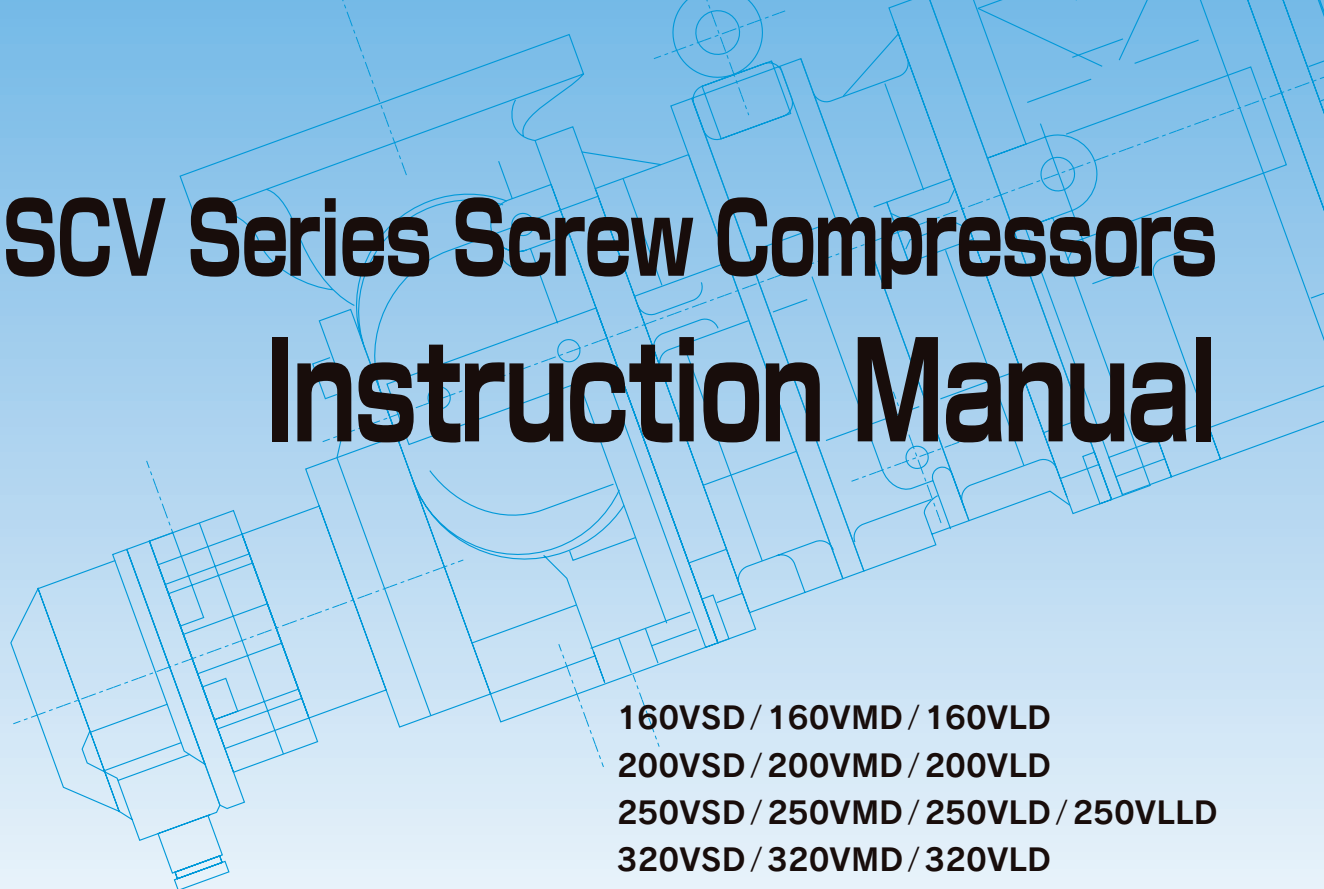
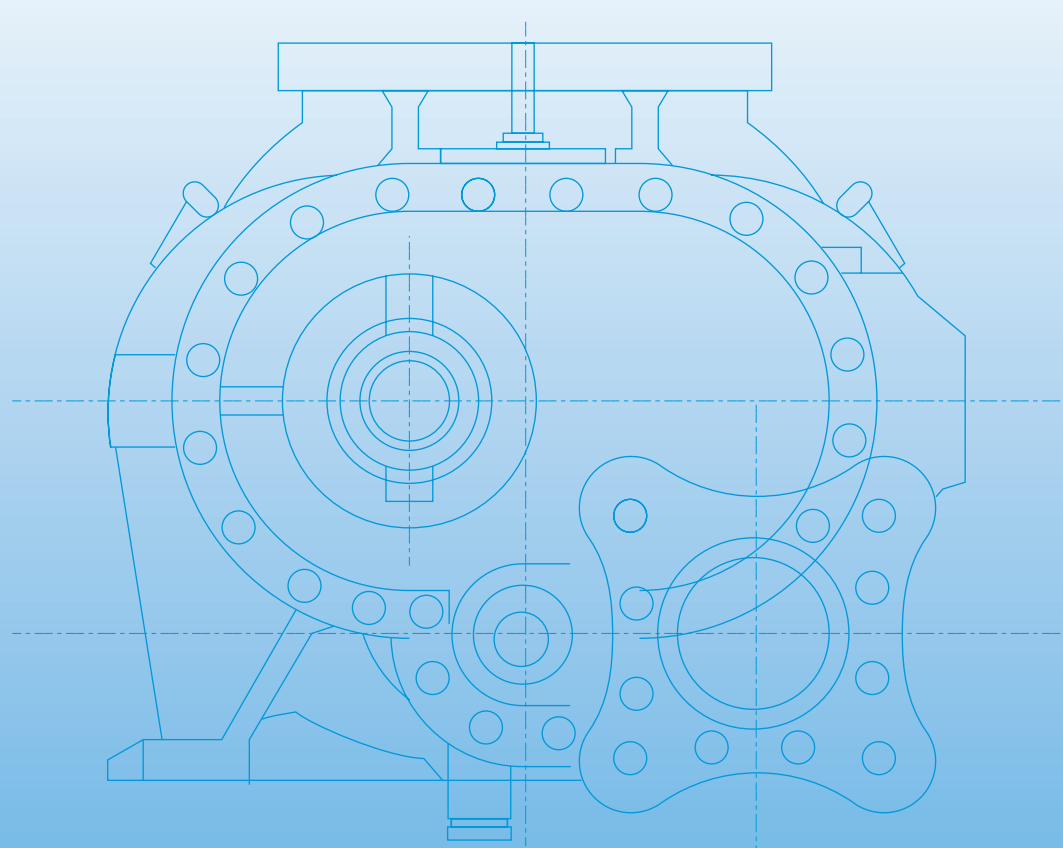


**W
Y
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W**

SCV Series Screw Compressors Instruction Manual



**160VSD / 160VMD / 160VLD
200VSD / 200VMD / 200VLD
250VSD / 250VMD / 250VLD / 250VLLD
320VSD / 320VMD / 320VLD
160VSG / 160VMG / 160VLG
200VSG / 200VMG / 200VLG
250VSG / 250VMG / 250VLG / 250VLLG**



About this Manual

- This instruction manual is for the MYCOM SCV Series Screw Compressors produced by Mayekawa Mfg. Co., Ltd. for refrigerating applications (hereafter collectively called 'the product'). The manual contains information on the construction and principle of operation, essential points to be observed during operation, and instructions for servicing and maintenance of the product.
- The manual applies to the product models listed below. If any part of the manual applies only to specific models, such part is identified by indicating the applicable models.

160VSD, 160VMD, 160VLD

200VSD, 200VMD, 200VLD

250VSD, 250VMD, 250VLD, 250VLLD

320VSD, 320VMD, 320VLD

160VSG, 160VMG, 160VLG


200VSG, 200VMG, 200VLG


250VSG, 250VMG, 250VLG, 250VLLG


- Keep this manual handy for ready reference by all persons working on the product.
- If the manual is lost or damaged, contact any of the offices or sales/service centers listed at the end of this manual to order a new copy.
- If you have anything in doubt about the information in this manual, please feel free to contact any of the office or sales/service centers listed at the end of this manual.
- This manual must remain with the product when you resell it to another user.
- All the descriptions, instructions and data contained in this manual are based on the information that are available at the time of producing the manual. Mayekawa reserves the right to make changes to the product for improvements without prior notice. If you have any query due to inconsistency between the product and the information in this manual that can result from such changes, please ask questions to any of the office or sales/service centers listed at the end of this manual.

Important Safety Information

- Be sure to thoroughly read this manual before operating or servicing the product in order to familiarize yourself with the instructions and recommendations in it. During operation and servicing of the product, we urge you to follow these instructions and recommendations. Failure to follow these instructions and recommendations will or could result in death or personal injury and also may cause operational problems or damage not only to the product but also to the related equipment in your system.
- Throughout this manual, the instructions especially important for assuring safety and preventing property damages are highlighted using the symbols/letters shown below. You should understand what each symbol/letter alerts to before using this manual.

 **DANGER** Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING** Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

 **CAUTION** Indicates a hazardous situation which, if not avoided, will or could result in minor or moderate injury.

CAUTION Indicates a hazardous situation which, if not avoided, will or could result in damage to the product or other property.

- The safety instructions in this manual are not exhaustive. There may be other safety precautions to be observed that vary from user to user. It is your responsibility to establish a safety management system most appropriate for your particular use of the product.

Warranty Notice

Warranty

Mayekawa will repair this product or replace its components free of charge in the case of malfunctions of or damage to the product due to defects in design or workmanship during normal use of the product under conditions not contradicting to the specifications and instructions Mayekawa has given by any means including this manual, provided the malfunctions or damage in question occurs within the warranty period indicated below.

The warranty period shall be 12 months from the date of shipment of the product from the factory.

Mayekawa will not be liable for any personal or property damages consequential to any malfunction of or damage to this product, including but not limited to any loss of business or profits.

Disclaimer of Warranty

Despite the warranty clauses mentioned above, Mayekawa shall be exempted from offering the warranty for malfunctions of and damage to the product that result from any of the following causes:

- Malfunctions or damage resulting from natural disaster or other force majeure (including windstorm, intense rainfall, flood, tidal wave, earthquake, land subsidence, thunderbolt, and fire) and any causes beyond the control of Mayekawa
- Malfunctions or damage resulting from improper usage of the product, examples of which are the following:
 - Malfunctions, damage, or deterioration due to misuse or unacceptable use of the product (including improperly storing the product outdoors or under too hot/humid conditions, too frequent liquid flow-back operation*, too frequent start-stop cycles, etc.).
 - Malfunctions of or damage to the product resulting from the method of operation or control of those devices or equipment that are not supplied from Mayekawa
 - Malfunctions or damage resulting from the use of refrigerants, gases, or lubrication oils not approved for use with the product, or the use of the product under other conditions than those for which the product is designed
 - Malfunctions or damage resulting from maintenance or inspection performed in other ways than those recommended by Mayekawa
 - Malfunctions or damage resulting from the use of other replacement parts than genuine Mayekawa parts
 - Malfunctions or damage resulting from modifications to the product performed according to any instructions not given by Mayekawa
 - Malfunctions or damage resulting from the use of the product for any purposes not intended by Mayekawa

* Liquid flow-back operation

Although the compressor normally sucks gaseous refrigerant, it can suck liquid refrigerant due to such causes as a poorly adjusted or damaged expansion valve. We call this state of compressor operation "liquid flow-back operation". As the compressor cannot compress liquid, it can be damaged when sucking any liquid.

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Chapter 1 Principle of Operation and Construction

1.1 General

MYCOM SCV Series Screw Compressors are rotary compressors falling into the category of the positive displacement compressor. The compressor sucks refrigerant gas into a cavity, gradually reduces the volume of the cavity, and discharge the refrigerant as a high-pressure gas. More specifically, a sealed cavity is formed by a casing and a pair of intermeshing rotors (called the male and female rotors) in the casing. The rotors are different in lead and number of screw lobes. The volume of the sealed cavity gets reduced as the rotors rotate. The gas trapped in the cavity is thus compressed before it is discharged.

The SCV Series models feature a mechanism for readily changing the internal volume ratio V_i , which refers to the ratio between the volume of the cavity just before the start of compression and the volume of the cavity just before the discharge of the compressed gas (see section 1.3 for further details). In addition, the SCV Series compressors employ O-profile screw lobes for the rotors, which minimize leaks and thus enhance the compression efficiency.

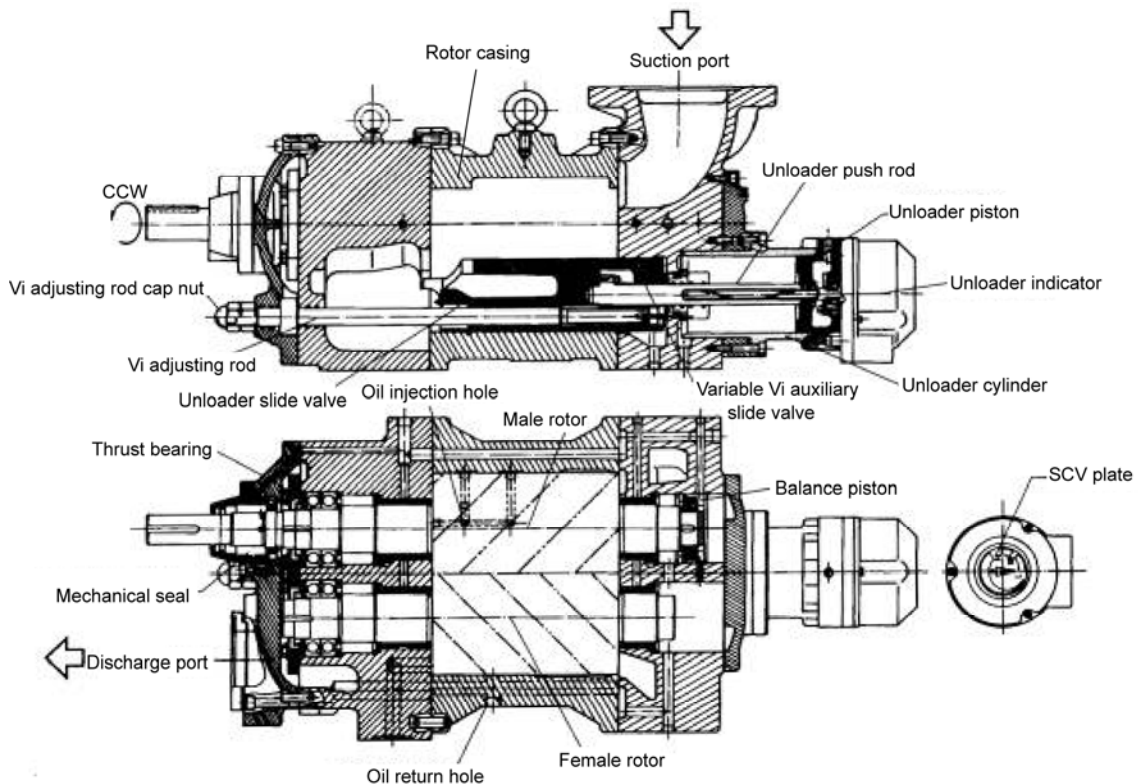


Fig. 1-1 Sectional View of SCV Series Screw Compressor (Typical)

1.2 Refrigerant Gas Compression Mechanism

Inside the main rotor casing, there are the male rotor (number of screw lobes: 4) and female rotor (number of screw lobes: 6), intermeshing and rotating in the opposing directions each other. Together with the rotor casing, these two rotors constitute the essential elements of the compressor for sucking and compressing the refrigerant gas.

The male rotor is directly coupled to a two-phase electric motor and driven at a standard speed of 2,950 rpm (with a 50 Hz power supply) or 3,600 rpm (with a 60 Hz power supply). If necessary, the speed may be changed using an inverter or a gear set.

One end of each rotor constitutes the gas suction end, while the other end the compressed gas discharge end. While the rotors are rotating over a certain angular range, their suction ends open the suction port; the suction ends close the port while the rotors are rotating over another angular range. This is also true with the discharge ends and the discharge port (see Fig. 1-3).

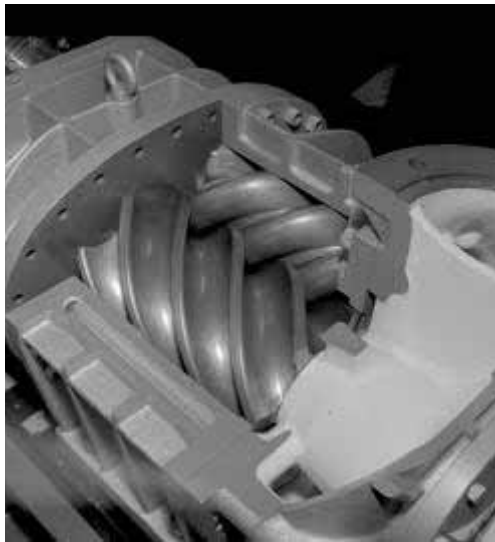


Fig. 1-2 Rotors in Main Rotor Casing

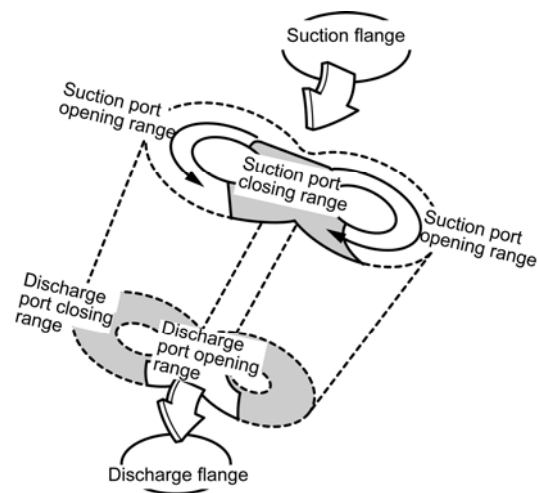


Fig. 1-3 Suction and Discharge Ports in Rotor Casing

1.2.1 Suction Phase

While both rotors' suction ends are rotating over the suction port opening range, the cavity formed by the screw lobe grooves and the casing gradually expands, which causes refrigerant gas to be sucked into the cavity. When the volume of the cavity becomes the maximum, the rotors' suction ends start rotating over the suction port closing range. Since the rotors' discharge ends start rotating over the discharge port closing range at the same time, the cavity becomes a completely closed space (see Figs. 1-4 to 1-7).

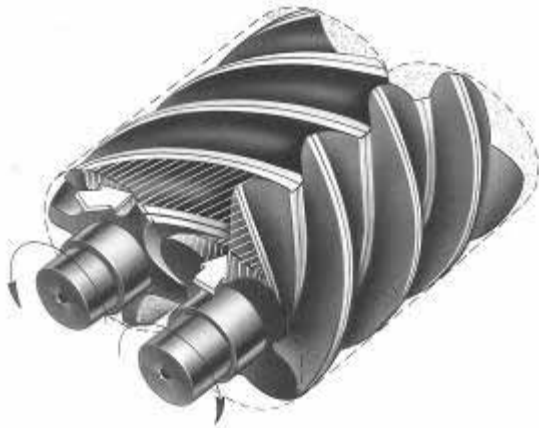


Fig. 1-4 Gas Suction Started

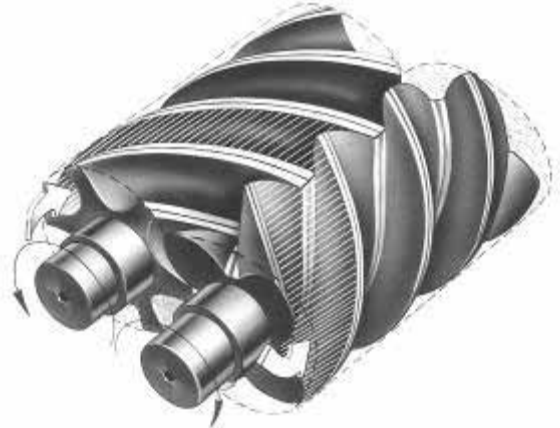


Fig. 1-5 Gas Suction in Progress



Fig. 1-6 Gas Suction Phase Is About to End

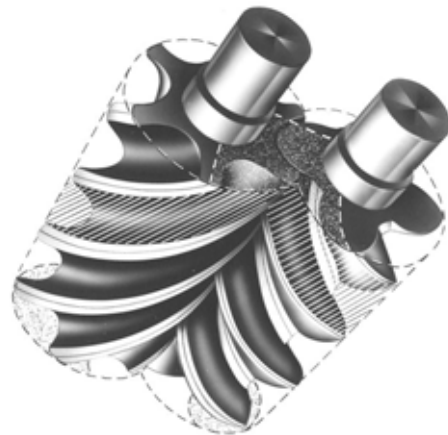


Fig. 1-7 Suction Port Closed

1.2.2 Compression Phase

As the rotors further rotate, the sealing line formed by the screw rotor grooves and the casing wall moves toward the discharge end, gradually decreasing the volume of the cavity. The refrigerant gas trapped in the cavity thus gets compressed (see Fig. 1-8).



Fig.1-8 Compression Phase

1.2.3 Discharge Phase

Just when the preset V_i value is reached as a result of reduction in volume of the refrigerant gas compared with the volume just before the start of compression, rotation of the rotors' discharge ends enters the discharge port opening range. This allows the compressed refrigerant gas to be discharged through the discharge port (see Fig. 1-9).



Fig. 1-9 Discharge Phase

1.3 Internal Volume Ratio V_i

1.3.1 What Is the Internal Volume Ratio V_i ?

In the case of reciprocating compressors, the refrigerant compression capacity is controlled by setting the pressure attained by piston displacement to an optimum level for the intended application.

With screw compressors, on the other hand, the compression capacity is controlled by setting the extent to which the volume of the sucked refrigerant gas is to be reduced. In other words, the compression capacity control applied to the screw compressor is a volumetric ratio control. This volumetric ratio is called the 'internal volume ratio' and defined by the following formula:

$$V_i = \frac{\text{Volume of suction refrigerant gas just before start of compression}}{\text{Volume of refrigerant gas just before opening of discharge port}}$$

The V_i value is fixed at 2.63, 3.65, or 5.80 for the conventional MYCOM compressors; compressors with V_i at 2.63 are called the L-port compressors, those with V_i at 3.65 are called the M-port compressors, and those with V_i at 5.80 are called the H-port compressors. These designations are associated with the discharge port types.

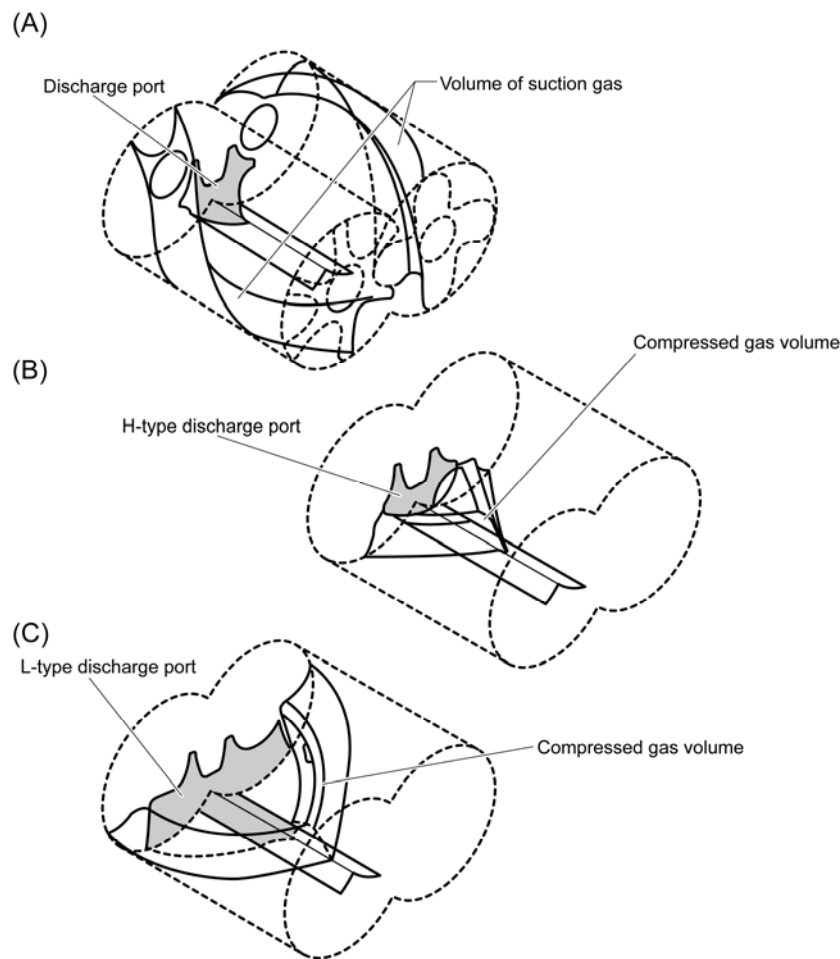


Fig. 1-10 Internal Volume Ratio V_i

1.3.2 Why the Vi Needs to Be Changed?

The SCV Series Screw Compressors have a mechanism that allows adjusting the Vi in the worksite. This adjusting mechanism is needed for the following two purposes.

(1) To adapt the Vi to the refrigerant used

The internal volume ratio Vi can be expressed as a function of the internal pressure ratio as follows:

$$V_i = \left(\frac{P_d}{P_s}\right)^{\frac{1}{K}} \text{ or } V_i^K = \frac{P_d}{P_s}$$

Where,

Pd: discharge pressure

Ps: suction pressure

K: ratio of specific heats (a constant specific to each refrigerant)

As seen from the formula, the Vi corresponding to a certain pressure ratio varies with the type of refrigerant gas. Therefore, an adjustment of the Vi is needed to attain the optimum compression ratio for each type of refrigerant gas.

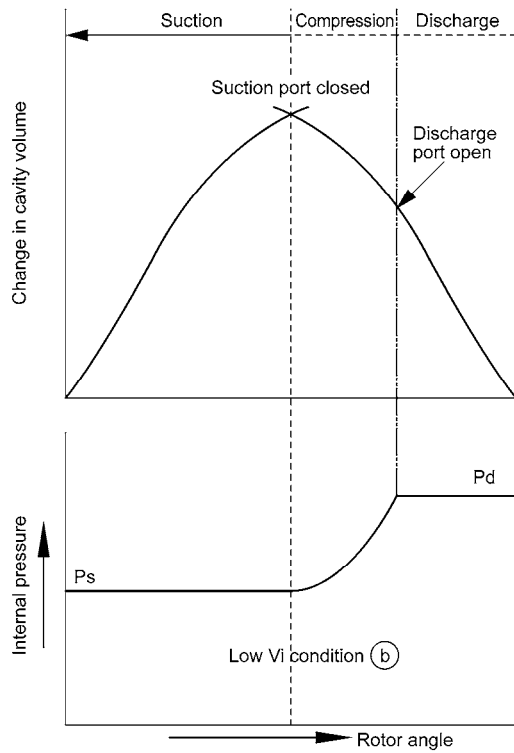
(2) To operate the compressor most efficiently under varying conditions

Compressors of the same model will be used for a variety of applications whose load conditions are different, e.g. air conditioning, cold storage, and freezing. The compressor, however, can be operated most efficiently when the Vi is matched with the load condition.

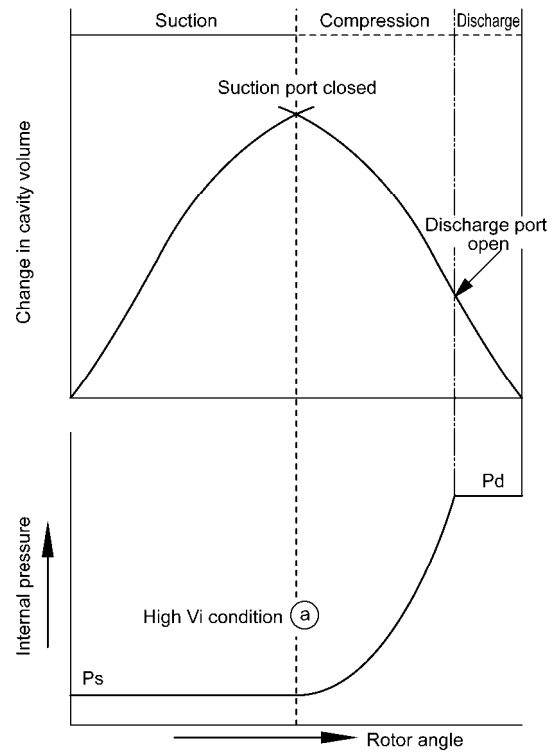
For example, if a conventional M-port compressor with the fixed Vi is used for a low compression-ratio application (an application with small difference between suction and discharge pressures (or small $\frac{P_d}{P_s}$)), a pressure higher than the necessary pressure will be reached before the discharge port opens as shown in the lower right graph of Fig. 1-11. This means that power will be used wastefully for unneeded compression.

Conversely, if the same compressor is used for a high compression-ratio application (an application with large difference between suction and discharge pressures (or large $\frac{P_d}{P_s}$)), the discharge port will open before the refrigerant gas pressure has risen to the necessary level. This would cause the refrigerant gas in the outlet piping to flow back through the discharge port as shown in the lower left graph of Fig. 1-11 unless the flowing-back gas is overcome by driving the compressor using extra power.

(A) Properly adapted V_i to load condition

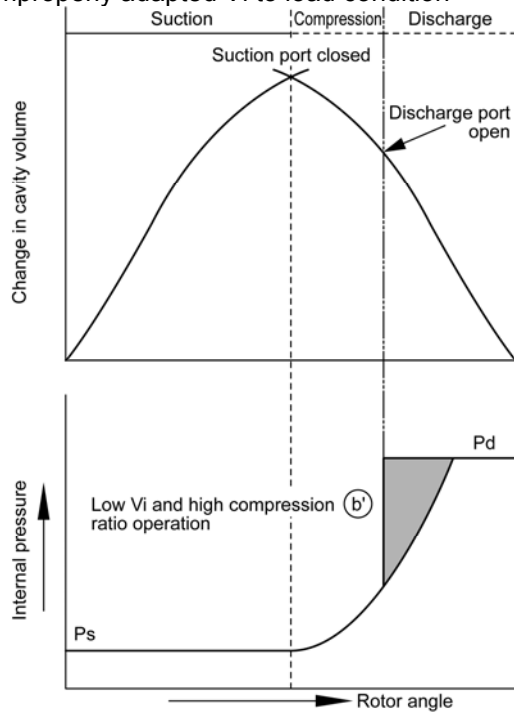


Necessary compression ratio and V_i are both low

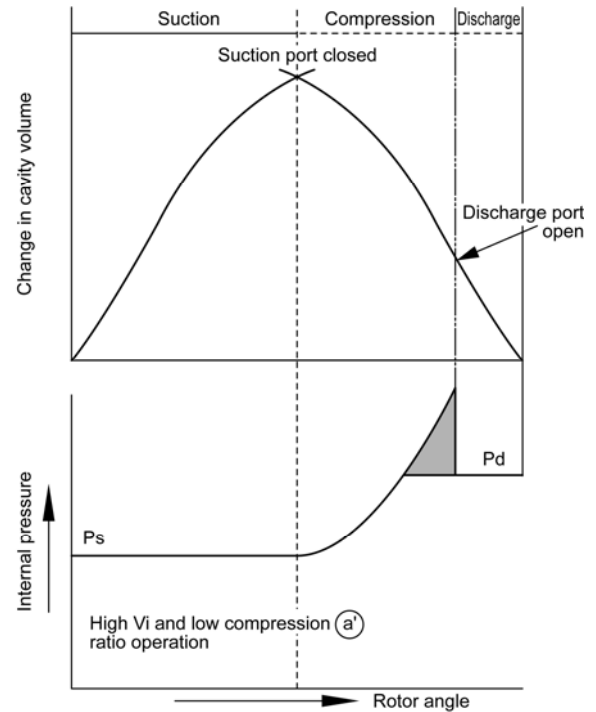


Necessary compression ratio and V_i are both high

(B) Improperly adapted V_i to load condition



Too low V_i compared with necessary compression ratio



Too high V_i compared with necessary compression ratio

Fig. 1-11 Proper and Improper Adaptation of V_i to Load Condition

1.3.3 Variable Vi Mechanism

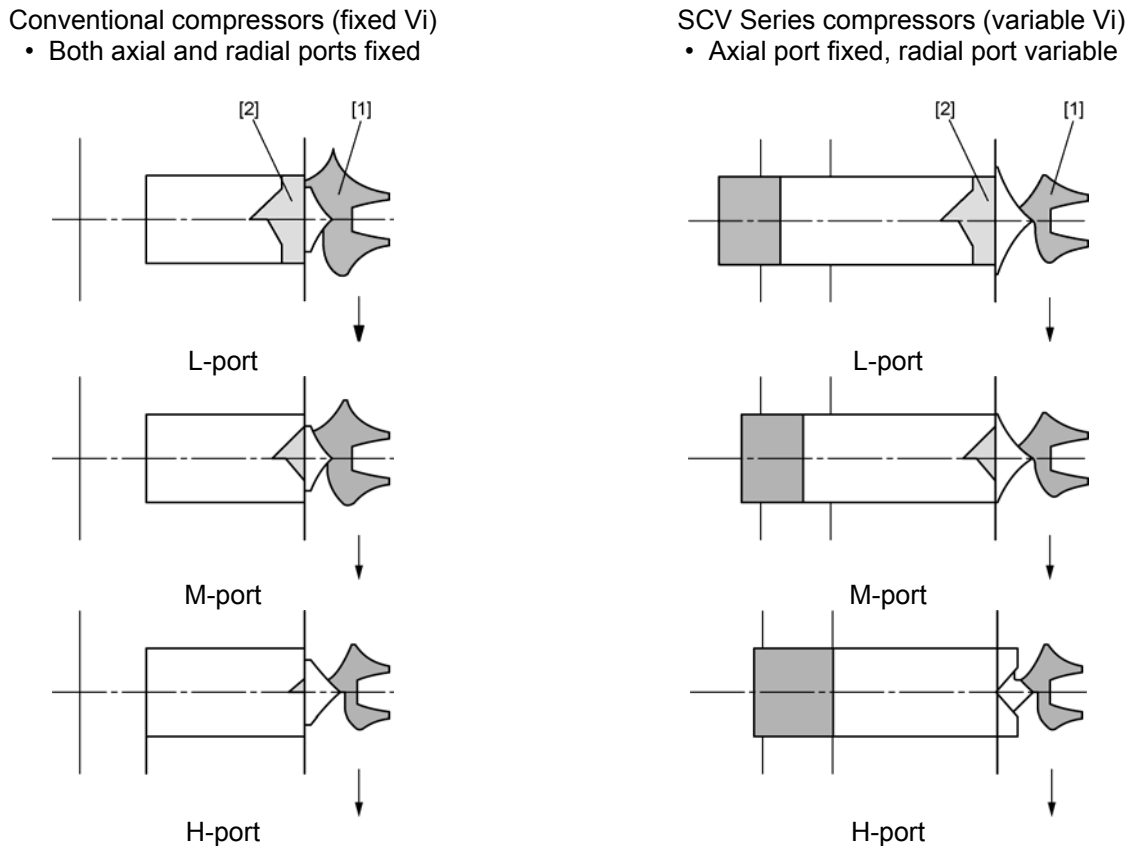
The combination of the following two factors determines the Vi value:

- [1] The size of the axial port in the bearing head (port extending in the rotor axis direction)
- [2] The size of the radial port in the unloader slide valve (port extending in the direction perpendicular to the rotor axis direction)

The conventional fixed-Vi MYCOM compressors have axial and radial ports both fixed to the sizes corresponding to the L, M, or H port.

The SCV Series compressors also have a fixed axial port of the size corresponding to Vi = 5.1, but the radial port in the unloader slide valve is made variable to constitute a variable Vi mechanism. This is achieved by making the full-load end of the unloader slide valve, which is fixed with the conventional models, variable as necessary.

Fig. 1-12 compares the discharge ports of the fixed and variable Vi compressors. Fig. 1-13 shows the detail of the variable Vi mechanism.



[1] The size of the axial port in the bearing head

[2] The size of the radial port in the unloader slide valve

Fig. 1-12 Discharge Ports of Variable and Non-variable Vi Compressors

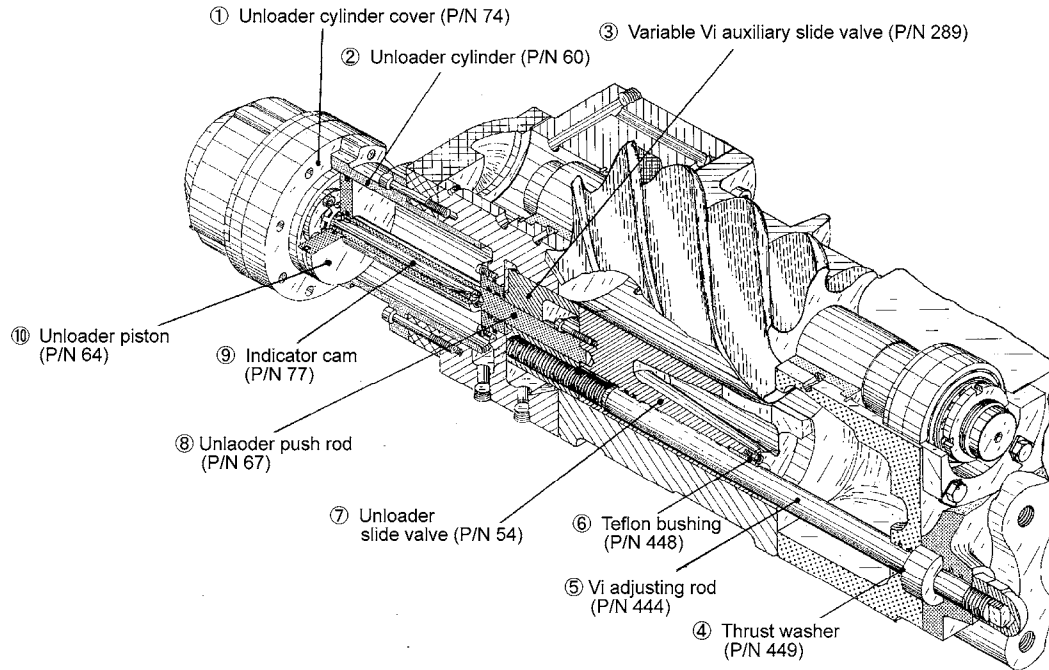


Fig. 1-13 Variable Vi Mechanism

The greatest benefit provided by properly setting the Vi value is that the rotor driving power (brake horse power) is made optimum for the load. The refrigeration capacity generally changes little even if the Vi is varied. However, the efficiency of the brake horse power becomes the maximum and the loss of power is minimized if the Vi is optimally adjusted.

The performance curves in Fig. 1-14 show the relationship between the refrigeration capacity and the brake horse power. The curves indicated by thick solid lines in the graph represent the brake horse powers most efficient for achieving the specific refrigerating capacities. In a compressor with a fixed Vi value, each brake horse power curve leaves away from the ideal curve in some refrigerating capacity areas. On the other hand, it is possible for a variable Vi compressor to set the brake horse power in the vicinity of the ideal value.

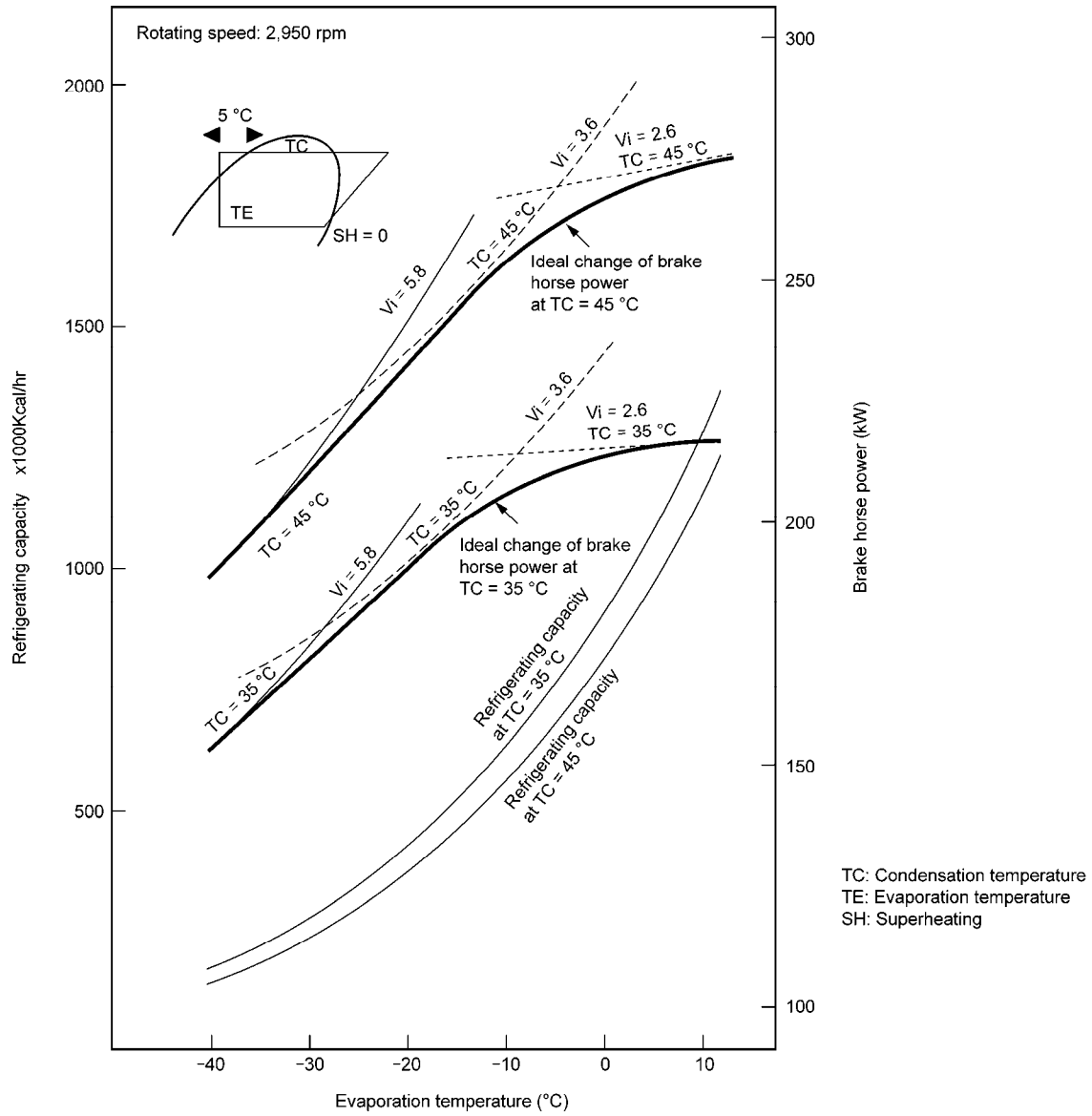


Fig. 1-14 Refrigerating Capacity vs. Brake Horse Power

1.4 Description of Components

Read the following description referring to the compressor components drawings and the parts lists in section 1.6. The numbers in parentheses are part numbers.

1.4.1 Rotors

The male rotor (P/N 25) and female rotor (P/N 26) are supported at their both ends by the side bearings (P/N 28) in the suction cover (P/N 5) and the main bearings (P/N 27) in the bearing head (P/N 11). In addition, the thrust bearings (P/N 38) located outside the main bearings support the thrust loads working on the rotors, which result from both the rotation of the rotors and the difference in refrigerant gas pressure that takes place during the compression process.

The male rotor undergoes a thrust force 1.5 times greater than that on the female rotor, as the male rotor receives an extra thrust from being driven by the motor in addition to the thrust from the differential pressure in the refrigerant gas. To reduce the load acting on the thrust bearing of the male rotor, a hydraulic piston (balance piston (P/N 30)) is provided in the suction cover.

1.4.2 Sealing of Male Rotor to Prevent Refrigerant Gas Leakage

To prevent refrigerant gas leakage, various types of mechanical seal are used as the mechanical seal assembly (P/N 100) for the male rotor, which is the compressor's drive shaft. For the friction section of any mechanical seal type, a combination of carbon and a hard metal (or silicon carbide (SiC)) is used to assure adequate sealing and resistance to wear.

The oil seal (P/N 50) used as a shaft seal is made of materials that are resistant to various types of refrigerant gas.

1.4.3 Capacity Control

The unloader slide valve (P/N 54), which is activated hydraulically via the unloader cylinder (P/N 60) and the unloader piston (P/N 64), automatically carries out capacity control (suction volume control) of each compressor.

The unloader cylinder is connected to the unloader indicator assembly (P/N 120) via the indicator cam (P/N 77), allowing the indicator to indicate the positions of both the variable V_i auxiliary slide valve (P/N 289) and the unloader slide valve. The indicator cam has a spiral groove, in which the guide pin (P/N 68) implanted in the unloader slide valve push rod (P/N 67) is movably inserted. As this pin and cam combination converts a linear displacement of the unloader slide valve into an angular displacement, the pointer of the indicator indicates the position of the valve.

In addition to the visual reading of the position of the unloader slide valve, the unloader indicator assembly can also provide the following electric signals for output to external devices: ON/OFF signals produced by the cam mechanism contacts and resistance signals produced by a potentiometer. The contact resistance type potentiometer is provided as standard equipment, and an explosion-proof type potentiometer is also available as optional equipment.

1.4.4 Oil Supply System (Lubrication Oil and Capacity Control Hydraulic Oil)

Depending on applications, the SCV Series Screw Compressors use either of the following types of oil supply system.

- Forced oil supply system – This system uses pump-pressurized oil for both the lubrication and capacity control purposes (Type A).
- Differential pressure oil supply system – This system supplies lubrication oil under the effect of the differential pressure, but uses pump-pressurized oil as the capacity control oil and as the lubrication oil during startup of the compressor (Type B).

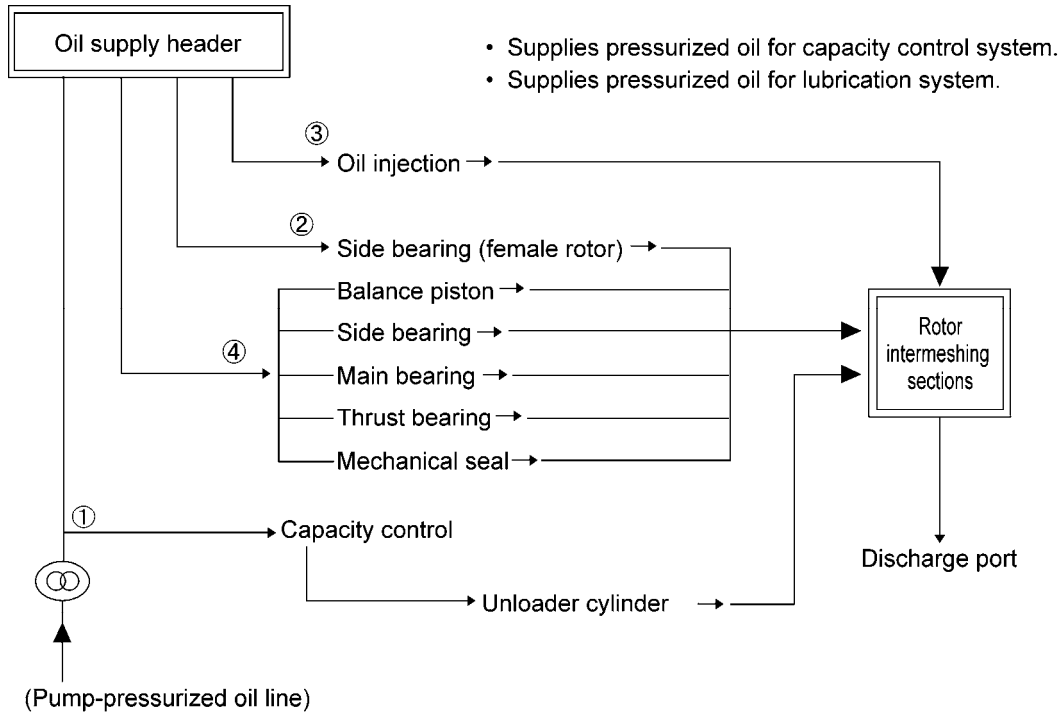


Fig. 1-15 Type A Oil Supply System

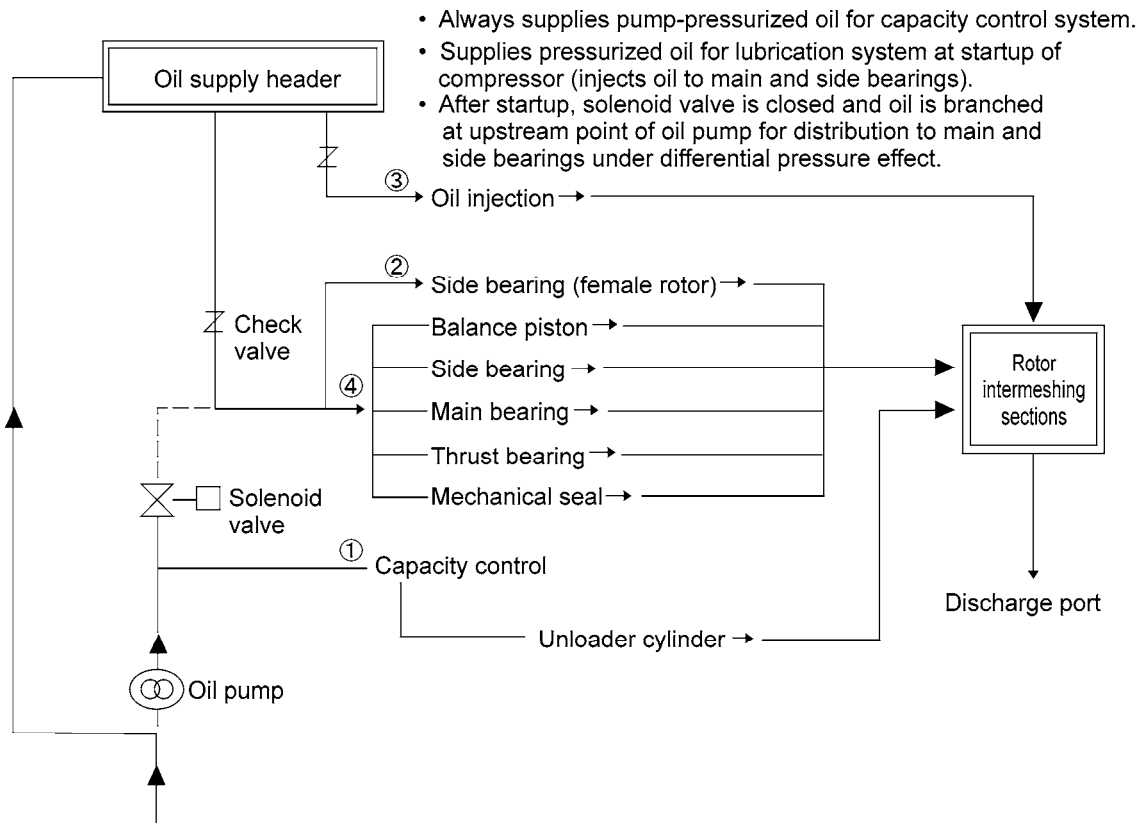


Fig. 1-16 Type B Oil Supply System

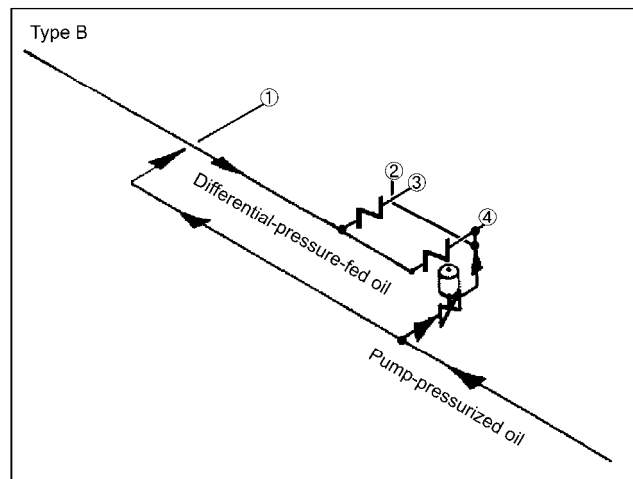
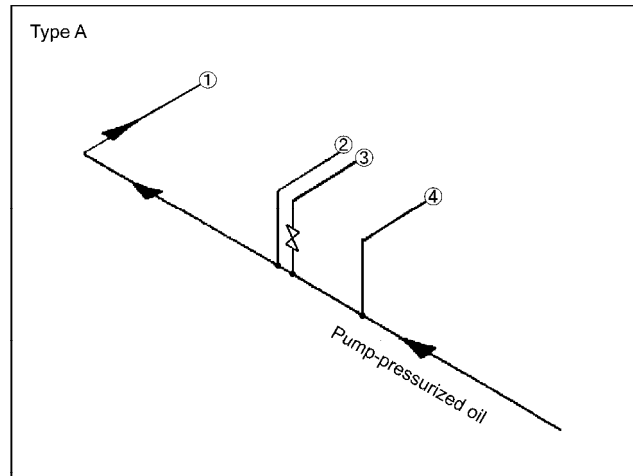
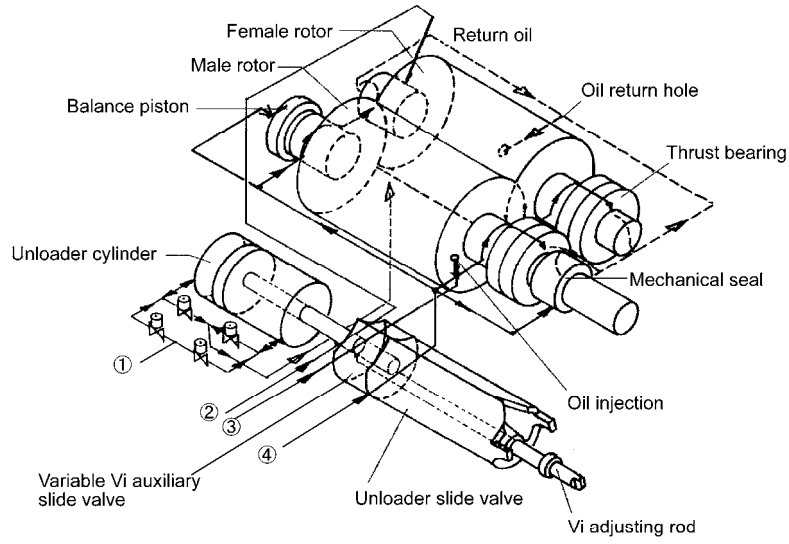


Fig. 1-17 Oil Supply System

1.5 Model Designations of SCV Series Screw Compressors

The models of SCV Series Screw Compressor covered by this manual are the following:

160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG

200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG

250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG

320VSD, 320VMD, 320VLD

The letters and numbers constituting the above model designations are interpreted as follows:

Letter V stands for the SCV Series; numbers 160, 200, 250, and 320 represent the rotor diameters; letters S, M, L, and LL represent the rotor lengths; and letters D and G indicate the discharge directions (D for sideways discharge and G for downward discharge).

NOTE: The SCV Series compressors also include 400 type models, which are not covered by this manual because of the difference in construction.

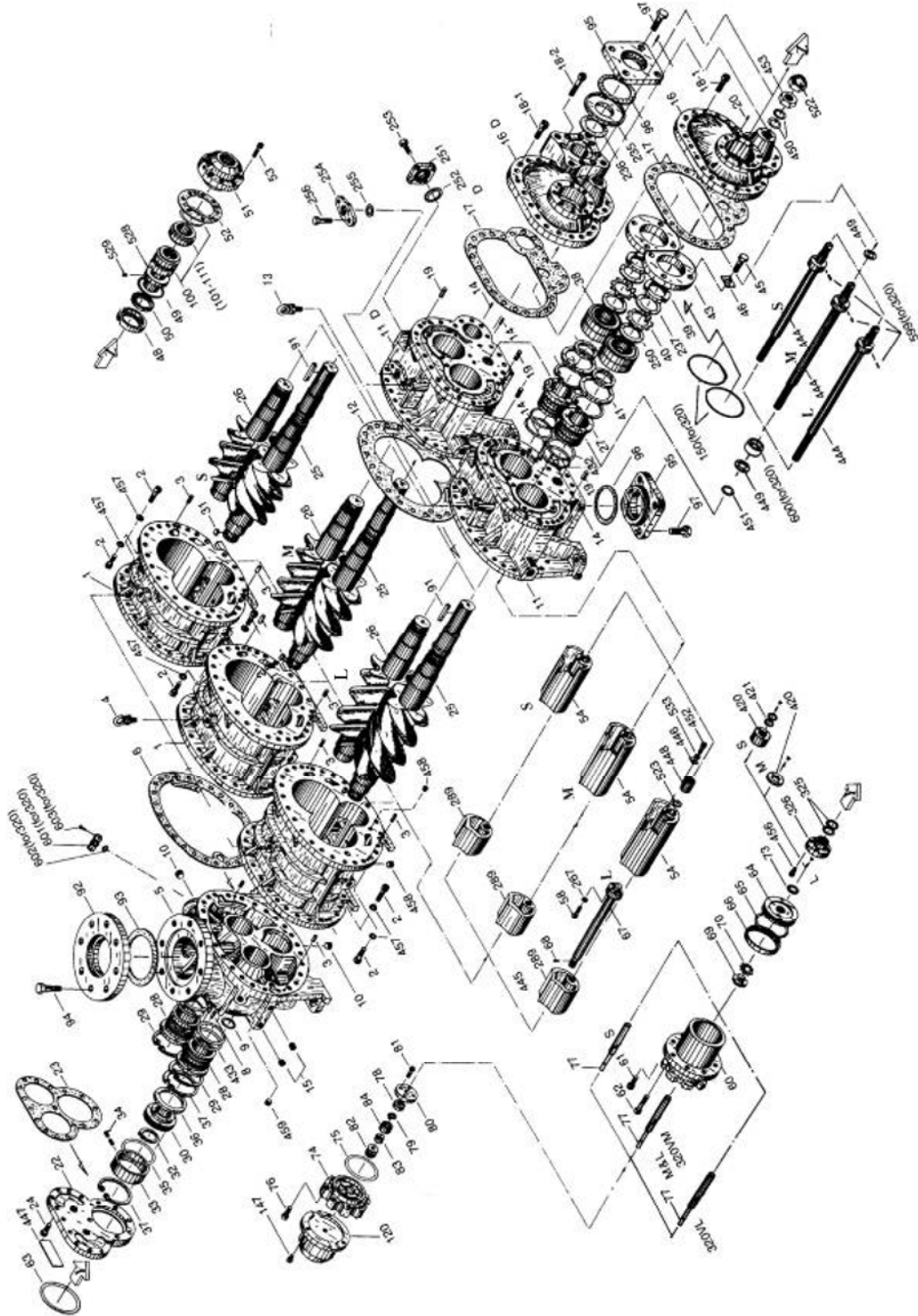
1.6 Components and External Dimensions

1.6.1 Components Drawings

This section shows the components drawings for the following models of compressor.

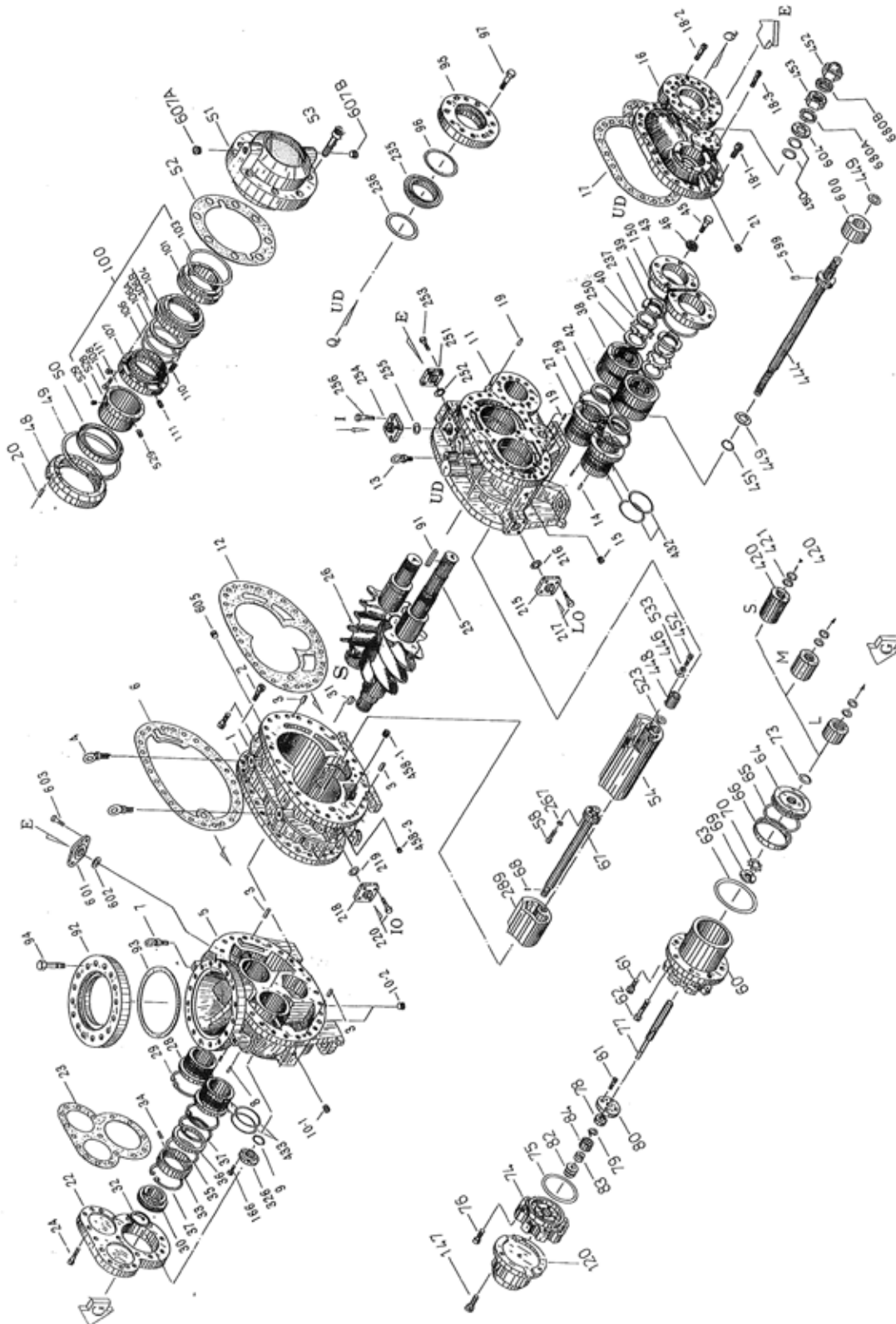
- (1) 160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG
200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG
250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG
- (2) 320VSD, 320VMD and 320VLD

- (1) 160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG
 200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG
 250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG
 Use the part numbers in the drawing as keys to the parts lists in section 1.6.2.



(2) 320VSD, 320VMD and 320VLD

Use the part numbers in the drawing as keys to the parts lists in section 1.6.2.



1.6.2 Parts Lists

This section shows the parts lists for the following models.

- (1) **160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG**
- (2) **200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG**
- (3) **250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG**
- (4) **320VSD, 320VMD, 320VLD**

NOTE: The code numbers indicated in each list are those updated in and after December 2009.

Chapter 1 Principle of Operation and Construction

(1) 160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
1		Main Rotor Casing	CS00100-160VXS	160VS*	1			1		
1		Main Rotor Casing	CS00100-160VXM	160VM*		1			1	
1		Main Rotor Casing	CS00100-160VXL	160VL*			1			1
2		Hexagon Socket Head Cap Screw	NB35412-045	M12 x 45	52	52	52	52	52	52
3		Alignment Pin	NE2013-040	Ø13 x 40	4	4	4	4	4	4
4		Hanger Bolt	NB600-20	M20	1	1	1	1	1	1
5		Suction Cover	CS00500-160VX	160V**	1	1	1	1	1	1
6		Gasket, Suction Cover	CS0061-DV	160LDV	1	1	1	1	1	1
8		Spring Pin	NE3204-010	Ø4 x 10	2	2	2	2	2	2
9		“O” Ring	PA11-046	JISB2401P46	1	1	1	1	1	1
10	A	Plug	NF06-008	R 1/4	1	1	1	1	1	1
10	B	Plug	NF06-008	R 1/4	1	1	1	1	1	1
10	C	Plug	NF06-010	R 3/8	1	1	1	1	1	1
10	D	Plug	NF06-010	R 3/8	1	1	1	1	1	1
11		Bearing Head	CS01100-160VXD	160V**	1	1	1			
11		Bearing Head	CS01100-160VXG	160V*G				1	1	1
12		Gasket, Bearing Head	CS01200-160N	160***	1	1	1	1	1	1
13		Hanger Bolt	NB600-12	M12	1	1	1	1	1	1
14		Spring Pin	NE3204-010	Ø4 x 10	2	2	2	2	2	2
16		Bearing Cover	CS01600-160VXD	160V**	1	1	1			
16		Bearing Cover	CS01600-160VXG	160V*G				1	1	1
17		Gasket (D), Bearing Cover	CS01700-160VD	160V**	1	1	1			
17		Gasket (G), Bearing Cover	CS01700-160VG	160V*G				1	1	1
18	1	Hexagon Socket Head Cap Screw	NB35412-040	M12 x 40	19	19	19	24	24	24
18	2	Hexagon Socket Head Cap Screw	NB35412-080	M12 x 80	7	7	7			
19		Alignment Pin	NE2010-040	Ø10 x 40	2	2	2	2	2	2
20		Spring Pin	NE3203-010	Ø3 x 10	1	1	1	1	1	1
22		Balance Piston Cover	CS02200-160VX	160V**	1	1	1	1	1	1
23		Gasket, Balance Piston Cover	CS02300-160N	160*	1	1	1	1	1	1
24		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	11	11	11	11	11	11
25		Male Rotor	CS02500-160VS	160VS*	1			1		
26		Female Rotor		160VS*	1			1		
25		Male Rotor	CS02500-160VM	160VM*		1			1	
26		Female Rotor		160VM*		1			1	
25		Male Rotor	CS02500-160VL	160VL*			1			1
26		Female Rotor		160VL*			1			1
27		Main Bearing	CS0270-DRT	160***	2	2	2	2	2	2
28		Side Bearing	CS0280-DRT	160***	2	2	2	2	2	2
29		Stop Ring	NG11-102	H102	4	4	4	4	4	4
30		Balance Piston	CS03000-160H	160**H	1	1	1	1	1	1
31		Key, Balance Piston	CS03100-160	160**	1	1	1	1	1	1
32		Stop Ring	NG12-050	S50	1	1	1	1	1	1
33		Sleeve, Balance Piston	CS03300-160H	160**H	1	1	1	1	1	1
34		Set Screw	NA83606-015	M6 x 15	2	2	2	2	2	2
35		“O” Ring	PA12-095	JISB2401G95	1	1	1	1	1	1
36		“O” Ring Spacer	CS03600-160	160***	1	1	1	1	1	1
37		Stop Ring	NG11-102	H102	2	2	2	2	2	2
38		Thrust Bearing	CS03800-160P	7212B	2	2	2	2	2	2
39		Lock Nut	NG31-012	AN12	2	2	2	2	2	2
40		Lock Washer	NG32-012	AW12	2	2	2	2	2	2
41		Spacer, Thrust Bearing Outer Race	CS04100-160	160***	2	2	2	2	2	2

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
42		Spacer, Thrust Bearing Alignment	CS04200-160	160***	2	2	2	2	2	2
43		Thrust Bearing Gland	CS04300-160	160***	2	2	2	2	2	2
45		Hexagon Head Bolt	NB15510-030	M10 x 30	8	8	8	8	8	8
46		Conical Spring Washer (hexagon head bolt lock washer)	- (CS0469-D)	M10 (160***)	8	8	8	8	8	8
48		Retainer, Oil Seal	CS04800-160	160***	1	1	1	1	1	1
49		"O" Ring	PA12-090	JISB2401G90	1	1	1	1	1	1
50		Oil Seal	CS05010-160VD	SA1J55 x 70 x 9	1	1	1	1	1	1
51		Seal Cover	CS051000-160BBS	160***	1	1	1	1	1	1
52		Gasket, Seal Cover	CS05200-160N	160***	1	1	1	1	1	1
53		Hexagon Socket Head Cap Screw	NB35408-025	M8 x 25	8	8	8	8	8	8
54		Unloader Slide Valve	CS05400-160VSD	160VS*	1			1		
54		Unloader Slide Valve (grooved)	-	160VS*	1			1		
54		Unloader Slide Valve	CS05400-160VMD	160VM*		1			1	
54		Unloader Slide Valve (grooved)	-	160VM*		1			1	
54		Unloader Slide Valve	CS05400-160VLD	160VL*			1			1
54		Unloader Slide Valve (grooved)	-	160VL*			1			1
58		Hexagon Socket Head Cap Screw	NB35406-030	M6 x 30	5	5	5	5	5	5
60		Unloader Cylinder	CS06000-160VX	160V**	1	1	1	1	1	1
61		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	2	2	2	2	2	2
62		Hexagon Socket Head Cap Screw	NB35410-065	M10 x 65	6	6	6	6	6	6
63		"O" Ring	PA12-125	JISB2401G125	1	1	1	1	1	1
64		Unloader Piston	CS06400-160D	160***	1	1	1	1	1	1
65		"O" Ring	PA11-100	JISB2401P100	1	1	1	1	1	1
66		Cap Seal	CS06600-160	CAP-1BE100	1	1	1	1	1	1
67		Push Rod, Unloader Slide Valve	CS0671-DV	160V**	1	1	1	1	1	1
68		Guide Pin	CS06809-03	Ø3 x 8	1	1	1	1	1	1
69		Lock Nut	NG31-005	AN05	1	1	1	1	1	1
70		Lock Washer	NG32-005	AW05	1	1	1	1	1	1
73		"O" Ring	PA11-021	JISB2401P21	1	1	1	1	1	1
74		Unloader Cylinder Cover	CS07400-160	160*	1	1	1	1	1	1
75		"O" Ring	PA12-110	JISB2401G110	1	1	1	1	1	1
76		Hexagon Socket Head Cap Screw	NB35408-025	M8 x 25	8	8	8	8	8	8
77		Indicator Cam	CS07700-160VXS	160VS*	1			1		
77		Indicator Cam	CS07700-160VXML	160VM*160VL*		1	1		1	1
78		Ball Bearing	CS07800-200	#6000	1	1	1	1	1	1
79		Stop Ring	NG12-010	S10	1	1	1	1	1	1
80		Bearing Gland	CS08000-200	200***	1	1	1	1	1	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6 x 15	3	3	3	3	3	3
82		V-ring	CS08200-200B	20 x 10 x 12	1	1	1	1	1	1
83		Spring	CS08300-200	200***	1	1	1	1	1	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1	1	1	1	1	1
91		Shaft Key	CS09100-160	160***	1	1	1	1	1	1
92		Suction Flange	CS71400-P125	MYK125A	1	1	1	1	1	1
93		Gasket, Suction Flange	CR72000-125N		1	1	1	1	1	1
94		Hexagon Head Bolt	NB12020-055	M20 x 55	8	8	8	8	8	8
95		Discharge Flange	CS71400-P100CD	MYK100CD	1	1	1			
95		Discharge Flange	CS71400-P100	MYK100A				1	1	1
96		Gasket (G), Discharge Flange	CR72000-100N					1	1	1
97		Hexagon Head Bolt	NB12022-055	M22 x 55	4	4	4	4	4	4
97		Hexagon Head Bolt	NB12022-080	M22 x 80 (in Japan)	4	4	4	4	4	4
100		Mechanical Seal Assembly	CS10000-160BT	BOS-T1	1	1	1	1	1	1

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P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
100		Mechanical Seal Assembly	CS10002-160EBS	BBS-E1	1	1	1	1	1	1
120		Unloader Indicator Assembly	CS12000-200F		1	1	1	1	1	1
137		Dial, Unloader Indicator	CS13700-200VD	200VL*	1	1	1	1	1	1
235		Spacer, Discharge Flange	FX101-160		1	1	1			
236		Gasket, Discharge Flange Spacer	CS23600-160N		1	1	1			
237		Torsional Slip Washer	CS23700-160	160***	2	2	2	2	2	2
250		Thrust Washer	CS25000-160	160***	2	2	2	2	2	2
251		Electromizer Flange	CR74000-025	MYK25A	1	1	1	1	1	1
252		Gasket, Electromizer Flange	CR72000-025N		1	1	1	1	1	1
253		Hexagon Head Bolt	NB15512-035	M12 x 35	4	4	4	4	4	4
254		Aquamizer Flange	CR74000-020	MYK20A	1	1	1	1	1	1
255		Gasket, Aquamizer Flange	CR72000-020N		1	1	1	1	1	1
256		Hexagon Head Bolt	NB15512-035	M12 x 35	2	2	2	2	2	2
267		Special Spring Washer	ND330-06	M6	5	5	5	5	5	5
289		Variable Vi Auxiliary Slide Valve	CS28900-160VSD	160VS*	1			1		
289		Variable Vi Auxiliary Slide Valve	CS28900-160VMD	160VM*		1			1	
289		Variable Vi Auxiliary Slide Valve	CS28900-160VLD	160VL*			1			1
325		“O” Ring	PA11-030	JISB2401P30	2	2	2	2	2	2
326		Gland, “O” Ring	CS32600-160VD		1	1	1	1	1	1
420		Spacer, Unload Position	CS42000-160VSD	160VS*	1			1		
420		Spacer, Unload Position	CS42000-160VMD	160VM*		1			1	
421		“O” Ring	PA11-030	JISB2401P30	2			2		
432		“O” Ring	PA12-085	JISB2401G85	4	4	4	4	4	4
433		“O” Ring	PA12-085	JISB2401G85	4	4	4	4	4	4
444		Vi Adjusting Rod	CS44400-160VSD	160VS*	1			1		
444		Vi Adjusting Rod	CS44400-160VMD	160VM*		1			1	
444		Vi Adjusting Rod	CS44400-160VLD	160VL*			1			1
446		Vi Square Washer	CS44600-160VD		1	1	1	1	1	1
448		Teflon Bushing	CS44800-160VD		1	1	1	1	1	1
449		Thrust Washer	CS44900-160VD		2	2	2	2	2	2
450		“O” Ring	PA11-025	JISB2401P25	2	2	2	2	2	2
451		“O” Ring	PA11-025	JISB2401P25	1	1	1	1	1	1
452		Hexagon Socket Head Cap Screw	NB35404-010	M4 x 10	1	1	1	1	1	1
453		Hexagon Nut	NC140-24	M24	1	1	1	1	1	1
456		Hexagon Socket Head Cap Screw	NB35405-010	M5 x 10	2	2	2	2	2	2
458		Plug	NF06-004	R 1/8	4	4	4	4	4	4
459		Plug	NF06-015	R 1/2	1	1	1	1	1	1
522		Domed Cap Nut	NC921-24	M24	1	1	1	1	1	1
523		“O” Ring	PA11-025	JISB2401P25	1	1	1	1	1	1
533		Spring Washer	ND330-04	M4	1	1	1	1	1	1
605		Plug	NF06-015	R 1/2	1	1	1	1	1	1
607	A	Plug	NF06-004	R 1/4	1	1	1	1	1	1
607	B	Plug	NF06-004	R 1/4	1	1	1	1	1	1
680	A	Conical Spring Washer		M24	1	1	1	1	1	1
680	B	Conical Spring Washer		M24	1	1	1	1	1	1

(2) 200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
1		Main Rotor Casing	CS00100-200VXS	200VS*	1			1		
1		Main Rotor Casing	CS00100-200VXM	200VM*		1			1	
1		Main Rotor Casing	CS00100-200VXL	200VL*			1			1
2		Hexagon Socket Head Cap Screw	NB35416-050	M16 x 50	50	50	50	50	50	50
3		Alignment Pin	NE2016-055	Ø16 x 55	4	4	4	4	4	4
4		Hanger Bolt	NB600-20	M24	1	1	1	1	1	1
5		Suction Cover	CS00500-200VX	200V**	1	1	1	1	1	1
6		Gasket, Suction Cover	CS0061-EV	200LDV	1	1	1	1	1	1
8		Spring Pin	NE3206-012	Ø6 x 12	2	2	2	2	2	2
9		“O” Ring	PA12-060	JISB2401G60	1	1	1	1	1	1
10	A	Plug	NF06-010	R 3/8	1	1	1	1	1	1
10	B	Plug	NF06-008	R 1/4	1	1	1	1	1	1
10	C	Plug	NF06-015	R 1/2	1	1	1	1	1	1
10	D	Plug	NF06-015	R 1/2	1	1	1	1	1	1
11		Bearing Head	CS01100-200VXD	200V**	1	1	1			
11		Bearing Head	CS01100-200VXG	200V*G				1	1	1
12		Gasket, Bearing Head	CS01200-200N	200***	1	1	1	1	1	1
13		Hanger Bolt	NB600-12	M12	1	1	1	1	1	1
14		Spring Pin	NE3206-012	Ø6 x 12	2	2	2	2	2	2
16		Bearing Cover	CS01600-200VXD	200V**	1	1	1			
16		Bearing Cover	CS01600-200VXG	200V*G				1	1	1
17		Gasket (D), Bearing Cover	CS01700-200VD	200V**	1	1	1			
17		Gasket (G), Bearing Cover	CS01700-200VG	200V*G				1	1	1
18	1	Hexagon Socket Head Cap Screw	NB35416-050	M16 x 50	15	15	15	18	18	18
18	2	Hexagon Socket Head Cap Screw	NB35416-075	M16 x 75	8	8	8			
18	3	Hexagon Socket Head Cap Screw	NB35416-065	M16 x 65	6	6	6	6	6	6
19		Alignment Pin	NE2010-050	Ø10 x 50	2	2	2	2	2	2
20		Spring Pin	NE3203-010	Ø3 x 10	1	1	1	1	1	1
21		Plug	NF06-004	R 1/8	1	1	1	1	1	1
22		Balance Piston Cover	CS02200-200VX	200V**	1	1	1	1	1	1
23		Gasket, Balance Piston Cover	CS02300-200N	200**	1	1	1	1	1	1
24		Hexagon Socket Head Cap Screw	NB35412-030	M12 x 30	11	11	11	11	11	11
25		Male Rotor	CS02500-200VS	200VS*	1			1		
26		Female Rotor	-	200VS*	1			1		
25		Male Rotor	CS02500-200VM	200VM*		1			1	
26		Female Rotor	-	200VM*		1			1	
25		Male Rotor	CS02500-200VL	200VL*			1			1
26		Female Rotor	-	200VL*			1			1
27		Main Bearing	CS0270-ERT	200***	2	2	2	2	2	2
28		Side Bearing	CS0280-ERT	200***	2	2	2	2	2	2
29		Stop Ring	NG11-130	H130	4	4	4	4	4	4
30		Balance Piston	CS03000-200H	200*DH	1	1	1	1	1	1
31		Key, Balance Piston	CS03100-200	200***	1	1	1	1	1	1
32		Stop Ring	NG12-065	S65	1	1	1	1	1	1
33		Sleeve, Balance Piston	CS03300-200H	200*DH	1	1	1	1	1	1
34		Set Screw	NA83608-015	M8 x 15	2	2	2	2	2	2
35		“O” Ring	PA11-120	JISB2401P120	1	1	1	1	1	1
36		“O” Ring Spacer	CS03600-200	200***	1	1	1	1	1	1
37		Stop Ring	NG11-130	H130	2	2	2	2	2	2
38		Thrust Bearing	CS03800-200P	7313B	2	2	2	2	2	2
39		Lock Nut	NG31-013	AN13	2	2	2	2	2	2
40		Lock Washer	NG32-013	AW13	2	2	2	2	2	2

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P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
41		Spacer, Thrust Bearing Outer Race	CS04100-200	200***	2	2	2	2	2	2
42		Spacer, Thrust Bearing Alignment	CS04200-200	200***	2	2	2	2	2	2
43		Thrust Bearing Gland	CS04300-200	200***	2	2	2	2	2	2
45		Hexagon Head Bolt	NB15512-035	M12 x 35	8	8	8	8	8	8
46		Conical Spring Washer (hexagon head bolt lock washer)	- (CS0469-E)	M12 (200***)	8	8	8	8	8	8
48		Retainer, Oil Seal	CS04800-200VD	200V** BOS TYPE	1	1	1	1	1	1
49		“O” Ring	PA12-115	JISB2401G115	1	1	1	1	1	1
50		Oil Seal	CS05010-200VD	SA1J65 x 85 x 12	1	1	1	1	1	1
51		Seal Cover	CS051000-200BBS	200***	1	1	1	1	1	1
52		Gasket, Seal Cover	CS05200-200N	200***	1	1	1	1	1	1
53		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	8	8	8	8	8	8
54		Unloader Slide Valve	CS05400-200VSD	200VS *	1			1		
54		Unloader Slide Valve	CS05400-200VMD	200VM*		1			1	
54		Unloader Slide Valve	CS05400-200VLD	200VL*			1			1
58		Hexagon Socket Head Cap Screw	NB35408-045	M8 x 45	5	5	5	5	5	5
60		Unloader Cylinder	CS06000-200VX	200V**	1	1	1	1	1	1
61		Hexagon Socket Head Cap Screw	NB35412-030	M12 x 30	2	2	2	2	2	2
62		Hexagon Socket Head Cap Screw	NB35412-075	M12 x 75	6	6	6	6	6	6
63		“O” Ring	PA12-150	JISB2401G150	1	1	1	1	1	1
64		Unloader Piston	CS06400-200D	200***	1	1	1	1	1	1
65		“O” Ring	PA11-125	JISB2401P125	1	1	1	1	1	1
66		Cap Seal	CS06600-200	CAP-3BE125	1	1	1	1	1	1
67		Push Rod, Unloader Slide Valve	CS0671-EV	200V**	1	1	1	1	1	1
68		Guide Pin	CS06809-05	Ø5 x 12	1	1	1	1	1	1
69		Lock Nut	NG31-007	AN07	1	1	1	1	1	1
70		Lock Washer	NG32-007	AW07	1	1	1	1	1	1
73		“O” Ring	PA12-030	JISB2401G30	1	1	1	1	1	1
74		Unloader Cylinder Cover	CS07400-200	200***	1	1	1	1	1	1
75		“O” Ring	PA12-135	JISB2401G135	1	1	1	1	1	1
76		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	8	8	8	8	8	8
77		Indicator Cam	CS07700-200VXS	200VS*	1			1		
77		Indicator Cam	CS07700-200VXML	200VM* 200VL*		1	1		1	1
78		Ball Bearing	CS07800-200	#6000	1	1	1	1	1	1
79		Stop Ring	NG12-010	S10	1	1	1	1	1	1
80		Bearing Gland	CS08000-200	200**	1	1	1	1	1	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6 x 15	3	3	3	3	3	3
82		V-ring	CS08200-200B	20 x 10 x 12	1	1	1	1	1	1
83		Spring	CS08300-200	200***	1	1	1	1	1	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1	1	1	1	1	1
91		Shaft Key	CS09100-200	200***	1	1	1	1	1	1
92		Suction Flange	CS71400-P150	MYK150A	1	1	1	1	1	1
93		Gasket, Suction Flange	CR72000-150N	MYK150A	1	1	1	1	1	1
94		Hexagon Head Bolt	NB12022-055	M22 x 55	8	8	8	8	8	8
95		Discharge Flange	CS71400-P125	MYK125A				1	1	1
95		Discharge Flange	CS71400-P125CD	MYK125CD	1	1	1			
96		Gasket (G), Discharge Flange	CR72000-125N	MYK125A				1	1	1
97		Hexagon Head Bolt	NB12020-055	M20 x 55	8	8	8	8	8	8
97		Hexagon Head Bolt	NB12020-080	M20 x 80 (in Japan)	8	8	8			
100		Mechanical Seal Assembly	CS10000-200BE	BOS-E1	1	1	1	1	1	1

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VSG	VMG	VLG
100		Mechanical Seal Assembly	CS10002-200EBS	BBS-E1	1	1	1	1	1	1
120		Unloader Indicator Assembly	CS12000-200F		1	1	1	1	1	1
137		Dial, Unloader Indicator	CS13700-200VD	200VL*	1	1	1	1	1	1
215		Flange, Lubrication Oil Supply	CR74000-020	MYK20A	1	1	1	1	1	1
216		Gasket, Lubrication Oil Supply Flange	CR72000-020N	MYK20A	1	1	1	1	1	1
217		Hexagon Head Bolt	NB15512-035	M12 x 35	2	2	2	2	2	2
235		Spacer, Discharge Flange	FX101-200	200***	1	1	1			
236		Gasket, Discharge Flange Spacer	CS23600-200N	200***	1	1	1			
237		Torsional Slip Washer	CS23700-200	200***	2	2	2	2	2	2
250		Thrust Washer	CS25000-200	200***	2	2	2	2	2	2
251		Electromizer Flange	CR74000-032	MYK32A	1	1	1	1	1	1
252		Gasket, Electromizer Flange	CR72000-032N	MYK32A	1	1	1	1	1	1
253		Hexagon Head Bolt	NB15512-040	M12 x 40	4	4	4	4	4	4
254		Aquamizer Flange	CR74000-025	MYK25A	1	1	1	1	1	1
255		Gasket, Aquamizer Flange	CR72000-025N	MYK25A	1	1	1	1	1	1
256		Hexagon Head Bolt	NB15512-035	M12 x 35	4	4	4	4	4	4
267		Special Spring Washer	ND330-08	M8	5	5	5	5	5	5
289		Variable Vi Auxiliary Slide Valve	CS28900-200VSD	200VS*	1			1		
289		Variable Vi Auxiliary Slide Valve	CS28900-200VMD	200VM*		1			1	
289		Variable Vi Auxiliary Slide Valve	CS28900-200VLD	200VL*			1			1
325		“O” Ring	PA11-040	JISB2401P40	2	2	2	2	2	2
326		Gland, “O” Ring	CS32600-200VD		1	1	1	1	1	1
420		Spacer, Unload Position	CS42000-200VSD	200VS *	1			1		
420		Spacer, Unload Position	CS42000-200VMD	200VM*		1			1	
421		“O” Ring	PA11-040	JISB2401P40	2			2		
432		“O” Ring	PA62-022	WG22	4	4	4	4	4	4
433		“O” Ring	PA62-022	WG22	4	4	4	4	4	4
444		Vi Adjusting Rod	CS44400-200VSD	200VS*	1			1		
444		Vi Adjusting Rod	CS44400-200VMD	200VM*		1			1	
444		Vi Adjusting Rod	CS44400-200VLD	200VL*			1			1
446		Vi Square Washer	CS44600-200VD		1	1	1	1	1	1
448		Teflon Bushing	CS44800-200VD		1	1	1	1	1	1
449		Thrust Washer	CS44900-200VD		2	2	2	2	2	2
450		“O” Ring	PA11-035	JISB2401P35	2	2	2	2	2	2
451		“O” Ring	PA11-035	JISB2401P35	1	1	1	1	1	1
452		Hexagon Socket Head Cap Screw	NB35405-015	M5 x 15	1	1	1	1	1	1
453		Hexagon Nut	NC140-30	M30	1	1	1	1	1	1
456		Hexagon Socket Head Cap Screw	NB35405-010	M5 x 10	2	2	2	2	2	2
458		Plug	NF06-004	R 1/8	4	4	4	4	4	4
459		Plug	NF06-020	R 3/4	1	1	1	1	1	1
522		Domed Cap Nut	NC921-30	M30	1	1	1	1	1	1
523		“O” Ring	PA11-035	JISB2401P35	1	1	1	1	1	1
528		Sleeve, Oil Seal	CS52800-200VD	200V**	1	1	1	1	1	1
529		Set Screw	NA83606-005	M6 x 8(2005/3 -)	2	2	2	2	2	2
533		Spring Washer	ND330-05	M5	1	1	1	1	1	1
605		Plug	NF06-020	R 3/4	1	1	1	1	1	1
607	A	Plug	NF06-004	R 1/4	1	1	1	1	1	1
607	B	Plug	NF06-004	R 1/4	1	1	1	1	1	1
680	A	Conical Spring Washer		M30	1	1	1	1	1	1
680	B	Conical Spring Washer		M30	1	1	1	1	1	1

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(3) 250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VLLD	VSG	VMG	VLG	VLLG
1		Main Rotor Casing	CS00100-250VXS	250VS*	1				1			
1		Main Rotor Casing	CS00100-250VXM	250VM*		1				1		
1		Main Rotor Casing	CS00100-250VXL	250VL*			1				1	
1		Main Rotor Casing	-	250VLL*				1				1
2		Hexagon Socket Head Cap Screw	NB35420-060	M20 x 60	44	44	44	44	44	44	44	44
3		Alignment Pin	NE2016-070	Ø16 x 70	4	4	4	4	4	4	4	4
4		Hanger Bolt	NB600-30	M30	1	1	1	1	1	1	1	1
5		Suction Cover	CS00500-250VX	250V**	1	1	1		1	1	1	
5		Suction Cover	-	250WV*				1				1
6		Gasket, Suction Cover	CS0061-FV	250LDV	1	1	1	1	1	1	1	1
7		Hanger Bolt	NB600-12	M12	2	2	2	2	2	2	2	2
8		Spring Pin	NE3206-012	Ø6 x 12	2	2	2	2	2	2	2	2
9		“O” Ring	PA12-065	JISB2401G65	1	1	1	1	1	1	1	1
10	A	Plug	NF06-010	R 3/8	1	1	1	1	1	1	1	1
10	B	Plug	NF06-008	R 1/4	1	1	1	1	1	1	1	1
10	C	Plug	NF06-020	R 3/4	1	1	1	1	1	1	1	1
10	D	Plug	NF06-015	R 1/2	1	1	1	1	1	1	1	1
11		Bearing Head	CS01100-250VXD	250V**	1	1	1	1				
11		Bearing Head	CS01100-250VXG	250V*G					1	1	1	1
12		Gasket, Bearing Head	CS01200-250N	250***	1	1	1	1	1	1	1	1
13		Hanger Bolt	NB600-12	M12	1	1	1	1	1	1	1	1
14		Spring Pin	NE3206-012	Ø6 x 12	2	2	2	2	2	2	2	2
16		Bearing Cover	CS01600-250VXD	250V**	1	1	1	1				
16		Bearing Cover	CS01600-250VXG	250V*G					1	1	1	1
17		Gasket (D), Bearing Cover	CS01700-250VD	250V**	1	1	1	1				
17		Gasket (G), Bearing Cover	CS01700-250VG	250V*G					1	1	1	1
18	1	Hexagon Socket Head Cap Screw	NB35416-050	M16 x 50	18	18	18	18	22	22	22	22
18	2	Hexagon Socket Head Cap Screw	NB35416-090	M16 x 90	8	8	8	8				
18	3	Hexagon Socket Head Cap Screw	NB35416-070	M16 x 70	5	5	5	5	6	6	6	6
19		Alignment Pin	NE2010-050	Ø10 x 50	2	2	2	2	2	2	2	2
20		Spring Pin	NE3203-010	Ø3 x 10	1	1	1	1	1	1	1	1
21		Plug	NF06-004	R 1/8	1	1	1	1	1	1	1	1
22		Balance Piston Cover	CS02200-250VX	250V**	1	1	1	1	1	1	1	1
23		Gasket, Balance Piston Cover	CS02300-250N	250***	1	1	1	1	1	1	1	1
24		Hexagon Socket Head Cap Screw	NB35412-030	M12 x 30	11	11	11	11	11	11	11	11
25		Male Rotor	CS02500-250VS	250VS*	1				1			
26		Female Rotor	CS02500-250VS	250VS*	1				1			
25		Male Rotor	CS02500-250VM	250VM*		1				1		
26		Female Rotor	CS02500-250VM	250VM*		1				1		
25		Male Rotor	CS02500-250VL	250VL*			1				1	
26		Female Rotor	CS02500-250VL	250VL*			1				1	
25		Male Rotor	-	250VLL*				1				1
26		Female Rotor	-	250VLL*				1				1
27		Main Bearing	CS0270-FRT	250***	2	2	2	4	2	2	2	4
28		Side Bearing	CS0280-FRT	250***	2	2	2		2	2	2	
29		Stop Ring	NG11-160	H160	4	4	4	4	4	4	4	4
30		Balance Piston	CS03000-250H	250**H	1	1	1	1	1	1	1	1
31		Key, Balance Piston	CS03100-250	250***	1	1	1	1	1	1	1	1
32		Stop Ring	NG12-080	S80	1	1	1	1	1	1	1	1
33		Sleeve, Balance Piston	CS03300-250H	250**H	1	1	1	1	1	1	1	1
34		Set Screw	NA83608-020	M8 x 20	2	2	2	2	2	2	2	2
35		“O” Ring	PA11-150	JISB2401P150	1	1	1	1	1	1	1	1

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VLLD	VSG	VMG	VLG	VLLG
36		"O" Ring Spacer	CS03600-250	250***	1	1	1		1	1	1	
36		"O" Ring Spacer	-	250H**				1				1
37		Stop Ring	NG11-160	H160	2	2	2	2	2	2	2	2
38		Thrust Bearing	CS03800-250P	7317B	2set	2set	2set	2set	2set	2set	2set	2set
39		Lock Nut	NG31-017	AN17	2	2	2	2	2	2	2	2
40		Lock Washer	NG32-017	AW17	2	2	2	2	2	2	2	2
42		Spacer, Thrust Bearing Alignment	CS04200-250	250***	2	2	2	2	2	2	2	2
43		Thrust Bearing Gland	CS04300-250	250***	2	2	2	2	2	2	2	2
45		Hexagon Head Bolt	NB15516-045	M16 x 45	8	8	8	8	8	8	8	8
46		Conical Spring Washer (hexagon head bolt lock washer)	CS0469-F	M16 (250***)	8	8	8	8	8	8	8	8
48		Retainer, Oil Seal	CS04800-250VD	250V** BBSE BBS III BOS	1	1	1	1	1	1	1	1
49		"O" Ring	PA12-135	JISB2401G135	1	1	1	1	1	1	1	1
50		Oil Seal	CS05010-250VD	SA1J75 x 100 x 13 75 x 100 x 13	1	1	1	1	1	1	1	1
51		Seal Cover	CS051000-250BBS	250V**	1	1	1	1	1	1	1	1
52		Gasket, Seal Cover	CS05200-250N	250***	1	1	1	1	1	1	1	1
53		Hexagon Socket Head Cap Screw	NB35412-030	M12 x 30	8	8	8	8	8	8	8	8
54		Unloader Slide Valve	CS05400-250VSD	250VS*	1				1			
54		Unloader Slide Valve (grooved)	-	250VS*	1				1			
54		Unloader Slide Valve	CS05400-250VMD	250VM*		1				1		
54		Unloader Slide Valve (grooved)	-	250VM*		1				1		
54		Unloader Slide Valve	CS05400-250VLD	250VL*			1				1	
54		Unloader Slide Valve (grooved)	-	250VL*			1				1	
54		Unloader Slide Valve	-	250VLL*				1				1
54		Unloader Slide Valve (grooved)	-	250VLL*				1				1
58		Hexagon Socket Head Cap Screw	NB35410-055	M10 x 55	5	5	5	5	5	5	5	5
60		Unloader Cylinder	CS06000-250VX	250V**	1	1	1	1	1	1	1	1
61		Hexagon Socket Head Cap Screw	NB35416-040	M16 x 40	2	2	2	2	2	2	2	2
62		Hexagon Socket Head Cap Screw	NB35416-090	M16 x 90	6	6	6	6	6	6	6	6
63		"O" Ring	PA12-190	JISB2401G190	1	1	1	1	1	1	1	1
64		Unloader Piston	CS06400-250D	250***	1	1	1	1	1	1	1	1
65		"O" Ring	PA11-155	JISB2401P155	1	1	1	1	1	1	1	1
66		Cap Seal	CS06600-250	SUNR-BE-155 (S4101)	1	1	1	1	1	1	1	1
67		Push Rod, Unloader Slide Valve	CS0671-FV	250VL*	1	1	1		1	1	1	
67		Push Rod, Unloader Slide Valve	-	250VLL*				1				1
68		Guide Pin	CS06809-05	Ø5 x 12	1	1	1	1	1	1	1	1
69		Lock Nut	NG31-008	AN08	1	1	1	1	1	1	1	1
70		Lock Washer	NG32-008	AW08	1	1	1	1	1	1	1	1
73		"O" Ring	PA12-035	JISB2401 G35	1	1	1	1	1	1	1	1
74		Unloader Cylinder Cover	CS07400-250	250***	1	1	1	1	1	1	1	1
75		"O" Ring	PA12-170	JISB2401 G170	1	1	1	1	1	1	1	1
76		Hexagon Socket Head Cap Screw	NB35412-030	M12 x 30	8	8	8	8	8	8	8	8
77		Indicator Cam	CS07700-250VXS	250VS*	1				1			
77		Indicator Cam	CS07700-250VXML	250VL*/VM*		1	1	1		1	1	1
78		Ball Bearing	CS07800-200	#6000	1	1	1	1	1	1	1	1
79		Stop Ring	NG12-010	S10	1	1	1	1	1	1	1	1
80		Bearing Gland	CS08000-200	200***	1	1	1	1	1	1	1	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6 x 15	3	3	3	3	3	3	3	3

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P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VLLD	VSG	VMG	VLG	VLLG
82		V-ring	CS08200-200B	20 x 10 x 12	1set	1set	1set	1set	1set	1set	1set	1set
83		Spring	CS08300-200	200***	1	1	1	1	1	1	1	1
84		Retainer Indicator Cam Spring	CS08400-200	200***	1	1	1	1	1	1	1	1
91		Shaft Key	CS09100-250	250***	1	1	1	1	1	1	1	1
92		Suction Flange	CS71400-P250	MYK250A	1	1	1	1	1	1	1	1
93		Gasket, Suction Flange	CS09300-250N	MYK250A	1	1	1	1	1	1	1	1
94		Hexagon Head Bolt	NB12024-065	M24 x 65	12	12	12	12	12	12	12	12
95		Discharge Flange	CS71400-P151CD	MYK150CD	1	1	1	1				
95		Discharge Flange	CS71400-P150	MYK150A					1	1	1	1
96		Gasket (G), Discharge Flange	CR72000-150N	MYK150A					1	1	1	1
97		Hexagon Head Bolt	NB12022-055	M22 x 55	8	8	8	8	8	8	8	8
100		Mechanical Seal Assembly	CS10002-250BE	BOS-E1	1set	1set	1set	1set	1set	1set	1set	1set
100		Mechanical Seal Assembly	CS10002-250EBS	BBS-E1	1set	1set	1set	1set	1set	1set	1set	1set
120		Unloader Indicator Assembly	CS12000-200F	200V**	1set	1set	1set	1set	1set	1set	1set	1set
137		Dial, Unloader Indicator	CS13700-200VD	200VL*	1	1	1	1	1	1	1	1
215		Flange, Lubrication Oil Supply	CR74000-025	MYK25A	1	1	1	1	1	1	1	1
216		Gasket, Lubrication Oil Supply Flange	CR72000-025N	MYK25A	1	1	1	1	1	1	1	1
217		Hexagon Head Bolt	NB15512-035	M12 x 35	4	4	4	4	4	4	4	4
235		Spacer, Discharge Flange	FX101-250	250***	1	1	1	1				
236		Gasket, Discharge Flange Spacer	CS23600-250N	250***	1	1	1	1				
237		Torsional Slip Washer	CS23700-250	250***	2	2	2	2	2	2	2	2
250		Thrust Washer	CS25000-250	250***	2	2	2	2	2	2	2	2
251		Electromizer Flange	CS71400-050	MYK50A	1	1	1	1	1	1	1	1
252		Gasket, Electromizer Flange	CR72000-050N	MYK50A	1	1	1	1	1	1	1	1
253		Hexagon Head Bolt	NB15516-045	M16 x 45	4	4	4	4	4	4	4	4
254		Aquamizer Flange	CR74000-032	MYK32A	1	1	1	1	1	1	1	1
255		Gasket, Aquamizer Flange	CR72000-032N	MYK32A	1	1	1	1	1	1	1	1
256		Hexagon Head Bolt	NB15512-040	M12 x 40	4	4	4	4	4	4	4	4
267		Special Spring Washer	ND330-10	M10	5	5	5	5	5	5	5	5
289		Variable Vi Auxiliary Slide valve	CS28900-250VSD	250VS*	1				1			
289		Variable Vi Auxiliary Slide valve	CS28900-250VMD	250VM*		1				1		
289		Variable Vi Auxiliary Slide valve	CS28900-250VLD	250VL*			1				1	
289		Variable Vi Auxiliary Slide valve	-	250VLL*				1				1
325		“O” Ring	PA11-046	JISB2401P46	2	2	2	2	2	2	2	2
326		Gland, “O” Ring	CS32600-250VD	250V**	1	1	1	1	1	1	1	1
420		Spacer, Unloader Positioning	CS42000-250VSD	250VS*	1				1			
420		Spacer, Unloader Positioning	CS42000-250VMD	250VM*		1				1		
421		“O” Ring	PA11-046	JISB2401P46	2				2			
432		“O” Ring	PA12-135	JISB2401G135	4	4	4	4	4	4	4	4
433		“O” Ring	PA12-135	JISB2401G135	4	4	4	4	4	4	4	4
444		Vi Adjusting Rod	CS44400-250VSD	250VS*	1				1			
444		Vi Adjusting Rod	CS44400-250VMD	250VM*		1				1		
444		Vi Adjusting Rod	CS44400-250VLD	250VL*			1				1	
444		Vi Adjusting Rod	-	250VLL*				1				1
446		Vi Square Washer	CS44600-250VD	250V**	1	1	1	1	1	1	1	1
448		Teflon Bushing	CS44800-250VD	250V**	1	1	1	1	1	1	1	1
449		Thrust Washer	CS44900-250VD	250V**	2	2	2	2	2	2	2	2
450		“O” Ring	PA11-040	JISB2401P40	2	2	2	2	2	2	2	2
451		“O” Ring	PA11-040	JISB2401P40	1	1	1	1	1	1	1	1
452		Hexagon Socket Head Cap Screw	NB35406-020	M6 x 20	1	1	1	1	1	1	1	1
453		Hexagon Nut	NC140-36	M36	1	1	1	1	1	1	1	1
456		Hexagon Socket Head Cap Screw	NB35405-010	M5 x 10	4	4	4	4	4	4	4	4
458	1	Plug	NF06-015	R 1/2	1	1	1	1	1	1	1	1

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD	VLLD	VSG	VMG	VLG	VLLG
458	2	Plug	NF06-004	R 1/8	2	2	2	2	2	2	2	2
458	3	Plug	NF06-008	R 1/4	1	1	1	1	1	1	1	1
459		Plug	NF06-015	R 1/2	1	1	1	1	1	1	1	1
522		Domed Cap Nut	NC921-36	3 Type M36	1	1	1	1	1	1	1	1
523		"O" Ring	PA11-040	JISB2401P40	1	1	1	1	1	1	1	1
528		Sleeve, Oil Seal	CS52800-250VD	250V**	1	1	1	1	1	1	1	1
529		Set Screw	NA83606-008	M6 x 8 (2005/3-)	2	2	2	2	2	2	2	2
533		Spring Washer	ND330-06	M6	1	1	1	1	1	1	1	1
605		Plug	NF06-025	R 1"	1	1	1	1	1	1	1	1
607	A	Plug	NF06-004	R 1/4	1	1	1	1	1	1	1	1
607	B	Plug	NF06-004	R 1/4	1	1	1	1	1	1	1	1
680	A	Conical Spring Washer		M36	1	1	1	1	1	1	1	1
680	B	Conical Spring Washer		M36	1	1	1	1	1	1	1	1

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(4) 320VSD, 320VMD, 320VLD

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD
1		Main Rotor Casing	CS00100-320VXS	320VS*	1		
1		Main Rotor Casing	CS00100-320VXM	320VM*		1	
1		Main Rotor Casing	CS00100-320VXL	320VL*			1
2		Hexagon Socket Head Cap Screw	NB35424-080	M24 x 80	52	52	52
3		Alignment Pin	NE2025-080	Ø25 x 80	4	4	4
4		Hanger Bolt	NB600-30	M30	2	2	2
5		Suction Cover	CS00500-320VXD	320V**	1	1	1
6		Gasket, Suction Cover	CS00600-320VD	320V**	1	1	1
7		Hanger Bolt	NB600-16	M16	2	2	2
8		Spring Pin	NE3206-018	Ø6 x 18	2	2	2
9		“O” Ring	PA11-058	JISB2401P58	1	1	1
10	A	Plug	NF06-020	R 3/4	1	1	1
10	B	Plug	NF06-015	R 1/2	2	2	2
11		Bearing Head	CS01100-320VXD	320***	1	1	1
12		Gasket, Bearing Head	CS01200-320N	320***	1	1	1
13		Hanger Bolt	NB600-16	M16	1	1	1
14		Spring Pin	NE3206-018	Ø6 x 18	2	2	2
15		Plug	NF06-010	R 3/8	1	1	1
16		Bearing Cover	CS01600-320VXD	320V*D	1	1	1
17		Gasket (D), Bearing Cover	CS01700-320VD	320V*D	1	1	1
18	1	Hexagon Socket Head Cap Screw	NB35420-070	M20 x 70	19	19	19
18	2	Hexagon Socket Head Cap Screw	NB35420-120	M20 x 120	12	12	12
18	3	Hexagon Socket Head Cap Screw	NB35420-120	M20 x 120	6	6	6
19		Alignment Pin	NE2016-070	Ø16 x 70	2	2	2
20		Spring Pin	NE3203-016	Ø3 x 16	1	1	1
21		Plug	NF06-008	R 1/4	1	1	1
22		Balance Piston Cover	CS02200-320	320***	1	1	1
23		Gasket, Balance Piston Cover	CS02300-320N	320***	1	1	1
24		Hexagon Socket Head Cap Screw	NB35416-045	M16 x 45	11	11	11
25		Male Rotor	CS02500-320VS	320S*	1		
26		Female Rotor	-	320S**	1		
25		Male Rotor	CS02500-320VM	320M**		1	
26		Female Rotor	-	320M**		1	
25		Male Rotor	CS02500-320VL	320L**			1
26		Female Rotor	-	320L**			1
27		Main Bearing	CS0270-GRT	320***	2	2	2
28		Side Bearing	CS0280-GRT	320***	2	2	2
29		Stop Ring	NG11-200	H200	4	4	4
30		Balance Piston	CS03000-320H	320**H	1	1	1
31		Key, Balance Piston	CS03100-320	320***	1	1	1
32		Stop Ring	NG12-100	S100	1	1	1
33		Sleeve, Balance Piston	CS03300-320H	320**H	1	1	1
34		Spring Pin	NE3206-014	Ø6 x 14	1	1	1
35		“O” Ring	PA12-190	JISB2401G190	1	1	1
36		“O” Ring Spacer	CS03600-320	320***	1	1	1
37		Stop Ring	NG11-200	H200	2	2	2
38		Thrust Bearing	CS03800-320	7321A	2	2	2
39		Lock Nut	NG31-021	AN21	2	2	2
40		Lock Washer	NG32-021	AW21	2	2	2
42		Spacer, Thrust Bearing Alignment	CS04200-320	320***	2	2	2
43		Thrust Bearing Gland	CS04300-320	320***	2	2	2

P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD
45		Hexagon Head Bolt	NB15520-055	M20 x 55	8	8	8
46		Conical Spring Washer (hexagon head bolt lock washer)	- (CS0469-G)	M20 (320***)	8	8	8
48		Retainer, Oil Seal	CS04800-320VD	320***	1	1	1
49		“O” Ring	PA12-160	JISB2401G160	1	1	1
50		Oil Seal	CS05010-320VD	SAIJ95 x 120 x 13	1	1	1
51		Seal Cover	CS051000-320BBS	320***	1	1	1
52		Gasket, Seal Cover	CS05200-320N	320***	1	1	1
53		Hexagon Socket Head Cap Screw	NB35416-040	M16 x 40	8	8	8
54		Unloader Slide Valve	CS05400-320VSD	320VS*	1		
54		Unloader Slide Valve (grooved)	-	320VS*	1		
54		Unloader Slide Valve	CS05400-320VMD	320VM*		1	
54		Unloader Slide Valve (grooved)	-	320VM*		1	
54		Unloader Slide Valve	CS05400-320VLD	320VL*			1
54		Unloader Slide Valve (grooved)	-	320VL*			1
58		Hexagon Socket Head Cap Screw	NB35412-055	M12 x 55	5	5	5
60		Unloader Cylinder	CS06000-320V	320V**	1	1	1
61		Hexagon Socket Head Cap Screw	NB35420-050	M20 x 50	2	2	2
62		Hexagon Socket Head Cap Screw	NB35420-110	M20 x 110	6	6	6
63		“O” Ring	PA12-240	JISB2401G240	1	1	1
64		Unloader Piston	CS06400-320U	320***	1	1	1
65		“O” Ring	PA11-200	JISB2401P200	1	1	1
66		Cap Seal	CS06600-320	CAP-3BE200	1	1	1
67		Push Rod, Unloader Slide Valve	CS0671-GV	320V**	1	1	1
68		Guide Pin	NE3206-016	Ø6 x 16	1	1	1
69		Lock Nut	NG31-010	AN10	1	1	1
70		Lock Washer	NG32-010	AW10	1	1	1
73		“O” Ring	PA11-044	JISB2401P44	1	1	1
74		Unloader Cylinder Cover	CS07400-320	320***	1	1	1
75		“O” Ring	PA12-210	JISB2401G210	1	1	1
76		Hexagon Socket Head Cap Screw	NB35416-040	M16 x 40	8	8	8
77		Indicator Cam	CS07700-320VS	320VS*	1		
77		Indicator Cam	CS07700-320VM	320VM*		1	
77		Indicator Cam	CS07700-320VL	320VL*			1
78		Ball Bearing	CS07800-200	#6000	1	1	1
79		Stop Ring	NG12-010	S10	1	1	1
80		Bearing Gland	CS08000-200	200L**	1	1	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6 x 15	3	3	3
82		V-ring	CS08200-200B	20 x 10 x 12	1	1	1
83		Spring	CS08300-200	200L**	1	1	1
84		Retainer, Indicator Cam Spring	CS08400-200	200L**	1	1	1
91		Shaft Key	CS09100-320	320***	1	1	1
92		Suction Flange	CS71400-P350	MYK350A	1	1	1
93		Gasket, Suction Flange	CS09300-320N	MYK350A	1	1	1
94		Hexagon Head Bolt	NB12024-075	M24 x 75	16	16	16
95		Discharge Flange	CS71400-P200	MYK200A	1	1	1
95		Discharge Flange	CS71400-P200CD	MYK200CD	1	1	1
96		Gasket (G), Discharge Flange	CR72000-200N	MYK200A	1	1	1
97		Hexagon Head Bolt	NB12020-055	M20 x 55	12	12	12
100		Mechanical Seal Assembly	CS10000-320BE	BOS-E1	1	1	1
100		Mechanical Seal Assembly	CS10002-320EBS	BBS-E1			
120		Unloader Indicator Assembly	CS12000-200F		1	1	1
137		Dial, Unloader Indicator	CS13700-200VD	200VL*	1	1	1
150		“O” Ring	PA12-220	JISB2401G220	2	2	2

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P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD
166		Hexagon Socket Head Cap Screw	NB35405-010	M5 x 10	4	4	4
215		Flange, Lubrication Oil Supply	CS71400-040	MYK40A	1	1	1
216		Gasket, Lubrication Oil Supply Flange	CR72000-040N	MYK40A	1	1	1
217		Hexagon Head Bolt	NB14012-040	M12 x 40	4	4	4
218		Flange, Injection Oil Supply	CR74000-025	MYK25A	1	1	1
219		Gasket, Oil Injection Flange	CR72000-025N	MYK25A	1	1	1
220		Hexagon Head Bolt	NB14012-035	M12 x 35	4	4	4
235		Spacer, Discharge Flange	#N/A		1	1	1
236		Gasket, Discharge Flange Spacer	CS23600-320N		1	1	1
237		Torsional Slip Washer	CS23700-320	320***	2	2	2
250		Thrust Washer	CS25000-320	320***	2	2	2
251		Electromizer Flange	CR74000-080	MYK80A	1	1	1
252		Gasket, Electromizer Flange	CR72000-080N	MYK80A	1	1	1
253		Hexagon Head Bolt	NB15520-055	M20 x 55	4	4	4
254		Aquamizer Flange	CS71400-050	MYK50A	1	1	1
255		Gasket, Aquamizer Flange	CR72000-050N	MYK50A	1	1	1
256		Hexagon Head Bolt	NB15516-045	M16 x 45	4	4	4
267		Special Spring Washer	ND330-12	M12	5	5	5
289		Variable Vi Auxiliary Slide Valve	CS28900-320VSD	320VSD	1		
289		Variable Vi Auxiliary Slide Valve	CS28900-320VMD	320VMD		1	
289		Variable Vi Auxiliary Slide Valve	CS28900-320VLD	320VLD			1
326		Gland, "O" Ring	CS32600-320		1	1	1
420		Spacer, Unload Position	CS42000-320VSD	320VSD	1		
420		Spacer, Unload Position	CS42000-320VMD	320VMD		1	
420		Spacer, Unload Position	CS42000-320VLD	320VLD			1
421		"O" Ring	PA11-058	JISB2401P58	2	2	2
432		"O" Ring	PA12-165	JISB2401G165	4	4	4
433		"O" Ring	PA12-165	JISB2401G165	4	4	4
444		Vi Adjusting Rod	CS44400-320VSD	320VSD	1		
444		Vi Adjusting Rod	CS44400-320VMD	320VMD		1	
444		Vi Adjusting Rod	CS44400-320VLD	320VLD			1
446		Vi Square Washer	CS44600-250VD	250V**	1	1	1
448		Teflon Bushing	CS44800-320VD		1	1	1
449		Thrust Washer	CS44900-320VD		2	2	2
450		"O" Ring	PA11-044	JISB2401P44	2	2	2
451		"O" Ring	PA11-050A	JISB2401P50A	1	1	1
452		Hexagon Socket Head Cap Screw	NB35406-020	M6 x 20	1	1	1
453		Hexagon Nut	NC140-36	M36	1	1	1
458	1	Plug	NF06-008	R1 1/4	1	1	1
458	3	Plug	NF06-008	R 1/4	3	3	3
522		Domed Cap Nut	NC921-36	M36	1	1	1
523		"O" Ring	PA11-050A	JISB2401P50A	1	1	1
528		Sleeve, Oil Seal	CS52800-320VD		1	1	1
529		Set Screw	NA83606-010	M6 x 8 (2005/3-)	2	2	2
533		Spring Washer	ND330-06	M6	5	5	5
599		Guide Pin	NE3206-016	Ø6 x 16	1	1	1
600		Retainer, Vi Adjusting Rod	CS60000-320VD	320V**	1	1	1
601		Flange, Lubrication Oil Inlet	CR74000-020	MYK20A	1	1	1
602		Gasket, Lubrication Oil Inlet Flange	CR72000-020N	MYK20A	1	1	1
603		Hexagon Head Bolt	NB14012-035	M12 x 35	2	2	2
604		Vi Adjusting Rod Washer		JIS B1256 36	1	1	1
605		Plug	NF06-032	R1 1/4	1	1	1
607	A	Plug	NF06-004	R 1/4	1	1	1

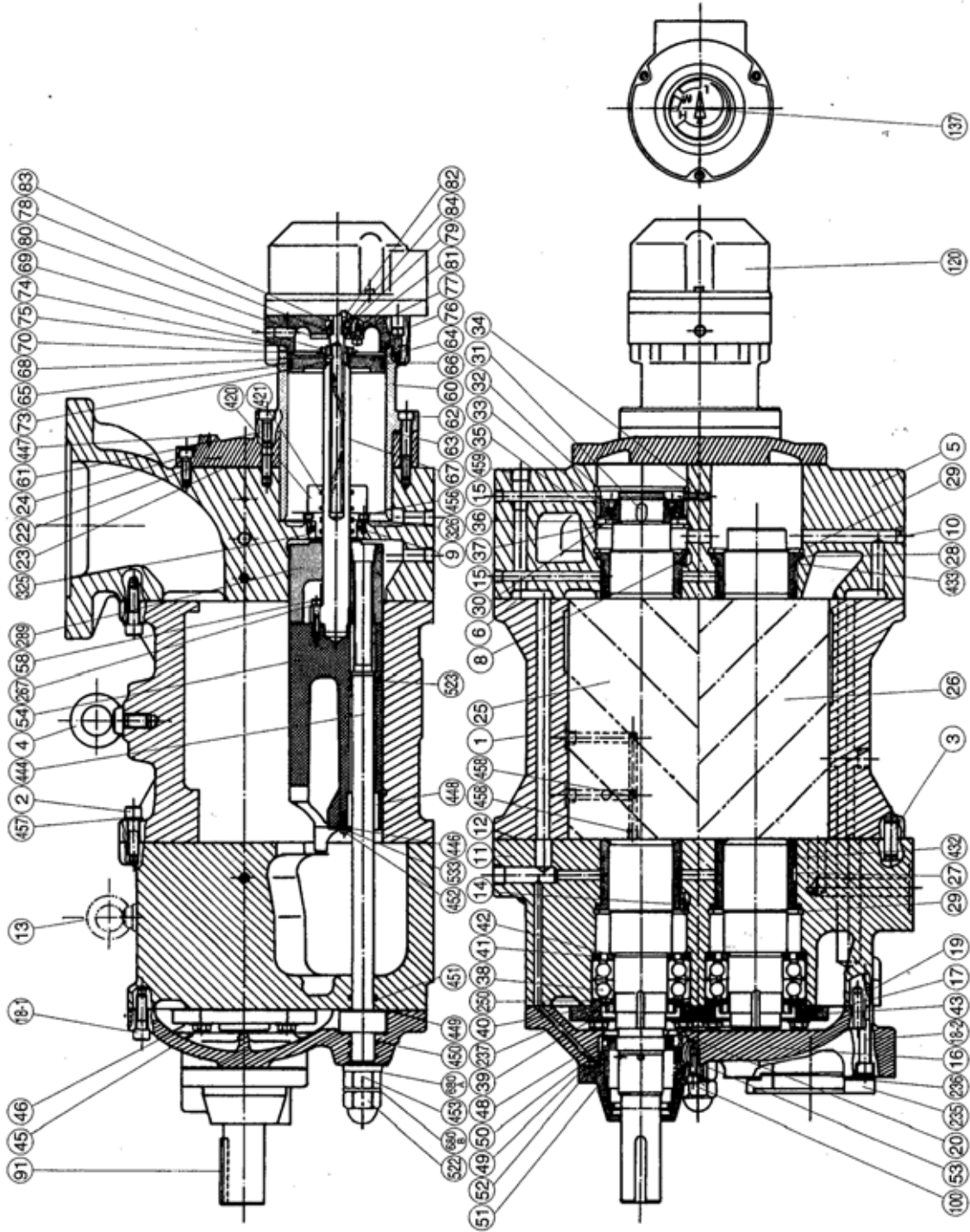
P/N	EX	Part Name	Code No.	Remarks	VSD	VMD	VLD
607	B	Plug	NF06-004	R 1/4	1	1	1
680	A	Conical Spring Washer		M36	1	1	1
680	B	Conical Spring Washer		M36	1	1	1

1.6.3 Sectional Views

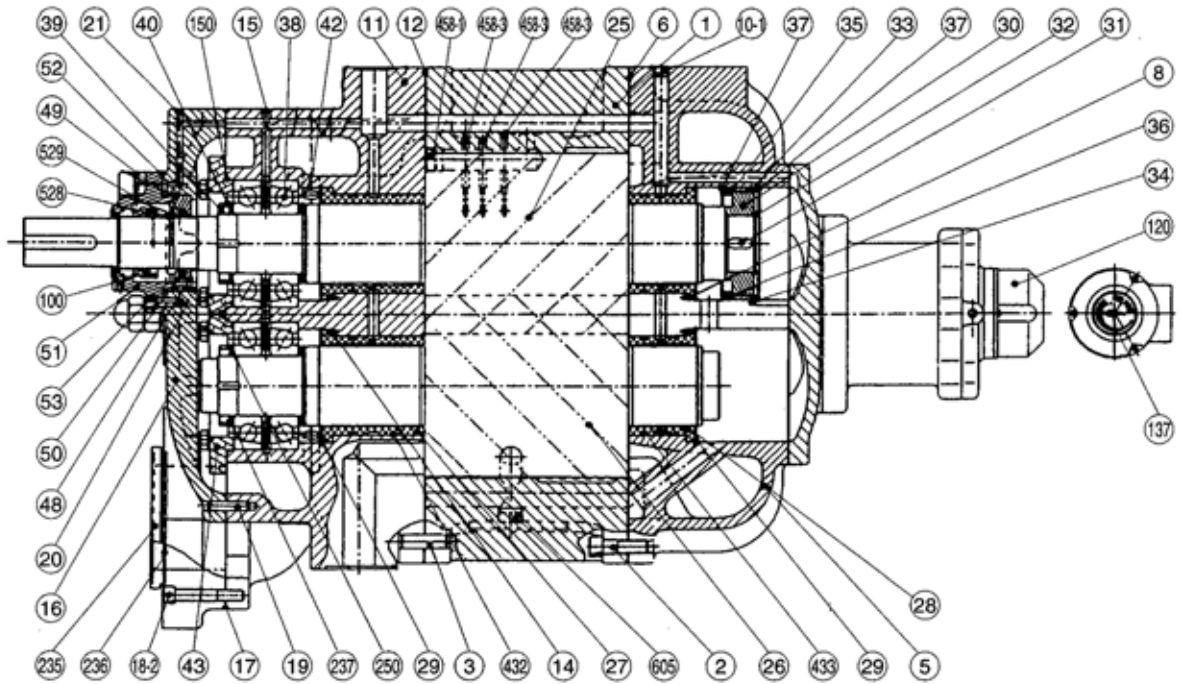
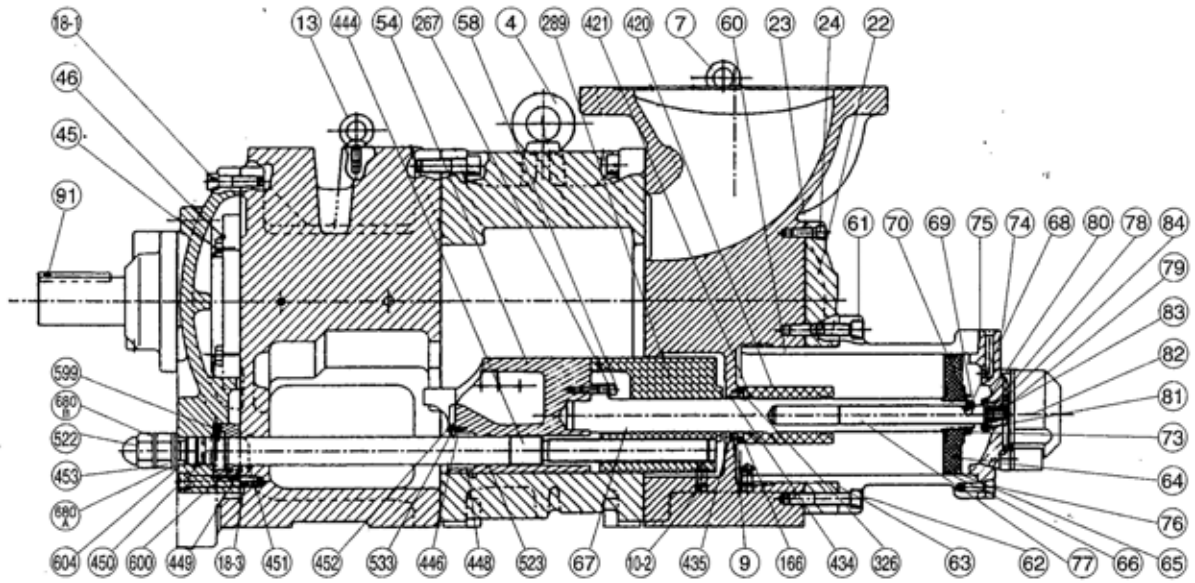
This section shows the sectional views of the following compressor models.

- (1) **160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG**
200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG
250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG
- (2) **320VSD, 320VMD and 320VLD**

- (1) 160VSD, 160VMD, 160VLD, 160VSG, 160VMG, 160VLG
 200VSD, 200VMD, 200VLD, 200VSG, 200VMG, 200VLG
 250VSD, 250VMD, 250VLD, 250VLLD, 250VSG, 250VMG, 250VLG, 250VLLG



(2) 320VSD, 320VMD and 320VLD

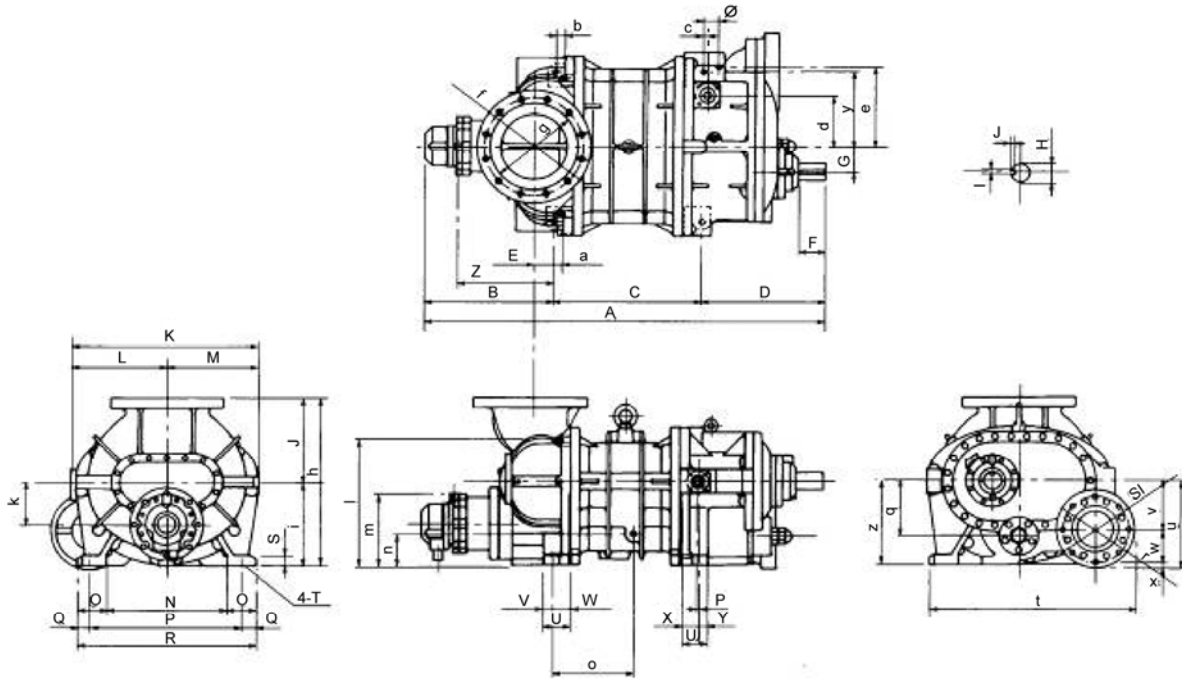


1.6.4 Dimensions and Weights

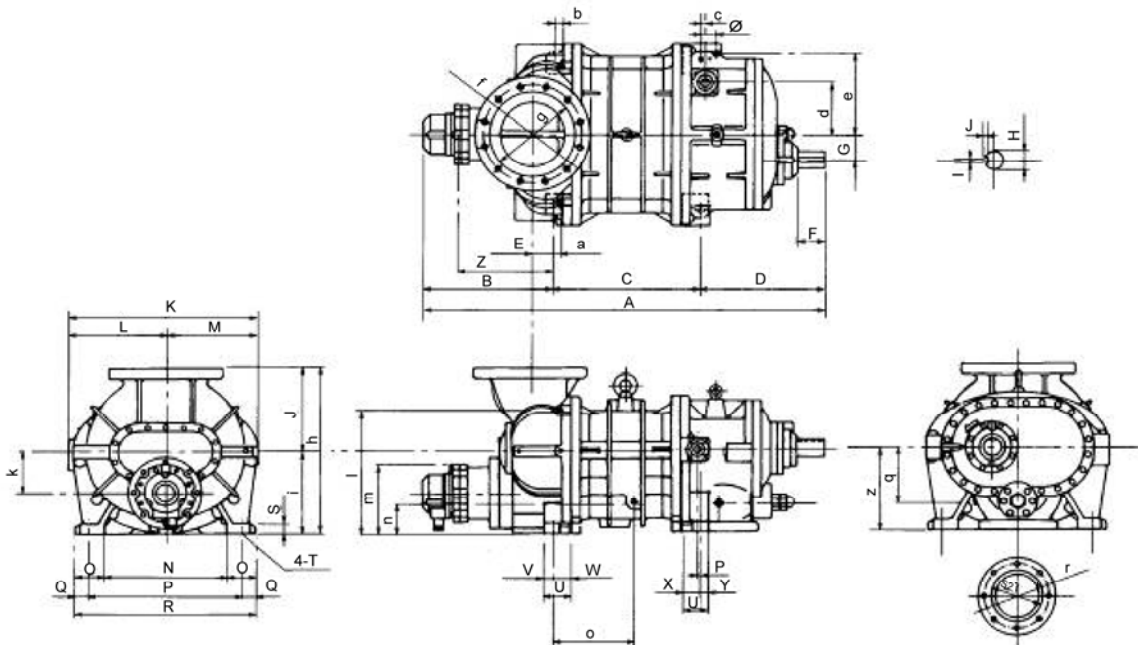
This section contains the drawings and table to show the external dimensions and weights of the individual SCV Series models.

NOTE: Use the letters in the drawings as keys to dimensions in the dimension table.

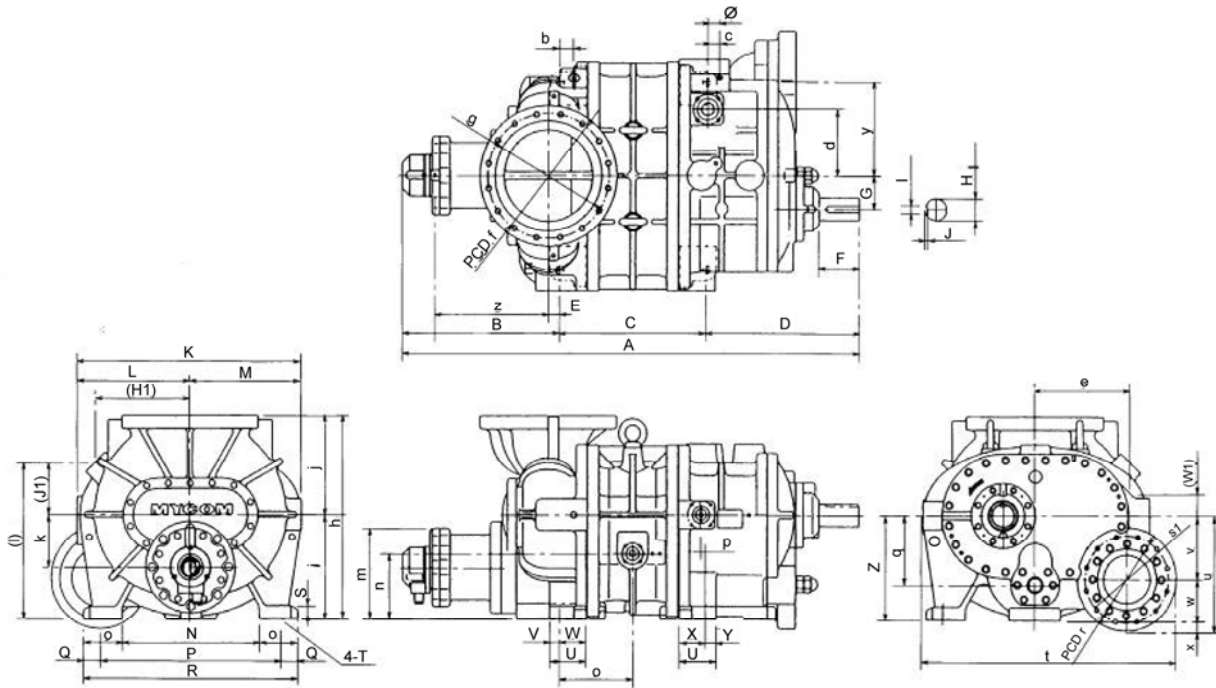
- (1) Dimension drawing – 160VSD, 160VMD, 160VLD, 200VSD, 200VMD, 200VLD, 250VSD, 250VMD, 250VLD, and 250VLLD (models with a sideways facing discharge port)



- (2) Dimension drawing – 160VSG, 160VMG, 160VLG, 200VSG, 200VMG, 200VLG, 250VSG, 250VMG, 250VLG, and 250VLLD (models with a downward facing discharge port)



(3) Dimension drawing – 320VSD, 320VMD, and 320VLD



(4) Dimension table

(mm)

Model	A	B	C	D	E	F	G	H	I	J	K
160VS*	1027	387	280	360	40.5	91	64	45 ^{+0.011} _{-0.005}	12 ^{+0.027} ₀	4.5 ^{+0.05} ₀	470
VM*	1072		325								
VL*	1117		370								
200VS*	1199	429	363	407	40.5	100	80	55 ^{+0.012} _{-0.007}	15 ^{+0.027} ₀	5 ^{+0.05} ₀	570
VM*	1256		420								
VL*	1311		475								
250VS*	1395	495	430	470	80.5	104	100	67 ^{+0.012} _{-0.007}	18 ^{+0.027} ₀	6 ^{+0.05} ₀	715
VM*	1467		502								
VL*	1535		570								
VLL*	1612.5		647.5								
320VSD	1796	620	576	600	45	156	126	85 ^{+0.011}	24 ^{+0.043} ₀	8 ^{+0.05} ₀	890
VMD	1884		664								
VLD	1971		751								

Model	L	M	N	O	P	Q	R	S	T	U	V	W
160VS*	240	230	300	80	370	45	480	25	Ø25	65	22.5	39.5
VM*												
VL*												
200VS*	290	280	360	100	460	50	560	30	Ø23	95	30.5	64.5
VM*												
VL*												
250VS*	385	350	460	110	580	50	680	40	Ø23	100	30.5	69.5
VM*												
VL*												
VLL*												
320VSD	450	440	540	155	720	65	850	50	Ø33	145	40	105
VMD												
VLD												

Model	X	Y	Z	a	b	c	d	e	f	g	h	i
160VS*	40	25	210	24.5	24.5	5	127	216	230	174	410	210
VM*												
VL*												
200VS*	63	30	260	39.5	39.5	15	160	251.5	248	199	510	260
VM*												
VL*												
250VS*	70	30	320	34.5	34.5	15	198	307	375	331	640	320
VM*												
VL*												
VLL*												
320VSD	105	40	400	-	55	5	255	376	480	422	780	380
VMD												
VLD												

Model	j	k	l	m	n	o	p	q	r	s1	s2	t
160VS*	200	102.5	302	187.5	70	140	10	132.5	190	111	144	450
VM*						162.5						
VL*						207						
200VS*	250	128	381.5	224.5	145	184.5	18	168	230	146	174	657
VM*						241.5						
VL*						296.5						
250VS*	320	160	482	257	120	215	10	210	248	176	199	779
VM*						256.5						
VL*						314.5						
VLL*						349.5						
320VSD	380	202	597	348	250	288	20	264	330	234	-	996
VMD						431						
VLD						394						

Model	u	v	w	x	y	z	Ø	HI	JI	WI
160VS*	225	130	80	5	125	261	34	-	-	-
VM*										
VL*										
200VS*	280	143	117	15	240	303	36	-	-	-
VM*										
VL*										
250VS*	335	186	134	20	290	388	57	-	-	-
VM*										
VL*										
VLL*										
320VSD	436	240	160	36	280	494	51	376	197	83
VMD										
VLD										

(5) Weight table

Weight (kg)			
160VSD	370	160VSG	350
VMD	380	VMG	360
VLD	390	VLG	410
200VSD	630	200VSG	610
VMD	670	VMG	650
VLD	700	VLG	680
250VSD	1,180	250VSG	1,120
VMD	1,220	VMG	1,180
VLD	1,300	VLG	1,260
VLLD	1,390	VLLG	1,350
320VSD	2,240		
VMD	2,480		
VLD	2,640		

Chapter 2 Essential Points for Operation

2.1 General

This chapter describes the instructions that are essential to be followed when operating the MYCOM SCV Series Screw Compressors, including the procedure for adjusting the Vi and recommendations for the lubricant to be used.

2.2 Points to Be Observed When Operating the Compressor

- The SCV Series Screw Compressors should be operated in the conditions within the limits indicated in Table 2-1.

As to the oil supply pressure (item No. 5 in the table), the pressures for the pump pressurized supply system should be applied to the capacity control system (hydraulic pressure for controlling the unloader slide valve).

Table 2-1 Operational Limits for SCV Series Screw Compressors

No.	Item	Limit		
1	Maximum discharge pressure	1.96 MPaG (1.37 MPaG for 250VLL)		
2	Maximum suction pressure	0.59 MPaG		
3	Minimum suction pressure	-0.080 MPaG		
4	Minimum difference between suction and discharge pressures	0.49 MPaG		
5	Oil supply pressure	Pump-pressurized supply system	Differential pressure supply system	
		Maximum	Pd +0.39 MPaG	Pd (= discharge pressure)
		Minimum	Pd +0.049 MPaG	Pd -0.049 MPaG
6	Maximum discharge gas temperature	90 °C		
7	Maximum supply oil temperature	60 °C		
8	Minimum supply oil temperature	30 °C		
9	Maximum male rotor speed	4,500 rpm (3,600 rpm for 250VLLD/VLLG and 320VSD/VMD/VLD)		
10	Minimum male rotor speed	1,450 rpm		
11	Refrigerant	NH ₃ , HFC, etc.		

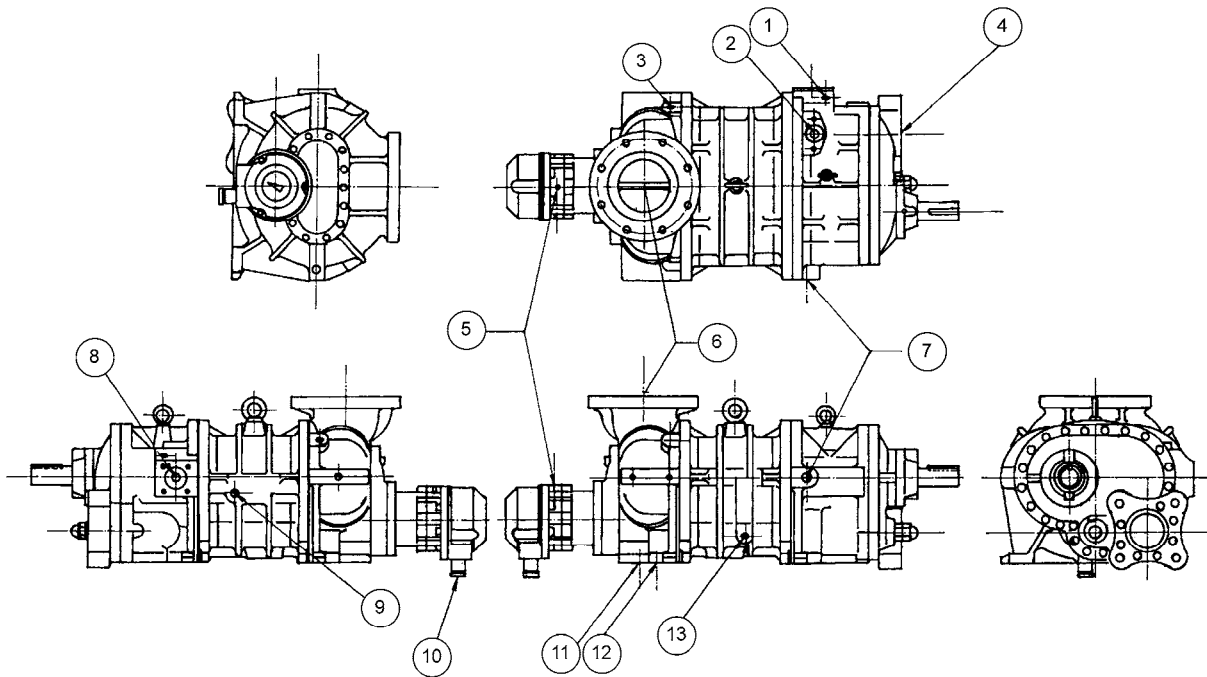
Ps: suction pressure

Pd: discharge pressure

- Prolonged 30 % or lower part-load operation may cause noise and vibration and, therefore, should be avoided.

2.3 Connecting Ports on Compressor

Fig. 2-1 shows the connecting port locations of the compressor.



No.		No.	
1	Connecting port II for liquid injection	8	Electromizer connecting port
2	Connecting port I for liquid injection	9	Oil return port plug
3	Oil supply port for female rotor side bearing	10	Control wiring connector
4	Discharge gas outlet	11	Connecting port I for unloader control oil (for 100 % load)
5	Connecting port II for unloader control oil (for 0 % load)	12	Oil drain port
6	Suction gas inlet	13	Connecting port for oil injection
7	Lubrication oil main supply port (journal)		

Fig.2-1 Connecting Ports of Compressor

2.4 Adjustment of Vi

2.4.1 Considerations to Take When Using Vi Adjusting Mechanism

- Change the Vi setting only when the application of the SCV Series Screw Compressor is significantly changed using the examples shown below as a guideline. Changes in operating condition experienced in daily operation have no significant influence on the brake horse power and thus constitute no reason for changing the Vi setting. However, the temperature difference between the summer and the winter is, besides the change in application, a typical factor that requires change of the Vi setting.

Typical case that requires Vi setting change:

When the application of the compressor is changed from a cold storage system (evaporation temperature at about 0 °C) to a refrigeration system (evaporation temperature at -40 °C), the brake horse power in the new application will be 1.5 times as large as that of the old application if the Vi remains at the L port setting. It is recommended to change the Vi setting to the H port setting for the new application.

Typical case that does not require Vi setting change:

With a compressor that is used for a freezing system in which the evaporation temperature varies between 0 and -30 °C as time passes, the Vi setting should not be changed according to the change resulting from rises in compression ratio. The compressor should be used with the Vi fixed at the original M port setting in this case.

- The same Vi setting should be maintained during operation of the compressor.
In the case of a special application that requires frequent adjustment of the Vi to match it with varying operating condition, it is recommended to use a Maximizer screw compressor (produced by Mayekawa as another series product) that incorporates a mechanism for hydraulically adjusting the position of the variable Vi auxiliary slide valve.

2.4.2 How to Adjust the Vi



- **Never perform Vi adjustments while the compressor is in operation. Perform Vi adjustments only after stopping the compressor. Because the rotary shafts are near the Vi adjustment location, there is an increased risk of personal injury or death as clothing can be caught in rotating shafts or tools may get in touch with them.**
- **Be sure to turn off both the compressor motor main power and the control power after following the pre-established compressor stopping procedure. In addition, take all necessary measures to prevent any persons other than the person performing the Vi adjustment from accidentally turning on the power supplies. Failure to do so will result in a serious accident.**



WARNING

- **When turning on or off the electric power supplies, be sufficiently careful to avoid electric shock.**

CAUTION

- **Do not operate the compressor with the Vi at any other setting than the L, M or H port setting.**

NOTE:

- The “P/N” numbers in the following procedure correspond to the part numbers in 1.6.1 “Components Drawings” and 1.6.2 “Parts Lists.”
- Read the instructions in the following procedure while referring to Fig. 2-4.

- (1) First, determine the expected operating condition of the system and work out the Vi value under the condition thus determined (use the formula shown in 1.3.1 “What Is the Internal Volume Ratio Vi?” for the calculation). Next, select the L, M, or H port setting, whichever is the closest to the calculated Vi value. The compressor is set to the “H” port position before shipment.
- (2) Push the unloader piston (P/N 64) to move the unloader slide valve to the no-load (0 %) position (position shown in Sequence (2) in Fig. 2-4).
- (3) From the table of Fig. 2-5 “Number of Turns of Vi Adjusting Rod for Individual Models”, determine how many turns the adjusting rod should be rotated in order to set to the port selected in Step (1) above.
- (4) Set the Vi adjusting rod to the selected port as follows:

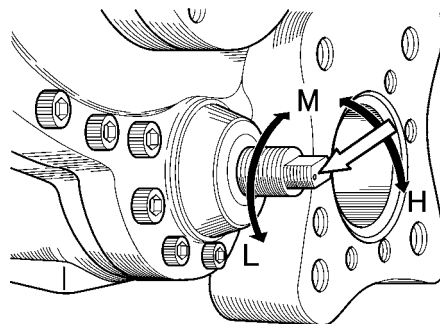


Fig. 2-2 Vi Adjusting Rod

- a. Remove the domed cap nut (P/N 522) at the end of the Vi adjusting rod, then loosen the hexagon nut (P/N 453) used as a lock nut. (On the compressors produced after March in 2005, a conical spring washer is provided between the hexagon nut and domed cap nut to prevent detachment of the cap nut.)
- b. Turn the Vi adjusting rod clockwise until it stops. The position where the rod stops corresponds to the H port position the setting before shipment. Do not turn the rod any further as applying undue force will break the rotation stopping mechanism. (This position corresponds to that in Sequence (2) in Fig. 2-4.)
- c. Check the inscribed mark (indicated by the white arrow in Fig. 2-2) on the Vi adjusting rod, which should be used as a reference point when counting the number of turns of the rod.

-
- d. Turn the Vi adjusting rod counterclockwise by the number of turns determined in step (3). The Vi setting will be changed from the H port setting to the M port setting (as shown in Sequence (3) in Fig. 2-4).
 - e. While holding the Vi adjusting rod against rotation, lock the rod by tightening the lock nut.
 - f. Install the domed cap nut to the end of the Vi adjusting rod and tighten it. Do not fail to install the conical spring washer between the hexagon nut and domed cap nut to prevent detachment of the cap nut.



Fig.2-3 Conical Spring Washer

- (5) Pull the unloader piston to move the unloader slide valve to the full-load (100 %) position (Sequence (4) in Fig. 2-4). If the pointer of the unloader indicator aligns with the 100 % graduation for the port in question on the dial, the Vi is correctly adjusted to that port. The M and H graduation marks are rather large in width. This is because there is a slight difference in indication of the M and H positions among the 13 compressor models, i.e. 160S/M/L, 200S/M/L, 250S/M/L/LL, and 320S/M/L, due to difference in rotor length. The setting may be considered correct if the needle indicates any point in the width of the graduation mark.

How to Change Vi - from H Port to M port

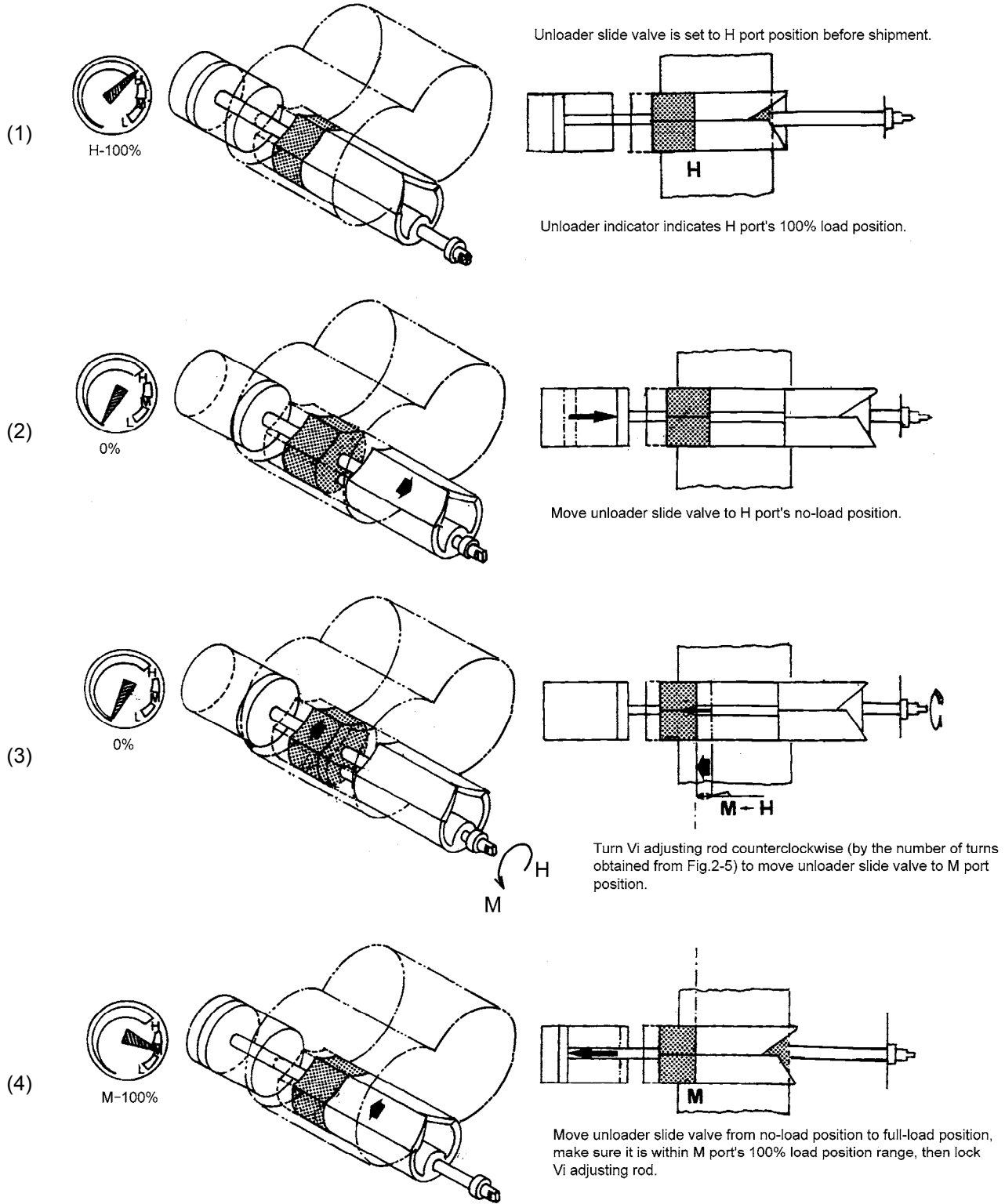


Fig. 2-4 Vi Changing Sequence from H Port to M Port

From H port to M port					From H port to L port				
H → M	160VS	160VM	160VL	-	H → L	160VS	160VM	160VL	-
Displacement distance	18 mm	23 mm	27 mm	-	Displacement distance	37 mm	45 mm	55 mm	-
Number of turns of rod	7.2	9.2	10.8	-	Number of turns of rod	14.8	18	22	-
H → M	200VS	200VM	200VL	-	H → L	200VS	200VM	200VL	-
Displacement distance	23 mm	28 mm	34 mm	-	Displacement distance	46 mm	57 mm	69 mm	-
Number of turns of rod	6.6	8.0	9.7	-	Number of turns of rod	13.1	16.3	19.7	-
H → M	250VS	250VM	250VL	250VLL	H → L	250VS	250VM	250VL	250VLL
Displacement distance	29 mm	36.5 mm	43 mm	52 mm	Displacement distance	58 mm	72.5 mm	87 mm	-
Number of turns of rod	7.3	9.1	10.8	13	Number of turns of rod	14.5	18.1	21.8	-
H → M	320VS	320VM	320VL	-	H → L	320VS	320VM	320VL	-
Displacement distance	59 mm	50 mm	47 mm	-	Displacement distance	98 mm	98 mm	105 mm	-
Number of turns of rod	13	11	10	-	Number of turns of rod	21.5	21.5	23	-

Fig. 2-5 Number of Turns of Vi Adjusting Rod for Individual Models

Reference:

Screw thread specifications of Vi adjusting rod

160V	M20 x P2.5 mm	250V	M36 x P3.5 mm
200V	M30 x P3.5 mm	320V	M36 x P3.5 mm

Number of turns x Pitch (mm) = Displacement distance of variable Vi auxiliary slide valve

2.5 Lubrication Oil

Selecting appropriate lubrication oil and properly controlling its condition is essential for proper operation of the compressor. This section describes the points you should consider when selecting and handling lubrication oil.

2.5.1 Selection of Lubrication Oil

- Selection of the lubrication oil should depend on the type of the refrigerant, the type of the evaporator used with the compressor, and the conditions under which the compressor is operated. Also to be considered when selecting lubrication oil are the properties of the oil that include not only the viscosity but also such characteristics as solubility in refrigerant, separability from refrigerant, low temperature fluidity, high temperature thermal stability, etc. As there are so many factors to consider, it is most advisable to ask any of our offices or sales/service centers about selection of lubrication oil. They can suggest suitable oil brands for your specific application of the compressor.

- Lubrication oil used for compressors must have a viscosity appropriate for lubricating the bearings and other components in the compressors.

The viscosity to be considered in this case should be the viscosity the oil shows at the oil inlet of the compressor. The viscosity of the lubrication oil significantly changes depending on the type of the refrigerant used in combination with the oil. If the refrigerant dissolves in the oil (or the oil and refrigerant are inter-soluble), the viscosity of the oil drops to a level remarkably below the level required for operation of the compressor under some operating conditions. On the contrary, if the refrigerant does not dissolve in the oil (or the oil and refrigerant are non-inter-soluble), the viscosity may become too high when the supply oil temperature is low. For this reason, the lubrication oil must be selected so that its viscosity is proper (13 - 40 cSt) when supplied during operation of the compressor.

- In a refrigeration system using a screw compressor, the lubrication oil supplied to compressor is discharged together with the compressed refrigerant gas and separated from the refrigerant by an oil separator. However, the oil cannot be separated completely in the oil separator, so very small part of the oil enters the condenser and can remain there. Part of the oil can also enter the evaporator. For this reason, the lubrication oil must be thermally stable under high temperatures, be separable from the refrigerant gas, and maintain adequate fluidity under low temperatures.
- Note that some lubrication oils are incompatible with a certain type of refrigerant. For example, Polyolester (POE) synthetic oil cannot be used with ammonia refrigerant.

2.5.2 Recommended Lubrication Oils

The lubrication oil must be selected considering the influence on the “O” rings used in the compressor in addition to all other necessary factors including the compatibility with the refrigerant. The following lubrication oils are recommended for the use with the MYCOM SCV Series compressors also from the problem-preventing viewpoint.

Oils for systems using ammonia refrigerants

(1) Polyalkylene Glycols (PAG) based synthetic oils

Brand	Kinematic viscosity (40 °C) mm ² /s	Manufacturer	Type
Freol PN46	46	JOMO	PAG

PN46 is only one type of inter-soluble oils that can be used with an ammonia refrigerant.

(2) Mineral oils (non-inter-soluble)

Brand	Kinematic viscosity (40 °C) mm ² /s	Manufacturer	Type
SUNISO 3GS	30	Sun Oil	Naphthene base
SUNISO 4GS	55	Sun Oil	
REFOIL NS 3GS	30	Nippon Oil	
GARGOYLE ARCTIC C HEAVY	46	Exxon Mobil	
GARGOYLE ARCTIC 300	68	Exxon Mobil	
CAPELLA WF46	46	Texaco	
CAPELLA WF68	64	Texaco	
CP-1009-32	34	CPI	Hydrotreated paraffinic base
CP-1009-68	69	CPI	
REFLO 46A	46	Petro Canada	
REFLO 68A	58	Petro Canada	
CAPELLA PREMIUM	67	Texaco	
RHT-68	68	Kluber	
REFLO XL	59	Petro Canada	

(3) Synthetic oils (non-inter-soluble)

Brand	Kinematic viscosity (40 °C) mm ² /s	Manufacturer	Type
Acemire 300	59	Acemire	AB
Mycold AB68	53	BVA	
ZERICE S46	46	Exxon Mobil	
ZERICE S68	68	Exxon Mobil	
BERREL FREEZE 46S	46	Matsumura Oil Co., Ltd.	
CP-4700-32	31	CPI	
CP-4700-68	56	CPI	
Gold - Cold 300	53	Goiden West	
GARGOYLE ARCTIC NH68	64	Exxon Mobil	PAO+AB
REFLO SYNTHETIC 68A	62	Petro Canada	
GARGOYLE ARCTIC SHC 224 See note	30	Exxon Mobil	PAO
GARGOYLE ARCTIC SHC 226 (E) See note	68	Exxon Mobil	

Note: Use only a mechanical seal of the standard BBSE type.

Oils for systems using HFC refrigerants

(1) Polyol Ester (POE) synthetic oils for R404A, R507A, and R410A (inter-soluble)

Brand	Kinematic viscosity (40 °C) mm ² /s	Manufacturer	Type
SUNISO SL-68S	67	Sun Oil	POE
EMKARATE RL68H	72	Lubrizol	

(2) Polyol Ester (POE) synthetic oils for R134a (inter-soluble)

Brand	Kinematic viscosity (40 °C) mm ² /s	Manufacturer	Type
Freol α100	107	JOMO	POE

CAUTION

- **If you intend to use a lubrication oil of a brand not listed in section 2.5 or to use any of the listed oils in a oil-refrigerant/gas combination different from those shown in section 2.5, please consult Mayekawa offices or sales/service centers for appropriateness before using the oil.**

2.5.3 When Changing to Different Brand's Oil

When you intend to change lubrication oil from the current brand to another, you should consider the points listed below.

CAUTION

If you change the lubrication oil to an oil of another brand, the new oil can be incompatible with the operating conditions or produce negative effects on the compressor operation. As changing the oil brand requires an appropriate procedure, be sure to consult Mayekawa before changing the oil brand.

- **Some lubrication oils contain additives for the purpose of improving lubricating property and preventing degradation. As the additive and its amount differ from type to type and brand to brand of oil, you should, as a rule, avoid mixing oils of different brands. Mixing oils of different brands can generate undesirable substances due to reaction between additives although such a case occurs rather rarely.**
- **If change of oil brand is unavoidable, recover oil not only from the compressor but also from the oil separator, oil cooler, condenser, evaporator, and all other refrigeration system components as thoroughly as possible before supplying the new oil. Flushing of the system is required in some cases.**
- **Change the lubrication oil to a different brand only after checking the supplier of the oils to make sure such change does not cause any problem. If the new and old oils are produced by different manufacturers, ask both the manufacturers for possible problems that result from the change of oil.**
- **If you consider changing oil to a one of different viscosity grade but of the same brand, confirm that the change will not cause any problem in compressor operation.**
- **The equipment type and flow design (e.g. type of evaporator and whether oil return lines are provided or not) of the refrigerating system should vary with the characteristics of the lubrication oil used (inter-soluble oil or non-inter-soluble oil). For this reason, any change from inter-soluble oil to non-inter-soluble oil should be prohibited. In the case of change from a non-inter-soluble oil to an inter-soluble oil, it is essential to select oil of an appropriately high viscosity that assures proper viscosity levels even when the refrigerant resolves into the lubrication oil supplied to the compressor, which will lower the viscosity level.**

2.5.4 Points to Be Noted for Handling of Lubrication Oil

- For replenishment, use only clean lubrication oil from a well-sealed container. Oil kept in open container may have absorbed moisture and be contaminated with dust and other foreign materials.
- When adding lubrication oil, prevent air and moisture from entering the oil.

(1) Handling of Polyalkylene Glycols (PAG)

PAG is much more hygroscopic compared with mineral oils. PAG easily absorbs the moisture in air if handled carelessly and may constitute a cause of rusting and corrosion wear inside the system components.

Especially when handling Freol PN46, take care of the following:

- Avoid replenishing oil on a rainy day or when the workplace is humid to prevent absorption of moisture.
- Thoroughly evacuate the system and leave it overnight in order to eliminate moisture as much as possible.
- Do not unseal the container until you start replenishing. Complete the oil charging operation in a shortest possible time after unsealing the container. (Finish charging of oil in one container within 15 minutes.)
- Close the gap between the container outlet and the charging hose with an appropriate material to prevent entry of foreign materials and moisture. A more effective method is to replace the air in the container with nitrogen gas.
- Do not leave oil in the container and do not use remaining oil in the container afterwards.
- PAG may damage coating, so wipe off the oil on a painted surface as soon as possible.

(2) Handling of Polyol Ester (POE)

POE is highly hygroscopic like PAG. In addition, POE is hydrolytic at high temperatures and thus entry of moisture must be strictly prevented. You must observe the same precautions as those for PAG when handling POE.

- Complete oil charging in a shortest possible time after unsealing the container for minimum contact with air.
- Try to completely use the oil in the container. If it is unavoidable to leave part of the oil in the container, cap and seal the container's outlet completely and keep it indoors. Limit the storage time only to a short period.
- As POE is hydrolytic, periodic oil analysis is recommended to check degradation in quality.

2.5.5 Quality Management of Lubrication Oil

(1) Quality management criteria

Lubrication oils are classified into the following three categories and different quality criteria are applied to each category.

- a. Synthetic oils: Polyalkylene glycols (PAG)
- b. Mineral oils: Naphthenic base oils and paraffinic base oils
Synthetic oils: Alkylbenzene (AB) and Polyalphaolefine (PAO)
- c. Synthetic oils: Polyolesters (POE)

We recommend performing sampling oil analysis every six months.

If any of the criteria (except for the water content of PAG) is not met, oil replacement is required.

The analysis items and the criteria for each of the oil categories are indicated in the following tables. Please note that these criteria may be changed without notice.

Synthetic oils (PAG)

Item	Criterion
(a) Color	Max. L4.0 according to ASTM D1500
(b) Total acid number (TAN)	Max. 0.1 mg·KOH/g
(c) Kinematic viscosity	Within ± 10 % in variation when compared with fresh oil
(d) Water content	Max. 2,000 ppm (See Note1.)
(e) Contamination level	Max. 15 mg/100 ml as measured by gravimetric (Millipore filter) method (See Note2.)

Mineral oils and synthetic oils (AB and PAO)

Item	Criterion
(a) Color	Max. L6.0 according to ASTM D1500
(b) Total acid number (TAN)	Max. 0.3 mg·KOH/g
(c) Kinematic viscosity	Within ± 15 % in variation when compared with fresh oil
(d) Water content	Max. 100 ppm (See Note1.)
(e) Contamination level	Max. 15 mg/100 ml as measured by gravimetric (Millipore filter) method (See Note2.)

Synthetic oils (POE)

Item	Criterion
(a) Color	Max. L4.0 according to ASTM D1500
(b) Total acid number (TAN)	Max. 0.2 mg·KOH/g
(c) Kinematic viscosity	Within ± 10 % in variation when compared with fresh oil
(d) Water content	Max. 200 ppm (See Note1.)
(e) Contamination level	Max. 15 mg/100 ml as measured by gravimetric (Millipore filter) method (See Note2.)

NOTE:

1. Synthetic oils (inter-soluble with ammonia) are so highly hygroscopic that they can absorb moisture at the time of sampling. In addition, the ammonia content they have absorbed may be detected as the water content at the time of the analysis, making it difficult to precisely measure the water content. Therefore, use the criterion value only as a reference.
2. The contamination level criterion assumes the use of an oil filter with nominal mesh size at 15 μ m or finer.
3. The above criteria are applicable only to refrigeration systems.

2.5.6 Lubrication Oil Replacement Intervals

(1) After initial startup of the system

Oil may become contaminated and deteriorated relatively quickly after startup of the refrigeration system due to scales and deposits remaining in piping and vessels. Therefore, the first replacement of lubrication oil should be carried out at 500 hours after the initial startup of the system.

(2) During regular operation

Lubrication oil deteriorates gradually as the system is operated over time. Although the rate of deterioration of the oil varies with operating conditions, the type of oil and the amounts of foreign substances and moisture content in the oil, we recommend replacing the oil every 5,000 operation hours or every year, whichever comes first. If oil filters frequently clog or the oil has turned dark and unclear, replace oil after removing the cause of problem.

Chapter 3 Maintenance

3.1 General

This chapter describes the procedures for disassembly, inspection, replacement of parts, and reassembly of the SCV Series Screw Compressors. The procedures for servicing the unloader indicator assembly are also included in this chapter.

NOTE:

- The part numbers (P/N) indicated in the following procedures correspond to those in Sections 1.6.1 “Component Drawings” and 1.6.2 “Parts List”.
- Chapter 4 of this manual provides the data and information on parts and tools necessary for servicing this product. Refer to Chapter 4 as necessary.

3.2 Disassembly and Inspection

Disassemble the compressor in the sequence indicated in each procedure. Inspect and handle components only after understanding the instructions concerned.



- **Be sure to turn off both the motor power switch and control system power switch before starting inspection and any other maintenance operation. In addition, take all necessary measures to prevent the power switches from being accidentally turned on during service operation. If the switches are turned on during service operation, operator’s clothing or part of body could be caught in rotating parts of the compressor and motor that will start running, possibly resulting in personal injury or death. Also, near areas under voltage, there is a high risk of life-threatening electric shock.**



- **When turning on or off the power switches, be extremely careful not to suffer electric shock.**

3.2.1 Preparation for Disassembly

On a base-mounted compressor, limit disassembly and inspection to the mechanical seals, thrust bearings, unloader cylinder and balance piston. When other parts of the compressor must be disassembled and inspected, remove the compressor from the base and move it to another place with an adequate space for efficient service operation.

3.2.2 Necessary Tools, Materials and Equipment

CAUTION

- **Tools used for assembling/disassembling operations must be the specified tools in good condition. Using worn-out or damaged tools or tools inappropriate for the operation increases a risk of personal injury or damage to compressor components.**

Select a dry, sand- and dust-free place with a space and lighting adequate for performing disassembly and inspection operation. Prepare the following items of hand tools, materials and equipment.

- Common hand tools such as a hammer, adjustable wrench, file, scraper, sandpaper, and scraper in addition to the tools supplied with the compressor (see “Tools” in Chapter 4)
- Cleaning solvent (light oil or kerosene), a container for washing disassembled components, rags, and a board (such as a plywood board) on which washed components are placed
- Fresh oil used during reassembly
- Lifting and carrying equipment for heavy components, as necessary
- A workbench (surface table or stand having a steel plate top) with a height appropriate for the work and strength enough to support the compressor’s weight

3.2.3 Removing the Compressor from the Base

(1) Recovering the Refrigerant

WARNING

Every time before disassembling and inspecting the compressor, be sure to confirm that the internal pressure of the compressor has dropped to the ambient air pressure or lower. If high-pressure refrigerant gas or refrigerant-mixed lubrication oil remains inside the compressor, a gas and oil under pressure will gush out as soon as a sealed part is loosened and cause injury to the operator.

When stopped under normal condition, the compressor retains (in its inside section up to the check valve) a pressure as high as the oil separator pressure. Therefore, it is essential to lower the compressor’s internal pressure to a level equal to or lower than the atmospheric pressure before removing the compressor from the base. The method for reducing the pressure varies with the refrigerating system for which the compressor is used. Use any of the following methods whichever appropriate for the system. Since almost all refrigerants have impacts on the environment, it is essential to select the method that can assuredly prevent refrigerant gas from being discharged into the atmosphere.

- Use a special refrigerant recovery unit if the system is provided with it.
- If the system uses two or more compressors and any one of them is available for operation, use the compressor to recover the refrigerant.

- Use a portable compressor designed for the refrigerant recovery purpose.
- Release the pressure into the low-pressure section inside the compressor using a bypass circuit.

(2) Disconnecting the Connections

The following preparation is necessary before disconnecting the connections on the compressor:

- Prepare containers to receive oil that will flow out of the compressor when the oil and refrigerant piping is disconnected.
- If ammonia is used as the refrigerant, maintain good ventilation to prevent suffering from strong odor that will be given off even under low refrigerant pressures.

Disconnect the connections in the following sequence.

1. Coupling → 2. Suction piping → 3. Discharge piping → 4. Oil piping → 5. Fluid injection →
6. Electromizer → 7. Oil injection → 8. Unloader indicator assembly → 9. Anchoring bolts (4 places)

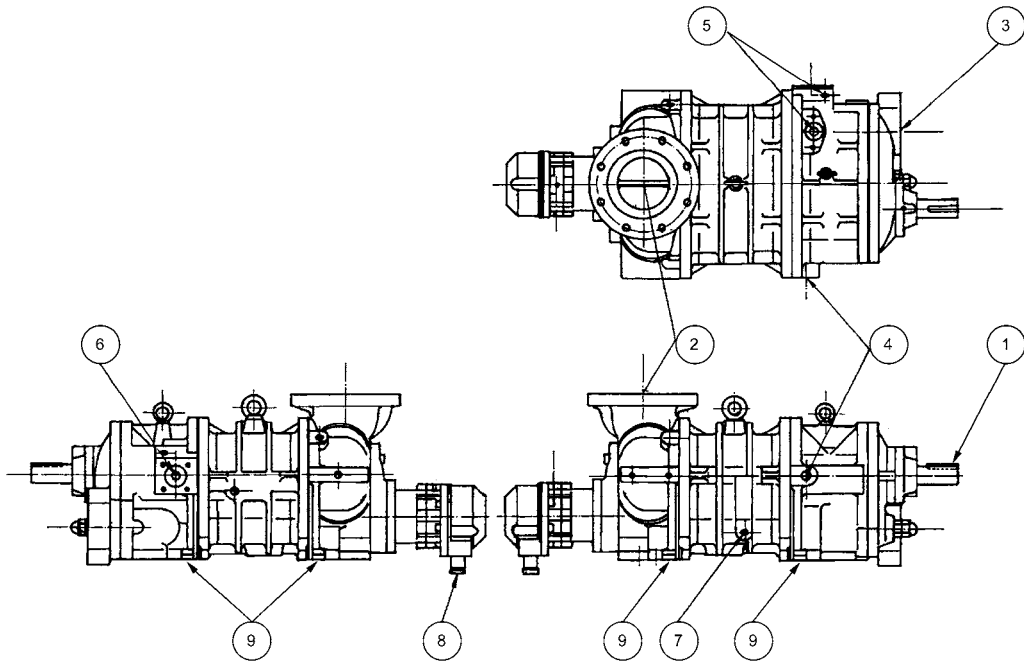


Fig. 3-1 Disconnection Sequence

(3) Lifting and Moving the Compressor to Workbench

⚠ WARNING

- **Only a qualified person must carry out lifting and moving operation of the compressor.**
 - **Disassembling and reassembling operation on a lifted compressor is extremely dangerous and should be avoided at all cost. Instead, support the compressor with a rigid stand and take every measure to prevent it from slipping off before starting the service work.**
- a) Remove the compressor from the base. When doing this operation, pay attention to the suction strainer at the top not to induce stress in the suction piping.
- b) Cover the suction cover flange with a plastic sheet or wooden board to prevent foreign materials from entering the compressor.
- c) Lift and move the compressor toward the workbench (see Fig. 3-2). Place the leg part of the suction cover on the workbench and support the remaining part of the compressor, at the leg part of the bearing head, on a stand of the same height as the workbench (see Fig. 3-3) so that lower hexagon socket head cap screws can be removed.



Fig. 3-2 Lifting and Moving the Compressor

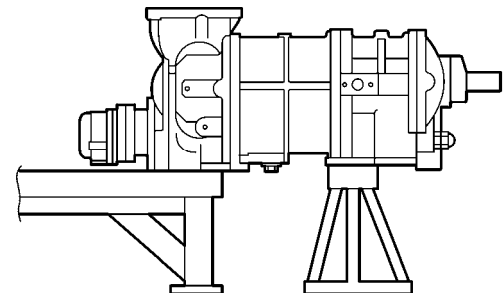


Fig. 3-3 Preparation for Removing Lower Screws



Fig. 3-4 Removing Lower Screws

d) Of the hexagon socket head cap screws (P/N 2) fastening both the bearing head and suction cover to the main rotor casing, remove the lower 6 to 8 screws each.

NOTE: These screws are removed in this stage of the procedure because they cannot be accessed after placing the entire compressor on the workbench.

e) Move the entire compressor still being lifted onto the workbench. Place the compressor on the workbench in either of the following methods according to the compressor type.

- In the case of a D version model, which has a discharge port facing down and thus a discharge port flange extending downward from the leg plane of the suction cover and bearing head, place the compressor with the flange portion outside of the workbench edge (see Fig. 3-5). Alternatively, place wooden brocks high enough to provide the flange with clearance from the workbench surface below the legs of the suction cover and bearing head and lower the compressor on the wooden blocks (see Fig. 3-6).
- In the case of a G version model with a discharge port facing sideways, the entire compressor can be placed on the workbench without doing any special arrangement, as the flange is on the same plane as the legs of the suction cover and bearing head.

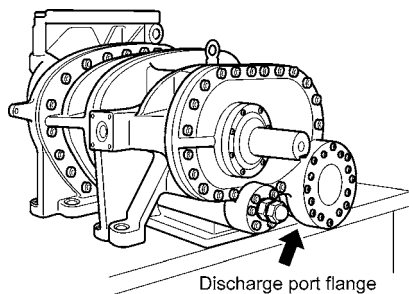


Fig. 3-5 Extending Flange to Outside of Workbench

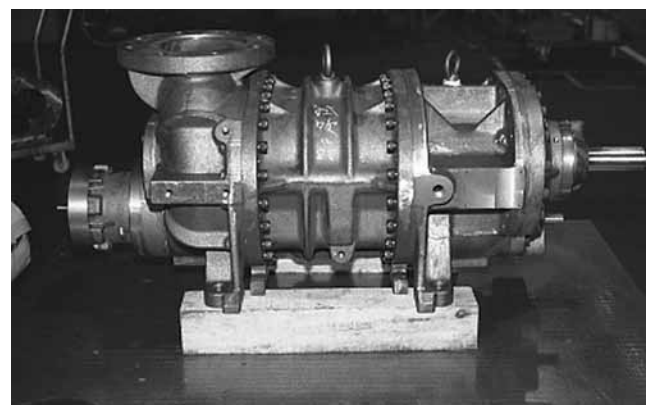


Fig. 3-6 Using Wooden Brocks

3.2.4 Compressor Disassembly Sequence

Disassemble the compressor in the following sequence.

1. Mechanical seal assembly
2. Unloader indicator assembly
3. Unloader cylinder cover
4. Unloader piston and unloader cylinder
5. Balance piston cover
6. Balance piston
7. Bearing cover and Vi adjusting rod
8. Thrust bearing
9. Suction cylinder and side bearings
10. Rotors and main rotor casing
11. Variable Vi auxiliary slide valve and unloader slide valve
12. Bearing head and main bearings

3.2.5 Disassembling Each Section

(1) Mechanical Seal Assembly

Disassembling the Mechanical Seal Assembly

- a) Of the six hexagon socket head cap screws (P/N 53) securing the seal cover (P/N 51), remove four screws, leaving the two diagonally opposite screws.
- b) Loosen the remaining two screws alternately, a little at a time. The seal cover of the mechanical seal will be raised slightly by the force of the inside spring, creating a gap under the cover. The gap will not be created if the gasket is sticking to both surfaces. In this case, free the cover by screwing the eye bolts (tools supplied with the compressor) into the screw holes in the seal cover to separate it.
- c) The inside oil will flow out through the gap. Receive oil with a container.
- d) Remove the seal cover by pulling it out in line with the rotor shaft axis. Inside the cover, there is the mating ring fitted with the “O” ring. So draw out the cover being careful not to let the mating ring be damaged by interference with the shaft.
- e) Remove the “O” ring (P/N 49) between the seal cover and oil seal retainer.



Fig. 3-7 Removing the Seal Cover



Fig. 3-8 Seal Cover and Mating Ring

- f) After the seal cover has been removed, wipe clean the shaft and then check its surface. If any scratches are found, smooth out the surface with fine emery paper in order to prevent damage to the “O” ring when the mechanical seal is pulled out.
- g) Loosen the set screws (P/N 111) securing the seal collar (P/N 109) about three turns. To do this, use different methods according to the compressor model. In the case of a 160 model compressor, first remove the plugs from the bearing cover and then insert a wrench in each hole to loosen the inside screw. In the case of a 200 or larger number model compressor, loosen the set screws from the seal cover fitting section. Do not remove the set screws completely, but loosen them by the amount necessary to make their ends

retract from the surface of the seal collar. These screws are located in two places 90 degrees apart from each other.



Fig. 3-9 Loosening the Set Screws on Seal Collar

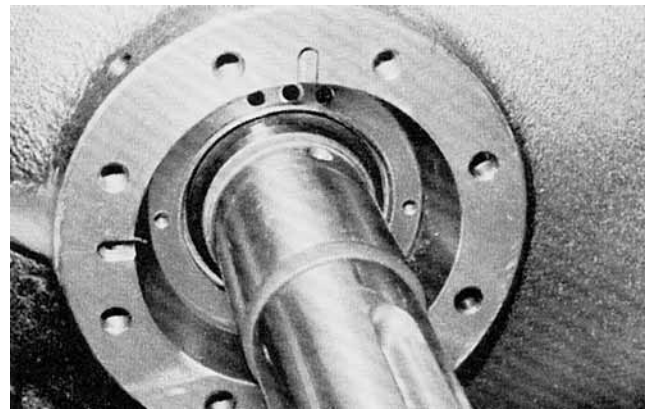


Fig. 3-10 Seal Retainer

- h) Pull out the mechanical seal assembly by holding the seal collar section with your fingertips. While removing the assembly, make sure that the ends of the set screws do not touch the shaft surface. Any scratches on the shaft will cause leakage.
- i) Remove the two set screws from the oil seal sleeve.
- j) Screw two eye bolts into the jacking screw holes in the seal retainer and pull out the seal retainer while keeping it in parallel with the shaft.

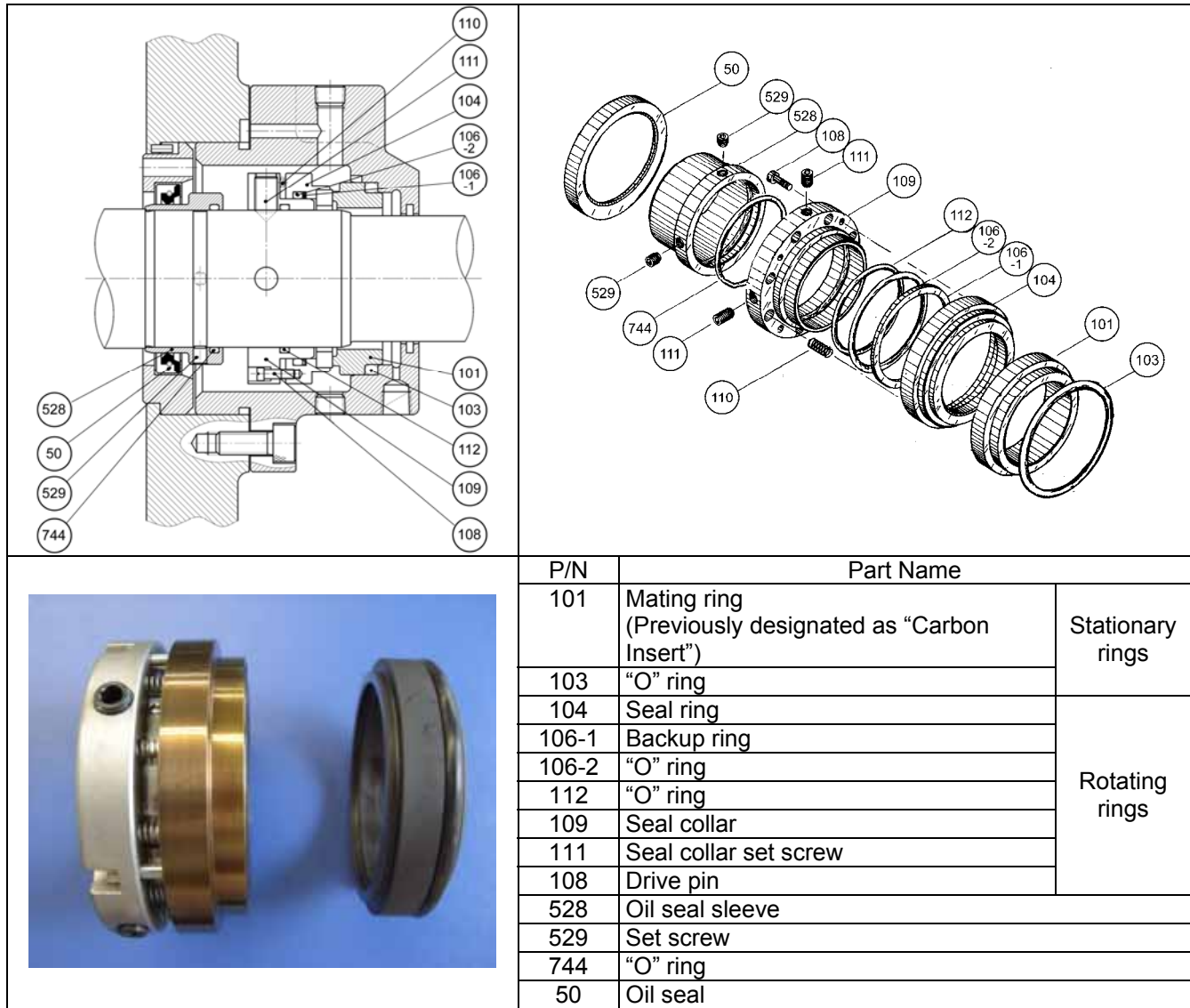


Fig. 3-11 BOS Type Mechanical Seal Assembly

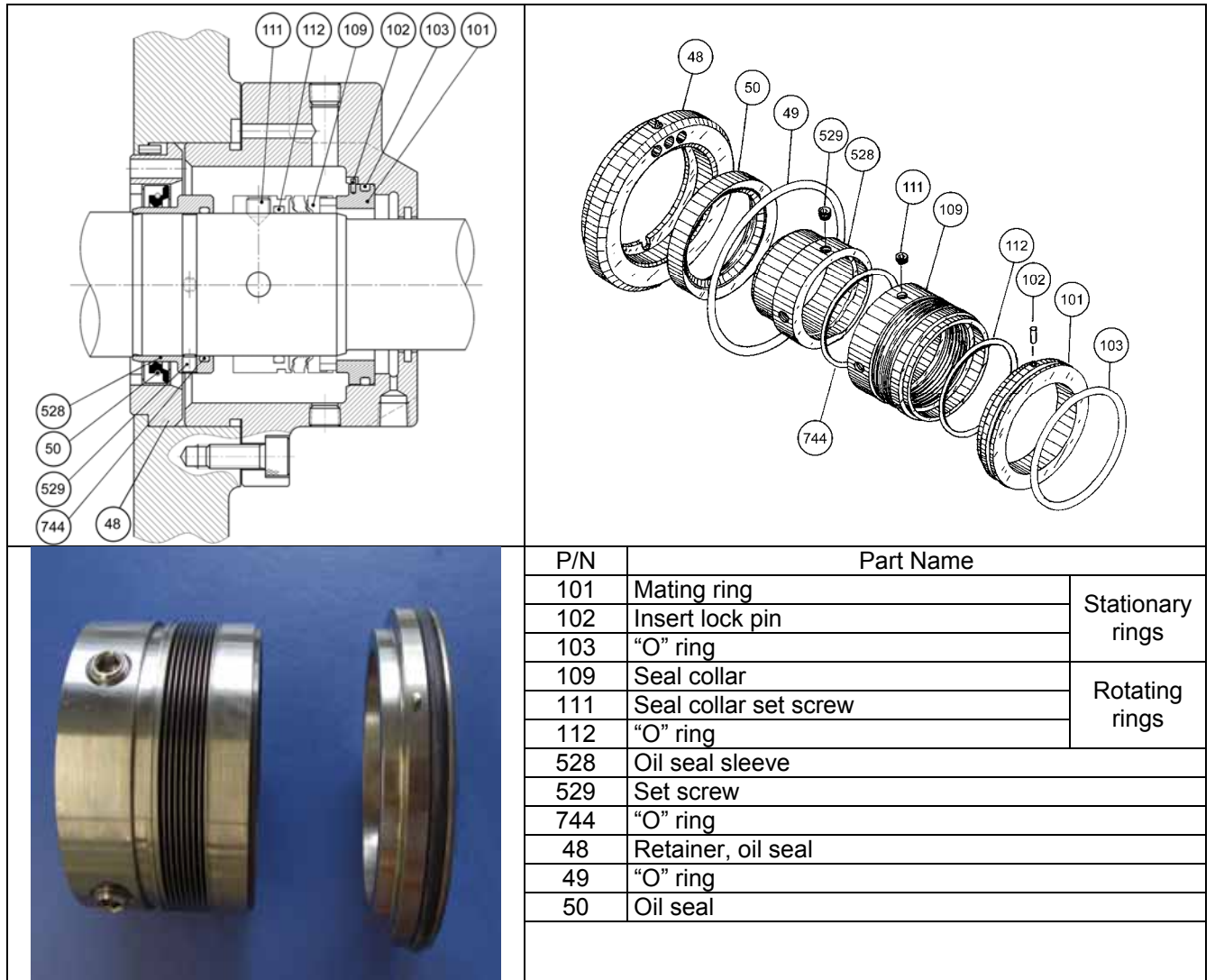


Fig. 3-12 BBS-III Type Mechanical Seal Assembly

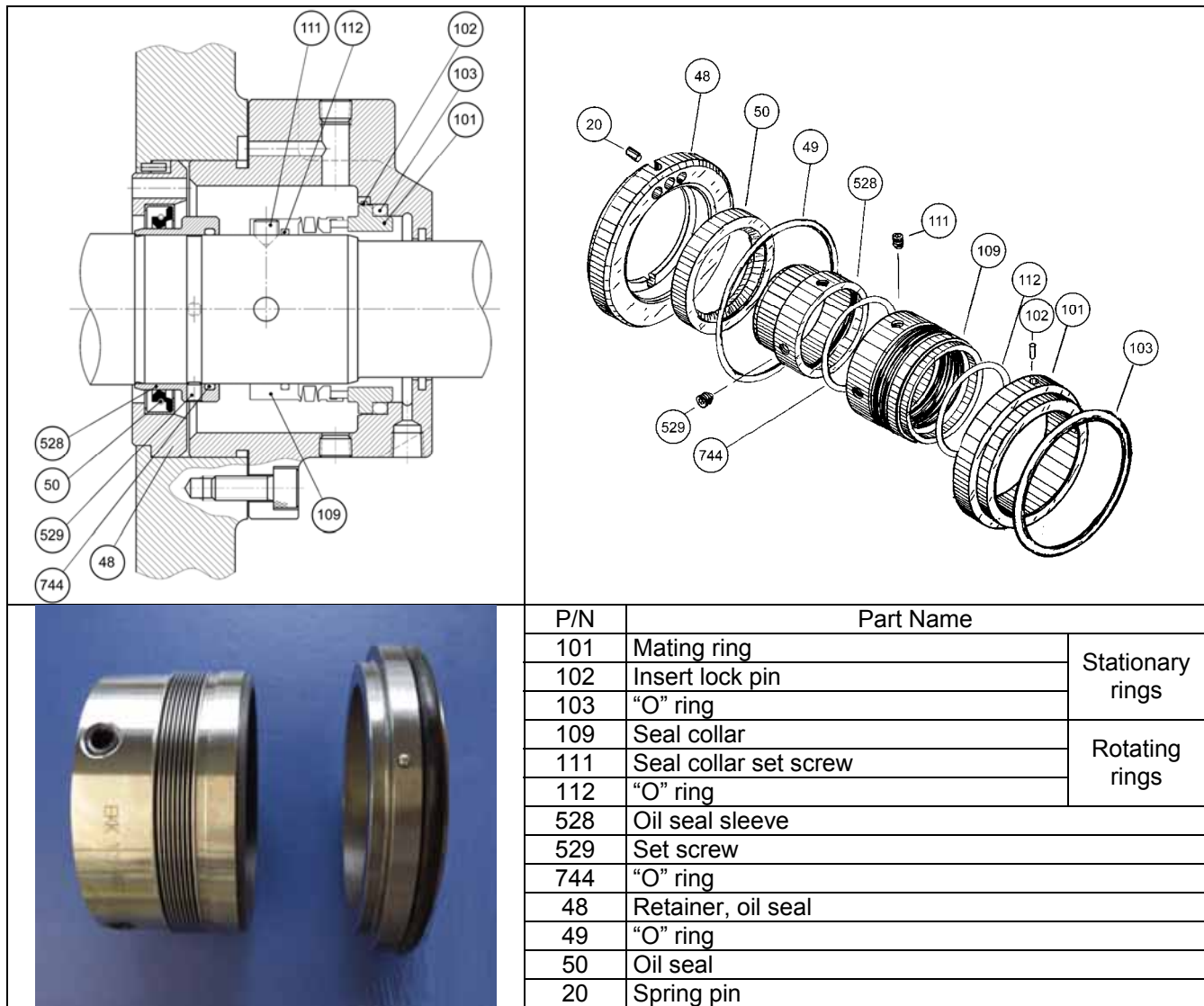


Fig. 3-13 BBSE Type Mechanical Seal Assembly

Inspecting the Mechanical Seal Assembly

- a) Inspect the friction surfaces of the mating and seal rings. If the mating and seal rings have evenly bright friction surfaces, they can be reused. If the rings show irregular or scratched surfaces, they will cause leaks and should be replaced with new ones.
- b) Replace the "O" rings every time the mechanical seal assembly is inspected because they normally swell and deform over time.

A total of four "O" rings are used for the sealing section. They are located between the seal cover and seal retainer (P/N 49); between the mating ring and seal cover (P/N 103); between the seal collar and shaft (P/N 112); and between the seal cover and oil seal sleeve (P/N 744).

- c) Inspect the oil seal sleeve for wear in its section rubbing against the oil seal lip. If wear is evident, replace both the oil seal (P/N 50) and oil seal sleeve (P/N 528) with new parts. Since the oil seal is made of a special material, only a genuine oil seal must be used for replacement.
- d) Replace the seal cover gasket with a new one.



Fig. 3-14 Seal Retainer and Oil Seal Sleeve

(2) Unloader Indicator Assembly

Removing the Unloader Indicator Assembly

- a) Remove the three bolts (P/N 147) fastening the indicator cover (P/N 146).
As the glass (P/N 141) and glass spacer (P/N 142) are easy to detach, be careful not to drop them.



Fig. 3-15 Removing the Indicator Cover



Fig. 3-16 Loosening the Micro-switch Cam Screws

- b) Behind the unloader indicator dial, there is the micro-switch cam that connects the potentiometer to the indicator cam.
Loosen the screws (P/N 128) on the indicator cam side (unloader cover side) to free the indicator cam.
- c) Remove all the hexagon socket head cap screws (P/N 122) that fasten the micro-switch base plate (P/N 121) to the unloader cover.
- d) Remove the micro-switch base plate by pulling it out in parallel with the axis of the indicator cam.



Fig. 3-17 Removing the Micro-switch Base Plate Screws



Fig. 3-18 Removing the Micro-switch Base Plate

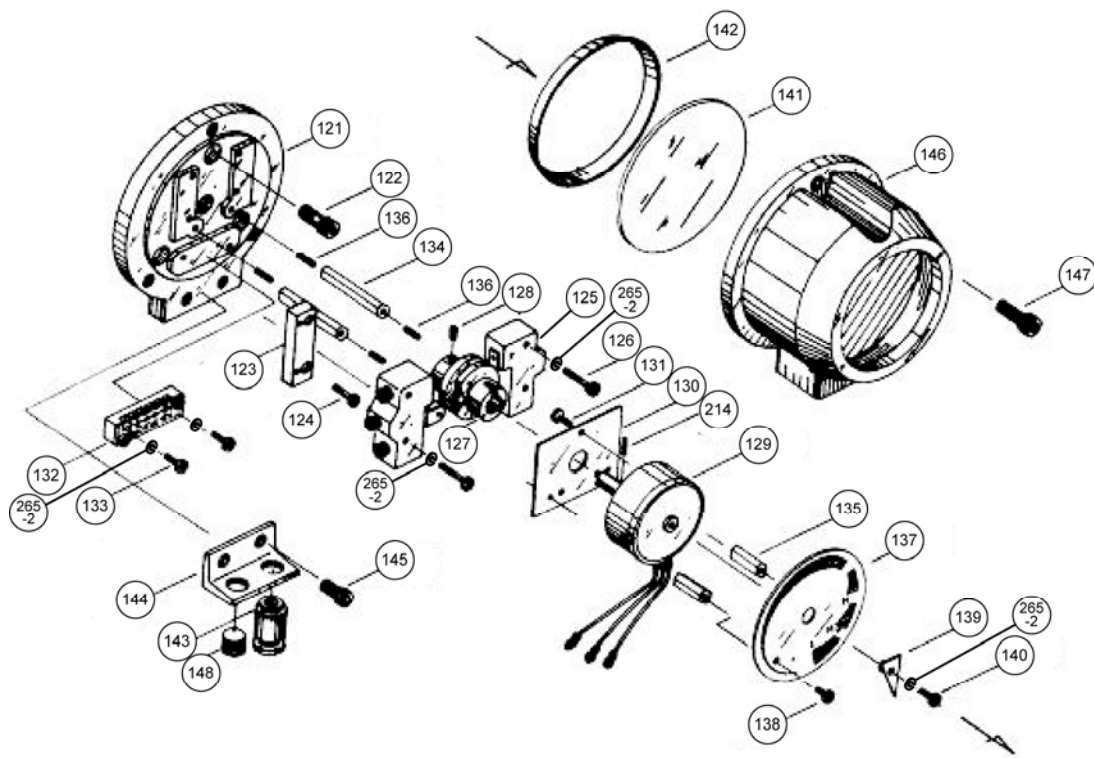


Fig. 3-19 Exploded View of Unloader Indicator

(3) Unloader Cylinder Cover

The unloader cylinder cover (P/N 74) is at the end of the unloader cylinder. Behind the unloader cylinder cover, there are the indicator cam, seal and ball bearing. Unless an abnormal operation (due to a leaky seal or worn indicator cam groove) is noticed, disassembly of the unloader cylinder cover and indicator cam assembly is not needed.

Removing the Unloader Cylinder Cover

- a) Remove the hexagon socket head cap screws (P/N 76) that fasten the unloader cylinder cover to the unloader cylinder.
- b) The indicator cam (P/N 77) installed in the unloader cylinder cover is fitted in the bore of the unloader push rod (P/N 67) inside the cylinder, and the guide pin (P/N 68) implanted in the push rod is engaged with the groove cut in the indicator cam.

Pull out the unloader cylinder cover in parallel with the axis of the push rod.



Fig. 3-20 Unloader Cylinder Cover

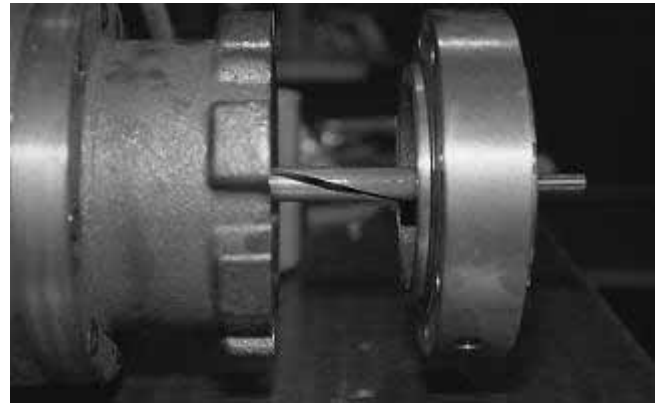


Fig. 3-21 Pulling Out the Unloader Cylinder Cover

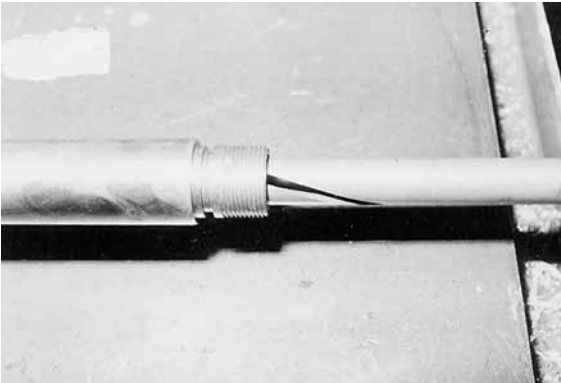


Fig. 3-22 Unloader Push Rod and Indicator Cam

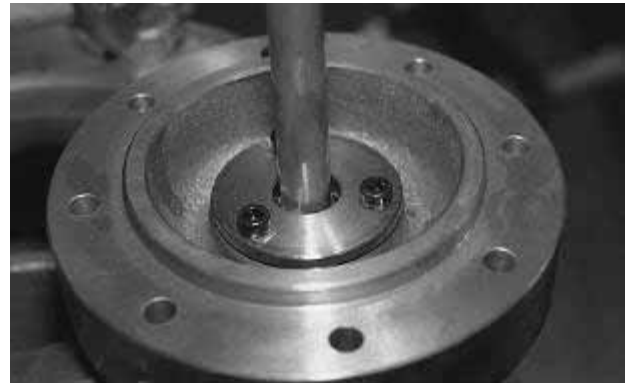


Fig. 3-23 Unloader Cylinder Cover

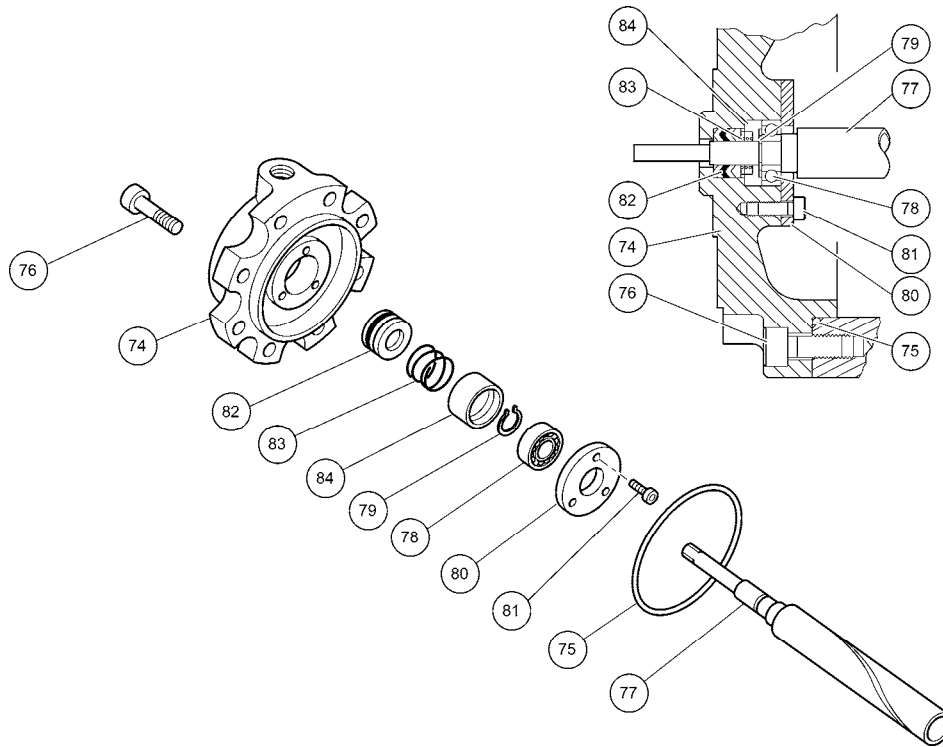


Fig. 3-24 Exploded View of Unloader Cylinder Cover



Fig. 3-25 Indicator Cam Seal Section Components

Inspecting the Unloader Cylinder Cover

- a) Check the indicator cam groove, bearing and pin (on the unloader push rod) for wear.
- b) If refrigerant or oil is found leaking from the indicator, replace the V-ring. To replace the V-ring, disassemble the seal section of the indicator cam according to the following procedure.
 - i) On the cylinder side of the unloader cylinder cover, there is the bearing gland (P/N 80) that retains the Indicator cam (P/N 77). Remove the bearing gland by loosening and removing the hexagon socket head cap screws (P/N 81). The indicator cam, ball bearing (P/N 78) and stop ring (P/N 79) will be removed as an assembly.
 - ii) Remove the stop ring. This allows the indicator cam and ball bearing to be detached.
 - iii) Remove the indicator cam spring retainer (P/N 84), spring (P/N 83) and V-ring assembly (P/N 82) from inside the cover.
- c) If the V-ring portion of the Indicator cam is worn, replace the indicator cam.

(4) Unloader Piston, Unloader Cylinder and Balance Piston Cover

Disassembling the Unloader Piston, Unloader Cylinder and Balance Piston Cover

- a) Remove the cap nut on the bearing head side of the Vi adjusting rod, loosen the lock nut, and set the variable Vi auxiliary slide valve to the H port position (by turning the Vi adjusting rod counterclockwise until it stops).
- b) Screw the eye bolts into the two screw holes in the unloader piston to move the piston toward the indicator to the full-load position. Unbend the claws of the lock washer on the lock nut that is securing the piston to the push rod (see Fig. 3-26).
- c) Loosen the lock nut (P/N 69) using the lock nut wrench (separately available tool).
- d) Remove the unloader piston from the push rod using the eye bolts.

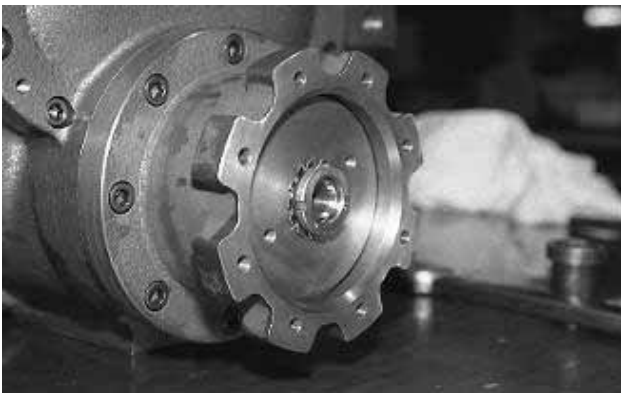


Fig. 3-26 Unbending the Claws of Lock Washer

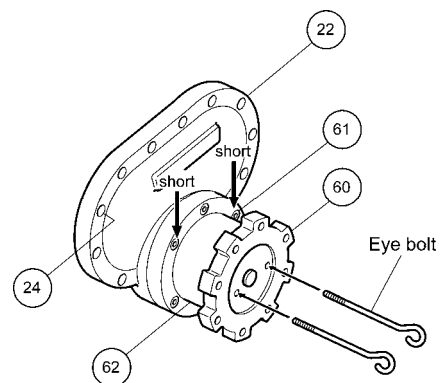


Fig. 3-27 Removing the Unloader Piston

- e) The unloader cylinder is fitted to the balance piston cover with two short hexagon socket head cap screws (P/N 61) and to the suction cover with six long hexagon socket head cap screws (P/N 62). Do not separate the balance piston cover and the unloader cylinder unless it is absolutely necessary to do so.
However, if the interval after the previous inspection is relatively long, replace “O” ring (P/N 63) after separating the balance piston cover and unloader cylinder by removing the two short hexagon socket head cap screws.
- f) Remove the screws on the balance piston cover. After placing a container under the cover to catch oil flowing out, pull the whole cover toward you to remove the unloader cylinder and balance piston cover from the suction cover.

Inspecting the Unloader Piston, Unloader Cylinder and Balance Piston Cover

- a) Check the cap seal (P/N 66) on the periphery of the unloader piston. Replace the seal if it is damaged, deformed or worn. Always replace the “O” ring.
- b) If the inner wall of the cylinder is scratched or contaminated with oil deposits, polish the wall with fine emery paper (finer than #400) and then thoroughly wash it clean.
- c) Replace the “O” ring (P/N 73) at the connection between the unloader push rod and unloader piston.

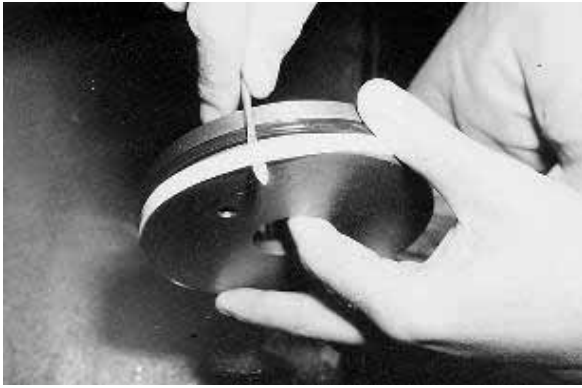


Fig. 3-28 Inspection of Cap Seal

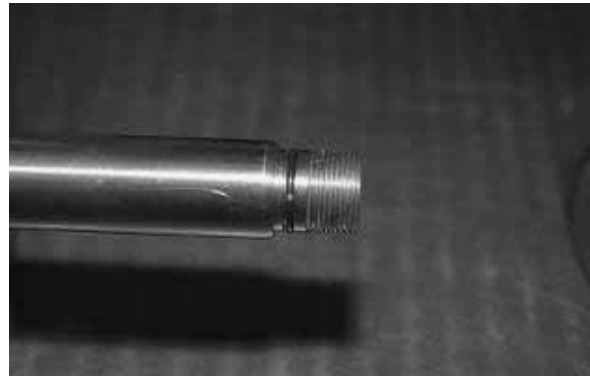


Fig. 3-29 "O" Ring on Unloader Push Rod

(5) Balance Piston and Balance Piston Sleeve

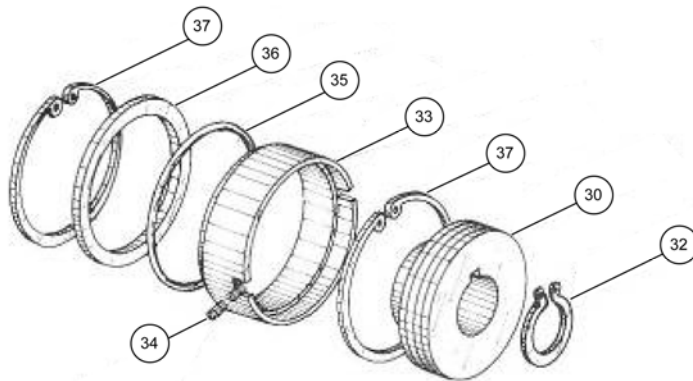


Fig. 3-30 Exploded View of Balance Piston

Disassembling the Balance Piston and Balance Piston Sleeve

- a) Remove the stop ring (P/N 37) retaining the balance piston (P/N 30) on the shaft using pliers.
- b) Screw the eye bolts into the hole in the balance piston and pull out the piston in parallel with the axis of the shaft (see Fig. 3-32).

Leave the balance piston key (P/N 31) fitted in the keyway of the rotor shaft.

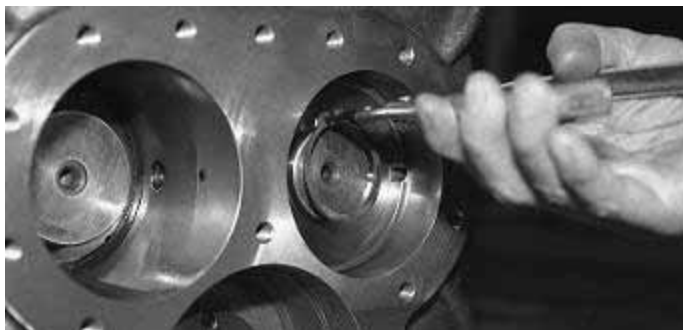


Fig. 3-31 Removing the Balance Piston Stop Ring

c) The balance piston sleeve is locked by either of the following methods:

Type 1: Locked by a screw at the notch in the balance piston sleeve
(160 – 250VSD/VMD/VLD/VLLD)

Type 2: Locked by a spring pin by driving the pin into the sleeve and fitting it into the suction cover groove
(320VSD/VMD/VLD)



Fig. 3-32 Pulling Out the Balance Piston



Fig. 3-33 Balance Piston Locking – Type 1



**Fig. 3-34 Balance Piston Locking (Groove)
– Type 2**



Fig. 3-35 Loosening the Balance Piston Locking Screw



Fig. 3-36 Spring Pin for Locking the Sleeve – 320V

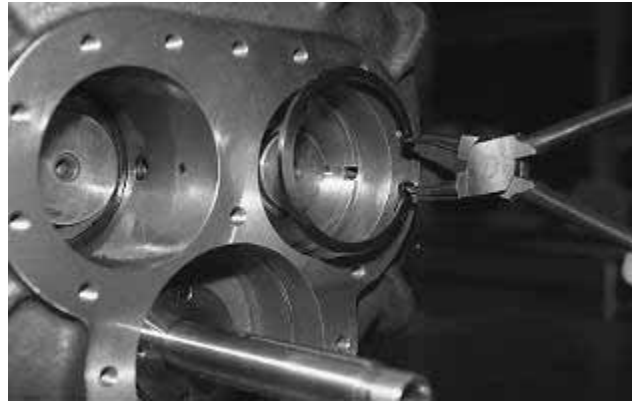


Fig. 3-37 Removing the Stop Ring for Balance Piston Sleeve

- d) With the balance piston sleeve (P/N 33) locked using the Type 1 method, the sleeve has a notch using which it is locked by screwing two hexagon socket head cap screws into a threaded hole, one from the notch side (male rotor side) and the other from the opposing side (female rotor side; see Fig. 3-33). To undo the lock of the sleeve, either remove the male rotor side screw or loosen the female rotor side screw and screw in the male rotor side screw.
- e) With the balance piston sleeve locked by the Type 2 method, simply remove the stop ring of the sleeve to undo its locking (see Fig. 3-37).
- f) Pull out the balance piston sleeve. The sleeve is loose fitted, so it can be removed easily.
- g) Remove the “O” ring (P/N 35) and spacer behind the sleeve.
- h) If the side bearings are to be removed, remove the stop rings located further inside as well.

Inspecting the Balance Piston and Balance Piston Sleeve

Check the balance piston sleeve for wear; replace the sleeve if it is worn.

Be sure to replace all the “O” rings with new ones. By their elasticity, the “O” rings work to center the clearance round the periphery of the balance piston sleeve on the center of the balance piston.

(6) Bearing Cover

Removing the Bearing Cover

The bearing cover differs in shape between the D version models (with a bearing head for sideways discharging) and the G version models (with a bearing head for downward discharging). The discharge port is in an unsymmetrical location with the D version models, so the bearing cover has imbalanced weight distribution between the right and left; this requires careful handling of the bearing cover during its removal.



WARNING

- **Handle heavy components extremely carefully. Use a crane and chain block effectively whenever necessary during their handling. Heavy components, if dropped, can cause serious consequences to both operators and equipment.**
- **Only a qualified person must use a crane. There will be an increased risk of accident if an unqualified operator handles a crane. In addition, the operator may violate local regulations.**

Disassembling the Bearing Cover



Fig. 3-38 Removing the Vi Adjusting Rod Lock Nut

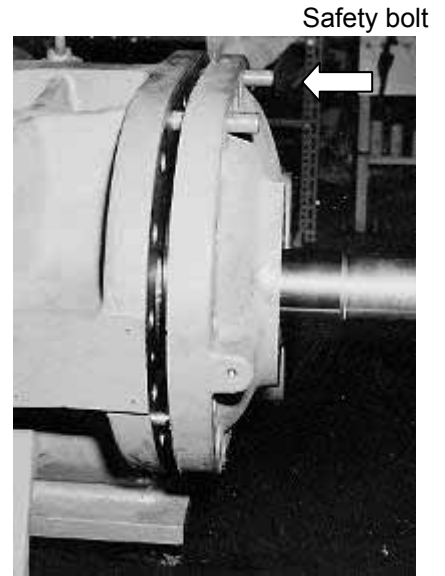
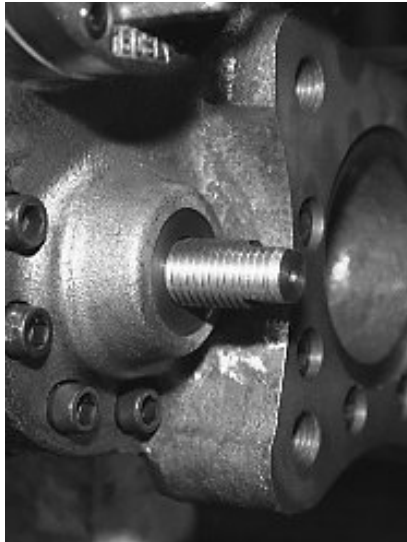


Fig. 3-39 Removing the Bearing Cover Screws

- Remove the lock nuts of the Vi adjusting rod (see Fig. 3-38).
- Of the hexagon socket head cap screws fastening the bearing cover (P/N 18-1, 18-2, 18-3), replace the two screws at the top of the cover with stud bolts (headless safety bolts) and then remove all the other screws.
- Jacking bolt holes are provided at the 2 o'clock and 8 o'clock positions on the bearing cover (these holes are plugged with vinyl caps at the time of shipment from the factory). First place a container for catching oil under the bearing cover and then install the two of the removed hexagon socket head cap screws into the jacking bolt holes and screw in them alternately to create and widen the clearance between the bearing head and bearing cover. Oil will flow out as the clearance is widened.
- The cover will come off the alignment pins located near the screws being turned in as the clearance increases. On the 200, 250 and 320 models, there are threaded holes at the top of the bearing cover's flange. As the bearing cover is heavy, install the eye bolts in these holes to hang the cover using a sling to remove it.

Inspecting the Bearing Cover

- Check the alignment pins as they would have been bent when removing the bearing cover.
- Inspect the thrust washer of the Vi adjusting rod. Replace the washer if it is defective (see Fig. 3-41).
- Always replace the bearing cover gasket and the bearing cover side "O" ring of the Vi adjusting rod.



Fig.40 Bearing Cover Side “O” Ring of Vi Adjusting Rod



Fig.41 Vi Adjusting Rod’s Thrust Washer

(7) Thrust Bearings

The thrust bearings (P/N 38) are important components that affect the performance of the screw compressor.

Improper installation of the thrust bearings will become a cause of operational problems of the compressor. They must be handled quite carefully during both disassembly and reassembly.

The thrust bearings are face-to-face angular contact, dual ball bearings each with a special retainer. As the outer race of each thrust bearing is clearance fitted in the bearing head, the bearing receives only thrust loads.

In addition to supporting thrust loads, each thrust bearing has a role of precisely maintaining the clearance between the rotor end and the discharge end face of the bearing head.

Disassembling the Thrust Bearings

- a) Remove the hexagon head bolts (P/N 45) that fasten the thrust bearing gland (P/N 43). Conical spring washers also come off when the bolts are removed. Do not lose them.



Fig. 3-42 Removing the Thrust Bearing Glands (1)

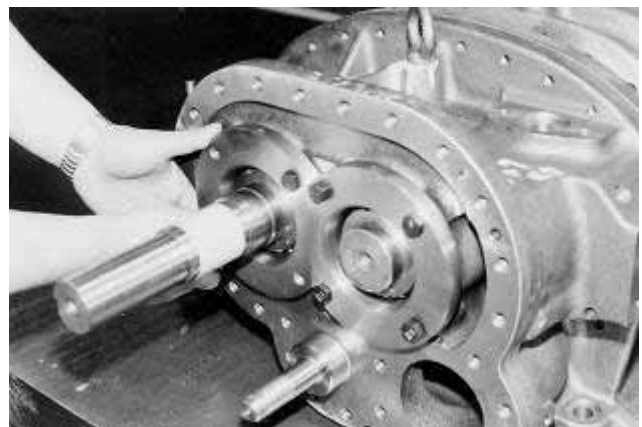


Fig. 3-43 Removing the Thrust Bearing Glands (2)

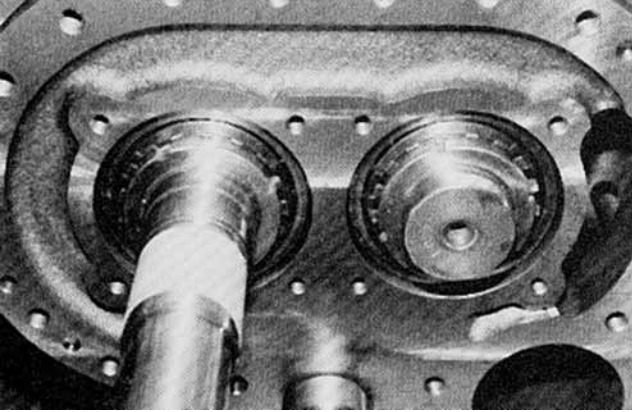


Fig. 3-44 State after Removal of Thrust Bearing Glands

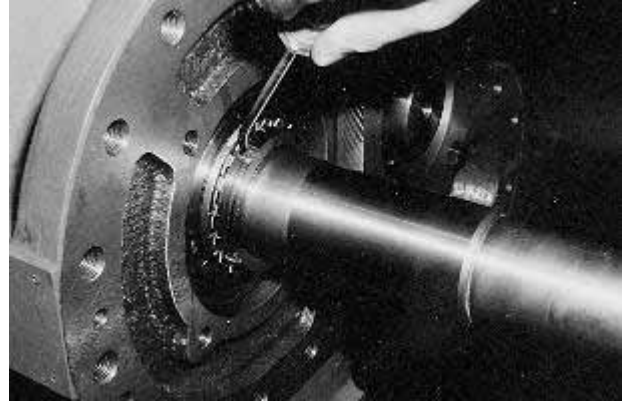


Fig. 3-45 Unbending the Lock Washer Claws

- b) Unbend the claws of the lock washer (P/N 40) holding the lock nut (P/N 39), which retains the inner race of each thrust bearing on the rotor shaft. Then remove the lock nut.
- c) Keep the torsional slip washer (P/N 237), a thin steel plate between the lock nut (P/N 39) and washer (P/N 40), being careful not to bend it.
Also keep the thrust washer (P/N 250) between the lock washer and bearing.

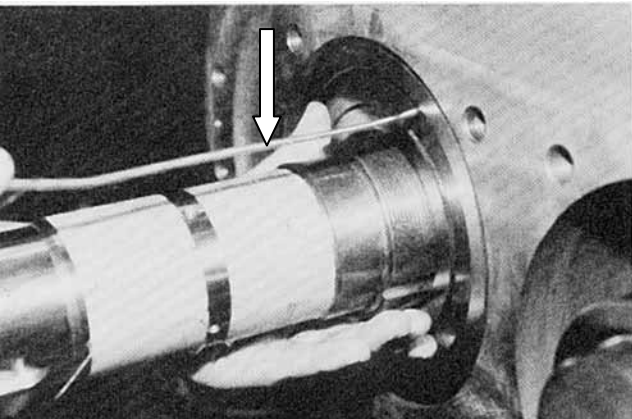


Fig. 3-46 Removing the Thrust Bearing



Fig. 3-47 Thrust Bearing Set

- d) The inner race of the thrust bearing is clearance fitted on the rotor shaft. Remove the thrust bearing as follows:
Flatten and slightly bend one end of a 2 - 3 mm-diameter steel wire. Insert the bent end of the wire into the clearance between the bearing's outer race and the bearing retainer, hook the wire end on the outer race and pull the bearing out (as indicated by the arrow in Fig. 3-46).
- e) Remove the thrust bearing alignment spacer (P/N 42) and thrust bearing outer race spacer (P/N 41) behind the thrust bearing. (There is no alignment spacer on some models for structural reasons.)
Store the thrust bearing outer race spacer and thrust bearing alignment spacer removed from the male rotor separately from those removed from the female rotor. (Both spacers have stamp marks identifying the rotor for which they are to be used (see Fig 3-48). If they are reinstalled for a wrong rotor, the end clearance between the discharge end surface of the rotor and the bearing head end surface will become incorrect, resulting in problems such as poor compressor performance and seizure at the rotor end.)

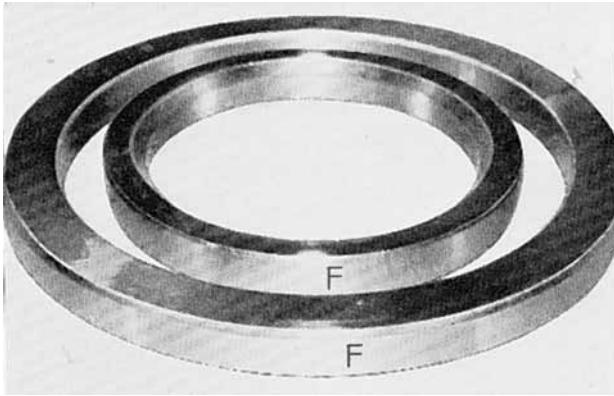


Fig. 3-48 Stamp Marks on Spacers

P/N	Part Name	160 - 200V	250V	320V
38	Thrust bearing	2set	2set	2set
39	Lock nut	2	2	2
40	Lock washer	2	2	2
41	Thrust bearing outer race spacer	2	-	-
42	Thrust bearing alignment spacer	2	2	2
43	Thrust bearing gland	2	2	2
45	Hexagon head bolt	8	8	8
46	Conical spring washer	8	8	8
150	"O" ring	-	-	2
237	Torsional slip washer	2	2	2
250	Thrust washer	2	2	2

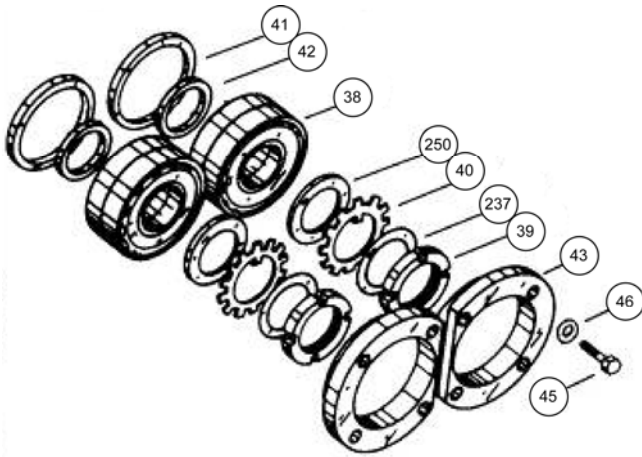


Fig. 3-49 Components of Thrust Bearing Section – 160 and 200 Models

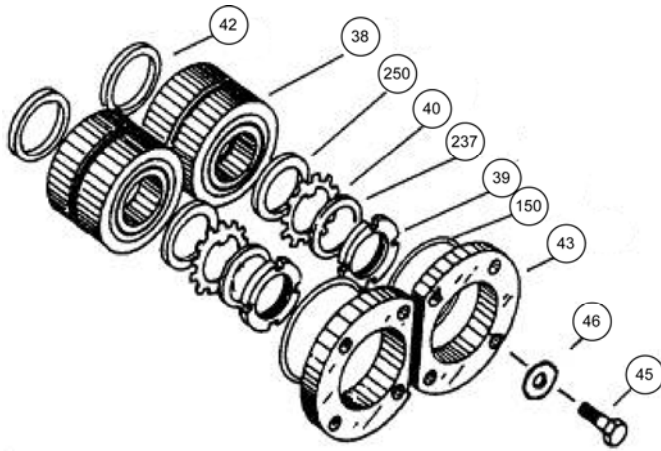


Fig. 3-50 Components of Thrust Bearing Section – 250 and 320 Models

The 250 models do not have the following components: oil supply ring (at the center of P/N 38) and “O” ring (P/N 150).

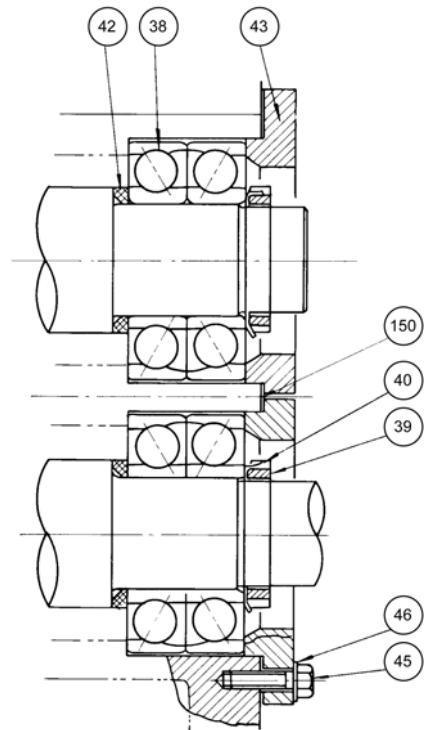
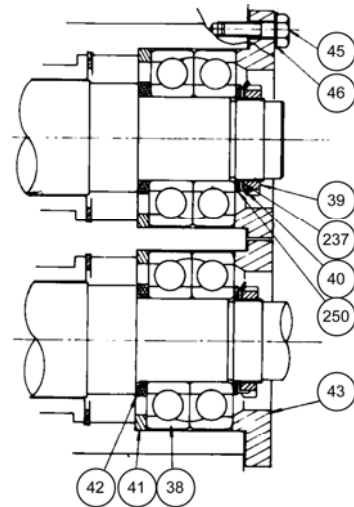


Fig. 3-51 Sectional Views

Inspecting the Thrust Bearings

- a) Clean each thrust bearing thoroughly, then remove cleaning solvent with compressed air.
 - First check that the surfaces of all balls are uniformly bright and free of any abnormalities such as damage and flaking.
 - Next, check that the thrust bearing’s ball cage is free of bent or worn edges at the holes inside which balls are retained.
 - Replace the bearing set in the case of any defect.

- b) Hold one of the bearings with the inner race facing down, and spin the outer race by hand. (Make sure the side facing inward when assembled is at the bottom.) If the outer race does not rotate smoothly or is irregular or sticky to rotate, foreign materials or damaged surfaces may be causes. In the event of such conditions, re-inspect the bearing set, and wash or replace it as necessary.

(8) Suction Cover and Side Bearings

Disassembling the Suction Cover and Side Bearings

- a) Remove all hexagon socket head cap screws fastening the suction cover to the main rotor casing.
(Several screws at the lower positions were already removed during the movement of the compressor to the workbench described in (3) of Section 3.2.3.)
- b) Install two of the removed screws into the jacking holes in the main rotor casing, and screw in them alternately a little at a time to separate the suction cover from the main rotor casing and widen the clearance between them. The two screws should be turned in alternately and evenly because otherwise, the alignment pins would be bent. When the clearance becomes adequate, separate the gasket so that it remains on the suction cover.
- c) Further screw in the screws alternately until the clearance becomes wide enough to remove the alignment pins.
After removing the alignment pins, slide the suction cover on the workbench in the direction away from the rotor casing and in line with the rotor shafts, in order to separate the rotor shafts and the unloader push rod from the suction cover. Do this operation while pushing the rotors toward the main rotor casing to prevent the rotors from dropping off (see Fig. 3-52).

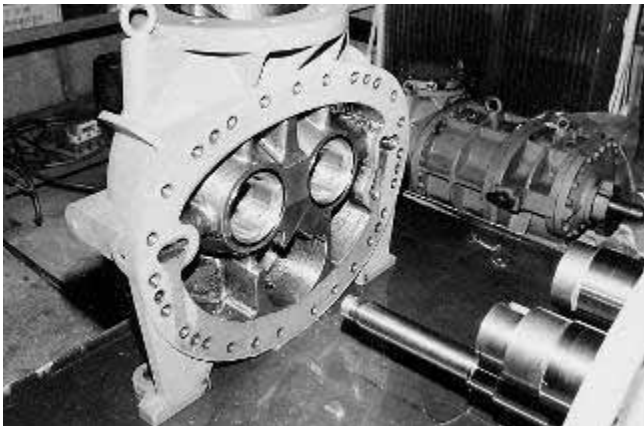


Fig. 3-52 Separating the Suction Cover

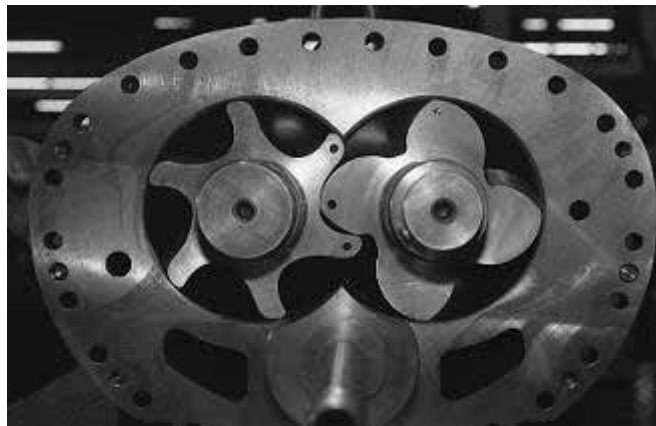


Fig. 3-53 Main Rotor Casing and Rotors

- d) After separating the suction cover, remove the “O” ring gland (P/N 326) at the location from which the unloader push rod was removed by removing the hexagon socket head cap screws (P/N 456) (see Fig. 3-55). To remove the “O” ring gland, use the threaded holes for jacking bolt in the “O” ring gland.
Repace both the “O” ring (P/N 9) behind the “O” ring gland and the “O” ring (P/N 325) on the suction cover.
- e) Remove each side bearing (P/N 28) by first removing the stop ring (P/N 29) (see Fig. 3-54) and then applying pressure on its rotor side to force the bearing out.
The side bearing is either interference fitted or clearance fitted due to manufacturing tolerances. If the bearing is interference fitted, hammer it not directly but through a cushioning material such as a copper, aluminum or plastic plate.
Replace the “O” ring (P/N 433) around each bearing.



Fig. 3-54 Removing the Side Bearing Stop Ring

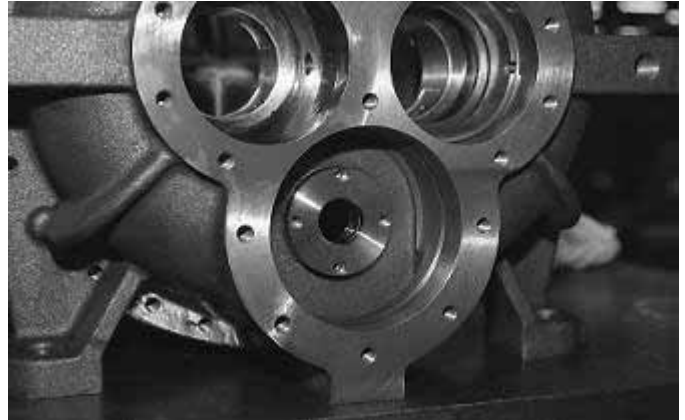


Fig. 3-55 "O" Ring Gland of Unloader Push Rod

Inspecting the Suction Cover and Side Bearings

- a) Inspect the unloader push rod (P/N 67). Replace the push rod if it is deformed or has damage on the outer friction surface. Always replace the "O" ring (P/N 73) of the unloader piston fitting section.
- b) Inspect each side bearing for foreign objects embedded in the inner friction surface. Also measure the dimensions of the bearing. Replace the bearing if necessary according to the inspection result.

(9) Rotors, Main Rotor Casing, Variable Vi Auxiliary Slide Valve and Unloader Slide Valve

The variable Vi auxiliary slide valve and the unloader slide valve are assembled together inside the main rotor casing while being guided by each other. Disassemble them after removing the rotors.

Disassembling the Rotors, Main Rotor Casing, Variable Vi Auxiliary Slide Valve and Unloader Slide Valve

WARNING

- **As each rotor is heavy in weight, handle it very carefully using a crane and chain block properly.**
 - **Only a qualified person must operate a crane. There will be an increased risk of accident due to falling down of the rotor if an unqualified operator handles a crane.**
- a) After pulling out the rotor partway along the length of the main rotor casing, attach a hemp rope or nylon belt to the rotor to suspend it from a crane. Lift the rotor while drawing it out of the casing. Do not use a wire rope, as it will damage the rotor.
Either the male or the female rotor may be removed first. When removing the female rotor first, rotate it counterclockwise as you pull it out. When the rotor comes out approximately two-thirds of its length, attach a belt on it and while lifting it slightly, pull out the remaining part. Be careful not to damage the bore surface of the main rotor casing with the rotor shaft ends.
 - b) Support the removed rotor by its both shaft ends with V-blocks so that the lobes will not touch the floor.
 - c) Remove the other rotor in the same way as Step a) and support it with V-blocks by both shaft ends.
 - d) Remove the hexagon head socket cap screw (P/N 454) securing the lock washer on the end of the Vi adjusting rod and remove the lock washer (see Fig. 3-58). (The lock washer is not used on the products manufactured in and after 2003.)

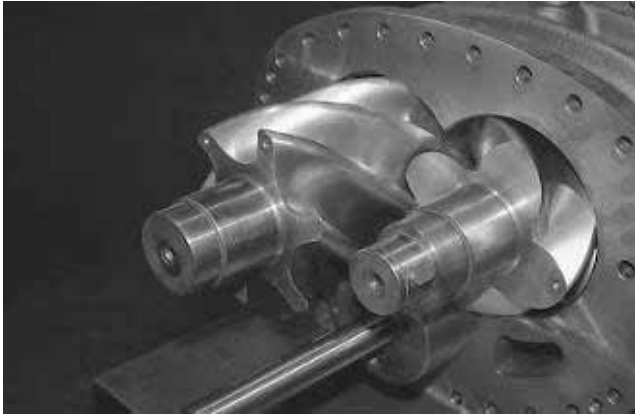


Fig. 3-56 Pulling Out the Female Rotor

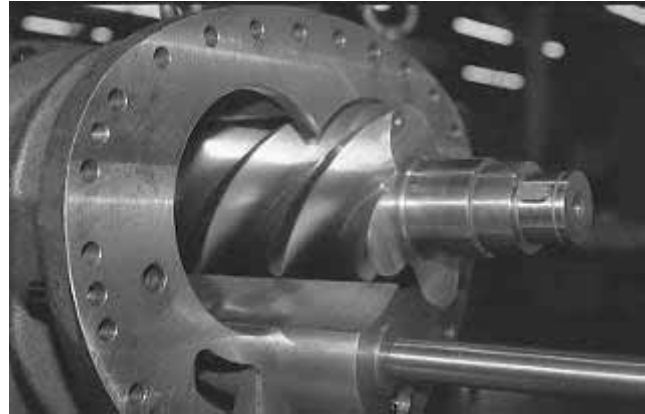


Fig. 3-57 Pulling Out the Male Rotor

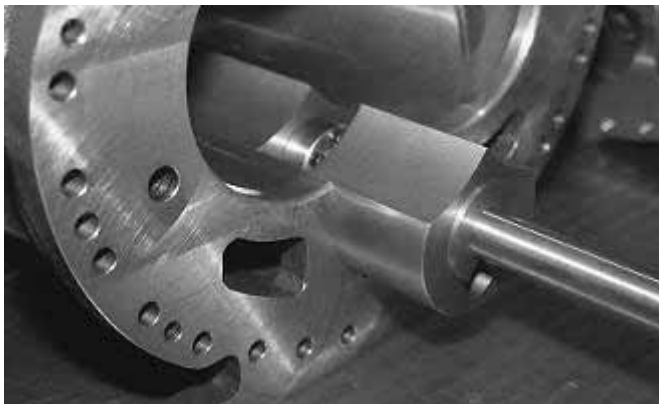
- e) Turn the Vi adjusting rod in the bearing head counterclockwise until its end disengages from the variable Vi auxiliary slide valve and then pull the rod out of the bearing head. Keep the thrust washers (P/N 449) together with the Vi adjusting rod.
- f) Return to the suction side. Pull the unloader slide valve and the variable Vi auxiliary slide valve out of the main rotor casing by holding the unloader push rod. Then hold the variable Vi auxiliary slide valve to pull out the unloader push rod and separate the variable Vi auxiliary slide valve and unloader slide valve.



**Fig. 3-58 Removing the Lock Washer
(Products in and before 2003)**



Fig. 3-59 Pulling Out the Vi Adjusting Rod



**Fig. 3-60 Pulling Out the Variable Vi Auxiliary
Valve and Unloader Slide Valve**



**Fig. 3-61 Separating the Variable Vi Auxiliary
Valve and Unloader Slide Valve**

Inspecting the Rotors, Main Rotor Casing, Variable Vi Auxiliary Slide Valve and Unloader Slide Valve

- a) Check that the shaft end surfaces and the “O” ring contact surface at the mechanical seal area of each rotor are free of damage.
- b) Inspect the rotor surfaces in the areas of engagement between the male and female rotors and the lobe contours for damage and wear. There should be no damage on these surfaces under normal operating conditions of the compressor. If they have damage, a probable cause may be foreign materials entering the compressor. The suction gas filter and/or oil filter should then be inspected.
- c) Inspect the surfaces of the unloader slide valve and variable Vi auxiliary slide valve that rub against the main rotor casing. Also check the clearance in their fitting areas and the fitting condition between the Vi adjusting rod and unloader slide valve bushing. Replace the bushing if it is worn.
- d) Inspect the rotor bore surfaces of the main rotor casing. These surfaces should normally have no change in condition, as the bore surface must be free from interference with the rotors. If there are any contact marks with rotors on the bore surfaces, there may be problems related to the rotors’ end shaft sections and bearings. If the rotors have worn down about 0.3 % or more in the outside diameter, the compressor’s performance will start declining.
- e) If the mechanical seal section of the rotor shaft needs to be repaired, please contact the nearest Mayekawa office or sales/service center.

(10) Bearing Head and Main Bearings

Disassembling the Bearing Head and Main Bearings

Separating the bearing head and main rotor casing is normally not required.

To remove each main bearing, remove the stop ring (P/N 29) from the bearing cover side using pliers (see Fig. 3-62) and push out the main bearing. If the bearing cannot be removed by pushing it, tap on the bearing using a hammer through a cushioning material such as copper, aluminum or plastic plate. Do not strike the bearing directly with a hammer.

Inspecting the Bearing Head and Main Bearings

Check the bore of the bearing for surface condition, dimensions and foreign matter embedded in it. Replace the main bearing if the inspection result shows any defect. Always replace the “O” rings (P/N 450 and 523) of the Vi adjusting rod.



Fig. 3-62 Removing the Stop Ring



Fig. 3-63 “O” Rings of Vi Adjusting Rod

3.3 Reassembly



Be sure to use only MAYEKAWA genuine parts for replacement. Use of substitute parts may result in serious problems in the compressor or other equipment in your refrigerating system during operation.

After completing inspection, necessary repairs and determination of the parts to be replaced, proceed to reassembly of the compressor. Almost all reassembly procedures are reverse to the disassembly procedures. Before starting reassembly operation, clean all parts, tools, and workbench surface. Also have fresh compressor oil ready to use for coating the components with it as necessary.

(1) Bearing Head and Main Bearings

- a) The main bearings may be clearance fitted in some compressors while they may be fitted with slight interference in other compressors. This is due to allowable difference within tolerances.

In the case of installing a bearing that is to be interference-fitted, make a simple jig (consisting of a disk that is slightly smaller in diameter than the rim of the bearing and has a hole (threaded or not) in the center, a long bolt with threads on its entire length, a nut for the bolt, and a rectangular plate with a loose hole) as shown in Fig. 3-65.

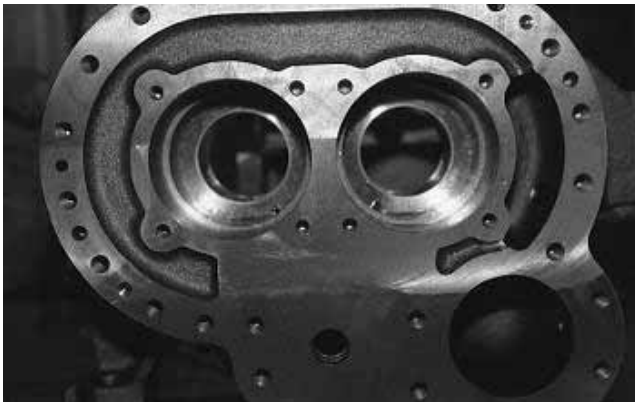


Fig. 3-64 Installing the Main Bearings

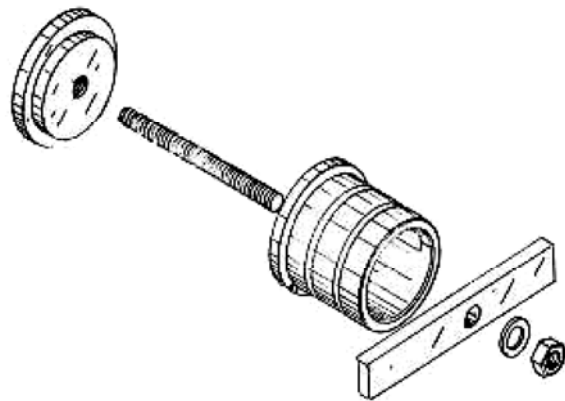


Fig. 3-65 Bearing Installation Jig

- b) There is a pin in each main bearing bore in the bearing head, which serves both as a locking and alignment pin. Fit each main bearing while aligning its notch with the pin.
- c) Install the stop ring to retain each bearing.
- d) Make sure the "O" ring (P/N 451) is fitted in the hole for the Vi adjusting rod.
- e) Apply oil to both surfaces of the gasket to be fitted between the bearing head and main rotor casing. Affix the gasket to the main rotor casing and hold it on the main rotor casing by inserting a screw into the casing. Since the holes in the gasket are not arranged symmetrically, make sure the holes in the gasket exactly align with the holes in the main rotor casing.

(2) Main Rotor casing, Unloader Slide Valve, Variable Vi Auxiliary Slide Valve and Bearing Head

a) Unloader slide valve

Check that the Vi adjusting rod's Teflon bushing (P/N 448) on the unloader slide valve has no defects (see Fig. 3-66).

Replace the "O" ring (P/N 523) fitted in the Vi adjusting rod hole of the unloader slide valve (the hole is located on the valve's end where the unloader push rod is installed) (see Fig. 3-67).

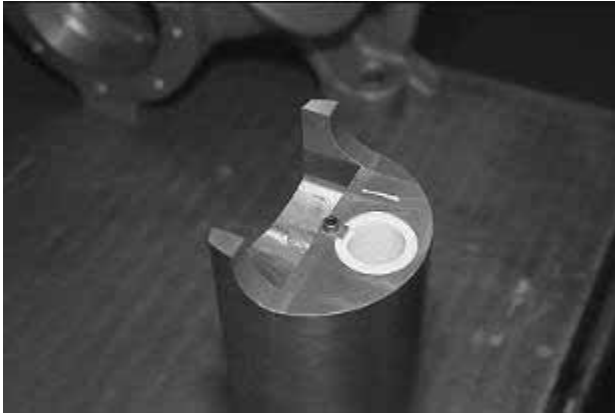


Fig. 3-66 Teflon Bushing for Vi Adjusting Rod



Fig. 3-67 "O" Ring for Vi Adjusting Rod

b) Main Rotor Casing

After removing the plugs (P/N 458), clean the oil injection circuit holes thoroughly. Fit the plugs into the original holes, install the unloader slide valve and confirm that the unloader slide valve moves smoothly. Next, install the variable Vi auxiliary slide valve and confirm that it also moves smoothly.



Fig. 3-68 Plug of Oil Injection Circuit Hole (1)

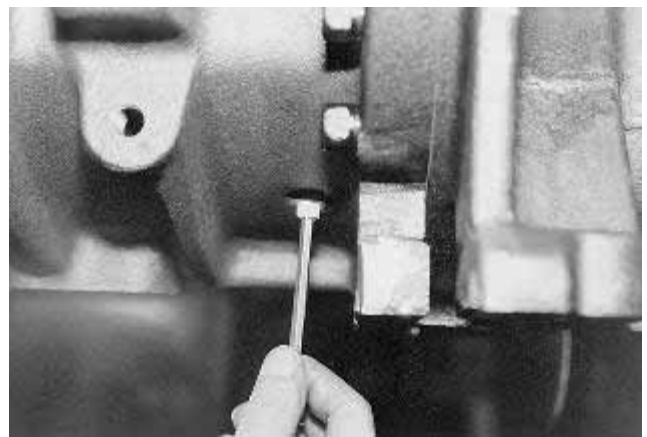


Fig. 3-69 Plug of Oil Injection Circuit Hole (2)

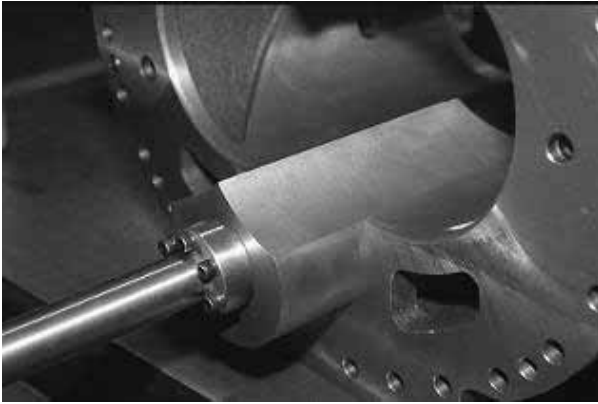


Fig. 3-70 Installing the Unloader Slide Valve

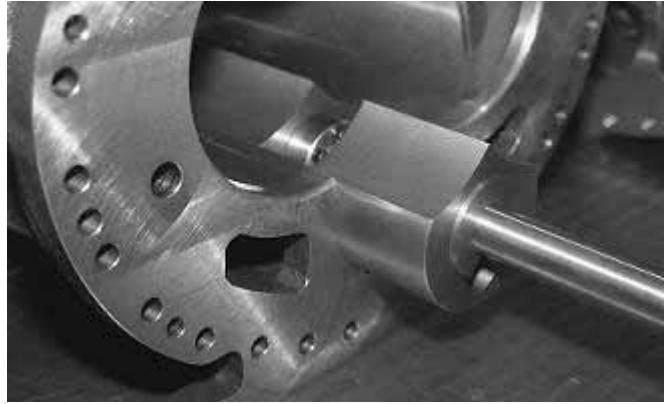


Fig. 3-71 Installing the Variable Vi Auxiliary Slide Valve

- c) Assemble the main rotor casing and bearing head (These parts are not disassembled during ordinary maintenance service.). Tighten the hexagon socket head cap screws in a diagonal sequence, a little at a time, and finally tighten them to the specified torque using a torque wrench (see “Tightening Torques for Hexagon Socket Head Cap Screws” in Chapter 4). The lower screws, however, should be installed simply to the state ready for final tightening when the compressor is lifted later.

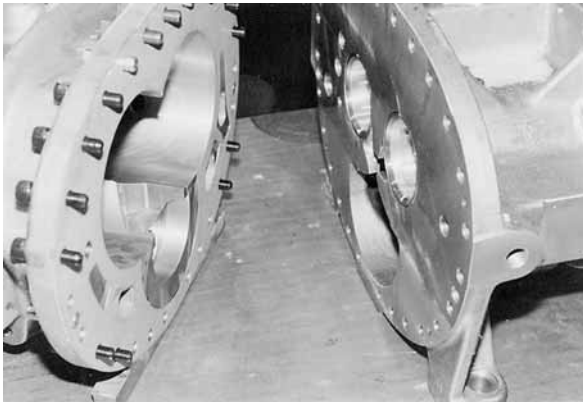


Fig. 3-72 Assembling the Bearing Head and Main Rotor Casing

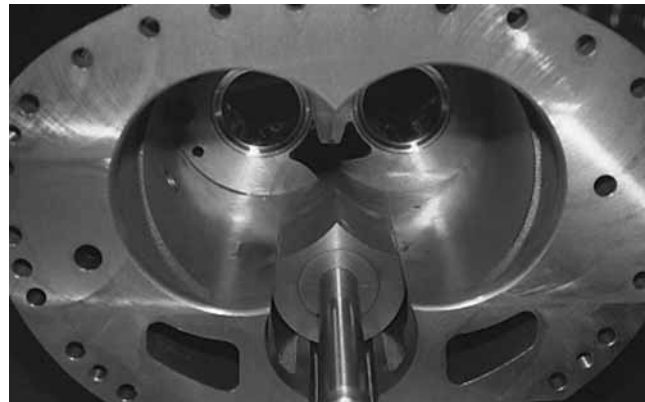


Fig. 3-73 Checking Again the Unloader Slide Valve for Smooth Movement

After assembling the main rotor casing and bearing head, check again that the unloader slide valve can be moved smoothly along the surface of the port section in the bearing head.

- d) Install the Vi adjusting rod from the bearing head side and screw it into the threaded hole in the variable Vi auxiliary slide valve. Do not fail to install the thrust washer (see Fig. 3-41).
- e) Check that the gasket does not protrude into the rotor rotating bores on the bearing head end of the main rotor casing. If any part of the gasket is extending into the bores, cut away that part with a knife or the like. (Otherwise, the exposed part of gasket is caught between the end surface of the rotor and bearing head, preventing proper thrust clearance adjustment and eventually causing degraded performance of the compressor.)

(3) Main Rotor Casing and Rotors

- a) Apply oil to the shaft portion on the bearing head side of the female rotor and also the inside of the female rotor's main bearing.

Install the female rotor into the main rotor casing. To do this, suspend the rotor's midpoint using a rope or strap from a crane or chain block, and insert the rotor into the casing halfway along its length while keeping it balanced on the rope or strap. Then detach the rope or strap from the rotor and push the rotor fully into the casing. (You may also install the male rotor first as long as the lobe mating work in Steps b) and c) below is correctly performed.)



Fig. 3-74 Stamp Mark on Suction Side Lobe End of Male Rotor



Fig. 3-75 Stamp Marks on Discharge Side Lobe End of Female Rotor

Each rotor has a lobe end mark(s) (stamped number mark (s)) on both the discharge side and suction side ends in such a way that the mating marks can be confirmed even when the male rotor is installed first.

- b) Identify the location of the groove between the female rotor's lobes marked "1" and "2".
- c) Suspend the male rotor from a crane or chain block, and install it while mating its lobe marked "1" with the groove between the female rotor's lobes marked "1" and "2" and then rotate the male rotor until its end reaches halfway in the main rotor casing bore. Detach the rope or strap from the male rotor and push it completely inward.

NOTE: Proper mating between the male and female rotor lobes is essential to assure proper lobe-to-lobe contact and clearance. If the original mating is disturbed, irregular contact and clearance (and hence irregular operating sound) will result. Make sure to keep the proper mating of the rotor lobes.



Fig. 3-76 Installing the Male Rotor

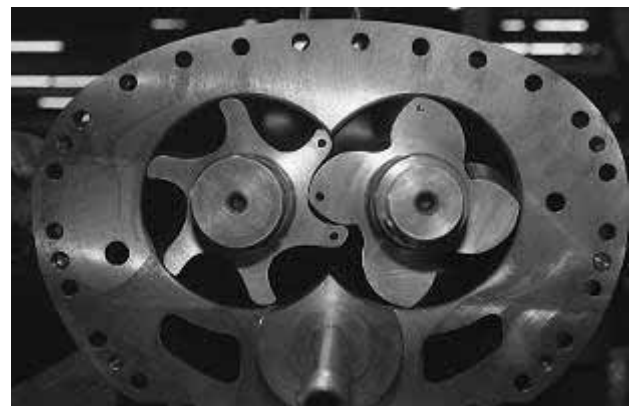


Fig. 3-77 Rotors Installed in Position

(4) Suction Cover

- a) Install the side bearings into the suction cover in the same way as for installing the main bearings into the bearing head. Do not fail to attach the “O” rings (P/N 433) on the outside diameter of each side bearing.

The side bearings may be either clearance fitted or interference fitted in the bores in the suction cover like with the main bearings in the bearing head. When installing an interference fitted bearing, tap it only through a copper, aluminum or plastic cushioning plate.

The pin will be easily aligned with the notch on the outer flange of each side bearing if a guide rod is attached to the pin as indicated by the arrow in Fig. 3-78.

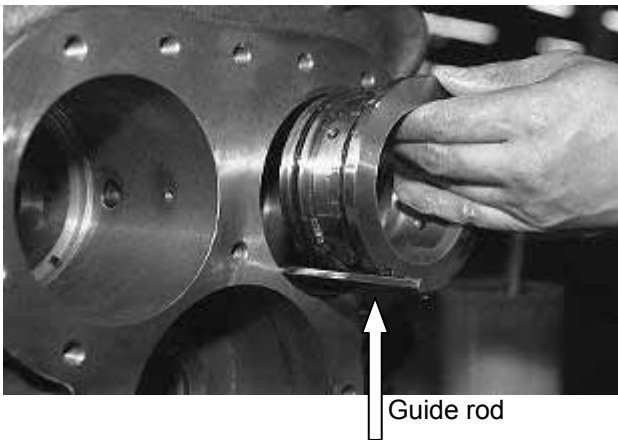


Fig. 3-78 Positioning the Side Bearing

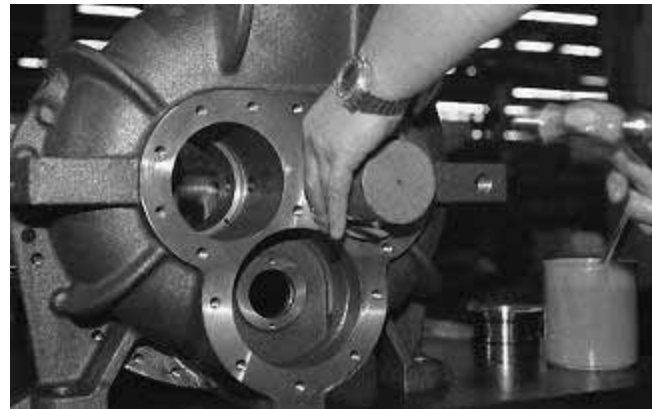


Fig. 3-79 Installing the Side Bearings

- b) Secure the side bearing by installing the stop ring.
- c) Attach the “O” ring (P/N 9) in the hole in the suction cover. Then install the “O” ring gland (P/N 326) through which the unloader push rod is to be installed.

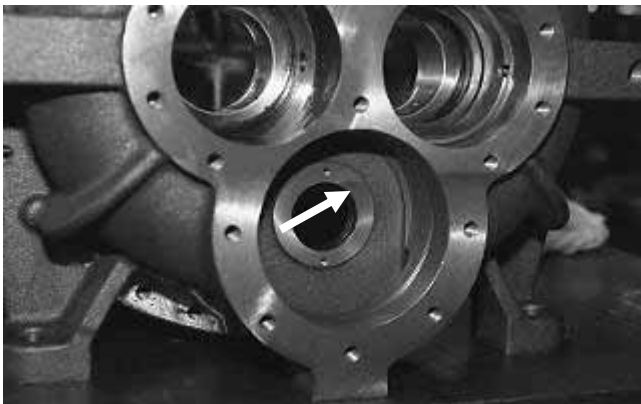


Fig. 3-80 “O” Ring (P/N 9) Installed in Suction Cover



Fig. 3-81 “O” Ring and “O” Ring Gland (P/N 326)

- d) Install the balance piston components into the suction cover as follows.
- Install the following parts in the order of mention: inner stop ring (P/N 37), “O” ring spacer (P/N 36), “O” ring (P/N 35), balance piston sleeve (P/N 33) and outer stop ring. As the outer stop ring installed last is pushed outward by the “O” ring, you must push it to fit it in its groove.
- When installing the balance piston sleeve during the above operation, block the sleeve against rotation using either of the following methods (see Figs. 3-34 to 3-36 in 3.2.5 (5)).
- Type 1 (160 – 250VSD/VMD/VLD/VLLD)
- Screw one set screw (P/N 34) into the suction cover from the male rotor side and screw the other set screw into the suction cover from the female rotor side.
- Type 2 (320VSD/VMD/VLD)
- Fit the pin provided on the outside diameter of the balance piston sleeve into the groove in the suction cover.
- e) Turn the Vi adjusting rod counterclockwise to set it to the L port position and then use the eye bolt to push the unloader slide valve to the no load position. Next, apply oil to the suction cover gasket and affix it to the main rotor casing. Insert a few screws in the main rotor casing to retain the gasket in position. Push the alignment pins toward the main rotor casing.
- f) Slide the suction cover on the workbench to first align the unloader push rod with the “O” ring gland in the suction cover and then align the shaft ends of the rotors with the side bearings. Finally push the suction cover in parallel with the shaft axes to put it together with the main rotor casing.

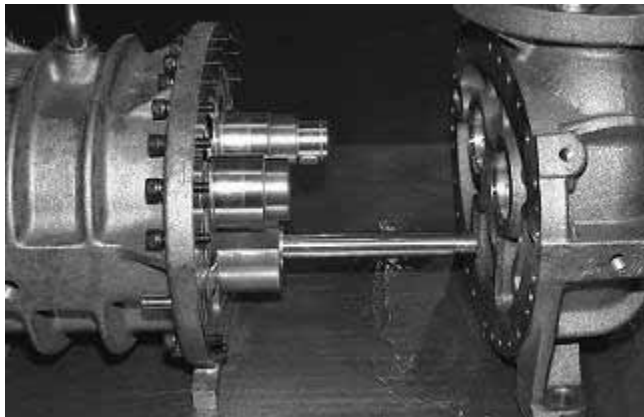


Fig. 3-82 Assembling the Suction Cover with Main Rotor Casing (on Workbench)



Fig. 3-83 Assembling the Suction Cover with Main Rotor Casing (Using a Crane)

For large-sized compressor models, assembling the suction cover with the main rotor casing by sliding the cover on the workbench is difficult. Instead, place the main rotor casing on the edge of the workbench and lift the suction cover with a crane (see Fig. 3-83). It is recommended to use a chain block with the crane to be able to make fine up and down adjustments.

- g) Drive the alignment pins into position. Then, tighten the hexagon socket head cap screws to the specified torque (see “Tightening Torques for Hexagon Head Cap Screws” in Chapter 4).

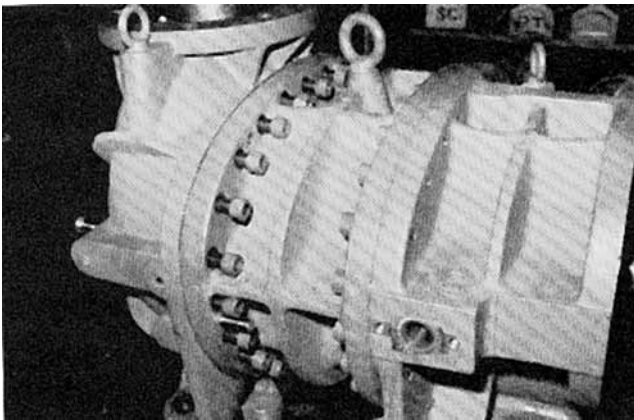


Fig. 3-84 Suction Cover Assembled with Main Rotor Casing

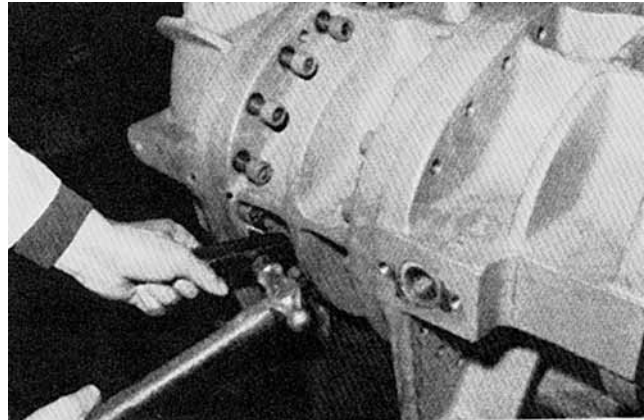


Fig. 3-85 Driving in Alignment Pins

- h) Check the unloader slide valve and variable Vi auxiliary slide valve for smooth movement. Also check that the male rotor shaft can be rotated by hand.



Fig. 3-86 Tightening Hexagon Head Cap Screws with Torque Wrench



Fig. 3-87 Tightening the Screws with Hydraulic Torque Wrench – Large-sized Models

(5) Thrust Bearings

- a) Install the thrust bearings and related parts paying attention to the following points:
- If removed thrust bearings (P/N 38) are reused, check the M and F marks on the thrust bearing alignment spacers (P/N 42) and install the spacers in the original combinations with the thrust bearings. While installing the thrust bearings, prevent any foreign matter from getting into the thrust bearing glands, thrust bearing alignment spacers, main bearings and bearing head, as foreign material in any of these locations will prevent reestablishing the original thrust clearance.
 - Install each thrust bearing with the “V” mark on the bearing pointing toward the rotor (see Fig. 3-88). If the thrust bearing is installed in the wrong direction, end clearance will become different from the original clearance because of the difference in end surface between the outer and inner races.

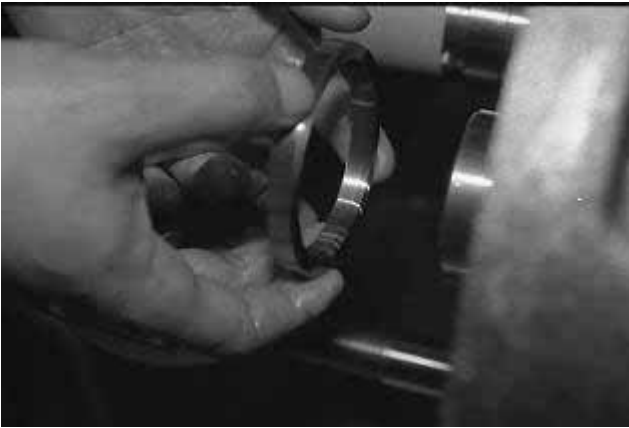


Fig. 3-88 Thrust Bearing Alignment Spacer



Fig. 3-89 V Mark on Thrust Bearing

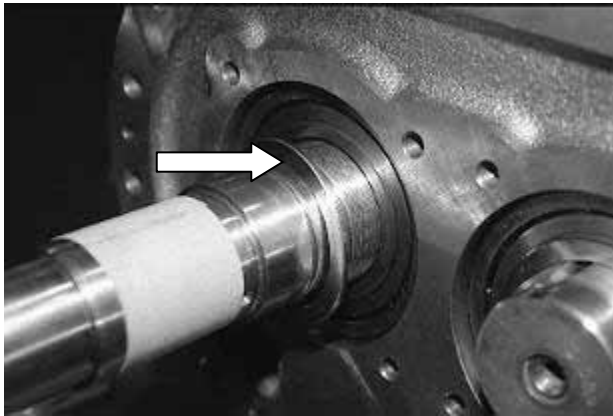


Fig. 3-90 Thrust Bearing Alignment Spacer

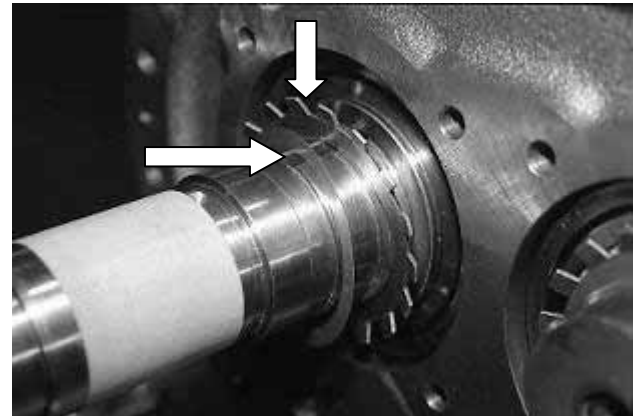


Fig. 3-91 Lock Washer and Torsional Slip Washer

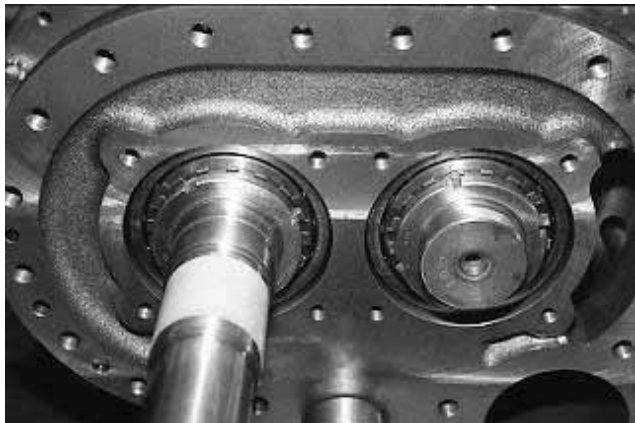


Fig. 3-92 Tightening the Lock Nut



Fig. 3-93 Lock Washer Claws

- Be sure to install the above parts in the following sequence:
Thrust bearing → Thrust washer → Lock washer → Torsional slip washer → Lock nut
- Be sure to replace the lock washers with new ones. If the washers are reused, the same claws on them have to be bent again and may break eventually.
- If the thrust bearings are replaced, change in the bearings' end clearance and consequential adjustment must be assumed during the assembly.
- Tighten each lock nut a little at a time, while making sure of presence of the necessary end clearance.

- When new thrust bearings are installed, their end clearance will change because of tolerable machining difference in end-to-end dimension between the inner and outer bearing races. Accurately measure the end clearance using the method of Step b) below and adjust the end clearance correctly. If the lock nut is fastened when there is no end clearance, the balls will be pressed against the rolling contact surfaces of the bearing and this will cause dimples on the surfaces.
- b) With the inner race of the thrust bearing firmly fitted on each rotor shaft, measure the rotor end clearance for each of the male and female rotors and then adjust the end clearance using the following method.
1. Press the rotor against the discharge end surface.
 2. Mount a dial indicator on the suction cover end of the main rotor casing with a magnetic stand, apply the dial indicator's probe on the end surface of the rotor shaft, then set the dial indicator needle to zero.
 3. Fasten the thrust bearing gland with four hexagon head bolts evenly, then finally tighten them to the torque indicated in the table below or "Tightening Torques for Hexagon Head Bolts (P/N 45) of Thrust Bearing Glands" in Chapter 4 (see Fig. 3-94).
 4. As the thrust bearing gland bolts are fastened, the rotor is pushed toward the suction cover and the amount of the displacement is indicated on the dial indicator. An end clearance equal in amount to the dial indicator indication is created on the rotor's discharge end (see Fig. 3-95).
 5. The end clearance is correct if the dial indicator reading is within the relevant range shown in the table on page 3-38. If the end clearance is too small, change the thrust bearing alignment spacer to a thicker one or add a shim of the necessary thickness. Shims for all models are available from MAYEKAWA. If the thinnest of the shims is still too thick for the adjustment, thin it down by grinding to the desired thickness. (Refer to Step c) for the method of the adjustment.)

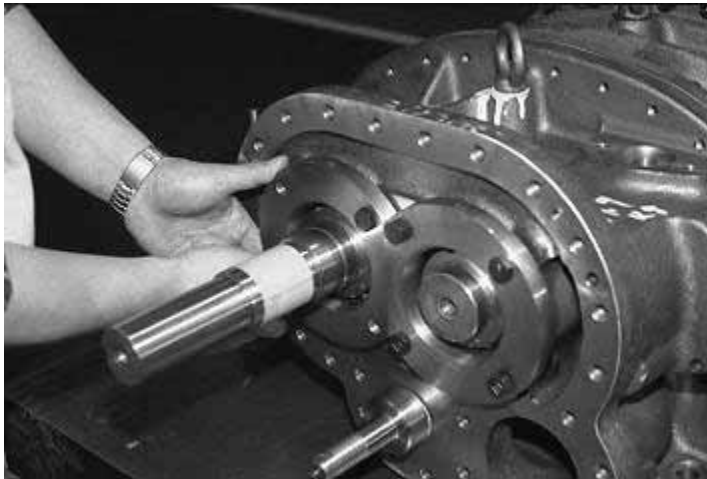


Fig. 3-94 Installing the Thrust Bearing Gland



Fig. 3-95 Measuring the End Clearance

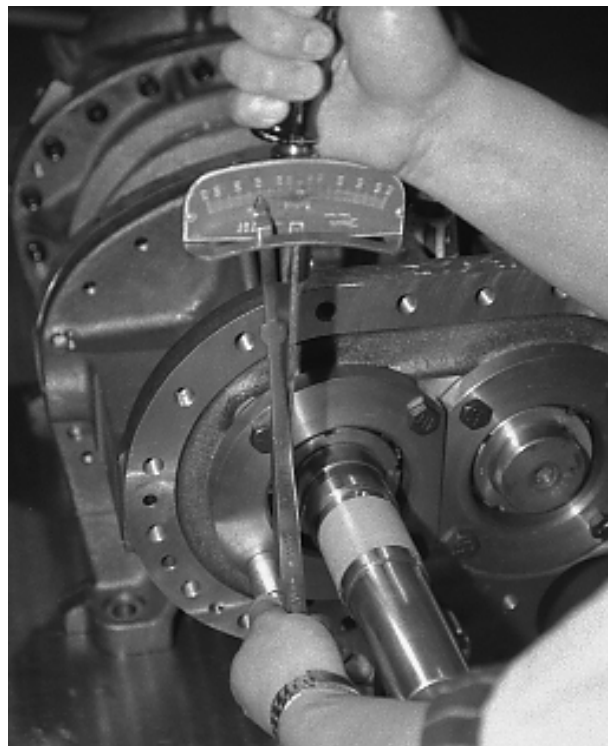


Fig. 3-96 Tightening the Hexagon Head Bolts to the Specified Torque

Tightening Torques for Hexagon Head Bolts of Thrust Bearing Glands

	Tightening Torque	
160V	400 kgf-cm	40 N·m
200V	500 kgf-cm	50 N·m
250V	600 kgf-cm	60 N·m
320V	1200 kgf-cm	120 N·m

End Clearance (mm)

Model	For Single Stage (High Stage)				For Booster (Low Stage)			
	S	M	L	LL	S	M	L	LL
160V	0.04 – 0.06				0.20 – 0.22	0.22 – 0.24	0.24 – 0.26	
200V	0.05 – 0.07				0.26 – 0.30	0.28 – 0.32	0.31 – 0.35	
250V	0.08 – 0.11				0.40 – 0.44	0.45 – 0.49	0.50 – 0.54	0.55 – 0.59
320V	0.17 – 0.21	0.20 – 0.24	0.23 – 0.27	0.26 – 0.30	0.70 – 0.76	0.73 – 0.79	0.77 – 0.83	0.81 – 0.87

End Clearance Adjustment [I]

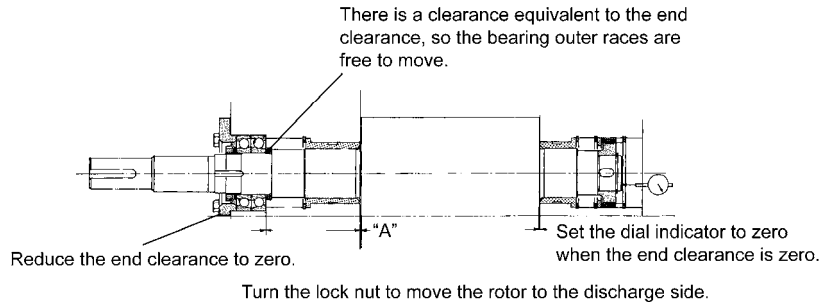


Fig. 3-97 End Clearance Adjustment by Pushing the Rotor toward Discharge End

End Clearance Adjustment [II]

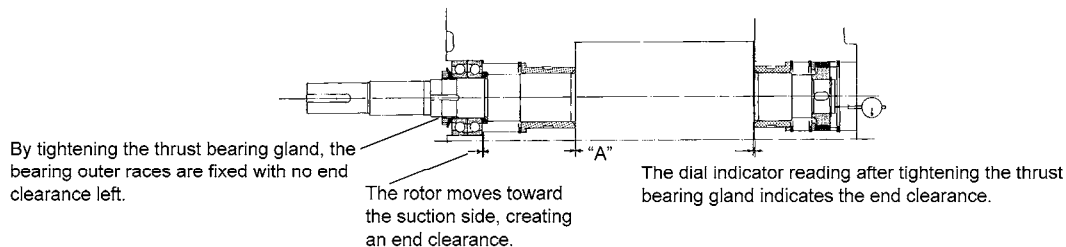


Fig. 3-98 End Clearance Adjustment by Tightening the Bolts for Thrust Bearing Gland

c) Procedure for end clearance adjustment

Perform the following adjustment procedure for both the male and female rotors. After the adjustment, measure the end clearance and perform the adjustment again if necessary.

(1) When end clearance is larger than the specified value

The distance between the rotor end surface and the discharge end of the bearing head is too large when the thrust bearing is fastened by the thrust bearing gland. The distance must be reduced by either of the following methods in this case.

- Method 1:

Dimension "A" in Fig. 3-97 is too large because the thrust bearing alignment spacer is too thick. The spacer must be ground down by the amount equivalent to the difference between the measured and specified values. Use a high precision surface-grinding machine for grinding the spacer. After

grinding, check the spacer for even thickness using a micrometer on its entire perimeter. This method can be applied to all compressor models.

- Method 2:

Insert a shim of an exactly necessary thickness between the thrust bearing gland and the outer race of the thrust bearing. The thickness of the shim should be equal to the difference between the measured and the specified values like with Method 1. Shims are available from MAYEKAWA.

(2) When end clearance is smaller than the specified value

The rotor becomes unable to rotate when the lock nuts are tightened to a certain extent. This condition is caused by too small thickness of the thrust bearing alignment spacer or excessive thickness of the thrust bearing outer race spacer. Use either of the following methods according to the compressor model to adjust the end clearance properly.

- Method for the 160 and 200 models that have thrust bearing outer race spacer:

Grind the spacer down to the necessary thickness using the same method as the Method 1 in (1) above.

- Method for the 250 and 320 models that have no thrust bearing outer race spacer:

Inserted a shim of a necessary thickness between the thrust bearing alignment spacer and the thrust bearing.

NOTE: We recommend ordering a new thrust bearing alignment spacer of the desired thickness from MAYEKAWA rather than using a shim.

d) Rotate the male rotor by hand to check for smooth rotation.

e) Check runout of the shaft by applying the dial indicator's probe to the mechanical seal portion of the male rotor and rotating the rotor(see Fig. 3-100).

A runout of up to 0.03 mm is acceptable for all models. Runout is generally caused by non-uniform thickness of the thrust bearing alignment spacer, non-alignment of the mark across the bearing halves, or existence of foreign materials between the bearing's inner or outer race and the spacer. Even with a proper end clearance, runout of the rotor shaft significantly affects its seal performance. If runout is excessive, disassembly and adjustments are necessary for the thrust bearing outer race spacers, thrust bearing alignment spacers and all areas related to the main bearings.

f) After completing the end clearance adjustment and subsequent tightening, bend the claw of the lock washer. Then bend the washers of the hexagon head bolts for the thrust bearing glands to lock the bolts. (Conical spring washers are used on the compressors produced in and after 2003)

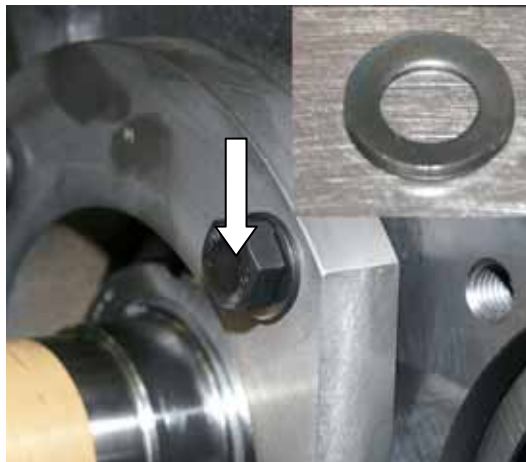


Fig. 3-99 Installing Conical Spring Washer under Head of Thrust Bearing Gland Bolt

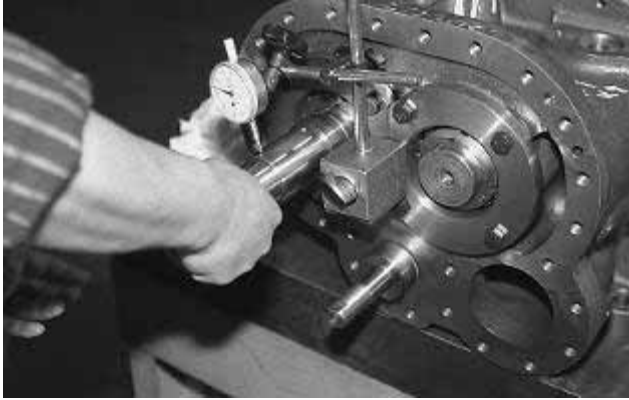


Fig. 3-100 Measuring Runout of Shaft

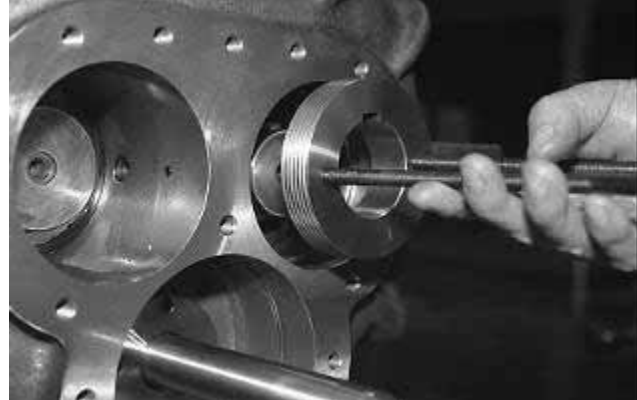


Fig. 3-101 Installing the Balance Piston

- g) Hold the balance piston with the eye bolts screwed into the holes in the piston. Install the balance piston by pressing it onto the male rotor shaft while aligning its keyway with the key on the shaft (see Fig. 3-101). Retain the piston with the stop ring.

(6) Bearing Cover

- a) Fit the thrust washer (P/N 449) on the Vi adjusting rod (see Fig. 3-103). There is a gland for the Vi adjusting rod on the 320 models (see Fig. 3-102).
- b) Screw long safety bolts with their heads removed into the bearing head (see Fig. 3-104). Apply compressor oil to the bearing head gasket, set it in position on the bearing head, then install the bearing cover.

For the 250 and 320 models, the bearing cover has a threaded hole for installing a hanging bolt in its center-of-gravity position. With the bearing cover suspended from a crane using the hanging bolt, install the bearing cover to the bearing head while keeping the clearance between the two components' peripheries so as not to damage the mechanical seals.

First screw in a pair of bolts at diagonally opposite positions evenly and alternately until the entire bearing cover comes in contact with the bearing head, and then fasten the remaining bolts (see Fig. 3-105).

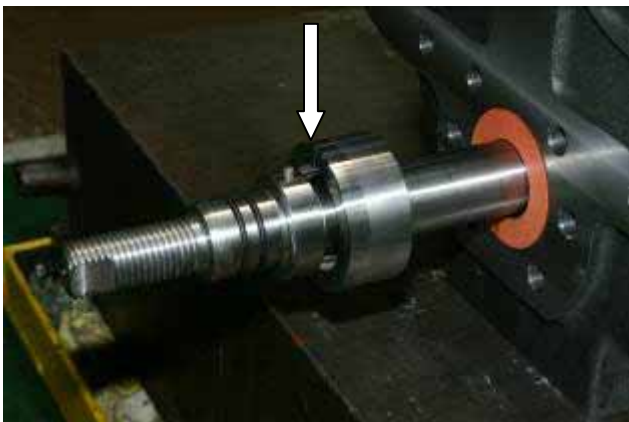


Fig. 3-102 Vi Adjusting Rod (320 Models)

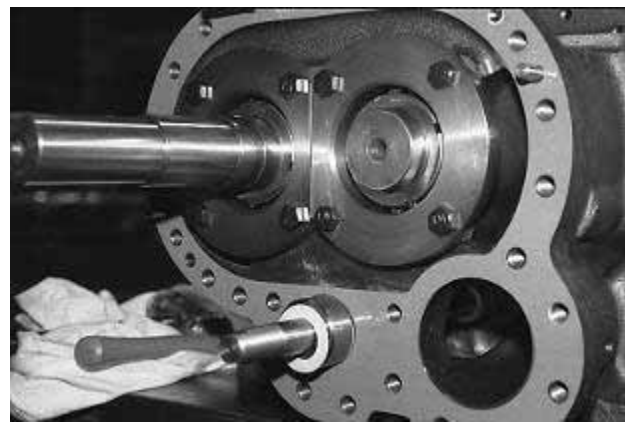


Fig. 3-103 Installing the Thrust Washer



Fig. 3-104 Safety Bolts for Retaining the Bearing Cover

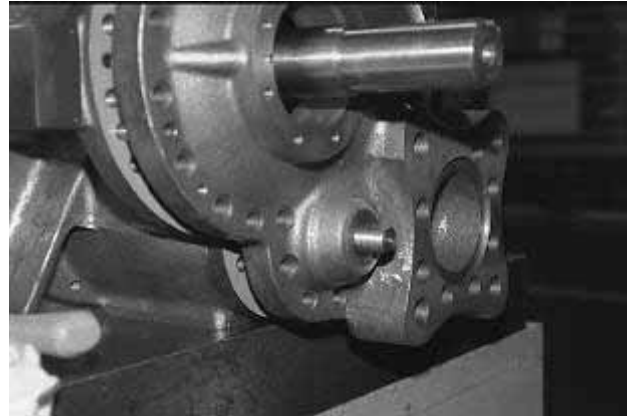


Fig. 3-105 Installing the Bearing Cover

(7) Balance Piston Cover, Unloader Cylinder and Unloader Piston

- a) Attach the "O" ring (P/N 65) on the unloader piston and put the cap seal (P/N 66) over it. Insert the piston into the unloader cylinder from the roundly chamfered end (rotor casing side) (see Fig. 3-106). Turn the piston's side with the eye bolt holes toward the unloader cover so that the cap seal can be fitted between the unloader cylinder and "O" ring.
- b) Attach the "O" ring (P/N 63) to the unloader cylinder's portion where the cylinder comes in contact with the suction cover (see Fig. 3-107) and install unloader cylinder to the balance piston cover (see Figs. 3-108 and 3-109). Install the unloader cylinder to the suction cover using the hexagon socket head cap screws (P/N 61) at two places.



Fig. 3-106 Unloader Cylinder and Unloader Piston

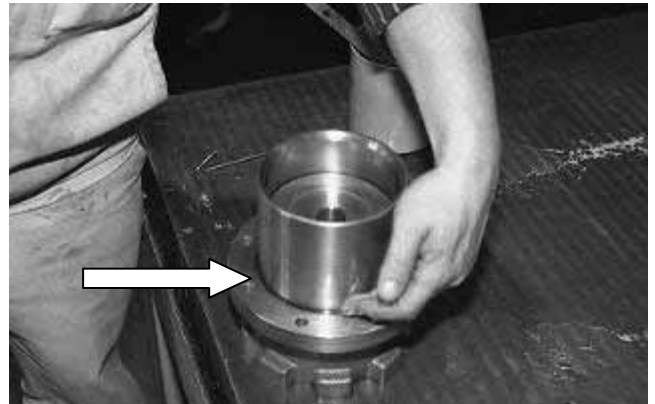


Fig. 3-107 Installing the "O" Ring



Fig. 3-108 Installing the Unloader Cylinder to Balance Piston Cover



Fig. 3-109 Installing the Unloader cylinder on Balance Piston Cover

- c) Move the unloader push rod fully toward you (full-load position), then fit the balance piston cover gasket (P/N 23) to the balance piston cover (see Fig. 3-110), and push the unloader cylinder into the suction cover.

The unloader piston and the unloader push rod will engage each other while the unloader cylinder is being pushed into the suction cover (see Fig. 3-111).

Fasten the balance piston cover temporarily to the suction cover using two or three hexagon socket head cap screws (see Fig. 3-112). Secure the unloader piston to the unloader push rod with the lock washer and lock nut. Bend the claw of the lock washer.



Fig. 3-110 Affixing the Gasket

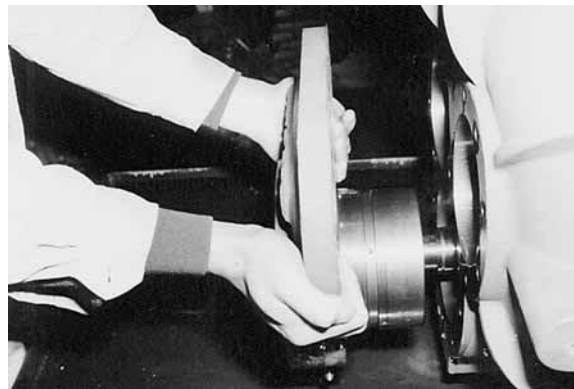


Fig. 3-111 Installing the Unloader Cylinder

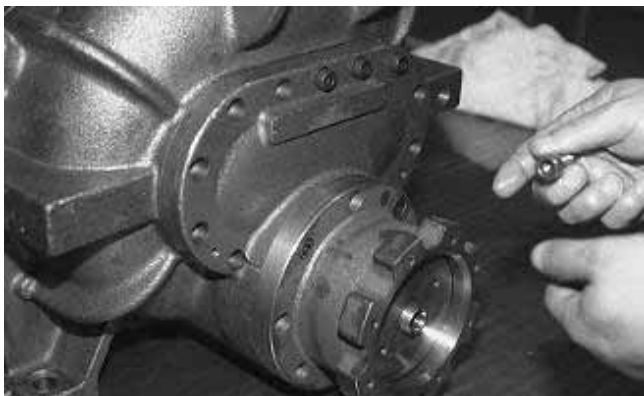


Fig. 3-112 Temporarily Installing the Balance Piston Cover

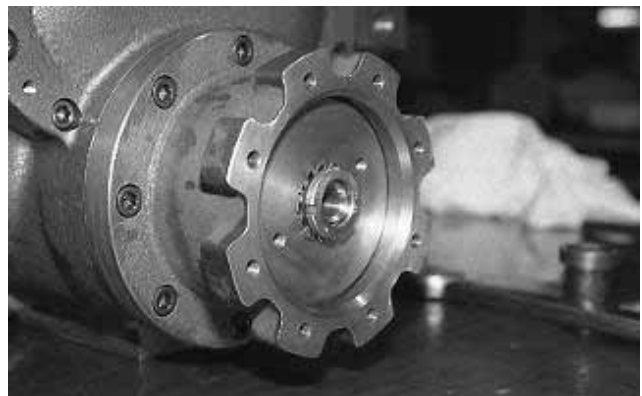


Fig. 113 Securing the Unloader Cylinder

- d) Finally secure the balance piston cover and unloader cylinder to the suction cover with the hexagon socket head cap screws (see Fig. 3-113).
- e) By moving the unloader piston using the eye bolts screwed in its threaded holes, check that the unloader slide valve moves smoothly.

(8) Unloader Cylinder Cover

When the indicator cam's seal portion in the unloader cylinder cover has been disassembled, reassemble the components according to the following procedure while referring to Fig. 3-114.

- a) Fit the ball bearing on the indicator cam's shaft (see Fig. 3-115).
When fitting the bearing onto the shaft, push the inner race of the bearing. Push the bearing to the stepped portion of the indicator cam and retain the bearing with the stop ring.
- b) Fit the V-ring set coated with oil into the unloader cylinder cover. One V-ring of the set is made of rubber for improved sealing performance. Fit the "V" section end into the unloader cylinder cover.
- c) Install the spring and the indicator cam spring retainer into position. Then insert the shaft of the indicator cam assembled in Step a) above into the V-ring. Retain the bearing in the unloader cylinder cover by installing the bearing gland with its hexagon socket head cap screws.
- d) After making sure the indicator cam rotates smoothly, attach the "O" ring (P/N 75) to the unloader cylinder cover.
- e) With the unloader slide valve in the no-load position, push in the cover while fitting the pin on the push rod in the helical groove on the indicator cam. Secure the unloader cylinder cover with the hexagon socket head cap screws with the hole for connecting the hydraulic piping facing upward (See Fig. 3-116).

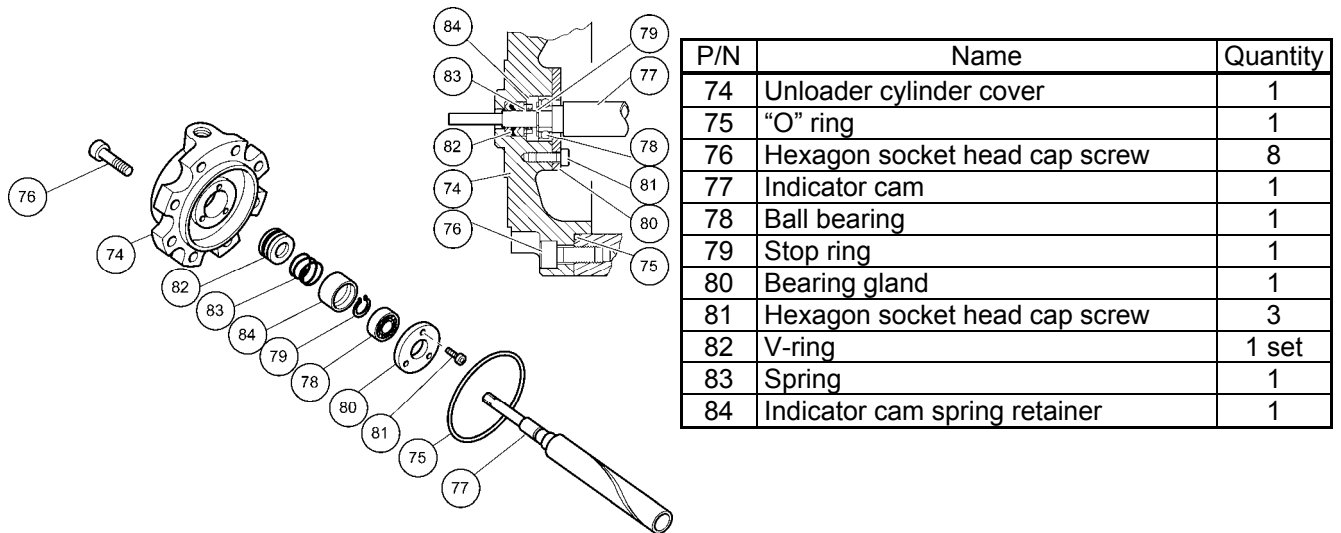


Fig. 3-114 Exploded View of Unloader Cylinder Cover

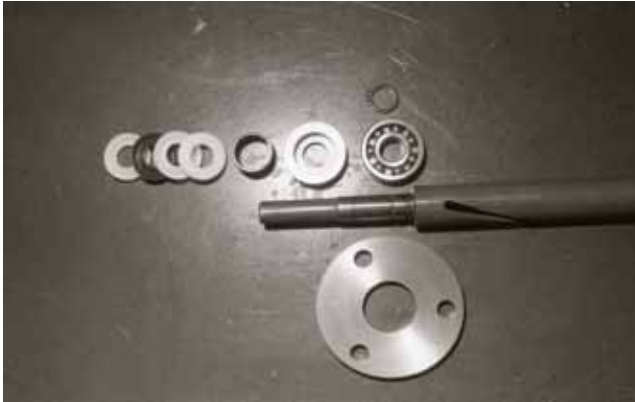


Fig. 3-115 Seal Section Components of Indicator Cam

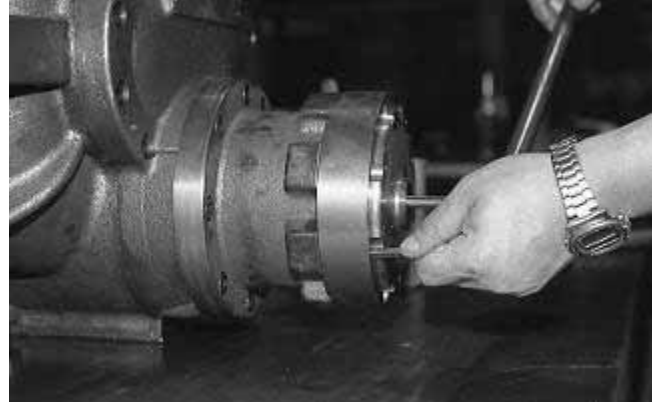


Fig. 3-116 Installation of Unloader Cylinder Cover

(9) Mechanical Seal Assembly

- a) Thoroughly clean the mechanical seal fitting portion of the male rotor and check the surface for condition. Inspect the stepped portion of the shaft carefully for scratches in longitudinal direction. Longitudinal scratches are harmful because they will cause refrigerant leakage (see Fig. 3-117).
- b) Press fit the oil seal into seal retainer. With the compressors produced in and after 2003, the sealing edge is on the opposite side to that in the compressors produced in the preceding period (see Fig. 3-118).
NOTE: Oil seal having sealing edge on any side is acceptable except for the mechanical seal having an oil pot.
- c) Screw the eye bolts into seal retainer. Push in the seal retainer with the oil release hole at the top and the rotation-preventing notch aligned with the pin inside the seal cover. Turn the seal retainer in both directions to make sure the pin is fitted in the notch.

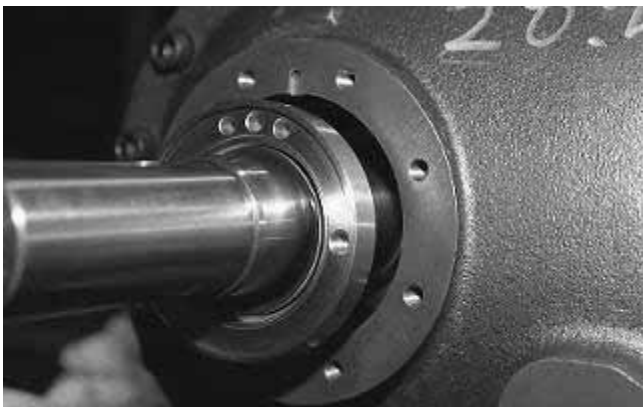


Fig. 3-117 Oil Seal and Seal Retainer



Fig. 3-118 Notch in Seal Retainer

- d) Attach the "O" ring into the oil seal retainer (do not fail to do this) (see Fig. 3-119). For the 200 and 320 models, fit the oil seal sleeve in position and secure it by screwing the two set screws while aligning them with the countersinks in the shaft (see Fig. 3-120).

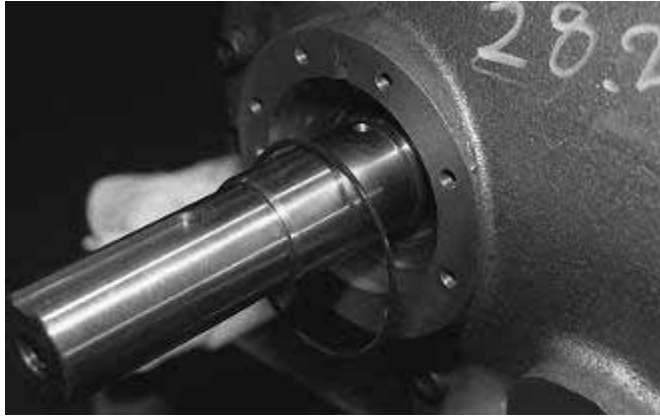


Fig. 3-119 "O" Ring for Seal Cover



Fig. 3-120 Installing the Mechanical Seal Assembly(200 and 320 Models)

- e) Install the mechanical seal assembly on the shaft. Then push the seal ring by hand to check it for axial movement. Push in the "O" ring (P/N 112) being careful not to cause damage to it by the step on the shaft.
- f) Install the shaft seal collar by tightening the two hexagon socket head set screws while aligning them with the countersinks in the shaft. Failure to align the screws with the countersinks will result in leakage (see Fig. 3-121).
- g) Fit the mating ring's "O" ring (P/N 103) and mating ring (P/N 101) to the seal cover (see Fig. 3-122). Fit the gasket to the seal cover (while aligning the oil holes in both parts), then install the seal cover while aligning its oil hole with that in the bearing cover and also keeping the seal cover at right angles with the shaft. When the seal cover is pushed to a midway point, its surface comes in contact with that of the mating ring. The seal cover will receive the repelling force from the seal spring while it is being pushed against the bearing cover. Keep the seal cover strongly pushed against the bearing cover, and fasten the seal cover by tightening the diagonally opposite two hexagon socket head cap screws (see Fig. 3-123).

After fastening the bearing cover until there is no clearance around its gasket surface, tighten all the remaining hexagon socket head cap screws (see Fig. 3-124).

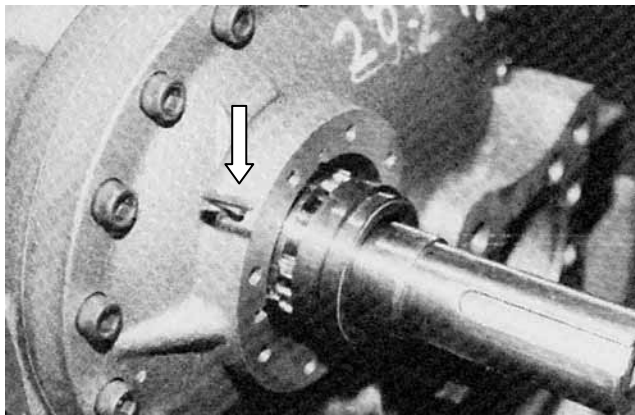


Fig. 3-121 Installing the Mechanical Seal Assembly (160 Models)

*** Do not forget to plug the hole!**



Fig. 3-122 Fitting the Mating Ring into Seal Cover



Fig. 3-123 Installing the Seal Cover

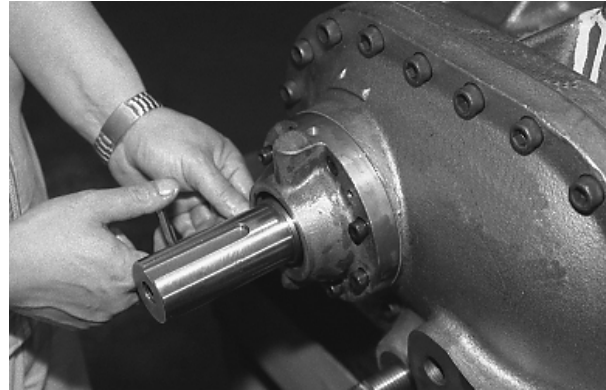


Fig. 3-124 Fastening the Seal Cover

3.4 Disassembly and Reassembly of Unloader Indicator Assembly

This section describes the instructions to be followed when disassembling, inspecting, reassembling and adjusting the unloader indicator assembly.

3.4.1 Components of Unloader Indicator Assembly

The unloader indicator assembly is necessary for automatic control of compressor operation. It consists of a potentiometer, micro-switch, and micro-switch cam. There are different types for each of these components and their combination differs according to the control specifications.

Each number in the following table indicates the required quantity of the corresponding component for one indicator assembly. A number in parentheses indicates the quantity of each of the component versions either of which is selectable.

Component	Standard Control	Special Control (1)	Special Control (2)	Special Control (3)*
Potentiometer (for sensing the unloader slide valve position)	1	1	1	1
Micro-switch (for sensing the no-load (0%) position of unloader slide valve)	1	1	1	1
Micro-switch (for sensing the full-load (100%) position of unloader slide valve)	1		(1)	
Micro-switch (for sensing the partial load (50%) position of unloader slide valve)		1	(1)	
Micro-switch (for sensing the partial load position of unloader slide valve; only for special specification control)				2
Micro-switch cam (0 – 100 % actuation)	1			
Micro-switch cam (0 – 50 % or 50 – 100 % actuation)			1	1
Micro-switch cam (special control)				1

*: 3 micro-switches

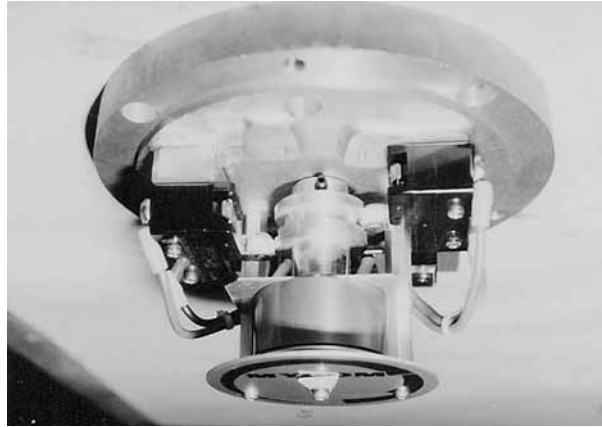


Fig. 3-125 Standard Unloader Indicator Assembly

Components of Unloader Indicator Assembly

P/N	Name	Q'ty	P/N	Name	Q'ty	P/N	Name	Q'ty
121	Micro-switch mounting plate	1	131	Screw	3	141	Indicator glass	1
122	Hexagon socket head cap screw	3	132	Terminal block	1	142	Indicator glass spacer	1
123	Micro-switch base plate	1	133	Screw	2	143	Electric wire guide	1
124	Screw	2	134	Dial plate support [1]	2	144	Bracket	1
125	Micro-switch	2	135	Dial plate support [2]	2	145	Hexagon socket head cap screw	2
126	Screw	4	136	Set screw	3	146	Unloader indicator cover (2)	1
127	Micro-switch cam	1	137	Unloader indicator dial	1	147	Hexagon socket head cap screw	3
128	Set screw	1	138	Screw	2	148	Plug	1
129	Potentiometer	1	139	Pointer	1	214	Spring pin	1
130	Potentiometer mounting plate	1	140	Screw	1	265-2	Spring washer	7

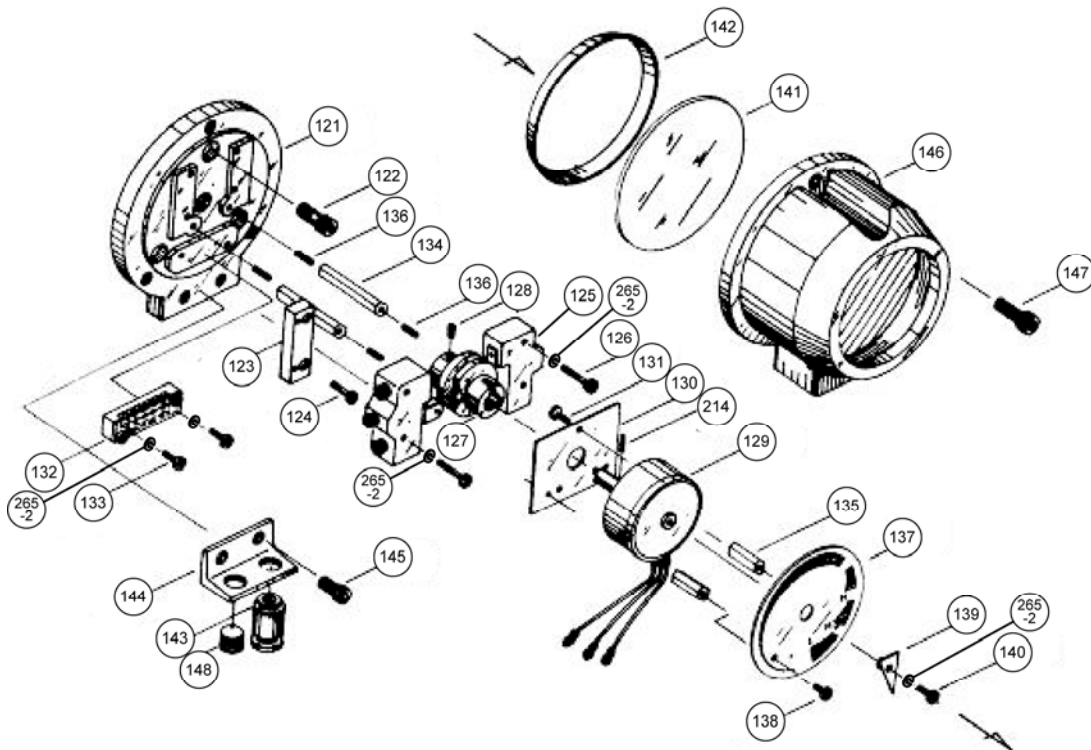


Fig. 3-126 Exploded View of Unloader Indicator Assembly

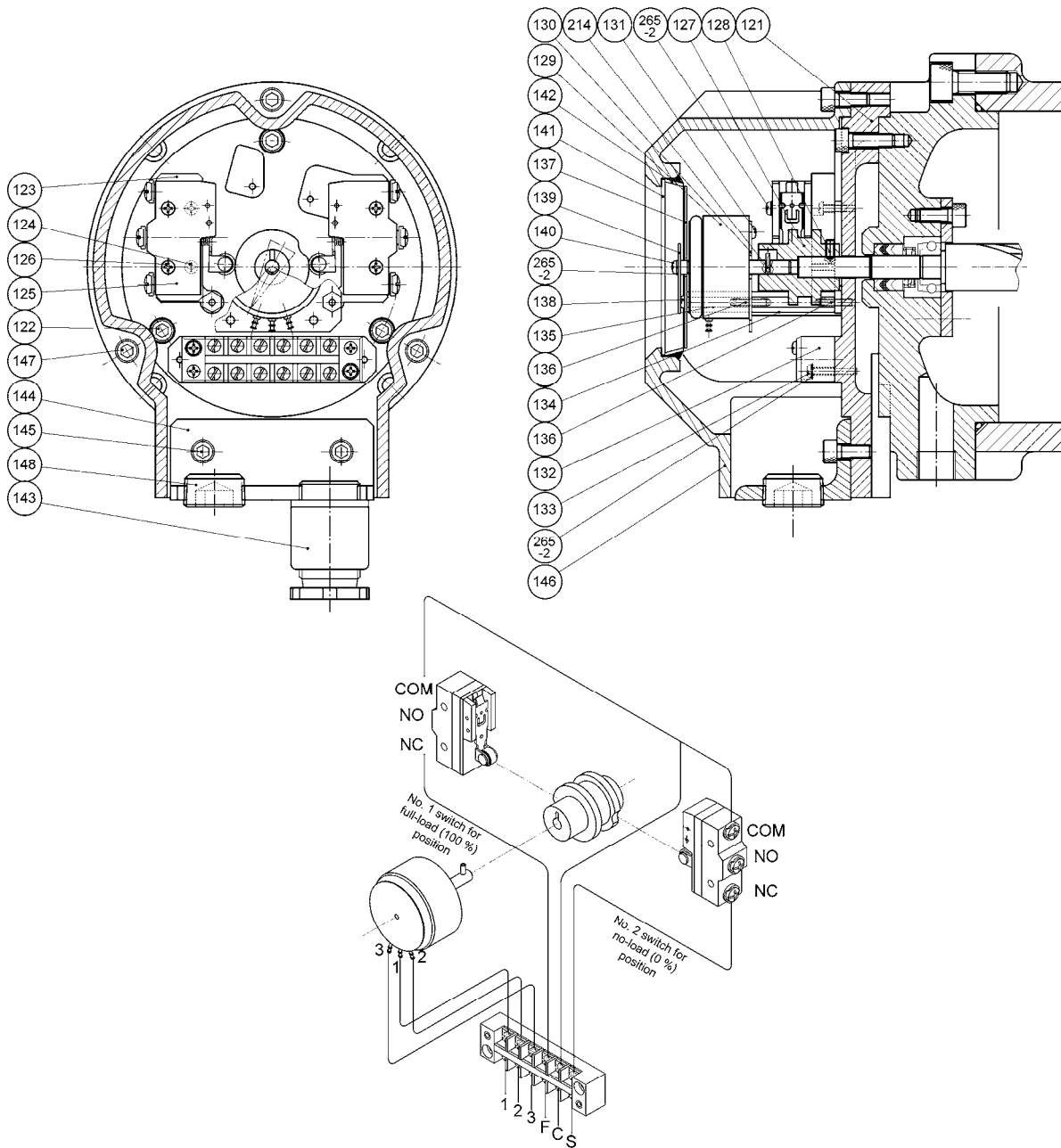


Fig. 3-127 Sectional View of Unloader Indicator Assembly

3.4.2 Disassembly

- a) Remove the screw (P/N 140) securing the pointer (PN139) to the shaft.
- b) Remove the screws (P/N 138) securing the unloader indicator dial (P/N 137) to the dial supports.
- c) The potentiometer mounting plate (P/N 130) is fitted between the dial plate supports [1] (P/N 134) and dial plate supports [2] (P/N 135). Loosen and remove the supports [2] by turning them counterclockwise while holding the supports [1].
- d) When the right and left supports are removed, the potentiometer (P/N 129) can be removed together with the mounting plate.
- e) The potentiometer is secured to the mounting plate with three screws.
- f) The micro-switch (P/N 125) is secured with two long screws (P/N 126). Loosen these screws to remove the micro-switch.
- g) The micro-switch on the right is for sensing the no-load (0 %) position and the micro-switch on the left is for sensing the full-load (100 %) position. The micro-switch base plate (P/N 123), secured with screws (P/N 124), is located under the left micro-switch so as to be able to use the outer cam of double actuator cams.
- h) Other parts can be removed by loosening their fastening screws.

3.4.3 Inspection

- a) Mainly check the contacts of electrical components. As to the potentiometer, check that the output resistance value varies smoothly throughout the entire rotation range of the potentiometer. If the compressor is used in an atmosphere containing much moisture or corrosive gas or in a place involving relatively strong vibration, also check the potentiometer's internal resistance coils for probable corrosion or wear.
- b) Check operation of the micro-switch contacts using a tester. Also check the rotating condition of the sensor roller of each micro-switch.
- c) Check the cam friction surfaces for wear and other damage.

3.4.4 Reassembly and Adjustment

To reassemble the unloader indicator, follow the disassembly procedure in reverse.

After the micro-switch base plate is installed on the reassembled unloader indicator, the unloader cover must be adjusted.

- a) The unloader slide valve is assembled inside the unloader cylinder cover with the unloader piston set at the no-load (0 %) position. So the indicator cam is at the no-load position. In order to recover this original state, secure the micro-switch cam by screwing the set screw (P/N 128) in alignment with the countersink in the shaft of the unloader indicator cam. Also, secure the micro-switch while mating the micro-switch roller with the concaved part of the micro-switch cam (see the sections indicated by the arrows in Fig. 3-128.).
- b) Assemble the potentiometer while fitting the spring pin on its shaft into the keyway (notch) in the micro-switch cam and fixing with the dial plate support [2] (P/N 135) (see Figs. 3-129 and 3-130.).

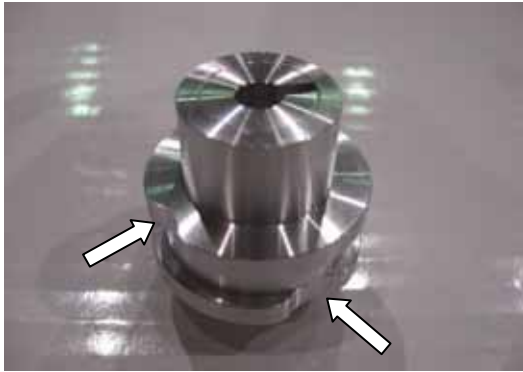


Fig. 3-128 Micro-switch Cam

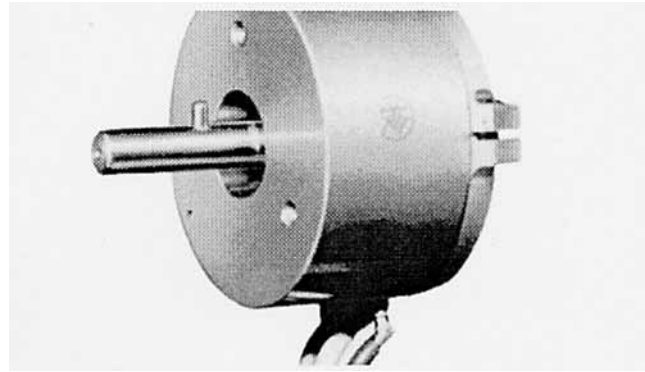


Fig. 3-129 Potentiometer



Fig. 3-130 Positioning Mark on Potentiometer



Fig. 3-131 Micro-switch

- c) Install the dial plate and secure the pointer while aligning it with the no-load position. Adjust the full-load side micro-switch by moving the unloader piston to the full-load position using air pressure so that the micro-switch can correctly send a signal at the full load position.
- d) After performing the above test, reconnect the control wiring and install the unloader indicator cover. Be careful not to pinch wires under the cover.

Chapter 4 Service Data

This chapter contains various data necessary for servicing the SCV Series Screw Compressors, including the standards and material specifications of replacement parts and lists of the tools used for servicing the compressors.

End Clearance (mm)

Model	Single (High) Stage				Booster (Low) Stage			
	S	M	L	LL	S	M	L	LL
160V	0.04 – 0.06				0.20 – 0.22	0.22 – 0.24	0.24 – 0.26	
200V	0.05 – 0.07				0.26 – 0.30	0.28 – 0.32	0.31 – 0.35	
250V	0.08 – 0.11				0.40 – 0.44	0.45 – 0.49	0.50 – 0.54	0.55 – 0.59
320V	0.17 – 0.21	0.20 – 0.24	0.23 – 0.27	0.26 – 0.30	0.70 – 0.76	0.73 – 0.79	0.77 – 0.83	0.81 – 0.87

Mechanical Seal Assembly (P/N 100)

160V	BBSE	BBS III	BOS-T1
200V			BOS-E1
250V			BOS-E1
320V			BOS-E1

Bolt Sizes (quantity in parentheses)

P/N	Location	Type	160V	200V	250V	320V
2	Main rotor casing	Hexagon socket head cap screw	M12x45 (52)	M16x50 (50)	M20x60 (44)	M24x80 (52)
18-1	Bearing cover	Hexagon socket head cap screw	M12x40 (19) D M12x40 (24) G	M16x50 (15) D M16x50 (18) G	M16x50 (18) D M16x50 (22) G	M20x70 (19)
18-2	Bearing cover	Hexagon socket head cap screw	M12x80 (7)	M16x75 (8)	M16x90 (8)	M20x120 (12)
18-3	Bearing cover	Hexagon socket head cap screw	–	M16x65 (6)	M16x70 (5) D M16x70 (6) G	M20x120 (6)
24	Balance piston cover	Hexagon socket head cap screw	M10x25 (11)	M12x30 (11)	M12x30 (11)	M16x45(11)
34	Balance piston sleeve	Set screw	M6x15 (2)	M8x15 (2)	M8x20 (2)	–
45	Thrust bearing gland	Hexagon head bolt	M10x30 (8)	M12x35 (8)	M16x45 (8)	M20x55 (8)
53	Seal cover	Hexagon socket head cap screw	M8x25 (8)	M10x25 (8)	M12x30 (8)	M16x40 (8)
58	Unloader push rod	Hexagon socket head cap screw	M6x30 (5)	M8x45 (5)	M10x55 (5)	M12x55 (5)
61	Unloader cylinder	Hexagon socket head cap screw	M10x25 (2)	M12x30 (2)	M16x40 (2)	M20x50 (2)
62	Unloader cylinder	Hexagon socket head cap screw	M10x65 (6)	M12x75 (6)	M16x90 (6)	M20x110 (6)
76	Unloader cylinder cover	Hexagon socket head cap screw	M8x25 (8)	M10x25 (8)	M12x30 (8)	M16x40 (8)
81	Bearing gland	Hexagon socket head cap screw	M6x15 (3)	M6x15 (3)	M6x15 (3)	M6x15 (3)
94	Suction flange	Hexagon head bolt	M20x55 (8)	M22x55 (8)	M24x65 (12)	M24x75 (16)
97	Discharge flange	Hexagon head bolt	Overseas M22x55 (4)	M20x55 (8)	M22x55 (8)	M20x55 (12)
		Japan M22x80 (4)	M20x80 (8)	–	–	
217	Lubrication oil supply flange	Hexagon head bolt	–	M12x35 (2)	M12x35 (4)	M12x40 (4)
218	Oil injection flange	Hexagon head bolt	–	–	–	M12x40 (4)
253	Electromizer flange	Hexagon head bolt	M12x35 (4)	M12x40 (4)	M16x45 (4)	M20x55 (4)
256	Aquamizer flange	Hexagon head bolt	M12x35 (2)	M12x35 (4)	M12x40 (4)	M16x45 (4)

Chapter 4 Service Data

P/N	Location	Type	160V	200V	250V	320V
452	Vi square washer	Hexagon socket head cap screw	M4x10 (1)	M5x15 (1)	M6x20 (1)	M6x20 (1)
* 454	Variable Vi auxiliary slide valve lock washer	Hexagon socket head cap screw	M4x20 (2)	M6x20 (2)	M6x35 (2)	–
456	“O” ring gland	Hexagon socket head cap screw	M5x10 (2)	M5x10 (2)	M5x10 (4)	M5x10 (4)
529	Oil seal sleeve	Set screw	–	M6x8 (2)	M6x8 (2)	M6x8 (2)
603	Female rotor side bearing oil supply flange	Hexagon head bolt	–	–	–	M12x35 (2)

* Used for the compressors produced before 2003

Tightening Torques for Hexagon Socket Head Cap Screws

Size	N·m	kgf·cm
M4	2.8	28
M5	6	60
M6	10	100
M8	25	250
M10	50	500
M12	90	900
M14	140	1,400
M16	240	2,400
M20	450	4,500
M24	750	7,500

Tightening Torques for Hexagon Head Bolts (P/N 45) of Thrust Bearing Glands

Model	Size	N·m	kgf·cm
160V	M10x30	40	400
200V	M12x35	50	500
250V	M16x45	60	600
320V	M20x55	120	1,200

Tightening Torques for Lock Nuts

AN Size	Standard Torque		Maximum Torque	
	N·m	kgf·cm	N·m	kgf·cm
AN 05	28	280	35	350
AN 06	49	490	61	610
AN 07	79	790	99	990
AN 08	90	900	113	1,130
AN 09	206	2,060	258	2,580
AN 10	238	2,380	297	2,970
AN 11	312	3,120	390	3,900
AN 12	408	4,080	510	5,100
AN 13	522	5,220	653	6,530
AN 14	656	6,560	820	8,200
AN 15	810	8,100	1,012	10,120
AN 16	984	9,840	1,230	12,300
AN 17	1,186	11,860	1,483	14,830
AN 18	1,413	14,130	1,766	17,660
AN 19	1,664	16,640	2,080	20,800
AN 20	1,876	18,760	2,345	23,450
AN 21	2,259	22,590	2,824	28,240

Stop Rings (quantity in parentheses)

P/N	Location	160V	200V	250V	320V
29	Main bearing	H 102 (2)	H 130 (2)	H 160 (2)	H 200 (2)
29	Side bearing	H 102 (2)	H 130 (2)	H 160 (2)	H 200 (2)
32	Balance piston	S 50 (1)	S 65 (1)	S 80 (1)	S 100 (1)
37	Balance piston sleeve	H 102 (2)	H 130 (2)	H 160 (2)	H 200 (2)
79	Indicator cam ball bearing	S 10 (1)	S 10 (1)	S 10 (1)	S 10 (1)

Lock Nuts (quantity in parentheses)

P/N	Location	160V	200V	250V	320V
39	Thrust bearing	AN12 (2)	AN13 (2)	AN17 (2)	AN21 (2)
69	Push rod, unloader slide valve	AN05 (1)	AN07 (1)	AN08 (1)	AN10 (1)

“O” Rings (quantity in parentheses)

P/N	Location	160V	200V	250V	320V
9	Suction cover / “O” ring spacer	P46 (1)	G60 (1)	G65 (1)	P58 (1)
35	Balance piston sleeve	G95 (1)	P120 (1)	P150 (1)	G190 (1)
49	Oil seal retainer / Seal cover	G90 (1)	G115 (1)	G135 (1)	G160 (1)
63	Unloader cylinder / Balance piston cover	G125 (1)	G150 (1)	G190 (1)	G240 (1)
65	Unloader piston	P100 (1)	P125 (1)	P155 (1)	P200 (1)
73	Unloader push rod / Unloader piston	P21 (1)	G30 (1)	G35 (1)	P44 (1)
75	Unloader cover / Unloader cylinder	G110 (1)	G135 (1)	G170 (1)	G210 (1)
103	Mechanical seal (BOS type)	*P35 (1)	*P40 (1)	*P43 (1)	P110 (1)
106-2		G55 (1)	*G10 (1)	Ø79.6x3.5 (1)	Ø99.6x3.5 (1)
112		G50 (1)	G60 (1)	G70 (1)	G90 (1)
103	Mechanical seal (BBS III type)	*G8 (1)	*G13 (1)	*G16 (1)	*G24 (1)
112		*G4 (1)	*G7 (1)	*G10 (1)	*G17 (1)
103	Mechanical seal (BBSE type)	*P32 (1)	*P35 (1)	*P43 (1)	P110 (1)
112		P50 (1)	Ø59.92x3.53 (1)	Ø69.52x2.62 (1)	Ø91.67x3.53 (1)
150	Thrust bearing gland	–	–	–	G220 (2)
325	Unloader push rod / “O” ring gland	P30 (2)	P40 (2)	P46 (2)	–
421	**Stroke position spacer / Unloader push rod	P30 (2)	P40 (2)	P46 (2)	P58 (2)
432	Main bearing / Bearing head	G85 (4)	*G22 (4)	G135 (4)	G165 (4)
433	Side bearing / Suction cover	G85 (4)	*G22 (4)	G135 (4)	G165 (4)
450	Vi adjusting rod (bearing cover side)	P25 (2)	P35 (2)	P40 (2)	P44 (2)
451	Vi adjusting rod (bearing head side)	P25 (1)	P35 (1)	P40 (1)	P50A (1)
523	Vi adjusting rod (unloader slide valve side)	P25 (1)	P35 (1)	P40 (1)	P50A (1)

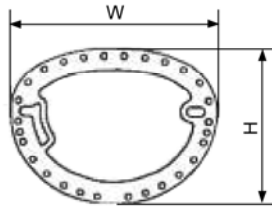
*: “O” rings conforming to JIS W 1516. (All other “O” rings conform to JIS B 2401.)

** : Used only for 160VS, 200VS, 250VS and 320VS.

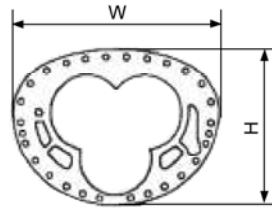
NBR (Buna-N) is used for all “O” rings as standard material.

Chapter 4 Service Data

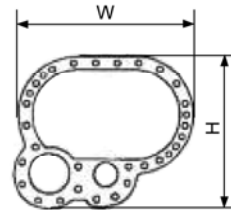
Gaskets



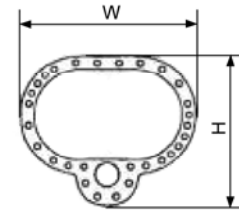
6. Suction cover gasket



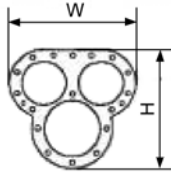
12. Bearing head gasket



17. Bearing cover gasket (D)



17. Bearing cover gasket (G)



23. Balance piston cover gasket



52. Seal cover gasket



93. Suction flange gasket



96. Discharge flange gasket (G)



216. Lubricating oil flange gasket
219. Oil injection flange gasket
236. Discharge flange spacer gasket



252. Electromizer flange gasket



255. Aquamizer flange gasket



602. Female rotor side bearing flange gasket

All flanges are produced to the MYCOM standards.

Part No.	Gasket		160V	200V	250V	320V
6	Suction cover gasket	H	354	420	525	660
		W	460	560	700	880
12	Bearing head gasket	H	345	420	525	660
		W	460	560	700	880
17	Bearing cover gasket (D)	H	338	414	505	641
		W	397	591	709	887
17	Bearing cover gasket (G)	H	332.5	380	463	—
		W	388	480	580	—
23	Balance piston cover gasket	H	270	333	340	517
		W	283	350	420	532
52	Seal cover gasket	Ø	140	170	200	250
93	Suction flange gasket	Ø	173	198	325	421
			(125A)	(150A)	(250A)	(350A)
96	Discharge flange gasket (G)	Ø	143	173	198	250
			(100A)	(125A)	(150A)	(200A)
216	Lubrication oil flange gasket	Ø	—	44	51	67
				(20A)	(25A)	(40A)
219	Oil injection flange gasket	Ø	—	—	—	51
						(25A)
236	Discharge flange spacer gasket	Ø	110	146	176	233
			(100CD)	(125CD)	(150CD)	(200CD)
252	Electromizer flange gasket	Ø	51	59	83	118
			(25A)	(32A)	(50A)	(80A)
255	Aquamizer flange gasket	Ø	44	51	59	83
			(20A)	(25A)	(32A)	(50A)
602	Female rotor side bearing flange gasket	Ø	—	—	—	44
						(20A)









“O” Ring Materials (applicable to all models)

“O” Rings Materials (except for “O” rings in mechanical seals)

Refrigerant Type	“O” Ring Material
Ammonia	NBR
HFC	
CO ₂	FKM
	HNBR
R23	FKM
Propane	
Propylene	
Natural gas	
City gas	
Helium	






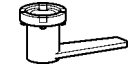


Tools

Standard Tools

Tool	Sketch	160V	200V	250V	320V	
Ratchet wrench (1/4")		○	○	○	○	
Adjustable wrench (250mm)		○	○	○	○	
Phillips head screwdriver (+)		○	○	○	○	
Flat head screwdriver (-)		○	○	○	○	
Stop ring priers (medium size)		○	○	○	○	
Stop ring priers (large size)		○	○	○	○	
Eye bolt M8 (two-piece set)		○	○	○	○	
Allen wrench set (WAF: width across flats in mm)		WAF 2	○	○	○	○
		WAF 3	○	○	○	○
		WAF 4	○	○	○	○
		WAF 5	○	○	○	○
		WAF 6	○	○	○	○
		WAF 8	○	○	○	○
		WAF 10	○	○	○	○
		WAF 12	-	-	-	-
		WAF 14	-	○	○	○
		WAF 17	-	-	○	○
		WAF 19	-	-	-	○

Chapter 4 Service Data

Special Tools (Separately Available)

Tool		Sketch	160V	200V	250V	320V
Ratchet wrench			○	○	○	○
Adjustable wrench			○	○	○	○
Phillips head screwdriver (+)			○	○	○	○
Flat head screwdriver (-)			○	○	○	○
Stop ring pliers (medium size)			○	○	○	○
Lock nut wrench			AN-12	AN-13	AN-17	AN-21
			AN-05	AN-07	AN-08	AN-10
Eye bolt M8 (two-piece set)			○	○	○	○
Allen wrench set (WAF: width across flats in mm)	WAF 2		○	○	○	○
	WAF 3		○	○	○	○
	WAF 4		○	○	○	○
	WAF 5		○	○	○	○
	WAF 6		○	○	○	○
	WAF 8		○	○	○	○
	WAF 10		○	○	○	○
	WAF 12		-	-	-	-
	WAF 14		-	○	○	○
	WAF 17		-	-	○	○
	WAF 19		-	-	-	○

Contact Information

For further information and questions, please contact us at any of the offices and sales/service centers listed below.

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Tohoku Branch Office	2-5-12, Ideka, Miyagino-ku, Sendai-shi, Miyagi-ken 983-0012	TEL: (81) 22-259-5060 FAX: (81) 22-259-5223
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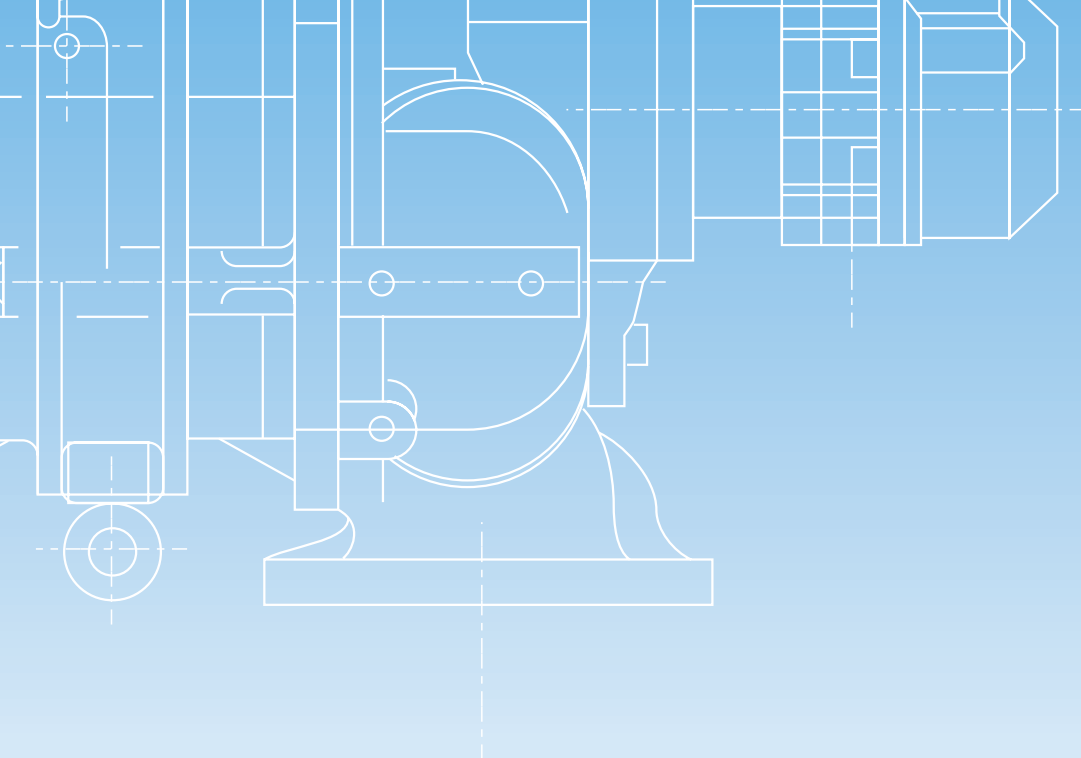
160VSD / 160VMD / 160VLD
200VSD / 200VMD / 200VLD
250VSD / 250VMD / 250VLD / 250VLLD
320VSD / 320VMD / 320VLD
160VSG / 160VMG / 160VLG
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Mayekawa Mfg. Co., Ltd. reserves the right to change design and specifications in response to technical developments and improvements.

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