2205Q2JE-HO-S6-N_2020.01.

MYCOM

SCV-series Screw Compressor Instruction Manual

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

CAUTION

Read this manual carefully and thoroughly before operating, maintaining or inspecting this product. It is important to fully comprehend the contents of this manual. Keep the operation manual in a safe, designated place for future reference whenever the need arises.

Specifications of this product are subject to change without prior notice.

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Preface

Thank you for purchasing the MYCOM SCV-series/screw compressor (hereinafter referred to as "this product").

This instruction manual (hereinafter referred to as "this manual") describes safety information, operational and detailed maintenance procedures for safe and effective use of this product、It is applicable to the following compressor types

160VSD, 160VMD, 160VLD, 200VSD, 200VMD, 200VLD, 250VSD, 250VMD, 250VLD, 250VLLD, 320VSD, 320VMD, 320VLD

160VSG, 160VMG, 160VLG, 200VSG, 200VMG, 200VLG, 250VSG, 250VMG, 250VLG, 250VLLG

Before installing or using this product, make sure you read this manual.

Keep this manual in a safe place near this product for quick reference whenever needed.

Revision History

Title of Instruction Manual		Document No.	Date of Initial Issue
SCV-series Instruction Manual		2205Q2JE-HO-S6-N_2020.01.	February 17, 2015
Rev. No.	**Issue Date**	**Revision Details**	**Prepared/Approved by**
00	Feb. 17, 2015	Complete revision and reissue as an electronic manual.	Ikehara/ Muta
01	June 12, 2015	Corrected errors in writing (e.g., footer in Chapter 2)	Ikehara/ Muta
02	Feb.28.2018	Corrected Table 2-1, 2-5, 3-1, 4-2, 7.Parts Configuration Table, 7.5.1 List of O-rings Used, Corrected other errors. Deleted Contact Information	Takenouchi・Ito / Kato
03	Mar.11.2019	7.Parts Configuration Table of 250V** models	Takenouchi / Kato
04	Jun.11.2019	Correction of the outer dimension. Revision of lock nut tightening angle.	Muta / Kato
05	Jan.07.2020	Correction of errors and sentences. Revision of parts list	Takita,Takenouchi / Muta

Warranty and Disclaimer

Warranty Clauses

If malfunctions or damages occur under proper usage and conditions following documents such as specifications or instruction manual of this product, or, if MAYEKAWA judges that malfunctions or damages are related to design or manufacture of the product, and if the malfunctions or damages are within the warranty period, MAEKAWA will repair this product or replace parts without any charges.

The warranty period is “12 months from factory shipment of this product”. However, if any separate agreement has been concluded, such an agreement will have the priority in principle.

Disclaimer Clauses (Exclusion of Warranty Clauses)

Please note that we disclaim any responsibility for malfunction and/or damage to this product in case of the following incidents:.

- Malfunction or damage of this product caused by force majeure such as windstorm, intense rainfall, flood, tidal wave, earthquake, land subsidence, thunderbolt, fire, etc.
- Malfunction, damage, or defect to this product due to abuse or misuse such as storing this product outdoors or in hot and humid locations, operation with excessive liquid flow-back and start-and-stop.
- Malfunction or damage caused by devices or equipment not provided by MAYEKAWA including operation control methods of those devices or equipment.
- Malfunction or damage caused by the usage of refrigerants, gases, and/or lubricants which are not approved by MAYEKAWA for this product.
- Malfunction or damage caused by maintenance or inspection procedures which are not recommended by MAYEKAWA.
- Malfunction or damage caused by parts which are not MAYEKAWA genuine.
- Malfunction or damage caused by parts which are not MAYEKAWA genuine.
- MAEKAWA shall not be liable to buyer for any incidental, indirect, special or consequential damages that buyer may suffer in relation to this product.

Important Information

Intended Use of this Product

This product is a screw compressor intended use for freezing and refrigeration.

Do not use this product for any other purposes for which it is not intended or deviate from the specifications which are described in Chapter 2, Article 2.3 “Compressor Specifications”.

The maintenance service should be performed according to the procedures described in this manual. Always pay attention to perform the works in a safe manner and working environment.

Important Information for Safe Use of This Product

Although MAYEKAWA has paid a lot of attention to safety measures for this product, all hazards including potential hazards caused by human errors, or due to environmental conditions can not be anticipated.

There are guidelines that must be followed to ensure proper use of this product. However, the warnings in this manual and safety labels on this product are not all inclusive. When operating the product, pay extreme caution on personnel safety as well as on items described in this manual or required by common safety practice.

Important rules for safety work with the product that apply to all workers including managers and supervisors are listed below.

Before using this product, carefully read and fully understand the contents written in this manual and pay attention to safety.

- Operation, maintenance, and inspection of this product should be performed by qualified personnel educated about the fundamentals of the product and trained about hazards involved and measures to avoid danger.
- Do not allow any person other than those educated on the fundamental expertise of the product and trained about hazards involved and measures to avoid dangers to approach the product while it is operating or during maintenance.
- Observe all related federal/national and local codes and regulations.
- To prevent accidents, do not carry out any operation or maintenance other than those described in this manual, or use the product for any unapproved purpose.
- Replace the parts with the MYCOM genuine parts.
- Not only workers but also managers should actively participate safety and health activities in the workplace to prevent accidents.
- When closing or opening valves during work, apply lockout/tagout without failure, to prevent the valves from closing or opening accidentally during the work.

[Lockout] To lock with a key in order to keep people, except the workers involved, from operating the product.

“Lockout” is a safety procedure to make sure that machines or equipment are property shut off and not able to be started up again by locking the power source to them.

Lockout is not just simply turning off the switches to stop the power supply, but includes immobilizing them with a key or similar device to prevent unauthorized access.

Lockout devices are devices such as keys, covers, and latches, to immobilize and shut-off switches, valves, opening and closing levers, etc.

[Tagout] To prevent any inappropriate work by hanging tag plates indicating like “work in progress”.

“Tag-out” means to clearly indicate that a device is in lockout and that operation of the device is

prohibited. The sole purpose of the tag plates such as prohibition of operation or commissioning is to warn others that it is prohibited to operate the locked out product. It should always be accompanied by a suitable lockout device to make operation impossible.

Observe the following precautions when performing maintenance work on electrical control.

- Electrical maintenance of the product must be performed by certified/qualified personnel and only those who have been trained in the potential danger and its avoidance relevant to the electrical control of the product.
- Before servicing or inspecting the electrical equipments or devices, turn "OFF" the motor main power and control power, and perform lockout/tagout to prevent the power from being turned on during work.

During maintenance work, make sure that the power supply on the power source side is shut off and perform lockout/tagout to prevent the product from being accidentally turned on.

About this Manual

- This product may be modified without prior notice. Therefore, the appearance of actual machine may differ from the descriptions in this manual. If you have any questions contact your sales offices or service centers. For each sight of MAYEKAWA, refer to following URL. http://www.mayekawa.com/about/network/
- This manual is in English. If any other language is required it is the customers responsibility to prepare a manual for safety education and operation instructions.
- This manual is copyrighted. Drawings and technical references including this manual shall not, in whole or part, be copied, photocopied, or reproduced into any electronic medium or machine-readable form without prior permission from MAYEKAWA.
- Photographs or drawings included in this manual may differ from the appearance of actual product.
- If this manual is lost or damaged, immediately place a purchase order to your local sales office or service center for a new manual. Using the product without the manual may result in safety issues.
- In the event that this product or the compressor package is resold, don’t forget to supply this manual together with the product.

Construction of this Manual

Title of section and chapter	Description details
Preface	Describes the outline of this manual and how to read it.
Warranty and Disclaimer	Describes clauses and coverage of warranty. Exemption of warranty clauses is described as disclaimer.
Important Information	Describes important information related to this product and this manual.
1. Safety	Describes safety information for the worker, safety rules for this product, and management details regarding work safety required for handling the product.
2. Structure and Specifications of the Compressor	Describes the main components of this product, functional information, specifications, and operating limits.
3. Installation	Describes installation procedure of this product.
4. Compressor and Package Operation	Describes precautions for operating this product.

Title of section and chapter	Description details
5. Maintenance and Inspection	Describes sections and period for inspecting, disassembly and assembly of the product.
6. Troubleshooting	Describes troubleshooting methods for the product in case problems occur during operation of the product.
7. Related Documents	Describes documents such as illustrated parts breakdown and parts list.

Table of Contents

Chapter 6 Troubleshooting

Chapter 7 Related Documents

Chapter 1 Safety

1.1 Observation/Prevention

1.1.1 Observance (Do's)

1.1.1.1 Do’s on Operation

- Always use the MAYEKAWA specified or recommended controller designed for this product.
- The controller protects this product based on the sensor output values.
- Make sure that all necessary safety devices are installed and that their control values are set correctly to assure proper and safe operation.
- Inspect the safety devices and the controller's protective functions on a regular base. Ensure that they perform according to the specifications.
- If the safety devices and the controller's protective functions do not work properly or the machine operates abnormally, immediately stop the operation and report the incident to your supervisor. Do not restart the machine until the supervisor determines the machine’s safety and provides proper instructions for a safe restart of the compressor.
- If the machine stops due to unknown reasons, immediately inform your supervisor. Do not restart the machine until the supervisor determines the machine’s safety and provides proper instructions for a safe restart of the compressor.
- Some types of refrigerants are toxic and/or generate bad odors which can cause oxygen deficiency. Make sure to ventilate the working area sufficiently to prevent asphyxiation.
- Some refrigerants and refrigeration compressor oils may be corrosive, decomposable, or toxic. Make sure to obtain their Safety Data Sheets (SDS) and strictly follow the mentioned instructions.
- When stopping the compressor for a long time, turn "OFF" the main motor, heater, and control power. Close the suction and discharge side shut-off valves.

1.1.1.2 Do’s on Maintenance

- When performing work with at least two or more persons, thoroughly confirm the work procedure and clearly understand each others work before commencement.
- Always turn “OFF” and use the lockout /tag-out procedure for the main motor, control and other devices before troubleshooting, setup, cleaning, maintaining, or inspecting this product. Also, make sure that the power is NOT turned on accidentally during the intervention.
- Always confirm that the pressure inside the packages for freezing, refrigerating and air conditioning is at atmospheric level before troubleshooting, setup, cleaning, maintaining or inspecting this system.
- Before troubleshooting, setup, cleaning, servicing or inspecting this product, apply the lockout / tag-out procedure to the liquid supply stop valves and valves in the upstream and downstream of the compressor so that they do not open accidentally during the work.
- Some types of refrigerants are toxic and/or generate bad odors which can cause oxygen deficiency. Make sure to ventilate the working area sufficiently to prevent asphyxiation.
- Some refrigerants and refrigerant oils may be corrosive, decomposable, or toxic. Make sure to obtain their Safety Data Sheets (SDS) and strictly follow the mentioned instructions.
- After working on the machine, always store the used tools at specified places and make sure that no tools are left in or around the machine.

1.1.1.3 Do's on Lockout/Tagout after Shutting off the Power

- Prepare lockout / tag-out devices for the main breakers in the power lines to the main motor and control cabinet.
- By applying the lockout/tag-out procedure after turning off the power, you can prevent any other personnel from restoring the power inadvertently. It enhances the safety of the personnel working on the power supply equipment and the package.
- If there are any possibilities of danger during work (especially during cleaning, maintenance, inspection, or troubleshooting), turn the main motor and control power "OFF" and perform a lockout/tag-out procedure.
- Before working on the package for troubleshooting, setup, cleaning, maintenance and/or inspection, it is recommended to always perform a lockout/tag-out procedure to the main motor and control power. It is also recommended to check if the lockout/tag-out procedure has been performed according to good practice.
- Turn off the power and perform lockout/tag-out before working on the package. Clearly notify the workers of the necessity of lockout/tagout.
  - It is assumed that workers do not perform lockout/tagout of the main motor and control power before starting work because it is troublesome, and only turn "OFF" the main motor and control power.
  - It is assumed that workers only turn off main motor and control power and do not lockout/tagout the main motor and control power, because they think it is not important.
- Upon completion of the work, the worker responsible for the lockout/tag-out must remove the lockout/tag-out device.

1.1.1.4 Do’s about Personal Protective Equipment(PPE)

- Prepare and use personal protective equipment which is in accordance with the area’s safety standards.
- Check the function of each PPE before use.
- Wear appropriate work cloth and avoid loose clothing.
- Do not wear any neckties or jewelry that can get entangled in the moving or rotating parts. A helmet is recommended for the protection against head injuries
- Empty your pockets to prevent objects from falling into the machine

1.1.1.5 Do’s about Handling of Hazardous and Toxic Substances

- Obtain Safety Data Sheets (SDS) from manufacturers/suppliers of hazardous and toxic substances.
- Check the SDS and follow the handling instructions recommended by the manufacturers to handle and store those substances.

1.1.1.6 Do’s about the Handling Emergency Situations

- Develop an emergency action procedure in accordance with the legal regulations and post it at a safe and easy to reach place.

1.1.1.7 Do’s about Waste Oil, Fluid, and Materials

- Disposal of refrigerant and waste oil from the compressor are subject to a number of environmental protection regulations. Follow the local, state or federal acts and regulations as well as your company's rules, when disposing of such waste oil, fluid and materials.

1.1.1.8 Other Do's

- Keep the floor around the freezing, refrigeration, and/or air conditioning packages clean and provide a safety aisle.
- Use the safety aisle only to move around the equipment. Keep the safety aisle free under all circumstances to ensure safe passage when required.
- If water or oil is spilled on the compressor or the floor, immediately wipe it off to prevent workers from injury caused by slipping.

1.1.2 Prohibitions (Don'ts)

- Do not remove or relocate any safety devices, including electrical interfaces.
- Do not disable any safety device by short-circuiting or bypassing without any permission.
- Do not leave the compressor unsafe and unattended, by removing the safety cover or some other safety measures.
- Do not touch, clean, or lubricate any part of the compressor (especially moving parts) when the compressor is operating.
- Do not touch relays or electric systems such as terminal block with bare hands when activating the power.

1.2 Warnings

To alert workers about possible dangers, the following information is always provided with the compressor.

- Warnings described in this manual
- Safety labels on the compressor

1.2.1 Types and Meanings of Warnings

This manual uses the following four types of warnings to emphasize potential hazards during operation or maintenance of the compressor:

Neglecting the warnings may cause damage to the compressor or its auxiliary equipment. Furthermore, it may lead to accidents, personal injury or even death. Be sure to always take the instructions in this manual into consideration.

Table 1-1 Types and Meanings of Warnings in this manual

Warning Type	Meaning
DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.
WARNING	Indicates a potential hazardous situation which, if not avoided, could result in serious injury or death.
CAUTION	Indicates a potential hazardous situation which, if not avoided, may result in minor or moderate injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in property damage.

1.2.2 Safety labels

The section shows the different types of safety labels and their positions affixed on the compressor.

Always follow the warnings instructed on the safety label.

WARNING

- **Make sure to follow the instructions mentioned on the safety labels. Failure to do so may result in personal injury, death, or property damage.**
- **Do not smear, cover, or remove the safety labels.**
- **If the safety labels are damaged or missing, purchase new labels and install them onto their proper positions according to this manual.**

【POINT】

- Inform our service centers the product name and safety label number when placing a purchase order for safety labels.

■ Types of Safety Labels

Table 1-2 Safety Label

No.	Safety label	Remarks
1		
2		

1.3 Residual Risks

The following information is provided on the assumption that this product is operated, inspected, and maintained while being used in freezing, refrigeration, and air conditioning packages. Note that all hazardous sources cannot be predicted for the applications mentioned.

Foresee appropriate countermeasures for hazardous sources applicable to your systems.

Table 1-3 Hazardous Sources

	Danger source	Predicted hazard	Measures to be taken in operation	Measures to be taken when cleaning, inspecting, and replacing parts
A	Coupling for motor and compressor	Entanglement caused by contact	Install coupling covers and prohibit opening 1)Avoid contact	Shut off and lockout/tagout of motor's main power and control power
B	Motor terminals	Electric shock caused by live wiring contact and electrical leakage	2)Avoid contact Do not open terminal box Do not touch terminal box	Shut off and lockout/tagout of motor's main power and control power
C	Compressor suction casing	Frostbite caused by contact Contact with or inhalation of hazardous substances caused by leaking refrigerant, etc.	3)Avoid contact Wear protective gear Gas leakage detection	Wear protective gear Work under normal temperature
D	Compressor discharge casing	Burn caused by contact Contact with or inhalation of hazardous substances caused by leaking and blowing off refrigerant, etc.	4)Avoid contact Wear protective gear Sufficient ventilation Gas leakage detection	Wear protective gear Work in temperatures below 40 °C Appropriate refrigerant handling Sufficient ventilation
E	Discharge piping			
F	Lubricating piping and joints			
G	Solenoid valves and motorized valves mounted on compressor unit	Electric shock caused by live wiring contact and electrical leakage Trapping caused by contact with a drive part	Install terminal protective cover and prohibit opening 5)Avoid contact Wear protective gear	Shut off each breaker, and shut off and lockout/tagout the control power Wear protective gear
H	electric components (oil heater, protective switch, etc.) mounted on compressor unit	Electric shock caused by live wiring contact and electrical leakage Burn caused by contact	Install terminal protective cover and prohibit opening 6)Avoid contact Wear protective gear	Shut off each breaker, and shut off and lockout/tagout the control power Wear protective gear Work in temperatures below 40 °C

	Danger source	Predicted hazard	Measures to be taken in operation	Measures to be taken when cleaning, inspecting, and replacing parts
I	Oil drains from compressor unit	Contact with hazard-ous substances caused by leakage and blowoff Burn caused by contacting with high temperature fluid	Sufficient ventilation 7)Avoid contact Keep away and do not touch Wear protective gear	Sufficient ventilation Wear protective gear Work in temperatures below 40 °C
J	Noises	Hearing disabilities caused by noises	Wear protective gear	—

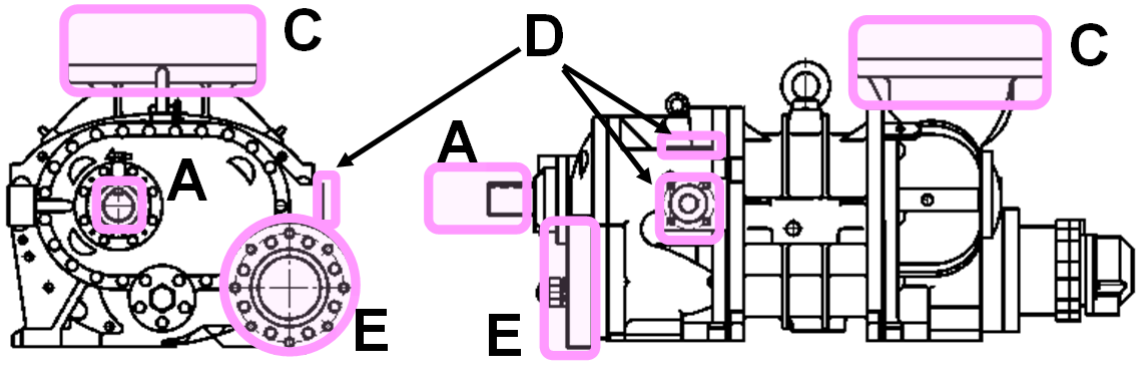


Figure 1-1 Hazardous Sources
(Compressor: V*D type i.e. discharge port facing sideways)

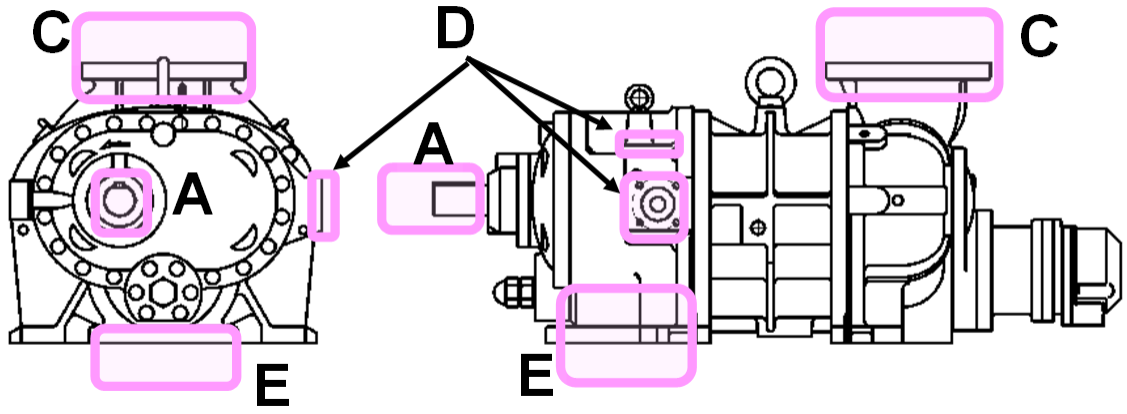


Figure 1-2 Hazardous Sources
(Compressor: V*G type i.e. discharge port facing down)

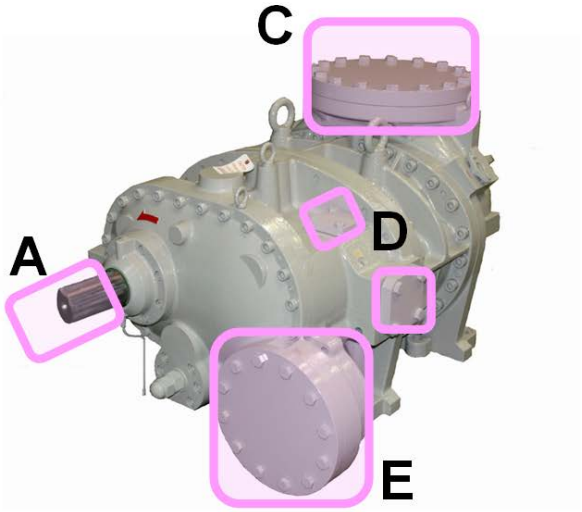


Figure 1-3 Hazardous Sources
(Compressor: V*D type)

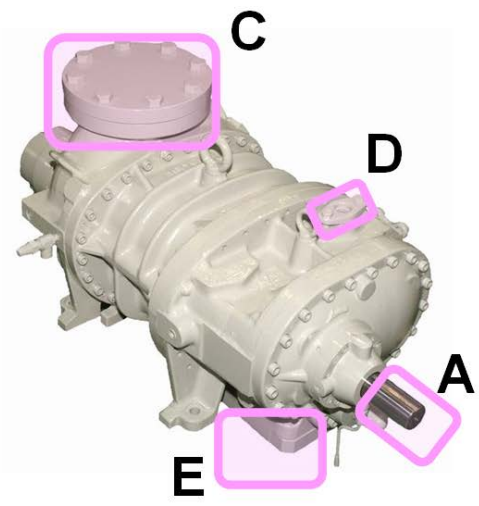


Figure 1-4 Hazardous Sources
(Compressor: V*G type)

1.4 Safety Devices

For safe use and protection of the compressor, make sure to foresee and install safety devices to the compressor that comply with the regulations and the following descriptions.

Safety devices must be properly and periodically maintained and inspected. It is important to include maintenance and inspection of safety devices in the periodical maintenance/inspection schedule. Make sure to provide users of the compressor with necessary information on types, attachment positions, functions, inspection method of the safety devices.

WARNING

- **Please inspect the operation of all safety protection devices before starting the compressor. If any kind of malfunction and/or wrong operation is detected, immediately take measures to resolve the hazardous situation. Operating the compressor with faulty safety devices can lead to dangerous situations for personnel and environment.**

1.4.1 Emergency Stop Button

Overview/Function/Purpose

The emergency stop buttons are used to stop the compressor operation immediately if an emergency occurs to the compressor.

Installation Locations

The emergency stop buttons should be installed in the controller on the compressor and in the operating control room

Stop/Reset Methods

To activate and reset the emergency stop buttons, refer to the unit instruction manual.

Inspection Method/Cycle

The emergency stop buttons must be activated before commissioning as well as periodically. For details about the inspection procedure and inspection cycle of the emergency stop buttons, please consult the unit instruction manual.

1.4.2 Breakers for the Main Motor Power and Control Power (with Lockout/Tagout Devices)

Overview/Function/Purpose

Turn off the main motor and control power, and if there are any possibilities of danger during work (especially during cleaning, maintenance, inspection, or troubleshooting), lockout/tagout devices must be set up for breakers of the main motor and control powers to prevent injury to workers in case the power is turned on accidentally during work.

Methods of Performing and Releasing Lockout/Tagout

In accordance with the regulations created by Occupational Safety & Health Administration (OSHA) and other authorities, make sure to clearly indicate methods of performing and releasing lockout/tagout and provide users of this compressor with the necessary information.

Inspection Method/Cycle

Please consult the unit instruction manual for inspection procedures.

1.4.3 Compressor Protection Devices

■ Overview/Function/Purpose

To protect the compressor, the following safety functions of the CP4 controller are used.

■ Protection against High discharge temperature

This function stops the compressor when the discharge temperature exceeds the set value.

A temperature sensor is installed in the oil separator.

■ Protection against High oil temperature

This function stops the compressor when the oil temperature exceeds the set value.

A temperature sensor is installed in the package lubrication piping after the oil cooler.

■ Protection against abnormal High pressure

This function stops the compressor when the discharge pressure abnormally rises due to faulty operation of the compressor or insufficient cooling water supply to the condenser.

This function prevents explosion of the equipment and components.

A pressure sensor is installed in the oil separator.

■ Protection against abnormal Low suction pressure

This function stops the compressor when the suction pressure is below the set value.

A pressure sensor is installed in the suction piping.

■ Protection against abnormal oil pressure

This function stops the compressor when oil supply is not sufficient, the oil filter is clogged, too much refrigerant in oil, or oil supply pressure difference (from suction pressure) is below the set value. This is to protect the compressor from wear and seizure.

A pressure sensor is installed in the package lubrication piping after the oil filter.

■ Protection against oil filter Differential pressure

This function stops the compressor when the differential pressure between discharge and lubrication pressure is below the set value due to clogging of filters or other reasons.

The discharge and the oil pressure sensors is used.

■ Protection against Low oil level

[Case 1 Differential pressure oil supply system]

This function continuously detects the oil level in the oil separator and stops the compressor when the oil level is below the lower limit.

Oil level sensor is installed in the oil separator.

[Case 2 Forced oil supply system]

When the oil level gets lower and the oil pump takes in the refrigerant gas, the differential pressure between before and after the oil pump decreases. When the differential pressure between before and after the oil pump is less than the specified value, the system will stop the compressor operation.

■ Protection against motor over-current

When motor current exceeds the set value (upper limit), it stops the compressor..

The current value is monitored by MAYEKAWA controller.

■ Sensor positions and settings

Consult the package instruction manual for the positions and sensor settings for compressor protection. Make sure that the set values of the sensors do not exceed the operating limits indicated in Chapter 2, section 2.3.2 and Table 2-6 in this manual.

■ Inspection Method/Cycle

Compressor protection sensors require activation tests and checking the set values before starting or operating the compressor and must be periodically inspected. For inspection methods and periods, please consult the package instruction manual.

⚠ WARNING

- **Adjust and fine-tune the set values of all safety protection devices (controllers and sensors) during the commissioning.**

⚠ CAUTION

- **To test the functionality and operation of each safety device, use appropriate testing tools to ensure that all alarms and switches operate normally. Do not operate the compressor with all valves closed or in any other conditions which will lead to dangerous situations.**
- **It is highly recommended to investigate the cause when the safety protection devices detect low oil pressure, abnormal high discharge pressure or high oil filter differential pressure. The compressor should not be operated as long as the situation has been unresolved.**

Chapter 2 Compressor Specifications and Structure

2.1 Features of SCV-series Screw Compressors

MYCOM SCV-series Screw is a single-stage screw compressor classified into a rotary displacement pump type, and it consists of the following features.

■ High Efficiency

The SCV-series has achieved high efficiency by applying "MYCOM original O-profile screw robes with the minimum leakage".

In addition, the SCV series provides economical operations due to its variable capacity control mechanism, which well follows the load variation.

■ Responding to a Wide Range Condition

In the SCV-series compressors, there are four types of rotor lobe diameter, and each rotor has three types of shaft length (for types shaft length in the 250 mm diameter rotor) as a standard specification.

Also, there are two types of the discharge direction of the compressed gas, i.e. one is sideway discharge type, another one is downward discharge type. For details, refer to next Section 2.2.

With these features, the SCV-series compressor is providing a high versatility that can satisfy a wide range of operation conditions required by different applications at the load side.

Moreover, the SCV-series models feature a “Readily changing mechanism to three ranges of internal volume ratio Vi”. Using this variable Vi mechanism, customers can be corresponding to large change of the load side operating conditions as a case of refrigerant changing or like.

■ High Reliability

The SCV-series has extended the long span continuous operation without compressor overhauling because of the following features:

Radial sleeve bearings specially designed with MYCOM’s original technology, special high-load capacity thrust ball bearings, and a bellows type mechanical seal assembly.

Furthermore, from December 2014 Moriya factory production, the SCV-series models have employed the new type unloader indicator assembly with the protection grade IP66 of the dust and water proof, at the same timing, have installed a durable conductive plastic potentiometer as the standard inner component of the indicator.

Because of this improvement, the SCV-series has equipped with further high reliability.

■ Less Vibration/Noises

The O-profile rotors along with other various design considerations have reduced noise and vibrations further.

2.2 Model Designation of the Compressor

The meaning of the type designation, which is engraved on the MODEL column of the compressor nameplate, is as follows.

[1]	[2]		[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
N	**200**	**V**	**L**	**D**			**-**	**H**		

[1] When there is specification, working fluid is shown by the symbol. This symbol may not be indicated.
(Example: **N**= Ammonia, **F**=Hydro Fluoro Carbon, **P**: Propane)

[2] Means rotor diameter which is **160**, **200**, **250** or **320.**

[3] Means the specifications of the rotor length which is **S**, **M**, **L** or **LL** (for rotor diameter 250 only).

[4] Means gas discharge direction which is **D** (sideways) or **G** (down: except for rotor diameter 320).

[5] Means the specifications of the slide valve, which is D (grooved type) or Z (low Vi type) as special specifications. When using standard slide valve, symbol is not added and left justified.

[6] When using the short cut rotors, add the symbol "S". When using the standard rotors, symbol is not added and left justified.

[7] When the compressor is standard specifications (standard slide valve, H-port, standard compression ratio, with economizer port and with liquid injection port) without symbols [8] to [10], this symbol is not indicated, either.

[8] This symbol is indicated only when specified by the order. This symbol means a discharge port which is H (Vi=5.8, with gorooveless standard slide valve), M (Vi=3.65, with gorooveless standard slide valve), MS (Vi=2.63 equivalent, with grooved slide valve), HS (Vi=1.8, with low Vi slide valve), or MS (Vi=1.3, with low Vi slide valve).

Note: In the case of following specifications set of discharge port and slide valve, variable Vi slide valve should be adjusted the first character of this symbol (left side to "S").

Note: If the evaporating temperature of the system exceeds 0 °C under the L port condition, select a grooved slide valve for the compressor.
In addition, note that grooved slide valve is available to even less than 0 °C evaporating temperature under the L port condition.

[9] When the compressor is booster specifications, the symbol "B" is added. When the compressor is standard specifications, symbol is not added and left justified.

[10] This symbol is indicated only when specified by the order. This symbol indicates if there is economizer port or/and liquid injection port or not. When this symbol is not indicated, both ports are provided and symbol may be added as “X”.

Symbol	Economizer port	Liquid injection port
E	with port	no port
I	no port	with port
X	with port	with port
N	no port	no port

The meanings of symbols [8] to [10] are shown below as examples.

200VLD: Discharge port is H port. With economizer and liquid injection ports both.

N200VID-MX: Discharge port is M port. With economizer and liquid injection ports both.

N200VLD-MBX: Discharge port is M port. Booster type, with economizer and liquid injection ports both.

N200VLD-HE: Discharge port is H. With economizer port, without liquid injection port

N200VLD-HN: Discharge port is H. Without economizer and liquid injection ports both.

2.3 Compressor Specifications

2.3.1 Standard Specifications

Table 2-1 Standard Specifications of SCV-series 160V**

Item			160					
			VLD	VMD	VSD	VLG	VMG	VSG
Working fluid (Refrigerant)		—	Ammonia, Hydro Fluoro Carbon and Other					
Mass of compressor alone		kg	390	380	370	410	360	350
Capacity control (Actual load)		%	10 to 100					
Rotation direction		—	CCW viewed from motor					
Swept volume	@ 3550 min^{-1}	m^3/h	749	624	499	749	624	499
	@ 2950 min^{-1}	m^3/h	622	519	415	622	519	415
Connected pipe size								
Gas inlet port			MYK 125A					
Gas outlet port			MYK 100CD			MYK 100A		
Main oil supply port (Journal)			Rc1/2					
Oil supply port for side bearing of F rotor			Rc1/4					
Oil injection port			Rc1/2					
Economizer port			MYK 25A					
Liquid injection port 1			MYK 20A					
Liquid injection port 2			Rc3/8					
Capacity control	decrease (unload)		Rc3/8					
	increase (load)		Rc3/8					
Oil drain			Rc3/8					

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.
Note 2: MYK flange is the standard flange for MYCOM single screw compressor.

Table 2-2 Standard Specifications of SCV-series 200V**

Item			200					
			VLD	VMD	VSD	VLG	VMG	VSG
Working fluid (Refrigerant)		—	Ammonia, Hydro Fluoro Carbon and Other					
Mass of compressor alone		kg	700	670	630	680	650	610
Capacity control (Actual load)		%	10 to 100					
Rotation direction		—	CCW viewed from motor					
Swept volume	@ 3550 min^{-1}	m^3/h	1460	1220	975	1460	1220	975
	@ 2950 min^{-1}	m^3/h	1210	1020	810	1210	1020	810
Connected pipe size								
Gas inlet port			MYK 150A					
Gas outlet port			MYK 125CD			MYK 125A		
Main oil supply port (Journal)			MYK 20A					
Oil supply port for side bearing of F rotor			Rc3/8					
Oil injection port			Rc1/2					
Economizer port			MYK 32A					
Liquid injection port 1			MYK 25A					
Liquid injection port 2			Rc1/2					
Capacity control	decrease (unload)		Rc3/8					
	increase (load)		Rc3/8					
Oil drain			Rc1/2					

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.
Note 2: MYK flange is the standard flange for MYCOM single screw compressor.

Table 2-3 Standard Specifications of SCV-series 250V*D

Item			250			
			VLLD	VLD	VMD	VSD
Working fluid (Refrigerant)		—	Ammonia, Hydro Fluoro Carbon and Other			
Mass of compressor alone		kg	1390	1300	1220	1180
Capacity control (Actual load)		%	10 to 100			
Rotation direction		—	CCW viewed from motor			
Swept volume	@ 3550 min^{-1}	m^3/h	3370	2840	2380	1900
	@ 2950 min^{-1}	m^3/h	2800	2360	1980	1580
Connected pipe size						
Gas inlet port			MYK 250A			
Gas outlet port			MYK 150CD			
Main oil supply port (Journal)			MYK 25A			
Oil supply port for side bearing of F rotor			Rc3/8			
Oil injection port			Rc1/2			
Economizer port			MYK 50A			
Liquid injection port 1			MYK 32A			
Liquid injection port 2			Rc1/2			
Capacity control	decrease (unload)		Rc3/8			
	increase (load)		Rc1/2			
Oil drain			Rc1/2			

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.
Note 2: MYK flange is the standard flange for MYCOM single screw compressor.

Table 2-4 Standard Specifications of SCV-series 250V*G

Item			250			
			VLLG	VLG	VMG	VSG
Working fluid (Refrigerant)		—	Ammonia, Hydro Fluoro Carbon and Other			
Mass of compressor alone		kg	1350	1260	1180	1120
Capacity control (Actual load)		%	10 to 100			
Rotation direction		—	CCW viewed from motor			
Swept volume	@ 3550 min^{-1}	m^3/h	3370	2840	2380	1900
	@ 2950 min^{-1}	m^3/h	2800	2360	1980	1580
Connected pipe size						
Gas inlet port			MYK 250A			
Gas outlet port			MYK 150A			
Main oil supply port (Journal)			MYK 25A			
Oil supply port for side bearing of F rotor			Rc3/8			
Oil injection port			Rc1/2			
Economizer port			MYK 50A			
Liquid injection port 1			MYK 32A			
Liquid injection port 2			Rc1/2			
Capacity control	decrease (unload)		Rc3/8			
	increase (load)		Rc1/2			
Oil drain			Rc1/2			

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.
Note 2: MYK flange is the standard flange for MYCOM single screw compressor.

Table 2-5 Standard Specifications of SCV-series 320V*D

Item			320		
			VLD	VMD	VSD
Working fluid (Refrigerant)		—	Ammonia, Hydro Fluoro Carbon and Other		
Mass of compressor alone		kg	2640	2480	2240
Capacity control (Actual load)		%	10 to 100		
Rotation direction		—	CCW viewed from motor		
Swept volume	@ 3550 min^{-1}	m^3/h	5700	4760	3820
	@ 2950 min^{-1}	m^3/h	4740	3960	3170
Connected pipe size					
Gas inlet port			MYK 350A		
Gas outlet port			MYK 200CD		
Main oil supply port (Journal)			MYK 40A		
Oil supply port for side bearing of F rotor			MYK 20A		
Oil injection port			MYK 25A		
Economizer port			MYK 80A		
Liquid injection port 1			MYK 50A		
Liquid injection port 2			Rc3/4		
Capacity control	decrease (unload)		Rc3/8		
	increase (load)		Rc1/2		
Oil drain			Rc1/2		

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.
Note 2: MYK flange is the standard flange for MYCOM single screw compressor.

2.3.2 Operation Limits

Table 2-6 Operation Limits of SCV-series Screw Compressors

Item		Operation Limit	
Maximum discharge pressure	MPa	1.96 (250VLL* is 1.37)	
Maximum suction pressure	MPa	0.59	
Minimum suction pressure	MPa	-0.080	
Minimum differential pressure between discharge pressure and suction pressure	MPa	0.49	
Maximum oil supply pressure	MPa	Forced oil supply	Differential pressure oil supply
		Pd + 0.39	Pd （＝Discharge pressure）
Minimum oil supply pressure	MPa	Forced oil supply	Differential pressure oil supply
		Pd + 0.049	Pd - 0.049
Maximum suction temperature	°C	85	
Minimum suction temperature	°C	-60	
Maximum discharge temperature	°C	90	
Maximum oil supply temperature	°C	60	
Minimum oil supply temperature	°C	30	
Maximum M rotor rotation speed	min^{-1}	4500 (250VLL and 320V*D are 3600)	
Minimum M rotor rotation speed	min^{-1}	1450	

Note 1: Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.

Note 2: The oil supply pressure of the capacity control part (control hydraulic pressure of the unloader slide valve), the value of the forced oil supply pressure is applied.

Note 3: When it is required that pressure difference between Pd (discharge pressure) and Ps (suction pressure) should be not greater than 0.49 MPa, oil pump needs to be installed.

If a combination of "NH_3 + compatible oil (PN46)" is used for working fluid (refrigerant) and lubricating oil, oil pump must be installed.

CAUTION

- **If operation at partial load, which is not greater than 30 % of the indicated load, is continued for a long time except when starting up the machine, abnormal noises or vibration may be generated. So avoid such operation.**
- **Repeated startup and stop in a short period is harmful not for the startup devices and electric machinery but also for the compressor itself. For information on the start/stop limitations, refer to each instruction manual. Wait at least 15 minutes after stopping the compressor before restarting it.**

2.3.3 Outer Dimensions

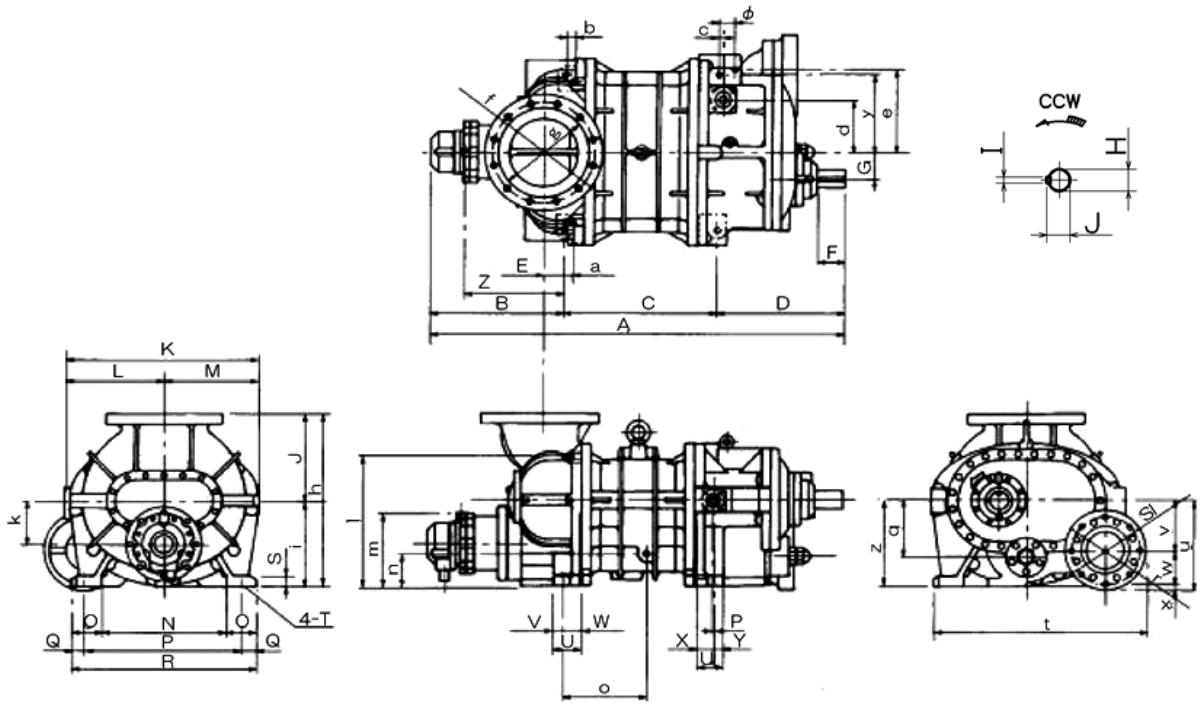


Figure 2-1 Outer Dimensions 160V*D, 200V*D, 250V*D, 250VLLD (Sideways discharge type)

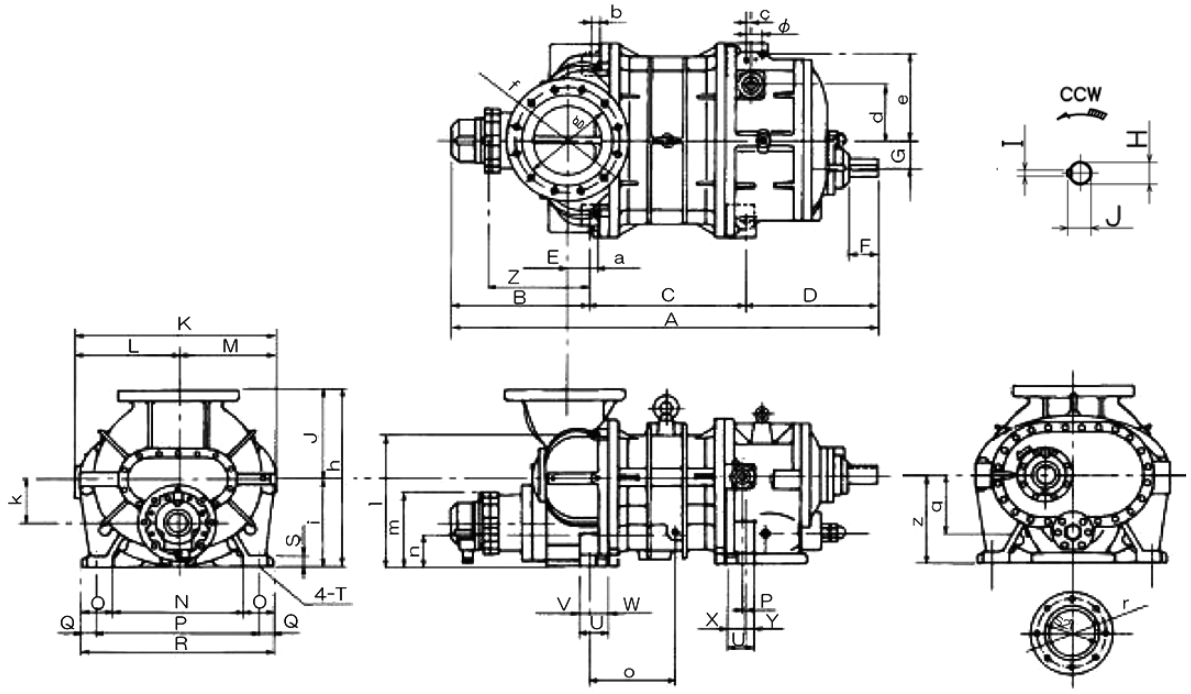


Figure 2-2 Outer Dimensions 160V*G, 200V*G, 250V*G, 250VLLG (Down discharge type)

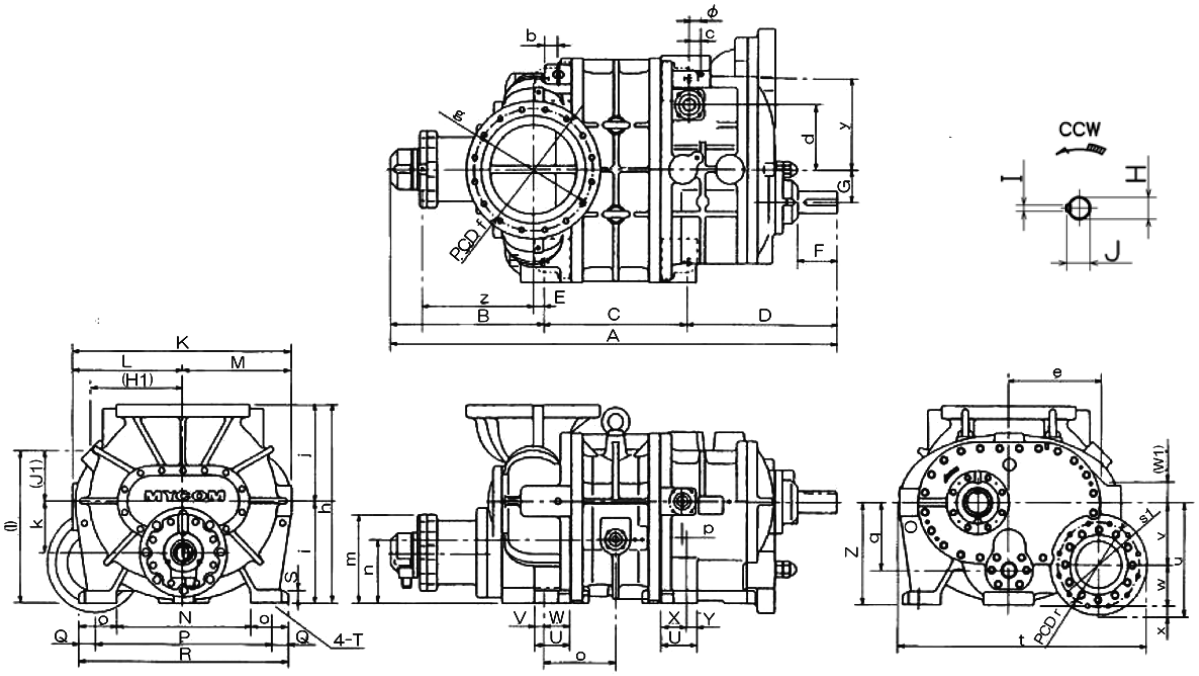


Figure 2-3 Outer Dimensions 320V*D

Table 2-7 Outer Dimensions (1/2)

(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	48.5	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	60	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	73	715
VM*	1467		502								
VL*	1535		570								
VLL*	1612.5		647.5								
320VSD	1796	620	576	600	45	156	126	85 +0.011 −0.011	24 +0.043 0	93	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	φ19	65	22.5	39.5
VM*												
VL*												
200VS*	290	280	360	100	460	50	560	30	φ23	95	30.5	64.5
VM*												
VL*												
250VS*	385	350	460	110	580	50	680	40	φ23	100	30.5	69.5
VM*												
VL*												
VLL*												
320VSD	450	440	540	155	720	65	850	50	φ33	145	40	105
VMD												
VLD												

Table 2-7 Outer Dimensions (2/2)

(mm)

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	400
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	ϕ	HI	JI	WI
160VS*	225	130	80	5	125	261	34	–	–	–
VM*										
VL*										
200VS*	280	143	117	15	240	303	36	–	–	–
VM*										
VL*										
50VS*	335	186	134	20	290	388	57	–	–	–
VM*										
VL*										
VLL*										
320VSD	436	240	160	36	280	494	51	376	197	83
VMD										
VLD										

2.4 Compressor Structure and Mechanism

2.4.1 Overview of SCV-series Screw Compressor

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 = M and female = F 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 Vi, 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.

In addition, the SCV-series compressors employ O-profile screw lobes for the rotors, which minimize leaks and thus enhance the compression efficiency.

【POINT】

- For names and positions of each part of the compressor, refer to Section 7.1 "Exploded Views, Sectional Views ", and Section 7.2 "Parts Configuration Table" in this manual Chapter 7.

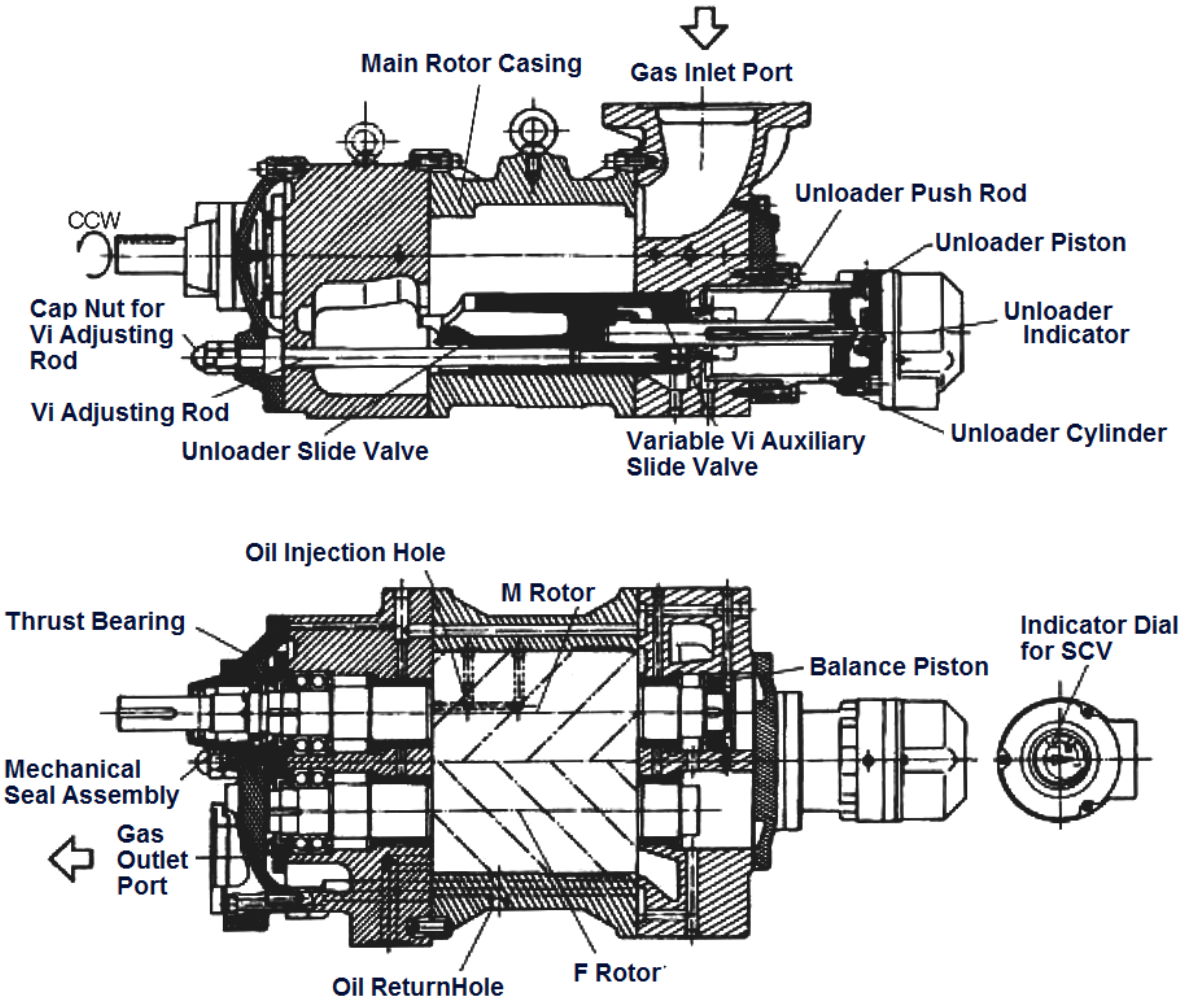


Figure 2-4 Compressor Structure (Representative View of Sideways Discharge Type)

2.4.2 Refrigerant Gas Compression Mechanism

Inside the main rotor casing, there are the M rotor (number of screw lobes: 4) and F 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 M rotor is directly coupled to a two-phase electric motor and driven at a standard speed of 2950 min^{-1} (with a 50 Hz power supply) or 3550 min^{-1} (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 Figure 2-5).

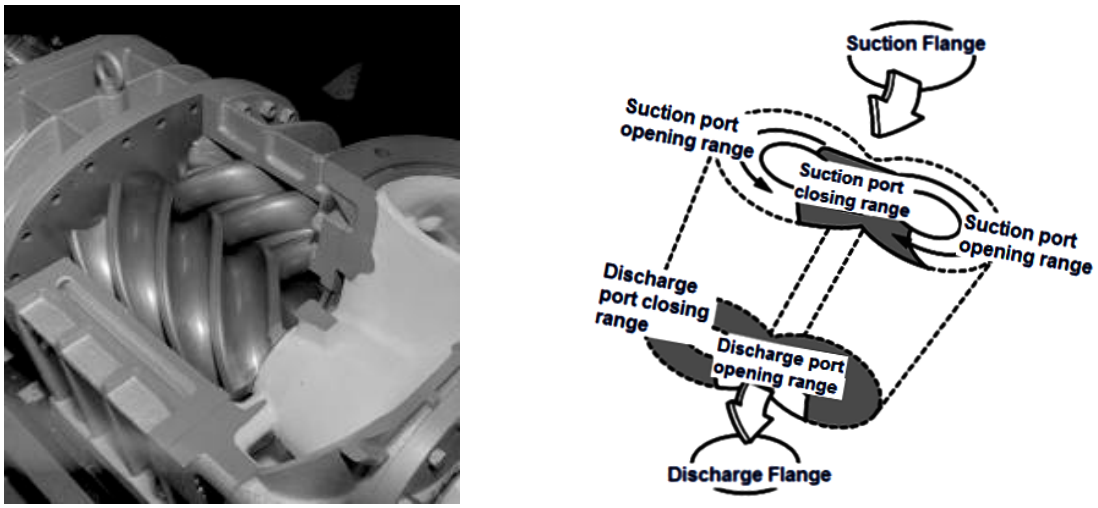
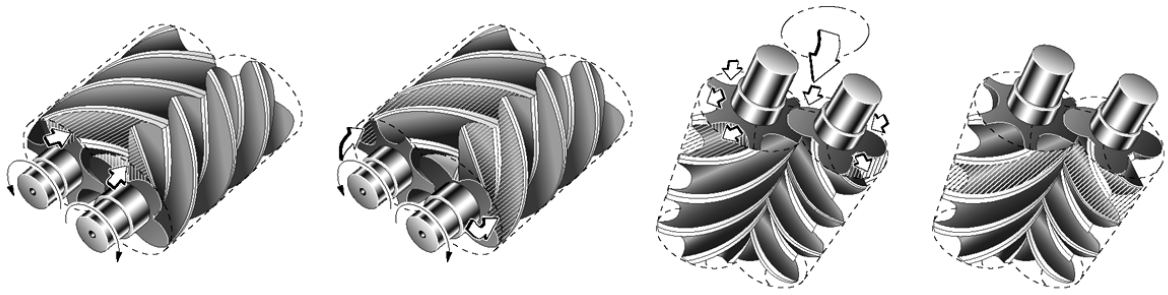


Figure 2-5 Suction and Discharge Port

2.4.2.1 Gas Suction Phase

As shown in Figure 2-8, the rotors with different tooth profiles are engaged. As the rotors turn, the volume between the M and F rotor tooth profiles and the compressor casing gradually increases starting from the suction side.

As the rotation continues, at a certain point when the volume reaches its maximum, the rotors isolate the gas (volume), which is enclosed by the rotors and the compressor casing, from the suction port and then continues rotation.



(1) Gas Suction Started | **(2) Gas Suction in Progress** | **(3) Gas Suction Phase about to End** | **(4) Suction Port Closed**

Figure 2-6 Gas Suction Phase

2.4.2.2 Compression Phase

As the rotors rotate further, the volume between the rotor lobes and grooves decreases while the sealing line moves toward the discharge side, which compresses the trapped refrigerant gas.

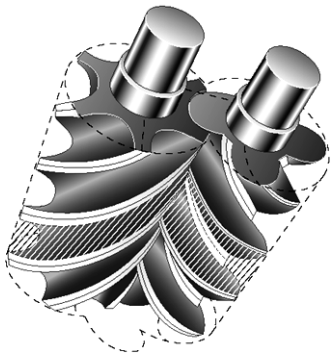


Figure 2-7 Compression Phase

2.4.2.3 Discharge Phase

The volume between the rotor lobes and grooves decreases to a level predetermined by the discharge port. With the rotations of the rotors, the compressed refrigerant gas is pushed out to the discharge port.

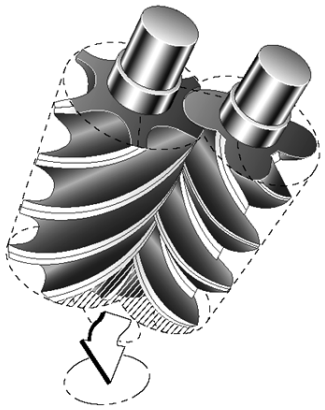


Figure 2-8 Discharge Phase

2.4.3 Internal Volume Ratio Vi

2.4.3.1 What is the Internal Volume Ratio Vi ?

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 Vi' and defined by the following formula:

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

In the case of the screw compressor without the Vi variable mechanism, Vi values are fixed at a specific value for each compressor.

For example, the Vi value is fixed at 2.63, 3.65, or 5.80 for MYCOM UD/G-series compressor; compressors with Vi at 2.63 are called the L-port compressors, those with Vi at 3.65 are called the M-port compressors, and those with Vi at 5.80 are called the H-port compressors.

Also, the Vi of SCV-series compressors with variable Vi mechanism are these three types i.e. L port, M port, H port.

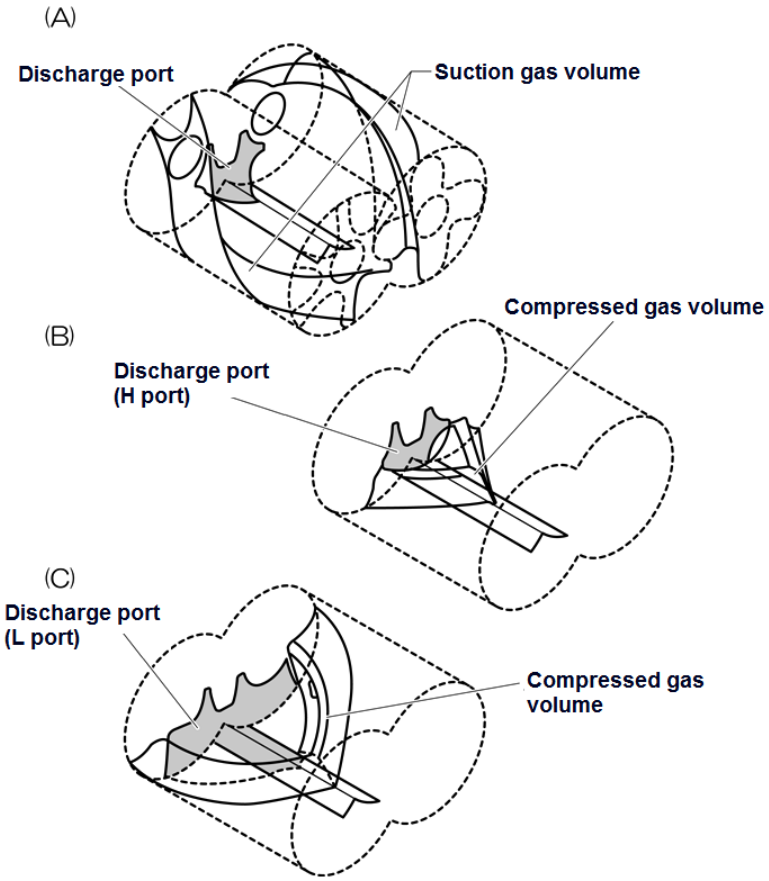


Figure 2-9 Internal Volume Ratio Vi

2.4.3.2 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.

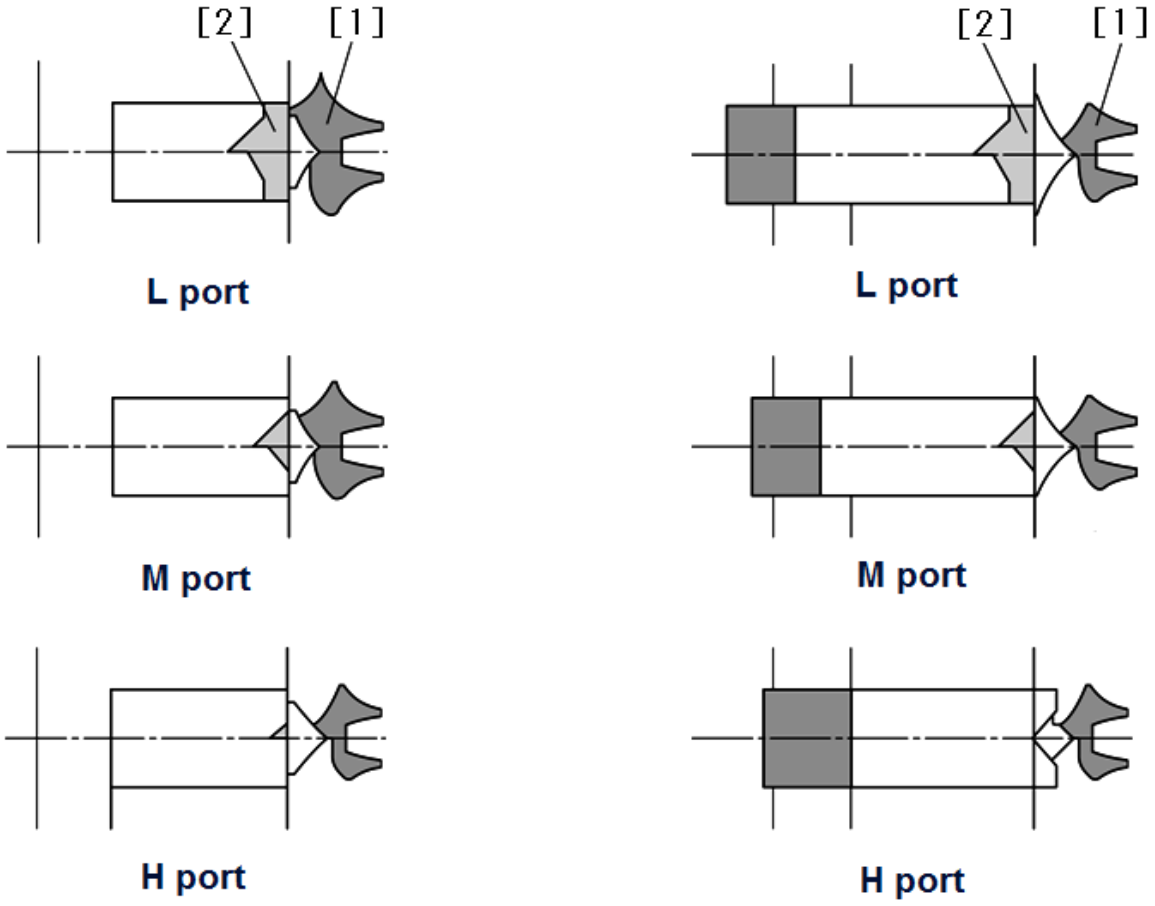
Figure 2-10 compares the discharge ports or the fixed and variable Vi compressors.

Conventional compressors (fixed Vi)

• Both axial and radial ports fixed

SCV Series compressors (variable Vi)

• Axial port fixed, radial port variable



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

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

Figure 2-10 Discharge Ports of Variable and Fixed Vi Compressors

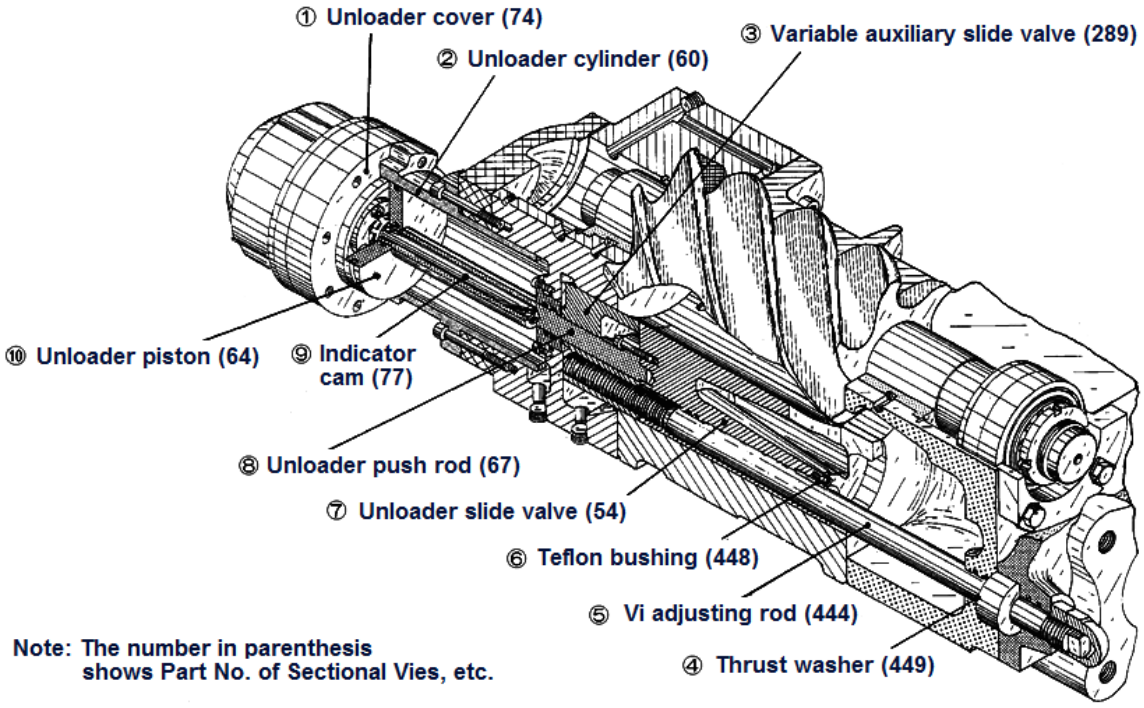


Figure 2-11 Variable Vi Mechanism of SCV-series

2.4.3.3 Why the Vi Needs to Be Changed?

The advantages that can change the Vi settings of the compressor are as follows:

[1] You ca set the Vi that is suitable for use refrigerant.
Internal volume ratio Vi is expressed as follows with the compression ratio.

$$Vi = \left(\frac{Pd}{Ps}\right)^{\frac{1}{\kappa}} \quad \text{or} \quad Vi^{\kappa} = \frac{Pd}{Ps}$$

Pd: discharge pressure, Ps: suction pressure,
κ : 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. If you can change the Vi settings, you will be able to apply to a variety of refrigerant using a single compressor.

[2] You can 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), a pressure higher than the necessary pressure will be reached before the discharge port opens as shown in the lower right graph of Figure 2-13 in next page. 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), 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 Figure 2-13 unless the flowing-back gas is overcome by driving the compressor using extra power.

In summary, 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 below Figure 2-12 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.

As for how to change the Vi settings, refer to Section 4.1 in this manual Chapter 4.

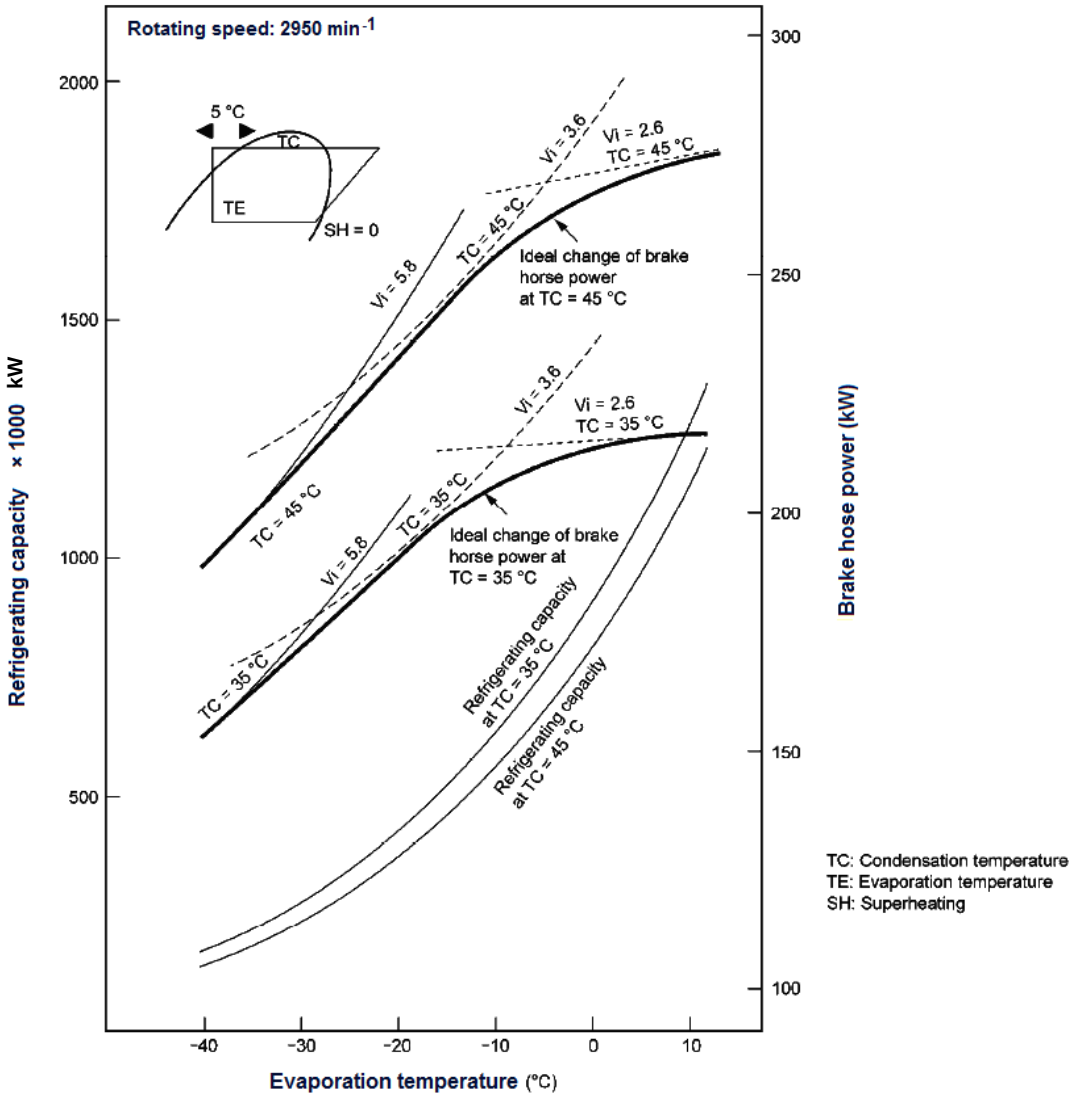
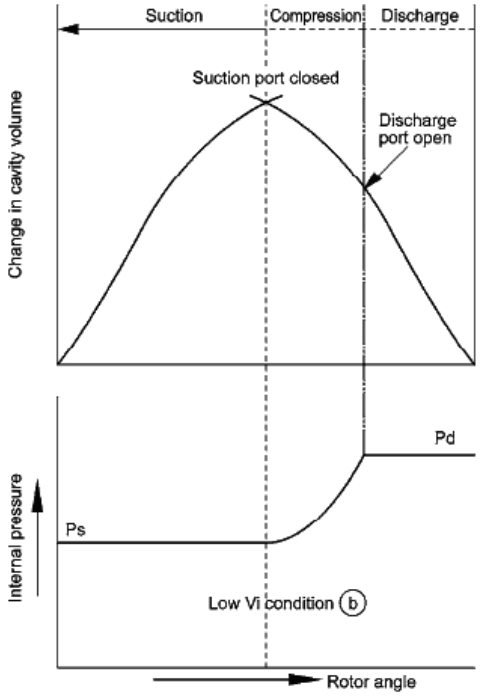
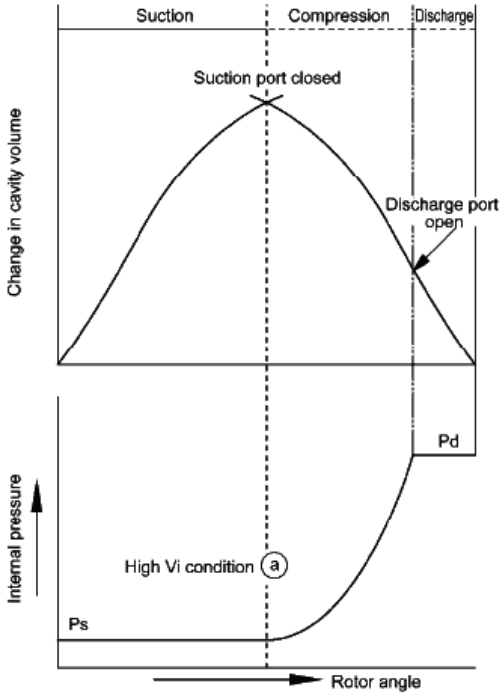


Figure 2-12 Refrigeration Capacity of Screw Compressor

(A) Properly adapted Vi to load condition

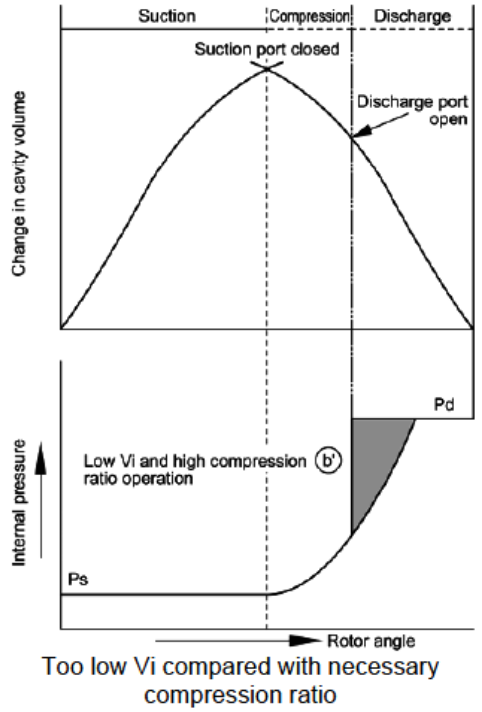


Necessary compression ratio and Vi are both low

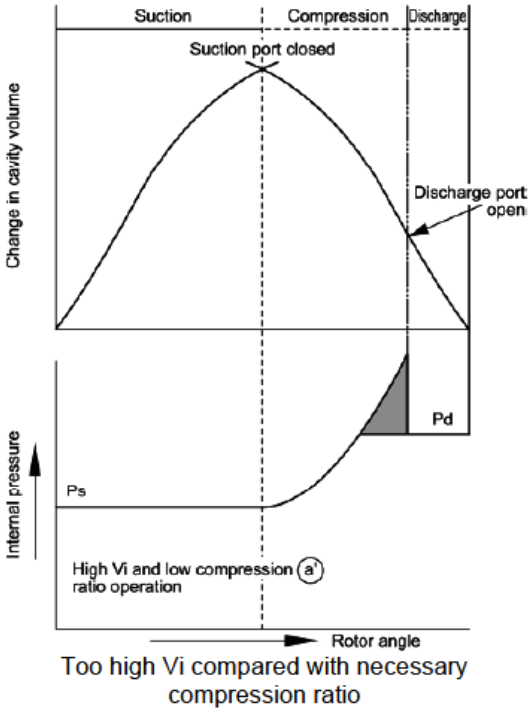


Necessary compression ratio and Vi are both high

(B) Improperly adapted Vi to load condition



Too low Vi compared with necessary compression ratio



Too high Vi compared with necessary compression ratio

Figure 2-13 Proper and Improper Adaptation of Vi to Load Condition

2.4.4 Bearings and Balance Piston

The M rotor and F rotor are supported at their both ends by the side bearings in the suction cover and the main bearings in the bearing head. These bearings use sleeve type white metal lined bearings.

In addition, the thrust bearings 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. For the thrust bearing, SCV-series compressors use the angular contact ball bearing.

In particular, because the M rotor is a kind of helical gear and also because the thrust force produced by discharge pressure is larger than that for F rotor. To reduce the load acting on the thrust bearing of the male rotor, a hydraulic piston (balance piston is provided in the suction cover.

2.4.5 Shaft Seal

To prevent refrigerant gas leakage, a reliable mechanical seal assembly is used for the shaft seal of the male rotor, which is the compressor’s drive shaft.

Mechanical seal assembly is mainly composed of "rotating ring" installed on the rotor shaft and "stationary ring" installed in the seal cover. Rotating ring rotates with the shaft, and slides each other with the stationary ring while maintaining a micron class gap. The sliding each other place is called as the sliding surface.

For example, the BBSE (Balance Bellow Single Seal) which is currently used as standard seal, employs a stationary ring (mating ring) made of special cast steel, a rotating ring made from carbon, and O-rings for the packing.

2.4.6 Capacity Control

The unloader slide valve, which is activated hydraulically via the unloader cylinder and the unloader piston, automatically carries out capacity control (suction gas amount control) of each SCV-series compressor.

The unloader indicator assembly is connected to the unloader cylinder via the indicator cam, allowing the indicator to indicate the positions of both the variable Vi auxiliary slide valve and the unloader slide valve. The indicator cam has a spiral groove, in which the guide pin implanted in the unloader slide valve push rod 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 slide 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. Mechanisms

2.4.7 Oil Supply Route

Depending on applications, the SCV-series 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.

- **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.

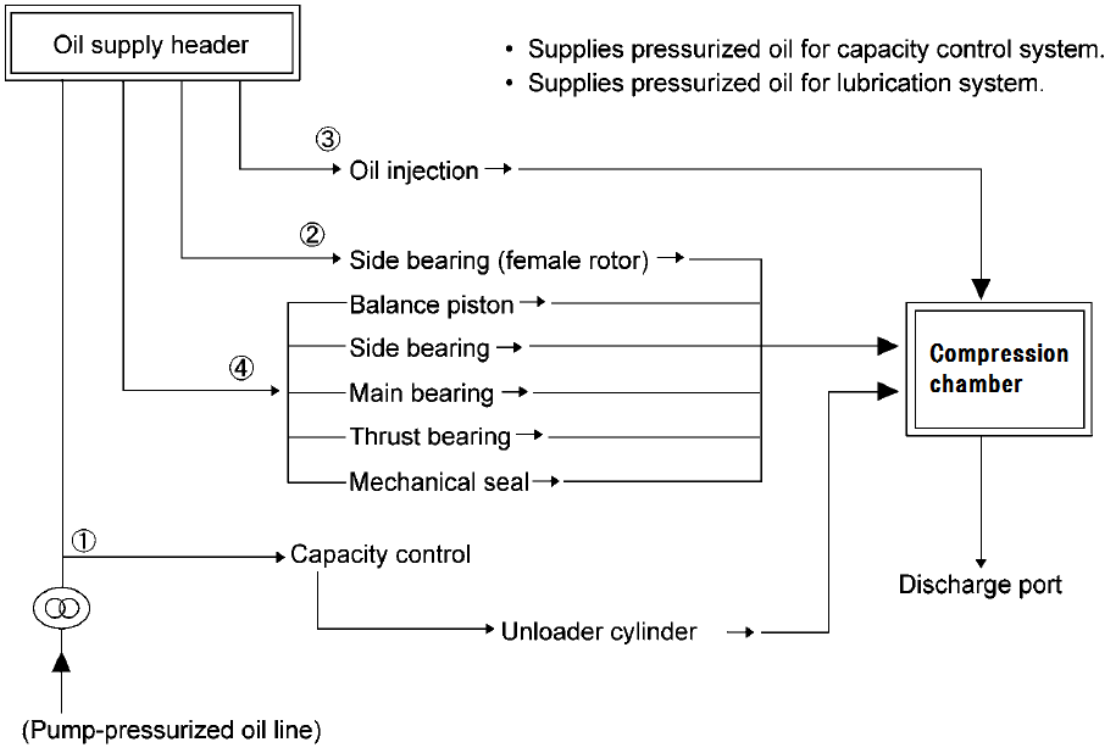


Figure 2-14 Oil Supply Route of Forced Oil Supply System

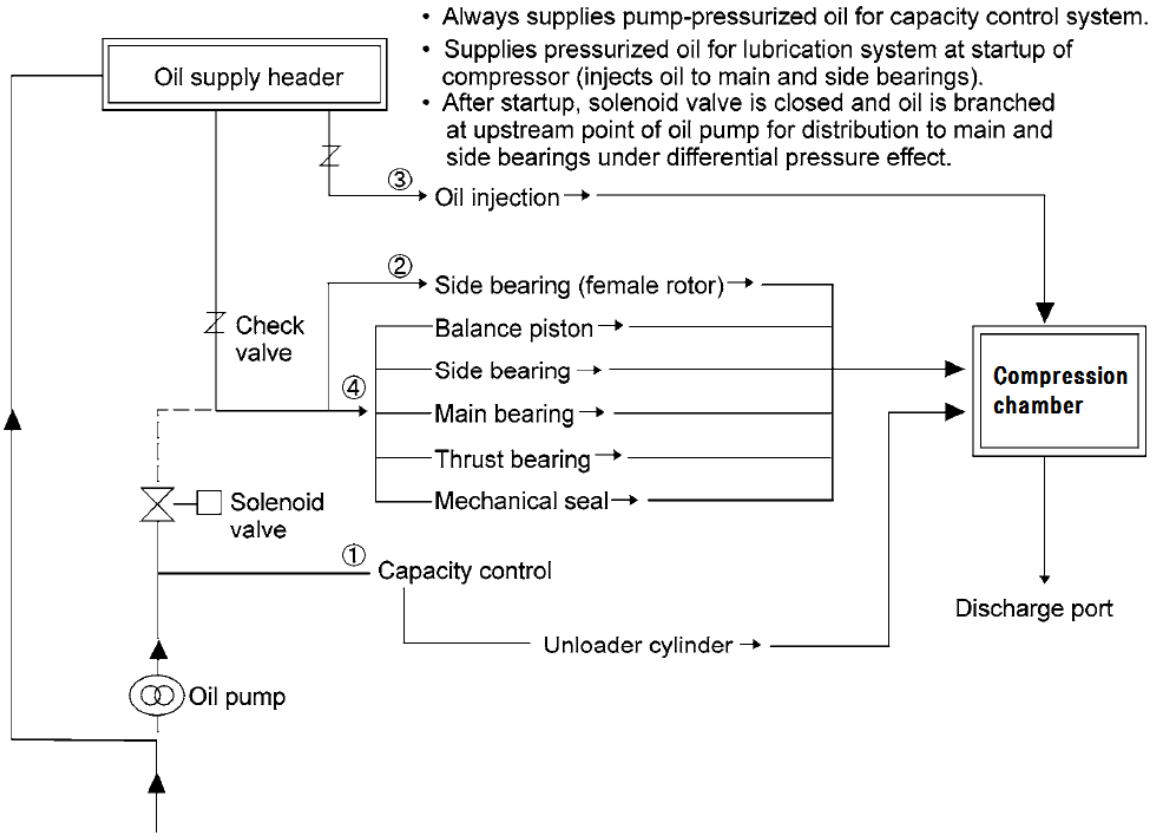


Figure 2-15 Oil Supply Route of Differential Pressure Oil Supply System

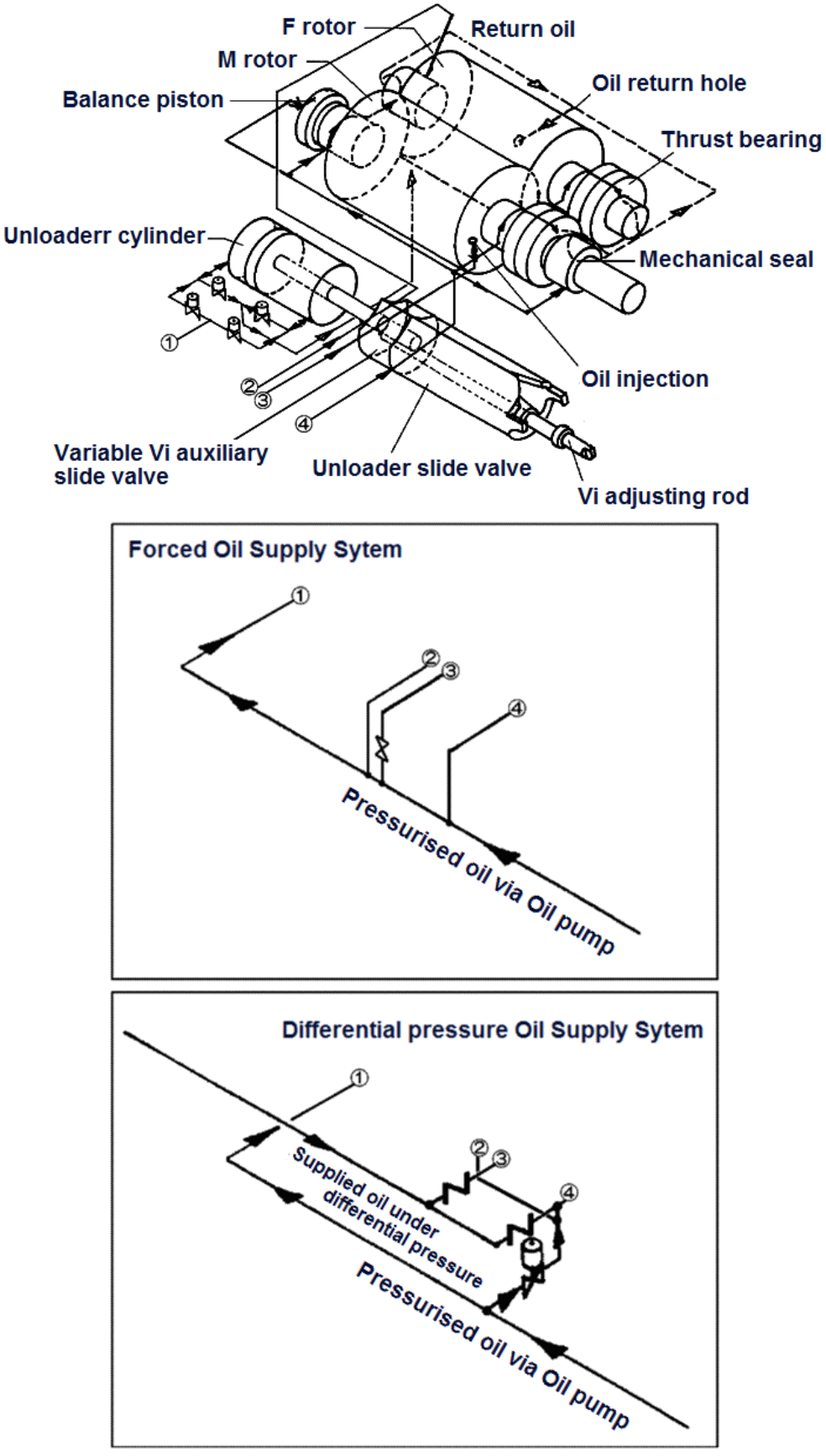


Figure 2-16 Oil Supply Route

Chapter 3 Installation

3.1 General Precautions for Installation

【POINT】

- This chapter (Installation) assumes that the compressor is installed to a standard refrigeration / cold storage package unit.
  If the unit you are actually using is not the standard type refrigeration/cold storage package unit, prepare a proper installation manual by referring to the description in this chapter and paying due consideration to safety, before installing the compressor.
  If there are any questions, please contact our local sales offices or service centers.

- In some cases, it may be required that installation is performed by qualified personnel. Make sure that the work is performed by qualified personnel in compliance with local laws, ordinances and other regulations/requirements.
- Before installing the compressor, please read this chapter and related documents attentively and fully understand their contents.
- Electrical works should be performed only by electrical engineers.

3.2 Installation Works

3.2.1 Unpacking

Confirm whether a compressor does not have abnormality including the damage.

【POINT】

- If there are abnormalities or deficient parts on the compressor, please contact our sales offices or service centers immediately.
- Unnecessary packing materials should be discarded according to the laws and ordinances, or your company's rules.

3.2.2 Storage

Perform the followings to store the compressor before installation.

- Store it indoors.
- Infuse nitrogen gas into the compressor and seal it. (Pressure: Approximately 0.15 Mpa)

3.2.3 Transportation

DANGER

- **Dropping of the lifted compressor may cause death or serious injury. Do not stand under the lifted compressor.**

1. At first, mass and dimensions of the compressor should be confirmed referring to Section 2.3.1 "Standard Specifications" and Section 2.3.3 "Outer Dimensions" in this manual Chapter 2.

For lifting the compressor within the safety limit, use lifting equipment and tools appropriate for the mass of the compressor.

2. Secure sufficient space for safe lifting.

3. Always check the wire ropes before using them. Thoroughly check the wire ropes for problems such as kinks, knots and broken strands. Do not perform lifting before confirming the safety of the wire ropes. If you cannot make a correct evaluation or judgment, entrust an expert to check.

4. To lift the compressor, attach the wire ropes to the appended eye bolts by using appropriate shackles and hooks.
Use the eye bolts only for lifting the compressor. Do not use the eye bolts when lifting the compressor together with additive equipment.

CAUTION

- **The compressor eye bolts must not be used for lifting the package unit. To lift the unit, use the lifting chains provided around the base or other lifting means provided on the base.**

5. Check path of compressor installation to make sure it is free of obstacles in consideration of the compressor size.

6. Before lifting, check that the hook is located above the gravity center of the compressor.

7. Direct all the workers to stay clear of the work site before lifting.

8. Before lifting the compressor, alert all workers in area of dangers during lifting process by signal (such as calling at the beginning of the work or making a signal by hand). Do not lift the compressor unless the signals (such as calling out or hand signals) are completely understood by the workers at site.

9. Slowly wind up the wire ropes until immediately before the compressor leaves the ground.

10. Then, wind up the wire ropes a little further until the compressor is slightly up away from the ground. Check that the compressor is not tilted. If the compressor is tilted, return the compressor to the ground and correct the tilt by adjusting the wire ropes. After that, restart the lifting operation.

11. Be sure to lift up the compressor slowly. If it is lifted rapidly, it may damage the lifting tools such as wire ropes or a part of the compressor.

12. When the lifting work starts, observe to see if wire ropes and lifting tools are normal. Be sure that the compressor is not tilted.

13. When moving the lifted compressor, always use guiding ropes.

14. When moving the compressor, turn away workers from the movement direction and check safety.

15. Do not lift the compressor above the safety passage unless absolutely necessary.

16. Do not lower the compressor on the safety passage. Always keep the safety passage free of obstacles.

17. Remove any obstacles before lowering the compressor onto the ground. The compressor should not be tilted or unstable.

18. Before lowering the compressor, announce to the workers around the working area in advance.

19. When lowering the compressor onto two or more blocks, align the tops of blocks so that the compressor becomes stable horizontally on them.

20. Slowly lower the lifted compressor so that it is not damaged by shock.

3.2.4 Preparation for Installation

■ Installation Space

Secure sufficient working space for easy operation, cleaning, maintenance, and inspection.

■ Illumination

Prepare illumination devices which allow easy operation, cleaning, maintenance, and inspection.

■ Ventilation

If natural ventilation is insufficient, install ventilation fans according to the relevant regulations.

■ Connecting Port of Compressor

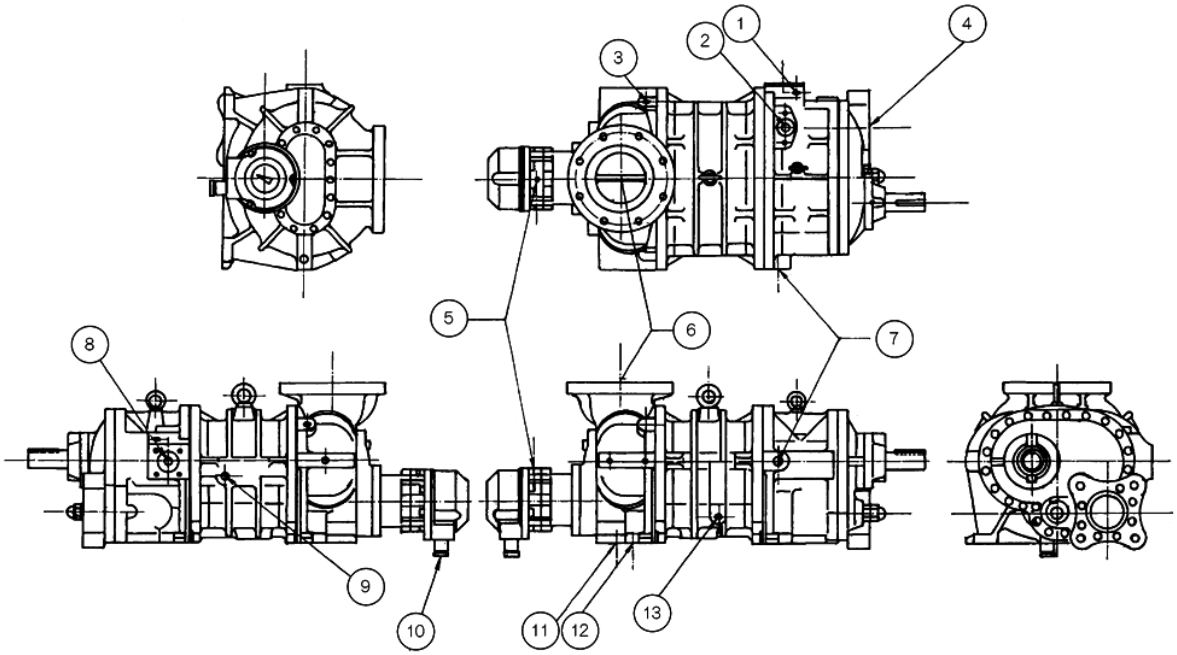
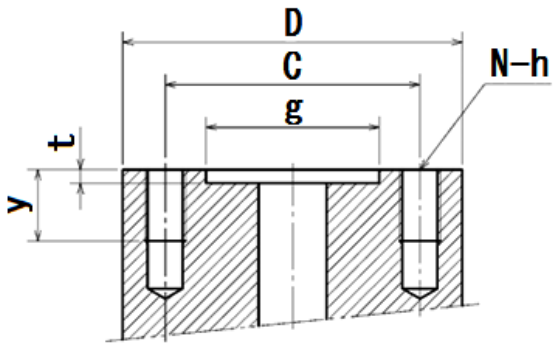


Figure 3-1 Connecting Port of Compressor

Table 3-1 Connecting Port of Compressor

No.	Item	Compressor Model			
		160V**	200V**	250V**	320V*D
1	Connecting port for liquid injection 2	Rc3/8	Rc1/2	Rc1/2	Rc3/4
2	Connecting port for liquid injection 1	MYK 20A	MYK 25A	MYK 32A	MYK 50A
3	Oil supply port for F rotor side bearing	Rc1/4	Rc3/8	Rc3/8	MYK 20A
4	Discharge gas outlet (type D)	MYK 100CD	MYK 125CD	MYK 150CD	MYK 200CD
	Discharge gas outlet (type G)	MYK 100A	MYK 125A	MYK150A	-
5	Unloader control (increase)	Rc3/8	Rc3/8	Rc3/8	Rc3/8
6	Suction gas inlet	MYK 125A	MYK 150A	MYK 250A	MYK 350A
7	Lubricating oil main supply port (journal)	Rc1/2	MYK 20A	MYK 25A	MYK 40A
8	Economizer connecting port	MYK 25A	MYK 32A	MYK 50A	MYK 80A
9	Plug for (oil return)	-	-	-	-
10	Control wiring connector for indicator	-	-	-	-
11	Unloader control (decrease)	Rc3/8	Rc3/8	Rc1/2	Rc1/2
12	Oil drain port	Rc3/8	Rc1/2	Rc1/2	Rc1/2
13	Connecting port for oil injection	Rc3/8	Rc1/2	Rc1/2	MYK 25A



	D	t	g	C	N-h	y
☐ 20A	110	4.5	45	76	2-M12×P1.75	24
☐ 25A	91	4.5	52	83	4-M12×P1.75	18
☐ 32A	98	4.5	60	95	4-M12×P1.75	18
☐ 40A	108	4.5	68	108	4-M12×P1.75	22
☐ 50A	120	4.5	84	116	4-M16×P2	24
☐ 80A	160	4.5	119	158	4-M20×P2.5	30
☐100A	192	4.5	144	190	4-M22×P2.5	30
100CD	190	4.5	111	190	4-M22×P2.5	33
125A	270	5	174	230	8-M20×P2.5	27
125CD	274	5	146	230	8-M20×P2.5	25
150A	300	5	199	248	8-M22×P2.5	30
150CD	298	5	176	248	8-M22×P2.5	35
200CD	392	5	234	330	12-M20×P2.5	40
250A	435	5	331	375	12-M24×P3	34
350A	540	5	422	480	16-M24×P3	40

Figure 3-2 Dimensions of the MYK Flange Joint Part (Compressor)

3.2.5 Installation

3.2.5.1 Placement

Check that the surface of the package unit, where the compressor is to be installed, is even and horizontal. If it is uneven and non-horizontal, tightening the bolts may lead to compressor deformation, which may prevent normal operation.

3.2.5.2 Shaft Alignment between the Compressor and Driving Machine

DANGER

- **Turn off the main power and control power of the driving machine before shaft alignment work between the compressor and the driving machine. Be careful so that the power of instruments does not turn on during shaft alignment work. If the power turns on during shaft alignment work, the driving machine starts moving and there is a risk of being entangled with the rotating shaft.**
- **At the time of turning ON/OFF each electric power breaker, make sure to prevent electric shock.**

CAUTION

- **For shaft alignment work between the compressor and driving machine, use designated tools in normal condition. If a worn or damaged tool or a tool unsuitable for the work is used, there is a risk of being injured.**

In the case shaft alignment between this product and the driving machine, be sure that the deviations within the range shown in the Table 3–2. However, if alignment tolerance of the driving machine side is more stringent than Table 3-2, please adjust to the request within the allowable value of the driving machine side.

Table 3–2 Tolerance of Misalignment

	Tolerance
Offset	6/100 mm
Angularity	3/100 mm (reference: Φ100 mm)

The Figure 3–3 and 3–4 show how to measure offset and angularity when performing the centering of the shafts of the driving machine and this product using a dedicated hub, a dial gauge and a magnet stand.

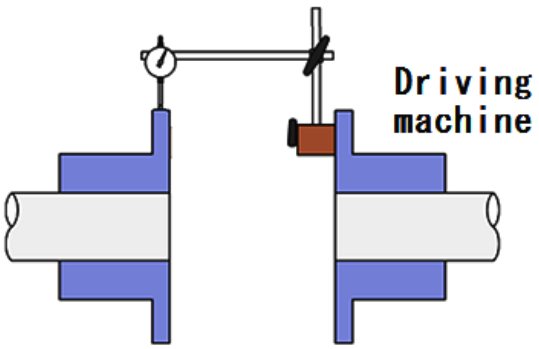


Figure 3-3 Measurement of Offset

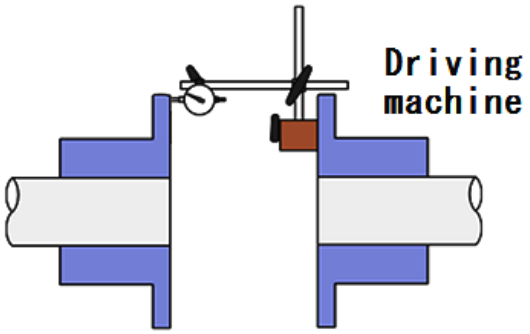


Figure 3-4 Measurement of Angularity

3.2.5.3 Piping Connection

■ Refrigerant Piping

Observe the following when connecting the refrigerant piping to the compressor.

- The compressor is one of the few devices installed within the package unit that have moving components. These moving components are adversely affected by foreign substances within the system (scale, dust, spatter, etc.). Therefore, when connecting the piping, do not allow any of such foreign substances to enter inside.
- Some compressors (mainly those for export) are charged with nitrogen gas to prevent rust. Be sure to release the pressure before starting piping work.
- Be sure not to allow moisture to enter the piping. There is a high probability that it will cause trouble after the start of operation. Be sure to assemble piping when it is dry.
- Improper piping may cause operating problems such as oil not returning to the compressor or liquid flow-backs.
- When connecting the piping to the compressor, use piping that is the same size as the compressor connection port. If the pipe size of the piping is smaller than the compressor connection port, the flow of lubricating oil or refrigerant will be obstructed leading to problems.
- Do not let the mass of the piping connected to the compressor applied onto flanges or joints. Be sure to prepare proper supports for piping.

3.2.5.4 Equipment and Devices for Protection of the Compressor

■ Oil Filter

According to the requirements of the use of the package unit or the standard to apply, install an oil filter of appropriate filtration precision in the lubrication system of the compressor.

In the case of general applications such as closed-cycle refrigeration systems, we recommend to use an oil filter with beta ratio in the range of $\beta_{20} \geq 150$ that conforms to requirements of NAS 1638 class 8 or ISO 4406 17/15/13.

When the package unit requires API 619 4th/5th edition conformity, use an oil filter with beta ratio in the range of $\beta_{10} \geq 200$.

The oil filter may be clogged just after commissioning. We recommend installing two oil filters in parallel. This will enable replacement of either filter during operation.

■ Oil Heater for Oil Separator

To preserve the temperature of the lubricating oil before starting the compressor, install an oil heater on the oil separator. Make sure to install a protection function (thermostat, or like) to prevent overheating.

■ Suction Strainer

When inter-soluble oil is used, the mesh size of suction strainer should be not less than 200 meshes. When non-miscible oil is used, it should be not less than 100 meshes.

For details about inter-soluble and non-inter-soluble oils, see Section 4.1 "Lubricating Oil (Refrigerant Oil)" in this manual.

During the commissioning, small particles and scale may come from the system. We recommend installing a finer filter temporarily.

■ Compressor Protective Devices (Safety Devices)

To protect the compressor, install the necessary protective devices as described in Section 1.4.3 "Compressor Protective Devices" in this manual.

3.2.6 Airtightness Test

Perform an airtightness test on the package unit before starting commissioning. To prevent water entry in the package unit, use nitrogen gas or dry air for the airtightness test.

3.2.7 Vacuuming

CAUTION
● **Do not turn the compressor rotor shaft during vacuuming.**

Vacuuming involves discharging the air in the unit before the refrigerant and oil are charged in the unit. Always use a vacuum pump when vacuuming.

3.2.8 Lubricating Oil Charge

CAUTION
● **TO select the lubricating oil to be used, refer to Section 4.1 "Lubricating Oil (Refrigerant Oil)" in this manual.** ● **When refilling lubricating oil, ensure that it is clean and does not contain foreign matters.** ● **Be careful that air and water are not mixed in when refilling.** ● **To ensure that the lubricating oil does not absorb air moisture, keep it indoors in an airtight container until use.**

3.2.8.1 Initial Charge of Lubricating Oil

Depending on the package unit configuration and operating condition, specify the procedure, method and amount of the initial charge of lubricating oil, and make sure to provide users of this product with such information.

In determining the procedure and work procedure, please care oil is to be filled in the oil filter and oil cooler always.

3.2.8.2 Additional Charge of Lubricating Oil

Specify the procedure of the additional filling of lubricating oil based on the configuration of the package unit, and make sure to provide users of this product with the information.

3.2.9 Charge of Refrigerant

Depending on the use working fluid and equipment configuration of your package unit, specify the work procedure that considered safety enough, and conduct the refrigerant initial filling work accordingly.

In addition, specify the procedure of the additional filling of refrigerant, make sure to provide users of this product with the information.

3.2.10 Check after Installation

Depending on the package unit to which this product is installed, formulate the necessary confirmation items and methods for package unit after installation and conduct them accordingly before the commissioning. In addition, make sure to record and keep the results of your confirmation.

Chapter 4 Compressor and Package Unit Operation

4.1 Adjustment of Vi

4.1.1 Overview

The internal volume ratio Vi of SCV-series screw compressors has been adjusted as H port (5.8) at the time of shipping.

Before starting the commissioning of the package unit, confirm the appropriate Vi of the compressor for customer's operating conditions and change the Vi setting if necessary.

When changing of the intended use of the compressor and/or there are large temperature changes of seasons in usual operation of the package unit, confirm the properly of the Vi setting and change it if necessary.

Changes in operating condition experienced in daily operation have no significant influence on the shaft power. Therefore, it is not necessary to change the Vi setting that adjusted once to operating conditions.

In addition, 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. In this example case, the compressor should be used with the Vi fixed at M port setting.

CAUTION

- **Fix the Vi setting and do not adjust it while the compressor is in operation.**
  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 MYCOM 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.
- **Do not operate the compressor with the Vi at any other setting than the L, M or H port setting.**
- **In case of considering change from L port to H port or reverse, be sure to consult us beforehand because it will be necessary detailed examination due to specification of compressor's unloader slide valve.**

4.1.2 How to adjust the Vi setting

DANGER

- **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.**

Numbers enclosed in [ ] in following instructions means the part number in Section 7.1 "Exploded Views and Sectional Views" and Section 7.2 "Parts Configuration Table" in this manual Chapter 7.

a) 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 Section 2.4.3.3 "Why the Vi Needs to Be Changed?" for the calculation) in this manual Chapter 2.
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.

b) From the table 4-1 “Number of Turns of Vi Adjusting Rod for Individual Models”, determine how many turns the adjusting rod [444] should be rotated in order to set to the port selected in Step a) above.

Table 4-1 Number of Turns of Vi Adjusting Rod for Individual Models

(The unit of "Displacement distance" is "mm".)

From H port to M port					From H port to L port				
	–	160VL	160VM	160VS		–	160VL	160VM	160VS
Displacement distance	–	27	23	18	Displacement distance	–	55	45	37
Number of turns of rod	–	10.8	9.2	7.2	Number of turns of rod	–	22	18	14.8
	–	200VL	200VM	200VS		–	200VL	200VM	200VS
Displacement distance	–	34	28	23	Displacement distance	–	69	57	46
Number of turns of rod	–	9.7	8.0	6.6	Number of turns of rod	–	19.7	16.3	13.1
	250VLL	250VL	259VM	250VS		250VLL	250VL	250VM	250VS
Displacement distance	52	43	36.5	29	Displacement distance	–	87	72.5	58
Number of turns of rod	13	10.8	9.1	7.3	Number of turns of rod	–	21.8	18.1	14.5
	–	320VL	320VM	320VS		–	320VL	320VM	320VS
Displacement distance	–	47	50	59	Displacement distance	–	105	98	98
Number of turns of rod	–	10	11	13	Number of turns of rod	–	23	21.5	21.5

Note 1: Prior consultation to MAYEKAWA is necessary prerequisite as mentioned in CAUTION in the previous page when the port is changed from H port to L port.

Note 2: The travel distance and the rotation number of "From H port to M port" on 320V* have different tendency of change compared with those of other types. The reason can be found in design difference of variable Vi auxiliary slide valve.

Note 3: If the evaporating temperature of your system exceeds 0 °C under the L port condition, select a grooved slide valve for the compressor.
In addition, note that grooved slide valve is available to even less than 0 °C evaporating temperature under the L port condition.

Table 4-2 Screw Thread Specifications of Vi Adjusting Rod

160V**	200V**	250V**	320V*D
M20×P2.5	M30×P3.5	M36×P4.0	M42×P4.5

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

c) If Vi settings are the initial settings before commissioning, set the position of the slide valve at the no load point, that indicates 0 % in unloader indicator, by driving the oil pump alone after adjusting the position 0 % to 100 % of the unloader indicator pointer.

If Vi adjusting work is conducted as a change during usual operation, stop the compressor operation after slide valve reaches 0 % position.

d) Shut off the electric main power source and control power source of the package unit.
In addition use lockout/tagout to prevent power from being reconnected accidentally during the Vi setting operation.

WARNING

- **Take care to the electric shock accident at the time of conducting the electric power ON/OFF.**

e) Remove the domed cap nut [522] at the end of the Vi adjusting rod, then loosen the hexagon nut [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.

f) 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 Figure 4-3.

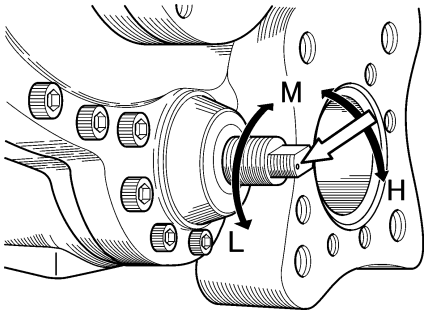


Figure 4-1 Vi Adjusting Rod

CAUTION

- **Do not turn the Vi adjusting rod any further as applying undue force will break the rotation stopping mechanism.**

g) Check the inscribed mark (small black point indicated by the white arrow in Figure 4-1) on the Vi adjusting rod, which should be used as a reference point when counting the number of turns of the rod.

h) 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 Figure 4-3.

i) While holding the Vi adjusting rod against rotation, lock the rod by tightening the lock nut.

j) 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 due to vibration, or like.

Figure 4-2 Conical Spring Washer

k) By releasing lockout/tagout of the electric power breaker temporarily, and then turn on the control power and the oil pump power.

m) Supply oil pressure to increase the capacity control by individual oil pump operation until the slide valve stops at the full loaded position.

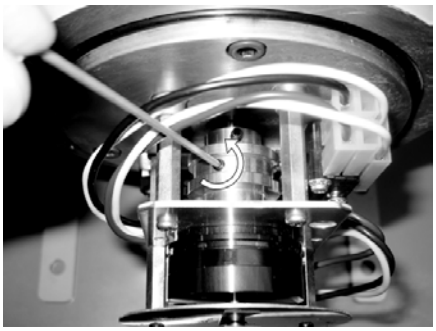
n) If the pointer of the unloader indicator aligns with the 100 % graduation for the port in question on the dial, the Vi is correctly adjusted to that port. This is the Sequence (4) in Figure 4-3.

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 pointer indicates any point in the width of the graduation mark.

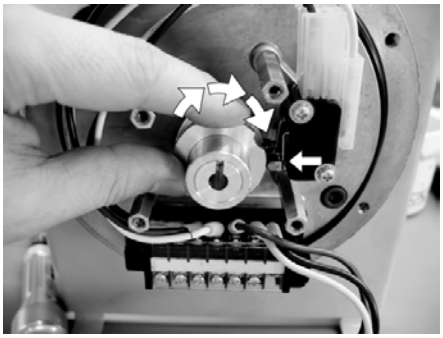
o) Adjust the position of micro switch cam No.2.

Remove the cover and loosen the micro switch cam set screw.

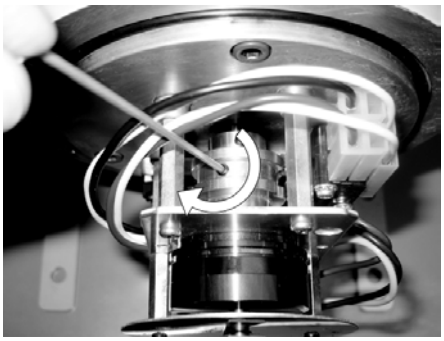


p) Turn counterclockwise until the micro switch lever is raised.

q) Slowly turn clockwise, and stop turning when the micro switch lever is lowered.



r) While holding the micro switch cam stationary, tighten the micro switch cam set screw.



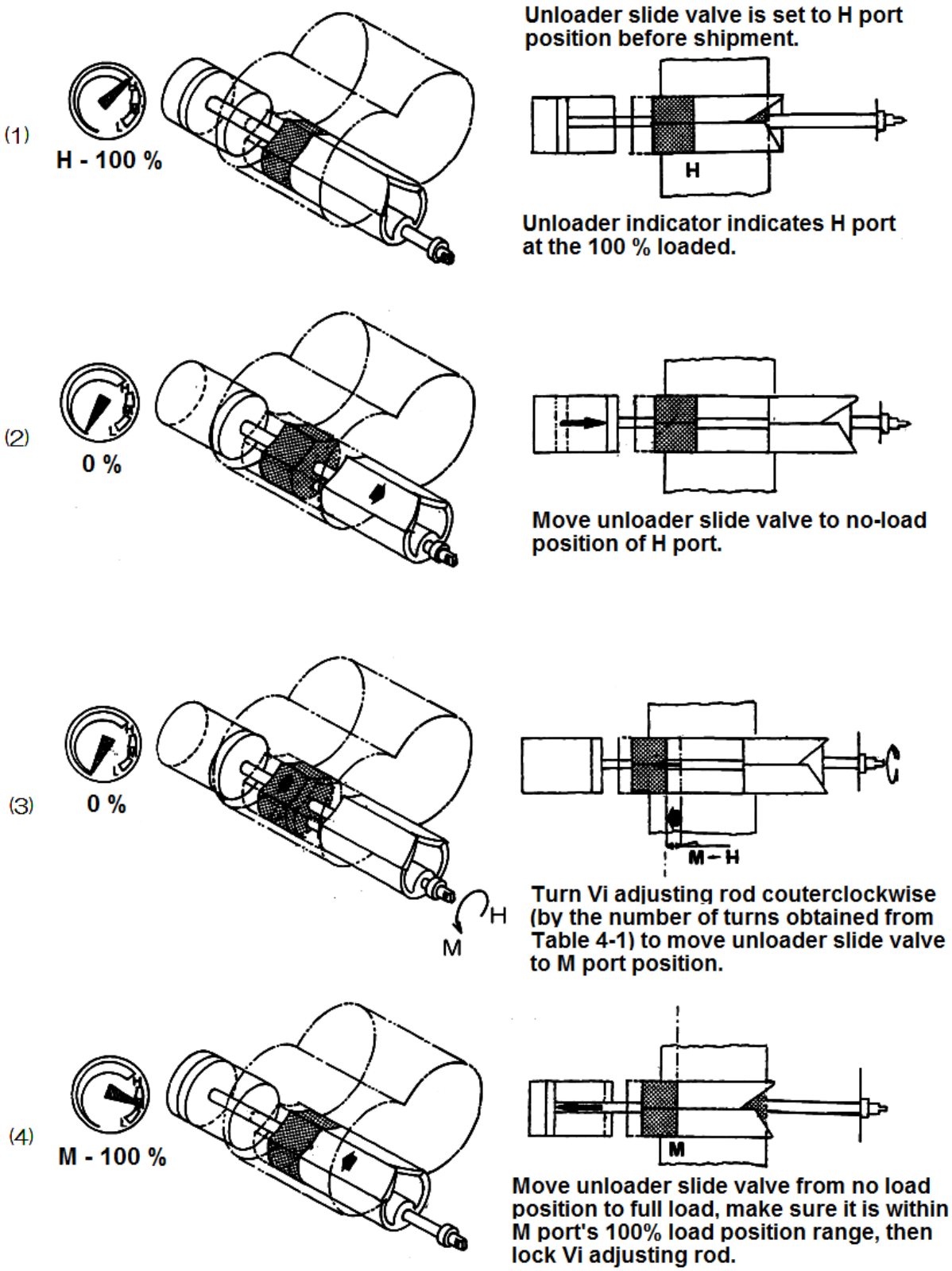


Figure 4-3 Vi Changing Sequence from H port to M port

4.2 Lubricating Oil (Refrigerant Oil)

Selecting and managing lubricating oil (refrigerant oil) is very significant to keep the compressor in a good operating condition.

Take the following notes when selecting and managing lubricating oil.

4.2.1 Precautions for Selecting the Lubricating Oil

- Selection of the lubricating 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 lubricating 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. We therefore recommend contacting our sales offices or service centers for choice of a specified brand for your system.
- Lubricating 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 lubricating 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 compatible), 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 incompatible), the viscosity may become too high when the supply oil temperature is low. For this reason, the lubricating oil must be selected such that it is supplied to the compressor with an appropriate viscosity (kinematic viscosity of 13 - 40 mm^2/s) in the operating state.
- In a refrigeration system using a screw compressor, the lubricating 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 lubricating oil must be thermally stable under high temperatures, be separable from the refrigerant gas, and maintain adequate fluidity under low temperatures.
- Note that some lubricating oils are incompatible with a certain type of refrigerant.
  The caution below is an example case that is required especially attention.

CAUTION
● **Be careful since polyolester synthetic oil (POE) cannot be used with ammonia refrigerant.**

4.2.2 Recommended Lubricating Oils

When selecting lubricating oil, not only compatibility with refrigerant but also effects on O-rings must be considered. To prevent compressor malfunctions, we recommend the lubricating oil described below.

4.2.2.1 Recommended Lubricating oil for Ammonia Refrigerant

■ **Polyalkylene Glycols (PAG) Based Synthetic Oils**

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

■ **Mineral Oils (incompatible oils)**

Brand	Kinematic viscosity (40 °C) mm^2/s	Manufacturer	Type
SUNISO 3GS	30	Sun Oil	Naphthenic base
SUNISO 4GS	55	Sun Oil	
REFOIL NS 3GS	30	JX	
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	

■ **Synthetic Oils (incompatible oils)**

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	Golden West	
GARGOYLE ARCTIC NH68	64	Exxon Mobil	PAO+AB
REFLO SYNTHETIC 68A	62	Petro Canada	
Gargoyle arctic SHC 224[Note]	30	Exxon Mobil	PAO
Gargoyle arctic SHC 226(E)[Note]	68	Exxon Mobil	

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

4.2.2.2 Oils for Systems Using Hydrofluorocarbon (HFC) Refrigerants

■ **Polyolester synthetic oil (POE) for R404A, R507A and R410A: (compatible synthetic oils)**

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

■ **Polyolester Synthetic Oil (POE) for R134a (incompatible synthetic oil)**

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

CAUTION

- **When using lubricating oil of a brand not described in this section, or when using lubricating oil along with refrigerants or gases not described in this Section, please contact us.**

4.2.3 Change of Lubricating Oil Brand

CAUTION

- **The change of lubricating oil brand may cause problems in operating conditions and the compressor. When changing the lubricating oil brand in use, make sure to contact us because appropriate steps must be surely followed.**
- **Package unit composition differs depending on the characteristics of lubricating oil (compatible/incompatible with refrigerant).**
  As a general rule, changing compatible oil to incompatible oil or vice versa is not allowed.

- Lubricating oil contains various additives to fulfill necessary lubricating conditions. Types of additives and their mixing ratio depend on each oil brand. We, therefore, recommend to avoid mixed use of different brands of lubricating oil. If mixed brands of lubricating oil are used, the different additives in the lubricating oil may react with each other and produce foreign substances like slurry.
- If it is necessary to change the brand of lubricating oil, collect as much as oil as possible from the compressor as well as from the condenser, evaporator, and all other refrigerating unit components before charging the new lubricating oil. After 100 to 200 hours of operation, replace the oil again.
- If lubricating oil manufacturers differ, contact both of them and inquire whether the changing is appropriate. The same confirmation is required for changing the brand even if it is of the same manufacturer.
- There is no problem in changing the viscosity level within the same brand. However, make sure that the viscosity grade will not cause problems during operation. (Example : SUNISO 3GS→SUNISO 4GS)

4.2.4 Precautions for Handling lubricating Oil

- When refilling lubricating oil, ensure that it is clean and does not contain foreign matters.
- Be careful that air and water are not mixed in when refilling.
- To ensure that the lubricating oil does not absorb air moisture, keep it indoors in an airtight container until use.

4.2.4.1 Precautions for Handling Polyalkylene Glycol (PAG)

PAG oil is much more hygroscopic than mineral oils and any moisture mixed in the oil may lead to rust, corrosion and wear within the package. When handling PAG oil, pay special attention to the following points.

- Do not perform oil charging in rainy weather or at a place with high humidity to prevent absorbing moisture.
- Before charging, remove as much moisture as possible from the system by exhausting it with a vacuum pump for a sufficient length of time and leaving the system in vacuum condition overnight.
- Do not open the lid of pail (oil container) until just before charging. Once the can is opened, finish the oil charge as quickly as possible. (Finish the charge of a single can of oil within 15 minutes.)
- Cover any gaps between the pail opening and the charge hose so that foreign substances or moisture cannot enter. A more effective way is to substitute any space inside the pail with nitrogen gas .
- Always charge all oil from the pail. Even if some oil remains, do not use it subsequently.
- If any oil drops on a painted surface, wipe it away as soon as possible. Otherwise the paint may come off.

4.2.4.2 Precautions for Handling Polyolester (POE) Oil

This type of oil has high hygroscopicity as polyalkylene glycol, and also exhibits hydrolyzability under high temperature environments. Moisture entry must be avoided. Therefore, special attention must be paid as with PAG when handling POE.

- Finish the charging in as short a time as possible after opening the pail to minimize exposure to air.
- Make sure that all oil in a pail is used in a single charging. Any remaining oil must be stored indoors with the can lid closed tightly. Do not attempt to store it for a long time.
- Because POE can hydrolyze, make sure to perform an oil analysis regularly in the package to see if any abnormal conditions are present.

4.2.5 Lubricating Oil Control Criteria

Lubricating oils that are controlled by the criteria are classified into the following categories:

(1) Synthetic oils: Polyalkylene glycols (PAG)
(2) Mineral oils: Naphthenic base oils and paraffinic base oils
(3) Synthetic oils: Alkylbenzene (AB) and Polyalphaolefine (PAO)
(4) Synthetic oils: Polyolesters (POE)

- **Oil sampling and analysis is recommended every six months.**
- **If the following control criteria are not satisfied, replace the oil.**
  - ◆ Note that the water content of PAG shall be excluded from the above oil replacement criteria. Refer to the Note *1 in the table below.

The analysis items and the criteria are shown in the following tables. Please note that these control criteria may be changed without notice.

Table 4-3 Synthetic Oil (PAG)

Item	Criteria
(a) Color phase	ASTM color scale: 4.0 or less
(b) Total acid number (TAN)	0.1 mg KOH/g or less
(c) Kinematic viscosity	Within ±10 % from that of fresh oil
(d) Water content	2000 mass ppm or less **Note1**
(e) Degree of contamination	Degree of contamination measured by mass method (Millipore value) shall be 15 mg/100 mL or less

Table 4-4 Mineral Oil and Synthetic Oil (AB, PAO)

Item	Criteria
(a) Color phase	ASTM color scale: 6.0 or less
(b) Total acid number (TAN)	0.3 mg KOH/g or less
(c) Kinematic viscosity	Within ±15 % from that of fresh oil
(d) Water content	100 mass ppm or less
(e) Degree of contamination	Degree of contamination measured by mass method (Millipore value) shall be 15 mg/100 mL or less

Table 4-5 Synthetic Oil (POE)

Item	Criteria
(a) Color phase	ASTM color scale: 4.0 or less
(b) Total acid number (TAN)	0.2 mg KOH/g or less
(c) Kinematic viscosity	Within ±10 % from that of fresh oil
(d) Water content	200 mass ppm or less
(e) Degree of contamination	Degree of contamination measured by mass method (Millipore value) shall be 15 mg/100 mL or less

Note 1: Synthetic oils (compatible 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. Thus, use the criterion value only as a reference.

4.2.6 Lubricating Oil Replacement Timing

4.2.6.1 After Starting the Initial Operation

As the oil can easily be contaminated and degraded relatively quickly during the initial operation due to scales and deposits remaining in piping and vessels, be sure to sample and analyze the oil after 500 hours of operation.

If it is found as a result of the analysis that the criteria given in Tables 4-3 to 4-5 are not satisfied, the oil must be replaced.

4.2.6.2 During Normal Operation

Lubricating oils will degrade gradually as the system is operated over time.

The rate of degradation depends on the operating condition, type of oil and amount of foreign matters and moisture contained in the oil. The lubricating oil must be sampled and analyzed every six months. If it is found as a result of the analysis that the control criteria given in Tables 4-3 to 4-5 are not satisfied, the oil must be replaced.

If the oil filters are frequently clogged or the oil color quickly becomes darker and unclear, replace the oil after removing the cause of the problem.

4.3 Precautions for Operation

If the package unit is used in the refrigeration cycle, please keep in mind the contents of this section in particular.

4.3.1 Prevention of Liquid Flow-back Operation

Liquid flow-back is a phenomenon where refrigerant that did not completely evaporate with the gas reaches the compressor. Liquid flow-back may cause insufficient lubrication of the compressor, abnormal vibrations and noises, and abnormal foaming of lubricating oil (too much oil loss).

To prevent liquid flow-back, appropriately adjust the expansion valve to the evaporator and/or liquid cooler. In addition, special attention must be paid to the suction pipe line connection way to the system and means of starting up the compressor after a long time of stoppage.

4.3.2 Purging of Non Condensable Gases

Any non condensable gas in the system may cause the compressor discharge pressure to rise higher than the refrigerant saturation pressure that depends on cooling water temperature of condenser. This is caused by the non condensable gas staying in the condenser which deteriorates the heat exchange performance.

If the vacuum pumping performed upon initial installation or maintenance is insufficient or the suction pressure is lower than the atmospheric pressure to suck air if the suction pipe had a leak, non condensable gases accumulate in the condenser.

When a considerable amount of non condensable gases accumulate in the condenser, the compressor load increases and finally the motor overcurrent alarm may occur.

In such a case, purge any non condensable gas from the condenser.

WARNING

- **Some types of refrigerants may have bad smell, toxicity, and/or flammability. In a airtight space such as a machine room, oxygen shortage may occur due to high concentration of the refrigerant gas. Maintain sufficient ventilation while working.**
- **When handling fluorocarbon refrigerants, remember that they are prohibited from being purged into air by law..**

1. When the compressor is stopped, allow the cooling water to flow to the condenser and check that there is no difference in water temperature between the inlet and outlet. If any difference is present between the inlet and outlet water temperatures, keep the cooling water flowing until the temperature difference is eliminated.
2. Measure the pressure of the condenser and compare it with the refrigerant saturation pressure depending on the cooling water temperature.
3. If the condenser pressure is higher than the refrigerant saturation pressure by 0.05 MPa or more, purge any non condensable gases.

4.4 When Stopping the Compressor for a Long Time

Before stopping the compressor for a long time, make sure to perform the following steps.

- Turn off the motor main power.
- Turn off the oil heater power and the control power.
- Close the suction stop valve and discharge stop valve.
- If an economizer and/or liquid injection is (are) used, close the (each) stop valve(s) located at the compressor inlet.

If the operation stop period is 1 month or longer, perform the following checks every month.

- Operate the oil pump for 10 seconds per week.
  After that, rotate the compressor shaft (10 rotations or more).
- Measure the system pressure once per month.
- Check for refrigerant leak once per month.

When restarting the compressor after an operation stop period of 1 year or longer, check the system for refrigerant leak and analyze the lubricating oil. If it is found as a result of the analysis that the control criteria given in Section 4.3.1 Tables 4-3 to 4-5 are not satisfied, the oil must be replaced.

Also check the motor insulation resistance.

Supply power to the oil heater at least 1 day before operation start. Before starting the operation, confirm that the refrigerant is not condensed in the package by checking the package temperature and pressure.

Chapter 5 Maintenance and Inspection

5.1 Precautions for Maintenance and Inspection

When reading this Section, also refer to Section 1.1 in this manual Chapter 1.

DANGER

- **When entering the machine room for maintenance services, ensure that sufficient ventilation has been started and measure the oxygen concentration so that there is no risk of oxygen deficiency. The ventilation must be continued steadily until the work is completed.**
- **For performing the inspection work, be sure to prepare safety shoes, protective glasses, gas mask and other proper protective equipment and do not fail to use them whenever they are required.**
- **After stopping the machine and before working on a periodic inspection or overhaul, be sure to shut off the main motor power, control power, and other power to each equipment and valve. After they are shut off, be sure to make the switches inoperable by others. Also, be sure to attach notification tags to prohibit operation (lock-out/tag-out).**
- **When any manual stop valve has been closed, be sure to make the valve inoperable by others and put a notification tag to prohibit the operation (tag-out).**
- **When the compressor is to be overhauled, check that the internal pressure of this product is at the atmospheric pressure before starting the work.**
- **When using lifting devices, e.g. a crane, etc. and/or lifting tools, ensure that they can sufficiently withstand the load.**
- **When lifting a heavy load object, do not allow anyone's body to put under it.**
- **The work to turn each power supply ON/OFF or operate a lifting unit must be exclusively performed by qualified personnel.**
- **When using electric tools, ensure that they are properly managed in accordance with each instruction manual. Especially before using and while using, be sure to follow the care instructions on the safety of each instruction manual.**

WARNING

- **Be sure to use only MYCOM genuine parts for replacement. Using parts that are not genuine can cause damage to this product or other devices during operation.**
- **Do not convert or modify this product or its components without prior permission from MAYEKAWA. Otherwise, it can lead to an unexpected accident.**
- **Exercise sufficient care for handling a heavy load, and use such a lifting device as a crane or work with an adequate number of personnel commensurate with the magnitude of the weight. Also, be sure to use stud bolts (safety retention bolts) and other support tools for the work. Neglecting the above warning can lead to low back pain of the worker or injury due to dropping of the parts.**
- **If two or more people are to work together, be sure to clearly define the work procedures to share a common understanding among all workers before performing the work.**
- **Not only the work to turn each power supply ON/OFF or operate a lifting device, but also any type of work requiring qualification must be exclusively performed by qualified personnel.**

CAUTION

- **When checking the operation data of units and executing other daily maintenance services, pay particular attention to avoid touching the area heated to a high temperature causing skin burns or inadvertently moving the handle of a valve leading to an erroneous operation.**
- **In the disassembly/inspection workplace, secure a sufficient space for temporary storage of the removed parts and tools, replacement parts, and for the disassembling work as well as safety passages, and then put up necessary off-limit signs.**
- **In the workplace, secure a sufficient space and refrain from putting tools directly on the floor or from haphazardly laying wires.**
- **Keep the floor clean all the time. Leaving the floor smeared with oil and the like causes it to be slippery and may result in the fall and injury of personnel. Thus, do not leave it but wipe it off right away.**
- **Make sure that the temperature of the high temperature sections such as bearing head and discharge lines has been cooled down to normal ambient temperature, before working on them.**
- **When disassembling and reassembling the compressor, use the specified tools properly. Before starting to use those tools, gain the full understanding of their characteristics and the method for use.**
- **During the maintenance service, keep the tools clean all the time. Using those tools smeared with oil increases the risk of slip and fall, leading to an injury. Also during the service, there is a risk of foreign matters intruding inside the compressor to cause its damage.**
- **Parts are slippery with oil. Fully watch out for the risk of any object falling down. Pay attention to any parts falling down, which could lead to personal injury.**

CAUTION

- **Before disassembly, inspections, and handling of the compressor, sufficiently understand the disassembly and assembly procedures.**
  This manual is not intended to provide complete disassembly and assembly procedures for the compressor. Instead, it describes only the important points in relation to the maintenance service of the compressor.
- **If complete disassembly and assembly of the compressor are required, please contact your nearest sales office or service center of MAYEKAWA.**
- **When removing a part, be careful not to damage it.**
- **Place the removed parts on a clean workbench in an orderly manner.**
- **For cleaning parts, use kerosene and/or machine parts cleaner.**
- **Washed parts shall be dried by compressed air or wiped up using clean cloth. Do not use synthetic textiles or woolen textiles to prevent fibers from attaching the parts.**
- **When separating the assembled compressor casings, sometimes it is difficult to separate them due to the gasket stuck. In such a case, never hammer in a screw driver or flat chisel into the gap. Screw jack bolts using the screw holes to separate the casing each other. When some gap is observed between them, use a scraper to remove one side of the gasket from the surface.**
- **Removed bolts from each part should be classified into each used section to prevent confusion.**

5.2 Maintenance and Inspection List

5.2.1 Daily Management

For the purpose of daily maintenance, check the items listed in Table 5-1 "Daily Inspection Items" and record the results.

These operation data should be recorded in an operating log book on a daily basis. This practice is significantly effective and helpful in finding out any abnormal condition of the compressor and prevents possible compressor failures.

In particular, it is important to confirm the absence of any abnormality between the temperature and pressure correlations related to the refrigerant evaporation and condensation. It is possible to find any abnormal condition in the compressor or the system quickly by monitoring the evaporation and condensation temperature and pressure.

If any compressor/system failure or operating accident occurs, the operating log book will help the cause to be clear and take appropriate measures promptly.

Table 5-1 Daily Inspection Items

Inspection item			Inspection details	Checkpoints and actions
Compressor	Operating hours	hr.	Total operating hours	• Judgment of periodic maintenance timing
	Suction pressure	MPa	Difference from the set value of evaporation temperature equivalent pressure	• Contamination in the evaporator • Temperature, flow rate, etc. of the object to be cooled
	Discharge pressure	MPa	Difference from cooling water temperature equivalent condensing pressure	• Contamination on condenser cooling pipes • Non-condensable gases mixed into the system • Quantity, temperature, etc. of cooling water
	Oil supply pressure	MPa	Difference from discharge pressure	• Whether differential pressure is decreasing • Operation with liquid flow-back • Whether compressor parts are worn
	Oil filter pressure loss	MPa	Pressure difference between oil filter inlet and outlet	• Contamination of the lubricant • Clogged of oil filter
	Suction temperature	°C	Whether within upper and lower limits	• Temperature, flow rate, etc. of the object to be cooled
	Degree of suction superheat	°C	Whether degree of superheat is proper	• Adjust expansion valve • Insufficient refrigerant flow
	Discharge temperature	°C	Whether within upper limit	• Non-condensable gases mixed into the system • Oil supply temperature, insufficient oil supply • Compressor failure
	Oil supply temperature	°C	Whether within upper and lower limits	• Contamination on cooling pipes of oil cooler
	Operation check of Slide valve	%	Whether operation is normal	• Damage to solenoid valve coil • Adjustability of manual control(needle) valve for Solenoid valve assembly
	Leak from mechanical seal	mL/h	Leak per hour	• Damage to mechanical seal assembly
	Noise and vibration	-	Abnormal noise/vibration	• Compressor failure

Table 5-1 Daily Inspection Item (continued)

Inspection item			Inspection details	Checkpoints and actions
Others	Motor current	A	Whether it is higher than the current at test run	• Compressor failure • Motor failure
	Oil level of oil separator	-	Oil level	• Oil loss • Replenish oil
	Fluid level in the receiver	-	Fluid level	• Replenish refrigerant
	Check for refrigerant leak	-	Leak or not	• The machine room and the load side facilities(Cold storage etc)

■ Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.

■ Daily Maintenance Items

1. Lubrication oil level
When the oil level in the oil separator reaches the lower limit, charge lubricant by referring to the instruction manual of the compressor package.

2. Replacing Oil Filter
When the differential pressure between oil filter inlet and outlet is higher than specified by the manufacture, replace the oil filter element. The oil filter differential pressure may increase for a short time during startup.

3. Cleaning of Suction Strainer
After 500h of operation inspect the suction strainer. Also remove the temporary filter(suction cloth bag) if it was supplied with the package.
At the beginning of operation or just after the periodical maintenance, the differential pressure of the suction strainer may increase in a short time. If the differential pressure increases, inspect and clean the suction strainer.

4. Oil Leak from Mechanical Seal
If there is a significant increase of oil leak from the mechanical seal, confirm the rate of the leakage per hour. The table below specifies the allowable leak rate and the upper limit for inspection. If any damage is found in the mechanical seal during inspection, replace the mechanical seal.

Table 5-2 Reference values for Leak Rate from Mechanical Seal

	Model of SCV-series			
	160V**	200V**	250V**	320V*D
Acceptable leakage amount (mL/h)	≤ 3	≤ 3	≤ 3	≤ 6
Inspection is required (mL/h)	≥ 9	≥ 9	≥ 9	≥ 18

Note: The specifications above are just for reference. They are not guaranteed values.

5. Contamination of Condenser and Oil Cooler Tubes.
The degree of clogging and contamination of the cooling tubes is mostly affected by the cooling water quality. If the oil temperature and discharge pressure increase gradually in an initial period of operation, inspect and clean the cooling water side of the oil cooler and condenser even when the inspection time has not come.

5.2.2 Periodic Inspection

Inspect the following points at specified intervals.

Table 5-3 Periodic Inspection Items

Item	Inspection interval	Remarks
Pressure sensors	Annually	
Temperature sensors	Annually	
Protection devices and safety valves	Annually	
Suction strainer	Inspection after the first 500h of operation	If the differential pressure between the front and back of the suction strainer increses, inspect and clean the suction strainer
	Inspect and clean annually	
Lubricant	Replace after the first 500h of operation	If the analysis results do not satisfy the management criteria provided in" 4.2.5 Mngement of Lubricant, in this manual, replace oil.
	Analyze lubricant at intervals of 6 months	
Oil filter	Replace annually	Replace the filter element if the pressure difference between the inlet and outlet ports of the oil filter exceeds 0.1 MPa.
Cooling water side of oil cooler	Annually	Clean the oil cooler if it is confirmed that it is heavily contaminated.
Cooling water side of condenser	Annually	Clean the oil cooler if it is confirmed that it is heavily contaminated.
Mechanical seal	Annually or every 8,000 operating hours *	To be replaced if any abnormality is found. However, in the case that it is difficult to stop the operation not at regular inspection replace the mechanical seal assembly at every inspection.
Coupling	Annually or every 8,000 operating hours *	

Note*: Inspect the machine per period or operating hours, whichever comes first.

5.2.3 Guidelines for Compressor Overhaul Frequency

When servicing or overhauling the compressor, follow the instructions and guidelines described below. The compressor inspection frequency significantly differs depending on the operating conditions, refrigerant in use, type and condition of lubricant, and the system in which the compressor is operated. The table below indicates the overhaul frequency recommended by MYCOM based on the operating conditions of the compressor.

Table 5-4 Standard Package Operaion Conditions and Overhaul Frequency Guidelines

Conditions of use	Example application	Guideline for the overhaul timing
Relatively stable operating conditions	Cold storage and refrigeraion	Every 5 years or 40,000 operating hours
Relatively changing operating condition	Ice maker/Chiller	Every 4 years or 30,000 operating hours
Frequent started/stoped, and relatively changing operating conditions	Heat pump	Every 3 years or 20,000 operating hours

Note 1: The above guidelines are only applicable when the compressor is operated within the operation limits which are specified separately. (See Chapter 2, Section 2.3.2 "Operation Limits" in this manual.)

Note 2: The above guidelines are only applicable when the compressor undergoes daily and periodical inspections specified separately. (See 5.2.1 "Daily Management" in this manual.)

Note 3: Inspect the compressor at the intervals ofspecified period or operating hours, whichever comes first.

Note 4: The above guidelines do not constitute any warranty.

5.3 Compressor Disassembly Preparation

Although screw compressors are very reliable machines, it is still necessary to perform overhaul to inspect internal parts after a certain period of operation.

This chapter 5 explains the essential points of disassembly methods, where to inspect on parts, and reassembly procedure.

In principle, compressor overhaul that require complete disassembly should be performed in the maintenance factory. If you must do the overhaul work at the installation site due to unavoidable reasons, use the methods described in the following paragraphs.

However, please note that regular overhaul work requires removal of the compressor from the base frame. And then, the compressor should be placed on a work bench which has properly size area to disassembling the compressor.

When moving the compressor from the unit base to the workbench, be sure to follow the instructions given in Chapter 3, Section 3.1 "General Installation Precautions" and Section 3.2.3 "Transportation" of this manual.

Carefully read this manual and fully understand the details before starting to work.

Note that some parts name given in the text of this manual is followed by a number enclosed in square brackets [ ], which indicates the part identification number given in assembly sectional views or parts configuration table.

5.3.1 Tools for Disassembly and Workplace

Prepare all the required tools as mentioned in “ 7.6 Tools for Disassembly" in this manual Chapter 7.

It is also recommended to prepare general hand tools, green silicon carbide grinding stone, emery paper (#80 - #100), empty paper (#400 to #800) parts cleaning oil, lubrication oil, a lubricator, an oil can for oil sump, waste cloth and so on

When removing the compressor from the installation flame for an overhaul, foresee enough space on the workbench to perform the task.

To safely reach the bolts and plugs used on the lower side of the compressor, place the compressor on an additional frame. Consult article 5.3.5 in this chapter for more information.

Perform the work in a dry place with as little sand, dust or any other contamination as possible.

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5.3.2 Replacement Parts

Prepare the MYCOM genuine parts for replacement.

Parts listed in Table 5-5, we recommend to be replaced on the occasion of each compressor overhaul.

For each part size and code No. of each compressor model, refer to Section 7.2 "Parts Configuration Table" in this manual Chapter 7.

When ordering parts, be sure to inform the (a) model name, (b) serial number, (c) part name, (d) code No. and (e) quantity required, to our sales offices or service centers.

In particular, if the serial number (b) is unknown, the details of the applicable design and manufacturing specifications cannot be identified, and thus it becomes difficult to choose correct parts.

Table 5-5 Replacement Parts of SCV-series Compressor Overhauling

P/N	Part Name	Remarks	Q'ty.			
			160	200	250	320
6	Gasket, Suction Cover		1	1	1	1
9	O-ring, Suction Cover		1	1	1	1
12	Gasket, Bearing Head		1	1	1	1
23	Gasket, Balance Piston Cover		1	1	1	1
27	Main Bearing	with O-ring	2	2	2	2
28	Side Bearing	with O-ring	2	2	2	2
30	Balance Piston	To be replaced if any abnormality is found.	1	1	1	1
33	Balance Piston Sleeve		1	1	1	1
35	O-ring, Balance Piston Sleeve		1	1	1	1
38	Thrust Bearing		2	2	2	2
39	Lock Nut	To be replaced if any abnormality is found.	2	2	2	2
40	Lock Washer		2	2	2	2
49	O-ring, Oil Seal Retainer		1	1	1	1
50	Oil Seal		1	1	1	1
52	Gasket, Seal Cover		1	1	1	1
63	O-ring, Unloader Cylinder		1	1	1	1
65	O-ring, Unloader Piston		1	1	1	1
66	Cap Seal		1	1	1	1
68	Guide Pin (Grooved Pin)	To be replaced if any abnormality is found.	1	1	1	1
69	Lock Nut, Unloader Piston	To be replaced if any abnormality is found.	1	1	1	1
70	Lock Washer, Unloader Piston		1	1	1	1
73	O-ring, Unloader Push Rod		1	1	1	1
75	O-ring, Unloader Cover		1	1	1	1
78	Ball Bearing, Unloader Cylinder Cam	#6000	1	1	1	1
79	Snap ring C type External S10	.	1	1	1	1
82	V-ring, Unloader Cylinder Cam	VH10 NBR	1	1	1	1
93	Gasket, Suction Flange		1	1	1	1
96	Gasket, Discharge Flange (1)	It is not necessary for CD flange of sideways discharge type.	1	1	1	1
100	Mechanical Seal Assembly	BBS-E as standard	1	1	1	1
125	Micro Switch	To be replaced if any abnormality is found.	2	2	2	2
129	Potentiometer	To be replaced if any	1	1	1	1

P/N	Part Name	Remarks	Q'ty.			
			160	200	250	320
		abnormality is found.				
150	O-ring, Thrust Bearing Gland 320	for 320V*D	-	-	-	2
216	Gasket, Lubricating Oil Inlet Flange	Journal inlet	-	1	1	1
219	Gasket, Oil Injection Inlet Flange	for 320V*D	-	-	-	1
236	Gasket, Discharge Flange Spacer	for Sideways discharge type	1	1	1	1
237	Torsional Slip Washer		2	2	2	2
255	Gasket, Liquid Injection Inlet Flange		1	1	1	1
325	O-ring, Unloader Push Rod	JIS B 2401 P46	2	2	2	-
421	O-ring, Unloader Spacer	for only VS* type	2	2	2	-
421	O-ring, Unloader Spacer	for 320V*D	-	-	-	2
432	O-ring, Main Bearing		4	4	4	4
433	O-ring, Side Bearing		4	4	4	4
448	Teflon Bushing	To be replaced if any abnormality is found.	1	1	1	1
449	Thrust Washer	To be replaced if any abnormality is found.	1	1	1	1
450	O-ring, Bearing Cover		2	2	2	2
451	O-ring, Vi Adjusting Rod		1	1	1	1
523	O-ring, Vi Adjusting Rod (in Slide Valve)		1	1	1	1
701	Backup Ring		1	1	1	1

【POINT】

In case of replacing the main bearings [27] and side bearings [28], it is not necessary to prepare the O-rings [432] and [433] because the main/side bearings have the O-rings.

5.3.3 Refrigerant Gas Recovery

At the time the compressor operation is stopped, the pressure inside the compressor is still high. As such, it is necessary to drop the pressure down to the atmospheric pressure before starting the disassembly process. To do this, there are the following methods for example. Perform your recovery work in an appropriate manner considering site conditions, requirements of regulatory laws and regulations.

- Use the bypass valve to release the high pressure gas in the unit into the low pressure side.
- If there is an adjacent compressor to which a bypass line is connected from this compressor, run the adjacent compressor to drop the internal pressure of this compressor through the bypass line.
- Operate the refrigerating system and close the supply source valve to turn the gas into liquid, and recover the liquid at the receiver.
- Use a refrigerant recovery machine to recover the liquid at the receiver.

In using either method, prepare a working flow sheet of the system beforehand. Check the valves to be controlled during the recovery work, according to the method to be used, by comparing them with the ones in the flow sheet, and clearly note the valves to be operated, other connected devices, and tubes on the flow sheet.

Two flow sheets must be prepared: one at the foreman and the other for posting in the workplace.

In addition, prepare a work procedure document for the refrigerant recovery work to reflect the actual conditions of the workplace, and sufficiently share the work details among all the coworkers through checking and confirmation before actually starting the work.

WARNING

- **Before the work, be sure to check and communicate the work details and procedure among all coworkers, and carry out hazard prediction activities based on the information shared. Neglecting to do this will increase the risk of on-the-job accidents and injuries to a considerable level.**
- **All the valves that have been opened or closed during the work must be prevented from accidental operation through proper lock-out and tag-out procedures.**

5.3.4 Removal of Connections to the Unit

DANGER

- **If high-pressure refrigerant gas or refrigerant-mixed lubricating oil remains inside the compressor, a gas and oil under pressure will gush out as soon as a sealed part is opened and cause injury to the operator such as frostbite or loss of eyesight. Be sure the check that there is no residual pressure before disconnecting any pipe joint.**
- **Before opening the sealed part, make sure to reconfirm that ventilation of the workplace is appropriate.**
- **Wear the appropriate preventive gear before opening the sealed part.**

【POINT】

When oil lines are removed from the compressor, any residual oil in the pipe can flow out. To be prepared for this, either check the amount of oil outflow by slightly loosening the pipe joint or drain the oil from the oil temperature gauge at the oil supply header before removing the pipe.

As the unloader cylinder is filled with oil, have an oil pan ready to catch the oil when the pipe is disconnected. An empty 18-liter can for lubricating oil is suitable as the oil pan.

For easy reconnection, disconnected electric wires should be properly marked for identification. Any wrong reconnection may result in a startup failure or inability to operate the capacity control mechanism.

When removing the compressor from the mounting base frame, the following parts must be disconnected beforehand in numeric order of Figure 5-1:

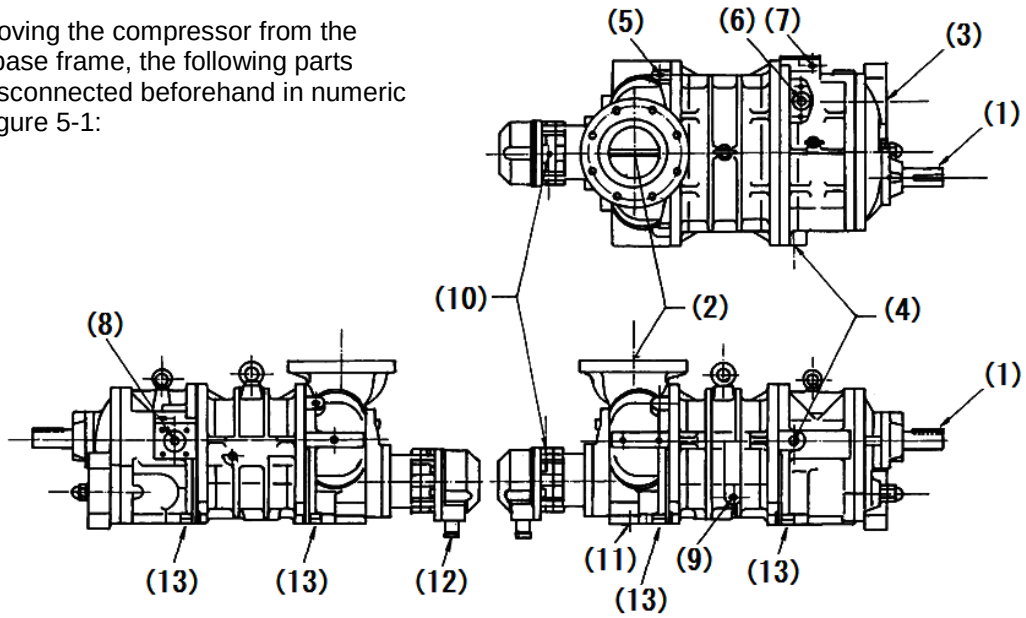


Figure 5-1 Disconnecting Parts

(1) Coupling to connect the compressor to the driving machine;

(2) Suction piping of the compressor.
If the suction strainer is directly connected to the compressor, also remove the strainer;

(3) Discharge piping of the compressor;

(4) Oil supply piping to the compressor (Journal oil inlet port);

(5) Oil supply piping to the side bearing of compressor F rotor side;

(6) Liquid injection (Aquamizer) 1 piping to the compressor;

(7) Liquid injection (Aquamizer) 2 piping to the compressor;

(8) Economizer (Electromizer) piping to the compressor

(9) Oil injection piping to the compressor

(10) Oil piping connection 2 for the capacity control (unload)

(11) Oil piping connection 1 for the capacity control (load)

(12) Electric wiring for capacity control operation (In some cases, the unloader indicator assembly may be removed without removing the wiring. Refer to Section 5.5.1.1 in this chapter.);

(13) Compressor mounting bolts (foot bolts); and

After performing work of (1) to (13), the openings of the flanges and screwed connections on the compressor should be prevented from entering foreign matters inside the compressor, by using cover flanges and plugs.

5.3.5 Removal of the Compressor from Base Frame

WARNING

- **The work to lift up or move the compressor must be performed by a qualified operator. If the work is done by an unqualified operator, it may result in a dropping accident.**
- **Never try to perform disassembly or assembly while the compressor is lifted in the air. The main body or some part of the compressor can drop down on people below.**

【POINT】

As the suction piping is located immediately above the compressor, lift up or partially remove the piping such that it will not interfere with the lifting device.
After lifting up the compressor, place it on a special stand to remove hexagon head cap screws around the bottom flange part. Instead of using the special stand, you can use the temporally stand which has same height as the workbench, i.e., place the leg part of the suction cover on the workbench and place the leg part of bearing head on the temporally stand as shown in Figure 5-2.

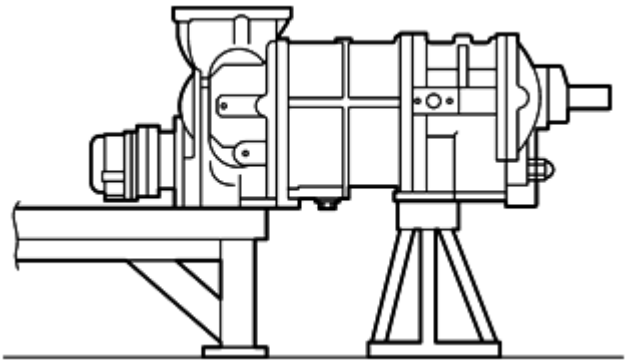


Figure 5-2 In case of using temporary stand

a) Place the compressor on the special stand or use a temporary stand as shown in Figure 5-2.
Then remove 6 to 8 hexagon head cap screws around the bottom flange part tightened rotor casing [1] to suction cover [5] / bearing head [11].
Note: After placing the compressor on the workbench, it is impossible to remove these lower bolts.

b) Remove the compressor onto the workbench. How to place the compressor on the workbench varies according to the compressor models described below;
In case of a V*G type which has 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.
In case of a V*D type 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 part outside of the workbench edge (see Figure 5-3 in next page).

Alternatively, place wooden blocks 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 as shown in below picture to the right.

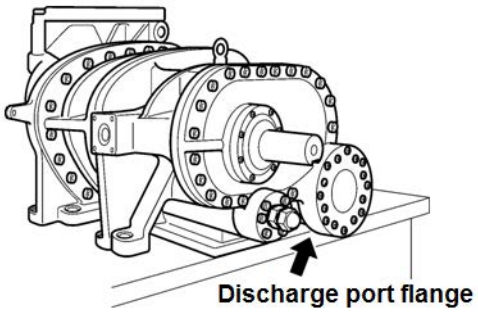
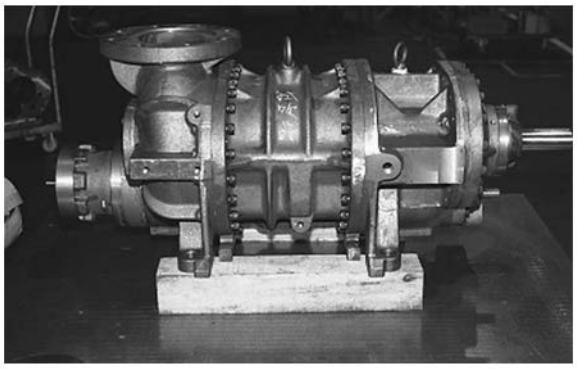


Figure 5-3



5.3.6 Compressor Disassembly Order

The disassembly order of the SCV-series compressor is general as described below.

Generally SCV-series compressors are disassembled in the order described below. But this order is just an example and the actual order may differ according to individual situations.

Depending on the situation, please complete the work in a safe and appropriate procedure.

a) Unloader indicator block
   (n some cases, the unloader indicator assembly may be removed without removing the wiring.)
b) Mechanical seal block
c) Unloader cover block
d) Unloader cylinder and Balance piston cover
e) Balance piston block
f) Bearing cover
g) Suction cover and Side bearings
h) Thrust bearing block
i) Rotor and Main rotor casing
j) Variable Vi auxiliary slide valve
k) Bearing head and Main bearing

5.4 Disassembly and Inspection

5.4.1 Unloader Indicator Block

The SCV-series unloader indicator has been changed to the new type indicator (right picture) with the protection grade IP66 by improving the performance of the dust and water proof from December 2014 Moriya factory production.

This new indicator IND-052WP and IND-062WP are nearly same to the traditional indicator in the following items: outer dimensions, mounting method to the compressor, signal output of the loaded capacity 0 % to 100 % by using a potentiometer, and contact output function by using micro-switches.

Major changes (improvements) are described in Table 5-6.

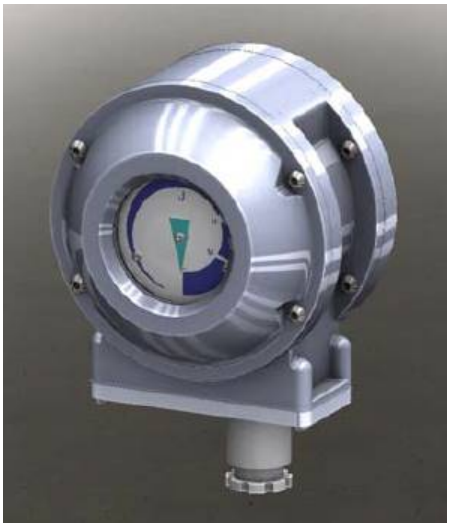


Table 5-6 Difference of Unloader Indicator between old type and new type

Item	Traditional type	New type
Dust and water proof	Equivalent to protection grade IP20	Protection grade IP66
Quantity of housing parts	2	4
Potentiometer	Wire wound type	Conductive plastic
Micro-switch	Wiring is screwed.	Wiring is connected with connector
Terminal block	6P terminals	7P terminals

For more details of the new type indicator IND-052WP, refer to the another dedicated instruction manual.
The traditional type indicator is described as the target.

5.4.1.1 Disassembly

■ **In the Case of Removing the Wiring only**

When removing the wiring of the unloader indicator upon removing the compressor, it is necessary to remove the cover as the indicator has a terminal block for the wiring. Perform the work according to the following procedure, and after removing the wires, attach the cover to them for protection.

a) By removing the three hexagon socket head cap screws [147] that are used to fasten the indicator cover [146], the cover can be removed.
b) The indicator cover will be removed with the glass [141] and spacer [142] attached. While the glass and spacer are glued, be careful not to drop these as they may be separated from the cover.
c) Remove the wiring. Be careful not to lose the phillips screws [133] of the terminal block [132].

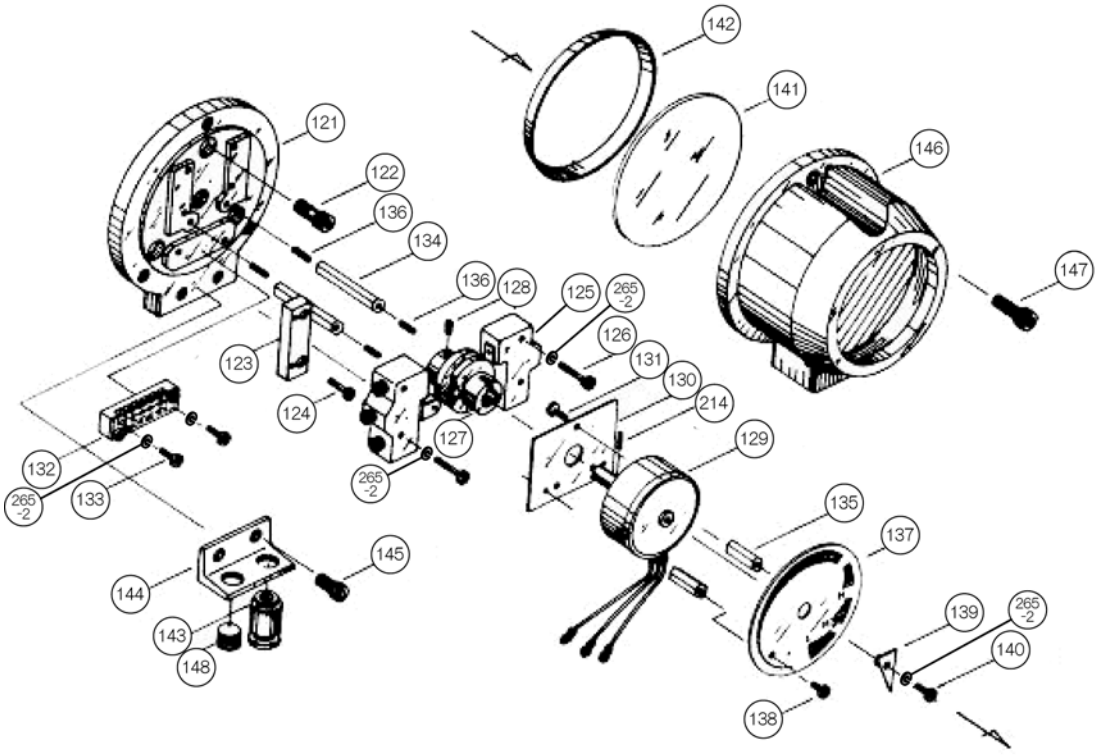


Figure 5-4 Traditional Standard type Unloader Indicator Assembly

Removal of the Indicator Cover

■ **For Further Disassembly (In the case of Removing as Unloader Indicator Assembly)**

As the indicator is an assembly to be removed as a whole, no further disassembly should be made unless the purpose of the disassembly is to disassemble this part.

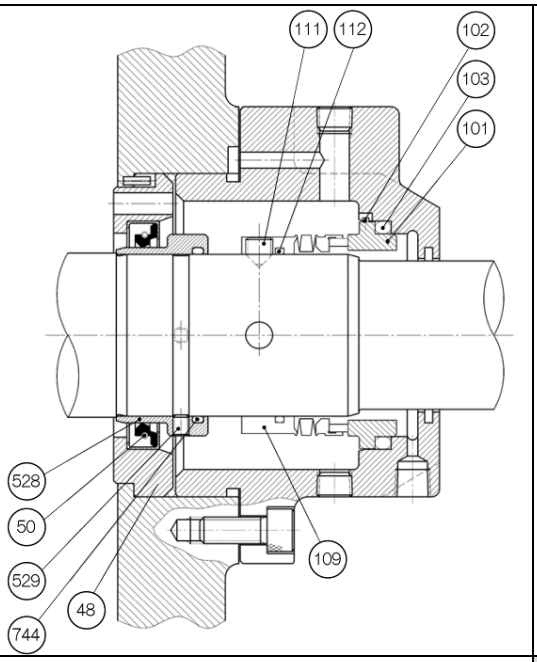
a) As a result of the previous disassembly process, the micro switch base plate [121], which is mounting the potentiometer [129], micro switches [125], and micro switch cam [127], can be removed.
b) Unscrew and remove three hexagon socket head cap screws [122].
c) Loosen the set screw [128] of the micro switch cam.
d) After that, the assembly can be removed by pulling it in the axial direction.

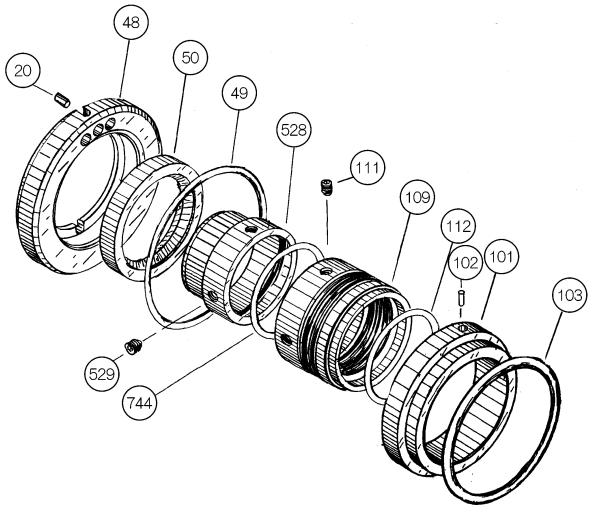
Loosen the Set Screw of the Micro Switch Cam

5.4.1.2 Inspection

The inspection procedure is described in the "Reassembly" section of this chapter, as it is often the case that the unloader indicator block is removed as an assembly and later inspected and adjusted after the overhauled compressor is reassembled and installed on the mounting base. Refer to Section 5.5.12 "Unloader Indicator" for details.

5.4.2 Shaft Seal Block





Mechanical Seal assembly

P/N		Part Name	
101	100	Mating ring	Stationary rings
102		Insert lock pin	
103		O-ring	
109		Seal collar	Rotating rings
111		Seal collar set screw	
112		O-ring	
528 **Note**		Oil seal sleeve	
529 **Note**		Set screw for oil seal sleeve	
744 **Note**		O-ring	
48		Retainer, oil seal	
49		O-ring	
50		Oil seal	
20		Spring pin	

Note: [528], [529], [744] are not used to 160V** models.

Figure 5-5 Details of BBSE-type Mechanical Seal Assembly and Related Parts

5.4.2.1 Disassembly

a) Of the eight hexagon socket head cap screws [53] securing the seal cover [51], remove six bolts leaving two diagonally opposite bolts.

b) Loosen the remaining two screws alternately and evenly, a little at a time. When the screws are loosened to some extent, the seal cover will be pushed by the spring force of the seal to create 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 M8 eye bolts into the jacking screw threads on the seal cover to separate it.

c) As the oil inside will flow out through the gap, be ready to receive the oil with a container.

d) Pull out the seal cover in the direction of the rotor shaft axis. Inside the cover, there is the mating ring fitted with the O-ring. In this, carefully remove the seal cover for the mating ring not to be damaged by touching the shaft.

e) Remove the O-ring [49] between the seal cover and oil seal retainer [48].

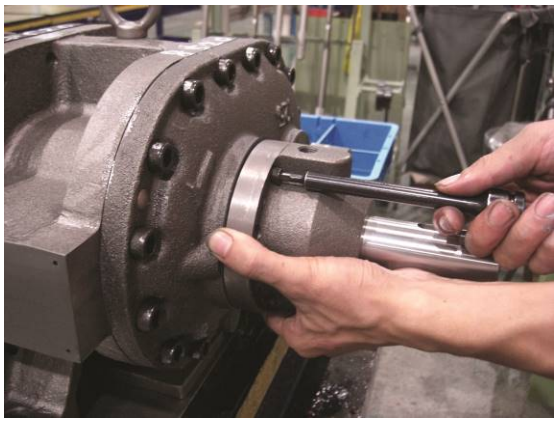
f) After the seal cover has been removed, wipe clean the shaft and then check its surface. If any flaw is found, use a fine sandpaper to smoothen the surface. This correction is intended to prevent possible damage of the internal O-ring when the mechanical seal is pulled out.

g) Loosen the set screws [111] securing the seal collar [109] about three turns. Do not remove the set screws completely. Loosen them such that their ends are retracted from the surface of the seal collar. These two screws are located 90° apart from each other.

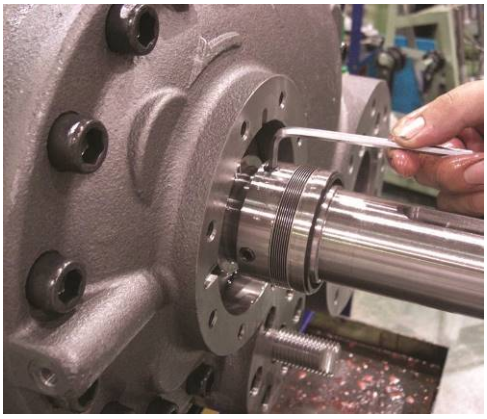
h) Pull out the mechanical seal assembly by holding the seal collar with your fingertips. While removing the assembly, make sure that the ends of the set screws do not touch the shaft surface. Any scratch on the shaft will cause leakage.

i) Pull out the oil seal sleeve [528] after removing the two set screws [744] (except for 160V* type).

j) Screw two M8 eye bolts into the jacking screw holes in the seal retainer and pull out the seal retainer while keeping it in the right angle with the shaft.



Removing the seal cover



Loosen the set screw of the seal collar

5.4.2.2 Inspection

a) Although it is instructed that the mechanical seal must be replaced after abnormality is found in the inspection, only visually checking the sliding surface may be insufficient in determining any abnormality. It is thus recommended to always replace it with a new one, similarly to the case of O-rings and gaskets, if the inspection is done in such a way.
However, even if the assembly is to be replaced without exception, it is still necessary to visually check the condition of the sliding surface between the mating ring and the seal collar. If any unevenness or flaw is observed on the sliding surface, analyze the condition to determine whether it is due to aging, overheating, or other reasons in order to take necessary corrective actions.

b) Replace the O-rings every time the mechanical seal assembly is inspected because they normally swell and deform over time.

c) Check the wear of the oil seal sleeve in the area it rubs against the oil seal lip.
If wear is evident, replace both the oil seal [50] and oil seal sleeve [528] with new parts. Since the oil seal is made of a special material, only genuine oil seals must be used for the replacement.

Information on the O-ring [744] for the oil seal sleeve

A design change was made in March 2010 to insert an O-ring in the oil seal sleeve [528].

5.4.3 Unloader Cover

The unloader cover [74] is mounted with the indicator cam [77] which converts the linear motion of the unloader slide valve to a rotational motion, and their mounting parts.

The indicator cam is supported by the ball bearing [78] and fixed to the cover with a bearing gland [80].

To make it airtight, the V-ring [82], spring [83], and spring retainer [84] are also attached.

The indicator cam has a spiral groove of 340° to cover the moving range of the unloader slide valve. The indicator cam shaft is rotated being pushed by the guide pin [68] on the top end of the unloader push rod [67].

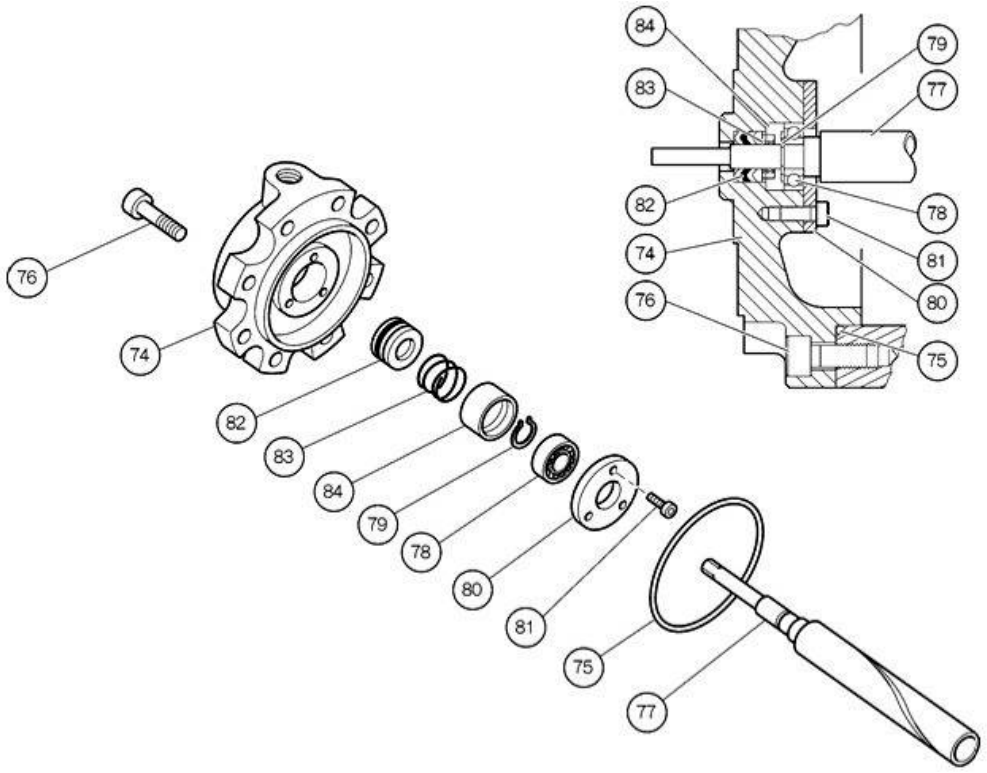


Figure 5-6 Unloader Cover Block

5.4.3.1 Disassembly

a) Unscrew and remove the unloader cover mounting hexagon socket head cap screws [76].

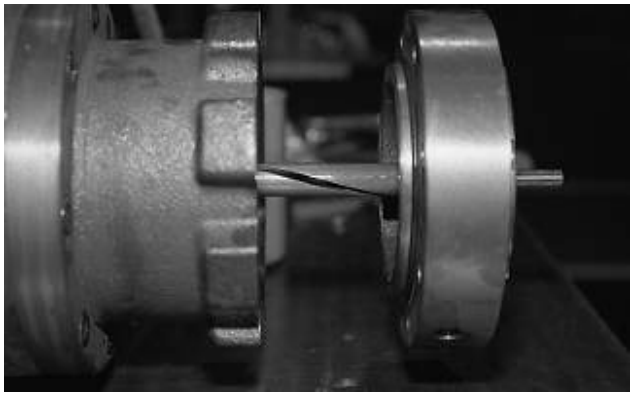
b) Pull the cover out in the direction parallel to the axis of the push rod in the unloader cylinder. Carefully pull it straight, because if the unloader cover is pulled sideways, the shaft of the indicator cam may be bent.

c) If the indicator cam will not move normally, check the groove of the indicator cam, bearing, and guide pin. The disassembly sequence is as follows:

   c-1) As the bearing gland [80], which fixes the indicator cam in place, is secured by three hexagon socket head cap screws [81] on the cylinder side of the unloader cover, unscrew and remove these bolts.

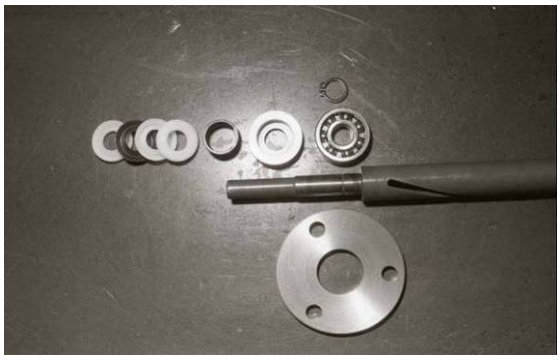
   c-2) Then, the indicator cam can be pulled out with the ball bearing [78] and the snap ring (retaining ring) [79] attached to the shaft.

   c-3) Inside the unloader cover, the spring retainer [84], spring [83], and then V-ring [82] are assembled in this order. Because the V-ring is tightly engaged with the bore of the unloader cover, the lip of the V-ring will be damaged when it is once removed, making it unusable again. Therefore, be sure to replace it with a new one once it is disassembled.



Removing the Unloader Cover

Ball Bearing for the Indicator Cam



Indicator Cam Mounting Parts

V-ring (The black part is NBR/FKM)

5.4.3.2 Inspection

a) Check the packing of the indicator cam shaft for any flaw. If the refrigerant leaks without any flaw observed in this part, it should be due to a defect of the V-ring or installing the V-ring without sufficient oil.

   In this case, replace the V-ring.

b) Check the spiral groove of the indicator cam. If an abnormal flaw or wear is observed, replace it with a new one.

5.4.4 Unloader Cylinder and Balance Piston Cover

Inside the unloader cylinder [60] is an unloader piston [64] around which the cap seal [66] and O-ring [65] are fitted. The unloader piston is assembled to the unloader push rod [67], which operates the unloader slide valve, with the lock nut [69].
Unloader cylinder is secured to the balance piston cover [22] with two short hexagon head cap screws 61] and to the suction cover with six log hexagon head cap screws [62].

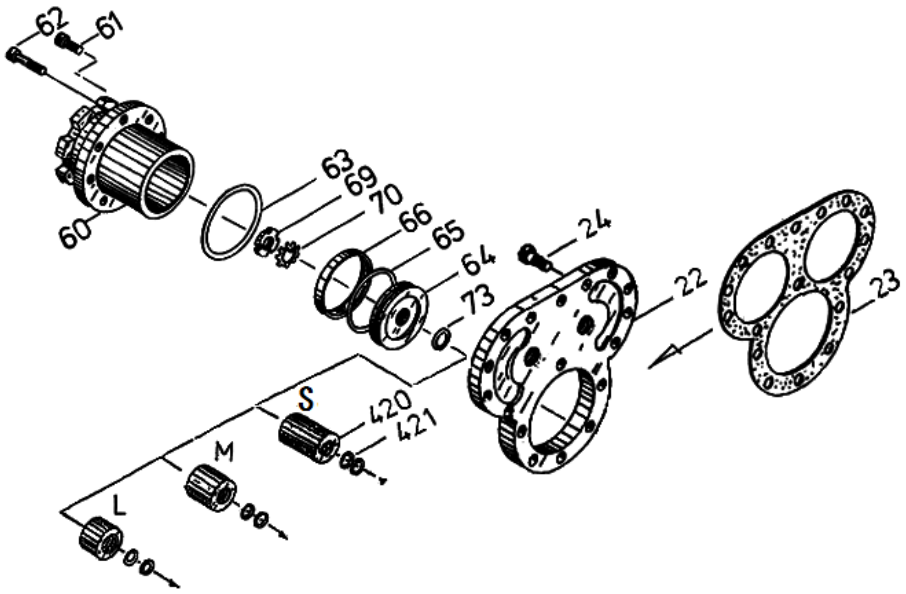


Figure 5-7 Unloader Cylinder Block and Balance Piston Cover (Example: 320V*D)

5.4.4.1 Disassembly

a) Remove the cap nut [522] on the bearing head side of the Vi adjusting rod [444], loosen the hexagon nut [453], and set the variable Vi auxiliary slide valve to the L 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 [64] to move the piston toward the indicator to the full-load position.

c) Unbend the claws of the lock washer [70] on the lock nut [69] that is securing the piston to the push rod [67].

d) Loosen the lock nut using the lock nut wrench. Remove the unloader piston from the push rod using the eye bolts again.

e) Remove the balance piston cover [22] fastening bolts (hexagon head cap screws) [24] and the hexagon head cap screws [62] fastening the unloader cylinder [60] to suction cover.

   After that, pull out the unloader cylinder with balance piston cover.

   At this time, as oil remains in the balance piston and side bearing block, be careful of the oil that will flow out when the balance piston cover is removed.

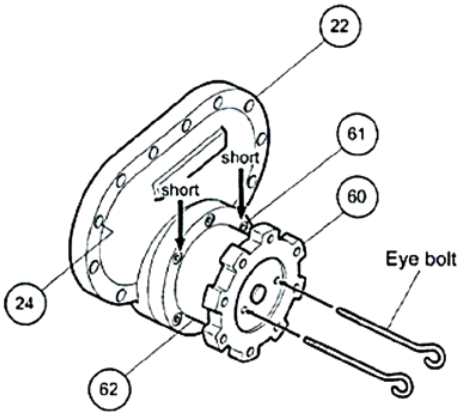


Figure 5-8 Removing the Unloader Piston

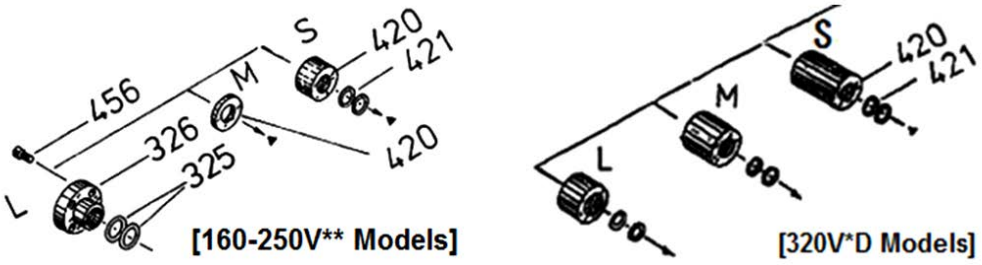
f) Screw in two M8 eye bolts to the two jacking bolt threads on the balance piston cover, and separate the balance piston cover with unloader cylinder from the suction cover.

g) Remove two fastening bolts [61], and separate the unloader cylinder and balance piston cover.

h) In case of SCV-series 320 models, i.e., VL* type, VM* type and VS* type are installed the unloader piston spacer [420] with two O-rings [421].

In case of 160 to 250V**, VM* type is installed the unloader piston spacer [420] without O-ring [421], VS* type is installed unloader piston spacer with two O-rings [421].

If your compressor is applicable above description, remove each part at this point.



, Figure 5-9 Unloader Piston Spacer and O-rings

5.4.4.2 Inspection

a) Both the O-ring [65] and cap seal [66] that are on the periphery of the unloader piston [64] must be replaced by new ones.

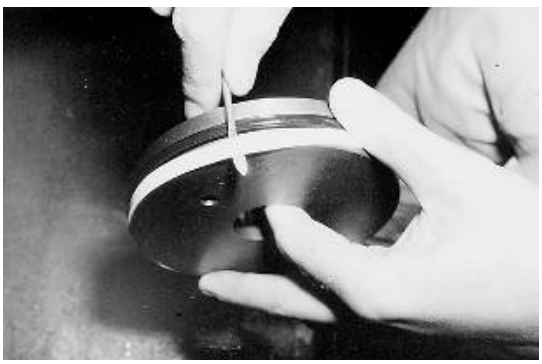
b) As it is often seen that the inside of the unloader cylinder has flaws or is contaminated by oil residue, thoroughly clean the area and use fine sandpapers to finish the surface.

c) Inspect the guide pin [68] on the tip of unloader push rod and replace it with a new one if scratches and/or wear are found.

d) Replace the O-rings [421] for unloader piston spacer, [73] at the tip of unloader push rod, [63] at the connection between the balance piston cover and unloader cylinder.

Also, replace the lock washer [70] for fastening the unloader piston to unloader push rod and the balance piston cover gasket [23].

e) When large deformation is found in the lock nut [69] grooves which may be hit by a lock nut wrench, replace the lock nut with a new one.



Removing the Cap Seal

O-ring [63] at the tip of Unloader Push Rod

5.4.5 Balance Piston Block

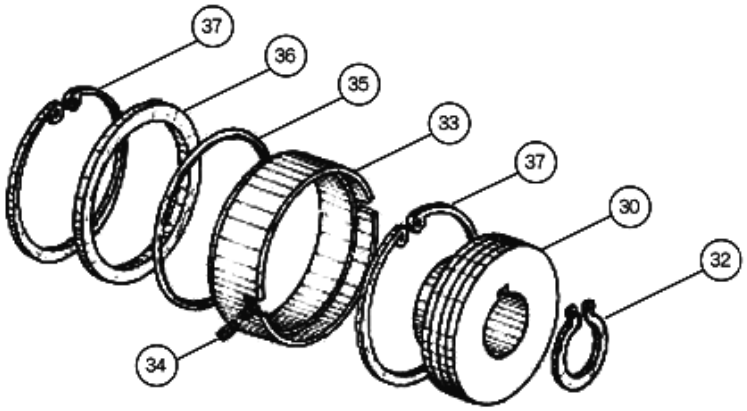


Figure 5-10 Exploded View of Balance Piston Block

5.4.5.1 Disassembly

a) Remove the snap ring [32] that secures the balance piston [30] on the M rotor shaft using external snap ring pliers.

b) Screw in two M8 eye bolts to the hole in the balance piston and pull out the piston in parallel with the axis of the shaft (see right picture). It is not necessary to remove the balance piston key [31] embedded in the rotor axis.

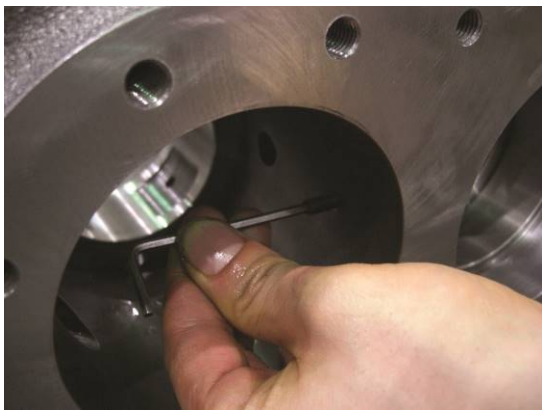
c) The balance piston sleeve is locked by either of the following methods:

Type 1 (following picture to the left) for 160 to 250V** models:

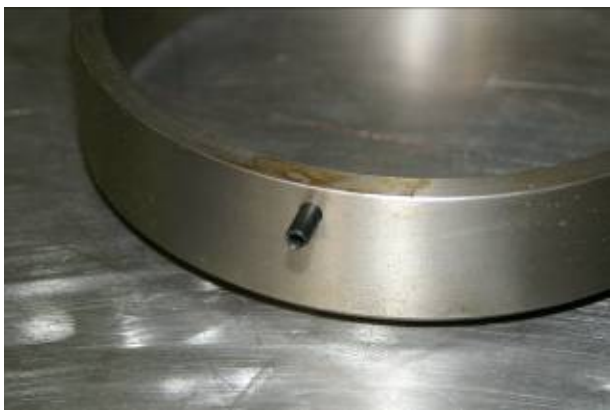
Locked by a screw at the notch in the balance piston sleeve

Type 2 (following picture to the right) for 320V*D models:

Locked by a spring pin by driving the pin into the sleeve and fitting it into the suction cover groove



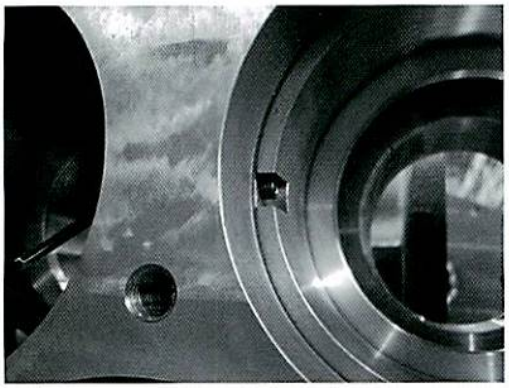
Type 1: Locked by a Screw



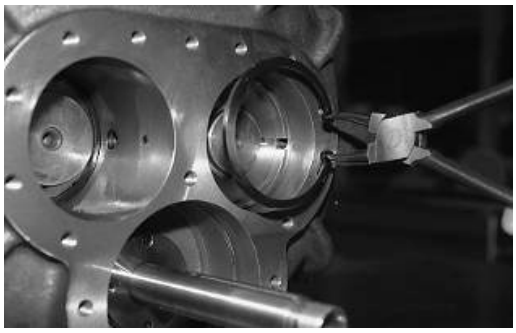
Type 2: Locked by a Spring Pin

With the balance piston sleeve [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 (M rotor side) and the other from the opposing side (F rotor side).
To undo the lock of the sleeve, either remove the M rotor side screw or loosen the F rotor side screw and screw in the M rotor side screw.

With the balance piston sleeve locked by the Type 2 method, simply remove the stop ring of the sleeve to undo its locking.



d) Remove the snap ring [37] that secures the balance piston sleeve by using internal snap ring pliers.
Since the snap ring is pushed out by the inner O-ring [35], it can be removed easily by pushing gently.



e) Pull out the balance piston sleeve. The sleeve is loose fitted, so it can be removed easily.

f) Remove the O-ring [35] and O-ring spacer [36] behind the sleeve.

5.4.5.2 Inspection

While you will be able to find some trace of wear on the inside surface of the balance piston sleeve, such wear is not abnormal as it is caused because the clearance between the balance piston and the sleeve is narrower than the clearance between the rotor shaft and the bearing.

Because enough clearance is given to the outside of balance piston sleeve in order not to apply the bearing load to the balance piston, no further development of the wear is expected.

However, you should still carefully check the condition because when the side bearing is significantly worn, the balance piston may also be worn.

Make sure to replace the O-ring [35] with a new one.
By its elasticity, the O-ring work to center the clearance round the periphery of the balance piston sleeve on the center of the balance piston.

5.4.6 Bearing Cover

The bearing cover differs in shape between the D type models (with a bearing head for sideways discharging) and the G type models (with a bearing head for downward discharging). The discharge port is in an unsymmetrical location with the D type 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

- **Make sure to take sufficient care to handle the heavy objects, and make better use of a crane or chain block, etc., if necessary.**
  Dropping heavy objects may cause a large damage to workers and goods

5.4.6.1 Disassembly

a) Apply protective tape or cloth, etc. on the rotor axis surface to prevent from any damage during the work.

b) Remove the domed cap nut [522] and hexagon nut [453] of the Vi adjusting rod [444].

c) Of the hexagon socket head cap screws fastening the bearing cover [18-1], [18-2], [18-3], replace the two screws at the upper side of the bearing cover with stud bolts (headless safety bolts) and then remove all the other screws.

d) 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.

e) The cover will come off the alignment pins located near the screws being turned in as the clearance increases.

CAUTION

- **At this point, if the bearing cover is not properly supported, it may fall or drop down onto the rotor shaft to cause damage on it.**
- **On the 200, 250, 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 threads to lift the cover using a crane or a chain block with lifting tools to removing work.**

5.4.6.2 Inspection

a) Check the alignment pins as they would have been bent when removing the bearing cover.

b) Inspect the thrust washer [449] (as the white ring part shown in following picture to the left) of the Vi adjusting rod. Replace the washer if it is defective.

c) Always replace the bearing cover gasket [17] and the bearing cover side two O-rings [450] (following picture to the right) of the Vi adjusting rod.

5.4.7 Suction Cover and Side Bearings

If the work sequence is such that the thrust bearing block is disassembled first and then the suction cover is removed, there is a risk that, when the suction cover is separated from the rotor casing, the rotor may also be pull out and dropped. As such, in the procedure described in this manual, the suction cover is removed first, and then the thrust bearing is disassembled.

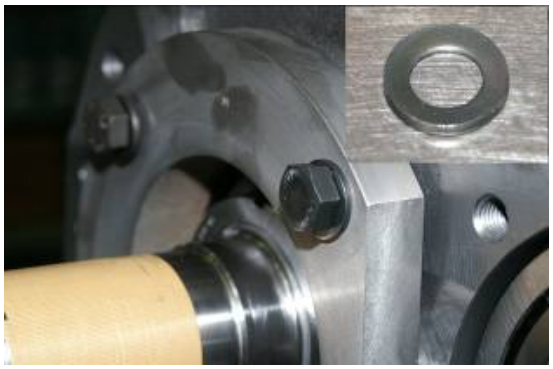
CAUTION

- **In this procedure to remove the suction cover before disassembling the thrust bearing block, it is necessary to sufficiently loosen the lock nut that are securing the thrust bearing while the rotor is supported by both the main and side bearings, in order not to damage the rotor during the disassembly process.**

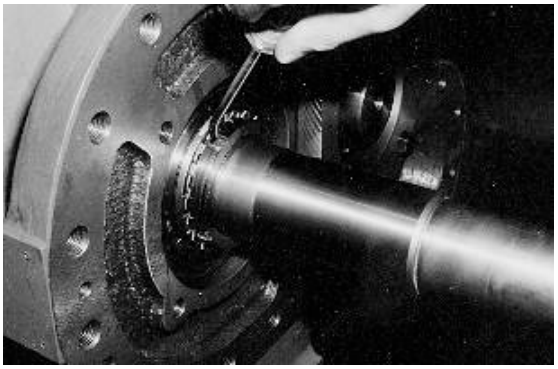
5.4.7.1 Disassembly

a) Remove the hexagon head bolts [45] and conical spring washers [46] that fasten the thrust bearing gland [43]. Then, remove the thrust bearing gland.

b) Unbend the claws of the lock washer [40] holding the lock nut [39], which retains the inner race of each thrust bearing on the rotor shaft and loosen the lock nut using a lock nut wrench.



Removing the Thrust Bearing Gland

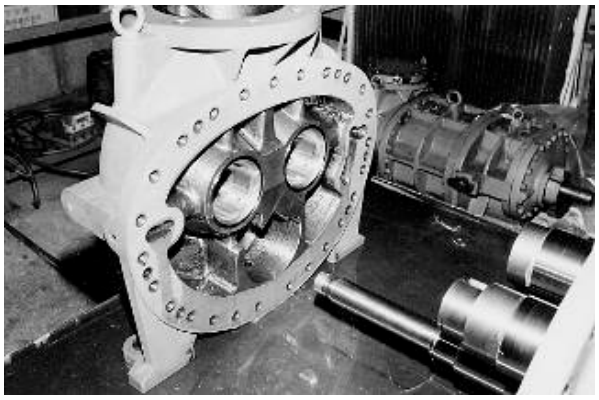


Unbend the Claw of the Lock Washer

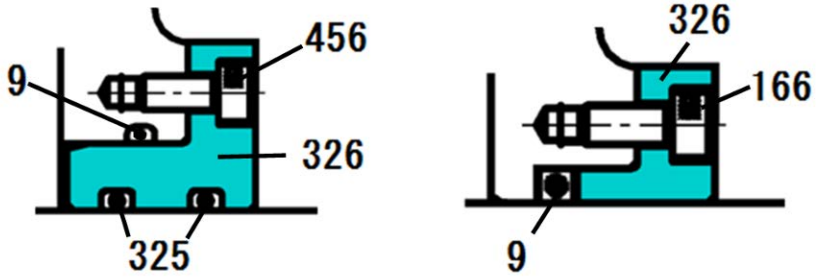
c) Loosen and remove the hexagon socket head cap screws [2] securing the suction cover [5] to the rotor casing [1].

d) As the gasket [6] of the suction cover is sticking to the surface of the flange, screw two hexagon socket head cap screws [2] that have been removed into the jacking threads in the rotor casing flange to evenly push the suction cover. When some gap is observed between them, use a thin knife or spatula to remove one side of the gasket from the surface.

e) When it comes to the position the alignment pins are disengaged, pull out the suction cover at once along the shaft axis.



f) The O-ring and O-ring gland [326] are mounted in the unloader push rod passes part of the suction cover. Remove them. At this time, take care not to lose the four fastening screws for O-ring gland due to their smallness (M5). The structure and part No. of around the O-ring gland are slightly different between 320V*D models and other models as shown in Figure 5-11.

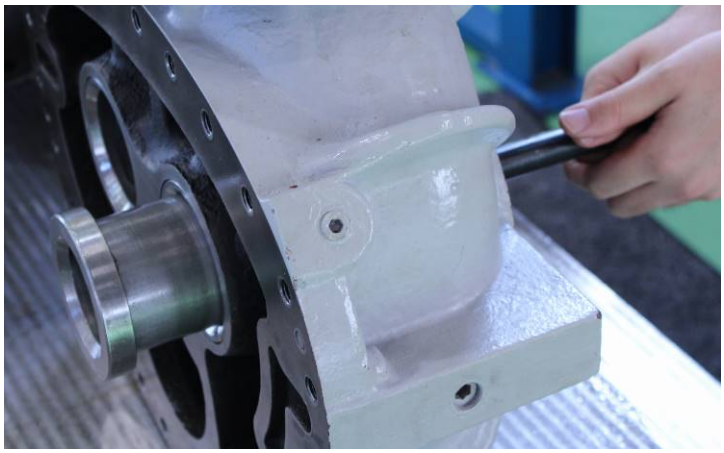


[160 to 250 V]** **[320V*D]**

Figure 5-11 Difference around the O-ring gland

g) The side bearing [28] has been press fit from the balance piston cover side of the suction cover. Remove the snap ring [29] using internal snap ring pliers.

h) Either push out the side bearing from the rotor casing side using some block or pull it out using a special tool such as shown in following picture.



5.4.7.2 Inspection

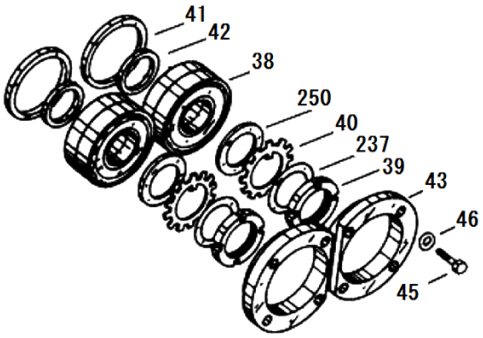
a) Check the oil inlet path to the balance piston part of the suction cover by spraying air, etc.

b) We recommend unconditional exchange of the side bearings on the occasion of the compressor overhaul, but for confirmation of the compressor condition and system operating condition, carefully check the sliding part metal surface of the side bearings.

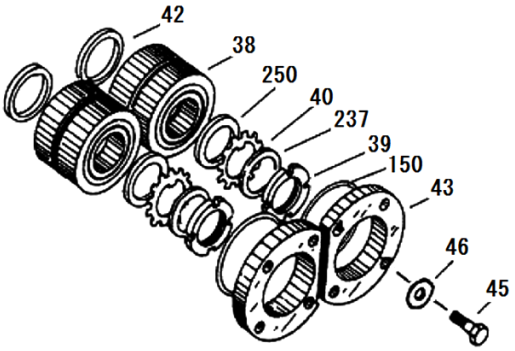
If the metal surface is gray or any foreign matter is buried, also carefully check the wear of the rotor shaft.

c) The inside surface of the rotor casing should have no problems because sufficient clearance is provided. However, if any trace of scraping by the end of the rotor is found, it should be determined that the thrust bearing is defective.
It is also necessary to check the operational condition, such as whether the system is operated for a long time with a high intermediate pressure.

5.4.8 Thrust Bearing Block



[160 to 250V**]



[320V*D]

Figure 5-12 Exploded Views of Thrust Bearing Block

Table 5-7 Parts Configuration of Thrust Bearing Block

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

【POINT】

- The thrust bearing block of 250V** models and 320V*D models have no spacer for the thrust bearing outer race. While the thrust bearing outer race spacer [41] is used to support (i.e., ensure a sufficient support width for) the outer race of the thrust bearing, 250 or higher models use no spacer for the thrust bearing outer race because the bearing head has sufficient margin to the support it.
- The thrust bearing block of 320V*D models is using an oil supply spacer for the combined surface. This is to facilitate lubrication of the ball bearing because as the rotor diameter becomes larger, the rotor shaft diameter become larger. Thus, a larger thrust bearing is required and the ball rotation speed increases accordingly.
- Only 320V*D models employ O-ring [150] to thrust bearing gland.

5.4.8.1 Disassembly

a) Remove the lock nut [39] that has been loosened. Then, remove the torsional slip washer [237], lock washer [40], and thrust washer [250].

b) The clearance fit is applied to two gaps between the outer race of the thrust bearing and the bearing head, between the inner race of the thrust bearing and the rotor shaft.

Prepare a 1 or 2 mm diameter wire, make the tip of the wire flat by hammering, and slightly bend the tip to make a hook. Then, insert the tip of the wire between the outer race and the ball retainer of the thrust bearing [38] to hook and pull out the bearing. In this way, the bearing can be easily removed.

c) The whole thrust bearing will be removed helped by the surface tension of the oil on the side face. If you have failed to remove the whole bearing at once, put the components in the order of the removal.

d) Inside the thrust bearing is an alignment spacer [42] for the inner race on the rotor shaft side. Also, 160V** models and 200V** models are used the thrust bearing outer race spacer [41] on the bearing head side. Each spacer has a marking to identify where to set, i.e., the M rotor side has a stamped marking of "M", and the F rotor side has a stamped marking of "F".

Neatly arrange the parts removed, i.e., the thrust bearing gland, thrust washer, thrust bearing, thrust bearing alignment spacer, and thrust bearing outer race spacer separately for the M rotor and F rotor as shown in right picture. You must be very careful because if an assembly error is made to result in a wrong combination of parts after failing to neatly arranging and separating the parts, it can lead to performance degradation and/or dragging accident due to overheating caused by excess tightness, for example.

5.4.8.2 Inspection

a) The thrust bearing is normal if the bearing balls are found fully glossy after the thrust bearing has been fully washed and cleaned. It is abnormal if the ball surface is tarnished or has some streaky pattern.

b) Support the inner race with your hand and rotate the outer race. If you feel abnormal vibration on the hand, the rolling contact surface of the inner or outer race or some balls may be in an abnormal condition. So, carefully check the conditions. You could feel some irregular click even with a small amount of foreign matter that has entered during the removal process. In such a case, it should return to the normal condition when high pressure air is used to blow out the foreign matters after washing and cleaning the unit. If the bearing is determined to be defective, it must be replaced with new ones.

c) If the inner race and outer race can be easily separated, the wear is considered excessive. If so, you cannot reuse the bearing.

d) After washing the bearing, you should be able to hear a clattering sound when the bearing is rotated y hand. Such a sound is due to the motion of the ball within the backlash or play, or the gap between the retainer and the ball. Such a sound will not be heard if the bearing is held horizontal and turned. If some lubricating oil is applied after washing the bearing, the sound should not be heard when the bearing is turned. If you can still hear the sound, you should check further details.

e) If the compressor has been operated for more than 20,000 hours without replacing the thrust bearing, it is recommended to replace the bearing with a new one for safely continuing the operation until the next overhaul, even if no abnormality is found in the above described inspection.

CAUTION

- **As the bearing used for the compressor is a specially designed combined-type bearing, the accuracy and material are different from normal ones of the same part number that may be found in the catalogue of a bearing manufacturer.**
  Be sure to use only MYCOM genuine parts for replacement. Otherwise, it will not be covered by the warranty.

5.4.9 Rotors and Main Rotor Casing

5.4.9.1 Disassembly

a) The rotor can be easily pulled out. While you can pull out the rotor either from the M or F side, you should be very careful in the work as either rotor is very heavy.
When pulling out the M rotor (or F rotor) first, pull out about 2/3 of the full length of the rotor by holding the shaft upward and turning it in the CW (or CCW) direction.

CAUTION

- **You should carefully note that the rotor must be rotated in the specified direction while pulling it out. If the M (F) rotor is not turned during the pulling out process, the F (M) rotor can also be pulled out together.**

b) As a preparation, use a nylon belt or other lifting belt that will not blemish the lifting surface to support the center of the rotor. Then, pull out the rotor while slightly lifting up the rotor using the belt.

c) The pulled out rotor should not be directly placed on the floor. Use appropriate wood boards to support the rotor as a cushion to prevent blemishing or use V-blocks to support the shaft to prevent blemishing of the outer surface.

5.4.9.2 Inspection

a) No abnormality should be observed on the surface of the rotor lobes under normal operations. Regarding the contact surface of the lobes, black luster should be seen on the root area of the M rotor lobes and on the tip area of the F rotor lobes.

In other cases, when the suction gas or oil is contaminated by fine dust, there may be fine linear scratches on the shaft surface, in the direction perpendicular to the shaft axis. If any such flaw is found, use a fine sandpaper or grindstone to smooth the surface.

b) In case of ammonia refrigerant or gas compressor, the non-contact surface of the rotor may be discolored by rust or deposits. Use sandpapers or others to finish the surface according to the degree of the problem.

c) Then, check the bearing areas of the rotor shaft. Two types of finishing are used: one is the induction hardening (polish finishing) for the standard specification, and the other is the hard chrome plating (polish finishing), as a special specification. The most suitable finish is selected according to the type of refrigerant and operation conditions.

Very little wear will be present unless the compressor is operated for a long time using dirty oil or any hard matter is buried in the metal of the inner circumference of the bearing.

d) Check the portion of the shaft on which the thrust bearing is mounted for any trace to show that the inner race of the bearing has rotated.
If the lock nut that fastens the inner race of the thrust bearing is loosened, or if the bearing is abnormally worn, the inner race will become loose and rotate. If any trace of rotation is seen, correct the problem as appropriate.

e) Check the portion of the shaft on which the mechanical seal is mounted for any scratches and/or trace to show that the oil seal lip has hit strongly. Particularly, damage in axial direction may cause the oil and/or gas leakage from the shaft seal part, if it is not disappeared in hand finishing, repairing the rotor is required.
In this case, contact our sales offices or service centers.

f) Check the inner surface of the rotor casing.
There is a narrow clearance between the periphery of the rotor and the rotor casing. Any slight flaw present on the tip of the rotor lobes or on the inner surface of the rotor casing, due to small foreign matters, will not be a problem.
If there is any trace to show that the tips of the rotor lobes have hit the inner surface of the rotor casing, it is an abnormal condition. In such a case, the possible cause is that the bearing is worn out. Take proper actions by finding the cause of the problem, such as contamination of the lubricating oil or entrance of foreign matters.

5.4.10 Variable Vi Auxiliary Slide Valve and Unloader Slide Valve

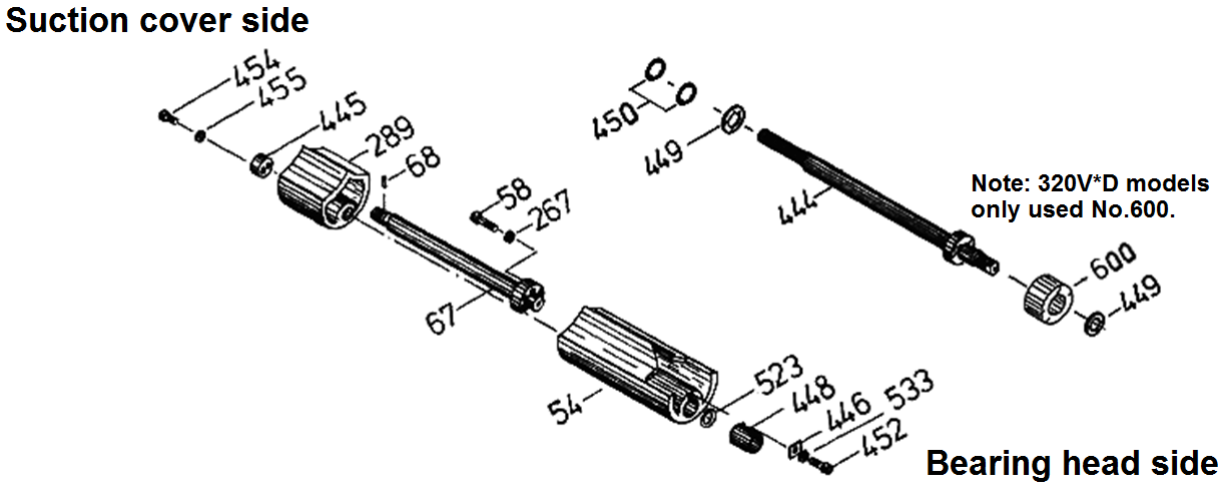


Figure 5-13 Variable Vi Auxiliary Slide Valve, Unloader Slide Valve and Vi Adjusting Rod

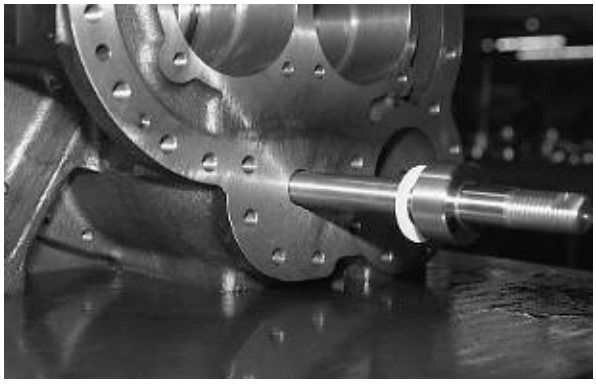
5.4.10.1 Disassembly

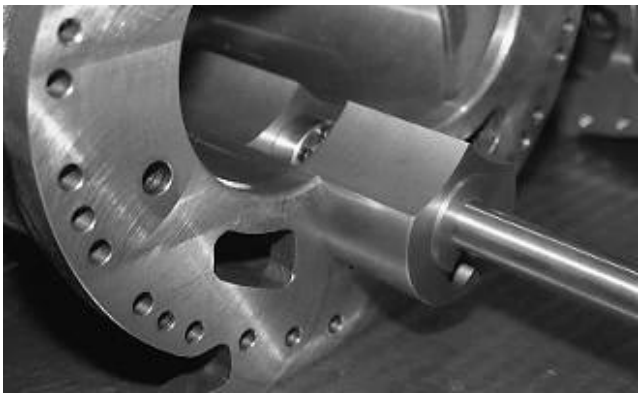
a) Remove the hexagon head socket cap screws [454] fastening the lock washer [445] on the tip of the suction cover side of Vi adjusting rod [444] and remove the spring washer [455] (following picture to the left).

Note: The lock washer [445], spring washer [455] and hexagon head cap screws [454] are not used on the products manufactured in and after 2003.

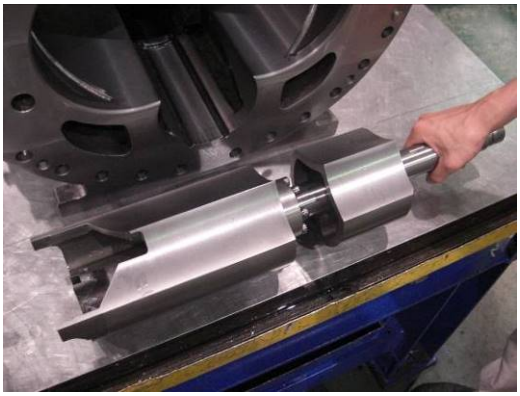
b) Turn the Vi adjusting rod in the bearing head counterclockwise until its end disengages from the variable Vi auxiliary slide valve and then pull the rod out of the bearing head (following picture to the right). Keep the thrust washer [449] together with the Vi adjusting rod.

c) Return to the suction cover 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.





Pulling out the Unloader Slide Valve and Variable Auxiliary Slide Valve



Separating the Unloader Slide Valve and Variable Auxiliary Slide Valve

5.4.10.2 Inspection

a) With the unloader slide valve and variable Vi auxiliary slide valve mounted in position, check the step height between the slide valves and the rotor casing surfaces. Generally, the surface of the slide valves should be lower than the surface of the rotor casing. If the top surface of the slide valves has a trace of hitting the rotor, the probable cause is that the slide valves are worn or the rotor shaft/bearing is worn. Please contact our sales offices or service centers

b) Inspect the sliding surfaces of the unloader slide valve and variable Vi auxiliary slide valve that rub against the main rotor casing. If any scratch and/or contact mark of casing with slide valve is found, the compressor is in bad condition. Examine their causes, e.g., lubricating oil contamination, entering foreign materials, and loosening of fastening portion. After identify the cause, take necessary measures.

c) If there is a discoloration like oil burned around the discharge port of the slide valve, oil compression operation may be occurring. In this case, please contact our sales offices or service centers, too.

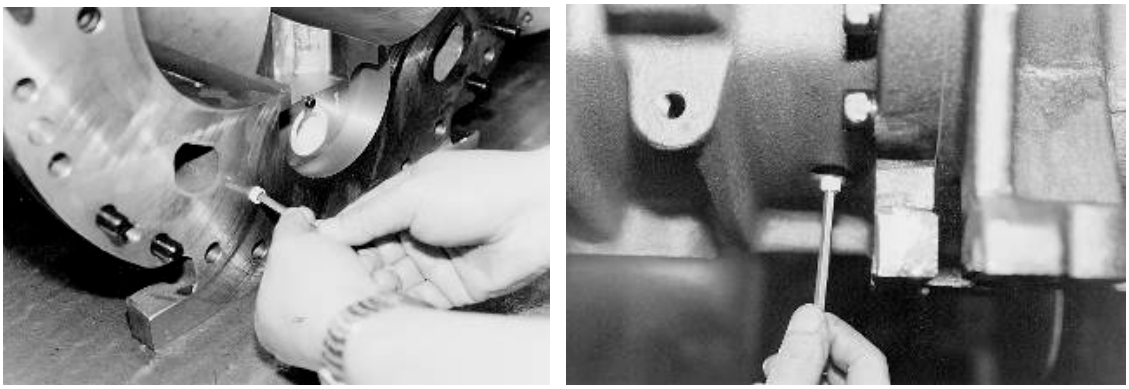
d) Replace the two O-rings [450] and O-ring [523] with new ones.

e) Replace the Teflon bushing [448], if any wear is found.

【POINT】

- Two O-rings [450] are fitted on the following portions.
  - 160 to 250V** models: on the Vi adjusting rod
  - 320V*D models: on the O-ring groove located at the Vi adjusting rod passes part in the bearing cover

f) Remove oil injection line plugs on the rotor casing, and confirm those oil lines are not clogged by using the compressed air and like. After confirming and cleaning the oil lines, do not forget to attach the plugs to the original positions.



Oil Injection line Plugs

5.4.11 Bearing Head and Main Bearings

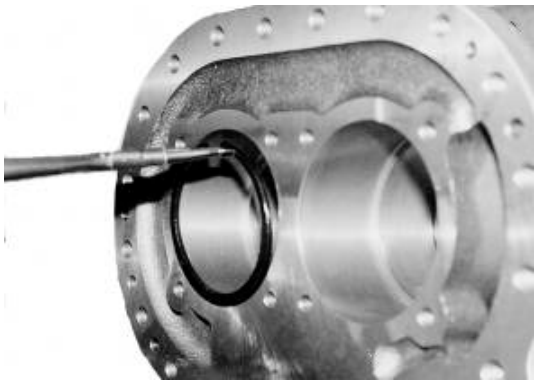
5.4.11.1 Disassembly

a) Unscrew and remove all the hexagon socket head cap screws [2] fastening the main rotor casing [1] and bearing head [11] .

b) Screw in two removed hexagon head cap screws to the jacking threads on the main rotor casing flange, and evenly screw them little by little.
Once some gap is produced between the main rotor casing and the bearing head, use a knife or a spatula like tool to detach the gasket from one side to other side.

When the alignment pins are disengaged, the bearing head is separated from the main rotor casing.

c) The main bearing [27-2] is lightly press fit.
To remove each main bearing, remove the snap ring [29] using internal snap ring pliers (following picture to the left). And then, push out the main bearing from the rotor side using a hammer through a plastic block or pull it out using a special tool such as shown in the Section 5.4.7.1 picture.



5.4.11.2 Inspection

a) We recommend as well as the side bearings, unconditional exchange of the main bearings on the occasion of the compressor overhaul, but for confirmation of the compressor condition and system operating condition, carefully check the sliding part metal surfaces of the main bearings.

If the metal surface is gray or any foreign matter is buried, also carefully check the wear of the rotor shaft.

b) Check the condition of the surface of the bearing head on the rotor side, where the discharge port is.

Properly mend the surface if any flaw is observed. If the entire surface has significant flaws, either the thrust bearing is defective or the end clearance adjustment is poor.

If oil compression has been caused during the operation, carefully and thoroughly check the area of the discharge port in particular. If the continued use is in doubt at all, perform the penetrant testing to determine if it can be used or not.

c) Replace the O-ring [451] for the Vi adjusting rod (upper picture to the right).

5.5 Reassembly

CAUTION

- **During the reassembly work, be very careful in selecting the correct replacement O-rings of the specified standard, not to make a mistake regarding the size, material, for fixed use, for sliding use, etc. Using a wrong O-ring can lead to oil leak or other problems.**
- **Some gaskets are not symmetrically shaped. In such a case, be careful not to misplace the gasket. If the gasket is misplaced, it can lead to a significant problem such as blocking any oil supply route on the casing.**

After completing the disassembly and inspection procedures, start the assembly process.

Before starting the assembly, check the replacement parts once again.

Like gaskets, all O-rings that have been removed during the compressor disassembly must be replaced with new ones.

The assembly sequence is mostly the reverse of the disassembly sequence. First of all, clean the work bench and the tools to be used.

Immediately prior to the assembly, use wash oil to clean the parts to be assembled, dry them with compressed air, and sufficiently apply lubricating oil, etc. For this, prepare a sufficient amount of clean lubricating oil for the reassembly. Also, apply oil on both sides of the gasket..

Please fully understand the details in this Section 5.5 for correct assembly work.

Table 5-8 Tightening Torques for Hexagon Socket Head Cap Screws

Torque Unit	M4	M5	M6	M8	M10	M12	M14	M16	M20	M24
N·m	2.8	6	10	25	50	90	140	240	450	750
kgf·cm	28	60	100	250	500	900	1400	2400	4500	7500

When fastening each hexagon head cap screw, use the tightening torque specified in the above table.

For other tightening torques of hexagon head bolts and lock nuts needed specified tightening torque, refer to Section 7.3 in this manual Chapter 7.

5.5.1 Bearing Head and Main Bearings

The main bearing (O-ring type) [27] is installed by a light press fit.

a) Align the notch on the main bearing [11] with the spring pin [14] that is driven in into the bearing head [11], and then drive it in with a pad. For the alignment, it is convenient to use a tool such as a guide bar (see the picture in Section 5.5.4).
b) After the bearing has been inserted, install the snap ring [29] to retain the bearing in position. Securely install the snap ring to be fully seated in the ring groove, by pushing the snap ring with a guide bar or the like, or by lightly hitting the guide bar with a hammer while placing the guide bar on the snap ring.
c) Install the O-ring [451] to the O-ring groove which located inside the hole to which is attached to the Vi adjusting rod of bearing head.

【POINT】

When press fitting the bearing, it is recommended to prepare a collared plastic cylinder (spacer) that exactly fits inside the inner diameter of the bearing and also a collared weight that fits inside the plastic cylinder as shown in Figure 5-14. Then, hit the top of the weight for easy press fitting of the bearing. Instead of the above, special tools are also available from us for the main and side bearings. These tools are similar to the above described weight, and the surface finish of which is improved to eliminate the need of a plastic spacer (Refer to Chapter 7, Section 7.6). You are welcome to place an order if necessary.

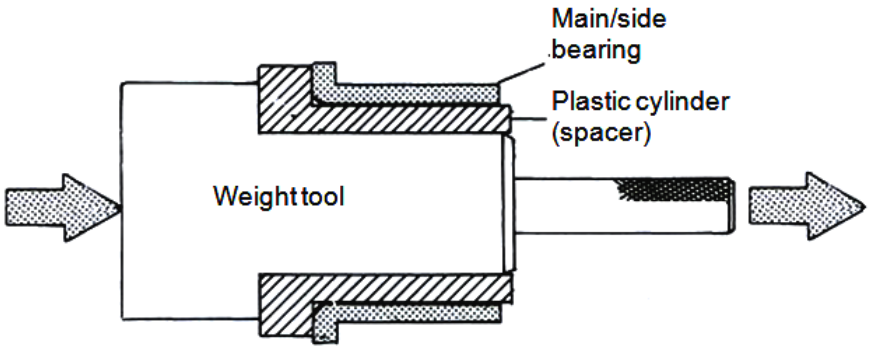


Figure 5-14 Example Tool for Press Fitting the Bearing

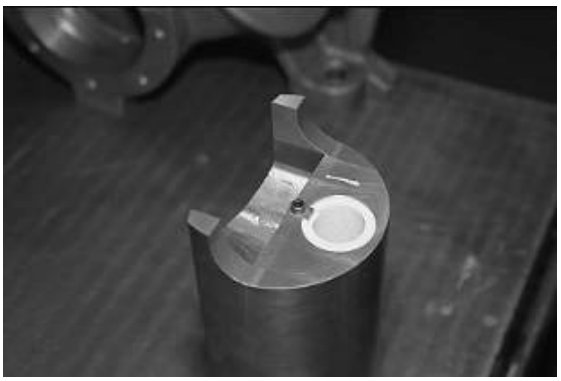
5.5.2 Unloader Slide Valve

a) Check that the O-ring [523] fitted in the Vi adjusting rod hole of the unloader slide valve has replaced, and check that the Teflon bushing [448] for the Vi adjusting rod has no defects.

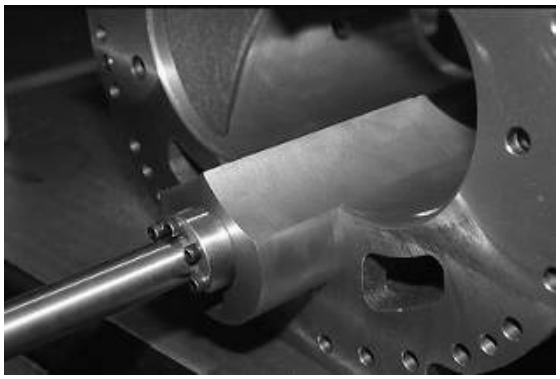
b) Check that all removed plugs for oil injection circuit, etc. of the main rotor casing are fitted into the original holes.

c) Install the unloader slide valve to the main rotor casing and confirm that the unloader slide valve moves smoothly.

d) Install the variable Vi auxiliary slide valve and confirm that is moves smoothly.



Teflon Bushing



Install the Unloader Slide Valve

e) Apply sufficient oil or like to both sides of the bearing head gasket [12] and attach it to the main rotor casing. Screw in the stud bolts to the main rotor casing to hold the gasket.

CAUTION

- **As the bearing head gasket [12] is not symmetrically shaped, carefully check the orientation when attaching the gasket.**
- **If you place the bearing head gasket by just hanging it on the stud bolts, the gasket will protrude into the inside of the rotor casing when the casing is assembled. Apply sufficient amount of oil, etc. to the gasket to make it fully attached to the surface to prevent protruding upon the assembly.**

f) Combine the flange surfaces of the main rotor casing and the bearing head.

g) After lightly fastening two bolts, drive in the alignment pins [3] to fix the position by using a copper or an aluminum hammer.

h) 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. The bottom bolts that cannot be fastened on the workbench are to be fastened later on.

i) After tightening the bolts, check that the gasket is not protruding into the inside of the casing. If any part of the gasket is extending into the bores, there is a possibility that the performance of the compressor is deteriorated.

j) Also check that the unloader slide valve and variable Vi auxiliary slide valve can be moved smoothly along the surface of the port section in the bearing head.

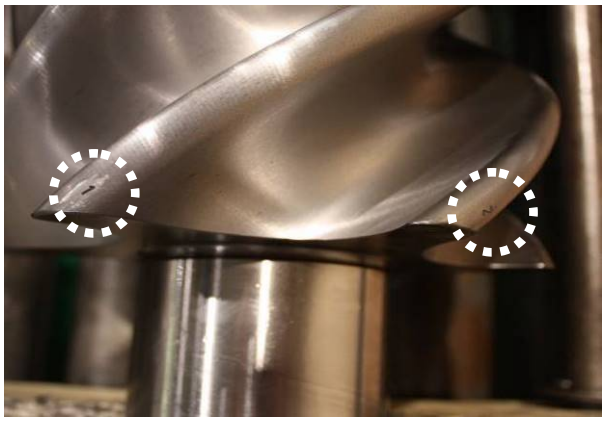
k) Install the Vi adjusting rod from the bearing head side, and screw in it to the screw thread of the variable auxiliary slide valve. Do not forget attaching the thrust washer.

5.5.3 Installing the Rotors

The rotor must be sufficiently reworked. If any slight flaw is observed on the shaft surface in the area of attaching the bearing or seal, use a sand paper to correct and finish the surface. After finishing the surface to attach the seal, apply protective tape on the surface.

Both the M rotor and F rotor have a specific engagement position, and the position is marked by carving.
In order to make it easier to match the positions when installing the rotor into the rotor casing, a number is marked on the lobe tip: the M rotor has the marking on the discharge side, and the F rotor has the marking on the suction side.

Mating Mark on the M Rotor



Mating Mark on the F Rotor

a) Apply sufficient amount of lubricating oil on the main bearing in the bearing head and on the bearing area of the rotor shaft.

b) Lift up the rotor's midpoint using a crane or a chain block with a belt sling, and insert the rotor into the casing halfway along its length while keeping it balanced on the belt sling.

   Then detach the belt sling from the rotor and push the rotor fully into the casing.

【POINT】

While it is easier to mate the markings if the F rotor is first installed into the casing, it is not a mistake to install the M rotor first.

Regardless of which rotor is installed first, the lobe of the M rotor with the carved marking of "1" must be set in between the F rotor's lobes that are marked "1" and "2". As it affects smooth engagement of the teeth as well as the balance, be sure to mate the markings as describes here.

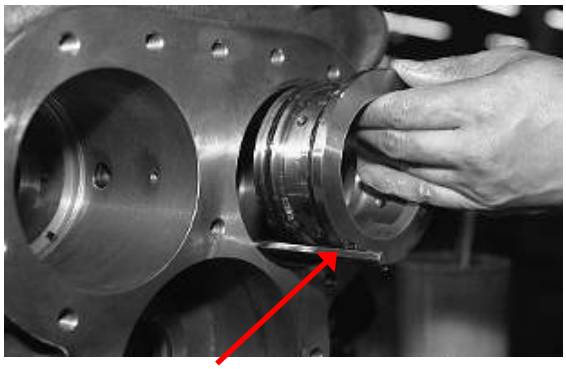
CAUTION

- **As the circumference of the rotor is touching the rotor casing in this condition, any rotation of the rotor should be kept to the minimum required. Otherwise, the lobes tip of the rotor may be worn.**

5.5.4 Suction Cover and Side Bearings

a) Similarly to the main bearing, the side bearing (O-ring type) [28] is machined to the size that will allow light press fitting to the suction cover.
Press fit the bearing by aligning the notch position of the bearing with the spring pin [8] for positioning the bearing driven-in on the suction cover. During the press fitting process, check that the notch position of the bearing is at the pin position. If the position has been shifted, pull out the bearing and try the press fitting process again.

b) After installing the bearing, insert the snap ring [29] to retain the bearing. Make sure that the snap ring is fully seated in the ring groove either by pushing the ring with a guide bar or tapping the head of the guide bar while applying the bar on the ring.



Aligning the Bearing position using Guide Bar

Installing the Bearing using the Jig

c) In case of 160 to 250V** models, after attaching the O-ring [9] to the O-ring groove located on the unloader push rod passes parts of the suction cover, attach O-ring gland [326] with two O-rings [326] at inner diameter.

In case of 320V*D models, attach the O-ring [9] and O-ring gland [326] after assembling the suction cover and main rotor casing.

5.5.5 Balance Piston Sleeve

Install the balance piston sleeve to the M rotor side of the suction cover.

a) First, install the snap ring for the O-ring spacer [37], and then install the O-ring spacer [36].

b) After fitting the O-ring [35] in position, install the balance piston sleeve [33].
Insert the chamfered side of the balance piston sleeve towards the O-ring already placed.

c) In case of 160 to 250V** models, align the notch of the balance piston sleeve with the thread hole on the suction cover. And then, screw the set screw [34] for the balance piston sleeve detent, and attach a remaining set screw from the opposite side (F rotor side) to secure the set screw which is attached earlier.

In case of 320V*D models, fit the spring pin provided on the outside diameter of the balance piston sleeve into the notch in the suction cover for the balance piston sleeve detent.

d) Insert the snap ring [37] to retain the balance piston sleeve. As it should be difficult to fit the snap ring into the groove due to the elastic force of the O-ring, either push the side of the ring by a guide bar or tap the head of the guide bar to fit the ring securely into the groove.

5.5.6 Installing the Suction Cover

a) Turn the Vi adjusting rod counterclockwise to set it to the L port position.

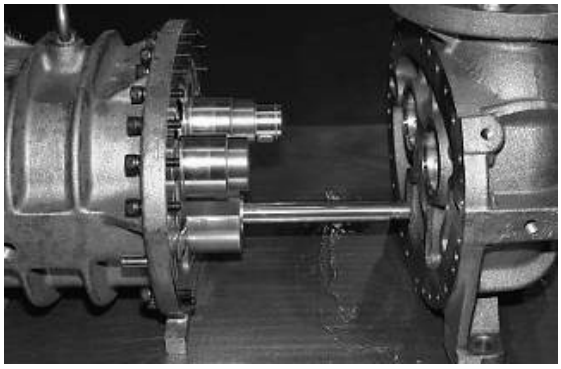
b) Apply oil on both sides of the gasket [6], and attach it to the main rotor casing [1] while carefully checking the position of oil supply holes. Screw in stud bolts to the main rotor casing to retain the gasket in position.

CAUTION

- **As the gasket of the suction cover is not symmetrically shaped, take care the gasket direction when attaching to the main rotor casing.**

c) Slide (or use a lifting device to move) the suction cover [5] in parallel along the shaft axis, and align the unloader push rod [67] with the O-ring gland [325] in the suction cover.

d) Then, engage the shaft ends of the rotors with the side bearings while pushing the suction cover gradually. At this time, be careful not to damage the inner surfaces of the side bearings.



Sliding the Suction Cover on the Workbench

Using a Crane and pushing to ・・・

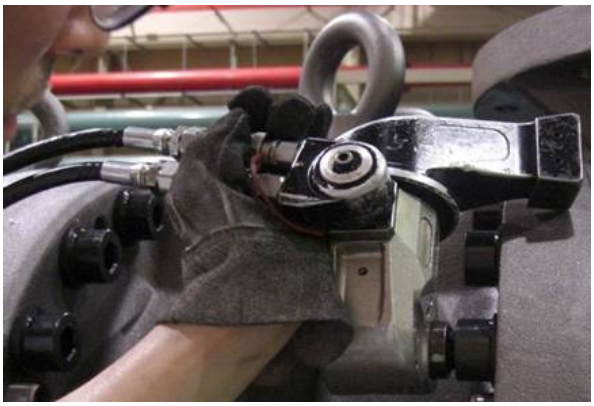
e) After the suction cover has been pushed in up to the flange surface of the main rotor casing, lightly fasten some of the hexagon socket head cap screws [2].

f) Using a copper hammer or an aluminum hammer, drive in the alignment pins [3].

g) Tighten the hexagon socket head cap screws evenly up to the specified tightening torque. The bolts on the bottom side (about 6 bolts) are to be tightened during the final assembly stage, on the special stand used in the disassembly process.

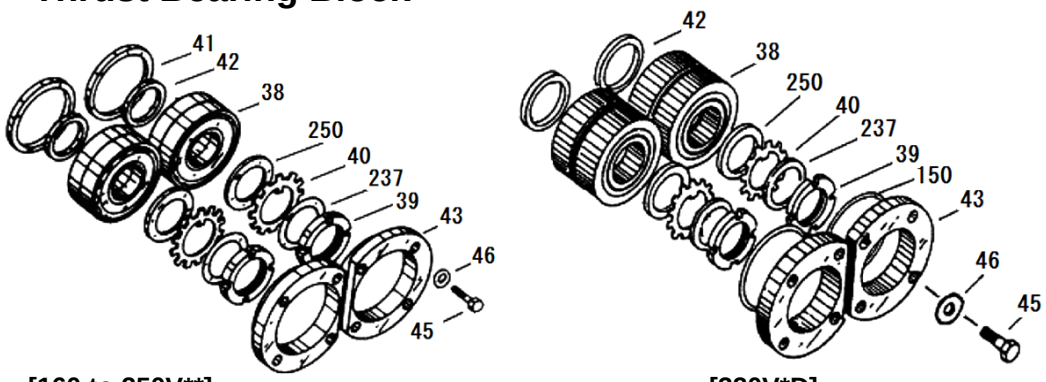
h) Check that the unloader slide valve and variable Vi auxiliary slide valve can be moved smoothly. Also, hold and rotate the M rotor shaft to check if it works normally.
In addition, check that the rotor has an axial play (i.e., the rotor can move in the axial direction).

Tightening the Bolts using a Torque Wrench



In case of Large sized Models, use a Hydraulic Torque Wrench

5.5.7 Thrust Bearing Block



[160 to 250V]** **[320V*D]**

Note: 250V models do not use the No.41.**

Figure 5-15 Exploded View of the Thrust Bearing Block

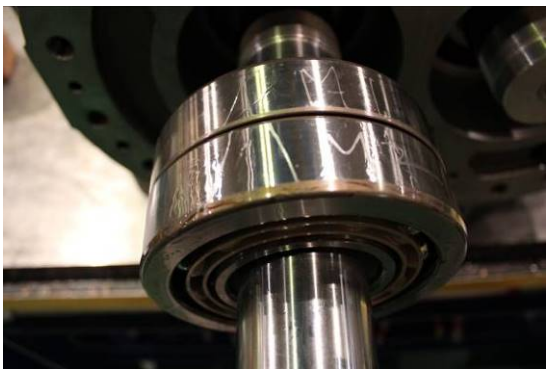
CAUTION

- **The torsional slip washer [237] and lock washer [39] must be replaced with new ones.**
- **If the removed thrust bearing is to be installed as it is, check the marking of "M" or "F" on the thrust bearing outer race spacer [41] (160V**, 200V** models) and alignment spacer [42], and assemble them in the same combinations as they ware disassembled. This is important in controlling the end clearance on the discharge side of the rotor.**
- **Even if the same bearing is installed, the work must be very carefully done as the dimension can change if any foreign matter such as a chip of paint or dust is pinched by the thrust bearing outer race spacer and/or alignment spacer.**
- **In determining the installation direction of the thrust bearing, there are two methods depending on the existence of an alignment "V" marking on the outer circumference of the bearing. Install the bearing according to the following procedure provided for each case.**

The assembly sequence for this part is as illustrated in Figure 5-15. The important points to be noted in the procedure are described below:

a) Check the marking of either "M" or "F" on the thrust bearing outer race spacer and alignment spacer to ensure that the units are assembled in the same combination of parts.

   The front and back of the outer race spacer and alignment spacer must be distinguished when it is installed. The larger chamfering side is on the machine side, and the smaller chamfering side is on the thrust bearing side.

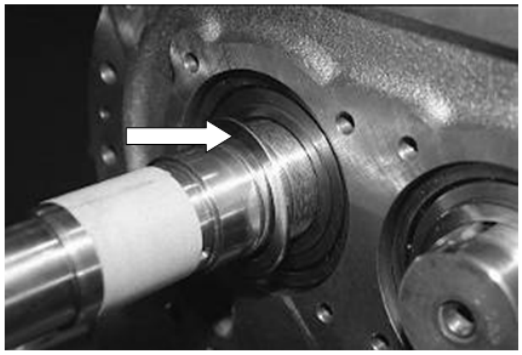


b) If thrust bearing has a "V" marking on the outer circumference, it means that the installation direction of the bearing will sensitively affect the end clearance adjustment. In this case, the bearing must be installed with the pointed end of the marking pointed toward the inside of the machine.
   If there is no "V" marking, it means that the direction of the bearing installation will not affect the end clearance adjustment. However, in order to clearly determine the orientation (whether it is on the inside or outside of the machine), first combine both bearings with the bearing number carving facing the outside of the machine. Then, use a blue whetstone to write the above "V" marking on the bearing to show the inside direction of the machine (see above picture). Then, install the bearing

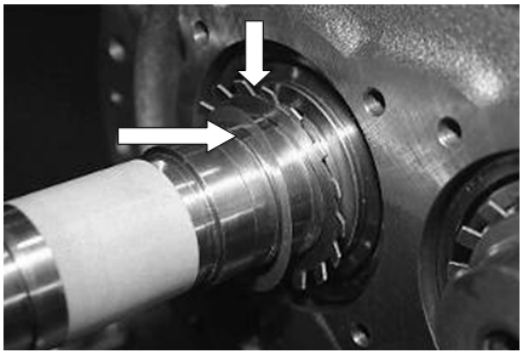
.

c) After installing the thrust bearing, attach the thrust washer [250], lock washer [40], and torsional slip washer [237]. Then, tighten the lock nut [39] at the specified torque or within the specified range of the tightening angle (refer to Chapter 7, Section 7.3 "Tightening Torques for Bolts and Nuts" in this manual) to secure the inner race of the thrust bearing on the rotor shaft.

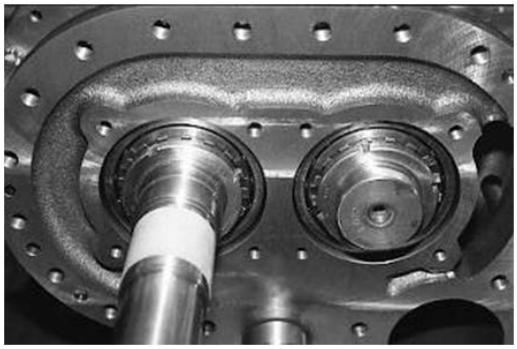
d) After tightening the lock nut, turn the M rotor shaft by hand to make sure that rotation of rotors is smooth.



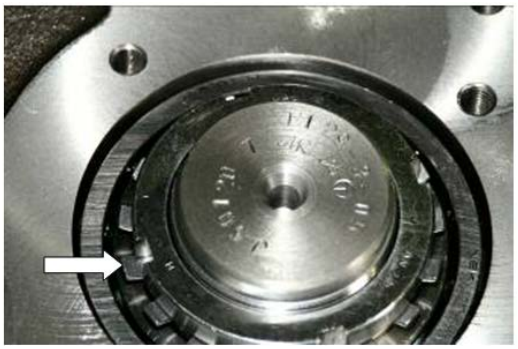
Thrust Washer



Lock Washer and Torsional Slip Washer



After titeging the Lock Nut



Claw for rotation stop

【POINT】

Tightening the lock nut while keeping the setting position between the lock nut wrench hooks and the lock nut notches may cause to make the rotor run-out to enlarge due to uneven tightening forces. Change the setting position between the lock nut wrench hooks and lock nut notches about four times when fastening the lock nut.

CAUTION

- **As clearance fit is used for the inner race of the thrust bearing, this tightening work is very important because the bearing is secured only by the tightening force of the lock nut.**
- **When the thrust bearing has been replaced, the dimensional difference between the sides of the inner race and outer race varies even if it is within the tolerance of the applicable standard specification. As such, if the thickness of the thrust bearing alignment spacer that has been used is insufficient, and if the lock nut is securely tightened from the first, the end clearance between the rotor shaft end and the end face of the discharge side bearing head will be lost. Furthermore, as the balls are pressed against the rolling contact surface to create impression on the surface, it will damage the bearing. To avoid this, gradually tighten the lock nut while rotating the rotor to make sure the outer race is free, until the lock nut is fully tightened. If it comes to require more force to turn the rotor while the lock nut is being tightened, the thickness of the spacer is considered insufficient.**

5.5.7.1 End Clearance Measurement

At this point (i.e., after the thrust bearing block has been fully assembled), measure the end clearance of the rotor on the discharge side.
In particular, this measurement must be made when the thrust bearing has been replaced. Even if the same bearing is used, the measurement should be made for verification.
If the measured clearance does not satisfy the range specified in Table 5-9, proper adjustment must be made.

Table 5-9 Specified Limits of End Clearance (unit: mm)

Model	for Single Stage (High Stage) Use				for Booster (Low stage) Use			
	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*D	0.17～0.21	0.20～0.24	0.23～0.27	-	0.70～0.76	0.73～0.79	0.77～0.83	-

a) For pressing the rotor shaft on to the discharge side, hit the rotor shaft strongly from the suction side while putting a jig (Teflon block or like).
b) Prepare the thrust bearing gland to be readily mounted. Mount a dial gauge on the axial end of the rotor, and set the indication needle to zero point while the rotor is fully pressed onto the discharge end face.

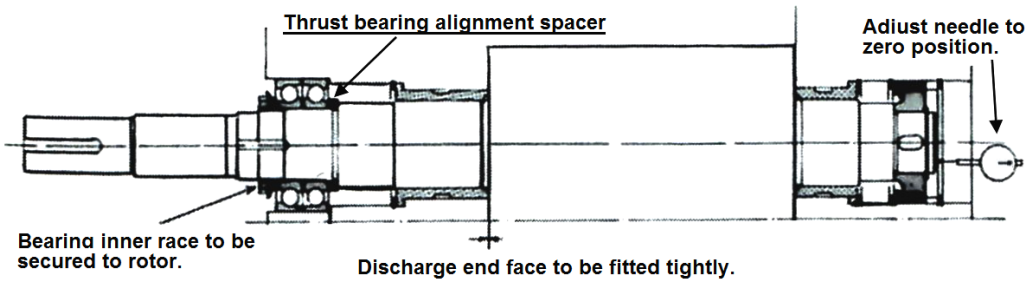


Figure 5-16 End Clearance Measurement Preparation

c) Without inserting the conical spring washer [46], tighten the four fastening bolts [45] of the bearing gland sequentially and evenly up to the specified tightening torque. Tightening each bolt at once at the specified torque must be avoided because it will result in uneven tightening. So Tighten with the procedure shown in 7.3.4.

Table 5-10 Tightening Torques of Thrust Bearing Gland

Model	Bolt Size	Tightening Torque	
		N·m	kgf·cm
160V**	M10x30	40	400
200V**	M12x35	50	500
250V**	M16x45	60	600
320V*D	M20x55	120	1200

d) Then, read the dial gauge indication. This value shows the actual end clearance. If the end clearance is outside the specified value, perform the adjustment work described in the next section. If the end clearance is within the specified value, turn the M rotor shaft by hand and confirm the smooth turning without uneven tightening. And then perform the measurement of the run-out of the rotor shaft described in next section (3).

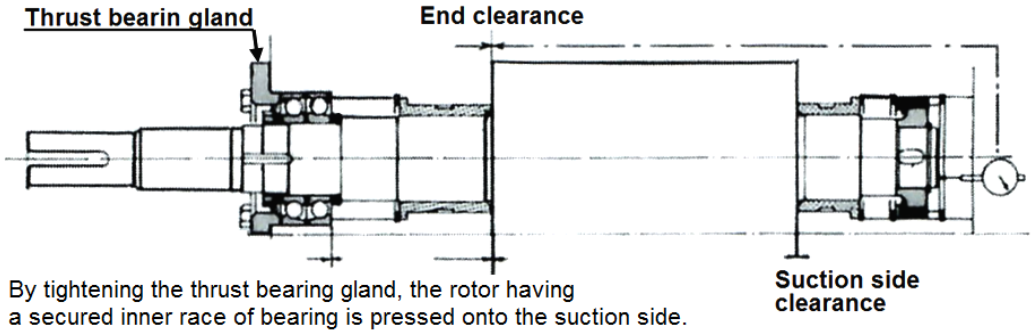


Figure 5-17 Measurement of the End Clearance

5.5.7.2 End Clearance Adjustment Procedure

(1) When the end clearance is less than the specified value
In this case, a shim (thrust adjustment liner) must be inserted between the thrust alignment spacer [42] and the inner race of the thrust bearing to increase the end clearance.
The thickness of the shim must be determined by the difference between the specified end clearance and the measured value.

- Although the thrust adjustment liner is not shown in the exploded view, you can place an order to us indicating the model name.

Also, in case of 160V** or 200V** models, using a highly accurate surface grinding machine or asking professional service vendors to grind, grind the surface of thrust bearing outer race spacer [41] by the difference from the specified value.
After grinding the flat surface, measure the whole circumference of the outer race spacer by using a micrometer, and check that the thickness is even.

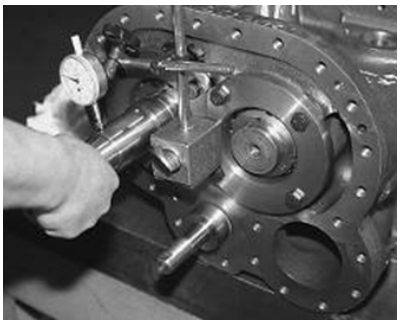
(2) When the end clearance exceeds the specified value
If any shim (thrust adjustment liner) has been inserted between the thrust bearing alignment spacer and the inner race of the thrust bearing, and the thickness corresponds to the difference between the measured end clearance and the specified value, just remove the shim.

If no shim is used or the thickness of the shim is insufficient to compensate for the excess end clearance, use a surface-grinding machine (or ask a vendor) to make the thrust bearing alignment spacer [42] thinner by the amount of the end clearance difference between the measured and specified values. After the surface grinding is done, use a micrometer to measure the thickness of the spacer for the entire circumference to make sure the thickness is even.

(3) Measuring the run-out of the rotor shaft

If the end clearance adjustment has been successfully completed, then measure the run-out of the l M rotor shaft using a dial gauge at the point of the mechanical seal attachment and turning the shaft by hand (see following picture).

A run-out of up to 0.03 mm is acceptable for all models. The run-out occurs if the thickness of the thrust alignment spacer is not even or the marking on the thrust bearing is not properly positioned. And it occurs if fastening the lock nut performed without changing the position of the lock nut wrench, . The run-out also becomes significant if any small foreign matter is present in between relevant parts.



If the run-out exceeds the allowable value, disassemble this block again even if the end clearance is within the specified limits, and adjust the relative position of the outer race spacer, alignment spacer and thrust bearing.

This adjustment is very important as any run-out affects the function and service life of the mechanical seal.

5.5.7.3 Tightening after Finishing the End Clearance Adjustment

(1) In case of 160 to 250V** models:

a) Remove a hexagon head bolt [45] which is used to fasten thrust bearing gland [43], and insert the conical spring washer [46] to prevent the bolt loosening. Then, screw and tighten the hexagon head bolt again up to the specified tightening torque. Tighten the rest of bolts [45] in the same manner.

b) Bend the claw of lock washer [40] to the notch of lock nut [39], which tightens the thrust bearing inner race, to prevent the lock nut loosening.

Steps a) and b) can be reversed.

(2) In case of 320V*D models:

a) Remove the fastening bolts [45] and the thrust bearing gland [43].

b) Attach the O-ring [150] to removed thrust bearing gland. Without inserting the conical spring washers in the same manner as in the case of the end clearance measurement/alignment, tighten the hexagon head bolts i n a diagonal sequence, a little at a time, and finally tighten them to the specified torque. (See 7.3.4)

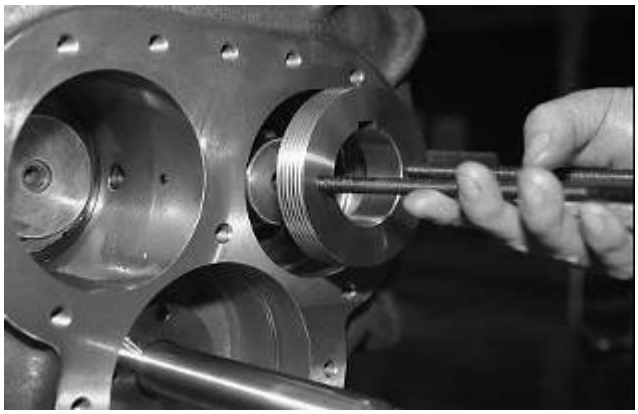
The procedures after this are same step (1) above.

【POINT】

Conical spring washer has been adopted instead of the plate type lock washer from October, 2001. When using the conical spring washers for the compressors produced before this modification, the hexagon head bolt heads may interfere with the bearing cover inner face. In case of overhauling the compressor produced before October, 2011, do not change the lock washer to the conical spring washer.

5.5.7.4 Installing the Balance Piston

Install the balance piston [30] on the M rotor shaft (suction cover side).
Then, use the external snap ring pliers to install the snap ring [32], and fix it in position.
Check that the snap ring is fully seated in the groove.



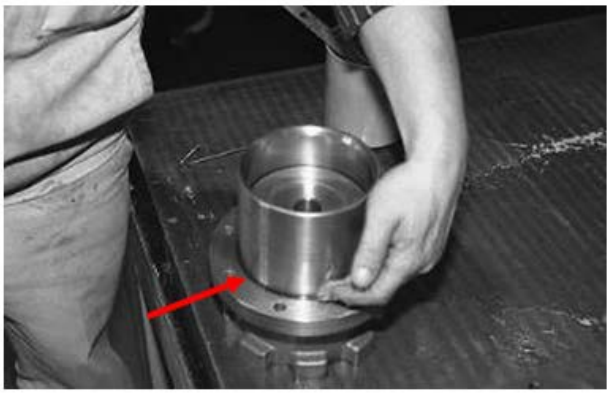
5.5.8 Balance Piston Cover and Unloader Cylinder

The assembly work of this block will become easier if the unloader cylinder is first installed on the balance piston cover [22] and then the resulting assembly is installed on the suction cover [5].

a) Install the O-ring [63] in the O-ring groove on the machined surface of the balance piston cover along which the unloader cylinder is installed.

【POINT】

The fitting position of this O-ring [63] has been changed in Oct. 1996 to the current position shown in following picture to the right from the previous flange surface of the unloader cylinder (following picture to the left).



b) Align the position of the balance piston cover with the unloader cylinder. As no gasket is used on the mating flange between the balance piston cover and unloader cylinder, evenly and thinly apply liquid gasket (made of special synthetic rubber) on the surface of the flange of the unloader cylinder inside from the center of the bolt holes.

c) As the O-ring of the balance piston cover is already installed, lightly tap the flange surface with a soft hammer to install it.

d) When joining the flanges, also align the bolt hole positions if any positioning steel rod is not used. Then, insert two hexagon socket head cap screws [61] in the positions shown in the picture to the right and to fasten the unloader cylinder to the balance piston cover.

e) Install the O-ring [73] in the O-ring groove on the tip of the unloader push rod [67], at the position where the unloader piston is installed.

f) Install the unloader positioning spacer [420] in the unloader push rod [67], and push it to the bottom. How to install the unloader positioning spacer varies depending on the compressor models as shown in Table 5-11 in next page.

Table 5-11 Unloader Positioning Spacer with Model

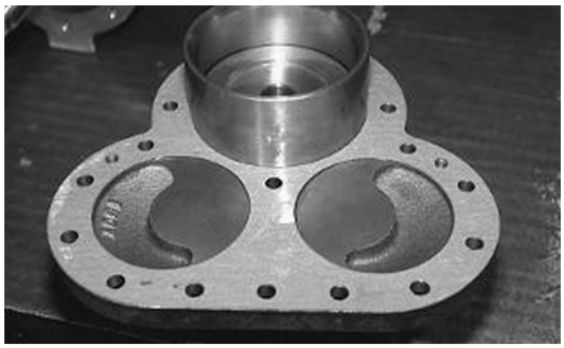
Model	Quantity	
	Positioning Spacer【420】	O-ring【421】
250VLL*	-	-
160 to 250VL*	-	-
160 to 250VM*	1	2
160 to 250VS*	1 (PTFE)	-
320VLD	1	2
320VMD	1	2
320VSD	1	2

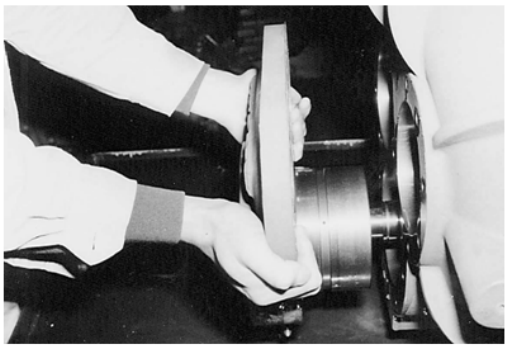
g) Attach the O-ring [65] without lubricating oil on the unloader piston [64], and then install the cap seal [66] on it. It can be smoothly installed by slightly folding the cap seal along the circumferential direction. Also, using a small and smooth spatula (following picture to the left) will facilitate the assembling work.

h) Install the unloader piston fitted with the O-ring and cap seal in the unloader cylinder. One side of the unloader piston is with screw holes for eye bolts, while the other side does not have such holes. First, to make it easier to fit the cap seal on the wall, lightly press one side of the piston onto the chamfered area of the unloader cylinder by hand, changing the side of the piston for several times. Finally, apply lubricating oil to the unloader cylinder, then, push and install the piston with the screw holes side of the piston facing the unloader cover. After the installation, check that the cap seal is not broken or pinched.

i) Push the unloader piston into the unloader cylinder and set it in the middle of the cylinder, pull the unloader push rod [67] toward yourself, and install the balance piston cover with the gasket fitted as shown in following picture to the left onto the suction cover (following picture to the right).

Pushing the piston into the push rod and temporarily fastening the lock nut [69] in the course of the work will make later work easier.





j) After setting the flanges of the suction cover and balance piston cover together, tighten the hexagon socket head cap screws [24] for the balance piston cover and the same ones [62] for the unloader cylinder, the specified torque respectively.

k) Use the eye bolts to pull the piston toward yourself, once remove the temporarily fastened lock nut, install the lock washer [70] and lock nut [69], and then tighten the lock nut at the specified torque.

To prevent loosening, bend the claw of the lock washer at the notch of the lock nut.

m) Lastly, use the M8 eye bolts to check the smooth movement of the piston (slide valve).

5.5.9 Unloader Cover

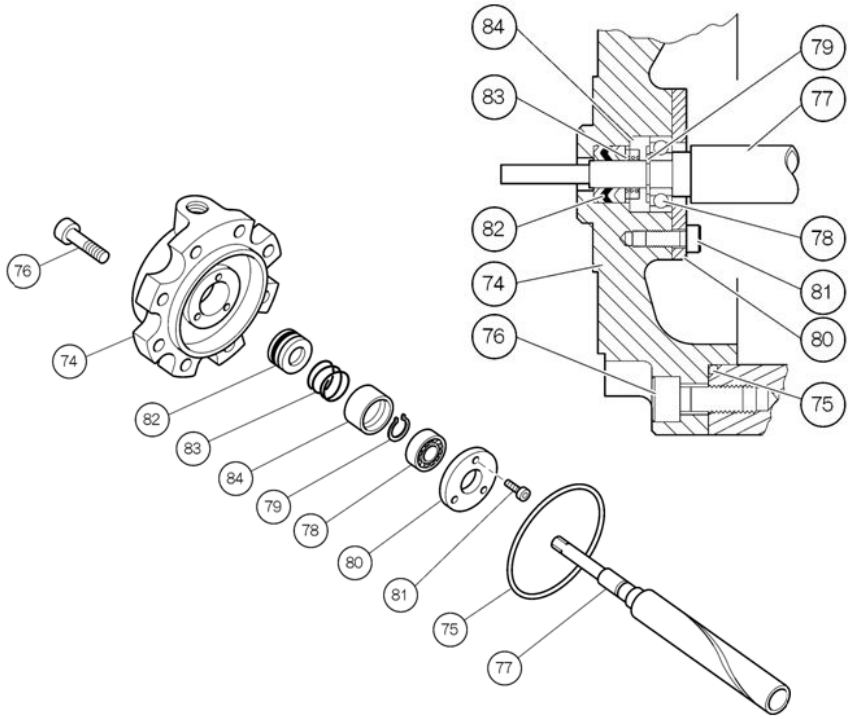


Figure 5-18 Unloader Cover Block

a) Use eye bolts to move the unloader piston back and forth to check the normal operation again.

b) Assemble the ball bearing [78] on the shaft portion of the indicator cam [77]. When fitting the bearing onto the shaft, push the inner race of the bearing. Pushing the outer race may damage the bearing. Push the bearing to the stepped portion of the indicator cam and retain the bearing with the external snap ring [79].

c) Sufficiently apply oil on the unloader cover [74], and install the V-ring set [82] in it. One of the rings of the V-ring set (i.e., dark colored one) is made of rubber to improve the sealing performance, and is placed as the second item from the outside as shown in Figure 5-18.

   The orientation of the V-ring must be such that the apex of the V-shape faces the outside and the lips face inside.

d) Install the spring [83] and the spring retainer [84] into position. Then, insert the shaft of the indicator cam assembled in Step b) above into the V-ring. Lastly, fasten the bearing gland [80] onto the unloader cover to retain the bearing.

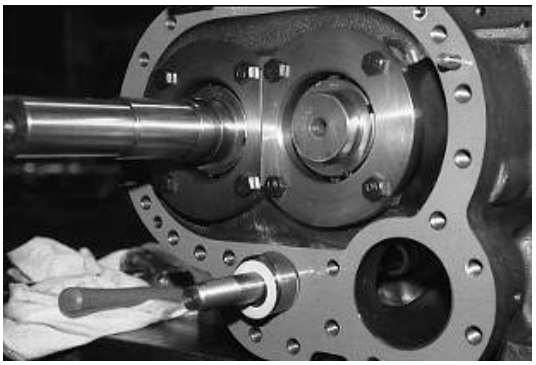
e) After making sure that the indicator cam rotates smoothly, attach the O-ring [75] to the unloader cover.

f) Install the unloader cover on the unloader cylinder [60]. Making sure that the guide pin [68] of the unloader push rod [67] is well engaged in the spiral groove of the indicator cam, push-in the unloader cover.

   With the oil supply hole for the unloader operation up, secure the unloader cover by fastening the hexagon socket head cap screws [76] at the specified torque.

5.5.10 Bearing Cover

a) Install the thrust washer [449], as shown a red arrow in following picture to the left, on the Vi adjusting rod. In case of 320V*D models except other models are installed the Vi adjusting rod retainer [600] as shown in following picture to the right.



b) Before installing the bearing cover [16], check that the claw of the lock washer of the thrust bearing block have been properly bent to prevent rotation and that the hexagon head bolts fastening the thrust bearing gland are with conical spring washers.

c) For ensuring the safety, screw two stud bolts in the upper bolt holes on the flange of the bearing head [11].

d) After applying sufficient amount of oil, etc. on the flange surface of the bearing head as well as on both sides of the gasket [17] for the bearing cover, attach the gasket onto the flange surface, and retain the gasket by hanging at the upper stud bolts.

CAUTION

- **The bearing cover gasket is not symmetric because there is a hole for lubricating oil line to the mechanical seal block in the left (seal) side.**
  Be careful that do not mistake the direction of the gasket when attaching onto the bearing head flange surface. Mistaken the direction of the gasket causes the lubrication failure to the mechanical seal block.

e) In case of 160V** and 200V** models, holding the bearing cover by your hand and install it on the bearing head. Sideways discharge type compressors have uneven balance so care must be taken when working on them.

For the 250V* and 320V*D models, the bearing cover has a threaded hole for installing a eye bolt in its center-of-gravity position. Screw an eye bolt into this threaded hole, and lift up and install the bearing cover to the bearing head. At this time, while keeping the clearance between the two components' peripheries, make sure not to damage the M rotor's installation area of the Mechanical seal assembly.

f) After correctly setting the position of the alignment pins, lightly tap the flange at different places alternately using a copper hammer or soft hammer to install the cover in position.

g) When the cover has come to the position the bolts can be screwed in, screw in two or three hexagon socket head cap screws and evenly tighten them to reduce the clearance and make the cover contact the bearing head. Then, tighten all the bolts at the specified torque.

CAUTION

- **Since fastening bolts for the bearing cover are used two or three kinds of bolt lengths depending on the models and fitting positions, make sure to confirm the bolt differences in your assembly work of this block.**

5.5.11 Shaft Seal Block

The BBSE (balance bellows single) type of the mechanical seal assemblies used in current standard MYCOM screw compressors as standard specification.

There are other cases where the BOS (balance O-ring single) type seals are used, according to the specification by the customer.

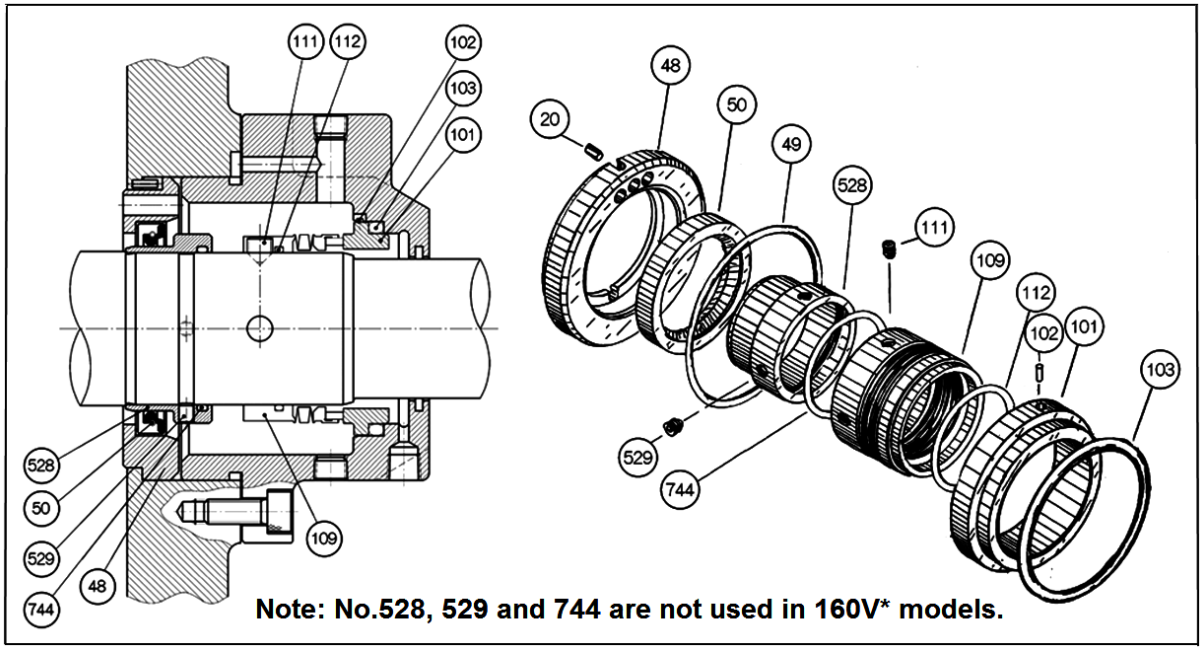


Figure 5-19 BBSE type Mechanical Seal Assembly and Related Parts

a) Before installing the mechanical seal, clean the seal installation area on the rotor shaft. In particular, immediately prior to the assembly, check again that no flaw is present on the step area of the shaft where the seal is to be installed.

b) Install the oil seal [50] on the seal retainer [48]. The installation orientation of the oil seal has been reversed in November 2002 as a design change. While the oil seal had been installed with the oil seal lip facing the direction of the atmosphere, the direction was reversed. This is because excessively high pressure should be avoided by helping the escape of oil from the seal box.

Using a Teflon block or the like as a pad (right above picture), lightly hit the pad to push the oil seal evenly into the retainer until it is fully seated. Once the oil seal is fully inserted, you can easily sense it as the hitting sound as well as the response will change.

After the installation, check that the level difference with the retainer is uniform and that the oil seal is evenly inserted by observing the condition from the opposite side.

c) Insert the O-ring [744] into the inner circumference of the oil seal sleeve [528], and install the sleeve into the oil seal retainer with an O-ring inserted as shown in the right picture.

Note: The oil seal sleeve is not used in 160V** models.

d) Install the oil seal retainer with the oil seal and sleeve (in case of 160V** models, install the oil seal retainer with the oil seal) along the rotor shaft using two M8 eye bolts. At this time, position the oil escape hole of the oil seal retainer on the upper side of the rotor shaft, and accurately align the notch in the retainer with the position of the spring pin [20] that is driven in into the bearing cover to prevent its rotation.

   After the installation, check that it is securely fixed by trying to rotate the retainer with the eye bolts. If the position is correct, the retainer will not rotate.

e) Secure the oil seal sleeve using two set screws [529] on the rotor shaft.

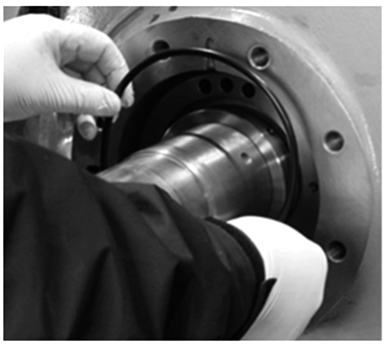
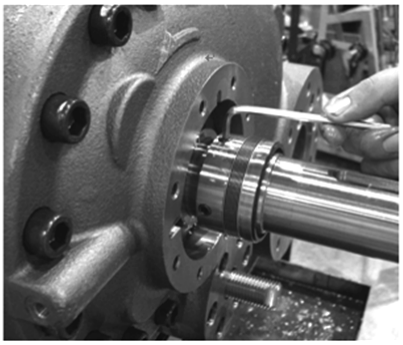
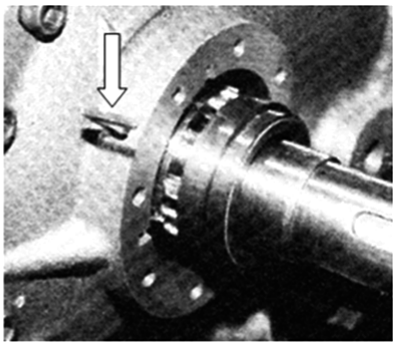
f) Then, insert the O-ring [49] for the oil seal retainer (following picture to the left).

CAUTION

- **You should be particularly careful on this point, as the O-ring [49] for the seal retainer is often forgotten to be installed.**

g) Insert the O-ring [112] on the inner circumference of the seal collar [109], and install the seal collar on the rotor shaft. Before the assembly, apply sufficient lubricating oil onto the rotor shaft and the seal in such a way to wash out dust and stains. Push in the O-ring [112] carefully not to damage it by the step on the rotor shaft (following picture to the left).

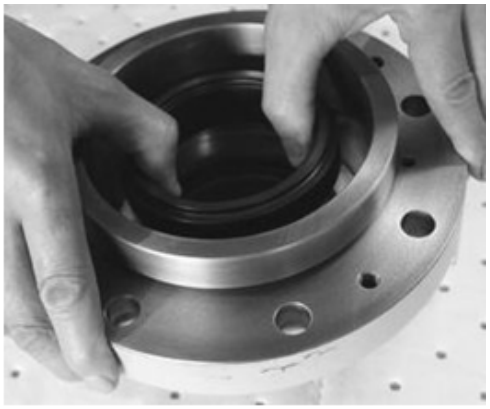
h) Fasten the seal collar on the rotor shaft by screwing the two seal collar set screws [111] at the countersinks on the rotor shaft (following picture to the middle and the right). Failing to fasten the screws at the countersink positions will damage the rotor shaft, and it can cause a leakage.

CAUTION

- **Fastening the set screws for the 160V** models seal collar using the machining hole of the bearing cover (see the white arrow part in the picture above to the right) . After fastening the set screws, do not forget fitting the plug.**

i) Install the O-ring [103] for the mating ring and the mating ring [101] on the seal cover [51] (right picture).



j) Apply oil on the seal cover gasket [52] and attach it to the seal cover flange by carefully aligning the oil hole position on the gasket and the one on the flange.

- ◆ In case of the standard internal oil supply system for the shaft seal block, oil is first sent from the bearing cover to the seal cover through the oil supply hole machined on them, then from the notch in the seal cover to the upper part of the seal cover through a groove, and lastly supplied from the oil supply hole in the seal cover to the upper part of the sliding surface of the mechanical seal.

k) Apply and flow sufficient lubricating oil on the sliding surface of the mechanical seal assembly.

m) Install the seal cover with the gasket such that the oil drop tube comes to the bottom side.
At this time, carefully install the seal cover not to hit the mating ring in the seal cover with the rotor shaft. For this, hold the seal cover at the right angle to the rotor shaft or only slightly incline it such that the top side follows the bottom side.

n) At a midway point, the sliding surface of the seal ring comes in contact with that of the mating ring. At this point, use a taper gauge (right picture) to check the clearance between the surfaces of the seal cover gasket and the bearing cover flange.

This clearance is called "fastening margin" of the seal, and is used as a guideline in determining the sliding surface pressure between the rotating ring and stationary ring of the seal. In case of the BBSE type seals for SCV-series, make sure that this value is in the range shown in Table 5-12.

Table 5-12 Fastening Margin of the Seal （mm）

Seal type	160V**	200V**	250V**	320V*D
BBSE	2.0 to 3.0	2.0 to 3.0	3.0 to 4.0	3.5 to 4.5

o) If it is confirmed that the fastening margin of the seal is appropriate, firmly press the seal cover onto the bearing cover. While you will feel the reaction of the seal bellows, keep pressing the cover and fasten two hexagon socket head cap screws [53] evenly to secure the seal cover at opposite positions separated by 180°. When there is no clearance between the surface of the flange and gasket, tighten all other bolts at the specified torque.

p) After tightening the seal cover, supply oil into the seal cover while rotating the rotor shaft (right picture).

After this, do not forget attaching the plug for the oil supply hole of the seal cover.

5.5.12 Unloader Indicator

The specifications of the unloader indicator for SCV-series has been changed from December 2014 Moriya factory production.

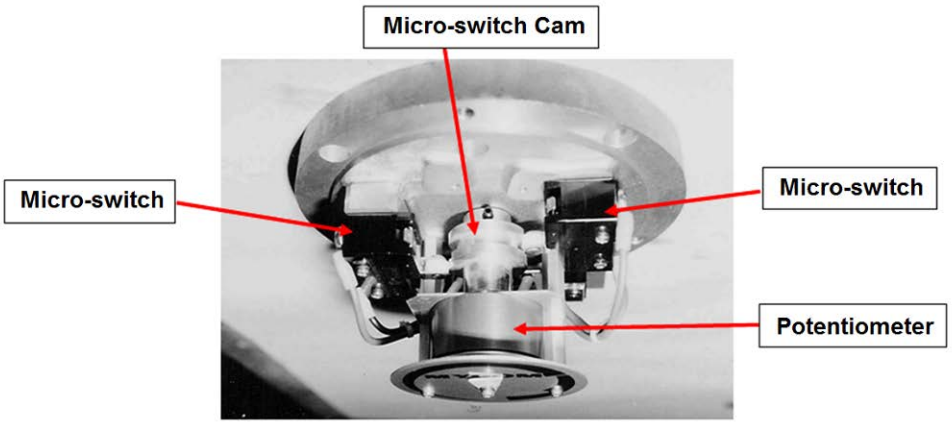
For details of the new indicator specifications indicator after change, refer to the separately dedicated manual. In this manual, previous standard type indicator is the described.

The unloader indicator is implemented with micro switches, micro switch cam, and potentiometer. These parts are used to detect the change in the rotation angle of the indicator cam shaft, which converts the axial position change of the unloader slide valve into rotational position change, convert the change into an electric signal, and send the signal to the package unit and/or the controller of the refrigeration system.

To check the unloader indicator after inspection, adjustment, or parts replacement, coordination with the controller side will be required. Even in a case where the compressor is carried out of the installation site for overhaul, the indicator assembly is often removed from the compressor (to be kept at the site) and the inspection/adjustment and parts replacement are performed at the site. Thus, this section provides a detailed procedure, which may be helpful after the reassembly work.

WARNING

- **When removing the indicator block or performing inspection/adjustment or parts replacement, be sure to shut down the control power and use lock-out and tag-out procedures. If the power is not shut down, there is a risk of electric shock.**



5.5.12.1 Potentiometer

The potentiometer of the indicator is a full-turn potentiometer, and it is used to feedback the unloader slide valve position, in the form of electric signal, to the control system of the package unit or refrigerator system to complete the feedback control system to enable non-incremental, indicated load 0 to 100% continuous control of the load. While the expected service life of the potentiometer will significantly vary depending on the installation environment of the compressor (e.g. corrosive gas atmosphere, moisture, etc.) and operational conditions (e.g. frequent partial load operations, frequent start/stop operation, vibration, etc.), the potentiometer is a consumable part that requires regular replacement according to the situation.

■ Inspection

a) Check at the terminal block that the lead wires of the potentiometer are not loosened.

b) Check for any crack or other defects in the soldering of the lead wires of the potentiometer.

c) Manually rotate the shaft of the potentiometer and measure the resistance value using a circuit tester to check that the resistance value changes smoothly.

5.5.12.2 Micro-switches and Micro-switch Cam

The traditional standard unloader indicator uses two micro-switches and one micro-switch cam to detect the indicated 0 % and 100 % capacity control positions of the unloader slide valve.

If the micro-switch fails or any of these connections becomes loose for some reason, correct position detection cannot be made, and it causes a problem in the operation control of the compressor.

■ Inspection

a) In the normal condition where the hydraulic line for the capacity control of the compressor is not opened, set the unloader piston to the no load and full load positions from the manual capacity control circuit and check the operation of the control circuit to see if the micro-switch can detect the 0 % and 100 % positions of the micro-switch cam (i.e., by checking the operation of the relevant relays and contacts).

b) After shutting down the control power and carrying out the lock-out and tag-out procedures, remove the indicator glass and check that the micro-switch mounting screws [126] are not loosened.

c) Check that the hexagon socket head cap screw (set screw) securing the micro-switch cam [127] are not loosened.

d) After checking that the wiring for the micro-switch has been removed, turn on and off the switch to check the normal switching operation of the micro switch using a circuit tester.

e) If the hydraulic line for the capacity control of the compressor is opened for overhaul or other work, use nitrogen gas or compressed air to set the unloader piston to the no-load and full load positions and check if the micro-switch can detect the 0 % and 100 % positions of the micro-switch cam.

f) Carry out other visual inspection including any indication of water intrusion in the indicator, any rust on switch terminals, any wear of the switch roller or micro-switch cam, and so on.

5.5.12.3 Reassembly

To carry out the reassembly, follow the disassembly procedure in reverse. Lastly, correctly adjust the indicator needle position according to the following procedure:

a) If the hydraulic line for the capacity control of the compressor is opened for the purpose of overhaul or other work, use nitrogen gas or compressed air to set the unloader piston to the no-load position. Then, set and fix the indicator needle to the origin of the figure to show the rotation on the dial.

   Next, set the piston to the full load position. Make sure the indicator needle points to the end point of the figure on the dial.

b) In the normal condition where the hydraulic line for the capacity control is not opened, use the manual capacity control circuit to move the piston.

   While the control power is turned on, the indicator cover must be mounted to prevent possible electric shock.

   Then, after the piston position is fixed, control power is turned off, and the lock-out and tag-out procedures are completed, remove the indicator cover and secure the indicator needle in position.

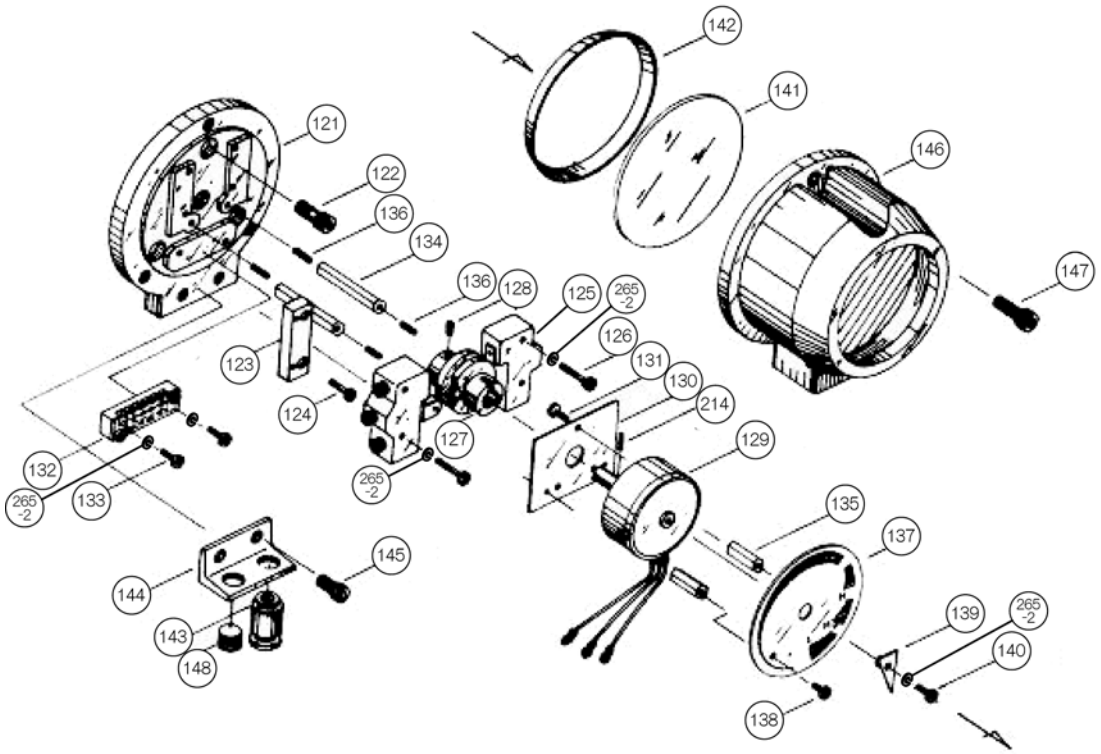


Figure 5-20 Exploded View of the Unloader Indicator (Traditional standard type)

Table 5-13 Component Parts of the Unloader Indicator (Traditional standard type)

P/N	Part Name	Q'ty	P/N	Part Name	Q'ty
121	Micro-switch base plate	1	136	Hexagon socket set screw, M3×14	3
122	Hexagon socket head cap screw, M6×20	3	137	Dial, SCV	1
123	Micro-switch base plate	1	138	Phillips Screw, M3×5	2
124	Phillips Screw, M3×10	2	139	Indicator needle	1
125	Micro-switch	2	140	Phillips Screw, M3×10	1
126	Phillips Screw, M3×25	4	141	Indicator glass	1
127	Micro-switch cam, 0 to 100%	1	142	Indicator glass spacer	1
128	Hexagon socket set screw, M4×8	1	143	Electric cable gland	1
129	Potentiometer	1	144	Bracket	1
130	Potentiometer mounting plate	1	145	Hexagon socket head cap screw, M6×15	2
131	Phillips Screw, M3×5	3	146	Unloader indicator cover	1
132	Terminal block	1	147	Hexagon socket head cap screw, M6×15	3
133	Phillips Screw, M3×20	2	148	Plug	1
134	Dial plate support [2]	2	214	Spring pin 2 dia. ×8	1
135	Dial plate support [1]	2	265-2	Spring washer, M3	7

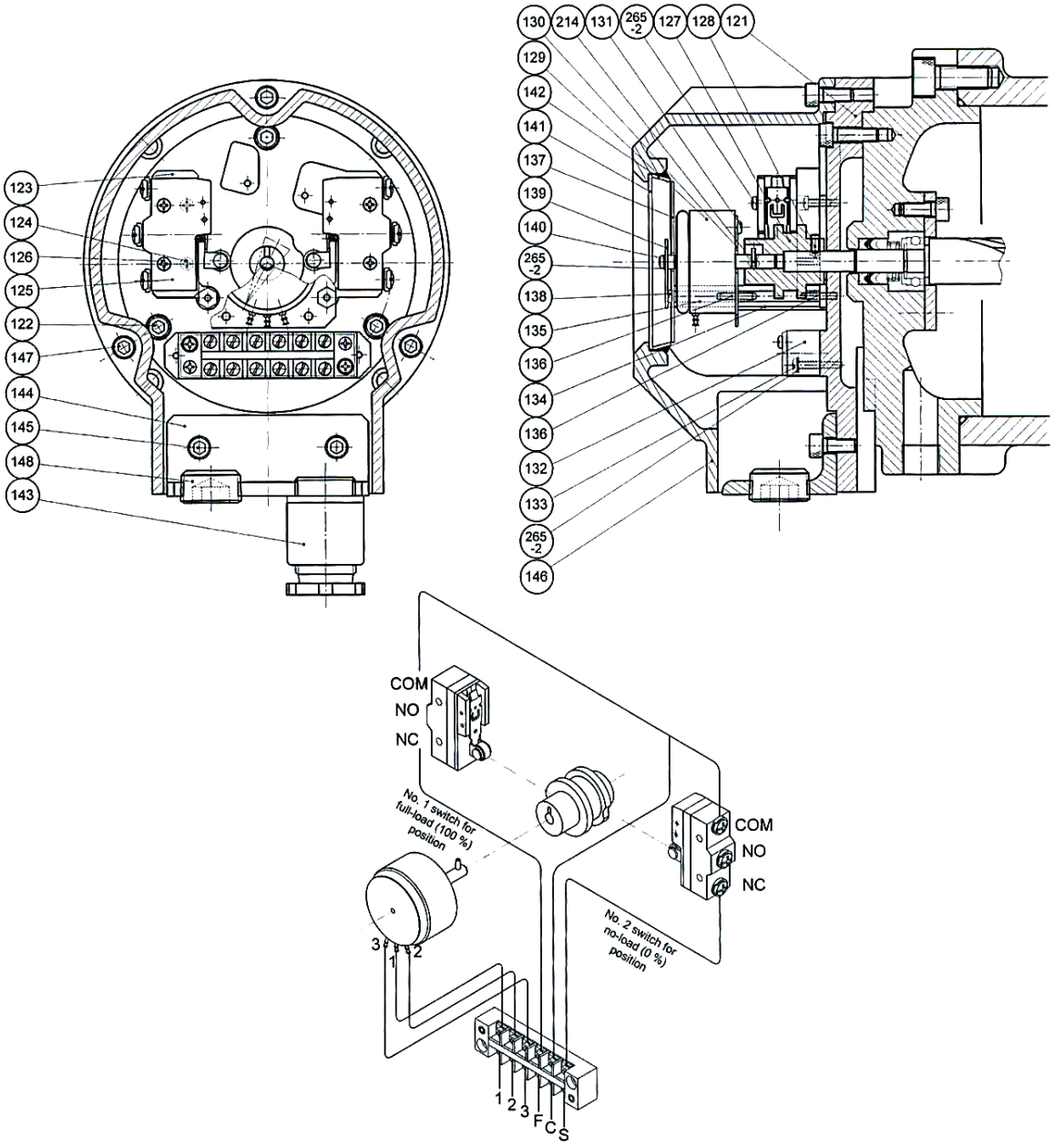


Figure 5-21 Sectional Views of SCV-series Unloader Indicator (Traditional standard type)

Chapter 6 Troubleshooting

Table 6-1 Troubleshooting

	Trouble	Direct causes	Factors	Actions
01	Compressor does not startup	Power source is off.	Power source not turned on after inspection.	Prevent oversight by checking a check sheet after inspection.
		Main motor malfunction	Most cases are due to overload protection circuit.	Refer to the motor instruction manual as well for other causes and actions.
		Capacity control of 0% undetected by unloader indicator	Malfunction of micro-switch	Replace micro-switch.
		Capacity control hydraulic circuit defect	Maladjustment of oil flow control valve (decreased too much)	Readjust.
			Leak or clogging in pipes and solenoid valves	Remove factors. Check oil contamination level and replace oil if necessary.
		Unconfirmed hydraulic pressure	Malfunction in hydraulic pressure protection device, pressure sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
			Clogging in connecting pipes	Remove clogging. Check oil contamination level and replace oil if necessary.
		Unconfirmed cooling water circulation	Malfunction in devices such as cooling water pumps and related circuits	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
			Clogging in circulation routes	Remove clogging.
		Malfunction in magnets, relays, etc., in compressor start circuit	Aging degradation	Replace with new devices.
			Bad installation environment	Replace ventilation fans, etc, if malfunctioning. Improve temperature, humidity, and ventilation for installation site.
02	Compressor stops immediately after startup.	Low pressure protection circuit (switch) activated	Insufficient refrigerant circulation volume • Insufficient refrigerant amount • Insufficient refrigerant supply • Heat exchange failure at heat exchanger	For insufficient refrigerant amount, check the system and stop leak, and then recharge refrigerant. * Be cautious about moisture contamination in the system.
				For insufficient supply, inspect expansion valves and liquid supply strainers, and then take necessary measures. Also, inspect devices and parameters (setting values) for expansion value aperture (opening) adjustment device, and then take necessary measures..

	Trouble	Direct causes	Factors	Actions
02	Compressor stops immediately after startup.	Low pressure protection circuit activated	Insufficient refrigerant circulation volume	If any heat exchange failures as typified by poor defrost performance, investigate the cause and take measures.
				For malfunction in pressure regulating valve operation, replace pressure regulating valve, or remove the cause.
			Malfunction of low pressure protection device, pressure sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
		Motor overload	In many cases, motor overload that occurs just after startup is caused by the motor, not by the refrigeration cycle. Refer to the motor instruction manual.	
03	Abnormally low pressure (low suction pressure)	Refer to the direct causes “Low pressure protection circuit activated” in item 2.	Same as on the left	Same as on the left
04	Low oil-supply pressure	Clogging in oil filter element * Big difference in outlet/inlet pressures	Contamination of lubricant	Remove clogging. Check oil contamination level and change lubricant as necessary.
			Defect inside compressor	Check oil contamination level. After vibration noise diagnosis, overhaul compressor as necessary.
		Insufficient oil amount in oil separator	Malfunctioning oil heater, excessive refrigerant dissolution during stoppage, thus resulting in oil carry over during startup.	Inspect oil heater. Inspect relays, etc., on related circuits. And replace parts as needed.
			Insufficient oil return caused by insufficient refrigerant circulation	Resolve insufficient volume of refrigerant circulation, and then return oil from load side heat exchanger. * Charge lubricant temporarily.
			Troubles such as clogging in oil return circuit	Remove any causes of trouble to restore.
			Extensive oil leak	Inspect machine room and around compressor and take measures. Inspect for presence of oil floating in cooling water system. If there is any oil floating, check for oil leak in oil cooler heat exchanger tube, and take measures.
				For damage in pipes, etc., caused by excessive vibration, take vibration reduction measures (including sympathetic vibration measures).

	Trouble	Direct causes	Factors	Actions
04	Low oil-supply pressure	Defect in hydraulic pressure detection divices.	Malfunction in hydraulic pressure protection device(switch), pressure sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
			Clogging in the tubing for oil pressure protection switch.	Remove clogging. Check oil contamination level and replace oil as necessary.
05	Abnormal high pressure (abnormal discharge pressure)	Heat exchange failure at condenser (heat exchanger)	Contaminated and blocked heat exchanger tubes, fins, etc.	Clean and wash them. Use solvent to clean depending on contamination.
			Malfunction of fan motor, thermo-switch, water spray bars, cooling water pumps, etc. (including shortage or out of water)	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
			Flow volume adjustment failure of cooling water, brine, etc.	If regulating valve is manually adjusted, readjust it. If an automatic control valve (including wax valve) is used, examine its cause and take measures.
			Other causes of insufficient circulation volume of cooling water, etc.	Inspect for clogging and contamination of filters for circulation route filters, and take measures as needed. Inspect for leak in circulation routes, and take measures if any. Inspect water supply routes and systems, and take measures as needed. If frozen, resolve by better insulation or heating.
			Shortage in capacity of heat exchanger.	If the trouble is caused by change in operating conditions, re-examine the conditions to improve. If the trouble is caused by change in installation environment, improve the environment if possible. For both cases, if it is difficult to improve, add more heat exchanger or increase their sizes.
		Uncondensed gas in the system	Intake air to low pressure side through pinholes, cracks, corrosions and other defective areas.	Inspect for leak, and take necessary measures. Then, air purge the heat exchanger.

	Trouble	Direct causes	Factors	Actions
05	Abnormally high pressure (abnormal discharge pressure)	Excessive refrigerant charge	Repetitive refrigerant charge by mistaking insufficient cooking as a lack of refrigerant in the system.	Adjust refrigerant to proper amount.
			Insufficient capacity of heat exchanger	If the trouble is caused by change in operating conditions, re-examine the conditions to improve. If it is difficult to improve, add more heat exchangers or increase the size.
		Defect in discharge pressure detection feature	Malfunction in abnormal high pressure protection device(switch), pressure sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
			Liquid stoppage, etc, by clogging in the tubing for high pressure protection switch.	Remove clogging. Check oil contamination level and replace oil as necessary.
		Closed outlet stop valve for oil separator	Neglected to restore after closing. Human error	Open valve or stop immediately. Make sure to perform tagout during valve operation. Make sure to perform a valve check before starting compressor.
06	Abnormally high discharge temperature	Overheating during operation	Insufficient refriger-ant circulation	Refer to Factors of item 02.
			Heat load on system load side is higher than design value.	Inspect the situation on load side (loading volume, opening and closing of doors, etc.), and take necessary measures.
			Malfunction in low pressure protection device, pressure sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
		Non-condensable gases in the system	Intake air to low pressure side	Inspect for leak, and take necessary measures. Then, air purge the heat exchanger.

	Trouble	Direct causes	Factors	Actions
06	Abnormally high discharge temperature	High oil supply temperature	Heat exchange failure in oil cooler	For water-cooled oil cooling, refer to “Heat exchange failure at condenser (heat exchanger)” in item 05. For liquid-injection oil cooling, inspect liquid supply expansion valve, temperature sensor, related relays, wiring, terminals, etc., and take necessary measures.
			Failure in oil temperature increase protection feature	Inspect temperature protection device (switch), temperature sensor, related relays, wiring, terminals, etc., and take measures.
		Defect in discharge temperature detection and protection devices	Malfunction in temperature protec-tion device, temperature sensor, relays, etc.	Identify malfunctioning devices, examine their causes, and take measures. Then, replace malfunctioning devices.
		Insufficient supply oil	Refer to item 04, “Low hydraulic pressure (low oil-supply pres-sure)”.	Same as on the left
07	Leak from mechanical seal	Initial leak after replacement until mating surface(seal and shaft) fit each other.	Initial wear stage of mating surface.	For initial leak, amount of leak might increase temporarily. However, it will gradually decrease, so check that the amount of leak does not increase continuously. Period of initial leak might differ according to design and operating conditions. 200 hours can be a rough guide.
		Damaged sliding surfaces due to excessive heat of sliding surfaces	Most cases are due to excessive repetition of compressor start/stop. * Under normal operating condition, more than 4 times /h is considered as excessive.	If heat load is below the design operating conditions, re-examine the conditions and set the control settings to fewer start/stop times.
				For capacity control malfunctions, see item 10, “Capacity control malfunction”.
			A lot of refrigerant mixed into the lubricant, resulting in decreased viscosity.	For liquid backflow operation, remove the causes. For malfunction of oil heater and other devices on control circuit, replace them.
			Overheat operation	Refer to Factor “Insufficient refrigerant circulation volume” in item 02.
			High supply oil temperature	Refer to the Direct cause “High supply oil temperature” in item 06.

	Trouble	Direct causes	Factors	Actions
07	Leak from mechanical seal	Long stoppage period (no oil film on sliding surfaces)	Due to user's specific conditions, such as heat load being intermittent.	If stoppage period becomes more than one week, manually operate oil pump as well as manually turn compressor rotor shaft, or equip external seal portion with oil pot.
		Deteriorated parts	Hardened O-ring	For aging degradation, replace O-ring. For other specific causes, the same factors and actions described above of "Damaged sliding surface due to excessive heat of sliding surface" can be applied.
			Swelled O-ring * Occurs in excessive refrigerant dissolution oil	For liquid backflow operation, remove the causes. For malfunction of oil heater and other devices on control circuit, replace them.
			Deteriorated seal ring or mating ring	For aging degradation, replace parts. For other specific causes, the same factors and actions described above of "Damaged sliding surfaces due to excessive heat of sliding surface" can be applied..
		Incompatibility between operating conditions (working temperature ranges, refrigerant, etc.) and lubricant	Inappropriate lubricant or change in operating conditions since installation of compressor.	Re-examine operating conditions if possible. If not, refer to Chapter 4.1, "Lubricant (Refrigerant Oil)", and re-select lubricant and replace all amount of current lubricant with new type.
		Inappropriate contact conditions of sliding surfaces	Foreign matter attached to sliding surfaces due to contamination of lubricant	Exchange all lubricant. Equip oil supply line with bypass filter.
			Faulty parts attachment Human error	Overhaul compressor to replace parts, and reassemble it. Check using assembly check sheet.
08	Squeaking sound from mechanical seal part	During initial period after replacement until sliding surface fits each other, squeaking sound caused by contact of sliding surfaces might be heard.	Sliding surfaces is high in hardness as well as in density, so it takes a while for them to fit each other.	Squeaking itself does not cause seal leak or functional deterioration of seal. Squeaking normally subsides after few dozens of hours, but it could continue in rare cases. →In this case, contact our service centers.

	Trouble	Direct causes	Factors	Actions
09	Faulty indication of capacity control posi-tion	Imprecision in compressor indicator	Loose screws for indicator	Manually tighten screws to the 0 % indication position of compressor capacity control.
		Imprecision in controller capacity control indicator	Worn groove of compressor indicator cam	Most cases are due to prolonged partial load operation. In this case, replace indicator cam. * Indicator cam that is currently manufactured has reinforced groove.
			Worn guide pin (dowel pin) of com-pressor push rod	Guide pin of compressor push rod is currently reinforced as well. However, if only indicator cam has reinforced groove, wear of guide pin might occur. Replace dowel pin.
			Malfunction in potentiometer	If cased by aging degradation or prolonged partial load operation, replace potentiometer. If cased by excessive vibration of compressor, take vibration reduction measures, and then replace parts.
			Maladjustment of zero point and span adjustment for E/E positioner	Readjust it.
			Malfunction of E/E positioner or its indicator	For aging degradation, replace E/E positioner. For unique causes such as surge current, remove the causes or take measures.
			Loose terminals or faulty wiring	For loose terminals, tighten them. For faulty wiring, replace it.
10	Capacity control malfunction	Refer to each factor in “Imprecision in controller capacity control indicator” above.	Same as on the left	Same as on the left
		Undetected 100 % or 0 % by indicator	Malfunction of micro-switch	Replace micro-switch.
		Malfunction of unloader solenoid valves or related relays, etc. for capacity control	Most cases are due to coil burnout.	For aging degradation, replace parts. For water leakage, etc., remove the cause and replace parts. Refer to the solenoid valve instruction manual for details.
		Internal leakage of unloader solenoid valves for capacity control	Expanded oil and refrigerant liquid trapped inside unloader cylinder due to temperature increases.	If caused by prolonged low load operation, improve by re-examining the operation method. Install a capacity control hydraulic line with an in-line check valve (internal reversal-stoppage valve) and an oil bypass line.

	Trouble	Direct causes	Factors	Actions
10	Capacity control malfunction	Capacity control hydraulic line defect	Maladjustment of oil flow controller valve	Readjust it.
			Leak and clogging in solenoid valve gland and oil pipes	Remove factors. Check oil contamination level and replace oil as necessary.
		Unloader piston does not move. (A defect of the capacity control hydraulic line is one of the causes, but described separately.)	Damaged cap seal for unloader piston	Check oil contamination level and replace oil as necessary. Replace O-ring, cap seal, etc.
			Pinched cap seal	Replace O-ring, cap seal, etc.
			Worn cap seal	Check oil contamination level and replace oil as necessary. Replace O-ring, cap seal, etc.
			Refrigerant gas retention in unloader cylinder	Stop compressor. Operate oil pump and repeat loading and unloading to purge refrigerant gas from cylinder. For liquid flow-back operation, remove the causes. For malfunction of oil heater and other devices on control circuit, replace them.
11	Abnormal vibration and/or noise of compressor	Insufficient alignment between compressor shaft and motor shaft	If vibration value is higher in the axial direction, insufficient alignment might be the cause.	Realign the shaft-center. If abnormal vibration and noise frequently occur in monocoque unit, hot alignment is recommended. (operate compressor at design conditions once to increase shaft temperature and realign before the temperature decreases).
		Large axial runout of Male rotor	Uneven tightening for thrust bearing glands	If loose locknuts exist and no other fault is found in parts such as thrust bearing, tighten locknuts evenly.
			Loose thrust bearing	Forgetting to bend lock washer claw or wear of thrust bearing rolling element (ball) can be considered. →Check for any defects in thrust bearings. If there are any defects, replace it. Then perform end clearance adjustment as well as axial runout check, and reassemble it.
			Imprecision in dynamic balance of rotors	If no other causes for abnormal vibration are found, and if on-site overhaul has been repeatedly performed, imprecision in rotor dynamic balance might be the cause of abnormal noise and vibration. If this is the case, overhaul and inspect compressor where rotor dynamic balance measurerment and adjustment is feasible.

	Trouble	Direct causes	Factors	Actions
11	Abnormal vibration and/or noise of compressor	Oil hammer	Continuous low load operation at below 30 % of capacity control	During low load operation, lubricant is poorly discharged. Because of this, the amount of oil that remains inside rotor mesh increases and oil becomes compressed. →Avoid continuous low load operation. * Especially for light gas such as He and NH_3, 10 minutes low load operation has a negative effect. For fluorocarbons, low load operations of more than 30 minutes are not recommended
		Liquid flow-back during startup * Initial abnormal noises are conspicuous. →If this phenomenon happens, in some cases, compressor gets instantly damaged.	When compressor is stopped, refrigerant is liquefied and remains in upstream piping.	This is due to various factors such as a leak inside the liquid supply solenoid valve on load side, insufficient heat exchange (refrigerant evaporation) in heat exchanger, or liquid trapping caused by wrong piping in piping route. →Identify the causes (more than one may exist), and take measures. Then, perform an overhaul of the compressor.
		Liquid flow-back during operation * Frosting on suction side is conspicuous. * In many cases, the phenomenon is often “mist-back” (suction of moist steam) rather than liquid flow-back. * To prevent this phenomenon, gas-liquid separator (accumulator) can be installed. * Refer to Factor “Insufficient refrigerant circulation volume” in item 02 as well.	Opening for liquid supply expansion valve is too large.	For temperature type expansion valve, inspect temperature sensitive cylinder and capillary tube. Take measures if any defects are found. For incompatible orifice due to the change in operating conditions, replace orifice.
				For electronic expansion valve, inspect devices on expansion valve opening control devices (circuit) such as temperature sensor, converter, controller (over-heating regulator). If any defects are found, replace the faulty devices. As with temperature type expansion valve, for incompatible orifice due to the change in operating conditions, replace orifice.
			Rapid change from unloaded operation to full load operation	Set control parameters so that rapid change will not occur. Or, re-adjust opening of oil controller valve on capacity control increase side towards the decrease side.

	Trouble	Direct causes	Factors	Actions
11	Abnormal vibration and/or noise of compressor		Expansion valve opening control cannot keep up with rapid changes in heat load on load side.	Avoid rapid changes in heat load.
			Shortage in heat exchanger capacity on load side due to an insufficient defrosting.	For frosting (icing), defrost manually. Reduce setting of defrosting interval. For malfunction of devices specific to defrosting methods, remove the cause and replace them. For blocked piping route specific to defrosting methods, remove the cause and take measures. * Especially for hot gas defrost, refer to the instruction manual related to devices/control on load side.
		Liquid flow-back during operation	Shortage in heat exchanger capacity on load side due to load side conditions	Improve the environment if cooling ventilation is blocked by excessive loads around heater exchanger. * Make sure to maintain sufficient air flow for heat exchanger on load side.
			Shortage in heat exchanger capacity on load side due to the failure of heat exchanger.	Inspect for blockage of heat exchanger tubes and malfunction of fans of heat exchanger. If any, take measures.
		Foreign substances entering into compressor	Entering of welding spatter, etc., from upstream side	Inspect suction strainer and oil filter. If any problems to element, replace it. Overhaul compressor. Collect foreign substances and objects. Identify the source and take measures.
			Neglect of collecting tools and rags during overhaul	
11	Abnormal vibration and/or noise of compressor	Damage to thrust bearing	Aging degradation (exceeded appropriate time for replacement)	Appropriate time for replacement will differ due to operating conditions (if low pressure or intermediate pressure is high, life of thrust bearing becomes shorter) and oil management conditions. However, if used under normal operating conditions based on steady and continuous operation, inspect and replace it after 40000 hours or within 5 years. For details, refer to chapter 5.2.3 in this manual.
			Liquid backflow operation	Refer to the Direct causes “Liquid flow-back during startup” and “Liquid flow-back during operation” above in this item.

	Trouble	Direct causes	Factors	Actions
			Entering of foreign substances	Refer to the Direct cause “Foreign substances entering into compressor” above.
			Excessive thrust stress High suction pressure exceeding operating conditions	Re-examine operating conditions and improve them if possible. If it is difficult to improve, re-examine maintenance interval management.
			Faulty assembly * Lock nuts tightened insufficiently, lock washer tab not bended, etc.	Tighten lock nuts by using specified torque. Be sure to record data on the assembly check sheet to prevent omission of work steps.
		Sympathetic vibration	This phenomenon occurs when the natural frequency of piping or support approaches to vibration of compressor.	In many cases, this occurs due to change in installation environment such as change in piping circuit or additional installation of devices in the machine room, and changes in oil levels. →If sympathetic vibration is suspected, contact our sales offices or service centers.

Chapter 7 Related Documents

7.1 Exploded Views and Sectional Views

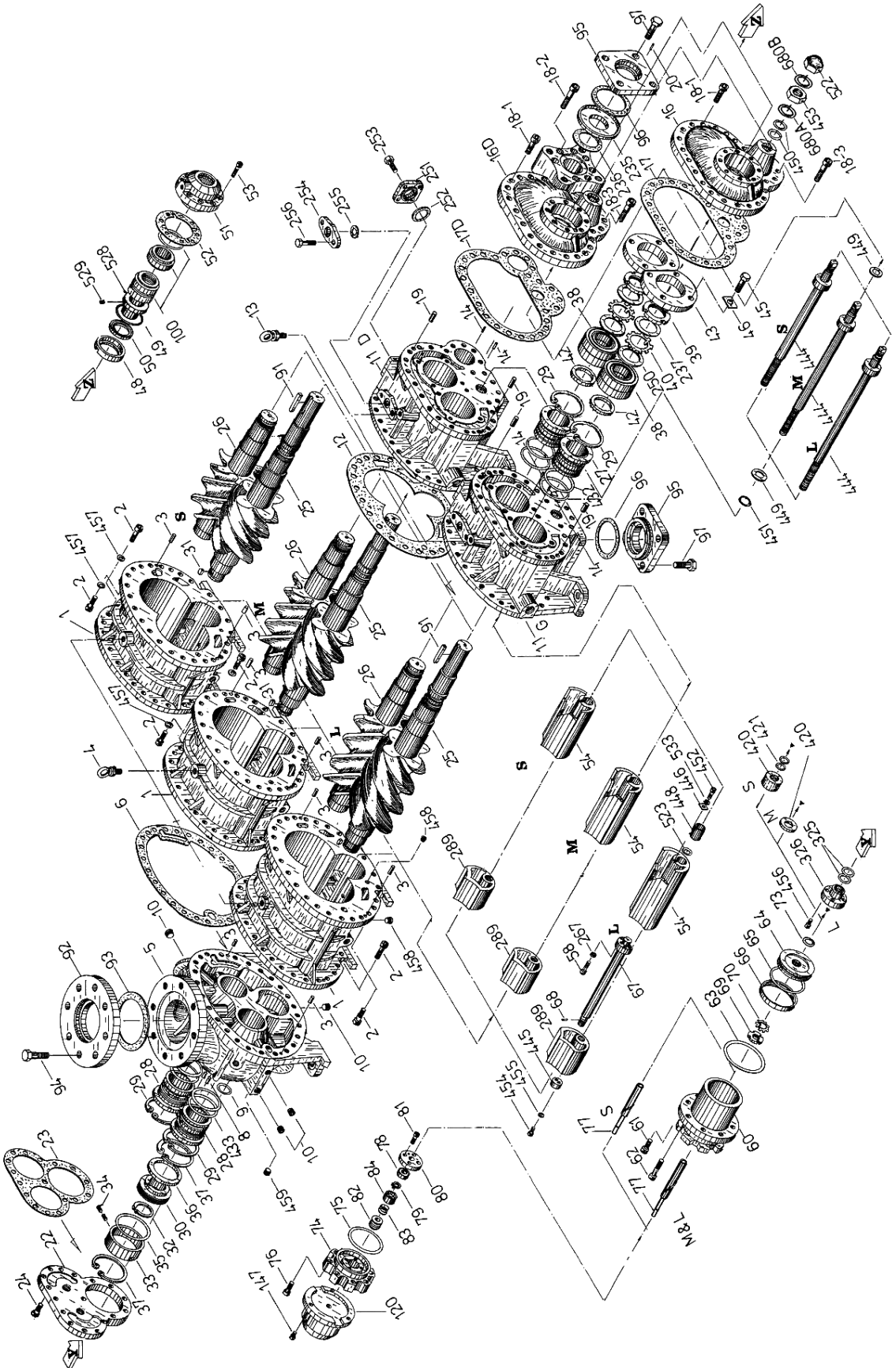


Figure 7-1 Exploded View (160 to 250V model)**

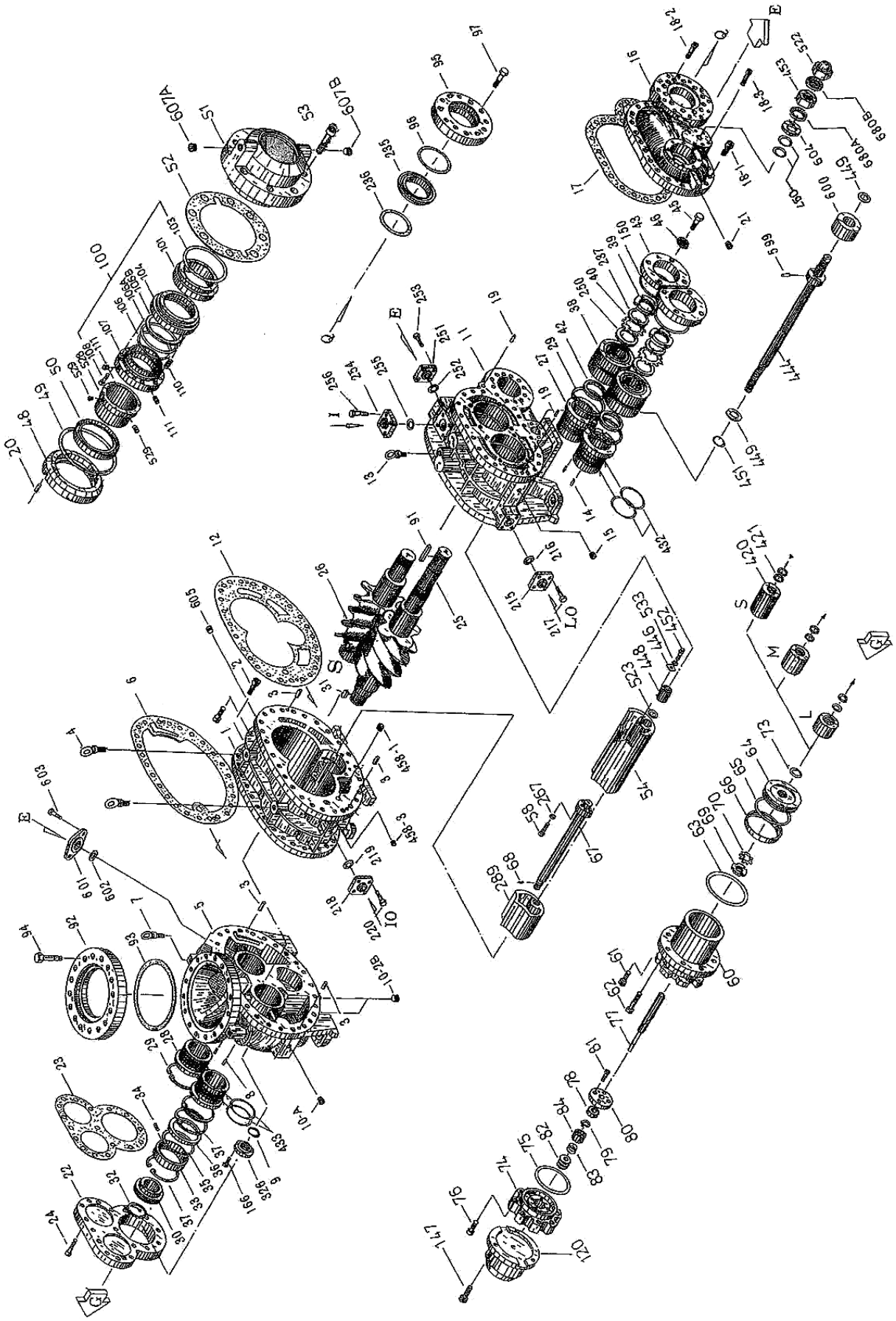


Figure 7-2 Exploded View (320V*D model)

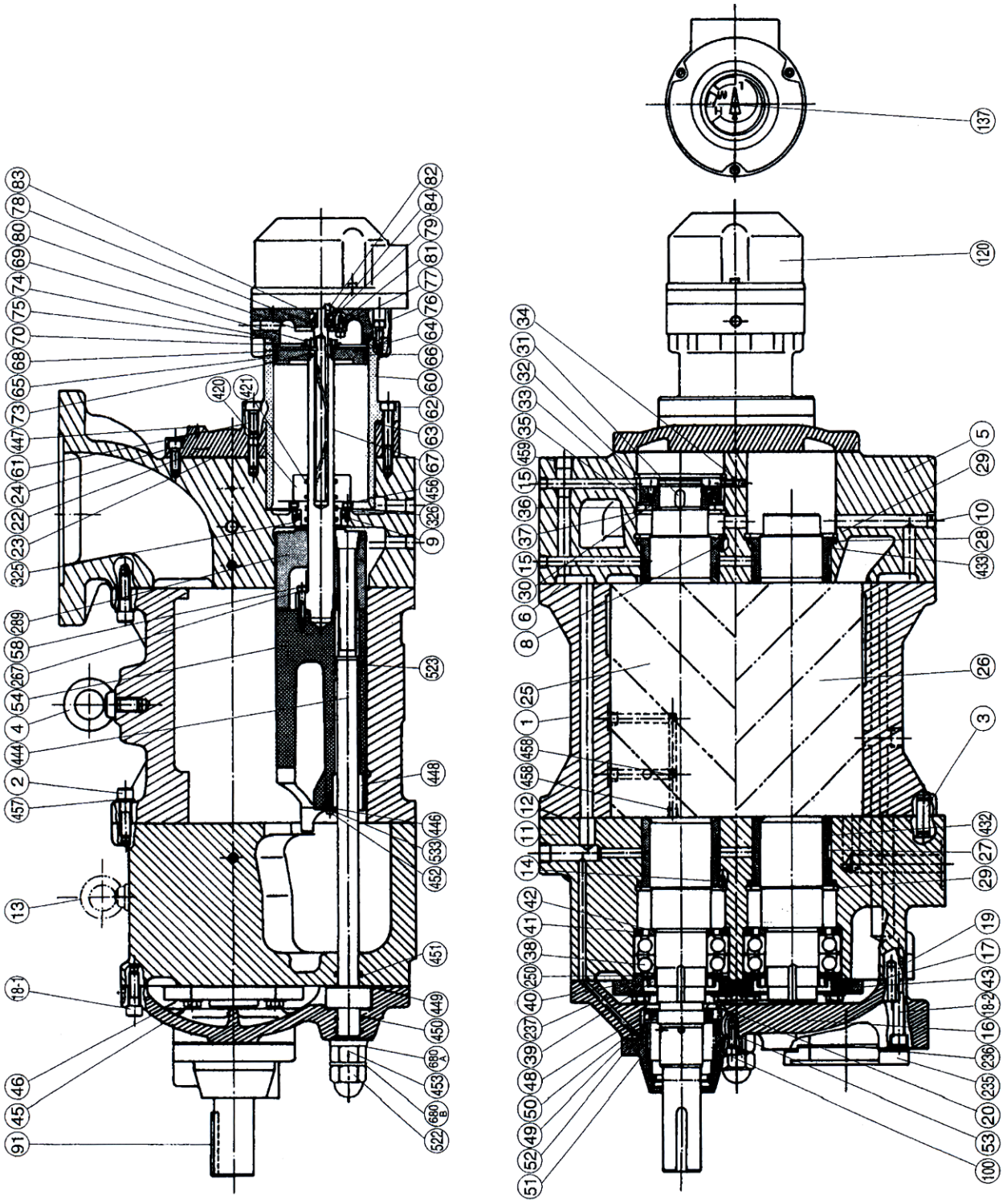


Figure 7-3 Sectional View (160 to 250V*D model)

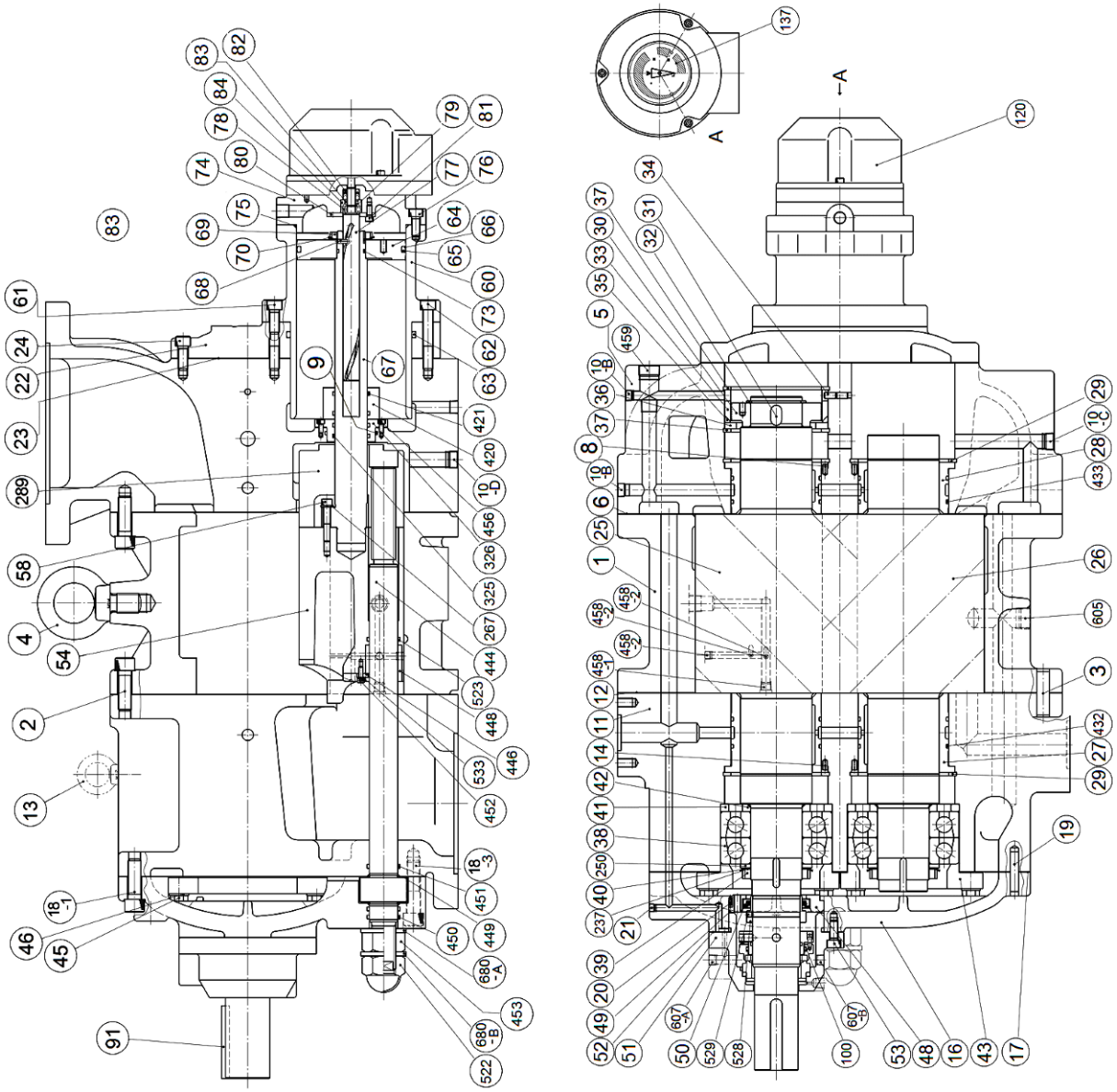


Figure 7-4 Sectional View (160 to 250V*G model)

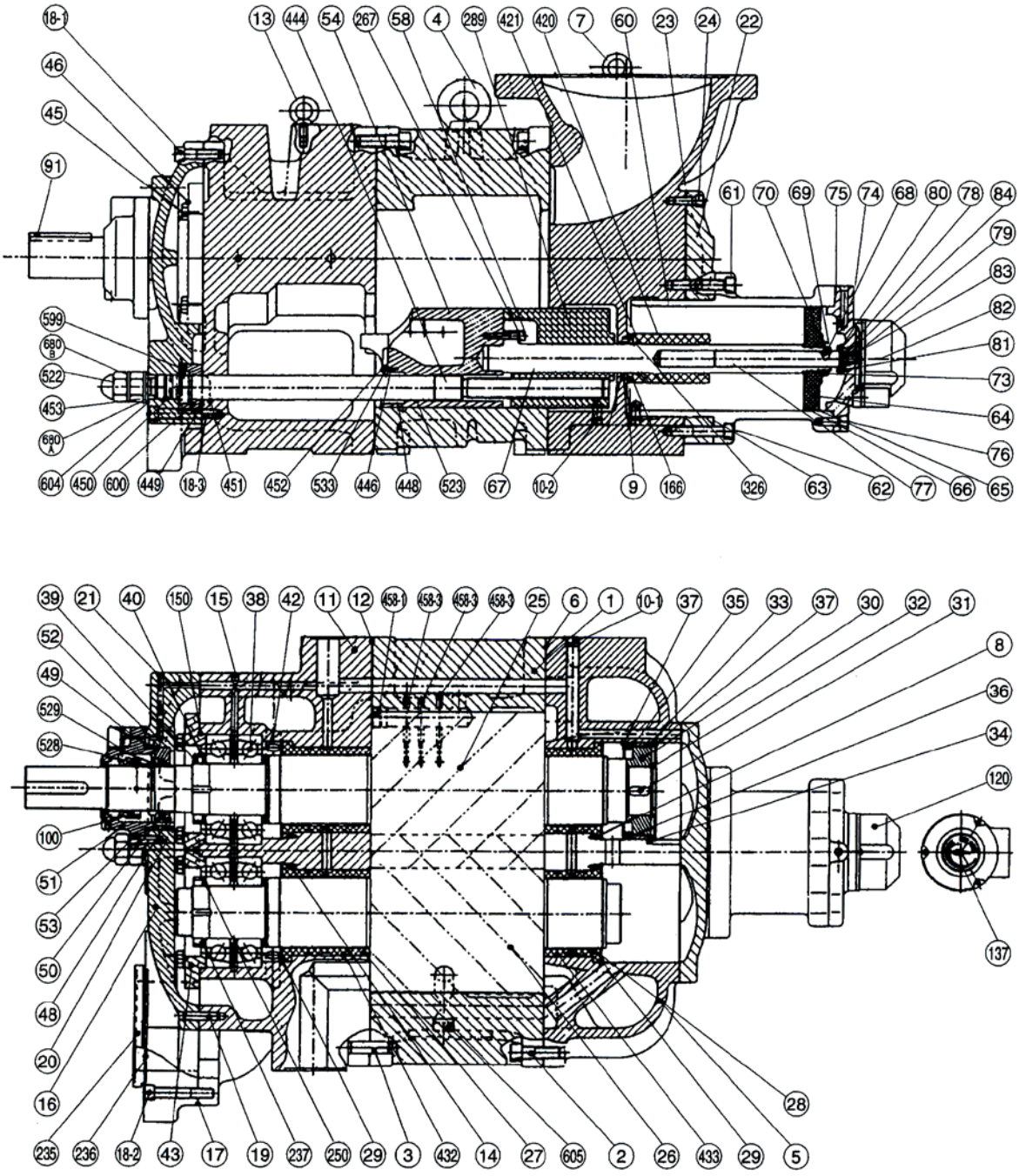


Figure 7-5 Sectional View (320V*D model)

7.2 Parts Configuration Table

Table 7-1 Parts Configuration Table of 160V models**

P/N		Part Name	Code No.	Remarks	Q'ty.
1		Main Rotor Casing	CS00100-160VXS	160VS*	1 (VS*)
1		Main Rotor Casing	CS00100-160VXM	160VM*	1 (VM*)
1		Main Rotor Casing	CS00100-160VXL	160VL*	1 (VL*)
2		Hexagon Socket Head Cap Screw	NB35412-040	M12 x 40	52
3		Alignment Pin	NE2013-040	Φ13 x 40	4
4		Eye Bolt	NB600-16	M16	1
5		Suction Cover	CS00500-160VX	160V**	1
6		Gasket, Suction Cover	CS00601-160VN	160LDV	1
8		Spring Pin	NE3204-010	Φ4 x 10	2
9		O-ring	PA11-046	JIS B 2401 P46	1
10	A	Plug	NF06-008	R 1/4	1
10	B	Plug	NF06-008	R 1/4	1
10	C	Plug	NF06-010	R 3/8	1
10	D	Plug	NF06-010	R 3/8	1
11		Bearing Head	CS01100-160VXG	160V*D	1 (V*D)
11		Bearing Head	CS01100-160VXD	160V*G	1 (V*G)
12		Gasket, Bearing Head	CS01200-160VN	160***	1
13		Eye Bolt	NB600-12	M12	1
14		Spring Pin	NE3204-010	Φ4 x 10	2
16		Bearing Cover	CS01600-160VXD	160V*D	1 (V*D)
16		Bearing Cover	CS01600-160VXG	160V*G	1 (V*G)
17		Gasket, Bearing Cover (D)	CS01700-160VD	160V*D	1 (V*D)
17		Gasket, Bearing Cover (G)	CS01700-160VG	160V*G	1 (V*G)
18	1	Hexagon Socket Head Cap Screw	NB35412-040	M12 x 40	19 (V*D) 24 (V*G)
18	2	Hexagon Socket Head Cap Screw	NB35412-080	M12 x 80	7 (V*D)
19		Alignment Pin	NE2010-040	Φ10 x 40	2
20		Spring Pin	NE3203-010	Φ3 x 10	1
22		Balance Piston Cover	CS02200-160VX	160V**	1
23		Gasket, Balance Piston Cover	CS02300-160N	160*	1
24		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	11
25		Male Rotor	CS02500-160VS	160VS*	1 (VS*)
26		Female Rotor			
25		Male Rotor	CS02500-160VM	160VM*	1 (VM*)
26		Female Rotor			
25		Male Rotor	CS02500-160VL	160VL*	1 (VL*)
26		Female Rotor			
27		Main Bearing O-ring type	CSH02700-160	160***	2
28		Side Bearing O-ring type	CSH02800-160	160***	2
29		Snap Ring (Internal)	NG11-102	H102	4
30		Balance Piston	CS03000-160H	160**H	1
31		Key, Balance Piston	CS03100-160	160**	1
32		Snap Ring (External)	NG12-050	S50	1
33		Sleeve, Balance Piston	CS03300-160H	160**H	1
34		Set Screw	NA83606-015	M6 x 15	2
35		O-ring	PA12-095	JIS B 2401 G95	1
36		O-ring Spacer	CS03600-160	160***	1
37		Snap Ring (Internal)	NG11-102	H102	2

P/N		Part Name	Code No.	Remarks	Q'ty.
38		Thrust Bearing	CS03800-160P	7212B	2
39		Lock Nut	NG31-012	AN12	2
40		Lock Washer	NG32-012	AW12	2
41		Spacer, Thrust Bearing Outer Race	CS04100-160	160***	2
42		Spacer, Thrust Bearing Alignment	CS04200-160	160***	2
43		Thrust Bearing Gland	CS04300-160	160***	2
45		Hexagon Head Bolt	NB15510-030	M10 x 30	8
46		Conical Spring Washer	ND150-010	M10	8
46		Lock Washer Set (old, plate type)	CS0469-D	160*** 8ps/set	-
48		Retainer, Oil Seal	CS04800-160	160***	1
49		O-ring	PA12-090	JIS B 2401 G90	1
50		Oil Seal	NB15510-030	SA1J55 x 70 x 9	1
51		Seal Cover	CS051000-160BBS	160***	1
52		Gasket, Seal Cover	CS05200-160N	160***	1
53		Hexagon Socket Head Cap Screw	NB35408-025	M8X25	8
54		Unloader Slide Valve	CS05400-160VSD	160VS*	1 (VS*)
54		Unloader Slide Valve (with groove)	-	160VS*	1 (VS*)
54		Unloader Slide Valve	CS05400-160VMD	160VM*	1 (VM*)
54		Unloader Slide Valve (with groove)	-	160VM*	1 (VM*)
54		Unloader Slide Valve	CS05400-160VLD	160VL*	1 (VL*)
54		Unloader Slide Valve (with groove)	-	160VL*	1 (VL*)
58		Hexagon Socket Head Cap Screw	NB35406-030	M6 x 30	5
60		Unloader Cylinder	CS06000-160VX	160V**	1
61		Hexagon Socket Head Cap Screw	NB35410-025	M10 x 25	2
62		Hexagon Socket Head Cap Screw	NB35410-065	M10 x 65	6
63		O-ring	PA12-125	JIS B 2401 G125	1
64		Unloader Piston	CS06400-160S	160***	1
65		O-ring	PA11-100	JIS B 2401 P100	1
66		Teflon Cap Seal	CS06600-160-1	CAP-1BE100	1
67		Push Rod, Unloader Slide Valve	CS0671-DV	160V**	1
68		Guide Pin	NE2503-008	Φ3 x 8	1
69		Lock Nut	NG31-005	AN05	1
70		Lock Washer	NG32-005	AW05	1
73		O-ring	PA11-021	JIS B 2401 P21	1
74		Unloader Cover	CS07400-160	160*	1
75		O-ring	PA12-110	JIS B 2401 G110	1
76		Hexagon Socket Head Cap Screw	NB35408-025	M8 x 25	8
77		Indicator Cam	CS07700-160VXS	160VS*	1 (VS*)
77		Indicator Cam	CS07700-160VXML	160VM*160VL*	1 (VM*) 1 (VL*)
78		Ball Bearing	CS07800-200	#6000	1
79		Snap Ring (External)	NG12-010	S10	1
80		Bearing Gland	CS08000-200	200***	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6 x 15	3
82		V-ring	CS08200-200B	20 x 10 x 12	1
83		Spring	CS08300-200	200***	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1

P/N		Part Name	Code No.	Remarks	Q'ty.
91		Shaft Key	CS09100-160	160***	1
92		Suction Flange	CS71400-125MK	MYK125A	1
93		Gasket, Suction Flange	CR72000-125N	MYK125A	1
94		Hexagon Head Bolt	NB12020-055	M20 x 55	8
95		Discharge Flange with hole	CS74100-100	MYK100A Female	1
95		Discharge Flange without hole	CS74100-100CDMK	MYK100CD	
95		Discharge Flange without hole	CS74100-P100	MYK100A	
96		Gasket, Discharge Flange (for the case V*G model or V*D model used No.235)	CR72000-100N	MYK100A	1
97		Hexagon Head Bolt (for the case that is not using No.235 Discharge flange spacer)	NB12022-055	M22 x 55	4
97		Hexagon Head Bolt (for the case using No.235 Discharge flange spacer)	NB12022-080	M22 x 80	4
100		Mechanical Seal Assembly (BOS-T1)	CS10000-160BT	160V** BOS Type	1
100		Mechanical Seal Assembly (BBSE)	CS10002-160EBS	BBS-E	1
100		Mechanical Seal Assembly (BBSⅢ)	CS10001-160BBS	BBSⅢ	1
100		Mechanical Seal Assembly (UV-4)	CS10009-160-F70	UV-4)	1
120		Unloader Indicator Assembly	CS120-IND063WP-VP	V-series 0-100%	1
125		Micro-Switch	CS12501-IND06P	200*** Z15GW	2
127		Micro-Switch Cam	CS1279-200V	200VS\L	1
129		Wire wound type Potentiometer	CS1299-E10	with Wires	1
129		Conductive Plastic type Potentiometer	CS12900-INDO6P	with Wires	-
137		Indicator Dial	CS13700-200VD	200VL*	1
235		Spacer, Discharge Flange (This spacer is not necessary for CD flange.)	FX101-160		1 (V*D)
236		Gasket, Discharge Flange Spacer	CS23600-160N		1 (V*D)
237		Torsional Slip Washer	CS23700-160	160***	2
250		Thrust Washer	CS25000-160	160***	2
251		Electromizer (Economizer) Flange	CR74000-025	MYK25A	1
252		Gasket. Electromizer (Economizer) Flange	CR72000-025N		1
253		Hexagon Head Bolt	NB15512-035	M12 x 35	4
254		Liquid Injection (Aquamizer) Flange	CR74000-020	MYK20A	1
255		Gasket, Liquid Injection Flange	CR72000-020N		1
256		Hexagon Head Bolt	NB15512-035	M12 x 35	2
267		Special Spring Washer	ND330-06	M6	5
289		Variable Vi auxiliary Slide Valve	CS28900-160VSD	160VS*	1 (VS*)
289		Variable Vi auxiliary Slide Valve	CS28900-160VMD	160VM*	1 (VM*)
289		Variable Vi auxiliary Slide Valve	CS28900-160VLD	160VL*	1 (VL*)
325		O-ring	PA11-030	JIS B 2401 P30	2
326		O-ring Gland	CS32600-160VD		1
420		Spacer, Unloader Positioning	CS42000-160VSD	160VS*	1 (VS*)
420		Spacer, Unloader Positioning	CS42000-160VMD	160VM*	1 (VM*)
421		O-ring	PA11-030	JIS B 2401 P30	2 (VS*)
432		O-ring	PA12-085	JIS B 2401 G85	4
433		O-ring	PA12-085	JIS B 2401 G85	4
444		Vi Adjusting Rod	CS44400-160VSD	160VS*	1 (VS*)
444		Vi Adjusting Rod	CS44400-160VMD	160VM*	1 (VM*)
444		Vi Adjusting Rod	CS44400-160VLD	160VL*	1 (VL*)
445		Lock Washer, Variable Vi Auxiliary Slide Valve	CS44500-160VD	160V**	1

P/N		Part Name	Code No.	Remarks	Q'ty.
446		Vi Square Washer, Teflon Bushing	CS44600-160VD		1
448		Teflon Bushing	CS44800-160VD		1
449		Thrust Washer	CS44900-160VD		2
450		O-ring	PA11-025	JIS B 2401 P25	2
451		O-ring	PA11-025	JIS B 2401 P25	1
452		Hexagon Socket Head Cap Screw	NB35404-010	M4 x 10	1
453		Hexagon Nut	NC720-24	M24	1
454		Hexagon Socket Head Cap Screw	NB35404-020	M4 x 20	1
455		Spring Washer, Hexagon Socket Head Cap Screw	ND330-04	M4	1
456		Hexagon Socket Head Cap Screw	NB35405-010	M5 x 10	2
458		Plug	NF06-004	R 1/8	4
459		Plug	NF06-015	R 1/2	1
522		Domed Cap Nut	NC921-24	M24	1
523		O-ring	PA11-025	JIS B 2401 P25	1
533		Spring Washer, Hexagon Socket Head Cap Screw	ND330-04	M4	1
605		Plug	NF06-015	R 1/2	1
607	A	Plug	NF06-008	R 1/4	1
607	B	Plug	NF06-008	R 1/4	1
607	C	Plug	NF06-008	R 1/4	1
680	A	Conical Spring Washer, Vi Adjusting Rod	ND160-024	M24	1
680	B	Conical Spring Washer, Vi Adjusting Rod	ND160-024	M24	1
701		Backup Ring	PBP11-045		1

CAUTION

- **The part code of the O-ring is the one assigned to NBR which is standard material. When the material of the O-ring is other than NBR, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

CAUTION

- **The Code No. of parts shown in parentheses below is applied to the product until the end of November, 2014:**
  (P/N 120 Unloader Indicator Assembly, P/N 125 Micro-Switch, P/N 129 Potentiometer)
- **For the Code No. of new type indicator part, refer to the separately dedicated Instruction manual for it.**

Table 7-2 Parts Configuration Table of 200V models**

P/N		Part Name	Code No.	Remarks	Q'ty.
1		Main Rotor Casing	CS00100-200VXS	200VS*	1 (VS*)
1		Main Rotor Casing	CS00100-200VXM	200VM*	1 (VM*)
1		Main Rotor Casing	CS00100-200VXL	200VL*	1 (VL*)
2		Hexagon Socket Head Cap Screw	NB35416-050	M16X50	50
3		Alignment Pin	NE2016-055	Φ16X55	4
4		Eye Bolt	NB600-20	M24	1
5		Suction Cover	CS00500-200VX	200V**	1
6		Gasket, Suction Cover	CS0061-EV	200***	1
8		Spring Pin	NE3206-012	Φ6X12	2
9		O-ring	PA12-060	JIS B 2401 G60	1
10	A	Plug	NF06-010	R3/8	1
10	B	Plug	NF06-008	R1/4	1
10	C	Plug	NF06-015	R1/2	1
10	D	Plug	NF06-015	R1/2	1
11		Bearing Head	CS01100-200VXD	200V**	1 (V*D)
11		Bearing Head	CS01100-200VXG	200V*G	1 (V*G)
12		Gasket, Bearing Head	CS01200-200VN	200***	1
13		Eye Bolt	NB600-12	M12	1
14		Spring Pin	NE3206-012	Φ6X12	2
16		Bearing Cover	CS01600-200VXD	200V**	1 (V*D)
16		Bearing Cover	CS01600-200VXG	200V*G	1 (V*G)
17		Gasket, Bearing Cover (D)	CS01700-200VD	200V**	1 (V*D)
17		Gasket, Bearing Cover (G)	CS01700-200VG	200V*G	1 (V*G)
18	1	Hexagon Socket Head Cap Screw	NB35416-050	M16X50	15 (V*D) 18 (V*G)
18	2	Hexagon Socket Head Cap Screw	NB35416-075	M16X75	8 (V*D)
18	3	Hexagon Socket Head Cap Screw	NB35416-065	M16X65	6
19		Alignment Pin	NE2010-050	Φ10X50	2
20		Spring Pin	NE3203-010	Φ3X10	1
21		Plug	NF06-004	R1/8	1
22		Balance Piston Cover	CS02200-200VX	200V**	1
23		Gasket, Balance Piston Cover	CS02300-200N	200V**	1
24		Hexagon Socket Head Cap Screw	NB35412-030	M12X30	11
25		Male Rotor	CS02500-200VS	200VS*	1
26		Female Rotor			
25		Male Rotor	CS02500-200VM	200VM*	1
26		Female Rotor			
25		Male Rotor	CS02500-200VL	200VL*	1
26		Female Rotor			
27		Main Bearing O-ring type	CSH02700-200	200***	2
28		Side Bearing O-ring type	CSH02800-200	200***	2
29		Snap Ring (Internal)	NG11-130	H130	4
30		Balance Piston	CS03000-200H	200**LDH	1
31		Key, Balance Piston	CS03100-200	200V**	1
32		Snap Ring (External)	NG12-065	S65	1
33		Sleeve, Balance Piston	CS03300-200H	200**H	1
34		Set Screw	NA83608-015	M8X15	2
35		O-ring	PA11-120	JTS B 2401 P120	1
36		O-ring Spacer	CS03600-200	200***	1

P/N		Part Name	Code No.	Remarks	Q'ty.
37		Snap Ring (Internal)	NG11-130	H130	2
38		Thrust Bearing	CS03800-200P	200*** PPS	2
39		Lock Nut	NG31-013	AN13	2
40		Lock Washer	NG32-013	AW13	2
41		Spacer, Thrust Bearing Outer Race	CS04100-200	200***	2
42		Spacer, Thrust Bearing Alignment	CS04200-200	200***	2
43		Thrust Bearing Gland	CS04300-200	200***	2
45		Hexagon Head Bolt	NB155112-035	M12X35	8
46		Conical Spring Washer	ND150-012	M12 1L	8
46		Lock Washer Set (old, plate type)	CS0469-E	200*** 8p./set	-
48		Retainer, Oil Seal	CS04800-200VDS	200V**	1
48		Retainer, Oil Seal	CS04800-200S	200V**	1
49		O-ring	PA12-115	JIS B 2401 G115	1
50		Oil Seal	CS05010-200VD	SA1J65x85x12	1
51		Seal Cover	CS051000-200BBS	200V**	1
52		Gasket, Seal Cover	CS05200-200N	200V**	1
53		Hexagon Socket Head Cap Screw	NB35410-025	M10X25	8
54		Unloader Slide Valve	CS05400-200VSD	200VS*	1 (VS*)
54		Unloader Slide Valve (with groove)	-	200VS*	1 (VS*)
54		Unloader Slide Valve	-	200VS* K-port	1 (VS*)
54		Unloader Slide Valve	CS05400-200VMD	200VM*	1 (VM*)
54		Unloader Slide Valve (with groove)	-	200VM*	1 (VM*)
54		Unloader Slide Valve	CS05400-200VLD	200VL*	1 (VL*)
54		Unloader Slide Valve (with groove)	-	200VL*	1 (VL*)
58		Hexagon Socket Head Cap Screw	NB35408-045	M8X45	5
60		Unloader Cylinder	CS06000-200VX	200V**	1
61		Hexagon Socket Head Cap Screw	NB35412-030	M12X30	2
62		Hexagon Socket Head Cap Screw	NB35412-075	M12X75	6
63		O-ring	PA12-150	JIS B 2401 G150	1
64		Unloader Piston	CS06400-200S	200***	1
65		O-ring	PA11-125	JTS B 2401 P125	1
66		Teflon Cap Seal	CS06600-200-1	CAP-3BE125	1
67		Push Rod, Unloader Slide Valve	CS0671-EV	200V**	1
68		Guide Pin	NE2505-012	Φ5X12	1
69		Lock Nut	NG31-007	AN07	1
70		Lock Washer	NG32-007	AW07	1
73		O-ring	PA12-030	JIS B 2401 G30	1
74		Unloader Cover	CS07400-200	200***	1
75		O-ring	PA12-135	JIS B 2401 G135	1
76		Hexagon Socket Head Cap Screw	NB35410-025	M10X25	8
77		Indicator Cam	CS07700-200VXS	200VS*	1 (VS*)
77		Indicator Cam	CS07700-200VXML	200VM* 200VL*	1 (VM*) 1 (VL*)
78		Ball Bearing	CS07800-200	#6000	1
79		Snap Ring (External)	NG12-010	S10	1
80		Bearing Gland	CS08000-200	200V**	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6X15	3

P/N		Part Name	Code No.	Remarks	Q'ty.
82		V-ring	CS08200-200B	20X10X12	1
83		Spring	CS08300-200	200V**	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1
91		Shaft Key	CS09100-200	200***	1
92		Suction Flange with hole	CS71400-P150MK	MYK150A(6")	1
93		Gasket, Suction Flange	CR72000-150N	MYK150A	1
94		Hexagon Head Bolt	NB12120-055	M22X55	8
95		Discharge Flange with hole	CS74100-125MK	MYK125A Female	1
95		Discharge Flange without hole	CS74100-P125MK	MYK125A(5")	1
95		Discharge Flange without hole	CS74100-125CDMK	MYK125CD	1
96		Gasket, Discharge Flange (for the case V*G model or V*D model used No.235)	CR72000-125N	MYK125A	1
97		Hexagon Head Bolt (for the case that is not using No.235 Discharge flange spacer)	NB12020-055	M20X55	8
97		Hexagon Head Bolt (for the case using No.235 Discharge flange spacer)	NB12120-080	M20X80	8
100		Mechanical Seal Assembly	CS10002-200EBS	200BBSE	1
100		Mechanical Seal Assembly	CS10001-200BBS	200*** BBS3	-
100		Mechanical Seal Assembly	CS10000-200BE	200*** BOS TYPE	-
100		Mechanical Seal Assembly	CS10009-200-F70	200*** UV-4	-
120		Unloader Indicator Assembly	CS120-IND063WP-VP	V-series 0-100%	1
125		Micro-Switch	CS12501-INDO6P	200*** Z15GW	2
127		Micro-Switch Cam	CS1279-200V	200VS\L	1
129		Wire wound type Potentiometer	CS12900-INDO6P	with wires	1
129		Conductive Plastic type Potentiometer	CS12900-INDO6P	with wires	-
137		Indicator Dial	CS13700-200VD	200V** L,M,H-port	1
215		Flange, Lubricating Oil inlet (Journal) with hole	CR74000-020	MM(MYK) 20A(3/4")	1
216		Gasket, Lubricating Oil inlet Flange	CR72000-020N	MYK20A	1
217		Hexagon Head Bolt	NB111012-035	M12 X35	2
235		Spacer, Discharge Flange (This spacer is not necessary for CD flange.)	FX101-200	200V**	1 (V*D)
236		Gasket, Discharge Flange Spacer	CS23600-200N	200V**	1 (V*D)
237		Torsional Slip Washer	CS23700-200	200***	2
250		Thrust Washer	CS25000-200	200***	2
251		Electromizer (Economizer) Flange with hole	CR74000-032	MM(MYK) 32A(l"1/4)	1
252		Gasket. Electromizer (Economizer) Flange	CR72000-032N	MYK32A	1
253		Hexagon Head Bolt	NB111012-040	M12X40	4
254		Liquid Injection (Aquamizer) Flange	CR74000-025	MM(MYK) 25A(1")	1
255		Gasket, Liquid Injection Flange	CR72000-025N	MYK25A	1
256		Hexagon Head Bolt	NB15512-035	M12X35	4
267		Special Spring Washer, Hexagon Socket Head Cap Screw	ND330-08	M8	5
289		Variable Vi auxiliary Slide Valve	CS28900-200VSD	200VS*	1 (VS*)
289		Variable Vi auxiliary Slide Valve	CS28900-200VMD	200VM*	1 (VM*)
289		Variable Vi auxiliary Slide Valve	CS28900-200VLD	200VL*	1 (VL*)
325		O-ring	PA11-040	JIS B 2401 P40	2
326		O-ring Gland	CS32600-200VD	200V**	1
420		Spacer, Unloader Positioning	CS42000-200VSD	200VS*	1 (VS*)
420		Spacer, Unloader Positioning	CS42000-200VMD	200VM*	1 (VM*)
421		O-ring	PA11-040	JIS B 2401 P40	2 (VS*)

P/N		Part Name	Code No.	Remarks	Q'ty.
432		O-ring	PA62-022	AS568A-244	4
433		O-ring	PA62-022	AS568A-244	4
444		Vi Adjusting Rod	CS44400-200VSD	200VS*	1 (VS*)
444		Vi Adjusting Rod	CS44400-200VMD	200VM*	1 (VM*)
444		Vi Adjusting Rod	CS44400-200VLD	200VL*	1 (VL*)
445		Lock Washer, Variable Vi Auxiliary Slide Valve	CS44500-200VD	200V**	1
446		Vi Square Washer, Teflon Bushing	CS44600-200VD	200V**	1
448		Teflon Bushing	CS44800-200VD	200V**	1
449		Thrust Washer	CS44900-200VD	160V** to 320VD	2
450		O-ring	PA11-035	JIS B 2401 P35	2
451		O-ring	PA11-035	JIS B 2401 P35	1
452		Hexagon Socket Head Cap Screw	NB35405-015	M5X15	1
453		Hexagon Nut	NC140-30	M30	1
454		Hexagon Socket Head Cap Screw	NB35406-020	M6X20	1
455		Special Spring Washer, Hexagon Socket Head Cap Screw	ND330-06	M6	1
456		Hexagon Socket Head Cap Screw	NB35405-012	M5X12	2
458	1	Plug	NF06-008	R1/4	1
458	2	Plug	NF06-004	R1/8	3
459		Plug	NF06-020	R3/4	1
522		Domed Cap Nut	NC921-30	M30	1
523		O-ring	PA11-035	JIS B 2401 P35	1
528		Oil Seal Sleeve	CS52810-200VD	200V**	1
528		Oil Seal Sleeve with O-ring	CS52809-200VD	200V**	1
529		Set screw	NA83606-008	M6X8	2
533		Spring Washer, Hexagon Socket Head Cap Screw	ND320-005	M5	1
605		Plug	NF06-020	R3/4	1
607	A	Plug	NF06-008	R1/4	1
607	B	Plug	NF06-008	R1/4	1
680	A	Conical Spring Washer, Vi Adjusting Rod	ND160-030	M30 Type	1
680	B	Conical Spring Washer, Vi Adjusting Rod	ND160-030	M30 Type	1
701		Backup Ring	PBP11-055		1
715		Cover Plate, Lubricating oil inlet Flange	CS71500-020	20A	1
715		Cover Plate, Economizer inlet Flange	CS71500-032	32A	1
715		Cover Plate, Liquid injection Flange	CS71500-025	25A	1
744		O-ring	PA12-060	JIS B 2401 G60	1

CAUTION

- **The part code of the O-ring is the one assigned to NBR which is standard material. When the material of the O-ring is other than NBR, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

CAUTION

- **The Code No. of parts shown in parentheses below is applied to the product until the end of November, 2014:**
  (P/N 120 Unloader Indicator Assembly, P/N 125 Micro-Switch, P/N 129 Potentiometer)
- **For the Code No. of new type indicator part, refer to the separately dedicated Instruction manual for it.**

Table 7-3 Parts Configuration Table of 250V models**

P/N		Part Name	Code No.	Remarks	Q'ty.
1		Main Rotor Casing	CS00100-250VXS	250VS*	1 (VS*)
1		Main Rotor Casing	CS00100-250VXM	250VM*	1 (VM*)
1		Main Rotor Casing	CS00100-250VXL	250VL*	1 (VL*)
1		Main Rotor Casing	-	250VLL*	1 (VLLD)
2		Hexagon Socket Head Cap Screw	NB35420-060	M20×60	44
3		Alignment Pin	NE2016-070	Φ16×70	4
4		Eye Bolt	NB600-30	M30	1
5		Suction Cover	CS00500-250VX	250V**	1
5		Suction Cover	-	250WV*	1 (VLLD)
6		Gasket, Suction Cover	CS00600-250VN	250***	1
7		Eye Bolt	NB600-12	M12	2
8		Spring Pin	NE3206-012	Φ6×12	2
9		O-ring	PA12-065	JIS B 2401 G65	1
10	A	Plug	NF06-010	R3/8	1
10	B	Plug	NF06-008	R1/4	1
10	C	Plug	NF06-020	R3/4	1
10	D	Plug	NF06-015	R1/2	1
11		Bearing Head	CS01100-250VXD	250V**	1 (V*D)
11		Bearing Head	CS01100-250VXG	250V*G	1 (V*G)
12		Gasket, Bearing Head	CS01200-250N	250***	1
13		Eye Bolt	NB600-12	M12	1
14		Spring Pin	NE3206-012	Φ6×12	2
16		Bearing Cover	CS01600-250VXD	250V**	1 (V*D)
16		Bearing Cover	CS01600-250VXG	250V*G	1 (V*G)
17		Gasket, Bearing Cover (D)	CS01700-250VD	250V**	1 (V*D)
17		Gasket, Bearing Cover (G)	CS01700-250VG	250V*G	1 (V*G)
18	1	Hexagon Socket Head Cap Screw	NB35416-050	M16×50	18 (V*D) 22 (V*G)
18	2	Hexagon Socket Head Cap Screw	NB35416-090	M16×90	8 (V*D)
18	3	Hexagon Socket Head Cap Screw	NB35416-070	M16×70	5
19		Alignment Pin	NE2010-050	Φ10×50	2
20		Spring Pin	NE3203-010	Φ3×10	1
21		Plug	NF06-004	R1/8	1
22		Balance Piston Cover	CS02200-250VX	250V**	1
23		Gasket, Balance Piston Cover	CS02300-250N	250***	1
24		Hexagon Socket Head Cap Screw	NB35412-030	M12×30	11
25		Male Rotor	CS02500-250VS	250VS*	1 (VS*)
26		Female Rotor			
25		Male Rotor	CS02500-250VM	250VM*	1 (VM*)
26		Female Rotor			
25		Male Rotor	CS02500-250VL	250VL*	1 (VL*)
26		Female Rotor			
25		Male Rotor	-	250VLL*	1 (VLL*)
26		Female Rotor			

P/N		Part Name	Code No.	Remarks	Q'ty.
27		Main Bearing O-ring type	CSH02700-250	250VS*, VM*, VL*	2
27		Main Bearing O-ring type	CSH02700-250	250VLL*	4
28		Side Bearing O-ring type	CSH02800-250	250***	2
29		Snap Ring (Internal)	NG11-160	H160	4
30		Balance Piston	CS03000-250H	250**H	1
31		Key, Balance Piston	CS03100-250	250***	1
32		Snap Ring (External)	NG12-080	S80	1
33		Sleeve, Balance Piston	CS03300-250H	250**H	1
34		Set Screw	NA83608-020	M8×20	2
35		O-ring	PA11-150	JIS B 2401 P150	1
36		O-ring Spacer	CS03600-250	250***	1
37		Snap Ring (Internal) 250VS*, VM*, VL*	NG11-160	H160	2
37		Snap Ring (Internal) 250VLL*	NG11-160	H160	1
38		Thrust Bearing	CS03800-250P	250*** PPS	2
39		Lock Nut	NG31-017	AN17	2
40		Lock Washer	NG32-017	AW17	2
42		Spacer, Thrust Bearing Alignment	CS04200-250	250***	2
43		Thrust Bearing Gland	CS04300-250	250***	2
45		Hexagon Head Bolt	NB15516-045	M16×45	8
46		Conical Spring Washer	ND150-016	M16 1L	8
46		Lock Washer Set (old, plate type)	CS0469-F	250*** 8p./set	-
48		Retainer, Oil Seal	CS04800-250VDS	250V** BBSⅢ BBSE BOS	1
48		Retainer, Oil Seal	CS04800-250S	250V** UV-4 BBS Ⅰ He	1
49		O-ring	PA12-135	JIS B 2401 G135	1
50		Oil Seal	CS05010-250VD	SA1J 75×100×13	1
51		Seal Cover	CS05100-250BBS	250V** BBSⅢ BBSE BOS	1
52		Gasket, Seal Cover	CS05200-250N	250***	1
53		Hexagon Socket Head Cap Screw	NB35412-030	M12×30	8
54		Unloader Slide Valve	CS05400-250VSD	250VS*	1 (VS*)
54		Unloader Slide Valve	CS05400-250VMD	250VM*	1 (VM*)
54		Unloader Slide Valve	CS05400-250VLD	250VL*	1 (VL*)
54		Unloader Slide Valve	-	250VLL*	1 (VLLD)
58		Hexagon Socket Head Cap Screw	NB35410-055	M10×55	5
60		Unloader Cylinder	CS06000-250VX	250V**	1
61		Hexagon Socket Head Cap Screw	NB35416-040	M16×40	2
62		Hexagon Socket Head Cap Screw	NB35416-090	M16×90	6
63		O-ring	PA12-190	JIS B 2401 G190	1
64		Unloader Piston	CS06400-250S	250***	1
65		O-ring	PA11-155	JISB2401 1A P155	1
66		Teflon Cap Seal	CS06600-250-1	SUNR-BE-155	1
67		Push Rod, Unloader Slide Valve	CS0671-FV	250V**	1
67		Push Rod, Unloader Slide Valve	CS06700-250VLLD	250VLL*	1 (VLLD)
68		Guide Pin	NE2505-012	Φ5×12	1

P/N		Part Name	Code No.	Remarks	Q'ty.
69		Lock Nut	NG31-008	AN08	1
70		Lock Washer	NG32-008	AW08	1
73		O-ring	PA12-035	JIS B 2401 G35	1
74		Unloader Cover	CS07400-250	250***	1
74		Unloader Cover	CS07460-250	250*** Explosion proof	1
75		O-ring	PA12-170	JIS B 2401 G170	1
76		Hexagon Socket Head Cap Screw	NB35412-030	M12×30	8
77		Indicator Cam	CS07700-250VXS	250VS*	1 (VS*)
77		Indicator Cam	CS07700-250VXML	250VL*/VM*	1 (VM*) 1 (VL*) 1(VLLD)
78		Ball Bearing	CS07800-200	#6000	1
79		Snap Ring (External)	NG12-010	S10	1
80		Bearing Gland	CS08000-200	200V**	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6×15	3
82		V-ring	CS08200-200B	20×10×12	1
83		Spring	CS08300-200	200V**	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1
91		Shaft Key	CS09100-250	250***	1
92		Suction Flange with hole	CS71400-P250MK	MYK250A Male	1
93		Gasket, Suction Flange	CS09300-250N	MYK250A	1
94		Hexagon Head Bolt	NB12024-065	M24×65	12
95		Discharge Flange without hole	CS71400-150CDMK	MYK150CD Male	1 (*UD)
95		Discharge Flange with hole	CR74100-150	MYK150A Female	1 (*UD)
95		Discharge Flange without hole	-	MYK150A Male	1 (*UD)
95		Discharge Flange with hole	CR74000-150	MYK150A Male	1 (*G)
95		Discharge Flange without hole	CR71400-P150	MYK150A Female	1 (*G)
96		Gasket, Discharge Flange (for the case V*G model or V*D model used No.235)	CR72000-150N	MYK150A	1
97		Hexagon Head Bolt (for the case that is not using No.235 Discharge flange spacer)	NB12022-055	M22×55	8
97		Hexagon Head Bolt (for the case using No.235 Discharge flange spacer)	NB12022-085	M22×85	8
100		Mechanical Seal Assembly	CS10000-250BE	BOS-E1	1
100		Mechanical Seal Assembly	CS10002-250EBS	BBS-E	1
100		Mechanical Seal Assembly	CS10001-250BBS	BBS3	1
100		Mechanical Seal Assembly	CS10009-250-F70	UV-4	1
120		Unloader Indicator Assembly	CS120-IND063WP-VP	V-series 0-100%	1
125		Micro-Switch	CS12501-IND06P	200*** Z15GW	2
127		Micro-Switch Cam	CS1279-200V	200VS\L	1
129		Wire wound type Potentiometer	CS12900-INDO6P	with lead wire	1
129		Conductive Plastic type Potentiometer	CS12900-INDO6P	with lead wire	-
137		Indicator Dial	CS13700-200VD	200V** L,M,H-port	1
137		Indicator Dial	CS13700-200VD	250VLL*	1 (VLLD)
215		Flange, Lubricating Oil inlet (Journal) with hole	CR74000-025	MYK25A Male	1

P/N		Part Name	Code No.	Remarks	Q'ty.
216		Gasket, Lubricating Oil inlet Flange	CR72000-025N	MYK25A	1
217		Hexagon Head Bolt	NB111012-035	M12×35	4
235		Spacer, Discharge Flange (This spacer is not necessary for CD flange.)	FX101-250	250***	1(V*D)
236		Gasket, Discharge Flange Spacer	CS23600-250N	250***	1(V*D)
237		Torsional Slip Washer	CS23700-250	250***	2
250		Thrust Washer	CS25000-250	250***	2
251		Electromizer (Economizer) Flange without hole	CS74000-050	MYK50A Male	1
251		Electromizer (Economizer) Flange with hole	CR71400-050MK	MYK50A Male	1
252		Gasket. Electromizer (Economizer) Flange	CR72000-050N	MYK50A	1
253		Hexagon Head Bolt	NB111016-045	M16×45	4
254		Liquid Injection Flange with hole	CR74000-032	MYK32A Male	1
255		Gasket, Liquid Injection Flange	CR72000-032N	MYK32A	1
256		Hexagon Head Bolt	NB111012-040	M12×40	4
267		Special Spring Washer, Hexagon Socket Head Cap Screw	ND330-10	M10 TYPE	5
289		Variable Vi auxiliary Slide Valve	CS28900-250VSD	250VS*	1 (VS*)
289		Variable Vi auxiliary Slide Valve	CS28900-250VMD	250VM*	1 (VM*)
289		Variable Vi auxiliary Slide Valve	CS28900-250VLD	250VL*	1 (VL*)
289		Variable Vi auxiliary Slide Valve	-	250VLL*	1 (VLLD)
325		O-ring	PA11-046	JIS B 2401 P46	2
326		O-ring Gland	CS32600-250VD	250V**	1
420		Spacer, Unloader Positioning	CS42000-250VSD	250VS*	1 (VS*)
420		Spacer, Unloader Positioning	CS42000-250VMD	250VM*	1 (VM*)
421		O-ring	PA11-046	JIS B 2401 P46	2 (VS*)
432		O-ring	PA12-130	JIS B 2401 G130	4
433		O-ring	PA12-130	JIS B 2401 G130	4
444		Vi Adjusting Rod	CS44400-250VSD	250VS*	1 (VS*)
444		Vi Adjusting Rod	CS44400-250VMD	250VM*	1 (VM*)
444		Vi Adjusting Rod	CS44400-250VLD	250VL*	1 (VL*)
444		Vi Adjusting Rod	CS44400-250VLL	250VLL*	1 (VLLD)
445		Lock Washer, Variable Vi Auxiliary Slide Valve	CS44500-250VD	200V**	1
446		Vi Square Washer, Teflon Bushing	CS44600-250VD	250V***	1
448		Teflon Bushing	CS44800-250VD	250V**	1
449		Thrust Washer	CS44900-250VD	250V**	2
450		O-ring	PA11-040	JIS B 2401 P40	2
451		O-ring	PA11-040	JIS B 2401 P40	1
452		Hexagon Socket Head Cap Screw	NB35406-020	M6×20	1
453		Hexagon Nut	NC720-36	M36	1
454		Hexagon Socket Head Cap Screw	NB35406-035	M6×35	1
455		Special Spring Washer, Hexagon Socket Head Cap Screw	ND330-06	M6	1
456		Hexagon Socket Head Cap Screw	NB35405-010	M5×12	4
458	1	Plug	NFO6-015	R1/2	1
458	2	Plug	NFO6-004	R1/8	2

P/N		Part Name	Code No.	Remarks	Q'ty.
458	3	Plug	NFO6-008	R1/4	1
459		Plug	NFO6-015	R1/2	1
522		Domed Cap Nut	NC921-36	M36	1
523		O-ring	PA11-040	JIS B 2401 P40	1
528		Oil Seal Sleeve	CS52810-250VD	250V**	1
528		Oil Seal Sleeve with O-ring	CS52809-250VD	250V**	1
529		Set screw	NA83606-008	M6×8	2
533		Spring Washer, Hexagon Socket Head Cap Screw	ND330-06	M6	1
605		Plug	NF06-025	R 1"	1
607	A	Plug	NF06-008	R1/4	1
607	B	Plug	NF06-008	R1/4	1
680	A	Conical Spring Washer, Vi Adjusting Rod	ND160-036	M36	1
680	B	Conical Spring Washer, Vi Adjusting Rod	ND160-036	M36	1
701		Backup Ring	PBP11-067		1
715		Cover Plate, Lubricating oil inlet Flange	CS71500-025	25A	1
715		Cover Plate, Liquid injection Flange	CS71500-032	32A	1
744		O-ring	PA12-070	JIS B 2401 G70	1

CAUTION

- **The part code of the O-ring is the one assigned to NBR which is standard material. When the material of the O-ring is other than NBR, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

CAUTION

- **The Code No. of parts shown in parentheses below is applied to the product until the end of November, 2014:**
  (P/N 120 Unloader Indicator Assembly, P/N 125 Micro-Switch, P/N 129 Potentiometer)
- **For the Code No. of new type indicator part, refer to the separately dedicated Instruction manual for it.**

【POINT】

The sizes of O-ring No.432-2 and No.432-2 have been changed to G130 from G135 in October 2012 as a design change.

Table 7-4 Parts Configuration Table of 320V*D models

P/N		Part Name	Code No.	Remarks	Q'ty.
1		Main Rotor Casing	CS00100-320VXS	320VS*	1(VSD)
1		Main Rotor Casing	CS00100-320VXM	320VM*	1(VMD)
1		Main Rotor Casing	CS00100-320VXL	320VL*	1(VLD)
2		Hexagon Socket Head Cap Screw	NB35424-080	M24×80	52
3		Alignment Pin	NE2025-080	Φ25×80	4
4		Eye Bolt	NB600-30	M30	2
5		Suction Cover	CS00500-320VXD	320V*D	1
6		Gasket, Suction Cover	CS00600-320VD	320***	1
7		Eye Bolt	NB600-16	M16	2
8		Spring Pin	NE3206-018	Φ6×18	2
9		O-ring	PA11-058	JIS B 2401 P58	1
10	A	Plug	NF06-020	R3/4	1
10	B	Plug	NF06-015	R1/2	2
11		Bearing Head	CS01100-320VXD	320V*D	1
12		Gasket, Bearing Head	CS01200-320N	320***	1
13		Eye Bolt	NB600-16	M30 (from 2006.03.30)	1
14		Spring Pin	NE3206-018	Φ6×18	2
15		Plug	NF06-010	R 3/8	1
16		Bearing Cover	CS01600-320VXD	320V*D	1
17		Gasket, Bearing Cove	CS01700-320VD	320V*D	1
18	1	Hexagon Socket Head Cap Screw	NB35420-070	M20×70	19
18	2	Hexagon Socket Head Cap Screw	NB35420-120	M20×120	12
18	3	Hexagon Socket Head Cap Screw	NB35420-120	M20×120	6
19		Alignment Pin	NE2016-070	Φ16×70	2
20		Spring Pin	NE3203-016	Φ3×16	1
21		Plug	NF06-008	R1/4	1
22		Balance Piston Cover	CS02200-320	320***	1
23		Gasket, Balance Piston Cover	CS02300-320N	320***	1
24		Hexagon Socket Head Cap Screw	NB35416-045	M16×45	11
25		Male Rotor	CS02500-320VS	320VS*	1(VSD)
25		Female Rotor			
25		Male Rotor	CS02500-320VM	320VM*	1(VMD)
26		Female Rotor			
25		Male Rotor	CS02500-320VL	320VL*	1(VLD)
26		Female Rotor			
27		Main Bearing O-ring type	CSH02700-320	320***	2
28		Side Bearing O-ring type	CSH02800-320	320***	2
29		Snap Ring (Internal)	NG11-200	H200	4
30		Balance Piston	CS03000-320H	320**H	1
31		Key, Balance Piston	CS03100-320	320***	1
32		Snap Ring (External)	NG12-100	S100	1

P/N		Part Name	Code No.	Remarks	Q'ty.
33		Sleeve, Balance Piston	CS03300-320H	320**H	1
34		Spring Pin	NE3206-014	Φ6×14	1
35		O-ring	PA12-190	JIS B 2401 G190	1
36		O-ring Spacer	CS03600-320	320***	1
37		Snap Ring (Internal)	NG11-200	H200	2
38		Thrust Bearing	CS03800-320	320***	2
39		Lock Nut	NG311-021	AN21	2
40		Lock Washer	NG32-021	AW21	2
42		Spacer, Thrust Bearing Alignment	CS04200-320	320***	2
43		Thrust Bearing Gland	CS04300-320	320***	2
45		Hexagon Head Bolt	NB15520-055	M20×55	8
46		Conical Spring Washer	ND150-020	M20 1L	8
46		Lock Washer Set (old, plate type)	CS0469-G	320*** 8p./set	-
48		Retainer, Oil Seal	CS04800-320VDS	320***	1
48		Retainer, Oil Seal	CS04800-320P	320*** with Seal pot	1
49		O-ring	PA12-160	JIS B 2401 G160	1
50		Oil Seal	CS05010-320VD	SA1J 95×120×13	1
51		Seal Cover	CS051000-320BBS	320*** BBSⅢ, BOS	1
51		Seal Cover	CS05100-320UV4	320*** UV-4	1
52		Gasket, Seal Cover	CS05200-320N	320***	1
53		Hexagon Socket Head Cap Screw	NB35416-040	M16×40	8
54		Unloader Slide Valve	CS05400-320VSD	320VS*	1(VSD)
54		Unloader Slide Valve	CS05400-320VMD	320VM*	1(VMD)
54		Unloader Slide Valve	CS05400-320VLD	320VL*	1(VLD)
58		Hexagon Socket Head Cap Screw	NB35412-055	M12×55	5
60		Unloader Cylinder	CS06000-320V	320V*D	1
61		Hexagon Socket Head Cap Screw	NB35420-050	M20×50	2
62		Hexagon Socket Head Cap Screw	NB35420-110	M20×110	6
63		O-ring	PA12-240	JIS B 2401 G240	1
64		Unloader Piston	CS06400-320S	320***	1
65		O-ring	PA11-200	JIS B 2401 P200	1
66		Teflon Cap Seal	CS06600-320-1	CAP-3BE200	1
67		Push Rod, Unloader Slide Valve	CS0671-GV	320V*D	1
68		Guide Pin	NE2506-016	Φ6×16	1
69		Lock Nut	NG31-010	AN10	1
70		Lock Washer	NG32-010	AW10	1
73		O-ring	PA11-044	JIS B 2401 P44	1
74		Unloader Cover	CS07400-320	320***	1
75		O-ring	PA12-210	JIS B 2401 G210	1
76		Hexagon Socket Head Cap Screw	NB35416-040	M16×40	8
77		Indicator Cam	CS07700-320VS	320VS*	1(VSD)
77		Indicator Cam	CS07700-320VM	320VM* 320VL*	1(VMD) 1(VLD)

P/N		Part Name	Code No.	Remarks	Q'ty.
78		Ball Bearing	CS07800-200	#6000	1
79		Snap Ring (External)	NG12-010	S10	1
80		Bearing Gland	CS08000-200	200V**	1
81		Hexagon Socket Head Cap Screw	NB35406-015	M6×15	3
82		V-ring	CS08200-200B	20×10×12 VH10 NBR	1
83		Spring	CS08300-200	200V**	1
84		Retainer, Indicator Cam Spring	CS08400-200	200***	1
91		Shaft Key	CS09100-320	320***	1
92		Suction Flange	CS71400-P350	MYK350A	1
93		Gasket, Suction Flange	CS09300-320N	MYK350A	1
94		Hexagon Head Bolt	NB12024-075	M24×75	16
95		Discharge Flange	CS71400-P200MK	MYK200A	1
95		Discharge Flange	CS71400-200CDMK	MYK200CD	1
96		Gasket, Discharge Flange (for the case V*G model or V*D model used No.235)	CR72000-200N	MYK200A	1
97		Hexagon Head Bolt (for the case that is not using No.235 Discharge flange spacer)	NB12020-055	M20×55	12
97		Hexagon Head Bolt (for the case using No.235 Discharge flange spacer)	NB12020-085	M20×85	12
100		Mechanical Seal Assembly	CS10000-320BE	BOS-E1	-
100		Mechanical Seal Assembly	CS10002-320EBS	BBS-E	1
100		Mechanical Seal Assembly	CS10001-320BBS	BBS3	-
100		Mechanical Seal Assembly	CS10009-320-F70	UV-4	1
120		Unloader Indicator Assembly	CS120-IND063WP-VP	200V** 0-100%	1
125		Micro-Switch	CS12501-INDO6P	200*** Z15GW	2
127		Micro-Switch Cam	CS1279-200V	200VS\L	1
129		Wire wound type Potentiometer	CS12900-IND06P	with Wires	1
129		Conductive Plastic type Potentiometer	CS12900-IND06P	with Wires	-
137		Indicator Dial	CS13700-200VD	320V*D	1
150		O-ring	PA12-220	JIS B 2401 G220	2
166		Hexagon Socket Head Cap Screw	NB35405-010	M5×10	4
215		Flange, Lubricating Oil inlet (Journal) without hole	CS71400-040	MYK40A	1
216		Gasket, Lubricating Oil inlet Flange	CR72000-040N	MYK40A	1
217		Hexagon Head Bolt	NB14012-040	M12×40	4
218		Flange, Oil Injection with hole	CR74000-025	MYK25A	1
219		Gasket, Oil Injection Flange	CR72000-025N	MYK25A	1
220		Hexagon Head Bolt	NB14012-035	M12×35	4
235		Spacer, Discharge Flange (This spacer is not necessary for CD flange.)	-	320***	1
236		Gasket, Discharge Flange Spacer	CS23600-320N	320***	1
237		Torsional Slip Washer	CS23700-320	125～400	2
250		Thrust Washer	CS25000-320	320***	2
251		Electromizer (Economizer) Flange without hole	CS71400-080	MYK80A Male	1

P/N		Part Name	Code No.	Remarks	Q'ty.
251		Electromizer (Economizer) Flange with hole	CR74000-080	MYK80A Male	1
252		Gasket. Electromizer (Economizer) Flange	CR72000-080N	MYK80A	1
253		Hexagon Head Bolt	NB15520-055	M20×55	4
254		Liquid Injection Flange without hole	CS71400-050	MYK50A Male	1
254		Liquid Injection Flange with hole	CR74000-050	MYK50A Male	-
255		Gasket, Liquid Injection Flange	CR72000-050N	MYK50A	1
256		Hexagon Head Bolt	NB15516-045	M16×45	4
267		Special Spring Washer, Hexagon Socket Head Cap Screw	ND330-12	M12	5
289		Variable Vi auxiliary Slide Valve	CS28900-320VSD	320VS*	1(VSD)
289		Variable Vi auxiliary Slide Valve	CS28900-320VMD	320VM*	1(VMD)
289		Variable Vi auxiliary Slide Valve	CS28900-320VLD	320VL*	1(VLD)
326		O-ring Gland	CS32600-320	320***	1
420		Spacer, Unloader Positioning	CS42000-320VSD	320VS*	1(VSD)
420		Spacer, Unloader Positioning	CS42000-320VMD	320VM*	1(VMD)
420		Spacer, Unloader Positioning	CS42000-320VLD	320VL*	1(VLD)
421		O-ring	PA11-058	JIS B 2401 P58	2
432		O-ring	PA12-165	JIS B 2401 G165	4
433		O-ring	PA12-165	JIS B 2401 G165	4
444		Vi Adjusting Rod	CS44400-320VSD	320VS*	1(VSD)
444		Vi Adjusting Rod	CS44400-320VMD	320VM*	1(VMD)
444		Vi Adjusting Rod	CS44400-320VLD	320VL*	1(VLD)
446		Vi Square Washer, Teflon Bushing	CS44600-250VD	250V***	1
448		Teflon Bushing	CS44800-320VD	320V*D	1
449		Thrust Washer	CS44900-320VD	200V**	2
450		O-ring	PA11-044	JIS B 2401 P44	2
451		O-ring	PA11-050A	JIS B 2401 P50A	1
452		Hexagon Socket Head Cap Screw	NB35406-020	M6×20	1
453		Hexagon Nut	NC140-36	M36	1
458	1	Plug	NF06-015	R1/2	1
458	2	Plug	NF06-004	R1/8	2
458	3	Plug	NF06-008	R1/4	1
459		Plug	NF06-015	R1/2	1
522		Domed Cap Nut	NC921-36	M36	1
523		O-ring	PA11-050A	JIS B 2401 P50A	1
528		Oil Seal Sleeve	CS52810-320VD	320***	1
528		Oil Seal Sleeve with O-ring	CS52809-320VD	320***	1
529		Set screw	NA83606-010	M6×8	2
533		Spring Washer, Hexagon Socket Head Cap Screw	ND330-06	M6	1
599		Guide Pin	NE3206-016	Φ6×16	1
600		Retainer, Vi adjusting Rod	CS60000-320VD	320V*D	1
601		Flange, Lubricating Oil inlet (F Rotor side)	CR74000-020	MYK20A	1
602		Gasket, Lubricating Oil inlet (F Rotor side)	CR72000-020N	MYK20A	1

P/N		Part Name	Code No.	Remarks	Q'ty.
		Flange			
603		Hexagon Head Bolt	NB14012-035	M12×35	2
604		Vi Adjusting Rod Washer	ND160-036	JIS B 1256 36	1
605		Plug	NF06-032	R1 1/4	1
607	A	Plug	NF06-004	R1/4	1
607	B	Plug	NF06-004	R1/4	1
680	A	Conical Spring Washer, Vi Adjusting Rod	ND160-036	M36	1
680	B	Conical Spring Washer, Vi Adjusting Rod	ND160-036	M36	1
701		Backup Ring	PBP11-85		1
715		Cover Plate, Liquid injection Flange	CS71500-025	MYK25A	1
744		O-ring	PA12-090	JIS B 2401 G90	1

CAUTION

- **The part code of the O-ring is the one assigned to NBR which is standard material. When the material of the O-ring is other than NBR, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

CAUTION

- **The Code No. of parts shown in parentheses below is applied to the product until the end of November, 2014:**
  (P/N 120 Unloader Indicator Assembly, P/N 125 Micro-Switch, P/N 129 Potentiometer)
- **For the Code No. of new type indicator part, refer to the separately dedicated Instruction manual for it.**

7.3 Tightening Torques for Bolts and Nuts

7.3.1 Hexagon Head Bolts

Table 7-5 Hexagon Head Bolts Used and Each Tightening Torque

P/N	Tightening Location			Nominal Designation x Length mm (Qty) Tightening Torque N·m			
				160V	200V	250V	320V
45	Thrust Bearing Gland			M10x30 (8) 40	M12x35 (8) 50	M16x45 (8) 60	M20x55 (8) 120
94	Suction Flange			M20x55 (8) 140	M22x55 (8) 160	M24x65 (12) 200	M24x75 (16) 200
97	Discharge Flange	CD type	Sideways discharge	M22x55 (4) 160	M20x55 (8) 140	M22x55 (8) 160	M20x55 (12) 140
		A type	Sideways discharge	M22x80 (4) 240	M20x80 (8) 140	M22x85 (8) 160	M20x85 (12) 140
			Downward discharge	M22x55 (4) 160	M20x55 (8) 140	M22x55 (8) 160	—
217	Lubricating Oil inlet Flange			—	M12x35 (2) 40	M12x35 (4) 40	M12x40 (4) 40
218	Oil Injection inlet Flange			—	—	—	M12x40 (4) 40
253	Economizer inlet Flange			M12x35 (4) 40	M12x40 (4) 40	M16x45 (4) 110	M20x55 (4) 140
256	Liquid Injection inlet 1 Flange			M12x35 (2) 40	M12x35 (4) 40	M12x40 (4) 40	M16x45 (4) 110
603	Lubricating Oil inlet (F Rotor side) Flange			—	—	—	M12x35 (2) 40

Note: When MYK-A type flange is used as discharge flange for sideways discharge type compressor, the length of the fastening bolt [97] is longer than other type models due to using the discharge flange spacer [235].
Pay particular attention to the tightening the thrust bearing gland so that they are not partially tightened.
Tighten with the procedure shown in 7.3.4.

7.3.2 Hexagon Socket Head Cap Screws

Table 7-6 Hexagon Socket Head Cap Screw Used

P/N	Location	160V	200V	250V	320V
2	Main Rotor Casing	M12x45 (52)	M16x50 (50)	M20x60 (44)	M24x80 (52)
18-1	Bearing Cover	M12x40 (19) D M12x40 (24) G	M16x50 (15) D M16x50 (18) G	M16x50 (18) D M16x50 (22) G	M20x70 (19)
18-2	Bearing Cover	M12x80 (7)	M16x75 (8)	M16x90 (8)	M20x120 (12)
18-3	Bearing Cover	—	M16x65 (6)	M16x70 (5) D M16x70 (6) G	M20x120 (6)
24	Balance Piston	M10x25 (11)	M12x30 (11)	M12x30 (11)	M16x45 (11)
34	Balance Piston Sleeve	M6x15 (2)	M8x15 (2)	M8x20 (2)	—
53	Seal Cover	M8x25 (8)	M10x25 (8)	M12x30 (8)	M16x40 (8)
58	Unloader Push Rod	M6x30 (5)	M8x45 (5)	M10x55 (5)	M12x55 (5)
61	Unloader Cylinder	M10x25 (2)	M12x30 (2)	M16x40 (2)	M20x50 (2)
62	Unloader Cylinder	M10x65 (6)	M12x75 (6)	M16x90 (6)	M20x110 (6)
76	Unloader Cylinder Cover	M8x25 (8)	M10x25 (8)	M12x30 (8)	M16x40 (8)
81	Bearing Gland	M6x15 (3)	M6x15 (3)	M6x15 (3)	M6x15 (3)
166	O-ring Gland	—	—	—	M5x10 (4)
452	Unloader Slide Valve, Teflon Bushing	M4x10 (1)	M5x15 (1)	M6x20 (1)	M6x20 (1)
454	Variable Vi Auxiliary Slide Valve Lock Washer	M4x20 (2)	M6x20 (2)	M6x35 (2)	—
456	O-ring Gland	M5x10 (2)	M5x10 (2)	M5x10 (4)	—
529	Oil Seal Sleeve	—	M6x8 (2)	M6x8 (2)	M6x8 (2)

Note: The bolt types of No.34 and No.529 are hexagon socket head cap screw (set screw).
Note: No.454 bolt had been used in the products until 2002.

Table 7-7 Tightening Torques for Hexagon Socket Head Cap Screw

Torque Unit	M4	M5	M6	M8	M10	M12	M14	M16	M20	M24
N・m	2.8	6	10	25	50	90	140	240	450	750
kgf・cm	28	60	100	250	500	900	1400	2400	4500	7500

7.3.3 Lock Nuts

Table7-8 Lock Nut Used and Each Tightening Torque

P/N	Location	Nominal Designation of Lock Nut（Qty） Tightening Torque N·m			
		160V	200V	250V	320V
39	Thrust Bearing Standard/Maximum	AN12 (2) 408/510	AN13 (2) 522/653	AN17 (2) 1186/1483	AN21 (2) 2259/2824
69	Unloader Piston	AN05 (1) 80	AN07 (1) 120	AN08 (1) 140	AN10 (1) 180

When tightening a lock nut, if it is difficult to use a torque wrench, manage the tightening torque of the lock nut controlling the tightening angle range as explained below.

■ Distortion correction of slip washers and lock washers

a) Tighten the lock nut by hand.
b) Use a lock nut wrench and tighten until the rotor turns.
c) Use a lock nut wrench and a hammer, hit twice lightly.
d) Use a lock nut wrench and a hammer, loosen the lock nut.

■ Tightening Angle Range of Lock Nuts for Rotors

a) After tightening the lock nut by hand, further tighten the lock nut by using a lock nut wrench until the rotor starts to turn. Take care not to over-tighten.
b) Put a mark on the lock nut at the right side edge of the rotor groove where the stopper tongue of the lock washer fits in, as shown in Figure 7-9.
c) From this marking position, tighten the lock nut in such a way that rotation can be stopped within the tightening angle range shown in Table 7-3.
   When measuring the angle, use an angle gauge which is set to the diameter of rotor shaft.

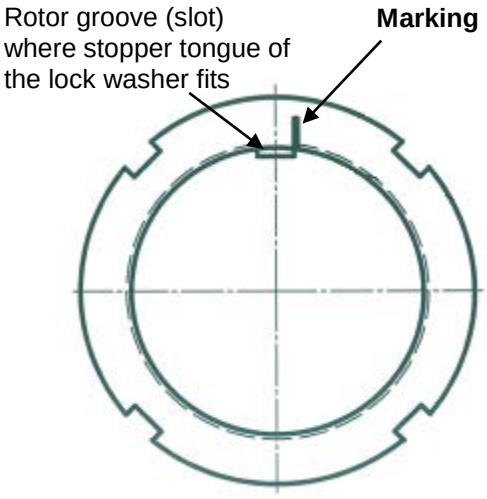
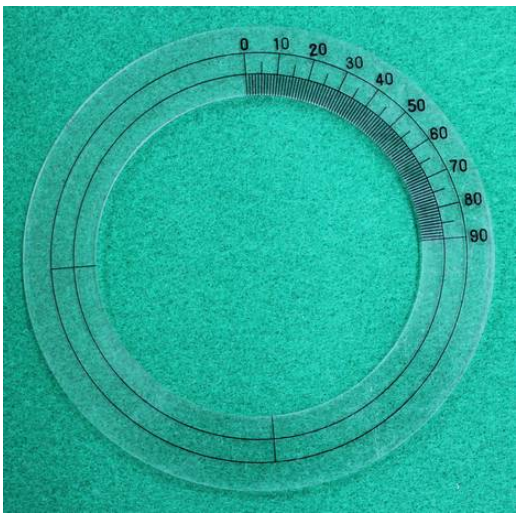


Figure 7-6 Position where mark is put

Table 7-9 Tightening Angles Specified for Lock Nuts of Rotor

Model	Angle range
160V** - 320V**	15° to 30°



Angle gauge (example)

7.3.4 Thrust Bearing Gland

Standard tightening torque of thrust bearing gland bolt and its tightening method

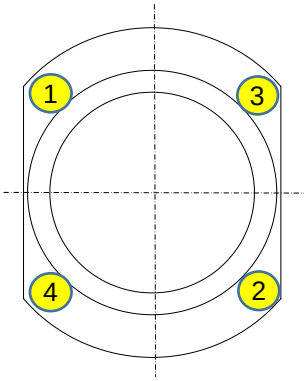
1. Introduction

Thrust bearing gland bolts for screw compressors are a very important task in assembling precision thrust bearings.
In this work, excessive tightening or partial tightening exceeding the specified torque may affect the bearing life, so be sure to use the specified torque and tightening method below.

2. Specified tightening torque and tightening method

STEP	Working procedure	Specified tightening torque (%)	Tightening torque at each STEP (N·m)			
			160	200	250	320
			4-M10	4-M12	4-M16	4-M20
1	First, tighten all bolts by hand. (①→②→③→④)	0 %	0	0	0	0
2	Next, temporarily tighten diagonally and uniformly with a snug torque (25 % x specified torque). (①→②→③→④)	25 %	10	13	15	30
3	Next, tighten uniformly diagonally with 50 % x specified torque. (①→②→③→④)	50 %	20	25	30	60
4	Next, tighten uniformly diagonally with 50 % x specified torque. (①→②→③→④)	100 %	40	50	60	120

Note 1) STEP1 and STEP2 in this procedure are intended to ensure that the bolt seating surface is securely and uniformly contacted with the object to be fastened without any gaps, thereby preventing one-sided tightening.
Note 2) STEP3 and STEP4 in this procedure are intended to fix the outer ring of the bearing, which is the object to be fastened, with uniform tightening.
Note 3) When tightening bolts, always use a torque wrench. If using a ratchet type torque wrench, be careful not to overtighten.



7.4 O-rings Used

7.4.1 List of O-rings Used

Table 7-10 List of O-rings Used (Quantity in parentheses)

P/N	Location		160V	200V	250V	320V
9	Suction Cover		P46 (1)	G60 (1)	G65 (1)	P58 (1)
35	Balance Piston Sleeve		G95 (1)	P120 (1)	P150 (1)	G190 (1)
49	Seal Retainer		G90 (1)	G115 (1)	G135 (1)	G160 (1)
63	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		P21 (1)	G30 (1)	G35 (1)	P44 (1)
75	Unloader Cylinder Cover		G110 (1)	G135 (1)	G170 (1)	G210 (1)
103	Mechanical Seal（BOS type）		AS568A 332 (1)	AS568A 337 (1)	AS568A 340 (1)	P110 (1)
106-2			G55 (1)	AS568A 232 (1)	Φ79.6x3.5 (1)	Φ99.6x3.5 (1)
112			G50 (1)	G60 (1)	G70 (1)	G90 (1)
103	Mechanical Seal (BBS III type）		AS568A 230 (1)	AS568A 235 (1)	AS568A 238 (1)	AS568A 246 (1)
112			AS568A 226 (1)	AS568A 229 (1)	AS568A 232 (1)	AS568A 239 (1)
103	Mechanical Seal（BBSE type）	stationary	AS568A 332 (1)	AS568A 337 (1)	AS568A 340 (1)	P110 (1)
112		rotation	P50 (1)	Φ59.92x3.53 (1)	Φ69.52x2.62 (1)	Φ91.67x3.53 (1)
150	Thrust Bearing Gland		—	—	—	G220 (2)
325	O-ring Gland		P30 (2)	P40 (2)	P46 (2)	—
421	★Unloader Positioning Spacer used in only VS* models		P30 (2)	P40 (2)	P46 (2)	P58 (2)
432	Main Bearing		G85 (4)	AS568A 244 (4)	G130 (4)	G165 (4)
433	Side Bearing		G85 (4)	AS568A 244 (4)	G130 (4)	G165 (4)
450	Vi Adjusting Rod・Bearing Cover		P25 (2)	P35 (2)	P40 (2)	P44 (2)
451	Vi Adjusting Rod・Bearing Head		P25 (1)	P35 (1)	P40 (1)	P50A (1)
523	Unloader Slide Valve		P25 (1)	P35 (1)	P40 (1)	P50A (1)

7.4.2 O-ring Materials Used for Screw Compressor

Table 7-11 List of O-ring Materials Used for Screw Compressor (excluding mechanical seal)

Working fluid	O-ring material
Ammonia	NBR
Hydrofluorocarbon (HFC)	
CO_2	FKM
	HNBR
R23	FKM
Propane	
Propylene	
Natural gas	
City gas	
Helium	

7.5 Gaskets Used

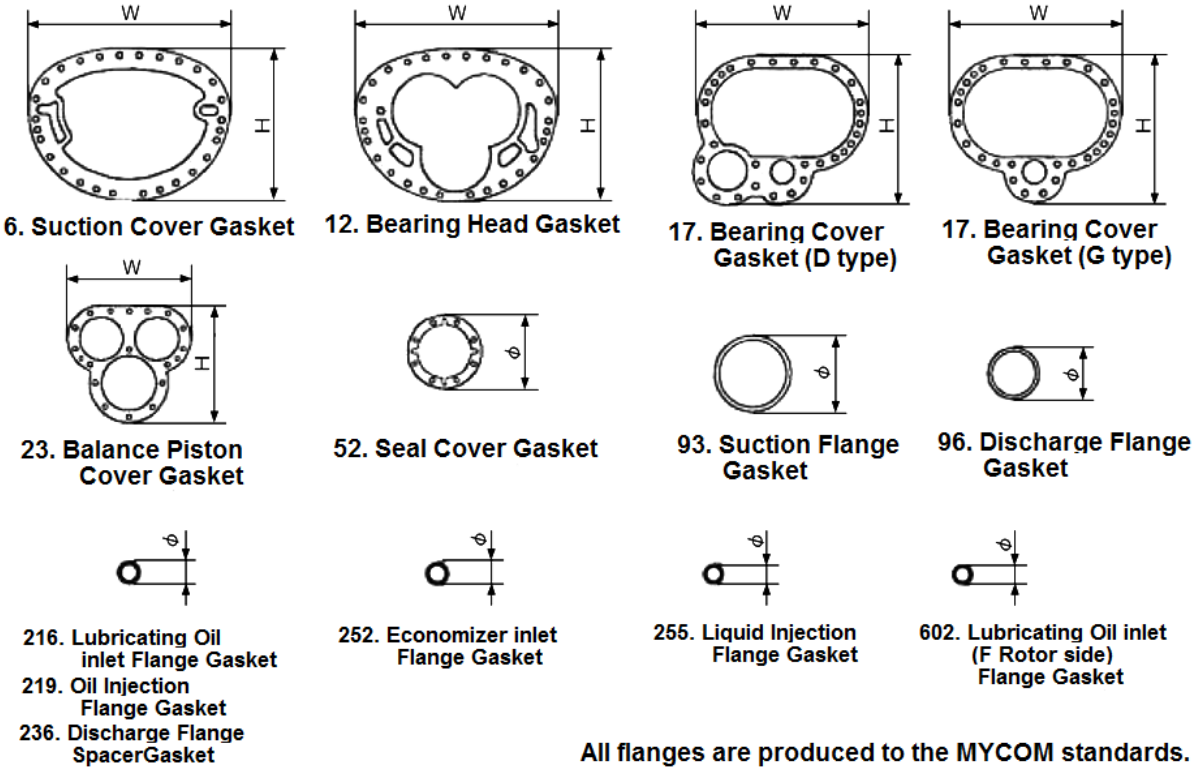


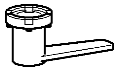
Figure 7-7 Gaskets Used

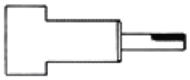
Table 7-12 Gasket Size (mm)

P/N	Location		160V	200V	250V	320V
6	Suction Cover	H	354	420	525	660
		W	460	560	700	880
12	Bearing Head	H	345	420	525	660
		W	460	560	700	880
17	Bearing Cover (D: Sideways discharge)	H	338	414	505	641
		W	397	591	709	887
17	Bearing Cover (G: Downward discharge)	H	332.5	380	463	—
		W	388	480	580	—
23	Balance Piston Cover	H	270	333	340	517
		W	283	350	420	532
52	Seal Cover	Φ	140	170	200	250
93	Suction Flange	Φ	173 (125A)	198 (150A)	325 (250A)	421 (350A)
96	Discharge Flange	Φ	143 (100A)	173 (125A)	198 (150A)	250 (200A)
216	Lubricating Oil inlet Flange	Φ	—	44 (20A)	51 (25A)	67 (40A)
219	Oil Injection Flange	Φ	—	—	—	51 (25A)
236	Discharge Flange Spacer	Φ	110 (100CD)	146 (125CD)	176 (150CD)	233 (200CD)
252	Economizer Flange	Φ	51 (25A)	59 (32A)	83 (50A)	118 (80A)
255	Liquid injection Flange	Φ	44 (20A)	51 (25A)	59 (32A)	83 (50A)
602	Lubricating Oil (for F Rotor side Bearing) inlet Flange	Φ	—	—	—	44 (20A)

7.6 Tools for Disassembly

Table 7-13 List of Tools for Disassembly (example)

Tool name	Illustration	size, etc.;		Parts Center Code No.
Ratchet wrench		1/4”		SG261-08
Adjustable wrench		250 mm		SG231-250
Screwdriver		Phillips	75 mm	SG112-075
			125 mm	SG112-125
Screwdriver		Flat blade	75 mm	SG111-075
			125 mm	SG111-125
Snap ring pliers		External	ST-1	SG311-01
			ST-2N	SG311-02N
			ST-3	SG311-03
Snap ring pliers		Internal	RT-4	SG312-04
			RT-5	—
Eye bolt		M8×200 two-peace-set		UHT0016
Allen wrench key		Across flats	2 mm	SG241-02
			3 mm	SG241-03
			4 mm	SG241-04
			5 mm	SG241-05
			6 mm	SG241-06
			8 mm	SG241-08
			10 mm	SG241-10
			12 mm	SG241-12
			14 mm	SG241-14
			17 mm	SG241-17
			19 mm	SG241-19
Lock nut wrench		AN-05		SAS111-05
		AN-07		SAS111-07
		AN-08		SAS111-08
		AN-10		SAS111-10
		AN-12		SAS111-12
		AN-13		SAS111-13
		AN-17		SAS111-17
		AN-21		SAS111-21

Tool name	Illustration	size, etc.;	Parts Center Code No.
Torque wrench for assembly		5-25 N·m	-
		20-100 N·m	SG132-0900
		60-420 N·m	SG132-4200
Assembly and Disassembly Tool, Main/Side Bearing		160V	CS70300-160
		200V	CS70300-200
		250V	CS70300-250
		320VL	CS70300-320

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