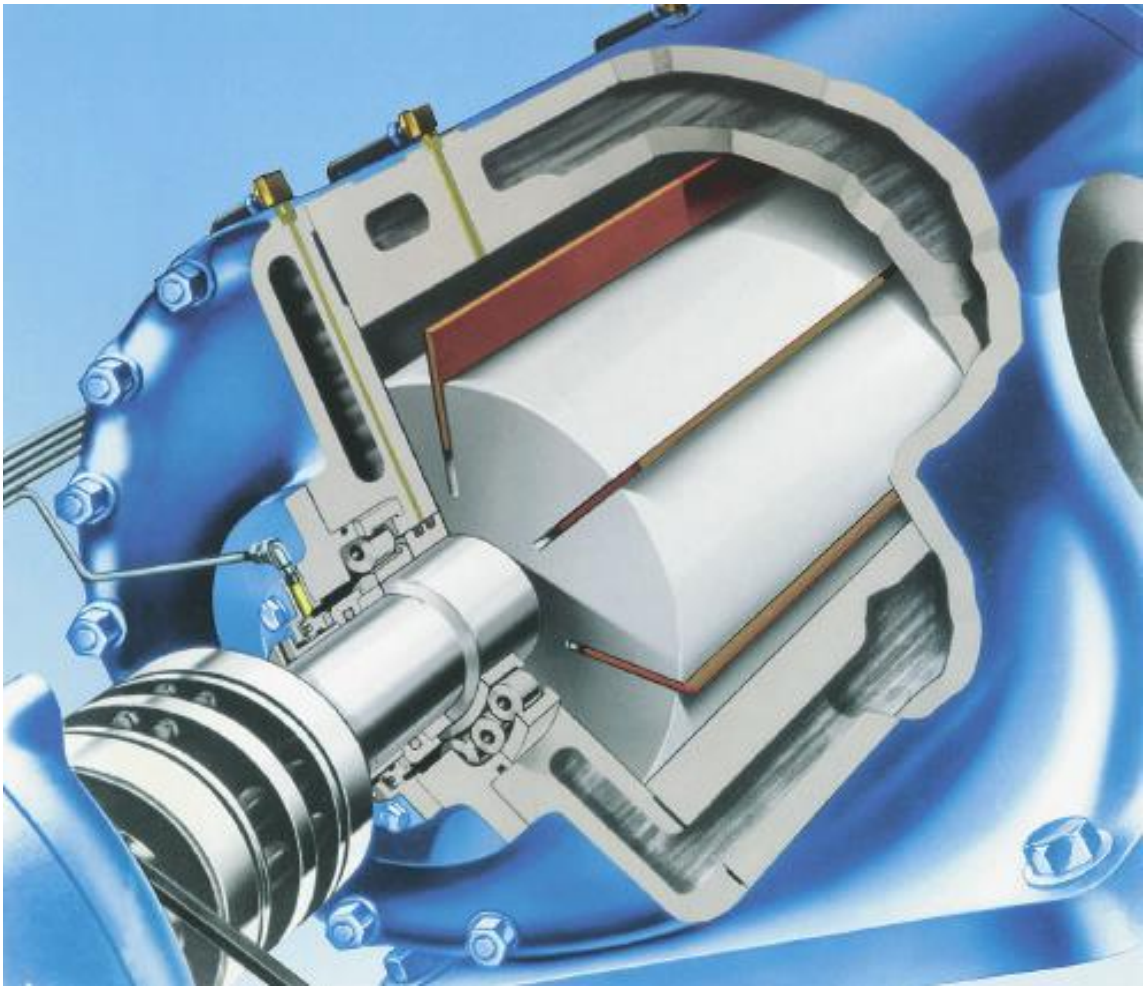
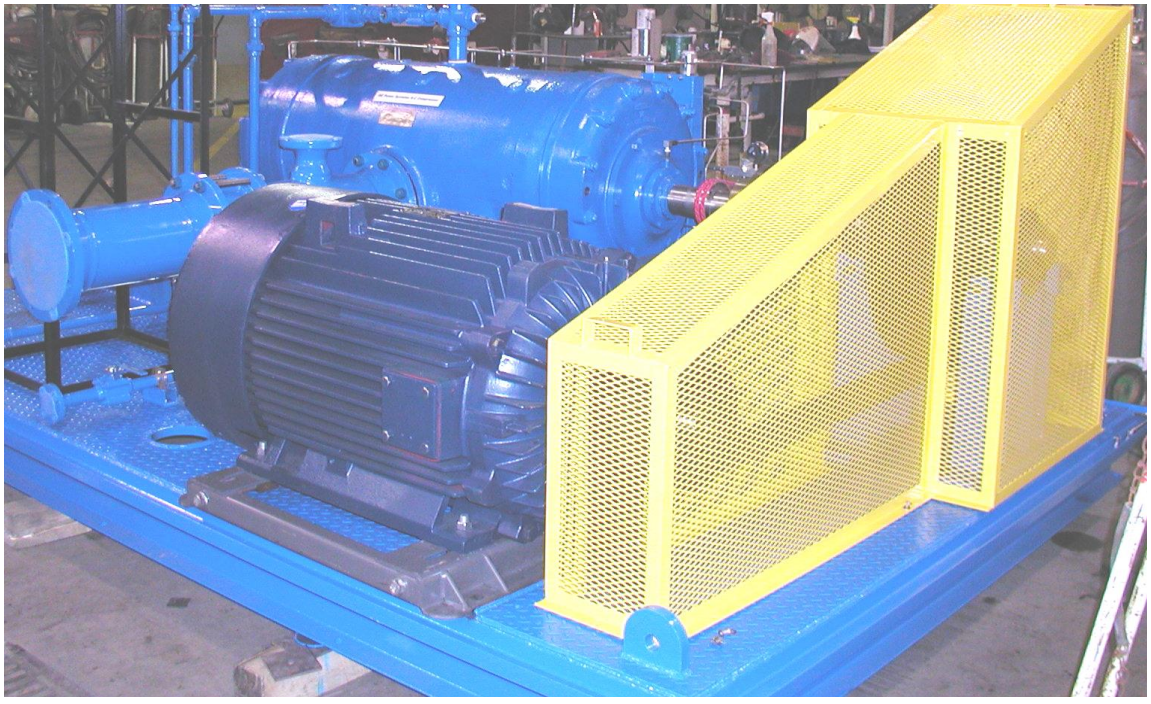
INSTRUCTIONS

INSTALLATION, OPERATION, & MAINTENANCE OF

Ro-Flo® COMPRESSORS

罗夫洛压缩机安装、运行、维护保养手册





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SAFETY INFORMATION 安全说明

CAUTION 小心

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.
在使用压缩机之前，请阅读和理解本操作手册。参考撬装商的运行操作手册非常重要。

FAILURE TO FOLLOW OPERATING INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH.
不能遵从运行操作指导可能导致严重的伤害或死亡。

Read this document carefully before installing and starting your compressor.
在安装和启动你的压缩机之前，请仔细阅读本文件。

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.
本文件是为了帮助你进行安装、操作和维护你的 Ro-Flo® 压缩机。按照这个手册和提供的其他压缩机撬的指导文件，能使你的设备有更长的运行寿命。

The entire manual should be reviewed before attempting to install, operating, service, or repair the compressor.
整本手册需在试图安装、操作、服务、或修理压缩机前被仔细阅读。

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.
Ro-Flo® 滑片式压缩机是容积式压缩机，是设计用来压缩气体的。压缩机绝对不能在入口气流中含有液体。Ro-Flo 压缩机公司不负责防止摄入液体的系统设计，因而 Ro-Flo 压缩机公司也不能为因不当保护和不当设备操作而引起的设备损坏提供质保。

CAUTION 小心

PERSONAL PROTECTIVE EQUIPMENT (PPE) SHOULD BE USED TO AVOID HEALTH HAZARDS (EXCESSIVE SOUND LEVEL EXPOSURE) DUE TO HIGH NOISE LEVEL DURING NORMAL OPERATION.
要用人员防护装备（PPE）以避免设备正常运行时运行人员（过度暴露在）噪声环境中而造成健康伤害。

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.
建议客户建立一个有效的EHS计划，以避免运行人员承受超出美国职业安全与健康管理局（OSHA）或其他监管机构所允许的限值（PEL）之外工作的风险。

CAUTION 小心

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.
本手册所提供的资料是为了帮助运行人员了解设备的一般特性。但这并不能免除用户对所购设备在安装、使用、和维修过程中的具体实践的责任。

INTRODUCTION 介绍

RO-FLO® SLIDING VANE COMPRESSORS RO-FLO®滑片式压缩机

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.

Ro-Flo®压缩机的基本构造是由两个气缸盖，偏心地把一个转子定位在一个圆形的缸膛中。压缩机运行时，离心力使八个转子槽里的叶片甩出，在运转中与气缸膛腔保持接触。这个运转结构产生了八个相对独立封闭的气室，这些气室由气缸、气缸盖、转子和叶片围绕形成。压缩机的进气口是在转子与缸膛最大距离点，这样，每个气室在转动经过进气口时，都会是在最大容积和最小压力的状态，这样就使得气体被吸入压缩机。随着旋转的继续，转子与气缸膛之间的距离减小，从而减小了各气室的容积而提升了气室的压力。压缩机的排气口是在转子与气缸膛的最小距离点，当转动经过排气口时，每个气室都是在其最小容积和最大压力的状态，这样就迫使气体被排出压缩机。 需要注入少量润滑油到压缩机气缸以便润滑这些部件。

WARRANTY 质保

General Provisions 总则

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.
Ro-Flo 公司保证对产品有所有权、也保证产品从装运时日起，产品的质量是好的可销售的，也没有加工和材料方面的缺陷。非本公司生产的产品除外。

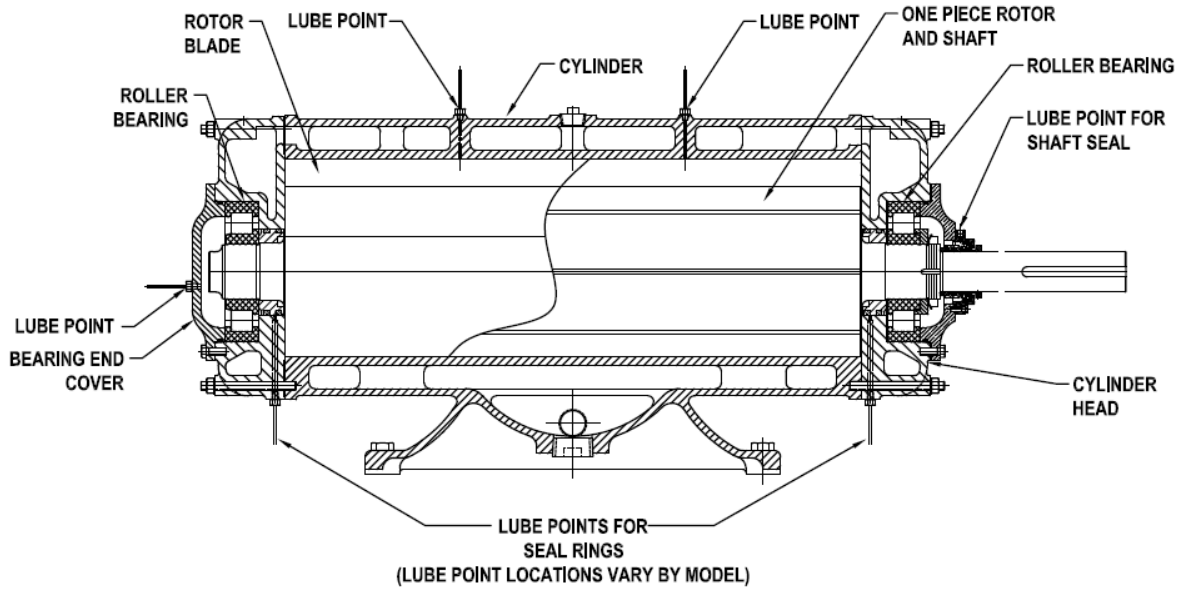


FIGURE 1 - General cross section of a Ro-Flo® Low Pressure model sliding vane compressor along the rotor axis.

图 1 - 滑片压缩机低压模型沿着转子轴的截面图

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).
本担保将取代所有明文其它担保。包括但不限于适销性和适用性的默示保证，并构成公司相对于该产品唯一担保。

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.
公司的质保期为从压缩机的初始运行日起一年，但同时不能超过压缩机装运发货之日起的十八个月。如果买方发现该产品不符合以上的质保可及时书面通知本公司，公司将给以解决。由公司来决定进行调整、修理、更换需质保的产品或零部件。买方则应承担由这些补救措施而产生的全部责任以及拆、装、和运输的费用。同样的义务和条件，也适用于公司提供更换的零部件。公司也有权处置被换下的零件。

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.
任何非本公司生产的产品都不在本公司质保范围之内，而只能由制造方提供质保。这阐述了买方对本公司及其供应商有关产品所享有的专有补偿，无论是合同，或侵权行为，或任何其他法律理论下，以及无论是否由质保，陈述，说明，安装，或者其他任何原因引起的设备缺陷。

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.
对于没有被买方按照操作维修手册上的操作指南正确存储、处理、操作和维护的产品，本公司和其供应商不承担责任。

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.
如果非原产的零配件已被用于压缩机的维修或再造，本担保将失效。

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.
零部件质保期 - 从装运之日始，更换的零部件拥有为期九十天的质保期。

Performance Guarantee 性能保证

The Performance Guarantee on Volume and/or Brake Horsepower is subject to a tolerance of ±5%.
性能保证之于流量和/或马力方面允许有±5%的误差。

Special Warranty Provisions 特殊质保条款

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.
Ro-Flo 公司将不承担因腐蚀、气体中携带液体或固体、或因买方运行操作不当造成的损失。

ALL REPAIR PARTS orders must be accompanied by the original compressor serial number.
所有的维修配件的订单必须附有压缩机的原始序列号。

SECURING COMPRESSOR FOR SHIPMENT 将压缩机固定装运

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.

应通过装备脚孔将压缩机牢固地固定在运输撬板上，如果用绳带绑扎压缩机到橇板上，应将绳带固定在气缸体上，**严禁**用绳带绑扎在气缸盖或转子上来固定压缩机，因为这可能会影响压缩机组件的对准。

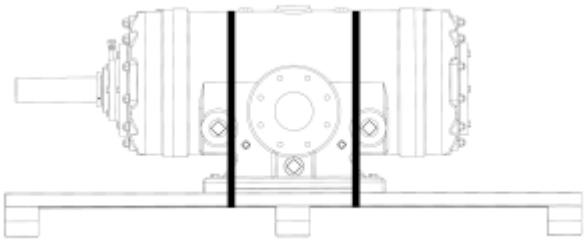


FIGURE 2 - Securing compressor for shipment. Never apply banding over the cylinder heads or rotor shaft.

图 2 - 将压缩机固定装运。严禁用绳带绑扎在气缸盖或转轴上来固定压缩机

COMPRESSOR LIFTING 压缩机的吊装

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.

压缩机可以用吊索从其下方的安装脚或用吊具绕在压缩机气缸上吊起。**严禁通过气缸盖上的螺纹孔将压缩机吊起**。用吊索正确地吊起压缩机的方法参见图 3。压缩机的近似重量参照表 1。

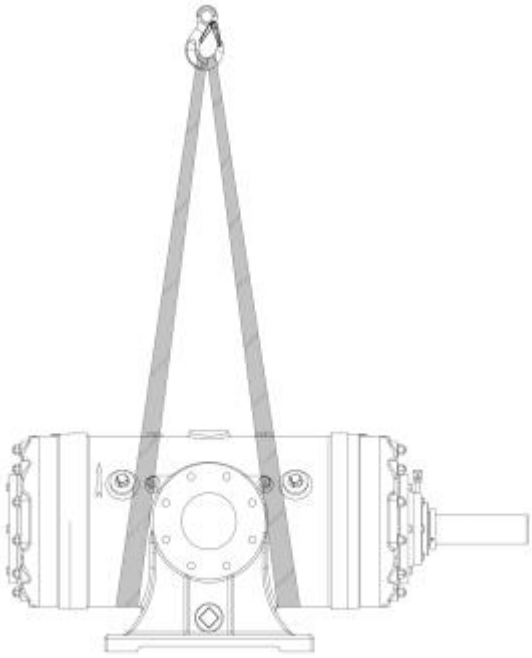


FIGURE 3 - Compressor lifting with a sling. **NEVER** lift the compressor by the threaded holes in the cylinder head. The threaded holes are for lifting of the cylinder head only during maintenance and assembly.

图 3 - 用吊索吊起压缩机。**严禁通过气缸盖上的螺纹孔将压缩机吊起**，螺纹孔是用于在维修和装配过程中仅仅吊起气缸盖用的。

Table 1 - Compressor Weights
表 1 - 各种压缩机机型的重量

MODEL	WEIGHT	
	lbs.	kg
Low Pressure Models		
2CC	215	98
4CC	220	100
5CC	240	109
7D	510	232
8D	800	363
8DE	780	354
10G	1350	613
11S	2000	908
11L	2150	975
12S	2100	953
12L	2450	1111
17S	3500	1588
17L	4450	2019
19S	5100	2313
19L	5500	2495
19LE	5270	2390
High Pressure Models		
206	560	254
207	550	250
208B	540	245
210M	860	390
211M	1250	567
212M	1825	828
217M	2400	1089
219M	2900	1315

RECEIVING INSPECTION 压缩机的验收

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.
在验收压缩机时，应及时检查是否存在任何在运输过程中发生的损坏，如果存在这种损坏，应立即向承运人提出赔偿申请。

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.
此外，检查舱单，以保证所有与压缩机一起订购的材料已收到。

STORAGE OF BARE FRAME COMPRESSORS 压缩机裸机的存储

The compressor should be stored in a clean dry indoor area until used. Assure that all openings to the unit are sealed and that the factory applied rust preventative has not been removed from the shaft extension. All units shipped by Ro-Flo® compressors are coated internally with a protective light film of rust preventative, which is adequate protection for a month of indoor storage. This rust preventative will be displaced by the lubricating oil during initial hours of operation.

压缩机应存放在清洁干燥的室内直到使用。确保压缩机的所有开口是密封的，确保轴外伸部上的防锈剂尚未被清除。所有由 Ro-Flo®运出的压缩机都涂有防锈保护薄膜，这足以提供一个月的室内储存保护。当压缩机初始运行时，该防锈剂将被润滑油取代。

1. Equipment should be stored in a clean, dry-well ventilated place, free from vibration, and rapid or wide variations in temperature.
   设备应存放在清洁、干燥、通风良好的地方，避免振动和温度变化较快或较普遍的地方。
2. Rotate the shaft at least 10 full revolutions once a week to coat the bearings with lubricant.
   每周至少使转轴充分旋转 10 次，以便将润滑剂涂到轴承上。
3. Rust protect internal surfaces with preservative (light Tectyl #511-M or similar). Coat exposed shaft with heavy preservative (Tectyl #890 or similar).
   用防护剂（light Tectyl #511-M 或类似产品）保护压缩机内表面。将重型防护剂（Tectyl #890 或类似产品）涂在裸露的转轴上。

STORAGE OF INSTALLED COMPRESSORS 已安装的压缩机的存储

Below are Ro-Flo Compressor's recommendations for storage of compressors:
以下是 Ro-Flo 关于已安装压缩机储存的建议：

Short Term Storage (< 1 Month) 短期存储（少于 1 个月）

1. Equipment should be stored in a clean, dry-well ventilated place, free from vibration, and rapid or wide variations in temperature.
   设备应存放在清洁、干燥、通风良好的地方，避免振动和温度变化较快或普遍的地方。
2. Isolate the compressor from process with bubble tight sealing valves.
   将压缩机与工艺泡沫密封阀分离。
3. A nitrogen purge system should be installed to protect the equipment with a slight positive pressure of clean dry nitrogen. If nitrogen is unavailable, desiccant bags should be placed in the suction and discharge flanges.
   应当配有一个氮气吹扫系统使用低压、清洁干燥的氮气来保护设备。 如果无法使用氮气，干燥剂袋应放置在吸气和排气法兰里。
4. Rotate the shaft at least 10 full revolutions once a week to coat the bearings with lubricant.
   每周至少使转轴充分旋转 10 次，以便将润滑剂涂到轴承上。
5. Rust protect internal surfaces with preservative (light Tectyl #511-M or similar). Coat exposed shaft with heavy preservative (Tectyl #890 or similar).
   用防护剂（light Tectyl #511-M 或类似产品）保护压缩机内表面。将重型防护剂（Tectyl #890 或类似产品）涂在裸露的转轴上。

Medium Term Storage (> 1 Month but < 1 Year) 中期存储（超过 1 个月，但不超过 1 年）

1. Follow all procedures for Short Term Storage above.
   遵循以上短期储存的所有步骤。
2. Replace desiccant bags monthly.
   每月更换干燥剂袋。
3. Remove the rotor blades from the compressor and wrap them twice with desiccant inside of polyethylene (or alternatively ocean wrap bearing paper) and tape shut. Store the blades on a level, flat shelf.
   拆下压缩机上的转子叶片，并用干燥的塑料膜（或者海洋包承纸）将叶片包裹两层，用胶带封好。 将叶片存储在水平、平坦的架子上。

Long Term Storage (1 year or greater) 长期存储（1 年或 1 年以上）

1. Follow all procedures for Medium Term Storage above.
   遵循以上中期存储的所有步骤。
2. Coat all compressor internals with tectyl spray.
   给压缩机所有的内部构件涂上泰利德防锈油。

PROTECTION OF IDLE COMPRESSORS 闲置压缩机的保护

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.

当压缩机闲置时，一定程度的保护是明智的，以避免内部零件生锈和叶片在转子槽里的膨胀。最理想的保护方法是每周运行压缩机大约一小时。当这个方法不能实现时，应在压缩机的口径和各轴承腔里彻底地喷上轻油。此外，当入口和/或排出管道被拆除或暴露在空气中，用塞子密封或用盖板盖住压缩机的开口，以防止潮湿或灰尘进入压缩机。

WARNING 警告

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.
膨胀的叶片可能与转子槽合并，引起附加应力强加到任何自由的滑片上。这会导致叶片破损和压缩机的灾难性故障。

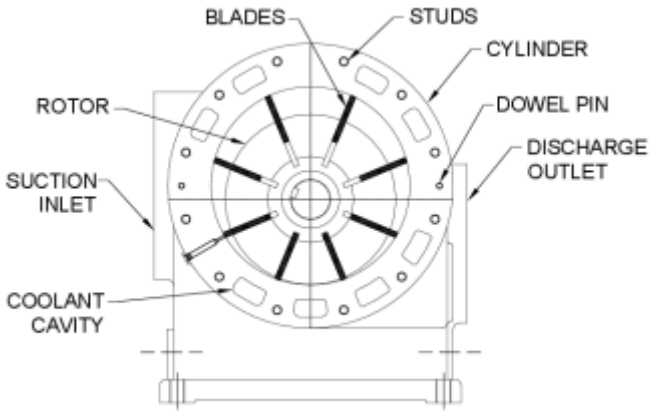


FIGURE 4 - Cross section of a Ro-Flo® Low Pressure model, perpendicular to rotor axis.

图 4 - Ro-Flo®压缩机低压模型垂直于转子轴的横截面

INSTALLATION 压缩机的安装

FOUNDATION 地基

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 control.

使用垫片将压缩机橇安装在水平的地基上，以便在拧紧地基螺栓时，机撬不会发生变形。机橇应符合静载重的压缩机，驱动器和其他设备的安装要求，以便存在足够的刚度来保持耦合对准。用高强无收缩的水泥浆填灌撬和地基之间的空隙，这样有助于防止压缩机橇移动，也有助于控制噪声。

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.

当使用撬或简单的混凝土上加板时，地面以上的高度要足够以适合压缩机的维修和保养。

Table 2 - Compressor shaft dimensions.

表 2 - 各种模型压缩机轴的尺寸

MODEL	SHAFT DIAMETER @ COUPLING		NOMINAL SQUARE KEYWAY DIMENSION
	inch		inch
2CC, 4CC, 5CC	1.250	+0.000 −0.001	0.25
7D	1.625	+0.000 −0.001	0.375
8D, 8DE	1.625	+0.000 −0.001	0.375
10G	2.625	+0.000 −0.001	0.625
11S, 11L	3.000	+0.000 −0.001	0.75
12S, 12L	3.000	+0.000 −0.001	0.75
17S, 17L	3.500	+0.000 −0.001	0.875
19S, 19L, 19LE	3.500	+0.000 −0.001	0.875
206, 207, 208B	1.625	+0.000 −0.001	0.375
210M	2.625	+0.000 −0.001	0.625
211M	3.000	+0.000 −0.001	0.75
212M	3.000	+0.000 −0.001	0.75
217M	3.500	+0.000 −0.001	0.875
219M	3.500	+0.000 −0.001	0.875

COMPRESSOR DRIVE 压缩机的驱动

All Ro-Flo® compressors have a straight shaft with a keyway. Compressor shaft dimensions can be found in **TABLE 2**.

所有 Ro-Flo® 压缩机都装配有键槽直轴。 压缩机轴的尺寸可以在表 2 中找到。

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 3**. It should be noted that these are minimum and maximum operating speeds, however, the compressor speed may be further limited by the application conditions.

和一个变速驱动装置配合就能让 Ro-Flo®压缩机拥有控制流量的能力。压缩机的运行速度范围如表 3 所示。应当指出的是，这些都是最小和最大运行速度，而实际压缩机的运转速度可能会因具体应用条件而被进一步限制。

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.

Ro-Flo® 压缩机可选择电动机或引擎驱动。Ro-Flo® 压缩机可以直接连结或皮带传动。要确定它是否可使用皮带传动需要具体分析。

Table 3 - Compressor operating speed range.

表 3 - 各种机型压缩机的运行速度范围。

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

COMPRESSOR ALIGNMENT 压缩机的对中

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.

压缩机的校准应在运输结束后和管道安装之前完成。轴对准不当会导致很高的噪声、联轴器磨损、和/或轴承的损坏。轴对准不当对皮带传动的压缩机而言可能导致皮带打滑和/或皮带的磨损，从而缩短皮带的使用寿命。

Direct Drive Units 直接驱动的机组

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

Ro-Flo® 压缩机适合直接驱动的应用，如图 5 所示

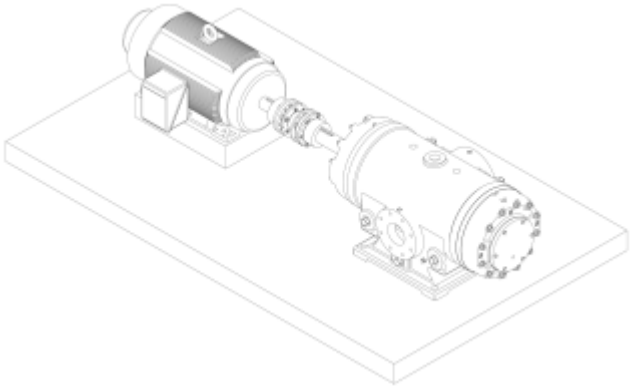


FIGURE 5 - Compressor directly coupled to electric motor.

图 5 - 压缩机直接连接电机。

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.

参考图 6、图 7 和图 8 展示了有角度和平行偏差的情况，以及检查这些偏差用的刻盘指示器方法。重要的是要同时旋转两个轴，这样可避免因连结轴的表面缺陷而产生的误差。请注意，每个轴的旋转联轴器会显现出平行和角度偏差的叠加效果。所有这些可归结为整体轴偏差。

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

压缩机和驱动设备的平行和角度校准应不超过 0.006 英寸或符合耦合器的限制，以较小者为准。

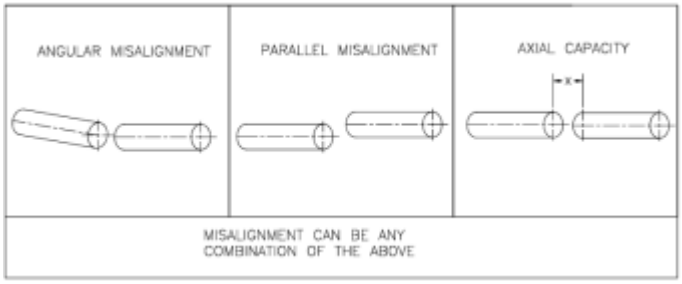


FIGURE 6 - Angular misalignment, parallel misalignment, and axial capacity illustrated.

图 6 - 角偏差、平行度偏差和轴向距的示意说明

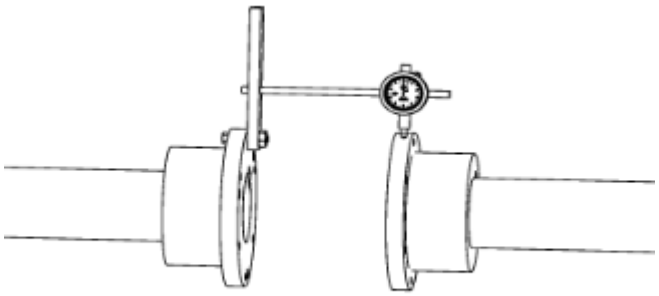


FIGURE 7 - Checking parallel alignment with dial indicator on coupling flange.

图 7 – 用千分尺来检查联轴器法兰面的平行度

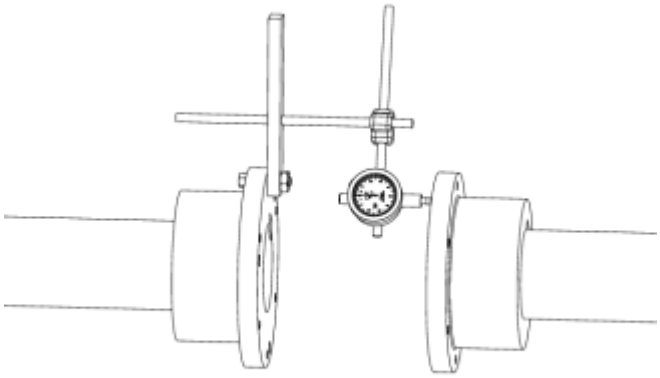


FIGURE 8 - Checking angular alignment with dial indicator on coupling face.

图 8 -用千分尺来检查联轴器表面的角对准

Belt Drives 皮带驱动

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.

皮带驱动设计必须由压缩机的运行条件和皮带生产厂家来定。皮带制造商须明确皮带的张力水平和操作限制。皮带驱动器制造商确定的皮带负荷预估值应参考 Ro-Flo 的压缩机性能软件，以便确定是否需要安装一个中间传动轴。

Excessive Belt Load 皮带的超载

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.

图 9 示意了一个典型的中间传动轴安装布置，从而消除了压缩机上的皮带超载。压缩机和中间传动轴之间的校准与直接驱动压缩机的校准方法相同。

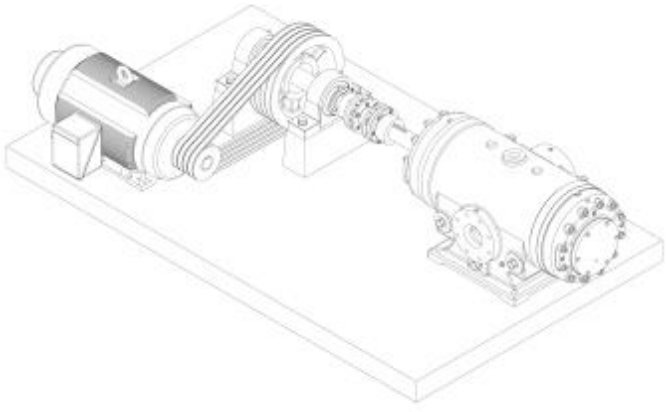


FIGURE 9 - Typical arrangement for belt drives with pedestal bearings and a jackshaft.

图 9 - 皮带驱动的带座式轴承和中间传动轴的典型布置。

Acceptable Belt Load 可承受的皮带负载

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.

图 10 展示了压缩机滑轮直接安装在压缩机上的布置。如果轴承的负载和弯矩不超过压缩机的设计限度，这是一个可以接受的安装布置。

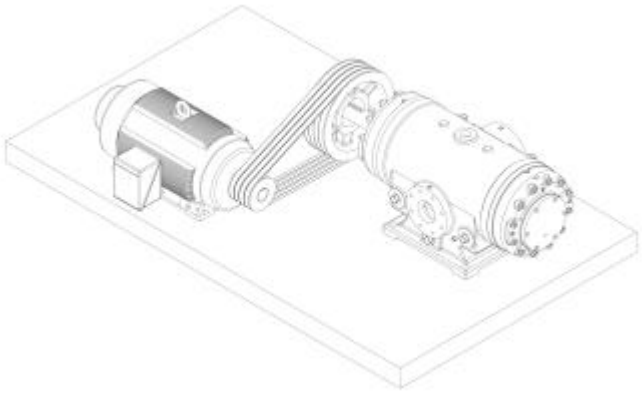


FIGURE 10 - V-belt drive with sheave mounted directly on compressor shaft.

图 10 - 滑轮直接安装在压缩机轴上的 V 型皮带驱动。

2 Stage Compressor Train 2 级压缩机组

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

图 11 展示了一个典型的由一个电动机驱动的 2 级压缩机组布置

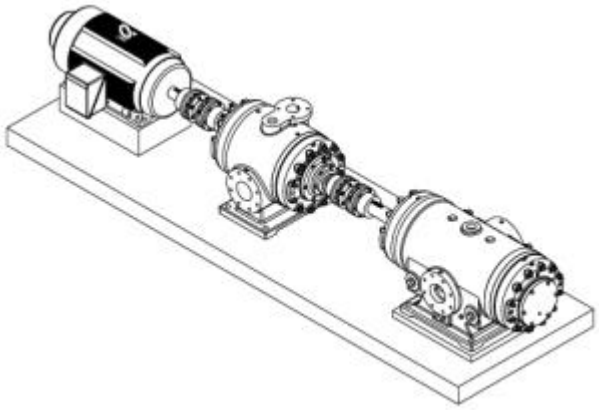


FIGURE 11 - Example of a 2 stage compressor train driven by one electric motor. (Couplings sold by others.)

图 11 - 由一个电机驱动的 2 级压缩机组范例。（联轴器由其他供应商提供）

PROCESS PIPING 工艺管道

Piping connected to the compressor should be adequately supported and aligned such that minimal stress is transmitted to the compressor/piping connection. See **TABLE 4** 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.

连接压缩机的管道应有适当支撑和对齐，这样使管道传给压缩机或管接头的压力最小。表 4 列出了 Ro-Flo®压缩机的法兰所能允许的负载值。此外，管道必须含有足够数量的弯头、三通和阀芯件，以便易于从机组中拆除管道。

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.

气体吸入管的内部必须是清洁的。一个 16 目的启动屏应安装在近压缩机的进气法兰上。当杂物停止堆积时，可移除该屏。

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

在吸入和排出管路上，推荐安装油和液体的排污管线如图 12 所示。

⚠ WARNING 警告

Liquid ingestion in the compressor can result in catastrophic failure.
液体吸入到压缩机中会导致灾难性的故障。

Typical piping arrangements contain basic features, such as (refer to **FIGURE 13**):
典型管道布置一般包含一些基本特征的，诸如（参见图 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
   出口止回阀尽可能紧挨着安装在压缩机排放口旁，以防关闭压缩机时发生倒流。
2. A discharge safety valve placed before the first isolation valve.
   排出安全阀安装在第一隔离阀之前。
3. Drain valve, either manual or automatic, for the drop legs and liquid separators.
   排污阀无论手动或自动阀的均作为排液管和液体分离器。
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.
   进气过滤器用于从入口气流中除去至少 90%的灰尘颗粒（10 微米或更大）。气流通过过滤器会因污染物而增加压降，在设备选型时就应考虑到这个因素。
5. Instrumentation should be placed as close as possible to the compressor to accurately determine the operating conditions.
   仪表应尽可能紧挨着压缩机安装，以便准确地判定的运行状况。

Table 4 - Loading Limits on Ro-Flo® suction and discharge flanges

表 4 - 各种机型压缩机进、排气法兰的负载限度

MODEL	SUCTION FLANGE DIA.	DISCHARGE FLANGE DIA.	SUCTION FLANGE		DISCHARGE FLANGE	
			Fx,y,z	Mx,y,z	Fx,y,z	Mx,y,z
	(in)	(in)	(lbs)	(ft-lbs)	(lbs)	(ft-lbs)
2CC	2	1.5	100	1190	75	970
4CC	2	1.5	100	1190	75	970
5CC	2	1.5	100	1190	75	970
7D	3	3	150	1500	150	1500
8D	4	3	200	1670	150	1500
8DE	4	3	200	1670	150	1500
10G	5	4	250	1670	200	1670
11S	6	5	300	1670	250	1670
11L	6	5	300	1670	250	1670
12S	8	6	400	1670	300	1670

12L	8	6	400	1670	300	1670
17S	8	6	400	1670	300	1670
17L	8	6	400	1670	300	1670
19S	10	8	500	1670	400	1670
19L	10	8	500	1670	400	1670
19LE	10	8	500	1670	400	1670
206	3	2*	150	1500	80	970
207	3	2*	150	1500	80	970
208B	3	2*	150	1500	80	970
210M	4	2.5*	200	1670	100	1375
211M	5	3*	250	1670	120	1500
212M	6	4*	300	1670	160	1670
217M	6	4*	300	1670	160	1670
219M	8	4*	400	1670	160	1670
* Vertical Orientation (top Discharge)						

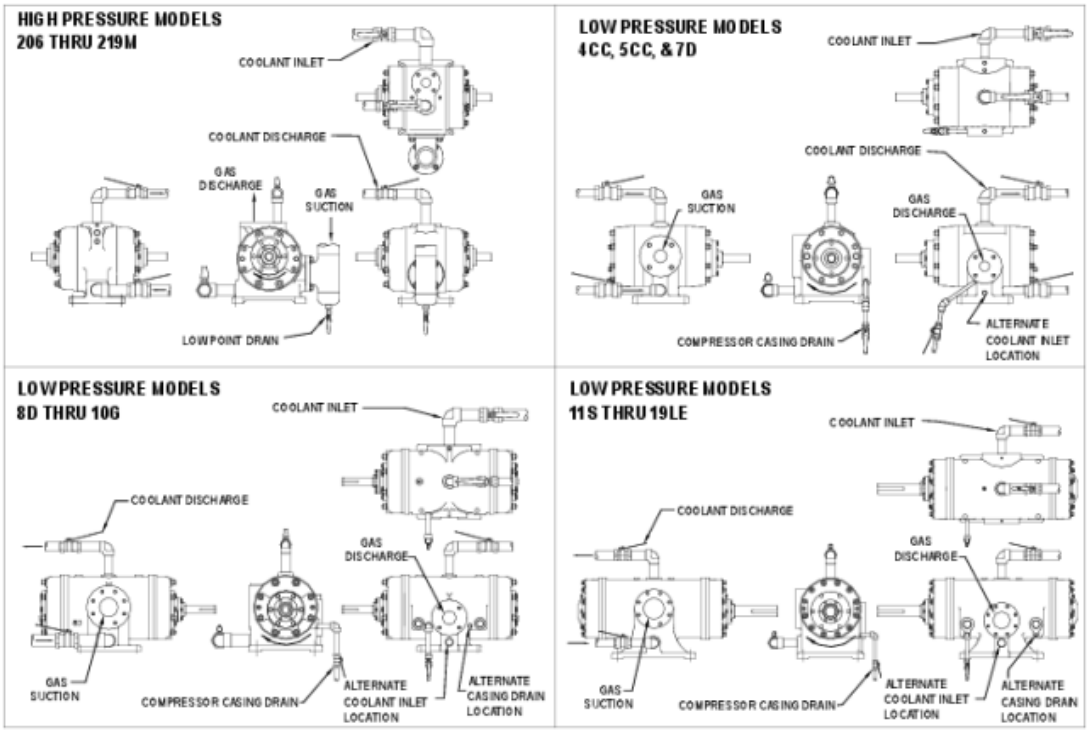


FIGURE 12 - Ro-Flo® cylinder drain locations and arrangements. (Note: All pipe & valve positions shown for clarity only, customer configuration may differ per application.)

图 12 - Ro-Flo®气缸的排污位置和安装。（注：图上所有管道和阀门的位置只是为了显示清晰，客户可根据不同的应用而选用不同的布置位置。）

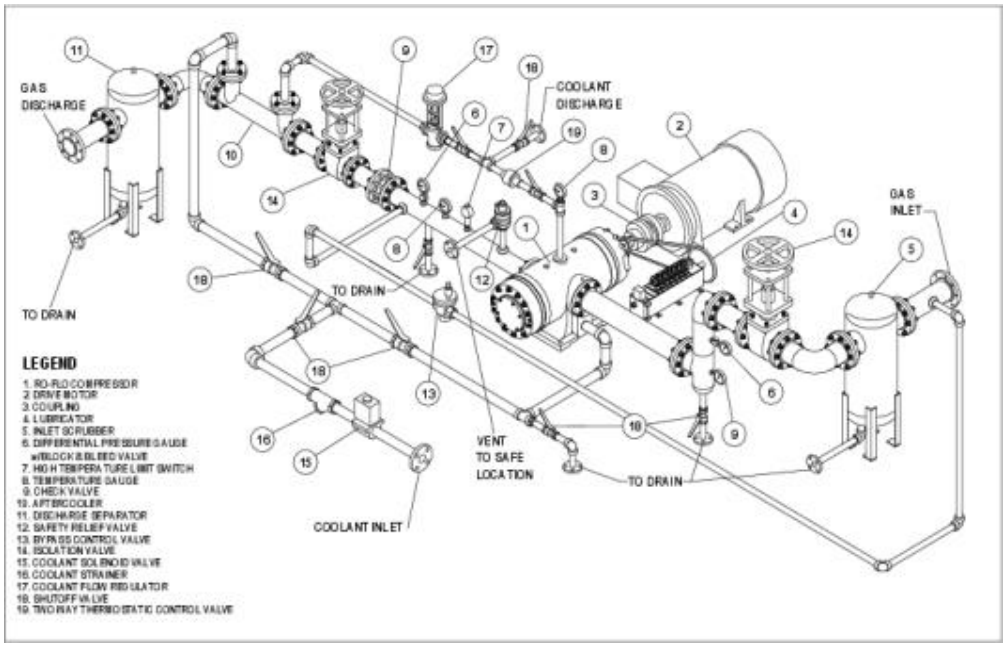


FIGURE 13 - Typical piping arrangement - open loop cooling system shown. (Note: All pipe & valve positions shown for clarity only, customer configuration may differ per application.)

图 13 - 典型的管道布置 - 显示的是开式循环冷却系统。（注：图上所有管道和阀门的位置只是为了显示清晰，客户可根据不同的应用而选用不同的布置位置。）

COMPRESSOR COOLING SYSTEM 压缩机的冷却系统

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.

压缩机冷却系统是被用来控制压缩机的热膨胀以使它保持正常的内部间隙的。这个系统不是用来控制气体排放温度的。

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.

冷却液排放温度低于 100 °F（37.8 °C）会导致内部间隙减小，这可能会导致转子接触而损伤。冷却液排放温度高于 160 °F（71 °C）则可能会导致气缸盖衬垫失效。

CAUTION 小心

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

压缩机停机时，必须停止冷却液的流动，以防止转子/气缸接触。

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

关机时，冷却液的循环会引起内间隙减小，这可能会导致转子/气缸接触。

CAUTION 小心

Water jacket pressure must not exceed 50 psig.

冷却用的夹套水/冷却液的压力不能超过 50 psig。

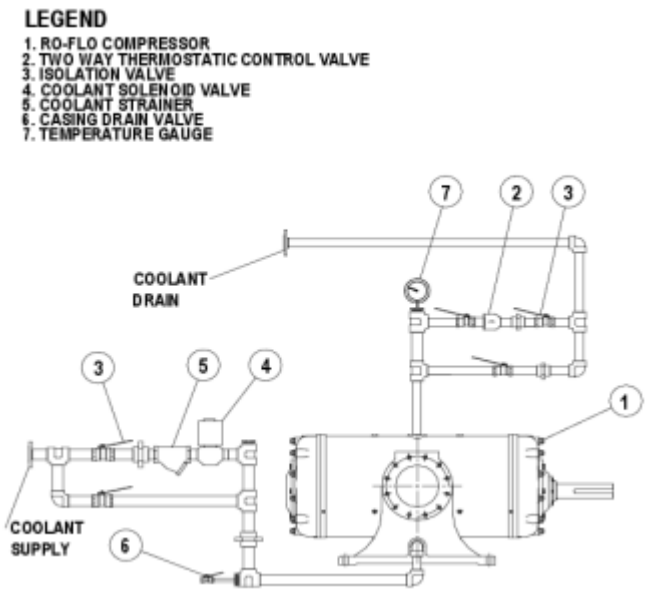


FIGURE 14 - Typical open loop cooling system.

图 14 - 典型的开式冷却系统

Open Loop Cooling 开式冷却

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.

开式冷却系统通常在压缩机的冷却水或冷却液排放处旁安装一个两位流量调节器，如图 14 所示的。最佳的冷却水出水或冷却液出液温度为 105 ± 5 ºF（40.5 ± 2.7 °C）。压缩机冷却系统在启动前必须先充满冷却水或冷却液并完全排出空气。

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.

当压缩机启动或停止时，电磁阀可取代手动阀来启动或停止冷却液的流动。 好的管道设计通常在电磁阀及两位流量调节器边上按一个手动旁路系统。

Closed Loop Cooling 闭式冷却

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.

闭式的乙二醇/水（图 15）散热器冷却系统可作为按照“冷却液流量要求”计算出的近似流量。一个足够尺寸的散热器可将冷却液温度降低约 15 ºF（8.3 °C）。较高的压缩机外壳温度会导致较高的压缩机排气温度。

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).

一个三通冷却液流量调节器，如图 15 所示，是保持压缩机冷却液出口温度高于 100 ºF（37.8 °C）的基本需要。

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

冷却系统在启动前必须完全排出空气。

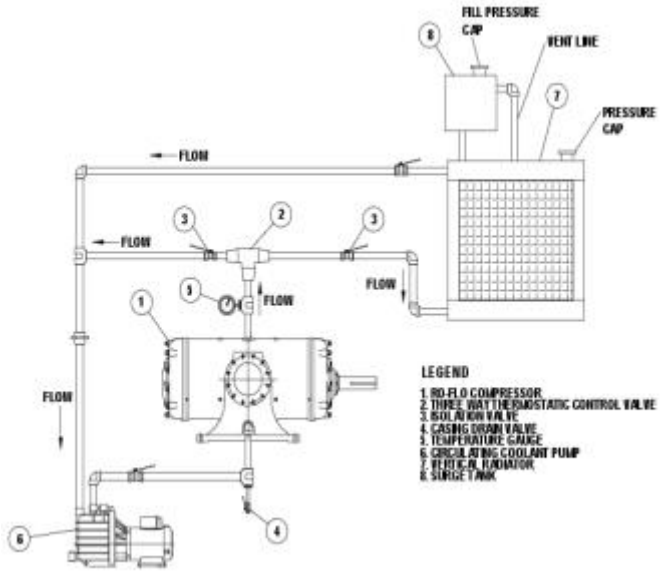


FIGURE 15 - Typical closed loop cooling system.

图 15 - 典型的闭式冷却系统

Coolant Flow Requirement 冷却液的流量要求

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

压缩机应用应该配备着拥有一定冷却液流量的管道，冷却液流量（加仑/每分钟（GPM））由下面公式来计算：

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

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

作为真空泵使用，冷却液流量（加仑/每分钟（GPM））则由下面公式来计算：

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

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.

上述估算的流量是基于冷却液温度上升了 15 ºF（8.3 °C）的一个设计温度。这个流量能使冷却液在入口以 90 ºF （32.2 °C）温度入，而以 105 ºF（40.5 °C）的温度出。

Cooling Water Contaminants 冷却水污染物

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.

冷却水的总硬度（TDS）应不超过 300 ppm (毫克/升)。 随着时间的推移，沉淀物将逐渐增加，就隔一段时间用酸来清洗压缩机夹套层。

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

如果水含有悬浮颗粒，这种水就不能使用，因为悬浮颗粒会迅速在压缩机夹套层中沉积下来，影响冷却效果。

Cooling Water Pressure Drop 冷却水压降

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.

一般估计冷却水通过压缩机夹套层会有 5 PSI（35 kPa）的压力降。 系统设计时也应考虑到冷却水通过水温调节阀和入口电磁阀的压降。

Table 5 - Compressor coolant jacket capacities.

表 5 - 各种机型压缩机冷却液夹套层的容量

MODEL	APPROXIMATE VOLUME Gallons (Liters)	MODEL	APPROXIMATE VOLUME Gallons (Liters)
2CC	0.8 (3)	**206**	2.8 (10.6)
4CC	1.0 (3.8)	**207**	2.8 (10.6)
5CC	1.3 (4.9)	**208B**	2.8 (10.6)
7D	3.0 (11.4)	**210M**	6.0 (23)
8D	5.5 (21)	**211M**	9.0 (34)
8DE	5.5 (21)	**212M**	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	27.0 (102)		
19L	30.0 (114)		
19LE	30.0 (114)		

Cooling of Two Stage Systems 两级布置压缩机组的冷却

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.

两级布置的压缩机系统应该有同时供应给每台压缩机的冷却液连接管路。每台压缩机都应该有一个温控阀来独立控制冷却液的排放温度。压缩机的冷却回路不应当串联连接，因为这可能会导致压缩机内部过热，并可能损坏密封件和/或缸膛过早磨损或叶片损坏。

LUBRICATION SETUP 设置润滑油装置

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

Ro-Flo 压缩机要求在所有润滑点安装止回阀。Ro-Flo 压缩机提供以下润滑部件。

Table 6 - Compressor Lubrication Accessories

表 6 - 各种压缩机机型的润滑组件

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	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	10	8	(2 required) 16-630-888-037	5	16-132-399-501
206 207 208B	7	3	16-630-888-034	3	16-132-506-502
210M	7	4	16-630-888-035	4	16-132-492-503
211M 212M	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 33

*润滑点位置的详细信息参阅 33 页的“润滑油”

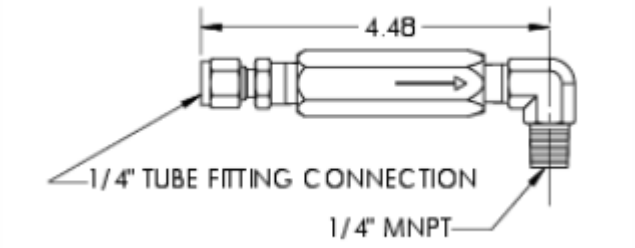


FIGURE 16 - Angled Double Check Valve for compressor lube points.

图 16 - 压缩机润滑点的直角型双止回阀

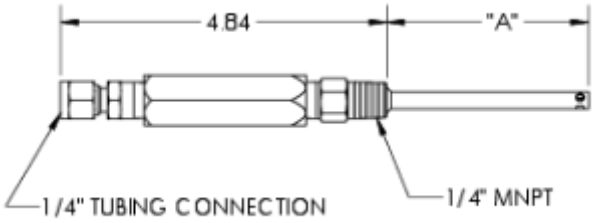


FIGURE 17 - Inlet Lubrication Quill.

图 17 - 入口润滑油套筒

Oil System for Double Bellows Type Shaft Seal 双波纹管式轴密封的油系统

The double bellows shaft seal oil system 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.

双波纹管轴密封油系统是用来使密封部件浸润在油中并维持油的压力的。如果外密封发生泄漏，油会溢向外侧来阻止空气进入压缩机系统。如果内密封发生泄漏，油会渗透进入压缩机。

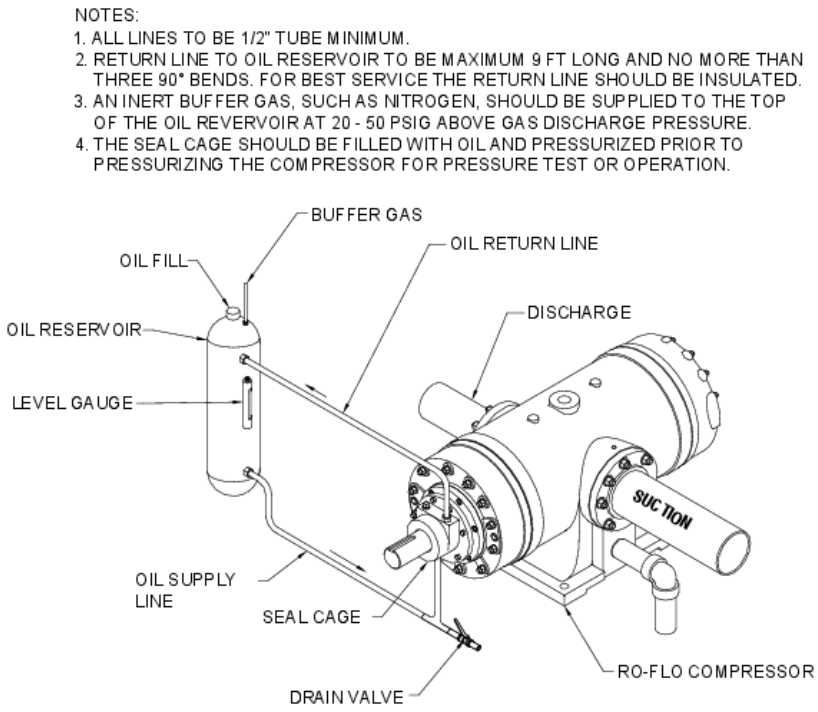


FIGURE 18 - Typical piping arrangement for double bellows seal.

图 18 - 典型的双波纹管密封管道布置

The double bellows seal (see "Double Bellows Mechanical Seal" on page 57) consists of two carbon rings that rotate and seal against two highly polished stationary iron 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.

双波纹管密封（见 57 页的“双波纹管机械密封”）的两个碳环旋转并密封住两个高度磨光的铁环密封件。整个密封套件浸润在充满油的密封罩里，密封罩外侧上方装有一个充满油的储油罐。密封的润滑和冷却都由油的循环来完成。

The oil 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.

储油罐的连接必须与图 18 所示一致。低侧的储油罐管线应连接到密封罩的底部。

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.

高侧的储油罐管线应连接到密封罩顶部。低压型压缩机使用最靠近压缩机吸气法兰的连接。高型压缩机使用最靠近压缩机排气法兰的那个连接。

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.

使用 1/2 英寸或更大尺寸的管道。确定储油罐的位置，使管线尽可能笔直，以便最大程度地减少对油流的阻力。

The bottom of the oil reservoir should be 12” - 36” above the compressor shaft centerline. 储油罐底部要求比压缩机轴线高出 12 至 36 英寸。

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.

注意：为了保证适当的油循环，一定要让储油器的油位保持在高于上连接管的位置。在初始启动时，油位会有所下降。

OPERATION 压缩机的运行操作

COMPRESSOR WORKING PRESSURES 压缩机工作压力

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

所有 Ro-Flo® 压缩机的最大允许工作温度（MAWT）是 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.

表 7 列出了 Ro-Flo® 压缩机的最大允许工作压力（MAWP）。用户应参考成撬商提供的资料，因压缩机可能不是系统中最低的 MAWP 系统构成部分。 应用条件可能会限制运行压力使排出压力低于 MAWP。

Table 7 - Compressor Maximum Allowable Working Pressure (MAWP)

表 7 - 各种机型压缩机允许的最大工作压力（MAWP）

LOW PRESSURE	
MODEL	**MAWP (psig)**
2CC	80
4CC	80
5CC	80
7D	80
8D	80
8DE	80
10G	80
11S	80
11L	80
12S	80
12L	80
17S	80
17L	80
19S	80
19L	80
19LE	80

HIGH PRESSURE	
MODEL	**MAWP (psig)**
206	150
207	150
208B	150
210M	150
211M	150
212M	150
217M	150
219M	150

LUBRICATION 压缩机的润滑

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:

Ro-Flo® 压缩机的润滑是通过油润滑器来强制实现的。 润滑点参见图 19 和表 9 所列。压缩机的"性能数据表"应当被用来设置供油速率的依据。 咨询润滑油供应商的工程师，为压缩机系统选择适当润滑油。 如果运行条件或被处理的气体有变化，必须考虑下列三个方面因素：

A. Oil Viscosity – depends on gas discharge temperature.
油粘度 – 取决于气体的排出温度。
B. Oil Type and Additive Package – Depends on chemical nature of gas/vapor being handled.
油的种类和添加剂 – 取决于被处理的气体/挥发气的化学性质。
C. Lubrication Rate – Depends on compressor size, operating speed, and chemical/physical action of gas/vapor being handled.
润滑油流量 – 取决于压缩机的大小、运行速度和被处理的气体/挥发气的物理化学性质。

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

更多润滑油相关问题的论述详见以下章节的内容。

Considerations for Oil Viscosity Selection 润滑油粘度的选择考虑

- If the gas handled is expected to condense and dilute the oil, use the next higher viscosity grade.
  如果被压缩气体可能会凝结成液体并稀释润滑油，请选用较高粘度等级的润滑油。
- Multi-viscosity grades of oil are recommended for inlet temperatures below 32 °F (0 °C), as are lubricator reservoir heater and thermostat.
  如果被压缩气体入口温度低于 32 °F（0 °C），推荐选用多粘度等级的润滑油，以及润滑油箱加热器和恒温器。
- On multi-stage units, use the highest discharge temperature to select the oil viscosity.
  对于多级压缩机组，按最高的排气温度来选择润滑油的粘度。
- 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.
  如果进气和/或排气温度持续 70º F（21° C），低于"性能数据表"上的温度，请使用较低粘度等级的润滑油。
- For solvents, heavy paraffin's, and gasoline vapors use the next higher viscosity grade.
  对于溶剂、硬石蜡和汽油蒸气，请使用再高一级粘度等级的润滑油。

Table 8 - Recommended Oil Viscosity Grades 表 8 - 润滑油粘度级的建议

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 润滑油的类型和添加剂的考量

- Lubricants containing detergents have been observed to cause foaming when encountering water saturated gas and turbulence.
  含洗涤剂的润滑油，遇到饱和水气并被搅动时，会出现发泡现象。
- Lubricants produced from vegetable oils have been known to cause harmful deposits in the compressor and may lead to premature failure.
  用植物油生产出来的润滑油，会在压缩机中产生有害沉淀物，这会过早地损坏压缩机。

Considerations for Lubrication Rate 润滑油流量的考虑

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.

表 9 所示的润滑油流量仅供指导（基于空气，倍数为 1）。对于其他气体，请将表 9 中的润滑油流量与表 10 中应用条件相应的值相乘。如果 Ro-Flo®"性能数据表"已随压缩机提供给您，请使用数据表上的润滑油流量，因气体成分和压缩机运行速度已被考虑在内。

Other lubrication rate notes:
关于润滑油流量，需要注意的其它地方：

A. Double the lubrication rate for initial break-in period of 300 hours.
   在初始的 300 小时运行期间，请使用双倍的润滑油流量。
B. Prime all oil feed lines before starting compressor.
   启动压缩机前，使进油管路处于满油状态。
C. Suction flange lubrication points 7, 8, 9, 22, and 32, must have an inlet quill/check valve (see FIGURE 17 on page 28) for proper cylinder lubrication.

为了有适当的油润滑气缸，进气法兰润滑点 7、8、9、22 和 32，必须安装有一个套筒/止回阀（见 28 页的图 17）。

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.
“滴每分钟”的流量信息只适合初始启动时使用！ 运行 24 小时后，请用“品脱每小时”的流量信息，以便核实正确的油耗量。

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.

表 9 - 各种机型压缩机的注油点和近似润滑油流量。此表中列出的润滑油流量适用于在空气中以最大速度运行的压缩机。

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	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	1-2-8-9-10-11-12-13-28-29	10	.42	10
19L, 19LE	1-2-8-9-10-11-12-13-28-29	10	.50	12
206, 207, 208B	17-18-19-20-30-31-32	7	.15	5
210M	17-18-19-20-22-30-31	7	.17	6
211M	17-18-19-20-22-24-25	7	.24	9
212M	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.

*假设 14000 滴油每品脱。 润滑油制造商使用不同的“滴/品脱”标准，会影响上面提到的“滴/分钟”的润滑油流量。更多信息见润滑剂制造商的手册。

Table 10 - Lubrication Rate Multiplier 表 10 - 润滑油流量乘数

Gas/Vapor Handled 处理的气体	Multiplier 乘数
For air and dry inert gases 空气和干燥的惰性气体	1.0
Water vapor, wet non-corrosive gases and vapors 水蒸汽、湿的非腐蚀性气体和挥发气体 Condenser service	1.1

冷凝器服务	
Refrigeration, sweet natural gas, methane, ethane, propane, butane 制冷气、不含硫天然气、甲烷、乙烷、丙烷、丁烷	1.2
Sour natural gas, sludge gas, heavy hydrocarbons (pentane & heavier) 含硫天然气、沼气、重烃（戊烷及以上）	1.5
Vapor recovery, solvents, acids, ketones 挥发气体回收、溶剂、酸、酮	2.0
Gasoline vapors 汽油挥发气	4.0

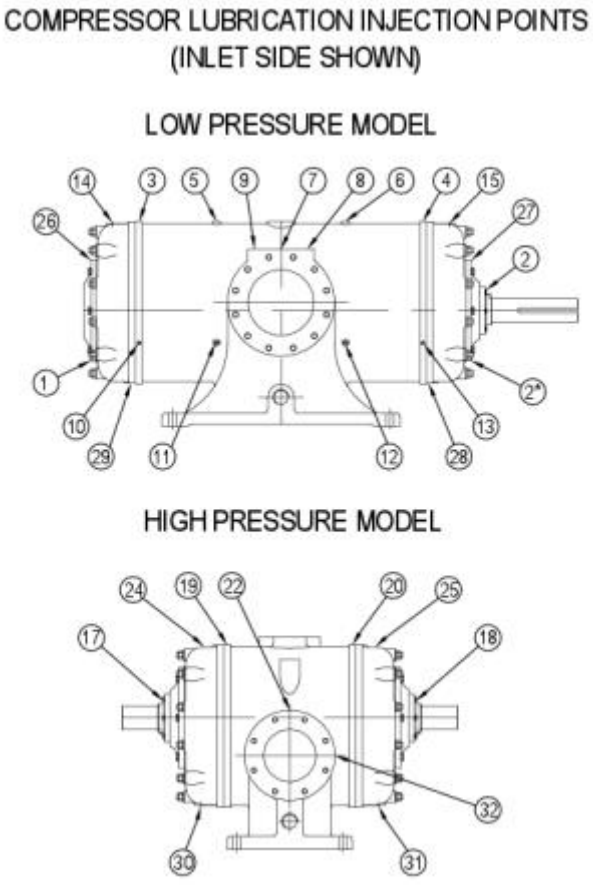


FIGURE 19 - Compressor lubrication injection points, inlet side shown. For more specific locations see the compressor general arrangement drawings available on the Ro-Flo Compressors website.

图 19 – 从入口端展示的压缩机润滑油的注入点。更具体的位置详见 Ro-Flo 压缩机网站上的各压缩机总布置图

PRE-START-UP CHECKS 启动前的检查

- 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.
  打开进气、排气管路的排污阀以确保不存在液体。如果没有安装排污阀，松开的吸气法兰和排气法兰的螺栓，以确定是否有任何液体已进入气缸。

⚠ WARNING 警告

Liquids in the compressor during start-up can cause catastrophic failure.
压缩机中有液体会在使压缩机启动时发生灾难性的故障。

- Manually rotate the compressor shaft to assure no rubbing or binding.
  手动旋转压缩机轴，以确保其内部没有摩擦或粘合。
- Check motor for correct direction of rotation by momentarily "jogging" the start/stop switch.
  快速点动“启动/停止”开关，来检查电机的转动方向正确。
- Recheck all piping and flange connections, in addition to valves on suction and discharge lines.
  复核所有管道和法兰的连接。
- Check the settings of pressure relief and control valves to ensure they are adjusted and operating correctly.
  检查减压阀和控制阀的设置，以确保他们的校正和运行正确。
- Verify the pressure relief valve is properly sized for the expected operating conditions.
  核实减压阀的选择是否符合预期的运行工况。
- Fill lubricator pump case with oil.
  润滑油泵充满油。
- Fill the day tank supplying oil for compressor lubrication.
  为压缩机的常用润滑油箱灌油。
- 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.
  准备好所有的润滑管线，具体操作如下：松开每个油线路上止回阀的油管螺母，泵油直到所有的空气都从管线中被清除 – 然后重新拧紧油管螺母。
- For belt-driven lubricators, assure the belt has proper tension.
  对于皮带驱动的润滑，应确保皮带有适当的张力。
- Test lubricator low oil level and no flow switches by simulating the condition.
  模拟测试润滑油器的低油位和无流量开关。
- Verify that the compressor water jacket is filled with coolant and purged of air.
  确定压缩机夹套已注满冷却液并且已完全排出空气。
- Confirm all instrumentation is working properly.
  确认所有仪表都正常地工作。
- 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.
  对于那些安有双波纹管密封的压缩机，要确保密封罩和储油罐中都充满油，并且使密封油的油压在超过压缩机排气压力的 20 到 50 psi（138 - 345 kPa）的范围。

START-UP CHECKS 启动检查

- Start the system and verify all operating parameters are within their expected ranges and are within the compressor design specifications.
  启动压缩机系统，验证所有的操作参数在其预期的范围内，并且在压缩机的设计范围内。
- Visually check lubrication system to verify it is operating properly, per the manufacturer's instruction manual.
  按照制造商的说明书，目测润滑油系统，确保它正确运行。
- 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.

监控压缩机冷却液排出温度的升高，确保其在初始运转 20 分钟内稳定在 100 -110º F（37.8 - 43.3° C）。如果冷却液的排出温度大于 110º F（43.3° C），将会引起内部间隙的增大和压缩机容积效率的降低。

- 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.
  压缩机排气温度是压缩机是否正常运行的最重要的指标。 要在压缩机运行过程中连续地监测其排气温度。就地温度指示器应位于排气法兰的 1 英尺以内，以确保读数最大的准确性。 温度计套管应延伸到气流的中心。
- 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 1.
  验证所有的运行参数都在预期的范围内，并且都在压缩机的设计范围内。 如果温度超出预期的范围，请参考第 1 页的“温度说明了所有问题”。

CAUTION 小心

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

最小吸气温度为 -20°F（-28.8 C° ）。

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

如果吸气温度低于 -20°F（-28.8 C° ），请联系 Ro-Flo 压缩机公司。

OPERATING CHECKS 运行检查

CAUTION 小心

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.
在排气温度高于 350 °F（176.6° C）的工况下连续运行会降低叶片寿命，并可能导致气缸膛被擦损，降低压缩机的寿命。

- 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.
  温度转换器的普通设定点是压缩机预期应用的最高正常运行温度再加 10 -15º F（5.6 - 8.3° C），决不能比预期排气温度还要高出 25° F（13.9° C）。
- Verify the proper 24 hour lubrication rate.
  核实适当的 24 小时润滑油流量。
- 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.
  如果用振动传感器监控设备的健康，建议在设备启动且工艺流程稳定后，立即记录下基线的振动水平。将这个数据与未来的振动测量作比较。通常 Ro-Flo®压缩机振动水平低于 0.5 英寸 /秒，然而，每个压缩机的设计安装都是独一无二的由于其撬体设计、管道布置、气体组分、运行速度等

方面的不同。为了作出最精确的比较，应在压缩机撬的同一位置用同一仪器测出振动读数。对于垂直和水平振动的测量，应直接在气缸盖上轴承的外侧部位，分开 90 度的方向上测取。轴向的测量应在气缸盖垂直面测取。所有外围设备的振动测量应按照制造商推荐的方法来测量。

CAUTION 小心

It is recommended that an air quality monitoring system be installed for processes containing toxic gases.
建议安装一个空气质量监测系统，以便监测工艺过程中含有的有毒气体。

MAINTENANCE 压缩机的保养维护

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.

压缩机的运行条件，如温度、压力、速度、工艺气体等，直接会影响到个别的压 缩机组件的寿命，并最终影响压缩机的寿命。由于压缩机的应用条件存在许多变量，不可能为每一种应用工况的压缩机预先提供一个的检查，维护和维修计划。压缩机检查后可能需要进行一般的压缩机维护或维修。维护程序将在本章的后面介绍。压缩机的维修程序，请参阅 Ro-Flo 压缩机的维修手册。

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.

在正确的操作下，最先被磨损的 Ro-Flo®压缩机组件应该是旋转叶片，但同样重要的是要检查压缩机的所有零件以便确认有无其他不正常或过早的磨损。

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.

压缩机的高可靠性可以通过为每台安装的压缩机制定一个全面的预防性维护方案来实现 。对维护方案的建议如下面的清单所示，但这只是我们的一些建议，不应该被认为是一个全面的清单，因为不同应用的压缩机是有很大的差异的。

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. PIease refer to the documentation provided with your compressor package for proper maintenance of all associated compressor support systems.

Ro-Flo® 压缩机是最终由成撬商安装到一个压缩机撬上的。正确的压缩机撬维护需要正确地操作和保护压缩机。关于所有相关的压缩机支持系统的正确维护，请参阅压缩机撬的随机文件。

PREPARATION FOR COMPRESSOR INSPECTION AND MAINTENANCE 检查和维护压缩机的准备

WARNING 警告

Follow the lockout and depressurization procedures provided with your compressor package before servicing the compressor.
在压缩机进行维修之前，请先阅读随机文件中的停工和去压步骤。

WARNING 警告

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).
压缩机系统可能含有爆炸性和/或有毒气体。在这种气体环境下工作时需配备适当的个人防护装备，请参阅相关的随机文件信息。

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.

在开始任何压缩机维护或拆卸任何压缩机部件前，请先关停压缩机的驱动力设备并释放压缩机中的所有压力。 关于完全放空压缩机的步骤，请参阅成撬商提供的操作指南。

CAUTION 小心

It is important to have the compressor cylinder properly secured during maintenance or repair activities to prevent personal injury or damage to the compressor.
在维护或维修压缩机的过程中，使压缩缸正确地固定是非常重要的，这样可防止人身伤害或压缩机被损坏。

ESTABLISHING A PREVENTATIVE MAINTENANCE (PM) SCHEDULE 建立一个压缩机预防性维护计划

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.

一个好的压缩机维护计划应对压缩机进行定期检查。气体组分、运行温度、运行速度和压力差都能决定预防性维护的程度。下表列出了典型的维护频率。 这个维护方案可以按照每个压缩机的运用工况的不同来作调整。

24 Hour (Daily) Inspection
24 小时（日常）检查

- Monitor compressor operating conditions such as process gas pressures and temperatures, coolant temperatures, etc. Sudden changes may indicate a problem within the compressor.
  监控压缩机的运行工况，例如工艺气体的压力和温度、冷却液的温度等。这些工况参数的突然变化可能表明压缩机出现了问题。
- Verify gas discharge temperatures are within the expected operating range for your application.
  核实压缩机的排气温度在预期的温度范围内。
- Drain all points of liquid accumulation in the gas system (receivers, control lines, drop-legs, interconnecting piping, separators, etc…).
  排干系统中（接收器、控制管线、落水管、连接管线、分离器等）所有的积液。
- Verify lubricator pump sight glass oil level.
  核实润滑泵可视镜的油位。
- Fill lubricator oil supply tank and verify the lubrication system is operating properly.
  供油箱灌满润滑油并确保润滑系统工作正常。
- Check the compressor for coolant, oil, or gas leaks.
  检查压缩机是否有冷却液、润滑油或气体泄漏现象。
- Look for discolored paint, which may indicate excessive heat.
  查找压缩机上是否有脱色现象，脱色可能表明那个部位过热。
- Check for loose peripheral equipment such as oil injection lines, coolant lines, process gas piping, instrumentation, etc.
  检查外部设备，如注油管线、冷却液管线、工艺气体管道、仪表仪器等。
- If equipped with a Double Bellows Mechanical Seal verify seal reservoir oil level and buffer gas supply pressure.
  如果配备双波纹管机械密封，检查密封罐油位和缓冲气体供应压力。

NOTE 注意

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.
Ro-Flo®机械密封的设计是为了用油来润滑间于静止和旋转密封件之间的部位。因此，机械轴密封可能有轻微的渗油现象。

4000 Hour (Semi-Annual) Inspection
4000 小时（半年）检查

- Follow the PM procedures listed for the "24 Hour (Daily) Inspection".遵循“24 小时（日常）检查”的预防性维护程序。
- Check coupling alignment or belt tension.检查联轴器的校准或皮带张力。
- Evaluate if blades are acceptable for reuse by following the guidelines in "Blade Evaluation".根据“叶片评估”指南，评估叶片是否能再使用。

CAUTION 小心

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.
禁止反转方向安装叶片。当把叶片重新装到转子槽里时，确保叶片按照其原先的方向来安装。反向安装可能会导致叶片的过早损坏。

NOTE 注意

Changes in operating conditions (operating speed, temperatures, pressures, gas composition, liquid carry over, etc.) may affect the blade wear rate requiring inspection interval adjustment.
运行工况的变化（运行速度、温度、压力、气体组分、携带的液体等）可能会影响叶片的磨损率，这就需要调整检查的时间间隔。

8000 Hour (Annual) Inspection
8000 小时（1 年）检查

Completely disassemble compressor and inspect the following items per "Component Inspection" on page 30:

根据第 30 页上的“组件的检查”，彻底拆卸压缩机并检查以下组件：

- Gaskets and O-Rings 垫片和 O 形圈
- Seal Rings 密封环
- Mechanical Seal 机械密封
- Blades 叶片
- Rotor 转子
- Bearings 轴承
- Cylinder Heads 气缸盖
- Cylinder 气缸

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

重新组装压缩机时需要更换密封环，垫片和 O 形圈。

COMPONENT INSPECTION 零部件的检查

Blade Evaluation 叶片评估

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.

监测转子叶片是非常重要的，因为他们是压缩机的主要磨损部件。在压缩机初始运行过程中，建议了解并确定叶片磨损的时长。该时长可作为两次检查之间的最长间隔时间。

Evaluating Blade Wear 评估叶片的磨损

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.

叶片磨损发生在叶片宽度和厚度的磨损，叶片宽度的磨损是由于叶片与气缸壁的摩擦作用，叶片厚度的磨损是由于叶片与转子槽的摩擦作用。 图 20 显示了上述叶片的尺寸。表 11 提供了 Ro-Flo®标准压缩机模型建议的叶片磨损限度。 制冷/冷凝器的叶片磨损限度可能有所不同，相关信息请咨询工厂。

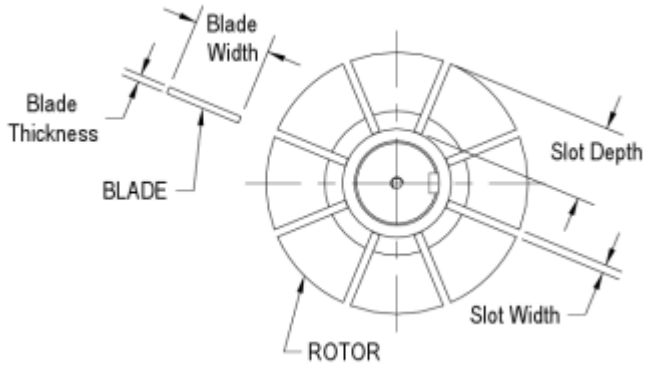


FIGURE 20 - Blade and Rotor dimensions illustrated.

图 20 - 叶片和转子尺寸的说明

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

各种机型压缩机的叶片磨损限度见下表。表中显示的是标准叶片的磨损限度值。关于制冷应用的压缩机叶片磨损限度值，请咨询 Ro-Flo 公司。

MODEL	Minimum Allowable Thickness		Minimum Allowable Width	
	inch	(mm)	inch	(mm)
2CC	.106	(2.7)	1.012	(25.7)
4CC	.106	(2.7)	1.012	(25.7)
5CC	.106	(2.7)	1.012	(25.7)
7D	.159	(4.0)	1.530	(38.9)
8D, 8DE	.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	.372	(9.4)	3.825	(97.2)
206	.212	(5.4)	1.518	(38.6)
207	.212	(5.4)	1.518	(38.6)
208B	.212	(5.4)	1.518	(38.6)
210M	.265	(6.7)	1.746	(44.3)
211M	.319	(8.1)	2.286	(58.1)
212M	.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.

正常叶片的磨损是受压差、温度、运行速度和气体条件的不同而不同的。 较高的压差、较高的温度、更快的运行速度和气流中的污染物高都会增加叶片的磨损率。

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

如果发生下列任何一种情况，建议更换叶片：

- Delamination of the blade edge in contact with the cylinder
  与气缸接触的叶片边缘出现分层
- Chipping on the edge or face of the blade
  叶片的边缘或表面出现碎片
- Appears scorched / charred
  叶片出现烧焦或碳化

Initial Blade Inspection 叶片的初次检查

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.

叶片的初次检查可以通过评估压缩机叶片边缘剩余的倒角来进行。如果发现任何倒角，说明叶片只剩下50%的寿命。叶片的倒角可以通过气体吸入或排出管的法兰处观察到。或者，低压型机（10G 到 19LE ）可以从设置在压缩机的排出侧的观察口来检查（参见总布置图）。请注意，这些观察口与被气体接触，所以要遵循适当的安全措施。

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

倒角被磨掉之后，应将压缩机的叶片拆出并测量叶片宽度。

Bearing Evaluation 轴承的评估

NOTE 注意
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. 当从气缸盖拆下轴承外圈和垫片时，应当标注它们的安装方向和相对位置，以便在重新安装轴承外圈和垫片时，按照和拆卸时的同一气缸盖和同一方向上进行。

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

如果发现下列现象，建议更换轴承：

- Uneven wear 不均磨损
- Discoloration due to heat 表面受热褪色
- Pitting 锈斑
- Spalling 表层剥落

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

轴承内圈和外圈是配套的，因此，必须更换整个轴承。

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

可用火焰或轴承感应加热器（在加热轴之前）快速加热来剥离轴承内圈。

WARNING 警告

The roller bearings used in Ro-Flo® compressors are special design for Ro-Flo® compressors. They 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.
Ro-Flo® 压缩机使用的滚子轴承是为 Ro-Flo®压缩机特殊设计的。所以轴承要求有特殊的径向间隙（不同于一般轴承代理商销售的轴承）来进行热膨胀，所以绝对不能用市场上非 Ro-Flo 本厂指定的轴承来更换。如果不遵循此规定，会导致压缩机产生故障并使保修无效。

Seal Rings and Bearing Spacing Rings 密封环和轴承隔环

Seal ring replacement is recommended if they are:
如果密封环出现下列现象，建议更换密封环：

- Broken 破碎
- Worn 磨损
- Brittle 脆断
- Insufficient gap (new, seal rings have approximately ¼" gap between the ends) 间隙不足（新的密封环两端有大约¼" 的间隙）

The seal rings are located in the bearing spacer ring.
密封环位于轴承隔环内。

Bearing spacing ring replacement is recommended if it is:
如果轴承隔环出现下列现象，建议更换轴承隔环：

- Scored 刮痕
- Pitted 凹痕

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

可用火焰或轴承感应加热器（在加热轴之前）快速加热来剥离轴承隔环。

Cylinder Evaluation 气缸的评估

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.

检查气缸冷却液夹套是否有固体沉积和/或腐蚀。 如果发现有固体沉积，要除去对冷却液流量有影响的沉积物。如果发现腐蚀，要检查冷却液添加剂的包装袋（闭式循环）和/或阴极防蚀保护装置。

Inspect the cylinder bore for unusual wear:

检查气缸膛是否有下列异常磨损：

- Normally occurring wave pattern, maximum peak to crest is 0.010 in. (0.25 mm).
  通常波形纹的最大峰值为 0.010 英寸（0.25 毫米）。

- Circumferential grooves of 0.030 in. (0.76 mm), or greater
  圆周槽为 0.030 英寸（0.76 毫米）或更大。

(Note: Minor bore defects may be improved by hand to an acceptable condition).
（注：微小的气缸膛缺损可通过手工改善到正常范围）。

When scoring or severe wear is found, re-boring is required. Refer to the Ro-Flo Compressors - Repair Manual for more information.
当发现擦痕或磨损非常严重时，需要更换气缸膛。 详细信息请参阅 Ro-Flo 压缩机维修手册。

Rotor Evaluation 转子的评估

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.

检查转子是否有偏心，应用千分表刻度指示器在转子的两端和由"V"型板支撑轴承内圈的轴外伸部测取。

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

转子轴的检查应在表 12 中的标注的位置进行。这些位置如图 21 所示。

Table 12 - Rotor Inspection - Total Indicator Runout.

表 12 - 转子的检查 - 总的千分表刻度盘指示器偏心值。

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

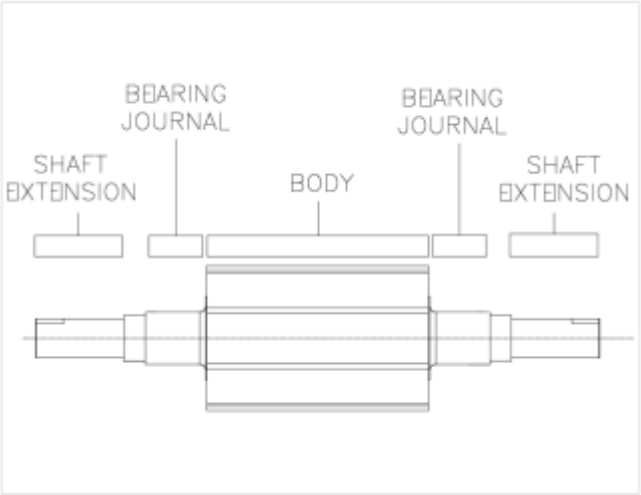


FIGURE 21 - Rotor terminology. A High Pressure model rotor is shown.

图 21 - 转子术语 高压型压缩机转子展示图

COMPRESSOR DISASSEMBLY PROCEDURE 压缩机的拆卸程序

WARNING 警告

Review "Preparation for Compressor Inspection and Maintenance" on page 37 before

servicing the compressor.
维修压缩机之前，请先阅读“压缩机的检查和维护准备”的第 37 页。

CAUTION 小心

Cylinder head dowel pins are brittle by design. Take care when removing and installing the cylinder head to avoid breaking the dowel pins.
气缸盖定位销是脆性的，拆卸和安装气缸盖时应多加小心，以免破坏定位销。

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.

Ro-Flo®压缩机的设计考虑到了为在压缩机撬上便于维修且用少量的手操工具。下面的程序适用于所有 Ro-Flo®压缩机机型。

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.

请注意，高压型的压缩机转子是被朝向气缸顶侧偏心地安装的。对于这些机型，在维修压缩机时，转子必须如图 22 所示被支撑起来，以防止人身伤害或损坏压缩机。

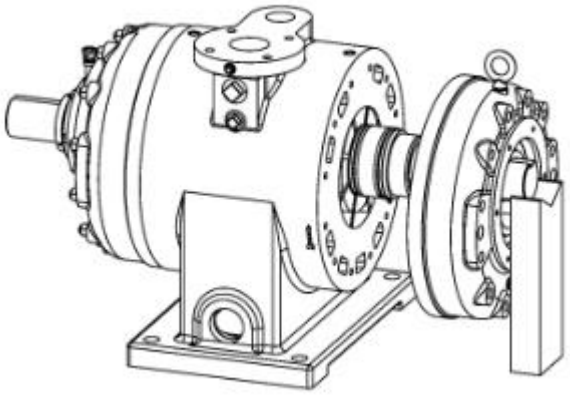


FIGURE 22 - Shaft support for a High Pressure model compressor.

图 22 - 高压型压缩机的轴支撑

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.

如果高压型压缩机被拆卸下来维修，可以反转过来，把排气法兰朝下放置并固定，这样可以无需支撑转子就能拆解压缩机了。

Cylinder Head Removal 气缸盖的拆卸

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**.

所有 Ro-Flo®压缩机都安有安装吊耳用于气缸盖拆卸用。 气缸盖组件大致的重量列于表 13。

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

表 13 - 各种压缩机机型的大致气缸盖组件的重量，包括盖、轴承和端盖的重量。

MODEL	Cylinder Head Weight	
	lbs.	kg
2CC, 4CC, 5CC	33	15
7D	65	30
8D, 8DE, 206, 207, 208B	97	44
10G, 210M	133	60
11S, 11L, 211M	188	85
12S, 12L, 212M	211	96
17S, 17L, 217M	275	125
19S, 19L, 19LE, 219M	349	159

Removal of Outboard Cylinder Head (Non-drive end) 外侧气缸盖（非驱动端）的拆卸

1. Depressurize and properly vent the compressor.
   使压缩机减压并正确地排空。
2. Drain water jacket.
   排干夹套水。
3. Remove the lubrication lines.
   拆除润滑油管线。
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.)
   在气缸盖螺纹孔里安装一个吊环螺栓并固定到升降装置上（组件的重量参照表 13）。
5. Remove the cylinder head nuts (the end cover can remain bolted in place).
   拆下气缸盖螺母（端盖可以让螺栓留在原位）。
6. Use the two jack-screws (provided with each compressor) to evenly push the head away from the cylinder.
   用两个插孔螺钉（与每台压缩机一起提供）均匀地将气缸盖推离气缸。
7. When the cylinder head is clear of the dowel pins the head can be lifted off of the studs.
   当气缸盖脱离定位稍，气缸盖就能被举离螺柱。

Removal of Inboard Cylinder Head (Drive End) 内侧汽缸盖（驱动端）的拆卸

1. Depressurize and properly vent the compressor.
   使压缩机减压并正确地排空。
2. Drain water jacket.
   排干夹套水。
3. Remove drive sheave or coupling hub.
   拆下驱动轮或联轴器轮毂。
4. Remove the lubrication lines.
   拆除润滑油管线。
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.)
   在气缸盖螺纹孔里安装一个吊环螺栓并固定到升降装置上。（组件的重量参照表 13。）
6. Remove the shaft seal. Refer to ""Mechanical Shaft Seals" on page 55 for information on removing the mechanical shaft seal.
   拆下轴封。 拆卸轴封的信息详见“机械轴封”的第 55 页。

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" for information on which compressors require an “H” ring.

如果机组安装有“H”环，请按步骤 6 执行。如果机组没有“H”环，请执行步骤 8。 关于需要安装“H”环的压缩机，详细信息请参阅“零件更换”章节。

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.
   拆下密封接头。注：当拆卸气缸盖和密封接头时，必须小心，以防轴承滑出。
8. Remove the bearing lock nut, lock-washer, and "H" ring.
   拆下轴承锁紧螺母、锁紧垫圈和"H"环。
9. Remove the cylinder head nuts.
   拆下气缸盖螺母
10. Use the two jack-screws (provided with each compressor) to evenly push the head away from the cylinder.
    用两个插孔螺钉（与每台压缩机一起提供）均匀地将气缸盖推离气缸。
11. When the cylinder head is clear of the dowel pins the head can be lifted off of the studs.
    当气缸盖脱离定位稍，气缸盖就能被举离螺柱。

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.

如果你将从气缸盖拆卸轴承外圈，注意标注一下是从哪个气缸盖拆卸下来的以及轴承的位置。轴承的后面是轴承垫片。必须注意不要丢失或损坏这些轴承垫片。

ROTOR REMOVAL 转子的拆卸

⚠ 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.
转子很重，不好弄。拆卸转子时必须非常小心，以防转子跌落而造成人身伤害或转子损坏。

Table 14 - Compressor rotor weights (including bearing spacer ring and bearing inner race).

表 14 - 各种机型压缩机转子的重量（包含轴承隔环和轴承内圈的重量）

MODEL	lbs.	kg
2CC	30	14
4CC	43	20
5CC	52	24
7D	96	44
8D	210	96
8DE	200	91
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
206	76	35
207	76	35
208B	76	35
210M	150	68
211M	340	155
212M	400	182
217M	611	277
219M	870	395

Rotor Removal Steps 拆卸转子的步骤

1. Support the end of the rotor in the direction you will be removing the rotor from the cylinder.
   支撑好要从气缸移出转子的那个转子端。
2. Slide the rotor approximately 2/3 out of the cylinder, past the center of gravity.
   将转子滑动至气缸外约 2/3 处，把重心移出。
3. With the rotor still being supported, attach a lifting device at the rotor center of gravity and remove from the cylinder.
   在转子仍被支撑时，把吊装装置系在转子的重心处，然后将转子移出气缸。
4. Lower rotor onto “V” blocks (on bearing inner races).
   将转子架放在“V”型板（在轴承内圈上）上。

COMPRESSOR REASSEMBLY PROCEDURES 压缩机重新组装步骤

CAUTION

The compressor should be secured before reassembly.

在重新组装前，先固定压缩机。

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.

下面的组装步骤适用于已完成常规维修和/或更换组件的压缩机。如果压缩机重新钻孔、就需要重新销钉，关于这些程序的详细信息，请参阅 Ro-Flo 压缩机维修手册。

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

Ro-Flo 压缩机公司提供修理工具包，此工具包配备有压缩机日常维护和大修所需要的所有工具组件。关于此工具包的价格和供应，请咨询 Ro-Flo 压缩机公司在当地的销售代表。

New gaskets and O-rings should always be used for reassembly.重新组装压缩机时要用新的垫片和 O 形圈。

Reassembly Steps 重装步骤

1. Coat the rotor and cylinder bore with oil.
   给转子和气缸膛上油。
2. Slide the rotor into the cylinder bore until rotor body is even with the ends of the cylinder.
   将转子滑入气缸膛，使转子完全达到气缸两端。
3. Coat compressor blades with clean oil and slide them into the rotor.
   给压缩机叶片涂上干净的油，并将叶片滑进去安装到转子上。
4. Coat seal rings with oil and install in the bearing spacing ring.
   给密封环涂上油并安装到轴承隔环上。
5. Install the drive end cylinder head gasket over the studs until it is completely in contact with the cylinder.
   把驱动端气缸盖垫片安装在螺栓上，使垫片与气缸完全密合。
6. Install the bearing shims and bearing outer race into the drive end cylinder head.
   把轴承垫片和轴承外圈安装到驱动端的气缸盖上。
7. On compressors with H-Rings: Install the H-ring, lock-washer, and lock nut.
   如果压缩机有 H 环，就安装 H 环、锁紧垫圈和止动螺母。
8. Install the seal adapter or end cover.
   安装密封接头或端盖。
9. Compress the seal rings as illustrated in **FIGURE 23**.
   压紧密封圈，如图 23 所示。
10. 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.
    用已安有的吊环螺栓举起驱动端的气缸盖。 小心把气缸盖安装在转子轴和钉柱上，直至气缸盖接触到第一个密封环。

    a. Adjust the first seal ring so that it slides into the seal ring bore.
       调整第一个密封环位置，使其滑入密封环孔。
    b. Remove the seal ring compression tool.
       拆下密封环的压缩工具。
    c. Repeat this procedure for the second seal ring.
       重复以上步骤，安装第二个密封环。

(**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.)
（友情提示： 在安装气缸盖时，注意防止将转子推离正确的位置。 气缸盖螺母（带垫圈）可以将气缸盖拉到转子上。 请均匀地拉，以防止定位销破碎。）

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 **TABLE 15**.
   使用交叉模式，均匀地将气缸盖往上拉，直到气缸盖与气缸有金属与金属的接触。适当的气缸盖螺母力矩值列于表 15 中。
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.
    给叶片上油，并将叶片安装到转子槽中。 旋转转子以便安装所有的叶片。 用过的叶片必须按照与拆卸前相同的方向和位置安装。
11. Repeat steps 3 – 9 above for the non-drive end cylinder head.
    对于非驱动端气缸盖的安装，请重复上面的步骤 3-9。
12. Check rotor float as described in "Checking Assembly Clearances" on page 49.
    按照“检查装配间隙”第 49 页上的描述，检查转子浮距。

Table 15 - Cylinder head stud torque recommendations for lubricated studs.
表 15 - 为润滑过的螺栓推荐的各种机型压缩机气缸盖螺栓力矩

MODEL	Stud Dia. inch	Torque lbf-ft (Nm)
2CC, 4CC, 5CC, 7D, 10G, 210M	1/2	30 (40.7)
8D, 8DE, 11S/L, 12S/L, 206, 207, 208B, 211M, 212M	5/8	60 (81.4)
17S/L, 19S/L/LE, 217M, 219M	3/4	120 (162.7)

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.
对带有 H 环的压缩机：设定净转子浮筒后，将转子移到压缩机的驱动端并安装 H 环。
14. Reinstall the shaft seal. Refer to "Mechanical Shaft Seals" on page 55.
关于重新安装轴密封，请参阅 55 页的“机械轴封”章节。

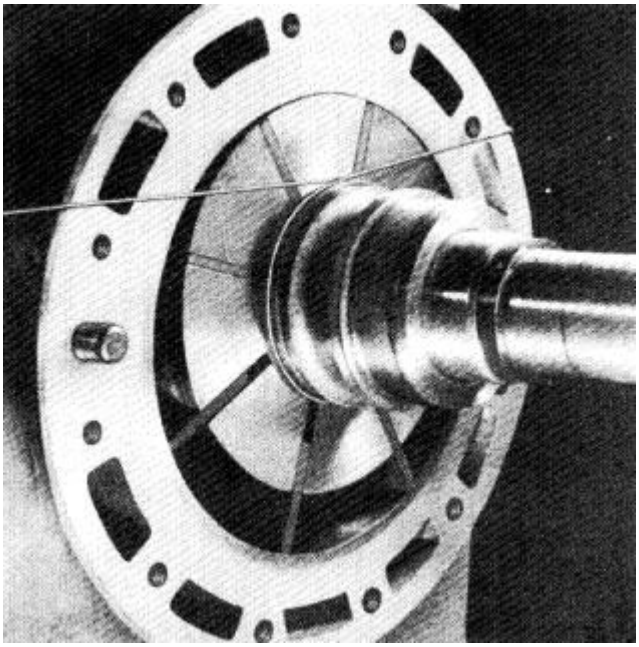


FIGURE 23 - Compressor seal ring compression prior to re-installing cylinder head.

图 23 - 重新安装气缸盖之前，请先压紧压缩机密封环

CHECKING ASSEMBLY CLEARANCES 核实装配间隙

Definitions 定义

Total Rotor Float 总的转子浮距

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

总的转子浮距是指气缸长度和转子本体长度之间的差值（见图 27）。

Rotor End Clearance 转子端间隙

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**).

转子端间隙是指在轴承已正确定位后，转子与气缸盖之间的距离。轴承的轴向定位是通过在轴承外圈和气缸盖之间插入垫片来实现的（见图 28）。

Net Rotor Float 净转子浮距

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.

净转子浮距是指转子端间隙被设定之后，转子的总轴向位移（参见图 29）。请注意，这个位移的测量必须在安装 H 环之前进行。

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

转子端间隙与净转子浮距两者的总和应等于总的转子浮距。

Fixed Rotor Float (applies only to compressors with an H-Ring installed) 固定的转子浮距（仅适用于安装有 H 环的压缩机）

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.

固定转子浮距是指安装 H 环后转子的总轴向位移（见图 26）。固定转子浮距是由端轴承和 H 环的制造公差决定的。压缩机初始启动时，应记录固定转子浮筒的读数， 作为今后该机维修的参考。

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.

H 环安装在 17S 至 19LE 的有单面机械密封的机型，以及 11S 至 19LE 有的双波纹管机械密封的机型。

Rotor to Cylinder Bore Clearance 转子与气缸膛之间的间隙

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

转子与气缸膛的间隙是指转子与气缸的最小距离。

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.

低压型机组的最小距离是在气缸的底部（六点钟位置）。图 24 显示了压缩机底部间隙。

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.

高压机型的最小距离是在气缸的顶部（十二点钟位置），把转子提起来以消除轴承间隙。在组装高压机型时，往往将压缩机倒靠在出口法兰上，以避免必须提升转子和引起轴承间隙。图 25 显示了顶部间隙。

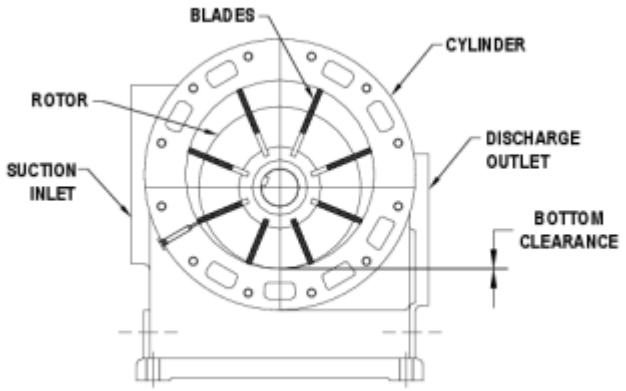


FIGURE 24 - Illustration of bottom clearance between rotor and cylinder (Low Pressure models).

图 24 - 转子与气缸之间的底部间隙的图解（低压机型）

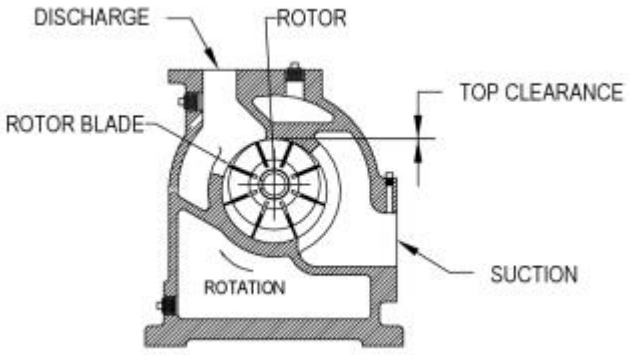


FIGURE 25 - Illustration of top clearance between rotor and cylinder (High Pressure models).

图 25 - 转子与气缸之间的顶部间隙的图解（高压机型）

Procedure for Checking Clearances 核算间隙的步骤

Net Rotor Float should be checked after compressor inspection or part replacement. The Net Rotor Float should be within the tolerances listed in **TABLE 16**

压缩机检查或更换零件后要核查净转子浮距。净转子浮距值应该在表 16 中列出的公差范围之内。

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.

转子和气缸膛之间的间隙（也称为底部间隙或顶部间隙）不常在日常维护过程中检查。但要在压缩机维修时设定/检查。

NOTE
Refrigeration compressors have different clearances. Please consult Ro-Flo Compressors for assistance. 制冷压缩机具有不同的间隙。详情请咨询 Ro-Flo 压缩机公司。

Checking Total Rotor Float 核实总转子浮距

Important: All clearance measurements must be made with all compressor parts at ambient temperature.
要点：所有间隙的测量必须在所有的压缩机零件都处于正常环境温度下进行。

There are two measurement methods required to check Total Rotor Float:
以下是核算总转子浮距需要用到的两种测量方法：

1. Determine the difference between the cylinder length and rotor body length.
   确定气缸长度和转子本体长度之间的差值。
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**.
   根据安装步骤，安装转子，轴承和气缸盖。推动转子对准一个气缸盖。在转子的一端将千分表刻度盘指示器设置为零，并推动转子对准对面的气缸盖。这样从一端到另一端所测量到的轴向位移称为总转子浮距。参见图 27。

If the above two steps result in a difference greater than 0.002 inch, this may indicate:
如果上面两个步骤的测量值只差大于 0.002 英寸，这可能表明：

- 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.
  气缸盖和转子端之间可能夹有碎片异物。应重新拆卸压缩机，注意观察是否有任何影响了测量正确间隙的异物在那儿。
- There is a high spot on the rotor or cylinder head. Disassemble the compressor and remove the high spot.
  转子和汽缸盖之间有一个凸点。应把压缩机拆开并除去那个凸点。
- 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.
  由于转子没有对准一端或两端的气缸盖，导致转子的轴线与气缸膛的轴线不平行。请参阅 Ro-Flo 压缩机的维修手册上关于纠正这个问题的更多信息。

Checking Rotor End Clearance 核实转子的端面间隙

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.
核实转子端面间隙前，应已经安装好转子、气缸盖和轴承。

1. With the bearing end cover loose the rotor should be pushed against the non-drive end cylinder head.
   松开轴承端盖，推紧转子对准非驱动端的气缸盖。
2. A dial indicator should be placed on the opposite end of the compressor and set to zero.
   将千分表刻度盘指示器放置在压缩机的另一端，并设置为零。
3. Evenly tighten the bearing end cover bolts until they are at the appropriate torque value.
   均匀地拧紧轴承端盖螺栓，直到他们处于合适的扭矩值。
4. Record the Rotor End Clearance reading from the dial indicator.
   记录千分表刻度盘指示器上的转子端面间隙的读数。
5. Push the rotor against the non-drive end cylinder head, and confirm the dial indicator returns to zero.
   朝非驱动端的气缸盖推紧转子，并确认刻度盘指示器归零。

If the dial indicator shows a value different than the compressor name plate (or is outside of the values listed in **TABLE 16** if components were replaced), bearing shims may need to be added or removed.

如果千分表刻度盘指示器显示的数值不同于压缩机铭牌值（或不在表 16 列出的数值范围内，如果组件已更换），可能需要添加或移除轴承垫片。

This procedure should then be repeated for the drive end bearing, this time loosening the seal adapter.
重复以上步骤，以便测量驱动端的转子端面间隙，不同的是，这次应松开密封接头。

Checking Net Rotor Float 核算转子净浮距

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

可通过下式计算转子净浮距：转子净浮距 = 总转子浮距 - 转子的两个端面间隙。

The Net Rotor Float can be measured by:

转子净浮距的测量步骤如下：

1. Removing the locknut, lock washer, and H-ring from the compressor shaft (if installed).
   从压缩机轴拆下锁紧螺母，锁紧垫圈和 H 环（如果已安装）。
2. Ensure bearing shims are installed as required.
   确保轴承垫片已按要求安装。
3. Tighten the end cover and seal adapter to the appropriate torque values.
   拧紧端盖和密封接头以达到适当的扭矩值。
4. Push the rotor to one end of the cylinder.
   将转子推向气缸的一端。
5. Place a dial indicator on the rotor shaft and set it to zero.
   将千分表刻度盘指示器放在转子轴上并将其设置为零。
6. Push the rotor toward the opposite cylinder head.
   将转子推到另外一侧的气缸盖。
7. Record the Net Rotor Float from the dial indicator.
   记录千分表刻度盘指示器上的净转子浮距的读数。
8. Push the rotor against the non-drive end cylinder, and confirm the dial indicator returns to zero.
   将转子推到非驱动端气缸，并确认千分表刻度盘指示器归零。

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 16**.

计算和测量的净转子浮距数值应一致。应将这些数值与压缩机铭牌值作比较。可接受的净转子浮距值列于表 16。

Table 16 - Compressors clearances.

表 16 - 各种机型压缩机的间隙

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	0.034 - 0.044	0.003 - 0.004	0.002 - 0.003
8DE	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	0.080 - 0.097	0.009 - 0.010	0.005 - 0.006
19L	0.087 - 0.105	0.009 - 0.010	0.005 - 0.006
19LE	0.087 - 0.105	0.009 - 0.010	0.005 - 0.006
Model	**Net Rotor Float (inch)**	**Top Clearance (inch)**	**End Clearance (inch)**
206	0.014 - 0.021	0.002 - 0.003	0.002 - 0.0025
207	0.014 - 0.021	0.002 - 0.003	0.002 - 0.0025

208B	0.014 - 0.021	0.002 - 0.003	0.002 - 0.0025
210M	0.024 - 0.030	0.002 - 0.003	0.003 - 0.004
211M	0.032 - 0.040	0.002 - 0.003	0.003 - 0.004
212M	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	0.033 - 0.041	0.003 - 0.004	0.004 - 0.005

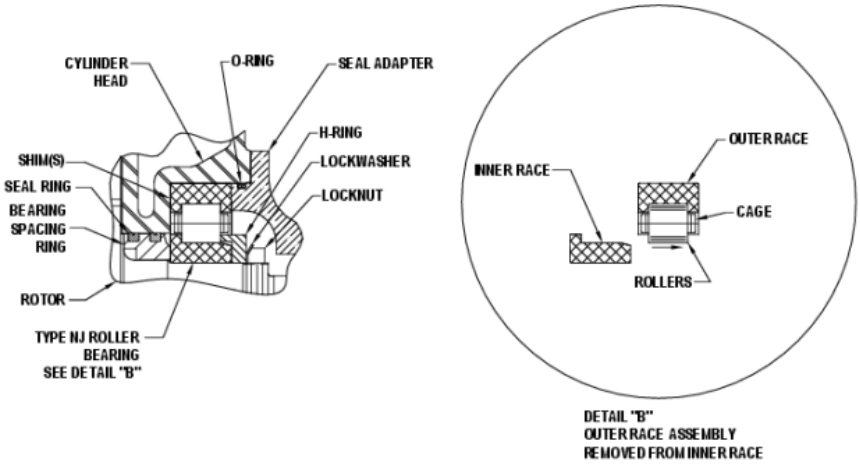


FIGURE 26 - H-Ring, lock washer, locknut, and roller bearing detail.

图 26 - H 环、锁紧垫圈、锁紧螺母和滚子轴承的细节图

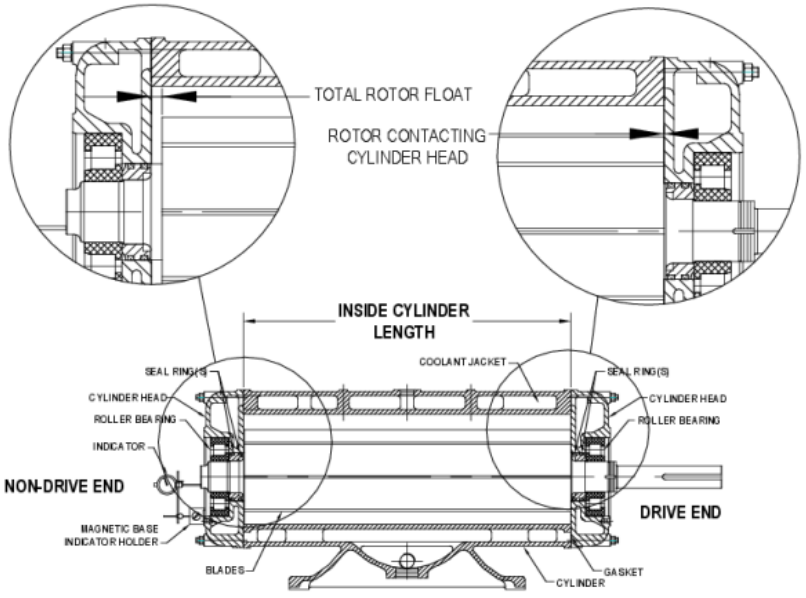


FIGURE 27 - Total Rotor Float - bearings not positioned by shims or end cover / seal adapter.

图 27 - 总的转子浮距 - 不用垫片或端盖或密封接头来给轴承定位

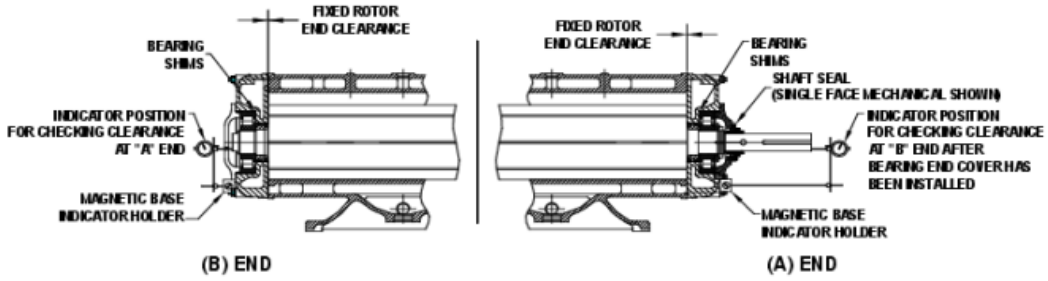


FIGURE 28 - Rotor End Clearance - bearings positioned by shims.

图 28 - 转子端面间隙 - 用垫片给轴承定位

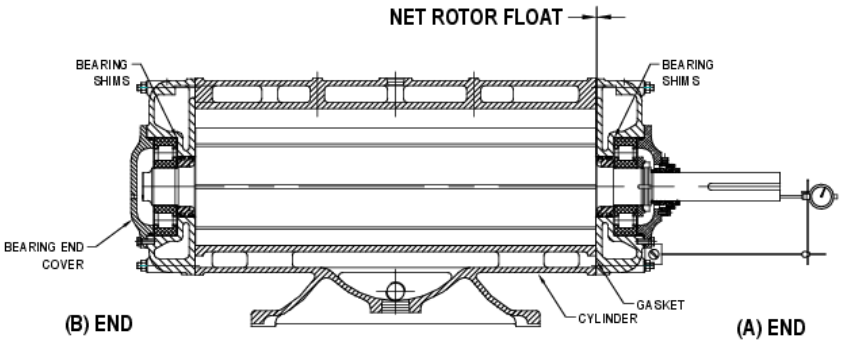


FIGURE 29 - Net Rotor Float (Total Rotor Float less the sum of Fixed Rotor End Clearances).

图 29 - 净转子浮距（总转子浮距应小于固定转子端面间隙的总和）

MECHANICAL SHAFT SEALS 机械轴封

Single Face Mechanical Seal (Rebuild-able) 单面机械密封（可重新组装的）

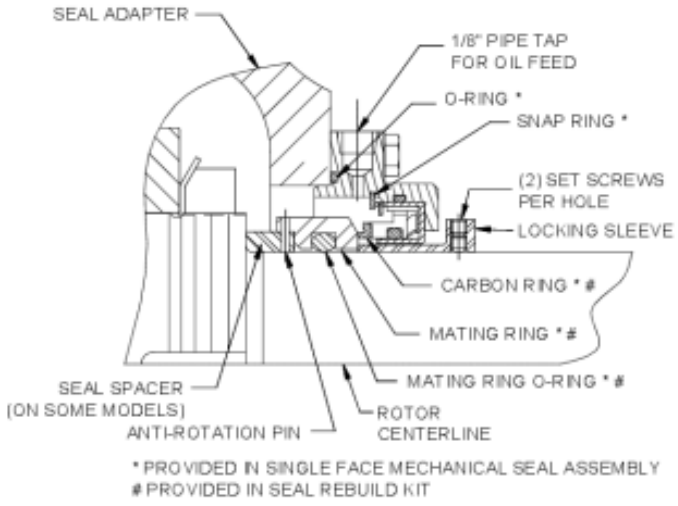


FIGURE 30 - Single face mechanical seal.

图 30 - 单面机械密封

General 概述

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.

单面机械密封有一个波形弹簧，这个弹簧紧压着一个碳环（静态的）并紧顶着一个 52100 碳钢的配对面（旋转的）。这些密封面被研磨得有着极为接近的公差，因此，装配时应非常小心。

Single Face Mechanical Seal Disassembly 单面机械密封的拆卸

1. Refer to "Preparation for Compressor Inspection and Maintenance" on page 37.
   参阅 37 页的“压缩机的检查和维护准备”。
2. Remove drive sheave or coupling hub.
   拆下驱动轮或联轴器轮毂。
3. Remove all burrs from shaft and keyway.
   除去轴和键槽上的所有毛刺。
4. Lubricate shaft to ease disassembly.
   润滑轴，使轴易于拆卸。
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.
   卸下所有旧的密封件，除防转销和密封垫片外。注：在三个固定螺钉的每个螺钉的位置上，锁紧套筒都安装有两个固定螺钉。

Single Face Mechanical Seal Reassembly 单面机械密封的重新组装

1. Clean shaft and seal adapter bore.
   清洁轴和密封接头孔。
2. Lubricate shaft and “O” ring in mating ring.
   润滑轴和接合配对环中的“O”型圈。
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).
   滑动轴上的接合环直到槽孔与防转销接合，并且使接合环紧紧地压着密封垫片（如果配备有）。
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.
   用无绒材料如面巾纸给密封面抹油；不要用脏手指擦密封面。
5. With O-ring in place, slide seal assembly onto seal adapter.
   固定 O 形圈在适当的位置，将密封组件滑入安装在密封接头上。
6. Approximately 1/8” compression on seal wave spring should be observed to provide sufficient “preload” on seal faces.
   密封波形弹簧有大约 1 / 8”的压缩，给密封面提供足够的“预载”。
7. Reinstall seal bolts and lock washers; tighten seal flange evenly.
   重新安装密封螺栓和锁紧垫圈；均匀地紧固密封法兰。
8. Reinstall locking sleeve by firmly holding the locking sleeve against mating ring while tightening setscrews.
   重新安装锁紧套筒：拧紧固定螺钉时，使锁紧套筒紧靠着接合环。

Double Bellows Mechanical Seal 双波纹管机械密封

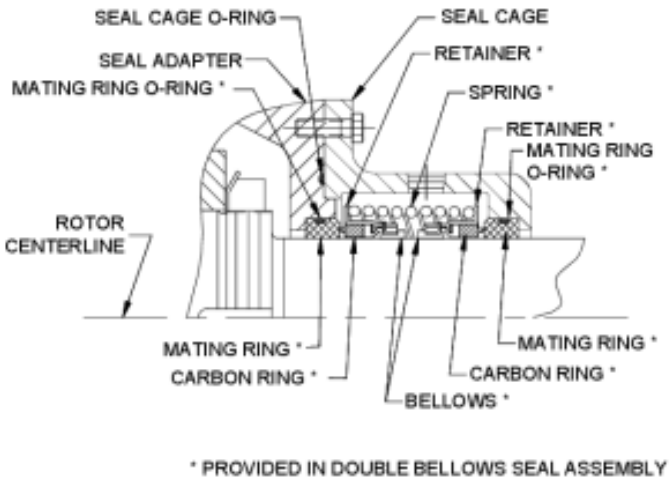


FIGURE 31 - Details of double bellows mechanical seal.

图 31 - 双波纹管机械密封的细节图

General 概述

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.

双波纹管机械密封由两个碳密封环（内外两个，旋转的）和两个镍铸铁接合环（静态的）组成。密封的压力是通过弹簧和加压的隔离液对两个碳密封环在两个相反方向施加形成的。这些密封面被研磨得有着极为接近的公差，因此，装配时应非常小心。

Double Bellows Mechanical Seal Disassembly 双波纹管机械密封的拆卸

1. Refer to "Preparation for Compressor Inspection and Maintenance" on page 37.
   参阅 37 页的“压缩机的检查和维护准备”。
2. Remove the drive sheave or coupling hub.
   拆下驱动轮或联轴器轮毂。
3. Remove all burrs from shaft and keyway.
   除去轴和键槽上的所有毛刺。
4. Shut off buffer gas supply and drain oil from seal cage.
   关停缓冲气体的供应，并排干密封罩中的油。
5. Remove seal cage.
   拆下密封罩。
6. Carefully remove the outer carbon ring assembly from the bellows.
   小心地从波纹管拆下外部碳环组件。
7. Lubricate the shaft generously with oil.
   充分地润滑轴。
8. Pull on outer retainer to loosen outer rubber bellows and remove from the shaft.
   拉开外挡板，松开外橡胶波纹管并从轴上拆下。
9. Remove spring from the shaft.
   从轴上拆下弹簧。
10. Pull on inner steel retainer to loosen inner bellows and remove bellows, retainer and inner carbon ring from the shaft.

拉开内部钢挡圈，松开内波纹管并从轴上拆下波纹管、挡圈和内碳环。

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.
检查两个碳环和接合面，看是否有损坏或磨损的迹象。检查波纹管和 O 形圈，看是否有硬化、开裂或变坏的现象。

Double Bellows Mechanical Seal Reassembly 双波纹管机械密封的重新组装

Note: Ensure the original inner carbon ring & mating ring AND outer carbon ring & mating ring are assembled as matched sets.
注意：要确保原有内碳环和接合环，以及外碳环和接合环能够完全配套起来。

1. Remove any burrs on the shaft
除去轴上的任何毛刺。
2. Lightly oil the mating ring O-ring, slide it over the shaft and carefully push it into the adapter bore until fully seated.
轻轻润滑接合环和 O 形环，使它们滑过轴并小心推入接头孔至完全固定。
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.
润滑内碳环-挡圈-波纹管，并把这个组件滑入轴上，直到碳面与接合环面接触。

CAUTION 小心

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.

按设计，具有弹性的波纹管会吸收油并膨胀开来，从而锁定在轴上。所以在使用润滑油之后，应立即安装整个密封。

4. Slide the spring over the shaft.
把弹簧滑入轴上。
5. Oil the outer carbon ring-retainer-bellows and slide the assembly over the shaft until the retainer contacts the spring.
润滑外碳环-挡圈-波纹管，并把这个组件也滑进轴，直到挡板与弹簧接触。
6. Lightly oil the mating ring O-ring, and carefully push it into the seal cage bore until fully seated.
轻轻地润滑接合环和 O 形圈，并小心地将它们推入密封罩孔至完全固定。
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.
小心地把密封罩孔朝轴端定位，在轴上滑入密封罩，直到接合环接触到外碳环。

CAUTION 小心

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

在安装密封罩时，不要让密封环的面接触到压缩机轴，因为接触会损坏密封面。

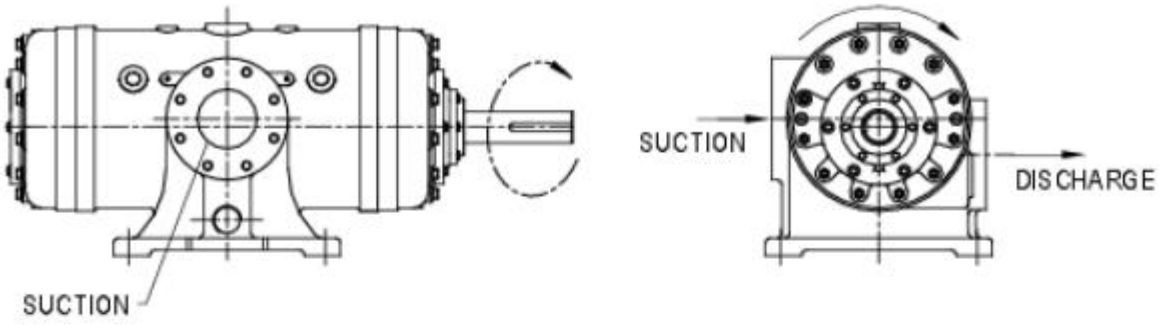
8. Push the seal cage evenly until it contacts the seal adapter, making sure that the O-ring stays in the seal adapter O-ring groove. Install two cap screws opposite each other and turn them until cage is in contact with the seal adapter. Install remaining cap screws.
均匀地推动密封罩直到它接触到密封接头，确保 O 形圈进入密封接头的 O 形环槽中。反向安装两个螺钉并旋转它们直到密封罩与密封接头接触。安装剩余的螺钉。
9. Refer to the "Oil System for Double Bellows Type Shaft Seal" on page 28 for instruction on the usage of this seal.

关于该密封的使用说明，请参阅 28 页的“双波纹管式轴密封的油系统”。

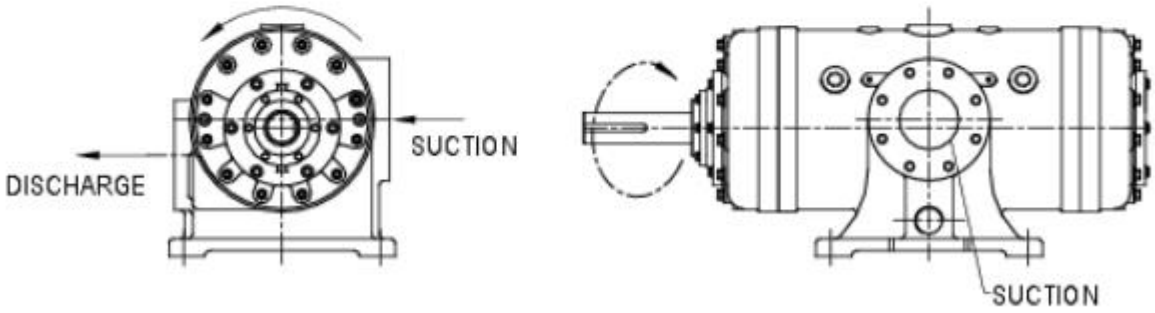
COMPRESSOR ROTATION 压缩机旋转方向

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

压缩机旋转方向 – 低压机型（2CC -19LE）



LOW PRESSURE MODELS - CW ROTATION (STANDARD)



LOW PRESSURE MODELS - CCW ROTATION

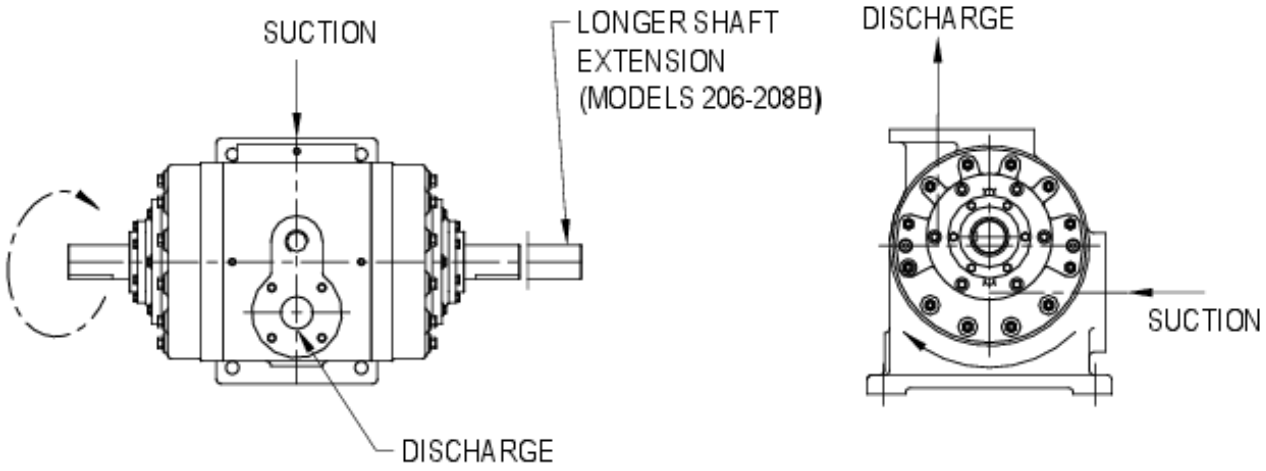
Clockwise Rotation (CW) – When viewing the driven end of the shaft, the suction flange will be on the left side and the shaft rotates clockwise. When viewing the suction flange of the compressor, the shaft is on the right hand side.
顺时针（CW）- 当看轴的被驱动轴端时，入口法兰是在压缩机左侧而且轴是顺时针转的。当看压缩机的入口法兰时，轴应该在右手侧。

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.
逆时针（CCW）- 当看轴的被驱动轴端时，入口法兰是在压缩机右侧而且轴是逆时针转的。当看压缩机的入口法兰时，轴应该在左手侧。

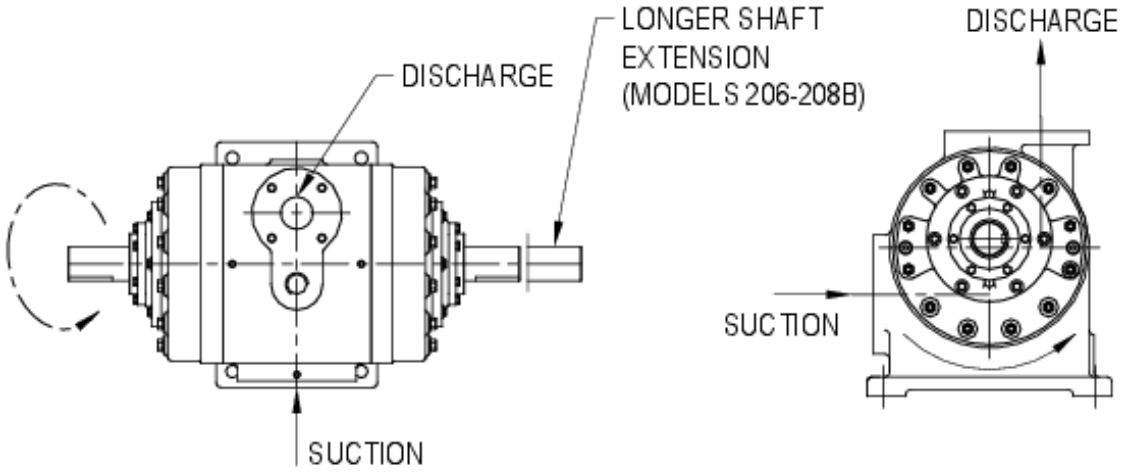
NOTE: Unless rotation is specified at time of order, all compressors will be furnished clockwise rotation standard.
注：除非在订单中具体规定，否者提供的压缩机都按顺时针为标准。

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

压缩机旋转方向 – 高压机型（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.
顺时针（CW）- 当看较长轴的轴端时，入口法兰是在压缩机右侧而且轴是顺时针转的。当看压缩机的入口法兰时，较长轴应该在左手侧。

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.
逆时针（CCW）- 当看较长轴的轴端时，入口法兰是在压缩机左侧而且轴是逆时针转的。当看压缩机的入口法兰时，较长轴应该在右手侧。

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.
注：除非在订单中具体规定，否者提供的 206 至 208B 的压缩机都按顺时针作为标准，210M 至 219M 是对称的，按顺时针作为标准。

CHANGING COMPRESSOR ROTATION 改变压缩机转向

Please refer to the "MAINTENANCE" section of this manual for proper disassembly and reassembly procedures for your compressor.请参阅本手册"保养维护"章节中正确的压缩机拆装步骤。

The procedure for changing compressor rotation is listed below:
改变压缩机转向的的步骤如下：

1. Check and record all clearance per the nameplate data.按铭牌检查并记录所有的间隙数据
2. Remove any sheaves or coupling hubs from the compressor shaft. 从压缩机轴上移开所有滑轮和联轴器轮毂
3. Remove the seal assembly from the drive end and the outboard end cover from the non-drive end of the compressor. If a bearing H-ring and locknut are installed on the seal end, remove these also. NOTE: On High Pressure models there will be two shaft seals to remove. 从驱动端拆下密封组件，以及从压缩机的非驱动端拆下外侧端罩。如果密封端装有轴承 H-环和锁紧螺母，也要拆下这些。注意：高压型压缩机有两个轴密封要拆除。
4. 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. 卸下气缸端盖。标记好端盖和气缸位置，以便重新按装时按原装的位置次序重新组装起来。
5. Remove blades and rotor. Tie or hold blades in position before completely removing the rotor. 拆下叶片和转子。在转子完全移出来前系好或保持好叶片的位置。
6. 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 heads. Insure they are reassembled onto the original inner races from which they were removed by marking inner and outer races. 除去每个头上的轴承外圈装配。保持轴承垫片在原来的气缸盖内。重新安装轴承外圈到另一侧的头上。确保它们被装到其原先的内圈上。
7. Reassemble the rotor and blade assembly with the coupling end on the opposite end of the cylinder compared to the original assembly. 重新组装转子和叶片组件，使联轴器在和原先安装相反的一侧。
8. Reassembly cylinder heads with outer race assemblies onto their respective inner races. 重新安装缸盖和外圈组件至各自相应的内圈上。
9. Check and reset end clearances.检查并重置端面间隙
10. Check rotor bottom clearance.检查转子的底部间隙
11. Check motor rotation by "jogging" motor before reinstalling the coupling or sheave.在重新安装联轴器或滑轮前，用点动方式检查马达的转向。

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.
对低压机型，当压缩机和驱动设备相连时，压缩机入口和出口法兰和他们的原来位置相比较是相反的。压缩机的旋转必须从入口法兰横跨缸体的顶端至出口法兰。所有压缩机气缸都有箭头铸于缸体上用于标识压缩机原先的正确转向。

EXPECTED SOUND CHARACTERISTICS 预期的声响特性

The expected sound pressure levels shown in **TABLE 1** and **TABLE 2** 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.
表 1 及表 2 示出了用作一般参考的预期的声压水平。实际的声响特性将随应用的不同而不同，这些不同存在于气体性质，气体压力，气体的温度，运行速度，管路布置，以及其他压缩机撬设计等因素之中。

Table 1 - Expected Sound Characteristics of Ro-Flo® sliding vane compressors. 表 1 – Ro-Flo®滑片压缩机预期的声响特性

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	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	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	575	50	94	67	81	85	84	91	86	91	86	90	77	100
19L	575	50	95	69	78	87	89	86	88	89	93	91	90	101
19LE	575	50	95	69	78	87	89	86	88	89	93	91	90	101
206	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
207	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
208B	1160	40	85	59	62	71	84	76	73	70	78	80	70	87
210M	1160	40	84	65	76	81	80	75	76	75	73	70	66	86
211M	865	40	85	63	75	80	82	74	77	76	71	73	69	87
212M	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 2 - Expected Sound Characteristics of Ro-Flo® sliding vane vacuum pumps. 表 2 – Ro-Flo®滑片机用作真空泵时预期的声响特性

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	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	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	575	25	90	71	74	84	83	84	82	80	79	70	60	92
19L	575	25	91	73	77	85	82	83	83	81	78	73	65	93
19LE	575	25	91	73	77	85	82	83	83	81	78	73	65	93

TROUBLESHOOTING 消缺

TEMPERATURE TELLS ALL 温度说明了一切

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:
一旦偏离正常运行，温度往往是第一个也是最显著的反映出机械故障的信号！要使用这条格言来评估设备的性能表现，就必须知道：

- Where is the most significant temperature measured? 在哪儿测量最显著的温度变化？
- What are the temperatures of "normal" operation? 什么是“正常”运行时的温度？

This instruction is concerned with temperatures that are used to evaluate the efficiency of compressing gases from suction pressure to discharge pressure.
这个指导方法是用温度来评估从吸入压力到排出压力之压缩气体的工作效率。

Four facts are necessary to evaluate operation 以下几个是用以评估运行的很重要的方面:

1. What is the atmospheric pressure? 设备安装地的大气压力是多少？
2. What is gas composition entering the compressor suction flange? 进压缩机入口法兰的气体是什么组分？
3. What is the gas flow rate entering the compressor suction flange? 进压缩机入口法兰的气体流量是多少？
4. What are the gas pressure and temperature at the suction flange of the compressor?压缩机的进气压力和温度是多少？
5. What are the gas pressure and temperature at the discharge flange of the compressor? 压缩机的排气压力和温度是多少？
6. The extent of jacket cooling, such as flow rate of cooling water and its inlet and discharge temperatures?压缩机的夹套冷却，诸如冷却水的流量、冷却水入口和出口温度是多少？

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.
请注意，很重要的一点是，压力和温度的测量要尽可能靠近压缩机的法兰。实际的压缩机入口压力和温度在压缩机入口法兰处会受到脏物、堵塞的滤芯/捕物器、或者是有故障的过程控制而影响。在压缩机的出口法兰处，实际的排气压力和温度会受堵塞的排气单向阀、后冷却器、或分离器的影响。

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.
压缩机是看绝对入口压力和绝对出口压力，而不是表压。因为压力比是用出口绝对压力除以入口绝对压力来计算的。

The compressor performance can be predicted using the Ro-Flo Performance software, available on the Ro-Flo Compressors website: www.roflocompressors.com.
压缩机的运行性能能用 Ro-Flo 的性能软件来预测。该软件在 Ro-Flo 的网站上有: www.roflocompressors.com

TROUBLESHOOTING TABLE 消缺表

TROUBLE 缺陷	PROBABLE CAUSE 可能的原因	REMEDY 补救措施
Discharge air or gas temperature excessive **出口气体温度超标**	Operation of machine at higher-pressure ratio than needed 压缩机在比需要更高的压缩比下运行	Operate unit at rating plate pressures. 使压缩机运行在额定压力下
	Excessive suction temperature. 入口气体超温	Reduce suction temperature. 降低入口气体温度
	Insufficient or high temperature inlet water. 冷却水不足或冷却水入口温度高	Increase water flow rate or provide cool water supply. 增加水流量或提供冷的冷却水供应·
	Scale or residue build-up in water jacket. 压缩机夹套层有结垢	Clean water jacket and filter or treat water supply as required. 清洗走冷却水的压缩机夹套层，按要求过滤或进行水处理
	Clogged intake filter. 入口滤网堵塞	Clean intake filter. 清洗入口滤网
	Unloading valve not fully open or clogged 安全卸载阀没有全开或堵塞	Clean valve and replace any warn or broken parts. 清洁阀门以及更换磨损或断裂的部件
	Suction valve not fully open. 入口阀没全开	Open suction valve. 全开入口阀
	Insufficient or wrong lubricating oil. 润滑油不足或选用了错误的润滑油	Use correct oil and feed rates recommended in instruction manual or lube sheet. 按手册推荐，选用正确油粘度的正确油品
	Swelled or warped rotor blades. 叶片膨胀或弯曲	Dry out or replace rotor blades.干燥或更换叶片
	Improper clearances. 装配间隙不正确	Reassemble unit to proper clearances 按正确的装配间隙重新组装压缩机
	Ratio of specific heats higher than expected. 比热值比预期的高	Change gas composition. 改变气体组分
Excessive blade wear **叶片磨损过度**	Insufficient quantity of lubricant to one or more cylinder feeds 缸体的一个或多个喂油点供油量不足	Inspect Lubricator V-belt for slippage or breakage; tighten or replace as required.检查润油器 V 型皮带是否有打滑或断裂;拧紧或根据需要进行更换 Check lube rate and increase by several drops per minute. 查看润滑量，把每分钟的润滑滴油量增加几滴 Inspect lubricator sight glasses; replace if cracked.

		检查润油器玻璃视窗，如果开裂了换掉它 Inspect cylinder lube check valves; clean or replace as required. 检查缸体的止回阀，清洗或替换 Inspect oil holes in cylinder clean if dirty. 检查缸体上的油孔，脏的话清洗一下
	Incorrect lubricant and/or viscosity. 选择的润滑油或润滑油粘度不对	Use correct oil and viscosity as recommended on lube oil recommendation sheet or instruction manual. 按手册推荐，选用正确油粘度的正确油品
	Dirty inlet air or gas. 压缩机进气入口进了脏物	Clean and inspect intake filter or scrubber. 检查和清洗入口滤网或分离器
	Excessive discharge temperature. 出口气体超温	See remedies under excessive discharge gas or jacket outlet water temperature.见出口气体或夹套水温超标的补救措施
	Excessive discharge gas pressure. 出口气体超压	Operate unit at rating plate pressures. 使机组在规定的压力范围运行
	Faulty lube oil check valve. 止回阀故障	Replace or repair check valve. 更换或修理止回阀
Jacket outlet water temperature excessive **出口夹套水温超标**	Insufficient or high temperature inlet water.入口水流量不足或温度高	Increase water flow rate or provide cool water supply.增加水流量或提供冷的水供应
	Fouled or faulty water temperature flow regulator.调水温的流量调节阀误动作或有故障	Clean, repair or replace regulating valve.清洗、修理或更换调节阀
	Supply valve (manual or automatic type) either not fully open or clogged.（手动或自动）供水阀不能全开或堵塞	Open or clean valve. Check solenoid and wiring on automatic type valve 开启或清理阀门。检查电磁阀和自动阀的接线
	Inlet water strainer clogged. 进水滤网堵塞	Clean strainer. 清洗进水滤网
	Scale or residue build-up in water jacket. 压缩机夹套层有结垢	Clean water jacket.清洗走冷却水的压缩机夹套层
Water drained from main or inspection ports 有水从主或检查口排出	Leaky head gasket.端盖垫片有渗漏	Replace gasket.更换端盖垫片
	Leaky aftercooler or inter-cooler.后冷却器或中间冷却器有渗漏	Remove cooler and hydrostatic test for leaks. Repair or replace leaky cooler.移开冷却器并作压力试验查漏。修理或更换漏的冷却器

Undue noise, vibration or periodic knocking 过度的噪音，振动或周期性敲击声	Worn bearings.轴承磨损了	Replace bearing.更换轴承
	Excessive blade wear.叶片磨损过度	Replace blades and check lubrication.更换叶片、检查油润滑
	Erratic cylinder wear. 气缸磨损不稳定	Re-bore, re-dowel, and check lubrication.重新镗缸体，重新做销定位，以及检查油润滑
	Insufficient lubrication.油润滑不足	See remedies under excessive blade wear.见叶片磨损过度的补救措施
	Rotor contacting cylinder heads.转子碰触到了压缩机缸头	Check temperature and pressure conditions; check internal clearance.检查温度和压力条件；检查内部间隙
	Misalignment 机组对中不正确	Realign units.机组重新对中
	Swelled or warped rotor blades. 叶片膨胀或弯曲了	Dry out or replace rotor blades.干燥或更换叶片
	Compressor unloaded.压缩机没有加载	Load compressor.给压缩机加载
	Inadequate piping support 撬上管路的支撑不够	Support piping.增加撬上管路的支撑
	Bad foundation.撬的地基不好	Fix or replace foundation.修理或更换地基
Low or no capacity **流量低或无流量**	Restricted suction line.进气管道有限制	Remove restriction.清除进气管道的限制物
	Clogged inlet filter.入口滤网堵塞	Clean inlet filter.清洗入口滤网
	Defective bypass loop.有旁路缺陷	Repair valve or controls.修理阀门或控制系统
	Wrong speed. 转速不对	Operate at correct speed.运行在矫正的速度之下
	Excessive internal clearance.内部间隙过大	Reassemble unit to proper clearance.用正确的间隙重新组装压缩机
	Blades rubbing cylinder heads.叶片摩擦气缸头	Dry or replace blades. 干燥或更换叶片
	Blades binding in slots.叶片被约束在转子槽内	Dry or replace blades. 干燥或更换叶片
	Broken blades.叶片断裂	Replace blades. 更换叶片

Low or no pressure **出口压力低或没压力**	Defective bypass loop. 有旁路缺陷	Repair valves or controls. 修理阀门或控制系统
	Blades binding in slots. 叶片被约束在转子槽内	Clean slots or blades.清理槽和叶片 Dry or replace blades. 干燥或更换叶片 Reduce operating temperatures.降低运行温度
	Leaky piping.管道泄漏	Fix leaks.修理泄漏处
	Restricted discharge piping upstream of gauge.排气管压力表前有障碍物	Remove restriction.排除障碍物
Excessive power consumption **能耗过大**	Blades swelled or warped. 叶片膨胀或弯曲	Dry out or replace blades. 干燥或更换叶片
	Operation at wrong pressure ratio.机组运行在错误的压比下	Operate unit at correct pressure ratio. 让机组运行在矫正的压比下
	K-value (ratio of specific heats) too high. K 值过高	Reduce pressure ratio.降低压比
	Inadequate lubrication.润滑油量不够	See remedies under excessive blade wear.见叶片过度磨损的补救措施
	Improper clearances.装配间隙不正确	Reassemble unit to proper clearances.按正确的间隙重新组装机组
	Speed too high.转速过高	Reduce speed.降低转速
	Scale or residue build-up water jacket. 压缩机夹套层有结垢	Clean water jacket. 清洗走冷却水的压缩机夹套层
	Abrasive particles in gas stream.气流中有颗粒	Filter inlet gas. 对进气进行过滤
Excessive oil consumption from double bellows seal **双波纹管密封油耗过量**	Worn or damaged sealing elements 轴封部件磨损或损坏	Replace shaft seal.更换轴封

REPLACEMENT PARTS 零件更换

GENUINE RO-FLO® PARTS RO-FLO®正品零件

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.
Ro-Flo 压缩机建议使用正品的 Ro-Flo®零件。Ro-Flo®的零件是定制设计的，尤其适用于腐蚀性气体和恶劣环境。这就是为什么 Ro-Flo®压缩机性能优越的主要原因。使用 Ro-Flo®的零件是质保期完成的有力保证，且提升了长期可靠的服务。

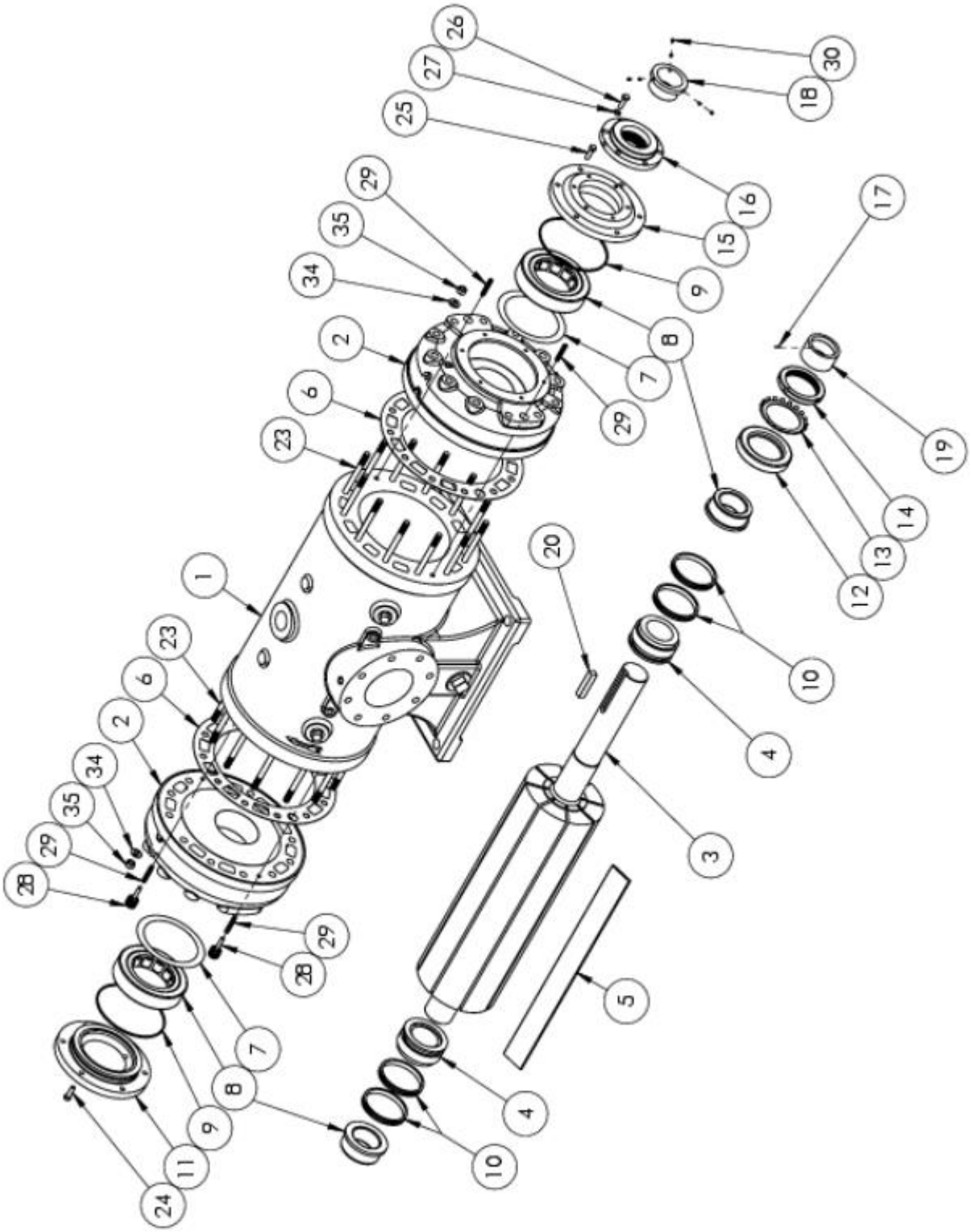
HOW TO ORDER REPLACEMENT PARTS 怎样定更换的零件

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. Maintenance and rebuild kits are also available. Please contact Ro-Flo Compressors local representative for quotations and placing orders:
下订单时，需要提供压缩机的序列号连同零件的描述。用所附的分解图及其上面对应的零件描述将有助于识别各个零件。压缩机维修与重建的套件 Ro-Flo 也有提供。有关零件的报价和订货，请联系 Ro-Flo 当地的代表：

- Email: sales@sunalliansys.com

EXPLODED PARTS VIEW - LOW PRESSURE MODEL WITH SINGLE FACE MECHANICAL SEAL

零件分解图 – 带单面机械密封的低压型压缩机（2CC – 19LE）



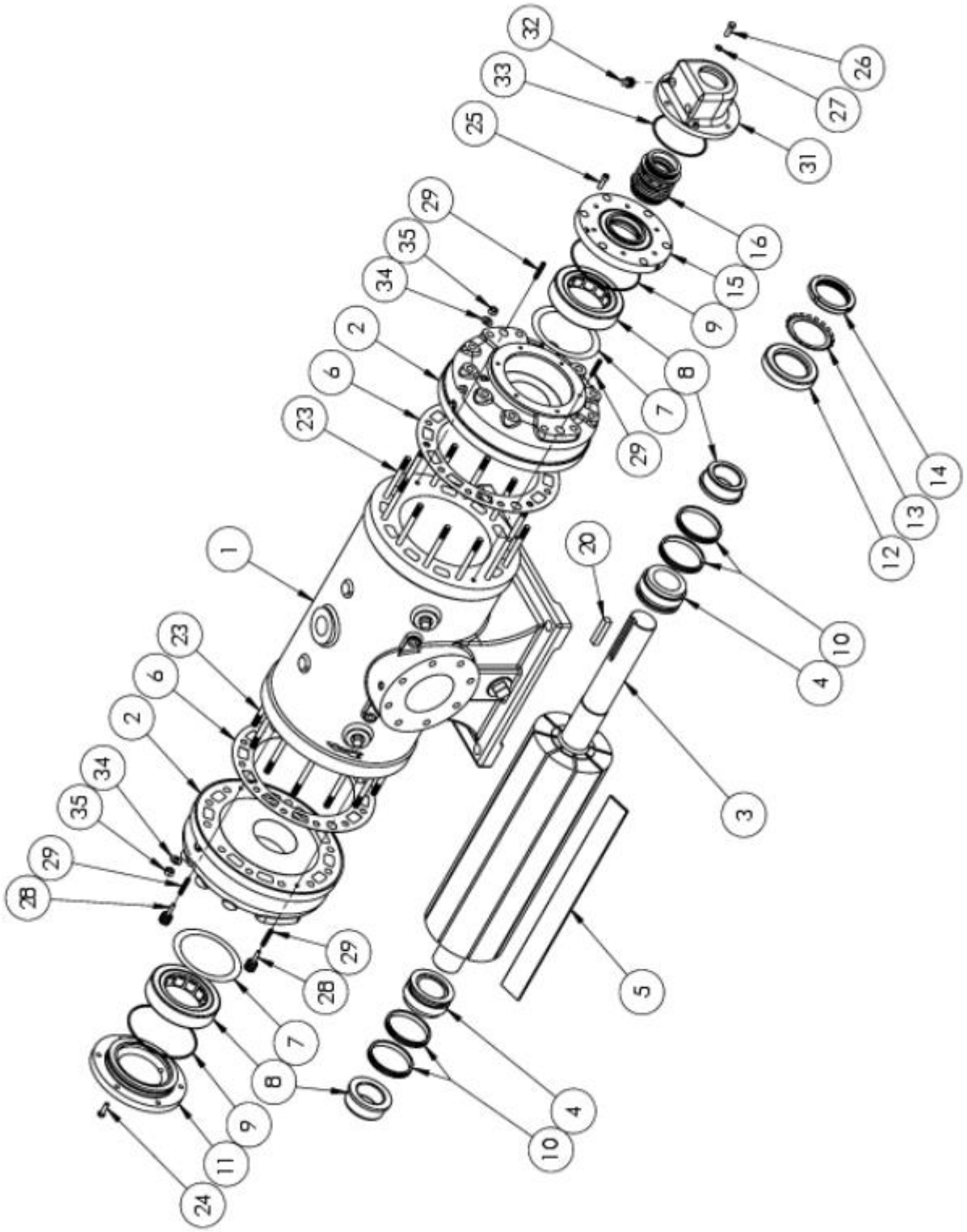
PARTS LIST - LOW PRESSURE MODEL WITH SINGLE FACE MECHANICAL SEAL

零件清单 – 带单面机械密封的低压型压缩机 （2CC – 19LE）

ITEM	PART DESCRIPTION	QTY	REMARKS
1	Cylinder	1	
2	Cylinder Head	2	
3	Rotor Shaft	1	
4	Bearing Spacer Ring	2	
***5**	Rotor Blade Set	1	Contains 8 Blades
***6**	Cylinder Head Gasket	2	
***7**	Bearing Shim Set	2	
***8**	Roller Bearing	2	
***9**	O-Ring	2	
***10**	Seal Ring	4	
11	End Cover	1	
12	Bearing H-Ring	1	Required on Models 17S and Up
13	Bearing Lock Washer	1	
14	Bearing Lock Nut	1	
15	Seal Adapter	1	
***16**	Single Face Mechanical Seal	1	
17	Seal Drive Pin	1	
18	Locking Sleeve	1	
19	Seal Spacer	1	
20	Square Key	1	
23	Stud		As required
24	Screw – End Cover		
25	Screw – Seal Adapter		
26	Screw – Seal		
27	Lock Washer - Seal		
28	Jack Screw – Cylinder Head	2	
29	Dowel Pin – Cylinder Head	4	
30	Socket Head Set Screw	6	
34	Washer, Cylinder Head Stud		As required
35	Nut, Cylinder Head Stud		

* Recommended Spare Part.

EXPLODED PARTS VIEW - LOW PRESSURE MODEL WITH DOUBLE BELLOWS MECHANICAL SEAL 零件分解图 – 带双波纹管密封的低压型压缩机 （2CC – 19LE）



PARTS LIST - LOW PRESSURE MODEL WITH DOUBLE BELLOWS MECHANICAL SEAL

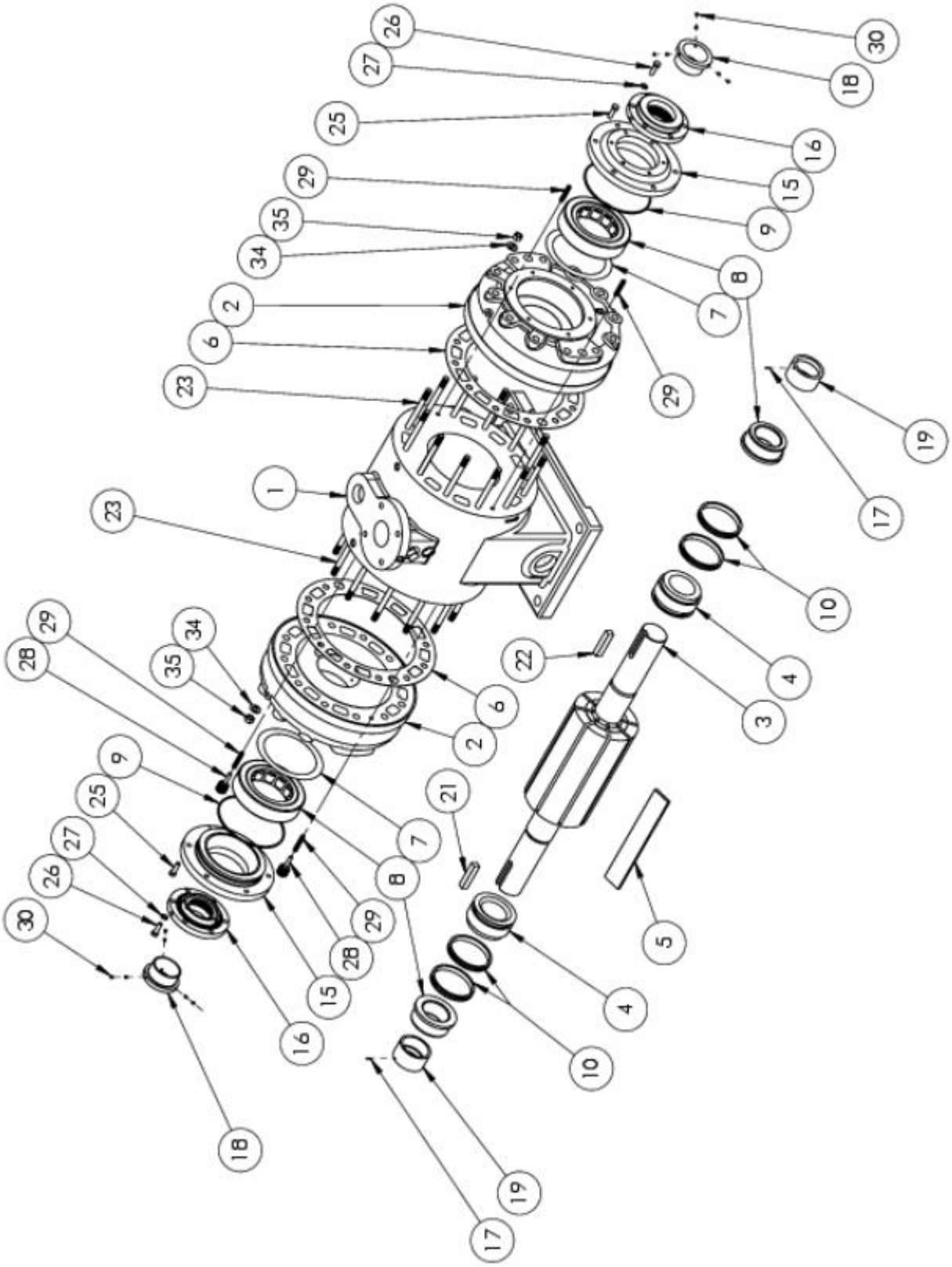
零件清单 – 带双波纹管机械密封的低压型压缩机 （2CC – 19LE）

ITEM	PART DESCRIPTION	QTY	REMARKS
1	Cylinder	1	
2	Cylinder Head	2	
3	Rotor Shaft	1	
4	Bearing Spacer Ring	2	
***5**	Rotor Blade Set	1	Contains 8 Blades
***6**	Cylinder Head Gasket	2	
***7**	Bearing Shim Set	2	
***8**	Roller Bearing	2	
***9**	O-Ring	2	
***10**	Seal Ring	4	
11	End Cover	1	
12	Bearing H-Ring	1	Required on Models 11S and Up
13	Bearing Lock Washer	1	
14	Bearing Lock Nut	1	
15	Seal Adapter	1	
***16**	Double Bellows Mechanical Seal	1	
20	Square Key	1	
23	Stud		As required
24	Screw – End Cover		
25	Screw – Seal Adapter		
26	Screw – Seal		
27	Lock Washer - Seal		
28	Jack Screw – Cylinder Head	2	
29	Dowel Pin – Cylinder Head	4	
31	Seal Cage	1	
32	Pipe Plug	1	
***33**	O-Ring, Seal Cage	1	
34	Washer, Cylinder Head Stud		As required
35	Nut, Cylinder Head Stud		

* Recommended Spare Part.

EXPLODED PARTS VIEW - HIGH PRESSURE MODEL WITH SINGLE FACE MECHANICAL SEALS

零件分解图 – 带单面机械密封的高压型压缩机 （206 -219M）



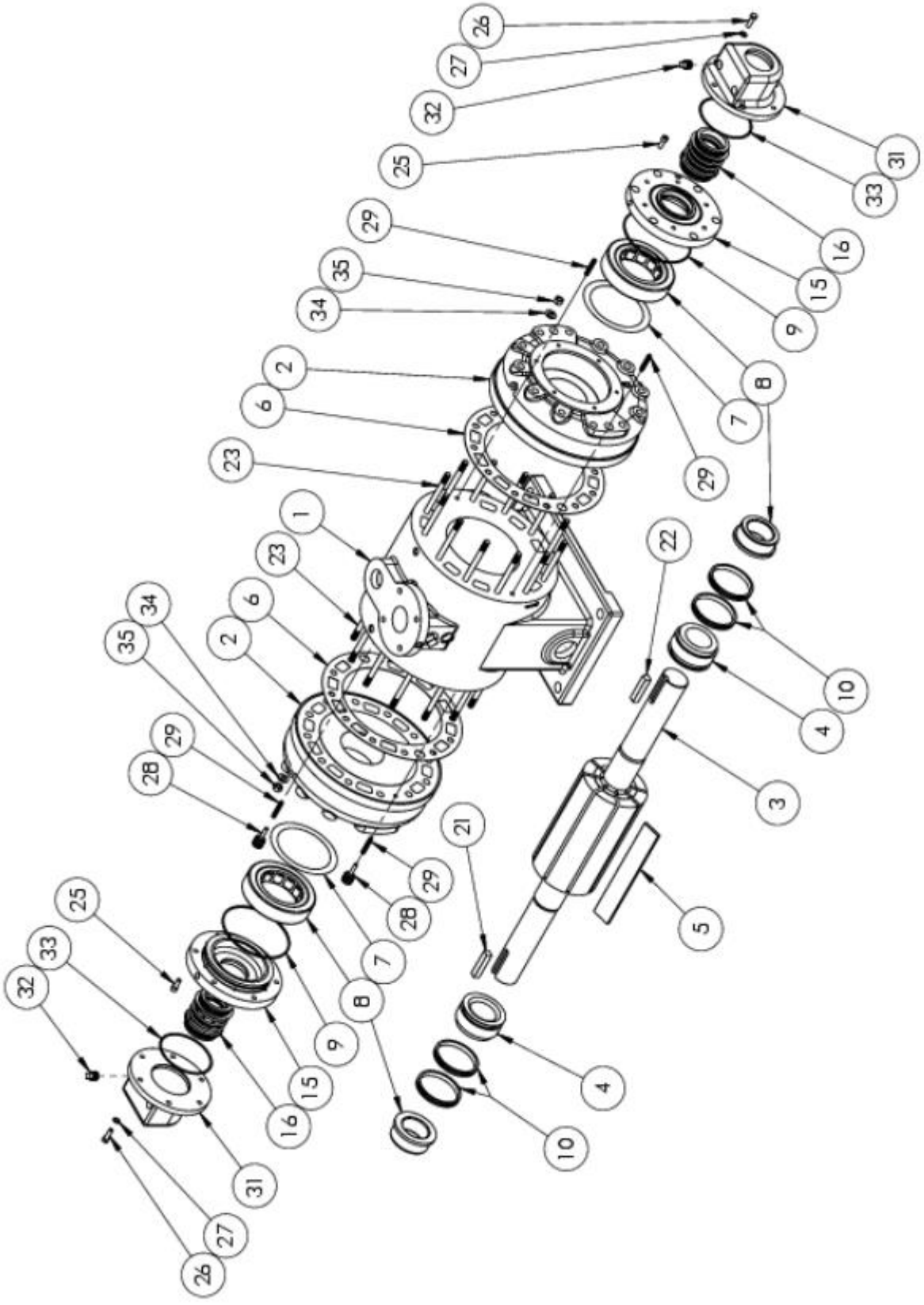
PARTS LIST - HIGH PRESSURE MODEL WITH SINGLE FACE MECHANICAL SEALS

零件分解图 – 带单面机械密封的高压型压缩机 （206 – 219M）

ITEM	PART DESCRIPTION	QTY	REMARKS
1	Cylinder	1	
2	Cylinder Head	2	
3	Rotor Shaft	1	
4	Bearing Spacer Ring	2	
*5	Rotor Blade Set	1	Contains 8 Blades
*6	Cylinder Head Gasket	2	
*7	Bearing Shim Set	2	
*8	Roller Bearing	2	
*9	O-Ring	2	
*10	Seal Ring	4	
15	Seal Adapter	2	
*16	Single Face Mechanical Seal	2	
17	Seal Drive Pin	2	
18	Locking Sleeve	2	
19	Seal Spacer	2	High Pressure Models 206, 207, 208B, and 210M Only – Not Used on models 211M and Up
21	Square Key, Inter-stage	1	
22	Square Key, Drive End	1	
23	Stud		As required
25	Screw – Seal Adapter		
26	Screw – Seal		
27	Lock Washer - Seal		
28	Jack Screw – Cylinder Head	2	
29	Dowel Pin – Cylinder Head	4	
30	Socket Head Set Screw	12	
34	Washer, Cylinder Head Stud		As required
35	Nut, Cylinder Head Stud		

* Recommended Spare Part.

EXPLODED PARTS VIEW - HIGH PRESSURE MODEL WITH DOUBLE BELLOWS MECHANICAL SEALS 零件分解图 – 带双波纹管机械密封的高压型压缩机 （206 – 219M）



PARTS LIST - HIGH PRESSURE MODEL WITH DOUBLE BELLOWS MECHANICAL SEAL

零件分解图 – 带双波纹管机械密封的高压型压缩机 （206 – 219M）

ITEM	PART DESCRIPTION	QTY	REMARKS
1	Cylinder	1	
2	Cylinder Head	2	
3	Rotor Shaft	1	
4	Bearing Spacer Ring	2	
***5**	Rotor Blade Set	1	Contains 8 Blades
***6**	Cylinder Head Gasket	2	
***7**	Bearing Shim Set	2	
***8**	Roller Bearing	2	
***9**	O-Ring	2	
***10**	Seal Ring	4	
15	Seal Adapter	2	
***16**	Double Bellows Mechanical Seal	2	
21	Square Key, Inter-stage	1	
22	Square Key, Drive End	1	
23	Stud		As required
25	Screw – Seal Adapter		
26	Screw – Seal		
27	Lock Washer - Seal		
28	Jack Screw – Cylinder Head	2	
29	Dowel Pin – Cylinder Head	4	
31	Seal Cage	2	
32	Pipe Plug	2	
***33**	O-Ring, Seal Cage	2	
34	Washer, Cylinder Head Stud		As required
35	Nut, Cylinder Head Stud		

* Recommended Spare Part.