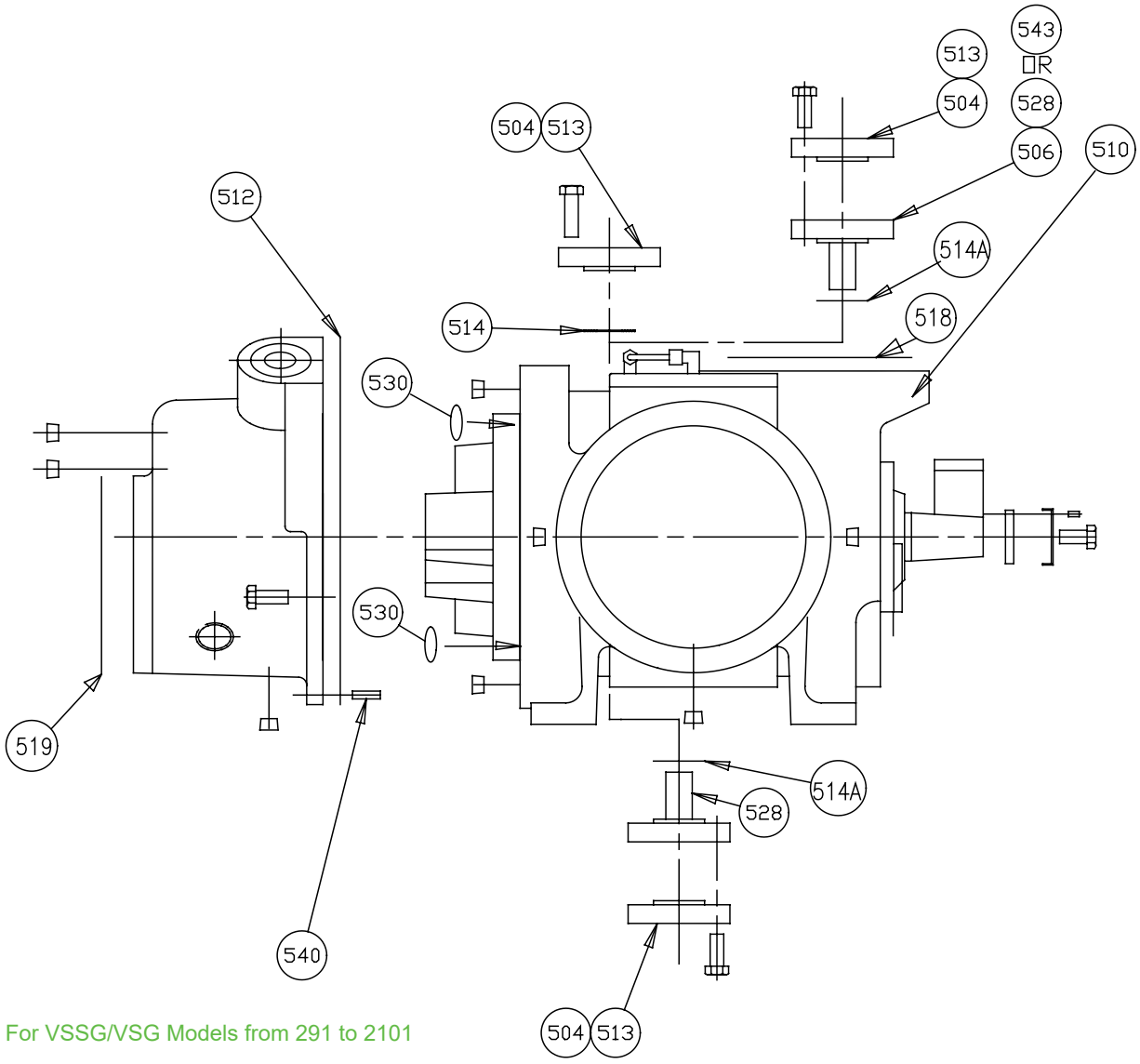
Actuator and Command Shaft



ITEM	DESCRIPTION	QTY	MODEL NUMBER				
			VSSG 291 thru VSSG 601	VSG 751 thru VSG 901	VSG 1051 VSG 1201 VSG 1301	VSG 1551 thru VSG 2101	VSG 2401 thru VSG 3001
			VPN	VPN	VPN	VPN	VPN
400	COMMAND SHAFT ASSEMBLY	2	A25994B	A25994C	A25994D	A25994E	A25994F
401	SLIDE VALVE ACTUATOR	2	25972D or 25972XP	25972D or 25972XP	25972D or 25972XP	25972D or 25972XP	25972D or 25972XP
446	O-RING SEAL	2	2825C	2825C	2825C	2825C	2825C

Miscellaneous Frame Components (VSSG 291 - VSG 2101)

VSG Screw Compressor



For VSSG/VSG Models from 291 to 2101

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Miscellaneous Frame Components (VSSG 291 - VSG 2101)

ITEM	DESCRIPTION	MODEL NUMBER							
		VSSG 291 thru 601		VSG 751 VSG 901		VSG 1051 VSG 1201		VSG 1551 thru VSG 2101	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
-	GASKET & O-RING KIT	1	KT710AN	1	KT710B	1	KT710C	1	KT710D
504	FLANGE SET (513, 514, 547A)	1	A25190A	1	A25190A	1	A25190B	1	A25190C
504	FLANGE SET 513A, 514A & 547 ECON-O-MIZER PORT	-	N/A	-	N/A	-	N/A	2	A25190D
506	ECON-O-MIZER PORT	2	A25190B	-	N/A	-	N/A	-	N/A
512	MANIFOLD GASKET	1	25503A	1	25541A	1	25324A	1	25676A
513	FLANGE OIL	1	25058A	1	25058A	1	25058B	1	12477C
513	FLANGE ECON-O-MIZER	2	25058A	-	N/A	-	N/A	-	N/A
514	FLANGE GASKET OIL	1	11323D	1	11323D	1	11323E	1	11323F
514	FLANGE GASKET ECON-O-MIZER	2	11323D	-	N/A	-	N/A	-	N/A
518	SUCTION FLANGE GASKET	1	25199C	1	25199C	1	25199D	1	25199D
519	DISCHARGE FLANGE GASKET	1	25199B	1	25199B	1	25199C	1	25199C
526	ORIFICE PLATE	-	N/A	1	25223CB (751) 25223CA (901)	1	25223DB	-	N/A
527	INLET SCREEN	-	N/A	-	N/A	-	N/A	-	N/A
528	ECONOMIZER PLUG	-	N/A	-	N/A	-	N/A	-	N/A
529	WAVE SPRING	-	N/A	1	2912E	1	2912E		
530	O-RING	2	2825B	2	2825R	2	2825R	2	2825R
538	PIPE PLUG 3/4" MPT	-	N/A	-	N/A	6	2606A	3	2606A
539	PIPE PLUG	-	N/A	-	N/A	-	N/A	-	N/A
540	DOWEL PIN	2	2868B	2	2868B	2	2868B	2	2868K
542	PIPE PLUG 3/4" MPT	-	N/A	-	N/A	-	N/A	1	13163F
545	HEX HEAD CAP SCREW FOR OIL SUPPLY FLANGE	2	2796C	-	N/A	-	N/A	4	11397E
545	HEX HEAD CAP SCREW FOR ECON-O-MIZER FLANGE	4	2796C	-	N/A	-	N/A	-	N/A
547	HEX HEAD CAP SCREW	8	2796C	24	2796GP	24	2796GP	-	N/A
554	HEX HEAD CAP SCREW	-	N/A	1	2796U	1	2796U	-	N/A

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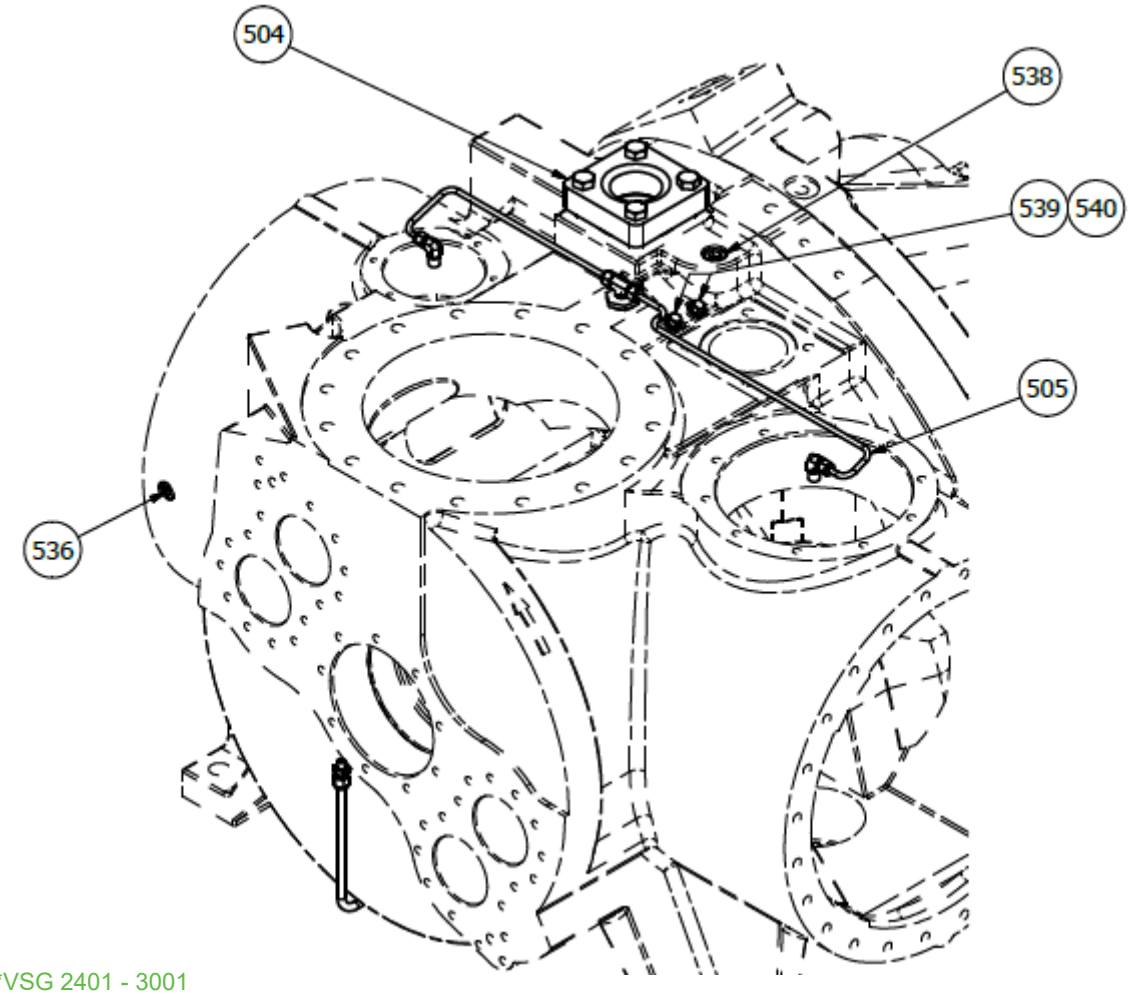
Miscellaneous Frame Components (VSG 2401 - 3001)



*VSG 2401 - 3001

ITEM	DESCRIPTION	MODEL NUMBER VSG 2401 - 3001	
		QTY	VPN
504	FLANGE SET (1.250)	1	A25190EA
505	TUBING	1	A25201F
536	FLUSH SEAL PLUG (1/2-14 NPTF) SOCKET HEAD	2	2606E
538	FLUSH SEAL PLUG (3/4-14 NPTF) SOCKET HEAD	3	2606A
539	PLUG, LIQUID INJECTION	4	26293A
540	O-RING (0.171 X 0.499) VITON	4	2825AT
*	GASKET & O-RING KIT	1	KT710EV
*	FLANGE	1	12478G
*	PLUG SET, ECONOMIZER	1	A25243BB

Note: N/A: Not Shown.

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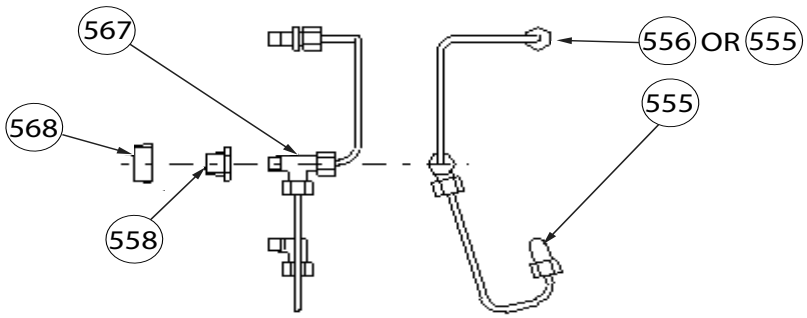
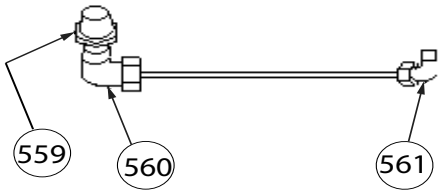
Miscellaneous Frame Components Tubing and Fittings (VSSG 291 - VSG 1801)

Gaterotor Bearing Supply Lines

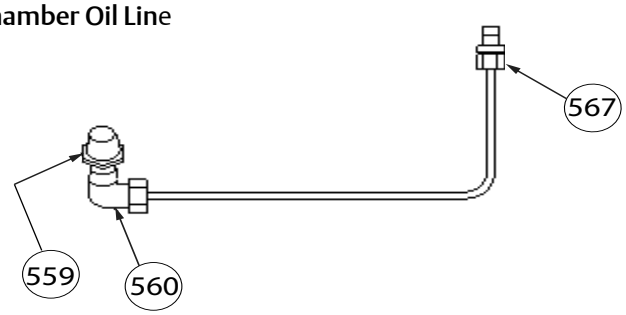


VSSG 291 - VSG 1801

Seal Chamber Oil Line

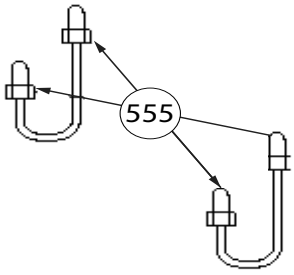


VSSG 291 - VSG 1201

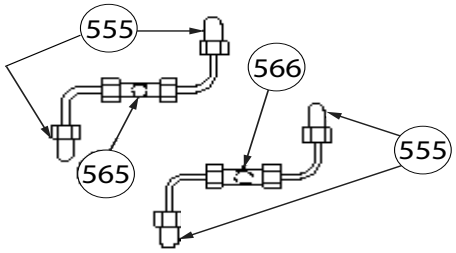


VSG 1501 & VSG 1801

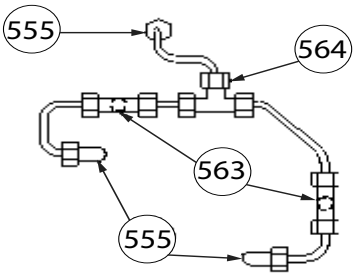
Slide Valve Balance Piston Equalizing Line



VSSG 291 to VSSG 601



VSG 751 & VSG 901



VSG 1051 & VSG 1201

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Miscellaneous Frame Components Tubing and Fittings (VSSG 291 to VSG 1801)

ITEM	DESCRIPTION	MODEL NUMBER							
		VSSG 291 VSSG 601		VSG 751 VSG 901		VSG 1051 VSG 1201		VSG 1501 VSG 1801	
		QTY	VPN	QTY	VPN	QTY	VPN	QTY	VPN
555	MALE ELBOW (1/4 ODT X 1/4 MPT) 90°	5	13375D	5	13375D	3	13375D	2	13375D
556	STRAIGHT (1/4 ODT X 1/4 MPT)	1	13229D	1	13229D	2	13229D	-	N/A
557	TEE, MALE RUNNING (1/4 OD X 1/4 MPT)	1	1509A	1	1509A	1	1509A	1	13376D
558	HEX BUSHING	1	13231AA	1	13231AA	1	1101H	1	13231AA
559	HEX BUSHING	-	N/A	-	N/A	1	1101K	1	1101K
560	MALE ELBOW (3/8 ODT X 1/2 MPT) 90°	1	13375Z	1	13375Z	1	13375Z	1	13375Z
561	MALE ELBOW (3/8 OD X 1/4 MPT 90°)	1	13375F	1	13375F	1	13375F	-	N/A
562	PLUG	1	2606E	1	2606E	1	2606A	-	N/A
563	BRANCH TEE (1/4 ODT X 1/4 ODT X 1/4 MPT)	-	N/A	-	N/A	2	13376D	-	N/A
564	TEE (1/4)	-	N/A	-	N/A	1	13239C	-	N/A
565	FEMALE TEE (1/4T X 1/4T X 1/4 FPT)	-	N/A	2	1884A	-	N/A	-	N/A
566	PIPE NIPPLE (1/4 X 2-1/2)	-	N/A	2	13181D	-	N/A	-	N/A
567	CONNECTOR SET (1/2-13 NC-2 X 1)	-	N/A	-	N/A	-	N/A	1	13299C
568	REDUCING BUSHING (1 X 1/4)	-	N/A	-	N/A	-	N/A	1	1101M

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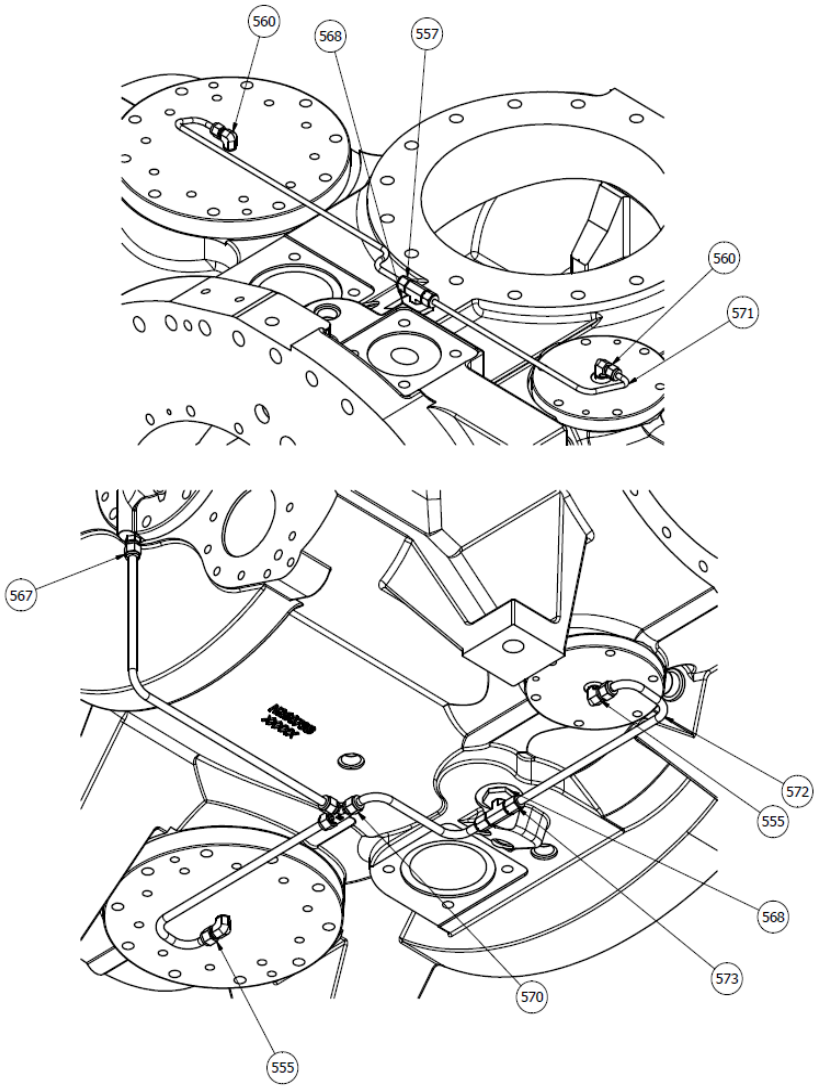
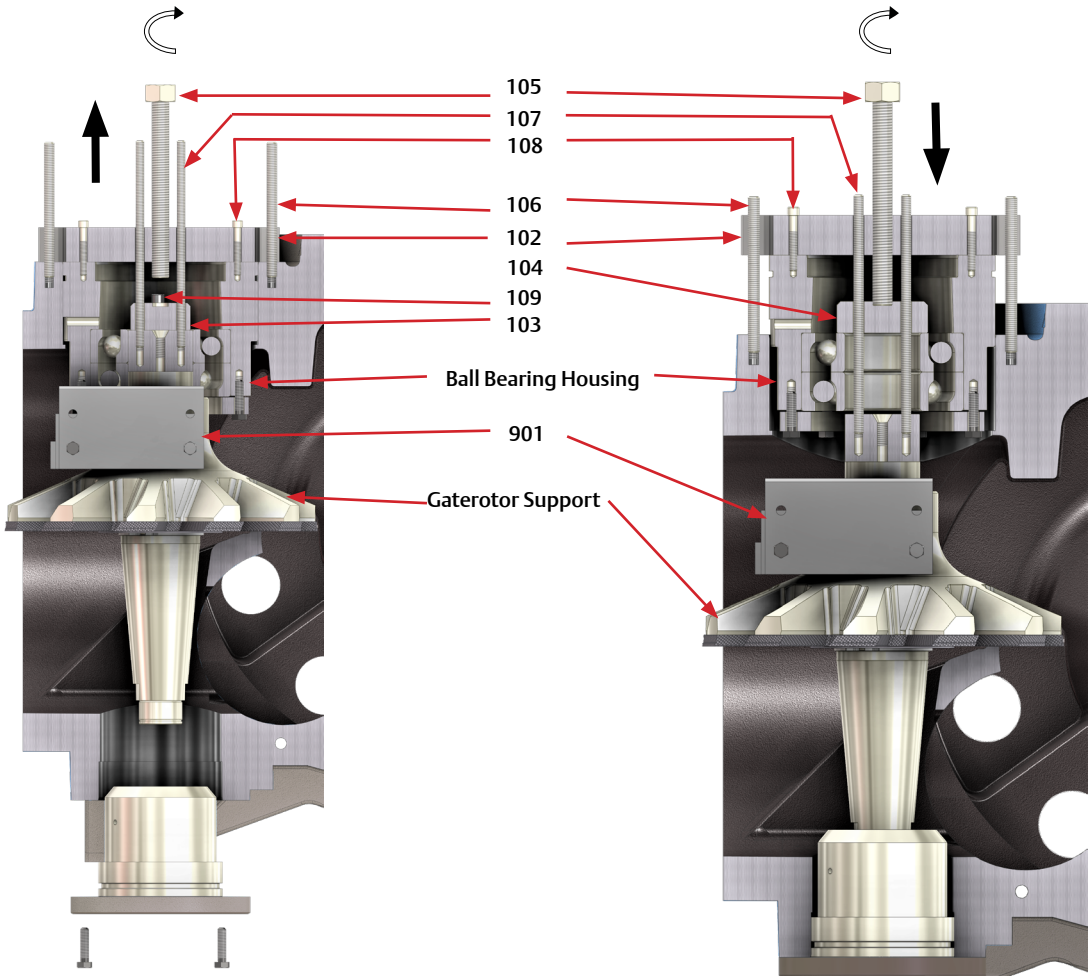
Miscellaneous Frame Components Tubing and Fittings (VSG 2401 - 3001)



ITEM	DESCRIPTION	MODEL NUMBER	
		VSG 2401 - VSG 3001	
		QTY	VPN
555	MALE ELBOW (3/8 ODX 1/4MPT) 90°	2	13375F
557	BRANCH MLE TEE (1/4ODTX1/4ODTX1/4MPT)	1	13376D
560	MALE ELBOW (1/4ODTX1/4MPT) 90°	2	13375D
567	COMPRESSION CONNECTOR (3/8 ODT X 1/8MPT)	1	13229W
568	BUSHING (1 X 1/4) HEXAGON	2	1101M
570	UNION TUBE TEE (3/8)	1	13239E
573	BRANCH MALE TEE (3/80 DT X 1/4MPT)	1	2084A
571	STEEL TUBING (1/4 X .035) SMLS	2	3509A
572	STEEL TUBING (3/8 X .035) SMLS	4	3509B

Replacement Tools

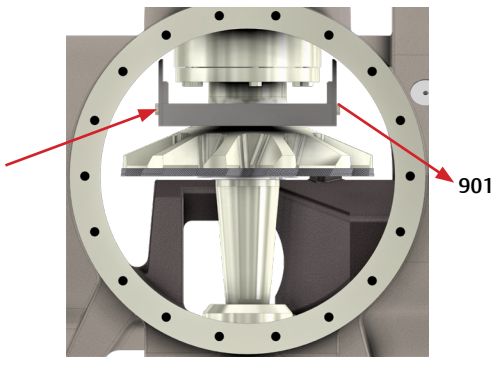


TO REMOVE BEARING HOUSING

TO INSTALL BEARING HOUSING

Position	Description
901	STABILIZER
102	BAR PULLER
103	PULLER SHOE
104	PUSHER SHOE
105	SCREW JACKING
106	STUD
107	STUD
108	SCREW
109	SCREW

For VSG 751-901 & VSG 1051/1201 ASSEMBLE SIDE RAILS AS STAMPED. FOR VSSG 291-601 COMPRESSORS, DO NOT USE SIDE RAILS. FOR VSG 1551 & 1801, ASSEMBLE SIDE RAILS ONLY ONE WAY



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Replacement Tools

ITEM	DESCRIPTION	QTY	MODEL NUMBER				
			VSSG 291 thru 601	VSG 751 VSG 901	VSG 1051 VSG 1201 VSG 1301	VSG 1551 thru VSG 2101	VSG 2401 thru VSG 3001
			VPN	VPN	VPN	VPN	VPN
900	GATEROTOR TOOLS (901, 910, 911, 912, 913, 914, 915, 916, 917)	1	A25205B	A25205C	A25205C	A25205E	A25205F
901A	GATEROTOR STABILIZER SET (901A, 901B, 901C)	1	A25698A	A25698A	A25698A	A25699A	N/A

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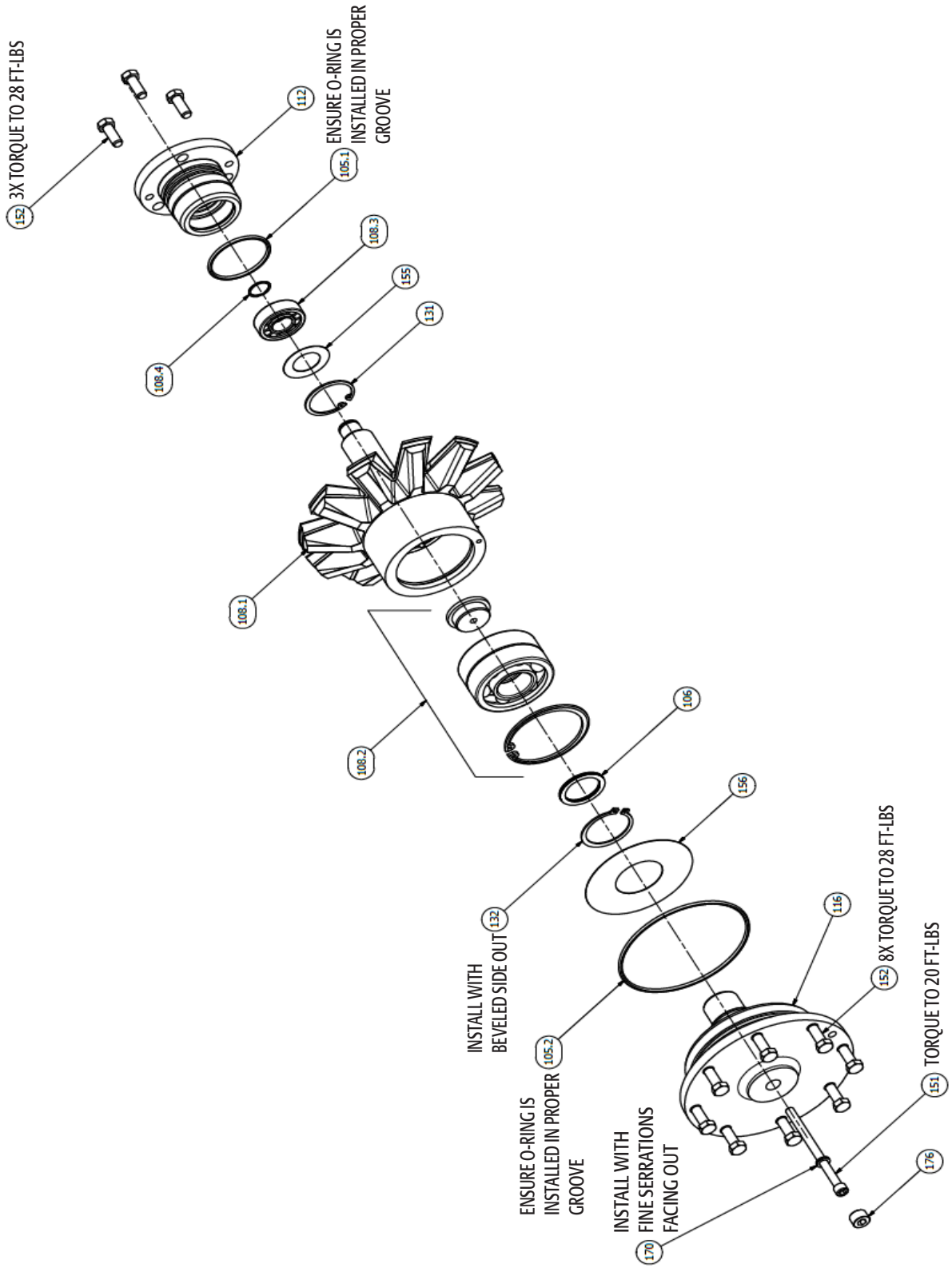
VSG 301 - 701
Recommended Spare Parts List

Refer to the Custom Manual
Spare Parts Section for Specific Applications

Please have your Model # and Sales Order # available when ordering.
These are found on the compressor's Name Plate.

Gaterotor Assembly



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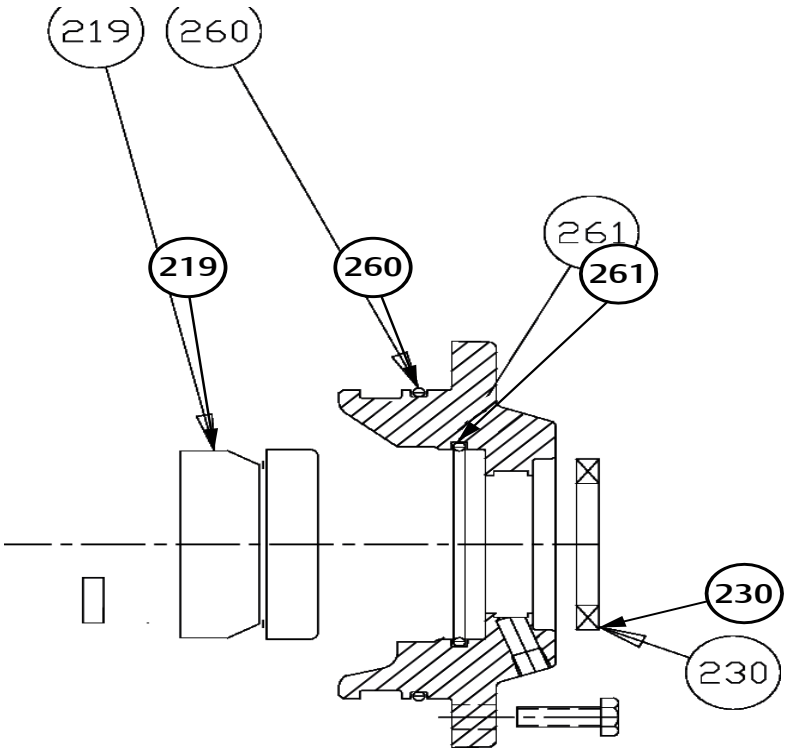
Gaterotor Assembly

Part totals indicated are for one gaterotor assembly, machines with two gaterotors will require double the components listed below.

ITEM	DESCRIPTION	MODEL NUMBER							
		QTY	VSG 301	VSG 361	VSG 401	QTY	VSG 501	VSG 601	VSG 701
			VPN	VPN	VPN		VPN	VPN	VPN
	GATEROTOR BLADE REPLACEMENT KITS	1	KT1098A	KT1098B	KT1098C	1	KT1098D	KT1098E	KT1098F
	GATEROTOR BEARING REPLACEMENT KITS	1	KT759F	KT759G	KT759H	1	KT759BG (REMAN)	KT759BH (REMAN)	KT759BJ (REMAN)
105	SEAL GATEROTOR	1	A25164A A25164AV*	A25164A A25164AV*	A25164A A25164AV*	1	A25164B	A25164B	A25164B
105.1	O-RING	1	2825AL	2825AL	2825AL	1	2825D	2825D	2825D
105.2	O-RING	1	2825F	2825F	2825F	1	2825G	2825G	2825G
106	SHIM GATEROTOR	1	A25165A	A25165A	A25165A	1	A25165B	A25165B	A25165B
108	SUPPORT GATEROTOR	1	A25222AB	A25222AA	A25222AC	1	A25222BB	A25222BA	A25222BC
108.1	SUPPORT GATEROTOR	1	A25161AB	A25161AA	A25161AC	1	A25161BB	A25161BA	A25161BC
108.2	BALL BEARING	1	A25163A	A25163A	A25163A	1	A25163B	A25163B	A25163B
108.3	ROLLER BEARING	1	2864F	2864F	2864F	1	2864B	2864B	2864B
108.4	RETAINING RING 0.781 ID X .065 X .031	1	2928Y	2928Y	2928Y	1	2928W	2928W	2928W
112	HOUSING GATEROTOR ROLLER BEARING	1	25407B	25407B	25407B	1	25407C	25407C	25407C
116	SUPPORT GATEROTOR BALL BEARING	1	25408B	25408B	25408B	1	25408C	25408C	25408C
131	RETAINING RING	1	2867S	2867S	2867S	1	2867A	2867A	2867A
132	RETAINING RING 1.875 x 0.062 EXTERNAL BEVELED	1	2866J	2866J	2866J	1	2866K	2866K	2866K
151	SCREW	1	2795AP	2795AP	2795AP	1	2795AAA	2795AAA	2795AAA
152	SCREW 3/8-16 NC X 1	11	2796CG	2796CG	2796CG	12	2796CG	2796CG	2796CG
155	SHIM	AR	25977D	25977D	25977D	AR	25977G	25977G	25977G
156	SHIM	AR	25977C	25977C	25977C	AR	25977H	25977H	25977H
170	WASHER .312	1	3004C	3004C	3004C	1	3004C	3004C	3004C
176	PLUG 3/8-18 NPTF FLUSH SEAL SOC HD	1	2606D	2606D	2606D	1	2606D	2606D	2606D

Notes: AR: As Required. *: VITON.

Shaft Seal



ITEM	DESCRIPTION	MODEL NUMBER			
		VSG 301 - 401		VSG 501 - 701	
		QTY	VPN	QTY	VPN
*	SHAFT SEAL KIT VITON KIT (219, 230, 260)	1	KT709DG	1	KT709AG
219	SHAFT SEAL.	1	A	1	A
230	OIL SEAL.	1	2930C	1	25040A
244**	TEFLON SEAL	1	25939A	1	25939A
252**	RETAINER RING	1	2928M	1	2928M
260	O-RING	1	2825T	1	2825F
261	O-RING.(205 Only)	1	2825AX	-	N/A

Notes - * - Not Pictured.

A - Sold Only As Kit.

** - See recommended spare parts lists for complete assembly.

N/A - Not Available.

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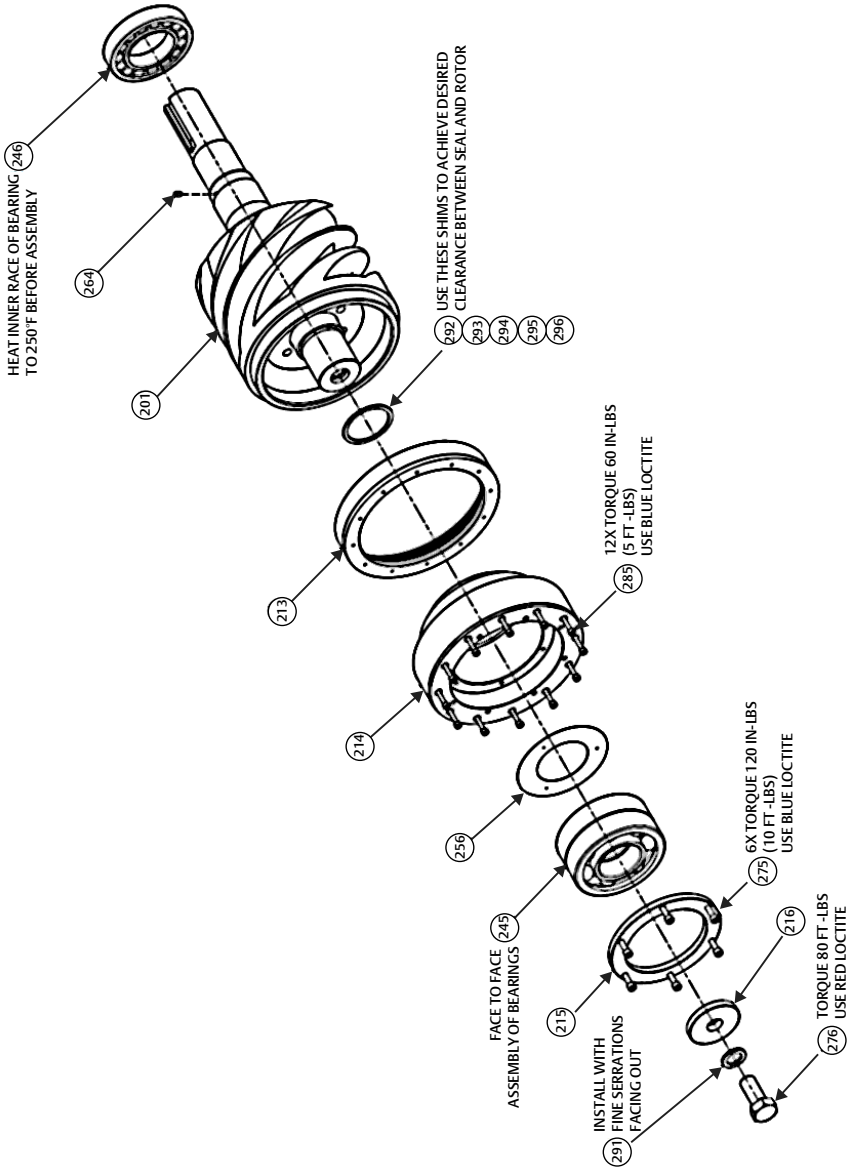
Main Rotor

Models VSG 301-401 Counter Clockwise ONLY

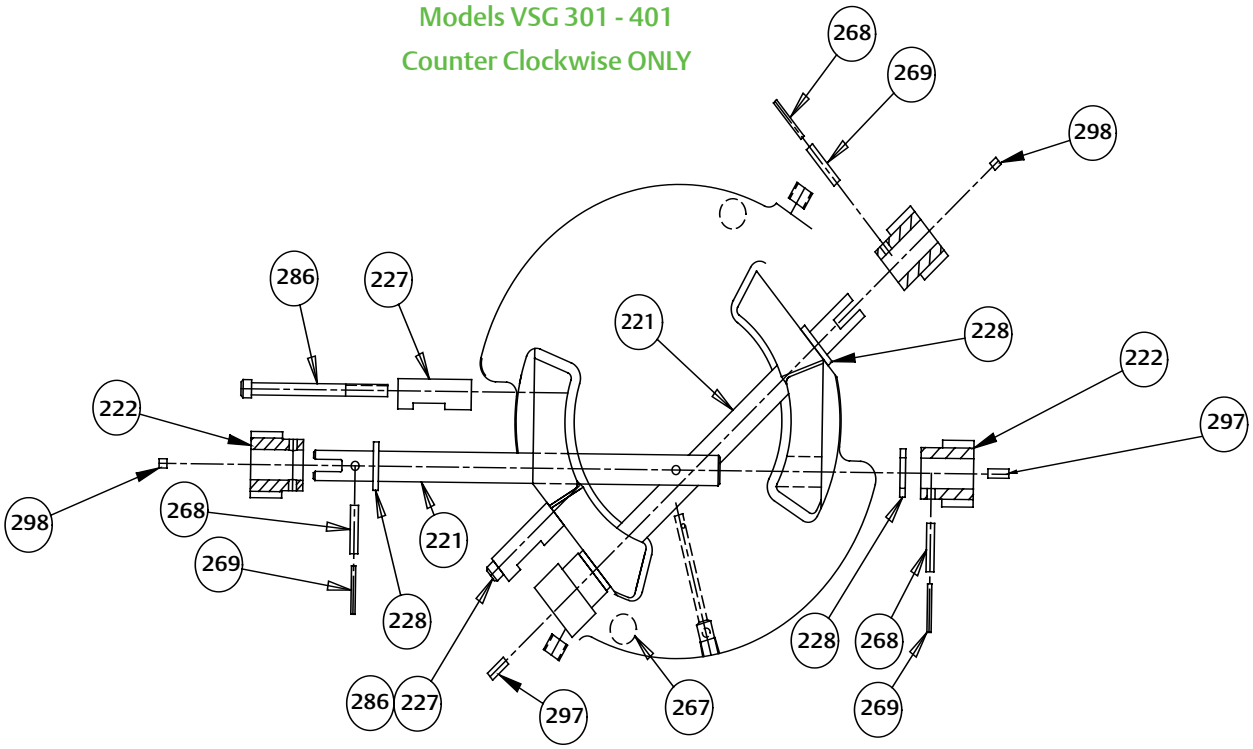
Models VSG 501-701 Clockwise ONLY



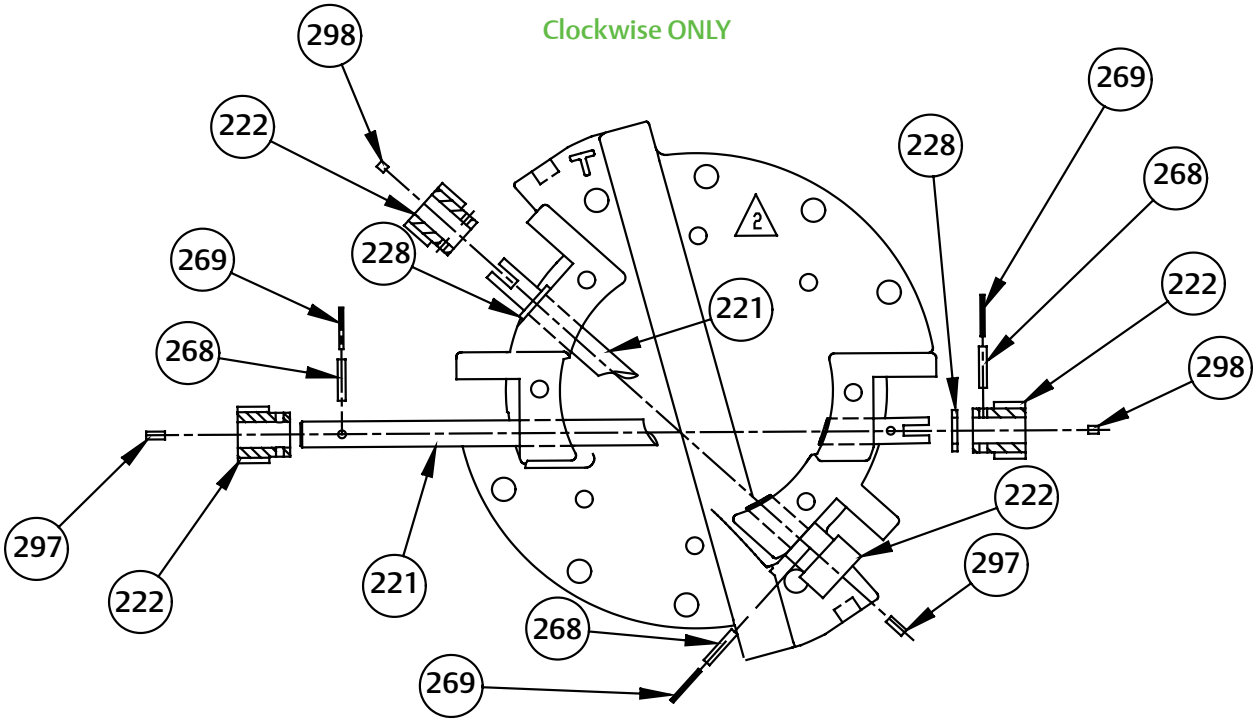
ITEM	DESCRIPTION	MODEL NUMBER							
		QTY	VSG 301	VSG 361	VSG 401	QTY	VSG 501	VSG 601	VSG 701
			VPN	VPN	VPN		VPN	VPN	VPN
	MAIN ROTOR ASSEMBLY	1	A25226AB	A25226AA	A25226AC	1	A26010BB	A26010BA	A26010BC
201	ROTOR	1	A25716AB	A25716AA	A25716AC	1	A26007BB	A26007BA	A26007BC
-	OIL BAFFLE ASSEMBLY	1	A25942AA	A25942AA	A25942AA	1	A26034B	A26034B	A26034B
292-296	SHIM ASSORTMENT	1	A25177A	A25177A	A25177A	1	A25177B	A25177B	A25177B

Slide Valve Cross Shafts and End Plate

Models VSG 301 - 401
Counter Clockwise ONLY



Models VSG 501 - 701
Clockwise ONLY



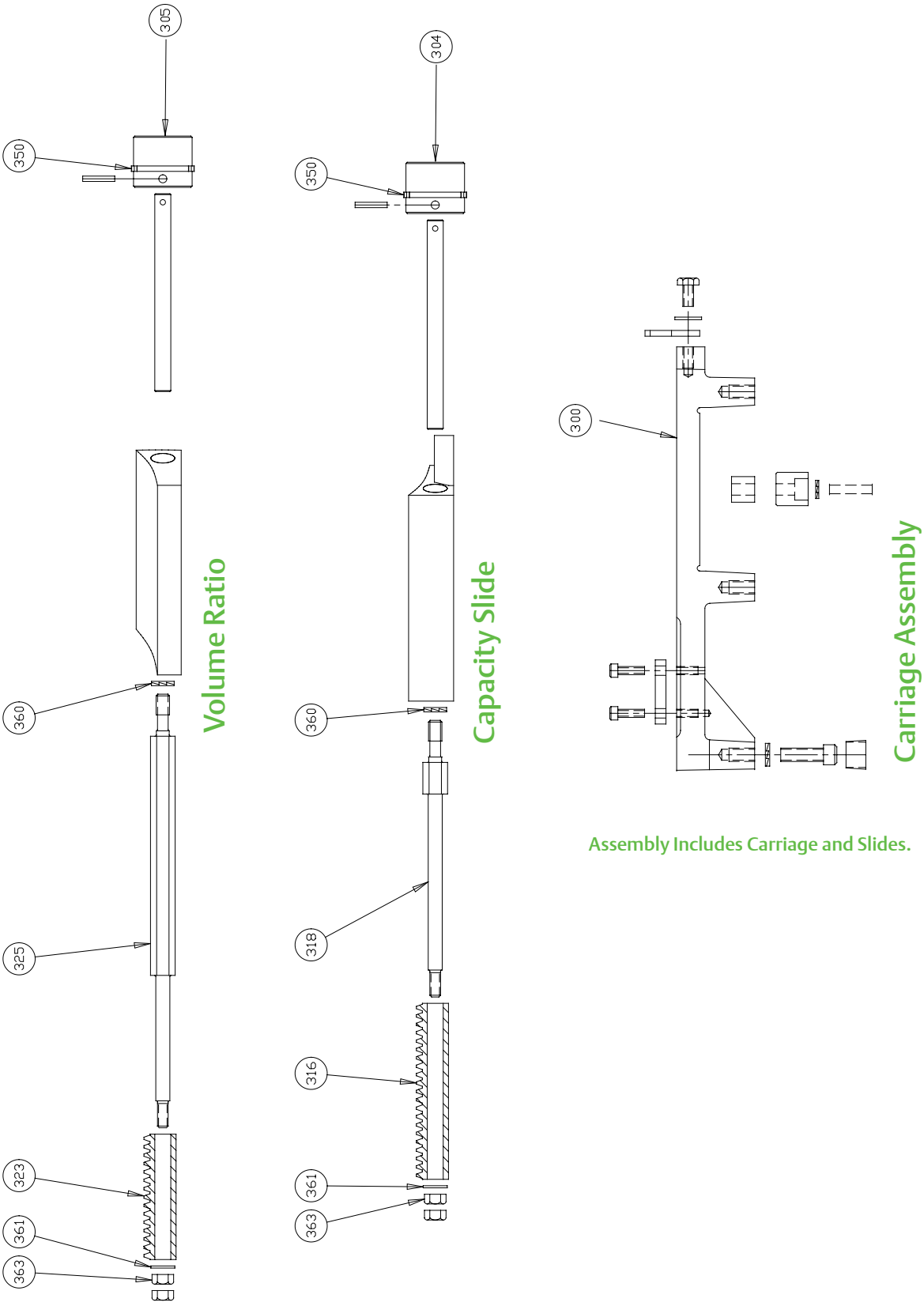
Slide Valve Cross Shafts and End Plate

ITEM	DESCRIPTION	MODEL NUMBER							
		QTY	VSG 301	VSG 361	VSG 401	QTY	VSG 501	VSG 601	VSG 701
			VPN	VPN	VPN		VPN	VPN	VPN
-	OIL BAFFLE ASSEMBLY ((1) 217, (1) 244, (1) 248, (1) 249, (1) 252)	1	A25942AA	A25942AA	A25942AA	1	A26034B	A26034B	A26034B
	SHIM ASSORTMENT ((2) 240, (2) 241, (1) 242, (1) 243)	1	A25177A	A25177A	A25177A	1	A26035B	A26035B	A26035B
217	OIL BAFFLE PLATE	1	25938A	25938A	25938A		26045A	26045A	26045A
220	END PLATE	1	25719D	25719D	25719D	1	26025B	26025B	26025B
221	SHAFT	2	25941A	25941A	25941A	2	25843A	25843A	25843A
222	GEAR	4	25027A	25027A	25027A	4	25027A	25027A	25027A
227	CLAMP	4	25913A	25913A	25913A	-	N/A	N/A	N/A
228	SPACER	4	25847A	25847A	25847A	4	25847A	25847A	25847A
293	SHIM 0.002"	AR	25409AA	25409AA	25409AA	2	26027BA	26027BA	26027BA
294	SHIM 0.003"	AR	25409AB	25409AB	25409AB	2	26027BB	26027BB	26027BB
295	SHIM 0.005"	AR	25409AC	25409AC	25409AC	1	26027BC	26027BC	26027BC
296	SHIM 0.010"	AR	25409AD	25409AD	25409AD	1	26027BD	26027BD	26027BD
244	TEFLON RING	1	25939A	25939A	25939A	1	25929B	25929B	25929B
248	CHECK VALVE	1	3120A	3120A	3120A	1	3120A	3120A	3120A
249	CHECK VALVE	1	3120B	3120B	3120B	1	3120B	3120B	3120B
252	RETAINING RING	1	2829M	2829M	2829M	1	2928N	2928N	2928N
255	WASHER	-	N/A	N/A	N/A	2	25977E	25977E	25977E
256	WASHER	-	N/A	N/A	N/A	2	25977F	25977F	25977F
268	EXPANSION PIN	4	1193D	1193D	1193D	4	1193D	1193D	1193D
269	EXPANSION PIN	4	2981AA	2981AA	2981AA	4	2981AA	2981AA	2981AA
271**	PLUG SOLID	1	25422A	25422A	25422A	-	N/A	N/A	N/A
281	HEX HEAD CAP SCREW.	6	2796N	2796N	2796N	8	2796B	2796B	2796B
286	SOCKET HEAD CAP SCREW	8	2795F	2795F	2795F	2	2795D	2795D	2795D
297	SET SCREW	2	2060J	2060J	2060J	2	2060J	2060J	2060J
298	SET SCREW	2	2060H	2060H	2060H	2	2060H	2060H	2060H

Notes: **: Required At Top Locate Single Gaterotor Only. AR: As Required.

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Slide Valve Carriage Assembly



Assembly Includes Carriage and Slides.

Slide Valve Carriage Assembly

ITEM	DESCRIPTION	QTY	MODEL NUMBER	
			VSG 301 - 401	VSG 501 - 701
			VPN	VPN
300	CARRIAGE ASSEMBLY	1	A25179A	A26012B
304	CAPACITY PISTON (340, 341, 350 & 355)	1	A25183A	A25183B
305	VOLUME PISTON (340, 342, 350 & 355)	1	A25184A	A25184B
316	CAPACITY RACK	1	25023D	25024AH
318	CAPACITY RACK SHAFT	1	25772C	25772A
323	VOLUME RATIO RACK	1	25023CH	25023AH
325	VOLUME RATIO RACK SHAFT	1	25772D	25772B
350	PISTON RING SET	2	2953AE	2953AA
360	LOCK WASHER (PAIR)	2	3004C	3004C
361	WASHER	2	13265B	13265B
363	NUT	4	2797A	2797A
372*	SOCKET HEAD CAP SCREW	1	N/A	2795M

Notes: There are two slide valve carriages per compressor. Each one each has its own Volume Ratio and Capacity slide valves. The above totals are per side of the compressor, double the quantities if both slide valve carriages are being worked on.

*: Not Pictured.

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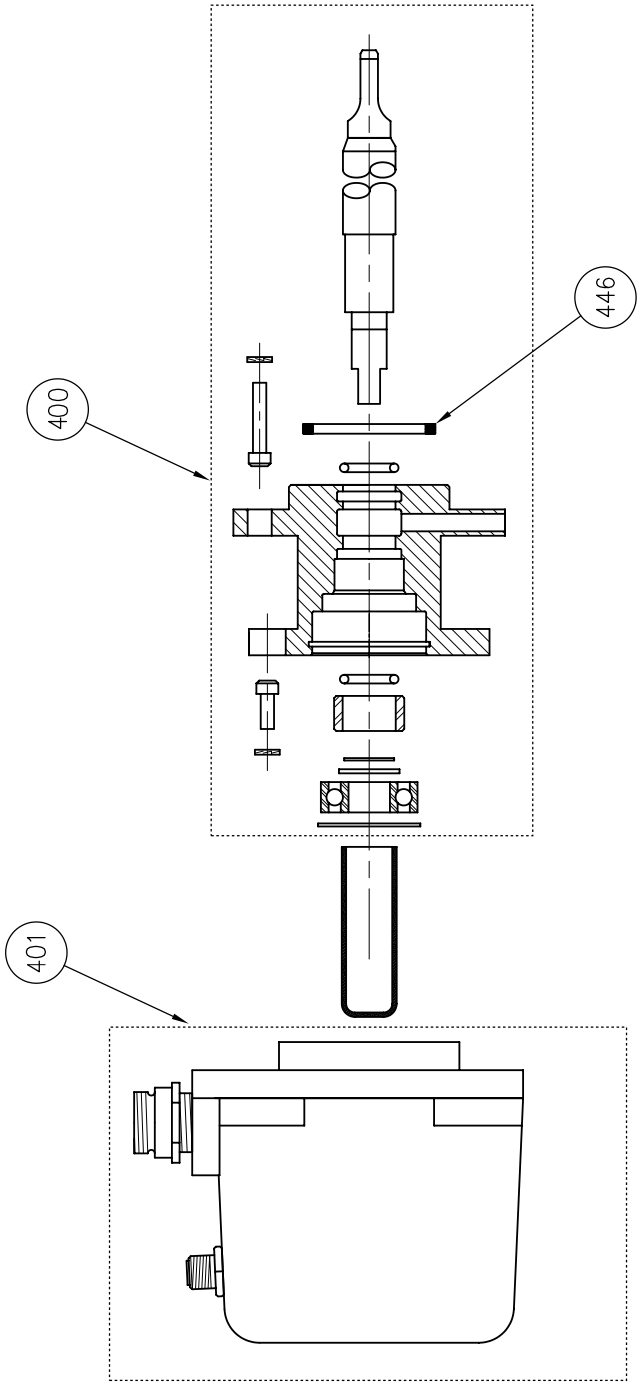
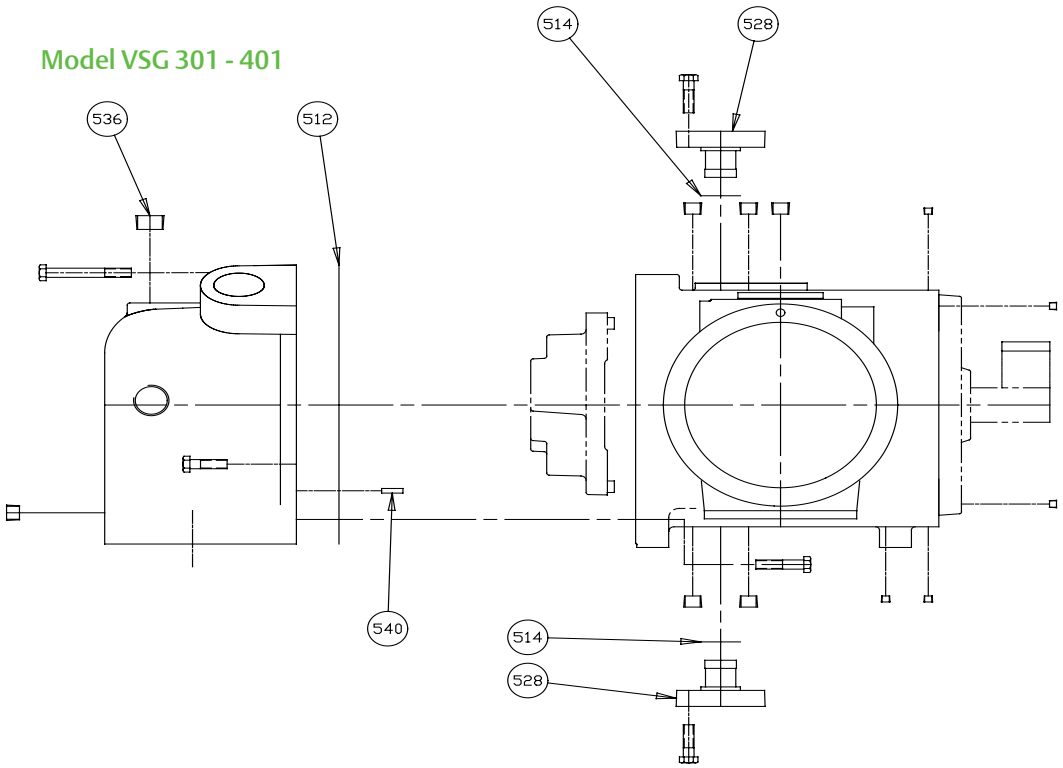
Actuator and Command Shaft



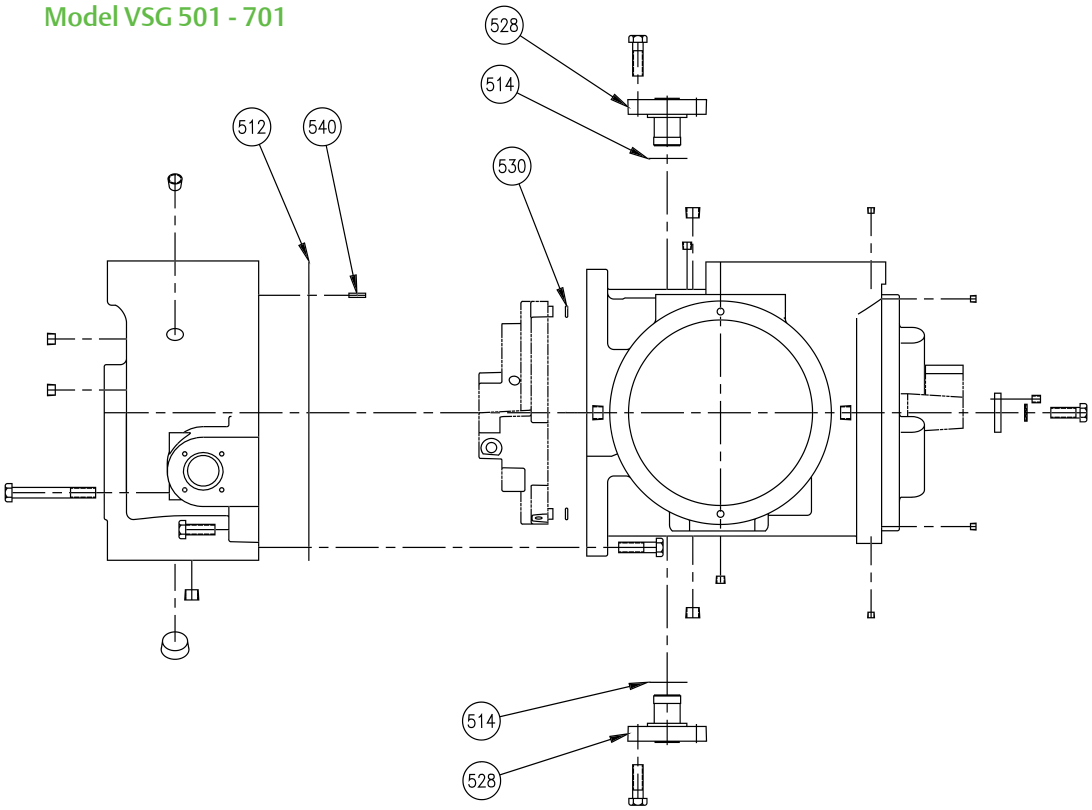
ITEM	DESCRIPTION	QTY	MODEL NUMBER	
			VSG 301 - 401	VSG 501 - 701
			VPN	VPN
400	COMMAND SHAFT ASSEMBLY	2	A25994A	A25994B
401	SLIDE VALVE ACTUATOR	2	25972D	25972D
446	O-RING SEAL	2	2825C	2825C

Miscellaneous Frame Components

Model VSG 301 - 401



Model VSG 501 - 701



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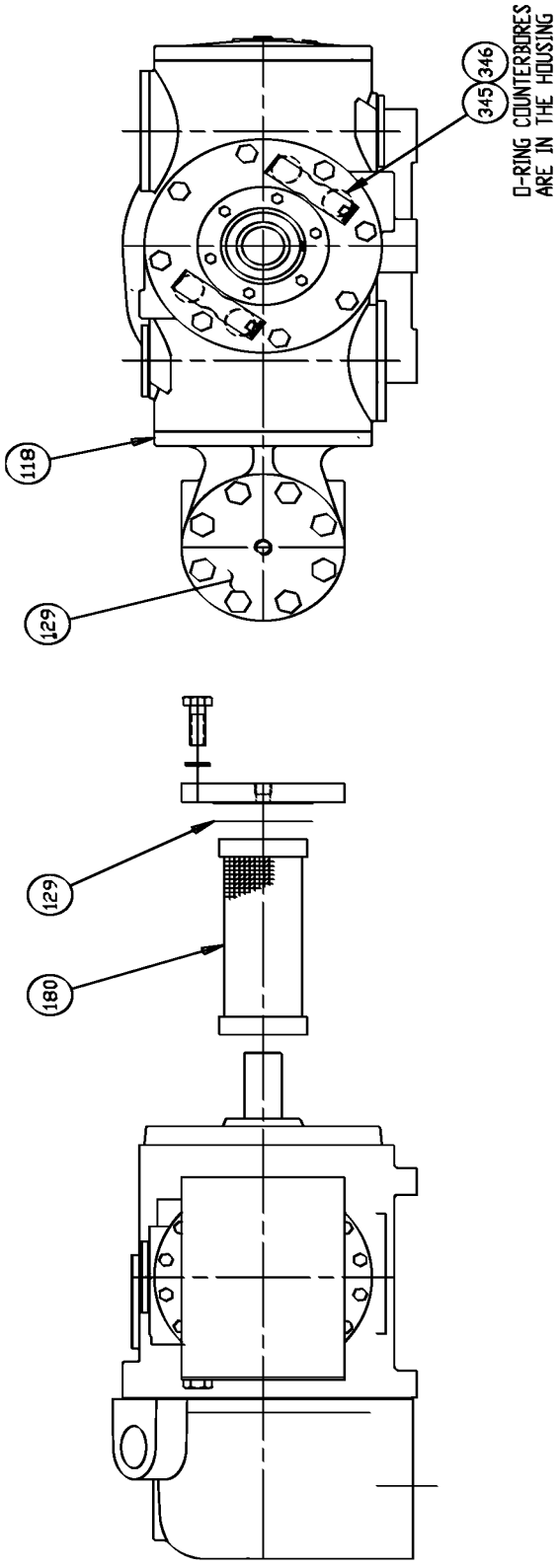
Miscellaneous Frame Components

ITEM	DESCRIPTION	MODEL NUMBER			
		VSG 301 - 401		VSG 501 - 701	
		QTY	VPN	QTY	VPN
512	MANIFOLD GASKET	1	25737A	1	26037A
514	ECON-O-MIZER GASKET	2	11323G	2	11323D
522	COUPLING LOCK PLATE	-	N/A	1	25004D
523	LOCK WASHER	-	N/A	1	3004H
528	ECON-O-MIZER PLUG	2	25419A	2	25397K
530	O-RING	-	N/A	2	3547AW
540	DOWEL PIN	2	2868B	2	2868B
542	PIPE PLUG	3	2606C	10	2606B
551	HEX HEAD CAP SCREW	-	N/A	2	2796C
570	BEARING OIL PLUG	1	25978A	-	N/A
571	PLUG	1	25979A	-	N/A
572	SPRING	1	3148A	-	N/A
*	GASKET / O-RING SET	1	KT1075A	1	KT1075B

Note: *: Not Pictured.

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Housing Accessories



Housing Accessories

ITEM	DESCRIPTION	MODEL NUMBER	
		VSG 301 - 701	
		QTY	VPN
117	GATEROTOR COVER	1	25416B
118	COVER GASKET	2	25259B
129	GASKET	1	11323T
180	INLET SCREEN	1	25920A
343	PISTON COVER*	1	25724B

Note: *: Not Pictured.

ITEM	DESCRIPTION	MODEL NUMBER		
		QTY	VSG 301 - 401	VSG 501 - 701
			VPN	VPN
345	O-RING	4	2825AY	3547AX
346	O-RING	2	2825AD	2825AD

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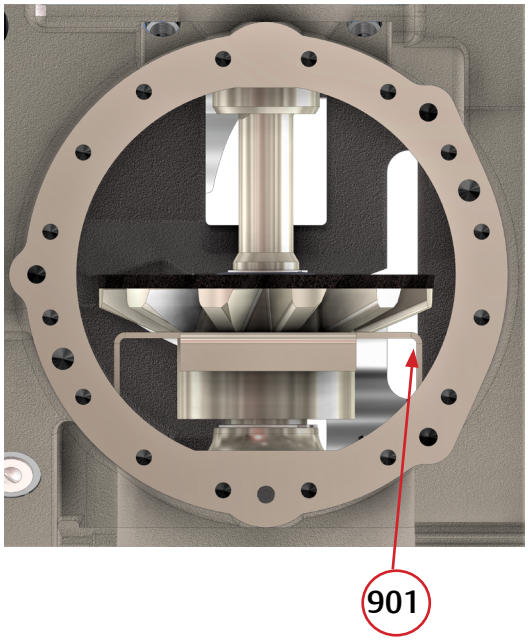
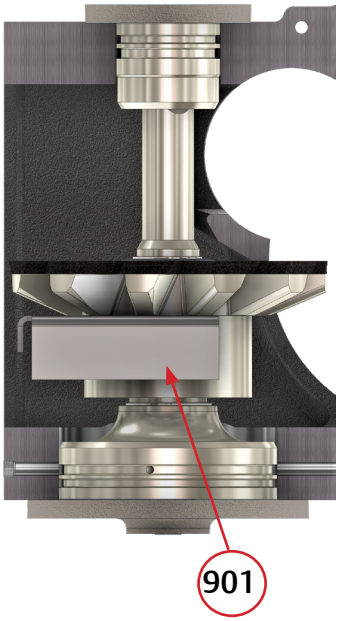
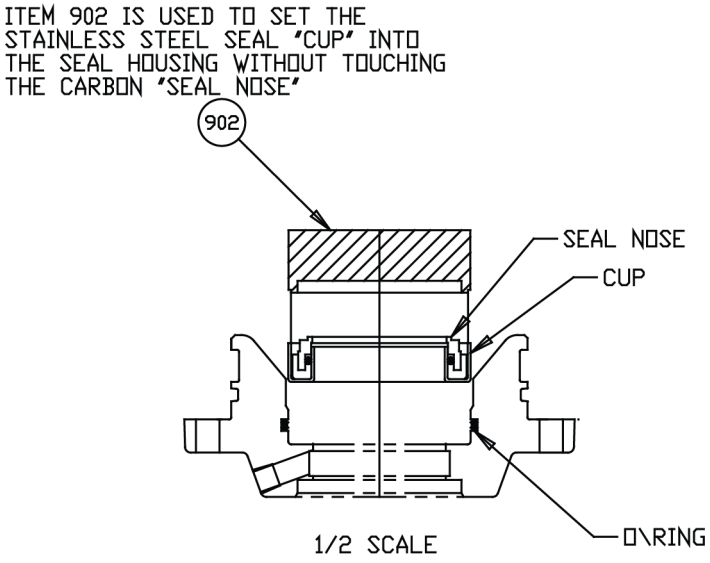
Replacement Tools



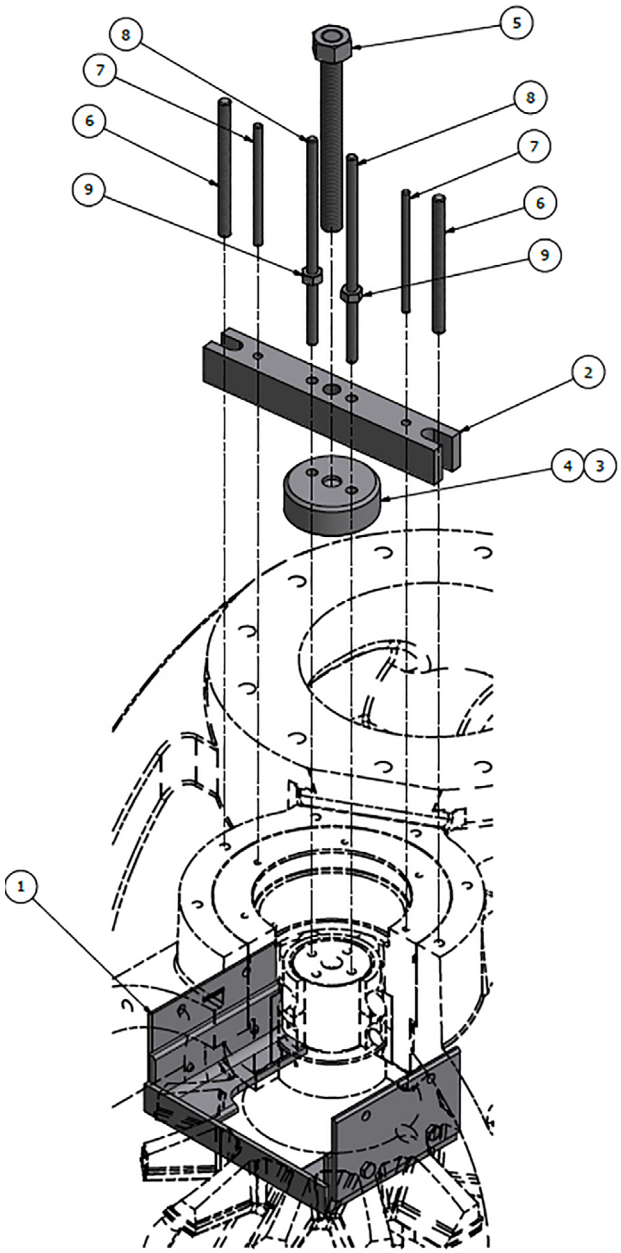


ITEM	DESCRIPTION	QTY	MODEL NUMBER	
			VSG 301 - 401	VSG 501 - 701
			VPN	VPN
900	GATEROTOR TOOLS	1	A25205B	A25205B
901	GATEROTOR STABILIZER	1	25742A	25742B
902	SEAL INSTALLATION TOOL	1	25455A	25455B



Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Replacement Tools



ITEM	DESCRIPTION	QTY	PART NUMBER
-	GATEROTOR TOOL SET	1	A25205B*
1	STABILIZER GATEROTOR ASSEMBLY	1	A25698A
2	BAR BEARING PULLER	1	25204A
3	SHOE PULLER 1.875	1	25157A
4	SHOE PULLER 2.500	1	25157B
5	JACKSCREW	1	A25156B
6	STUD .375-16 X 4.9	2	25908A
7	STUD .250-20 X 4.4	2	25908B
8	STUD .312-18 X 7.5	2	25908C
-	SCREW 1/4-20 NC X 1-3/4 CAP SOCK	2	2795W
9	PLAIN NUT 5/16-18NC-2B HEX	2	1726B

Note:

*: Assembly A25205B contains all parts listed. Parts are shown independently for illustration purposes only.

Vilter parts get renewed from time to time, so be sure to ask if the part listed in your manual is still the best for your compressor. Parts that appear on diagrams might be shown separately for reference, but are sold as an assembly or kit only.

Torque Specifications

Refer to the following tables for torque specifications.

Table A-1. Torque Specifications (ft-lbs)

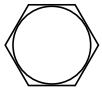
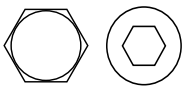
TYPE BOLT	HEAD MARKINGS	NOMINAL SIZE NUMBERS OR INCHES									
		#10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8
SAE GRADE 2 COARSE (UNC)			5	10	18	29	44	63	87	155	150*
SAE GRADE 5 COARSE (UNC)			8	16	28	44	68	98	135	240	387
SAE GRADE 5 FINE (UNF)				16							
SAE GRADE 8 COARSE (UNC)			11	22	39	63	96	138	191	338	546
SOCKET HEAD CAP SCREW (ASTM A574) COARSE (UNC)		5	13	26	46	73	112	155	215	380	614
NOTES:	1) Torque values on this sheet are not to override those given on the individual drawings.										
	2) When using loctite, the torque value on this sheet are only accurate if bolts are tightened immediately after loctite is applied.										
	* The proof strength of Grade 2 bolts is less for sizes 7/8 and above and therefore the torque values are less than smaller sizes of the same grade.										

Table A-2. Torque Specifications for 17-4 Stainless Steel Fasteners (ft-lbs)

Type Bolt/Nut	Head Markings	Nominal Size Numbers or Inches								
		#10	¼"	5/16"	3/8"	7/16"	½"	9/16"	5/8"	¾"
Hex & Socket Head Cap Screws		3	8	14	25	40	60	101	137	245
Nut		-	8	-	25	-	-	-	-	-

NOTE

Continue use of red loctite #271 (VPN 2205E) on currently applied locations. Use blue loctite #243 (VPN 2205F or 2205G) on all remaining locations.

Oil Analysis Report

OIL SERVICES LABORATORIES
www.oil-services-lab.com

PRODUCT ANALYSIS REPORT

No Action Required

Report Date:	3/4/2013
Report Number:	*********
Customer	Customer
Comp. Mfr.	Vilter
Oil Type	VILTER-717
Serial Number	****-***
Model Number	VSM-601
Hrs. on Fluid	6049
Hrs. on Machine	11239
Sample Date	Feb 21, 2013
Receive Date	Mar 01, 2013
I.D. #	*********

Customer Name
Customer Address

Evaluation:

The fluid is in good condition. Sample again in 6 months.

Physical Properties Results *

Sample Date (Lube Hours)	Feb 21, 2013 (6049)	Oct 19, 2012 (4809)	Jul 26, 2010 (5190)
Water by Karl Fischer (ppm)	19.5	147.7	41.4
Viscosity 40 C (cSt)	64.23	64.47	66.00
TAN Total Acid #	0.077	0.106	0.080
ISO Code	21/20/16	21/19/16	21/19/14

Spectrochemical Analysis

Wear Metals (ppm)			
Silver (Ag)	0	0	0
Aluminum (Al)	0	0	0
Chromium (Cr)	0	0	0
Copper (Cu)	0	0	0
Iron (Fe)	0	0	0
Nickel (Ni)	0	0	0
Lead (Pb)	0	0	0
Tin (Sn)	0	0	0
Titanium (Ti)	0	0	0
Vanadium (V)	0	0	0
Contaminant/Additive Metals (ppm)			
Barium (Ba)	0	0	0
Calcium (Ca)	0	0	0
Magnesium (Mg)	0	0	0
Molybdenum (Mo)	0	0	0
Sodium (Na)	0	0	0
Phosphorus (P)	0	0	0
Silicon (Si)	0	0	0
Zinc (Zn)	0	0	0

Thank you for this opportunity to provide technical assistance to your company. If you have any questions about this report, please contact us at 1-800-637-8628, or fax 1-989-496-2313 or email us at tslab@oil-services-lab.com

CC List

Accuracy of recommendations is dependent on representative oil samples and complete correct data on both unit and oil

* Property values should not be construed as specifications

Storage Guidelines For Vilter Lubricants

All Vilter lubricants are manufactured to meet strict requirements to ensure minimal water moisture content as shipped. The following guidelines are provided for the end-user of the equipment as a means to minimize the water content of lubricants in storage.

Guidelines

- Store all lubricant containers in a dry environment. Do not expose the lubricant to the atmosphere by opening the container until the compressor sump or separator is ready to be charged.
- Keep the lubricant in its original container. Some plastic containers allow water moisture to pass through the container itself.
- If possible, use container sizes appropriate to the compressor charge to avoid leaving partially containers for long period of times. Vilter lubricant is available in 5 and 55 gallon containers.

Table B-1. Cross Reference Index

VPN	Oil Type	Vilter Lube Type	Container Size	Applications
3143B	PAO-100	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143C	PAO-68	METHANE	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143D	PAO-68	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143G	PAO-150	METHANE	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143H	PAO-150	METHANE	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143J	PAO-100	DIGESTER	5 gallon pail	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3143K	PAO-100	DIGESTER	55 gallon drum	Hydrocarbon/natural gas, Landfill gas, Turbine feed gas
3339A	PAO	CO_2 GAS	5 gallon pail	CO_2, CO
3339B	PAO	CO_2 GAS	55 gallon drum	CO_2, CO
3636A	PAO	CO_2	5 gallon pail	Gas streams containing moisture, CO_2, CO and/or H_2S
3636B	PAO	CO_2	55 gallon drum	Gas streams containing moisture, CO_2, CO and/or H_2S
3643A	PAO	XG 105-100	5 gallon pail	Hydrocarbon/natural gas
3643B	PAO	XG 105-100	55 gallon drum	Hydrocarbon/natural gas
3653A	POE	POE-100	5 gallon pail	Air Compressor Lubricant
3653B	POE	POE-100	55 gallon drum	Air Compressor Lubricant

Vibration Measurements - Single Screw Compressor

Scope

The vibration criteria provided applies to broad-band vibration measurements taken on the bearings and housing of the Single Screw compressors under steady-state operating conditions within the nominal operating speed range in addition to the piping and tubing on the compressor unit. They relate to both acceptance testing and operational monitoring. The evaluation criteria is intended to apply to both continuous and non-continuous monitoring situations. The scope does not address the diagnostic evaluation of the condition of the roller element bearings. The criteria are applicable only for the vibration produced by the machine itself and not for vibration which is transmitted to the machine set from external sources. Information used in this chapter was taken from ISO Standard 10816-3, Mechanical Vibration – Evaluation of Machine Vibration by Measurements on Non-Rotating Parts – Part 3, First Edition, 1998.

Measurement Procedures and Operational Conditions

Measurement Equipment

The measurement equipment shall be capable of measuring broad-band rms vibration with flat response over a frequency range of at least 10 Hz to 1000 Hz. Depending on the vibration criteria, this may require measurements of displacement or velocity or combinations thereof.

Care should be taken to ensure that the measuring system is not influenced by environmental factors such as: temperature variations;

- Magnetic fields;
- Sound fields;
- Power source variations;
- Transducer cable length;
- Transducer orientation.

Particular attention should be given to ensure that the vibration transducers are correctly mounted and that such mountings do not degrade the accuracy of the measurements.

Compressor Measurement locations

Measurements taken on the compressor will usually be taken on exposed parts that are normally accessible. Care shall be taken to ensure that measurements reasonably represent the vibration of the bearing housing and do not include any local resonances or amplification. The locations and directions of vibration measurements shall be such that they provide adequate sensitivity to the machine dynamic forces. Typically, this will require two radial measurement locations on each bearing cover on the gaterotor housing support and back plate (near the compressor shaft). Vertical and horizontal directions are preferred for Single Screw compressors. The specific locations and directions shall be recorded with the measurement.

Continuous and Non-continuous Monitoring

While it is common practice on large or critical machinery to have installed instrumentation for continuous on-line monitoring of vibration values at key measurement

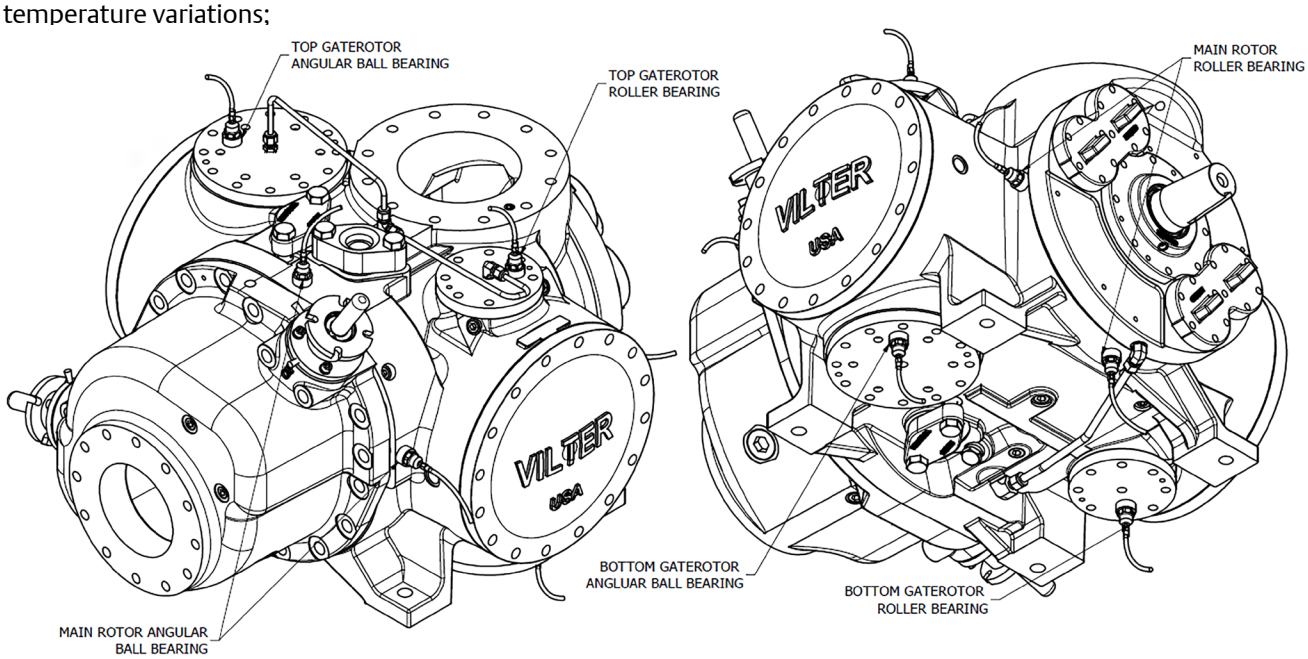


Figure C-1. Compressor Bearing Vibration Measurement Location

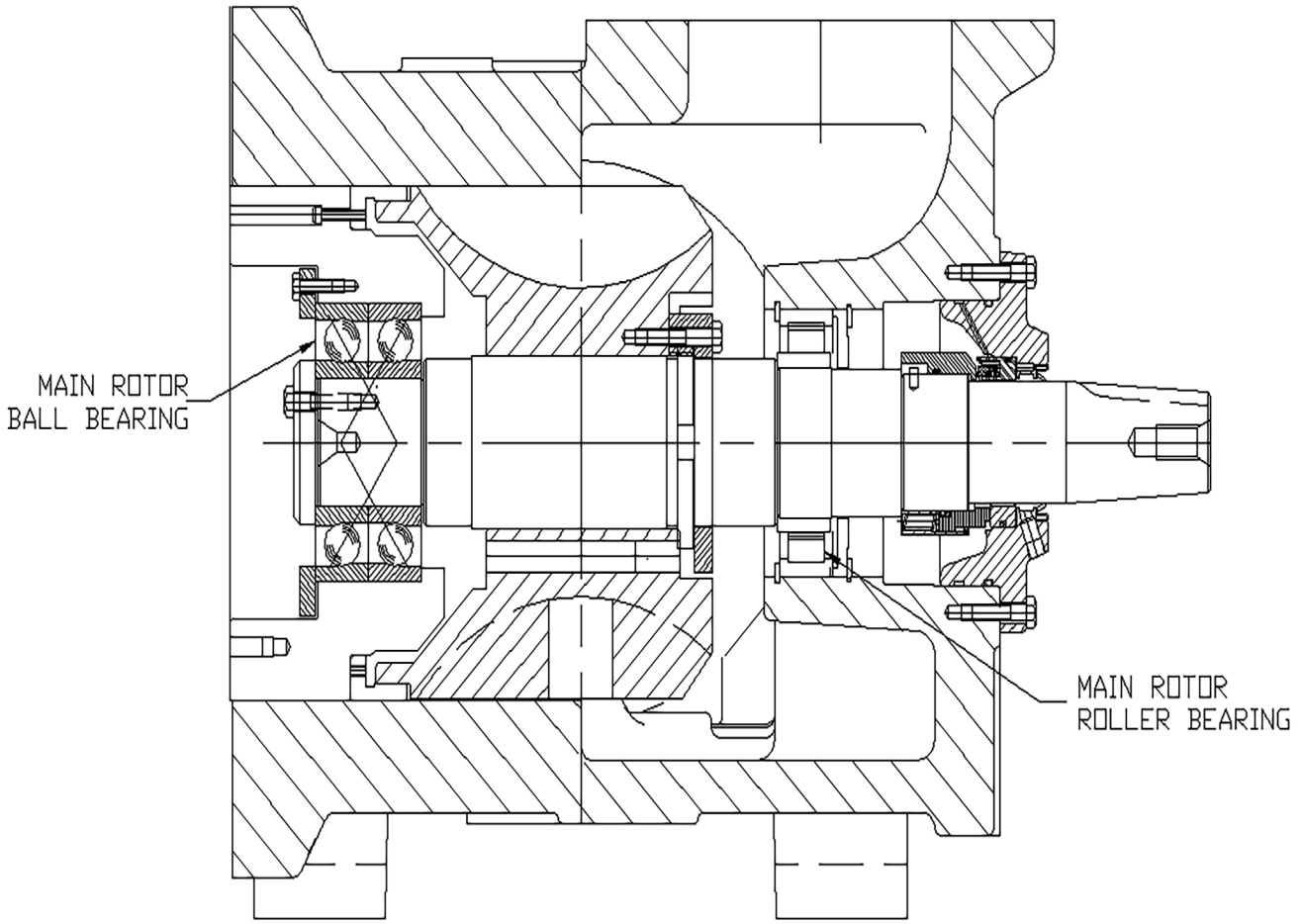


Figure C-2. Main Rotor Cross-Section VSS/VSMC Compressors

points, this is not necessarily carried out in industrial applications.

Changes in unbalance, bearing performance, alignment, etc., can be detected with sufficient reliability from periodic measurements with permanently installed or hand-held instruments. The use of computers for trend analysis and warning against malfunctions is also becoming more common.

Operational Conditions

Measurements shall be carried out when the compressor has reached normal steady-state operating temperatures and with the machine running under specified conditions. If the measured vibration is greater than the acceptance criteria allowed and an excessive background vibration is suspected, measurements should be made with the machine shut down to determine the degree of external influence. If the vibration with the machine stationary exceeds 25% of the value measured when the machine is running, corrective action may be necessary to reduce the effect of the background vibration.

Evaluation

There are two evaluation criteria used to assess vibration severity on various classes of machines. One criteria considers the magnitude of observed broad-band vibration;

the second considers changes in magnitude, irrespective of whether they are increases or decreases.

Criterion 1: Vibration Magnitude

This criterion is concerned with defining limits for vibration magnitude consistent with acceptable dynamic loads on the bearings and acceptable vibration transmission into the environment through the support structure and foundation. The maximum vibration magnitude observed at each bearing or pedestal is assessed against the evaluation zones for the support class. The evaluation zones have been established from international experience.

The following evaluation zones are defined to permit a qualitative assessment of the vibration of a given machine and provide guidelines on possible actions.

- Zone A: The vibration of newly commissioned machines would normally fall within this zone.
- Zone B: Machines with vibration within this zone are normally considered acceptable for unrestricted long-term operation.
- Zone C: machines with vibration within this zone are normally considered unsatisfactory for long term continuous operation. Generally, the machine may be operated for a limited period in this condition until a suitable opportunity arises for remedial action.
- Zone D: Vibration values within this zone are normally considered to be of sufficient severity to cause damage to the machine.

Numerical values assigned to the zone boundaries are not intended to serve as acceptance specifications, which shall be subject to agreement between Vilter™ manufacturing and the customer. However, these values provide guidelines for ensuring that gross deficiencies or unrealistic requirements are avoided. In certain cases, there may be specific features associated with a particular machine which would require different zone boundary values (higher or lower) to be used

Evaluation Zone limits

The values for the zone boundaries given below are based on the maximum broad-band values of velocity and displacement when measurements are taken from two orthogonally oriented radial transducers. Therefore when using these tables, the higher of each of the values

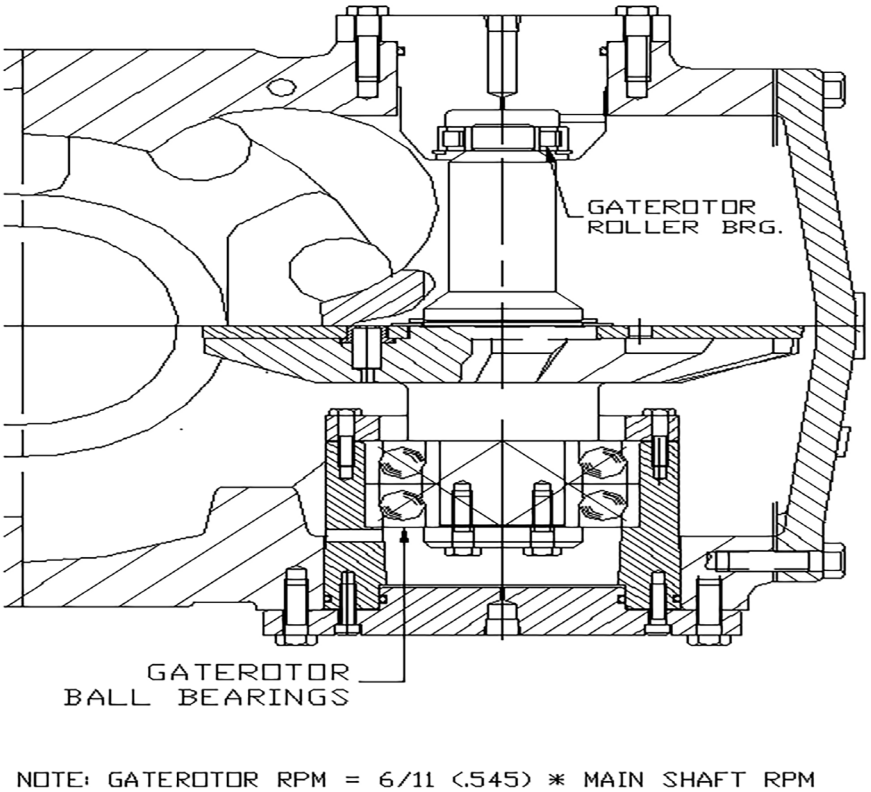


Figure C-3. Gaterotor Cross-Section VSS/VSR/VSMC Compressors

measured from the two transducers in each measurement plane should be used. When the maximum measured values of velocity and displacement are compared to the corresponding values in the table, the severity zone which is most restrictive shall apply.

Operational limits

For long-term operation, it is common practice to establish operational vibration limits. These limits take the form of ALARM and TRIP set points.

ALARM: To provide a warning that a defined value of vibration has been reached or a significant change has occurred, at which remedial action may be necessary. In general, if an ALARM situation occurs, operation can continue for a period while investigations are carried out to identify the reason for the change in vibration and define any remedial action.

TRIP: To specify the magnitude of vibration beyond which further operation of the machine may cause damage. If the TRIP value is exceeded, immediate action should be taken to reduce the vibration or the machine should be shut down.

Different operational limits, reflecting differences in dynamic loading and support stiffness, may be specified for different measurement positions and directions.

Setting of ALARMS

The ALARM values may vary considerably, up or down, for different machines. The values chosen will normally be set relative to a baseline value determined from experience for the measurement position or direction for that particular machine.

It is recommended that the ALARM value should be set higher than the baseline by an amount equal to 25% of the upper limit for zone B. If the baseline is low, the ALARM may be below zone C.

Where there is no established baseline (for example with a new machine) the initial ALARM setting should be based either on experience with other similar machines or relative to agreed acceptance values. After a period of time, the steady-state baseline value will be established and the ALARM setting should be adjusted accordingly.

It is recommended that the ALARM value should not normally exceed 1.25 times the upper limit of zone B.

If the steady-state baseline changes (for example after a machine overhaul), the ALARM setting should be revised accordingly.

Setting of TRIPS

The TRIP values will generally relate to the mechanical integrity of the machine and be dependent on any specific design features which have been introduced to enable the machine to withstand abnormal dynamic forces. The values used will, therefore, generally be the same for all machines of similar design and would not normally be related to the steady-state baseline value used for setting ALARMS.

There may, however, be differences for machines of different designs and it is not possible to have clear guidelines for absolute TRIP values. In general, the TRIP value will be within zone C or D, but it is recommended that the TRIP value should not exceed 1.25 times the upper limit of zone C.

Vibration limits For Piping and Tubing

The piping and tubing on the compressor units must be supported with the appropriate brackets and supports to minimize the vibration levels. These brackets and supports should also be strategically placed to prevent the natural frequency from matching the normal operating speed. The typical goal is to have the natural frequency of an assembly to be at least 10% above or below the

Table C-1. Vibration Zone Values

VIBRATION MEASUREMENTS – SINGLE SCREW COMPRESSOR*					
Support Class	ZONE	RMS Displacement		RMS Velocity	
		µmm	mils	mm/s	In/sec
	A	0-30	0-1.15	0-2.3	0-0.09
	B	30-57	1.15-2.25	2.3-4.5	0.09-0.18
	C	57-90	2.25-3.55	4.5-7.1	0.18-0.28
	D	Above 90	Above 3.55	Above 7.1	Above .28

*RMS= 0.707 X peak (sine wave only)

operating speed. In the case when a compressor is operated by a VFD (Variable Frequency Drive), there is a high probability that there will be an opportunity to match either the natural frequency of the assembly or it's 2nd or 3rd order since the compressor's speed will vary within a large range of RPM's.

The compressor unit should first be operated at either the normal operating speed or if it utilizes a VFD, through the operating range of speed. Visual observations of the vibration levels of all the piping and tubing should first be observed. After this initial survey, the vibration measurement equipment should be individually mounted or attached to each specific piece of piping or tubing as required in the location of what is perceived as the maximum amplitude or worse vibration.

While there are references which specifically allow higher levels of vibration for piping, the goals for the vibration levels of the piping and tubing on the compressor unit should still utilize the same criteria outlined in this standard. If possible, the vibration levels should be within the zone boundaries of Zone B or better. These values will ensure that the stress levels in the piping and tubing are acceptable for continuous operation. These values provide guidelines for ensuring that gross deficiencies or unrealistic requirements are avoided. In certain cases, there may be specific features associated with a particular compressor unit which would require different zone boundary values.

For compressors that are operated at a fixed speed, brackets and supports may be added or moved to reduce the vibration levels of the specific component. If the compressor is operated utilizing a VFD, a skip frequency should be inputted into the controls to ensure the compressor passes through the harmonic and that it operates either below or above the operating speed that matches the natural frequency of the specific component. It is not unusual to have three or four skip frequencies within the normal operating ranges of a compressor utilizing a VFD.

Bearing Vibration Data

The following pages contain tables of bearing vibration data collected for different models of VSMC and VSS single screw compressors. Please use your model number to find your compressor-specific information.

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Vilter is a technology leader in energy-efficient, environmentally conscious solutions in its industry. The 150-year history of the Vilter brand tells a rich story of perseverance and drive to cultivate continuous innovation within the industrial refrigeration and gas compression industries. Vilter offers unprecedented efficiency, productivity and reliability in cooling, recovery, and compression. It combines best-in-class technology with proven engineering and design to create quality products and latest solutions for customers worldwide.

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