2201M2JE-HO-C7-N_2015.05.

MYCOM

Compound 2-stage Screw Compressor

2520**C Instruction Manual

2520LLC/2520LMC/2520LSC
2520MMC/2520MSC
2520SLC/2520SMC/2520SSC

CAUTION

Before operating, servicing, or inspecting this product, read this manual thoroughly to fully understand the contents.
Keep this manual in a safe, designated place for future reference when necessary.
Specifications of this product and contents of this manual are subject to change without prior notice due to technical improvements, and the like.

MYCOM MAYEKAWA MFG. CO., LTD.

Preface

Thank you for purchasing the MYCOM C-series compound 2-stage screw compressor 2520**C (hereinafter referred to as "this product").

This Instruction Manual (hereinafter referred to as "this manual") provides safety information and operation and maintenance procedures, so that users correctly understand how to handle this product and, as a result, can use it safely and efficiently. This manual is applicable to the following models:

2520LLC-*B*-51	2520LLC-*B*-61	2520LMC-*B*-51	2520LMC-*B*-61	2520LSC-*B*-51	2520LSC-*B*-61
		2520MMC-*B*-51	2520MMC-*B*-61	2520MSC-*B*-51	2520MSC-*B*-61
2520SLC-*B*-51	2520SLC-*B*-61	2520SMC-*B*-51	2520SMC-*B*-61	2520SSC-*B*-51	2520SSC-*B*-61

* -51 (-61) may not be written. For more information, see "2.2 Model Designation of the Compressor" in this manual Chapter 2.

Make sure to read this manual before installing or using this product.

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

Revision History

Title		Document No.	First edition issue date
2520C Instruction Manual**		**2201M2JE-HO-C7-N_2015.05.**	**Feb. 12, 2014**
Revision No.	**Issue date**	**Major Contents of revisions**	**Created/approved by:**
-	Jun. 30, 1974	2520C initial edition was issued.	Yamamoto
-	Oct. 1, 1983	Newly issued as 2520**C/3225**C edition.	Yamamoto
-	Jun. 30, 1993	Revision of 2520**C/3225**C (correction of errors, etc.)	Yamamoto
-	Jun. 30, 1996	Reviewed pursuant to the Product Liability Law enacted in July 1994.	Ikehara / Syozu
00	Feb. 12, 2014	Overall review and document No. change associated with the reissue in an electronic document	Ikehara / Hirao
01	**May 01, 2015**	**Modified the constitution of Chapter 4 and Chapter 5. Correction of describing, etc.**	**Ikehara / Muta**

Warranty and Disclaimer

Warranty

MAYEKAWA shall repair or replace parts of this product for no charge if any failure resulting from defects in design or manufacture occurs, under normal use with the purpose and method that are in accordance with the specifications of this product and this manual, within the warranty period.

The warranty period is "12 months from factory shipment of this product". If there is a separate agreement, that agreement shall prevail in principle.

MAYEKAWA is not liable for production or man-made disaster compensation due to malfunction or damage of this product.

Disclaimer of Warranty

Although MAYEKAWA warrants the clauses mentioned above, the following clauses are exempted.

- Malfunction or damage of this product caused by natural disaster, or other accidental forces (such as fire, thunderbolt, windstorm, intense rainfall, flood, tidal wave, earthquake, land subsidence, etc.).
- Malfunction or damage caused by misusage described below.
  - Malfunctions, damage, or deterioration of this product due to abnormal or improper use (including improperly storing this product outdoors or under too hot/humid conditions, unexpected inspections, tests, operations, too frequent liquid flow-back operation*, and too frequent start-stop cycles, etc.).
  - Malfunction or damage caused by devices or equipments not provided by MAYEKAWA including operation control methods of those devices.
  - Malfunction or damage caused by refrigerants, gases, or refrigerant oils, and operating conditions (design conditions) not approved for this product.
  - Malfunction or damage caused by maintenance or inspection not recommended by MAYEKAWA.
  - Malfunction or damage caused by parts that are not MYCOM genuine.
  - Malfunction or damage caused by remodeling the product without approval of MAYEKAWA.
  - Malfunction or damage caused by unexpected misusage

"Liquid flow-back operation" is ・・・

Normally, while the compressor sucks in the refrigerant liquid only after vaporizing it in the evaporator, it may directly sucks it in because of the faulty adjustment or failure of the expansion valve. We call this state of compressor operation "liquid flow-back operation".

No compressor can compress a liquid. The compressor may be damaged should the liquid be sucked in.

Important Information

Intended Use of This Product

This product is a general-purpose screw compressor for refrigeration, cold storage and various gases compression. Do not use this product for any purpose other than intended or not in accordance with the specifications. For specifications of this product, refer to "2.3 Compressor Specifications".

Please perform the maintenance items described in this manual by using safe and assured procedures.

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 cannot be anticipated.

As there are too many items to be strictly observed or prohibited when using this product, it is impossible to inform all of them through this manual or warning labels. Therefore, when operating this product, pay extreme caution on personnel safety as well as on items described in this manual.

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

Please read this manual and fully understand the instructions provided herein before using this product. Be sure to follow the safety procedures described in this manual.

- Operation, maintenance, and inspection of this product should be performed by qualified personnel educated about the fundamentals of the product and trained about the hazards involved and measures to avoid danger.
- Do not allow any person other than those educated on the fundamental expertise of this product and trained about hazards involved and measures to avoid dangers to approach this 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. Do not use this product for any purpose other than intended.
- When replacing a part, use a genuine MYCOM part.
- Not only workers but also managers should actively participate safety and health activities in the workplace to prevent accidents.
- When closing or opening a valve during work, make sure to apply lockout/tagout to prevent the valve from being accidentally closed or opened during the work.

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

Lockout means disconnecting or keeping disconnected machines and devices by locking their energy (power) sources. Lockout refers to not only just stopping power supply by turning off the power switch but also keeping that switch turned off with a key or the like so as to make that switch unable to be handled.

Lockout device refers to a key, cover, latch or the like which is used to lock a switch, valve, or opening/closing lever in turned-off state.

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

“Tagout” means to clearly indicate, by hanging tag plates, that a device is in lockout and that operation of the device is prohibited. Tag plates forbidding operation, starting, opening, etc. are warnings clearly stating to not operate energy (power) sources, and are not for stopping blocking devices.

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 educated about the electrical control of the product.
- When maintaining or inspecting electrical equipment/devices, turn "OFF" the motor main power as well as the control power before starting the work. Perform lockout/tagout, or take measures to prevent the power from accidentally being turned on during the work.

If the power is supplied to the electrical system from outside the package unit in which this product is used, electrical currents may flow even when the motor main power and control power are turned "OFF". In such situations, be sure to cut the power supply, and perform lockout/tagout or take measures to prevent the power from accidentally being turned on during the work.

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 our sales offices or service centers. For each sight of MAYEKAWA, refer to "Contact Information" in this manual or 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.
- MAYEKAWA holds a copyright on this manual. Duplication, in whole or part and by any means such as electronic media, of the drawings and technical documents including this manual is not allowed without prior permission of MAYEKAWA.
- Photographs or drawings included in this manual may be different from the actual product.
- If this manual is lost or damaged, immediately request our local sales offices or service centers for a new one. Use of this product without the aid of this manual may cause an accident.
  If you transfer this product, be sure to hand over this manual to the next owner of this product.

Construction of This Manual

Chapter/Section Title	Details
Preface	Describes the outline of this manual and how to use it.
Warranties and Disclaimer	Describes what MAYEKAWA warrants and what are covered by the warranties. Warranty exemption is stated as disclaimer.
Important Information	Describes important information related to this product and this manual.
1. Safety	Describes workers' safety information, safety measures taken for this product, and administrative control on industrial safety which is required when handling this product.
2. Compressor Specifications and Structure	Describes main components of this product and their functions, specifications and operating limits.
3. Installation	Describes procedures for installing this product.
4. Compressor and Package Unit Operation	Describes precautions for using this product.
5. Maintenance and Inspection	Describes inspection locations & frequency and assembly & disassembly of this product.
6. Troubleshooting	Regarding major troubles that may occur during use of this product, describes how this product will act as well as what actions should be taken when a trouble may occur.
7. Related Documents	Shows materials such as exploded drawings and parts list.
Contact Information	MYCOM Provides contact information for our sales offices and service centers which is to be used for purposes such as genuine parts ordering.

Table of Contents

Chapter 6 Troubleshooting

Chapter 7 Related Documents

Contact Information

Chapter 1 Safety

1.1 Strict Requirements and Prohibitions

1.1.1 Strict Requirements (Do's)

1.1.1.1 Do's on Operation

- Make sure to install safety and protective devices on the package unit.
- Regularly inspect the safety and protective devices if they function properly.
- If the safety or protective devices do not work properly or if this product operates abnormally, immediately stop the operation and report to the supervisor. Obtain his/her approval and direction before restarting the compressor.
- If this product stops for unknown reasons, immediately inform your supervisor of it. Obtain his/her approval before restarting the compressor.
- Some types of refrigerants emit bad smell or toxic gases when they leak. Make sure to ventilate the air during operation.
- For information on the properties of refrigerant and lubricating oil (toxicity, corrosiveness, decomposability, etc.), obtain and see the Safety Data Sheet (SDS) and follow the relevant information.
- When stopping the operation of this product, close the suction and discharge side shut-off valves and turn "OFF" the motor (main power), heater power, and control power.

1.1.1.2 Do's on Maintenance

- Prepare work procedures based on a work schedule. Be sure to perform danger forecasting before starting the work.
- Before performing the work together with at least one other person, thoroughly confirm each other's work details and procedures to acknowledge the other worker's movement.
- When troubleshooting during operation or before performing setup, cleaning or maintenance/inspection of this product, always turn OFF the main power to the motor and control power and other devices. Also, lock and tag out them to prevent the power from being supplied erroneously during operation.
- When troubleshooting during operation or before performing setup, cleaning or maintenance/inspection of this product, confirm that the pressure inside this product and the package unit is at atmospheric pressure.
- Some refrigerants in use generate bad smell or toxic gases, or may cause deficiency of oxygen. Before starting work, measure oxygen concentration in the work area as necessary. Ventilate the area well. Be sure to keep the area well ventilated until the work is finished.
- For information on the properties of refrigerant and lubricating oil (toxicity, corrosiveness, decomposability, etc.), obtain and see the Safety Data Sheet (SDS) and follow the relevant information.
- After using tools always restore to designated place and never leave tools in the compressor.

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

- Attach lockout/tagout mechanism to the main breakers of the main power and control power of the motor. Lockout/tagout after power off is a very effective means to secure safety. It can prevent the power source from being turned on by accident by two or more workers which may cause injury to other worker(s).

- If there are any risks in work (especially cleaning, maintenance, and troubleshooting), turn "OFF" the main power and control power to the motor, and perform lockout/tagout.
- In the following situations, workers may neglect to perform power source shutoff or lockout/tagout. Clearly notify the workers of the necessity of lockout/tagout.
  - It is assumed that workers do not perform lockout/tagout 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 the main motor and control power without applying lockout/tagout to the main motor and control power, because they judge that there is no danger.

1.1.1.4 Do's about Personal Protective Gear

- Prepare and use protective gear complying with the safety standards of the regulations.
- Check the function of each protective gear before using.
- Wear appropriate work cloth and avoid loose clothing.
- Do not wear any neckties or jewelry as there is a risk of being entangled by a movable part or rotating part. Put on a helmet as your hair may get entangled.
- Do not have anything in your pocket to prevent objects from falling into the machine.

1.1.1.5 Do's about Handling of Hazardous and Toxic Substances

- Obtain Safety Data Sheet (SDS) from manufacturers 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 Handling Emergency Situations

- Formulate an emergency action plan complying with the regulations, and post it on a safe place.

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

- Disposing of refrigerant and oil used for this product are subject to a number of regulations for the environmental protection purposes. Follow the local, state, federal acts and regulations and your company's rules when disposing of such waste oil, fluid and materials.

1.1.1.8 Other Do's

- Clean the floor around the entire refrigerating/cold storage/gas compression package unit. Provide a safety passage.
- While moving around in the compressor package unit, walk only in the designated areas. Also, do not leave tools and cleaning solutions in the designated areas.
- If water or oil is spilled on this product or the floor, immediately wipe it off to prevent workers from slipping and getting injured.

1.1.2 Prohibitions (Don'ts)

- Do not remove or relocate any safety device, including electrical interfaces.
- Do not disable any safety device by short-circuiting or bypassing without any permission.
- Do not leave this product unsafe and unattended, by removing a safety cover or some other measures.
- Do not touch, clean or lubricate any movable parts of this product.
- Do not touch electric systems such as relays or terminal blocks with bare hands when turning on the power.

1.2 Warnings

The warning messages described in this manual alert dangerous situations that may arise during work by using the following four categories.

Neglecting such warnings may cause accidents, resulting in personal injury or even death.

Also, this product or its auxiliary equipment may be heavily damaged. Therefore, be sure to always observe the instructions of the warnings.

Table 1-1 Warning Symbols and their Meanings

Symbol	Meaning
DANGER	Indicates a hazardous situation which, if not avoided, could very likely cause serious injury or death.
WARNING	Indicates a potentially hazardous situation which, if not avoided, may cause serious injury or death.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may cause minor or moderate injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in property damage.

1.3 Residual Risks

The following information assumes that this product is operated or inspected/maintained while being used in general refrigerating/cold storage/gas compression package units.

Note that all hazardous sources cannot be predicted for the applications mentioned.

Devise appropriate countermeasures for hazardous sources in your systems.

Table 1-2 Hazardous Sources

	Hazardous sources	Predicted hazard	Countermeasures in operation	Countermeasures in cleaning, inspection, and parts exchange
A	Motor and compressor coupling Refer to Figure 1-1	• Caught in due to contact	• Install coupling cover and prohibit opening. • Keep away.	• Turn off motor main power and control power, and conduct lockout/tagout.
B	Motor terminals	• Electric shock caused by contact with live wires or electrical leakage	• Keep away. • Do not open terminal boxes. • Do not touch terminal boxes.	• Turn off motor main power and control power, and conduct lockout/tagout.
C	Compressor low-stage side suction casing Refer to Figure 1-1	• Frostbite due to contact • Contact with or inhalation of hazardous substances generated by leakage of refrigerant or the like	• Keep away and do not touch. • Wear protective gear. • Detect gas leakage.	• Wear protective gear. • Work under room temperature.
D	Compressor intermediate piping (low-stage discharge port to high stage suction port) Refer to Figure 1-1	• Burn injury due to contact • Contact with or inhalation of hazardous substances generated by leakage or spout of refrigerant or the like	• Keep away and do not touch • Wear protective gear • Gas leakage detection	• Wear protective gear • Work in temperatures below 40 °C
E	Compressor high-stage side discharge casing and discharge piping Refer to Figure 1-1	• Burn injury due to contact • Contact with or inhalation of hazardous substances generated by leakage or spout of refrigerant or the like	• Keep away and do not touch. • Wear protective gear. • Detect gas leakage.	• Wear protective gear. • Work at a temperature of not higher than 40°C.
F	Check valves/service valves and joints on each section of the package unit	• Contact with or inhalation of hazardous substances generated by mishandling or leakage • Frostbite or burn due to contact	• Sufficient ventilation • Indicate valve open/close state. • Keep away and do not touch. • Wear protective gear.	• Sufficient ventilation • Wear protective gear. • Tagout for controlled valve
G	Solenoid valves/motor operated valves on each section of the package unit	• Electric shock caused by contact with live wires or electrical leakage • Pinched due to contact with driving part	• Install protective cover on terminals, and prohibit opening. • Keep away and do not touch. • Wear protective gear.	• Turn off each breaker and the control power, and conduct lockout/tagout. • Wear protective gear.
H	Electric components in each section of the package unit (oil heater, protective switch, etc.)	• Electric shock caused by contact with live wires or electrical leakage • Pinched due to contact with driving part	• Install protective cover on terminals, and prohibit opening. • Keep away and do not touch. • Wear protective gear.	• Turn off each breaker and the control power, and conduct lockout/tagout. • Wear protective gear.
I	Package unit oil drains	• Contact with hazardous substances generated by leakage or spout • Burn caused by contact with high-temperature fluid	• Sufficient ventilation • Keep away and do not touch. • Wear protective gear.	• Sufficient ventilation • Wear protective gear. • Work at a temperature of not higher than 40°C.
J	Noises	• Damage caused by noise	• Wear protective gear.	—

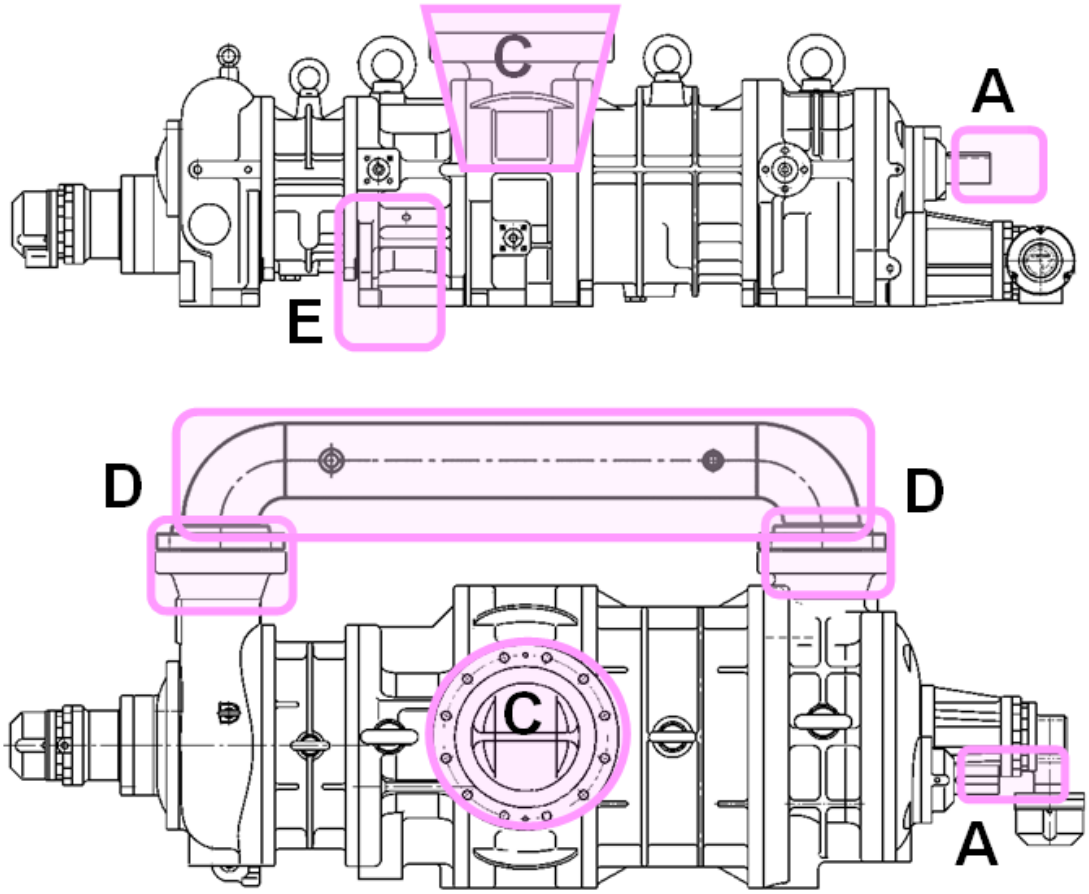


Figure 1-1 Locations of Hazardous Sources (Compressor)

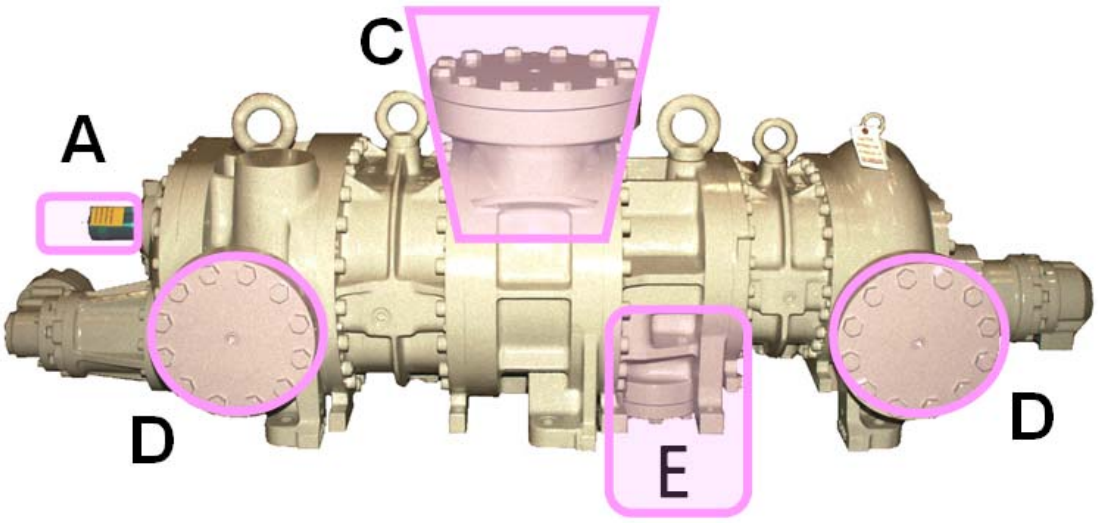


Photo 001 Locations of Hazardous Sources (Compressor)

1.4 Safety Devices

For safe use and protection of this product, make sure to attach safety devices to this product in accordance with the regulations and the following instructions.

Safety devices cannot be kept in normal condition unless inspected and maintained at regular intervals. Their maintenance and inspection need to be performed as an important part of the maintenance/inspection work project. Provide users of this product with necessary information on the safety devices, for example, types of the safety devices, installation position, function, and inspection method of safety related devices.

WARNING

- **Check the safety devices after turning on the power and before operation of this product. If they do not operate normally, immediately repair or replace the devices before starting this product.**

1.4.1 Emergency Stop Button

■ Overview/Function/Purpose

The emergency stop buttons are used to stop this product immediately if an emergency occurs in this product.

■ Installation Positions

On the control board and in the operation control room

■ Stop/Restoration Methods

The operating procedures for the emergency stop button, i.e., how to stop the operation and restore the normal operating condition, must be clearly defined and the information provided to the user of this product.

■ Inspection Method/Cycle

The emergency stop buttons must be tested before commissioning and must also be periodically re-tested after that. The inspection procedures and the inspection interval for the emergency stop button must be clearly defined and the information provided to the user of this product.

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

■ Overview/Function/Purpose

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

■ Methods of Performing and Releasing Lockout/Tagout

Make sure to establish how to perform and release lockout and tagout by referring to the regulations set forth by U.S. Occupational Safety and Health Administration (OSHA) or local governing body, and to clearly notify such methods to users of this product.

■ Inspection Method/Cycle

The inspection procedures and the inspection interval for the lockout/tagout devices, must be clearly defined and the information provided to the user of this product.

1.4.3 Compressor Protective Devices

WARNING

- **Be sure to adjust the set values and check operation of the protective devices at the commissioning.**

■ Overview/Function/Purpose

These protective devices are used to protect this product.

- **Protecting from discharge temperature rise (DT)**

  This device activates and stops the compressor operation when the compressor discharge temperature gets equal to or higher than the set value.
  Install a temperature sensing port to the discharge pipe.

- **Protecting from oil temperature rise (OT)**

  This device activates and stops the compressor operation when the compressor oil temperature gets equal to or higher than the set value.
  Install a temperature sensing port to the oil supply pipe of the package unit (after the oil cooler).

- **Protecting from high pressure (HP)**

  This device activates and stops the compressor operation when the compressor discharge pressure gets abnormally high due to mishandling of the compressor or suspension of water supply to the condenser. This device prevents explosion of the equipment and components.
  Install a pressure sensing port to the discharge pipe.

- **Protecting from intermediate pressure (IP)**

  This device activates when the intermediate pressure of the compressor gets higher than the set value and properly controls the compressor. In some cases, this device stops the compressor operation. Install a pressure output port to the package unit's intermediate gas pipe (or compressor's intermediate gas pressure output port).

- **Protecting from suction pressure drop (LP)**

  This device activates and stops the compressor operation when the compressor suction pressure gets equal to or lower than the set value.
  Install a pressure sensing port to the suction pipe.

- **Protecting from oil pressure (OP)**

  This device activates and stops the compressor operation when lubricating oil supply is not sufficient, the oil filter is clogged, the refrigerant is mixed into the lubricating oil, and oil supply pressure difference (from discharge pressure) becomes below the set value.

  This device is to protect the compressor from wear and burnout.
  Install a pressure sensing port to the package unit's oil supply ~~pump~~ pipe (after the oil pump) and the discharge pipe.

- **Protecting from motor over-current (OCR)**

  This device activates and applies appropriate control when the current gets equal to or higher than the set level flows. In some cases, this device stops the compressor operation.
  This device is normally installed inside the control panel.

■ Connection Positions and Settings

Specify the connection position and setting for each compressor protective device, and make sure to provide users of this product with them.

Make sure that the set values do not exceed the operating limits shown in Chapter 2, section 2.3 and Table 2-2 in this manual.

■ Inspection Method/Cycle

Compressor protective devices require operation tests and confirmation of the settings calibration before test run as well as at regular intervals.

Specify the inspection methods/intervals of the compressor protection devices, and make sure to provide users of this product with such information.

CAUTION

- **In the operation test, check that alarms and protective devices operate normally by using devices such as pressure tester. Do not operate the compressor with all the valves closed, or in any other dangerous conditions.**
- **If the protection from oil pressure (OP), high pressure (HP) activates, do not restart operation until the cause of activation is removed.**

Chapter 2 Compressor Specifications and Structure

2.1 Overview of the MYCOM 2520**C

The 2520**C model is the core model in the MYCOM compound 2-stage screw compressor C-series.

The 2-stage compression system, which has hitherto required two units of standard-type screw compressor for its embodiment, can now be realized by a single unit of compound 2-stage screw compressor.

Generally, a screw compressor uses oil injection to keep discharge temperature at a low level during operation without loss of volumetric efficiency even at high compression ratios. It can, therefore, be operated with a single-stage compression system even at evaporative temperatures near −40 °C.

However, for normal use at low temperatures, a 2-stage compression system is applied in order to improve kW/RT (the ratio of power consumption versus refrigerating capacity). If the 2-stage compression system is configured with standard-type screw compressors, at least two screw compressor units need to be installed, one on the high-stage and the other on the low-stage, which inevitably requires double installation of the entire system including machinery, power, utilities, etc. This 2-stage screw compressor is produced to solve this problem. It is a single unit that has two single-stage compressor units combined into one.

The 2520**C model has a capacity control mechanism for startup load reduction on the high-stage, and a capacity control mechanism for coping with load change on the low-stage.

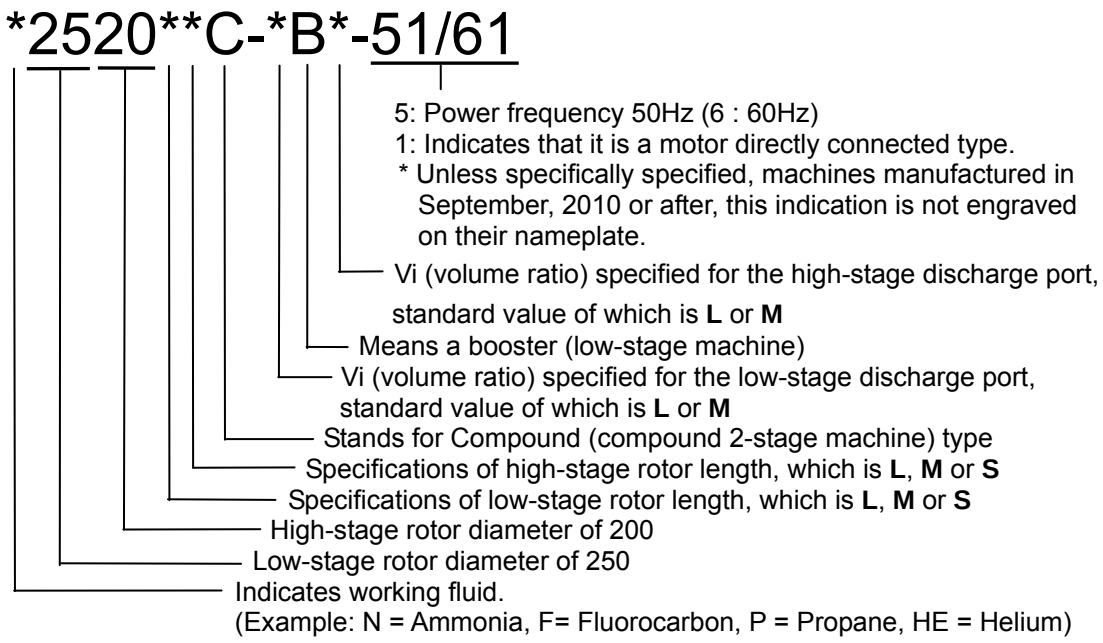
In addition, there are three specification types in rotor length for the low-stage and the high-stage each.

Moreover, customer is able to select each low-stage and high-stage volume ratio from two specifications. Employing these combinations of each specification, 2520**C is providing a high versatility that can satisfy a wide range of operation conditions required by different applications at the load side. Therefore, the 2520**C models are the long-selling products which have marketed for over 30 years since their development in 1983 as the large sized compound 2-stage screw compressor.

2.2 Model Designation of the Compressor

This manual describes 2520**C-*B*-51 and 2520**C-*B*-61 models.

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



2.3 Compressor Specifications

2.3.1 Standard Specifications

Table 2-1 2520C Standard Specifications**

Items			2520							
			LLC	LMC	LSC	MMC	MSC	SLC	SMC	SSC
Product mass		kg	2150	2100	2050	2040	1990	2010	1960	1910
Low-stage swept volume: @3550 min^{-1} /2950 min^{-1}		m^3/h	2840 /2360	2840 /2360	2840 /2360	2380 /1980	2380 /1980	1900 /1580	1900 /1580	1900 /1580
High-stage swept volume: @3550 min^{-1} /2950 min^{-1}		m^3/h	1460 /1210	1220 /1020	975 /810	1220 /1020	975 /810	1460 /1210	1220 /1020	975 /810
Working fluid (Refrigerant)		-	Ammonia, Hydrofluorocarbon, etc..							
Design pressure		MPa	2.6							
Capacity control (Actual load)		%	10 to 100							
Rotation direction		-	Counterclockwise viewed from motor							
Connected pipe size	Low-stage suction flange	-	JIS 20K 250A (10”)							
	Low-stage discharge flange	-	JIS 20K 150A (6”)							
	High-stage suction flange	-	JIS 20K 150A (6”)							
	High-stage discharge flange	-	JIS 20K 100A (4”)							
	Journal lubrication (low-stage)	-	JIS 20K 25A (1”)							
	Journal lubrication (high-stage)	-	JIS 20K 20A (3/4”)							
	Oil injection lubrication	-	JIS 20K 15A (1/2”)							
	Low-stage capacity control	-	Load : Rc3/8, Unload: Rc3/8							
	High-stage capacity control	-	Load : Rc3/8, Unload: Rc3/8							

- **Unless otherwise noted, the pressure unit MPa represents the gauge pressure in this manual.**
- **For limits of working temperature and pressure, see "2.3.2 Operation Limits" in next Section.**

2.3.2 Operation Limits

Table 2-2 Operation Limits of 2520C**

Items		Operation Limits
Maximum discharge pressure	MPa	1.96
Minimum suction pressure	MPa	−0.080
Maximum intermediate pressure	MPa	0.588
Minimum intermediate pressure	-	> Suction pressure
Oil supply pressure		
・ Maximum journal lubrication pressure	MPa	Discharge pressure + 0.39
・ Minimum journal lubrication pressure	MPa	Discharge pressure +0.049 and Suction pressure +0.49
・ Minimum oil injection lubrication pressure	MPa	Suction pressure +0.49
Maximum Suction temperature	°C	85
Minimum suction temperature	°C	−60
Maximum low-stage discharge temperature	°C	90
Maximum high-stage discharge temperature	°C	100
Maximum oil supply temperature	°C	60
Minimum oil supply temperature	°C	30
Maximum male rotor rotation speed	min^{-1}	3600
Minimum male rotor rotation speed	min^{-1}	1450

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

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.**
- **Repeating startup or shutdown operations in a short time is detrimental not for the startup devices and motors 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

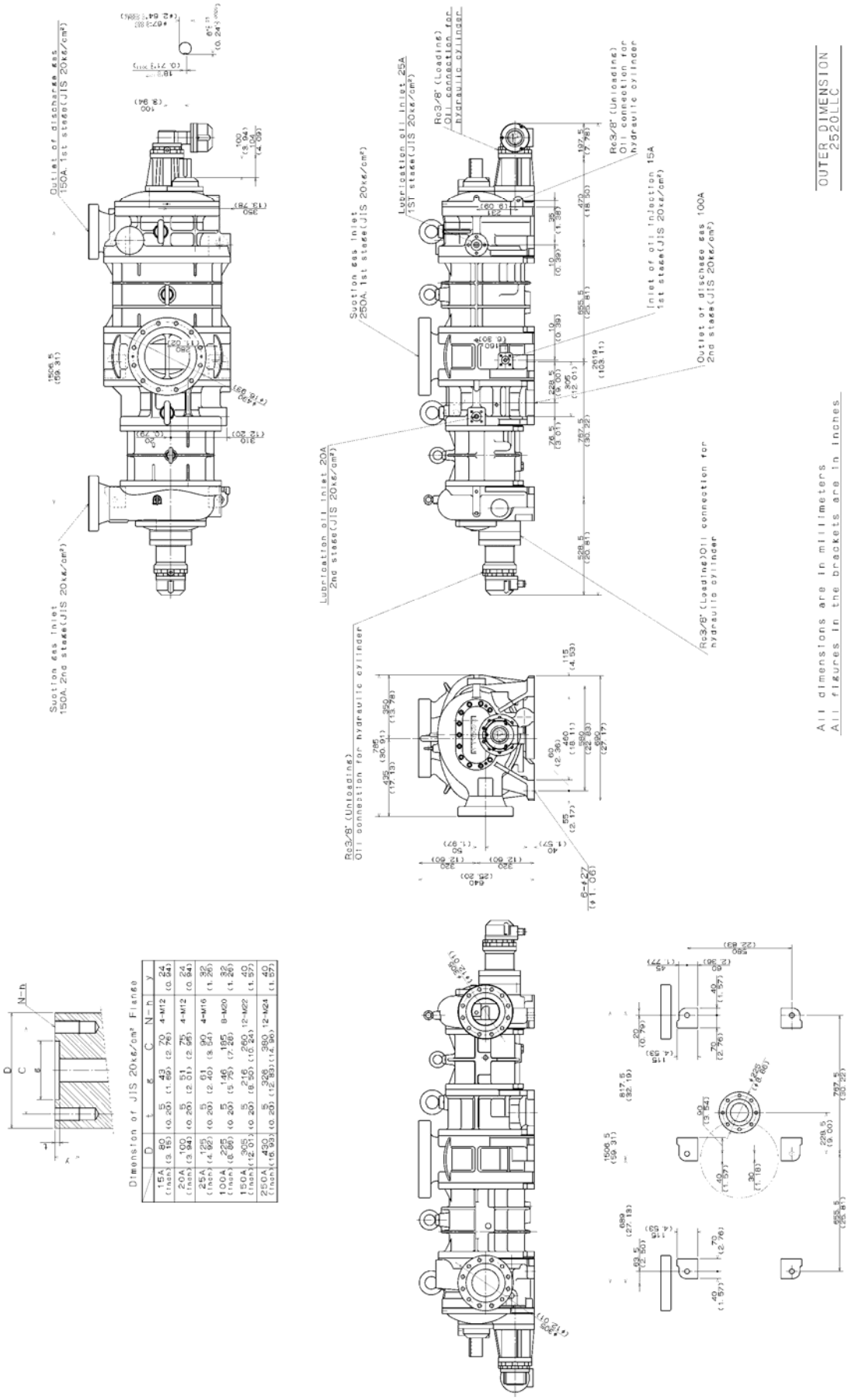
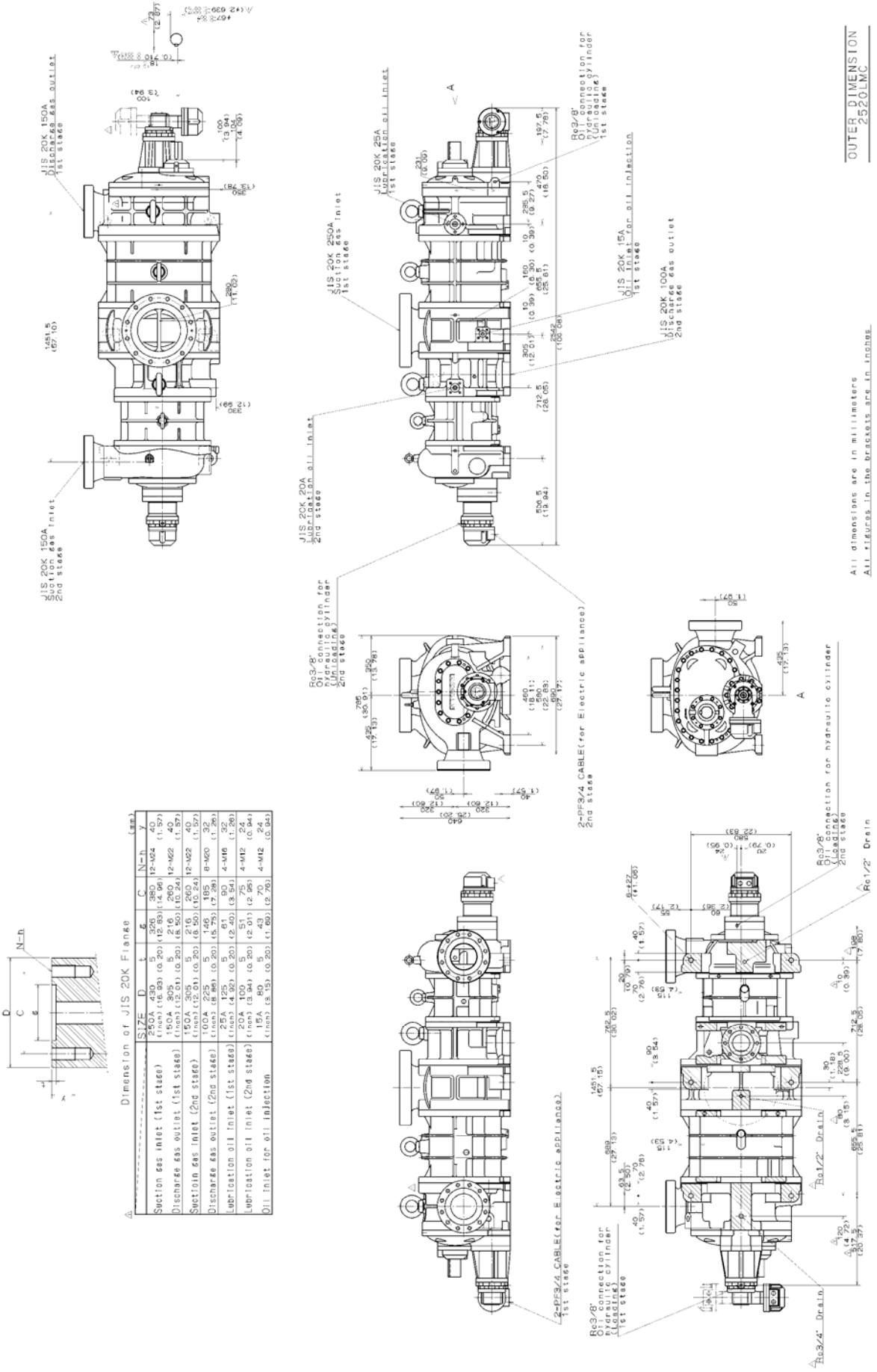


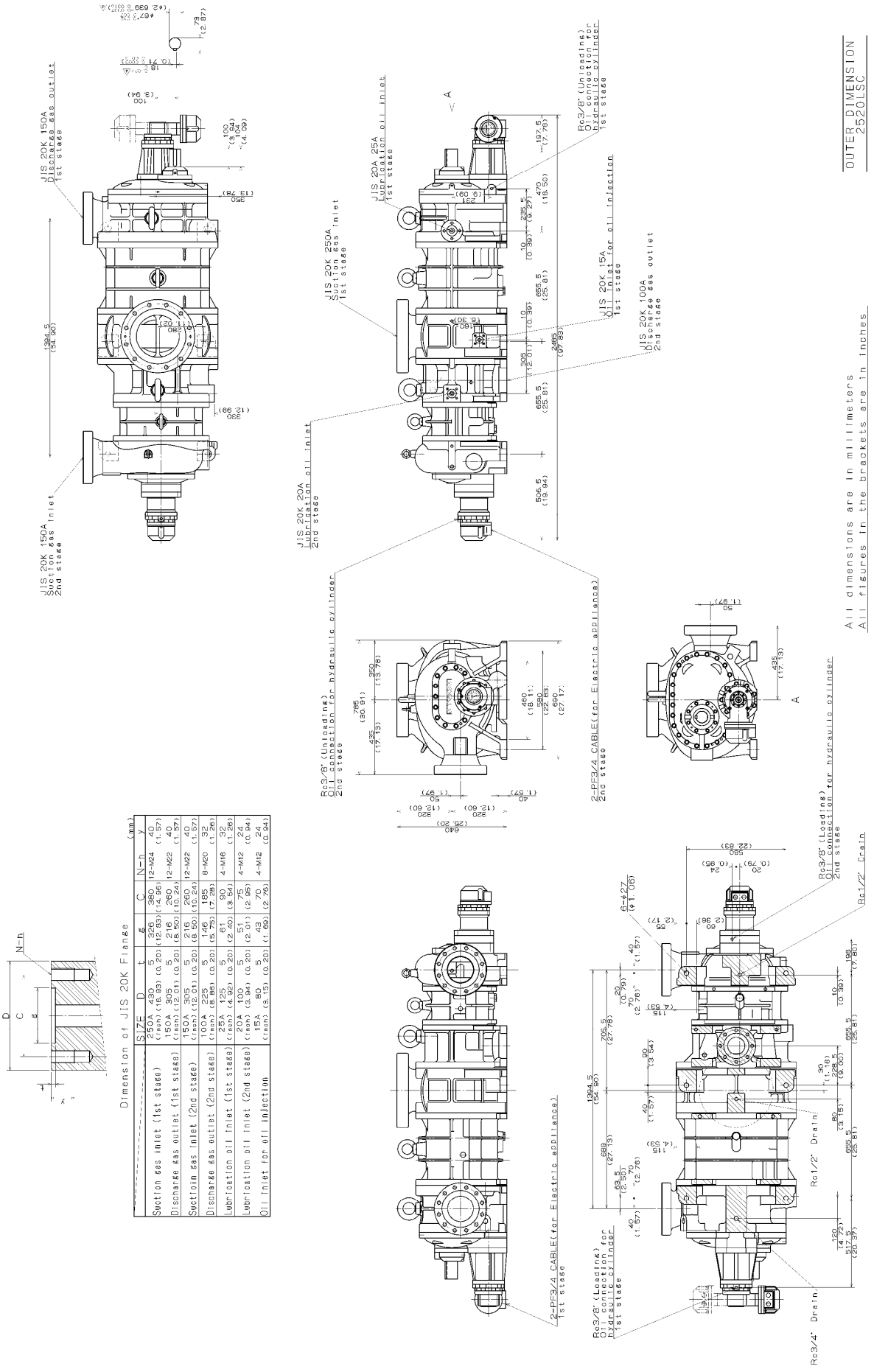
Figure 2-1 2520LLC Outer Dimensions



Dimension of JIS 20K Flange (mm)

Size	D	t	B	C	N-h	X
Suction gas inlet (1st stage)	450A (inch)	400 (16.93)	5 (0.20)	326 (12.83)	380 (14.96)	12-M24	40 (1.57)
Discharge gas outlet (1st stage)	150A (inch)	305 (12.01)	5 (0.20)	216 (8.50)	260 (10.24)	12-M22	40 (1.57)
Suction gas inlet (2nd stage)	150A (inch)	305 (12.01)	5 (0.20)	216 (8.50)	260 (10.24)	12-M22	40 (1.57)
Discharge gas outlet (2nd stage)	100A (inch)	225 (8.86)	5 (0.20)	146 (5.75)	185 (7.28)	8-M20	32 (1.26)
Lubrication oil inlet (1st stage)	25A (inch)	125 (4.92)	5 (0.20)	61 (2.40)	90 (3.54)	4-M16	32 (1.26)
Lubrication oil inlet (2nd stage)	20A (inch)	100 (3.94)	5 (0.20)	51 (2.01)	75 (2.95)	4-M12	24 (0.94)
Oil inlet for oil injection	15A (inch)	80 (3.15)	5 (0.20)	43 (1.69)	70 (2.76)	4-M12	24 (0.94)

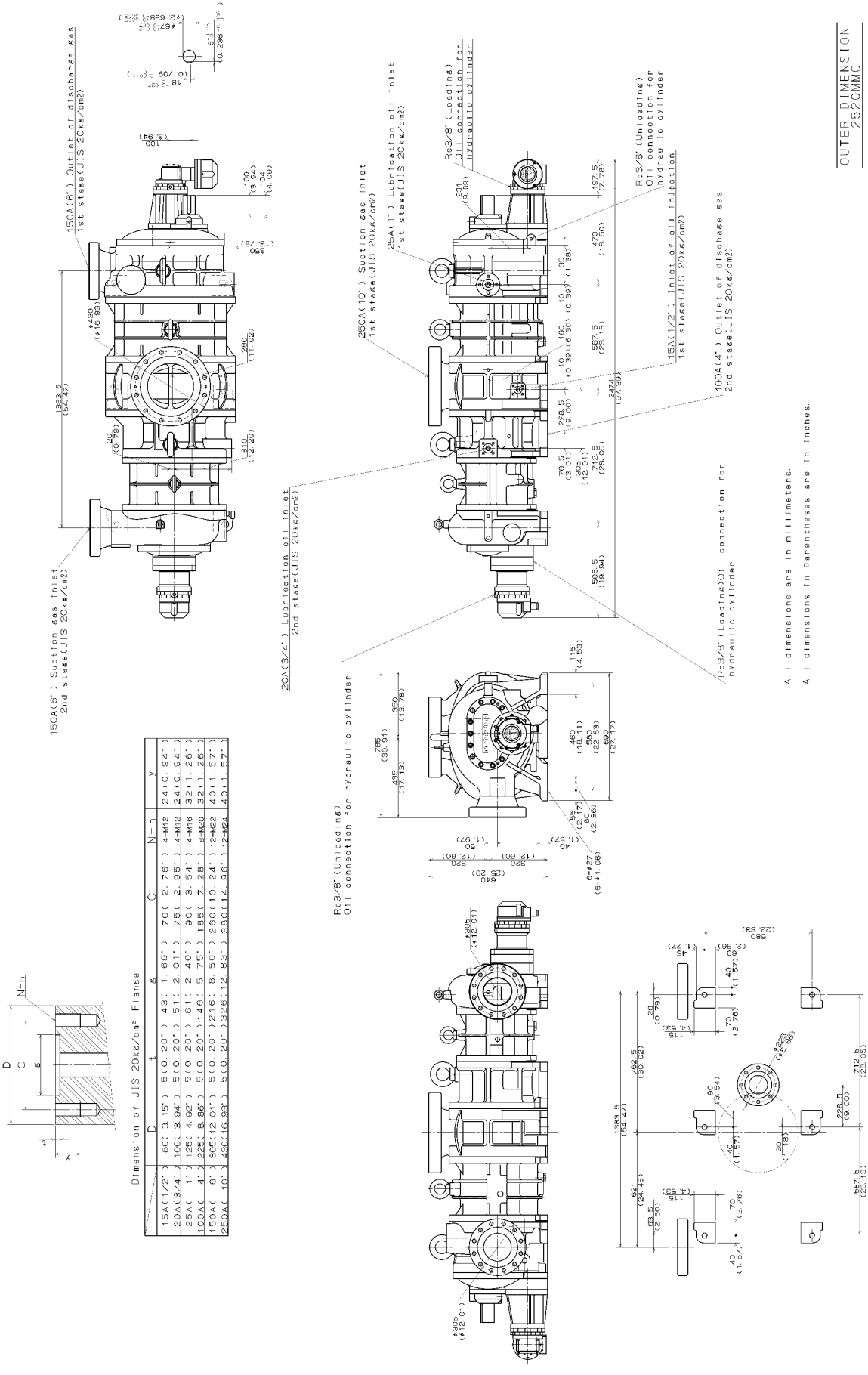
Figure 2-2 2520LMC Outer Dimensions



Dimension of JIS 20K Flange (mm)

SIZE	D	t	g	C	N-h	y
Suction gas inlet (1st stage)	250A	430	5	326	380	12-M24	40
(1st stage)	(10A)	(16.93)	(0.20)	(12.83)	(14.96)		(1.57)
Discharge gas outlet (1st stage)	150A	305	5	216	260	12-M22	40
(1st stage)	(inch)	(12.01)	(0.20)	(8.50)	(10.24)		(1.57)
Suction gas inlet (2nd stage)	150A	305	5	216	260	12-M22	40
(1st stage)	(inch)	(12.01)	(0.20)	(8.50)	(10.24)		(1.57)
Discharge gas outlet (2nd stage)	100A	225	5	146	185	8-M20	32
(1st stage)	(25A)	(8.86)	(0.20)	(5.75)	(7.28)		(1.26)
Lubrication oil inlet (1st stage)	25A	125	5	60	85	4-M16	28
(1st stage)	(inch)	(4.92)	(0.20)	(2.40)	(3.34)		(1.26)
Lubrication oil inlet (2nd stage)	20A	100	5	51	75	4-M12	24
(1st stage)	(inch)	(3.94)	(0.20)	(2.01)	(2.95)		(0.94)
Oil inlet for oil injection	15A	80	5	43	70	4-M12	24
(1st stage)	(inch)	(3.15)	(0.20)	(1.69)	(2.76)		(0.94)

Figure 2-3 2520LSC Outer Dimensions



	D	t	g	C	N−h	y
15A(1/2")	80(3.15")	5(0.20")	43(1.69")	70(2.76")	4-M12	24(0.94")
20A(3/4")	100(3.94")	5(0.20")	51(2.01")	75(2.95")	4-M12	24(0.94")
25A(1")	125(4.92")	5(0.20")	61(2.40")	90(3.54")	4-M16	32(1.26")
100A(4")	225(8.86")	5(0.20")	146(5.75")	185(7.28")	8-M20	32(1.26")
150A(6")	305(12.01")	5(0.20")	216(8.50")	260(10.24")	12-M22	40(1.57")
250A(10")	430(16.93")	5(0.20")	326(12.83")	380(14.96")	12-M24	40(1.57")

Figure 2-4 2520MMC Outer Dimensions

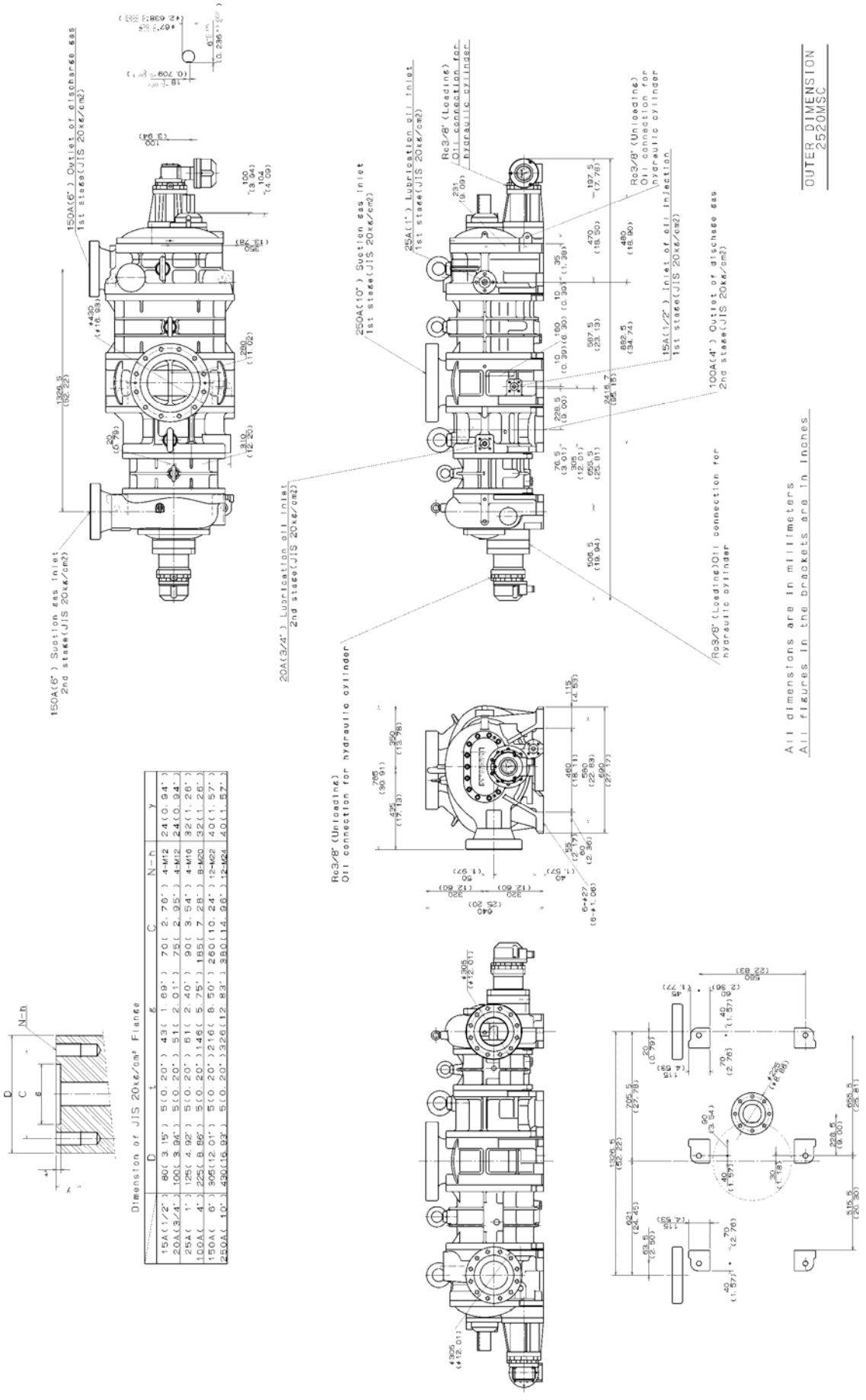
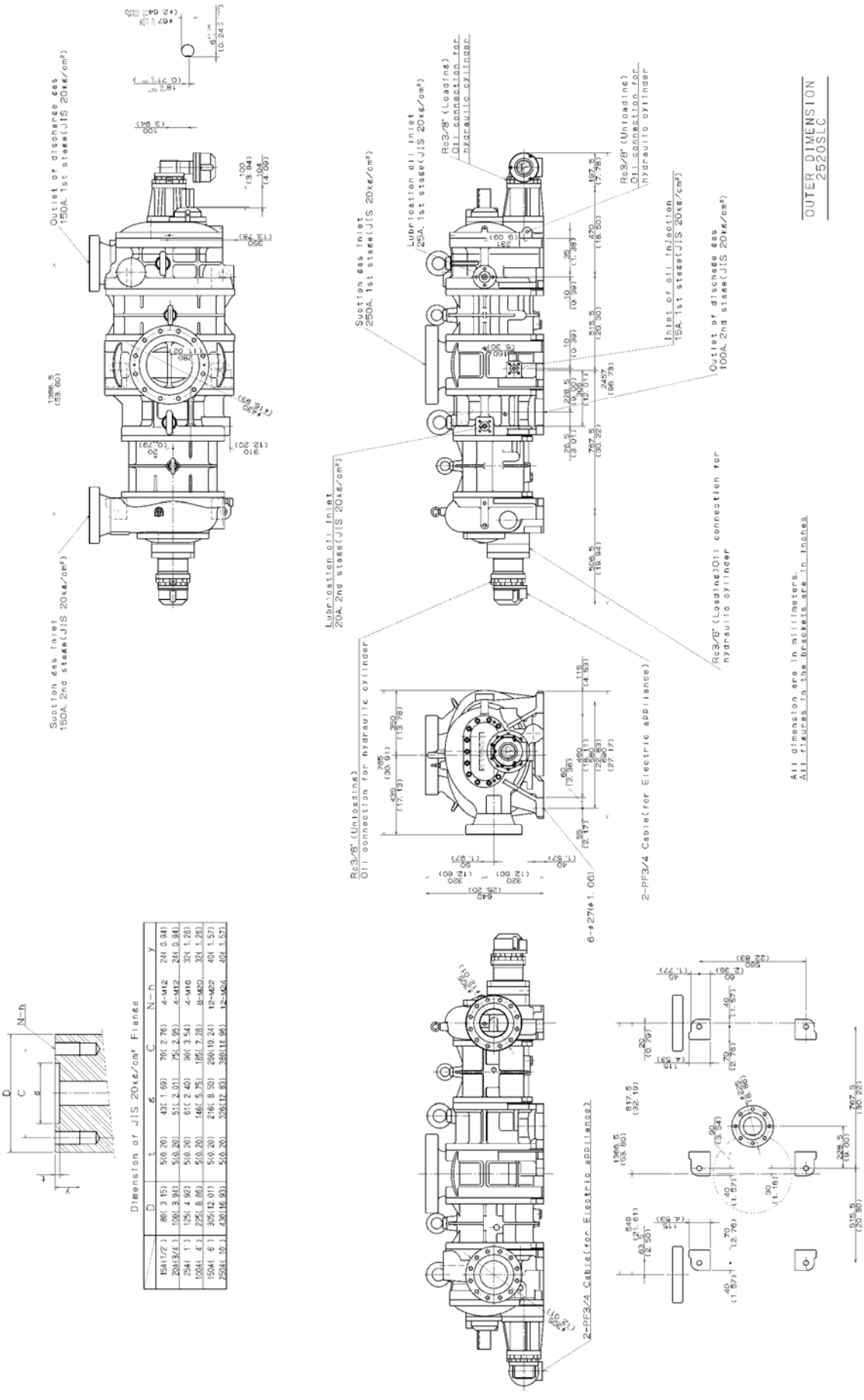


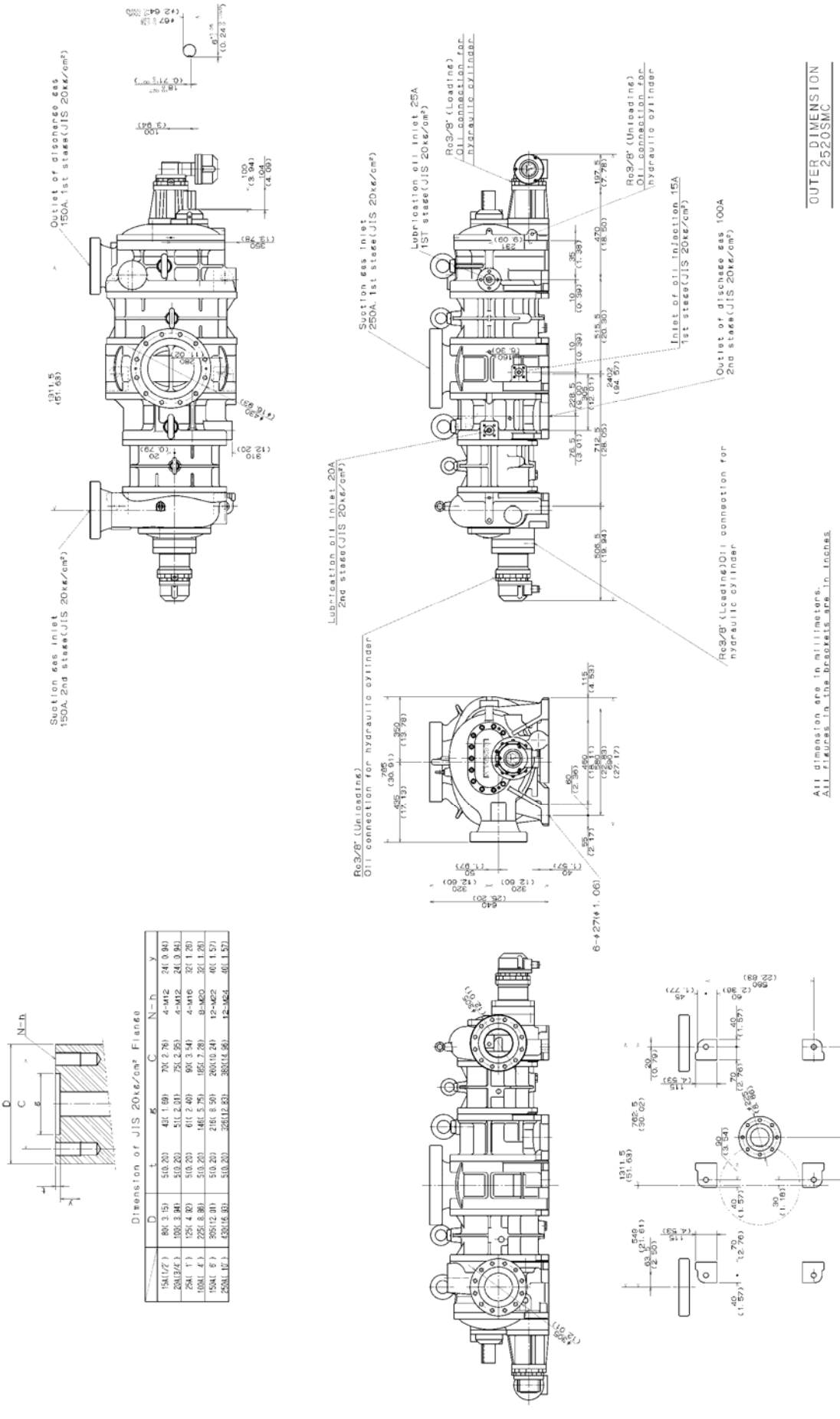
Figure 2-5 2520MSC Outer Dimensions



Dimension of JIS 20kg/cm² Flange

	D	t	g	C	N-h	y
15A(1/2")	90(3.15)	5(0.20)	43(1.69)	70(2.76)	4-M12	24(0.94)
20A(3/4")	100(3.94)	5(0.20)	51(2.01)	75(2.95)	4-M12	24(0.94)
25A(1")	125(4.92)	5(0.20)	61(2.40)	90(3.54)	4-M16	32(1.26)
100A(4")	225(8.86)	5(0.20)	146(5.75)	195(7.28)	8-M20	32(1.26)
150A(6")	305(12.01)	5(0.20)	216(8.50)	260(10.24)	12-M22	40(1.57)
250A(10")	430(16.93)	5(0.20)	326(12.83)	380(14.96)	12-M24	40(1.57)

Figure 2-6 2520SLC Outer Dimensions



	D	t	K	C	N-n	y
15A(1/2")	80(3.15)	510.20)	48(1.89)	70(2.76)	4-M12	24(0.94)
20A(3/4")	100(3.94)	510.20)	51(2.01)	75(2.95)	4-M12	24(0.94)
25A(1")	125(4.92)	510.20)	61(2.40)	90(3.54)	4-M16	32(1.26)
40A(4")	225(8.86)	510.20)	146(5.75)	185(7.28)	8-M20	32(1.26)
50A(6")	305(12.01)	510.20)	216(8.50)	260(10.24)	12-M22	40(1.57)
250A(10")	430(16.93)	510.20)	328(12.83)	380(14.96)	12-M24	40(1.57)

Figure 2-7 2520SMC Outer Dimensions

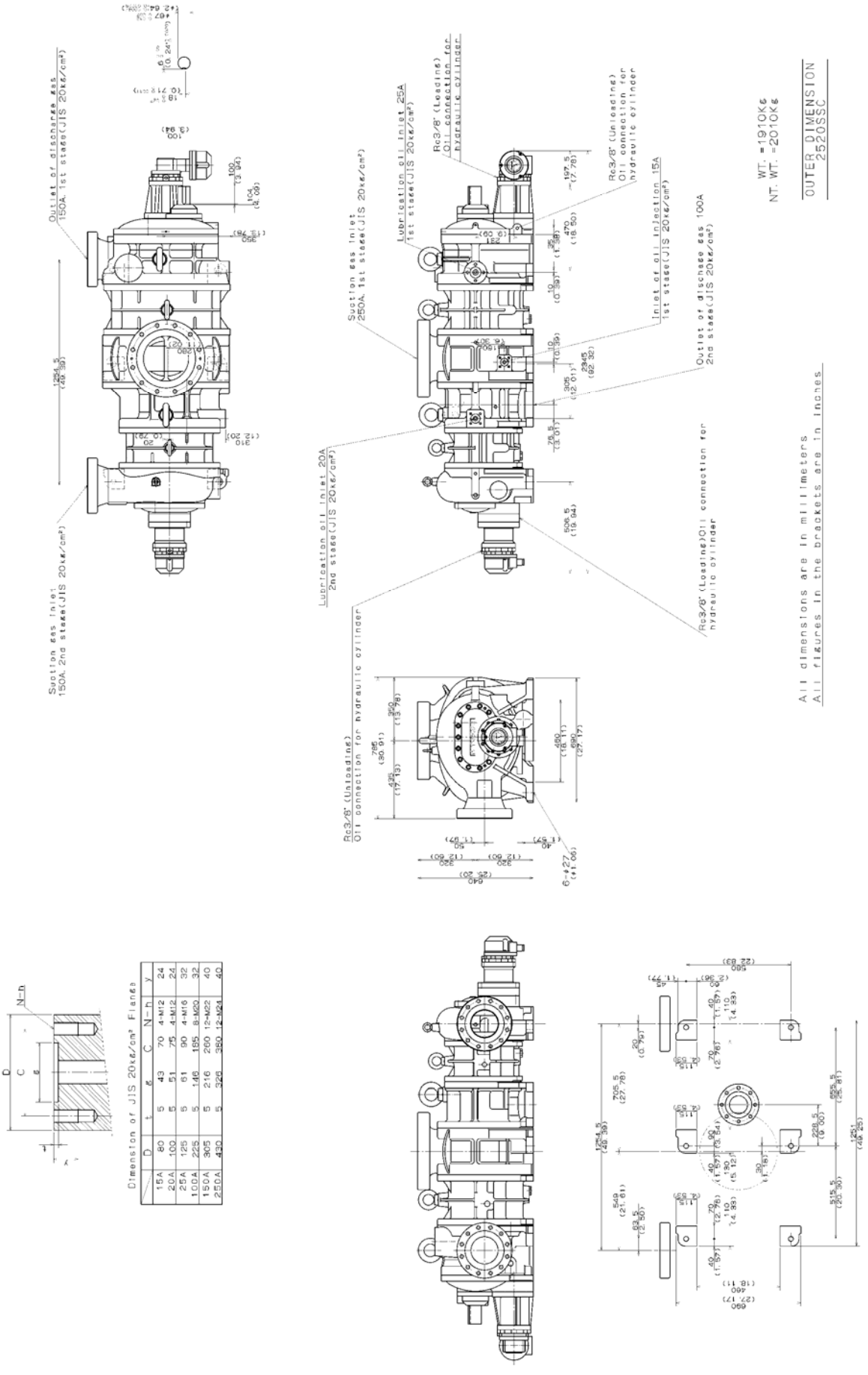


Figure 2-8 2520SSC Outer Dimensions

2.4 Structure of Compressor

【POINT】

- For names and locations of each part of the compressor, refer to Section 7.1 "Development Views, Assembly Sectional Views" and Section 7.2 "Parts Configuration Table" in this manual.

2.4.1 Sectional View

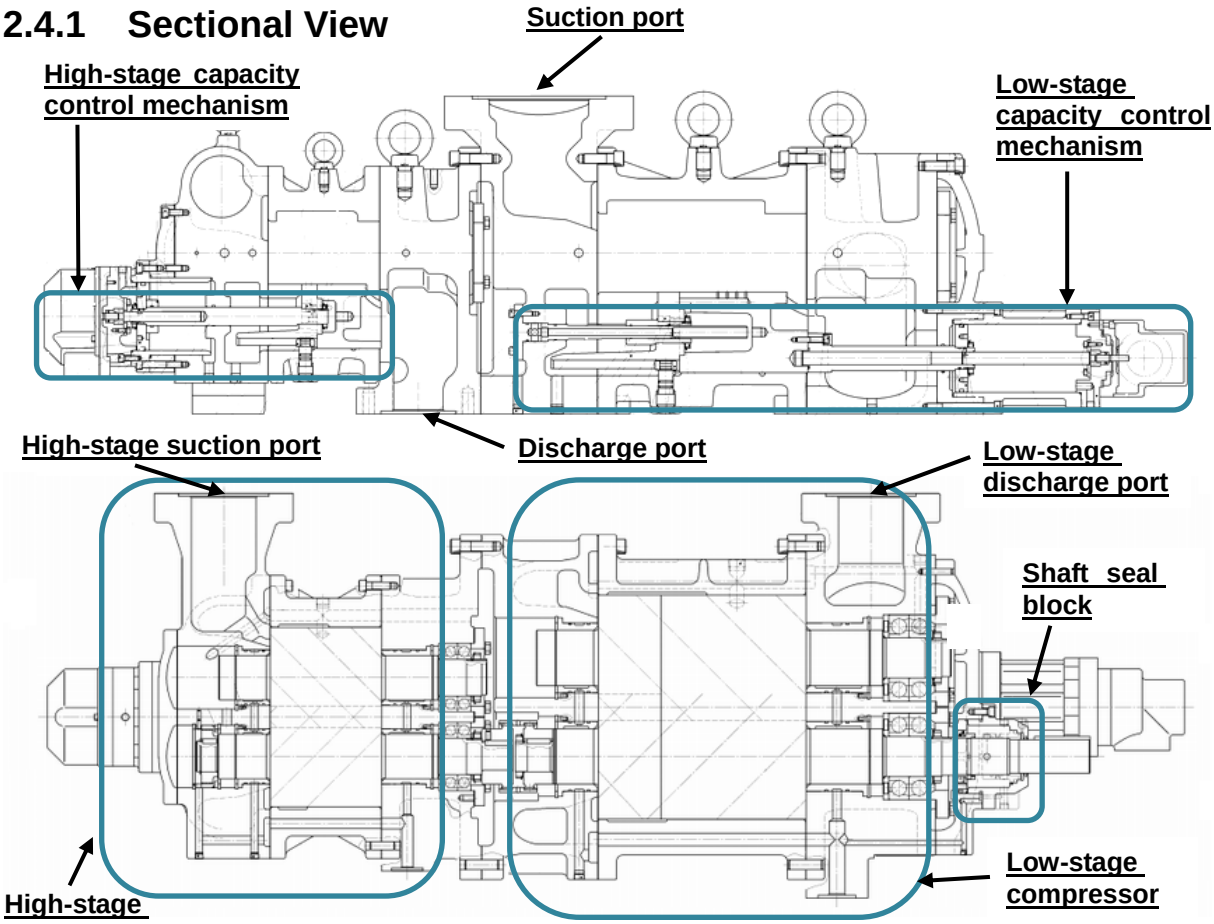


Figure 2-9 2520C Screw Compressor Sectional View**

The 2520**C model, a compound 2-stage compressor, consists of two compressors, (i) a low-stage compressor which suctions gas, working fluid, from the refrigerating unit and compresses (pressure-raises) the gas and (ii) a high-stage compressor which furthermore compresses the gas that has been pressure-raised by the low-stage compressor and sends the resulting gas to the refrigerating system side.

In each casing (low-stage, high-stage), two screw rotors are supported on both ends by bearings. They are meshed with each other in a joint assembly. These two screw rotors are a set of a male rotor having 4 protruding tooth profiles (M rotor) and a female rotor having 6 concave profiles (F rotor). They conduct compressing according to the mechanism explained below.

The standard compressor's M rotor is driven by a 2-pole motor; it operates at 3000 $mini^{-1}$ (50 Hz) or 3600 $mini^{-1}$ (60 Hz). The F rotor operates at 2000 $mini^{-1}$ (50 Hz) or 2400 $mini^{-1}$ (60 Hz), conforming to the operation of the M rotor.

Note: The actual speed of a motor is less than its calculated speed (synchronous speed).
This difference is caused by slipping of the motor rotor.

The shaft of the low-stage compressor's M rotor which is linked with the motor has a shaft seal block that keeps gas and lubricating oil from escaping from inside the compressor.

For high efficient operation, the 2520**C model has a capacity control mechanism for coping with load change on the low-stage, and a capacity control mechanism for reducing startup load on the high-stage.

2.5 Mechanisms

2.5.1 Basics of the Screw Compressor

The screw compressor is categorized as a positive displacement rotary compressor.

As shown in Figure 2-10, the refrigerant (gas) is continuously compressed by the 3-dimensional spaces that are formed by a pair of male and female screw rotors (with different sectional profiles) and the casing, as the spaces change continuously.

The rotor having 4 protruding lobe profiles is called a male or M rotor, and the rotor having 6 concave lobe profiles is called a female or F rotor. In this manual, they are referred to as M rotor and F rotor.

The compressor is driven by the motor connected to the shaft of the M rotor.

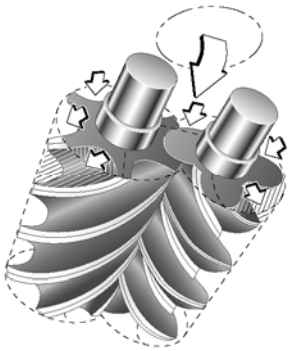


Figure 2-10 Compressor Mechanism

2.5.2 Suction Process

As shown in Figure 2-11, the rotors with different lobe profiles mate together. With the rotations of the rotors, the volume enclosed by the male and female rotor lobe 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.

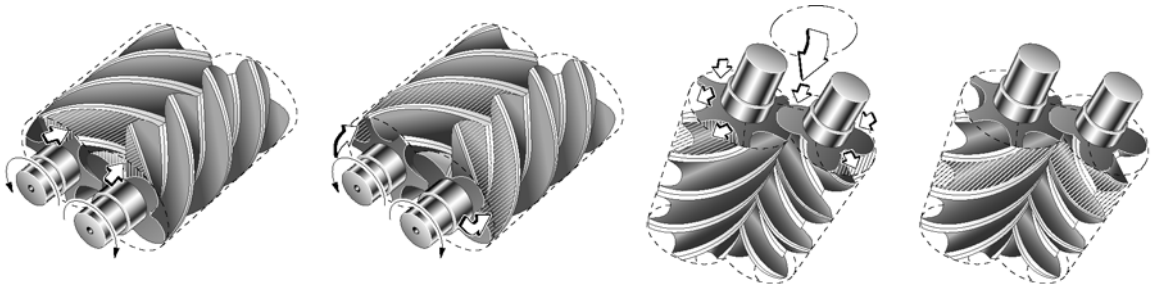


Figure 2-11 Suction Process

2.5.3 Compression Process

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

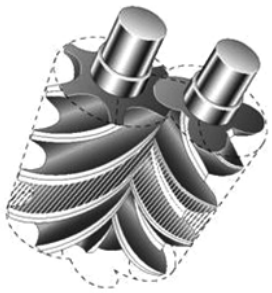


Figure 2-12 Compression Process

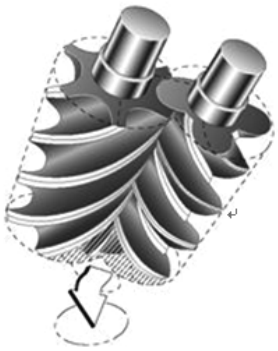


Figure 2-13 Discharge Process

2.5.4 Discharge Process

As the compression process advances, the volume between the rotor lobes 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.

2.5.5 Volume Ratio (Vi)

Volume ratios (Vi) of MYCOM C-series screw compressors are indicated in performance tables or catalogs by using port symbols L and M.

The volume ratio represented by each symbol is as follows:

L=2.63, M=3.65.

$$Vi = \frac{\text{Volume of suctioned refrigerant gas immediately before the start of compression}}{\text{Volume of refrigerant gas just before pushed out to discharge port}}$$

Which volume ratio (L or M) should be used is decided according to operating conditions. If the compressor is used with a volume ratio that does not match operating conditions, operation will go inefficiently wasting the power.

The relationship between volume ratios and generally used compression ratios is as follows:

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

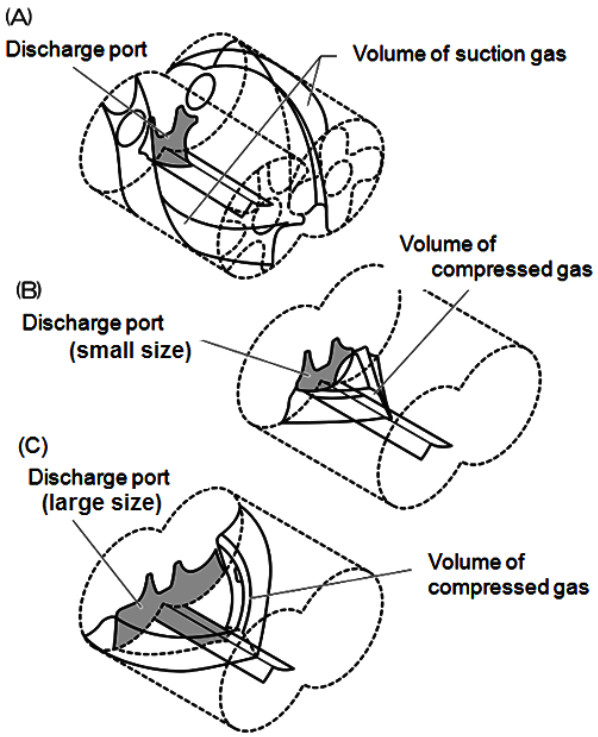


Figure 2-14 Volume Ratio

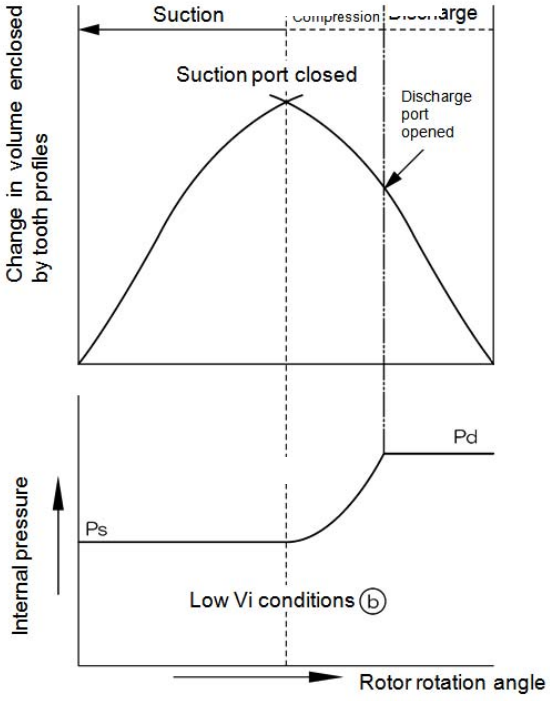
$(Vi)^{\kappa} = \pi i = Pd/Ps$ κ = Cp/Cv of refrigerant gas

Vi = Design volume ratio πi = Design compression ratio

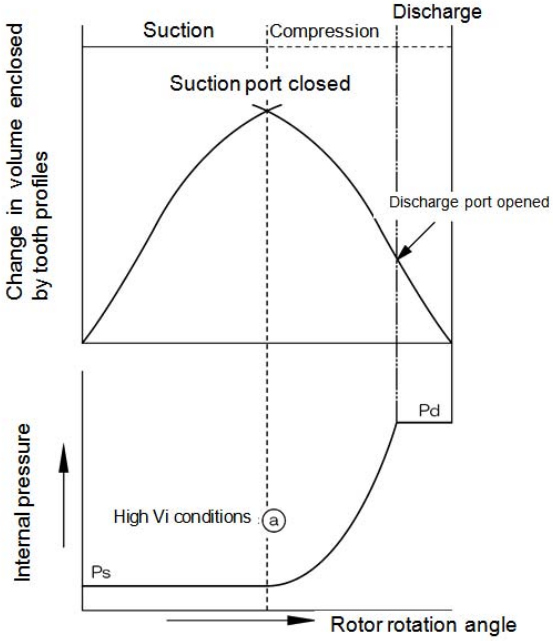
As Vi is affected by the constant of the refrigerant gas, its value that corresponds to the compression ratio will change depending on the refrigerant gas.

(A) Properly adapted Vi to load condition

Both the required compression ratio and Vi are low.

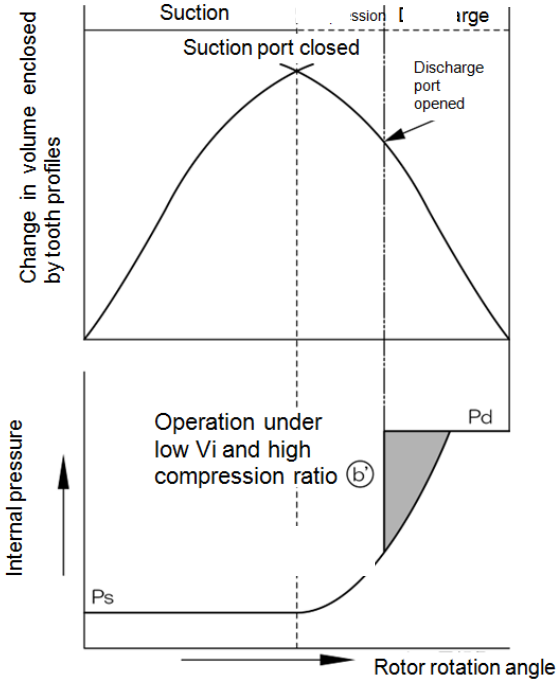


Both the required compression ratio and Vi are high.



(B) Improperly adapted Vi to load condition

Vi is too low compared to the required compression ratio.



Vi is too high compared to the required compression ratio.

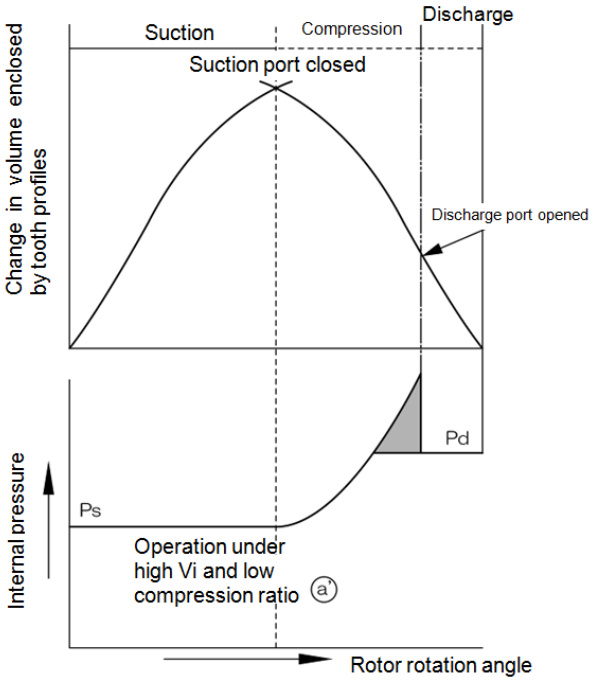


Figure 2-15 Relationship between Volume Ratio (Vi) and Operation Conditions

2.5.6 Capacity Control Mechanism

The capacity control mechanism, by moving a slide valve, lets suction gas (immediately before compressed) bypass and advance to the suction side, to help shorten the rotor portion used for compression. The slide valve is located at the bottom of the casing in which the rotors mesh together, and is constructed to move parallel to the rotor shaft. This movement is changed by a cam mechanism into rotation movement. Its position (namely, capacity control ratio) is indicated externally and, at the same time, fed back to the automatic control circuit by changing the electric resistance.

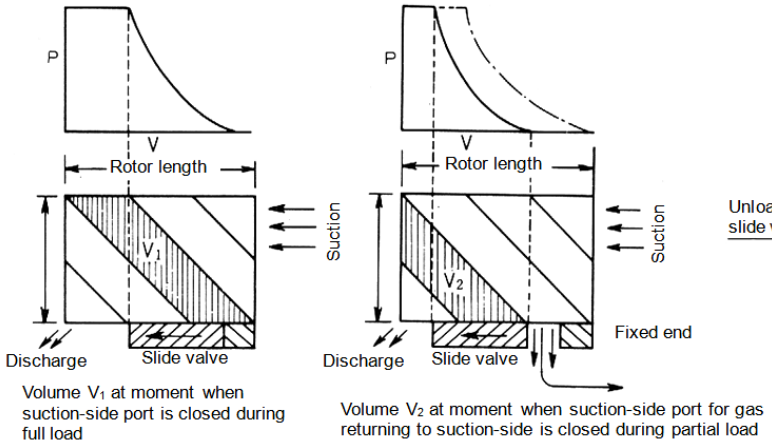


Figure 2-16 Capacity Control Mechanism

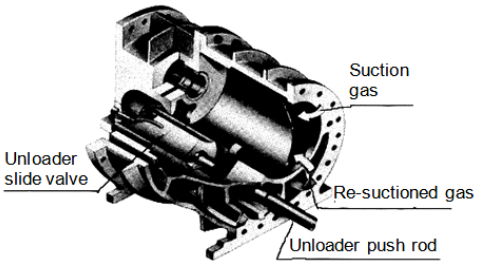


Figure 2-17 Slide Valve in the Main Rotor Casing

The 2520**C model has a capacity control mechanism (indicated load: 20 % to 100 %) for startup load reduction on the high-stage unit, and another one (indicated load: 0 % to 100 %) for coping with load change on the low-stage.

2.5.7 Bearings and Balance Piston

For the load created on the rotor perpendicular to the shaft, sleeve-type white metal-lined bearings are used. For the load created along the shaft direction, face-to-face combination type of angular contact ball bearings are used.

Special care is taken to cope with the load created along the shaft direction. Because the M rotor is a kind of helical gear and also because the thrust load produced by discharge pressure is larger than that for F rotor, the load applied onto the M rotor is reduced by using not only a thrust bearing but also a balance piston that applies pressure from the opposing direction.

2.5.8 Shaft Seal

To prevent refrigerant gas and oil leakage, a reliable mechanical seal assembly is used for the shaft seal of the M rotor.

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 iron, a rotating ring made from carbon, and O-rings for the packing.

2.6 Gas and Oil Flow

The compression process of the screw compressor is as described previous section.

Gas of the compound 2-stage screw compressor 2520**C is sent from the evaporator, and passes through the strainer and check valve. It is suctioned from the upper central area (1) of the compressor, compressed at the lower-stage (2), and then discharged at (3).

(3) and (4) are connected with a pipe. At the mid point of the pipe, that gas is mixed with the gas from liquid cooler which was used for super-cooling.

Lubricating oil injected at the low-stage is, while kept mixed with gas, suctioned from (4) into the high-stage.

After being compressed at (5), the gas mixed with lubricating oil is discharged from (6), and is sent from the oil separator to the condenser.

Even if without intermediate gas cooling, oil provides cooling effect.

So, the high-stage discharge temperature is maintained at a temperature not higher than 90 °C.

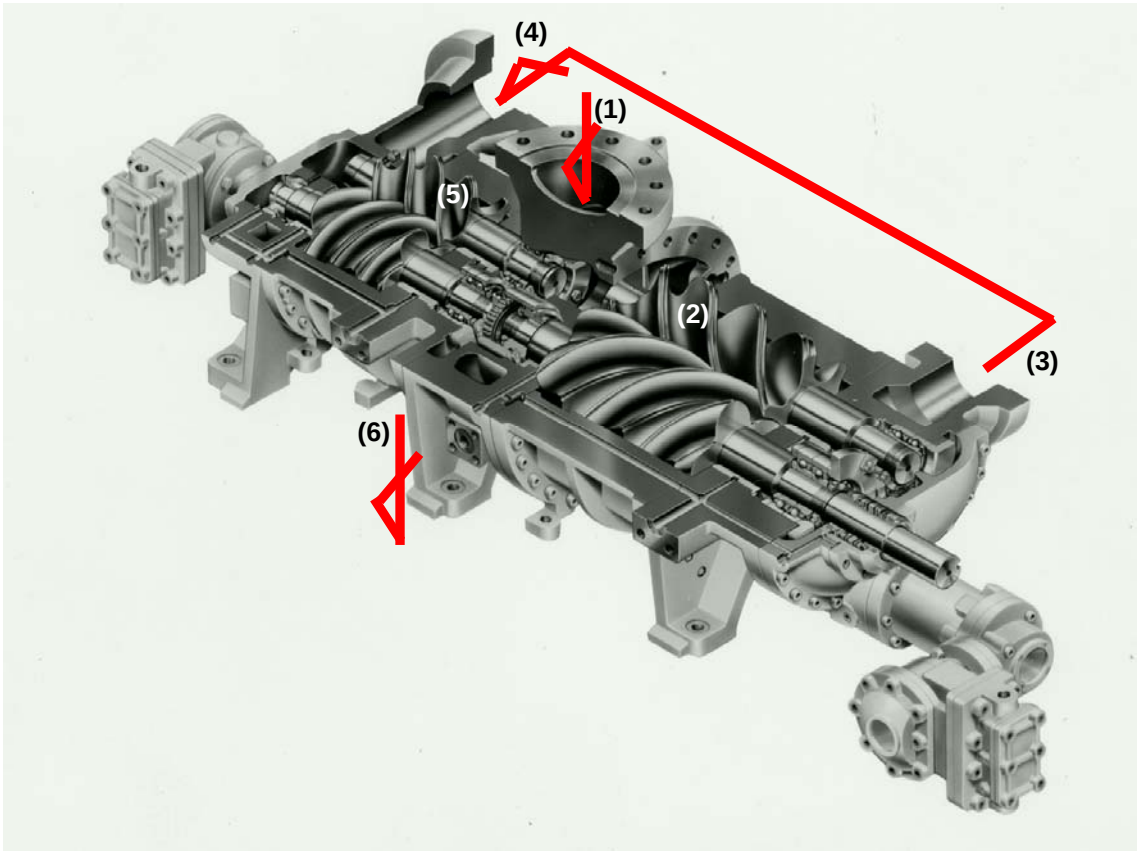


Figure 2-18 Gas Flow

■ Oil Supply Route

As shown in Figure 2-19, lubricating oil is split into five flows. After completing each role, the oil is mixed with discharge gas and leaves the compressor. In standard configuration, oil injection is not performed at the high-stage.

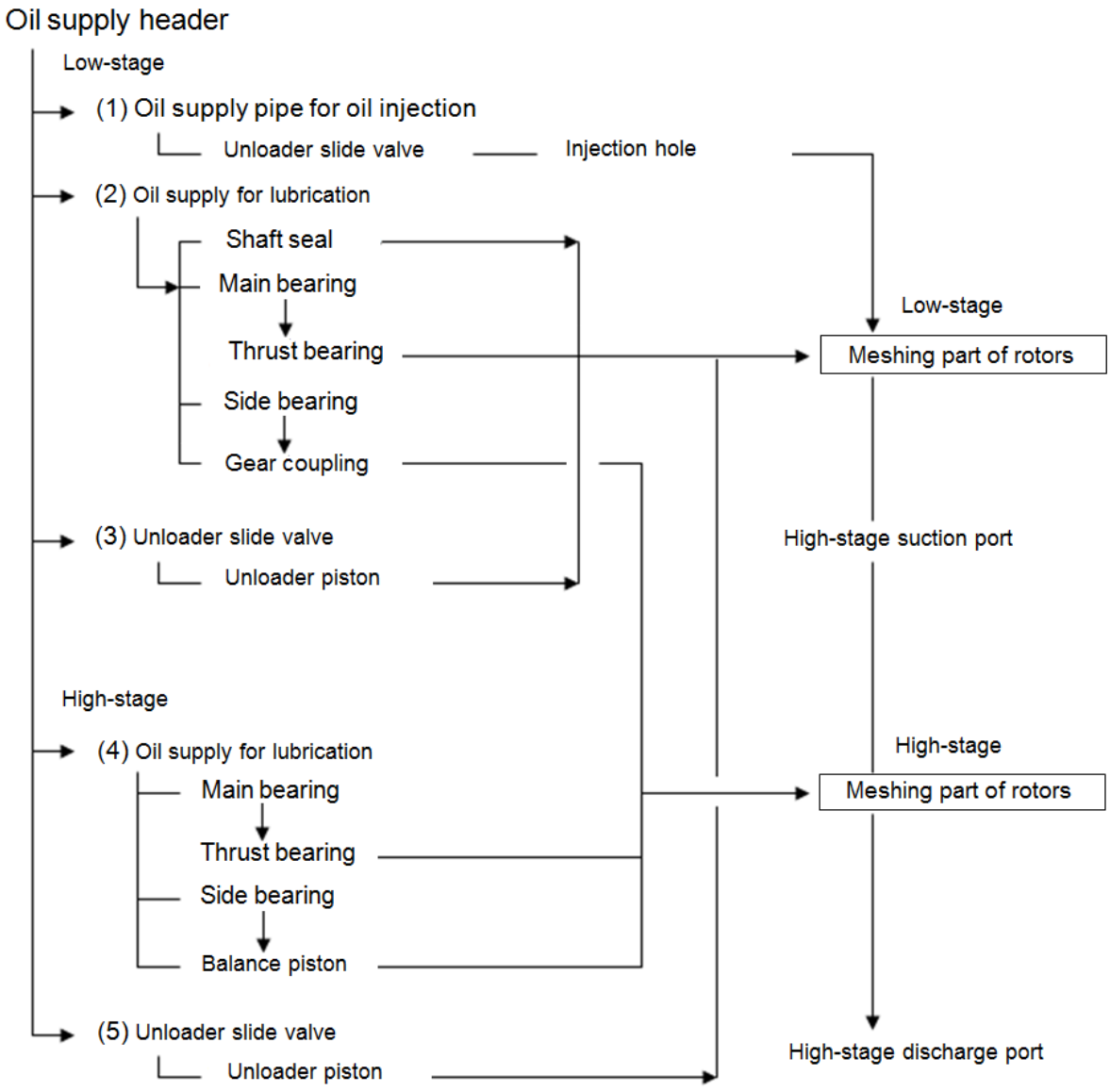


Figure 2-19 2520C Oil Supply Route**

Chapter 3 Installation

3.1 General Precautions for Installation

【POINT】

- This chapter (Installation) assumes that the compressor is installed to a general refrigeration / cold storage/gas compression package unit.
  If the package unit you are actually using is not the standard type refrigeration/cold storage/gas compression 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 in compliance with local laws, ordinances and other regulations/requirements.
- Read this chapter and related documents, and fully understand their contents before performing installation.
- Electrical works should be performed only by electrical engineers.

3.2 Installation Works

3.2.1 Unpacking

Check that there are no abnormalities such as damage on the compressor.

【POINT】

- If there are defective or missing parts on the compressor, please contact our local sales offices or service centers.
- Unnecessary packing materials should be discarded according to the laws and regulations and/or your company rules.

3.2.2 Storage

If you need to store the compressor before installation, perform the followings:

- 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 to the worker. Do not stand under the lifted compressor.**

1. For lifting the compressor within the safety limit, use lifting equipment and tools appropriate for the mass of compressor.
2. Secure sufficient space for safe lifting.

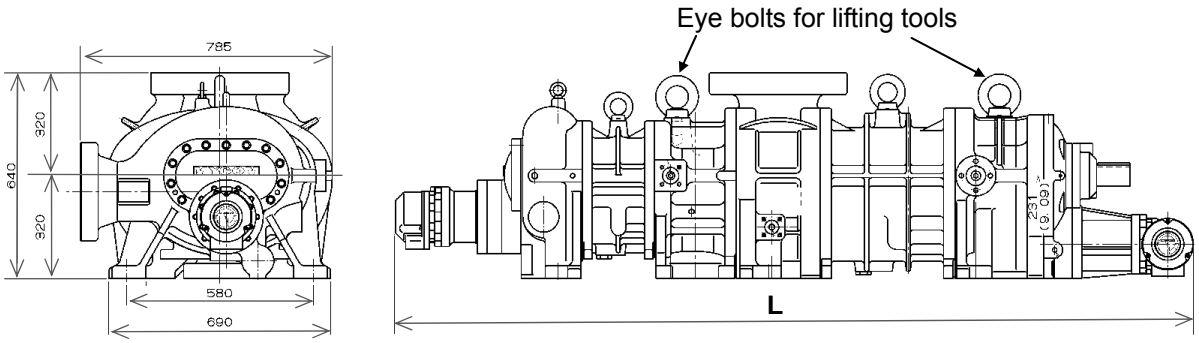
3. Always check the wire ropes before using them. Thoroughly check the wire ropes for problems such as kinks, knots and broken strands. Do not perform lifting before checking the wire ropes. If you cannot make a correct evaluation or judgment, entrust an expert to check.
4. To lift the compressor, attach wire ropes to the appended eye bolts by using appropriate shackles and hooks. Refer to Figure 3-1 and Photo 002 on next page.

   Use the eye bolts for lifting the compressor only. Do not use these 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 package unit, use the lifting chains provided around the base or other lifting means provided on the base.**

5. Check the transport route for any 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 or hand signals) are completely understood by the workers at site.
9. Slowly reel up the wire ropes until immediately before the compressor leaves the ground.
10. Then, reel up the wire ropes a little further until the compressor is slightly up away from the ground. Check that the compressor is not inclined. 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 functioning properly. 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 the attempt to lower the compressor to the workers around the area.
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.

■ Outer Dimensions, Mass and Lifting Position



	2520LLC	2520LMC	2520LSC	2520MMC	2520MSC	2520SLC	2520SMC	2520SSC
Product mass (kg)	2150	2100	2050	2040	1990	2010	1960	1910
L (mm)	2619	2542	2485	2474	2416.7	2457	2402	2345

Figure 3-1 Outer Dimensions, Mass and Lifting Position of Compressor

Photo 002 Lifting Position

3.2.4 Preparations for Installation

■ Installation Space

Secure space which allows easy operation, cleaning, maintenance, and inspection.

■ Illumination

Prepare lighting for easy operation, cleaning, maintenance, and inspection.

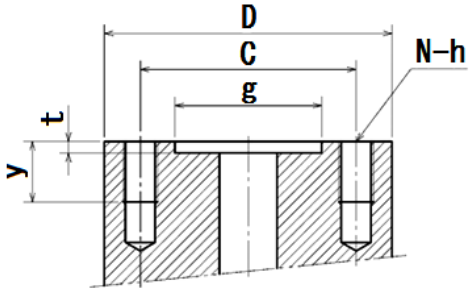
■ Ventilation

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

■ Piping

Table 3-1 List of Connecting Pipes (Compressor)

Items	Dimensions	Remarks
Suction gas inlet	JIS 20K 250A (10")	See Figure 3-2.
Low-stage gas outlet	JIS 20K 150A (6")	See Figure 3-2.
High-stage gas inlet	JIS 20K 150A (6")	See Figure 3-2.
High-stage discharge gas outlet	JIS 20K 100A (4")	See Figure 3-2.
Low-stage bearing (journal) lubrication port	JIS 20K 25A (1")	
Lubrication oil supply port for low-stage capacity control (load)	Rc3/8	
Lubrication oil supply port for low-stage capacity control (unload)	Rc3/8	
Lubrication oil supply port for oil injection	JIS 20K 15A (1/2")	
High-stage bearing (journal) lubrication oil supply port	JIS 20K 20A (3/4")	
Lubrication oil supply port for high-stage capacity control (load)	Rc3/8	
Lubrication oil supply port for high-stage capacity control (unload)	Rc3/8	



	D	t	g	C	N-h	y
15A	□ 80	5	43	70	4-M12 × P1.75	24
20A	□ 100	5	51	75	4-M12 × P1.75	24
25A	125	5	61	90	4-M16 × P2	32
100A	225	5	146	185	8-M20 × P2.5	32
150A	305	5	216	260	12-M22 × P2.5	40
250A	430	5	326	380	12-M24 × P3	40

Figure 3-2 JIS 20K Flange Dimensions of Compressor (mm)

3.2.5 Installation

3.2.5.1 Installation

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 hinder normal operation.

3.2.5.2 Shaft Alignment between 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 the compressor 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.

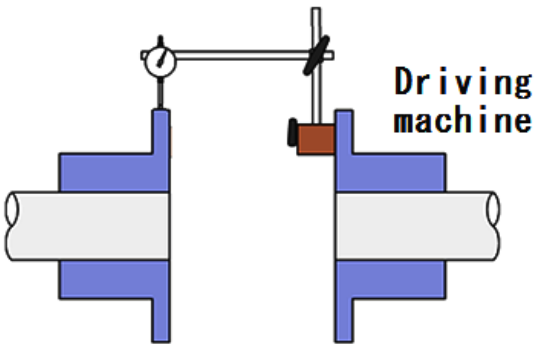


Figure 3-3 Measurement of Offset

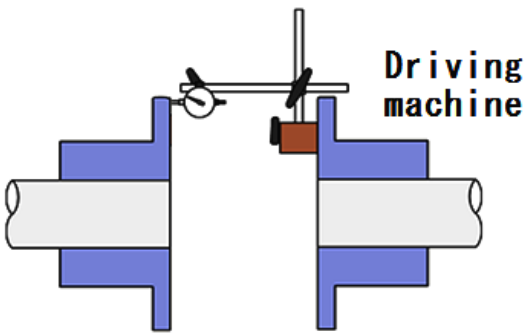


Figure 3-4 Measurement of Angularity

3.2.5.3 Piping Connection

■ Refrigerant Piping

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

- The compressor is one of the few devices installed within the package unit which 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 filled with nitrogen gas and sealed up 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 risk that it will cause trouble after the start of operation. Be sure to assemble piping when it is dry.
- Cover flanges are attached to the compressor's low-stage gas outlet and high-stage gas inlet. After installation, be sure to attach piping (intermediate piping) that links the both connection ports.
- 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, causing 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 protective function (thermostat, etc.) to the oil heater to prevent overheating.

■ Suction Strainer

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

For details about compatible and incompatible oils, refer to Section 4.1 "Lubricating Oil (Refrigerant Oil)" in this manual Chapter 4.

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

■ **Compressor Protective Devices (Safety Devices)**

To protect the compressor, install the protective devices as described in Section 1.4.3 "Compressor Protective Devices" in this manual chapter 1.

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 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 neither air nor water will be mixed in when refilling.**
- **To ensure that the lubricating oil does not absorb air moisture, keep it indoors in an airtight container until use.**

3.2.7.1 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 of the initial charge of lubricating oil, please care oil is to be filled in the oil filter and oil cooler always.

3.2.7.2 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.

3.2.8 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.

3.2.9 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 Lubricating oil (Refrigerant Oil)

Lubrication management is very important to keep good operating condition of the compressor.
Take the following notes when managing lubricating oil.

4.1.1 Precautions for Selecting a 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 compatibility 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 lubricating oil. If the refrigerant dissolves in the lubricating oil (or the lubricating oil and refrigerant are compatible), the viscosity of the lubricating 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 lubricating oil (or the lubricating 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 to 40 mm^2/s) in the operating state.
- The circulation of the lubricating oil for the entire system must be considered. After lubricating and cooling each part of the compressor, the lubricating oil is discharged with refrigerant gas. Most of the oil which is discharged from this compressor is trapped by the oil separator and is cycled to the compressor. A small quantity of refrigerant oil goes to the condenser and the evaporator. The lubricating oil is required to have sufficient fluidity and stability inside each part in the refrigerating cycle where temperatures differ.
- Note that some lubricating oils cannot be used depending on the combination with the refrigerant. The following caution is an example case that is required especially attention.

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

4.1.2 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.

4.1.2.1 Recommended Lubricating Oils for Ammonia Refrigerant

■ **Polyalkylene Glycols (PAG) Based Synthetic Oil (compatible oil)**

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

■ **Mineral Oils (incompatible oils)**

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

■ **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 seal of the standard BBSE type.

4.1.2.2 Oils for Systems Using Hydrofluorocarbon (HFC) Refrigerants

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

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

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

Brand	Kinematic viscosity (40°C) mm^2/s	Manufacturer	Type
JOMO Freol α100	107	JX Nippon Oil and Energy Corporation	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.**

4.1.3 Change of Lubricating Oil Brand

When changing the lubricating oil in currently use for some reason, attention must be paid to the following points.

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 system components before charging the new lubricating oil. After 100 to 200 hours of operation, replace the oil again.
- When changing the lubricating oil for one of a different brand, be sure to ask the lubricating oil supplier whether such change does not cause any problem. In particular, before changing current lubricating oil for new one by a different supplier, ask both manufacturers for any possible problems that may result from the lubricating oil change.
- 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)

4.1.4 Precautions for Handling Lubricating Oil

- When refilling lubricating oil, ensure that it is clean and does not contain foreign matters.
- Be careful that air or water will not be mixed in when refilling.
- To prevent lubricating oil from absorbing air moisture, store the oil sealed and indoors until it is used.

4.1.4.1 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.

4.1.4.2 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.

4.1.5 Lubricating Oil Management Criteria

Lubricating oils that are managed 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 following table.

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

●Table 4-1 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 4-2 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 4-3 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.

4.1.6 Lubricating Oil Replacement Timing

4.1.6.1 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 4-1 to 4-3 are not satisfied, the oil must be replaced.

4.1.6.2 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 4-1 to 4-3 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.

4.2 Precautions for Operation

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

4.2.1 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, properly adjust the expansion valve of each liquid cooler.

For details, refer to Chapter 6 "Troubleshooting" in this manual.

4.2.2 Purging of Non-Condensable Gases

WARNING

- **Some types of refrigerants emit bad smells or toxic gases. Make sure to ventilate the air during work.**
- **When handling fluorocarbon refrigerants, remember that they are prohibited from being purged into air by law.**

If there is a leak on the low-pressure side of the refrigeration cycle , air may get mixed into the package unit. If non-condensable gas like air enters the package unit, the condensing pressure rises and the energy consumption increases. This leads to uneconomical operation.

Check non-condensable gases in the following procedure:

1. When the compressor is stopped, allow the cooling water to flow to the condenser for at least 15 minutes. Check the condensing pressure by using the pressure gauge of the compressor.

2. Check the cooling water temperature.

3. Compare the condensing pressure checked in step 1 above with the refrigerant saturation pressure that depends on the cooling water temperature (as shown in the table below).

Table 4-1 Typical Refrigerant Temperature and Saturation Pressure

Temperature °C	Pressure (MPa)				
	Ammonia	R404A	R507A	R410A	R134a
0	0.328	0.509	0.523	0.699	0.192
4	0.396	0.590	0.606	0.807	0.237
8	0.472	0.678	0.696	0.924	0.287
12	0.557	0.775	0.795	1.053	0.342
16	0.652	0.881	0.903	1.193	0.403
20	0.756	0.996	1.021	1.346	0.471
24	0.871	1.121	1.148	1.513	0.545
28	0.998	1.256	1.286	1.693	0.626
32	1.137	1.401	1.435	1.887	0.714
36	1.289	1.559	1.595	2.098	0.811
40	1.454	1.728	1.768	2.324	0.916

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

4. When the pressure inside the condenser and the refrigerant saturation pressure that depends on the cooling water temperature are approximately equivalent, non-condensable gases do not exist. When the pressure inside the condenser is 0.05 MPa or more higher than the refrigerant saturation pressure that depends on the cooling water temperature, there is a possibility of non-condensable gases entering the unit. In that case, purge the non-condensable gases from the condenser.

4.3 When Stopping the Compressor for a Long Time

When stopping the compressor for a long period of time, make sure to perform the following steps.

- Turn off the motor main power.
- Turn off the heater power and control panel power.
- Close the suction and discharge side shut-off valves.

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

- Operate the oil pump for 10 seconds per week.
  After that, rotate the compressor shaft (10 rotations or more).
- Measure the package unit pressure once per month.
- Check for refrigerant leakage 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 this Chapter, Section 4.1.5 Tables 4-1 to 4-3 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 unit 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 regular 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 head covers 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

As daily management, check the items listed in Table 5-1 "Daily Inspection Items" and record the results.

Logging these operation data on a daily basis aids in finding out any abnormal conditions of the compressor. This is significantly effective in preventing compressor failures.

It is particularly important to check whether the temperature/pressure correlations related to the refrigerant evaporation and condensation is proper. This makes it possible to quickly find out problems in the compressor or the system.

If a failure or accident should occur in the compressor or the system, the operation logbook will help determine the cause and take prompt and proper actions.

Table 5-1 Daily Inspection Items

Inspection Items			Inspection Contents	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 on the cooling pipe surface • Temperature, flow rate, etc. of the object to be cooled
	Intermediate pressure	MPa	Pressure difference from the rated operation (normal value)	• If it is too high, check high-stage. If too low, check low-stage.
	Discharge pressure	MPa	Difference from the 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 the 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 the oil filter inlet and outlet	• Contamination of lubricating oil • Clogging of oil filter element
	Suction temperature	°C	Whether within upper and lower limits	• Temperature, flow rate, etc. of the object to be cooled
	Degree of superheat for suction	°C	Whether degree of superheat is proper	• Expansion valve adjustment • Insufficient refrigerant circulation
	Intermediate temperature	°C	Whether within upper and lower limits	• Intermediate expansion valve adjustment
	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 the oil cooler

Inspection Items			Inspection Contents	Checkpoints and Actions
Compressor	Capacity control specified load	%	Whether operation is normal	• Damage to solenoid valve coil • Improper adjustment of manual control valve of electromagnetic assembly
	Leakage from mechanical seal	mL/hr	Leak per hour	• Mechanical seal failure
	Noise and vibration	-	Abnormal noise/vibration	• Compressor failure
Others	Motor current	A	Whether it is higher than at test run	• Compressor/motor failure
	Oil level of oil separator	-	Oil level	• Oil loss • Replenish oil
	Fluid level of the receiver	-	Fluid level	• Replenish refrigerant
	Refrigerant leakage inspection	-	Leakage	• Inside the machine room and in the facility on the load side

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

■ Daily Maintenance Items

1. Lubricating oil level

When the oil level in the oil separator reaches the lower limit, charge lubricating oil.

2. Replace oil filter element

When the differential pressure between the inlet and outlet ports of the oil filter exceeds 0.1 MPa, replace the filter element . During the period of initial operation, the pressure difference between the inlet and outlet ports of the oil filter can quickly become large

3. Cleaning of suction strainer

When the compressor operating hours exceeds 500 from the initial operation starting, check the suction strainer. If a temporary filter is installed for the initial stage of operation, remove it.
At the beginning of the operation or after periodical check, the differential pressure between the front and back of the suction strainer may increase quickly. If the differential pressure becomes large, check and clean the suction strainer.

4. Lubricating oil leak rate from mechanical seal

If much oil leaks from the mechanical seal, determine the leak rate per hour. The following table shows guidelines for allowable leak rate and the rate at which inspection must be done.
If any problem is found in the mechanical seal, replace it with a new one.

Table 5-2 Guideline for Leak from Mechanical Seal

	2520**C
Allowable leak rate	≤ 3 mL/hr
Rate at which inspection must be done	≥ 9 mL/hr

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

5. Contamination on the cooling water side of the cooling pipes of condenser and oil cooler

Clogging and contamination of the cooling pipe is largely affected by the quality of cooling water. When the oil temperature and discharge pressure gradually rise during the initial stage of operation, inspect and clean the cooling water side of oil cooler and condenser even when the time has not yet come at which inspection must be done.

5.2.2 Periodic Inspection

Conduct inspection for the following items according to the specified intervals.

In addition, observe relevant laws and regulations on the inspections and recording of the results that are provided for other related items such as any safety devices (e.g. gas leak detectors), or other utility (gas/electricity) protection devices that constitute the cooling package unit together with the compressor.

Table 5-3 Periodic Inspection Items

Item	Inspection interval and Content	Remarks
Pressure gauges/ pressure sensors	Yearly inspection	
Thermometers/ temperature sensors	Yearly inspection	
Protection devices and safety valves	Yearly inspection	
Suction strainer	Inspect after 500 hours from the start of operation. Yearly inspection and cleaning	If the differential pressure between the front and back of the suction strainer increases, check and clean the suction strainer.
Lubricating oil	Analyze lubricating oil after 500 hours from the start of operation. Analyze oil every 6 months.	Replace the oil if the analysis result does not satisfy the control criteria given in Section 4.1.5 "Lubricating oil Management Criteria".
Oil filter element	Yearly replacement	Replace the filter element if the differential pressure between the inlet and outlet ports of the oil filter exceeds 0.1 MPa.
Cooling water side of oil cooler	Yearly inspection	Clean if excessively contaminated.
Cooling water side of condenser	Yearly inspection	Clean if excessively contaminated.
Mechanical seal	Inspection every year or every 8000 hours of operation **Note***	To be replaced if any abnormality is found If it is difficult to stop equipment except for scheduled inspections, replace the part at each inspection.
Coupling	Inspection every year or every 8000 hours of operation **Note***	

Note*: The inspection shall be performed according to the operating period or operating hours, whichever comes first.

5.2.3 Guidelines for the Timing of Compressor Overhaul

The compressor overhaul interval is largely affected by the compressor operating conditions, type and status of refrigerant and oil, and the system/equipment in which the compressor is operated.

The table below shows the recommended interval of overhaul, as a guideline.

Table 5-4 Guidelines for the Timing of Overhaul Based on the Conditions of Use (standard package)

Category of Operating Condition	Application Example	Guideline for the overhaul timing
Relatively stable operating condition	Cold storage and refrigeration	Every 5 years or 40,000 operating hours
Relatively variable operating condition	Ice maker/chiller	Every 4 years or 30,000 operating hours
Frequently started/stopped, and relatively variable 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 Section 2.3.2 "Operation Limits".)

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

Note 3: Inspect the compressor at the intervals of specified 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 disassemble and inspect parts after a certain period of operation.

This chapter 5 describes the essential points of disassembly methods, where to inspect on parts, and reassembly procedure of the compound 2-stage screw compressor 2520**C.
In principle, overhauling of the screw compressor 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 " in this manual.

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 and/or parts configuration table.

5.3.1 Disassembly Tools and Workplace

Prepare necessary disassembly tools for the compressor by referring to Section 7.5 "Disassembly Tools" in this manual Chapter 7.

In addition, prepare other necessary tools and materials including general hand tools, GC (green carbonite) grinding stones, sandpapers of #80 to #100, about #400 to #800 sandpapers, parts cleaner, lubricating oil, oilcan, empty can to receive drain oil, waste, etc.

If the overhaul work is to be done with the compressor removed from the installation base, prepare the work bench whose size is at least around 1.5 times the length and the width of the compressor..

In addition, a special stand for the compressor is required in order to safely perform the removal/fastening of bolts and plugs on the bottom side of the compressor. Refer to Section 5.3.5 of this chapter.

To the extent possible, choose a dry and clean workplace free from sand or dust. Note that a sufficient space is required around the compressor. In addition, it is necessary a temporary storage place for disassembled parts.

5.3.2 Replacement Parts

Prepare MYCOM genuine replacement parts.

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

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. So, make sure to inform the (b) serial number to us.

Table 5-5 Replacement Parts of 2520C Overhauling**

P/N	Part Name	Code No.	Remarks	Q'ty.
6-1	Gasket, Suction Cover (1)	CS00600-250N		1
6-2	Gasket, Suction Cover (2)	CS00600-200N		1
9	O-ring JIS B 2401 P40	PA11-040		1
12-1	Gasket, Bearing Head (1)	CS01200-250N		1
12-2	Gasket, Bearing Head (2)	CS01200-200N		1
17-1	Gasket, Bearing Cover (1)	CS01700-2520C1N		1
17-2	Gasket, Bearing Cover (2)	CS01700-2520C2N		1
23	Gasket, Balance Piston Cover	CS02300-2520CN		1
27-1	Main Bearing (1) with O-ring	CS0270-FRT		2
27-2	Main Bearing (2) with O-ring	CS0270-ERT		2
28-1	Side Bearing (1) with O-ring	CS0280-FRT		2
28-2	Side Bearing (2) with O-ring	CS0280-ERT		2
30	Balance Piston	CS03000-2520C	To be replaced if any abnormality is found.	1
33	Balance Piston Sleeve	CS03300-2520C		1
35	O-ring JIS B 2401 P140	PA11-140		1
38-1	Thrust Bearing (1)	CS03800-250P		2
38-2	Thrust Bearing (2)	CS03800-200P		2
39-1	Lock Nut (1) AN17	NG31-017	To be replaced if any abnormality is found.	2
39-2	Lock Nut (2) AN13	NG31-013		2
40-1	Lock Washer (1) AW17	NG32-017		2
40-2	Lock Washer (2) AW13	NG32-013		2
49	O-ring JIS B 2401 G135	PA12-135		1
50	Oil Seal	CS05010-250VD		1
52	Gasket, Seal Cover	CS05200-250N		1
59	O-ring JIS B 2401 P26	PA11-026		1
63-1	O-ring JIS B 2401 P26	PA11-026		1
63-2	O-ring JIS B 2401 G150	PA12-150		1
65-1	O-ring JIS B 2401 G150	PA12-150		1
65-2	O-ring JIS B 2401 P125	PA11-125		1
66-1	Cap Seal (1) BE-125	CS06600-200		1
66-2	Cap Seal (2) BE-125	CS06600-200		1
68-1	Guide Pin (1)	NE2505-012	To be replaced if any abnormality is found.	1
68-2	Guide Pin (2)	NE2505-012		1
69-1	Lock Nut (1), Unloader Piston AN08	NG31-008	To be replaced if any abnormality is found.	1
69-2	Lock Nut (2), Unloader Piston AN07	NG31-007		1
70-1	Lock Washer (1), Unloader Piston AW08	NG32-008		1
70-2	Lock Washer (2), Unloader Piston AW07	NG32-007		1
73-1	O-ring JIS B 2401 G35	PA12-035		1
73-2	O-ring JIS B 2401 G30	PA12-030		1
75	O-ring JIS B 2401 G135	PA12-135		2
78	Ball Bearing, Indicator Cam #6000	CS07800-200		2
79	Snap ring C type External S10	NG12-010		2
82	V-ring, Indicator Cam VH10 NBR	CS08200-200B		2
86	O-ring JIS B 2401 G25	PA12-025		1
89	O-ring JIS B 2401 P20	PA11-020		4

P/N	Part Name	Code No.	Remarks	Q'ty.
93-1	Gasket, Suction Flange (1)	CS71200-250N	JIS 20K 250A(10")	1
93-2	Gasket, Suction Flange (2)	CS71200-150N	JIS 20K 150A(6")	1
96-1	Gasket, Discharge Flange (1)	CS71200-150N	JIS 20K 150A(6")	1
96-2	Gasket, Discharge Flange (2)	CS71200-100N	JIS 20K 100A(4")	1
100	Mechanical Seal Assembly BBS-E	CS10002-250EBS		1
125	Micro-switch (1) and (2)	CS12500-200	To be replaced if any abnormality is found.	4
129	Potentiometer (1) and (2) 200-1k with Wire	CS1299-E10		1
	Gear Coupling Assembly (Current Type)	CS1519-L	To be replaced if any abnormality is found.	1
159	Knurled Cup Point Socket Set Screw	NA83612-020	To be replaced if any abnormality is found.	1
160	Lock Nut AN13, Drive Hub	NG31-013	To be replaced if any abnormality is found.	1
161	Lock Washer AW3	NG32-013		1
163	O-ring JIS B 2401 G35	PA12-035		1
165	O-ring JIS B 2401 G30	PA12-030		1
197	O-ring JIS B 2401 P50	PA11-050		1
201	Bevel Gear (1) 1612LSC(φ9)	CS20100-1612C9	To be replaced if any abnormality is found.	1
202	Bevel Gear (2) 1612LSC(φ6)	CS20100-1612C6		1
216-1	Gasket, Lubricating Oil Inlet Flange (1)	CS71200-025N	JIS 20K 25A (1")	1
216-2	Gasket, Lubricating Oil Inlet Flange (2)	CS71200-020N	JIS 20K 20A (3/4")	1
219	Gasket, Oil Injection Inlet Flange	CS71200-015N	JIS 20K 15A (1/2")	1
237-1	Tortional Slip Washer (1)	CS23700-250		2
237-2	Tortional Slip Washer (2)	CS23700-200		2
279	O-ring JIS B 2401 G130	PA12-130		1
432-1	O-ring JIS B 2401 G130	PA12-130		4
432-2	O-ring (Old JIS W 1516 G22)	PA62-022	AS568A-244	4
433-1	O-ring JIS B 2401 G130	PA12-130		4
433-2	O-ring (Old JIS W 1516 G22)	PA62-022	AS568A-244	4
528	Oil Seal Sleeve with O-ring	CS52809-250VD		1
744	O-ring, JIS B 2401 G70	PA12-070		1
-	O-ring Set 2520C NBR	CS7109-0L		-
-	Gasket Set 2520C	CS7118-0L		-

【POINT】

In case of replacing the main/side bearings of No.27 and No.28, it is not necessary to prepare the O-rings of No.432 and No.433 because the main/side bearings have the O-rings.

【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 modification.

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 us when placing an order.

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 lower 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.

- By using the bypass valve, release the high pressure gas in the package unit to the low pressure side.
- If there is another compressor unit to which a permanent bypass line is connected, operate the other compressor and lower the pressure through the bypass line.
- Operate the refrigerating system, and close the fluid supply master valve to turn the gas into liquid, and recover the liquid at the receiver.
- By using a refrigerant recovery machine, recover the liquefied refrigerant in 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.

The gas mask and other protective gears required at each stage of refrigerant recovery work must be prepared before 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.**
- **After closing (opening) a valve for work, conduct lockout/tagout to prevent it from being handled accidentally during the work.**

5.3.4 Removal of Connections to the Unit

DANGER

- **If high-pressure refrigerant gas or a mixture of refrigerant and oil remains in the compressor, refrigerant gas may blow off when the closed circuit is opened. This may result in injury such as frostbite or loss of vision.**
  Be sure to confirm that there is no residual pressure before opening any pipe connections.

When removing the compressor from the mounting base frame, the following parts must be disconnected beforehand:

(1) Coupling that is connecting the compressor and driving machine;
(2) Compressor suction piping and discharge piping.
If the suction strainer is connected directly with the compressor, also remove the strainer together;
(3) Oil supply lines to the compressor (journal lubrication (2 sets), oil injection (1 set) and capacity control increase/decrease (2 sets for each));
(4) Electric wiring for operating capacity control
(Depending on the situation of the workplace, unloader indicator assembly may be removed, with the wiring left as it is. Refer to Section 5.4.1.1 and Section 5.5.15 in this chapter);
(5) Bolts for mounting the compressor (leg bolts); and
(6) Intermediate connecting piping from the low-stage discharge port to high-stage suction port of the compressor (In some cases, this piping is not removed, and the compressor is removed with this piping attached.)

【POINT】

When removing oil lines from the compressor, there is possibility of gas and oil blowing out caused by residual pressure. And any residual oil in the pipe will 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 supply header before removing the pipe.

Work carefully in particular when disassembling the unloader cylinder block since there is residual pressure and oil fills in the unloader cylinder. Moreover, prepare a larger volume container than the unloader cylinder volume to receive oil flowing out.

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.

5.3.5 Removing and Lifting the Compressor

DANGER

- **The work to lift up or move the compressor must be performed by a qualified operator.**
- **Make sure that the lifting equipment and wires have sufficient load capacity for the compressor before starting the compressor lifting work.**
- **Never try to perform disassembly or assembly while the compressor is lifted in the air.**

【POINT】

As the suction pipe is located immediately above the compressor, lift up or partially remove the pipe such that it will not interfere with the lifting device.

For the lifting positions of the compressor, refer to Photo 002 or Figure 3-1 in page 3-3 of Chapter 3 in this manual.

If the planned overhaul work includes separation between low-stage and high-stage blocks of the compressor, place the compressor on a special stand as shown in Photo 003 and then remove eight or more hexagon head cap screws around the bottom flange part. Never try to remove these bolts while the compressor is lifted in the air. Note that these bolts cannot be removed once the compressor is placed on the work bench.

Photo 003 Loosening Lower Flange Fastening Bolts

5.3.6 Draining Oil from the Compressor

Remove oil in advance, since a large quantity of oil remains inside the compressor.

There are plugs under the suction cover [5-1] and [5-2], and under the bearing head [11-1].

Most of the oil will flow out of these plug holes.

Remove the remaining oil as it appears, while disassembling the compressor on the work bench.

Oil mainly resides inside a) unloader cylinder, b) balance piston cover [22], c) seal cover [51] and d) suction cover [5-1] and [5-2].

Prepare a receiving tray and waste cloth for oil that will spill during disassembly.

Photo 004 Draining Oil from Bearing Head

5.4 Disassembly and Inspection

During the overhaul work, be very careful in handling the parts. As the compressor is a delicate machine that is operated at very high speed, a minor handling error could result in a situation where the rotor and other major components must be entirely replaced. Another possibility is that it may cause a failure or performance degradation when the compressor is operated after the reassembly.

Please fully understand the following sections before starting the work.

In general, the disassembly sequence will follow the flow shown on the left side of Figure 5-1 "Illustration of the disassembly sequence". Note that the sequence shown is an example, and it may change depending on the situation. For example, it is allowed to separate the low-stage and high-stage blocks at first, as shown on the right side of the flow.

Also, in the case of the flow on the left side, the sequence of disassembly may be reversed between the unloader cover/unloader cylinder block and the mechanical seal block.

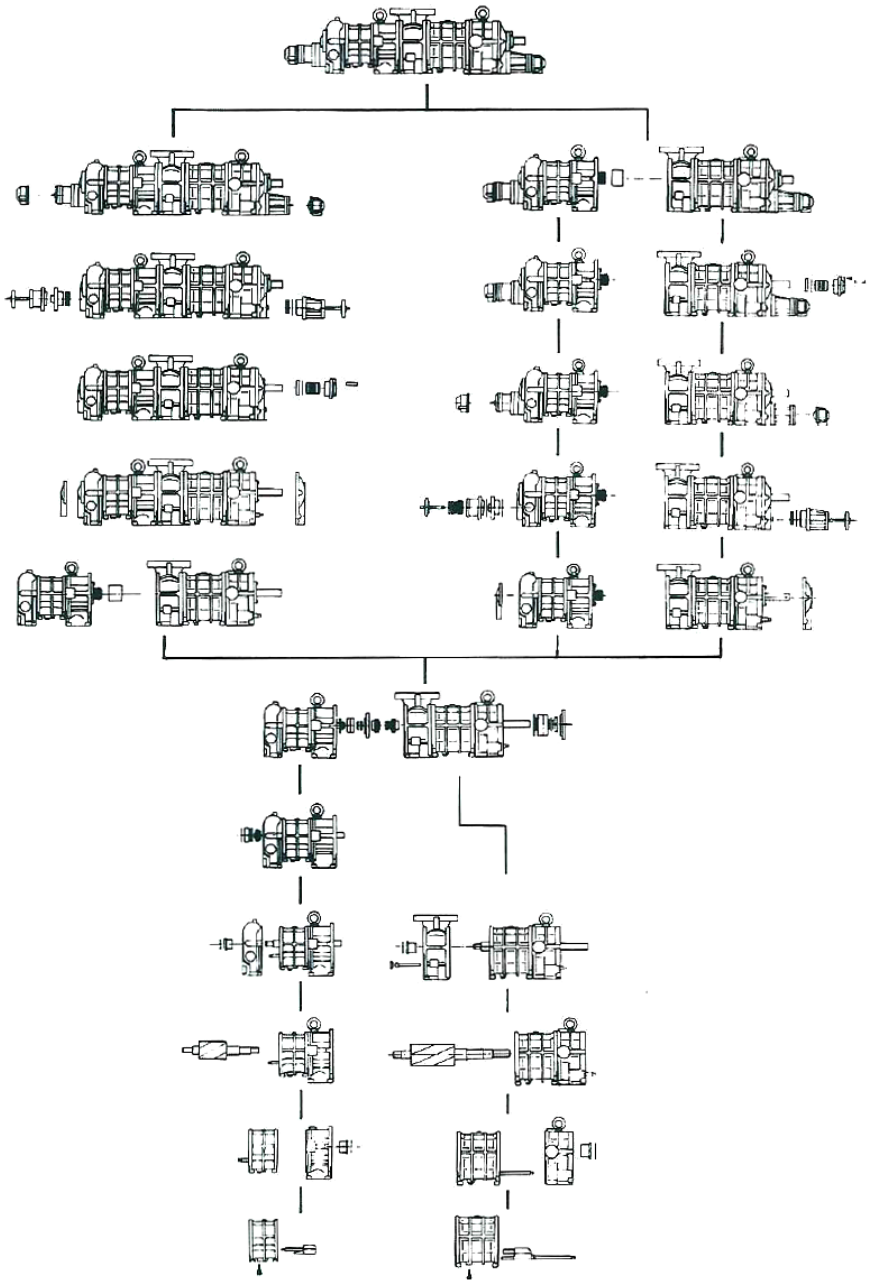


Figure 5-1 Illustrated Disassembly Sequence

5.4.1 Unloader Indicator

On the 2520**C model, unloader indicators are installed on both the high and low-stages. The high-stage unloader has the same indicator as that for the UD series single-stage compressors (standard model), while the dial and the micro-switch cam are designed for indicated load of 20 to 100 %.

On the low-stage side, the standard indicator assembly is attached with a fixture for 2520**C model (Photo 005) that bends the indicator by 90° clockwise or counterclockwise viewed from either of the rotor shaft ends.

The unloader indicator assembly has a potentiometer, two micro-switches, a micro-switch cam, a set of retainers, indicator needle with dial and terminal block.

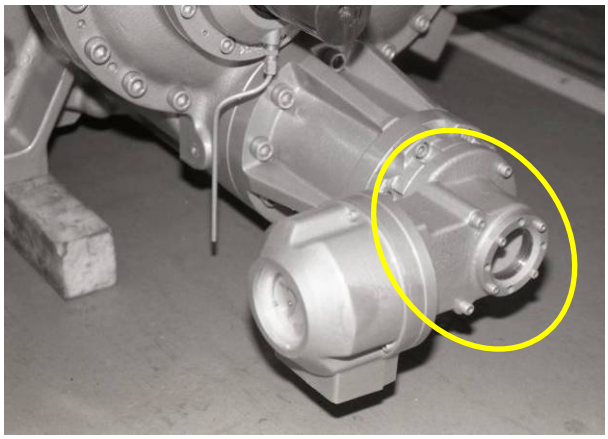


Photo 005 Low-stage Unloader Indicator Fixture (Circled Portion)

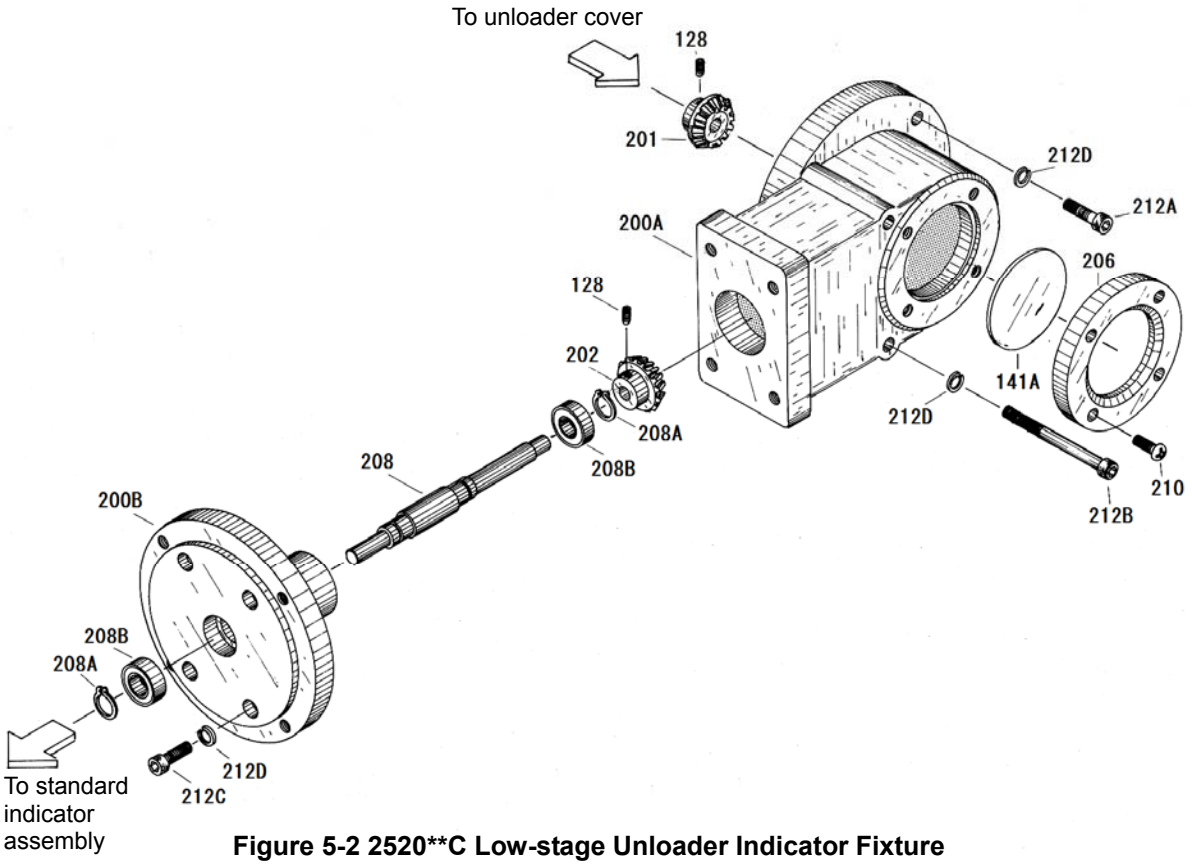


Figure 5-2 2520C Low-stage Unloader Indicator Fixture**

5.4.1.1 Disassembly

When dismounting the compressor, open the indicator cover before removing the wiring of unloader indicator and the indicator parts. Follow the procedure below. After the wiring or the indicator assembly parts are removed, attach the cover again for protection.

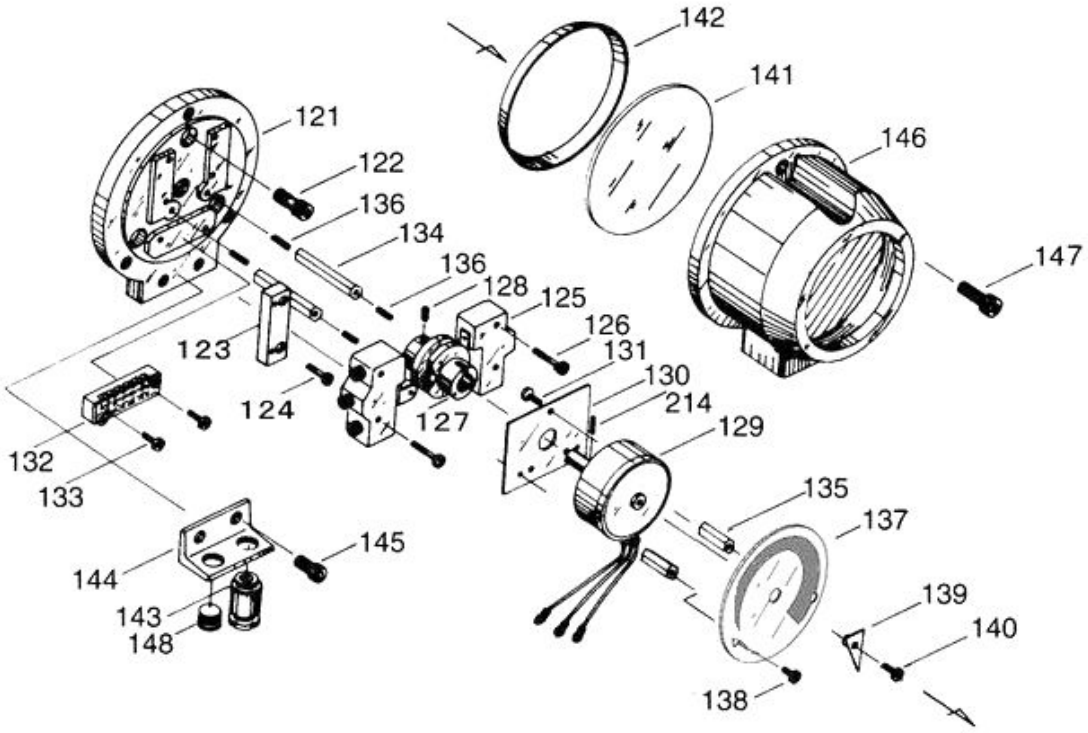


Figure 5-3 Standard-type Unloader Indicator (High-stage Dial Plate)

- When removing wiring only
  a) Remove three hexagon socket head cap screws [147] that fasten the indicator cover [146]. Then the cover gets removable.
  b) The indicator cover comes off with glass [141] and spacer [142] attached. The glass and the spacer are pasted together, however, take care not to drop them as they may come apart.
  c) Remove the plastic plate on the surface of the terminal block, and then remove the wiring. Apply vinyl insulation tape to the wiring terminals, and paint identification numbers to prevent them from being mixed up at recovery.

- When removing unloader indicator assembly parts, with the wiring left as it is

  Steps a) and b) are the same as described above.

  c) Loosen the cam set screw [128] which secures the micro-switch cam [127] on the shaft of the indicator cam [77-2] on the high-stage side, or on the shaft of the indicator bar [208] of the indicator fixture on the low-stage side.
  d) Loosen and remove the hexagon socket head cap screws [122] fastening the micro-switch mounting plate [121] to the unloader cover [74-2] on the high-stage side, or to the indicator fixture on the low-stage side.
  e) Now, the assembly can be pulled out as it is in the axial direction.

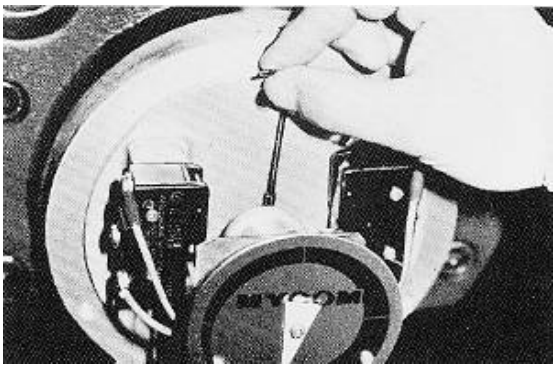


Photo 006 Loosening Micro-switch Cam Securing Set Screw

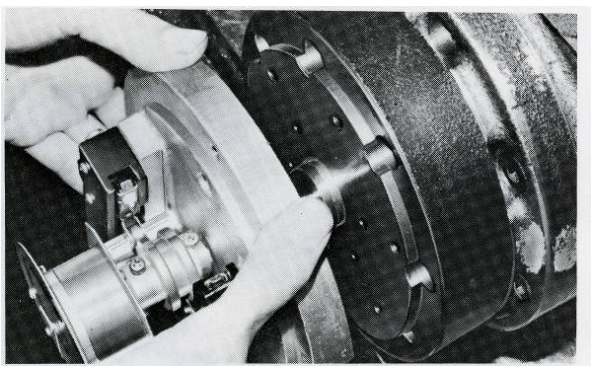


Photo 007 Removing Indicator Assembly

Photo 008 Removing Unloader Indicator Fixture

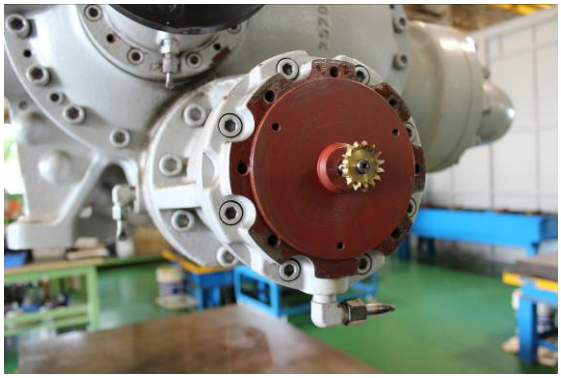


Photo 009 After Removing Indicator Fixture

5.4.1.2 Inspection

Inspection and adjustment of the unloader indicator is often done after its removal as part of indicator assembly. The inspection and adjustment is done after the compressor, which was disassembled and inspected, is reassembled and restored to the package unit frame. So, for information on inspection, refer to Section 5.5.15 "Unloader Indicator" in this chapter.

5.4.2 Unloader Cover

The unloader cover [74-1] [74-2] is mounted with the indicator cam [77-1] [77-2], 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 [68-1] [68-2] on the top end of the unloader push rod [67-1] [67-2].

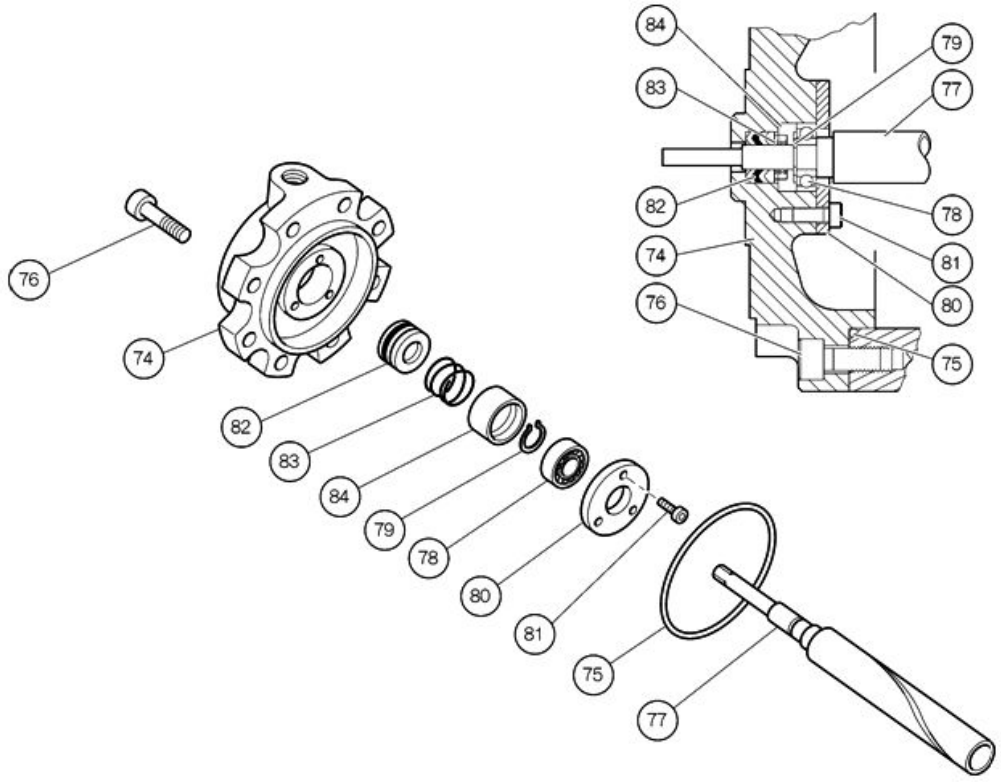


Figure 5-4 Unloader Cover Block

5.4.2.1 Disassembly

a) Unscrew and remove the unloader cover mounting hexagon socket head cap screws [76-1] and [76-2].

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 spiral 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.

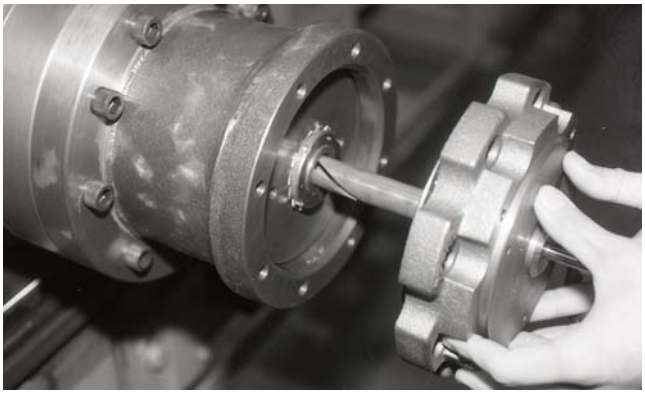


Photo 010 Pulling Out Unloader Cover

Photo 011 Ball Bearing for Indicator Cam

Photo 012 Parts Attached to Indicator Cam

Photo 013 V-ring (Black part is NBR/FKM.)

5.4.2.2 Inspection

a) Check the packing portion 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 defect such as damage or wear is found, replace it with a new one.

5.4.3 Unloader Piston and Unloader Cylinder

Inside the unloader cylinder [60-1] [60-2], unloader piston [64-1][64-2] with a cap seal [66-1] [66-2] and O-ring [65-1] [65-2] put on its outer circumference is attached with a lock nut [69-1] [69-2] to the unloader push rod [67-1] [67-2] which moves the unloader slide valve.

The unloader cylinder assembly on high-stage side of the 2520**C model has unloader cylinder guides [278A] [278B]. The unloader cylinder guide B [278B] is sandwiched between the unloader cylinder [60-2] and balance piston cover [22].

The unloader cylinder guide A [278A] acts like an alignment pin, positioning suction cover [5-2] and the balance piston cover [22].

The unloader cylinder guide B [278B] controls such that capacity control lower limit on the high-stage side is 20 % in terms of indicated load.

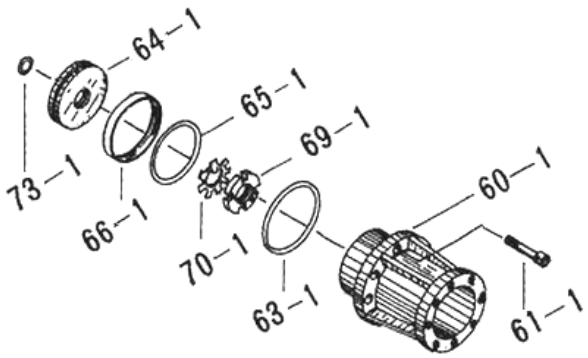


Figure 5-5 Unloader Cylinder Block (Low-stage)

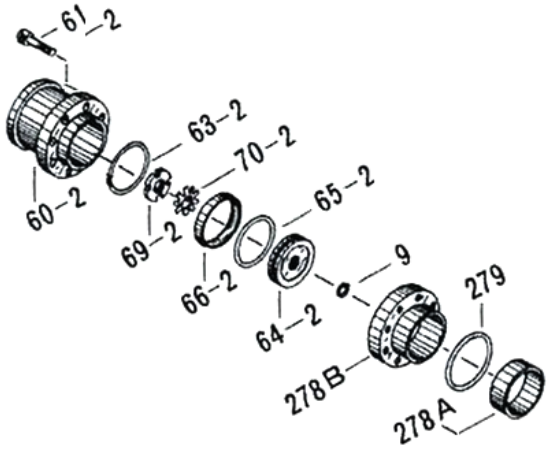


Figure 5-6 Unloader Cylinder Block (High-stage)

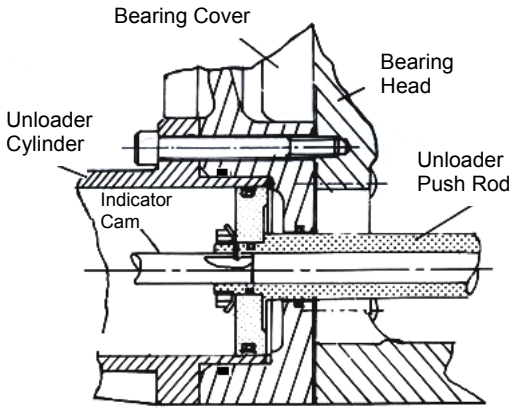


Figure 5-7 Unloader Cylinder Block (Low-stage)

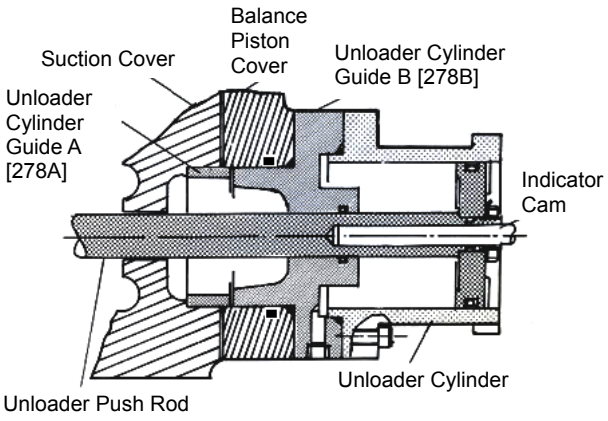


Figure 5-8 Unloader Cylinder Block (High-stage)

5.4.3.1 Disassembly

a) Screw two M8 eyebolts into the unloader piston [64-1] [64-2] to the utmost front.
b) Unbend the rotation stopper tooth of the lock washer [70-1] [70-2], so that the lock nut [69-1] [69-2] can rotate. Loosen and remove the lock nut.
c) Now, you can remove the unloader piston.

Photo 014 Bending back the Lock Washer Tooth

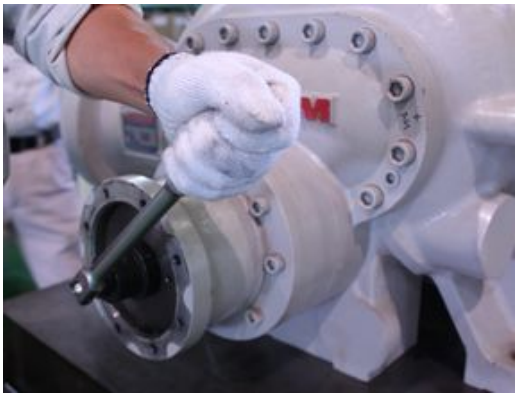


Photo 015 Loosening with Lock Nut Wrench

b) The low-stage unloader cylinder [60-1] is, together with the bearing cover [16], fastened to the low-stage bearing head [11-1] by using nine long hexagon socket head cap screws [62-1].

   Even if all of the hexagon socket head cap screws are removed, the unloader cylinder will not drop off because it fits in the bearing cover. Pull it out while holding its flange or rib.

c) The high-stage unloader cylinder [60-2] is, together with the unloader cylinder guide B [278B], fastened to the balance piston cover [22] by using nine long hexagon socket head cap screws [62-2].
   Remove all the hexagon socket head cap screws, and take out the cylinder and cylinder guide in order.

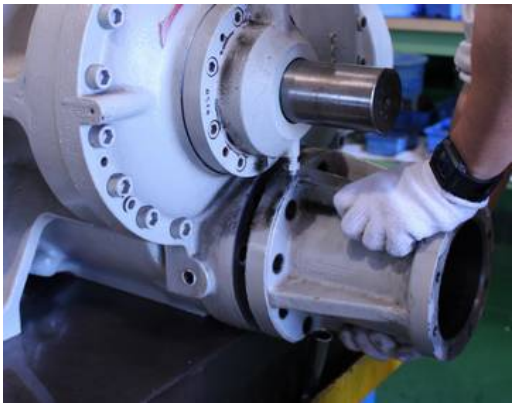


Photo 016 Removing Low-stage Unloader Cylinder

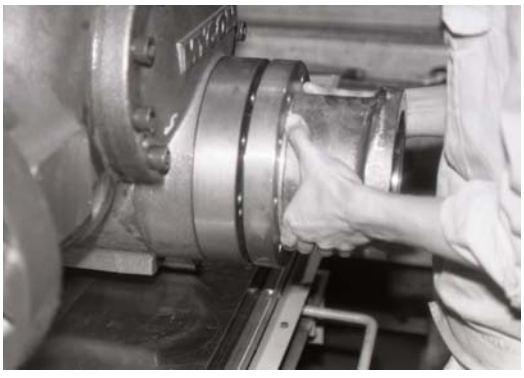


Photo 017 Removing High-stage Unloader Cylinder

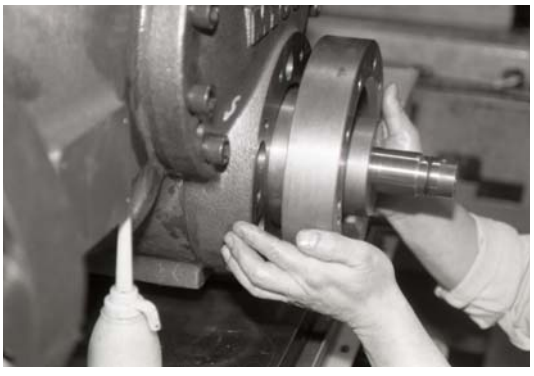


Photo 018 Removing Cylinder Guide B

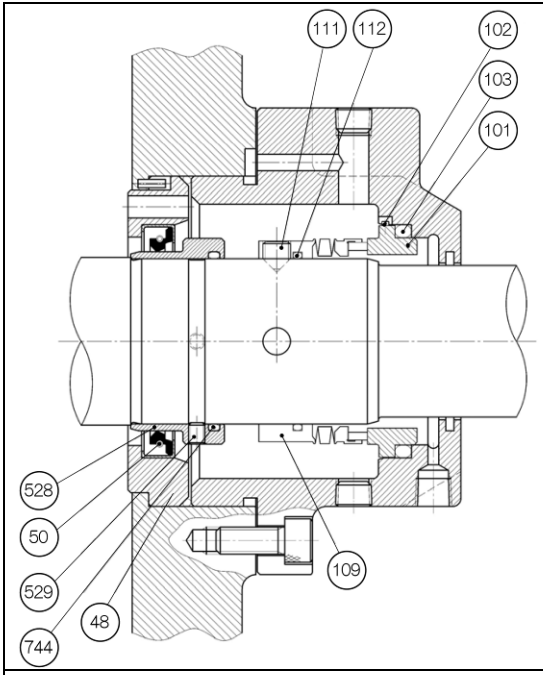
5.4.3.2 Inspection

a) Be sure to replace both the cap seal [64-1] [64-2] and O-rings [65-1] and [65-2], which are attached to the outer circumference of the unloader piston [64-1] [64-2], with new ones.

b) The unloader cylinder often has damage or oil refuse stuck to its inner surface. Clean it thoroughly, and smoothen its surface by using fine sand paper.

Photo 019 Removing Cap Seal

5.4.4 Shaft Seal Block



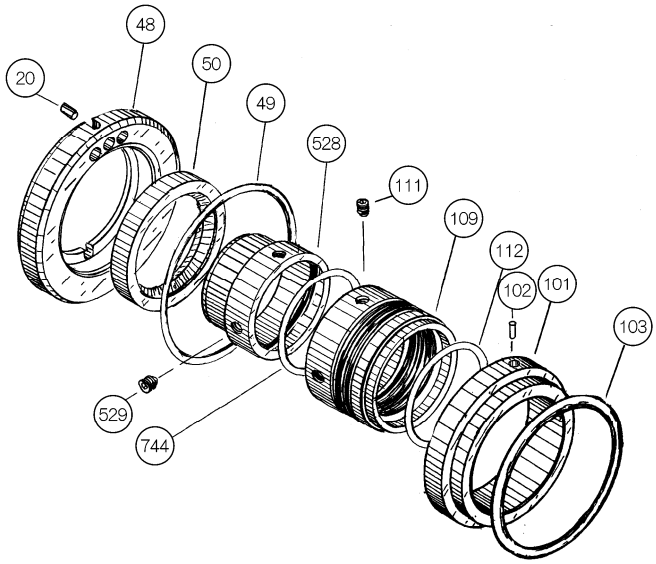


Photo 020 (Seal Assembly)

P/N		Part Name	
101	100	Mating Ring	Stationary rings
102		Insert Rotation Stopper Pin	
103		O-ring	
109		Seal Collar	Rotating rings
111		Seal Collar Set Screw	
112		O-ring	
528		Sleeve, Oil Seal	
529		Sleeve Set Screw, Oil Seal	
744		O-ring	
48		Oil Seal Retainer	
49		O-ring	
50		Oil Seal	
20		Spring Pin	

Figure 5-9 Details of BBSE Type Mechanical Seal Assembly and Rerated Parts

5.4.4.1 Disassembly

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

b) Loosen the remaining two screws alternately and evenly, a little at a time. After loosened to some extent, the seal cover of the mechanical seal will be raised slightly by the force of the inside spring, creating a gap under the cover. The gap will not be created if the gasket is sticking to both surfaces. In this case, free the cover by screwing the M8 eye bolts into the jacking screw holes in the seal cover to separate it.

c) Use a container to catch remaining oil that will flow out through the gap.

d) Pull out the seal cover, while keeping it in parallel with the shaft (rotor shaft). Inside the cover, there is the mating ring fitted with the O-ring. Be careful not to let the mating ring and the shaft damaged by contact.

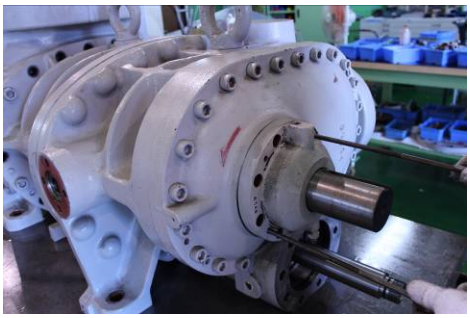


Photo 021 Separating Seal Cover with Eye Bolt

Photo 022 Removing Seal Cover

e) Remove the O-ring [49] from 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 sand paper 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, but leave them so that their ends are below the surface of the seal collar. These screws are located in two places 90 degrees apart from each other.

h) Pull out the seal collar with your fingers. While pulling out, make sure that the ends of the set screws do not touch the shaft surface. Any scratch on the shaft will cause leakage.

i) By removing the two set screws [529] (Photo 023), pull out the oil seal sleeve [528].

j) Screw two M8 eye bolts into the screw holes in the oil seal retainer [48] and pull out the oil seal retainer while keeping it in the right angle with the shaft (Photo 024).

k) Remove the oil seal [50] that is attached into the oil seal retainer.

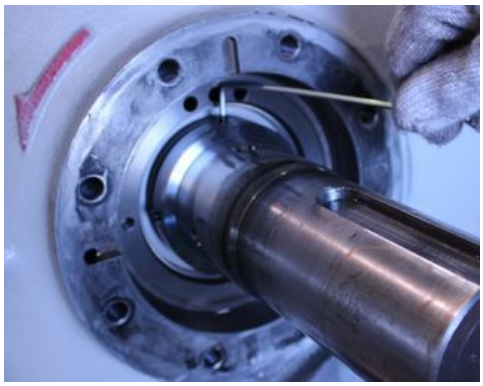


Photo 023

Photo 024

5.4.4.2 Inspection

a) Mechanical seal should be replaced if any defect is found during inspection. Actually, however, it is sometimes difficult to find out defects on the sliding surface only through visual inspection. In such circumstances, MAYEKAWA recommends to replace it with a new one in the same manner as with O-rings or gaskets.

   Also, if it is difficult to stop the compressor operation except for scheduled inspections, we recommend to replace the mechanical seal assembly with a new one at every inspection of this block.

   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 are likely to swell and deform over time.

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

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

   A design modification was made in March 2010 to insert an O-ring [744] in the oil seal sleeve.

d) Replace the seal cover gasket with a new one.

Photo 025 Oil Seal Retainer and Oil Seal Sleeve attached with O-ring

5.4.5 Bearing Cover

The bearing cover [16] should be removed when the low-stage thrust bearing block is inspected or the rotor is pulled out for inspection.

5.4.5.1 Disassembly

a) Remove all the hexagon socket head cap screws [18-1]. The bearing cover remains attached to the bearing head [11-1] with two alignment pins [19-1].
b) Screw the stud bolts into the two upper screw holes for safety.
c) Two jacking screw holes are provided in the opposite positions. Screw the two bolts that have been removed [18-1] into the right and left holes. This will cause the bearing cover to separate from the bearing head. When a small gap is created, peel up one side of the gasket [17-1] by using a scraper.
d) Screw the bolt further, until the cover comes off the alignment pins.

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. So, be sure to protect the shaft with a blanket or other protective covering before starting the work.**

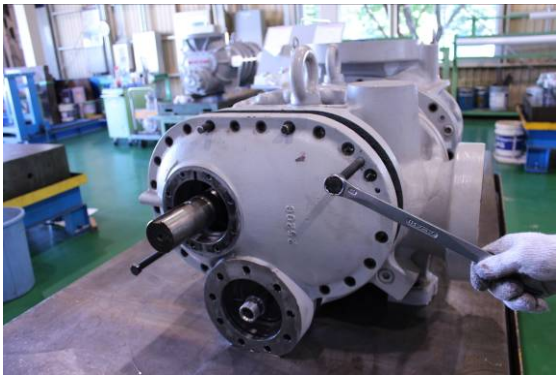


Photo 026 Removing Bearing Cover

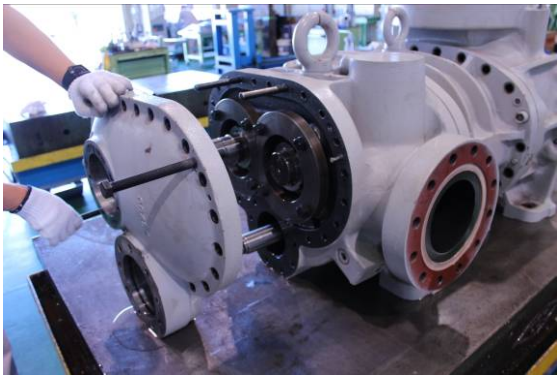


Photo 027 Removing Bearing Cover

5.4.6 Balance Piston Cover

5.4.6.1 Disassembly

a) The balance piston cover [22] is fastened to the suction cover [5-2] by using 18 hexagon socket head cap screws [24]. Remove all the hexagon socket head cap screws.

b) Tap the side face of the balance piston cover with a soft hammer, to remove the balance piston cover gasket [23] that is stuck. The unloader cylinder will not come off thanks to the unloader cylinder guide A [278A] attached between the suction cover and balance piston cover.

c) In this state, drain the oil that remains at the balance piston [30] and side bearing block inside the suction cover.

d) When you have drained the oil out, remove the balance piston cover.

e) Pull out the unloader cylinder guide A.

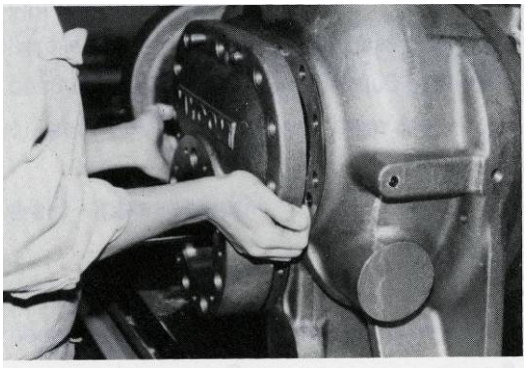


Photo 028 Removing Suction Cover

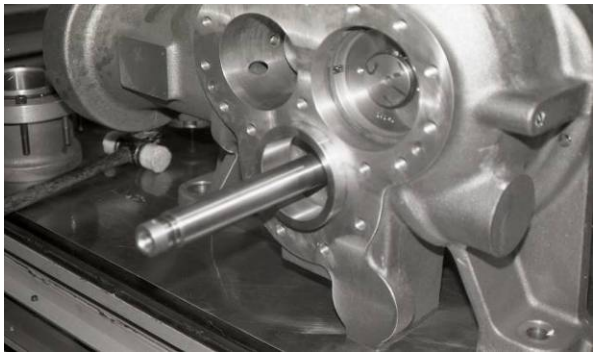


Photo 029 Unloader Cylinder Guide A

5.4.7 Separating High-stage and Low-stage Blocks

The high-stage and low-stage blocks should be separated when pulling out the high-stage thrust bearings, main bearing or rotors for inspection.

As explained at the beginning of Section 5.4 of this chapter, the separation may be done at the initial step of the overhaul work.

5.4.7.1 Disassembly

a) As explained 【POINT】 in 5.3.5 of this chapter, when separating the compressor's low-stage and high-stage, put the compressor on a special stand and remove the bolts from the lower side in advance.

b) Remove the hexagon socket head cap screws [18-2] that fasten the high-stage bearing head [11-2] and low-stage suction cover [5-1].

c) Hammer an alignment pin [19-2] into the low-stage suction cover [5-1].

d) As the gasket [17-2] is sticking to both surfaces of the high-stage bearing head and the low-stage suction cover, use the bolts [18-2] that have been removed to screw them into the jacking threads in the bearing head to evenly push the suction cover to separate the two blocks.

e) The gear coupling assembly [151 to 161] for power transmission is located inside, on the side of the M rotor shaft.

   Move the main body in parallel with the shaft to separate the driving side and the driven side in the direction of the shaft.

Photo 030 Tapping Alignment Pin

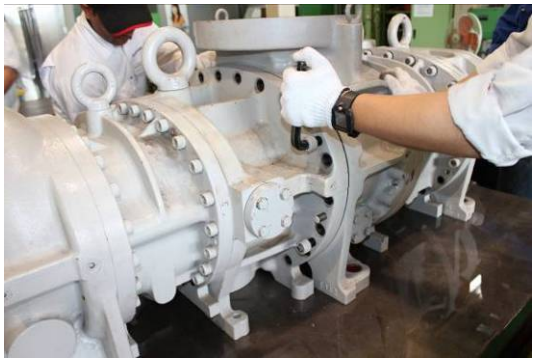


Photo 031 Pushing Cover off by Screwing Bolts

5.4.8 Gear Coupling

The gear coupling, which is used as a power transmission means, is divided into the high-stage and the low-stage blocks, with each block attached to the corresponding M rotor shaft, and these two blocks are directly connected by a drive sleeve.

Gear coupling mechanism of 2520C models**

In March 1982, the coupling method was changed from the initial type (coupling hub is directly connected using hexagon head screws) to the method using coupling hub and sleeve. This method was used for a long time.

However, the anti-falling method of the drive sleeve was modified in February 2011as the design modification. While the old couplings have stoppers on both outer ends of the drive sleeve, the stoppers are placed on the inside of the drive sleeve after the design modification (compatible with the old type).

After this design modification, the drive sleeve stopper [154] and snap ring [155] are no more used.

Refer to Figure 5-10 and Figure 5-11 in next page.

5.4.8.1 Disassembly

a) Driven sleeve [151] can be removed with hands when the high-stage and low-stage are separated.

b) On the high-stage (driven) side, loosen the set screw [159] of the key [157] attached on the driven hub [153], and then remove the driven hub. As it is clearance-fitted, it can be removed easily.

c) On the low-stage side, unbend the lock washer tooth [161] and loosen the lock nut [160] to remove the drive hub [152].

d) Two screw holes are provided on the drive hub. Screw in M8 eye bolts, and pull out the drive hub. As it is clearance-fitted, it can be removed easily.

【POINT】

MAYEKAWA recommends a knurled cup point locking screw with a nylon coating for the set screw [159].

5.4.8.2 Inspection

Check the hub and sleeve for possible deformation of the gear teeth and wear on each tooth flank.

If any defect is found, replace the whole gear coupling assembly. Also, investigate cause(s) of the defect.

Photo 032 Current Gear Coupling Parts

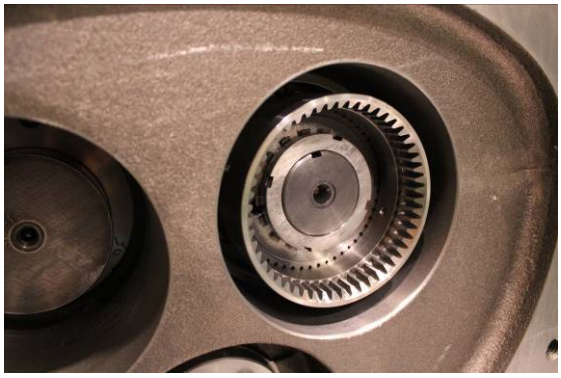
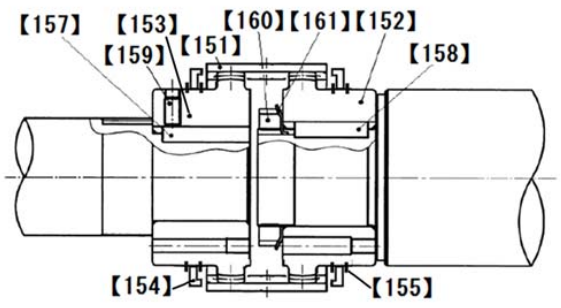
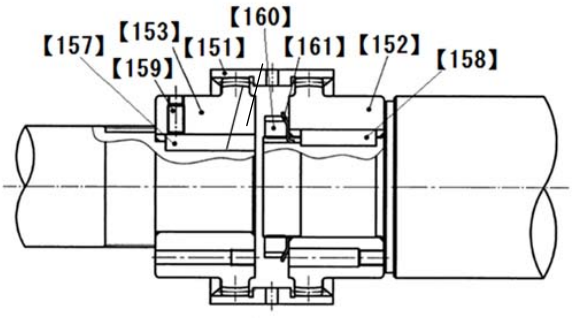


Photo 033 Low-stage Gear Coupling



Gear coupling assembly comprising
151, 152, 153, 154*2, 155*2 and 159.

**Figure 5-10 Former Method
(Used Until Design modification
in February 2011)**



Gear coupling assembly comprising
151, 152, 153 and 159.

**Figure 5-11 New Method
(Used After Design modification
in February 2011)**

5.4.9 Removing Oil Injection Pipe

The oil injection pipe [85] is located at the lower area of the low-stage suction cover [5-1].

5.4.9.1 Disassembly

Remove the oil injection pipe gland [164]. There are M20 screw hole on the head of the oil injection pipe. Screw the bolts [2-1], and pull out the pipe.

Photo 034 Removing Fastening Bolts from Oil Injection Pipe Gland

Photo 035 Removing Oil Injection Pipe Gland

Photo 036 Removing Oil Injection Pipe

5.4.10 Balance Piston Block

During the operation of a screw compressor, both the rotation rate and the thrust load of the M rotor are higher than those of the F rotor. Accordingly, the service life of the thrust bearing for the M rotor will be significantly shorter than that of the F rotor, if no special measures are taken. As such, in order to reduce the thrust bearing load on the M rotor side, a hydraulic piston is used on the shaft end of the high-stage M rotor shaft to cancel the thrust load.

* Note that no balance piston is used on the low-stage, because the low pressure conditions is lower than high-stage, the service life difference of the bearings is not so significant compared to the high-stage.

As the 2520**C model has a step difference part inside the suction cover to receive the O-ring for balance piston sleeve, it has neither O-ring spacer for sleeve nor snap ring for spacer which are attached to other MYCOM compressor models.

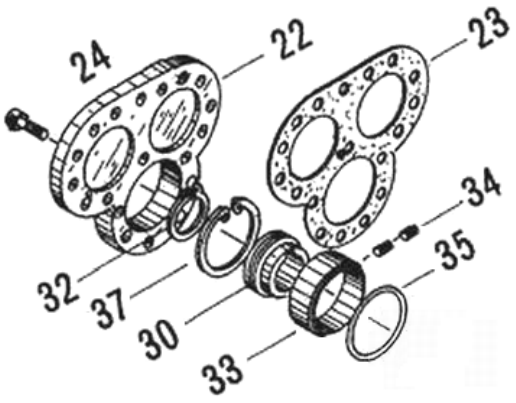


Figure 5-12 Balance Piston Block

5.4.10.1 Disassembly

a) By using external snap ring pliers, remove the snap ring [32] retaining the balance piston [30] on the shaft.

b) Screw two eye bolts into the screw holes, and pull out the balance piston straight forward. Leave the balance piston key [31] fitted in the rotor shaft as it is.

c) To prevent rotation of the balance piston sleeve [33], there are hexagon socket head set screws [34] screwed from both the M rotor side (balance piston)and F rotor side. So, loosen the set screw on the F rotor side, and place the M rotor side screw under the suction cover as shown in Photo 037.

Photo 037

d) By using internal snap ring pliers, remove the snap ring [37] for securing the balance piston sleeve. As the snap ring is pushed out by the force of the inner O-ring [35], it can be removed easily when pushed gently.

e) Remove the balance piston sleeve and O-ring.

As the outer diameter of the balance piston sleeve is clearance-fitted with the suction cover, it can be pulled out easily.

5.4.10.2 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.

5.4.11 High-stage 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 main 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.**

5.4.11.1 Disassembly

a) Either on M rotor and F rotor, remove the hexagon head bolts [45-2] and the conical spring washers [46-2] that are used to fasten the thrust bearing gland [43-2].

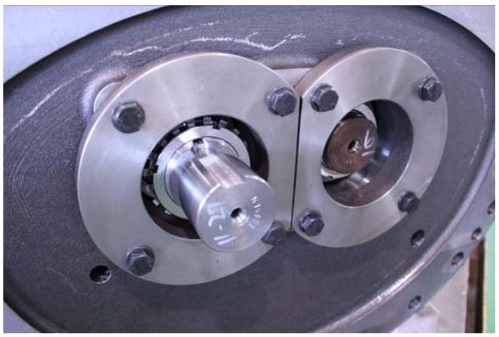


Photo 038 Appearance of High-stage T thrust Bearing Block

Photo 039 Removing Hexagon Head Bolts

b) After removing the thrust bearing gland, it can be pulling out the thrust bearing gland C [43-2C] from the M rotor and thrust bearing gland B [43-2B] from the F rotor.

These thrust bearing glands are added parts as the spacers when the specification of the 2520**C high-stage thrust bearing block have changed in June 1993, i.e., triple thrust bearings specification modified to twin thrust bearings specification. For details of this design modification, refer to Section 5.4.13 in this chapter.

c) Unbend the tooth of the lock washer [40-2] preventing rotation of the lock nut [39-2] that secures the thrust bearing to the rotor shaft, so that the lock nut can rotate. Loosen the lock nut with a locknut wrench.

Photo 040 Loosening Lock Nut

Photo 041

d) After preparatory work described above, start the removing work of the high-stage suction cover.

The high-stage rotor casing features a low overall height. It is attached between the suction cover and the bearing head like a bridge.
If the suction cover is removed, the rotor casing overhangs. So, place a support like rectangular blocks under the rotor casing, or lift it by using lifting tools as shown in Photo 041.

e) Loosen and remove the hexagon socket head cap screws [2-2] that fasten the high-stage suction cover [5-2] and high-stage rotor casing [1-2].

f) The suction cover gasket [6-2] and the flange surface are stuck together. Gently hammer the suction cover at its side face or screw two hexagon socket head cap screws [2-2] (which have been removed) into the jacking screw holes on the rotor casing flange, to push the suction cover evenly. When a small gap is created, peel up one side of the gasket by using a scraper (Do not insert a screwdriver or chisel into the gap).

g) At the position where the alignment pin can be pulled out, draw out the suction cover all at once in parallel with the shaft.

h) The side bearing [28-2] is press-fit from the balance piston cover side of the suction cover. Remove the snap ring [29-2] using a internal snap ring pliers.

i) Either push out the side bearing from the main rotor casing side using some block or pull it out using a special tool such as shown in Photo 042. For the details of the special tool, refer to Section 5.5.2 in this manual.

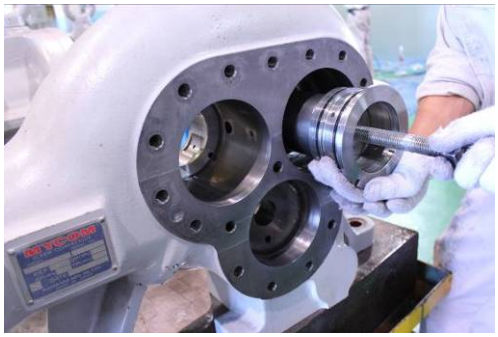


Photo 042 Removing Side Bearing

【POINT】

The high-stage suction cover of other models in C-series, i.e., 2016**C and 3225**C has an O-ring groove for the unloader push rod. There is no O-ring in the suction cover of the 2520**C model, because the O-ring for unloader push rod is on the unloader cylinder guide.

5.4.11.2 Inspection

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

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 turned gray or any foreign matter is embedded, also carefully check the wear of the rotor shaft.

c) The inside surface of the main 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.

5.4.12 Low-stage Suction Cover and Side Bearings

Similarly to the case of the high-stage, the lock nut fastening the thrust bearing should be loosened before removing the suction cover.

5.4.12.1 Disassembly

a) Remove the hexagon head bolts [45-1] fastening the thrust bearing gland [43-1]. As conical spring washers [46-1] are used together, be careful not to lose them.

b) Unbend the tooth of the lock washer [40-1] to preventing the lock nut rotation, and loosen the lock nut [39-1].

c) Similarly to the case of the high-stage, loosen and remove the hexagon socket head cap screws [2-1] that fasten the low-stage suction cover [5-1] and low-stage main rotor casing [1-1].

d) Hammer two alignment pins [3-1] into the main rotor casing side as shown in Photo 043. If it is difficult to do so, screw the suitable bolts into the jacking screw holes on the suction cover flange surface fastening to main rotor casing, to separate the suction cover in parallel by pushing.

e) The alignment pins will also be pulled out. However, as the rotor shaft and the side bearings remain fitted in, pull out the suction cover in parallel with the axis (Photo 044).

f) By using internal snap ring pliers, remove the snap ring [29-1] for holding the side bearing (Photo 045).

g) Either push out the side bearing from the main rotor casing side using some block or pull it out using a special tool such as shown in Photo 046. For the details of the special tool, refer to Section 5.5.2 in this chapter.

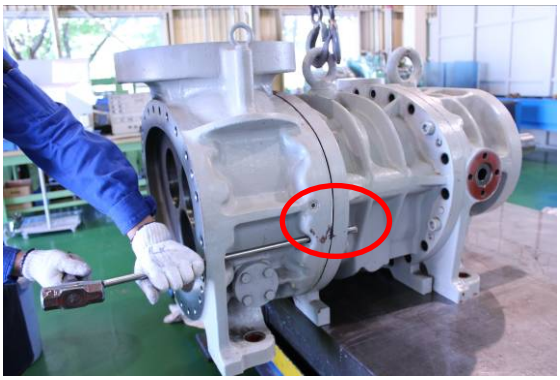


Photo 043

Photo 044

Photo 045

Photo 046

5.4.12.2 Inspection

Inspect the suction cover and side bearings in the same way as for the high-stage.

5.4.13 Thrust Bearing Block

Thrust bearing is one of the screw compressor components that are playing the most important role.

The standard-type thrust bearing is front assembly angular contact ball bearing. It supports the differential pressure produced by compressed gas and the thrust load (axial direction) produced by screw rotor rotations.

As there is a gap between the outer race of the thrust bearing and the bearing head, this bearing only receives thrust load. The radial load perpendicular to the axis is received by the main bearing and side bearing.

Apart from receiving the thrust load, the thrust bearing has the important role of securing the positional relationship of the gap between the rotor end face and the discharge side of the bearing head.

5.4.13.1 Disassembly of High-stage Thrust Bearings

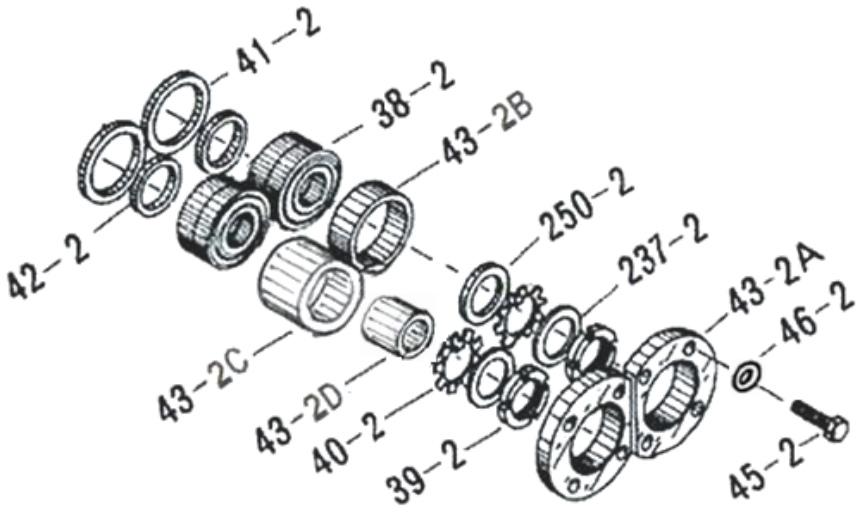


Figure 5-13 High-stage Thrust Bearing Block

Table 5-6 Parts List of High-stage Thrust Bearing Block

P/N	Part Name	Qty.
38-2	Thrust Bearing (2)	2
39-2	Lock Nut (2)	2
40-2	Lock Washer (2)	2
41-2	Thrust Bearing Outer Race Spacer (2)	2
42-2	Spacer, Thrust Bearing Alignment (2)	2
43-2A	Thrust Bearing Gland (2) A	2
43-2B	Thrust Bearing Gland (2) B	1
43-2C	Thrust Bearing Gland (2) C	1
43-2D	Thrust Bearing Gland (2) D	1
45-2	Hexagon Head Bolt	8
46-2	Conical Spring Washer (2)	8
237-2	Torsional Slip Washer (2)	2
250-2	Thrust Bearing Washer (2)	1

Triple thrust bearings had been used in the M rotor on the high-stage side of the MYCOM 2520**C model till the design was modified in June 1993. After that modification, twin thrust bearings are used in the same way as in other MYCOM screw compressor models. As a result, the following modifications were also applied:

1. Thrust bearing gland is added.
   On the high-stage M rotor side, bearing gland C [43-2C] is attached between the thrust bearing [38-2] and thrust bearing gland A [43-2A], and bearing gland D [43-2D] is attached between the thrust bearing and lock washer.

2. Oil line machined for the triple bearings was plugged.
   Through additive Rc3/8 machining on the oil line, R/3/8 plug [42-2] is attached.

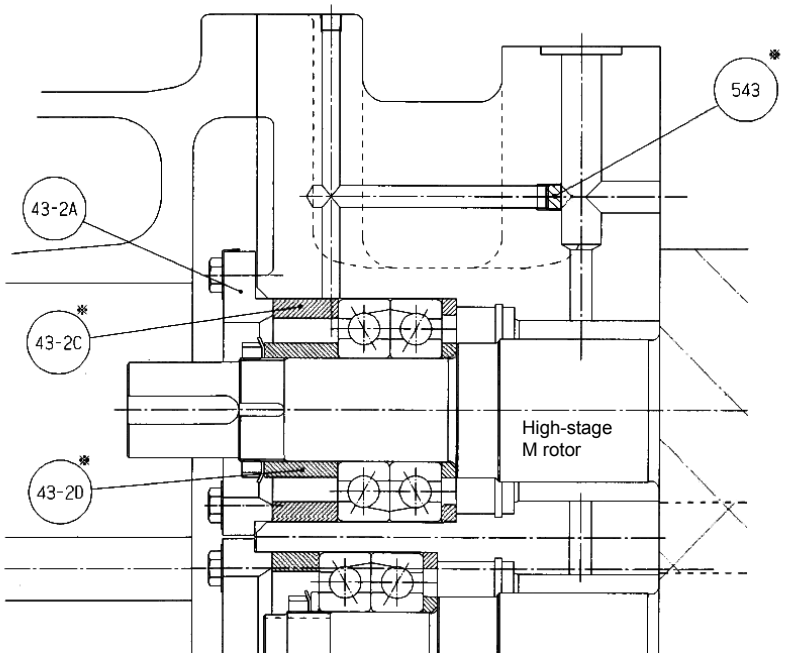


Figure 5-14 Modifications that Accompany Triple →Twin Type Modification in Thrust Bearings

a) Remove the lock nut [39-2] that has been loosened.
   Then, remove the torsional slip washer [237-2] and lock washer [40-2].

b) Remove bearing gland D [43-2D] from M rotor and thrust bearing washer [250-2] from F rotor.

c) 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 aluminum 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 [38-2] to hook and pull out the bearing. In this way, the bearing can be easily removed.

Photo 047 Removing Bearing Gland D

Influenced by the oil surface tension working on the thrust bearing side face, all the thrust bearings are removed in one united body. If they are removed separately, put them in order to prevent them from being mixed up at recovery.

g) Attached to the inside of the thrust bearing are; thrust bearing outer race spacer [41-2] for the bearing head-side outer race, and the thrust bearing alignment spacer [42-2] for the rotor-side inner race. Stamp mark 'M' is engraved on the M rotor. Stamp mark 'F' is engraved on the F rotor (Photo 048).
The thrust bearing glands, thrust bearing washers, thrust bearings, thrust bearing outer race spacers and thrust bearing alignment spacers, which have been removed, should be divided into two groups (M rotor group and F rotor group) (Photo 049).
Incorrect assembly can change the dimensions of the end clearance, which may deteriorate the performance or cause a galling accident due to the heat generated by being too narrow between sliding surfaces, for example.

Photo 048 Stamp Marks on Spacer (Outer) and Alignment Spacer (Inner)

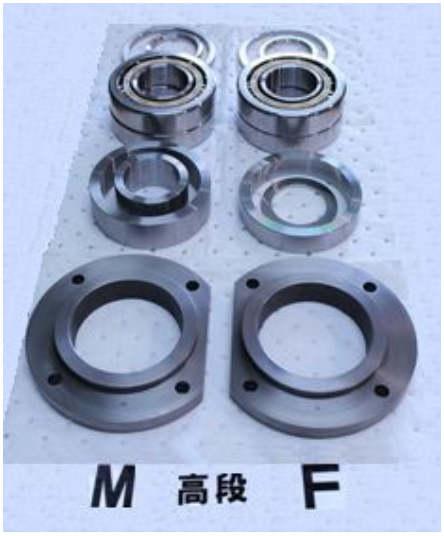


Photo 049

5.4.13.2 Disassembly of Low-stage Thrust Bearings

【POINT】

Differently from the high-stage side, thrust bearing outer race spacers are not used on the low-stage side thrust bearings of the 2520**C model. The role of thrust bearing outer race spacer is to retain the thrust bearing outer race (to secure width). However, as 250 or enhanced models can retain the outer race by means of the case (bearing head), they need not to use thrust bearing outer race spacer.

a) Remove the hexagon head bolts [45-1] fastening the thrust bearing gland [43-1].
A conical spring washer [46-1] is attached. Be careful not to get it lost.

b) In the same way as on the high-stage side, unbend the rotation stopper tooth of the lock washer [40-1] and loosen the locknut [39-1], to remove the lock washer, torsional slip washer [237-1] and thrust bearing washer [250-1].

c) In the same way as on the high-stage side, remove the thrust bearing [38-1] and thrust bearing alignment spacer [42-1].

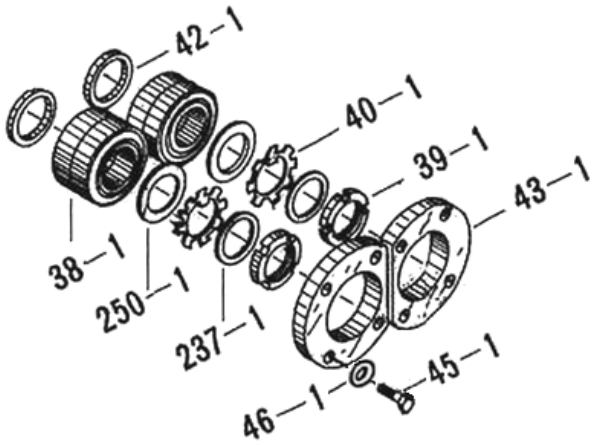


Figure 5-15 Low-stage Thrust Bearing Block

5.4.13.3 Inspection (High-stage/Low-stage)

a) After thoroughly cleaning the thrust bearing, if the entire balls of the bearing are shiny, there is no problem. If the ball surfaces are dull or have striation patterns on, the thrust bearing is defective.

b) Rotate the outer race while supporting the inner race with your hand. If you feel an abnormal vibration, the ball contact surface of the inner/outer race or the balls themselves are defective. So make a thorough check. Dirt that entered during removal can, however small it is, sometimes make you feel bumping sensation. In such case, blow off the dirt with high pressure air after cleaning.
If the problem persists, be sure to replace the part with new one.

c) If the outer and/or inner races come off easily, they are worn. They are out of use.

d) Moving the cleaned bearing with your hand will make a rattling sound. This is due to the gap between the balls and the retainer. This sound will disappear if you align the bearing flat.
If you lubricate the bearing after cleaned, it will emit no such sound. If the sound should still persist, the bearing should be checked for details.

e) If any abnormality is seen in the thrust bearing in the above inspection, replace with new ones.
In addition, carefully check the reason whether due to mere aging or any problem with the operating condition and/or lubricating mechanism.

   In case of ball bearing which is attached to the compressor with operating hours of not less than 20,000, it is recommended to replace the bearing with a new one even if no defect is found through the above inspection, to ensure operating safety until the next disassembly and inspection.

CAUTION

- **As a bearing is a combination of specifically designed parts, even if a bearing with the same number is found in a bearing manufacturer's catalog, the accuracy or material may not be identical. When replacing a part, be sure to use a genuine MYCOM part. Parts other than genuine parts are not covered by the warranty.**

5.4.14 High-stage Rotors and Main Rotor Casing

5.4.14.1 Disassembly

a) 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 you pull out the M (F) rotor without rotating it, the F (M) rotor will also be pulled out simultaneously.**

b) Attach a lifting tool that will not damage the rotor surface, such as nylon belt, around the outer circumference of the rotor, so that it can be lifted up and then pull out the remaining part of the rotor, with the shaft held slightly up.

Photo 050 Pulling out F Rotor

Photo 051 Lifting up F Rotor

Photo 052 Pulling out M Rotor

Photo 053 Lifting up M Rotor

c) Do not place the pulled-out rotor directly on the floor. Cover the floor with wooden pieces which can serve as a cushion or place its shaft on V-blocks to prevent damage to the outer circumference (Photo 054, Photo 056).

Photo 054

5.4.14.2 Inspection

a) No abnormality should be observed on the surface of the rotor lobes under normal operations. Regarding the contact surface of the teeth, 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 sand paper 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 sand papers 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 rotate. If any trace of rotation is seen, correct the problem. Depending on the degree of the rotation trace, it might be necessary to replace the rotors with new ones.

e) Check the inner surface of the main rotor casing.
   There is a narrow clearance between the periphery of the rotor and the main rotor casing. Any slight flaw present on the tip of the rotor teeth or on the inner surface of the main 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 teeth have hit the inner surface of the main rotor casing, it is an abnormal condition. In such a case, the possible cause is that the main bearing and/or side 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.

5.4.15 Low-stage Rotors and Main Rotor Casing

Follow the same disassembling procedure as for the high-stage machine. The work should be very carefully performed as the low-stage rotors are heavier than the high-stage rotors.

Inspect the low-stage side in the same way as for the high-stage side. As a mechanical seal is attached to the low-stage M rotor, take special care not to damage its shaft. It is recommended to apply a protection tape on the shaft surface (see the photo below).

Photo 055 Removing Low-stage M Rotor

Photo 056

5.4.16 High-stage Bearing Head and Main Bearings

On the rotor mounting side of the bearing head [11-2], there is a gas discharge port as determined by the operating conditions of the compressor. This discharge port affects the performance of the compressor.
In addition, the bearing head has the main bearing that supports one end of the rotor.

5.4.16.1 Disassembly

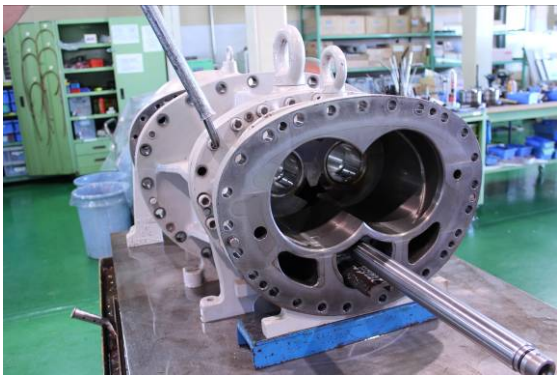


Photo 057 Loosening Bolts

a) Remove all the hexagon socket head cap screws [2-2] that fasten the bearing head and main rotor casing. Place a support like a rectangular block under the rotor casing.

b) Push the bearing head with jacking screws evenly. When a small gap is created, peel up the gasket by using a scraper.
When the alignment pins are disengaged, the bearing head and rotor casing are separated.

c) The main bearing [27-2] is lightly press-fit to the bearing head. To take out the main bearing, remove the snap ring [29-2] by using internal snap ring pliers. Then, either use a plastic block or other suitable element to push the bearing from the rotor side or use a special tool such as shown in Photo 059 to pull out the bearing. For the details of the special tool, refer to Section 5.5.2 in this manual.

Photo 058 Removing Snap ring

Photo 059 Removing Main Bearing

d) The unloader slide valve can be removed as an assembly by pulling it out from the bearing head side. If no specific abnormality is found, no further disassembly is required.

e) The guide block stem [88-2] is screwed from bottom of the main rotor casing, and the guide block [87-2] is engaged from the top.

To replace the O-rings [89-2], remove the guide block stem.

5.4.16.2 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 surface 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.

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 (color check) to determine if it can be used or not.

c) With the unloader slide valve mounted in position, check a step difference from the main rotor casing. Normally, the slide valve is positioned lower than the surface of the main rotor casing.
If the top surface of the slide valve has a trace of hitting the rotor, the probable cause is that the slide valve is worn or the rotor shaft/bearing is worn. Please contact our local sales offices or service centers.

d) Check for defect in the guide pin [68-2] at the tip end of the unloader push rod [67-2] which engages with the indicator cam [77-2].

5.4.17 Low-stage Bearing Head and Main Bearings

5.4.17.1 Disassembly

a) Remove all the hexagon socket head cap screws [2-1].

b) Hammer the alignment pin [3-1] from the bearing head side into the main rotor casing side.

c) Separate the bearing head and main rotor casing by using the jacking screw holes in the main rotor casing flange.

d) Separate them carefully along the shaft axis, as the unloader push rod [67-1] is engaged.

e) The main bearing [27-1] can be easily pulled out by removing the snap ring [29-1] and then lightly tapping it from the rotor side via a pad. Otherwise, use a special tool to pull it out.

f) Remove the slide valve as an assembly, using the same procedure as for the high-stage unit. Carefully perform the work, as you are handling a heavy object.

Photo 060 Removing Snap ring

Photo 061 Removing Slide Valve Assembly

5.4.17.2 Inspection

Perform inspection in the same way as for the high-stage.

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.**

Start the assembly process after finishing disassembly and inspection.

First, read again Section 5.1 "Precautions for Maintenance and Inspection" in this Chapter 5.

Recheck the purchased replacement parts before assembly.

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

The reassembly 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 washing agent (e.g., kerosene, parts cleaner) 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.

Because the assembly procedure is mostly similar between the high-stage and low-stage sides, the following sections provide explanations that are commonly used for both stages. For this purpose, the part number given in the common explanations will omit the distinction between high-stage and low-stage by means of a hyphenated suffix (the suffix of [**-1] for low-stage and [**-2] for high-stage part number will be omitted).

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

Table 5-7 Standard Tightening Torque for Hexagon Socket Head Cap Screws

Torque unit	M6	M8	M10	M12	M14	M16	M20	M24
N·m	10	25	50	90	140	240	450	750
kgf·cm	100	250	500	900	1400	2400	4500	7500

Tighten each hexagon socket head cap screw by referring to the torque shown in the above table.

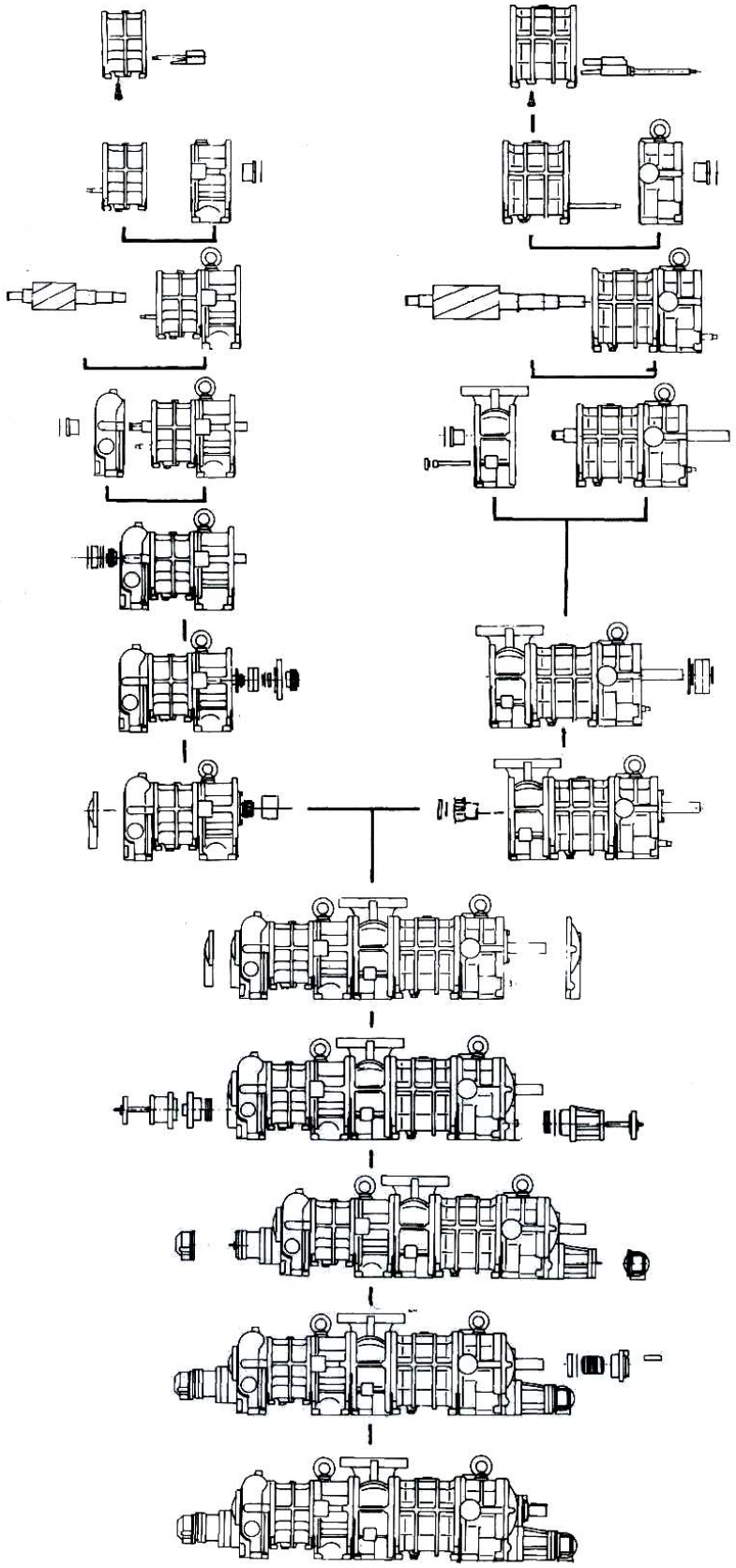


Figure 5-16 Illustrated Assembly Sequence (Example)

5.5.1 Unloader Slide Valve and Guide Block

a) Attach two O-rings [89] on the guide block stem [88] and screw in the guide block stem securely from the bottom of the casing. Then, mount the guide block [87] in the casing.

b) If the slide valve assembly has been disassembled, first make sure that the alignment position between the slide valves [54] and [55] is accurately reproduced and then tighten the hexagon socket head cap screws [58] with spring washers [267] at the specified torque. The outer diameter of the spring washers used here is less than normal spring washers for hexagon socket head cap screws. So, be careful not to mix up with other washers.

c) After using a grind stone or fine sand paper to lightly finish the circumference of the unloader slide valve assembly, mount the assembly in the main rotor casing. Then, slowly push-in the push rod while aligning the groove of the slide valve with the guide block.

d) After it is assembled, hold the unloader push rod and move it for several times to check that it moves smoothly. Then, carefully check the joint with the main rotor casing that there is no step between them.
If there is a step, check it by reversing the orientation of the guide block first. If the step is still present, it should be due to imperfect assembling, and it must be reassembled.

◆ A slight step between the surfaces of the unloader slide valve and the main rotor casing is allowed if the slide valve side is lower.

CAUTION

- **If the unloader slide valve is higher than the main rotor casing, there is a problem in assembly. Do not leave the problem as it is; be sure to reassemble the components properly. If used without being reassembled correctly, the outer periphery of the rotor may hit against the slide valve, which will cause a severe damage.**

e) The low-stage slide valve assembly has an oil injection pipe guide [168] on the opposite side of the push rod. Do not forget to install the O-ring [59] (Photo 063).

Photo 062 Installing Slide Valve (Low-stage)

Photo 063 O-ring for Oil Injection Pipe Guide

5.5.2 Bearing Head and Main Bearings

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

a) Position the notch of the main bearing in such a way that it aligns with the spring pin [14] which is screwed into the bearing head [11]. After that, place a cushioning material on the bearing and hit it. Use of a jig like the guide rod shown in Photo 064 is helpful.

b) When the bearing is inserted, attach a 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 (Photo 065).

Photo 064

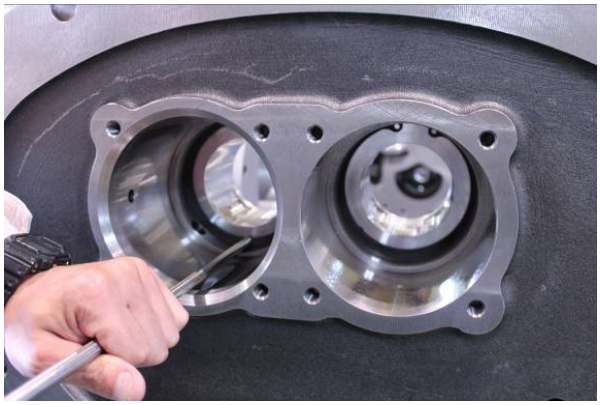


Photo 065

【POINT】

To press fit the bearing, create a plastic spacer with a brim (guard) which fits in the inner diameter of the bearing and hit the spacer inside using a brimmed jig weight (as shown in Figure 5-17).

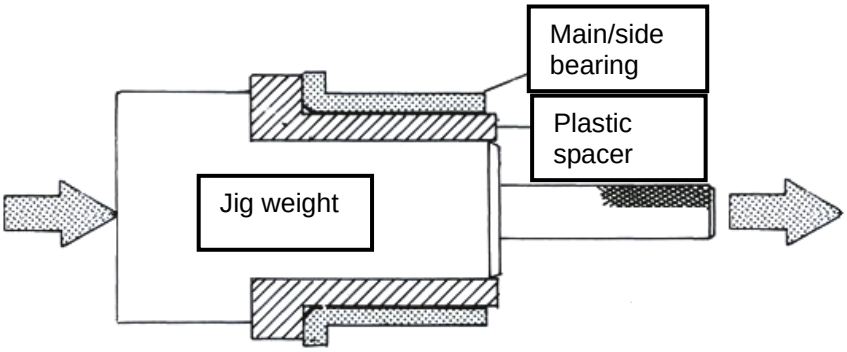


Figure 5-17 Jig (example) for Press fitting Bearing Installation

5.5.3 Bearing Head and Main Rotor Casing

CAUTION

- **Since the bearing head gasket [12] is not formed symmetric laterally, pay attention to the installation direction. If it is not oriented correctly, the oil route provided in the casing may be blocked.**
- **If you place the bearing head gasket by just hanging it on the stud bolts, the gasket will protrude into the inside of the main 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.**

a) In case of assembling the low-stage, fit the unloader push rod [67] in the hole of bearing head [11]. Then, slide the bearing head or main rotor casing [1] to let them mated together (crane is used in assembly on high-stage as shown in Photo 066).

b) Lightly tighten two screws [2]. Next, drive in the alignment pin [3] to fix a position (Photo 067).

Photo 066

Photo 067

c) After fastening the screws [2], move the slide valve forward and backward to check that there is no problem.

d) Check that the bearing head gasket is not protruding over the inner surface of the casing.

e) As the high-stage main rotor casing features a low overall height, its shaft does not align with the center of the bearing head. Therefore, either use a pedestal as used in the disassembly process or lift the main rotor casing using a crane or other device to align the centers.

The assembly procedure after mating the both casing flanges is same as the high-stage.

f) The bolts on the lower side cannot be fastened on the work bench. Fasten them all together later.

CAUTION

- **Be sure to check for possible protrusion of the gasket after the bearing head and main rotor casing have been assembled together. If you forget to check it out, it may lead to a measurement error in the end clearance adjustment process, as the gasket may be placed in between the rotor end and the bearing head surface. Furthermore, if the compressor is operated after the end clearance is erroneously adjusted and fixed in this condition, it may compromise the performance.**

5.5.4 Installing Rotors

Note on the rotor profile of 2520C**

The rotor profile has been changed from the A profile to O profile from the production in November 1993.
The most significant change is the existence or nonexistence of the lobe tip edges; profile A has these edges but profile O does not.

Make the rotors 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 and F rotors have unique engagement positions which are indicated by engravings.

To facilitate mating position alignment when installing the rotor to the main rotor casing, a number is engraved on the discharge-side lobe peak of the M rotor and the suction-side lobe peak of the F rotor, respectively.

Photo 068 Engraved mark indicating M rotor mating position

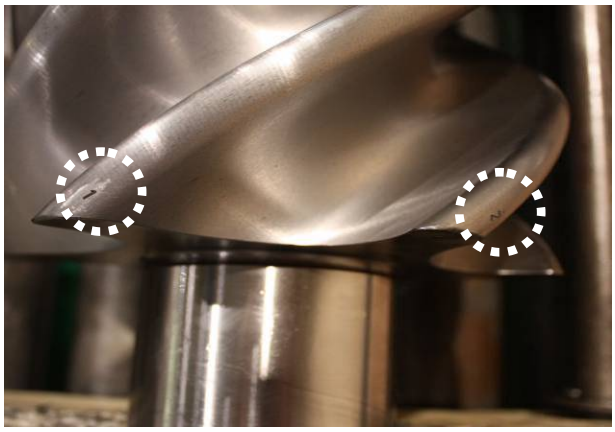


Photo 069 Engraved mark indicating F rotor mating position

a) Sufficiently lubricate the main bearing inside the bearing head as well as the bearing portion of the rotor shaft.

b) 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 as shown in the photo to the right.

c) Regardless of which rotor is installed first, engage the M rotor lobe, which has engraved mark 1, between the F rotor lobes having engraved marks 1 and 2. As factors, such as mating of lobes, balance, etc., should be considered, be sure to mate the lobe profiles as instructed.

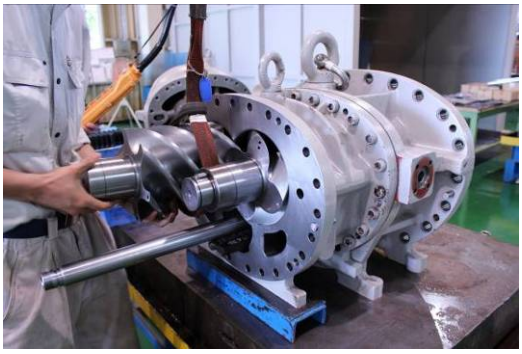


Photo 070 Attaching F rotor after M rotor

CAUTION
● **In this state, the rotor's outer periphery is in contact with the main rotor casing. Do not rotate it much. Letting it rotate may cause its lobe tips to wear.**

5.5.5 Suction Cover and Side Bearings

a) The side bearing (O-ring type) [28] is, like the main bearing, dimensioned in such a way that it is lightly press fit to the suction cover. Align the notch of the bearing with the spring pin [8] which is screwed into the suction cover, and press fit the bearing (Photo 071, 073). During the press fit, check the position of the pin and the notch. If the position is misaligned, pull the bearing out once and then press fit it again.

b) After the bearing has been installed, install 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 (Photo 072, 074).

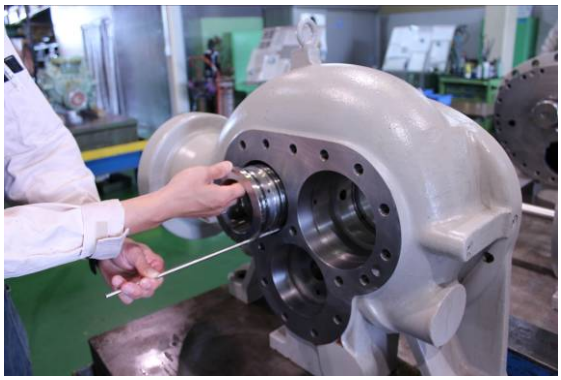


Photo 071 (High-stage Side)

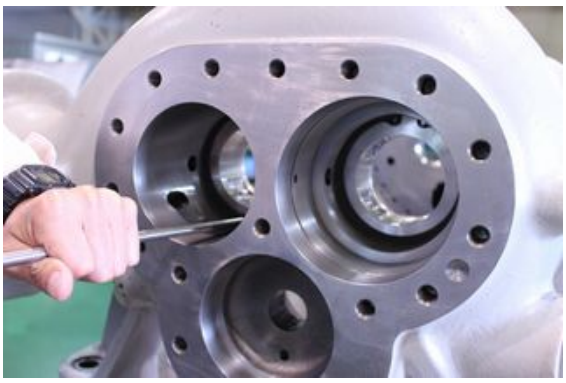


Photo 072 (High-stage Side)

Photo 073 (Low-stage Side)

Photo 074 (Low-stage Side)

5.5.6 Balance Piston Sleeve

The high-stage suction cover shall be further installed with the balance piston sleeve..

a) When attaching balance piston sleeve [33] on the 2520**C model, O-ring spacer and a snap ring for the spacer are not needed. Attach the O-ring [35] first (Photo 073), and then install the balance piston sleeve [33] (Photo 074).
Place the chamfered part of the balance piston sleeve on the side of the O-ring that has been inserted first. Align the notch of the balance piston sleeve with the rotation stopper and oil inlet port in the high-stage suction cover.

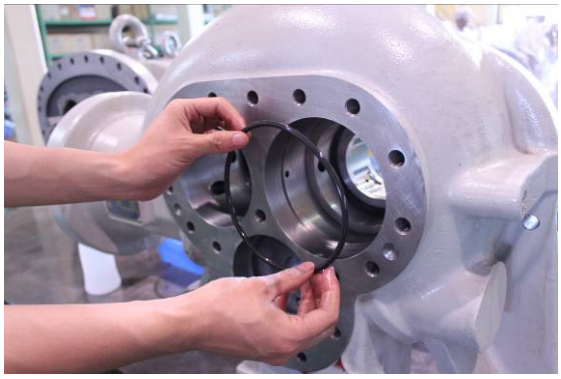


Photo 073

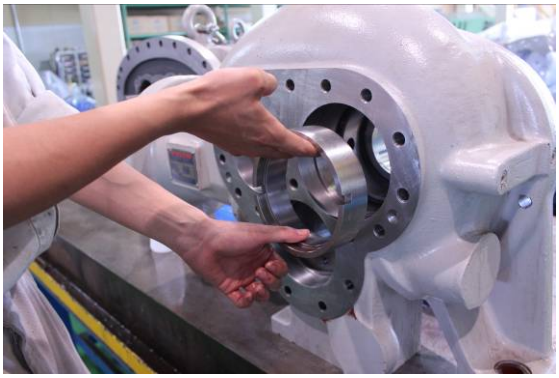


Photo 074

b) Thread screws [34] for stopping rotation of balance piston sleeve, and then insert fixing screws from opposite side (F rotor side) (Photo 075).

c) Attach the snap ring [37] for retaining the balance piston sleeve.
As the O-ring for the piston sleeve is elastic, it prevents the snap ring to fit in the groove smoothly. So lightly push its side face with a tool like guide rod or tap it with a hammer, so that it fits in the groove completely (Photo 076)

Photo 075

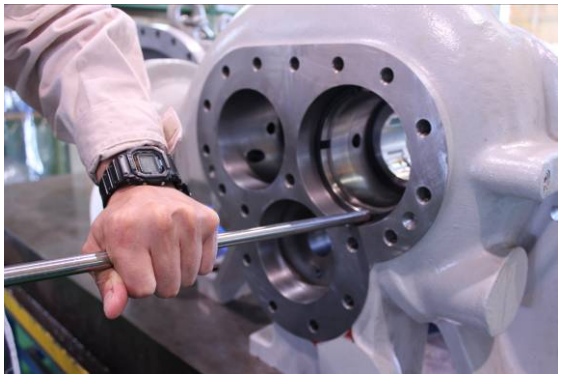


Photo 076

d) Attach the O-ring [73] on the unloader push rod [67] (Photo 077).

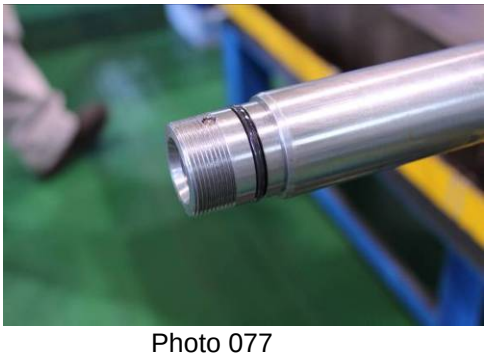


Photo 077

5.5.7 Installing Suction Cover

a) On both high-stage and low-stage, the suction cover gaskets [6] are not formed symmetric laterally. Apply oil on both sides of the gasket, and attach it to the main rotor casing side while carefully checking the position of oil supply holes.

Photo 078 (High-stage Side)

Photo 079 (Low-stage Side)

b) On the high-stage, pass the unloader push rod through the hole on the lower area of the suction cover.
Slide the suction cover [5] in parallel with the rotor shaft, or push it while lifting it with lifting tool (as shown in Photos 080 and 081), to align the side bearing with the rotor shaft. Be careful not to damage the inner surface of the side bearings by hitting the rotor shaft.
On the low-stage side, the unloader push rod is protruding to the bearing head side. So pay attention to the tip end of the rotor shaft during this work.

Photo 080 (High-stage)

Photo 081 (Low-stage)

c) When the suction cover is pushed until it contacts the flange surface, fasten several bolts [2] lightly.

Photo 082 (High-stage)

Photo 083 (Low-stage)

d) Drive two alignment pins [3] into the suction cover for positioning. Then, fasten the screws evenly with specified torque. The bolts (approximately 6 pcs) on the lower side should be fastened during final assembly, placed on the special stand which was used during disassembly.

Photo 084 (High-stage)

Photo 085 (Low-stage)

e) On both high-stage and low-stage, move the unloader push rod forward and backward with your hand, and check that it is working normally.

f) Rotate the M rotor shaft with your hand, and check the rotor mating condition.
Also check that a play in an axial direction exists (rotor moves in the direction of axis).

g) On the low-stage, attach the O-ring [86] to the oil injection pipe [85] and then push it into the suction cover (Photo 086).
After that, fasten it by using the oil injection pipe retainer [164] attached with O-ring [165].

Photo 086

Photo 087

Photo 088

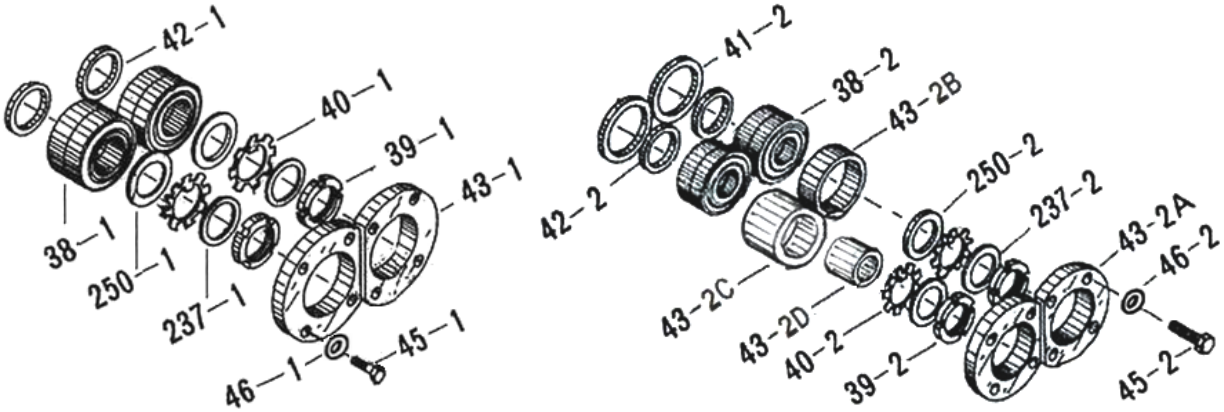
h) On the high-stage, install the balance piston [30] (Photo 089). By using external snap ring pliers, attach the snap ring [32] for securing the balance piston (Photo 090). Check that is fits well in the groove (Photo 091).

Photo 089

Photo 090

Photo 091

5.5.8 Thrust Bearing Block



【Low-stage】 【High-stage】

Figure 5-18 Thrust Bearing Block

Table 5-8 Parts List of Thrust Bearing Block

P/N	Part Name	Qty.	
		Low-stage	High-stage
41-2	Thrust Bearing Outer Race Spacer (2)	-	2
42-1, 42-2	Thrust Bearing Alignment Spacer (1), (2)	2	2
38-1, 38-2	Thrust Bearing (1), (2)	2	2
43-2B	Thrust Bearing Gland (2) B	-	1
43-2C	Thrust Bearing Gland (2) C	-	1
43-2D	Thrust Bearing Gland (2) D	-	1
250-1, 250-2	Thrust Bearing Washer (1), (2)	2	1 (F rotor side)
40-1, 40-2	Lock Washer (1) AW17, (2) AW13	2	2
237-1, 237-2	Torsional Slip Washer (1), (2)	2	2
39-1, 39-2	Lock Nut (1) AN17, (2) AN13	2	2
43-1, 43-2A	Thrust Bearing Gland (1), (2) A	2	2
46-1, 46-2	Conical Spring Washer (1), (2)	8	8
45-1, 45-2	Hexagon Head Screw (1), (2)	8	8

CAUTION

- **Replace torsional slip washer [237] and lock washer [39] with new ones.**
- **When installing the disassembled thrust bearing as it is, check the M (male)/F (female) engravings on the thrust bearing alignment spacer and thrust bearing outer race spacer (high-stage only).**
  Then, assemble them in the same way as before disassembly. This is essential to control the end clearance of the rotor discharge side.
- **Even if the same bearings are reassembled correctly, small pieces of part or dirt if caught between the outer race spacer and alignment spacer can cause dimensions to become incorrect.**
- **Regarding the direction of thrust bearing assembly, there may or may not be a V-shaped mark for assembly on the outer periphery of the bearing. In any case follow the instructions below accordingly.**

The procedure for assembling this block is described in Figure 5-18. The important points are explained below.

a) Check marks M and F engraved on the thrust bearing alignment spacer and thrust bearing outer race spacer (high-stage only), and then assemble in the same way as before disassembly.

   The thrust bearing alignment spacer should be attached in the predetermined direction; attach the largely chamfered part of the spacer on the inner machine side, and its limitedly chamfered part to the thrust bearing side.

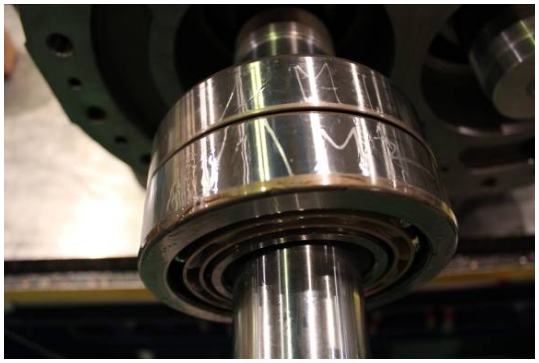


Photo 092

b) If there is a V-shaped mark for assembly on the outer periphery of the thrust bearing, assemble with the pointed end of the mark on the inner side of the machine, as there is a slight directional difference that affects end clearance adjustment.

   If there is no V-shaped mark, assembly direction does not affect end clearance adjustment. However, to clarify the difference between the inner side and outer side of the machine, assemble the thrust bearing with the bearing number engravings on the outer side. Then, put down a V-shaped mark on the side which is to be attached to the inner side of the machine, by using blue whetstone (Photo 092).

c) On the high-stage side, after attaching the thrust bearing, attach the thrust bearing gland B, thrust washer, lock washer and torsional slip washer on the F rotor. Attach thrust bearing glands C and D, lock washer and torsional slip washer on the M rotor. Fasten the lock nut with the specified torque or tightening angle range (see "7.3 Tightening Torques for Bolts and Nuts" in this manual), so that the inner race of the thrust bearing is fit in the rotor shaft (Photo 093).
   On the low-stage side, attach the thrust washer, lock washer and torsional slip washer on both the male and F rotors. Fasten the lock nut in the same way as for the high-stage, so that the inner race of the thrust bearing is fit in the rotor shaft (Photo 094).

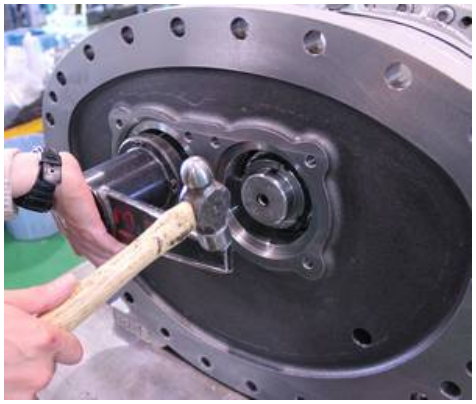


Photo 093 (High-stage)

Photo 094 (Low-stage)

【POINT】

Tightening the lock nut while keeping the setting position between the lock nut wrench hooks and the lock nut grooves 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 grooves about four times when fastening the lock nut.

d) Turn the M rotor shaft by hand, to make sure that rotation of rotors is smooth.

CAUTION

- **Since the inner race of the thrust bearing is clearance-fitted for ease of access at the assembly site and is secured by the tightening force of the nut alone, the tightening work is very important.**
- **If the thrust bearing has been replaced, the difference between the bearing inner race and outer race surfaces is different even when it is within standard values. Therefore, if the thrust bearing alignment spacer hitherto used lacks required thickness, fully tightening the nut from the start may lead to a noticeable reduction in the life of bearing, due to a lack of end clearance between the rotor and the bearing head discharge end face, and also due to indentations on the contact surface formed by ball pressure. To avoid this, rotate the rotor while tightening the locknut lightly. Tighten the inner race, while checking that there is enough clearance for the outer race. If the rotor does not rotate smoothly, the thickness of the thrust bearing alignment spacer is insufficient.**

5.5.8.1 End Clearance Measurement

At this point (i.e., after the thrust bearing block has been fully assembled), measure the clearance between the bearing head end face and the rotor end face on the discharge side. This clearance is called as the end clearance.

In particular, when the thrust bearing has been replaced, the end clearance must be measured. Even when the same bearing is used, measure the end clearance for confirmation. If the clearance does not fall within the specified range shown in Table 5-9, adjust the clearance as necessary.

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

Model of the Compressor	High-stage	Low-stage		
		S	M	L
2520**C	0.05 – 0.07	0.40 – 0.44	0.45 – 0.49	0.50 – 0.54

■ The same values apply to A-profile rotor and O-profile rotor.

a) Push the rotor to the discharge side, while the thrust bearing inner race is secured to the rotor shaft. Push the rotor from the suction side to the discharge side by using a jig (Teflon block or the like).

b) When the rotor has been pushed to the discharge side, prepare to attach the thrust bearing gland. Attach a dial gauge on the suction side axial end of the rotor, and match the needle (pointer) to 0 (Photo 095, 096).

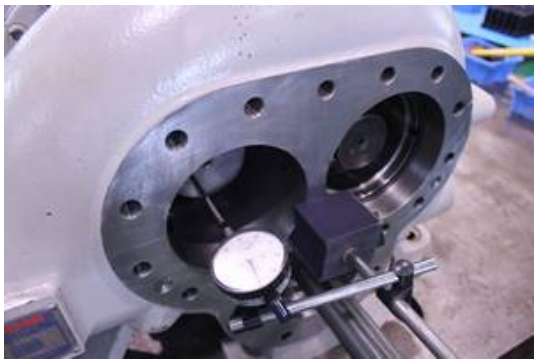


Photo 095 (High-stage)

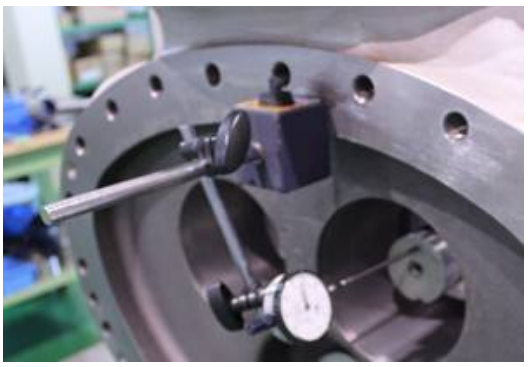


Photo 096 (Low-stage)

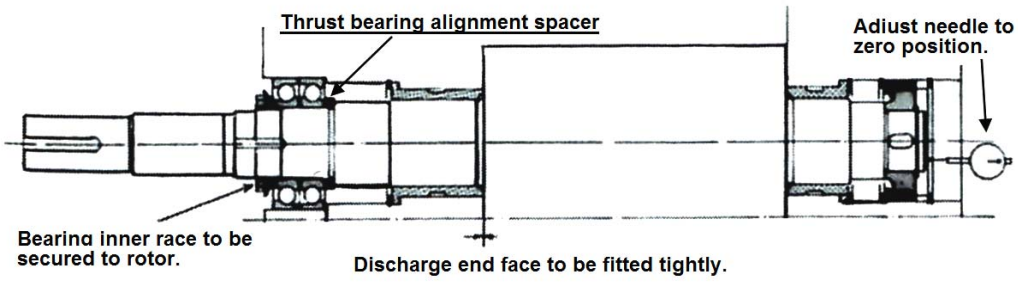


Figure 5-19 End Clearance Measurement Preparation

c) Fasten the bearing gland by tightening the four screws (without conical spring washer inserted) evenly and gradually to the specified torque (Photo 097). Tightening each screw to the specified torque at once will lead to uneven tightening. Tighten each screw in several steps. Then, read the dial gauge measurement. This value is 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).

Table 5-10 Tightening Torques for Thrust Bearing Gland

Model		Tightening Torque	
		N·m	kgf·cm
2520**C	High-stage	50	500
	Low-stage	60	600

Photo 097

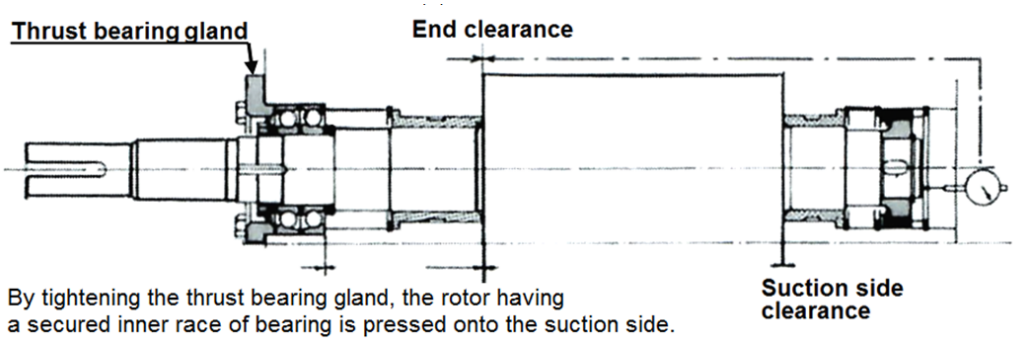


Figure 5-20 End Clearance Measurement

5.5.8.2 Procedure for End Clearance Adjustment

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

As end clearance is insufficient, insert shim material (thrust adjustment liner) of required thickness (difference in thickness from the specified value) between the thrust bearing alignment spacer [42] and thrust bearing inner race.

Note: The thrust adjustment liner is not shown in the sectional view and development view, but available from us. Place an order together with a model name.

On the high-stage where thrust bearing outer race spacer [41] is used, 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 saucer by using a micrometer, and check that the thickness is even.

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

As the end clearance is excessive, remove shim material (thrust adjustment liner) of a thickness equal to the difference between the measured value and the specified value if the shim material is used between thrust bearing alignment spacer and thrust bearing inner race.

Or if the shim material is not used between thrust bearing alignment spacer and thrust bearing inner race, or even if used but insufficient thickness, grind the surface of thrust bearing alignment spacer [42] by the difference between the measured value and the specified value or ask professional service vendors to do so.
After grinding the surface, measure the whole circumference of the spacer by using a micrometer, and check that the thickness is even.

(3) Rotor runout measurement (Low-stage M rotor)

When the end clearance has been adjusted to within the specified range, place a dial gauge probe on the mechanical seal attachment portion of the low-stage M rotor shaft. Measure runout by turning the rotor shaft.
The tolerance for runout is 0.03 mm or less for all models.

Runout occurs when the thrust bearing alignment spacer and thrust bearing spacer are not parallel or when the thrust bearing mark is not aligned. And it occurs if fastening the lock nut performed without changing the position of the lock nut wrench (i.e., the uneven fastening of the lock nut).
Moreover, small particles of dirt trapped between parts may cause excessive runout.

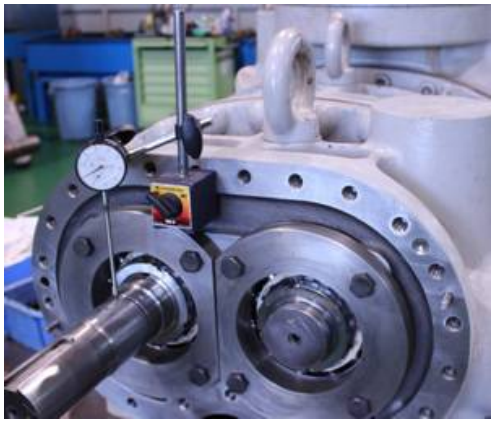


Photo 098 Measurement of Runout

If runout is over the tolerance, even if the end clearance is within the specified range, disassemble the assembly and adjust the relative positions of the outer race spacer, alignment spacer and thrust bearing. This is important because it affects the life and performance of the mechanical seal.

5.5.8.3 Tightening after End Clearance Adjustment

a) Remove one of the hexagon bolts fastening the thrust bearing gland [43], insert the conical spring washer [46], tighten the bolt at the specified torque, and repeat this procedure for all other hexagon head bolts.

b) Bend the tooth of the lock washer to set it in the notch of the lock nut fastening the inner race of the thrust bearing to prevent loosening (photos 099 and 100).

These steps a) and b) may be performed in reverse order.

Photo 099 (High-stage)

Photo 100 (Low-stage)

【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 low-stage bearing cover inner face.

In case of overhauling the compressor produced before October, 2011, do not change the lock washer [46] to the conical spring washer.

5.5.9 Balance Piston Cover and High-stage Unloader Cylinder

a) Install the unloader cylinder guide A [278A] to the high-stage suction cover [5-2] (Photo 101). Lubricate the both surfaces of the balance piston cover gasket [23], and then attach the gasket to the flange surface (Photo 102).

b) Attach the O-ring [279] to the O-ring groove provided on the surface of the balance piston cover [22] where the unloader cylinder guide B [278B] is to be installed (Photo103). Be careful not to forget to attach this O-ring.

【POINT】
Due to the design modification applied in October 1996, the position where this O-ring is attached is changed from the former triangular groove on corner. Simultaneously, the low-stage bearing cover is changed likewise. See 5.5.12 in this manual.

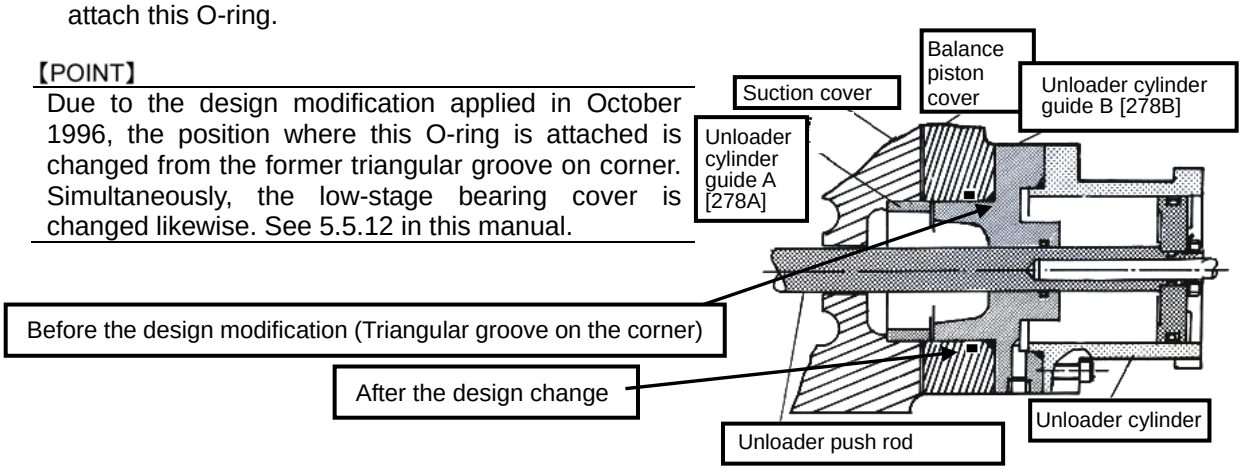


Figure 5-21 Modification of O-ring Attaching Position

Photo 101

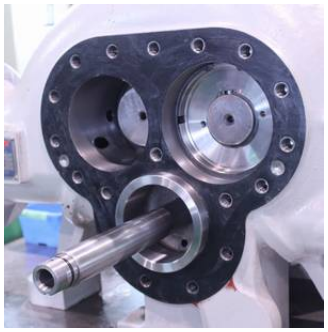


Photo 102

Photo 103

c) Install the balance piston cover [22], and tighten hexagon socket head cap screws [24] with the specified torque 240 N·m (Photo 104).

d) Attach the O-ring [65-2] to the unloader piston [64-2] without lubricating oil, and then attach the cap seal [66-2] on it. If you fold the cap seal softly by upward fold line in the circumferential direction, it will help smooth the work. Use of a small and smooth spatula-shaped tool (as shown in Photo 106) will help assemble smart.

Photo 104

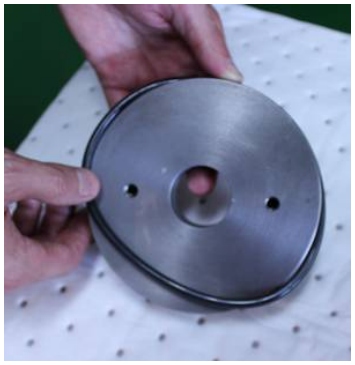


Photo 105

Photo 106

e) Install the unloader piston, which has the O-ring and cap seal attached, to the unloader cylinder [60-2]. The unloader piston has a surface which contains screw holes for eye bolts and another surface which contains no such holes. First, while exchanging these surfaces alternately several times, press the unloader piston softly with palms of your hands to the chamfered surface of the unloader cylinder, so that the cap seal is adjusted to fit to the unloader cylinder wall. Finally, as shown in Photo 107, attach the unloader piston with its surface having screw holes set face-to-face with the unloader cover. After assembly, check that the cap seal is not broken or pinched.

Photo 107

f) Before attaching the unloader cylinder guide B [278B], apply liquid gasket (made from special synthetic rubber) to the flange surface where the balance piston cover is to be attached (Photo 108). This step is done because gasket cannot be placed on the flange surface where the balance piston cover is to be attached.

g) Attach unloader cylinder guide B [278B] (Photo 109).

h) Push the unloader piston into the midst of the unloader cylinder. With the unloader push rod [67-2] pulled toward you, attach the unloader cylinder. Then, tighten the unloader cylinder together with unloader cylinder guide B, onto the balance piston cover by using nine hexagon socket head cap screws [61-2] and with specified torque 90 N·m (Photo 110).

Photo 108

Photo 109

Photo 110

i) Attach the lock washer [70-2] and lock nut [69-2] to the unloader push rod, and fasten the lock nut with the specified torque of 120 N·m (Photo 111).
To stop rotation, bend the lock washer tooth aligned with the notch of the lock nut (Photo 112).

j) Lastly, check the movement of the piston by using an eye bolt (Photo 113).

Photo 111

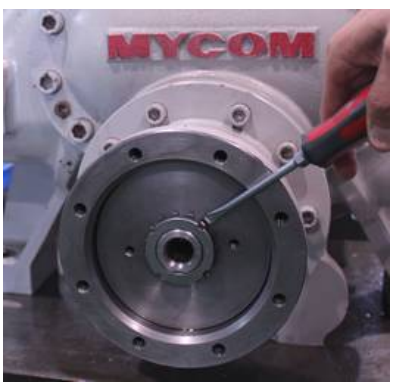


Photo 112

Photo 113

5.5.10 Bearing Cover

a) Before installing the bearing cover [16], confirm once again that the lock washer teeth of the thrust bearing part have been bent and that all the hexagon head screws for holding the thrust bearing gland have conical spring washer inserted.

b) For ensuring the safety, screw two stud bolts into the upper screw holes on the flange surface of the low-stage bearing head [11-1].

c) Apply oil to the bearing head flange surface and the both surfaces of the bearing cover gasket (1) [17-1]. Hang them on those stud bolts in such that they are put on the flange surface (Photo 114).

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 shaft seal block.

d) Attach the O-ring [197] to the area of bearing cover [16] where the unloader push rod [67] goes through (Photo 115).

Photo 114

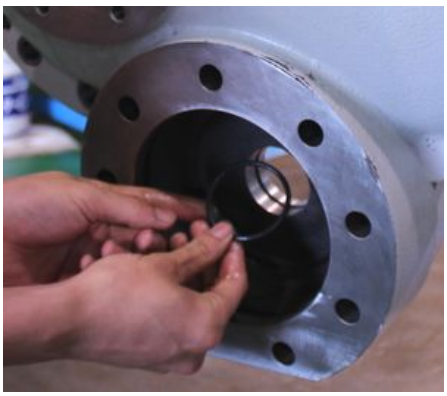


Photo 115

e) Attach lifting apparatus to the eye bolt of the bearing cover. Install the bearing cover taking care not to let it touch the M rotor shaft or push rod. After it is hung on the stud bolts, the lifting apparatus can be removed (Photo 116).

f) Align the alignment pin with the hole. Attach the bearing cover by gently tapping the flanges alternately with a soft hammer (Photo 117).

g) When the gap is narrowed to the extent that bolts can be screwed in, screw in two or three hexagon socket head cap screws [18-1]. Evenly narrow the gap further, until the flange surfaces are contacted together. Then, fasten other bolts that remain with specified torque of 240 N·m.

Photo 116

Photo 117

5.5.11 Shaft Seal Block

The BBSE (balance bellows single) type mechanical seal assembly is used as a standard shaft seal in the MYCOM standard screw compressors.

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

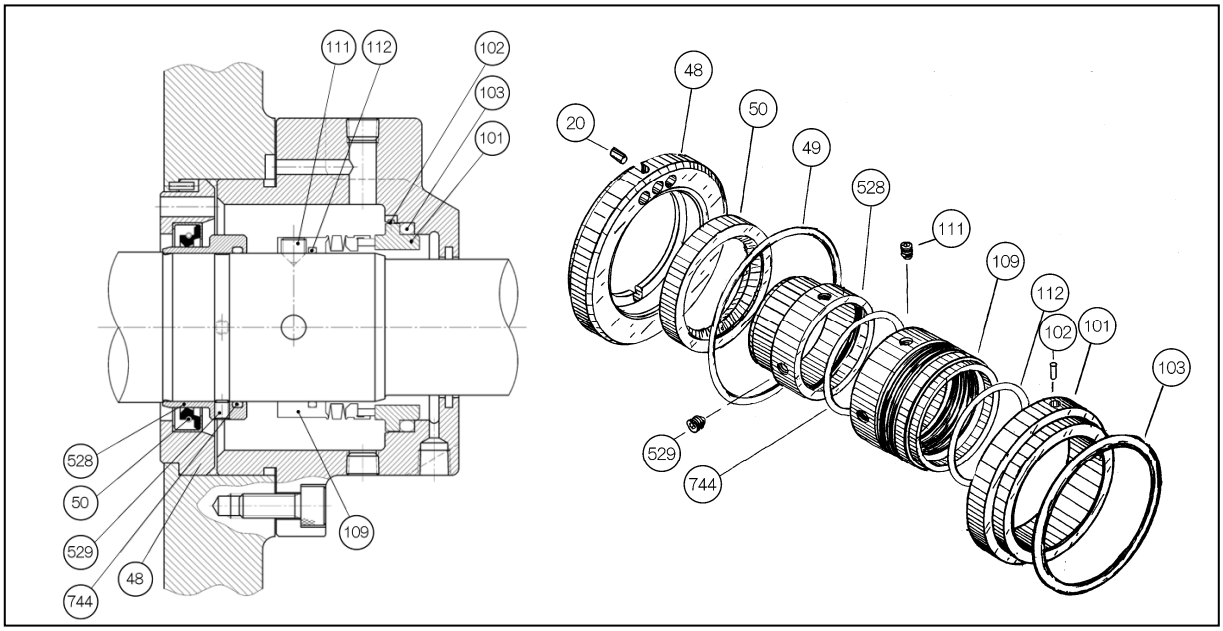


Figure 5-22 BBSE Type Mechanical Seal Assembly

a) Before assembly, clean the portion where the rotor shaft seal will be installed. In particular, check again, immediately before assembly, that the step portion where the axial seal will be mounted is free of damage.

b) Install the oil seal [50] to the seal retainer [48].
Since the design change in November 2002, the oil seal installation direction is changed from the "oil seal lip facing the atmosphere side" to the "oil seal lip facing the reverse side". The purpose of this change is to improve oil flow from inside the seal box so that the pressure will not rise too high.
Push the oil seal evenly into the retainer, while hitting it gently with a resinous material such as Teflon placed as cushioning material (Photo 118). Assemble it when it gets fully pushed in. When it gets fully pushed in, you will know by the change in the tapping sound and feel.
After assembly, check that the step formed at the boundary between the oil seal and the retainer is even. See from the opposite side, and confirm that they are evenly assembled.

c) Insert the O-ring [744] in the inner periphery of the oil seal sleeve [528], which should then be attached to the oil retainer with oil seal inserted (Photo 119).

Photo 118

Photo 119

d) Install the seal retainer, which has oil seal and sleeve attached, along the rotor shaft by using two standard eye bolts (as shown in Photo 120). At this time, ensure that the retainer's oil hole is on the upper side of the rotor shaft, and accurately align the rotation stop spring pin [20], which has been screwed to the bearing cover, with the notch of the retainer.
After the installation, check the position by slightly turning the retainer to the left and the right using the eye bolts. If the position is correct, the retainer will not rotate.

e) Secure the oil seal sleeve to the rotor shaft by using two set screws [529] (Photo 121).

Photo 120

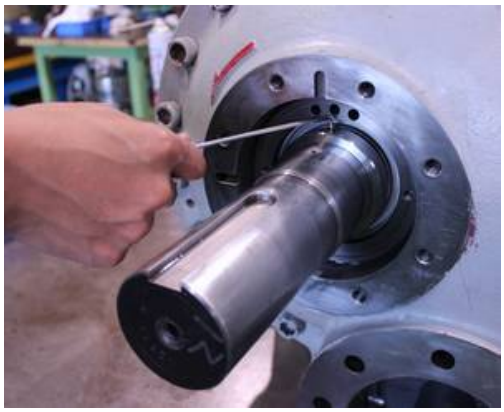


Photo 121

f) Then, insert the O-ring [49] intended for the seal retainer (Photo 122).

CAUTION

- **Take special care because workers frequently omit to insert the O-ring [49] for the seal retainer.**

g) Install the seal collar [109], which has the O-ring [112] attached to its inner periphery, to the rotor shaft. Before assembly, apply sufficient lubricating oil to the rotor shaft and wash away dust and stains. Push in the seal collar, carefully not to damage the O-ring [112] by the step on the rotor shaft (Photo 123). After installing the seal collar, push it by hand and check it's normal movement in the axial direction.

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 (Photo 124). Tightening the seal collar at other places than the countersunk holes can cause damage to the rotor shaft which can lead to leakage.

Photo 122

Photo 123

Photo 124

i) Fit the mating O-ring [103] and the mating ring [101] to the seal cover [51] (Photo 125).

j) Apply oil to the seal cover gasket [52], align the gasket oil hole with the oil hole on the seal cover flange surface, and mate them together.

* The 2520**C compressors employ the standard internal oil supply system. With this system, the bearing cover and the seal cover are connected by an oil supply hole. Oil is supplied from that oil supply hole, via the seal cover notch, along through a groove, and reaching the upper side of the seal cover, to the upper sliding surface of mechanical seal assembly.

k) Install the seal cover which has a gasket attached, in such a way that the oil drain piping of the seal cover is on the bottom side.

At this time, attach it carefully, either perpendicular to the rotor shaft or by delaying the upper side slightly, while paying attention not to cause the mating ring inside the seal cover hit against the rotor shaft (Photo 126).

m) The seal cover and the mating ring sliding surface will come into contact midway through attachment. At this moment, check the dimensions between the seal cover gasket and the bearing cover flange surface by using a taper gauge (Photo 127). This value is called "fastening margin" of the seal. It is used as a guideline when checking the sliding face pressure between the rotating ring and stationary ring of the seal.

In case of BBSE-type seal of the 2520**C, if this value is not within the range between 3 and 4 mm inclusive, measures should be taken, such as replacing mechanical seal assembly or adding another gasket. With the 2520**C compressor, the thickness of the seal cover gasket is 0.5 mm.

Photo 125

Photo 126

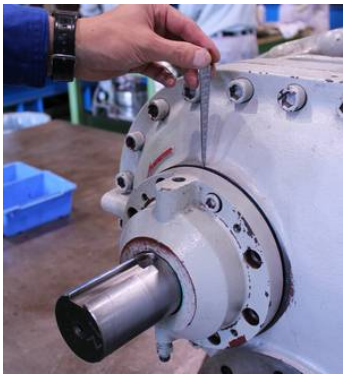


Photo 127

n) When the seal fastening margin is proper, push the seal cover firmly into the bearing cover. Since there is resiliency of the seal bellows, keep it pushed firmly and tighten the two hexagon socket head cap screws [53] (for tightening the seal cover) evenly at positions 180 degrees apart
When there is no gap between the flange surface and the gasket, tighten all the remaining screws with the specified torque (90 N·m).

o) When tightening of the seal cover is finished, remove the plug on the top of the seal cover, and supply oil approx. 400 mL into the seal cover while rotating the rotor shaft (Photo 128).

This oil refilling work is very important to maintain the airtightness in the shaft seal block when vacuuming after compressor overhauling.

Photo 128

After the oil refilling work, make sure to attach the removed plug on the seal cover.

5.5.12 Low-stage Unloader Cylinder

The installation of the low-stage unloader cylinder may be done either after the bearing cover installation described in Section 5.5.10 or after the installation of the mechanical seal.

a) Check that the O-ring [73-1] is attached in the O-ring groove at the tip end of the unloader push rod [67-1] where the unloader piston is to be attached.

b) Attach the O-ring [65-2] and cap seal [66-2] to the unloader piston [64-1].

c) Install the unloader piston, which has the O-ring and cap seal attached, to the unloader cylinder [60-1] (Photo 129). The procedure for this work is the same as the one described for the high-stage unit in Section 5.5.9, e) of this chapter.

d) Attach the O-ring [63-1] to the O-ring groove provided on the portion of the bearing cover [16] where the unloader cylinder is to be installed (Photo 130).

* The assembly method of this O-ring [63-1] has been changed in the design change dated Oct. 29, 1996. While the O-ring is inserted to the triangular part on the flange surface of the bearing cover that makes contact with the unloader cylinder in the previous method, the O-ring is inserted in the O-ring groove in the current method.

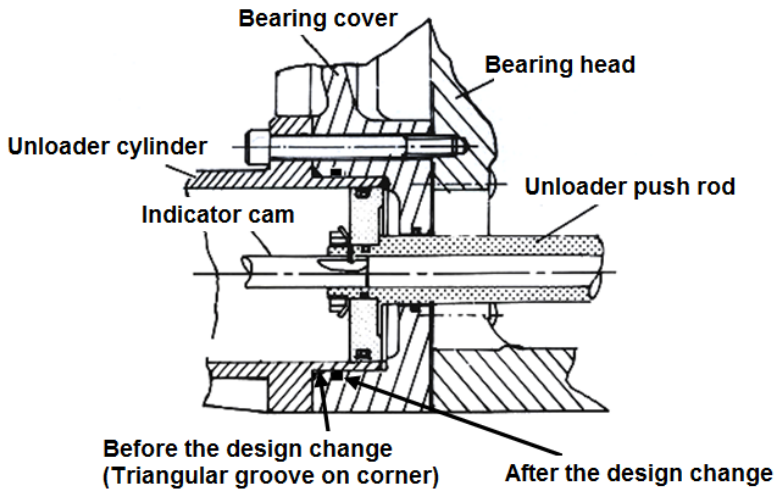


Figure 5-23 Modification of O-ring Attach Position (Low-stage Unloader Cylinder) Applied in 1996

e) Install the unloader cylinder to the bearing cover (Photo 131), and fasten the eight hexagon socket head cap screws [61-1] with the specified torque (240 N·m).

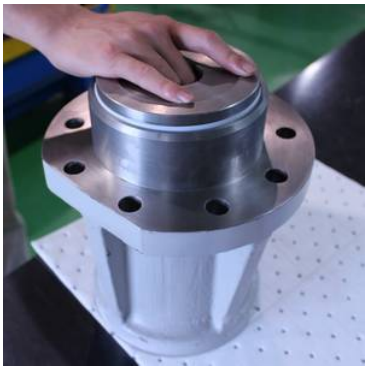


Photo 129

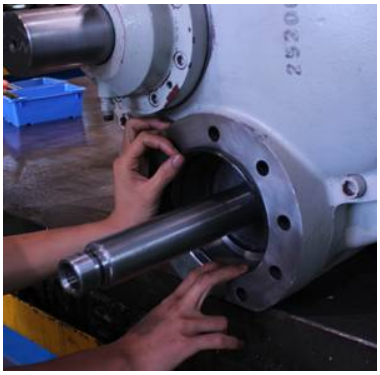


Photo 130

Photo 131

f) Attach the lock washer [70-1] and lock nut [69-1] to the unloader push rod, and fasten the lock nut with the specified torque of 140 N·m (Photo 132).

To stop rotation, align the lock washer tooth with the notch of the lock nut in the fastening direction, and bend the tooth (Photo 133).

Lastly, check the movement of the unloader piston by using eye bolts (Photo 134).

Photo 132

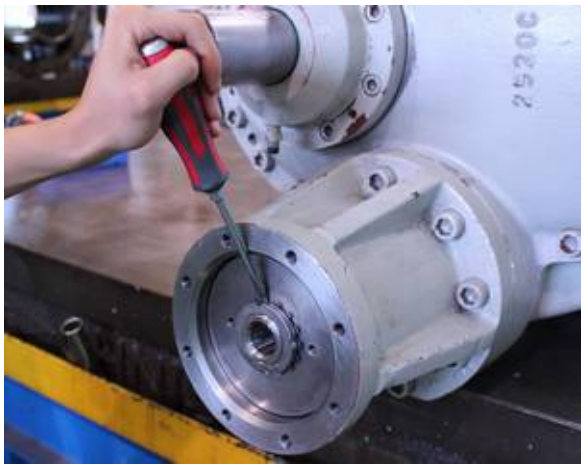


Photo 133

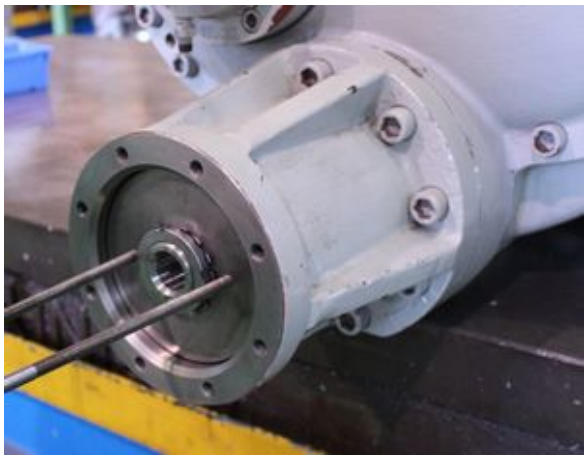


Photo 134

5.5.13 Unloader Cover

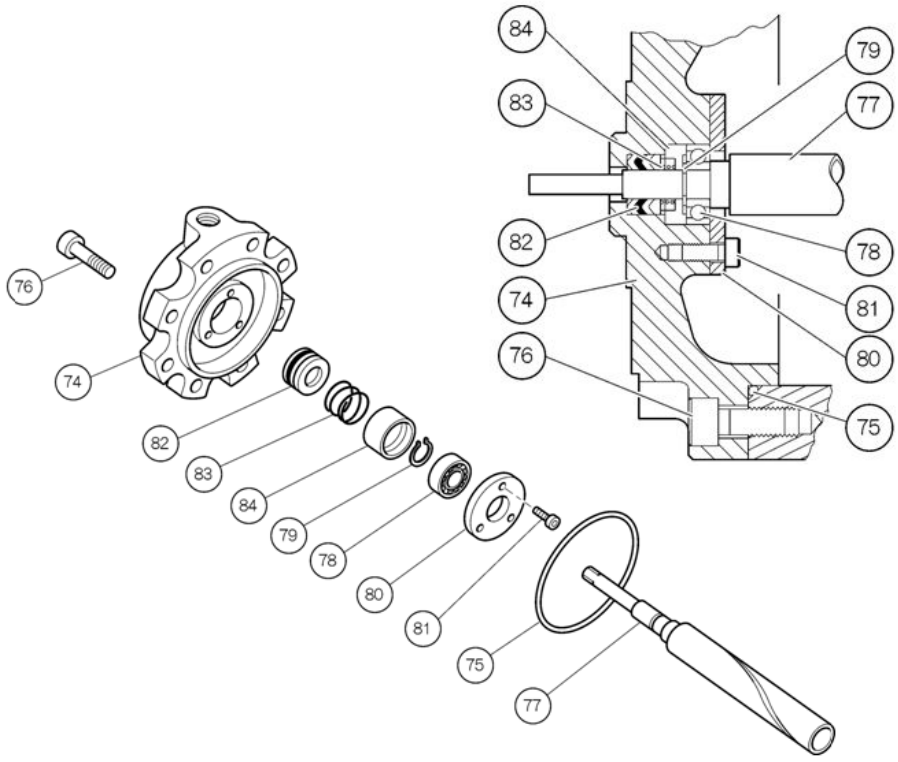


Figure 5-24 Unloader Cover Block

a) Attach eye bolts to the unloader piston, and move it back and forth. Check once again that it functions properly. On the 2520**C model, the slide valve will not come off the guide block even when the unloader piston is drawn to the utmost front.

b) Attach the ball bearing [78] to the shaft of the indicator cam [77]. When fitting, 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.

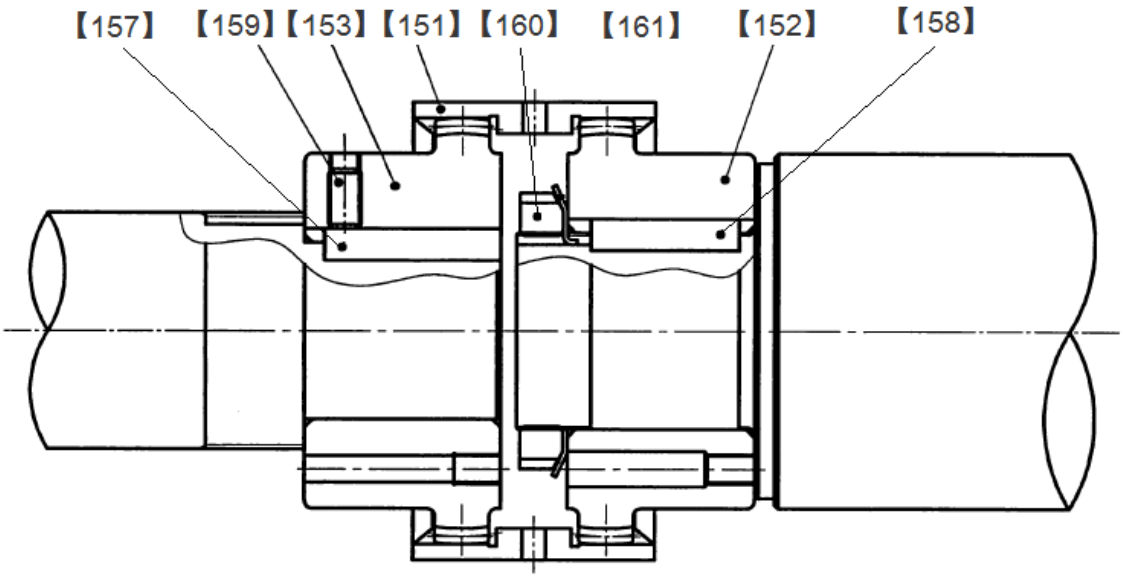
c) Apply sufficient oil to the unloader cover [74], and attach the V-ring set [82]. One of the V-rings in a set is made of rubber (dark color) to improve sealing performance. As shown in Figure 5-24, it is set at the second position viewed from the outer side of the machine.
Set the V-ring in such a way that its peak point of V-shape faces the machine's outer side and the lip faces the inner side.

d) Install the spring [83] and spring retainer [84] into position. Then insert the shaft of the indicator cam, which has been assembled in Step b) above, into the V-ring. Lastly, fasten the bearing gland [80] onto the unloader cover to retain the ball 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 to the unloader cylinder [60]. Push the unloader cover in such a way that the guide pin [68] of the unloader push rod [67] just fits to the spiral groove of the indicator cam. Secure the unloader cover by fastening the hexagon socket head cap screws [76] with specified torque (50 N·m for both low-stage and high-stage), with its hole for supplying unloader working oil facing upward.

5.5.14 High-Stage and Low-stage Assembly



【157】	Key, driven hub	【160】	Lock nut
【159】	Set screw	【161】	Lock washer
【153】	Driven hub	【152】	Drive hub
【151】	Driven sleeve	【158】	Key, Drive hub

Figure 5-25 Gear Coupling Block

a) On the high-stage, attach the driven hub [153] of the gear coupling, and fasten the M12 hexagon socket set screw [159] for securing the driven hub key [157]. This hexagon socket set screw is knurled and provided with anti-loosening.

b) On the low-stage, attach the drive hub [152], lock washer [161] and lock nut [160] in this order. Fasten the lock nut with the specified torque or tightening angle range (see "7.3 Tightening Torques for Bolts and Nuts" in this manual). Align the lock washer tooth with the notch of the lock nut, and bend it.

c) Set the driven sleeve onto the low-stage drive hub.

d) Screw the two stud bolts into the upper screw holes in the low-stage flange surface which is to be attached to the high-stage.

e) Apply oil to the both surfaces of the bearing cover gasket (2) [17-2]. Hang it on those stud bolts in such that it is put on the flange surface.

f) Lift the high-stage in such a way that it is slightly spaced apart the work bench, and move it toward the low-stage.
At this moment, on the low-stage, slightly move the M rotor shaft in the clockwise and counterclockwise direction, so that the gear coupling assembly will go smoothly (Photo 135).

Photo 135

g) After the gear coupling has fitted in, press the high-stage parallel with the rotor shaft. For both upper and lower sides, gradually and evenly tighten, temporarily, four to six hexagon socket head cap screws [18-2] that are set in the bolt holes, each hole located at least one hole apart from the left or right alignment pin, until the high-stage and low-stage flange surfaces are stuck together.

h) After the flange surfaces have contacted together, slightly loosen the hexagon socket head cap screws, which have been temporarily tightened, and then drive in the left and right alignment pins [19-2] (Photo 136).

i) Turn the low-stage M rotor (use of a jig for rotating the rotor is helpful) (Photo 137), and check that it rotates properly.

Photo 136

Photo 137

j) Tighten the hexagon socket head cap screws with the specified torque (450 N·m). The bolts in the lower area should be fastened, with the compressor placed on the special stand which was used during disassembly (Photo 138). When the compressor is placed on the special stand, be sure to attach the drain plug on the lower area.

Photo 138

5.5.15 Unloader Indicator

The unloader indicator contains micro-switches, a micro-switch cam and a 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

For confirmation after inspection/adjustment or parts replacement, they need to be linked with the control side. So, even during an overhaul which is conducted with the compressor carried out of the installation site, this portion is often removed from the compressor as an indicator assembly so that inspection/adjustment or parts replacement can be conducted at the site. This section provides helpful information for inspection and reassembly.

WARNING

- **When removing or inspecting/adjusting the indicator assembly or when replacing its parts, be sure to turn off the control power and conduct lockout/tagout. Failure to turn off the power supply could cause an electric shock.**

The 2520**C model has, on its high-stage, an indicator assembly which is designed for the standard-type single-stage compressor (only exception is the dial plate and micro-switch cam which are exclusively designed for the 2520**C high-stage 20 to100 %). On the low-stage, it has a unloader indicator fixture and standard-type indicator assembly.

5.5.15.1 Potentiometer

The potentiometer of the standard-type indicator is a rotary instrument for measurement over a full turn. It senses the continuously variable position (indicated load of 0 % to 100 %) of the unloader slide valve, and feeds the sensed position as electric signals to the control side of the package unit or refrigerating system. Life expectancy of the potentiometer varies significantly depending on the compressor's installation environment (e.g. with corrosive gas atmosphere or much moisture、or the like) or operating state (e.g. frequently operated with partial load, frequently started/stopped, subject to much vibration, etc.). It is a consumable part, and needs to be replaced periodically depending on the situation.

■ Disassembly

a) Turn off the control power and conduct lockout/tagout. After that, remove the indicator cover [146], indicator glass [141] and indicator glass spacer [142].
b) Remove the phillips screw [140] securing the indicator dial needle [139] to the shaft.
c) Remove the indicator dial screws [138] securing the indicator dial [137] to the dial supports.
d) Remove the electric wiring of the potentiometer. To avoid future assembly errors, put markings to indicate positional relationship of wiring by using different colors of tape or the like, and take a note.
e) The potentiometer set-plate [130] is fitted between the support arm (1) [134] and support arm (2) [135]. Loosen and remove the supports (2) by turning them counterclockwise while holding the supports (1).
f) When the right and left supports are removed, the potentiometer [129] can be removed together with the set-plate.
g) The potentiometer is secured to the set-plate with three screws.

■ Inspection

a) On the terminal block, check whether the lead wires of the potentiometer are loose or not.
b) Check for foreign substances such as cracks on the soldering portion of the potentiometer lead wires.
c) Rotate the axis of the potentiometer with hand, and check with a circuit tester whether the resistance value changes smoothly.

5.5.15.2 Micro-switch and Micro-switch Cam

The standard-type unloader indicator has two micro-switches and one micro-switch cam, for sensing that the unloader slide valve is at the 0% position or the 100% position of capacity control (indicated load). If, for any reason, their assembly gets loose or the micro-switch(es) gets faulty, proper sensing will be disabled, which will cause trouble in operation control of the compressor.

■ Disassembly

a) Turn off the control power and conduct lockout/tagout. Then, remove the indicator cover [146], indicator glass [141] and indicator glass spacer [142].
b) Remove the phillips screw [140] securing the indicator dial needle [139] to the shaft.
c) Remove the screws [138] securing the indicator dial [137] to the dial support arms.
d) Remove the electric wiring of the micro-switch. To avoid future assembly errors, put markings to indicate positional relationship of wiring by using different colors of tape or the like, and take a note.
e) The micro-switch [125] is secured with two long screws [126]. The micro-switch can be removed by loosening these screws. Do not remove these screws except when the micro-switch needs to be replaced. Leave them as they are when conducting inspections or positional adjustments.
f) The micro-switch on the right is for sensing the no-load (0 %) position and the micro-switch on the left is for sensing the full-load (100 %) position. Under the left micro-switch, the micro-switch base plate [123] is secured with different screws [124] on the micro-switch mounting frame. This is to use the cam which is outside the micro switch cam [127].

■ Inspection

a) In a normal state where the compressor's capacity control oil pressure pipe is not opened, pull the unloader piston to the no-load position/full-load position by using the manual capacity control circuit, in order to check, through the control circuit (operation check of related relays and/or contacts), whether the micro-switch senses the 0 %/100 % position of the micro-switch cam.
b) Turn off the control power, and conduct lockout/tagout. After that, remove the indicator glass and check for looseness on the screw for securing the micro-switch [126].
c) Check whether the hexagon socket set screw [128] for securing the micro-switch cam [127] get loosened.
d) Check that the wiring of the micro-switch has been removed. After that, turn the switch on and off and check whether it works properly by using a circuit tester.
e) When the compressor's capacity control oil pressure pipe is opened due to overhaul or the like, pull the unloader piston to the no-load position/full-load position by using nitrogen gas of compressed air pressure, in order to check whether the micro-switch senses the 0 %/100 % position of the micro-switch cam.
f) In addition, conduct appearance check to find out any sign of water entry inside the indicator, defect in the switch terminal such as corrosion, wear in the switch roller or micro-switch cam, etc.

5.5.15.3 Reassembly

For reassembly, perform the inspection procedure in reverse. Lastly, position the indicator dial needle correctly by following the procedure below.

a) When the compressor's capacity control oil pressure pipes are opened due to overhaul or the like, move the unloader piston to the no-load position/full-load position by using nitrogen gas or compressed air pressure. Then, align the indicator dial needle to the starting point of an illustration (on the dial plate) which indicates rotation, and fix it. Next, move the piston to the full-load position, and check that the indicator dial needle (pointer) points at the end point of the range drawn on the dial face.

b) In a normal state where the capacity control oil pressure pipes are not opened, move the unloader piston by using a manual capacity control circuit. When the control power is turned on, keep the indicator cover attached to avoid an electrical shock. After the position of the piston is determined, turn off the control power and conduct lockout/tagout. After that, remove the indicator cover and fix the indicator dial needle.

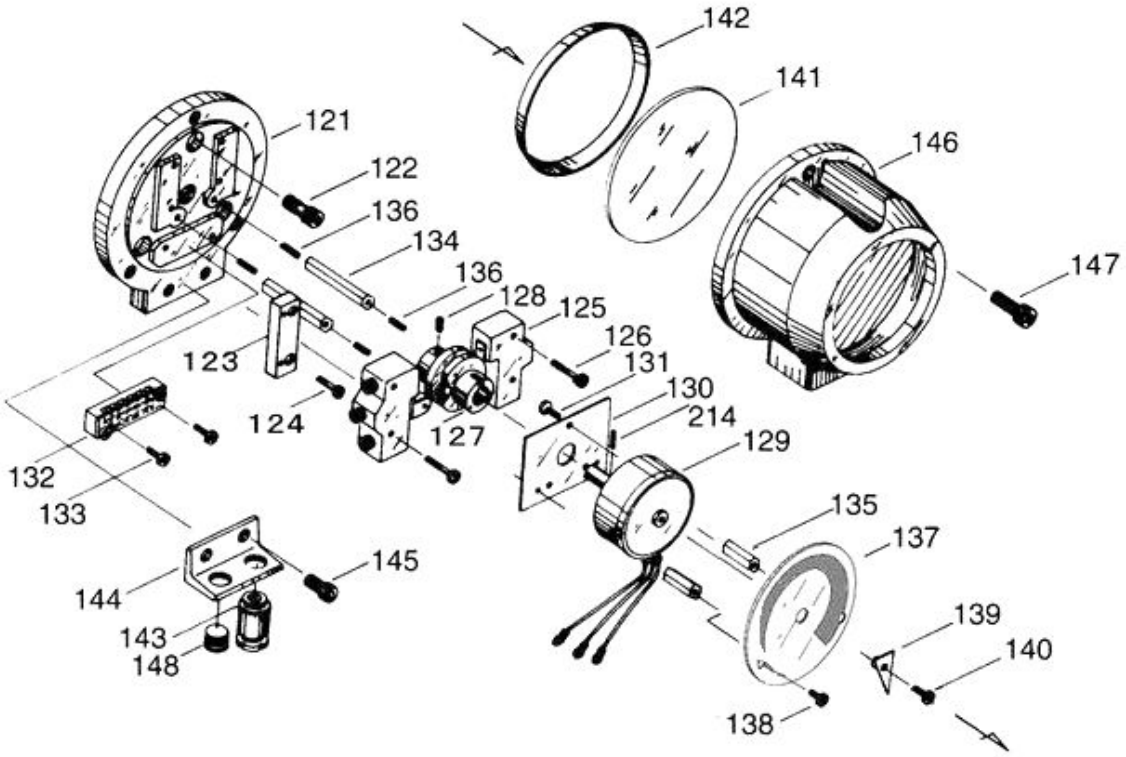


Figure 5-26 2520C Standard-type Unloader Indicator**

Table 5-13 Parts of Unloader Indicator (Standard Type)

No.	Part Name	Qty.	No.	Part Name	Qty.
121	Micro-switch Base Plate	1	136	Potentiometer Mounting Screw	3
122	Allen Screw	3	137	Indicator Dial	1
123	Micro-switch Set-plate	1	138	Indicator Dial Screw	2
124	Phillips Screw	2	139	Indicator Dial Needle	1
125	Micro-switch	2	140	Phillips Screw, Indicator Dial Needle	1
126	Phillips Screw	4	141	Indicator Glass	1
127	Micro-switch cam	1	142	Indicator Glass Spacer	1
128	Hexagon Socket Set Screw	1	143	Electric Wiring Connector	1
129	Potentiometer	1	144	Connector Support	1
130	Potentiometer Set-plate	1	145	Allen Screw	2
131	Phillips Screw	3	146	Unloader Indicator Cover (2)	1
132	Terminal Block	1	147	Allen Screw	3
133	Phillips Screw	2	148	Plug	1
134	Support Arm [1]	2	214	Spring Pin	1
135	Support Arm [2]	2	265-2	Spring Washer	7

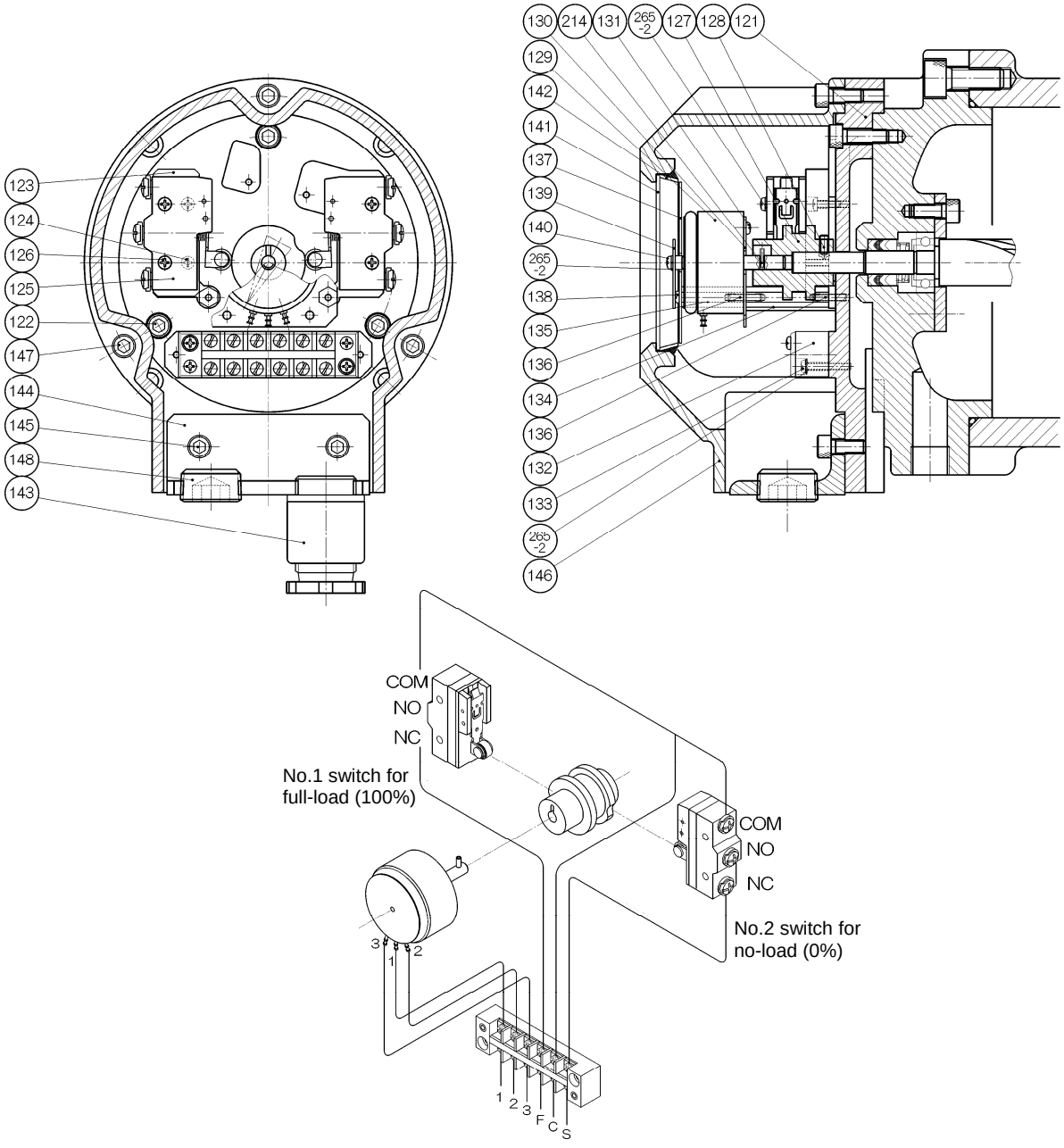


Figure 5-27 Assembly Drawing of Unloader Indicator (Standard type)

Chapter 6 Troubleshooting

Table 6-1 describes typical trouble symptoms of compressors, their causes and actions to be taken.

The explanations of this Chapter are assumed that the compressor is used in the general refrigeration cycle.

Table 6-1 Troubleshooting

01: Compressor does not start up

Direct cause	Root cause	Action
Power source is off.	Mostly caused by forgetting to turn on after inspection.	Use a check sheet for post-inspection actions and implement finger pointing and call check to prevent forgetting.
Main motor failure	Mostly caused by activation of overload protection circuit.	Refer to the operation manual of the motor for details including other causes and actions.
"Micro-switch and micro-switch cam" of the indicator do not sense capacity control of 0%.	Micro-switch failure	Replace.
	Loosening of micro-switch or micro-switch cam set screw due to vibration.	Adjust the position of the cam and switch, and tighten them. Use thread locking agent when necessary. When compressor's vibration is unusually high, see Item No. 12 "Compressor generates abnormal vibration and/or sound".
Defective capacity control oil supply line	Improper adjustment of oil flow control valve (throttled excessively).	Readjust.
	Leak/clogging in piping or solenoid valve	Remove cause, and check oil for contamination/replace oil.
Oil pressure not detected	Failure of oil pressure protection device, pressure sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
	Pressure pipe is clogged.	Remove clogging, and check oil for contamination/replace oil.
Cooling water circulation is not confirmed.	Failure of devices such as cooling water pump and related circuits	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
	Circulation route is clogged.	Remove the clogging.
Failure of magnet, relay, etc. in compressor startup circuit	Aging degradation	Replace with new one.
	Poor installation environment	Replace ventilation fans, etc. if defective. Improve temperature, humidity and ventilation at the installation site.

02: Compressor stops immediately after startup

Direct cause	Root cause	Action
Low pressure protection circuit activates.	Insufficient refrigerant flow • Insufficient refrigerant	To correct insufficient refrigerant, check leak, stop leak and then add refrigerant. * Also pay attention to moisture entering into the system.

02: Compressor stops immediately after startup (continued)

Direct cause	Root cause	Action
Low pressure protection circuit activates.	Insufficient refrigerant flow • Insufficient liquid supply	To correct insufficient liquid supply, inspect expansion valve and liquid supply strainer. Take necessary actions. In addition, inspect devices and parameters (set values) of the expansion valve aperture adjusting mechanism, and take necessary actions.
	Heat exchange failure in heat exchanger	If there are any problem (insufficiency) in heat exchange, such as malfunction of defrosting, investigate the cause and take necessary actions.
		In case of malfunction of pressure control valve, replace the valve or remove the cause.
	Failure of low pressure protection device, pressure sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
Motor overload	Motor overload that occurs just after startup is mostly caused not by the refrigeration cycle but by the motor. Refer to the instruction manual of the motor.	

03: Unusually low pressure (decrease of suction pressure)

Direct cause	Root cause	Action
Refer to direct cause, "Low pressure protection circuit activates", in Item 02 above.	Same as left	Same as left

04: Low oil pressure (low lubricating oil supply pressure)

Direct cause	Root cause	Action
Oil filter element is clogged. * Pressure difference between the outlet port and inlet port is large.	Contamination of lubricating oil	Remove clogging, and check oil for contamination/replace oil.
	Internal defects of compressor	Check for oil contamination and conduct vibration/noise diagnosis. Overhaul compressor if necessary.
Insufficient oil in oil separator.	Oil heater is not functioning, refrigerant dissolves excessively when the machine is stopped, and oil loss occurs at startup.	Inspect oil heater alone, inspect relays, etc. on related circuits, and replace parts as necessary.
	Insufficient oil return due to insufficient refrigerant circulation	Correct insufficient refrigerant circulation, and return oil from load-side heat exchanger. * Supply lubricating oil temporarily.
	Troubles such as clogging in oil return passage	Remove causes of the trouble, and restore the system.

04: Low oil pressure (continued)

Direct cause	Root cause	Action
Insufficient oil in oil separator.	Extensive oil leak	Inspect machine room and around the compressor, and take necessary actions. Check if there is oil floating in cooling water system. →If there is, check for oil leak from heat transmission tube of oil cooler and take necessary actions.
		If piping is damaged due to excessive vibration, take measures to reduce vibration (including measures for resonance vibration).
Oil pressure detection function is defective.	Failure of oil pressure protection device, pressure sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
	Pressure pipe is clogged.	Remove clogging, and check oil for contamination/replace oil.

05: Intermediate pressure is unusually high.

Direct cause	Root cause	Action
High suction pressure	Heat load on load side is higher than design value.	Inspect the conditions on load side (warehousing volume, opening/closing of doors, etc.), and take necessary measures.
	Malfunction of suction pressure control mechanism	In case of pressure sensing failure, replace the pressure sensor. * In some cases, pressure pick-up position is improper. → Change the position.
		If there is a problem in device(s) on the control circuit, find the defective device(s) and replace it.
		If parameter (set value) on the control circuit is improper, optimize it.
		In case of malfunction of pressure control valve, replace the valve or remove the cause.
	Malfunction of compressor's capacity control	See Item No. 11 "Capacity control malfunction".
Liquid flow-back from intermediate liquid cooler.	Failure or internal leakage of intermediate liquid supply expansion valve	Repair or replace.
There is problem in compressor's high-stage.	Malfunction of capacity control on compressor's high- stage	See Item No. 11 "Capacity control malfunction".
	Excessive wear or sliding damage of the part(s) on compressor's high- stage	Overhaul compressor and replace parts. Replace the whole quantity of lubricating oil.

06: Unusually high pressure (abnormal discharge pressure)

Direct cause	Root cause	Action
Heat exchange failure in condenser (heat exchanger)	Heat transmission tubes and/or fins are contaminated or blocked.	Clean and wash. Depending on the contamination level, use chemical cleaning.
	Failure or water dripping in fan motor, thermo switch, water spraying pipes, cooling water pumps, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
	Faulty adjustment of cooling water/brine	In case of manually adjusted valve, readjust the valve. When an automatic control valve (including wax valve) is used, investigate the cause and take necessary actions.
	Other causes of insufficient flow of cooling water, etc.	Inspect filters installed on the circulation route for clogging and contamination, and take necessary actions. Inspect for leaks in circulation routes, and take necessary actions. Inspect water supply routes/mechanisms, and take necessary actions. If frozen, take measures such as improvement of heat insulation or increase of temperature.
	Deficiency in heat exchanger performance	If the symptom is caused by change in operating conditions, re-examine the conditions for improvement. If the symptom is caused by change in installation environment, improve the environment if possible. In either case, if improvement measure is difficult to be made, add more heat exchangers or increase their sizes.
Non-condensable gases mixed into the system	Leak on low pressure side * There are also cases where the symptom was caused by corrosion in suction temperature gauge protection	Perform a leak check, and take necessary measures. Air-purge the heat exchanger.
Refrigerant is excessive.	In some cases, insufficient cooling is judged as caused by insufficient refrigerant and, as a result, refrigerant is charged repeatedly.	Properly adjust the refrigerant charge.
	Capacity of heat changer is insufficient.	If the symptom is caused by change in operating conditions, re-examine the conditions for improvement. If improvement is difficult, add heat exchangers or increase their sizes.

06: Unusually high pressure (continued)

Direct cause	Root cause	Action
Discharge ~~oil~~ pressure detection function is defective.	Failure of high pressure protection device, pressure sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
	clogging of pressure pipe	Remove clogging, and check oil for contamination/replace oil.
Outlet shut-off valve of oil separator is closed.	Operator forgot to restore after shut down operation. Human error	Open the valve or perform emergent stop. Be sure to conduct tagout while handling valves. Be sure to check valves before starting the compressor.

07: Discharge temperature is abnormally high.

Direct cause	Root cause	Action
Overheated during operation	Insufficient refrigerant flow	See the causes listed in item 02 above.
	Heat load on load side is higher than design value.	Inspect the conditions on load side (warehousing volume, opening/closing of doors, etc.), and take necessary measures.
	Failure of low pressure protection device, pressure sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
Non-condensable gases mixed into the system	Leak on low pressure side	Perform a leak check, and take necessary measures. Air-purge the heat exchanger.
Oil supply temperature is high.	Heat exchange failure in oil cooler	For water-cooling system, see "Heat exchange failure in heat exchanger" in 06 above. For liquid cooling system, check liquid supply expansion valve, temperature sensor and related relays/wiring/terminals, and take necessary actions.
	Oil temperature rise protection feature does not function.	Check temperature protection device, temperature sensor and related relays/wiring/terminals, and take necessary actions.
Defective discharge temperature detection/protection feature.	Failure of temperature protection device, temperature sensor, relay, etc.	Identify defective devices, investigate causes of failure and take necessary actions. Then, replace failed device(s).
Insufficient oil supply	See "Low oil pressure" in Item 04 above.	Same as left

08: Leak from mechanical seal

Direct cause	Root cause	Action
Initial leak after replacement until sliding surfaces settle	In some cases, immediately after replacement, the compressor-specific operating conditions and the pressure receiving conditions of machined sliding surface is unstable.	In case of initial leak, although leak amount might increase temporarily, it will decrease gradually. Check that leak does not increase continuously. Duration of initial leak depends on design/operating conditions. It is approximately 200 hours, as a rough indication.
Sliding surface is roughened due to overheating.	Started and stopped too many times. * In case of standard equipment, "four or more times per hour" is considered "frequent/too many".	If heat load is less than the level set by the equipment's design conditions, review the operating conditions and set control such that equipment is started/stopped less frequently.
		In case of capacity control malfunction, see "Capacity control malfunction" in item No. 11.
	Excessive refrigerant solved into the lubricating oil, resulting in decreased viscosity of oil.	In case of liquid flow-back, remove the cause(s). If oil heater or devices on its control circuit are defective, replace the defective part.
	Overheated operation	See the causes in item 02, "Insufficient refrigerant flow".
	Oil supply temperature is high.	See the causes in item 07, "Oil supply temperature is high".
Machine is stopped for a long time. (No oil film on sliding surfaces)	User-specific conditions, such as intermittent heat load	If machine is sometimes stopped longer than a week, take either of the following measures: (i) Manually operate oil pump alone and turn the rotor shaft of the compressor. (ii) Attach an oil pot for supply oil to the seal cover.
Deteriorated part(s)	Hardened O-ring	If deteriorated over time, replace. For other specific causes, see the causes/action for symptom "Overheating of sliding surface".
	Swelled O-ring * This occurs when the lubricating oil of refrigerating machine contains large amount of refrigerant.	In case of liquid flow-back, remove the cause(s). If oil heater or devices on its control circuit are defective, replace the defective part.
	Deteriorated seal ring/mating ring	If deteriorated over time, replace. For other specific causes, see the causes/action for symptom "Overheating of sliding surface".
Incompatibility of lubricating oil and operating conditions (such as working temperature range or refrigerant)	Unsuitable lubricating oil was selected, or operating conditions have changed after installation of the equipment.	If possible, review the operating conditions. If not, see "4-1 Lubricating Oil (Refrigerant Oil)" to select suitable lubricating oil and replace the whole quantity.

08: Leak from mechanical seal (continued)

Direct cause	Root cause	Action
Poor contact of sliding surfaces	Foreign matter attached to sliding surfaces, due to contaminated lubricating oil.	Replace the whole quantity of lubricating oil. Install bypass filter to oil supply line.
	Faulty assembly of parts Human error	Disassemble, replace parts and reassemble. Use assembly check sheet to ensure confirmation.

09: Squeaking of mechanical seal

Direct cause	Root cause	Action
During initial period after exchange for new mechanical seal, squeaks may be heard from sliding surfaces until they fit together.	As the sliding surfaces are very hard and dense, they need time to fit together.	Squeaking itself does not cause leak from seal or deterioration in sealing function. Normally, squeaking is heard for several dozens of hours, however, it may last longer in rare cases. →In this case, contact our service center.

10: Capacity control position is indicated incorrectly

Direct cause	Root cause	Action
Inaccurate reading of compressor indicator gauge.	Screw for securing indicator needle is loose.	Manually operate the compressor's capacity control to indicate 0% position, and tighten the screw again.
	Indicator's bevel gears are worn.	If deteriorated over time, replace. If the wear is caused by excessive vibration of the compressor, take measures to reduce vibration and then replace the bevel gears.
Inaccurate reading of capacity control indicator on the control panel.	The cam groove of compressor's indicator cam is worn.	Often caused by continued operation with load on a certain point. →Replace the indicator cam. * The currently shipped indicator cam has its grooved portion strengthened.
	The guide pin of the compressor push rod is worn.	Currently, this pin is also improved in resistivity against wear. If the indicator cam is replaced with the improved version, replace the pin with the countermeasure part.
	Failure of potentiometer	If the part is deteriorated over time or loaded at a certain point during operation for a long time, replace it. If the wear is caused by excessive vibration of the compressor, take measures to reduce vibration and then replace the potentiometer.
	Improper zero span adjustment of E/E positioner	Readjust.

10: Capacity control position is indicated incorrectly (continued)

Direct cause	Root cause	Action
Inaccurate reading of capacity control indicator on the control panel.	E/E positioner or/and indicator is faulty.	If deteriorated over time, replace. If there are specific causes such as surge current, remove the cause or take proper action.
	Loosened terminals or defective wires	Tighten the terminals if loosened. Replace defective wires.

11: Capacity control malfunction

Direct cause	Root cause	Action
↑ See the causes for "Inaccurate reading of capacity control indicator on the control panel".	Same as left	Same as left
"Micro-switches and micro-switch cam" of the indicator do not sense "100%" position and/or "0%" position.	Micro-switch failure	Replace.
	Loosening of micro-switch or micro-switch cam screw due to vibration.	Adjust the position of the cam and switch, and tighten them. Use thread locking agent when necessary. When compressor's vibration is unusually high, see Item No. 12 "Compressor generates abnormal vibration and/or sound".
Failure of capacity control solenoid valve or related relays	Mostly caused by coil burnout.	If deteriorated over time, replace. If the symptom is caused by wet with water, etc., remove the cause(s) and then replace defective part(s). For details, refer to the instruction manual of solenoid valve.
Internal leakage of capacity control solenoid valve	Oil compression due to temperature rise inside unloader cylinder	If the symptom is caused by long duration of low-load operation, review and improve the operating method. Arrange inline check valve and oil bypass route on the capacity control oil supply line.
Defective capacity control oil supply line	Improper adjustment of oil flow control valve	Readjust.
	Leak/clogging in solenoid valve gland or oil supply piping	Remove cause, and check oil for contamination/replace oil.
Unloader piston does not move. (Though this is one of the causes of "Defective capacity control oil supply line", it is listed separately here.)	Damage on the cap seal of the piston	Check oil for contamination/replace oil. Replace O-ring, cap seal, etc.
	Cap seal is pinched.	Replace O-ring, cap seal, etc.
	Cap seal is worn.	Check oil for contamination/replace oil. Replace O-ring, cap seal, etc.
	There is residual refrigerant gas inside unloader cylinder.	Stop the compressor. By operating the oil pump, repeat load/unload operation to purge refrigerant gas from unloader cylinder. In case of liquid flow-back, remove the cause(s). If oil heater or devices on its control circuit are defective, replace the defective part.

12: Compressor generates abnormal vibration and/or sound.

Direct cause	Root cause	Action
Shaft poorly aligned with motor	If the shaft vibration value of axial direction is high, it may be caused by this.	Conduct shaft alignment again. If this occurs frequently in monocoque unit, perform hot alignment (operate the compressor at rated speed to raise the temperature and make adjustment before it cools down).
M rotor shaft runout excessively.	Lock nuts and/or thrust bearing glands are tightened unevenly.	If lock nuts are not loose and parts such as thrust bearing are free of defects, tighten the glands evenly.
	Thrust bearing glands get loosened.	Lock washer tooth not bended, or thrust bearing rolling elements (balls) are worn. → Check the thrust bearing. If any defect is found, replace it, and then reassemble it after adjusting end clearance and checking shaft runout.
	Rotor dynamic balance is disturbed.	If no other causes are found for abnormal vibration, or if on-site overhaul only has been repeatedly performed for a long time, this may be the cause. → Overhaul the compressor at a place where a dynamic balance measurement/adjustment system is available, such as the MAYEKAWA Moriya Factory.
Oil compression	Continuous low-load operation with capacity control not greater than 30%	During low-load operation, lubricating oil is difficult to be discharged. As a result, oil that stays between the engaged rotors increases and gets compressed. → Avoid continuous low-load operation as far as possible. * Especially when the fluid is light gas (He, NH3, etc.), continuous operation of merely 10 minutes can cause bad effect. The maximum limit should be 30 minutes even for fluorocarbon fluids.
Liquid flow-back during startup * Loud abnormal noise at startup. * If this is heard, the compressor may get damaged instantaneously.	Refrigerant liquefies and stays inside upstream piping when equipment is stopped.	There are many probable causes, such as a leak inside liquid supply solenoid valve on the load side, insufficient heat exchange (refrigerant evaporation) in heat exchanger, or trapping due to mis-piping in the piping line. → Identify the cause(s) and take necessary measures. Then overhaul and inspect the compressor.

12: Compressor generates abnormal vibration and/or sound (continued)

Direct cause	Root cause	Action
Liquid flow-back during operation * Notable frosting on the suction side. * In many cases, flow-back of mist (steam) rather than liquid occurs. * Sometimes, gas-liquid separator (accumulator) is attached to prevent this symptom. * See also the causes in item 02, "Insufficient refrigerant flow"	Aperture of liquid supply expansion valve is large	In case of temperature-type expansion valve, check the condition of temperature sensitive cylinder and capillary tube. If any defect is found, take necessary actions. If orifice gets unsuitable due to the change in operating conditions, replace the orifice with proper size one(s).
		In case of electronic expansion valve, check devices attached on the expansion valve aperture control mechanism (circuit) such as temperature sensor, converter, controller (overheating regulator). If any of them is found defective, replace it. In the same way as with temperature-type expansion valve, if orifice gets unsuitable due to the change in operating conditions, replace the orifice with proper size one(s).
	Rapid change from no-load operation to full-load operation	Set control parameters so as to prevent rapid changes. Otherwise, make adjustment by throttling the aperture of the capacity control increase-side oil quantity adjusting valve.
	Expansion valve aperture control cannot keep up with rapid change in heat load on the load side.	Avoid rapid change in heat load that exceeds the set value of follow-up range of "heat exchanger on load side (evaporator)" and "expansion valve". For details, refer to the instruction manuals related to devices/control on load side.
	Heat exchange failure in heat exchanger on load side ・Related to defrosting	In case of frosting (icing), conduct manual defrosting. Set defrosting interval shorter. If a device which is specific to the defrosting type fails, remove the cause(s) and replace the device(s). If a piping route which is specific to the defrosting type gets blocked, remove the cause(s) and take necessary actions. * Especially when handling hot gas defrosting systems, thoroughly read and understand the contents of the instruction manuals for the units associated with devices/control on the load side.
	Heat exchange failure in heat exchanger on load side ・Load side conditions	If ventilation around the heat exchanger is obstructed for any reason such as piled up load, improve the conditions. * Ensure the flow of heating medium through the heat exchanger on the load side.
	Heat exchange failure in heat exchanger on load side ・Heat exchanger conditions	Check for any blocked heat transmission tubes or fan motor(s) failure. If any problem is found, take necessary actions.

12: Compressor generates abnormal vibration and/or sound (continued)

Direct cause	Root cause	Action
Foreign substances entering the compressor	Welding spatter, etc. flowing from upstream side	Check suction strainer and/or oil filters. Replace element if defective. Overhaul the compressor. Collect foreign substances and identify their sources. Then take necessary actions.
	Tools and/or waste cloth left uncollected after overhauling	
Damaged thrust bearings.	Deterioration over time (operated beyond recommended time of replacement)	The time for replacement depends largely on operating conditions (low pressure or high intermediate pressure will make the life shorter, etc.) and/or oil management conditions. In case of a typical refrigeration application which basically operates in a stable continuous mode, inspect and replace them every 40,000 hours or 5 years, whichever comes first. For details, see Chapter 5, Section 5.2.3 in this manual.
	Operation with liquid flow-back	Refer to causes of "Liquid flow-back during startup" and "Liquid flow-back during operation" in item 12.
	Entry of foreign substances	Refer to causes of "Foreign substances entering the compressor" above.
	Excessive thrust stress other than above ・High suction pressure/intermediate pressure exceeding the level set by operating conditions	Re-examine operating conditions, and improve if possible. If difficult to improve, review maintenance interval.
	Faulty assembly * Lock nuts tightened insufficiently, lock washer tooth not bended, rotation stopper not set to thrust bearing gland, gland not assembled, etc.	Tighten lock nuts by using specified torque or torque angle (see Chapter 7, "7.3 Tightening Torques for Bolts and Nuts" in this manual). Be sure to record data on the assembly check sheet to prevent omission of work steps.
Resonance vibration	This occurs when the frequency of vibration comes close to the natural frequency of any component in the entire vibrating system, including pipes and supports.	In many cases, this symptom is caused by change in installation environment (such as change in piping routes or additive installation of devices in the machine room, oil level change, etc.) →If occurrence of resonance vibration is a suspected, contact our service centers.

Chapter 7 Related Documents

7.1 Development Views, Assembly Sectional Views

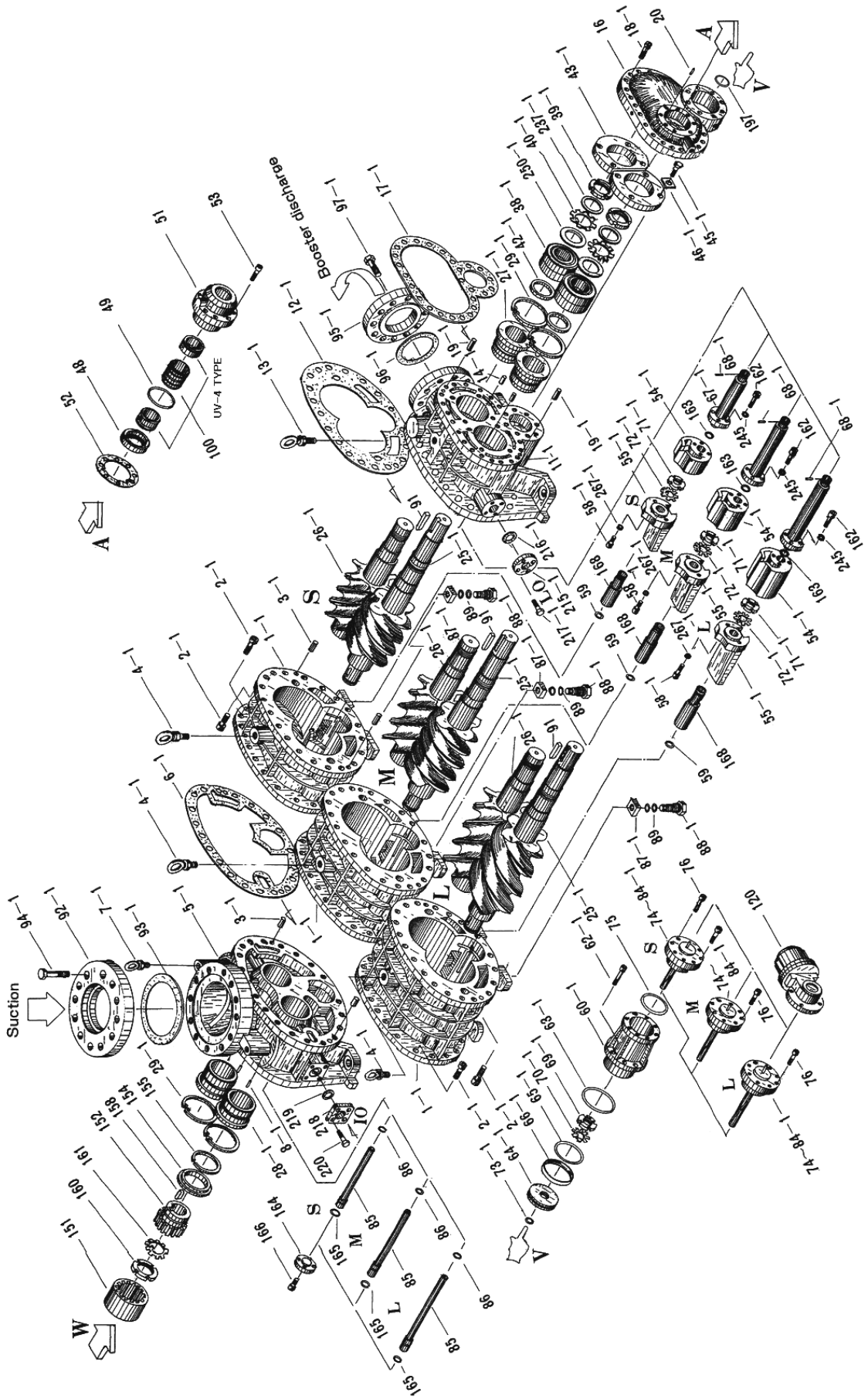


Figure 7-1 2520C Development View (Low-stage)**

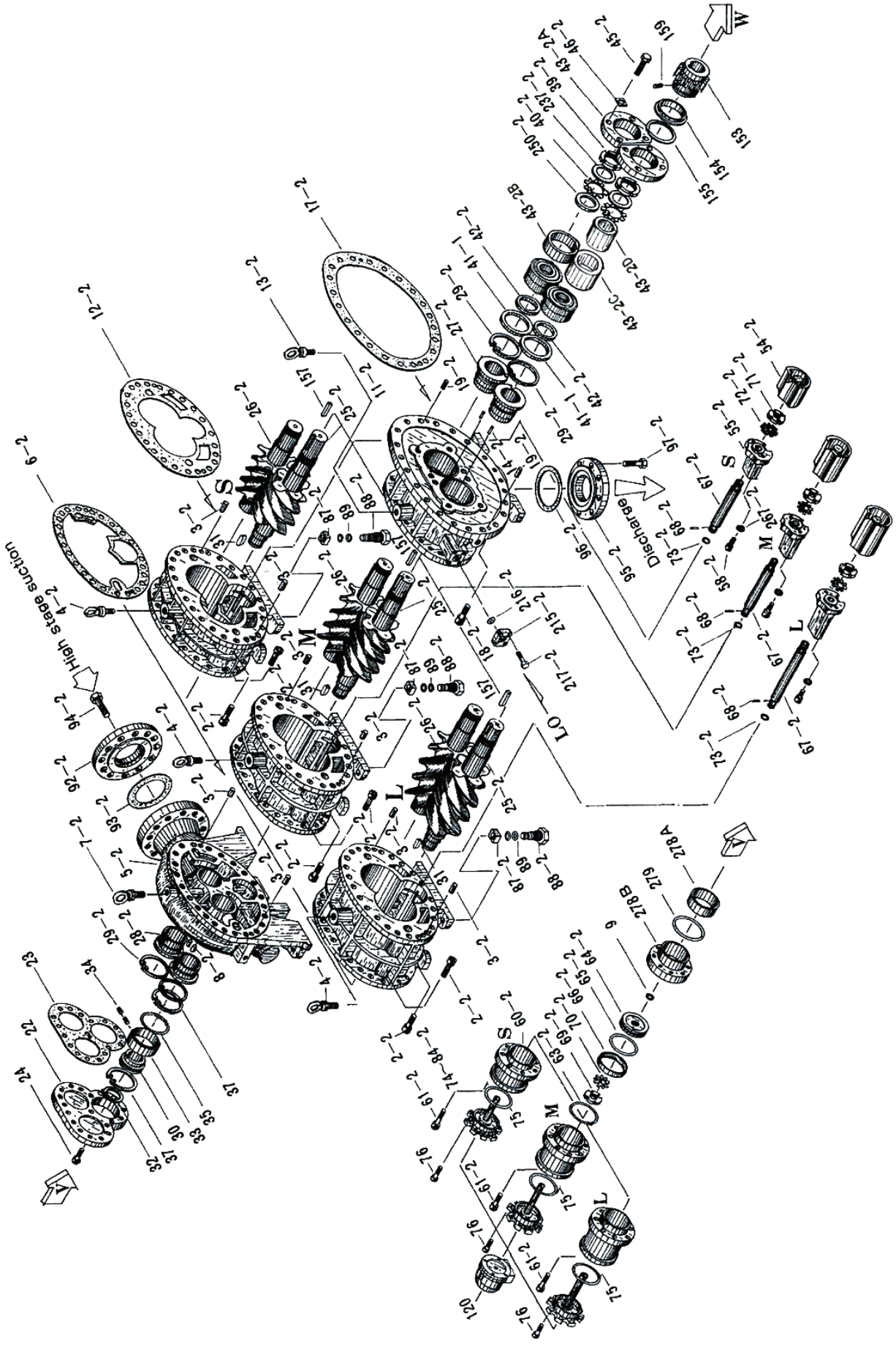


Figure 7-2 2520C Development View (High-stage)**

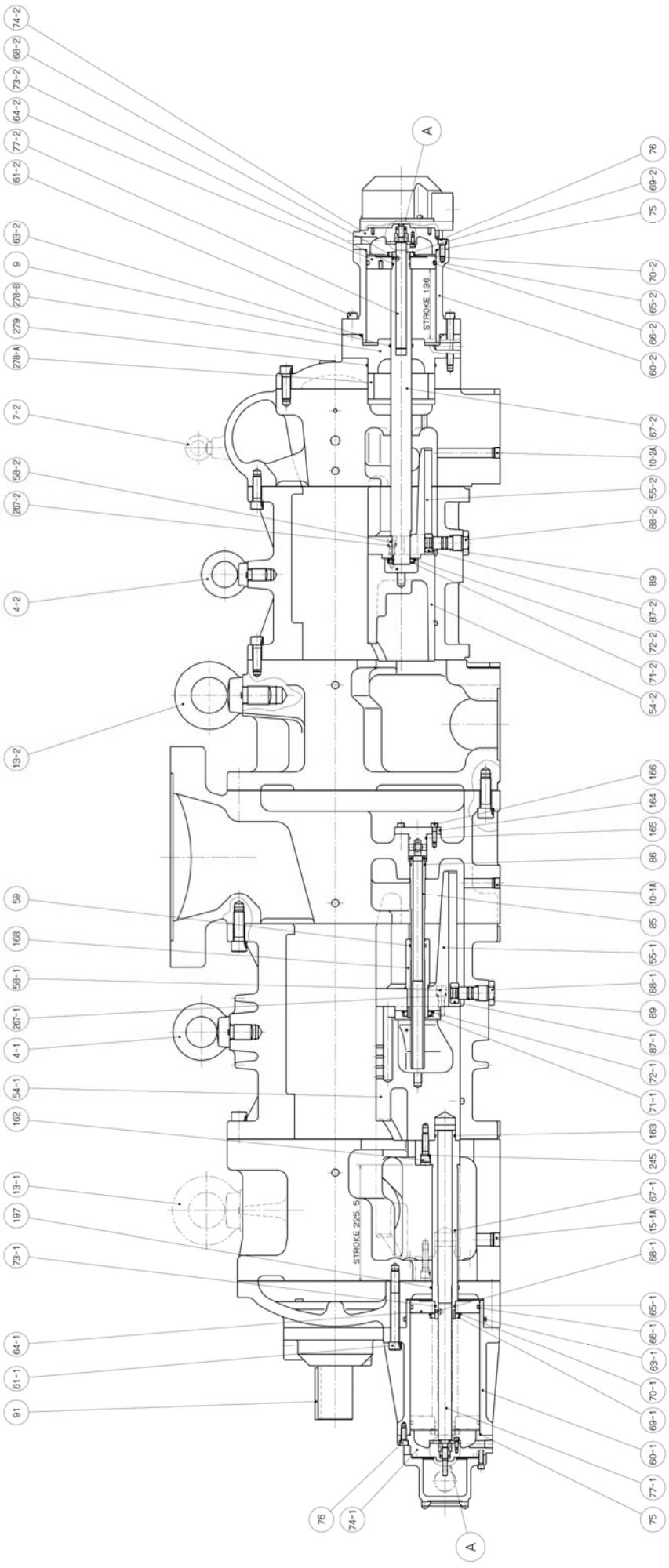


Figure 7-3 2520LLC Assembly Sectional View (Vertical)

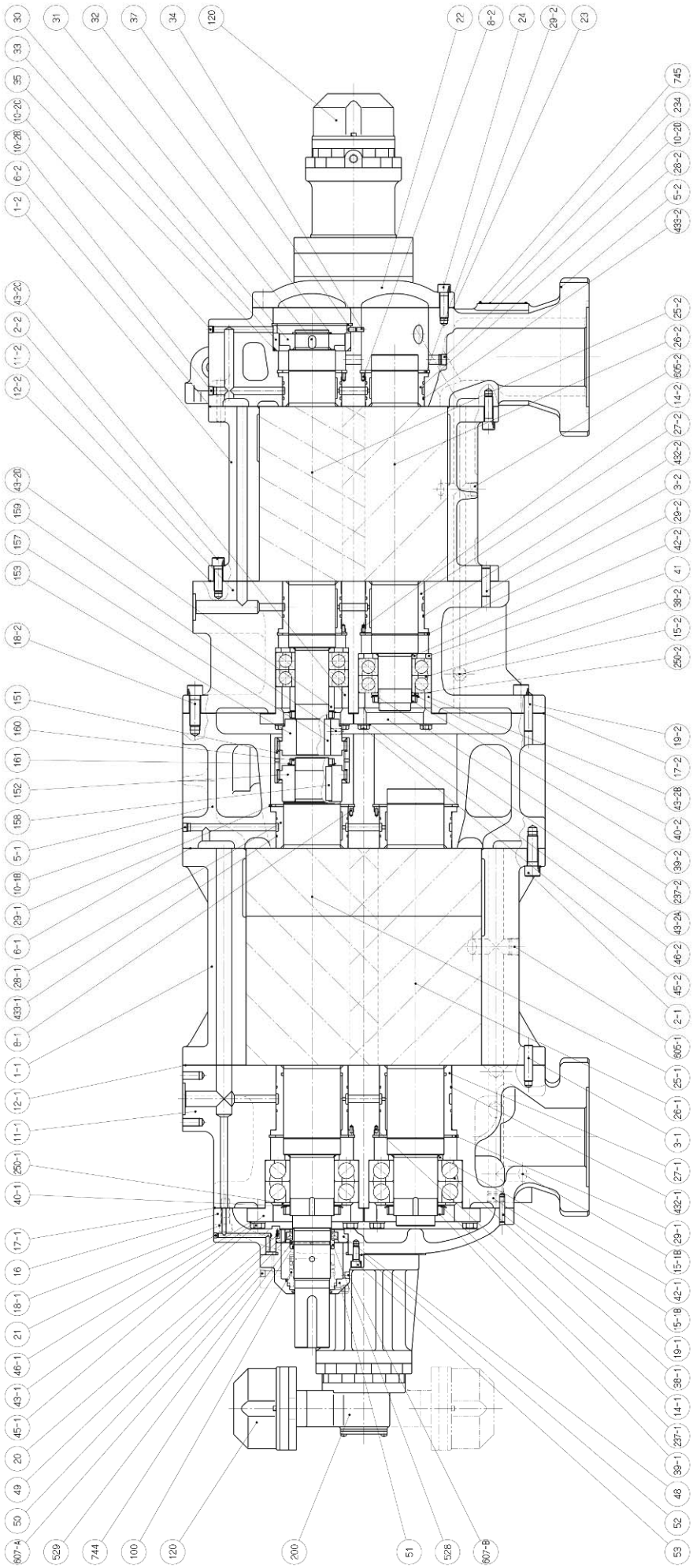


Figure 7-4 2520LLC Assembly Sectional View (Horizontal)

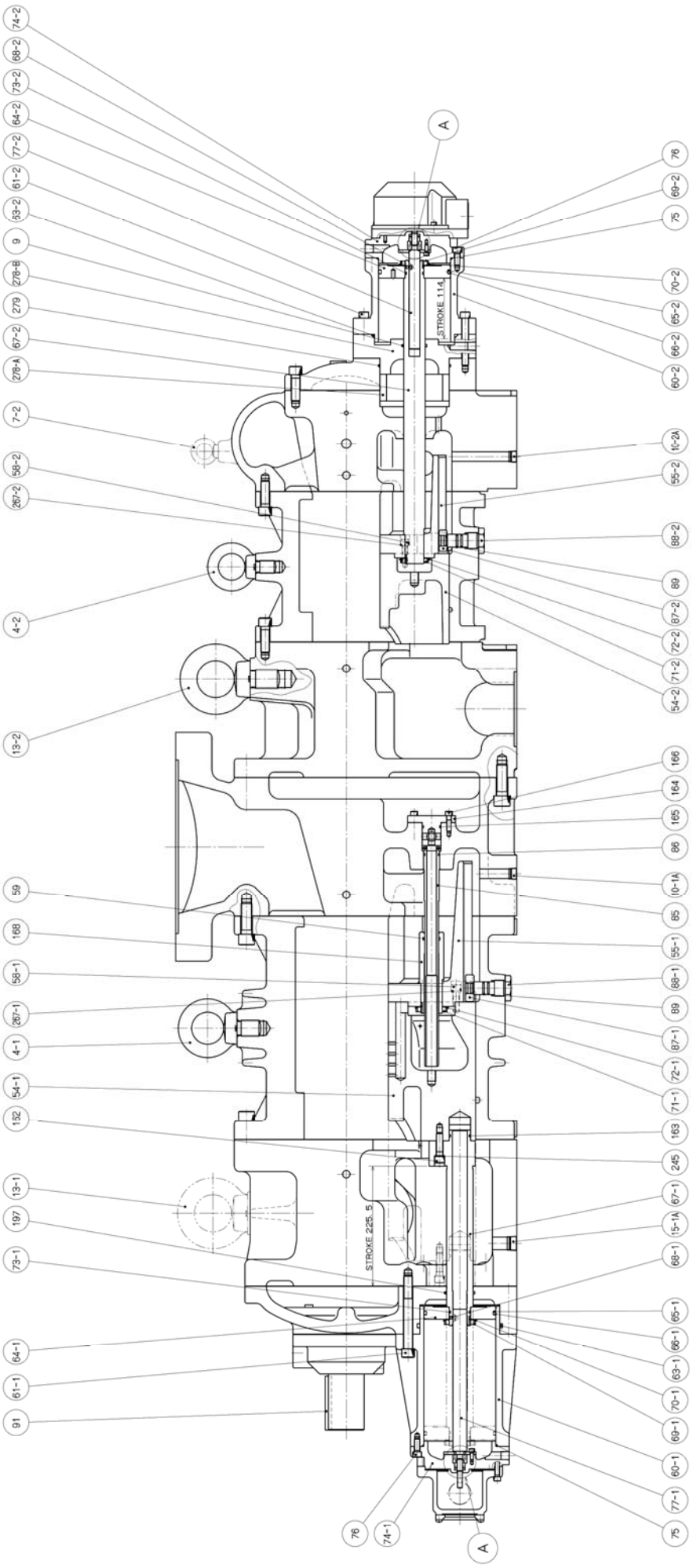


Figure 7-5 2520LMC Assembly Sectional View (Vertical)

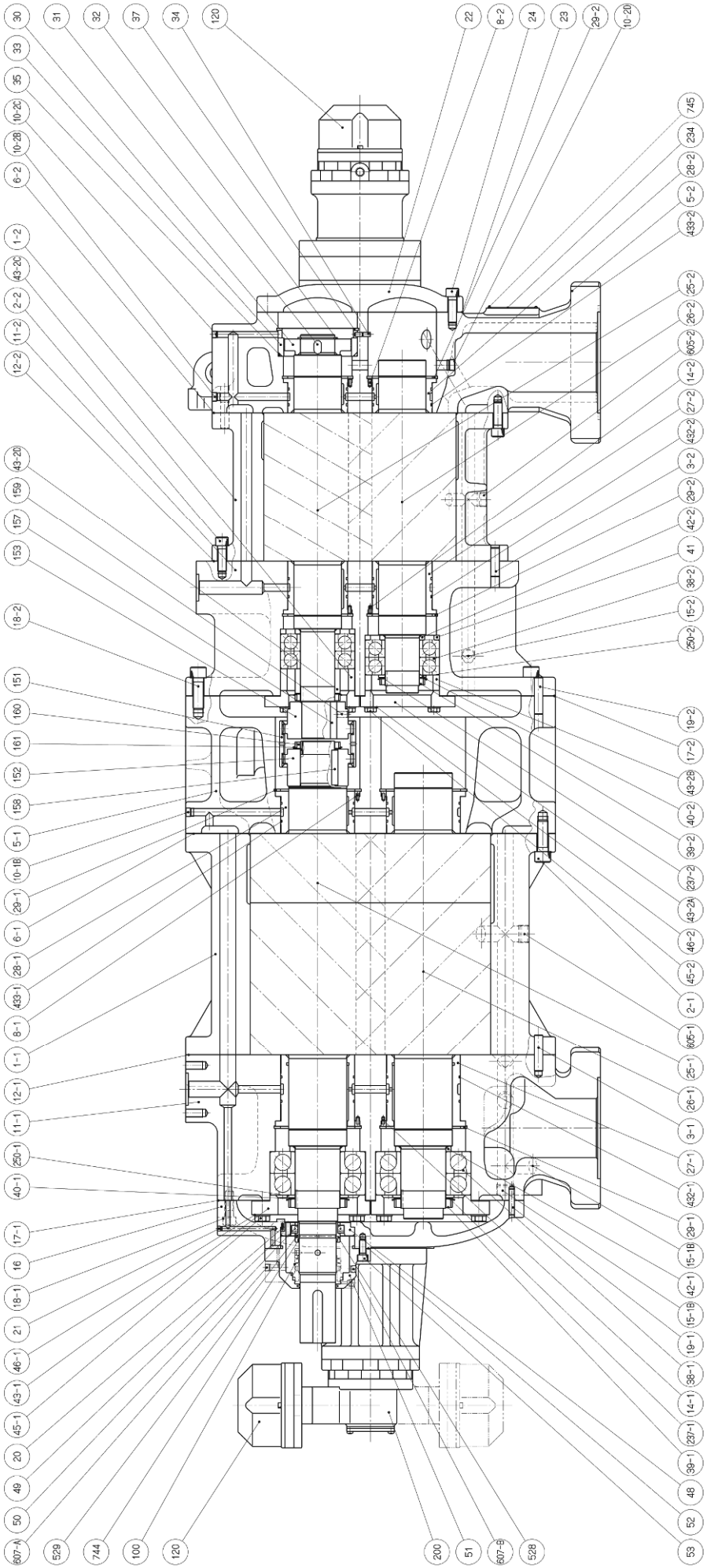


Figure 7-6 2520LMC Assembly Sectional View (Horizontal)

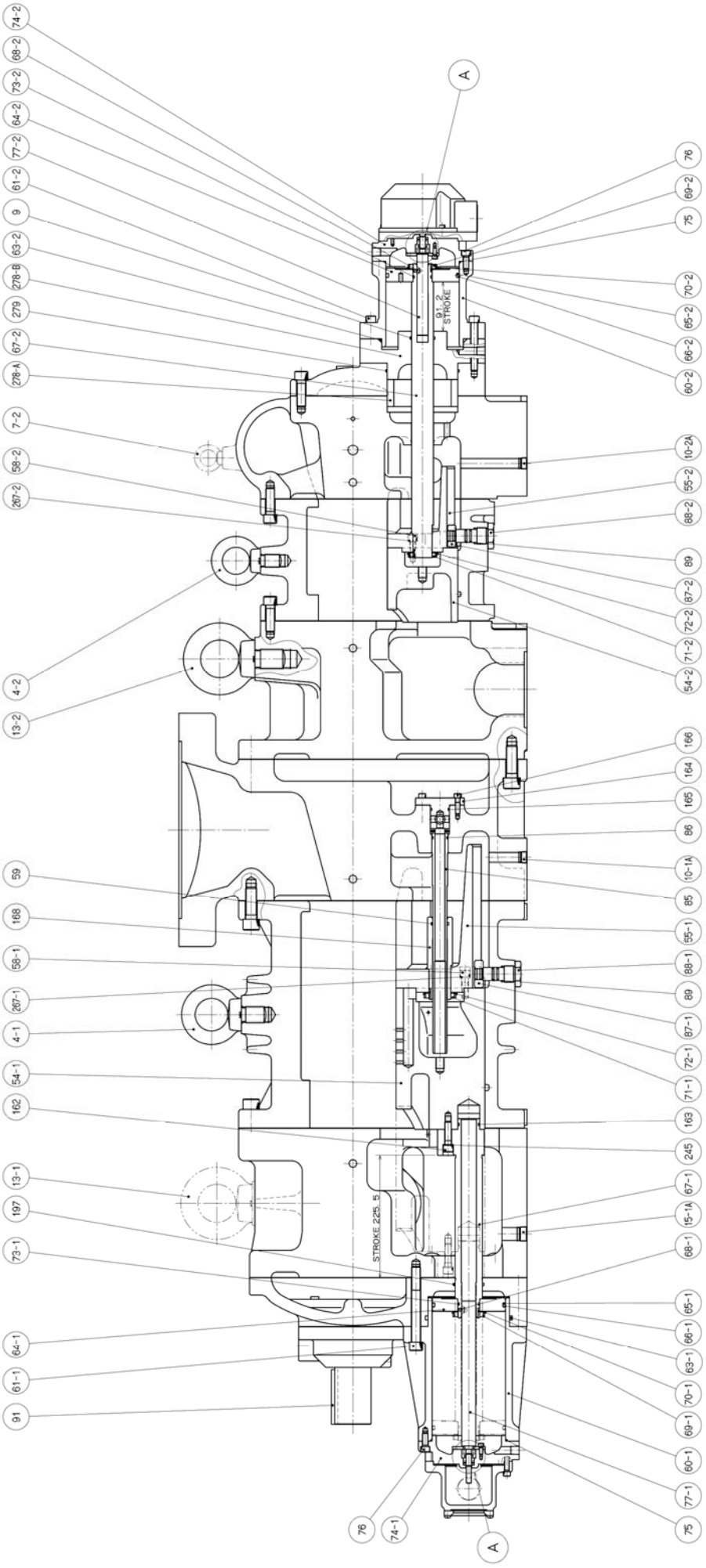


Figure 7-7 2520LSC Assembly Sectional View (Vertical)

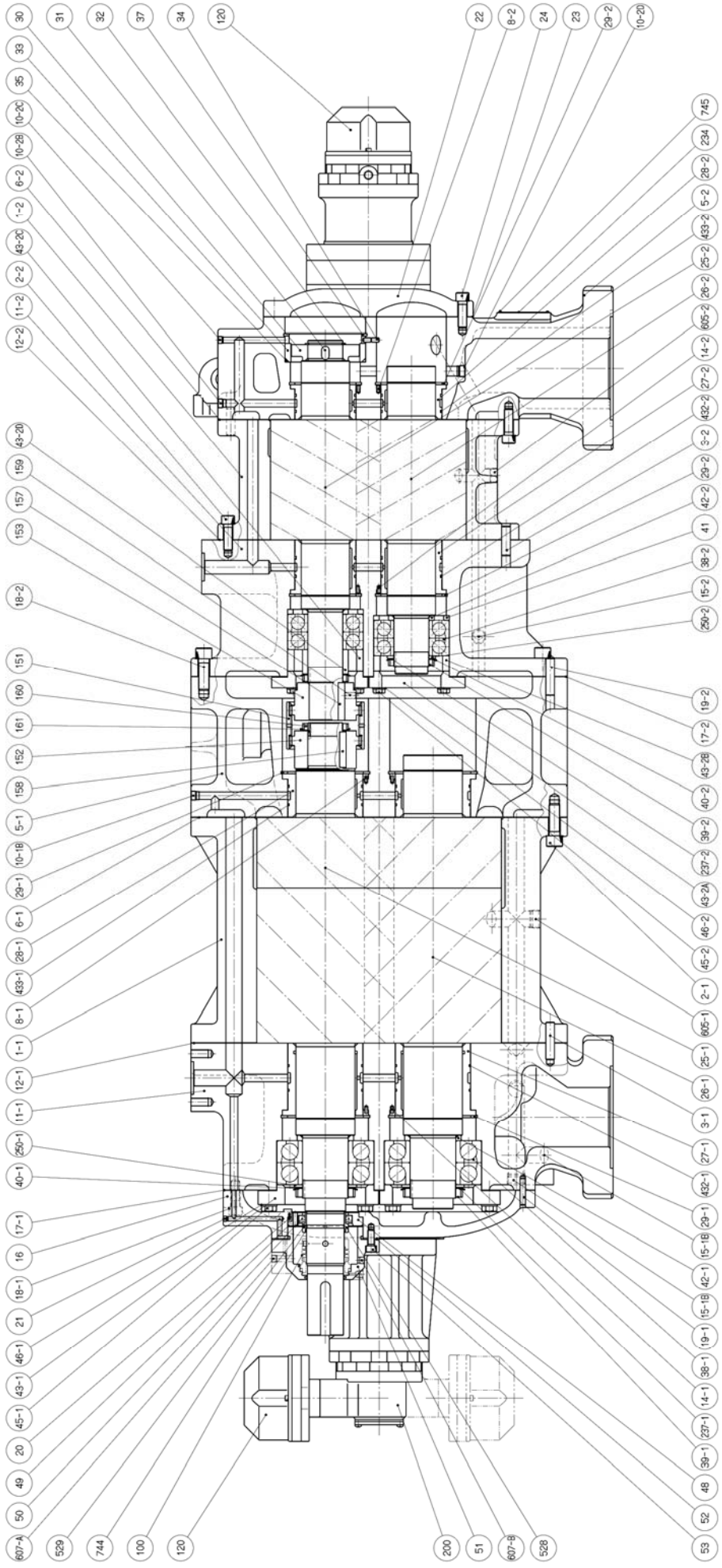


Figure 7-8 2520LSC Assembly Sectional View (Horizontal)

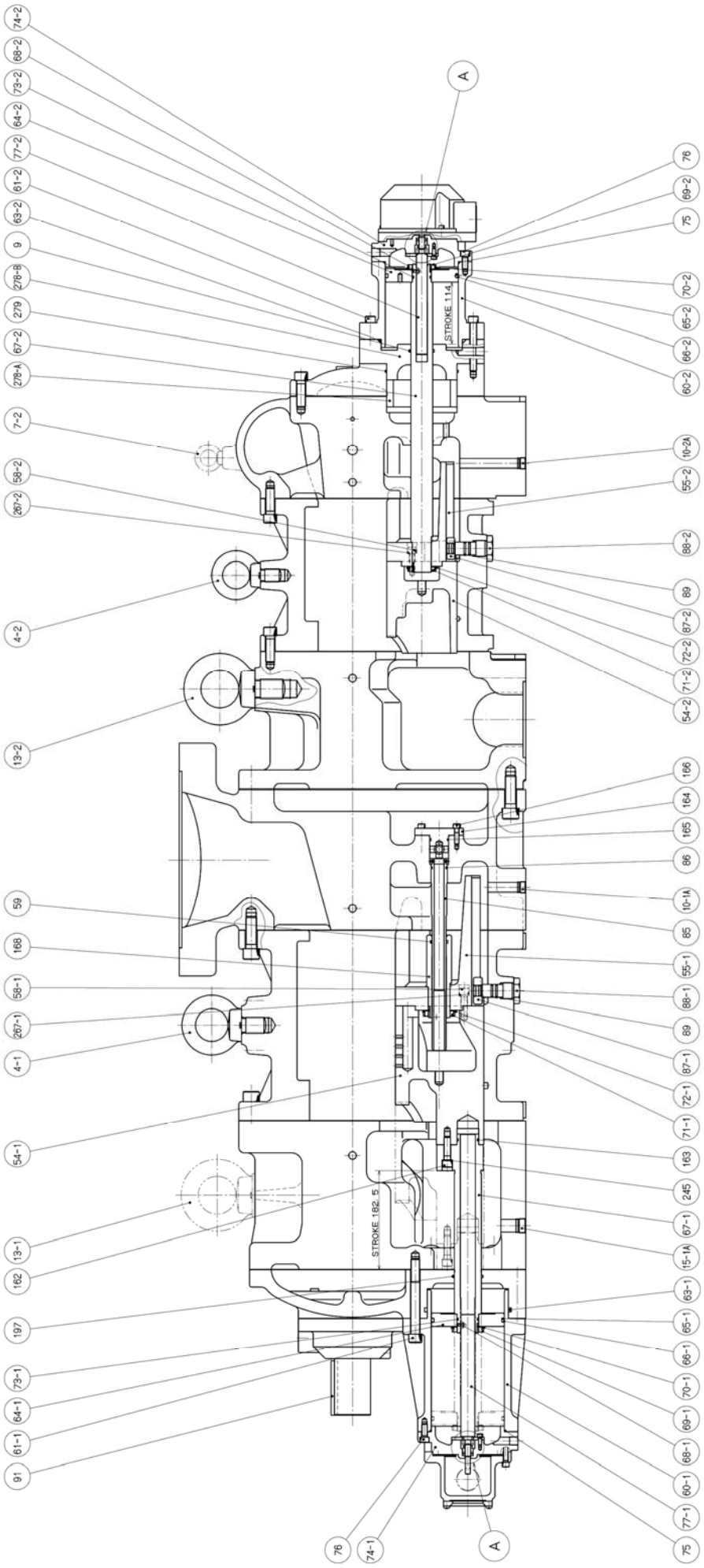


Figure 7-9 2520MMC Assembly Sectional View (Vertical)

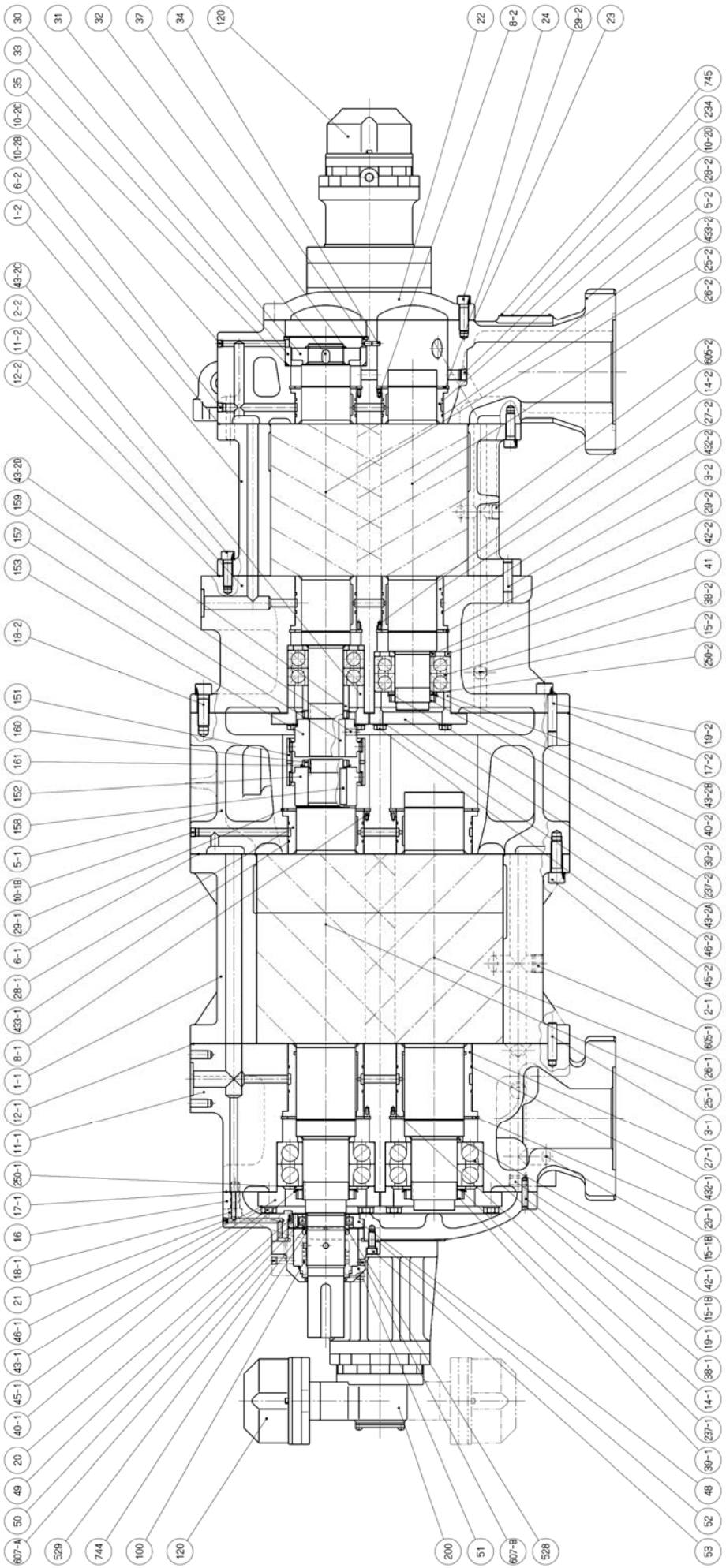


Figure 7-10 2520MMC Assembly Sectional View (Horizontal)

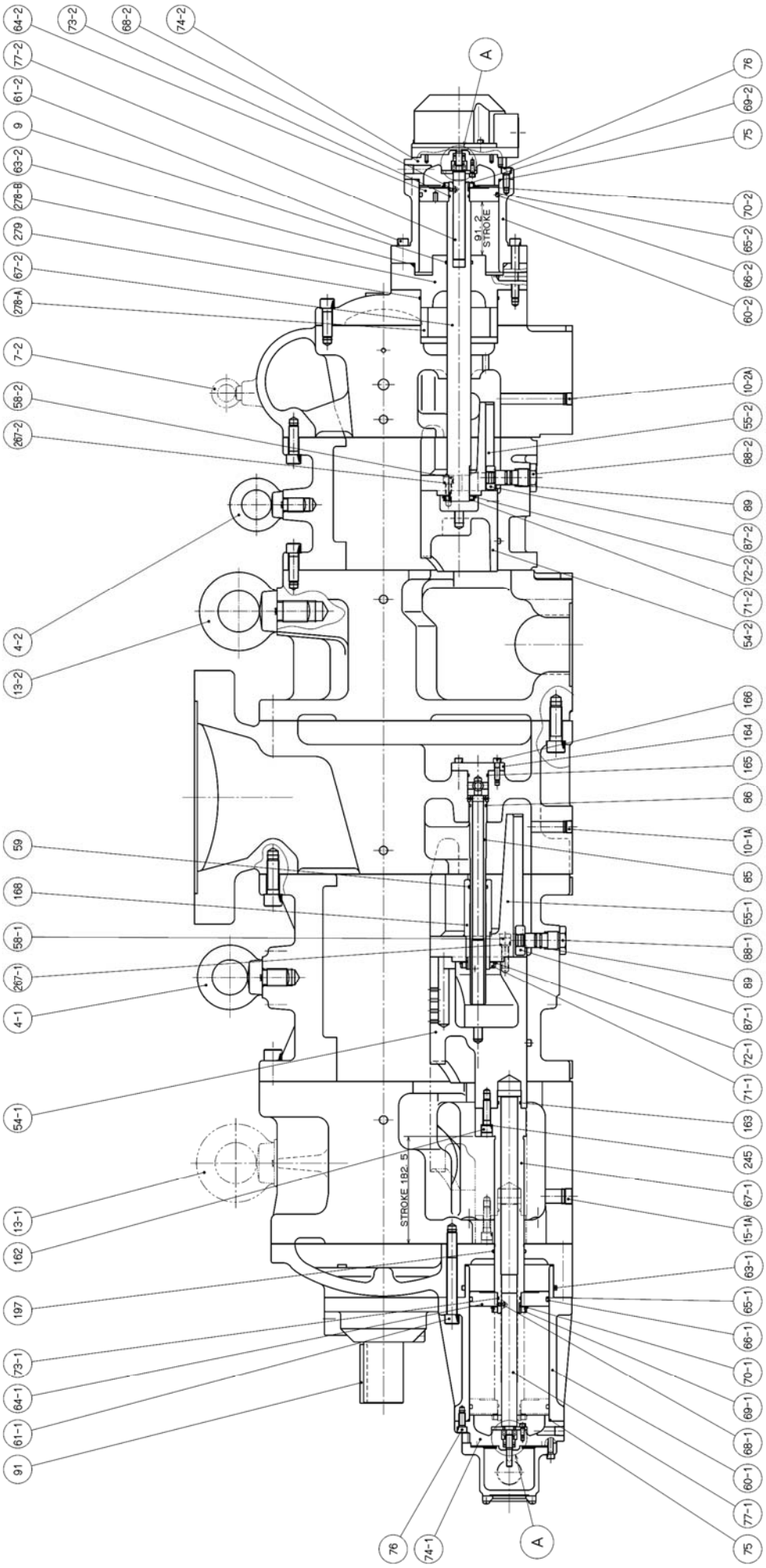


Figure 7-11 2520MSC Assembly Sectional View (Vertical)

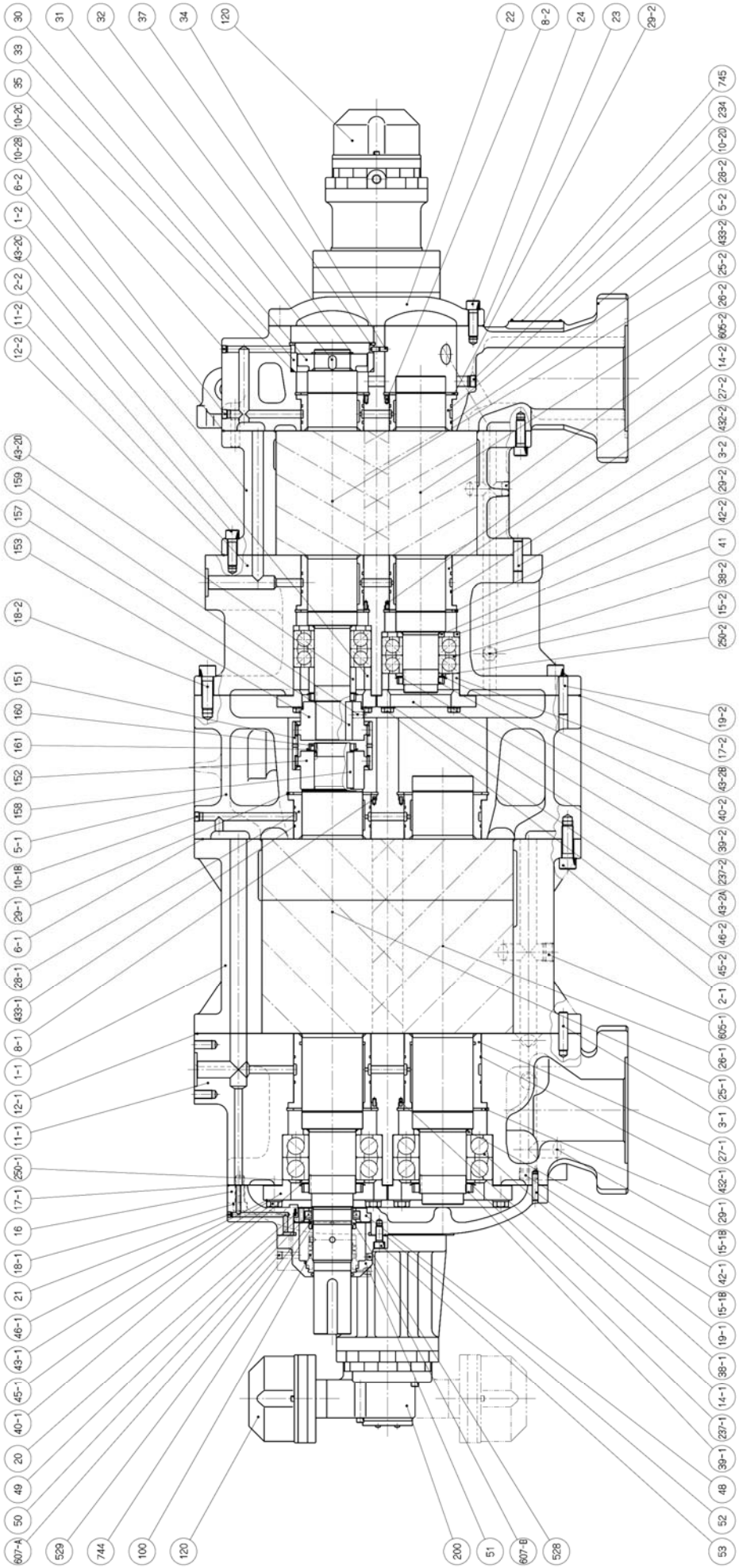


Figure 7-12 2520MSC Assembly Sectional View (Horizontal)

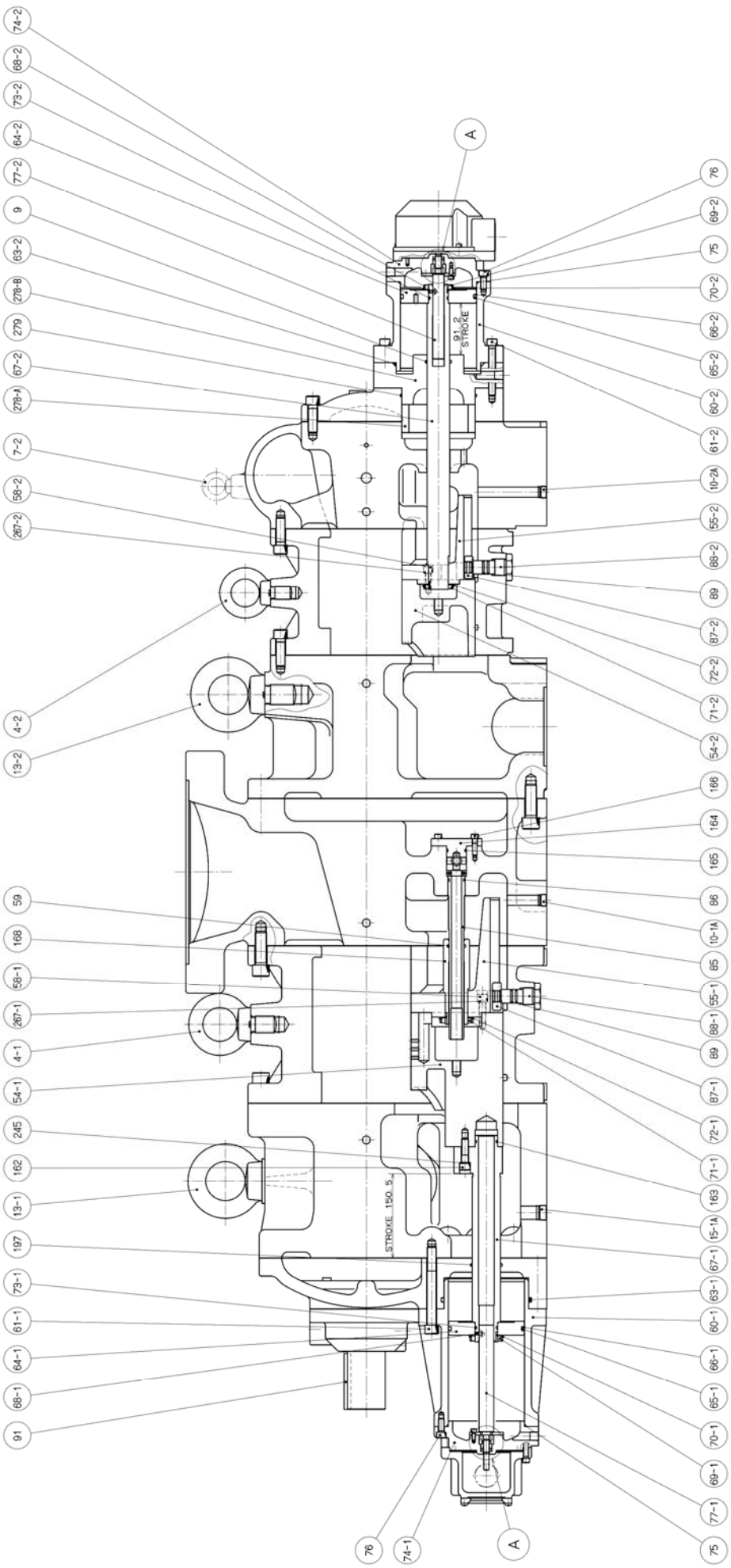


Figure 7-13 2520SSC Assembly Sectional View (Vertical)

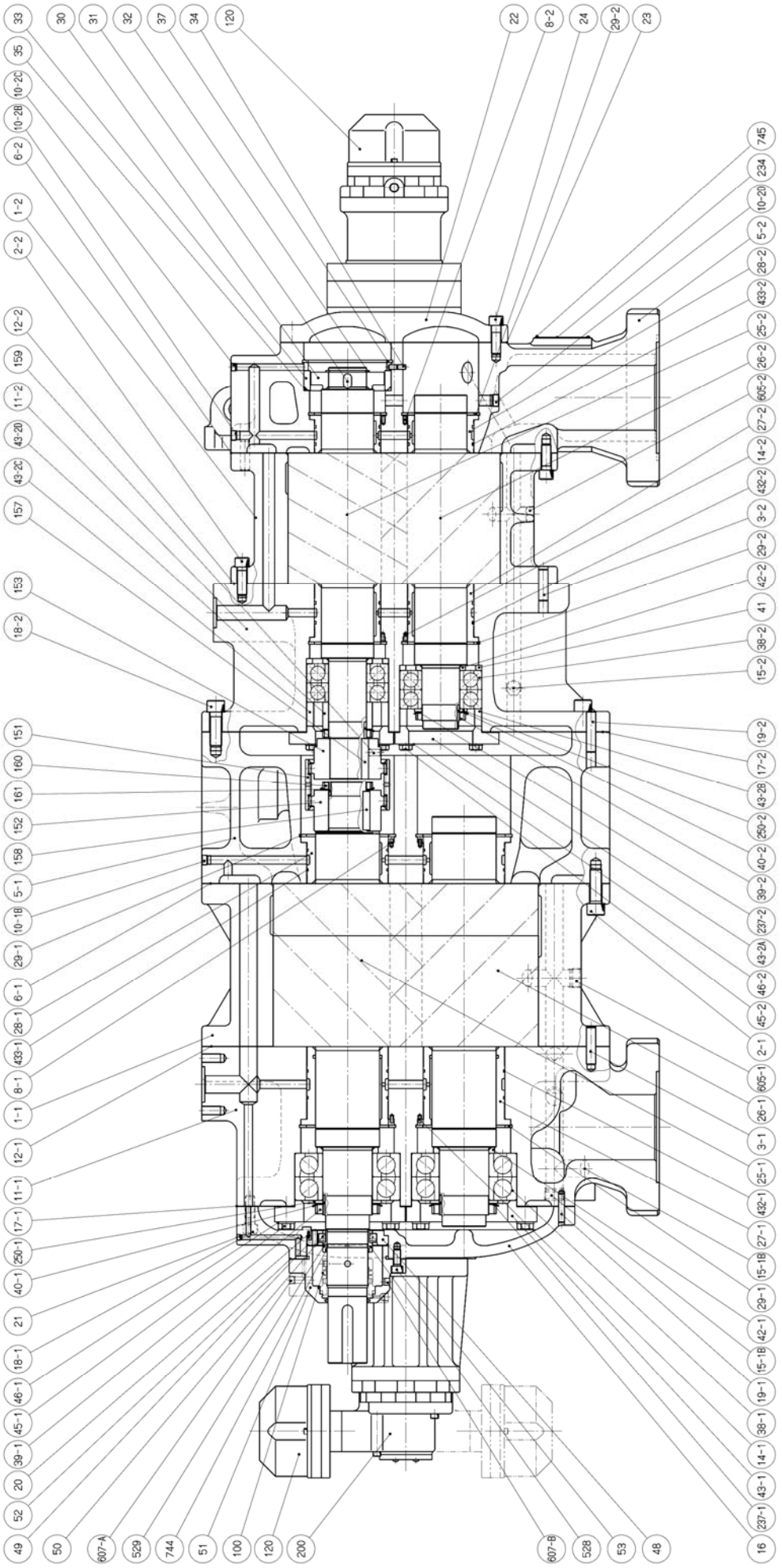
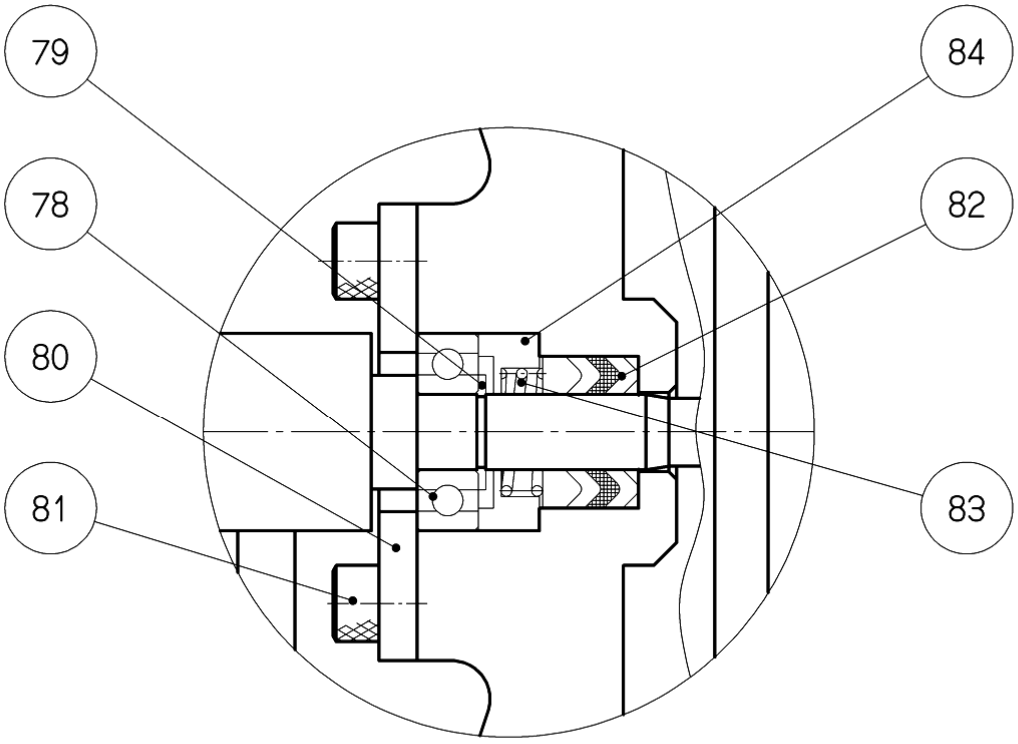


Figure 7-14 2520SSC Assembly Sectional View (Horizontal)



DETAILS A (SCALE 1/1)

No.	Part Name
78	Ball Bearing
79	Snap Ring
80	Bearing Gland
81	Hexagon Socket Head Cap Screw
82	V-ring
83	Spring
84	Retainer, Indicator Cam Spring

Figure 7-15 Assembly Sectional View, Details of A (Common)

7.2 Parts Configuration Table

Table 7-1 Parts Configuration Table

P/N	Part Name	Code No.	Remarks	Qty
1-1	Main Rotor Casing (1)	CS00100-250L	250L**	1 (L*C)
1-1	Main Rotor Casing (1)	CS00100-250M	250M**	1 (M*C)
1-1	Main Rotor Casing (1)	CS00100-250S	250S**	1 (S*C)
1-2	Main Rotor Casing (2)	CS00100-200L	200L**	1 (*LC)
1-2	Main Rotor Casing (2)	CS00100-200M	200M**	1 (*MC)
1-2	Main Rotor Casing (2)	CS00100-200S	200S**	1 (*SC)
2-1	Hexagon Socket Head Cap Screw	NB35420-060	M20×60	44
2-2	Hexagon Socket Head Cap Screw	NB35416-050	M16×50	50
3-1	Alignment Pin	NE2016-070	Φ16×70	4
3-2	Alignment Pin	NE2016-055	Φ16×55	4
4-1	Eye Bolt	NB600-30	M30	1
4-2	Eye Bolt	NB600-24	M24	1
5-1	Suction Cover (1)	CS00500-2520C1	2520**C	1
5-2	Suction Cover (2)	CS00500-2520C2	2520**C	1
6-1	Gasket, Suction Cover (1)	CS00600-250N	250***	1
6-2	Gasket, Suction Cover (2)	CS00600-200N	200***	1
7-1	Eye Bolt	NB600-12	M12	2
7-2	Eye Bolt	NB600-12	M12	1
8-1	Spring Pin (1)	NE3206-012	Φ6×12	2
8-2	Spring Pin (2)	NE3206-012	Φ6×12	2
9	O-ring	PA11-040	JIS B 2401 P40	1
10-1A	Plug	NF06-15	R1/2	3
10-1B	Plug	NF06-10	R3/8	2
10-2	Plug	NF06-008	R1/4	1
11-1	Bearing Head (1)	CS01100-2520C1	2520**C	1
11-2	Bearing Head (2)	CS01100-2520C2	2520**C	1
12-1	Gasket, Bearing Head (1)	CS01200-250N	250***	1
12-2	Gasket, Bearing Head (2)	CS01200-200N	200***	1
13-1	Eye Bolt	NB600-36	M36	1
13-2	Eye Bolt	NB600-36	M36	1
14-1	Spring Pin	NE3206-012	Φ6×12	2
14-2	Spring Pin	NE3206-012	Φ6×12	2
15-1	Plug	NF06-020	R3/4	1
16	Bearing Cover	CS01600-2520C	2520**C	1
17-1	Gasket, Bearing Cover (1)	CS01700-2520C1N	2520**C	1
17-2	Gasket, Bearing Cover (2)	CS01700-2520C2N	2520**C	1
18-1	Hexagon Socket Head Cap Screw	NB35416-050	M16×50	20
18-2	Hexagon Socket Head Cap Screw	NB35420-060	M20×60	33
19-1	Alignment Pin	NE2010-050	Φ10×50	2
19-2	Alignment Pin	NE2016-070	Φ16×70	2
20	Spring Pin	NE3203-010	Φ3×10	1
21	Plug	NF06-004	R1/8	1
22	Balance Piston Cover	CS02200-2520C	2520**C	1
23	Gasket, Balance Piston Cover	CS02300-2520CN	2520**C	1
24	Hexagon Socket Head Cap Screw	NB35416-050	M16×50	18
25-1	Male Rotor (1)	-	2520L*C	1 (L*C)
26-1	Female Rotor (1)			
25-1	Male Rotor (1)	-	2520M*C	1 (M*C)
26-1	Female Rotor (1)			

P/N	Part Name	Code No.	Remarks	Qty
25-1	Male Rotor (1)	-	2520S*C	1 (S*C)
26-1	Female Rotor (1)			
25-2	Male Rotor (2)	-	2520*LC	1 (*LC)
26-2	Female Rotor (2)			
25-2	Male Rotor (2)	-	2520*MC	1 (*MC)
26-2	Female Rotor (2)			
25-2	Male Rotor (2)	-	2520*SC	1 (*SC)
26-2	Female Rotor (2)			
27-1	Main Bearing (1)	CS0270-FRT	250*** with O-ring	2
27-2	Main Bearing (2)	CS0270-ERT	200*** with O-ring	2
28-1	Side Bearing (1)	CS0280-FRT	250*** with O-ring	2
28-2	Side Bearing (2)	CS0280-ERT	200*** with O-ring	2
29-1	Snap Snap Ring (1) C type internal	NG11-160	H160	4
29-2	Snap Ring (2) C type internal	NG11-130	H130	4
30	Balance Piston	CS03000-2520C	2520**C	1
31	Key, Balance Piston	CS03100-200	200***	1
32	Snap Ring C type external	NG12-065	S65	1
33	Sleeve, Balance Piston	CS03300-2520C	2520**C	1
34	Set Screw	NA83608-015	M8×15	2
35	O-ring	PA11-140	JIS B 2401 P140	1
37	Snap Ring C type internal	NG11-150	H150	1
38-1	Thrust Bearing (1)	CS03800-250P	7317B PPS	2
38-2	Thrust Bearing (2)	CS03800-200P	7313B PPS	2
39-1	Lock Nut (1)	NG31-017	AN17	2
39-2	Lock Nut (2)	NG31-013	AN13	2
40-1	Lock Washer (1)	NG32-017	AW17	2
40-2	Lock Washer (2)	NG32-013	AW13	2
41-2	Spacer, Thrust Bearing Outer Race (2)	CS04100-200	200***	2
42-1	Spacer, Thrust Bearing Alignment (1)	CS04200-B250	250***	2
42-2	Spacer, Thrust Bearing Alignment (2)	CS04200-200	200***	2
43-1	Thrust Bearing Gland (1)	CS04300-250S	250***	2
43-2A	Thrust Bearing Gland (2) A	CS04300-200S	200***	2
43-2B	Thrust Bearing Gland (2) B	CS04300-2520C2B	2520**C	1
43-2C	Thrust Bearing Gland (2) C	CS04300-2520C2C	2520**C	1
43-2D	Thrust Bearing Gland (2) D	CS04300-2520C2D	2520**C	1
45-1	Hexagon Head Bolt	NB111016-045	M16×45	8
45-2	Hexagon Head Bolt	NB111012-035	M12×35	8
46-1	Conical Spring Washer (1)	ND150-016	250***	8
46-1	Lock Washer (1) Set (old, plate type)	CS0469-F	250*** 8ps/set	-
46-2	Conical Spring Washer (2)	ND150-012	200***	8
46-2	Lock Washer (2) Set (old, plate type)	CS0469-E	200*** 8ps/set	-
48	Retainer, Oil Seal	CS04800-250VDS	250V**	1
49	O-ring	PA12-135	JIS B 2401 G135	1
50	Oil Seal	CS05010-250VD	SA1J 75×100×13	1
51	Seal Cover	CS05102-250	250***	1
52	Gasket, Seal Cover	CS05200-250N	250***	1
53	Hexagon Socket Head Cap Screw	NB35412-030	M12×30	8
54-1	Unloader Slide Valve (1-1) (L Port)	CS05400-2520****	2520LSC	1 (L*C)
54-1	Unloader Slide Valve (1-1) (M Port)	-	2520LSC	1 (L*C)
54-1	Unloader Slide Valve (1-1) (L Port)	-	2520MSC	1 (M*S)
54-1	Unloader Slide Valve (1-1) (M Port)	-	2520MSC	1 (M*C)
54-1	Unloader Slide Valve (1-1) (L Port)	-	2520SSC	1 (S*C)

P/N	Part Name	Code No.	Remarks	Qty
54-1	Unloader Slide Valve (1-1) (M Port)	-	2520SSC	1 (S*C)
54-2	Unloader Slide Valve (1-2) (L Port)	-	2520LSC	1 (*SC)
54-2	Unloader Slide Valve (1-2) (M Port)	-	2520LSC	1 (*SC)
54-2	Unloader Slide Valve (1-2) (L Port)	-	2520LMC	1 (*MC)
54-2	Unloader Slide Valve (1-2) (M Port)	-	2520LMC	1 (*MC)
54-2	Unloader Slide Valve (1-2) (L Port)	-	2520SLC	1 (*LC)
54-2	Unloader Slide Valve (1-2) (M Port)	-	2520SLC	1 (*LC)
55-1	Unloader Slide Valve (2-1)	-	250L**	1 (L*C)
55-1	Unloader Slide Valve (2-1)	-	250M**	1 (M*C)
55-1	Unloader Slide Valve (2-1)	-	250S**	1 (S*C)
55-2	Unloader Slide Valve (2-2)	-	200L**	1 (*LC)
55-2	Unloader Slide Valve (2-2)	-	200M**	1 (*MC)
55-2	Unloader Slide Valve (2-2)	-	200S**	1 (*SC)
58-1	Hexagon Socket Head Cap Screw	NB35412-040	M12×40	4
58-2	Hexagon Socket Head Cap Screw	NB35410-030	M10×30	4
59	O-ring	PA11-026	JIS B 2401 P26	1
60-1	Unloader Cylinder (1)	CS06000-2520C1	2520LSC	1
60-2	Unloader Cylinder (2)	CS06000-2520C2	2520LSC	1 (*MC/*SC)
60-2	Unloader Cylinder (2)	CS06000-2520SLC	2520SLC	1 (*LC)
61-1	Hexagon Socket Head Cap Screw	NB35416-140	M16×140	9
61-2	Hexagon Socket Head Cap Screw	NB35412-090	M12×90	9
63-1	O-ring	PA12-150	JIS B 2401 G150	1
63-2	O-ring	PA12-150	JIS B 2401 G150	1
64-1	Unloader Piston (1)	CS06400-2520T	2520**C	1
64-2	Unloader Piston (2)	CS06400-200T	200***	1
65-1	O-ring	PA11-125	JIS B 2401 P125	1
65-2	O-ring	PA11-125	JIS B 2401 P125	1
66-1	Cap Seal	CS06600-200	200*** BE125	1
66-2	Cap Seal	CS06600-200	200*** BE125	1
67-1	Push Rod, Unloader Slide Valve (1)	CS06700-2520C1	2520LSC	1
67-2	Push Rod, Unloader Slide Valve (2)	CS06700-2520C2	2520LSC	1 (*SC)
67-2	Push Rod,Unloader Slide Valve (2)	CS06700-2520SLC	2520LMC	1 (*MC)
67-2	Push Rod, Unloader Slide Valve (2)	CS06700-2520C2	2520SLC	1 (*LC)
68-1	Guide Pin	NE2505-012	Φ5×12	1
68-2	Guide Pin	NE2505-012	Φ5×12	1
69-1	Lock Nut (1)	NG31-008	AN08	1
69-2	Lock Nut (2)	NG31-007	AN07	1
70-1	Lock Washer (1)	NG32-008	AW08	1
70-2	Lock Washer (2)	NG32-007	AW07	1
71-1	Lock Nut (1)	NG31-008	AN08	1
71-2	Lock Nut (2)	NG31-007	AN07	1
72-1	Lock Washer (1)	NG32-008	AW08	1
72-2	Lock Washer (2)	NG32-007	AW07	1
73-1	O-ring	PA12-035	JIS B 2401 G35	1
73-2	O-ring	PA12-030	JIS B 2401 G30	1
74-1	Unloader Cover (1)	CS07460-200	200***	1
74-2	Unloader Cover (2)	CS07400-200S	200***	1
75	O-ring	PA12-135	JIS B 2401 G135	2
76	Hexagon Socket Head Cap Screw	NB35410-025	M10×25	16
77-1	Indicator Cam (1)	CS07700-2520C	2520LSC	1 (L*C)
77-1	Indicator Cam (1)	CS07700-200S	2520MSC	1 (M*C)

P/N	Part Name	Code No.	Remarks	Qty
77-1	Indicator Cam (1)	CS07700-2520SSC	2520SSC	1 (S*C)
77-2	Indicator Cam (2)	CS07700-200L	200L**	1 (*LC)
77-2	Indicator Cam (2)	CS07700-200M	200M**	1 (*MC)
77-2	Indicator Cam (2)	CS07700-200S	200S**	1 (*SC)
78	Ball Bearing	CS07800-200	#6000	2
79	Snap Ring C type external	NG12-010	S10	2
80	Bearing Gland	CS08000-200	200***	2
81	Hexagon Socket Head Cap Screw	NB35406-015	M6×15	6
82	V-ring	CS08200-200B	VH10 NBR	2
83	Spring	CS08300-200	200***	2
84	Retainer, Indicator Cam Spring	CS08400-200	200***	2
85	Oil Injection Pipe	CS08500-250LUK	250L**	1 (L*C)
85	Oil Injection Pipe	CS08500-2520USC	2520MSC	1 (M*C)
85	Oil Injection Pipe	CS08500-2520SSK	2520SSC	1 (S*C)
86	O-ring	PA12-025	JIS B 2401 G25	1
87-1	Guide Block (1)	CS08700-250	250***	1
88-1	Stem, Guide Block (1)			1
87-2	Guide Block (2)	CS08700-200	200***	1
88-2	Stem, Guide Block (2)			1
89	O-ring	PA11-020	JIS B 2401 P20	4
91	Shaft Key	CS09100-250	250***	1
92-1	Suction Flange (1) with hole	CS71300-250MK	JIS 20K 250A(10")	-
92-1	Suction Flange (1) without hole	CS71300-P250	JIS 20K 250A(10")	1
92-2	Suction Flange (2) with hole	CS71300-150MK	JIS 20K 150A(6")	-
92-2	Suction Flange (2) without hole	CS71300-P150	JIS 20K 150A(6")	1
93-1	Gasket, Suction Flange (1)	CS71200-250N	JIS 20K 250A(10")	1
93-2	Gasket, Suction Flange (2)	CS71200-150N	JIS 20K 150A(6")	1
94-1	Hexagon Head Bolt	NB12024-065	M24×65	12
94-2	Hexagon Head Bolt	NB12022-055	M22×55	12
95-1	Discharge Flange (1) with hole	CS71300-150MK	JIS 20K 150A(6")	-
95-1	Discharge Flange (1) without hole	CS71300-P150	JIS 20K 150A(6")	1
95-2	Discharge Flange (2) with hole	CS71300-100MK	JIS 20K 100A(4")	-
95-2	Discharge Flange (2) without hole	CS71300-P100	JIS 20K 100A(4")	1
96-1	Gasket, Discharge Flange (1)	CS71200-150N	JIS 20K 150A(6")	1
96-2	Gasket, Discharge Flange (2)	CS71200-100N	JIS 20K 100A(4")	1
97-1	Hexagon Head Bolt	NB12022-055	M22×55	12
97-2	Hexagon Head Bolt	NB12020-055	M20×55	8
100	Mechanical Seal Assembly (BOS-E1)	CS10000-250BE	250V** BOS	-
100	Mechanical Seal Assembly (BBSE)	CS10002-250EBS	BBS-E	1
100	Mechanical Seal Assembly (BBS3)	CS10001-250BBS	BBS3	-
120-1	Unloader Indicator Assembly (1)	CS12000-200F	200***	1
120-2	Unloader Indicator Assembly (2)	CS12000-2016	2016C(2) 20-100 %	1
125	Micro-Switch	CS12500-200	200*** Z15GW	4
127-1	Micro-Switch Cam (1)	CS12700-200F	200*** 0-100 %	1
127-2	Micro-Switch Cam (2)	CS12700-201620	2016C(2) 20-100 %	1
128	Set Screw, Bevel Gear	NA83604-005	M4×5	2
129	Potentiometer 200-1k	CS1299-E10	with lead wire	2
137-1	Indicator Dial (1)	CS13700-200	200***	1
137-2	Indicator Dial (2)	CS13700-2016	2016C(2) 20-100 %	1
-	Gear Coupling Assembly (new)	CS1519-L	151+152+153+159	1

P/N	Part Name	Code No.	Remarks	Qty
151	Driven Sleeve	CS1519-L (same as old and new type)		1
152	Drive Hub			1
153	Driven Hub			1
154	Stopper, Drive Sleeve	CS15400-2520C	Old part of coupling	(2)
155	Stop Ring	-	Old part of coupling	(2)
157	Key, Driven Hub	CS15700-2520CH	FRS-110	1
158	Key, Drive Hub	CS15800-2520CH	FRS-110	1
159	Set Screw	NA83612-020	M12×20 knurled, with anti-loosening	1
160	Lock Nut	NG31-013	AN13	1
161	Lock Washer	NG32-013	AW13	1
162	Hexagon Socket Head Cap Screw	NB35412-045	M12×45	5
163	O-ring	PA12-035	JIS B 2401 G35	1
164	Retainer, Oil Injection Pipe	CS16400-2520C	2520LSC	1
165	O-ring	PA12-030	JIS B 2401 G30	1
166	Hexagon Socket Head Cap Screw	NB35408-030	M8×30	4
168	Pipe Guide, Oil Injection	CS16800-2520C	2520LSC	1
197	O-ring	PA11-050	JIS B 2401 P50	1
200	Fixture Ass'y, Unloader Indicator (1)	CS20000-2520C	2520LSC(1)	1
200A	Fixture, Unloader Indicator (A)	CS20000-2520CA	2520LSC	1
200B	Fixture, Unloader Indicator (B)	CS20000-2520CB	2520LSC	1
201	Bevel Gear (1)	CS20100-1612C9	1612LSC (Φ9)	1
202	Bevel Gear (2)	CS20100-1612C6	1612LSC(Φ6)	1
206	Glass Gland, Unloader Indicator	CS20600-1612	1612LSC	1
208	Shaft, Unloader Indicator	CS12200-2520	2520LSC	1
208A	Snap Ring, Unloader Indicator Shaft	NG12-010	S10 C type external	2
208B	Bearing, Unloader Indicator Shaft	CS16460-200	#6000LL	2
210	Cross-recessed and Pan Head Screw	NB35405-015	M5×15	4
212A	Hexagon Socket Head Cap Screw	NB35405-030	M8×30	2
212B	Hexagon Socket Head Cap Screw	NB35408-095	M8×95	2
212C	Hexagon Socket Head Cap Screw	NB35408-020	M8×20	4
212D	Spring Washer	ND320-008	For M8	8
215-1	Flange, Lubricating Oil Supply (1) without hole	CS71300-025	JIS 20K 25A(1")	1
215-2	Flange, Lubricating Oil Supply (2) without hole	CS71300-020	JIS 20K 20A(3/4")	1
216-1	Gasket, Lubricating Oil Supply Flange (1)	CS71200-025N	JIS 20K 25A(1")	1
216-2	Gasket, Lubricating Oil Supply Flange (2)	CS71200-020N	JIS 20K 20A(3/4")	1
217-1	Hexagon Head Bolt	NB12016-045	M16×45	4
217-2	Hexagon Head Bolt	NB12012-035	M12×35	4
218	Flange, Injection Oil Supply without hole	CS71300-015	JIS 20K 15A(1/2")	1
219	Gasket, Injection Oil Supply Flange	CS71200-015N	JIS 20K 15A(1/2")	1
220	Hexagon Head Bolt	NB111012-035	M12×35	4
237-1	Torsional Slip Washer (1)	CS23700-250	250***	2
237-2	Torsional Slip Washer (2)	CS23700-200	200***	2
245	Spring Washer	ND330-12	M12	5
250-1	Thrust Bearing Washer (1)	CS25000-250	250***	2
250-2	Thrust Bearing Washer (2)	CS25000-200	200***	1
267-1	Spring Washer, Hexagon Socket Head Cap Screw	ND330-12	M12	4
267-2	Spring Washer, Hexagon Socket Head Cap Screw	ND330-10	M10	4
278A	Cylinder Guide, Unloader (A)	CS27800-2520CA	2520LSC	1

P/N	Part Name	Code No.	Remarks	Qty
278B	Cylinder Guide, Unloader (B)	CS27800-2520LMS	2520*MC, 2520*LC	1 (*LC/*MC)
278B	Cylinder Guide, Unloader (B)	CS27800-2520S	2520*SC	1 (*SC))
279	O-ring	PA12-130	JIS B 2401 G130	1
432-1	O-ring	PA12-130	JIS B 2401 G130	4
432-2	O-ring (Old JIS W 1516 G22)	PA62-022	AS568A-244	4
433-1	O-ring	PA12-130	JISB2401 1A G130	4
433-2	O-ring (Old JIS W 1516 G22)	PA62-022	AS568A-244	4
528	Sleeve, Oil Seal	CS52800-250VD	250V**	1
528	Sleeve with O-ring, Oil Seal	CS52809-250VD	250V**	1
529	Set Screw	NA83606-008	M6×8	2
605-1	Plug	NF06-020	R3/4	1
605-2	Plug	NF06-025	R 1"	1
607	Plug	NF06-008	R1/4	2
744	O-ring	PA12-070	JIS B 2401 G70	1

【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.

CAUTION

- **The Code No. 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 Code No. 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.
- **The SLC and SMC models are excluded from the above tables. If you need any relevant information, please contact our sales offices or service centers.**

7.3 Tightening Torques for Bolts and Nuts

Table 7-2 List of Tightening Torques

■ Hexagon Socket Head Cap Screw

P/N	What is Tightened	Tightening Torque		Qty.	Size
		N·m	kgf·cm		
2-1	Rotor Casing (1), Suction Cover (1) and Bearing Head (1)	450	4500	44	M20×60
2-2	Rotor Casing (2), Suction Cover (2), Bearing Head (2)	240	2400	50	M16×50
18-1	Bearing Cover and Bearing Head (1)	240	2400	20	M16×50
18-2	Suction Cover (1) and Bearing Head (2)	450	4500	33	M20×60
24	Balance Piston Cover and Suction Cover (2)	240	2400	18	M16×50
53	Seal Cover and Bearing Cover	90	900	8	M12×30
58-1	For Securing Unloader Slide Valve	90	900	4	M12×40
58-2	For Securing Unloader Slide Valve	50	500	4	M10×30
61-1	Unloader Cylinder (1) and Bearing Cover	240	2400	9	M16×140
61-2	Unloader Cylinder (2) and Balance Piston Cover	90	900	9	M12×90
76	Unloader Cover (1), (2) and Unloader Cylinder (1), (2)	50	500	16	M10×25
81	Bearing Gland	10	100	6	M6×15
162	Push Rod, Unloader Slide Valve (1)	90	900	5	M12×45
166	Oil Injection Pipe Retainer	25	250	4	M8×30

■ Hexagon Head Bolt

P/N	What is Tightened	Tightening Torque		Qty.	Size
		N·m	kgf·cm		
45-1	Thrust Bearing Gland (1)	60	600	8	M16×45
45-2	Thrust Bearing Gland (2)	50	500	8	M12×35
94-1	Suction Flange (1) JIS20K 150A	750	7500	12	M24×65
94-2	Suction Flange (intermediate pipe) (2) JIS20K 150A	240	2400	12	M22×55
97-1	Discharge Flange (intermediate pipe) (1) JIS20K 150A	240	2400	12	M22×55
97-2	Discharge Flange (2) JIS20K 100A	180	1800	8	M20×55
217-1	Journal Lubricant Supply Flange (1) JIS20K 25A	120	1200	4	M16×45
217-2	Journal Lubricant Supply Flange (2) JIS20K 20A	70	700	4	M12×35
220	Lubricant Injection Flange JIS20K 15A	70	700	4	M12×35

■ Lock Nut

P/N	What is Tightened	Tightening Torque (N·m)		Qty.	Size
		Standard	Maximum		
39-1	Thrust Bearing (1) **Note 1**	1186	1483	2	AN17
39-2	Thrust Bearing (2) **Note 1**	522	653	2	AN13
69-1	Unloader Piston (1)	140	-	1	AN08
69-2	Unloader Piston (2)	120	-	1	AN07
71-1	Unloader Slide Valve (1-1)	90	113	1	AN08
71-2	Unloader Slide Valve (1-2)	79	99	1	AN07
160	Gear Coupling Drive Hub **Note 1**	522	653	1	AN13

Note 1: 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.

■ 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 7-16.
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 (2016**C [39-1], [39-2] and [160]: 30° to 40°(first time tightening), 20° to 30°(second time tightening). When measuring the angle, use an angle gauge which is set to the diameter of rotor shaft.

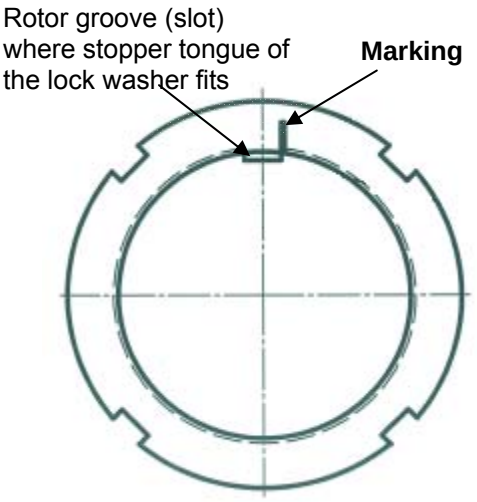


Figure 7-16 Position where mark is put

Table 7-3 Tightening Angles Specified for Lock Nuts of Rotor

	Model	Angle range
First time tightening	200 (High-stage) 250 (Low-stage)	30° to 40°
Second time tightening	200 (High-stage) 250 (Low-stage)	20° to 30°

* When tightening lock nut, tightening start position differs between the first time tightening and the tightening for the second time or after. Therefore, angle ranges are specified also for the second time tightening.

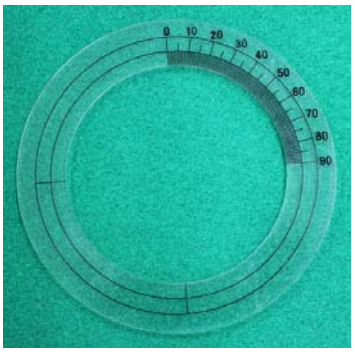


Photo 139 Angle gauge (example)

7.4 About the O-rings Used

7.4.1 List of O-rings Used

Table 7-4 List of O-rings Used

P/N	Location		Designation
	Installation Part	Functional Description (Conventional)	
9	Suction Cover (2)	Rod, Push (2)	P40
35	Sleeve, Balance Piston	Same as left	P140
49	Seal Retainer	Same as left	G135
59	Pipe Guide, Oil Injection	Pipe, Oil Injection	P26
63-1	Cover, Bearing	Cylinder, Unloader (1)	G150
63-2	Guide, Unloader B	Cylinder, Unloader (2)	G150
65-1	Unloader Piston (1)	Same as left	P125
65-2	Unloader Piston (2)	Same as left	P125
73-1	Rod, Unloader Push (1)	Unloader Piston (1)	G35
73-2	Rod, Unloader Push (2)	Unloader Piston (2)	G30
75	Unloader Cylinder Cover (1), (2)	Same as left	G135
86	Oil Injection Pipe	Same as left	G25
89	Stem, Guide Block (1), (2)	Same as left	P20
163	Unloader Slide Valve (1)	Same as left	G35
165	Retainer, Oil Injection Pipe	Same as left	G30
197	Cover, Bearing	Rod, Unloader Push (1)	P50
279	Balance, Piston Cover	Guide, Unloader Cylinder B	G130
432-1	Main Bearing (1)	Same as left	G130
432-2	Main Bearing (2)	Same as left	AS568A-244
433-1	Side Bearing (1)	Same as left	G130
433-2	Side Bearing (2)	Same as left	AS568A-244
744	Sleeve, Oil Seal	Same as left	G70

■ Designation codes are based on JIS B 2401 except AS568A-244.

■ "Installation Part" refers to a component with groove or tapered portion for installing an O-ring.

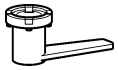
7.4.2 O-ring Materials Used for Screw Compressor

Table 7-5 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
Trifluoromethane (R23)	FKM
Propane	
Propylene	
Natural gas	
City gas	
Helium	

7.5 Tools for Disassembly

Table 7-6 List of Standard 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
Screwdriver		(Flat blade) 75 mm		SG111-075
Snap ring pliers external		For shafts	ST-1	SG311-01
			ST-3	SG311-03
Snap ring pliers internal		For holes	RT-4	SG312-04
Eye bolt		M8×200 2 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
Lock nut wrench		AN-07		SAS111-07
		AN-08		SAS111-08
		AN-13		SAS111-13
		AN-17		SAS111-17
Torque wrench		5-25 N·m		-
		20-100 N·m		SG132-0900
		40-280 N·m		SG132-2800
		200-800 N·m		-

Contact Information

Sales Offices/Service Centers

■ Sales Offices in Japan (as of April 21, 2015)

Description	Location	Phone/Fax
Head Office	3–14–15 BOTAN KOTO-KU, TOKYO 135-8482	TEL: 03-3642-8181 FAX: 03-3643-7094
Hokkaido Branch	2-5-1, 3-JYO NIJYUUYONKEN NISHI-KU, SAPPORO-CITY, HOKKAIDO 063-0803	TEL: 011-631-2052 FAX: 011-631-2053
Tohoku Branch	8-72, ROKUTYONO-MEMINAMI-MACHI, WAKABAYASHI-KU, SENDAI-CITY, MIYAGI 984-0013	TEL: 022-288-5001 FAX: 022-288-5155
Kanto Branch	3–14–15 BOTAN, KOTO-KU, TOKYO 135-8482	TEL: 03-3642-8968 FAX: 03-3641-8468
Chubu Branch	2-9-6, MARUNOUCHI, NAKA-KU, NAGOYA CITY, AICHI 460-0002	TEL: 052-218-3307 FAX: 052-218-3308
Kansai Branch	1-4-27, EBIE, FUKUSHIMA-KU, OSAKA CITY, OSAKA 553-0001	TEL: 06-4795-6000 FAX: 06-4795-6033
Chugoku Branch	2-3-40, TAKAYADAI, HIGASHIHIROSHIMA CITY, HIROSHIMA 739-2117	TEL: 082-491-1830 FAX: 082-491-1838
Shikoku Branch	410-1, OTAKAMI-MACHI, TAKAMATSU-CITY, KAGAWA 761-2117	TEL: 087-868-3400 FAX: 087-868-3399
Kyushu Branch	FUKUOKA-FUJILAND-BUILD. 10F, 2-3, NAKASHIMA-MACHI, NAKASU, HAKATA-KU, FUKUOKA CITY, FUKUOKA 810-0802	TEL: 092-262-0016 FAX: 092-262-0115

■ Manufacturing Bases in Japan (as of April 21, 2015)

Description	Location	Phone/Fax
Moriya Plant	2000, TATSUZAWA MORIYA-CITY, IBARAKI 302-0118	TEL: 0297-48-1361 FAX: 0297-48-5269
Higashi-Hiroshima Plant	2-3-40, TAKAYADAI, HIGASHIHIROSHIMA CITY, HIROSHIMA 739-2117	TEL: 082-491-1828 FAX: 082-491-1838

■ Global Network (as of April 21, 2015)

Description	Location	Telephone and facsimile No.
NORTH AMERICA		
MAYEKAWA CANADA INC. (VANCOUVER OFFICE)	12180 RIVERSIDE WAY, RICHMOND, B.C., V6W 1K5, CANADA	TEL: (1) 604-270-1544 FAX: (1) 604-270-9870
MAYEKAWA CANADA INC. (TORONTO OFFICE)	1745 BONHILL ROAD, UNIT #6&7 MISSISSAUGA, ONTARIO, L5T 1C1, CANADA	TEL: (1) 905-564-0664 FAX: (1) 905-564-7614
MAYEKAWA CANADA INC. (CALGARY OFFICE)	4525 6A STREET N.E., CALGARY, ALBERTA, T2E 4B2, CANADA	TEL: (1) 403-250-1554 FAX: (1) 403-250-1504
MAYEKAWA U.S.A. INC. (CHICAGO OFFICE)	1850 JARVICE AVENUE, ELK GROVE VILLAGE, IL 60007, U.S.A.	TEL: (1) 773-516-5070 FAX: (1) 773-516-5071
MAYEKAWA U.S.A. INC. (NEW YORK OFFICE)	250 WEST NYACK ROAD,SUITE 230,WEST NYACK, NY 10994, U.S.A.	TEL: (1) 914-301-9770 FAX: (1) 914-332-0400
MAYEKAWA U.S.A. INC. (HEAD QUARTERS) (NASHVILLE PLANT)	130 SMART PARK DRIVE, LEBANON, TN 37090, U.S.A.	TEL: (1) 615-773-2859 FAX: (1) 615-444-1995
MAYEKAWA U.S.A. INC. (LA OFFICE)	19475 GRAMERCY PLACE, TORRANCE, CA 90501, U.S.A.	TEL: (1) 310-328-1362 FAX: (1) 310-782-6759
MAYEKAWA U.S.A. INC. (SEATTLE OFFICE)	2615 W CASINO ROAD, UNIT-3D, EVERETT, WA 98204, U.S.A.	TEL: (1) 425-645-9400 FAX: (1) 425-353-3344
MAYEKAWA U.S.A. INC. (COVINA OFFICE)	1272 CENTER COURT DR, SUITE 106, COVINA, CA 91724, U.S.A.	TEL: (1) 626-598-5030 FAX: (1) -
MAYEKAWA U.S.A.INC. (SAN ANTONIO OFFICE)	1219 SAFARI, SAN ANTONIO, TX 78216, U.S.A.	TEL: (1) 210-599-4536 FAX: (1) 210-599-4538
MAYEKAWA U.S.A. INC. (YORK OFFICE)	3395 FARMTRAIL ROAD YORK, PA 17406, U.S.A.	TEL: (1) 717-779-0138 FAX: (1) 717-779-0109
MAYEKAWA U.S.A. INC. CHEMICAL PROCESS DIVISION (LA OFFICE & ANUFACTURING)	19475 GRAMERCY PLACE, TORRANCE, CA 90501, U.S.A.	TEL: (1) 310-328-6279 FAX: (1) 310-328-8487
MAYEKAWA U.S.A. INC. CHEMICAL PROCESS DIVISION (HUSTON SERVICE OFFICE)	3222 PASADENA FREEWAY PASADENA, TX 77503, U.S.A.	TEL: (1) 281-447-2599 FAX: (1) 281-447-6623
MAYEKAWA U.S.A. INC. CHEMICAL PROCESS DIVISION (HUSTON SALES & ENGINEERING OFFICE)	1770 ST. JAMES PLACE, SUITE 408, HOUSTON, TX 77056, U.S.A.	TEL: (1) 832-547-2320
EUROPE and AFRICA		
N.V.MAYEKAWA EUROPE S.A. (HEAD OFFICE, FACTORY)	LEUVENSESTEENWEG 605, 1930 ZAVENTEM, BELGIUM	TEL: (32) 2-757-9075 FAX: (32) 2-757-9023
MAYEKAWA DEUTSCHLAND GMBH	UNTER-BOHNHOF-STRASSE 38A, D-82110 GERMERING, DEUTSCHLAND	TEL:(49) 89-5527-989-0 FAX:(49)89-5527-989-19
MAYEKAWA DEUTSCHLAND GMBH (HUMBURG OFFICE)	WEIDESTRASSE 122A, 22083 HAMBURG, DEUTSCHLAND	TEL:(49)40-2788-9149-0 FAX:(49)40-2788-9149-9
N.V.MAYEKAWA EUROPE S.A.(UK)	16 OAKHURST GARDENS, BEXLEYHEATH, KENT DA7 5JP, UNITED KINGDOM	TEL: (44) 1322-433558 FAX: (44) 1322-433164

Description	Location	Telephone and facsimile No.
MAYEKAWA. S.L.	CALLE MONTEVIDEO 5, NAVE 13 POL. INDUSTRIAL CAMPORROSO 28806 ALCALA DE HENARES, MADRID, SPAIN	TEL: (34) 91-830-0392 FAX: (34) 91-830-0397
MAYEKAWA FRANCAISE SARL	9, RUE MICHAEL FARADAY, 78180 MONTIGNY-LE-BRETONNEUX, FRANCE	TEL: (33) 1-30-58-26-00 FAX: (33) 1-30-58-19-37
N.V. MAYEKAWA EUROPE MOSCOW REPRESENTATIVE OFFICE	KOROVY VAL ST., 7, OFFICE 228, 119049, MOSCOW,RUSSIA	TEL: (7) 499-230-01-76 FAX: (7) 499-230-21-12
MAYEKAWA-SVEDAN SP. Z 0.0. (MPL)	UL. DRUSKIENNICKA 8/10, 60-476 POZNAN, POLAND	TEL: (48) 61-842-0738 FAX: (48) 61-848-5837
MAYEKAWA INTERTEC AG	ROSENBERGSTRASSE 31, CH-6300 ZUG, SWITZERLAND	TEL: (41) 41-726-8626 FAX: (41) 41-726-8620
MAYEKAWA INTERTEC AG - EGYPT	P.O.BOX 341 NEW CAIRO - 5th SETTLEMENT, NORTH 90th St. THE 47th BUILDING - 4th FLOOR, OFFICE 419, EGYPT	TEL: (20) 22-503-2925 FAX: (20) 22-503-2801
MAYEKAWA INTERTECH AG - ABU DHABI	ALI & SONS BUSINESS CENTER OFFICE No.201 ALI KHALFAN RASHED AL MUTAWA AL DHAHIRI BLDG. PLOT No.29, AL AIN ROAD, UMM AL NAR, ABU DHABI U.A.E. P.O. BOX 129865	TEL: (971) 2-5102-451 FAX: (971) 2-5102-571
MAYEKAWA MIDDLE EAST FZCO	P.O.BOX 61349, PBU: RA08-UC05, JEBEL ALI FREE ZONE, DUBAI, U.A.E.	TEL: (971) 4-888-6363 FAX: (971) 4-888-6373
MAYEKAWA TURKEY SOGUTMA SANAYI VE TICARET LIMITED SIRKETI	ISTANBUL DUNYA TICARET MERKEZI A-2 BLOK KAT 10 No:325 YESILKOY 34149, ISTANBUL, TURKEY	TEL: (90) 212-4653631 FAX: (90) 212-4653635
N.V. MAYEKAWA EUROPE S.A. （BULGARIA）	24,KAMEN ANDREEV STR. 1303, SOFIA, BULGARIA	TEL: (359) 2-8910130 FAX: (359) 2-8910131
MAYEKAWA ITALIA S.R.L. （MILANO OFFICE）	VIA RICCARDO LOMBARDI 19/12, 20153 MILANO, ITALY	TEL: (39) 02-4892-9159 FAX: (39) 02-453-1728
MAYEKAWA ITALIA S.R.L. （BOLOGNA OFFICE）	VIA PRADAZZO 7,40012 CALDERARA DI RENO, BOLOGNA, ITALY	TEL: (39) 051-726-364 FAX: (39) 051-726-804
MAYEKAWA SOUTH AFRICA (PTY) LTD. (CAPE TOWN OFFICE)	WEST END, UNIT 3 PRIME PARK, PRINTERS WAY, MONTAGUE GARDENS 7441, REPUBLIC OF SOUTH AFRICA	TEL: (27) 21-551-1434 FAX: (27) 86-546-3618
ASIA PACIFIC		
MAYEKAWA AUSTRALIA PTY.LTD.	UNIT 2, 44 MCCAULEY STREET MATRAVILLE NSW 2036, AUSTRALIA	TEL: (61) 2-9695-7000 FAX: (61) 2-9695-7001
MAYEKAWA AUSTRALIA PTY. LTD.(NEW ZEALAND OFFICE)	UNIT 2, 30 TUI STREET, OTAHUHU, AUCKLAND 2024, NEW ZEALAND	TEL: (64) 9-276-2305 FAX: (64) 9-276-2306
MAYEKAWA INDIA PVT.LTD. (GURGAON OFFICE)	545, 1st FLOOR, SECTOR-20,VILLAGE DUNDAHERA GURAGAON-122016, HARYANA, INDIA	TEL: (91) 12-4651-0181 FAX: (91) 12-4651-0188

Description	Location	Telephone and facsimile No.
P.T.MAYEKAWA INDONESIA	GRAHA PRATAMA BUILDING, 9TH FLOOR JL. M.T. HARYONO KAV.15 JAKARTA 12810, INDONESIA	TEL: (62) 21-8370-9484 FAX: (62) 21-8370-9483
P.T.MAYEKAWA INDONESIA (MEDAN OFFICE)	JL. SUTRISNO No.274 MEDAN-20215, INDONESIA	TEL: (62) 61-7323627 FAX: (62) 61-7358848
P.T.MAYEKAWA INDONESIA (SURABAYA OFFICE)	BUMI MANDIARI BUILDING, 7TH FLOOR SUITE 702B, JL. JEND. BASUKI RACHMAT No. 129-137, SURABAYA-INDONESIA	TEL: (62) 31-531-6613 FAX: (62) 31-532-4341
MAYEKAWA (M) SDN. BHD.	No.3, JALAN PJU 3/50, SUNWAY DAMANSARA TECHNOLOGY PARK, 47810 PETALING JAYA, SELANGOR, MALAYSIA	TEL: (60) 3-78051406 FAX: (60) 3-78051409
MAYEKAWA PHILIPPINES CORP.	4/F UNIT A AND B SUNTREE TOWER, 13 MERALCO AVENUE, SAN ANTONIO, ORTIGAS CENTER, PASIG CITY 1605, PHILIPPINES	TEL: (63) 2-706-0473 FAX: (63) 2-706-0475
MAYEKAWA PHILIPPINES CORP. (GENARAL SANTOS OFFICE)	ROOM 4, LEAH DAPROZA BUILDING FISCAL DAPROZA AVENUE GENERAL SANTOS CITY 9500, PHILIPPINES	TEL: (63) 83-552-3282 FAX: (63) 83-301-2698
MAYEKAWA SINGAPORE PTE.LTD.	6 TAGORE LANE SINGAPORE 787470	TEL: (65) 6451-1565 FAX: (65) 6451-4932
MAYEKAWA (TAIWAN) CO., LTD. (KAOHSIUNG OFFICE)	No.2-1,XINZHAN RD.,QIANZHEN DIST., KAOHSIUNG CITY,80672 TAIWAN , ROC	TEL: (886) 7-821-0886 FAX: (886) 7-821-4688
MAYEKAWA (TAIWAN) CO., LTD. (CHEMICAL DEPARTMENT)	1F., NO.2, SHIN JANN ROAD, CHIEN CHEN DIST., KAOHSIUNG, TAIWAN 80672, ROC	TEL: (886) 7-812-7709 FAX: (886) 7-812-9019
MAYEKAWA (TAIWAN) CO., LTD. (TAIPEI HEAD OFFICE)	8F, NO, 421, SUNG-SHAN ROAD, TAIPEI, TAIWAN 11083, REP. OF CHINA	TEL: (886) 2-2727-9711 FAX: (886) 2-2759-8484
MAYEKAWA (TAIWAN) CO., LTD. (TAICHUNG BRANCH)	NO. 80-2, SEC.3, HUANJUNG RD., TAICHUNG, TAIWAN, 40755, REP. OF CHINA	TEL: (886) 4-2251-4128 FAX: (886) 4-2251-4129
MAYEKAWA CHINA INDUSTRIES CO., LTD. (SHANGHAI BRANCH)	ROOM 3001, NANZHENG BUILDING, NO.580 WEST NANJING RD., 200041 SHANGHAI, P.R. CHINA	TEL: (86) 21-5234-1988 FAX: (86) 21-5234-1788
MAYEKAWA CHINA MFG.CO., LTD.	201700 PLANT 1, NO.39, WEST XIQING ROAD, QINGPU, SHANHAI, P.R. CHINA	TEL: (86) 21-6920-7718 FAX: (86) 21-6920-7719
MAYEKAWA CHINA MFG.CO., LTD. (GUANGZHOU BRANCH)	RM.1205, TIANLHEFULI BUSINESS MANSION, No.4, HUA TING RD, GUANGZHOU, 510610, CHINA	TEL: (86) 20-8527-6161 FAX: (86) 20-8527-6165
MAYEKAWA CHINA MFG. CO., LTD. (QINGDAO BRANCH)	ROOM 601, FULIN BUILDING NO.87 SOUTH FUZHOU ROAD, SOUTH DISTRICT, QINGDAO CITY, 266071, CHINA	TEL: (86) 532-8602-6169 FAX: (86) 532-8602-6269

Description	Location	Telephone and facsimile No.
MAYEKAWA CHINA MFG. CO., LTD. (DALIAN BRANCH)	RM.A13-5, No.1 BUILDING, AREA A , WUCAI CITY, DALIAN ECO-TECH DEVELOPMENT ZONE, 116100, DALIAN, P. R. CHINA	TEL: (86) 411-8753-9620 FAX: (86)411-8757-9620
MAYEKAWA (THAILAND) CO., LTD. MAYEKAWA HOLDING (THAILAND)CO., LTD.	2/3 MOO 14, 3RD FLOOR BANGNA TOWER BLDG., TOWER A, BANGNA-TRAD RD, K.M.6.5, BANGKAEW BANGPLEE, SAMUTPRAKARN 10540, THAILAND	TEL: (66) 2-751-9610 FAX: (66) 2-751-9565
MAYEKAWA (THAILAND) CO., LTD. (TRANG BRANCH)	1/7 TRANG-PALIAN RD., MUANG, TRANG 92000, THALAND	TEL: (66) 75-224-784 FAX: (66) 75-224-351
MAYEKAWA VIETNAM ONE MEMBER CO., LTD.	ROOM 305, 3FL, TUOI TRE TOWER, 60A HOANG VAN THU, WARD 9, PHU NHUAN DIST., HO CHI MINH CITY, VIETNAM	TEL: (84) 8-3997-5284 FAX: (84) 8-3997-5287
MYCOM KOREA CO., LTD. (HEAD OFFICE)	2F, 345, CHEONGRA-RO , YONGSAN-KU, SEOUL, 140-710, REP.OF KOREA	TEL: (82) 2-796-1766 FAX: (82) 2-798-7715
MYCOM KOREA CO., LTD. CHANGWON FACTORY	19, BANGYE-RO, UICHANG-KU, CHANGWON-SI, GYEONGSANGNAM-DO 641-847, REP.OF KOREA	TEL: (82) 55-294-8678 FAX: (82) 55-299-7678
MYCOM KOREA CO., LTD. (BUSAN BRANCH)	5F, 26, JUNGANG-DAERO, JUNG-GU, BUSAN 600-714, REP.OF KOREA	TEL: (82) 51-242-3737 FAX: (82) 51-243-8542
LATIN AMERICA		
MAYEKAWA ARGENTINA S.A. (BUENOS AIRES OFFICE)	DR. JOSE VALENTIN GOMEZ 151, LOT42, HAEDO-PARTIDO DE MORON, BUENOS AIRES, CP B1706FMA, ARGENTINA	TEL: (54) 11-4627-6660 FAX: (54) 11-4628-1511
MAYEKAWA ARGENTINA S.A. (PUERTO MADRYN OFFICE)	OFICINA PTO. MADRYN LEOPOLDO LUGONES 45 (U9129KDA)-PUERTO MADRYN PCIA DE CHUBUT REPUBLICA ARGENTINA	TEL: (54) 2965-475414 FAX: (54) 2965-475414
MYCOM PERU S.A.C.	CALLE LUIS PASTEUR 1490, LINCE, LIMA, PERU	TEL: (51) 1-205-5400 FAX: (51) 1-222-1543
MAYEKAWA CHILE S.A.C.el. (SANTIAGO OFFICE)	CORDILLERA No.331, MODULO D14, FLEX CENTER, PUERTO VESPUCIO, QUILICURA, SANTIAGO, CHILE	TEL: (56) 2-739-0202 FAX: (56) 2-739-2700
MAYEKAWA CHILE S.A.C.el. (CONCEPCION OFFICE)	ANIBAL PINTO No.215, OFICINA 403, CONCEPCION, CHILE	TEL: (56) 41-223547 FAX: (56) 41-212443
MAYEKAWA CHILE S.A.C.el. (PUERTO MONTT OFFICE)	BERNARDINO 1057 MODULO 6, PARQUE INDUSTRIAL SAN ANDRES PUERTO MONTT, CHILE	TEL: (56) 65-257570 FAX: (56) 65-288073
MAYEKAWA ECUADOR S.A.	CALLE 15B Y AV. GUILLERMO PAREJA C.C.STEFANY LOCAL #4, CALLA.LA GARZOTA 1 MZ.28 SOLOR 13, GUAYAQUIL, ECUADOR	TEL: (593)4-262-9108 TEL: (593)4-262-6407 FAX: -
MAYEKAWA COLOMBIA S.A.S	TRANSVERSAL 93 NO.53-48 INTERIOR 37, PAQUE INDUSTRIAL EL DORADO, BOGOTA, COLOMBIA	TEL: (57) 1-430-9980 TEL: (57) 1-224-3028 FAX: (57) 1-437-0988

Description	Location	Telephone and facsimile No.
MAYEKAWA COLOMBIA S.A.S. (MEDELLIN OFFICE)	DIRECCION CR 43B No. 8 SUR 10 OFICINA 404 EDF. OVIEDO MEDELLIN, COLOMBIA	TEL: (57) 4-313-4343 FAX: (57) 4-313-4343
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA.	RUA LICATEM 250, BLOCO B/C, JARDIM PEROVA-ARUJA-SP CEP:07428-280, BRASIL	TEL: (55) 11-4654-8000 FAX: (55) 11-4654-8002
MAYEKAWA DO BRASIL LTDA. (BAHIA BRANCH)	RUA DR. JOSE PEROBA, 275 - SALA 902 EDIFICIO METROPOLIS - BAIRRO STIEPE, SALVADOR – BA,CEP:41770-235, BRASIL	TEL: (55) 71-3341-0737 FAX: —
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (CHAPECO BRANCH)	AV. NEREU RAMOS, 75D, SALA 503A, EDIFICIO CENTRO PROFISSIONAL CEP:89801-023 C.P.:177 CHAPECO-SC, BRASIL	TEL: (55) 49-3324-0681 FAX: (55) 49-3322-4241
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (CUIABA BRANCH)	AVENIDA ISSAC POVOAS, 586 – SALA 405 EDIFICIO WALL STREET - CENTRO CUIABA-MT, CEP 78055-560, BRASIL	TEL: (55) 65-3023-7559 FAX: —
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (CURITIBA BRANCH)	RUA XV DE NOVEMBRO, 2175 6 ANDAR SALA 30 SHOPPING CELLI CEP:83005-000 SAO JOSE DOS PINHAIS-PR, BRASIL	TEL: (55) 41-3383-1518 FAX: (55) 41-3383-1987
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (GOIANIA BRANCH)	RUA C, 255 – QUADRA 588 – LOTE 4/8 SALA 104 – CENTRO EMPRESARIAL SEBBA GOIANIA-GO, CEP 74280-010, BRASIL	TEL: (55) 62-3093-5062 FAX: —
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (OESTE PAULISTA BRANCH)	AV. FRANCISCO DE CHAGAS OLIVEIRA, 344 JARDIM PINHEIRO SAO JOSE DO RIO PRETO-SP, CEP 15091-330, BRASIL	TEL: (55) 17-3227-0235 FAX: (55) 17-3227-3120
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (RECIFE BRANCH)	RUA AGENOR LOPES, 292 SALA 305 CEP:51021-110 BOA VIAGEM RECIFE-PE, BRASIL	TEL: (55) 81-3342-7670 FAX: —
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (RIO GRANDE DO SUL BRANCH)	RUA MUCK, 298 – SALA 601 EDIFICIO SANTA HELENA CEP:92010-250 CANOAS-RS, BRASIL	TEL: (55) 51-3429-1860 FAX: (55) 51-3477-5212
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (LINHARES BRANCH)	AV. GOVERNADOR CARLOS LINDENBERG, 873/107 CENTRO CEP:29900-020 LINHARES-ES, BRASIL	TEL: — FAX: —
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (MACAE)	RUA PROFESSOR MARIETA PEIXOTO, 62 CENTRO - MACAE – RJ, CEP 27910-250, BRASIL	TEL: (55) 22-2772-6069 FAX: (55) 22-2759-3112
MAYEKAWA DO BRASIL EQIPAMENTOS INDUSTRIAIS LTDA. (RIO DE JANEIRO BRANCH)	AV.LUIZ CARLOS PRESTES, 350-SALA 313-EDIFICIO BARRA TRADE II, BARRA DA TIJUCA, RIO DE JANEIRO-RJ CEP:22775-055, BRASIL	TEL: (55) 21-2431-3600 FAX: (55) 21-2430-8882
MYCOM CENTROAMERICA S.A	BODEGA #63, CONDOMINIO COMERCIAL TIERRA DOS, EL CACIQUE DE RIO SEGUNDO, ALAJUELA, COSTA RICA	TEL: (506) 2441-4464 FAX: (506) 2441-4465

Description	Location	Telephone and facsimile No.
MYCOM VENEZUELA SALES & SERVICES,C.A. (CARACAS OFFICE)	CALLE LOS MANGOS, EDIFICIO SELEMAR, PISO 8, SABANA GRANDE, CARACAS, VENEZUELA	TEL: (58) 212-216-6026 FAX: (58) 212-216-0608
MYCOM VENEZUELA SALES & SERVICE, C.A. (MARACAY OFFICE)	AV.INTERCOMUNAL TURMERO, EDF.TECHOMAT METROPOLITANO, PISO 1, OFICINA 3, MARACAY, EDO.ARAGUA, VENEZUELA	TEL: (58) 243-269-4913 FAX: (58) 243-269-3952
MYCOM VENEZUELA SALES & SERVICE, C.A. (MARACAIBO OFFICE)	CALLE 148,CENTRO EMPRESARIAL SAN FRANCISCO NIVEL 1 LOCAL 5 Y 6, ZONA INDUSTRIAL IIETAPA,SAN FRANCISCO EDO.ZUILIA, VENEZUELA	TEL: (58) 261-418-1760 FAX: -
MYCOM VENEZUELA SALES & SERVICE, C.A. (BARCELONA OFFICE)	AV. MUNICIPAL DE PTO. LA CRUZ, EDIF. LOCAL NRO.57, PLANTA ALTA, MUNICIPIO SOTILLO, PUERTO LA CRUZ, VENEZUELA	TEL: (58) 261-765-1059
MYCOM CHEMICAL PROCESS CORP. DE VENEZUELA S.A.	CALLE 148,CENTRO EMPRESARIAL SAN FRANCISCO NIVEL 1 LOCAL 5 Y 6, ZONA INDUSTRIAL IIETAPA,SAN FRANCISCO EDO.ZUILIA, VENEZUELA	TEL: (58) 261-418-1760 FAX: -
MAYEKAWA DE MEXICO, S.A. DE C.V. (CUERNAVACA OFFICE)	AV.DE LOS 50MTS.NO.381, CIVAC. JIUTEPEC MORELOS, C.P.62578, MEXICO	TEL: (52) 77-73-19-0925 FAX: (52) 77-73-20-5762
MAYEKAWA DE MEXICO, S.A. DE C.V. (MEXICO CITY OFFICE)	AV.COYOACAN #945 COL .DEL VALLE DEL. BENITO JUAREZ C.P.03100, MEXICO, D.F. MEXICO	TEL: (52) 55-5062-0870 FAX: (52) 55-5062-0898
MAYEKAWA DE MEXICO, S.A. DE C.V. (GUADALAJARA OFFICE)	SANTA MARIA No.3086, COL. VALLARTA SAN LUCAS GUADALAJARA, JALISCO, C.P.44690, MEXICO	TEL: (52) 3336-15-5765 FAX: (52) 3336-15-1307
MAYEKAWA DE MEXICO, S.A. DE C.V. (MONTERREY OFFICE)	AV.CHAPULTEPEC NO.2233 OTE. FRACC, BUENOS AIRES MONTERREY N.L. C.P.64800, MEXICO	TEL: (52) 81-8347-3085 FAX: (52) 81-8347-5830
MAYEKAWA DE MEXICO, S.A. DE C.V. (HERMOSILLO OFFICE)	CALLE FRAY TORIBIO DE BENAVENTE #38 COL. LOS ARCOS CD. HERMOSILLO, SONORA, C.P.83250, MEXICO	TEL: (52) 662-216-2047 FAX: (52) 662-216-2047
MAYEKAWA DE MEXICO, S.A. DE C.V. (IRAPUATO OFFICE)	CALLE AGUSTIN ZARAGOZA NO.219 LOCAL-2 COL.DEPORTIVA, C.P.36612, IRAPUATO, GTO. MEXICO	TEL: (52) 462-624-9353 FAX: (52) 462-624-9264
MAYEKAWA DE MEXICO, S.A. DE C.V. (CULIACAN OFFICE)	AV. NICOLAS BRAVO 1572, LOCAL 1 COL.MORELOS CULIACAN, SINALOA, C.P.80170, MEXICO	TEL: (52) 66-7715-4199 FAX: (52) 66-7715-4150
MAYEKAWA DE MEXICO, S.A. DE C.V. (VILLAHERMOSA OFFICE)	CERRADA DE RIO AMATAN 106-A COL. CASA BLANCA PRIMERA SECCION, VILLAHERMOSA, TABASCO, C.P.86060, MEXICO	TEL: (52) 993-315-4025

MAYEKAWA MFG. CO., LTD.

Botan 3-14-15, Koto-ku, Tokyo, Japan
135-8482
TEL: +81-(0)3-3642-8181 (main)
URL: http://www.mayekawa.com