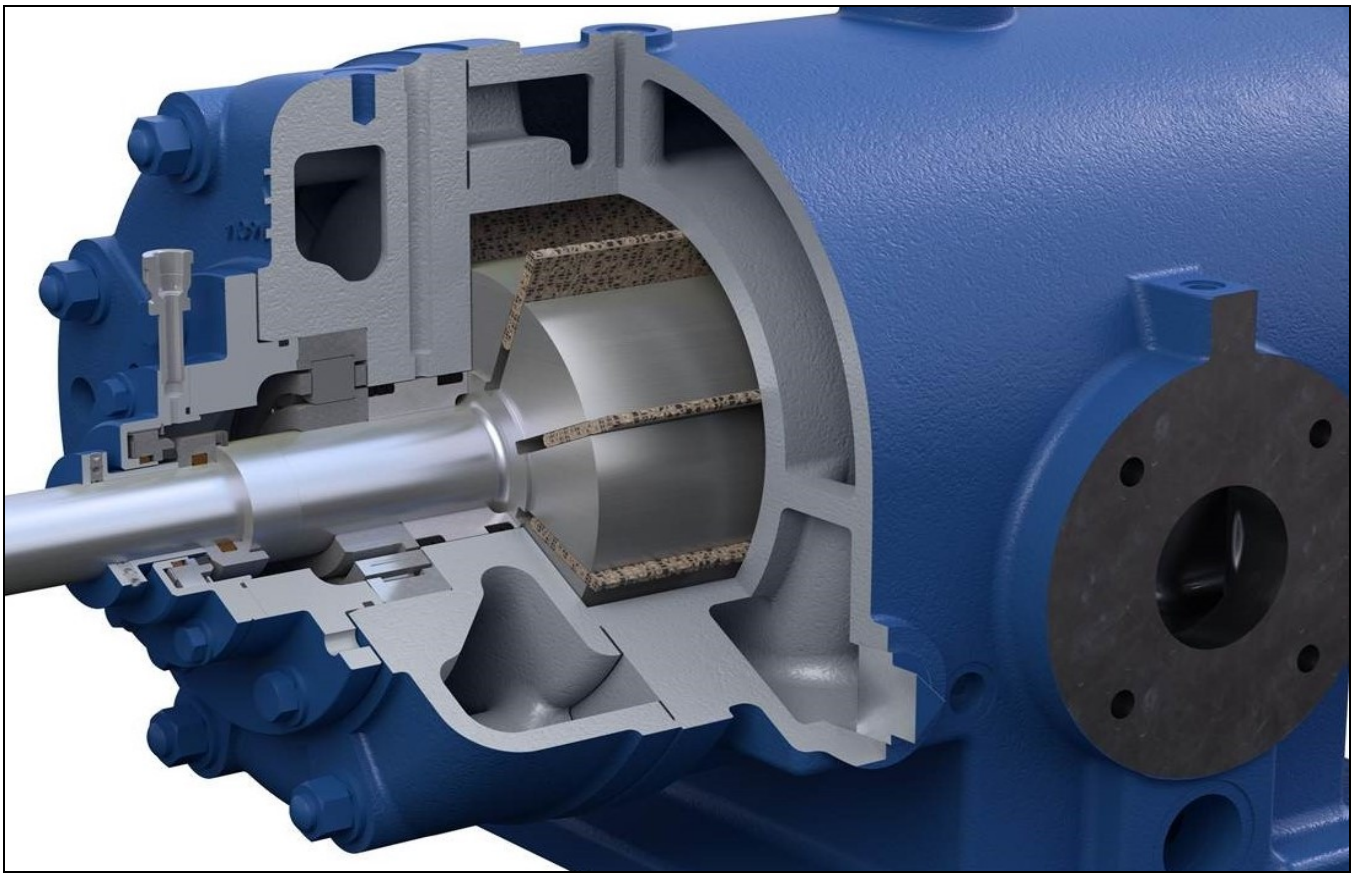
INSTALLATION, OPERATION, & MAINTENANCE MANUAL

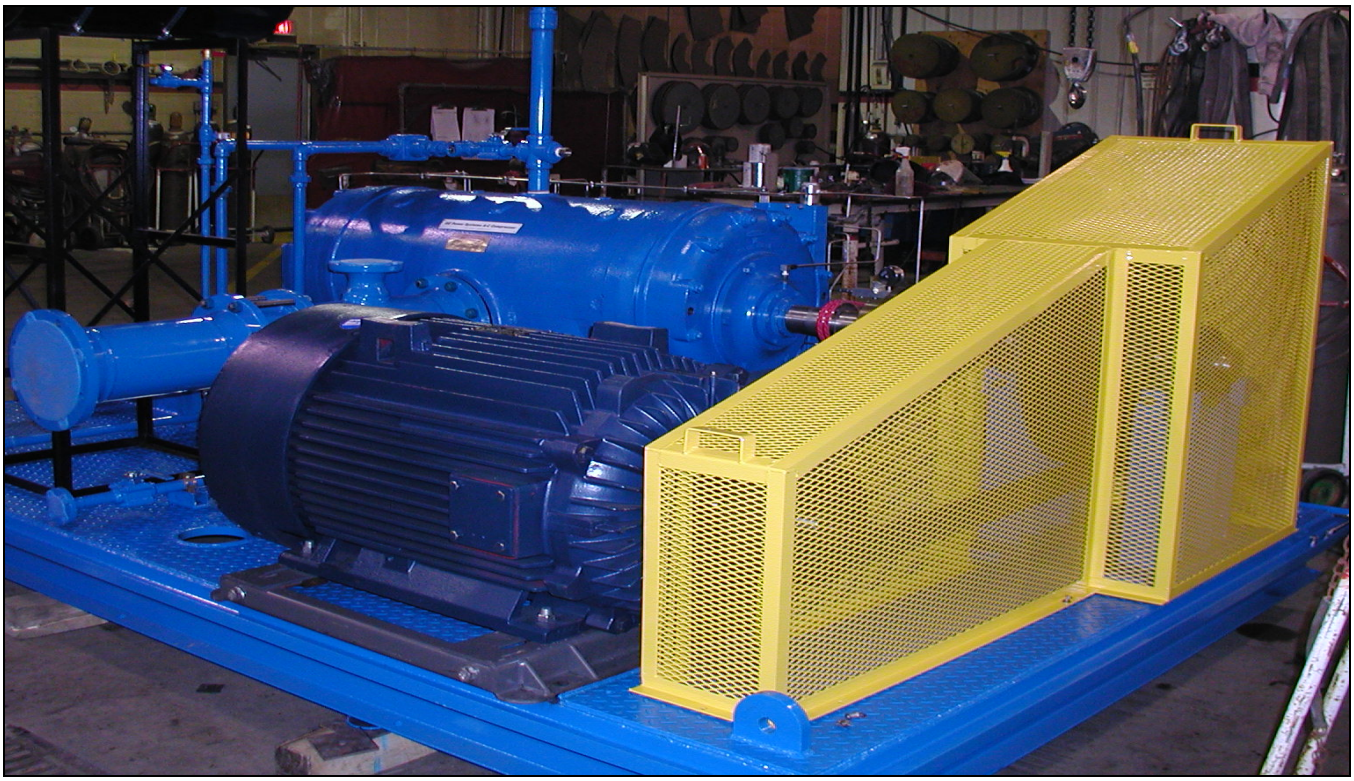
ORIGINAL INSTRUCTIONS FOR RO-FLO® COMPRESSORS AND VACUUM PUMPS

Ro-Flo Compressors, LLC
2540 West Everett St.
Appleton, WI 54914
United States of America

Compressor Serial Number: _____

16-620-101-000 REV 03





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SAFETY INFORMATION

⚠ CAUTION

RO-FLO COMPRESSORS AND VACUUM PUMPS MUST BE OPERATED BY PROFESSIONALS TRAINED IN THE USE OF GAS COMPRESSION EQUIPMENT.

PLEASE CONTACT YOUR SYSTEM INTEGRATOR / PACKAGER FOR TRAINING IN THE USE AND MAINTENANCE OF RO-FLO COMPRESSORS AND VACUUM PUMPS AS APPLIED IN YOUR SYSTEM.

⚠ CAUTION

READ AND UNDERSTAND THE OPERATOR'S MANUAL BEFORE USING THIS COMPRESSOR. IT IS ESSENTIAL TO REFER TO THE PACKAGER'S OPERATING MANUAL FOR COMPLETE OPERATING INSTRUCTIONS.

FAILURE TO FOLLOW OPERATING INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH.

Read this document carefully before installing and starting your compressor.

The following instructions have been prepared to assist in installation, operation, and maintenance of your Ro-Flo® sliding vane compressor. Following these instructions and those provided for the compressor package will ensure a long operational life for your equipment.

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

Ro-Flo® sliding vane compressors are positive displacement style compressors, which are designed to compress gas. The compressor must not be subjected to liquids in the inlet gas stream. Ro-Flo Compressors, LLC is not responsible for the system design to prevent liquid in the gas stream, and as such Ro-Flo Compressors, LLC cannot warrant equipment damaged by improperly protected or operated equipment.

⚠ CAUTION

PERSONAL PROTECTIVE EQUIPMENT (PPE) SHOULD BE USED TO AVOID HEALTH HAZARDS (EXCESSIVE SOUND LEVEL EXPOSURE) DUE TO HIGH NOISE LEVEL DURING NORMAL OPERATION.

IT IS RECOMMENDED THAT THE CUSTOMER ESTABLISH AN EHS PLAN TO AVOID AN EXPOSURE RISK IN EXCESS OF PERMISSIBLE EXPOSURE LIMIT (PEL) AS DEFINED BY THE OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA) OR OTHER REGULATING BODY.

⚠ CAUTION

THE INFORMATION CONTAINED WITHIN IS INTENDED TO ASSIST OPERATING PERSONNEL BY PROVIDING INFORMATION ON THE GENERAL CHARACTERISTICS OF EQUIPMENT OF THIS TYPE. IT DOES NOT RELIEVE THE USER OF RESPONSIBILITY TO USE SOUND ENGINEERING PRACTICES IN THE INSTALLATION, APPLICATION, AND MAINTENANCE OF PARTICULAR EQUIPMENT PURCHASES.

The PACKAGER and END USER of Ro-Flo® sliding vane compressors and vacuum pumps shall assess all hazards that are present, or are likely present, with the compressor package and determine what personal protective equipment (PPE) is necessary. In instances where the compressor process gas is considered hazardous, PPE may include respirators, personal gas detectors, etc. Hard hats may also be required depending upon the installation.

For individuals within danger zones of operating Ro-Flo® compressors and vacuum pumps, as defined by the PACKAGER and/or END USER, Ro-Flo Compressors recommends a minimum of eye protection and hearing protection. For individuals performing assembly, disassembly, service and/or maintenance of Ro-Flo® compressors not in operation, Ro-Flo Compressors recommends a minimum of eye protection, gloves, and steel toe footwear.

Lighting should be considered in the package design, the PACKAGER is referred to the compressor general arrangement drawings for areas of the compressor requiring service, maintenance, and/or inspection.

⚠ CAUTION

THE COMPRESSOR SURFACES AND ATTACHED PIPING MAY BE HOT. GASES AND FLUIDS WITHIN THE COMPRESSOR MAY BE HOT.

Before starting any maintenance or removing any components, lockout the compressor driver, relieve all pressure from the compressor, vent and purge any residual gases. drain fluids and decontaminate the compressor in accordance with the PACKAGER's instructions. Failure to properly depressurize the compressor could result in hot gases and/or liquids being ejected from the compressor and piping. Additionally, it may be necessary to allow the compressor and piping to cool prior to any assembly, disassembly, service, and/or maintenance to avoid burn hazards.

The PACKAGER and END USER of a Ro-Flo® compressor shall assess all hazards that are present, or are likely present, with the compressor package and develop an EHS program and plan that includes but is not limited to lock out/tag out procedures, depressurization procedures, venting procedures, draining procedures, and decontamination procedures.

INTRODUCTION

INTENDED USE OF RO-FLO® COMPRESSORS

Ro-Flo Compressors, LLC manufactures compressors and vacuum pumps for various industrial applications, including: oil & gas vapor recovery, industrial process gas recovery, rail car unloading, food processing, etc. Ro-Flo® compressors are typically employed in environments with wet, toxic, and/or corrosive gases. Please contact Ro-Flo Engineering about questions concerning suitability for a specific application. Ro-Flo compressors are suitable for ambient conditions of -20°F to 140°F (-28°C to 60°C).

RO-FLO® SLIDING VANE COMPRESSORS

The basic design of a Ro-Flo® compressor is comprised of two cylinder heads that eccentrically locate a rotor in a round cylinder bore. At operating speed, centrifugal force extends the blades from eight rotor slots so they maintain contact with the cylinder bore through a full revolution. This operating configuration produces eight individual enclosed sections bounded by the cylinder, cylinder heads, rotor and consecutive blades. The compressor inlet port is at the point of maximum rotor to cylinder bore distance so each section is at its maximum volume and minimum pressure as it rotates past the inlet port allowing gas to fill them. As the rotation continues, the distance between the rotor and cylinder bore decreases, thereby decreasing the volume and increasing the pressure of each section. The compressor discharge port is at the point of minimum rotor to cylinder bore distance so each section is at its minimum volume and maximum pressure as it rotates past the discharge port forcing the gas to exit the compressor. A small quantity of lube oil is injected into the compressor cylinder to lubricate these components.

WARRANTY

General Provisions

Ro-Flo Compressors, LLC (the Company) warrants title to the product(s) and, except as noted below with respect to items not of Company's manufacture, also warrants to the product(s) on date of shipment to purchaser, to be of the kind and quality described herein, merchantable, and free of defects in workmanship and material.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES. INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, AND CONSTITUTES THE ONLY WARRANTY OF COMPANY WITH RESPECT TO THE PRODUCT(S).

If from one year from date of initial operation, but not more than eighteen months from date of shipment by Company of any compressor, Purchaser discovers that such item was not as warranted above and promptly notifies Company in writing thereof, Company shall remedy such non-conformance by, at Company's option, adjustment or repair or replacement of the item and any affected part of the product(s). Purchaser shall assume all responsibility and expense for removal, re-installation, and freight in connection with the foregoing remedies. The same obligations and conditions shall extend to replacement parts furnished by Company hereunder. Company shall have the right of disposal of parts replaced by it.

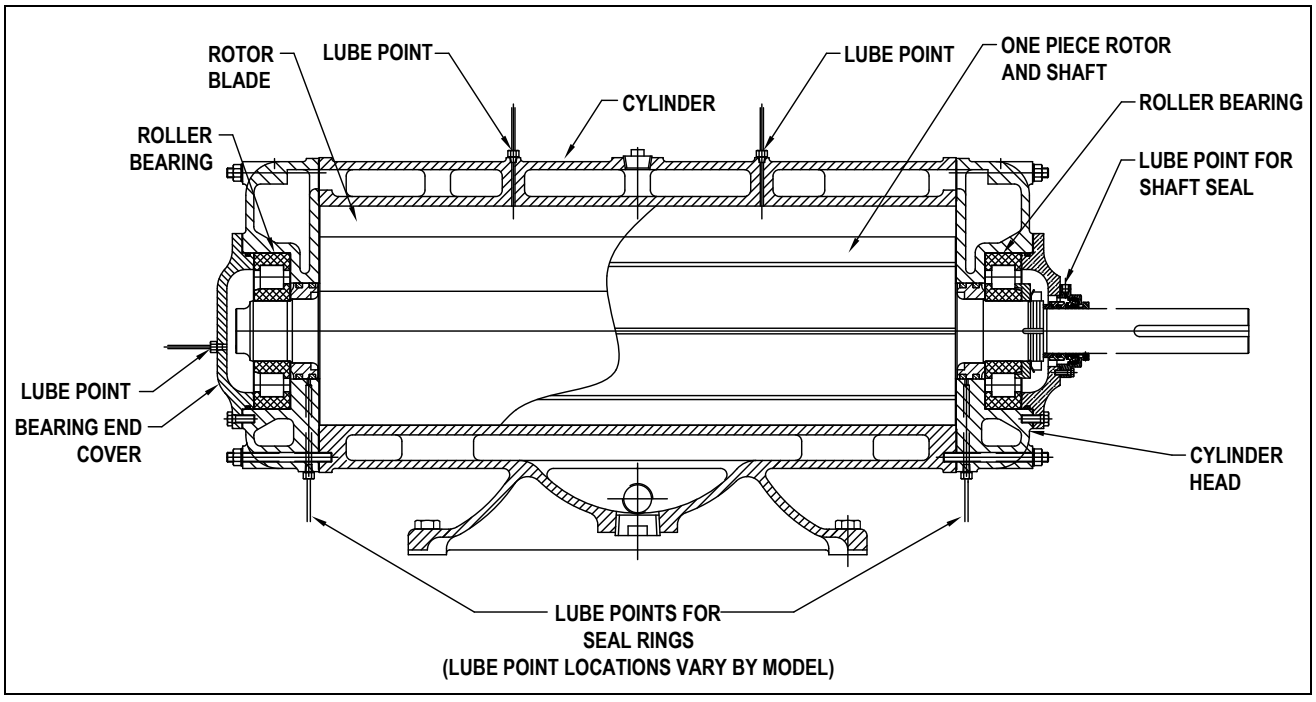


FIGURE 1 - General cross section of a Ro-Flo® Low Pressure model sliding vane compressor along the rotor axis.

ANY SEPARATELY LISTED ITEM OF THE PRODUCT(S) WHICH IS NOT MANUFACTURED BY COMPANY IS NOT WARRANTED BY COMPANY, and shall be covered only by the expressed warranty, if any, of the manufacturer thereof. THIS STATES PURCHASER'S EXCLUSIVE REMEDY AGAINST COMPANY AND ITS SUPPLIERS RELATED TO THE PRODUCT(S) WHETHER IN CONTRACT OR TORT OR UNDER ANY OTHER LEGAL THEORY, AND WHETHER ARISING OUT OF WARRANTIES, REPRESENTATIONS, INSTRUCTIONS, INSTALLATIONS OR DEFECTS FROM ANY CAUSE.

Company and its suppliers shall have no obligation as to any product which has been improperly stored or handled, or which has not been operated or maintained according to instructions in Company or supplier furnished manuals.

In the event that non-OEM parts have been used in conjunction with the repair or rework of the compressor, the warranty will become null and void.

Parts Warranty - Replacement parts are warranted for a period of ninety days from the date of shipment to be free of defects in workmanship and material.

Performance Guarantee

The Performance Guarantee on Volume and/or Brake Horsepower is subject to a tolerance of ±5% for a single operating point. Please contact Ro-Flo Compressors engineering for further information.

Special Warranty Provisions

Ro-Flo Compressors, LLC shall not be responsible for damage caused by corrosion, liquid or solid carry over in the gas, or improper operation on the Purchaser's part.

ALL REPAIR PARTS orders must be accompanied by the original compressor serial number.

SECURING COMPRESSOR FOR SHIPMENT

Compressors should be securely fastened to the shipping skid through the mounting feet holes. If banding the compressor to the skid, secure with band straps over the cylinder body**. DO NOT** secure the compressor over the cylinder heads or rotor, as this may affect the alignment of the compressor assembly.

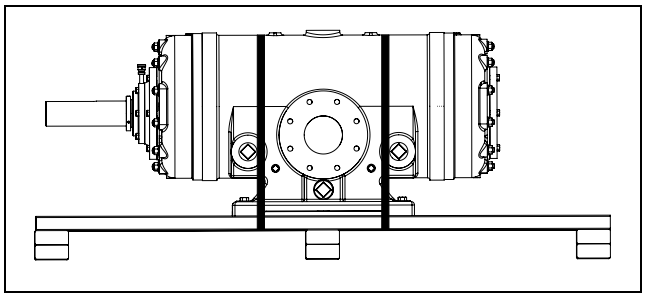


FIGURE 2 - Securing compressor for shipment. Never apply banding over the cylinder heads or rotor shaft.

COMPRESSOR LIFTING

The compressor can be lifted from beneath the mounting feet or with a sling around the cylinder. **DO NOT** lift from threaded holes in the top of the cylinder head. See **FIGURE 3** for the proper method of lifting with a sling. Refer to **TABLE 1** for approximate compressor weights.

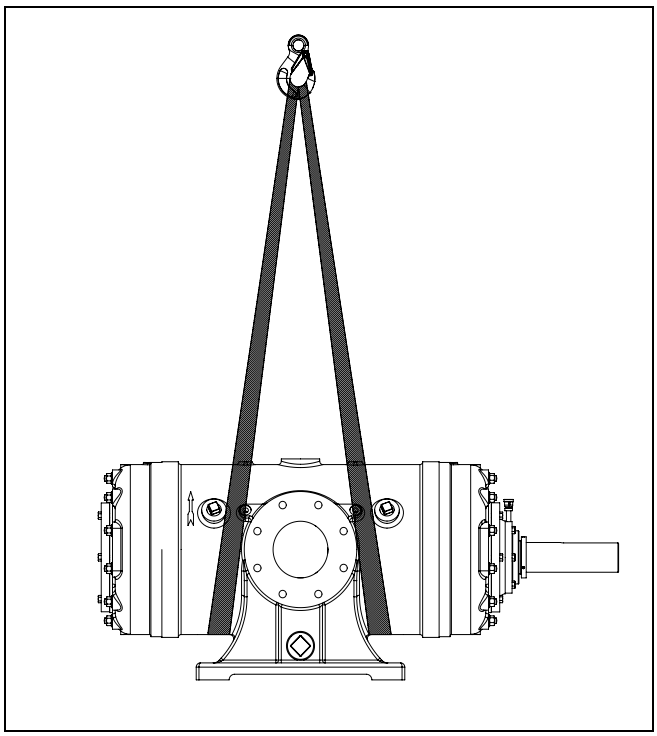


FIGURE 3 - Compressor lifting with a sling. **NEVER** lift the compressor by the threaded holes in the cylinder head. The threaded holes are for lifting of the cylinder head only during maintenance and assembly.

TABLE 1 - Approximate Compressor Weights

MODEL	WEIGHT	
	lbs.	kg
Low Pressure Models		
2CC	215	98
4CC	220	100
5CC	240	109
7D	450	205
8D, SD8D	750	341
8DE, SD8DE	730	332
10G	1350	613
11S	2000	908
11L	2150	975
12S	2100	1044
12L	2550	1157
17S	3500	1588
17L	4000	1815
19S, SD19S	5100	2313
19L, SD19L	5600	2540
19LE, SD19LE	5450	2472
High Pressure Models		
206, HP6	550	250
207, HP7	550	250
208B, HP8	550	250
210M, HP10	880	400
211M, HP11	1325	600
212M, HP12	1650	750
217M	2200	998
219M	3100	1407

RECEIVING INSPECTION

Upon receipt of the compressor, promptly check for any damage, which may have been incurred during transit. Make a claim for damage to the carrier immediately.

Additionally, check the shipping manifest for assurance that all material ordered with the compressor(s) has been received or alternately accounted for on back order.

UNPACKING

It is recommended to the leave the compressor in its original packaging until installation into the compressor package.

To unpack the equipment:

1. Position correctly rated lifting straps as shown in **FIGURE 3**.
2. Unbolt the compressor from the shipping skid.
3. Remove tape from the compressor input shaft.
4. Remove suction and discharge flange covers.
5. Remove plastic plugs from lube injection points.

PRESERVATION OF COMPRESSORS - VAPOR PHASE CORROSION INHIBITOR METHOD

All Ro-Flo® sliding vane compressors are shipped from the factory with vapor phase corrosion inhibitor (VpCI). The below procedures should be followed every 12 months or when equipment needs to be stored.

Preservation Materials and Equipment

Use the following or their equivalents:

1. A liquid vapor phase corrosion inhibitor (VpCI): Cortec VpCI 329 or VpCI-322. **NOTE: These products are incompatible with polyglycol (PAG) synthetic oils.**
2. A contact rust preventative: Cortec VpCI-368 corrosion inhibitor.

Preservation Procedure

1. Inspect and preserve the compressor in a clean dry environment.
2. Remove the following:
   - Suction and discharge nozzle flange covers.
   - Pipe plug from end cover and seal adapter, and top of double bellows seal if equipped.
3. Inspect all internal surfaces and cavities of the compressor.
   - Inspect for corrosion or standing water. If found, photograph affected areas and contact Ro-Flo Compressors.
   - Remove water contamination and corrosion prior to coating parts with rust preventative.
   - Inspect for potential leak paths for water and air and if found seal them.
   - Verify metal and plastic plugs are tight. Replace damaged plugs if necessary
   - Inspect suction and discharge nozzle flange covers and gaskets for damage. Replace if necessary.
4. Thoroughly mix liquid vapor phase corrosion inhibitor (VpCI-322 before dispensing it.
5. Spray or fog bearing cavities through the lube port with VpCI-322.
6. Spray or fog the rotor and cylinder bore evenly through the suction port with VpCI-322. Rotate the compressor rotor during application.
7. If equipped with a double bellows seal, spray or fog the double bellows seal cage.
8. Deposit VpCI-322 oil in compressor discharge plenum per the quantity listed in **TABLE 2**.
9. Brush VpCI-368 on the suction and discharge flanges.
10. VpCI corrosion inhibitors require protected cavities to remain sealed during storage. Open cavities depletes VpCI concentration, rendering it ineffective. To prevent VpCI depletion, seal the compressor ensure all plugs are tight and suction & discharge flanges should be sealed with blind flanges & gaskets.
11. Brush VpCI-368 on the compressor input shaft. Apply sufficient coats to provide 2 -3 mils of protection. Wrap input shaft with waterproof backed tape.

12. Apply tag to the compressor, noting the date of compressor preservation.
13. Apply a second tag to the shipping crate, noting the date of compressor preservation.

TABLE 2 - Liquid Vapor-phase Corrosion Inhibitor Application Volume

MODEL	QTY OF VPCI-322	
	Oz.	ml
2CC	0.25	7.5
4CC	0.25	7.5
5CC	0.25	7.5
7D	0.25	7.5
8D, SD8D	0.5	15
8DE, SD8DE	0.5	15
10G	1	30
11S	1.5	45
11L	2	60
12S	2	60
12L	2.5	75
17S	3.5	105
17L	4	120
19S, SD19S	5.5	165
19L, SD19L	6	180
19LE, SD19LE	6	180
206, HP6	0.25	7.5
207, HP7	0.25	7.5
208B, HP8	0.25	7.5
210M, HP10	0.5	15
211M, HP11	1	30
212M, HP12	1	30
217M	1.5	45
219M	2	60

Storage

Store the compressors in a clean, dry environment.

If the compressor is stored after packaging, protect all piping and bottles in the package in addition to the compressor. Verify all openings in the package are sealed.

Commissioning Compressor to Service

At commissioning:

1. Inspect all compressor internal surfaces and cavities. Inspect for corrosion or standing water. If found, photograph affected areas and contact Ro-Flo Compressors.
2. Remove temporary covers, gaskets, plugs, tape, tags, etc. that seal the compressor. There is no need to remove the preservative from the interior of the compressor. NOTE: VpCI-322 and VpCI-329 are not compatible with PAG oils.
3. Complete the "Pre-Start-Up Checks" on page 22.
4. Complete any start-up checks as provided by the compressor Packager.

PRESERVATION OF COMPRESSORS - DRY GAS METHOD

If a dry gas method is used to preserve Ro-Flo® sliding vane compressors, the gas supply should be are shipped from the factory with vapor phase corrosion inhibitor (VpCI). The below procedures should be followed every 12 months or when equipment needs to be stored.

Preservation Materials

Use the following or the equivalents:

1. A dry gas, inert gas. Nitrogen is recommended.
2. Pressure regulator.
3. Pressure gauge.
4. Isolation valves.
5. A contact rust preventative: Cortec VpCI-368 corrosion inhibitor.

Preservation Procedure

1. Inspect and preserve the compressor in a clean dry environment.
2. Remove the following:
   - Suction and discharge nozzle flange covers.
   - Pipe plug from the end cover and seal adapter, and top of double bellows seal (if equipped).
3. Inspect and preserve the compressor in a clean dry environment. Remove the following:
   - Inspect for corrosion or standing water. If found, photograph affected areas and contact Ro-Flo Compressors.
   - Remove water contamination and corrosion prior to pressuring with Nitrogen.
   - Inspect for potential leak paths for water & air and seal them.
   - Verify metal and plastic plugs are tight. Replace damaged plugs if necessary.
   - Inspect suction and discharge nozzle flange covers and gaskets for damage. Replace if necessary.
4. Attach a gauge (0-10 psi) in line with gas supply into end cover oil injection port prior to the isolation valve.
5. Attach pressure regulator to nitrogen supply and attach to isolation valve. Attach isolation valve to compressor.
6. Apply dry gas at 5 psig. Leave gas run for 30 minutes to ensure that only dry inert gas is in the compressor. Isolate the compressor so that the pressure gauge reads approximately 5 psig. (Changes in gas pressure may occur with temperature changes, the gauge is present to help detect any gas leaks.)
7. Brush VpCI-368 on the suction and discharge flanges.
8. The compressor is to remain sealed during storage.
9. Brush VpCI-368 on the compressor input shaft. Apply sufficient coats to provide 2 - 3 mils of protection. Wrap input shaft with waterproof backed tape.
10. Keep log of pressure, add dry gas as necessary.

Storage

Store the compressor in a clean, dry environment.

If the compressor is stored after packaging, protect all piping and bottles in the package in addition to the compressor. Verify all openings in the package are sealed.

Commissioning Compressor to Service

At commissioning:

1. Inspect all compressor internal surfaces and cavities for corrosion or standing water. If found, photograph affected areas and contact Ro-Flo Compressors.
2. Remove temporary covers, gaskets, plugs, tape, etc. that seal the compressor.
3. Reconnect oil lines and purge air from the oil line.
4. Complete the "Pre-Start-Up Checks" on page 22
5. Complete any start-up checks provided by the compressor Packager.

PROTECTION OF IDLE COMPRESSORS

During periods when the compressor remains idle, a degree of protection is advisable to avoid rusting of the internal parts and swelling of blades in the rotor slots. The most desirable method of protection is to run the unit weekly for approximately one hour. When this is not practical, the unit should be sprayed thoroughly in the bore and each bearing cavity with a light oil. Additionally, when inlet and/or discharge piping is removed or open to atmosphere during idle periods, the compressor openings should be sealed with plugs or cover plates to prevent humid or dirt from entering the compressor.

⚠ WARNING

Blades that swell may bind in the rotor slots, causing additional stress to be imposed on any free sliding blades. This can result in broken blades and catastrophic failure of the compressor.

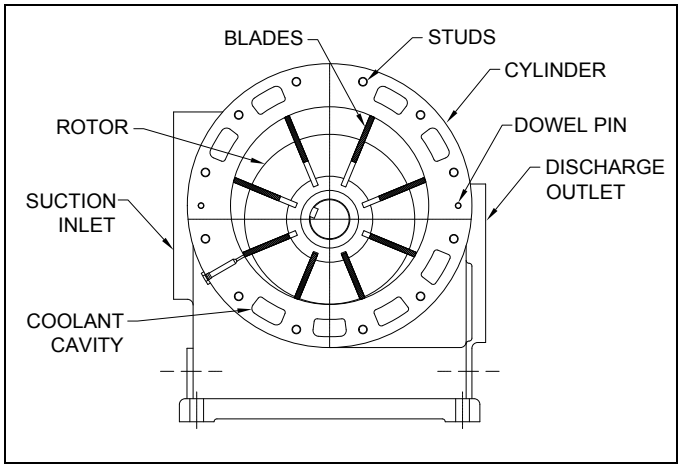


FIGURE 4 - Cross section of a Ro-Flo® Low Pressure model, perpendicular to rotor axis.

INSTALLATION

FOUNDATION

The compressor skid should be mounted on a level foundation with shims such that deformation does not occur when foundation bolts are tightened. Skids should be designed for the static loads of the compressor, driver, and other equipment mounted such that adequate stiffness exists to keep couplings in alignment. Filling the skid and the area between the skid and foundation with high strength non-shrinking grout will aid in preventing skid movement and also aid in noise & vibration control.

Whether a skid or alternately a simple concrete slab with sole plates is used, the height above ground should be adequate for compressor servicing and maintenance.

TABLE 3 - Compressor Shaft Dimension

MODEL	SHAFT DIAMETER @ COUPLING	NOMINAL SQUARE KEYWAY DIMENSION
	inch (+0.000 / -0.001)	inch
2CC, 4CC, 5CC	1.250	0.250
7D	1.625	0.375
8D, 8DE	1.625	0.375
SD8D, SD8DE	1.875	0.500
10G	2.625	0.625
11S, 11L	3.000	0.750
12S, 12L	3.000	0.750
17S, 17L	3.500	0.875
19S, 19L, 19LE	3.500	0.875
SD19S, SD19L, SD19LE	4.000	1.000
206, 207, 208B	1.625	0.375
HP6, HP7, HP8	1.875	0.500
210M, HP10	2.625	0.625
211M, HP11	3.000	0.750
212M, HP12	3.000	0.750
217M	3.500	0.875
219M	3.500	0.875

COMPRESSOR DRIVE

All Ro-Flo® compressors have a straight shaft with a keyway. Compressor shaft dimensions can be found in **TABLE 3**.

A variable speed driver will allow for utilization of the Ro-Flo® compressors turn down capability to control flow rate. Compressor operating speed ranges are shown in **TABLE 4**. It should be noted that these are minimum and maximum operating speeds, however, the compressor speed may be further limited by the application conditions.

Ro-Flo® compressors are suitable for use with electric motor or gas engine drives. Ro-Flo® compressors may be either direct coupled or belt driven. An application review is required to determine if it is possible to use a belt drive.

TABLE 4 - Compressor Operating Speed Ranges

MODEL	MINIMUM SPEED (RPM)	MAXIMUM SPEED (RPM)
2CC, 4CC, 5CC	865	2200
7D	690	1465
8D, 8DE SD8D, SD8DE	600	1465
10G	450	1300
11S, 11L	400	1000
12S, 12L	380	920
17S, 17L	310	760
19S, 19L, 19LE SD19S, SD19L, SD19LE	275	640
206, 207, 208B HP6, HP7, HP8	600	1465
210M, HP10	450	1300
211M, HP11	400	1000
212M, HP12	380	920
217M	310	760
219M	275	640

COMPRESSOR ALIGNMENT

Realignment should be completed following transit and before bolting piping to the compressor. Failure to assure proper shaft alignment on coupling drive units will result in excessive noise, coupling wear, and/or bearing damage. Improper shaft alignment for belt driven units may result in belt slippage and/or unequal belt wear, which may result in shortened belt life.

⚠ WARNING

Follow the lockout and depressurization procedures provided with your compressor package before accessing the couplings, belts, pulleys, etc.

Direct Drive Units

Ro-Flo® compressors are suitable for direct drive applications, as shown in **FIGURE 5**.

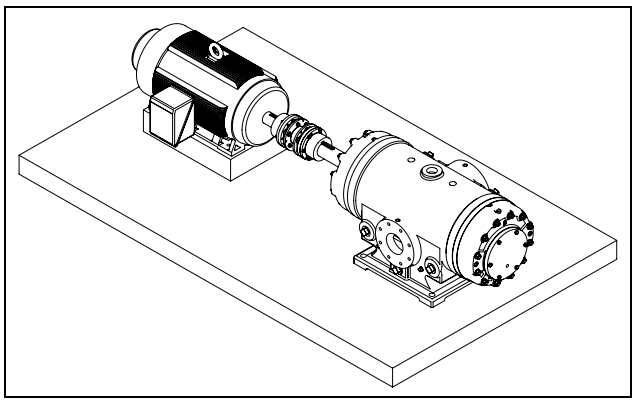


FIGURE 5 - Compressor directly coupled to electric motor.

Refer to **FIGURE 6**, **FIGURE 7**, and **FIGURE 8** illustrating angular and parallel misalignment and the dial indicator method for checking these. It is important to rotate both shafts simultaneously to avoid errors due to surface imperfections of the coupling hubs. Note that each shaft revolution the coupling will flex for the combined parallel and angular misalignment. The sum of these may be considered as the overall shaft misalignment.

Parallel and angular alignment of the compressor and driver should be within 0.006 inch or the coupling limits, whichever is less.

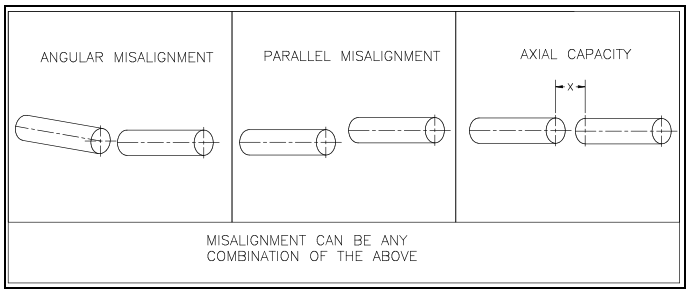


FIGURE 6 - Angular misalignment, parallel misalignment, and axial capacity illustrated.

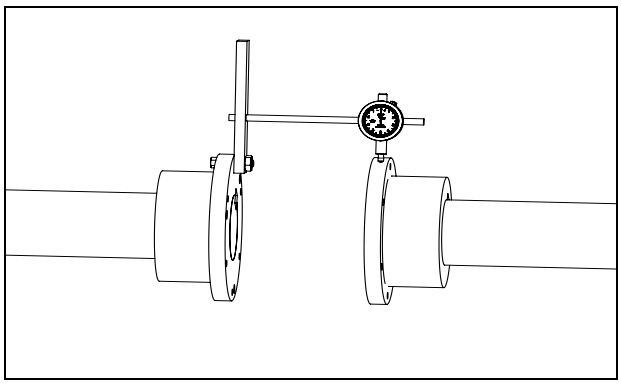


FIGURE 7 - Checking parallel alignment with dial indicator on coupling flange.

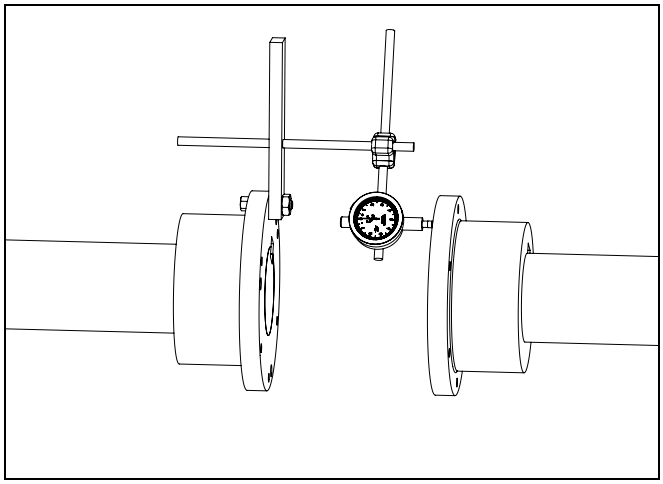


FIGURE 8 - Checking angular alignment with dial indicator on coupling face.

Belt Drives

Belt drive design must be determined by the compressor operating conditions and belt manufacturer. The belt manufacturer will define tension levels and belt operating limits. The loads predicted by the belt drive manufacturer should be reviewed with the Ro-Flo Performance software to determine if a jackshaft arrangement is required.

Excessive Belt Load

FIGURE 9 illustrates a typical jackshaft arrangement, which eliminates excessive belt load on the compressor. Alignment between compressor and jackshaft is checked in the same manner as with direct drive units.

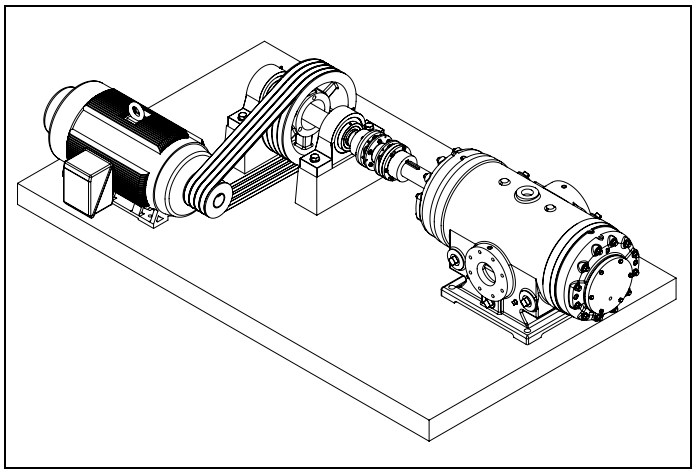


FIGURE 9 - Typical arrangement for belt drives with pedestal bearings and a jackshaft.

Acceptable Belt Load

FIGURE 10 illustrates the compressor sheave being mounted directly on the compressor. This is an acceptable arrangement if the bearing loads and bending moments do not exceed design limits of the compressor.

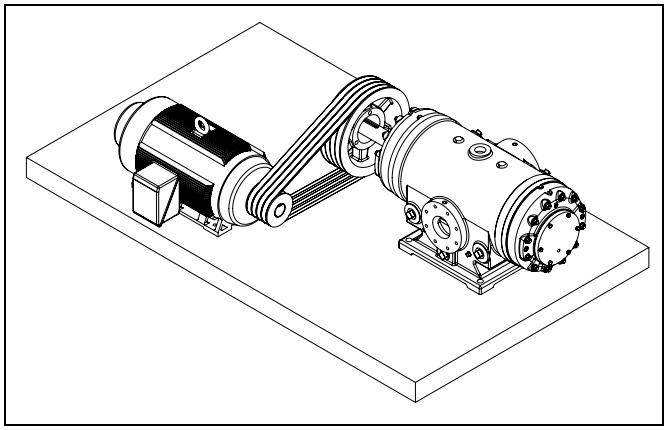


FIGURE 10 - V-belt drive with sheave mounted directly on compressor shaft.

2 Stage Compressor Train

FIGURE 11 shows a typical 2 stage compressor train driven by one electric motor.

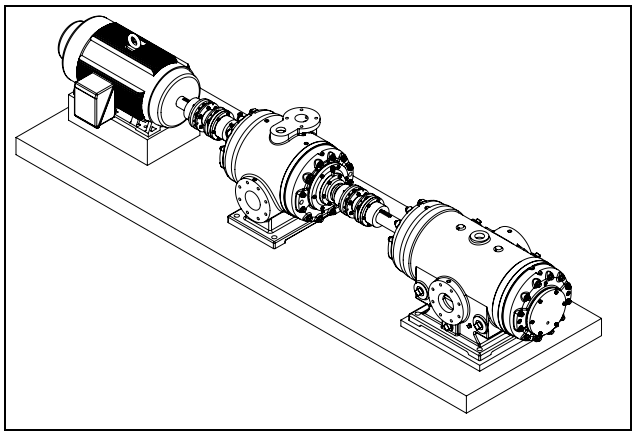


FIGURE 11 - Example of a 2 stage compressor train driven by one electric motor. (Couplings sold by others.)

PROCESS PIPING

Piping connected to the compressor should be adequately supported and aligned such that minimal stress is transmitted to the compressor/piping connection. See "FLANGE LOAD LIMITS" on page 46 for allowable flange loading for Ro-Flo® compressors & vacuum pumps. Additionally, the piping must have an adequate number of elbows, tee's and spool pieces to permit their removal for accessibility to the compressor for service.

Suction pipe internals must be cleaned. A 16-mesh start-up screen (witch's hat) should be installed near the compressor suction flange. The screen can be removed when debris stops accumulating.

Drains and drop legs for oil and liquid accumulation are recommended as shown in **FIGURE 12**, on both the suction and discharge piping.

⚠ WARNING

Liquid ingestion in the compressor can result in catastrophic failure.

Typical piping arrangements contain basic features, such as (refer to **FIGURE 13**):

1. The discharge check valve mounted as close as possible to the compressor discharge outlet to prevent reverse flow when the compressor is shut down
2. A discharge safety valve placed before the first isolation valve.
3. Drain valve, either manual or automatic, for the drop legs and liquid separators.
4. Intake filters to remove at least 90% of all dirt particles (10 microns or larger) from the inlet gas stream. Pressure drop through a filter will increase due to contamination and should be accounted for during equipment selection.
5. Instrumentation should be placed as close as possible to the compressor to accurately determine the operating conditions.

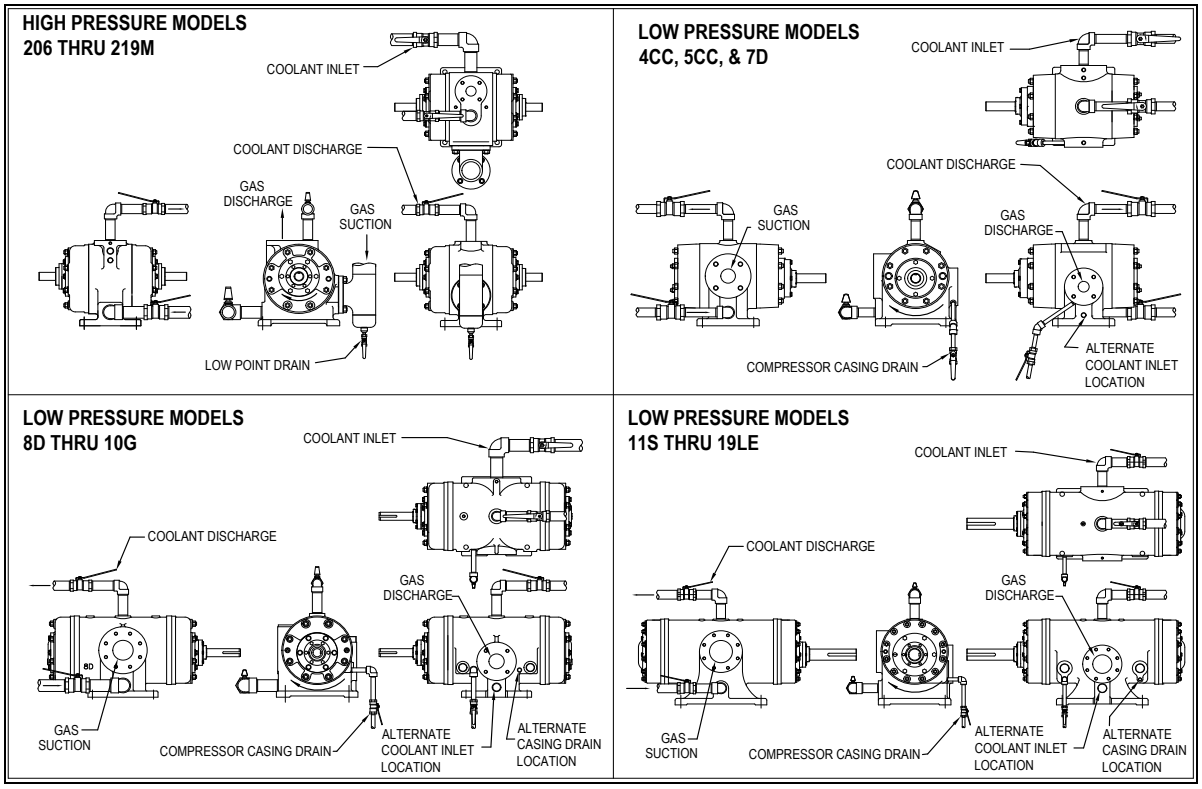


FIGURE 12 - Ro-Flo® cylinder drain locations and arrangements. (Note: All pipe & valve positions shown for clarity only, customer configuration may differ per application.)

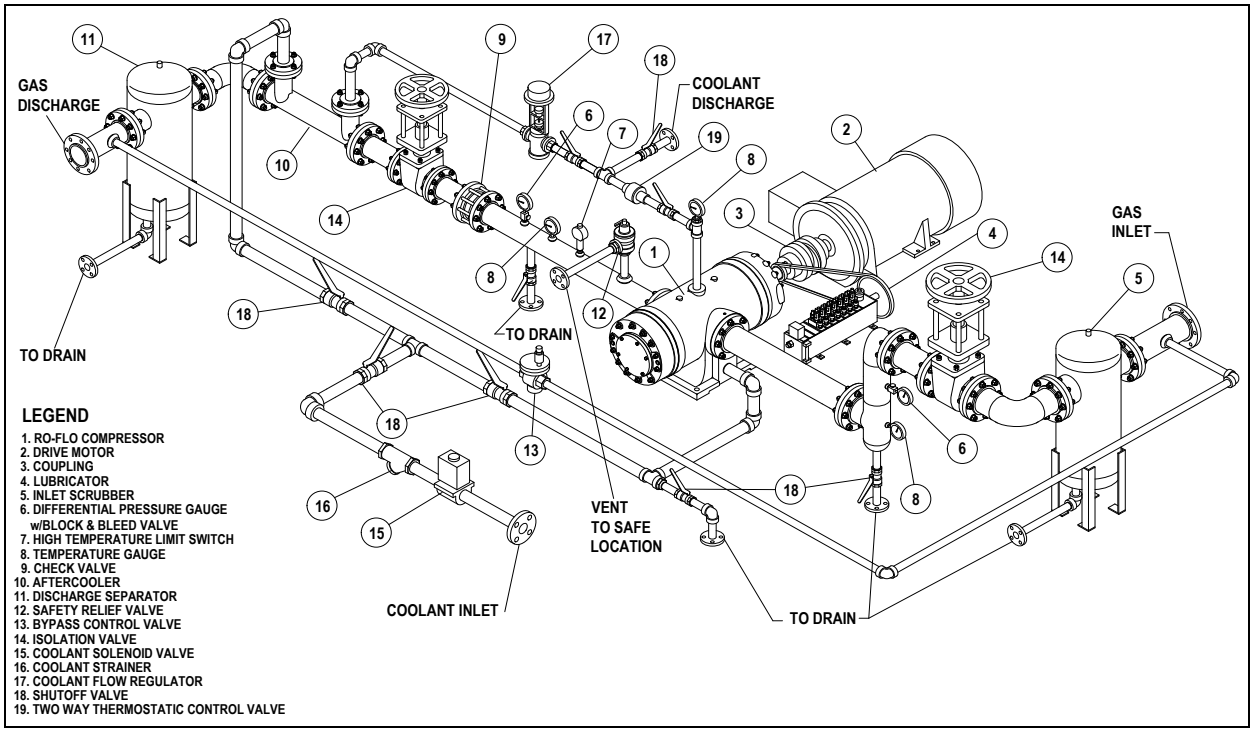


FIGURE 13 - Typical piping arrangement - open loop cooling system shown. (Note: All pipe & valve positions shown for clarity only, customer configuration may differ per application.)

COMPRESSOR COOLING SYSTEM

The compressor coolant system is used to control thermal expansion to maintain internal compressor clearances. This system is not designed to control gas discharge temperatures.

Coolant discharge temperatures below 100 °F (37.8 °C) can result in reduced internal clearances, which may cause rotor contact damage. Coolant discharge temperatures above 160 °F (71 °C) may result in head gasket failure.

⚠ CAUTION

Coolant flow must be stopped when the compressor is shutdown to prevent rotor/cylinder contact.

Circulation of coolant during shutdown periods can cause loss of internal clearances, which may result in rotor/cylinder contact.

⚠ CAUTION

Water jacket pressure must not exceed 50 psig (3.44 barg).

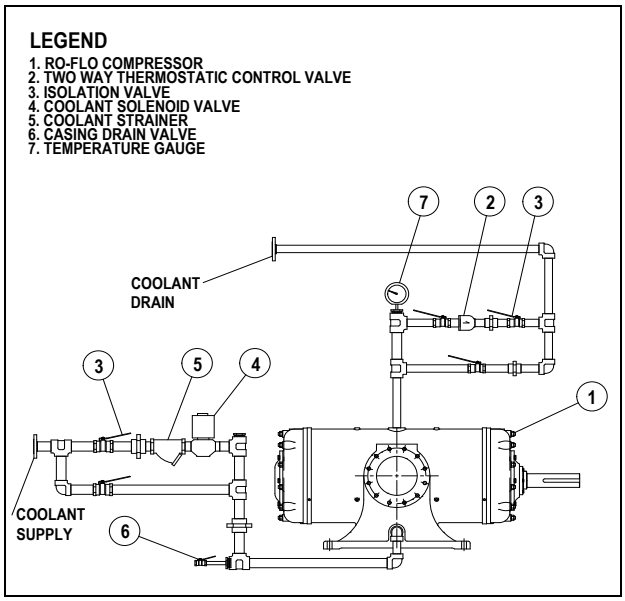


FIGURE 14 - Typical open loop cooling system.

Open Loop Cooling

Open loop cooling typically uses a two-way flow regulator installed near the compressor cooling water discharge as shown in **FIGURE 14**. The optimal water discharge temperature for the compressor is 105 ± 5 ºF (40.5 ± 2.7 °C). The compressor cooling system must be filled with coolant and purged of air prior to start-up.

Solenoid valves can replace manual valves to start and stop coolant flow when compressor is started and stopped. Good piping practice typically includes a manual bypass system around the solenoid valve and the two-way flow regulator.

Closed Loop Cooling

Closed loop glycol/water (**FIGURE 15**) radiator cooling systems may be designed for the approximate flow rates calculated in "Coolant Flow Requirement". An adequately sized radiator will reduce the coolant temperature approximately 15 ºF (8.3 °C). Higher compressor casing temperatures will result in higher gas discharge temperatures.

A three-way coolant flow regulator, as shown in **FIGURE 15**, is an essential requirement to maintain compressor coolant outlet temperature above 100 ºF (37.8 °C).

The cooling system must be purged of air prior to start-up.

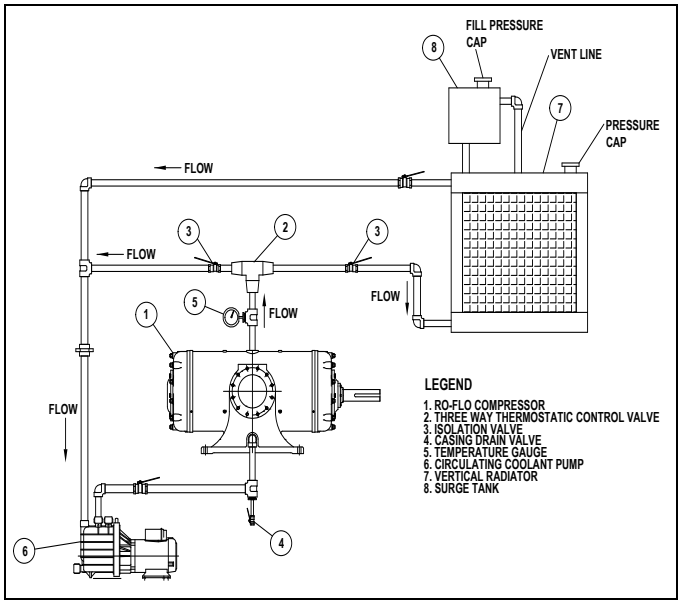


FIGURE 15 - Typical closed loop cooling system.

Coolant Flow Requirement

Compressor applications should have coolant piping capable of the flow rate (gallons per minute (GPM)) calculated by the following equation:

$$GPM = \frac{Motor\ Horsepower}{10}$$

Vacuum pump applications should have coolant piping capable of the flow rate (gallons per minute (GPM)) calculated by the following equation:

$$GPM = \frac{Motor\ Horsepower}{5}$$

The above estimated flow rates are based on a design coolant temperature rise of 15 ºF (8.3 °C). This flow rate will maintain 105 ºF

(40.5 °C) coolant discharge temperature with 90 ºF (32.2 °C) incoming coolant.

Cooling Water Contaminants

The total water hardness (TDS) of the cooling water should not exceed 300 ppm (mg/l). Deposits will build up over time and will require periodic acid cleaning of the compressor water jacket.

Water containing suspended solids should not be used since the solids will rapidly settle out in the compressor water jacket.

Cooling Water Pressure Drop

A pressure drop of 5 PSI (35 kPa) may be assumed through the compressor casing. The pressure drop through the water temperature regulating valve and inlet solenoid valve should be considered during system design.

TABLE 5 - Compressor Coolant Jacket Capacities

MODEL	APPROXIMATE VOLUME Gallons (Liters)	MODEL	APPROXIMATE VOLUME Gallons (Liters)
2CC	0.8 (3)	**206, HP6**	2.8 (10.6)
4CC	1.0 (3.8)	**207, HP7**	2.8 (10.6)
5CC	1.3 (4.9)	**208B, HP8**	2.8 (10.6)
7D	3.0 (11.4)	**210M, HP10**	6.0 (23)
8D, SD8D	5.5 (21)	**211M, HP11**	9.0 (34)
8DE, SD8DE	5.5 (21)	**212M, HP12**	10.5 (40)
10G	8.0 (30)	**217M**	13.0 (49)
11S	10.0 (38)	**219M**	16.3 (62)
11L	10.5 (40)		
12S	12.5 (47)		
12L	13.8 (52)		
17S	20.0 (76)		
17L	24.5 (93)		
19S, SD19S	27.0 (102)		
19L, SD19L	30.0 (114)		
19LE, SD19LE	30.0 (114)		

Cooling of Two Stage Systems

Two stage compressor systems should have the coolant supply connected in parallel to each compressor. Each compressor should have a thermostatic valve to control the coolant discharge temperature independently. The compressor cooling circuit should not be connected in series as this may cause excessive heat build up within the compressor and may cause damage to the sealing elements and/or premature cylinder bore wear/blade failure.

LUBRICATION SETUP

Ro-Flo Compressors recommends check valves at all lubrication points. Ro-Flo Compressors offers the following lubrication components.

TABLE 6 - Compressor Lubrication Accessories

MODEL	NUMBER OF LUBE POINTS	INLET LUBRICATION QUILL		LUBRICATOR DRIVE SHEAVE	
		Quill Length (inches) ("A" Dim.)	Part Number	Pitch Diameter (inches)	Part Number
2CC, 4CC 5CC	5	3	16-630-888-034	3	16-132-506-501
7D	7	4	16-630-888-035	3	16-132-506-502
8D, 8DE SD8D SD8DE	7	5	16-630-888-038	3	16-132-506-502
10G	7	5	16-630-888-038	4	16-132-492-503
11S, 11L	8	N/A	N/A	5	16-132-534 501
12S, 12L	9	6	16-630-888-036	5	16-132-534-501
17S, 17L	9	6	16-630-888-036	5	16-132-399-501
19S, 19L 19LE SD19S SD19L SD19LE	10	8	(2 required) 16-630-888-037	5	16-132-399-501
206, 207 208B HP6, HP7 HP8	7	3	16-630-888-034	3	16-132-506-502
210M HP10	7	4	16-630-888-035	4	16-132-492-503
211M 212M HP11 HP12	7	5	16-630-888-038	5	16-132-534-501
217M 219M	7	6	16-630-888-036	5	16-132-399-501

***** For detailed information on lubrication point locations refer to "Lubrication" on page 20

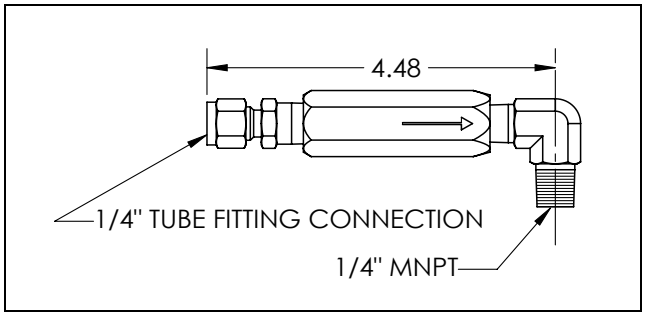


FIGURE 16 - Angled Double Check Valve for compressor lube points.

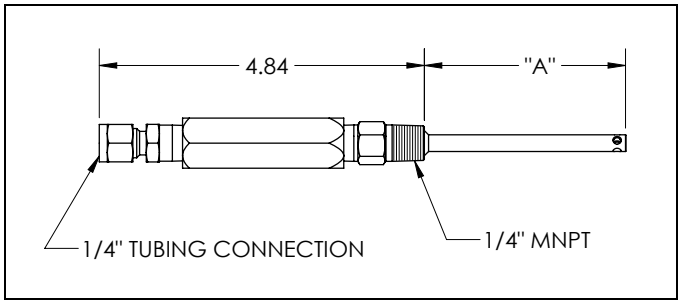


FIGURE 17 - Inlet Lubrication Quill.

Seal Support System for Double Opposed Shaft Seals

The seal support system for dual opposed shaft seals (double bellow type and dual opposed cartridge) is designed to keep the seal parts submerged in oil and to maintain the pressure on this oil. If leakage occurs at the outer seal, it will be towards the atmosphere and air will not be drawn into the system. If leakage occurs at the inner seal, it will be into the compressor.

The double bellows seal (see "Double Bellows Mechanical Seal" on page 33) and the dual opposed cartridge seal (see "Dual Opposed Cartridge Seal") consists of two carbon rings that seal against two highly polished stationary rings. The seal is filled with oil by a reservoir mounted above the seal cage. The seal is both lubricated and cooled by thermal circulation of the oil and rotation of the seal.

The oil reservoir should be designed to contain 1 gallon of oil per inch of shaft diameter. The reservoir must be connected as shown in **FIGURE 18**. The lower connection on the oil reservoir should be connected to the bottom of the seal cage.

The upper connection of the oil reservoir should be connected to the top of the seal cage. For low pressure models use the connection nearest the compressor suction flange. For high pressure models use the connection nearest the compressor discharge flange.

Use tubing sized 1/2 inch or larger. Locate oil reservoir so piping is as straight as possible to minimize restriction to convective oil flow.

NOTE: Be sure to maintain oil level in reservoir above upper pipe connection to provide proper oil circulation. Oil level will drop slightly during initial start-up.

NOTES:
1. ALL LINES TO BE 1/2" TUBE MINIMUM.
2. RETURN LINE TO OIL RESERVOIR TO BE MAXIMUM 9 FT LONG AND NO MORE THAN THREE 90° BENDS. FOR BEST SERVICE THE RETURN LINE SHOULD BE INSULATED.
3. AN INERT BUFFER GAS, SUCH AS NITROGEN, SHOULD BE SUPPLIED TO THE TOP OF THE OIL REVERVOIR AT 0 - 30 PSIG ABOVE GAS DISCHARGE PRESSURE.
4. THE SEAL SYSTEM SHOULD BE FILLED WITH OIL AND PRESSURIZED PRIOR TO PRESSURIZING THE COMPRESSOR FOR PRESSURE TEST OR OPERATION.

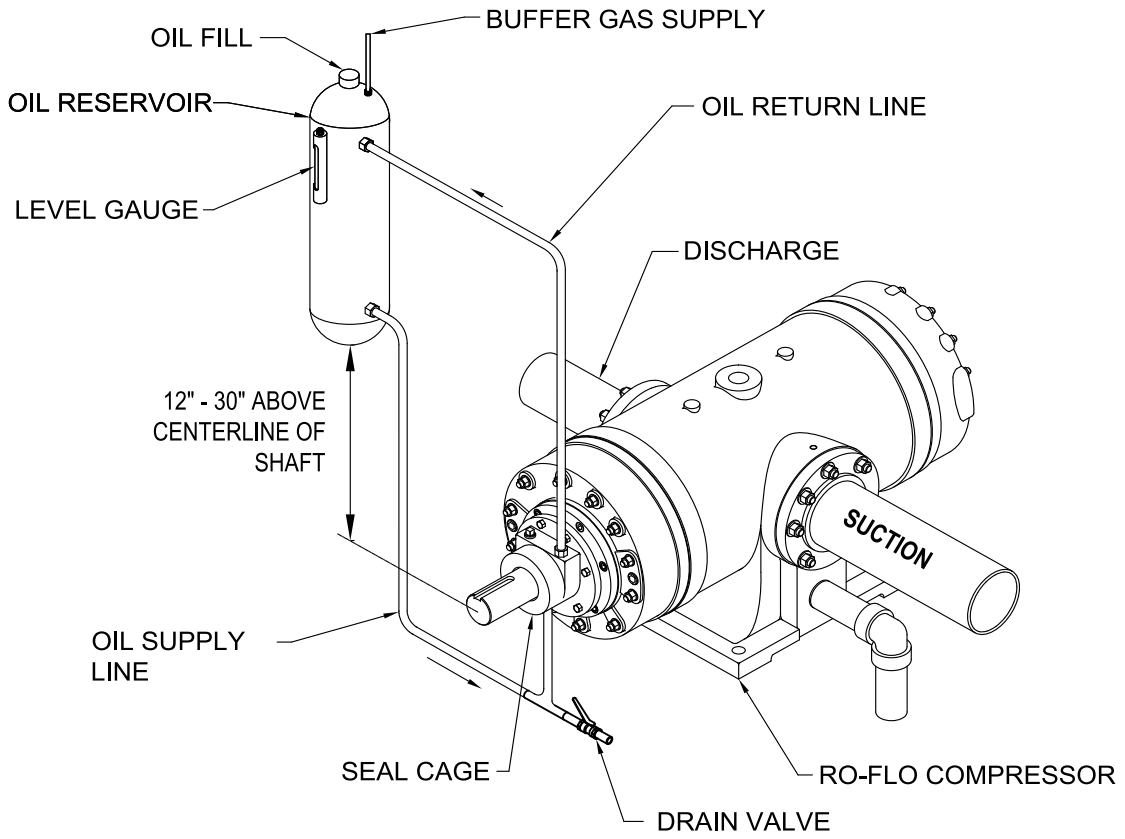


FIGURE 18 - Typical piping arrangement for dual opposed seals.

OPERATION

Ro-Flo® compressors and vacuum pumps must be operated by professionals trained in the use of gas compression equipment. Please contact your system integrator / packager for training in the use and maintenance of Ro-Flo® compressors and vacuum pumps as applied in your system.

COMPRESSOR WORKING PRESSURES

The maximum allowable working temperature (MAWT) for all Ro-Flo® compressor models is 350 °F (176 °C).

The maximum allowable working pressure (MAWP) for Ro-Flo® compressors are listed in **TABLE 7**. The user should refer to documentation provided by the Packager as the compressor may not be the lowest MAWP component in the system. Application conditions may limit the operating pressure to a discharge pressure level below the MAWP.

TABLE 7 - Compressor Maximum Allowable Working Pressure (MAWP)

LOW PRESSURE		HIGH PRESSURE	
MODEL	**MAWP (psig)**	**MODEL**	**MAWP (psig)**
2CC	80	**206**	150
4CC	80	**207**	150
5CC	80	**208B**	150
7D	80	**210M**	150
8D, SD8D	80	**211M**	150
8DE, SD8DE	80	**212M**	150
10G	80	**217M**	150
11S	80	**219M**	150
11L	80		
12S	80	**HP6**	200
12L	80	**HP7**	200
17S	80	**HP8**	200
17L	80	**HP10**	200
19S, SD19S	80	**HP11**	200
19L, SD19L	80	**HP12**	200
19LE, SD19LE	80		

LUBRICATION

Ro-Flo® compressors are oil lubricated by a force-feed lubricator. Lubrication points are shown in **FIGURE 19** and listed in **TABLE 9**. The "Performance Data Sheet" for your compressor should be used to set oil feed rates. Consult the lubrication engineer at your lube supplier to select the appropriate oil for your compressor system. If the operating conditions or gas handled changes, the following three items must be considered:

A. Oil Viscosity – Determined by gas discharge temperature.
B. Oil Type and Additive Package – Determined by chemical nature of gas/vapor being handled.
C. Lubrication Rate – Determined by compressor size, operating speed, and chemical/physical action of gas/vapor being handled.

See the following sections for a more detailed discussion of lubrication concerns.

Considerations for Oil Viscosity Selection

- If the gas handled is expected to condense and dilute the oil, use the next higher viscosity grade.
- Multi-viscosity grades of oil are recommended for inlet temperatures below 32 °F (0 °C), as are lubricator reservoir heater and thermostat.
- On multi-stage units, use the highest discharge temperature to select the oil viscosity.
- If the inlet and/or discharge temperatures are consistently 70 ºF (21 °C) lower than those printed on the "Performance Data Sheet", use the next lower viscosity grade.
- For solvents, heavy paraffin's, and gasoline vapors use the next higher viscosity grade.

TABLE 8 - Recommended Oil Viscosity Grades

Gas Discharge Temperature	SAE Grade	ISO VG
Below 200 °F (93 °C)	20	32-68
200 - 250 °F (93-121 °C)	30	68-100
250 - 300 °F (121 - 148 °C)	40	150
Above 300 °F (148 °)	50	220

Considerations for Oil Type and Additive Package

- Lubricants containing detergents have been observed to cause foaming when encountering water saturated gas and turbulence.
- Lubricants produced from vegetable oils have been known to cause harmful deposits in the compressor and may lead to premature failure.

Considerations for Lubrication Rate

The lubrication rates shown in **TABLE 9** are for guidance only (based on air = 1.0 multiplier). For other gases, multiply the lubrication rates in **TABLE 9** by the appropriate value in **TABLE 10** for your application. If a Ro-Flo® "Performance Data Sheet" has been provided with your compressor, use the rate on that sheet, as it takes into account gas composition and compressor operating speed.

Other lubrication rate notes:

A. Double the lubrication rate for initial break-in period of 300 hours.
B. Prime all oil feed lines before starting compressor.
C. Suction flange lubrication points 7, 8, 9, 22, and 32, must have an inlet quill/check valve (see FIGURE 17 on page 18) for proper cylinder lubrication.

D. Use drops per minute information for initial start-up only! Use "pints per hour" flow rate after 24 hours of operation to verify correct oil consumption.

TABLE 9 - Oil injection points and approximate lubrication rates. The lubrication rates listed in this table are for compressors operating on air at maximum operating speed.

Model	Lubrication Injection Points	Quantity Of Lube Points	Pints Per Hr Total	Approximate Drops/Min Per Lube Point*
2CC, 4CC 5CC	1-2-7-14-15	5	.09	5
7D	1-2-3-4-7-14-15	7	.15	6
8D, 8DE SD8D SD8DE	1-2-5-6-7-14-15	7	.19	7
10G	1-2-11-12-7-14-15	7	.29	10
11S	1-2-3-4-5-6-28-29	8	.28	9
11L	1-2-3-4-5-6-28-29	8	.35	11
12S	1-2-3-4-5-6-7-28-29	9	.36	10
12L	1-2-3-4-5-6-7-28-29	9	.36	10
17S	1-2-3-4-5-6-7-28-29	9	.37	10
17L	1-2-3-4-5-6-7-28-29	9	.45	12
19S, SD19S	1-2-8-9-10-11-12-13-28-29	10	.42	10
19L, 19LE SD19L SD19LE	1-2-8-9-10-11-12-13-28-29	10	.50	12
206, HP6 207, HP7 208B, HP8	17-18-19-20-30-31-32	7	.15	5
210M HP10	17-18-19-20-22-30-31	7	.17	6
211M HP11	17-18-19-20-22-24-25	7	.24	9
212M HP12	17-18-19-20-22-24-25	7	.24	9
217M	17-18-19-20-22-24-25	7	.29	10
219M	17-18-19-20-22-24-25	7	.29	10

*Assumes 14,000 drops per pint. Lubricator manufacturers use different standard drops per pint which will affect the above drops/min lubrication rate. See lubricator manufacturer's manual for more information.

TABLE 10 - Lubrication Rate Multiplier

Gas/Vapor Handled	Multiplier
For air and dry inert gases	1.0
Water vapor, wet non-corrosive gases and vapors Condenser service	1.1
Refrigeration, sweet natural gas, methane, ethane, propane, butane	1.2
Sour natural gas, sludge gas, heavy hydrocarbons (pentane & heavier)	1.5
Vapor recovery, solvents, acids, ketones	2.0
Gasoline vapors	4.0

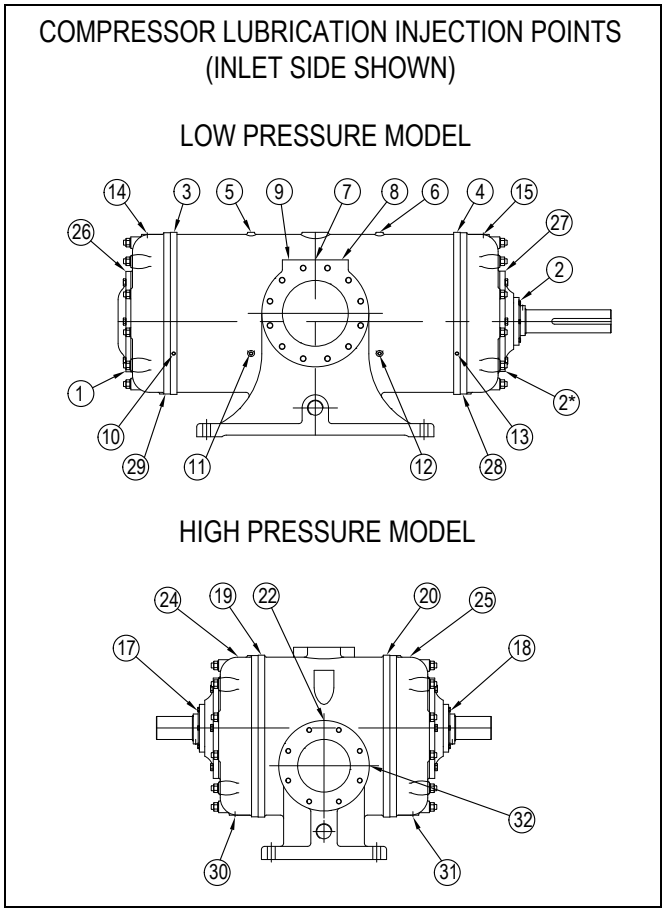


FIGURE 19 - Compressor lubrication injection points, inlet side shown. For more specific locations see the compressor general arrangement drawings available on the Ro-Flo Compressors website.

PRE-START-UP CHECKS

- Open inlet and discharge line drain valves to assure no liquid is present. Where no drain valves are installed, loosen the suction and discharge flange bolts to determine if any liquid has entered the cylinder bore.

⚠ WARNING

Liquids in the compressor during start-up can cause catastrophic failure.

- Manually rotate the compressor shaft to assure no rubbing or binding.
- Check motor for correct direction of rotation by momentarily "jogging" the start/stop switch.
- Recheck all piping and flange connections, in addition to valves on suction and discharge lines.
- Check the settings of pressure relief and control valves to ensure they are adjusted and operating correctly.
- Verify the pressure relief valve is properly sized for the expected operating conditions.
- Fill lubricator pump case with oil.
- Fill the day tank supplying oil for compressor lubrication.
- Prime all lube lines by loosening the tubing nut at each oil line check valve and pumping oil until all air is purged from the lines – then retighten the tubing nuts.
- For belt-driven lubricators, assure the belt has proper tension.
- Test lubricator low oil level and no flow switches by simulating the condition.
- Verify that the compressor water jacket is filled with coolant and purged of air.
- Confirm all instrumentation is working properly.
- For those compressor installed with a double bellows seal insure that the seal cage and reservoir are filled with oil, and that the seal oil is pressurized 20 to 50 psi (138 - 345 kPa) above gas discharge pressure.
- Ensure all guards and shields are installed correctly.

START-UP CHECKS

- Start the system and verify all operating parameters are within their expected ranges and are within the compressor design specifications.
- Visually check lubrication system to verify it is operating properly, per the manufacturer's instruction manual.
- Monitor the compressor coolant discharge temperature rise during the initial 20 minutes of operation to assure it stabilizes between 100-110 ºF (37.8 – 43.3 °C). Coolant discharge temperature greater than 110 ºF (43.3 °C) will result in increasing internal clearance and lower compressor volumetric efficiency.
- The gas discharge temperature is the most important indication of how well the compressor is operating. The gas discharge temperature should be monitored continuously during operation. The temperature indicator should be within one foot of the discharge flange for greatest accuracy. The thermowell should extend into the center of the gas stream.
- Verify all operating parameters are within their expected ranges and are within the compressor design specifications. If the temperatures are outside of their expected ranges refer to "Temperature Tells All" on page 48.

⚠ CAUTION

Minimum suction temperature -20 °F (-28.8 °C).

For suction temperatures below -20 °F (-28.8 °C) please contact Ro-Flo Compressors.

OPERATING CHECKS

⚠ CAUTION

Continuous operations with gas discharge temperatures above 350 °F (176.6 °C) will reduce blade life and may cause cylinder bore scoring, reducing compressor life.

- Common set points for temperature switches are the highest normal operating temperature expected for that compressor application PLUS 10 to 15 ºF (5.6 to 8.3 °C). It should never be set more than 25 °F (13.9 °C) above the expected gas discharge temperature.
- Verify the proper 24 hour lubrication rate.
- For units equipped with a double bellow type or dual opposed cartridge seal review seal pot oil level.
- If vibration sensors are used to monitor equipment health, it is recommended that baseline vibration levels are recorded soon after equipment start-up and process stabilization. Use this data for comparison to future vibration measurements. Ro-Flo® vibration levels will typically be less than 0.5 in/sec,however, each installation is unique due to skid design, piping arrangements, gas compositions, operating speeds, etc. Vibration readings should be made in the same location on the compressor/skid with the same equipment for the most accurate comparison. Vertical and horizontal vibration measurements should be taken 90 degrees apart on the cylinder head(s), directly outboard of the bearings. Axial measurements should be taken on the vertical face of the cylinder head(s). Vibration measurements on all peripheral equipment should be taken according to the manufacturer's recommendations.

⚠ CAUTION

It is recommended that an air quality monitoring system be installed for processes containing toxic gases.

MAINTENANCE

⚠ CAUTION

Maintenance of Ro-Flo® compressors should be conducted by professional maintenance personnel with proper training regarding compression equipment and lifting devices. If training is desired, please contact Ro-Flo Customer Support.

⚠ CAUTION

Solvents may be used for cleaning purposes during assembly, disassembly, service, and/or maintenance of Ro-Flo® compressors and vacuum pumps. Oil is used as a lubricant during assembly, disassembly, operation, service, and/or maintenance of Ro-Flo® compressors. Refer to the solvent and oil MSDS for PPE requirements.

Compressor operating conditions such as temperature, pressure, speed, process gas, etc., directly affect the operational life of individual compressor components, and ultimately, the life of the compressor itself. Due to many variables, it is not possible to provide a predetermined inspection, maintenance, and repair schedule for each application. Compressor inspection may lead to performing general maintenance or the need for compressor repair. Maintenance procedures will be covered later in this section. For compressor repair procedures please refer to the Ro-Flo Compressors - Repair Manual.

When properly operated, the primary wear items in a Ro-Flo® compressor are the rotor blades, but it is equally important to inspect all parts of the compressor to identify unusual or premature wear.

Compressor reliability can be achieved by developing a comprehensive preventative maintenance (PM) schedule for every compressor installation. Recommendations for developing a PM schedule are listed below. This should not be considered a comprehensive list as all installations are different.

Ro-Flo® compressors are incorporated into a compressor package by a Packager. Proper maintenance of the compressor package is required to properly operate and protect the compressor. Please refer to the documentation provided with your compressor package for proper maintenance of all associated compressor support systems.

PREPARATION FOR COMPRESSOR INSPECTION AND MAINTENANCE

⚠ WARNING

Follow the lockout, depressurization, and decontamination procedures provided with your compressor package before servicing the compressor.

⚠ WARNING

The compressor system may contain explosive and/or toxic gases. Refer to the reference information provided with your compressor package for working with these gases and proper personal protective equipment (PPE).

Before starting any maintenance or removing any components, lockout the compressor driver and relieve ALL pressure from the compressor. See the packager's instructions for completely venting the compressor.

⚠ CAUTION

It is important to have the compressor cylinder properly secured during maintenance or repair activities to prevent personal injury or damage to the compressor.

ESTABLISHING A PREVENTATIVE MAINTENANCE (PM) SCHEDULE

A good maintenance program should provide for periodic inspection of the compressor. The gas composition, operating temperature, operating speed, and pressure differential will determine the extent of preventative maintenance necessary. The following schedule shows typical frequency of maintenance. This schedule can adjusted to meet the needs of each installation.

24 Hour (Daily) Inspection

- Monitor compressor operating conditions such as process gas pressures and temperatures, coolant temperatures, etc. Sudden changes may indicate a problem within the compressor.
- Verify gas discharge temperatures are within the expected operating range for your application.
- Drain all points of liquid accumulation in the gas system (receivers, control lines, drop-legs, interconnecting piping, separators, etc…).
- Verify lubricator pump sight glass oil level.
- Fill lubricator oil supply tank and verify the lubrication system is operating properly.
- Verify gas discharge temperatures are within the expected operating range for your application.
- Check the compressor for coolant, oil, or gas leaks.
- Look for discolored paint, which may indicate excessive heat.
- Check for loose peripheral equipment such as oil injection lines, coolant lines, process gas piping, instrumentation, etc.
- If equipped with a Double Bellows Mechanical Seal verify seal reservoir oil level and buffer gas supply pressure.

NOTE

Ro-Flo® mechanical seals are designed to have oil lubricate the barrier between the stationary and rotating seal parts. For this reason mechanical shaft seals may have minor oil weeping.

4000 Hour (Semi-Annual) Inspection

- Follow the PM procedures listed for the "24 Hour (Daily) Inspection".
- Check coupling alignment or belt tension.
- Evaluate if blades are acceptable for reuse by following the guidelines in "Blade Evaluation".

⚠ CAUTION

Do NOT reverse blade orientation. When returning the blades to the rotor slots ensure the blades are installed their original orientation. Reversal of blades may result in premature blade failure.

NOTE

Changes in operating conditions (operating speed, temperatures, pressures, gas composition, liquid carry over, etc.) may affect the blade wear rate requiring inspection interval adjustment.

8000 Hour (Annual) Inspection

Completely disassemble compressor and inspect the following items per "Component Inspection" on page 24:

- Gaskets and O-Rings
- Seal Rings
- Mechanical Seal
- Blades
- Rotor
- Bearings
- Cylinder Heads
- Cylinder

Replace the seal rings, head gaskets, and O-rings upon reassembly.

COMPONENT INSPECTION

Blade Evaluation

Monitoring rotor blades is important as they are the primary wear component within the compressor. It is recommended to develop a baseline of blade wear during initial compressor operation. This baseline can then be used to maximize time between inspections.

Evaluating Blade Wear

Blade wear occurs on the blade width as a result of the rubbing action against the cylinder wall, and on the blade thickness as a result of the rubbing action against the rotor slot. **FIGURE 20** illustrates the blade dimensions described above. **TABLE 11** provides the recommended limits for blade wear on standard Ro-Flo® models. Refrigeration/condenser blade sets may differ, please consult the factory for assistance with these models.

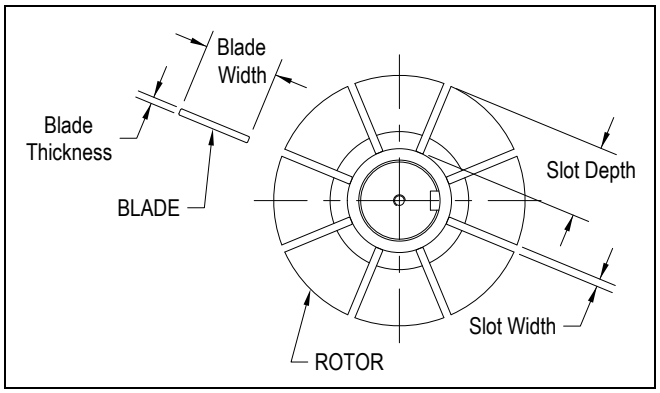


FIGURE 20 - Blade and Rotor dimensions illustrated.

TABLE 11 - Blade wear limits by model. Values shown are for standard blades. For refrigeration applications contact Ro-Flo Compressors for assistance.

MODEL	Minimum Allowable Thickness		Minimum Allowable Width	
	inch	(mm)	inch	(mm)
2CC, 4CC, 5CC	.106	(2.7)	1.012	(25.7)
7D	.159	(4.0)	1.530	(38.9)
8D, 8DE SD8D, SD8DE	.212	(5.4)	1.800	(45.7)
10G	.212	(5.4)	2.137	(54.3)
11S, 11L	.265	(6.7)	2.540	(64.5)
12S, 12L	.265	(6.7)	2.709	(68.8)
17S, 17L	.319	(8.1)	3.150	(80.0)
19S, 19L, 19LE SD19S, SD19L, SD19LE	.372	(9.4)	3.825	(97.2)
206, 207, 208B HP6, HP7, HP8	.212	(5.4)	1.518	(38.6)
210M, HP10	.265	(6.7)	1.746	(44.3)
211M, HP11	.319	(8.1)	2.286	(58.1)
212M, HP12	.319	(8.1)	2.457	(62.4)
217M	.371	(9.4)	3.150	80.0
219M	.425	(10.8)	3.609	(91.7)

Normal blade wear is affected by the pressure differential, temperature, operating speed, and condition of the gas. Higher pressure differentials, higher temperatures, faster operating speeds, and contaminants in the gas stream will increase the blade wear rate.

Blade replacement is recommended if any of the following are observed:

- Delamination of the blade edge in contact with the cylinder
- Chipping on the edge or face of the blade
- Appears scorched / charred

Initial Blade Inspection

Initial blade inspection can be performed by evaluating the remaining chamfer on the edge of the compressor blade. If any of the original chamfer is observed, the blade has 50% blade life left. Existing chamfer on the blade can be observed through the suction or discharge pipe flanges. Alternately, on Low Pressure models (10G through 19LE), inspection ports are located on the discharge side of the compressor (refer to General Arrangement Drawings). Please note that these inspection ports are in contact with the process gas, and proper safety precautions should be followed.

After the chamfer has been worn off, blade width should be measured by removing the blade from the compressor.

Bearing Evaluation

NOTE

When bearing outer races and shims are removed from the cylinder head, their orientation should be noted so that they are reassembled in the same cylinder head and in the same direction as removed.

Bearing replacement is recommended if any of the following are observed:

- Uneven wear
- Discoloration due to heat
- Pitting
- Spalling

Bearing inner and outer races are matched sets, therefore, the entire bearing must be replaced .

The bearing inner race can be removed by quickly heating with a torch or bearing induction heater (before heating of the shaft can occur).

⚠ WARNING

The roller bearings used in Ro-Flo® compressors have special radial clearances (different than bearings carried by distributors) to allow for thermal expansion and should never be replaced with non-factory specified bearings. Non-compliance can result in compressor failure and will void the warranty.

Seal Rings and Bearing Spacing Rings

Seal ring replacement is recommended if they are:

- Broken
- Worn
- Brittle
- Insufficient gap (new, seal rings have approximately ¼" gap between the ends)

The seal rings are located in the bearing spacer ring.

Bearing spacing ring replacement is recommended if it is:

- Scored
- Pitted

The bearing spacer ring can be removed by quickly heating with a torch or bearing induction heater (before heating of the shaft can occur).

Cylinder Evaluation

Inspect cylinder coolant jackets for solid build-up and/or corrosion. If solid build-up is found remove contaminants that restrict coolant flow. If corrosion is found, review coolant additive package (closed-loop) and/or cathodic protection.

Inspect the cylinder bore for unusual wear:

- Normally occurring wave pattern, maximum peak to crest is 0.010 in. (0.25 mm).
- Circumferential grooves of 0.030 in. (0.76 mm), or greater

(Note: Minor bore defects may be improved by hand to an acceptable condition).

When scoring or severe wear is found, re-boring is required. Refer to the Ro-Flo Compressors - Repair Manual for more information.

Rotor Evaluation

Rotor runout should be checked with dial indicator readings at each end of the rotor and shaft extension(s) with the bearing inner races supported in "V" blocks.

The rotor shaft should be inspected in the locations noted in **TABLE 12**. These areas are illustrated in **FIGURE 21**.

TABLE 12 - Rotor Inspection - Total Indicator Runout

MODEL	Maximum Total Indicator Runout (TIR) (inch)		
	Rotor Body	Bearing Journal OR Inner Race	Shaft Extension
ALL MODELS	0.004	0.0025	0.006

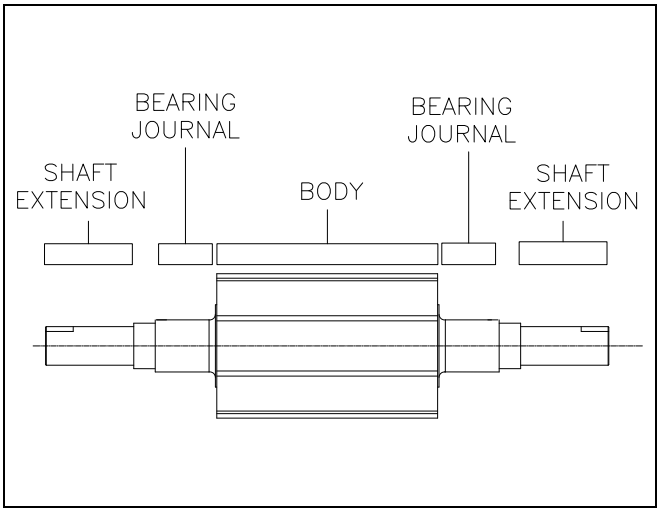


FIGURE 21 - Rotor terminology. A High Pressure model rotor is shown.

COMPRESSOR DISASSEMBLY PROCEDURE

⚠ WARNING

Review "Preparation for Compressor Inspection and Maintenance" on page 23 before servicing the compressor.

⚠ CAUTION

Cylinder head dowel pins are brittle by design. Take care when removing and installing the cylinder head to avoid breaking the dowel pins.

Ro-Flo® compressors are designed to be easily maintained while mounted to the compressor package and with a minimal amount of hand tools. The below procedures apply to all Ro-Flo® compressor models.

Please note, High Pressure models have their rotor mounted eccentrically toward the top of the cylinder. On these models the rotor must be supported during compressor service as shown in **FIGURE 22**, to prevent personal injury or damage to the compressor.

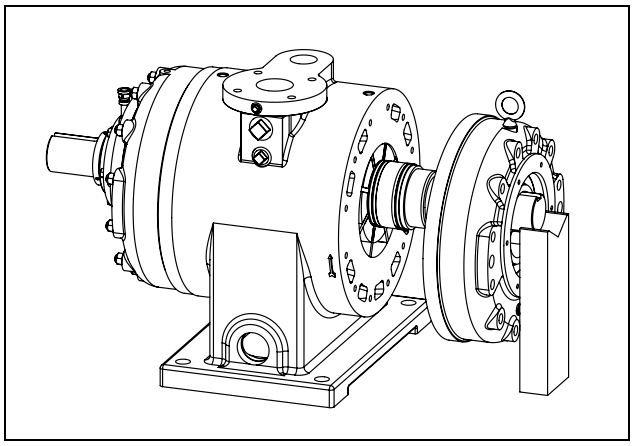


FIGURE 22 - Shaft support for a High Pressure model compressor.

If the High Pressure model compressor is removed for service, it can be inverted, placed on the discharge flange, and secured allowing it to be disassembled without the need to support the rotor.

Cylinder Head Removal

All Ro-Flo® cylinder heads have provisions for mounting lifting eyes for cylinder head removal. Approximate cylinder head assembly weights are listed in **TABLE 13**.

TABLE 13 - Approximate cylinder head assembly weights inclusive of head, bearing, and end cover.

MODEL	Cylinder Head Weight	
	lbs.	kg
2CC, 4CC, 5CC	33	15
7D	65	30
8D, 8DE, 206, 207, 208B SD8D, SD8DE, HP6, HP7, HP8	97	44
10G, 210M, HP10	133	60
11S, 11L, 211M, HP11	188	85
12S, 12L, 212M, HP12	211	96
17S, 17L, 217M	275	125
19S, 19L, 19LE, 219M SD19S, SD19L, SD19LE	385	175

Removal of Outboard Cylinder Head (Non-drive end)

1. Depressurize and properly vent the compressor.
2. Drain water jacket.
3. Remove the lubrication lines.
4. Install an eye-bolt in the tapped hole at the top of the cylinder head and secure to a lifting device. (Refer to **TABLE 13** for assembly weights.)
5. Remove the cylinder head nuts (the end cover can remain bolted in place).
6. Use the two jack-screws (provided with each compressor) to evenly push the head away from the cylinder.
7. When the cylinder head is clear of the dowel pins the head can be lifted off of the studs.

Removal of Inboard Cylinder Head (Drive End):

1. Depressurize and properly vent the compressor.
2. Drain water jacket.
3. Remove drive sheave or coupling hub.
4. Remove the lubrication lines.
5. Install an eye-bolt in the tapped hole at the top of the cylinder head and secure to a lifting device. (Refer to **TABLE 13** for assembly weights.)
6. Remove the shaft seal. Refer to ""Mechanical Shaft Seals" on page 33 for information on removing the mechanical shaft seal.

For units with an “H” Ring installed proceed to step 6. For units without an “H” Ring installed go to step 8. Refer to "REPLACEMENT PARTS" on page 51 for information on which compressors require an “H” ring.

7. Remove the seal adapter. Note: When removing the cylinder head with the seal adapter removed, care must be taken so the bearing does not slide out.
8. Remove the bearing lock nut, lock-washer, and “H” ring.
9. Remove the cylinder head nuts.
10. Use the two jack-screws (provided with each compressor) to evenly push the head away from the cylinder.
11. When the cylinder head is clear of the dowel pins the head can be lifted off of the studs.

If you will be removing the bearing outer race from the cylinder head, note which cylinder head they were removed from and the bearing orientation. There are bearing shims behind the bearing. Care must be taken to not lose or damage these bearing shims.

ROTOR REMOVAL

⚠ WARNING

Rotors are heavy and difficult to handle. Care must be taken when removing to prevent the rotor from falling and causing personal injury or damage.

TABLE 14 - Approximate rotor weights (including bearing spacer ring and bearing inner race).

MODEL	lbs.	kg
2CC	30	14
4CC	43	20
5CC	52	24
7D	96	44
8D	210	96
8DE	195	88
SD8D	210	96
SD8DE	195	88
10G	380	176
11S	670	304
11L	676	307
12S	880	400
12L	970	440
17S	1440	654
17L	1650	749
19S	2100	953
19L	2370	1075
19LE	2236	1014
SD19S	2120	960
SD19L	2381	1080
SD19LE	2247	1020
206, 207, 208B	76	35
HP6, HP7, HP8	79	36
210M, HP10	150	68
211M, HP11	340	155
212M, HP12	420	190
217M	611	277
219M	870	395

Rotor Removal Steps

1. Support the end of the rotor in the direction you will be removing the rotor from the cylinder.
2. Slide the rotor approximately 2/3 out of the cylinder, past the center of gravity.
3. With the rotor still being supported, attach a lifting device at the rotor center of gravity and remove from the cylinder.
4. Lower rotor onto “V” blocks (on bearing inner races).

COMPRESSOR REASSEMBLY PROCEDURES

⚠ CAUTION

The compressor should be secured to work table before reassembly.

The below assembly procedures apply to a compressor that has gone through routine maintenance and/or replacement of components. If the compressor was re-bored, re-doweling will be required. Please refer to the Ro-Flo Compressors - Repair Manual for more information on these procedures.

Ro-Flo Compressors offers repair kits that provide all of the components necessary for routine maintenance and compressor overhaul. Please contact Ro-Flo Compressors for pricing and availability.

New gaskets and O-rings should always be used for reassembly.

Reassembly Steps

1. Thoroughly clean all components before reassembly, paying particular attention to the gas passages, oil hole, and rotor slots.
2. Coat the rotor and cylinder bore with oil.
3. Slide the rotor into the cylinder bore until rotor body is even with the ends of the cylinder.
4. Coat compressor blades with clean oil and slide them into the rotor.
5. Coat seal rings with oil and install in the bearing spacing ring.
6. Install the drive end cylinder head gasket over the studs until it is completely in contact with the cylinder.
7. Install the bearing shims and bearing outer race into the drive end cylinder head.
8. *On compressors with H-Rings*: Install the H-ring, lockwasher, and lock nut.
9. Install the seal adapter or end cover.
10. Compress the seal rings as illustrated in **FIGURE 23**.
11. Lift the drive end cylinder head using the installed eyebolt. Carefully install the cylinder head over the rotor shaft and onto the studs until reaching the first seal ring.

    a. Adjust the first seal ring so that it slides into the seal ring bore.
    b. Remove the seal ring compression tool.
    c. Repeat this procedure for the second seal ring.

(**Helpful hints**: Take care to prevent pushing the rotor out of position when installing the cylinder head. The cylinder head nuts (with washers) can be used to draw the cylinder head onto the rotor. Draw the head up evenly to prevent breaking the dowel pins.)

9. Using a crossing pattern, draw the cylinder head up evenly until there is metal-to-metal contact with the cylinder. Torque cylinder head nuts to the appropriate value listed in "COMPRESSOR FASTENER TORQUE VALUES" on page 44.
10. Apply oil to the blades and slide into the rotor slots. The rotor will need to be rotated to install all of the blades. Used blades must be installed in the same orientation as removed.
11. Repeat steps 3 – 9 above for the non-drive end cylinder head.
12. Check rotor float as described in "Checking Assembly Clearances" on page 29.
13. *On Compressors with H-Rings*: After setting the Net Rotor Float move the rotor to the drive end of the compressor and install the H-ring.
14. Reinstall the shaft seal. Refer to "Mechanical Shaft Seals" on page 33.

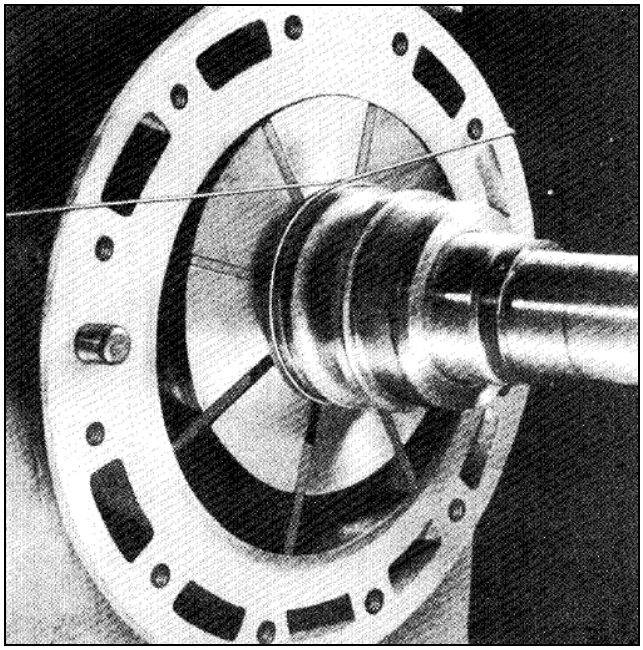


FIGURE 23 - Compressor seal ring compression prior to re-installing cylinder head.

15. After completing assembly the compressor should be barred over by hand to ensure free rotation. If resistance is encountered the issue should be investigated and resolved.
16. To test the integrity of the compressor, it is recommended to isolate the compressor with either blind flanges or isolation valves and then pressure test both the gas side and water side independently to ensure there are no leaks.

CHECKING ASSEMBLY CLEARANCES

Definitions

Total Rotor Float

Total Rotor Float is the difference between the cylinder length and rotor body length. (See .**FIGURE 27**.)

Rotor End Clearance

Rotor End Clearance is the distance between the rotor and cylinder heads after the bearings have been properly positioned. Bearings are axially positioned by inserting shim(s) between the outer bearing races and the cylinder heads. (See **FIGURE 28**).

Net Rotor Float

Net Rotor Float is the total axial movement of the rotor after the Rotor End Clearances have been set (See **FIGURE 29**). Please note that this measurement is prior to the H-ring being installed.

The sum of both Rotor End Clearances and the Net Rotor Float should equal the Total Rotor Float.

Fixed Rotor Float (applies only to compressors with an H-Ring installed)

The Fixed Rotor Float is the total axial movement of the rotor AFTER the H-Ring has been installed (See **FIGURE 26**) and is governed by the manufacturing tolerances of the (A) end bearing and the H-Ring. The Fixed Rotor Float reading should be recorded at start-up for future maintenance reference.

H-Rings are installed on models 17S thru 19LE that have a single-face mechanical seal and models 11S thru 19LE that have a double bellows mechanical seal.

Rotor to Cylinder Bore Clearance

The rotor to cylinder bore clearance is the minimum distance between the rotor and cylinder.

On Low Pressure models the minimum distance is at the bottom of the cylinder (6 o'clock position). **FIGURE 24** illustrates the compressor bottom clearance.

On High Pressure models the minimum distance is at the top of the cylinder (12 o'clock position), with the rotor lifted to remove bearing clearance. High Pressure models are often assembled with the compressor inverted and resting on the discharge flange, to avoid having to lift the rotor and account for bearing clearance. **FIGURE 25** illustrates the top clearance.

Procedure for Checking Clearances

Net Rotor Float should be checked after compressor inspection or part replacement. The Net Rotor Float should be within the tolerances listed in **TABLE 15**

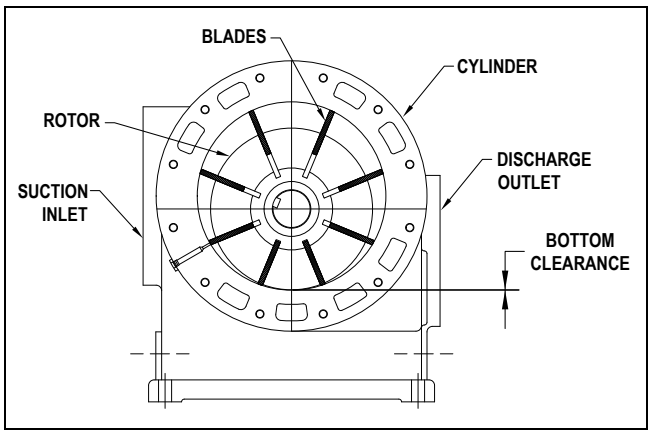


FIGURE 24 - Illustration of bottom clearance between rotor and cylinder (Low Pressure models).

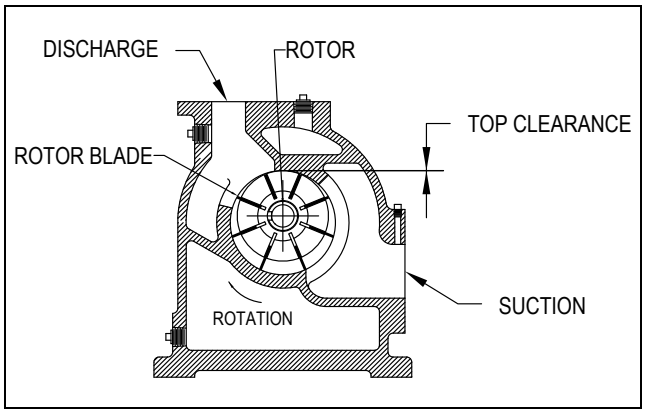


FIGURE 25 - Illustration of top clearance between rotor and cylinder (High Pressure models).

Rotor to cylinder bore clearance (also referred to as bottom clearance or top clearance) is not normally checked during routine maintenance. Rotor to cylinder bore clearance would be set/checked during compressor repair.

NOTE
Refrigeration compressors have different clearances. Please consult Ro-Flo Compressors for assistance.

Checking Total Rotor Float

Important: All clearance measurements must be made with all compressor parts at ambient temperature.

There are two measurement methods required to check Total Rotor Float:

1. Determine the difference between the cylinder length and rotor body length.
2. Install the rotor, bearings, and cylinder heads per the assembly procedure. Push the rotor against one cylinder head. Set a dial indicator at zero on one end of the rotor

and push the rotor against the opposite cylinder head. The resultant measured axial movement from one head to the other is called Total Rotor Float. Refer to **FIGURE 27**.

If the above two steps result in a difference greater than 0.002 inch, this may indicate:

- Debris may be between the cylinder head or rotor end preventing contact. Disassembly the compressor paying attention to any foreign objects that may prevent proper clearances from being obtained.
- There is a high spot on the rotor or cylinder head. Disassemble the compressor and remove the high spot.
- The axis of the rotor is not parallel to the cylinder bore axis due to misalignment of one or both cylinder heads. Refer to the Ro-Flo Compressors - Repair Manual for more information on repairing this issue.

Checking Rotor End Clearance

To check Rotor End Clearance the rotor should be installed in the compressor, the cylinder heads mounted and torqued, and the bearings should be installed.

1. With the bearing end cover loose the rotor should be pushed against the non-drive end cylinder head.
2. A dial indicator should be placed on the opposite end of the compressor and set to zero.
3. Evenly tighten the bearing end cover bolts until they are at the appropriate torque value.
4. Record the Rotor End Clearance reading from the dial indicator.
5. Push the rotor against the non-drive end cylinder head, and confirm the dial indicator returns to zero.

If the dial indicator shows a value different than the compressor name plate (or is outside of the values listed in **TABLE 15** if components were replaced), bearing shims may need to be added or removed.

This procedure should then be repeated for the drive end bearing, this time loosening the seal adapter.

Checking Net Rotor Float

The Net Rotor Float can be calculated by taking the Total Rotor Float minus both Rotor End Clearance values.

The Net Rotor Float can be measured by:

1. Removing the locknut, lock washer, and H-ring from the compressor shaft (if installed).
2. Ensure bearing shims are installed as required.
3. Tighten the end cover and seal adapter to the appropriate torque values.
4. Push the rotor to one end of the cylinder.
5. Place a dial indicator on the rotor shaft and set it to zero.
6. Push the rotor toward the opposite cylinder head.
7. Record the Net Rotor Float from the dial indicator.
8. Push the rotor against the non-drive end cylinder, and confirm the dial indicator returns to zero.

Both the calculated and measured Net Rotor Float Values should be in agreement. These values should also be compared to the compressor name plate. Acceptable Net Rotor Float values are listed in **TABLE 15** for current production compressors. For legacy units refer to .**TABLE 16***.

TABLE 15 - Current Production Compressors Clearances

Model	Net Rotor Float (inch)	Bottom Clearance (inch)	End Clearance (inch)
2CC	0.012 - 0.017	0.002 - 0.003	0.002 - 0.003
4CC	0.012 - 0.017	0.002 - 0.003	0.002 - 0.003
5CC	0.012 - 0.017	0.002 - 0.003	0.002 - 0.003
7D	0.023 - 0.030	0.0025 -0 .0035	0.002 - 0.003
8D, SD8D	0.034 - 0.044	0.003 - 0.004	0.002 - 0.003
8DE, SD8DE	0.034 - 0.044	0.003 - 0.004	0.002 - 0.003
10G	0.047 - 0.056	0.004 - 0.005	0.003 - 0.004
11S	0.050 - 0.062	0.006 - 0.007	0.003 - 0.004
11L	0.057 - 0.069	0.006 - 0.007	0.003 - 0.004
12S	0.055 - 0.067	0.007 - 0.008	0.004 - 0.005
12L	0.062 - 0.075	0.007 - 0.008	0.004 - 0.005
17S	0.065 - 0.078	0.008 - 0.009	0.004 - 0.005
17L	0.075 - 0.091	0.008 - 0.009	0.004 - 0.005
19S, SD19S	0.080 - 0.097	0.009 - 0.010	0.005 - 0.006
19L, SD19L	0.087 - 0.105	0.009 - 0.010	0.005 - 0.006
19LE, SD19LE	0.087 - 0.105	0.009 - 0.010	0.005 - 0.006
Model	**Net Rotor Float (inch)**	**Top Clearance (inch)**	**End Clearance (inch)**
206, HP6	0.019 - 0.024*	0.002 - 0.003	0.002 - 0.0025
207, HP7	0.019 - 0.024*	0.002 - 0.003	0.002 - 0.0025
208B, HP8	0.019 - 0.024*	0.002 - 0.003	0.002 - 0.0025
210M, HP10	0.028 - 0.035*	0.002 - 0.003	0.003 - 0.004
211M, HP11	0.035 - 0.042*	0.002 - 0.003	0.003 - 0.004
212M, HP12	0.035 - 0.043	0.002 - 0.003	0.003 - 0.004
217M	0.038 - 0.046	0.002 - 0.003	0.004 - 0.005
219M	0.042 - 0.049*	0.003 - 0.004	0.004 - 0.005

TABLE 16 - *Compressor clearances for legacy units.Please contact Ro-Flo Customer Service if you require support.

Model	Net Rotor Float (Inch)	Unit Built Prior To Date
206	0.017 - 0.021	September 2014
207	0.017 - 0.021	September 2014
208B	0.017 - 0.021	September 2014
210M	0.024 - 0.030	August 2014
211M	0.033 - 0.040	July 2014
219M	0.034 - 0.041	May 2014

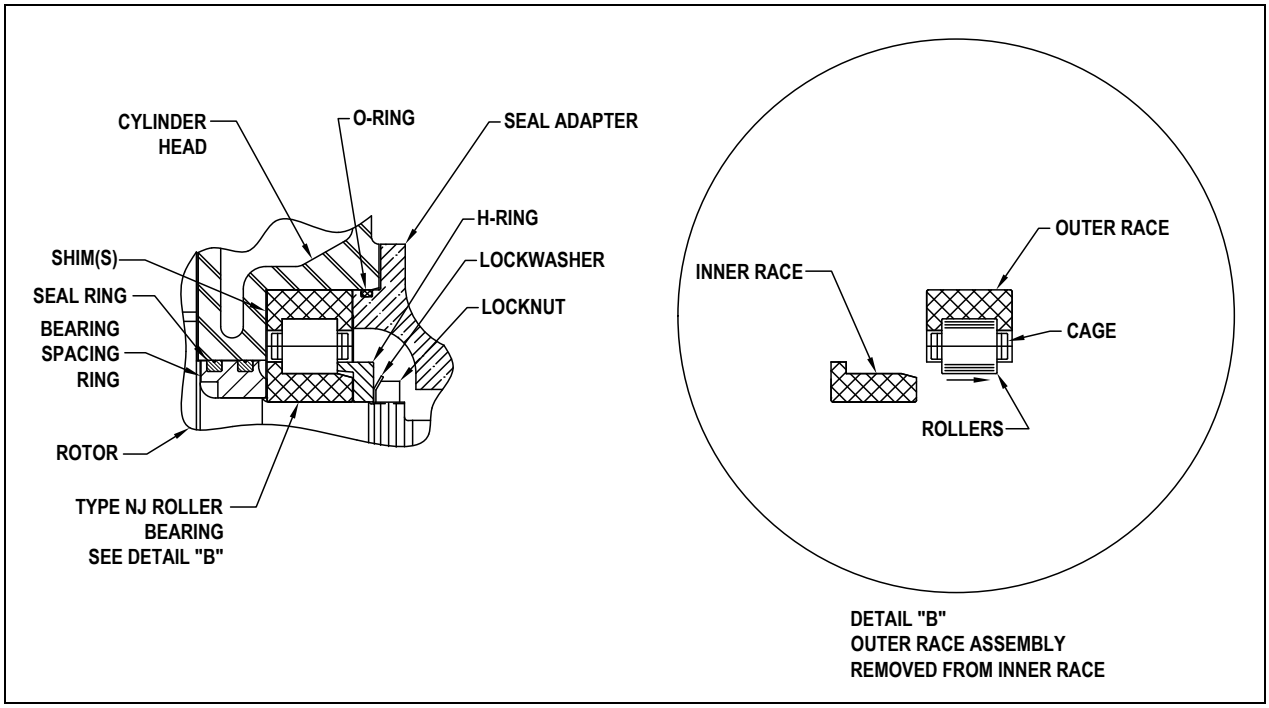


FIGURE 26 - H-Ring, lock washer, locknut, and roller bearing detail.

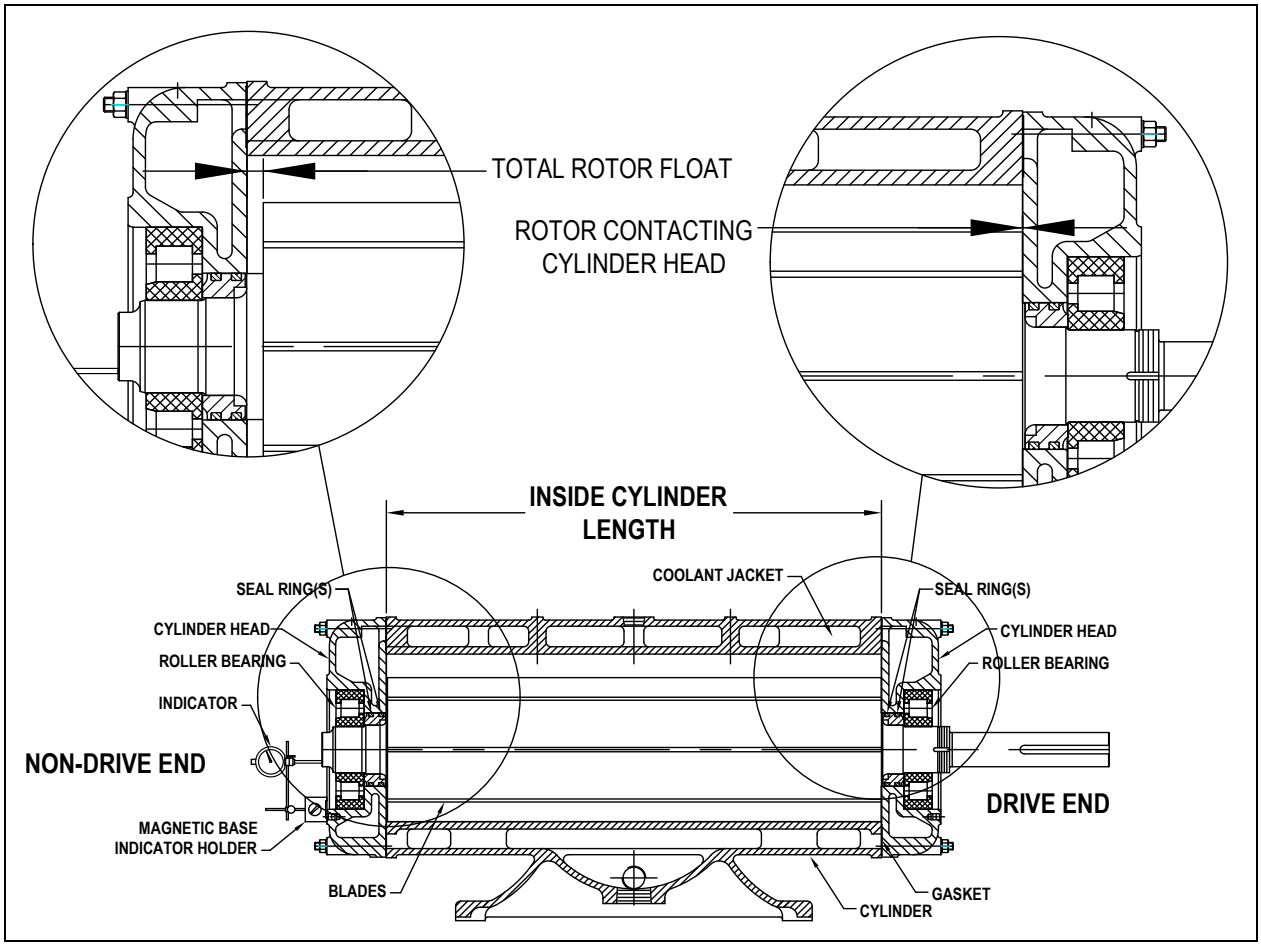


FIGURE 27 - Total Rotor Float - bearings not positioned by shims or end cover / seal adapter.

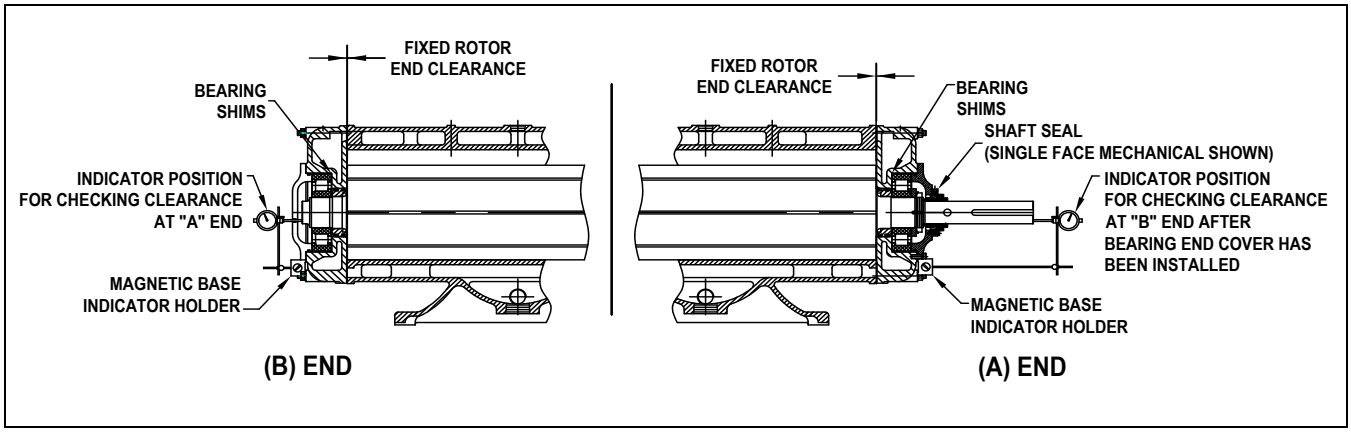


FIGURE 28 - Rotor End Clearance - bearings positioned by shims.

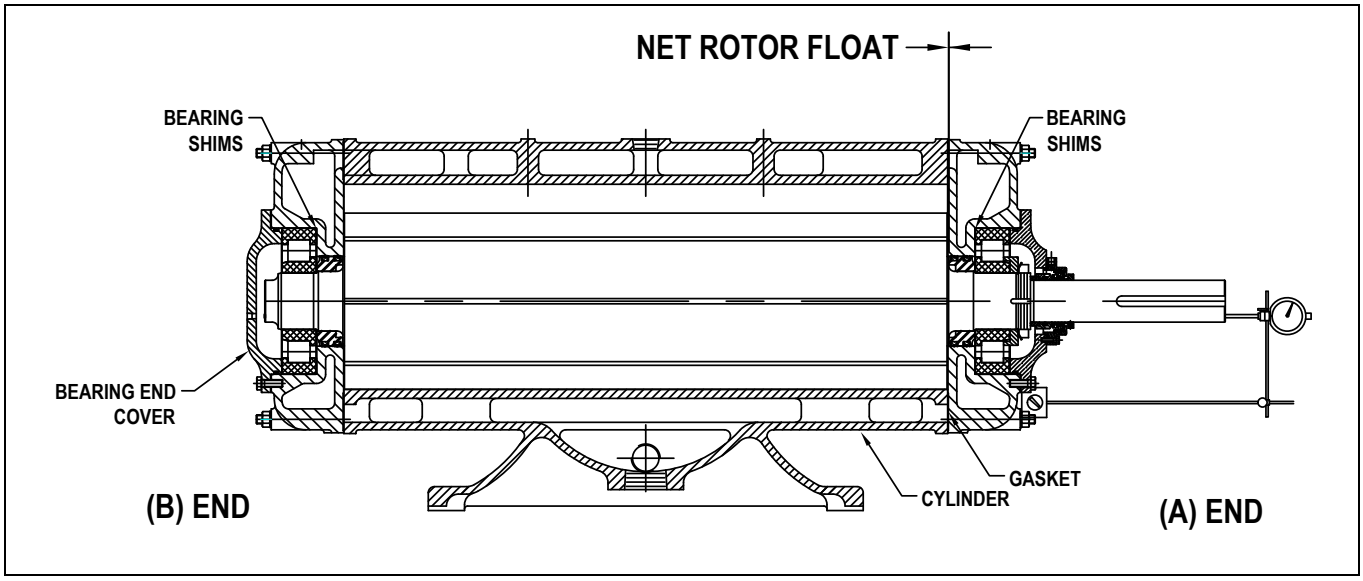


FIGURE 29 - Net Rotor Float (Total Rotor Float less the sum of Fixed Rotor End Clearances).

MECHANICAL SHAFT SEALS

Single Face Mechanical Seal (Rebuild-able)

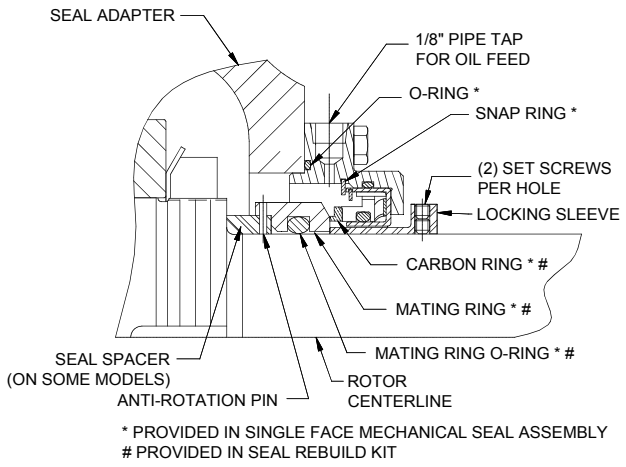


FIGURE 30 - Single face mechanical seal.

General

The single face mechanical seal consists of a wave spring that compresses a carbon ring (stationary) against of a mating face of 52100 carbon steel (rotating). These seal faces are polished to extremely close tolerances and therefore, should be handled with care.

Single Face Mechanical Seal Disassembly

1. Refer to "Preparation for Compressor Inspection and Maintenance" on page 23.
2. Remove drive sheave or coupling hub.
3. Remove all burrs from shaft and keyway.
4. Lubricate shaft to ease disassembly.
5. Remove all old seal parts, except anti-rotation pin and seal spacer. Note: The locking sleeve has two set screws in each of the three set screw locations.

Single Face Mechanical Seal Reassembly

1. Clean shaft and seal adapter bore.
2. Lubricate shaft and “O” ring in mating ring.
3. Slide mating ring on shaft until the slot engages the anti-rotation pin and mating ring is firmly against the seal spacer (if equipped).
4. Apply oil to seal faces with a lint free material such as facial tissue; do not wipe or rub dirty fingers over seal faces.
5. With O-ring in place, slide seal assembly onto seal adapter.
6. Approximately 1/8” compression on seal wave spring should be observed to provide sufficient “preload” on seal faces.
7. Reinstall seal bolts and lock washers; tighten seal flange evenly.
8. Reinstall locking sleeve by firmly holding the locking sleeve against mating ring while tightening setscrews.

Double Bellows Mechanical Seal

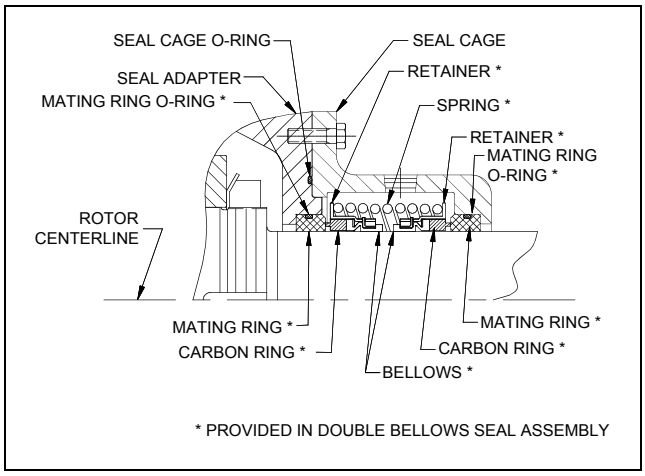


FIGURE 31 - Details of double bellows mechanical seal.

General

The double bellows mechanical seal consists of two carbon seal rings (inner and outer, rotating) and two Ni-resist iron mating rings (stationary). Pressure is applied in opposite directions to both carbon seal rings by a coil spring and pressurized barrier fluid. The seal faces are polished to extremely close tolerances and therefore, should be handled with care.

Double Bellows Mechanical Seal Disassembly

1. Refer to "Preparation for Compressor Inspection and Maintenance" on page 23
2. Remove the drive sheave or coupling hub.
3. Remove all burrs from shaft and keyway.
4. Shut off buffer gas supply and drain oil from seal cage.
5. Remove seal cage.
6. Carefully remove the outer carbon ring assembly from the bellows.
7. Lubricate the shaft generously with oil.
8. Pull on outer retainer to loosen outer rubber bellows and remove from the shaft.
9. Remove spring from the shaft.
10. Pull on inner steel retainer to loosen inner bellows and remove bellows, retainer and inner carbon ring from the shaft.
11. Inspect both carbon rings and mating faces for signs of damage or wear. Inspect bellows and O-rings for signs of hardening, cracking or deterioration.

Double Bellows Mechanical Seal Reassembly

Note: Ensure the original inner carbon ring & mating ring AND outer carbon ring & mating ring are assembled as matched sets.

1. Remove any burrs on the shaft.
2. Lightly oil the mating ring O-ring, slide it over the shaft and carefully push it into the adapter bore until fully seated.

3. Oil the inner carbon ring-retainer-bellows and slide the assembly over the shaft until the carbon face contacts the inner mating ring face.

⚠ CAUTION

By design the elastomer bellows absorbs oil and swells to lock onto the shaft. The entire seal should be assembled immediately following application of lubricating oil.

4. Slide the spring over the shaft.
5. Oil the outer carbon ring-retainer-bellows and slide the assembly over the shaft until the retainer contacts the spring.
6. Lightly oil the mating ring O-ring, and carefully push it into the seal cage bore until fully seated.
7. Carefully locate bore of seal cage with the shaft end and slide the seal cage over shaft until mating ring contacts the outer carbon ring.

⚠ CAUTION

Do not allow the ring face to contact the compressor shaft while in installing the seal cage, as this will damage the sealing surface.

8. Push the seal cage evenly until it contacts the seal adapter, making sure that the O-ring stays in the seal adapter O-ring groove. Install two cap screws opposite each other and turn them until cage is in contact with the seal adapter. Install remaining cap screws.
9. Refer to the "Seal Support System for Double Opposed Shaft Seals" on page 19 for instruction on the usage of this seal.

Dual Opposed Cartridge Seal

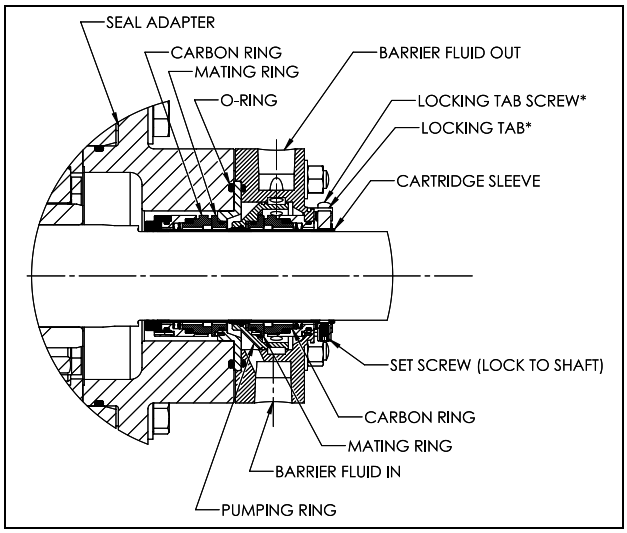


FIGURE 32 - Details of dual opposed cartridge seal.

General

The dual opposed cartridge seal seal consists of two carbon seal rings and two mating rings. Pressure is applied in opposite directions to both carbon seal rings by springs and pressurized barrier fluid. This seal is not customer serviceable and should be sent to an appropriate repair facility for maintenance & rebuild.

Dual Opposed Cartridge Seal Removal

1. Refer to "Preparation for Compressor Inspection and Maintenance" on page 23
2. Remove the drive sheave or coupling hub.
3. Remove all burrs from rotor shaft and keyway.
4. Shut off buffer gas supply and seal fluid from shaft seal.
5. Install seal locking tabs.
6. Loosen set screws securing cartridge seal to compressor shaft.
7. Lubricate the rotor shaft generously with oil or assembly lubricant.
8. Remove seal nuts and washers securing the seal.
9. Remove seal from the shaft.
10. Send seal to authorized service center for repair.

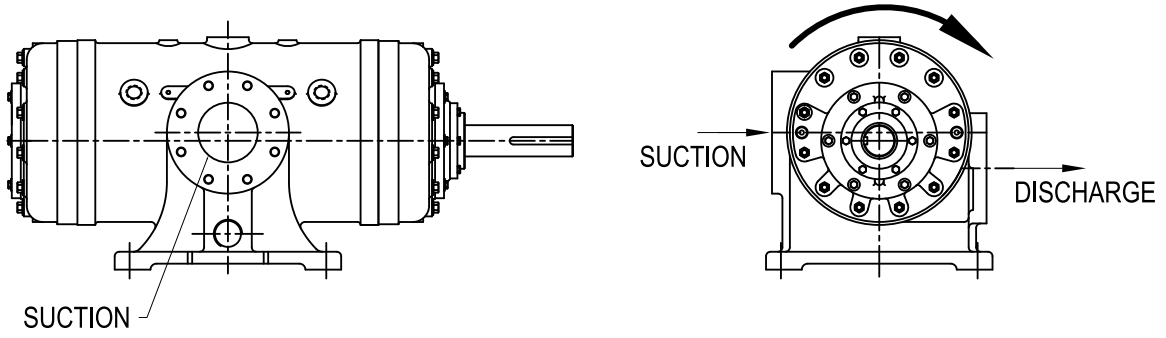
Dual Opposed Cartridge Seal Installation

1. Remove any burrs on the rotor shaft.
2. Secure the rotor in the middle of its net float.
3. Apply a compatible lubricant the compressor shaft and seal sleeve & O-ring to assist installation of seal
4. Slide the seal into location.
5. Install the washers and nuts to secure the seal to the seal adapter. Torque to 10 ft-lbs. (13.6 Nm) in a crossing pattern. Torque to a final value of 20 ft-lbs. (27.1 Nm) in a crossing pattern.

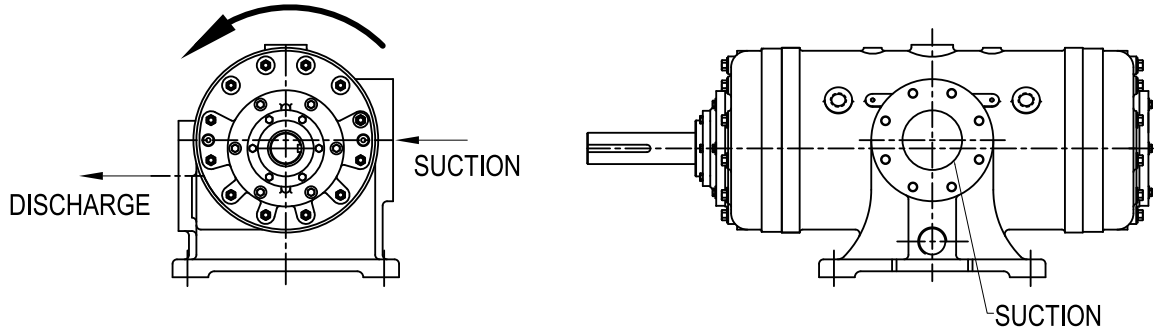
6. Tighten the set screws to secure the seal sleeve to the rotor shaft.
7. Remove the locking tabs and screws from the seal. Store the locking tabs and screws for future maintenance activities.
8. Fill the seal with seal fluid and purge air from system.
9. Verify proper seal fluid level in seal pot.
10. Apply buffer gas to proper operating pressure. Refer to the "Seal Support System for Double Opposed Shaft Seals" on page 19

COMPRESSOR ROTATION

COMPRESSOR ROTATION DESIGNATIONS – LOW PRESSURE MODELS (2CC - 19LE)



LOW PRESSURE MODELS - CW ROTATION (STANDARD)



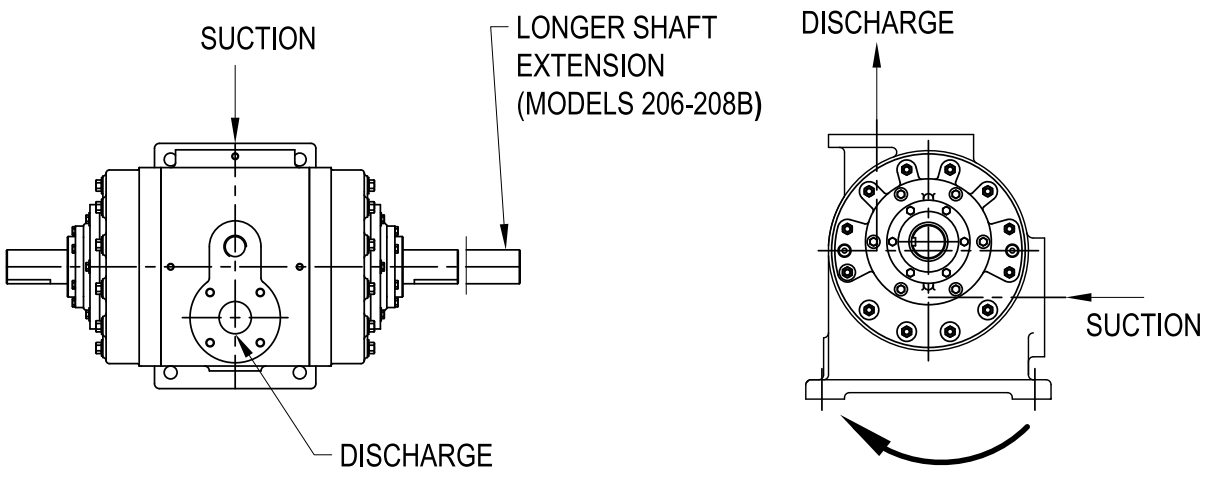
LOW PRESSURE MODELS - CCW ROTATION

Clockwise Rotation (CW) – When viewing the driven end of the shaft, the suction flange will be on the left side and the shaft rotates clockwise. When viewing the suction flange of the compressor, the shaft is on the right hand side.

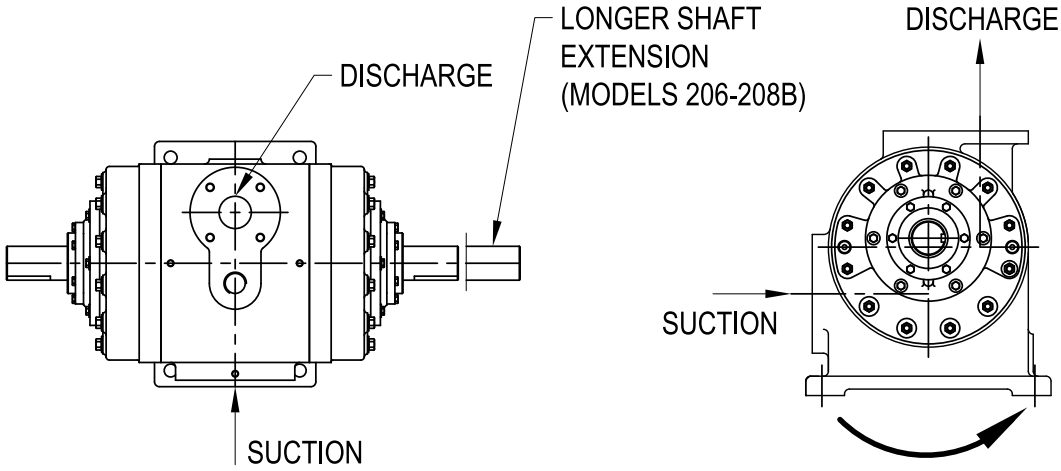
Counterclockwise Rotation (CCW) – When viewing the driven end of the shaft, the suction flange will be in the right side and the shaft rotates counterclockwise. When viewing the suction flange of the compressor, the shaft is on the left hand side.

NOTE: Unless rotation is specified at time of order, all compressors will be furnished clockwise rotation standard.

COMPRESSOR ROTATION DESIGNATIONS – HIGH PRESSURE MODELS (206 - 219M)



HIGH PRESSURE MODELS - CW ROTATION (STANDARD)



HIGH PRESSURE MODELS - CCW ROTATION

Clockwise Rotation (CW) – When viewing the longer end of the shaft, the suction flange will be on the right side and the shaft rotates clockwise. When viewing the suction flange of the compressor, the longer shaft is on the left hand side.

Counterclockwise Rotation (CCW) – When viewing the longer end of the shaft, the suction flange will be in the left hand side and the shaft rotates counterclockwise. When viewing the suction flange of the compressor, the longer shaft is on the right side.

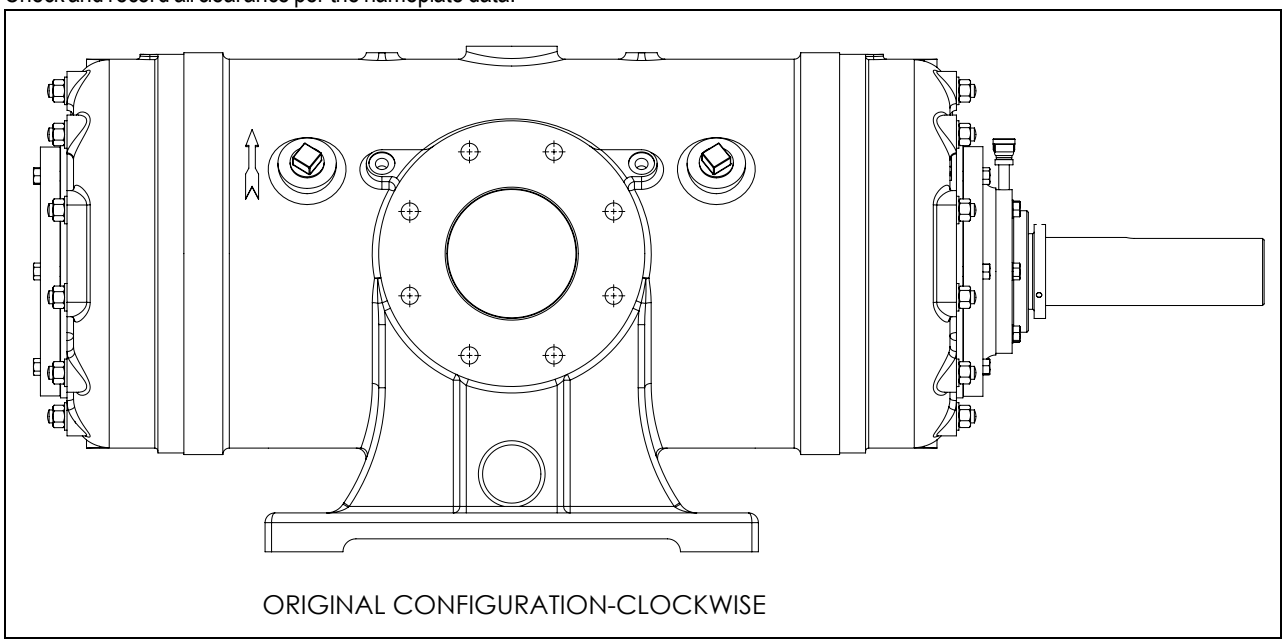
NOTE: Unless rotation is specified at time of order, compressors model numbers 206 through 208B will be furnished clockwise rotation as standard. Models 210M through 219M are symmetrical and are designated as clockwise rotation.

CHANGING COMPRESSOR ROTATION

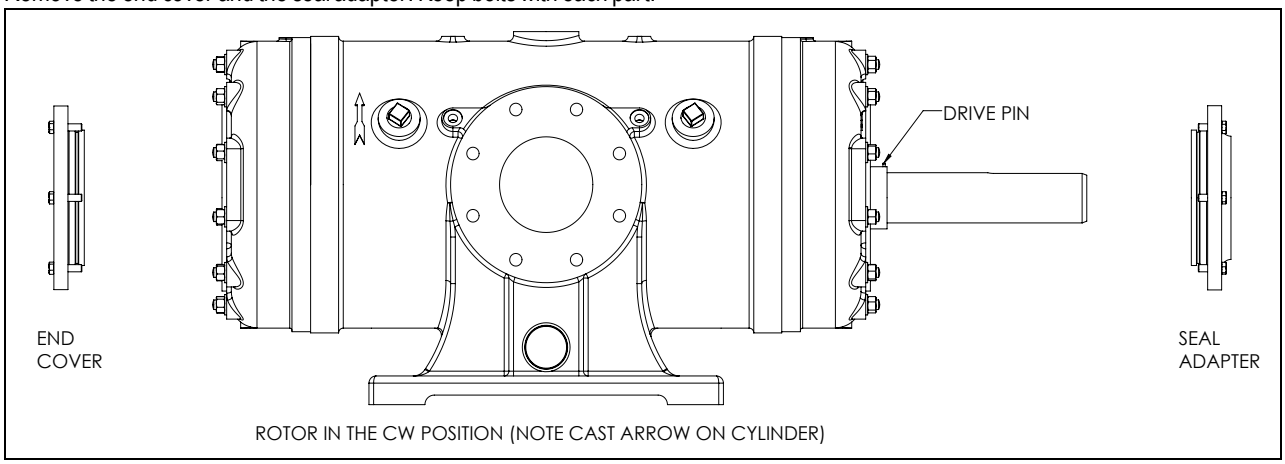
Please refer to the "MAINTENANCE" section of this manual for proper disassembly and reassembly procedures for your compressor.

The procedure for changing compressor rotation is listed below:

1. Check and record all clearance per the nameplate data.

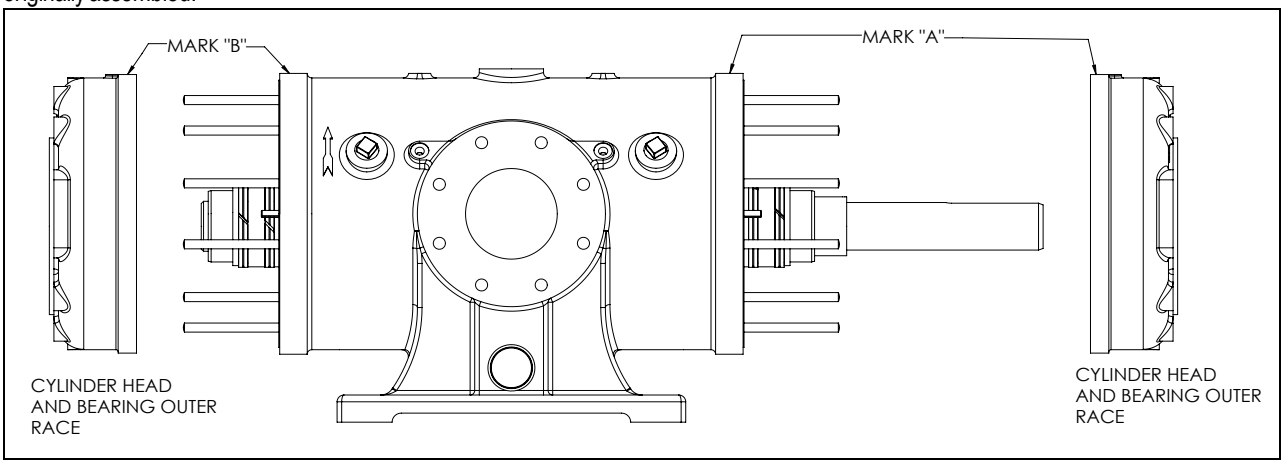


2. Remove any sheaves or coupling hubs from the compressor shaft.
3. Remove the seal assembly from the compressor. Refer to "Mechanical Shaft Seals" on page 33 for more information on seal disassembly. NOTE: On High Pressure models there will be two shaft seals to remove.
4. Remove the end cover and the seal adapter. Keep bolts with each part.

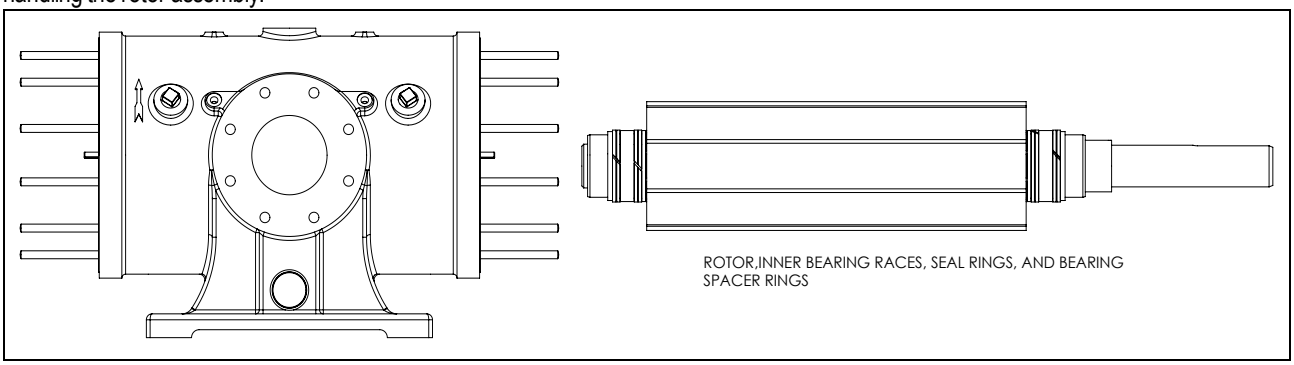


5. Remove locknut, lock washer, and H-ring (not installed on all models or configurations, refer to the Ro-Flo Parts Book for more information). Refer to FIGURE 26 on page 31 for an illustration of these items. If a single face mechanical seal is used, remove the seal drive pin.

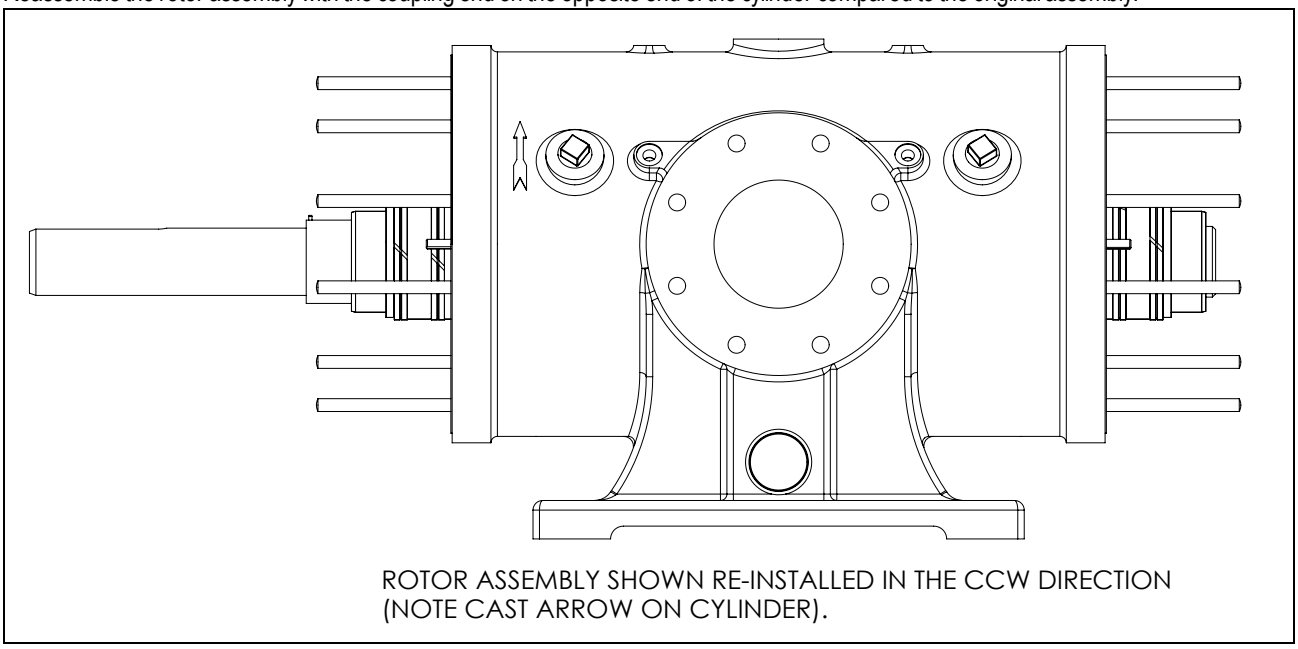
6. Remove both cylinder heads. Mark heads and cylinders so that the heads can be reassembled on the same end of the cylinder as they were originally assembled.



7. Remove blades from rotor. Note orientation of blades.
8. Remove rotor assembly, marking the bearing outer race assemblies to stay with the same inner race (mounted on the rotor). Take caution in handling the rotor assembly.

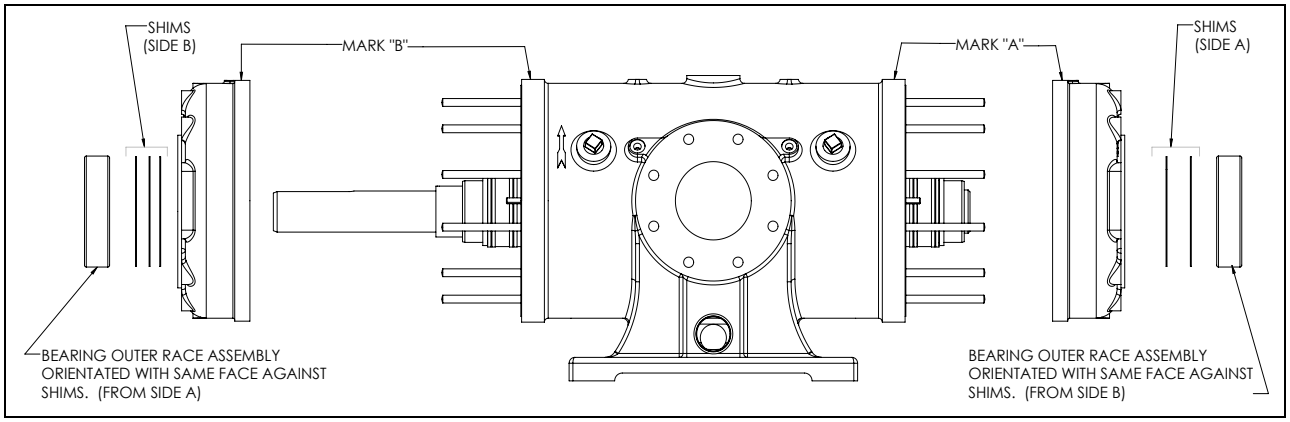


9. Reassemble the rotor assembly with the coupling end on the opposite end of the cylinder compared to the original assembly.

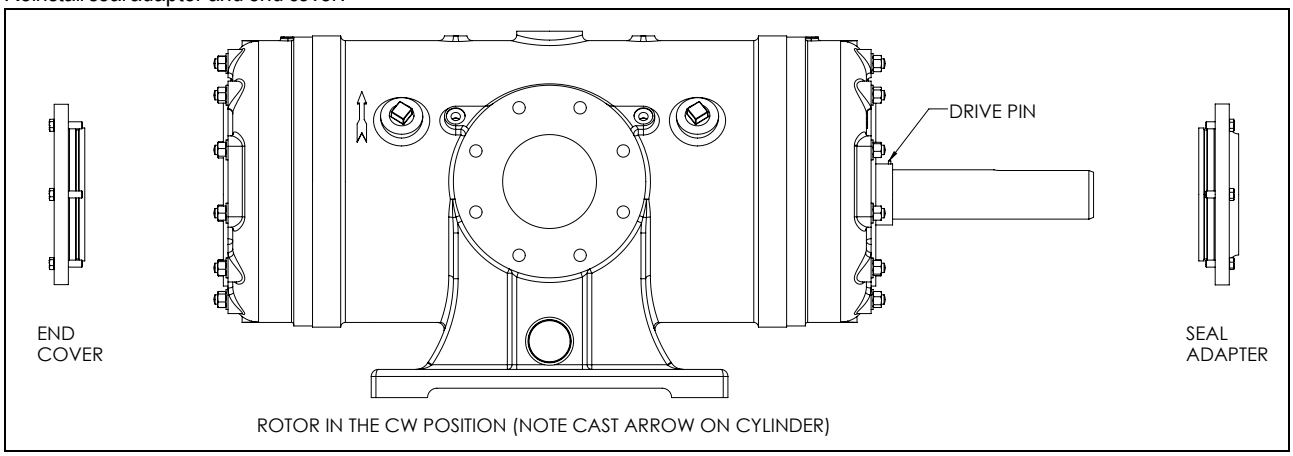


10. Reinstall compressor blades insuring they are installed in the same orientation as removed.

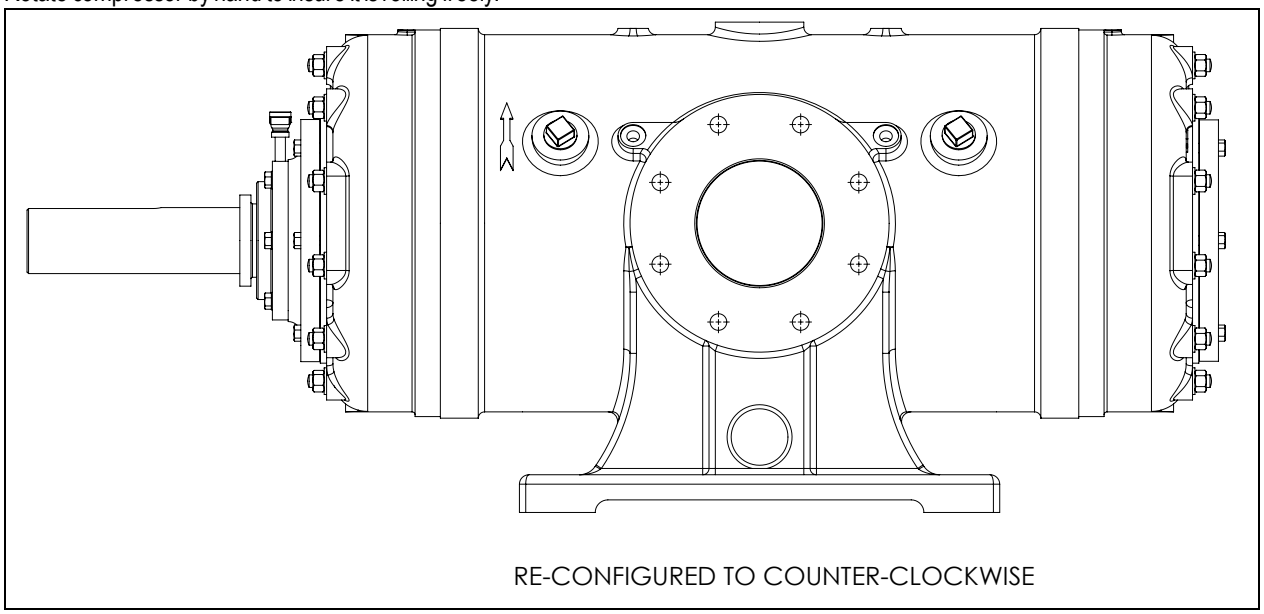
11. Remove the bearing outer race assemblies from each head. Maintain bearing shims within the original cylinder heads. Reinstall the bearing outer race assemblies into the opposite cylinder heads. Insure they are reassembled onto the original inner races from which they were removed .



12. Reinstall seal adapter and end cover.



13. Check and reset end clearances."Checking Assembly Clearances" on page 29
14. Check rotor bottom clearance. Refer to "Current Production Compressors Clearances" on page 30
15. Reinstall bearing H-ring, lock washer, and locknut. For single face mechanical seals reinstall the seal drive pin.
16. Reinstall mechanical seal.
17. Rotate compressor by hand to insure it is rolling freely.



18. Check motor rotation by "jogging" motor before reinstalling the coupling or sheave.

For Low Pressure models, the compressor suction and the discharge flange will be reversed from their original location when the unit is assembled with the driver. The compressor rotation must be from the suction flange to the discharge flange across the top of the cylinder. All compressor cylinders have arrows cast in the cylinder body that identify the correct rotation of the compressor.

EXPECTED SOUND CHARACTERISTICS

The expected sound pressure levels shown in **TABLE 17** and **TABLE 18** are provided as a general reference. Actual sound characteristics will vary by application due to changes in gas properties, gas pressures, gas temperatures, operating speeds, piping arrangements, and other factors of the skid design.

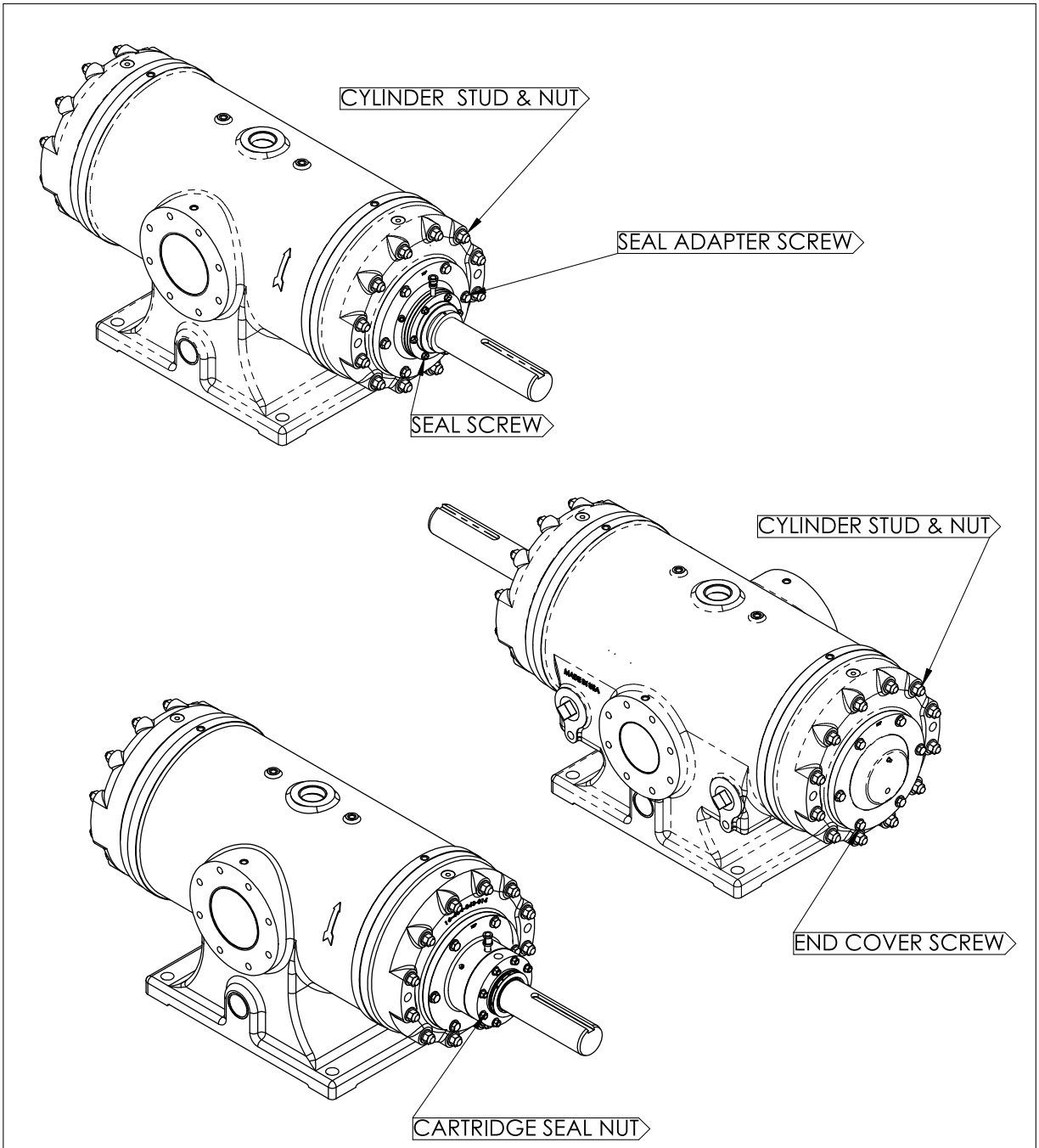
TABLE 17 - Expected Sound Characteristics of Ro-Flo® Sliding Vane Compressors

EXPECTED SOUND PRESSURE LEVELS (dB)														
Model	Speed (RPM)	Disch Press (PSIG)	dBA @ 3'	OCTAVE CENTER FREQUENCIES (Hz)										dBC @ 3'
				31.5	63	125	250	500	1000	2000	4000	8000	16000	
2CC	1160	50	75	61	62	66	73	70	69	62	60	59	55	77
	1740	50	78	63	64	69	76	72	72	71	68	64	60	80
4CC	1160	50	75	61	62	66	73	70	69	62	60	59	55	77
	1740	50	78	63	64	69	76	72	72	71	68	64	60	80
5CC	1160	50	75	61	62	66	73	70	69	62	60	59	55	77
	1740	50	78	63	64	69	76	72	72	71	68	64	60	80
7D	865	50	76	66	72	74	72	69	67	63	61	66	63	79
	1160	50	80	66	71	76	78	72	71	67	69	74	70	83
8D, SD8D	865	50	86	78	69	77	83	79	82	74	70	62	63	88
	1160	50	89	77	73	85	86	81	75	77	85	86	83	92
8DE, SD8DE	1160	50	90	76	74	81	87	80	77	78	86	79	82	92
10G	865	50	89	78	85	87	86	81	78	72	80	72	61	90
	1160	50	90	69	73	85	89	84	80	77	74	84	66	93
11S	865	50	90	70	72	86	88	85	81	73	76	83	59	92
11L	865	50	91	72	76	88	84	83	78	76	77	86	60	93
12S	865	50	91	69	67	78	80	81	80	84	86	83	67	94
12L	865	50	94	71	74	86	91	83	80	78	80	89	70	97
17S	690	50	95	72	72	88	90	89	83	83	89	84	73	98
17L	690	50	96	70	73	82	90	90	81	87	90	94	90	99
19S, SD19S	575	50	94	67	81	85	84	91	86	91	86	90	77	100
19L, SD19L	575	50	95	69	78	87	89	86	88	89	93	91	90	101
19LE, SD19LE	575	50	95	69	78	87	89	86	88	89	93	91	90	101
206, HP6	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
207, HP7	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
208B, HP8	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
210M, HP10	1160	40	84	65	76	81	80	75	76	75	73	70	66	86
211M, HP11	865	40	85	63	75	80	82	74	77	76	71	73	69	87
212M, HP12	865	40	86	65	77	82	81	75	78	82	73	75	70	88
217M	690	40	87	66	76	80	84	72	79	85	82	84	73	89
219M	575	40	87	62	78	77	81	78	80	85	84	86	64	90

TABLE 18 - Expected Sound Characteristics of Ro-Flo® Sliding Vane Vacuum Pumps

EXPECTED SOUND PRESSURE LEVELS (dB)														
Model	Speed (RPM)	Suction Press (Inches HgV)	dBA @ 3'	OCTAVE CENTER FREQUENCIES (Hz)										dBC @ 3'
				31.5	63	125	250	500	1000	2000	4000	8000	16000	
2CC	1160	25	75	61	60	66	72	69	70	66	61	59	52	76
	1740	25	76	62	61	68	73	74	70	69	63	60	55	57
4CC	1160	25	75	61	60	66	72	69	70	66	61	59	52	76
	1740	25	76	62	61	68	73	74	70	69	63	60	55	57
5CC	1160	25	75	61	60	66	72	69	70	66	61	59	52	76
	1740	25	76	62	61	68	73	74	70	69	63	60	55	57
7D	865	25	80	66	65	69	74	77	71	71	62	59	64	82
	1160	25	82	63	70	68	72	78	76	73	64	65	59	84
8D, SD8D	865	25	85	64	73	72	76	79	74	75	66	61	56	87
	1160	25	86	62	71	74	77	82	78	77	72	72	62	88
8DE, SD8DE	1160	25	86	62	71	74	77	82	78	77	72	72	62	88
10G	865	25	87	69	72	75	80	81	80	80	75	76	56	89
	1160	25	88	68	73	76	81	83	81	82	78	78	61	90
11S	865	25	88	72	71	76	82	81	84	81	77	80	57	89
11L	865	25	88	71	73	77	83	82	79	80	79	81	60	90
12S	865	25	88	71	72	76	82	80	77	79	80	70	63	89
12L	865	25	88	73	69	78	84	79	82	78	80	63	64	90
17S	690	25	88	74	74	81	84	81	81	81	79	69	60	90
17L	690	25	89	74	75	82	84	80	83	82	78	67	62	92
19S, SD19S	575	25	90	71	74	84	83	84	82	80	79	70	60	92
19L, SD19L	575	25	91	73	77	85	82	83	83	81	78	73	65	93
19LE, SD19LE	575	25	91	73	77	85	82	83	83	81	78	73	65	93

COMPRESSOR FASTENER TORQUE VALUES



		NAME	DATE
DIMENSIONS ARE IN INCHES TOLERANCES: ANGULAR: MACH ±.5 DEG. ONE PLACE DECIMAL ±.015 TWO PLACE DECIMAL ±.010 THREE PLACE DECIMAL ±.005	DRAWN	TRF	7/16/2018
	CHECKED	TSS	7/16/2018
	ENG APPR.	BTS	7/16/2018

MATERIAL: Material <not specified>

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Ro-Flo Compressors, LLC

TITLE: RO-FLO TORQUE REQUIREMENTS

SIZE	PART NO.	REV.
A	MANUAL-TORQUE REQUIREMENTS	00

SCALE:	WEIGHT:	SHEET:
1:12		1 OF 2

MODEL	CYLINDER STUD		SEAL ADAPTER & END COVER		SF AND DBS SEALS		CARTRIDGE SEALS	
	INCH	TORQUE lbf-ft (Nm)	SCREW SIZE	TORQUE lbf-ft (Nm)	SCREW SIZE	TORQUE lbf-ft (Nm)	STUD & NUT DIAMETER	TORQUE lbf-ft (Nm)
2CC	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
4CC	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
5CC	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
7D	1/2	30 (40.7)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
8D,8DE	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
SD8D, SD8DE	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
10G	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
11S,11L	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
12S,12L	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
17S,17L	3/4	120 (162.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
19S,19L, 19LE	3/4	120 (162.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
SD19S, SD19L,SD19LE	3/4	120 (162.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
206,207, 208B	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
210M	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
211M	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
212M	5/8	60 (81.4)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
217M	3/4	120 (162.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
219M	3/4	120 (162.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
HP6,HP7,HP8	5/8	90 (122.1)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
HP10	1/2	60 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)	3/8	20 (27.1)
HP11	5/8	110 (149.1)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
HP12	5/8	110 (149.1)	1/2	30 (40.7)	3/8	20 (27.1)	3/8	20 (27.1)
HP17	3/4	160 (216.9)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)
HP19	3/4	210 (284.7)	5/8	60 (81.4)	3/8	20 (27.1)	3/8	20 (27.1)

DIMENSIONS ARE IN INCHES
TOLERANCES:
ANGULAR: MACH ±.5 DEG.
ONE PLACE DECIMAL ±.015
TWO PLACE DECIMAL ±.010
THREE PLACE DECIMAL ±.005

MATERIAL

FINISH(UNLESS OTHERWISE NOTED)

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	NAME	DATE
DRAWN	TRF	7/16/2018
CHECKED	TSS	7/16/2018
ENG APPR.	BTS	7/16/2018

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Ro-Flo Compressors, LLC

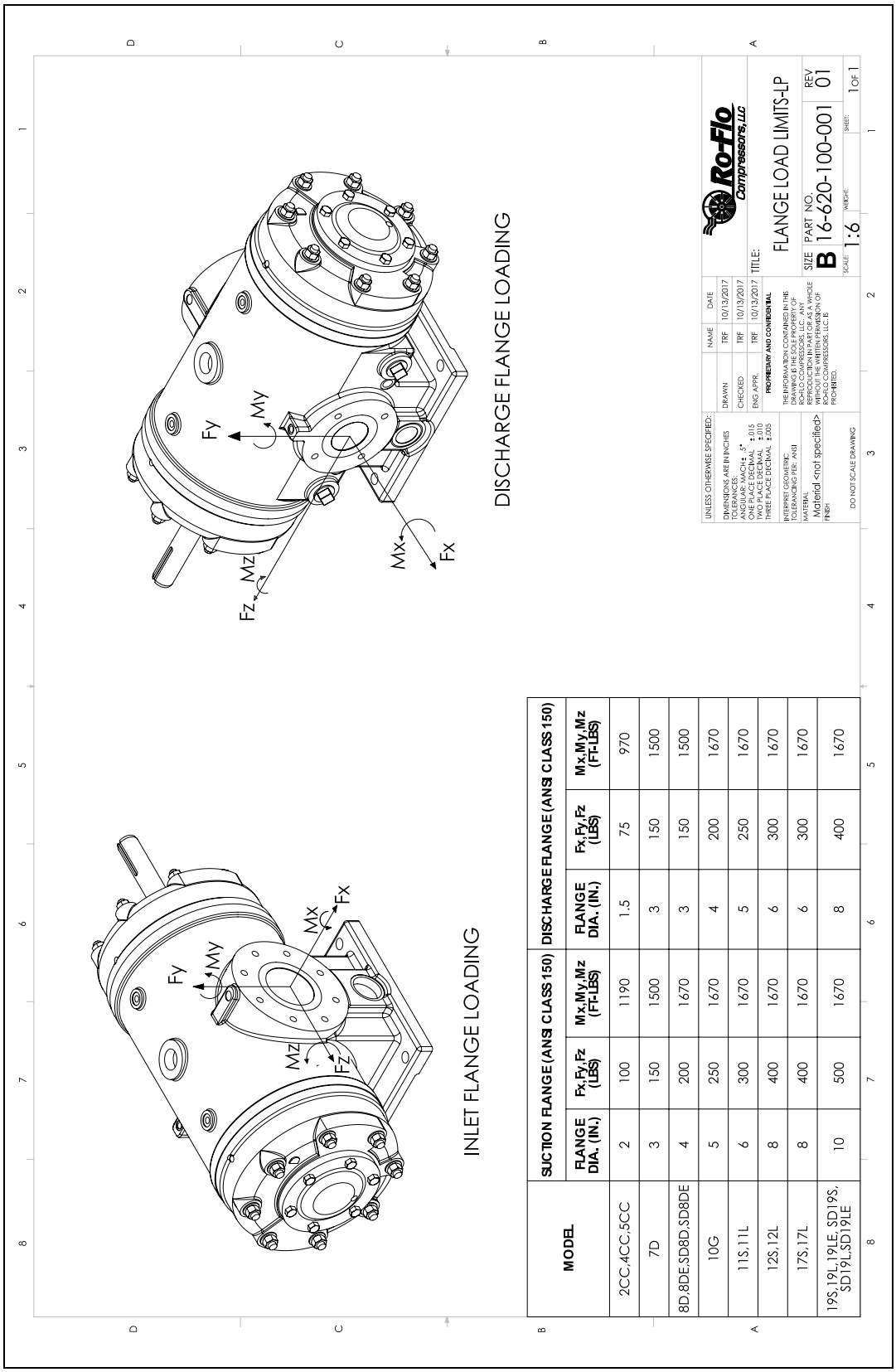
TITLE: RO-FLO TORQUE REQUIREMENTS

SIZE: A | PART NO.: MANUAL-TORQUE REQUIREMENTS | REV.: 00

SCALE: 1:12 | WEIGHT: | SHEET: 2OF2

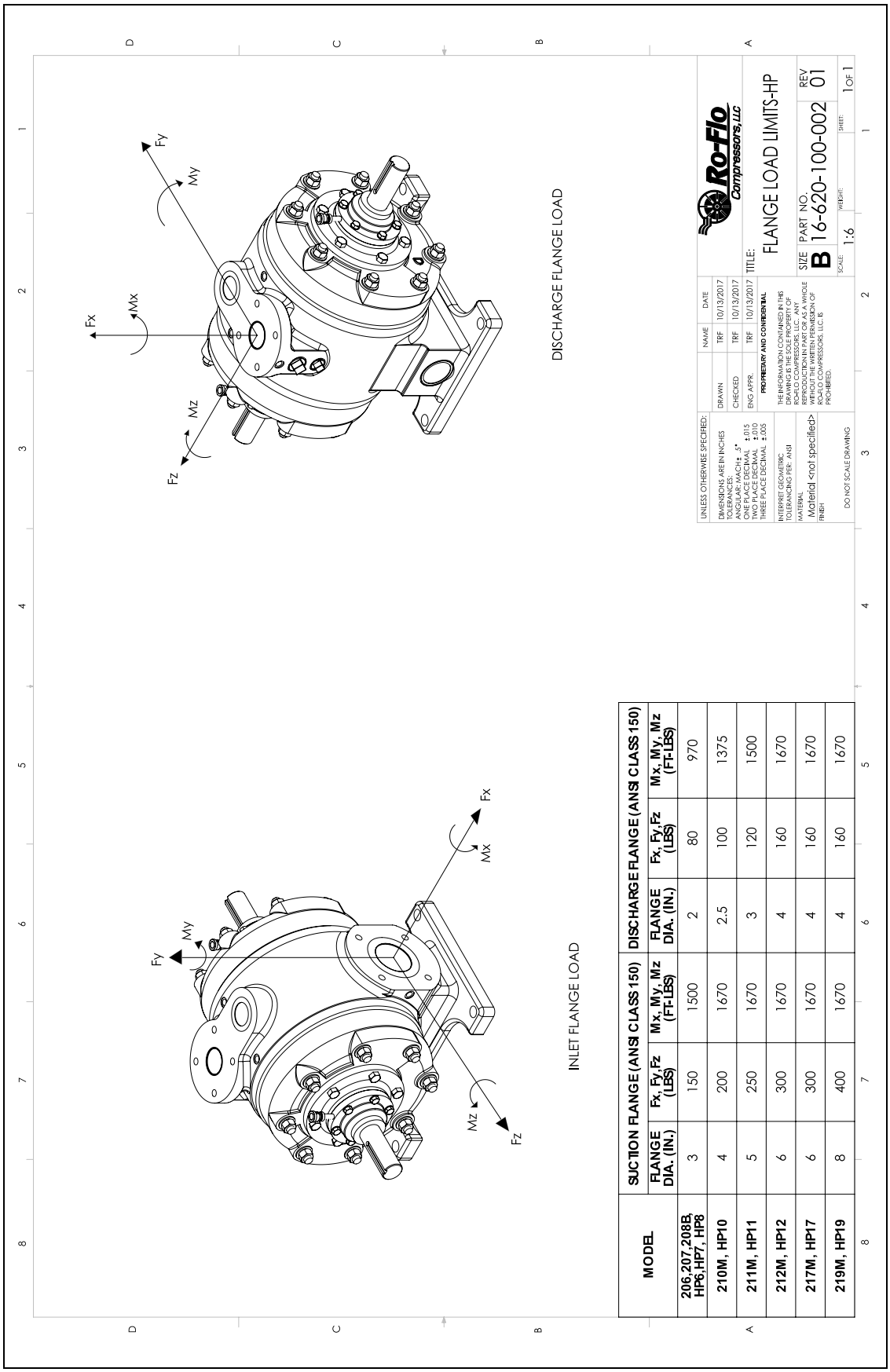
FLANGE LOAD LIMITS

LOW PRESSURE MODELS



MODEL	SUCTION FLANGE (ANSI CLASS 150)			DISCHARGE FLANGE (ANSI CLASS 150)		
	FLANGE DIA. (IN.)	Fx,Fy,Fz (LBS)	Mx,My,Mz (FT-LBS)	FLANGE DIA. (IN.)	Fx,Fy,Fz (LBS)	Mx,My,Mz (FT-LBS)
2CC,4CC,5CC	2	100	1190	1.5	75	970
7D	3	150	1500	3	150	1500
8D,8DE,SD8D,SD8DE	4	200	1670	3	150	1500
10G	5	250	1670	4	200	1670
11S,11L	6	300	1670	5	250	1670
12S,12L	8	400	1670	6	300	1670
17S,17L	8	400	1670	6	300	1670
19S,19L,19LE, SD19S, SD19L,SD19LE	10	500	1670	8	400	1670

HIGH PRESSURE MODELS



MODEL	SUCTION FLANGE (ANSI CLASS 150)			DISCHARGE FLANGE (ANSI CLASS 150)		
	FLANGE DIA. (IN.)	Fx, Fy, Fz (LBS)	Mx, My, Mz (FT-LBS)	FLANGE DIA. (IN.)	Fx, Fy, Fz (LBS)	Mx, My, Mz (FT-LBS)
206,207,208B, HP6,HP7, HP8	3	150	1500	2	80	970
210M, HP10	4	200	1670	2.5	100	1375
211M, HP11	5	250	1670	3	120	1500
212M, HP12	6	300	1670	4	160	1670
217M, HP17	6	300	1670	4	160	1670
219M, HP19	8	400	1670	4	160	1670

TROUBLESHOOTING

TEMPERATURE TELLS ALL

Temperatures that deviate from normal are generally the first and most significant signs of machinery malfunction! To make use of this maxim in evaluating machinery performance, it is necessary to know:

- Where is the most significant temperature measured?
- What are the temperatures of "normal" operation?

This instruction is concerned with temperatures that are used to evaluate the efficiency of compressing gases from suction pressure to discharge pressure.

Four facts are necessary to evaluate operation:

1. What is the atmospheric pressure?
2. What is gas composition entering the compressor suction flange?
3. What is the gas flow rate entering the compressor suction flange?
4. What are the gas pressure and temperature at the suction flange of the compressor?
5. What are the gas pressure and temperature at the discharge flange of the compressor?
6. The extent of jacket cooling, such as flow rate of cooling water and its inlet and discharge temperatures?

Please note it is important to make pressure and temperature measurements as close to the compressor flanges as possible. Actual suction pressure and temperature at the compressor inlet flange can be affected by dirty or plugged filters/mist pads or faulty process controls. Actual discharge pressure and temperature at the compressor discharge flange can be affected by plugged gas discharge check valves, after coolers, or separator vessels.

Compressors see absolute suction and discharge pressure rather than gauge pressures. The pressure ratio is calculated by dividing the absolute discharge pressure by the absolute inlet pressure.

The compressor performance can be predicted using the Ro-Flo Performance software, available on the Ro-Flo Compressors website

www.ro-flo.com

TROUBLESHOOTING TABLE

TROUBLE	PROBABLE CAUSE	REMEDY
Discharge air or gas temperature excessive	Operation of machine at higher-pressure ratio than needed	Operate unit at rating plate pressures.
	Excessive suction temperature.	Reduce suction temperature.
	Insufficient or high temperature inlet water.	Increase water flow rate or provide cool water supply.
	Scale or residue build-up in water jacket.	Clean water jacket and filter or treat water supply as required.
	Clogged intake filter.	Clean intake filter.
	Unloading valve not fully open or clogged	Clean valve and replace any warn or broken parts.
	Suction valve not fully open.	Open suction valve.
	Insufficient or wrong lubricating oil.	Use correct oil and feed rates recommended in instruction manual or lube sheet.
	Swelled or warped rotor blades.	Dry out or replace rotor blades.
	Improper clearances.	Reassemble unit to proper clearances
	Ratio of specific heats higher than expected.	Change gas composition.
Excessive blade wear	Insufficient quantity of lubricant to one or more cylinder feeds	Inspect Lubricator V-belt for slippage or breakage; tighten or replace as required. Check lube rate and increase by several drops per minute. Inspect lubricator sight glasses; replace if cracked. Inspect cylinder lube check valves; clean or replace as required. Inspect oil holes in cylinder clean if dirty.
	Incorrect lubricant and/or viscosity.	Use correct oil and viscosity as recommended on lube oil recommendation sheet or instruction manual.
	Dirty inlet air or gas.	Clean and inspect intake filter or scrubber.
	Excessive discharge temperature.	See remedies under excessive discharge gas or jacket outlet water temperature.
	Floating rings stuck on Models 23C, 23D, 27D, or 33D.	Disassemble unit and free-floating rings.
	Excessive discharge gas pressure.	Operate unit at rating plate pressures.
	Faulty lube oil check valve.	Replace or repair check valve.
Jacket outlet water temperature excessive	Insufficient or high temperature inlet water.	Increase water flow rate or provide cool water supply.
	Fouled or faulty water temperature flow regulator.	Clean, repair or replace regulating valve.
	Supply valve (manual or automatic type) either not fully open or clogged.	Open or clean valve. Check solenoid and wiring on automatic type valve
	Inlet water strainer clogged.	Clean strainer.
	Scale or residue build-up in water jacket.	Clean water jacket.
Water drained from main or inspection ports	Leaky head gasket.	Replace gasket.
	Leaky aftercooler or inter-cooler.	Remove cooler and hydrostatic test for leaks. Repair or replace leaky cooler.

TROUBLE	PROBABLE CAUSE	REMEDY
Undue noise, vibration or periodic knocking	Worn bearings.	Replace bearing.
	Excessive blade wear.	Replace blades and check lubrication.
	Erratic cylinder wear.	Re-bore, re-dowel, and check lubrication.
	Insufficient lubrication.	See remedies under excessive blade wear.
	Rotor contacting cylinder heads.	Check temperature and pressure conditions; check internal clearance.
	Misalignment	Realign units.
	Swelled or warped rotor blades.	Dry out or replace rotor blades.
	Compressor unloaded.	Load compressor.
	Inadequate piping support	Support piping.
	Bad foundation.	Fix or replace foundation.
Low or no capacity	Restricted suction line.	Remove restriction.
	Clogged inlet filter.	Clean inlet filter.
	Defective bypass loop.	Repair valve or controls.
	Wrong speed.	Operate at correct speed.
	Excessive internal clearance.	Reassemble unit to proper clearance.
	Blades rubbing cylinder heads.	Dry or replace blades.
	Blades binding in slots.	Dry or replace blades.
Low or no pressure	Broken blades.	Replace blades.
	Defective bypass loop.	Repair valves or controls.
	Blades binding in slots.	Clean slots or blades. Dry or replace blades. Reduce operating temperatures.
	Leaky piping.	Fix leaks.
	Restricted discharge piping upstream of gauge.	Remove restriction.
Excessive power consumption	Blades swelled or warped.	Dry out or replace blades.
	Operation at wrong pressure ratio.	Operate unit at correct pressure ratio.
	K-value (ratio of specific heats) too high.	Reduce pressure ratio.
	Inadequate lubrication.	See remedies under excessive blade wear.
	Improper clearances.	Reassemble unit to proper clearances.
	Speed to high.	Reduce speed.
	Scale or residue build-up water jacket.	Clean water jacket.
	Abrasive particles in gas stream.	Filter inlet gas.
Excessive oil consumption from double bellows seal	Worn or damaged sealing elements	Replace shaft seal.

REPLACEMENT PARTS

GENUINE RO-FLO® PARTS

Ro-Flo Compressors recommends the use of genuine Ro-Flo® replacement parts. Ro-Flo® parts have been custom designed for corrosive gases and harsh environments. This is the primary reason for superior performance of Ro-Flo® compressors. The use of Ro-Flo® parts ensures full warranty coverage and promotes long, reliable service.

HOW TO ORDER REPLACEMENT PARTS

Machine serial numbers together with part descriptions are required when placing parts orders. The exploded view with the accompanying cross-reference to part description will aid in identifying parts. Parts descriptions and part numbers can be found in the Ro-Flo Parts Book available on the Ro-Flo Compressors website: www.ro-flo.com/manuals. Maintenance and rebuild kits are also available. Please contact Ro-Flo Compressors for quotations and placing orders:

- Phone: (+1) 920-574-2653
- Email: parts@ro-flo.com

CONTACT RO-FLO COMPRESSORS

The people at Ro-Flo Compressors know that communication is key in providing a world class product. For that reason we have provided the following methods of contacting our team:

GENERAL INQUIRIES

Toll Free Phone: (+1) 855-427-6356

Main Phone: (+1) 920-574-2651

www.ro-flo.com

NEW COMPRESSOR AND VACUUM PUMP SALES

Toll Free Phone: (+1) 855-427-6356

Main Phone: (+1) 920-574-2651

Email: sales@ro-flo.com

PARTS INQUIRIES

Phone: (+1) 920-574-2653

Email: parts@ro-flo.com

SERVICE AND SUPPORT

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