2203K5JE-MY-GH-N_2014.12.

MYCOM

Screw Compressor
GH-series Instruction Manual

GH250S/L, GH320S

CAUTION

Before operating, inspecting, or servicing the compressor, read this manual thoroughly to fully understand the contents.

Keep this instruction manual in a safe, designated place for future reference whenever the manual is needed.

The specifications of the product are subject to change without notice.

MYCOM MAYEKAWA MFG. CO., LTD.
3–14–15 Botan Koto-ku, Tokyo 135-8482, Japan

Preface

Thank you for purchasing this MYCOM GH- series screw compressor (hereinafter indicated as "this product").
This instruction manual (hereinafter indicated as "this manual") describes safety information, operational and maintenance procedures in detail for safe and effective use of this product, and applies to the following types in the GH-series.

GH250S, GH250L, GH320S

Before installing or using this product, make sure you read this manual.
Keep this manual in a safe place near this product for quick reference.

Revision History

Instruction manual name		Document No.	First edition issue date
GH-series Instruction manual		2203K5JE-MY-GH-N_2014.12.	May 28, 2005
Revision No.	**Issuance Date**	**Contents of revisions (modified clause, page, and details)**	**Created/approved by:**
00	May 28, 2005	Newly issued as electronic version due to newly-designed GH250S/L	Hiraoka / Matsui
01	Oct. 01, 2010	Corrected editing errors	Ishizuki / Ikeda
02	Aug. 28, 2014	Added new model GH320S	Ishizuki / Muta, Hirao
03	**Dec. 08, 2014**	**Review the tightening torque value of the unloader piston lock nut**	**Takenouchi, Ikehara / Muta**

Warranty and Disclaimer

Warranty Clauses

If malfunctions or damages occur related to design or manufacture of this product under intended use, method and proper usage following documents such as specifications and this manual of this product, and if it is within the warranty period, we will repair or replace the product.
The warranty period is "12 months from factory shipment of this product". If there are any articles of agreement, the description written on the agreement takes precedence in principle.

Disclaimer Clauses (Exclusion of Warranty Clauses)

Please note that we assume no product liability for the following disclaimer clauses for this product.

- Malfunction or damage which has been caused by accidental forces such as natural disasters (windstorm, intense rainfall, flood, tidal wave, earthquake, land sinkage, thunderbolt, fire disaster, etc.).
- Malfunction, damage, or defect of this product which has been subjected to abnormal or improper use (such as storing this product outside the building or in locations subject to high temperatures and high humidity, excessive liquid back operation, and repeating start-up/stoppage of this product excessively).
- 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 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 MAYEKAWA genuine.
- Malfunction or damage caused by remodeling this product without approval of MAYEKAWA.
- Warranty for damage of production activities and any related damage caused by malfunction or damage of this product directly or indirectly.

Important Information

Intended Use of This Product

This product is a general-purpose screw compressor intended for refrigeration and cold storage.

Do not use the product for any purposes for which it was not intended or which depart from the specifications. For specifications of this product, refer to “2.3 Compressor Specifications”.

The maintenance items described in this manual should be performed safely and closely following procedures.

Important Information for Safe Use of This Product

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

There are guidelines that must be observed for operating this product. However, the warnings in this manual and safety labels on the product are not all inclusive. 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 the product that apply to all workers including managers and supervisors are listed below.

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

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

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

“Lockout” means disconnecting or keeping disconnected machines and devices by locking their energy (power) sources. Lockout is not just simply turning off the power switches to stop the supply of power, but includes immobilizing them with a key or similar device to keep any blocked switches from being operated.

Lockout devices are devices such as keys, covers, and latches, to immobilize switches, valves, opening and closing levers, etc., with a state of being locked.

[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.
- Before servicing or inspecting the electrical equipments or devices, turn "OFF" the motor main power and control power, and perform lockout/tagout to prevent the power from being turned on during work.

Even when the motor main power and control power are turned "OFF", this product may be turned on if the power is supplied from outside the refrigeration system, cold storage, and air conditioning unit. Make sure the power supply on the power source side is shut off, and perform lockout/tagout to prevent the product from being turned on during 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 your sales offices or service centers.
- This manual is in English. If any other language is required it is the customers responsibility to prepare a manual for safety education and operation instructions.
- This manual is copyrighted. Drawings and technical references including this manual shall not, in whole or part, be copied, photocopied, or reproduced into any electronic medium or machine-readable form without prior permission from MAYEKAWA.
- Photographs or drawings included in this manual may differ from the appearance of actual product.
- If this manual is lost or damaged, immediately place a purchase order to your local sales office or service center for a new manual. Using the product without the manual may result in safety issues.
- If you resell the product, never fail to attach this manual to the product.

Construction of This Manual

Title of Section/chapter	Description details
Preface	Describes the outline of this manual and how to read the manual.
Warranty and Disclaimer	Describes clauses and coverage of warranty. Exemption of warranty clauses is described as disclaimer.
Important Information	Describes important information related to this product and this manual.
1. Safety	Describes safety information for the worker, safety rules for this product, and management details regarding work safety required for handling the product.
2. Structure and Specifications of the Compressor	Describes the main components of this product, functional information, specifications, and operating limits.
3. Installation	Describes installation procedure of this product.
4. Compressor and Package Operation	Describes precautions for operating this product.
5. Maintenance and Inspection	Describes sections and period for inspecting, disassembly and assembly of the product.
6. Troubleshooting	Describes troubleshooting methods for the product in case problems occur during operation of the product.
7. Related Documents	Describes documents such as sectional views, parts configuration table and tightening torques of bolts and nuts.

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1 Safety

1.1 Observation/Prevention

1.1.1 Observance (Do's)

1.1.1.1 Do's on Operation

- Make sure that all necessary safety devices are installed and the control values for machine protection are set correctly.
- Regularly inspect the safety devices and the controller's protective functions. Ensure that they operate properly.
- If the safety devices and the controller's protective functions do not work properly or the machine operates abnormally, stop the operation immediately and report the incident to your supervisor. Do not restart the machine until the supervisor determines and provides instructions.
- If the compressor stops for unknown reasons, immediately inform your supervisor of it. Obtain his/her approval before restarting the compressor.
- Some refrigerants in use generate bad smell or toxic gases, or may cause deficiency of oxygen. Make sure to ventilate the air during operation.
- The properties of refrigerant and refrigerant oil can be corrosive, decomposable, and/or toxic, insure to obtain the Safety Data Sheet (SDS) and follow its instructions.
- When stopping the operation of this compressor, shut off the motor (main power), heater power, and control power. Close the suction and discharge side shut-off valves. Follow proper compressor evacuation procedures.

1.1.1.2 Do's on Maintenance

- Before performing the work together with at least one other person, thoroughly confirm the work details and acknowledge other worker's movement.
- Always turn OFF and lock out/tag out the motor (main power), control power, and other devices before troubleshooting during operation, and before setup, cleaning, or maintenance and inspection of the compressor.
- Always confirm that there is atmospheric pressure inside the compressor as well as refrigerating, cold storage, and air conditioning package before troubleshooting during operation, and before setup, cleaning, or maintenance and inspection of the compressor.
- Always lock out/tag out the fluid supply/stop valve and the valves at downstream or upstream side of an opening part before troubleshooting during operation, setup, cleaning, or maintenance and inspection of the compressor to prevent the valves from opening during work.
- Some refrigerants in use generate bad smell or toxic gases, or may cause deficiency of oxygen. Make sure to ventilate the air during work.
- The properties of refrigerant and refrigerant oil can be corrosiveness, decomposability, and/or toxicity, insure to obtain the Safety Data Sheet (SDS) and follow its instructions.
- After using tools always restore to designate place and never leave tools into the compressor package unit.

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

- Set up lockout/tagout devices for the main breakers of the main motor and control power.
- The lockout/tagout after shutting off the power is a very effective way to secure workers' safety and can prevent injury to workers caused by a number of workers accidentally turning the power source on.
- If there are any possibilities of danger during works (especially during cleaning, maintenance and inspection, and troubleshooting), shut off the motor main power and control power, and perform lockout/tagout.
- The worker himself must always lock out/tag out the compressor before working in the compressor for troubleshooting during operation, setup, cleaning, or maintenance and inspection of the compressor.
- 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 shut off the main motor and control power.
  - It is assumed that workers only shut off the main motor and control power and do not lockout/tagout the main motor and control power, because they judge that there is no danger.
- The worker who performed lockout/tagout should release them after checking that all procedures have completed.

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 designated clothes such as work outfits.
- Do not wear any neckties or jewelry as there is a possibility 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 Strict Do's about Handling Emergency Situation

- Formulate an emergency action plan complying with the regulations, and post it on a safe place.
- Strict Do's about Waste Oil, Fluid, and Materials.
- Disposing of refrigerant and oil used for the compressor 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.

1.1.1.7 Other Do's

- Keep the floor clean around the refrigerating, cold storage, and air conditioning units, and keep passages and walkways clear.
- Walk only on the areas set up as a work floor. Also, do not leave tools and cleaning solutions in that area.
- If water or oil is spilled on the compressor or the floor, immediately wipe it off to prevent workers from injury caused by slipping.

1.1.2 Don'ts

- Do not remove or relocate any safety devices, including electrical interfaces.
- Do not disable any safety devices by short-circuiting or bypassing without any permission.
- Do not leave the compressor unsafe and unattended, by removing a safety cover or some other measures.
- Do not touch, clean, or lubricate any moving part of the compressor during operation. Do not touch, clean, or lubricate the compressor during its operation.
- Do not touch relays or electric systems such as terminal block with bare hands when turning on the power.

1.2 Warnings

This manual includes the following four types of warnings to be used for expected hazards during operation and maintenance of the compressor.

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

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

Table 1-1 Types and Meanings of Warnings

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

1.3 Residual Risks

The following information is provided on the assumption that this compressor is operated, inspected, and maintained while being used in general refrigerating, cold storage, and air conditioning packages. Note that all hazardous sources cannot be predicted for the refrigerating, cold storage, and air conditioning packages you actually use.

Devise appropriate countermeasures for hazardous sources in your systems.

Table 1-2 Hazardous Sources

Hazardous source		Predicted hazard	Counter measures in operation	Counter measures in cleaning, inspection, and parts exchange
A	Coupling part of motor and compressor	• Entanglement caused by contact	• Attachment of coupling cover and opening or releasing prohibited. • Keep off.	• Shut off main power and control power, and lockout/tagout are performed.
B	Motor terminals	• Electric shock caused by contact to live wires and electrical leakage	• Keep off. • Do not open and release the terminal box cover. • Do not contact the terminal box.	• Shut off main power and control power, and lockout/tagout are performed.
C	Suction part of compressor casing	• Frostbite caused by contact • Contact with and inhale of toxic substances caused by refrigerant leakage	• Keep off. Do not contact. • Wear protective gear. • Use the gas leak detection gear.	• Wear protective gear. • Operate with normal temperature.
D	Discharge part of compressor casing	• Burns caused by contact • Contact with and inhale of toxic substances caused by refrigerant leakage and blast	• Keep off. Do not contact. • Wear protective gear. • Use the gas leak detection gear.	• Wear protective gear. • Operation with a temperature of 40 °C or less • Sufficient ventilation • Handle the refrigerant gas properly.
E	Discharge piping of compressor			
F	Lubrication piping and fitting			
G	Various electrical parts of package (oil heater, solenoid valve, motor-operated valve, etc.)	• Electric shock caused by contact to live wires and electrical leakage • Trapping caused by contact to driving section.	• Attachment of protection cover to terminal section and opening or releasing prohibited • Keep off. Do not contact. • Wear protective gear.	• Shut off every breaker and control power, and lockout/tagout are performed. • Wear protective gear.

Hazardous source		Predicted hazard	Counter measures in operation	Counter measures in cleaning, inspection, and parts exchange
H	Gas purge valve	• Contact with and inhale of toxic substances caused by refrigerant leakage and blast	• Keep off. Do not contact. • Wear protective gear. • Use the gas leak detection gear.	• Wear protective gear. • Sufficient ventilation
I	Oil drain of the package unit	• Contact with toxic substances caused by leakage and blast • Burns caused by contact with high temperature fluid	• Sufficient ventilation • Keep off. Do not contact. • Wear protective gear.	• Sufficient ventilation • Wear protective gear. • Operation with a temperature of 40 °C or less
J	Noises	• Auditory difficulties caused by noise	• Wear protective gear.	—

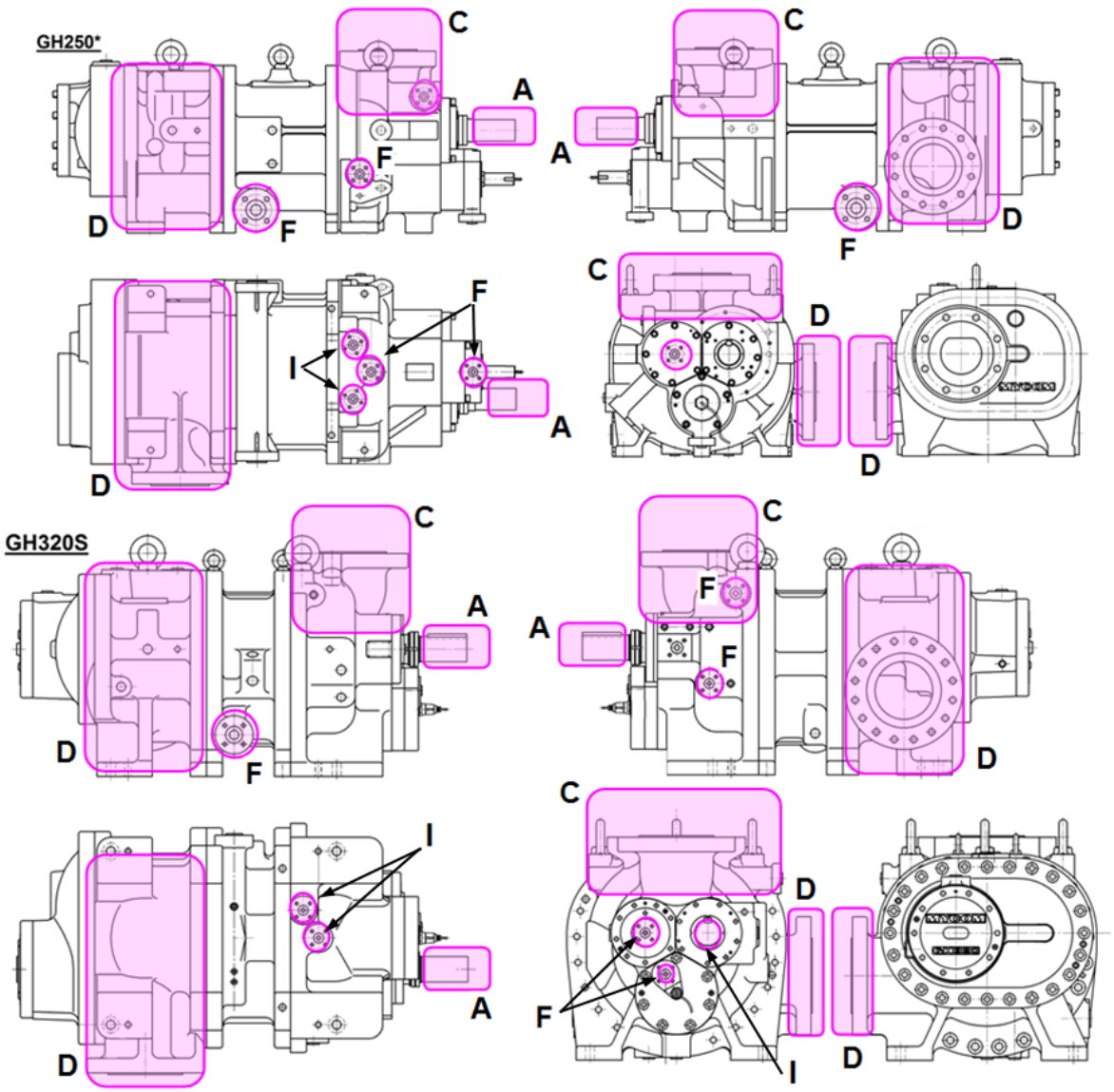


Figure 1-1 Hazardous Sources

1.4 Safety Devices

For safe use and protection of this product, make sure to attach safety devices to your compressor package unit, complying with the regulations and the following instructions for each device.

Periodically perform inspection and maintenance of devices for normal/proper operation. Maintenance and inspection must be performed as an important part for the safety of machine and personnel. 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 take repair or replace safeties before starting compressor.**

1.4.1 Emergency Stop Button

■ Overview/Function/Purpose

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

■ Installation Positions

At the local control panel and in the operation control room

■ Stop/Restoration Methods

Specify the stop/restoration methods of emergency stop buttons, and make sure to provide users of this product with them.

■ Inspection Method/Cycle

The emergency stop buttons must be tested before commissioning and must also be periodically re-tested after that. Specify the inspection methods/cycle of the emergency stop buttons, and make sure to provide users of this product with such information..

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

■ Overview/Function/Purpose

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

■ Installation Positions

Breakers of motor main power and control power

■ Methods of Performing and Releasing Lockout/Tagout

Make sure to clearly notify methods of performing and releasing lockout/tagout referring to the regulations created by Occupational Safety & Health Administration (OSHA) or local governing body.

■ Inspection Method/Cycle

Specify the inspection methods/cycle of the lockout/tagout devices, and make sure to provide users of this product with them.

1.4.3 Compressor Protection Devices

■ Overview/Function/Purpose

To protect the compressor, the following protection functions are used.

■ Protection from increasing discharge temperature

This function is activated to stop the operation of compressor when the discharge temperature increases to or above a predetermined value.

Install the temparature sensor in the oil separator.

■ Protection from increasing oil temperature

This function is activated to stop the operation of compressor when the oil temperature increases to or above a predetermined value.

Install the temperature sensor to the package lubrication piping after the oil cooler.

■ Protection from abnormally high pressure

This function is activated to stop the operation of compressor when the discharge pressure becomes abnormally high due to compressor misoperations or water supply stop to condenser.

It prevents explosion of equipment components.

Install the pressure sensor to the oil separator.

■ Protection from abnormally low suction pressure

This function is activated to stop the operation of compressor when the suction pressure lowers to or below a predetermined value.

Install the pressure sensor to the suction piping.

■ Protection from abnormal oil pressure

This function is activated to stop the operation of compressor and thus prevent any compressor failure due to abnormal wear or seizure of sliding parts, when the differential pressure for lubrication (lubrication piping pressure minus discharge pressure) lowers to or below a predetermined value due to shortage of refrigerant oil, plugging of filters, or refrigerant entry to refrigerant oil.

Install the pressure sensor to the package lubrication piping after the oil filter.

■ Protection from filter differential pressure

This function stops the compressor when the differential pressure between discharge pressure and lubrication pressure lowers to or below a predetermined value due to plugging of filters or other reasons.

To sense the pressure, the same sensor as the oil pressure protection is used.

■ Protection from low oil level

This function constantly senses the oil level in the oil separator and stops the compressor when it reached to the lower limit.

Install the oil level sensor to the oil separator.

■ Protection from motor overcurrent

This function is activated to stop the operation of the compressor when current exceeding a predetermined level flows.

The current value is read by the controller.

■ Settings

Make sure that the set values of the devices for compressor protection do not exceed the operation limits indicated in Chapter 2 Section 2.3.2 Table 2-2 in this manual.

■ Inspection Method/Cycle

Each compressor protection device requires operational test and check of set values before commissioning and on a periodical basis.

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

⚠ WARNING

- **To the compressor protection functions of the controller and the sensors in use, make sure to adjust the set values and check the operations before commissioning.**

⚠ CAUTION

- **To test the operation of each device used for compressor protection, use devices such as pressurize tester to check that alarms and switches operate normally. Do not operate the compressor with all the valves closed, or in any other dangerous conditions.**
- **If the oil pressure decrease protection, abnormal high pressure protection or protection from filter differential pressure operates, make sure to eliminate the cause of it before recovering the compressor operation.**

2 Configuration and Specification of Compressor

2.1 Features of Screw Compressor GH-series

The MYCOM GH-series screw compressor is intended mainly for the applications below.

a. Fuel gas supply to combustion turbine that requires the high inlet pressure.

b. Process gas service, where the conformance to the internationally recognized standards such as API 619 is required.

c. Refrigeration use utilizing the gas, such as CO_2, that requires higher pressure than standard refrigerants, e.g. HCFC's or HFC's.

For the above purposes MYCOM GH-series screw compressor has some characteristics shown below.

a. Rotor profile suitable for the high discharge pressure. MYCOM 's own profile is adopted.

b. Lobe combination of 5 (Male rotor) to 7 (Female rotor) is adopted in order to maintain the high compressor efficiency even under the operating conditions of high pressure differential between suction and discharge.

c. Tilting Pad Bearing is used for carrying the thrust forces in accordance with API 619, if specified. For the refrigeration use where the tilting pad thrust bearing is not required, anti-friction bearing is also available as a thrust bearing.

d. Special unloader indicator mechanism essentially free from the electric spark is adopted to avoid explosion that may be caused when handling the flammable gases.

2.2 Model Designation of the Compressor

This manual describes GH250*-* and GH320S-* models.
The meaning of the type designation, which is engraved on the MODEL column of the compressor nameplate, is as follows.

GH	250	S	-	M
[1]	[2]	[3]		[4]

[1] Indicates GH-series
[2] Rotor diameter, which is **250** or **320**
[3] Rotor length, which is **S** or **L** (250), and **S** (320)
[4] Specifications of Vi (volume ratio) of the discharge port,
which is **E** (Vi=1.3), **L** (Vi=2.3), **M** (Vi=3.3), **H** (Vi=4.5)

2.3 Compressor Specifications

2.3.1 Specifications

Table 2-1 Specifications of GH250S/GH250L/GH320S

Item		Unit	Specifications		
			GH250S	GH250L	GH320S
Handling Gas		—	Hydrocarbon, Helium, Hydrogen and other gases		
Theoretical Swept Volume @2950 min^{-1}		m^3/h	1552	2347	3208
		CFM	913	1381	1888
Compressor Data	Design Pressure of Casing	MPa **Note1**	6.0		
	Drive Direction	—	CW viewed from Motor Side		
	Radial Bearings	—	Hydrodynamic Sleeve Bearing		
	Thrust Bearings	—	Tilting Pad Bearing		
	Shaft Seal	—	Stationary Balanced Double Mechanical Seal Segment Seal (Additional Option to Double Seal)		
	Capacity Control Range (Actual load)	%	Continuously Adjustable in the range of 30-100		
	Vi Control Range	—	2.3, 3.3, 4.5	1.3	1.3, 2.3, 3.3, 4.5
	Capacity Regulation Indicator	—	Magnetostrictive Non-contact Displacement Transducer Safety approval /Class: Exib II CT4, TIIS intrinsically safety		
	Approx. Product Mass Including cover flanges	kg	2250	2410	5000
	Dimensions	—	Refer to 2.3.4 ''Outer Dimensions'' in this manual		
	Connections	—			
	Fastener(Bolts)	—	Stud Bolts		
	Sealing Materials	-—	O-ring FKM-70 for Compressor **Note2** Spiral-wound gasket for connections		
Oil Supply	Bearings, Mechanical Shaft Seal and Oil Injection	—	by Main Oil Pump		
	Capacity Control Valve	—	by Oil Pump for exclusive use		
	Balance Piston	—	by pressure differential *Oil pump is required depending on running condition.		
Applicable Standards (Industrial Code)		—	API 619 4th, 5th Edition, NACE		

Note 1: Unless otherwise noted, pressure unit indicated in this manual is used MPa as gauge pressure.

Note 2: The materials of the O-ring may change by use working fluid.

2.3.2 Operation Limits

2.3.2.1 Limit Value

Table 2-2 Operation Limits of GH250S/GH250L/GH320S

Item	Unit	Limit value		
		GH250S	GH250L	GH320S
Maximum discharge pressure	MPa **Note 1**	5.1		
Maximum suction pressure at full load	MPa	2.0		3.0
Minimum suction pressure	MPa	0.5		
Minimum oil supply pressure **Note 2**	MPa	0.2		
Minimum differential pressure **Note 3**	MPa	1.2		0.5
Maximum discharge temperature	°C	100		
Maximum suction temperature	°C	85		
Minimum suction temperature	°C	-60		
Maximum oil supply temperature	°C	60		
Minimum oil supply temperature	°C	30		
Maximum rotation speed	min^{-1}	4500		3600
Minimum rotation speed	min^{-1}	1450		2950
Maximum compression ratio	—	E-port: 2.0 L-port: 5.0 M-port: 7.0 H-port: 10.0		
Minimum Vi (internal volume ratio)	—	1.2		
Maximum number of start/stop times **Note 4**	times/hour	4		

Note 1: Unless otherwise noted, pressure unit indicated in this manual is used MPa as gauge pressure.

Note 2: Oil supply pressure means lubrication piping pressure minus discharge pressure.

Note 3: Differential pressure means a pressure value between suction pressure and discharge pressure.

Note 4: For the number of start/stop times, restrictions by motor specifications must also be confirmed.

2.3.2.2 Selection of Vi-port and Balance Piston According to Running Pressure Limits

In the GH-series compressor, the best Vi-port and the balance piston can choose according to the operating condition.

Following Figures show the conditional relationship such as the Vi-port, balance piston and the operating condition (running pressure limits at full load).

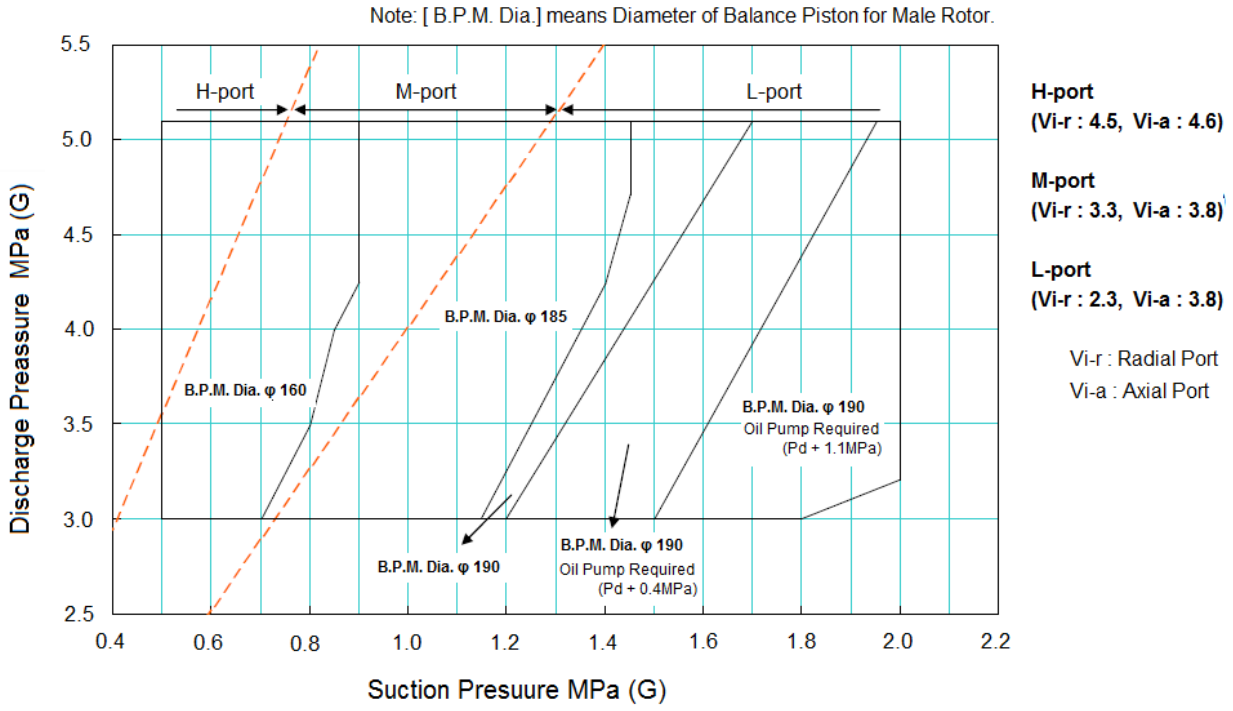


Figure 2-1 Compressor Running Pressure Limits of GH250S/L at Full Load

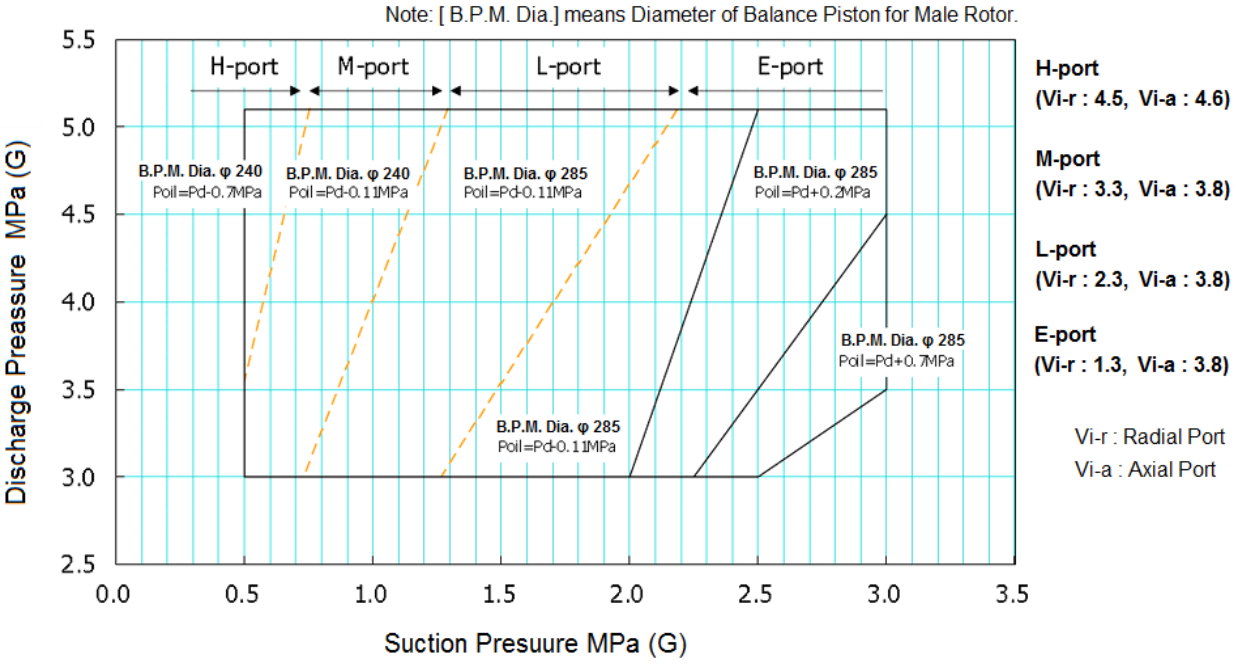


Figure 2-2 Compressor Running Pressure Limits of GH320S at Full Load

2.3.3 Alarm Set Values

To protect the compressor, please set the alarm shown in the table below.

Table 2-3 Alarm set values of GH250S/GH250L/GH320S

Item	Unit		Alarm point	Trip		
				Trip point	Time delay (sec.)	
					Start-up inter lock	Running
Discharge pressure	MPa **Note 1**	High	Normal value +2.5%	Normal value +5%	0	0
		Low	Normal value -2.5%	Normal value -5%	60	0
Suction pressure *if necessary	MPa	High	Normal value +2.5%	Normal value +5%	60	0
		Low	Normal value -2.5%	Normal value -5%	60	0
Minimum differential pressure **Note 2**	MPa	High	—	—	—	—
		Low	0.6	0.45	30	0
Pressurized lubrication	MPa	High	—	—	—	—
		Low	0.2	0.17	30	0
Discharge temperature	°C	High	100	105	30	0
		Low	—	—	—	—
Suction temperature *if necessary	°C	High	Normal value +5%	Normal value +10%	60	0
		Low	Normal value -5%	Normal value -10%	60	0
Discharge superheat	°C	High	—	—	—	—
		Low	20	15	60	60
Suction superheat	°C	High	—	—	—	—
		Low	0	0	60	60
Lubrication temperature	°C	High	Normal value +5%	Normal value +10%	60	0
		Low	Normal value -5%	Normal value -10%	60	0
Vibration (V,H,A) Displacement **Note 3**	μm	High	—	20 (peak)	—	0
		Low	—	—	—	—
Vibration (V,H,A) Velocity **Note 4**	mm/s	High	14 (rms)	20 (rms)	—	0
		Low	—	—	—	—

Note 1: Unless otherwise noted, pressure unit indicated in this manual is used MPa as gauge pressure

Note 2: Differential pressure means a pressure value between suction pressure and discharge pressure.

Note 3: Frequency range is 20Hz to 200Hz.

Note 4: Frequency range is 10Hz to 1000Hz. These values are only as a guide.

2.3.4 Outer Dimensions

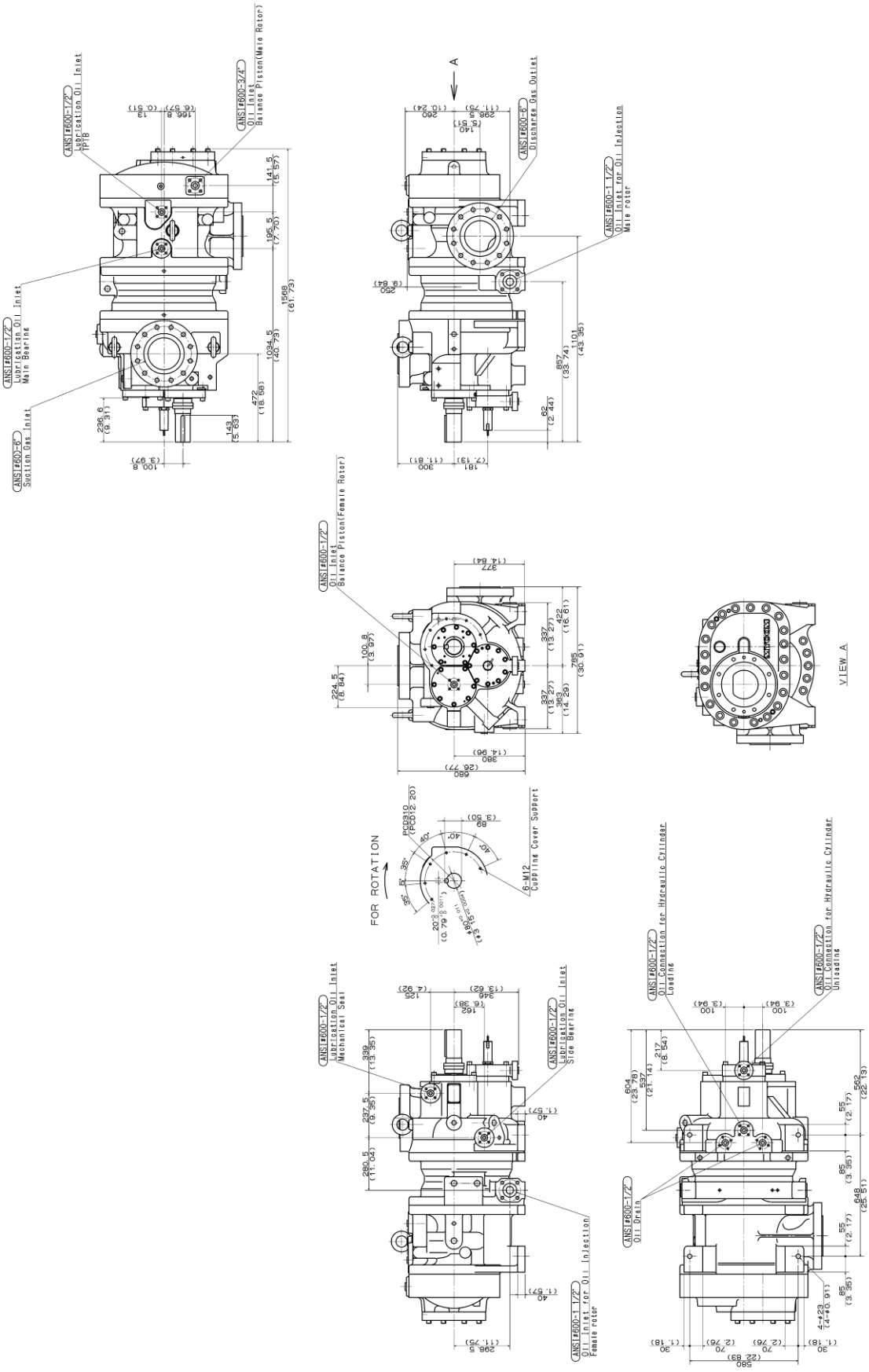


Figure 2-3 Outer Dimensions of GH250S

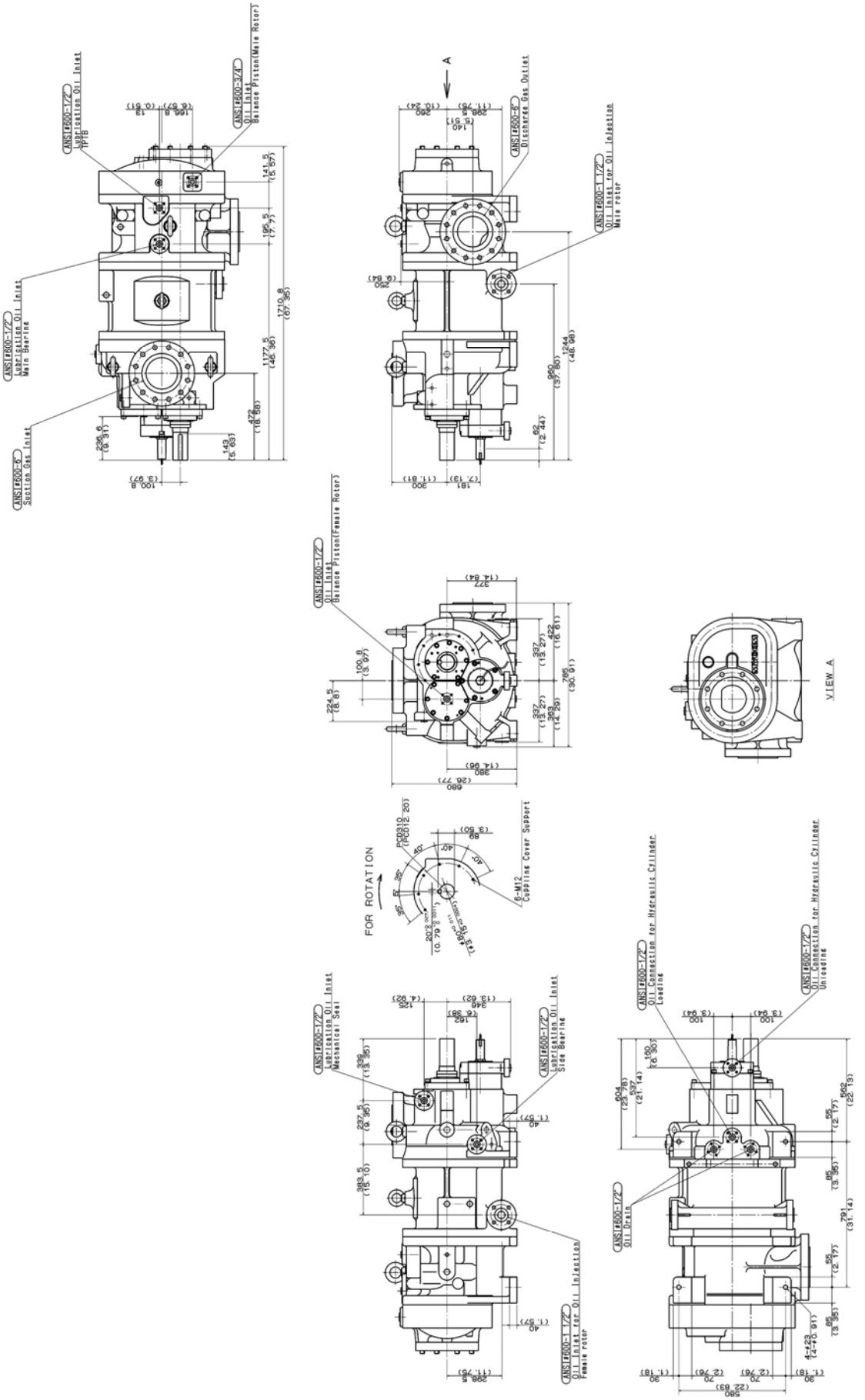


Figure 2-4 Outer Dimensions of GH250L

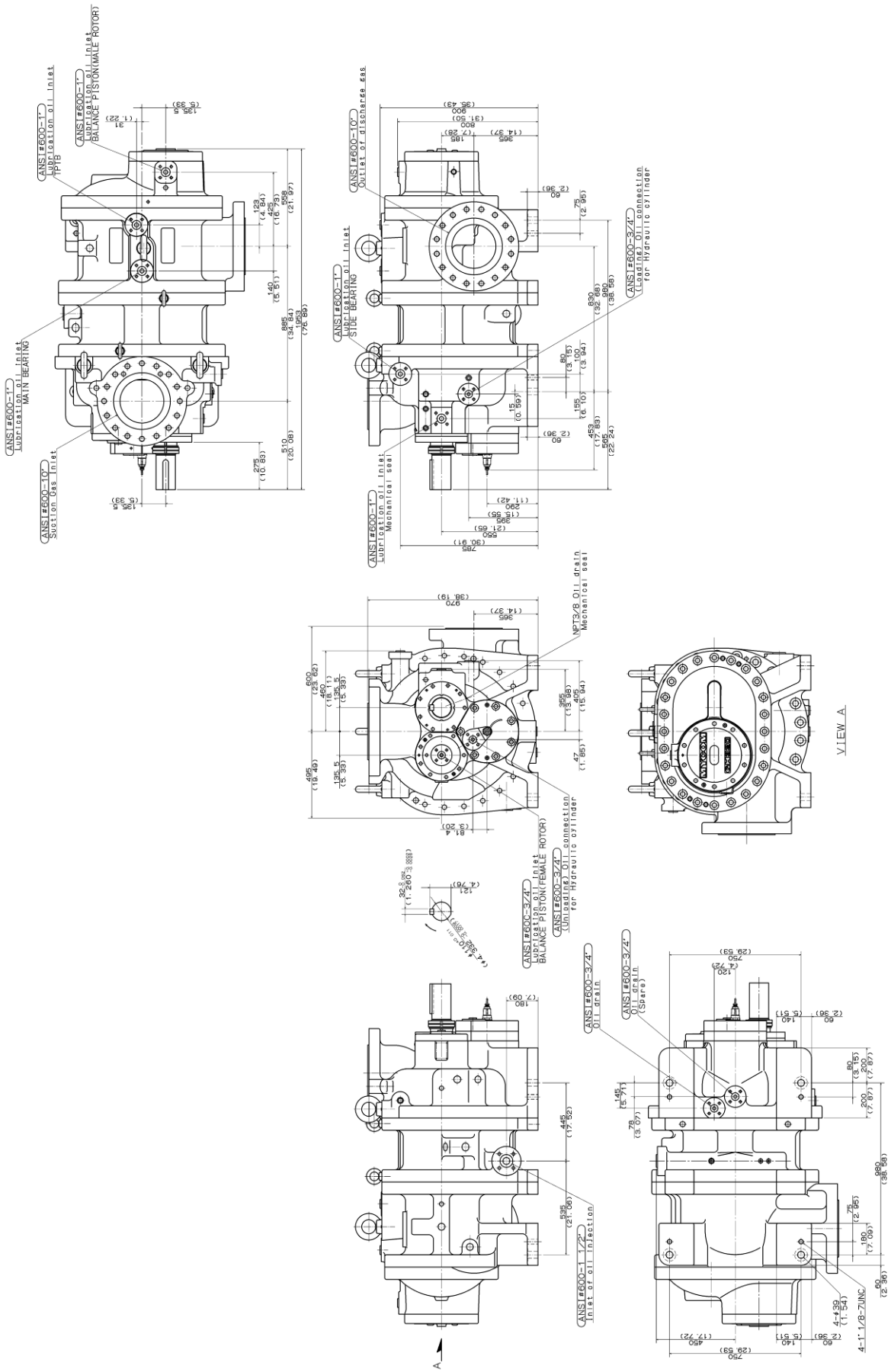


Figure 2-5 Outer Dimensions of GH320S

2.4 Configuration of Compressor

2.4.1 Overview of Compressor

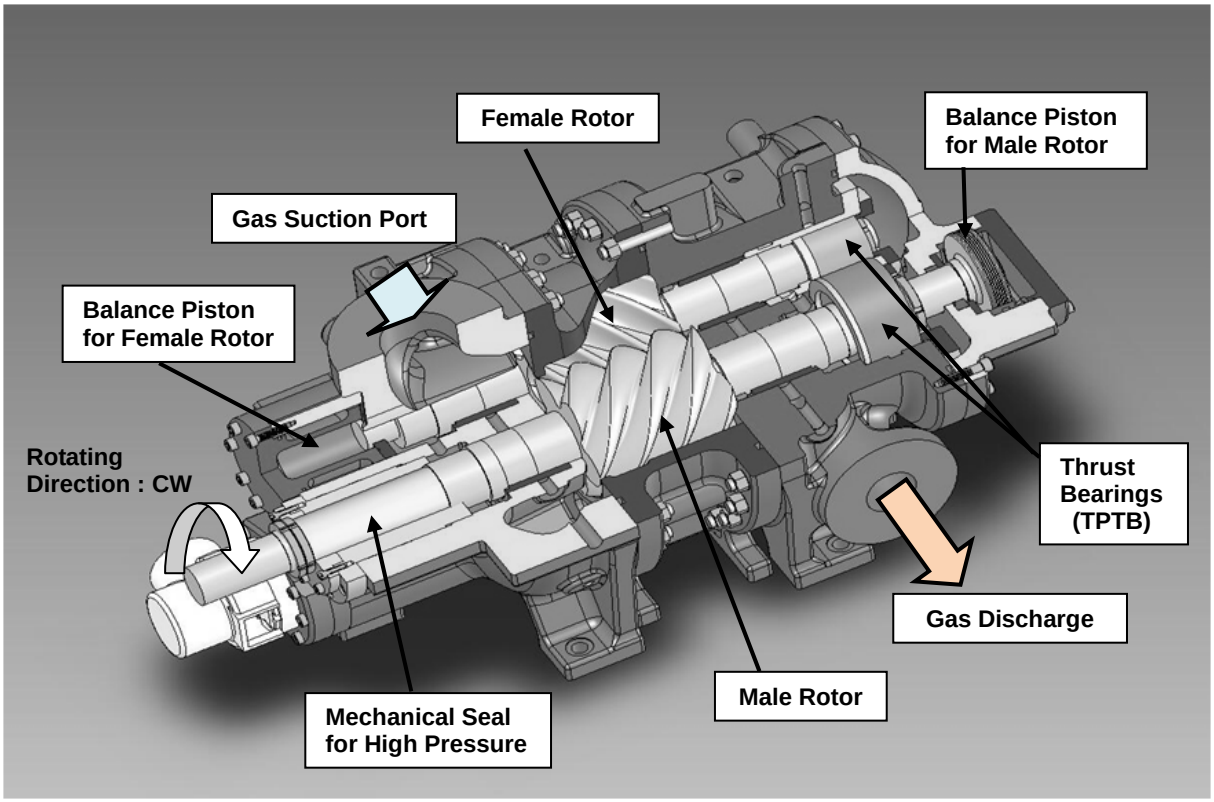


Figure 2-6 Overview of Compressor

There is no major difference in GH250S/L and GH320S; outline of the structure is shown in Figure 2-6 both.

The structural features of GH-series compressors, the following points will be mentioned.

a. Unlike the UD/G-series and SCV-series and other MYCOM single-stage screw compressors, Male rotor shaft connecting to the motor shaft appears the suction cover side (Gas inlet side).
   In the present MYCOM single-stage screw compressors, the FM-series and the i-series have the characteristic to be the same.

b. A balance piston is built in not only the Male rotor but also the Female rotor. This is a characteristic by the high discharge pressure specification.

2.5 Mechanisms

2.5.1 General Introduction of Screw Compressor

The screw compressor is categorized as a positive displacement rotary compressor. It has features of both reciprocating and centrifugal compressors.

The working 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.

a. Suction Process

The inlet gas passes through the suction port of the compressor and enters the closed space formed by the both rotors and the casings. As the rotation of the rotor proceeds, the volume of the closed space reaches its maximum and the suction process has ceased.

b. Compression Process

After the completion of suction process, trapped gas is compressed by the reduction of the closed space volume and the gas is displaced toward the discharge port. This is the compression process.

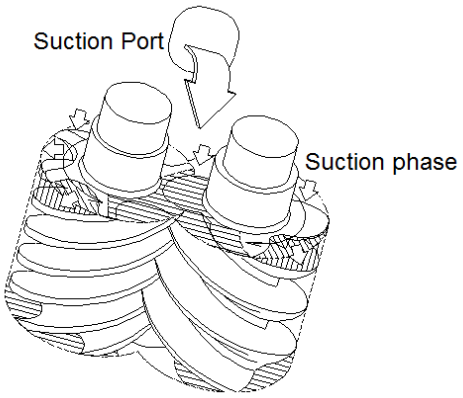


Figure 2-7 Suction Process

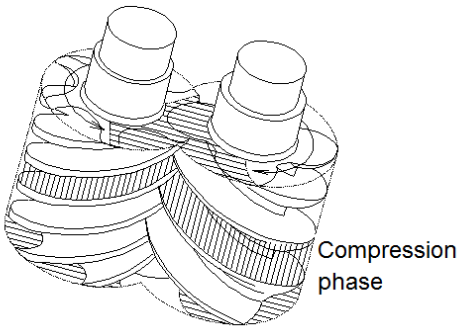


Figure 2-8 Compression Process

c. Discharge Process

Finally, when the compressed gas reaches the designed volume, it is discharged through the discharge port of the compressor.

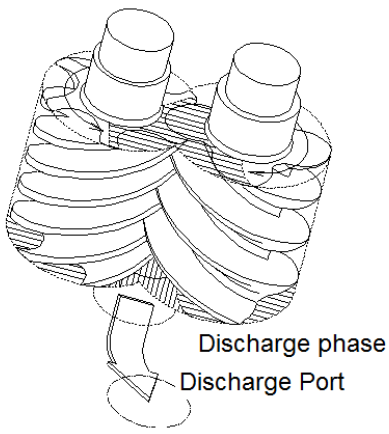


Figure 2-9 Discharge Process

2.5.2 About Volume Ratio (Vi)

Volume ratios (Vi) are indicated in property tables or catalogs by using port symbols E, L, M and H.
The volume ratio represented by each symbol (GH-series screw compressors) is as follows:

E=1.3, L=2.3, M=3.3, H=4.5.

$$Vi = \frac{\text{(Volume of suctioned working gas just before compression)}}{\text{(Volume of working gas just before sent to discharge port)}}$$

Decide which volume ratio (E, L, M or H) should be used 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:

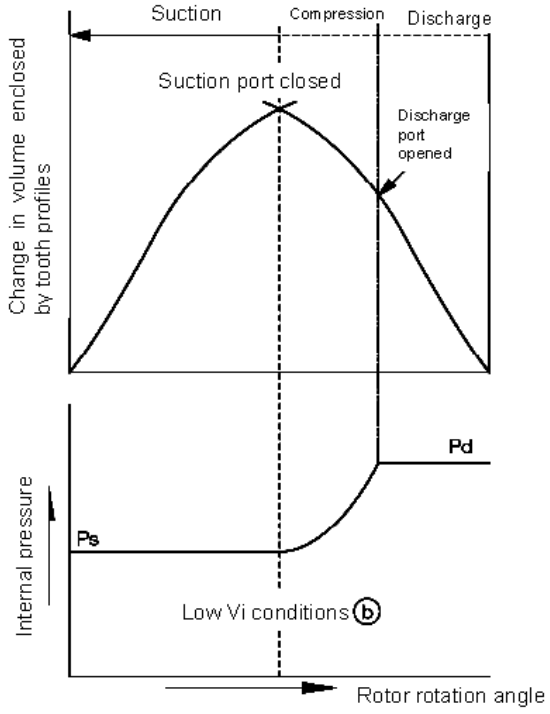
$$Vi = \left(\frac{Pd}{Ps}\right)^{\frac{1}{\kappa}} \quad \text{or} \quad Vi^{\kappa} = \frac{Pd}{Ps}$$

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

Vi is related to the specific heat ratio (κ) and therefore its value relative to the compression ratio varies depending on the type of 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.

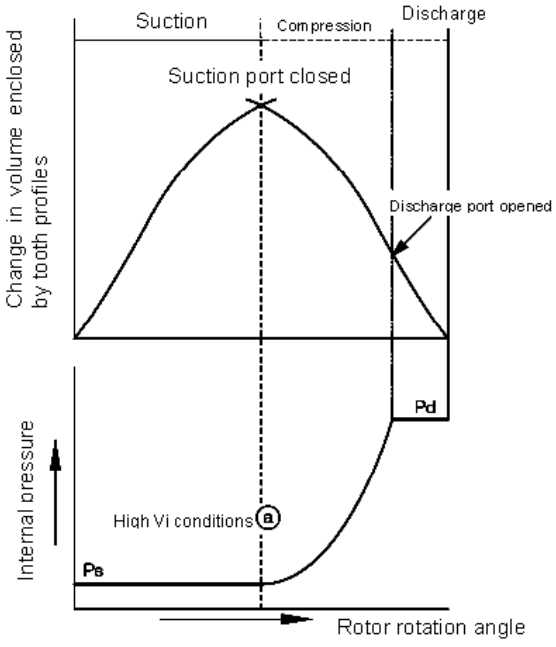
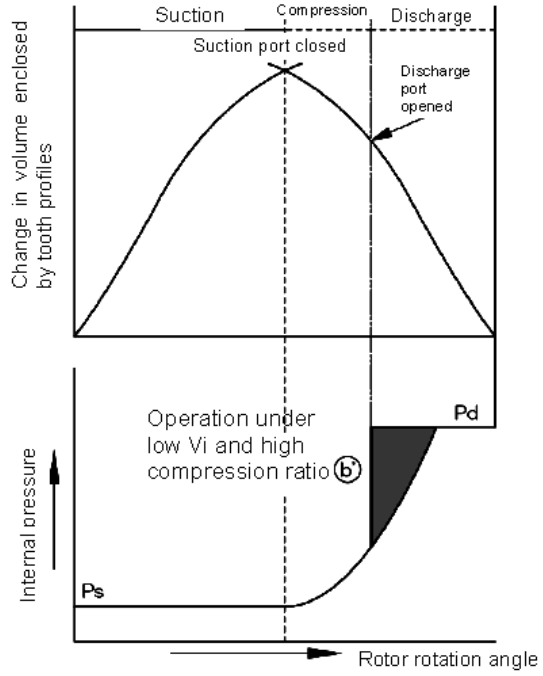


Figure 2-10 Relationship between Volume ratio (Vi) and Operation Conditions (A)

(B) Improperly adapted Vi to load condition

Too low Vi compared with necessary compression ratio.



Too high Vi compared with necessary compression ratio

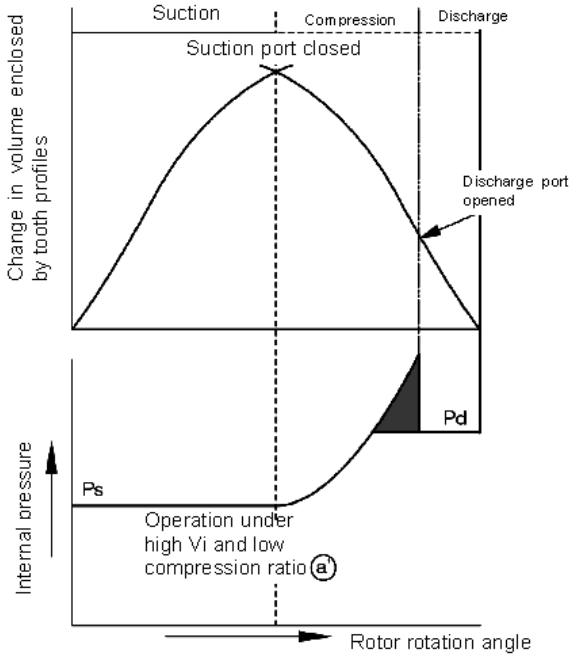


Figure 2-11 Relationship between Volume ratio (Vi) and Operation Conditions (B)

2.5.3 Bearings

The radial load is supported by the sleeve bearing, while the axial load acted on the rotors are supported by the tilting pad thrust bearing or ball bearings. Balance piston that kills the axial force is located on the same side of the thrust bearing.

2.5.4 Sealing Device

Balance type mechanical seal is used to maintain high reliability and high durability.

A combination of carbon and silicone carbide is used to assure the durability of the frictional parts and sealing effect.

2.5.5 Unloader Slide Valve Indicator

Non-contact type position detector is used as an unloader indicator to avoid electric spark, thus making the compressor be operated in safe for the flammable gas compression service.

Capacity control indication can be output to remote indicator using the electric cable.

2.6 Oil Flow

As described in Table2-1 of Section 2.3.1 in this Chapter, the oil supply method to the GH-series compressor is divided into three ways.

a. to Bearings, Mechanical Shaft Seal and Oil Injection by Main Oil Pump

b. to Balance Piston by Differential Pressure between suction pressure and discharge pressure

c. to Unloader Cylinder by Oil Pump for exclusive use

The following figure shows the oil flow a. and b. among these. For detail of each part structure, refer to Chapter 5 in this manual.

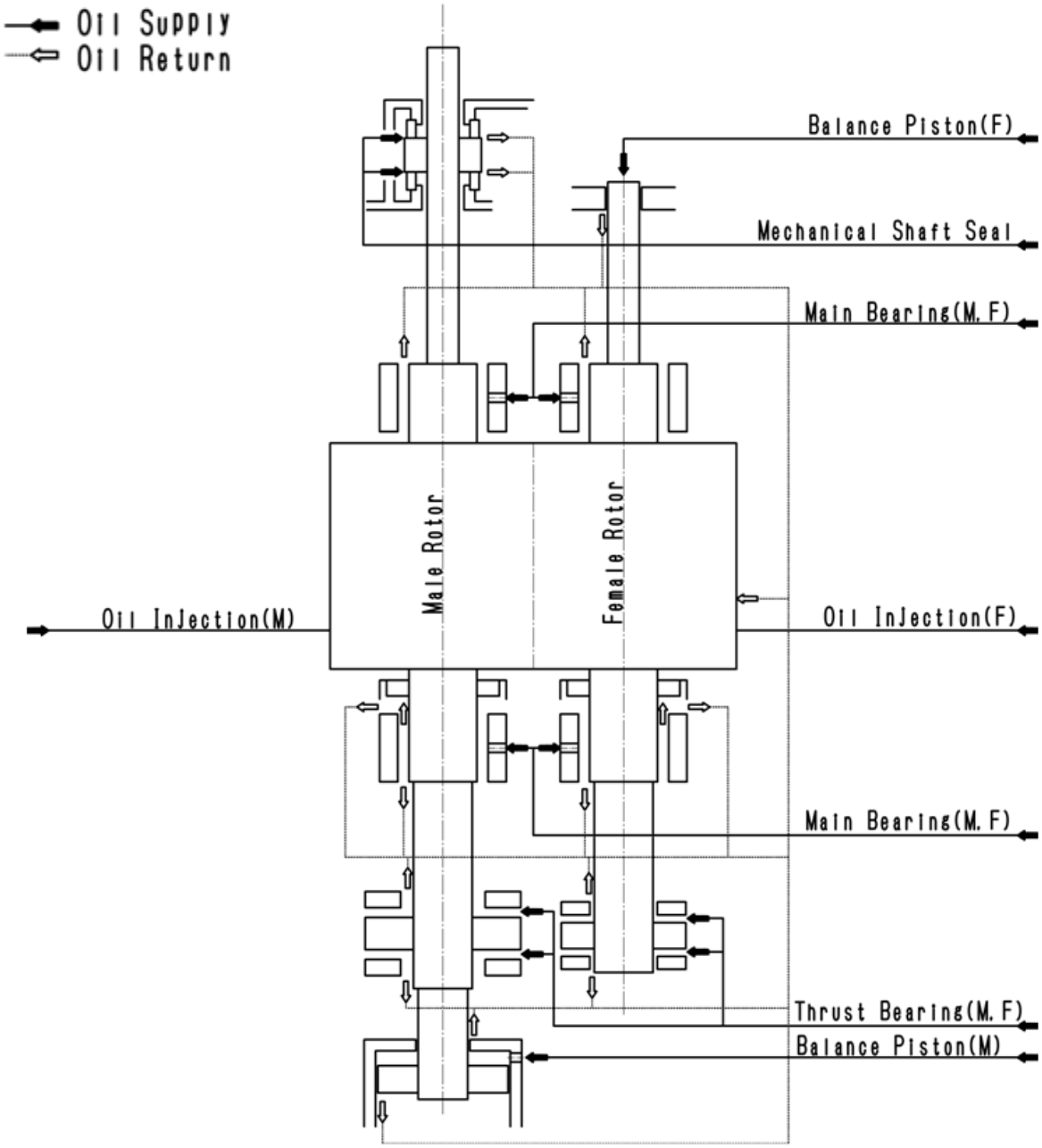


Figure 2-12 Oil Flow 01

The following figure shows the oil flow of the unloader cylinder for capacity control.

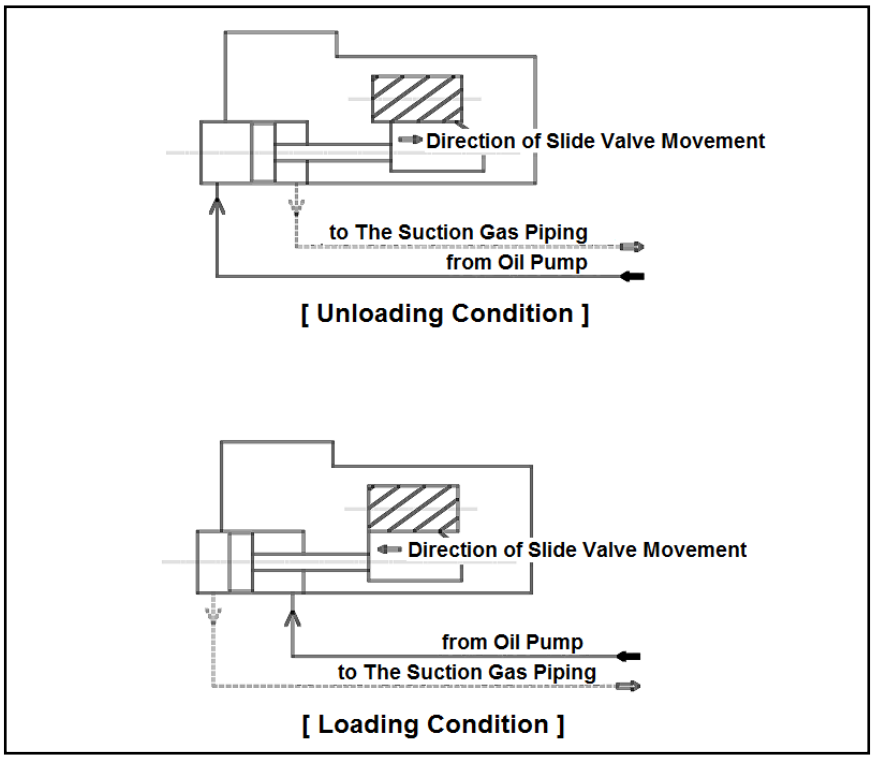


Figure 2-13 Oil Flow 02

2.7 Capacity Control

The following figure shows the capacity control characteristics of the GH-series compressors.

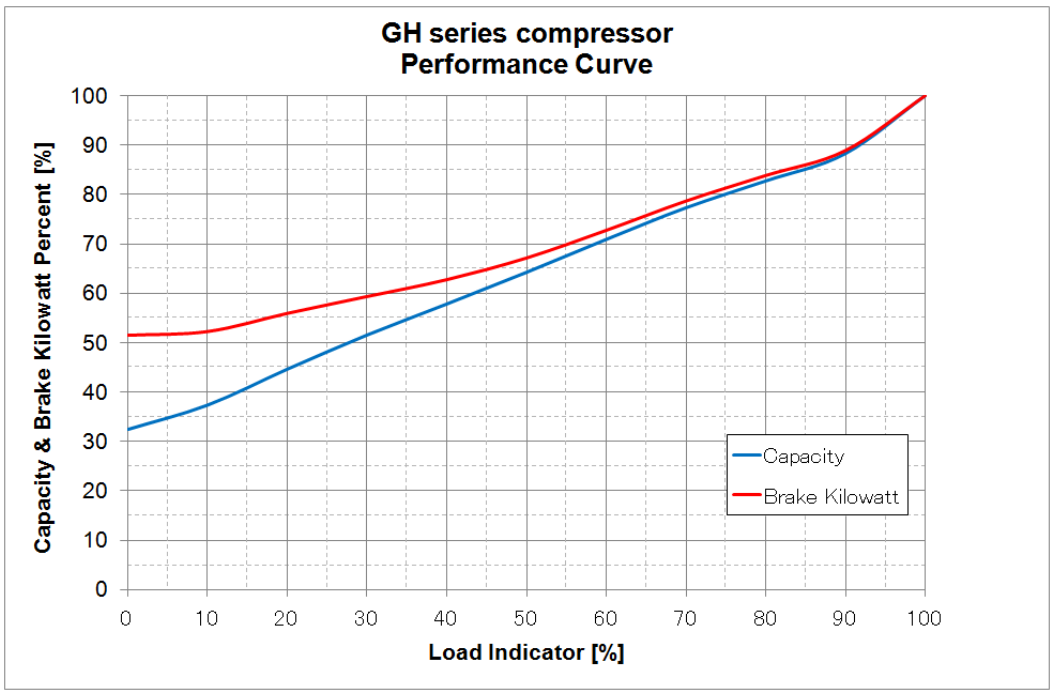


Figure 2-14 Characteristics of Capacity Control

3 Installation

3.1 General Precautions for Installation

【POINT】

- The description in Chapter 3 “Installation” assumes that the compressor is installed to a package unit intended for standard type refrigeration, cold storage, or other gas compression system.
  If the package unit you are actually using is not the one for standard type refrigeration, cold storage, or other gas compression system, make sure to 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 one of our local sales offices or service centers.

- In some cases, it may be required that installation is performed by qualified personnel. Make sure that the work is performed by qualified personnel in compliance with local laws, ordinances and other regulations/requirements.
- 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 abnormalities or deficient parts on the compressor, please contact one of our local sales offices or service centers immediately.
- Unnecessary packing materials should be discarded according to the laws and ordinances, or your company's rules.

3.2.2 Storage

Perform the followings to store the compressor before installation.

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

3.2.3 Transfer

DANGER

- **Should the compressor being lifted up drop, there is a high risk of death or severe injury. Provide sufficient protection such that no one can enter an area below a compressor being lifted up.**

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 work before confirming the safety of the wire ropes. If you cannot make a correct evaluation or judgment, entrust an expert to check.

4. To lift the compressor, attach the wire ropes to the appended eye bolts by using appropriate shackles and hooks. Use the eye bolts only for lifting the compressor.

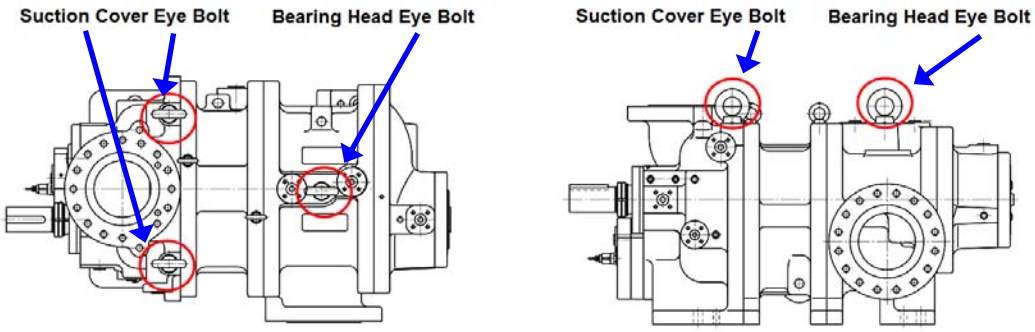


Figure 3-1 Eye bolts for 3 points lifting the compressor (Arrows)

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

5. Check path of compressor installation to make sure it is free of obstacles in consideration of the compressor size.
6. Before lifting, check that the hook is located above the gravity center of the compressor.
7. Before starting to lift up the compressor, instruct all the workers to be sufficiently away from the lifting area.
8. Just before starting to lift up, provide the coworkers with a sign (such as a call, hand signal, etc.) of starting the lifting action. Do not start to lift up unless the sign (such as a call, hand signal, etc.) has been fully acknowledged.
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 tilted. If the compressor is tilted, return the compressor to the ground and correct the tilt by adjusting the wire ropes. After that, restart the lifting operation.
11. Be sure to lift up the compressor slowly. If it is lifted rapidly, it may damage the lifting tools such as wire ropes or a part of the compressor.
12. When the lifting work starts, observe to see if wire ropes and lifting tools are normal. Be sure that the compressor is not tilted.
13. When moving the lifted compressor, always use guiding ropes.
14. When moving the compressor, turn away workers from the movement direction and check safety.
15. Do not lift the compressor above the safety passage unless absolutely necessary.
16. Do not lower the compressor on the safety passage. Always keep the safety passage free of obstacles.
17. Remove any obstacles before lowering the compressor onto the ground. The compressor should not be tilted or unstable.
18. Before lowering the compressor, announce to the workers around the working area in advance.
19. When lowering the compressor onto two or more blocks, align the tops of blocks so that the compressor becomes stable horizontally on them.
20. Slowly lower the lifted compressor so that it is not damaged by shock.

3.2.4 Preparation for Installation

■ Installation Space

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

■ Minimum interval of Male rotor shaft to Motor shaft (GH250S/L and GH320S)

The interval between the Male rotor shaft end and a driving machine shaft end is required at least more than 250 mm as shown in Figure 3-2.

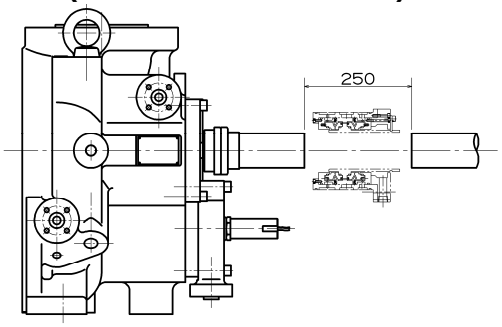


Figure 3-2 Minimum Interval of Shafts

■ Lighting

Provide sufficient lighting to allow easy operation, cleaning, maintenance, and inspection.

■ Ventilation

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

■ Piping

Refer to the relevant figures Section 2.3.4 "Outer Dimensions" in this manual chapter 2.

3.2.5 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 prevent normal operation.

3.2.5.1 Piping Connection

■ Working Gas Piping

Observe the following when connecting the working gas piping.

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

3.2.5.2 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 lubricant before starting the compressor operation, install an oil heater on the oil separator. In cold districts, install a band heater to the oil supply piping if necessary.
Make sure to install a protection function (thermostat, etc.) to the heater to prevent overheating.

■ **Suction Strainer**

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

For details about miscible and non-miscible oils, refer to Section 4.1 "Lubricating Oil" in this manual Chapter 4.

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

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

Install the necessary protective devices, referring to Section 1.4.3 "Compressor Protection Devices" and Section 2.3.3 "Alarm Set Values", in this manual.

3.2.6 Airtightness Test

Perform an airtightness test before commissioning. To prevent water entry in the package unit, use nitrogen gas or dry air for the airtightness test. Set the test pressure to the design pressure of the package and maintain the pressure for at least 30 minutes while checking the flange connections and fittings for any leak using leak detection fluid (soapy water, etc).

3.2.7 Lubricating Oil Charge

CAUTION
● **For the initial charge, always use new oil not opened to air.** ● **When adding lubricating oil, make sure that no air or water enters the package.** ● **Store the lubricating oil in a sealed container placed indoors.**

3.2.7.1 Initial Charge of Lubricating Oil

At initial commissioning or after periodical inspection, the compressor's moving parts such as bearings and mechanical seals may not be sufficiently lubricated. Therefore, charge lubricating oil according to the following procedure.

a) Thoroughly evacuate the compressor and oil separator to 40 Torr. At that time, make sure to open the unloader valve to evacuate the cylinder.

b) Close the oil separator outlet valve in the oil line.

c) Add lubricating oil from the drain valve on the oil cooler (or on the oil filter).
When the oil level reaches to the lower limit of the oil level gauge in the oil separator, finish the oil charge from the oil line.

d) After that, add lubricating oil to the specified level from the oil separator lubrication valve.

e) Start the oil pump and check the oil pump discharge pressure to see that the lubricating oil is circulated. If possible, check that the oil level on the oil separator lowers.

f) Adjust the lubrication differential pressure on the oil pump.

g) After adjusting the lubrication pressure, operate the oil pump for 2 minutes. Then, after checking that the motor main power is turned off, turn the driving shaft of the compressor.

h) If the lubricating oil is found to circulate through the oil supply line normally after the above operations, the initial charge of package unit is finished.

【POINT】

- When working in the initial charging of lubricating oil, make sure that the oil cooler and oil filter are filled with lubricating oil.
- For details about lubricating oil to be used, refer to Section 4.4.1 "Lubricating Oil" in this manual.
- Determine the specified amount of the initial charge of lubricating oil based on the configuration of the package unit, and make sure to specify in the instruction manual of the package unit.

3.2.7.2 Additional Charge of Lubricating Oil

Determine the procedure of the additional filling of lubricating oil based on the configuration of the package unit, and make sure to specify in the instruction manual of the package unit.

3.2.8 Charge of Working Fluid

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 filling work accordingly.

Also, as in the lubricating oil filling work, the working fluid filling work must be performed carefully so that no water or air enters the system.

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.

4 Compressor and Package Operation

4.1 Lubricating Oil

The selection and management of lubricating oil are critical factors in compressor operation.
When selecting and managing lubricating oil, take the following points into consideration

4.1.1 Precautions for Selecting the Lubricating Oil

- The type of lubricating oil must be selected in consideration of the working fluid in use, type of evaporator, and operation conditions. Various properties of lubricating oil must be checked in addition to viscosity, such as solubility to working fluid, separability, fluidity at low temperature and thermal stability at high temperature. Therefore, we recommend consulting one of our sales offices or MAYEKAWA representative for the specified brand usable to your system.
- The lubricating oil for the compressor must have appropriate viscosity to lubricate the bearing and other mechanical components properly. The oil viscosity must be measured at the oil filler port of the compressor. The viscosity of lubricating oil is significantly affected by the combination of working fluid type and oil type. If the working fluid dissolves in the oil (the oil is compatible), the actual viscosity may be substantially lower than the required viscosity for the compressor depending on the operation conditions. If the working fluid does not dissolve in the oil (the oil is not compatible) and the oil temperature is low, the viscosity may become excessively high. An appropriate type of lubricating oil must be selected so that it is supplied to the compressor with appropriate viscosity (13 to 40 mm^2/s) in the operating state.
- In a refrigerator or a other gas compression system utilizing a screw compressor, the lubricating oil supplied to the compressor is discharged along with the discharge gas and separated from the working fluid by the oil separator. However, because the oil separator cannot separate the oil and working fluid completely, a very small part of lubricating oil enters and stays in the condenser. This results in oil entry to the evaporator. Because of these circumstances, the lubricating oil must have thermal stability at high temperature, separability from working fluid gas and fluidity at low temperature.
- Depending on the type of working fluid, some lubricating oils cannot be used. For example, polyolester synthetic oil (POE) cannot be used for anmonia refrigerant.

4.1.2 Change of Lubricating Oil Brand

When changing the brand of lubricating oil in use, the user must pay attention to the following points.

CAUTION
● **The change of lubricating oil brand may cause troubles in respect of operation conditions and compressor operation. When changing the lubricating oil brand in use, make sure to contact us because appropriate steps must be surely followed.**

- Lubricating oil may contain additives for the purpose of improving lubrication characteristic and preventing degradation. The types of additives and the additive rate differ depending on the type and brand of lubricating oil. Theodore, we recommend avoiding the mixed use of different brands of lubricating oil. If mixed, the additives in the lubricating oil may react with each other and create by-products.
- If it is inevitable to change the brand of lubricating oil, recover as much oil as possible from the compressor as well as oil separator, oil cooler, condenser, evaporator and other refrigerator components before refilling the new lubricating oil.

- When changing the brand of lubricating oil, always confirm the validity of the change from the lubricating oil manufacturer. Particularly when changing the brand to that of a different manufacturer, consult both manufacturers to verify that the brand change will not cause problems.
- When changing the lubricating oil to another product of the same brand at a different viscosity grade, confirm that the viscosity grade after change will not cause problems in compressor operation.
- Depending on the property of lubricating oil (compatible or non-compatible), a working fluid system must adopt different packages and working fluid flow (type of evaporator, with or without oil return line). Therefore, any oil change from compatible one to non-compatible one is unallowable. If you change the lubricating oil from non-compatible to compatible, select the lubricating oil paying particular attention to the viscosity. The actual viscosity will lower because compatible oil dissolves in the working fluid.

4.1.3 Precautions for Handling the Lubricating oil

- For lubricating oil refilling, always use clean oil that has been sealed and stored indoors. Any oil left open to air may absorb moisture and contain dust and foreign objects.
- When adding lubricating oil, take extreme care not to allow entry of air and moisture.

4.2 Precautions for Operation

Please pay enough attention to the mention contents of this section, especially when the package unit is used in a refrigeration cycle.

4.2.1 Prevention of Liquid Flow-back

Liquid flow-back is a phenomenon that refrigerant liquid (mist) not evaporated in the evaporator is drawn into the compressor.

The liquid flow-back may cause abnormal vibrations and noises from compressor, foaming of lubricating oil in oil separator (too much oil loss), and poor lubrication of compressor.

To prevent liquid flow-back, appropriately adjust the expansion valve of evaporator or liquid cooler.
In addition, special attention must be paid to the outgoing routing of suction piping and the activation of compressor after a long-time operation stop.

4.2.2 Purging of Non-condensable Gas

WARNING

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

Any non-condensable gas in the system may cause the compressor discharge pressure to rise excessively in comparison with the refrigerant saturation pressure corresponding to cooling water temperature of condenser. This is caused by the non-condensable gas staying in the condenser which deteriorates the heat exchange performance.

If the vacuum pumping performed upon installation or maintenance is insufficient or the suction pressure is lower than the atmospheric pressure, non-condensable gas may stay in the condenser due to a leak from piping on the suction side.

As an increasing amount of non-condensable gas stays in the condenser, the compressor load becomes larger and finally a motor overcurrent alarm may occur.

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

1. While the compressor is stopping, allow the cooling water to flow to the condenser and check that there is no unignorable difference in water temperature between inlet and outlet. If any difference is present between the inlet and outlet water temperatures, keep flowing the cooling water until the temperature difference is eliminated.
2. Measure the pressure of the condenser and compare it with the refrigerant saturation pressure corresponding to the cooling water temperature.
3. If the condenser pressure is higher than the working fluid saturation pressure by 0.05 MPa or more, purge any non-condensable gas.

4.2.3 Action for Stopping the Compressor for Long Period of Time

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

- Turn off the motor main power.
- Turn off the oil heater power and the control power.
- Close the suction stop valve and discharge stop valve.

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

- Measure the system pressure.
- Check for working fluid leak.
- Operate the oil pump for 5 minutes. After that, rotate the compressor shaft (10 rotations or more).

When restarting the compressor after an operation stop period of 1 year or longer, check the system for working fluid leak and replace the lubricating oil. Also check the motor insulation resistance.

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

5 Maintenance and Inspection

5.1 Precautions for Maintenance and Inspection

- Before starting a maintenance/inspection work following working gas treatment, make sure that the motor power, control power and power for equipment and valves are turned off and the power switches are protected from any unauthorized access. In addition, attach a tag to each power switch informing other workers that the switch must not be operated. (Lockout/tagout)
- Also when a manual valve is closed, apply appropriate measures so that it cannot be operated by other workers and attach a tag stating that the device must not be operated.
- Before disassembling, inspecting or handling the compressor, you have to understand the disassembly/assembly procedure of the compressor. This document does not provide a complete procedure of compressor disassembly and assembly but just instructs the points in compressor service.
- If you need to perform the complete procedure of compressor disassembly/assembly, consult MYCOM in your region.
- When replacing a part, always use the MYCOM genuine part. If any unauthorized part is used, unexpected troubles may occur.
- Do not remodeling the compressor and other parts without approval of MYCOM. The compressor may be damaged and cannot maintain functions.
- To disassemble the compressor, it must be removed from the package and placed on a work bench. Before removing the compressor from the package, make sure to perform working gas treatment and verify that the atmospheric pressure is recovered inside the compressor.
- Prior to the compressor removal from the package, check that the high temperature side (discharge side) is cooled down to 40 °C or less.
- Perform the compressor disassembly on a rigid and flat work bench.
- When removing the compressor from the package and place it on the work bench, follow the instructions in Section 3.1 "General Precautions for Installation" and Section 3.2.3 "Transfer" in this manual Chapter 3.
- The lifting and carrying works for the compressor and package unit must be performed by qualified personnel.
- For the compressor disassembly/assembly, use specified tools that are properly functioning.
- When handling heavy objects, exercise extreme caution and use auxiliary tools including stud bolts (safety bolts).
- When carrying a heavy object, use lifting equipment such as crane, chain block, etc. or work with one or more co-workers.
- When working with other personnel, make sure that all workers clearly understand the work procedure.
- When turning on and off the power supplies, take care not to suffer electric shock.
- Any electric work requiring some expert qualifications must be performed by personnel who have relevant qualifications.

5.2 Maintenance List

This section explains about the management, maintenance and inspection with a focus on the compressor.

5.2.1 Daily Management

Inspect the each corresponding item indicated in Table 5-1 "Daily Inspection Item" and record the results as daily management.

Any abnormal condition can be found by these operation data recorded in an operation journal on a daily basis. This practice is significantly effective to prevent possible compressor failures.

Especially if the package unit is a refrigeration device, it is important to monitor the temperature and pressure correlation related to the refrigerant evaporation and condensation. By doing so, the user can detect any abnormal condition in the compressor or the equipment in an early stage.

If any compressor/equipment failure or operation accident occurs, the operation records will help the user identify the causal factors correctly and take appropriate measures promptly.

Inspect the devices of package unit and load side condition in addition to Table 5-1, and record the result as daily management. For details, refer to the instruction manual of the package unit.

Table 5-1 Daily Inspection Item

Inspection Items		Unit	Inspection Contents	Check Items/Actions
Compressor	Operation time	hour	Total operation time	• Judgment of periodic maintenance timing
	Suction pressure	MPa **Note 1**	Difference from setting of evaporation temperature equivalent pressure	• Contamination of cooling pipe surface • Temperature and flow rate of components cooled
	Discharge pressure	MPa	Difference from condensation pressure equivalent to cooling water temperature	• Contamination of condenser cooling pipes • Mixing of non-condensable Gas • Cooling water amount, cooling water temperature
	Oil supply pressure	MPa	Difference from discharge pressure	• Any decreasing trend in differential pressure • Liquid back operation • Wear of compressor parts
	Oil Filter Pressure loss	MPa	Pressure difference between inlet and outlet of oil filter	• Contamination of refrigerant oil • Clogging of oil filter element
	Suction temperature	°C	Whether it is in a range between upper limit and lower limit	• Temperature and flow rate of components cooled
	Suction superheat	°C	Whether superheat is appropriate	• Adjust expansion valve. • Refrigerant gas circulating amount shortage
	Discharge temperature	°C	Whether it does not exceed upper limit	• Mixing of non-condensable gas • Lubrication temperature, insufficient lubricant • Compressor failure
	Lubrication temperature	°C	Whether it is in a range between upper limit and lower limit	• Contamination of oil cooler pipes
	Mechanical shaft seal Leaks	mL/h	Oil leak rate from seal cover drain	• Mechanical shaft seal failure
	Vibrations and noises	—	Abnormal noises, abnormal vibrations	• Compressor failure
Others	Motor current	A	Whether it is larger than that checked during test operation	• Compressor failure
	Oil level of the oil separator	mm or %	Oil level	• Oil entry • Add oil
	Fluid level of the receiver	mm or %	Fluid level	• Check for refrigerant leak • Add refrigerant (working fluid)

Note 1: Unless otherwise noted, pressure unit indicated in this manual is used MPa as gauge pressure.

■ Daily Maintenance Items

1. **Oil level of lubricant**
   When the oil level of the oil separator reaches the lower limit, add lubricating oil.

2. **Replacing or cleaning oil filter element**
   When the differential pressure between the oil supply pressure and the discharge pressure increases to or above 0.15 MPa, replace or clean the oil filter element. In an early stage of operation, the oil filter differential pressure may increase in a short time.

CAUTION

- **With some operation conditions, any differential pressure before and after the oil filter at 0.15 MPa or more may significantly deteriorate the thrust bearing life. Moreover, the oil filter element may be broken, resulting in compressor damage.**

3. **Cleaning suction strainer**
   When the compressor operation hours have exceeded 500 hours, inspect the suction strainer and remove the temporary filter for early operation stage if it is attached.

   At the beginning of the operation or just after a periodical maintenance, the differential pressure before and after suction strainer may increase in a short time. If such a phenomenon is observed, inspect and clean the suction strainer.

4. **Oil leak from mechanical shaft seal**
   If there is much oil leak from the mechanical shaft seal, confirm the leak rate. The table below specifies the allowable leak rate and the upper limit for inspection.
   If any damage is found in the mechanical shaft seal during inspection, replace the seal assembly.

Table 5-2 Guideline for Leak Rate from Mechanical Shaft Seal

Condition		Model	
		GH250S/L	GH320S
Allowable leak rate	(mL/h)	≤ 12	≤ 12
Inspection criteria	(mL/h)	≥ 36	≥ 36

Note: The specifications above are just guidelines.
They do not constitute any assurance about the performance.

5. **Contamination of condenser and oil cooler pipes on cooling water side**
   The degree of clogging and contamination in the cooling pipes is largely affected by the cooling water quality.

   If the oil temperature and discharge pressure increase gradually in an early stage of operation, inspect and clean the cooling water side of the oil cooler and condenser even when the inspection timing has not come.

5.2.2 Periodical Inspection

Inspect the following items at specified intervals.

Table 5-3 Periodical Inspection Items of GH250S/L and GH320S

Item	Operating Hours or Translating Period			
	200	4000 or Half a year	8000 or 1 year	16000 or 2 year
Compressor (in addition, refer to Table 5-4 Replacement Parts at Overhaul)				
Mechanical shaft seal portion	C	C	IR	IR
Unloader mechanism portion	—	—	C	IR
Slide Valve portion	—	—	C	IR
Thrust bearings portion	—	—	—	IR
Main/side bearings portion	—	—	—	IR
Rotors	—	—	—	IR
Balance piston and sleeve portion	—	—	—	IR
O-rings	—	—	R (partial)	R (total)
Compressor Unit / Refrigeration system (for reference)				
Pressure gauges/sensors	—	—	C	C
Temperature gauges/sensors	—	—	C	C
Protection devices	—	—	C	C
Safety valves	—	—	C	C
Control circuit and electrical devices	M			
Suction strainer	I	IR/CL	IR/CL	IR/CL
Suction check valve	—	—	I	IR
Oil filter elements	I	IR/CL	IR/CL	IR/CL
Oil separator elements	—	—	IR	IR
Connection leak	C	C	C	C
Lubricating oil	C	C	C	R
Cooling water side of oil cooler	—	—	CI/CL	CL/CL
Cooling water side of condenser	—	—	CI/CL	CI/CL
Coupling assembly	C	—	IR	IR
Shaft alignments	A	—	A	A
Main motor (for details, refer to the instruction manual of the main motor)				
Grease up	G	G	GC	GIR
Bearings	G	G	GC	GIR
Insulation resistance	M			
motor starting equipment	M			

Note: Inspect the machine per period or specified operation hours, whichever comes first.

Abbreviations:

C: check and/or analysis routinely

I : inspection to be done with removing or disassembling of relevant parts

R: replace periodically or if abnormal condition found by inspection

A: alignment of the shafts (main motor shaft and compressor male rotor shaft) must be checked and adjusted

G: grease up periodically as required by the instruction manual of the main motor

CL: cleaning

M: inspection as required by each instruction manual

5.2.3 Replacement Parts of the Compressor in Overhauling

Following Tables show the items that need to be replaced every overhaul of the compressor.

Table 5-4 Replacement Parts at Overhaul (O/H) of GH250S/L

Item No.	Part Name	Code No.	Qty.		Remarks
			Partial O/H	Full O/H	
6-1	O-ring	CS00600-GH250	—	2	544. 8×8. 4
6-2	O-ring	PC11-046	—	2	JIS B2401 P46 FKM-70
9	O-ring	PC12-070	1	1	JIS B2401 G70 FKM-70
17	O-ring	CS01700-GH250	—	1	497.3×8. 4 FKM-70
23-M	O-ring	PC12-230	1	1	JIS B2401 G230 FKM-70
23-F	O-ring	PC12-170	1	1	JIS B2401 G170 FKM-70
27	Main bearing	CS02700-GH250	—	4	GH250
28-1	Floating seal (A)	CS02800-GH250A	—	2	GH250
28-2	O-ring	PC12-130	—	2	JIS B2401 G130 FKM-70
30-M	Balance piston (M)	CS03000-GH250M	—	1	φ190/φ185/0φ160 choice
32-2	Lock washer	NG32-010	—	1	JIS B1554 AW10-A
33-3	Floating seal (B)	CS02800-GH250B	—	1	GH250
33-M	Balance piston sleeve (M)	CS03300-GH250M	—	1	φ190/φ185/0φ160 choice
33-F1	Balance piston sleeve (F)	CS03300-GH250F	1	1	GH250 φ55
33-F2	Balance piston (F)	CS03000-GH250F	—	1	GH250
35-MS1	O-ring	PC11-225	1	1	JIS B2401 P225 FKM-70
35-MS2	Backup ring	PG11T2-225	1	1	SUN-2BP-225-T2 PTFE
35-MS3	O-ring	PC12-070	—	1	JIS B2401 G70 FKM-70
35-M	O-ring	PC12-065	2	2	JIS B2401 G65 FKM-70
35-F	O-ring	PC12-055	1	1	JIS B2401 G55 FKM-70
38-M	Thrust bearing assembly (M)	CS038T-H25M-ORI	—	1	GH250 TPTB
38-F	Thrust bearing assembly (F)	CS038T-H25F-ORI	—	1	GH250 TPTB
44-M	O-ring	PC12-195	—	1	JIS B2401 G195 FKM-70
44-F	O-ring	PC12-160	—	1	JIS B2401 G160 FKM-70
63	O-ring	PC12-160	1	1	JIS B2401 G160 FKM-70
65	O-ring	PC11-140	1	1	JIS B2401 P140 FKM-70
66	Cap seal	CS06600-3225	1	1	SUNR-BE-140
70	Lock Washer	NG32-008	—	1	JIS B1554 AW08-A
73	O-ring	PC12-035	1	1	JIS B2401 G35 FKM-70
75	O-ring	PC12-145	1	1	JIS B2401 G145 FKM-70
100	Mechanical seal assembly	CS10000	1	1	GH250
102	O-ring	PC12-080	1	1	JIS B2401 G80 FKM-70
325-1	O-ring	PC11-050	2	2	JIS B2401 P50 FKM-70
325-2	Backup ring	PG11T2-050	4	4	SUN-2BP-50-T2 PTFE
325-3	Wearing	CS1060-WEARING-GH250	1	1	WHR50 PTFE
432	O-ring	PC12-140	—	8	JIS B2401 G140 FKM-70
662	O-ring	PC12-035	1	1	JIS B2401 G35 FKM-70

Note: For other parts, visually inspect the parts and replace them if any abnormality is found.

Note: [Partial] and [Full] of Q'ty column mean partial overhaul and whole overhaul of the compressor.

Note: The materials of the O-ring may change by use working fluid.

Table 5-5 Replacement Parts at Overhaul (O/H) of GH320S

Item No.	Part Name	Code No.	Qty.		Remarks
			Partial O/H	Full O/H	
6-1	O-ring		—	2	
6-2	O-ring	PC11-056	—	2	JIS B2401 P56 FKM-70
9	O-ring	PC12-090	1	1	JIS B2401 G90 FKM-70
17	O-ring		—	1	
23-M	O-ring		1	1	JIS B2401 P300 FKM-70
23-F	O-ring	PC12-210	1	1	JIS B2401 G210 FKM-70
27	Main bearing		—	4	GH320
28-1	Floating seal		—	2	GH320
28-2	O-ring	PC12-165	—	2	JIS B2401 G165 FKM-70
30-M1	Balance piston (M-1)		—	1	φ285/φ240 choice
30-M2	Balance piston (M-2)		—	1	GH320
30-F	Balance piston (F)		—	1	GH320
32-M2	Lock washer	NG32-010	—	1	JIS B1554 AW19A
33-M1	Balance piston sleeve (M-1)		—	1	φ285/φ240 choice
33-M2	Balance piston sleeve (M-2)	CS03300-GH320M2	—	1	GH320 M-2
33-F1	Balance piston sleeve (F-1)	CS03300-GH320F1	—	1	GH320 F-1
35-M1	O-ring		1	1	JIS B2401 P300 FKM-70
35-M2	Backup Ring		1	1	SUN-2BP-300-T2
35-M3	O-ring	PC12-130	1	1	JIS B2401 G130 FKM-70
35-M4	O-ring	PC12-115	1	1	JIS B2401 G115 FKM-70
35-F1	O-ring	PC12-100	1	1	JIS B2401 G100 FKM-70
35-F2	O-ring	PC12-085	1	1	JIS B2401 G85 FKM-70
35-F3	O-ring	PC12-200	1	1	JIS B2401 G200 FKM-70
38-M	Thrust bearing assembly (M)		—	1	TPTB
38-F	Thrust bearing assembly (F)		—	1	TPTB
63	O-ring	PC12-250	1	1	JIS B2401 G250 FKM-70
65	O-ring	PC11-215	1	1	JIS B2401 P215 FKM-70
66	Cap seal		1	1	SUNR-BE-215
70	Lock Washer		—	1	JIS B1554 AW10-A
73	O-ring	PC11-050A	1	1	JIS B2401 P50A FKM-70
75	O-ring	PC12-220	1	1	JIS B2401 G220 FKM-70
100	Mechanical seal assembly		1	1	GH320
112	O-ring	PC12-110	—	1	JIS B2401 G110 FKM-70
150-M	O-ring	PC12-290	—	1	JIS B2401 G290 FKM-70
150-F	O-ring	PC12-195	—	1	JIS B2401 G195 FKM-70
325-1	O-ring	PC11-070	2	2	JIS B2401 P70 FKM-70
325-2	Backup ring	PG11T2-070	4	4	SUN-2BP-70-T2
432	O-ring	PC12-170	—	8	JIS B2401 G170 FKM-70
662	O-ring	PC12-035	1	1	JIS B2401 G35 FKM-70

Note: For other parts, visually inspect the parts and replace them if any abnormality is found.

Note: [Partial] and [Full] of Q'ty column mean partial overhaul and whole overhaul of the compressor.

Note: The materials of the O-ring may change by use working fluid.

5.3 Management of Lubricating Oil

5.3.1 Management Criteria of Lubricating Oil

Lubricating oil, to which the management criteria is applied, is classified as follows:

(1) Synthetic oil: Polyalkylene glycol (PAG)
(2) Mineral oil: Naphthene series, Paraffin series
Synthetic oil: Alkyl benzene (AB), Polyalphaolefin (PAO)
(3) Synthetic oil: Polyolester (POE)

- We recommend analyzing oil by sampling at intervals of 6 months.
- If the oil does not fulfill the management criteria below, replace the oil.
*This does not apply to water contents in PAG oil. See Note 1 of the table below.

Each item and criterion are as follows. The management criteria may be changed without notice.

Table 5-6 Synthetic Oil (PAG)

Item	Criteria
(a) Color phase	ASTM color standard: 4.0 or less
(b) Total acid value	0.1 mg•KOH/g or less
(c) Kinetic viscosity	Amount of change must be within ±10% relative to the new oil.
(d) Water content	2000 mass ppm or less **Note 1**
(e) Degree of contamination	Degree of contamination measured by mass method (millipore value) is 15 mg/100 mL or less.

Table 5-7 Mineral Oil, Synthetic Oil (AB, PAO)

Item	Criteria
(a) Color phase	ASTM color standard: 6.0 or less
(b) Total acid value	0.3 mg•KOH/g or less
(c) Kinetic viscosity	Amount of change must be within ±15% relative to the new oil.
(d) Water content	100 mass ppm or less **Note 1**
(e) Degree of contamination	Degree of contamination measured by mass method (millipore value) is 15 mg/100 mL or less.

Table 5-8 Synthetic Oil (POE)

Item	Criteria
(a) Color phase	ASTM color standard: 4.0 or less
(b) Total acid value	0.2 mg•KOH/g or less
(c) Kinetic viscosity	Amount of change must be within ±10% relative to the new oil.
(d) Water content	200 mass ppm or less
(e) Degree of contamination	Degree of contamination measured by mass method (millipore value) is 15 mg/100 mL or less.

Note 1: Synthetic oil (ammonia compatible oil) has high hygroscopicity and the sample may contain water. In addition, ammonia dissolved in the oil may be detected as water during analysis, preventing correct measurement of water content. Therefore, the control Criteria above should be construed as guidelines.

5.3.2 Replacement Interval for Lubricating Oil

5.3.2.1 First Package Startup

When the package is started up for the first time, the lubricating oil may be contaminated or deteriorated due to residual scales inside the piping and containers.

After 500 hours from the first startup, sample the lubricating oil and analyze it. If the results do not fulfill the management criteria for each oil type detailed in Table 5-6 to 5-8, replace the lubricating oil.

5.3.2.2 During Normal Operation

Lubricating oil gradually degrades as it is used.

The degradation rate differs depending on the operation conditions, oil type, and any foreign objects/water in the oil. Sample and analyze the lubricant at intervals of 6 months. If the results do not fulfill the management criteria detailed in Table 5-6 to 5-8, replace the lubricating oil.

However, if the oil filter is clogged frequently or the oil becomes turbid in black, replace the oil after identifying and eliminating the causal factor.

5.4 Compressor Disassembly Preparation

5.4.1 General Precautions for Disassembly Work

As a general rule, compressor disassembly work at the installation site is limited to the shaft seal portion and capacity control (unloader) portion. Disassembly work on other components should only be carried out after the compressor has been removed from the compressor unit frame and can be worked on in a clean, safe environment.

Disassembly, inspection and handling of the parts should be done only with a full understanding of the construction of the compressor and the instruction manual should be referred to frequently as the work proceeds.

⚠ DANGER

- **Before starting compressor disassembly work, be sure to cut off the main power supply and control power supply. Be careful that the power will not be turned on during the work.**
- **If the power is turned on during the work, the compressor or oil pump may start moving, which may cause the operator to be caught in or the devices to be damaged. In addition, there is a risk of receiving an electric shock through contact with live parts.**
- **In order to avoid these risks, be sure to lockout / tagout the breakers after cut off the power supply.**

⚠ CAUTION

- **Any casing or cover dropped may cause injuries or damage to the compressor. Always attach stud bolts for safety before disassembling the casing or cover.**
- **The retaining ring may jump out, causing injuries. Always use retaining ring pliers of appropriate size and wear protective goggles.**

5.4.2 Tools and Working Areas for Disassembly

⚠ CAUTION

- **For compressor disassembly/assembly work, use specified tools that are properly functioning. Using tools that are worn or damaged or that are inappropriate for the work, can result in injury.**

Prepare tools to be required for the work referring to Section 7.2 Table7-1 in this manual Chapter 7 and Table 5-9 “Tools for Disassembly of GH250S/L” in next page.
In case of GH320S, we have not created special tools, so refer to Section 7.2 Table 7-2 in this manual Chapter 7.

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

When removing the compressor from the installation unit flame and doing an overhaul, prepare a large surface plate as the work bench.

To safely perform bolts removal used in the lower side of the compressor, an exclusive frame for placing the compressor is required. Refer to the Section 5.4.6 in this Chapter.

Perform the work in a dry place with as little sand and dust as possible, with a sufficiently wide space around there.

Table 5-9 Tools for Disassembly of GH250S/L

No.	Tool Name	Remarks	Q'ty
x-1	Special Tool for Floating Seal (A)	OD: φ125 × ID: φ100 × L115	1
x-2	Special Tool for Removing Balance Piston M, F	L340 mm	1
x-3	Special Tool for Main Bearing	L300 mm	1
x-4	Special Tool for Parallel Pin		1
x-5	Special Tool for Parallel Pin	Bearing #6000	1
x-6	Stud Bolt	M8 × L100 mm	2
x-7	Stud Bolt	M8 × L170 mm	2
x-8	Stud Bolt	M8 × L220 mm	2
x-9	Stud Bolt	M8 × L310 mm	2
x-10	Hexagon Head Screw	M20 × L260 mm	1
x-11	Ratchet Wrench	1/4 "	1
x-12	Spanner Wrench	46 mm	1
x-13	Screw Driver (+)		1
x-14	Screw Driver (-)		1
x-15	Offset Wrenches	36 mm × 32 mm	1
x-16	Plier for C-type Retaining Ring	H155	1
x-17	Lock Nut Wrench	AN17	1
x-18	Lock Nut Wrench	AN15 (long)	1
x-19	Lock Nut Wrench	AN14 (long)	1
x-20	Lock Nut Wrench	AN10 (long)	1
x-21	Lock Nut Wrench	AN8	1
x-22	Spinner Handle for Socket Wrenches	#380	1
x-23	Sockets for Socket Wrenches	#36	1
x-24	Eyebolt	M8	2
x-25	Eyebolt	M6	2
x-26	Eyebolt	M5	2
x-27	Allen Wrench Key	Across Flat 2.5 mm	1
x-28	Allen Wrench Key	Across Flat 4 mm	1
x-29	Allen Wrench Key	Across Flat 6 mm	1
x-30	Allen Wrench Key	Across Flat 14 mm	1
x-31	Eyebolt	M16	1
x-32	Rod for Hexagon Socket Screw Keys	φ20 mm × L300 mm	1
x-33	Closing Plate for Small Flange	10A TYPE, 15A TYPE	1
x-34	Hexagon Head Nut	M8	2
x-35	Plain Washer	M8	2
x-36	Plain Washer	M12	2
x-37	Plain Washer	M16	2
x-38	Hexagon Socket Screw Keys	19 mm	1
x-39	Socket for Socket Wrenches	#24	1
x-40	Socket for Socket Wrenches	#18	1
x-41	Rod for Allen Wrench Keys	25A (Sch40) ×L300 mm	1
x-42	Stud Bolt	M16 × L250 mm	1
x-43	Hexagon Head Nut	M16	2
x-44	Special Tool for Main Bearing		1

5.4.3 Parts Replacement

Prepare MYCOM genuine replacement parts referring to Section 5.2.3 "Replacement Parts of the compressor in overhauling" in this Chapter.

Because O-rings and gaskets which are removed for the inspection are easy to be damaged, replace all with new ones.

When purchasing any part, inform its (a) model, (b) serial number, (c) part name, (d) code No. and (e) necessary number to one of our sales offices or service centers. Especially when the (b) serial number of the compressor is not identified, it will be difficult to decide the required parts because we can not specify the design and manufacturing specifications.

5.4.4 Working Gas Treatment / Recovery

After stopping operation of the compressor package unit, internal pressure is still high.
Before disassembling the compressor, it is necessary to lower the internal pressure to atmospheric pressure, using following methods for example.

- If there is another compressor package unit connected by bypass piping (or which can be temporarily installed), extract the working gas from one unit by operating the other compressor.
- Operate the refrigerating unit, close the fluid supply master valve, and collect the liquefied gas to the receiver.
- By using a small portable compressor which is a exclusive use for working gas recovery, collect the liquefied gas to the receiver.

【POINT】

During the working gas treatment work, open the capacity control solenoid valve to lower the pressure in the unloader cylinder..

For either of the methods above, prepare a device flow sheet for the work, check the necessary valve operation on the flow sheet and on the device, and specify valve operation and device/tube connection on the flow sheet.

Prepare one flow sheet for the foreman and one for displaying in the work area.

Also, make a working gas recovery procedure showing the conditions of the workplace and make sure all workers have read and understand it before starting the work.

⚠ WARNING

- **Make sure that all risk assessment checks, including checking the work contents and procedure, are implemented before starting work. Neglecting these checks will lead to an increase in industrial accidents to a level that cannot be ignored.**
- **Perform sufficient ventilation during the work.**

5.4.5 Removal of Connecting Parts of the Unit

When working gas treatment finish, remove the connecting parts of the unit.

a) Be sure cut off the main motor power and control power.

b) Close the suction stop valve, discharge stop valve, and liquid supply stop valve.

c) Be sure lockout/tagout the breakers and valves.

⚠ DANGER

- **If working gas or a mixture of working fluid and oil remains in the compressor, working 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.

d) Disconnect the following parts.

1. Coupling that is connecting the compressor and main motor
2. Compressor suction piping and discharge piping
   If the suction strainer is connected directly with the compressor, remove the strainer together.
3. Lubrication oil pipes with connection flanges
4. Two oil drain flanges of the suction cover bottom
5. Electric wiring of magnetrostrictive sensor probe for unloader indicator
6. Bolts for installing compressor (leg bolts)

【POINT】

- Since remaining oil may leak out when disconnecting the lubrication oil pipes with flanges from the compressor, slightly warm the piping and then disconnect it while checking the state of oil spillage. Prepare a receiving container and waste cloth for oil that will spill.
  Especially oil drain flange portion of suction cover bottom is full of oil. When removing drain flanges, prepare a container large enough to receive the oil.
- When disconnecting electrical wiring of magnetrostrctive displacement sensor probe, disconnect at the terminal box about 5 m away. Take care the terminal part of the disconnected wiring with Electric Works tape, and rolls up on the side of the compressor and fixes beforehand in the sensor.

5.4.6 Removing and Lifting the Compressor

DANGER

- **Make sure that the lifting equipment and wires have sufficient load capacity for the compressor. Otherwise, the compressor may fall, resulting in death or injuries and damage to the compressor. Before lifting compressor, always check that the lifting equipment and wires have sufficient loading capacity. Do not allow anyone to be under the lifted compressor.**

WARNING

- **Do not allow anyone other than qualified personnel to lift and carry the compressor. Entrusting the work to unqualified personnel may result in fall accident.**
- **Be sure not to assemble/disassemble the compressor while it is being lifted. There is a risk that the compressor's main body or parts may drop on human body.**

【POINT】

- In case of the suction piping is located immediately above the compressor, hold the piping or remove it in part, so that the compressor lifting work is not hindered.
- For the compressor locations where lifting tools should be attached, see Figure 3-1in this manual.
- Before starting compressor disassembly work, put the compressor on a exclusive frame as shown in Figure 5-1, and remove approximately 6 nuts for stud bolts, which are needed, from the lower side of the flange.

  These nuts cannot be removed after the compressor is brought down on the work bench.

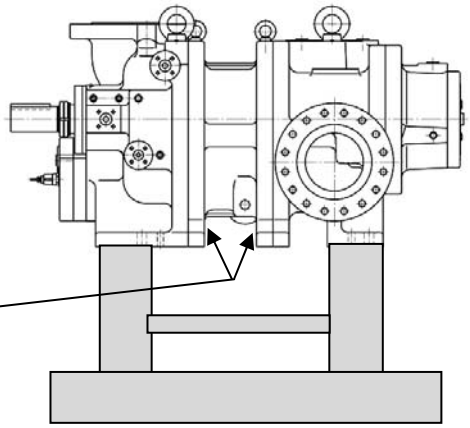


Figure 5-1 Exclusive Frame for placing the Compressor

5.5 Disassembly and Inspection

■ **About the part number notation of explanation in the text**

The number denoted by [ ] after part name in this Chapter means the item No. of sectional views of the GH-series compressors. Refer to Section 2.4.2 in this manual Chapter 2.

■ **About the stud bolt for safety**

In disassembly work especially when removing covers stud bolts are used for safety, in case of GH320S, you can use securing bolts of covers as safety stud bolts because securing bolts of covers of GH320S are all stud bolts.

■ **Caution on heavy parts**

Sufficient care must be taken to handle the compressor parts, because the parts of GH-series compressors are heavy.

Following Table 5-10 is a list of parts that require special attention about the mass.

When handling these parts, in order to prevent personal injury, use a crane, a chain block, etc.

Table 5-10 Parts List of mass 15kg or more

Item No.	Part Name	Mass of Part (kg)			Remarks
		GH250S	GH250L	GH320S	
1	Rotor Casing	360	440	800	
5	Suction Cover	490	490	1100	
11	Bearing Head	550	550	1350	
16	Bearing cover	215	215	300	
22-M	Balance Piston Cover (M)	40	40	65	
22-F	Balance Piston Cover (F)	25	25	25	
25	Male Rotor	150	190	350	
26	Female Rotor	100	130	240	
30-M1	Balance Piston (M)	—	—	20	φ 285 mm
33-M1	Balance Piston Sleeve (M)	—	—	25	φ 240 mm
38-M	Thrust Bearing (M)	20	20	50	
38-F	Thrust Bearing (F)	—	—	20	
43-M	Gland, Thrust Bearing (M)	—	—	20	
54	Unloader Slide Valve	20	30	50	
60	Unloader Cylinder	15	25	50	
64-1	Unloader Piston	—	—	15	
74	Unloader Cover	20	20	45	
100	Mechanical Seal Assembly	20	20	—	cartridge type
		Max. 10	Max. 10	Max. 15	assemble type

5.5.1 Probe of Magnetrostrictive Displacement Sensor Assembly

Loosen the sensor probe of unloader indicator assembly [120] screwed in to an unloader cover.
After screwing off, pull straight the sensor probe.
Be careful not to injure an electric wire.

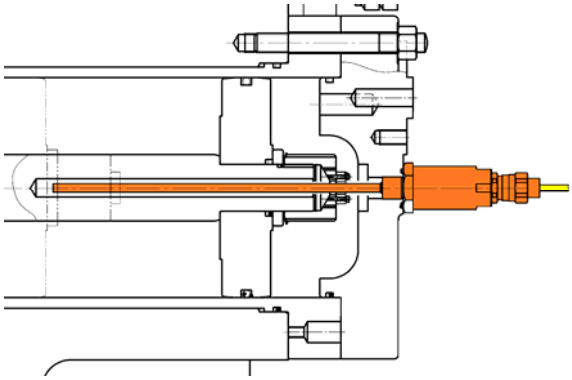


Figure 5-2 Sensor Probe

5.5.2 Shaft Seal Part

We have been using two kinds of mechanical seal assembly for GH250S / L as shaft seal so far.
Figure 5-3 is assemble type and Figure 5-4 is cartridge type. There is no superiority or inferiority between two types as for features and the durability. Also, there is compatibility mutually.
Both types, replace as an assembly. And, removed assembly requires inspection in Company.

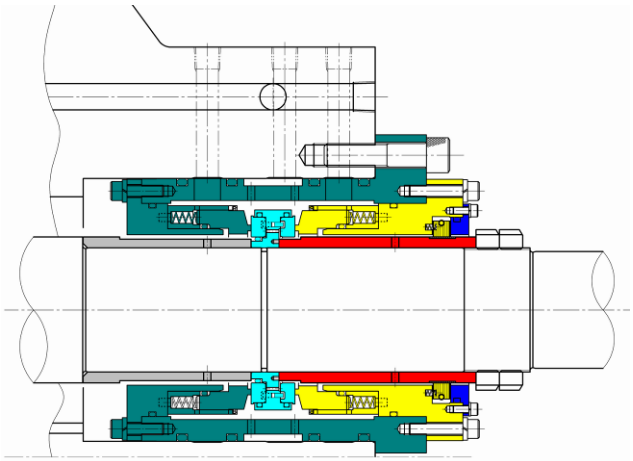


Figure 5-3 GH250S/L Shaft Seal (1) Assemble Type

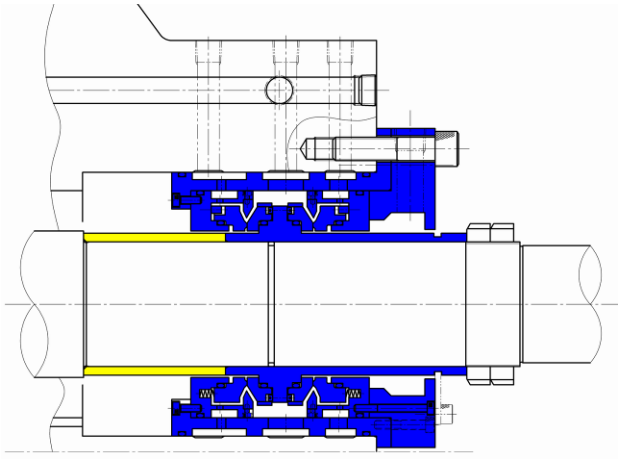
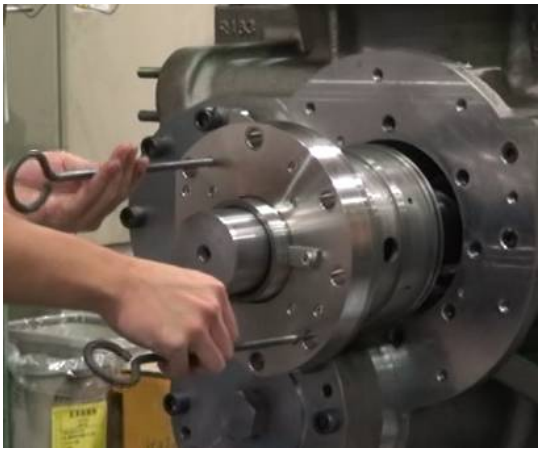
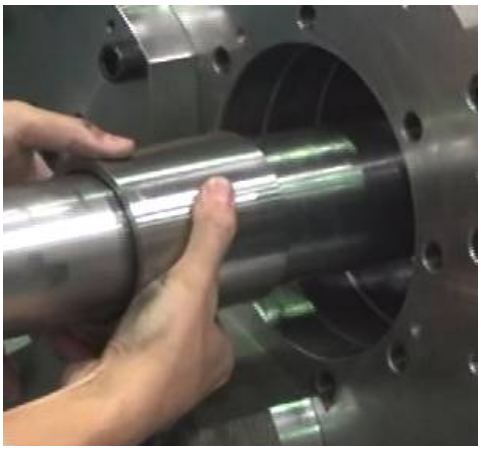
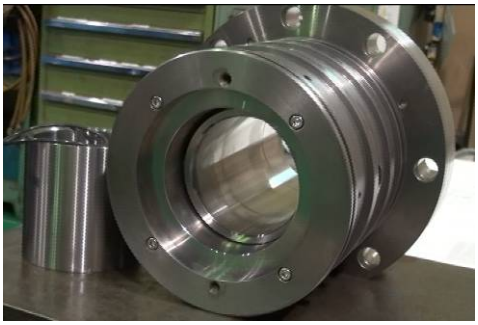


Figure 5-4 GH250S/L Shaft Seal (2) Cartridge Type





Upper and right photos show the scenes removing the mechanical seal assembly that is an cartridge type for GH250S.



Disassembly order of the mechanical seal assembly is as follows.

a) Loosen and remove two lock nuts [101: GH250S/L] [111-1: GH320S] using the lock nut wrench.

b) Remove the coloring part shown in Figure 5-3, Figure 5-4 and Figure 5-5 in the following order; that is, dark-blue part, yellow part, red part, light-blue part, green part, ash part.

Shaft seal of GH320S is only one kind of mechanical seal assembly that is a assemble type shown in Figure 5-5.

Since a cartridge type mechanical seal assembly becomes too heavy, we do not use it as the shaft seal of GH320S.

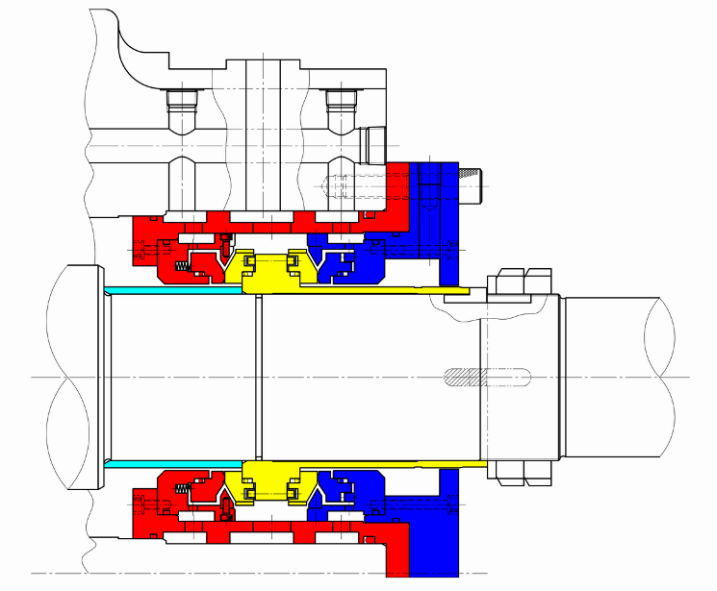


Figure 5-5 GH320S Shaft Seal

5.5.3 Balance Piston Cover (F) and Balance Piston Sleeve (F)

Characteristic difference between GH250S/L and GH320S of this part is how to hold the balance piston sleeve. GH250S/L holds the sleeve [33-F1] by a balance piston cover [22-F], while GH320S holds sleeves [33-F1] [33-F2] by a C type retaining ring [37-3].

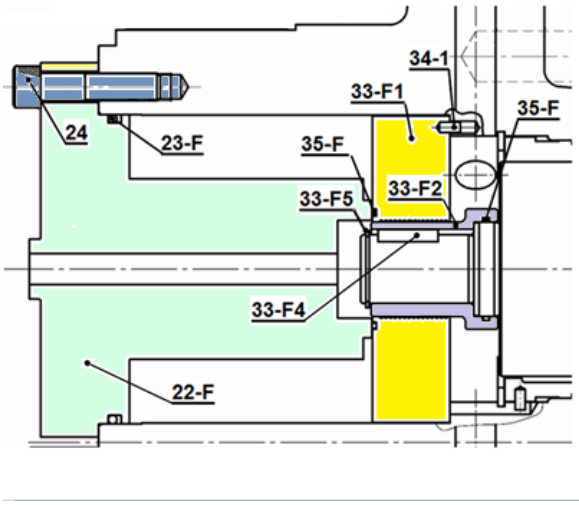


Figure 5-6 GH250S/L Balance Piston (F) Part

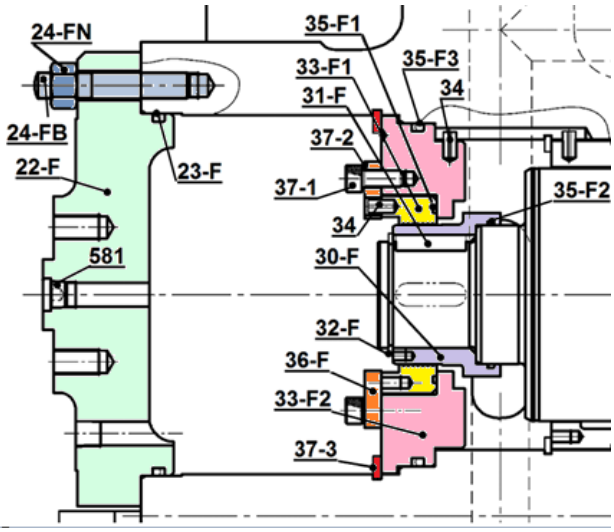


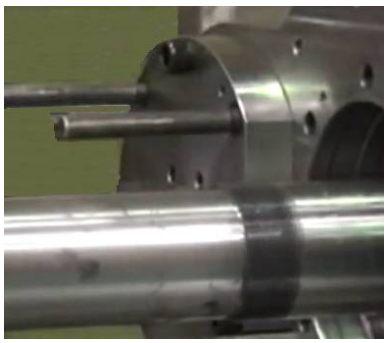
Figure 5-7 GH320S Balance Piston (F) Part

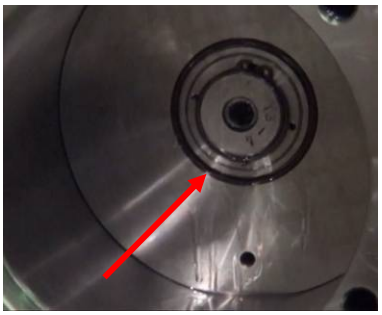
5.5.3.1 GH250S/L

a) Among hexagon socket head cap screws [24] securing the balance piston cover (F) [22-F], loosen and remove two bolts of the clock position of about 10:10.

b) Instead of the removed bolts, screw two M16 stud bolts for safety shown in the right photo, and remove remaining bolts.

c) Screw two M8 eyebolts into two threaded holes on the balance piston cover (F) and pull out the balance piston cover (F) from the suction cover. Lower center photo is the view after removing the balance piston cover.





d) Remove the O-ring [33-F5] shown by the red arrow in upper center photo.

e) Screw two M8 eyebolts into two threaded holes on the balance piston sleeve (F) [33-F1] and pull out it as shown in upper right photo.

【POINT】

If it is impossible to pull out the balance piston sleeve only with M8 eyebolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-8

1. Attach special tools to the balance piston sleeve (F) with refering to Figure 5-8.
2. Screw hexagon head bolt (x-10) until the balance piston sleeve (F) is removed from the Female rotor [26].

Note: These special tools for GH320S are not prepared, so they should be prepare locally.

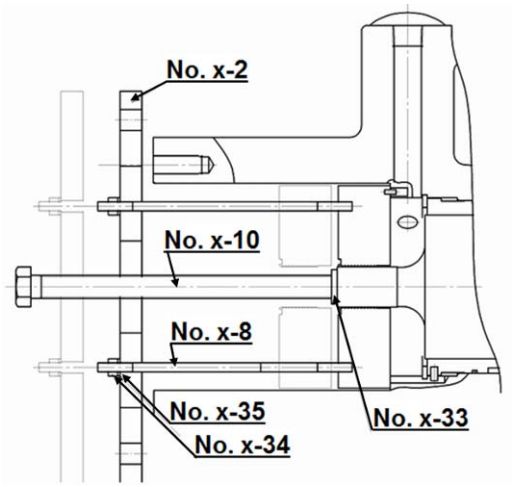


Figure 5-8 Special Tools for Balance Piston Sleeve (F) of GH250S/L

f) Remove the C type retaining ring [33-F5] using a retaining ring plier for external. The retaining ring may jump out, causing injuries. Wear protective goggles.

g) Pull out the balance piston [33-F2] by hand. An O-ring [35-F] is in the balance piston as shown in upper right photo.

5.5.3.2 GH320S

Shape/structure of the balance piston sleeve and balance piston cover is different, but the disassembling method is the same as roughly GH250S/L.

In addition, in case of GH320S, securing bolts for covers and casings are stud bolts.

Since sizes of bolts and other parts of GH320S are different from those of GH250S/L, work with the correct size tool for each, referring to Section 5.2.3 "Replacement Parts of the compressor in overhauling".

After removing the balance piston cover [22-F], remove the C type retaining ring [37-3] holding the balance piston sleeve assembly [33-F1 and 33-F2] by using a retaining ring plier for internal.

⚠ CAUTION

- **Since this retaining ring [37-3] has not only large diameter but also large spring force, take extreme care for your removing work using correct size plier and wearing protective goggles.**

■ Inspection:

a) Balance Piston Cover (F)

Inspect the surface of Female rotor in contact with the O-ring [35-F: GH250S/L] / [35-F2: GH320S]. If any damages are found on the contact surface, finish the surface with fine emery paper after cleaning.

b) Balance Piston Sleeve (F)

Measure the inner diameter of the balance piston sleeve (F) [33-F: GH250S/L] / [33-F1: GH320S]. If it exceeds the use limits designated on Table 5-11 below, replace the sleeve with new one.

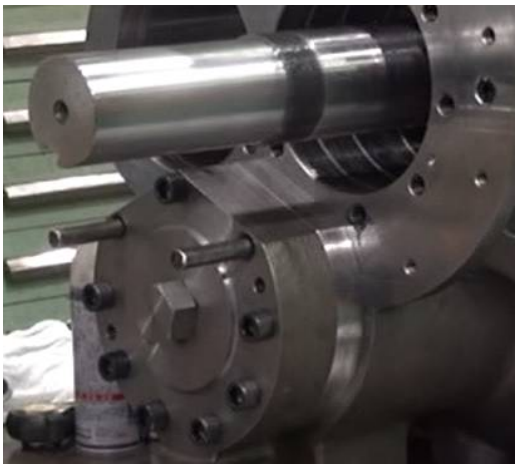
Table 5-11 Use Limits of Balance Piston Sleeve (F)

Compressor Model	Item No.	Measurement Point	Nominal Dimension	Use Limit
GH250S/L	33-F1	Inner Diameter	φ 55	+ 0.07 mm
GH320S	33-F1	Inner Diameter	φ 85	+ 0.08 mm

5.5.4 Unloader Cover

a) Among hexagon socket head cap screws [76: GH250S/L] / hexagon nuts for stud bolts [76-B: GH320S] securing the unloader cover [74], loosen and remove two bolts of the clock position of about 10:10.

b) Instead of the removed bolts, screw two stud bolts for safety as shown in lower left photo, and remove remaining bolts. In case of GH320S, leave two stud bolts at the same position for safety.



c) Remove the remaining hexagon head cap screws (GH250S/L) / stud bolts and nuts (GH320S).

d) Screw two M8 eyebolts into two threaded holes on the unloader cover as shown in upper right photo.

e) Until the unloader cover completely separates from the suction cover, continue screwing two eyebolts evenly.

f) After separate the unloader cover from the suction cover, remove eyebolts and pull out, the unloader cover from stud bolts with holding it steady by both hands (GH250S/L).

⚠ CAUTION

- **Mass of the unloader cover of GH250S/L is approx. 20 kg, and of GH320S is approx. 45 kg. Because large mass of the unloader cover, there is risks of injury, take extreme care to this work.**

g) In case of GH320S, because there are two screw holes drilling upper side of unloader cover, never hold with it only by hands. Remove certainly using the clamps such as a crane, chain block, and so on.

【POINT】

In case of GH320S, because there is possibility that a lot of oil spills when removing the unloader cover, do beforehand the preparation to receive with the oil pan.

5.5.5 Unloader Piston Assembly

a) Loosen and remove the M3 hexagon socket head cap screws [663] and washers [697] on the magnet as shown in lower left photo.

Since these screws and washers are small, be careful not to lose.

Note: Magnet is one of the components of the unloader indicator assembly

b) Remove the magnet from the lock nut [No.69-B: GH250S/L] / [No.69: GH320S]..

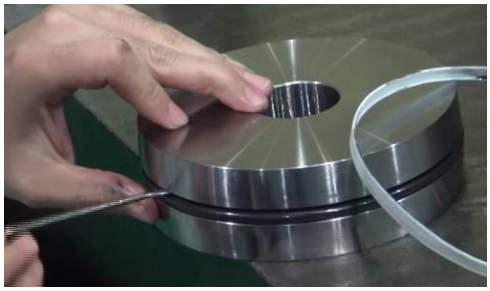
c) Loosen and remove the lock nut using the lock nut wrench as shown in upper right photo.

d) Remove the lock washer [No.70].

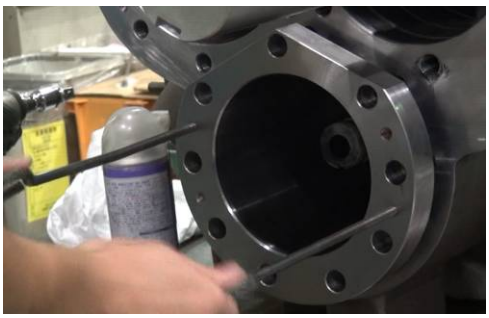
In case of GH320S, after removing the lock washer, remove the O-ring gland [64-2] and the O-ring [73] for the unloader piston.

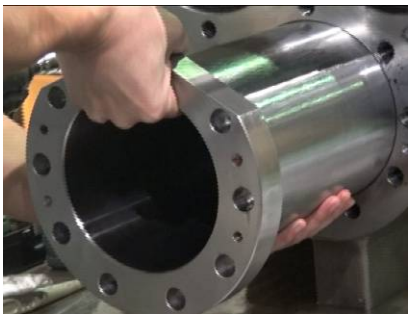
e) Set two eyebolts into threaded holes on unloader piston [64: GH250S/L] / [64-1: GH320S] and pull out the unloader piston from the unloader push rod [67] as shown in lower left photo.

f) Remove the cap seal [66] and the O-ring [65] from the unloader piston as shown in lower right photo.



g) Set two eyebolts into threaded holes on the unloader cylinder [60] and pull out the unloader cylinder. Mass of the unloader cylinder is heavy (15 kg: GH250S, 25 kg: GH250L, 50 kg: GH320S). Take care when removing it. In case of GH320S, remove it certainly using a crane, and so on.





■ Inspection:

The internal surface of the unloader cylinder may sometimes be scored.
Finish the internal surface with fine emery paper after cleaning.

5.5.6 Balance Piston Cover (M) and Balance Piston Assembly (M)

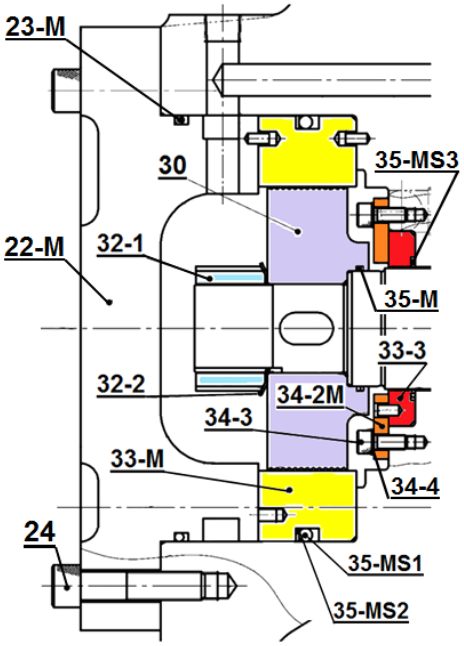


Figure 5-9 GH250S/L Balance Piston (M) Part

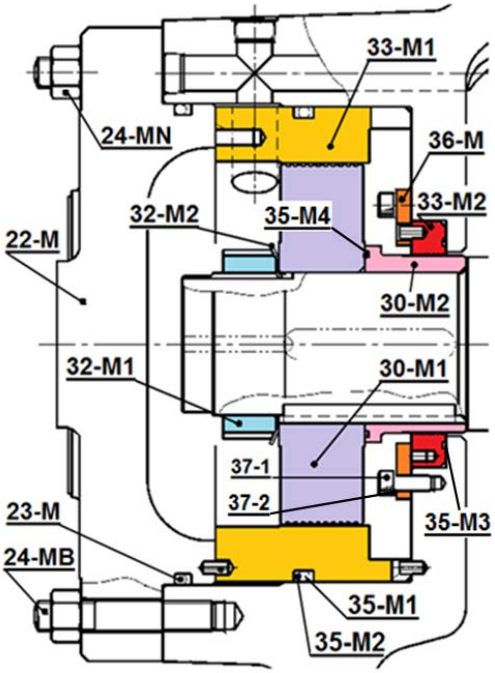


Figure 5-10 GH320S Balance Piston (M) Part

5.5.6.1 Balance Piston Cover (M)

a) Set the eyebolt (M10: GH250S/L) / (M12: GH320S) into the threaded hole at the top of the balance piston cover (M) [22-M] as shown in lower left photo.

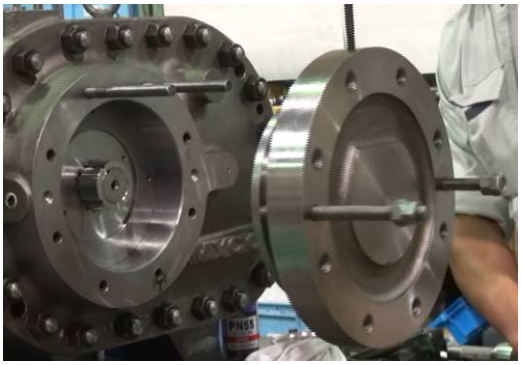
b) Loosen and remove two hexagon socket head cap screws [24: GH250S/L] / hexagon nuts [24-MN: GH320S] for stud bolts securing the balance piston cover (M) of upper side.

c) Instead of the removed bolts, screw two stud bolts for safety as shown in lower center photo, and remove remaining bolts. In case of GH320S, leave two stud bolts at the same position for safety.

d) Lift up the balance piston cover (M) using the eyebolt by a crane or a chain block, etc.

e) Set two hexagon head bolts which have longer than 60 mm (GH250S/L) / 75 mm (GH320S) of threaded part into two threaded holes on the balance piston cover (M) and screw them equally in order to remove flange face of balance piston cover (M) from the bearing cover [16] until O-ring [23-M] is removed from the bearing cover as shown in upper right photo.

f) After removing the O-ring [23-M] from the bearing cover, pull out the balance piston cover (M) from the bearing cover using a crane or a chain block, etc.

5.5.6.2 Balance Piston Assembly (M)

a) Loosen and remove lock nut [32-1: GH20S/L] / [32-M1: GH320S] using lock nut wrench and remove lock washer [32-2: GH250S/L] / [32-M2: GH320S] as shown in lower left and center photos.

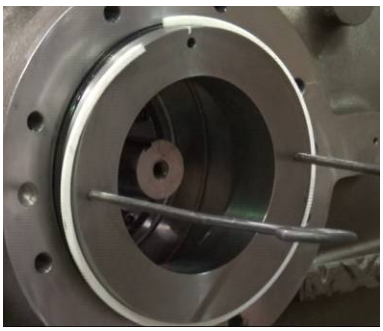


b) Screw two M8 eyebolts into two threaded holes on the balance piston (M) [30: GH320S/L] / [30-M2: GH320S] and pull out the balance piston (M) from the Male rotor as shown in the upper right photo.

At this time, there is a case that balance piston (M) and sleeve (M) pulled out together. In the case, remove together just as they are by using a crane or a chain block, etc

c) Screw two M8 eyebolts into two threaded holes on the balance piston sleeve (M) [33-M: GH250S/L] / [33-M1: GH320S] and pull out the balance piston sleeve (M) from the bearing cover as shown in lower left photo.

d) Balance piston sleeve (M) has O-ring and backup ring [35-MS1, -MS2: GH250S/L] / [35-M1, -M2: GH320S], remove them as shown in lower right photo.

【POINT】

If it is impossible to pull out the balance piston (M) and/or balance piston sleeve (M) only with M8 eyebolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-11.

1. Attach special tools to the balance piston (M) with refering to Figure 5-9.
2. Screw hexagon head bolt (x-10) and pull out the balance piston (M) from the Male Rotor .
3. In the same way, pull out the balance piston sleeve (M) [33-M] from the bearing cover.

Note: These special tools for GH320S are not prepared, so they should be prepare locally.

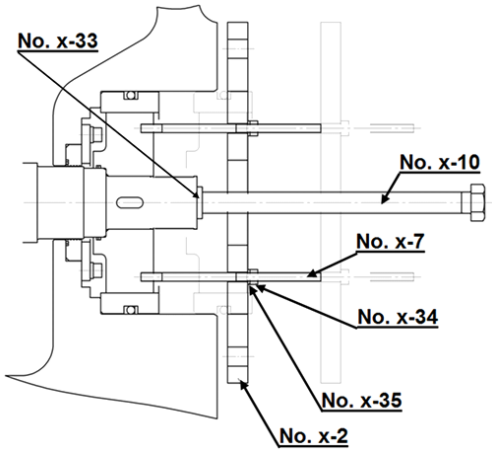


Figure 5-11 Special Tools for Balance Piston (M) of GH250S/L

e) In case of GH320S, because there is a balance piston (M-2) [30-M2] in the back of the balance piston (M-1) [30-M1], remove it by pulling by hand.

f) In case of GH320S, because moreover, there is a balance piston sleeve (M-2) [33-M2] held by a balance piston sleeve gland [36-M], remove the hexagon head cap screws [37-1], conical spring washers [37-2], balance piston sleeve gland and balance piston sleeve (M-2).

g) Parts of the same functionality as described in item e) are incorporated into GH250S/L.

Remove the hexagon socket head cap screw [34-3] and conical spring washer [34-4] and remove the floating seal (B) gland [34-2M]. Remove the floating seal (B) [33-3] from the bearing cover (16).

■ Inspection:

a) Since the clearance between the balance piston (M) and the balance piston sleeve (M) is smaller than the clearance between the rotor shaft and the bearing, the sleeve may have been worn.

b) Measure the inner diameter of the balance piston sleeve (M) and the outside diameter of the balance piston (M). If it exceeds the use limits designated on Table 5-12 below, replace the sleeve and/or piston with new one.

Table 5-12 Use Limits of Balance Piston and Sleeve (M)

Compressor Model	Item No.	Measurement Point	Nominal Dimension	Use Limit
GH250S/L	33-M	Depth of groove abrasion of Balance Piston Sleeve (M)	—	0.07 mm
	30	Outside Diameter (φ) of Balance Piston (M)	190/185/160	- 0.1 mm
GH320S	33-M1	Depth of groove abrasion of Balance Piston Sleeve (M)	—	0.15 mm
	30-M1	Outside Diameter (φ) of Balance Piston (M)	285/240	-0.22 mm

5.5.7 Bearing Cover

In this work, remove the bearing cover [16] from the bearing head [11].

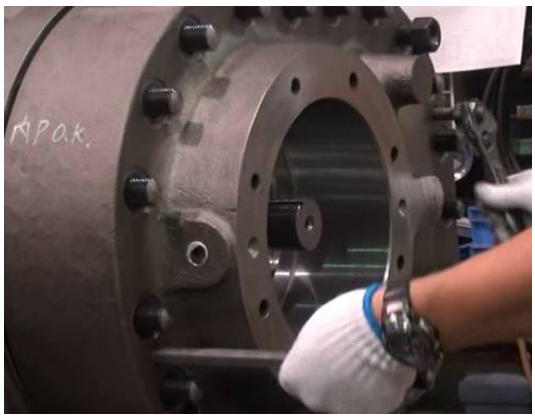
Prepare the oil pan in order to receive much oil spilt from the bearing cover.

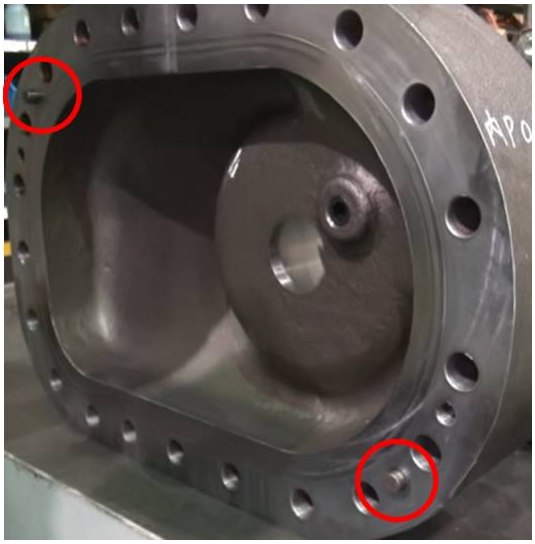
a) Loosen and remove hexagon nuts [18-N] and stud bolts [18-B].

b) Set eyebolt into threaded hole on the top of the bearing cover [16] and lift the bearing cover by a crane.

c) Screw hexagon head screws into two threaded holes on the bearing cover. Use the bolt which is more than 100 mm longer than the thickness of the bearing cover flange.

d) Screw two screws evenly until parallel pins come out from bearing head. Positions of parallel pins are red circle points as shown in right photo.





【POINT】

If it is impossible to pull out the bearing cover only with hexagon head screws as jack bolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-12.

1. Install special removing tools on the parallel pins [19] with referring to Fig 5-12.
2. Screw a hexagon nut (x-34) and remove the parallel pin from the bearing cover.

Note: These special tools for GH320S are not prepared, so they should be prepare locally.

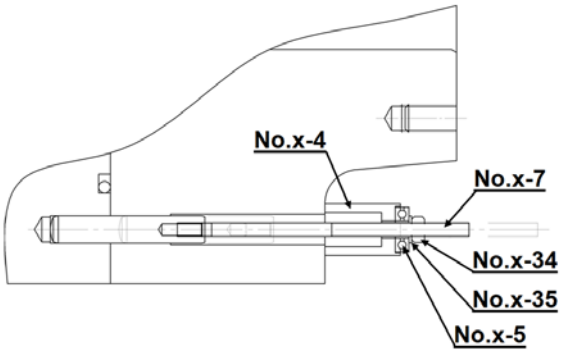


Figure 5-12 Special Tools for Parallel Pin of GH250S/L

5.5.8 Thrust Bearing Assembly

GH-series compressor is using the TPTB (Tilting Pad Thrust Bearing Assembly) as the thrust bearing.

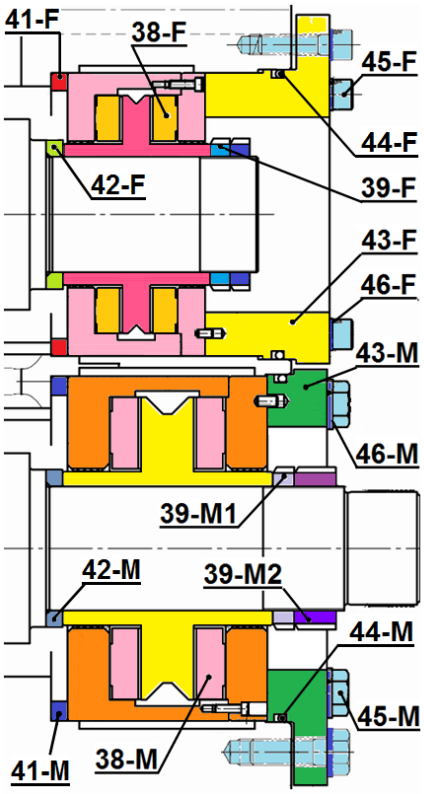


Figure 5-13 Thrust Bearing Part of GH250S/L

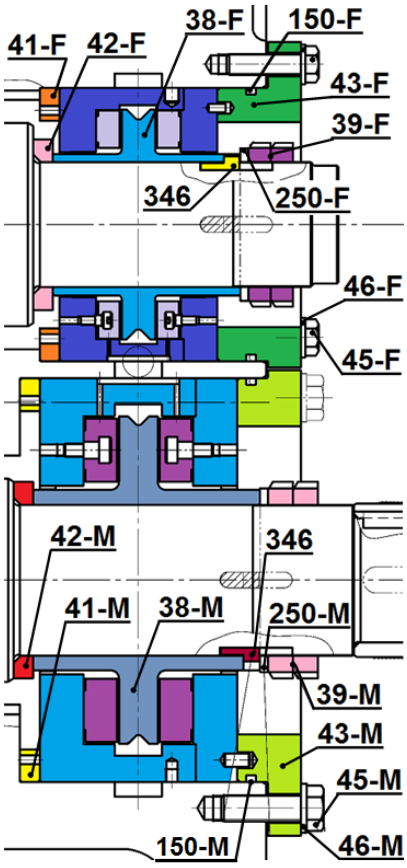


Figure 5-14 Thrust Bearing Part of GH320S

5.5.8.1 Thrust Bearing Assembly (M)

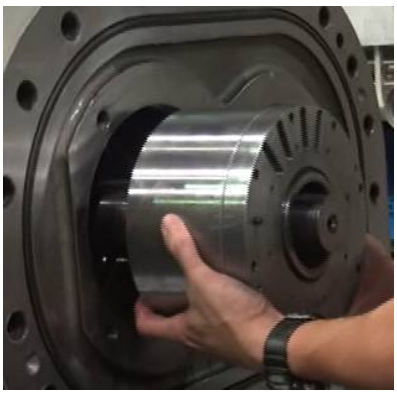
a) Loosen and remove hexagon head bolts [45-M] and conical spring washers [46-M].

b) Remove the thrust bearing gland (M) [43-M].

c) Using a curing tape, protect the part of the Male rotor surface attaching the floating seal (B) [33-3] and the O-ring [35-M] .

d) Loosen and remove lock nuts [39-M2 and M1: GH250S/L] / [39-M: GH320S] using lock nut wrench.

e) In case of GH320S, after removing the lock nuts, remove the thrust washer [250-M] and the rotation stop key [346].



f) Set two M8 eyebolts into threaded holes on the thrust bearing assembly (M) [38-M] and pull out the thrust bearing assembly (M) from the bearing head [11].

If you had enough muscle power, you could remove this assembly (M) of GH250S/L (also this assembly (F) of GH320S) by hand, but in case of this assembly (M) of GH320S, you need a crane or a chain block, etc. The top of this assembly (M) of GH320S has a threaded hole for eyebolt; you use the threaded hole for lifting and remove the assembly (M) of GH320S.

g) Pull out the thrust bearing alignment spacer [42-M] as shown in lower left photo.

h) Pull out the thrust bearing outer race spacer [41-M] using two M8 eyebolts as shown in lower right photo.

5.5.8.2 Thrust Bearing Assembly (F)

a) Remove the thrust bearing assembly (F) in the same method as the thrust bearing assembly (M).

b) Pull out the thrust bearing spacer [41-F] and the end clearance adjusting spacer [42-F].

■ Inspection:

a) Disassemble the tilting pad thrust bearing. Inspect the frictional surface of the tilting pad and the thrust collar.

If there are any signs of damage or peeling on the tilting pads, replace the thrust bearing assembly with new one.

If the thrust collar is slightly damaged, finish the thrust surface with fine emery paper after cleaning.

If the thrust collar and tilting pads are heavily damaged, replace the thrust bearing assembly with new one.

b) Inspect the friction surface of the seal and the thrust collar. See Figure 5-15 below.

If the thrust collar and the floating seal are slightly damaged, finish the frictional surface with fine emery paper after cleaning.
If the thrust collar and the floating seal are heavily damaged, replace the thrust bearing assembly with new one.

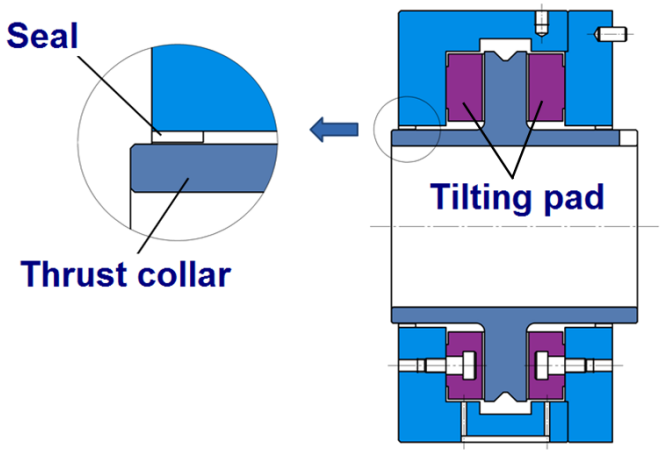
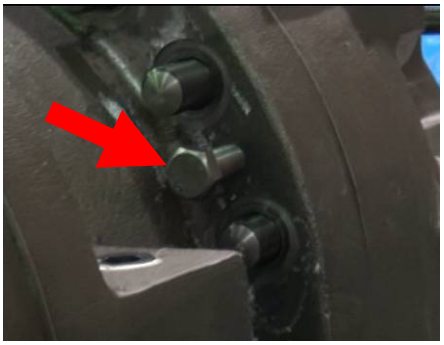


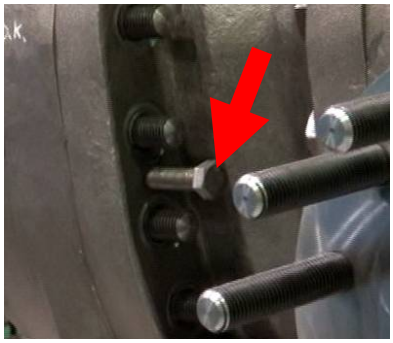
Figure 5-15 Inspection Part of TPTB

5.5.9 Separating Suction Cover from Rotor Casing

a) Loosen and remove the hexagon nuts [2-N] and the stud bolts [2-B] from the rotor casing flange of the suction cover side.

b) Screw two hexagon head screws to threaded holes on the rotor casing flange of the suction cover side. In the Lower photos red arrows indicate screwing positions.





c) Screw two hexagon head screws evenly as jack bolts until parallel pins [3] come out.

d) And then, slide the suction cover little by little and horizontally away from the rotor casing until the Male rotor comes out completely from the suction cover.

In the right photo is the suction cover of GH250S after it was separated from the rotor casing.

【POINT】

If it is impossible to pull out the suction cover only with hexagon head screws as jack bolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-15.

1. Install special removing tools on the parallel pins [3] with referring to Fig 5-16.
2. Screw hexagon nut (x-34) and remove the parallel pin from the rotor casing flange.

Note: These special tools for GH320S are not prepared, so they should be prepare locally.

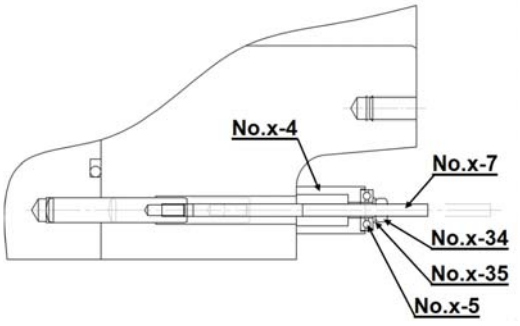


Figure 5-16 Special Tools for Parallel Pin of GH250S/L

e) The part which the pushrod passes is sealed up by the O-ring grand [326] which O-rings [9, 325-1], backup rings [325-2], a wearing [325-3] (only GH250S/L) were installed into.

Loosen and remove the hexagon socket cap screws [456].

Screw two M8 eyebolts into threaded holes on the O-ring gland and pull out the O-ring gland from the suction cover.

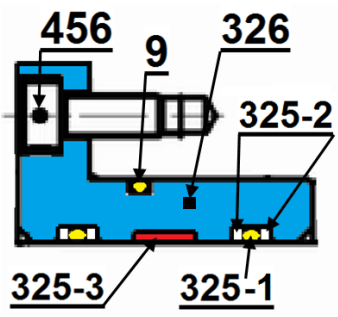


Figure 5-17 O-ring Gland of GH250S/L Suction Cover

■ Inspection:

Inspect the inner surface of the suction cover flange contacting with the O-ring.

IF any damages are found on the surface, finish the surface with fine emery paper after cleaning.

5.5.10 Rotor Assembly

a) Pull out the half of the male rotor [25] and fasten Male rotor by the lifting belt.
b) Lift up the Male rotor and pull it out horizontally.
c) Push out the half of the female rotor [26] and fasten Female rotor by the lifting belt.
d) Lift it up the Female rotor and pull it out horizontally using a crane.

■ Inspection:

a) Inspect the rotor journals and the mechanical shaft seal mounting part for damage.
b) Inspect the rotor lobes, especially the circumference, for damage or abnormal wear. If the compressor has been operating normally, there should be no damage found. If, however, scoring or scratches, etc. are found, it may be caused by a foreign material entering the system. Check the suction strainer.
c) If the circumference shows the heavy damage or wear consult the nearest our office.

5.5.11 Slide Valve

Pull out the push rod [67] and slide valve [54] assembly from the rotor casing.

■ Inspection:

a) Measure the outside diameter of the slide valve [54]. If it exceeds the use limit designated on Table 5-13 below, replace the slide valve with new one.

Table 5-13 Use Limits of Slide Valve

Compressor Model	Item No.	Measurement Point	Nominal Dimension	Use Limit
GH250S/L	54	outside diameter	φ 140	- 0.10 mm
GH320S			φ 210	- 0.15 mm

b) Inspect the sliding surfaces of the slide valve even if the outside diameter of the slide valve does not exceed the use limit. If any damage is found on the sliding surface, finish the surface with fine emery paper after cleaning.

5.5.12 Separating Bearing Head from Rotor Casing

a) Loosen and remove the hexagon nuts [2-N] and the stud bolts [2-B] from the bearing head side flange of the rotor casing.
b) Screw two hexagon head screws to threaded holes on the rotor casing flange of the bearing head side.
c) Screw two hexagon head screws evenly as jack bolts until parallel pins [3] come out.
d) And then, slide the suction cover little by little and horizontally away from the rotor casing.

【POINT】

If it is impossible to pull out the bearing head only with hexagon head screws as jack bolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-16.

1. Install special removing tools on the parallel pins [3] with referring to Fig 5-18.
2. Screw hexagon nut (x-34) and remove the parallel pin from the rotor casing flange In case of Male rotor side.
3. In case of Female rotor side, in the same way, remove the parallel pin from the bearing head flange.

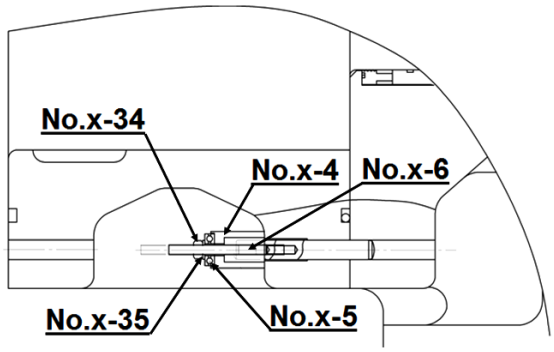


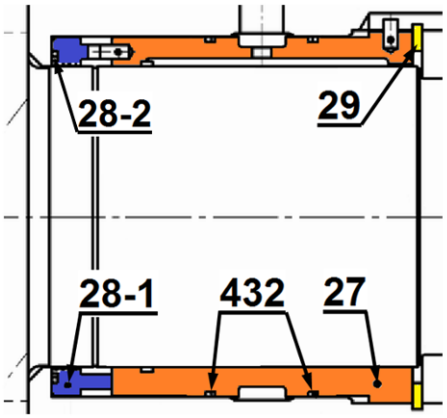
Figure 5-18 Special Tools for Parallel Pin of GH250S/L

Note: These special tools for GH320S are not prepared, so they should be prepare locally.

■ Inspection:

a) Inspect the discharge end plane. If rotation traces are visible on the discharge end plane of the bearing head, finish the surface with fine emery paper and oil stone flatly after cleaning.
b) Inspect the internal surface of the rotor casing. If no damage is found on the circumference of the rotor assembly, there should be no damage or abnormality of the casing internal surface either.

5.5.13 Main Bearings (installed in the Bearing Head and the Suction Cover)



In the GH-series, four main bearings decide the position of the radial direction of the rotor axis.
Two main bearings are installed into the bearing head Male rotor and Female rotor parts, and two main bearings are installed into Male rotor and Female rotor parts in the suction cover.

In addition, in case of bearing head, floating seals are installed into back of the main bearings.

a) Remove the C type retainer ring [29] by using a retaining ring plier internal type.

Figure 5-19 Main Bearing Part (Bearing Head)

b) Screw two M8 eyebolts to threaded holes on the main bearing [27].

c) Since two O-rings [432] are attached to the main bearing, pulling out the main bearing manually is difficult. By using a splint as shown in lower left photo, remove the main bearing.

d) In case of bearing head side, there is a floating seal (A) [28-1] with O-ring [28-2] back of the main bearing, remove them as shown in upper center and right photos.

【POINT】

If it is impossible to pull out the main bearing only with M8 eyebolts, remove it using the special tools (refer to Table 5-9) as shown in Figure 5-18.

1. Install special removing tools for main bearings [27] with referring to Fig 5-20.
2. Screw hexagon bolt (x-10) until the main bearing is pulled out from the bearing head [11] / suction cover [5].

Note: These special tools for GH320S are not prepared, so they should be prepare locally. .

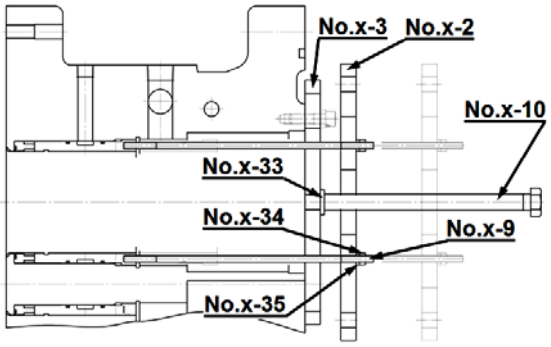


Figure 5-20 Special Tools for Main Bearing of GH250S/L

■ Inspection:

a) Measure the internal diameter of the main bearing [27]. If it exceeds use limit designated on Table 5-14 below, replace it with new one.

Table 5-14 Use Limits of Main Bearing

Compressor Model	Item No.	Measurement Point	Nominal Dimension	Use Limit
GH250S/L	54	outside diameter	φ 125	- 0.145 mm
GH320S			φ 155	- 0.200 mm

b) Inspect the sliding surfaces of the main bearing even if the internal diameter of it does not exceed the use limit. If some foreign materials are imbedded in the bearing white metal, replace the main bearing with new one.

Note: If you are replacing the main bearing, replace in pairs for Male rotor and Female rotor.

5.6 Reassembly

WARNING

- **When turning on/off electric tools, take care to avoid electric shocks.**
- **When handling heavy objects take a sufficient care and use an auxiliary tool such as a crane, a chain block, and so on. There is a risk that the compressor's main body or parts may drop on human body.**
- **When using a crane, allow only qualified personnel to operate it. Entrusting the work to unqualified personnel may result in fall accident.**
- **Be sure to use only MYCOM genuine parts for replacement. If parts other than genuine parts are used, there is a risk that the compressor and devices can be damaged or ruptured.**

CAUTION

- **When using electric tools, check in advance that there is no problem with insulation resistance. Otherwise, use double-insulated tools.**

CAUTION

- **When reassembling, ensure that the replacing O-rings are of the correct standard (size, material, use for fixed portion or sliding portion, etc.). Incorrect replacement can lead to defects such as oil leakage.**

Commence the reassembly work immediately after completion of inspection and repair.

Recheck the purchased replacement parts before assembly.

As a general rule, all the O-rings that have been removed while the compressor is disassembled should be replaced.

Most steps of the reassembly procedure are reverse to those of the disassembly procedure.

First, clean the work bench and tools to be used.

Clean the assembly parts with wash oil (kerosene, etc.) immediately before assembly. Dry these parts by blowing compressed air, and then apply sufficient lubricating oil over their surface. Prepare sufficient amount of clean lubricating oil for use during reassembly.

Read and fully understand the instructions before performing assembly work.

For tightening torque of various bolts and nuts of the GHS-Series compressor refer to Section 7.3"Tightening Torque for Bolts and Nuts" in this manual Chapter 7.

5.6.1 O-ring Gland to Suction Cover

a) Set the O-rings [9, 325-1] and backup rings [325-2] on the O-ring gland [326] after applying silicone grease on each O-ring. In case of GH250S/L, set the wearing [325-3] between two O-rings [325-1]. Refer to Figure 5-17 in Section 5.5.9.
b) Set two M8 eyebolts into threaded holes on the O-ring gland.
c) Push the O-ring gland into the bore of suction cover [5] from the unloader cover side.
d) Tighten the hexagon socket head cap screws [456] on the O-ring gland flange.

5.6.2 Main Bearings

5.6.2.1 For the Bearing Head

a) Knock the spring pins [14] into small notch on the main bearings [27]. The bearing head side, total 4 spring pins should be knocked into 2 main bearings.
b) Set the O-rings [432] on the main bearings [27] after applying the silicone grease on the O-rings [432] for Male rotor and Female rotor.
c) Set the O-rings [28-2] on the floating seals (A) [28-1] after applying the silicone grease on the O-rings [28-2] for Male rotor and Female rotor.
d) Insert the floating seals (A) [28-1] into the bearing head for Male rotor and Female rotor.
Care should be taken to the angle of the notch on the floating seal (A), since it must be fixed for anti-rotation by the spring pin located on the main bearing. Refer to Figure 5-21 below.

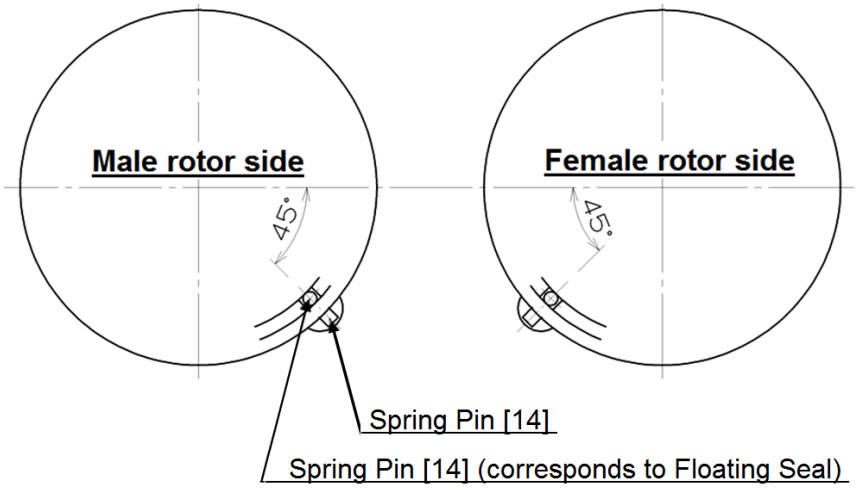


Figure 5-21 Spring Pins on the Main Bearing for the Bearing Head

e) Insert the main bearings into the bearing head. Care should be taken to the angle of the spring pins [14] located on the circumference of the main bearings, since it must be fixed for anti-rotation by the notch on the bearing head. Refer to Figure 5-19 upper.
If the main bearing fit is tight, tap in using hammer cushioned with plastic block.

f) When the end face of the main bearing is just across the groove for C type retaining ring [29], perform the assembly work according to the following procedure.

f)-1. Insert the special tool (No.x-1) into the floating seal (A) and the main bearing from the rotor casing side in order to maintain concentricity between the floating seal (A) and the main bearing. Refer to Figure 5-22.

f)-2. Set C type retaining ring [29] at the end face of the main bearing.

f)-3. Tap the face of C type retaining ring until it is installed in the groove.

f)-4. After having installed C type retaining ring, ensure that there is some clearance between the floating seal (A) [28-1] and the bearing head by checking the axial movement of the floating seal (A) manually.

f) -5. Remove the special tool (No.x-1) from the bearing head.

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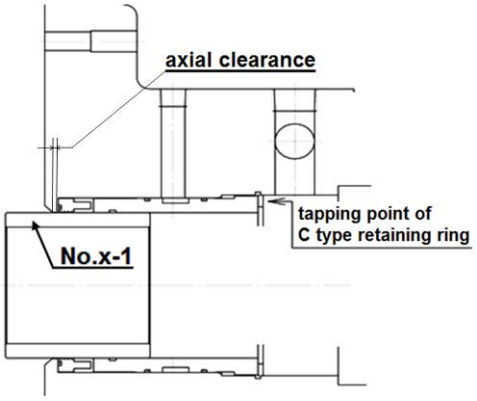


Figure 5-22 Assembling Tool for Main Bearing

5.6.2.2 For the Suction Cover

a) Knock the sprig pins [1] into small notch on the main bearings [27]. On the suction cover side, total two spring pins should be knocked into two main bearings.

b) Set the O-rings [432] on the main bearings [27] for Male rotor and Female rotor after applying silicone grease on the O-ring [432].

c) Insert the main bearings into the suction cover. Care should be taken of the angle of the spring pins [14] located on the circumference of the main bearing, since the pins must be fixed for anti-rotation by notch on the suction cover. Refer to Fig 5-23.

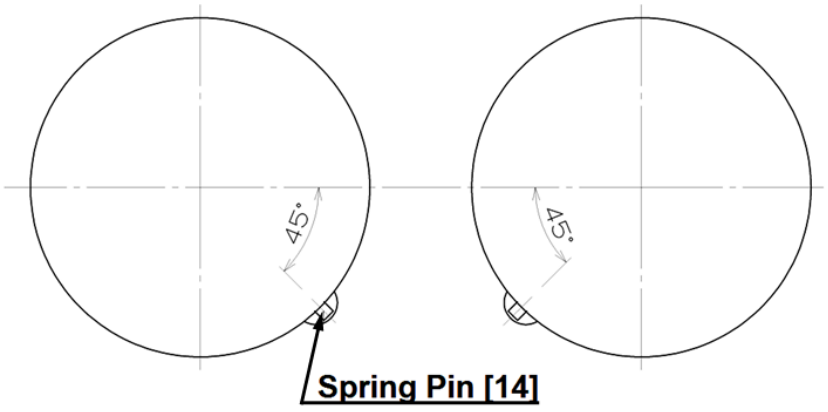


Figure 5-23 Spring Pins on the Main Bearing for the Suction Cover

d) If the main bearing fit is tight, tap in with using the hammer cushioned with plastic or wooden block.

e) Attach the C-type retaining rings [29] with using a retaining plier internal type.

5.6.3 Bearing Head and Rotor Casing

a) Set the O-rings [6-1, 6-2] on the bearing head side flange of the rotor casing after applying the silicone grease on the O-rings.
b) Set the stud bolts [2-B] into threaded holes on the rotor casing flange and the bearing head flange.
c) Hoist the bearing head slightly from the surface plate using a crane and couple it with the rotor casing slowly.
d) Tighten four hexagon nuts [2-N] slightly in order to avoid separation of the bearing head flange and the rotor casing flange.
e) In case of GH250S/L, install the parallel pins [3] as follows.

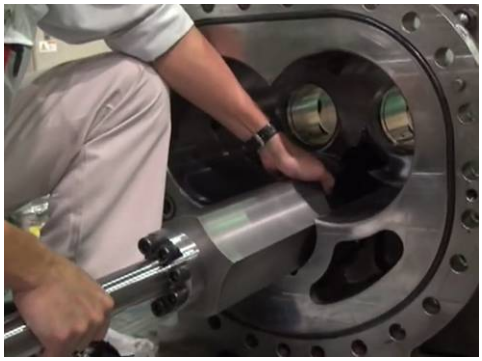
As for male rotor side, knock the parallel pin [3] from the rotor casing to the bearing head.

As for female rotor side, knock the parallel pin [3] from the bearing head to the rotor casing.

In case of GH320S, knock the both parallel pins [3] from the bearing head to the rotor casing. Refer to Section 2.4.2 "Sectional View" in this manual Chapter 2.

f) Tighten all hexagon nuts [2-N] on the rotor casing flange with the tightening torque value which is designated on Table 7-1 in this manual Chapter 7.

5.6.4 Slide Valve Assembly



a) Insert the push rod and the slide valve assembly into the rotor casing [1].

If you lay slightly the ridge part of the slide valve as shown in right photo, you can install the assembly smoothly.

b) Check if the movement of the slide valve is smooth. If it is not smooth, finish the circumference of the slide valve with fine emery paper.

5.6.5 Rotor Assembly

a) Lift up the male rotor and insert it into the rotor casing using a crane.
b) Lift up the female rotor and insert it into the rotor casing using a crane. At this time, insert the lobe marked the “1” on the male rotor into the space between the “1” and the “2” on the female rotor.
c) After rotor’s robes are meshed, a few turning clockwise of Male rotor makes it easy to install the Female rotor as shown in right photo.

5.6.6 Suction Cover and Rotor Casing

a) Knock two parallel pins [3] into the holes on the rotor casing from the suction cover side to the bearing head side until the end face of the parallel pins and the joint surface of the rotor casing flange are in the same plane.

Make sure that the threaded holes on each parallel pin (size: M8) must face to the bearing head. Refer to Section 2.4.2 "Sectional View" in this manual Chapter 2.

During tapping the face of parallel pins do not tap the face of the rotor casing flange.

b) Set the O-rings [6-1, 6-2] on the joint surface of the rotor casing after applying the silicone grease on the O-rings [6-1, 6-2].

c) Set the stud bolts [2-B] into threaded holes on the suction cover.

d) Hoist the rotor casing slightly from the surface plate using a crane and slide the suction cover to the rotor casing until both flanges coupled completely as shown in lower left photo.

e) Tighten four hexagon nuts [2-N] slightly in order to avoid separation of the suction cover flange and the rotor casing flange.

f) Tap two parallel pins [3] from the bearing head side to the suction cover side.

Since the positions of parallel pins are hard to tap, use a something pad for easy tapping as shown in upper right photo.

g) Tighten all hexagon nuts [2-N] with the torque value designated on Table 5-15.

5.6.7 Thrust Bearing Part

5.6.7.1 Confirmation of End Play

Before starting to assemble this part, measure the end play of the TPTB (tilting pad thrust bearing).

End play means the amount of axial or end to end movement in the bearings.

In the lower left photo, TPTB is placed on a surface plate, and the end face of the thrust collar appears on the top. In the lower right photo, TPTB is placed on a cylinder-shaped wooden frame, and the end face of the thrust collar falls down.

Confirm the end play of the TPTB by measuring the amount of thrust collar movement. If the measured value is not in the specified range shown in Table 5-15 below, then the TPTB cannot be used.

Table 5-15 Specified range of End Play

Model	End Play (mm)
GH250S/L	0.20 to 0.25
GH320S	0.26 to 0.33

Note: These criteria apply to M rotor side and F rotor side both.

5.6.7.2 Assembly

a) Install the thrust bearing alignment spacers [42-M, 42-F] and the thrust bearing outer race spacers [41-M, 41-F].

b) Install the TPTB assemblies [38-M, 38-F].

As with disassembly stage, you can install the TPTB (M) and (F) of GH250S/L by hand, but you must use a crane in case of installing the TPTB (M) of GH320S.

c) In case of GH250S/L, tighten the first lock nut [Male rotor side: 39-M1] [Female rotor side: 39-F] by using specified torque or torque angle (Refer to Section 7.1 in this manual Chapter 7). During tightening up the lock nut for the male rotor side, protect the floating seal (B) [33-3] part and the O-ring [35-M] part of the Male rotor shaft.

In case of GH320S, before tighten the lock nut, attach the rotation stop key [346] and thrust washer [250-M, 250-F].

Rotation stop key [346] should be attached to fit the key groove of the rotor [25, 26] and the cut-out portion of the thrust collar. After that, install the thrust washers.

d) Attach the thrust bearing gland [43-M, 43-F] with hexagon head screws [45-M, 45-F].

In the end clearance adjustment work after this, to avoid for the uneven tightening of thrust bearing gland, do not insert the O-ring [GH250S/L: 44-M, 44-F] [GH320S: 150-M, 150-F] and conical spring washers [46-M, 46-F] at this time.

5.6.7.3 End Clearance Adjustment

a) In case of end clearance adjustment for Male rotor side, turn the drive shaft counterclockwise and push the Male rotor from suction cover side, so as to make the end face of the Male rotor in contact with the discharge end plane of the bearing head. See lower left photo.

b) In case of end clearance adjustment for Female rotor side, turn the drive shaft clockwise and push the Female rotor in the same way as Male rotor side.

c) Place the dial gauge steadily using magnet stand in a position near the end face of the rotor shaft. Set the measuring probe of the dial gauge on the end face of the rotor shaft and set the indicator to the zero position. See upper right photo.

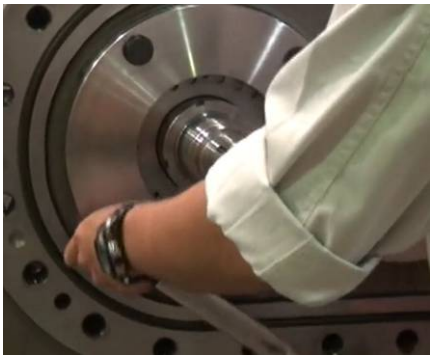
d) Tighten the hexagon head screws [45-M, 45-F] evenly and gradually to the specified torque value designated on Table 5-16 below.

When tightening hexagon head screws, the rotor is moved to the suction side and the end clearance is formed between the rotor end surface and the discharge end plane.

Tightening each screw to the specified torque at once will lead to uneven tightening. Tighten each screw in several steps.

Table 5-16 Tightening Torques for Thrust Bearing Gland

Model	Screw's Item No.	Screw's Size	Torque Value (N·m)
GH250S/L	45-M	M16	60
	45-F	M12	50
GH320S	45-M	M20	120
	45-F	M16	60



e) Read the dial gauge measurement value. This value is the actual end clearance. If the end clearance does not fall within the specified range shown in Table 5-17, adjust the clearance as necessary.

Table 5-17 Specified Value of End Clearance

Model	End Clearance (mm)
GH250S/L	M/F rotor side both 0.08 to 0.11
GH320S	M/F rotor side both 0.17 to 0.21

f) Adjust the end clearance according to the following procedures when the end clearance is out of the specified range.

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

As the 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 the TPTB.

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

Instead of using shim, there is also the following method.

Using a highly accurate surface grinding machine or asking professional service vendors to grind, grind the surface of thrust bearing outer race spacer [41-M, 41-F] by the difference from the specified value.
After grinding the flat surface, measure the whole circumference of the outer race spacer by using a micrometer, and check that the thickness is even.

(2) When 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 TPTB.

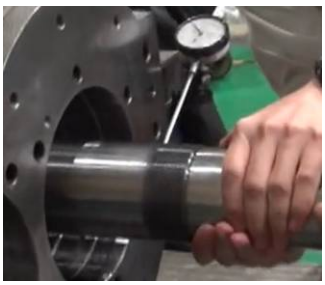
Or if the shim material is not used between thrust bearing alignment spacer and TPTB, or even if used but insufficient thickness, grind the surface of thrust bearing alignment spacer [42-M, 42-F] by the difference between the measured value and the specified value or ask professional service vendors 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) Measurement of Male rotor shaft runout

When the end clearance of Male rotor side and Female rotor side both has been adjusted to within the specified range, rotate the male rotor manually to confirm smooth rotation.

Place a dial gauge on the mechanical seal attachment portion of the Male rotor shaft and measure runout by turning the rotor shaft. The tolerance for runout is 0.03 mm or less for all models.



Runout error may be caused by non-uniformity of the thrust bearing alignment spacer or the thrust bearing outer race spacer or the lock nuts.

When the runout is larger than 0.03 mm, remove TPTB and check burs on contact surfaces and non-uniformity of the thrust bearing alignment spacer or the thrust bearing outer race spacer or the lock nuts. Clean and correct them and reassemble the thrust bearing part. When assembling the thrust bearing, confirm that the proper end clearance is obtained. Check the runout of shaft rotation again and confirm that the proper runout is obtained.

5.6.7.4 After End Clearance Adjustment

a) After completing end clearance and runout, tighten the second lock nut [Male rotor side: 39-M2] [Female rotor side: 39-F] securely by using specified torque or torque angle.

b) Remove the hexagon head screws [45-M, 45-F] and the thrust bearing gland [43-M, 43-F], to attach the O-ring [GH250S/L: 44-M, 44-F] [GH320S: 150-M, 150-F] to the thrust bearing gland.

c) Install the thrust bearing gland and tighten the hexagon head screws without conical spring washers by specified torque again.

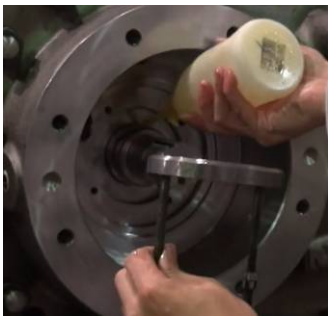
d) Then, remove one of the hexagon head screws and insert the conical spring washer [46-M, 46-F], and tighten with the specified torque again. Take the same method to remaining three screws.

5.6.8 Bearing Cover

a) Knock two parallel pins [19] into holes on the bearing cover from the bearing head side to the bearing cover side until the end face of the parallel pins and the joint face of the bearing cover flange are in the same plane.
b) Attach the O-ring [17] on the groove of the bearing head flange after applying the silicone grease or sufficient lubricating oil to the O-ring.
c) Set the stud bolts [18-B] into threaded holes on the joint surface of the bearing head.
d) Lift up the bearing cover using eyebolt by a crane and go against the bearing head until both flanges are coupled completely.
e) Tap two parallel pins by using hammer and proper rod.
f) Tighten all of hexagon head nuts [18-N] to the specified torque value designated on Table 5-15.

5.6.9 Floating Seal (B) / Balance Piston (M-2)

5.6.9.1 Floating Seal (B) *Note: This part name applies to GH250S/L only.



a) Apply sufficient lubricating oil to the surface of Male rotor shaft when installing the floating seal (B).
b) Set the O-ring [35-MS3] on the floating seal (B) [33-3] after applying silicone grease or sufficient lubricating oil to the O-ring.
c) If floating seal (B) is replaced, knock the spring pin [34-1] to the floating seal (B).
d) Set two eyebolts (No.x-24) into threaded holes on the floating seal (B) and insert the floating seal (B) into the bore of the bearing cover until the O-ring [35-MS3] touches the surface of bearing cover. Remove the two eyebolts (No.x-24) from the floating seal (B).

e) Set the floating seal (B) gland [34-2M] on the floating seal (B).
Care should be taken to the angle of the notch on the floating seal (B) gland, since it is fixed for anti-rotation by the spring pin [34-1] located on the floating seal (B).
f) Tighten the hexagon socket head cap screws [34-3] with conical spring washer [34-4].

5.6.9.2 Balance Piston Sleeve (M-2) *applies to GH320S only

Assembly procedure of this part of GH320S is almost the same as GH250S/L. The different point is installing the balance piston (M-2) [30-M2] with the O-ring [35-M4] after the proceeding clause f).
Read the parts names with replacement as follows.

Table 5-18 Part Name Replacement List

GH250S/L			GH320S		
Item No.	Part Name	Remarks	Item No.	Part Name	Remarks
33-3	Floating Seal (B)	—	33-M2	Balance Piston Sleeve (M-2)	—
35-MS3	O-ring	G70	35-M3	O-ring	G130
34-1	Spring Pin	φ 6 ×12	34	Spring Pin	φ 8 ×16
34-2M	Floating Seal (B) Gland	—	36-M	Balance Piston Sleeve (M) Gland	—
34-3	Hexagon Socket Head Cap Screw	M8×20	37-1	Hexagon Socket Head Cap Screw	M10×25
34-4	Conical Spring Washer	M8	37-2	Conical Spring Washer	M10
—	—	—	30-M2	Balance Piston (M-2)	—

5.6.10 Balance Piston Sleeve (M) / Balance Piston Sleeve (M-1)

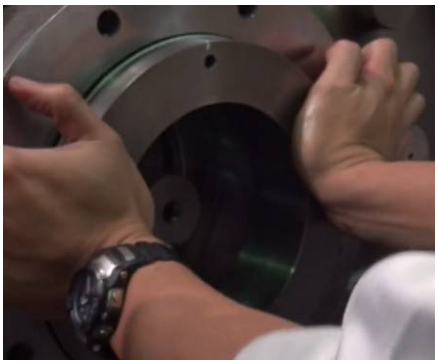
5.6.10.1 Balance Piston Sleeve (M) *Note: This part name applies to GH250S/L only.

a) Attach the O-ring [35-MS2] and the backup ring [35-MS1] to the balance piston sleeve [33-M] after applying silicone grease or sufficient lubricating oil to them.

As shown in Figure 5-9 and Figure 5-10 of Section 5.5.6, O-ring position is inner side of machine and backup ring position is outer side of the O-ring.

b) Hold the balance piston sleeve and push it into the bearing cover by palm of hand sown in lower right photo.

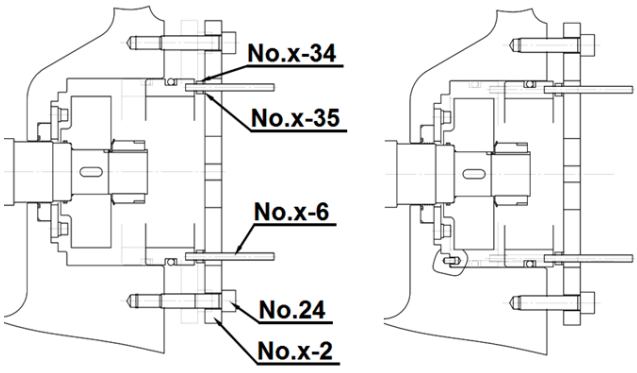
CAUTION
● **When installing the balance piston sleeve (M), take care not to tack the bias cut part of the backup ring by the bearing cover. See lower left photo.**



【POINT】

If it is impossible to install the balance piston sleeve (M) only with your hands, install it using the special tools (refer to Table 5-9) as shown in Figure 5-24.

1. Attach special tools to the balance piston sleeve (M) with refering to Figure 5-24.
2. Screw two hexagon socket head cap screws (No.24) equally until they are tightened up.
3. See right side picture in Figure 5-24. Screw two hexagon nuts until the end face of the balance piston sleeve (M)(No.33-M) is in contact with the bearing cover. Care should be taken to the angle of the notch on the balance piston sleeve (M), since it is fixed for anti-rotation by the spring pin (No.34-1) located on the bearing cover.



Note: These special tools for GH320S are not prepared, so they should be prepare locally.

Figure 5-24 Special Tools for Balance Piston Sleeve(M) of GH250S/L

5.6.10.2 Balance Piston Sleeve (M-1) * applies to GH320S only

Assembly procedure of this part of GH320S is almost the same as GH250S/L. In case of GH320S, the different point is the mass of the Sleeve (M-1) which is 25kg, so care must be taken during handling it not to drop.

Item numbers and parts names not the same, but will be assembled without any problems with reference to Figure 5-9 and Figure 5-10 in this manual Section 5.5.6.

5.6.11 Balance Piston (M)

a) In case of GH250S/L, set the O-ring [35-M] on the balance piston (M) [30] after applying silicone grease or sufficient lubricating oil to the O-ring.

In case of GH320S, confirm that the O-ring [35-M4] is attached to the balance piston (M-2) and apply silicone grease or sufficient lubricating oil to the O-ring.

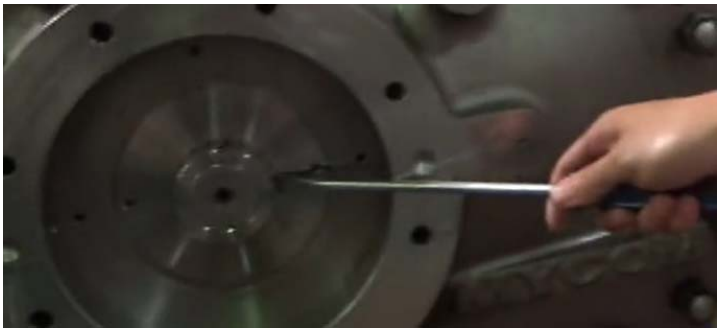
b) Set two eyebolts (No.x-24) into threaded holes on the balance piston (M) and install the balance piston (M) on the Male rotor shaft.

c) In case of GH250S/L, push out the balance piston (M) until the end face of balance piston touches the contact face of the Male rotor shaft.

In case of GH320S, push out the balance piston (M-1) until the end face of balance piston touches the balance piston (M-2) [30-M2].

d) Set lock washer [32-2: GH250S/L] [32-M2: GH320S] and lock nut [32-1: GH250S/L] [32-M1: GH320S] to the Male rotor and tighten the lock nut by using specified torque or torque angle.

e) Bend the claw of the lock washer into the cut-out portion of the lock nut to prevent looseness of the lock nut.



5.6.12 Balance Piston Cover (M)

a) Set the O-ring [23-M] on the balance piston cover [22-M] after applying silicone grease or sufficient lubricating oil to the O-ring.

b) In case of GH250S/L, screw two sufficient length stud bolts to the bearing cover [16] for safety.

In case of GH320S, screw the stud bolts [24-MB] to threaded holes on the bearing cover [16]

c) Screw the eyebolt to the top of the balance piston cover and lift up the cover by using a crane or a chain block. Push the balance piston cover to the bearing cover.

d) Take care to the angle of the spring pin [34-1: GH250S/L] [34: GH320S] on the balance piston cover, since the balance piston sleeve (M) is fixed for anti-rotation by the spring pin.

e) In case of GH250S/L, tighten the hexagon socket head cap screws [24] by specified torque.

In case of GH320S, tighten the hexagon-nuts [24-MN] by specified torque.

5.6.13 Balance Piston and Balance Piston Sleeve (F)

5.6.13.1 GH250S/L

a) Attach the O-ring [35-F] to the balance piston (F) [33-F2] after applying silicone grease or sufficient lubricating oil to the O-ring.

b) Attach the balance piston key (F) [33-F4] to the key groove of the Female rotor shaft.

c) Install the balance piston (F) on the Female rotor shaft by hand.

d) Secure the balance piston (F) by attaching the C type retainer ring by using a retainer ring pliers external.

e) If you replace the balance piston sleeve, knock the spring pin [34-1] to the balance piston sleeve (F) [33-F].

f) Set two M8 eyebolts (No.x-24) to threaded holes of the balance piston sleeve (F).

g) Insert the balance piston sleeve (F) into the suction cover [5].

Take care to the angle of the spring pin [34-1] located on the balance piston sleeve (F), since it is fixed for anti-rotation by the notch on the suction cover.

h) Remove two eyebolts (No.x-24) from the balance piston sleeve (F) and set these eyebolts to threaded holes on the balance piston cover (F) [22-F].

i) Set the O-ring [35-F] on the balance piston sleeve (F) and set the O-ring [23-F] on the balance piston cover [22-F] after applying silicone grease or sufficient lubricating oil to each O-ring.

j) Insert and push in the balance piston cover (F) into the suction cover [5]. Remove two eyebolts (No.x-24).

k) Tighten the hexagon socket head cap screws [24].

5.6.13.2 GH320S

The difference of this part between GH250S/L and GH320S is as follows.

- Item numbers and parts names are not the same.
- Balance piston sleeve of GH320S is divided into two pieces.
- The fixing way of the balance piston sleeve; GH250 is holding directly by the balance piston cover, while GH320 is fixed by the C type retaining ring.

These parts will be assembled without any problems with reference to Figure 5-6 and Figure 5-7 in this manual Section 5.5.3, since assembly procedure of this part is the same as roughly GH250S/L.

⚠ CAUTION

- **Since the retaining ring [37-3] is not only large diameter but also large spring force, take extreme care for when assembling. Use correct size plier and wear protective goggles.**

5.6.14 Unloader Piston Assembly

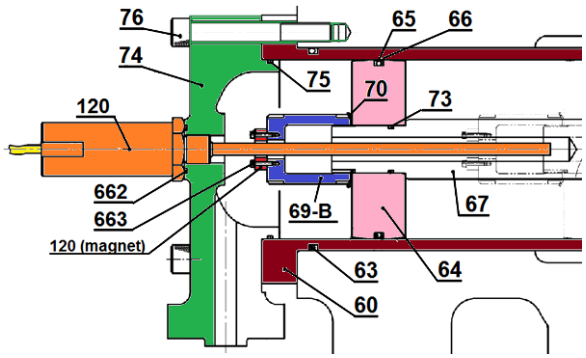


Figure 5-25 GH250S/L
Unloader Cylinder Part

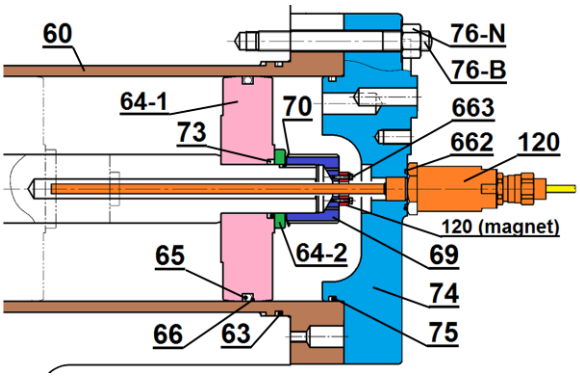
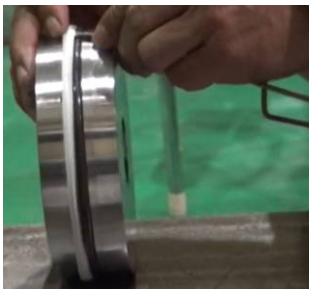


Figure 5-26 GH320S
Unloader Cylinder Part

a) In case of GH250S/L, set the O-ring [73] on the unloader push rod [67].

b) Set the O-ring [65] on the unloader piston [64] after applying silicone grease or sufficient lubricating oil to the O-ring.

c) Wrap the O-ring [65] fitted on the unloader piston with the cap seal [66]. Lightly making a mountain fold in the circumferential direction of the cap seal will make the work easier.
Use of a small and smooth spatula-shaped tool (as shown in lower left and center photos) will be helpful to the assembly.



d) Insert the unloader piston [64: GH250S/L] / [64-1: GH320S] into the unloader cylinder [60]. The unloader piston has a surface which has threaded holes for eye bolts and another surface without such holes.
As shown in upper right photo, attach the unloader piston with its surface having threaded holes faced to the unloader cylinder cover.
After attaching, check that the cap seal is not broken or pinched.

e) Set the O-ring [63] on the unloader cylinder after applying silicone grease or sufficient lubricating oil to the O-ring.

f) Insert the unloader cylinder [60] into the suction cover [5].
The unloader cylinder is heavy (15kg: GH250S, 25kg: GH250L, 50kg: GH320S).
Take care when installing it. In case of GH250L and/or GH320S, certainly use a crane and so on.

g) Push the unloader piston to the push rod by tapping with soft hammer as shown in next page left photo.

h) In case of GH320S, attach the O-ring [73] and O-ring gland [64-2] to the unloader piston.

i) Set the lock washer [70] and lock nut [69-B: GH250S/L] / [69: GH320S] on the threaded part of the push rod [67]. Tighten the lock nut by using specified torque or torque angle.

j) Set the magnet to the end face of the lock nut [69-B: GH250S/L] / [69: GH320S] and fix it by tightening the hexagon socket head cap screws [663].
As shown in upper right photo, before attaching the lock nut [69-B / 69], the magnet may be attached to the lock nut.

5.6.15 Unloader Cover

a) In case of GH250S/L, set two M8 eyebolts into threaded holes on the unloader cover [74].
In case of GH320S, set two eyebolts on the top of the unloader cover and hang them by a crane or a chain block and so on.

b) Set the O-ring [75] on the unloader cover after applying silicone grease or sufficient lubricating oil to the O-ring.

c) Insert the unloader cover into the unloader cylinder [60].

d) In case of GH250S/L, tighten the hexagon socket head cap screws [76].
In case of GH320S, tighten the hexagon nuts [76-N] to the stud bolts [76-B]

e) Set the O-ring [662] on the unloader cover after applying silicone grease or sufficient lubricating oil to the O-ring.

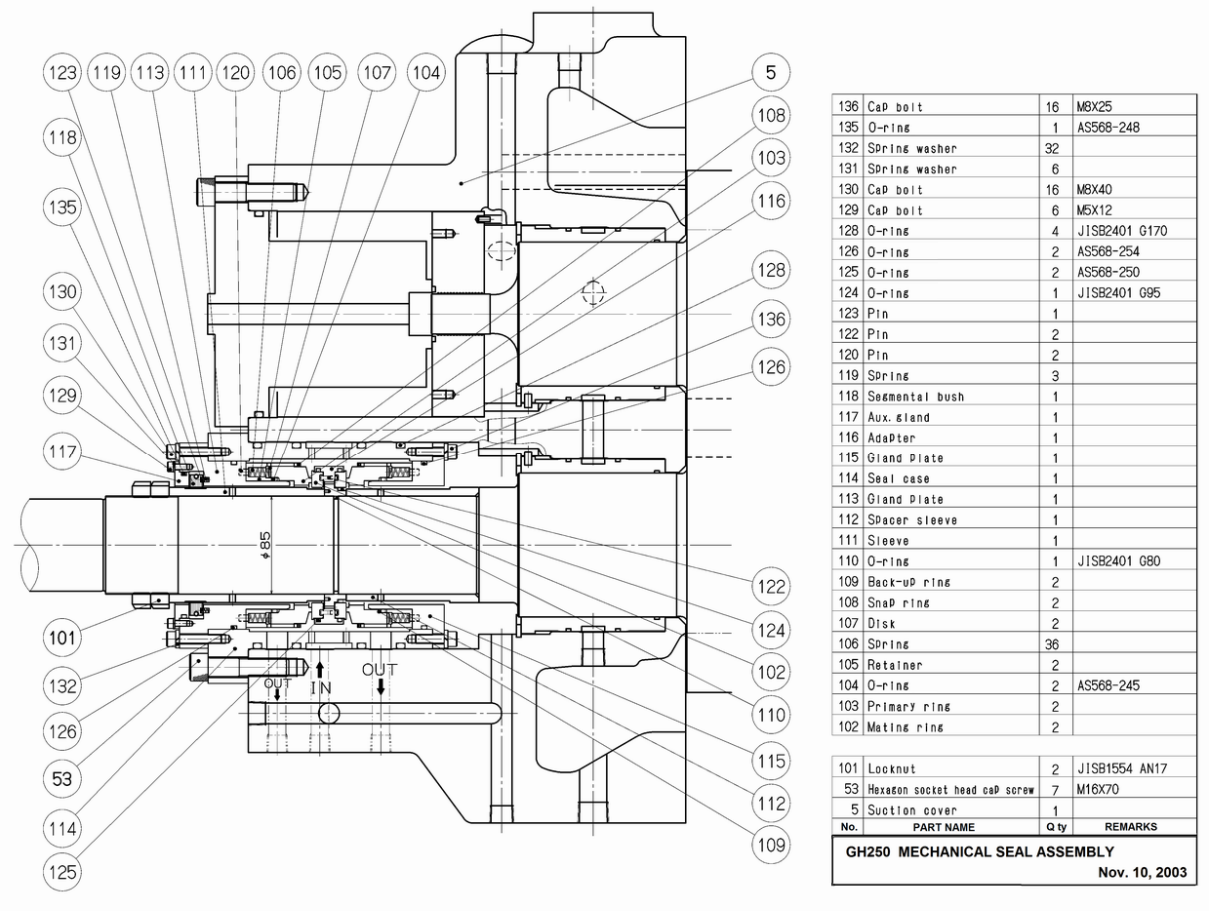
f) Set the probe of the unloader indicator assembly [120] to the unloader cover and tighten using the hexagonal part of the detector.

5.6.16 Shaft Seal Part

Shaft seal failure can be caused by assembly error. Care should be taken when assembling the shaft seal because the life of the mechanical seal is greatly affected by the assembly work itself.

Assemble the mechanical seal according to the following procedure and refer to each MECHANICAL SEAL ASSEMBLY drawing.

5.6.16.1 Assemble type Shaft Seal for GH250S/L



No.	PART NAME	Q'ty	REMARKS
136	Cap bolt	16	M8X25
135	O-ring	1	AS568-248
132	Spring washer	32	
131	Spring washer	6	
130	Cap bolt	16	M8X40
129	Cap bolt	6	M5X12
128	O-ring	4	JISB2401 G170
126	O-ring	2	AS568-254
125	O-ring	2	AS568-250
124	O-ring	1	JISB2401 G95
123	Pin	1	
122	Pin	2	
120	Pin	2	
119	Spring	3	
118	Segmental bush	1	
117	Aux. gland	1	
116	Adapter	1	
115	Gland Plate	1	
114	Seal case	1	
113	Gland Plate	1	
112	Spacer sleeve	1	
111	Sleeve	1	
110	O-ring	1	JISB2401 G80
109	Back-up ring	2	
108	Snap ring	2	
107	Disk	2	
106	Spring	36	
105	Retainer	2	
104	O-ring	2	AS568-245
103	Primary ring	2	
102	Mating ring	2	
101	Locknut	2	JISB1554 AN17
53	Hexagon socket head cap screw	7	M16X70
5	Suction cover	1	

GH250 MECHANICAL SEAL ASSEMBLY
Nov. 10, 2003

Figure 5-27 GH250 Mechanical Seal Assembly (Assemble type)

a) Set the O-rings [128] to the groove on the circumference of the seal case [114] after applying silicone grease or sufficient lubricating oil to the O-ring.

b) Set the O-ring [126] on the gland plate [115] after applying silicone grease or sufficient lubricating oil to the O-ring. Insert the gland plate [115] into the seal case [114].
Tighten the hexagon socket head cap screws [136].

c) Set the backup ring [109] to the internal part of the machine side primary ring [103], then set the O-ring [104]. Insert the machine side primary ring into the gland plate [115].

d) Set two M8 eyebolts into threaded holes on the seal case and insert the seal case into the suction cover [5]. Tighten the hexagon socket head cap screws [53].

e) Set the spacer sleeve [112] in the direction the chamfered side faces to the contact face of the male rotor shaft until the end face of the spacer sleeve is touches the contact face of the male rotor shaft.

f) Set the O-ring [110] on the male rotor after applying silicone grease or sufficient lubricating oil to the O-ring.

g) Set the O-rings [124, 125] and assemble the mating rings [102] and the adapter [116] after applying silicone grease or sufficient lubricating oil to the O-rings.

h) Set two eyebolts (No.x-26) into threaded holes on the adapter [116]. Set the assembly of the mating ring and the adapter on the male rotor and push in carefully until the end face of the adapter touches the end face of the spacer sleeve using two eyebolts.

i) Set the O-ring [126] on the gland plate [113] after applying silicone grease or sufficient lubricating oil to the O-ring.

j) Set the backup ring [109] into the internal part of the atmospheric side primary ring [103], then set the O-ring [104]. Set the atmospheric side primary ring to the gland plate [113].

k) Set two eyebolts (No.x-26) into threaded holes on the gland plate [113]. Insert the assembly of the gland plate and primary ring into the seal case [114] carefully using two eyebolts.

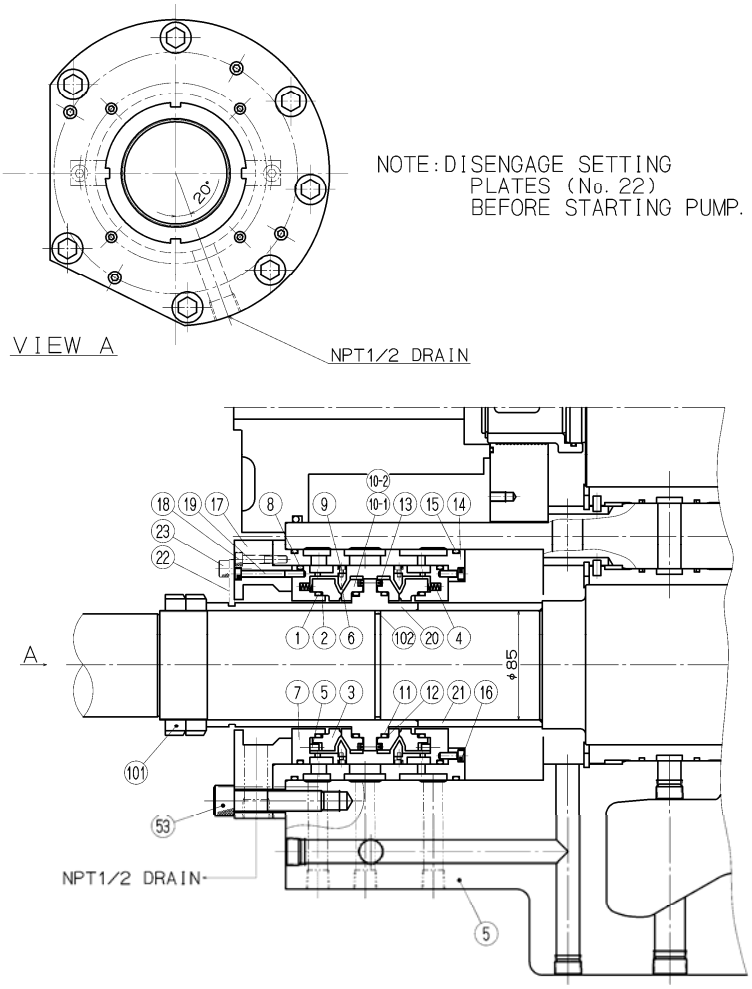
m) Set the hexagon socket head cap screws [130] and spring washer [132] and tighten the hexagon socket head cap screws.

n) Set the O-ring [135] on the auxiliary gland [117] after applying silicone grease or sufficient lubricating oil to the O-ring.

o) Set two eyebolts (No.x-26) into threaded holes on the auxiliary gland and insert the auxiliary gland into the gland plate.

p) Set the hexagon socket head cap screws [129] and the spring washer [131] and tighten the hexagon socket head cap screws.

5.6.16.2 Cartridge type Shaft Seal for GH250S/L



No.	PART NAME	Q'ty	REMARKS
23	HEXAGON SOCKET HEAD CAP SCREW	2	
22	SET PLATE	2	
21	SLEEVE	1	
20	SLEEVE	1	
19	HEXAGON SOCKET HEAD CAP SCREW	4	
18	HEXAGON SOCKET HEAD CAP SCREW	4	
17	FLANGE COVER	1	
16	HEXAGON SOCKET HEAD CAP SCREW	4	
15	O-ring	2	
14	SEAL COVER	1	
13	DRIVE PIN	6	
12	BACKUP RING	2	
11	O-ring	2	
10-2	RETAINER	2	
10-1	MATING RING	2	
9	HEXAGON SOCKET HEAD CAP SCREW	6	
8	O-ring	2	
7	CASE	2	
6	CASE	2	
5	KNOCK PIN	8	
4	COIL SPRING	24	
3	SEAL RING	2	
2	BACKUP RING	2	
1	O-ring	2	
102	O-ring	1	JIS B2401 G80
101	LOCK NUT	2	JIS B1554 AN17
53	HEXAGON SOCKET HEAD CAP SCREW	7	M16x70
5	SUCTION COVER	1	

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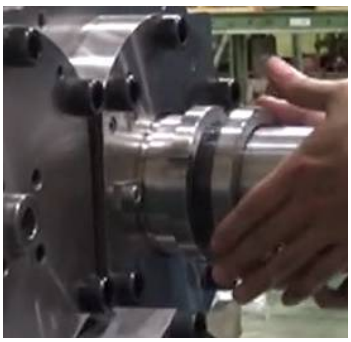
Figure 5-28 Mechanical Seal Assembly (Cartridge type)

a) Install the seal collar [21] on the Male rotor shaft with applying sufficient lubricating oil as shown in lower left photo.

b) Set the O-ring [102] to the Male rotor shaft after applying silicone grease or sufficient lubricating oil to the O-ring. See the lower center photo.

c) Set the O-rings [15] to the seal cover [14] with applying sufficient lubricating oil as shown in lower right photo.





d) Screw two stud bolts for safety as shown in upper left photo.
e) Install and push the flange cover [17] into the suction cover.
f) Tighten the hexagon head cap screws evenly.
g) Install and tighten two lock nuts [101] with specified torque or torque angle. About the specified torque and torque angle refer to Section 7.3 and Section 7.4 in this manual Chapter 7.

5.6.16.3 Assemble type Shaft Seal for GH320S

Install each assemble type part shown in coloring part Figure 5-29 in the following order, that is, light-blue part, red part, yellow part, dark-blue part.

a) Light-blue part: Sleeve [22]
b) Red part: Case [14] and etc.
c) Yellow part: Sleeve [21]
d) Dark-blue part: Case [5, 6] and Flange Cover [18]

For details of component part name and item number, refer to Figure 5-30 in next page.

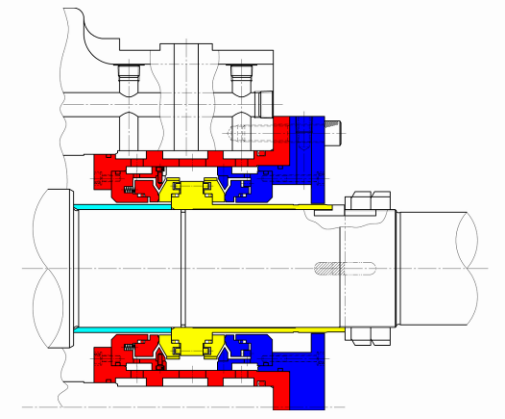
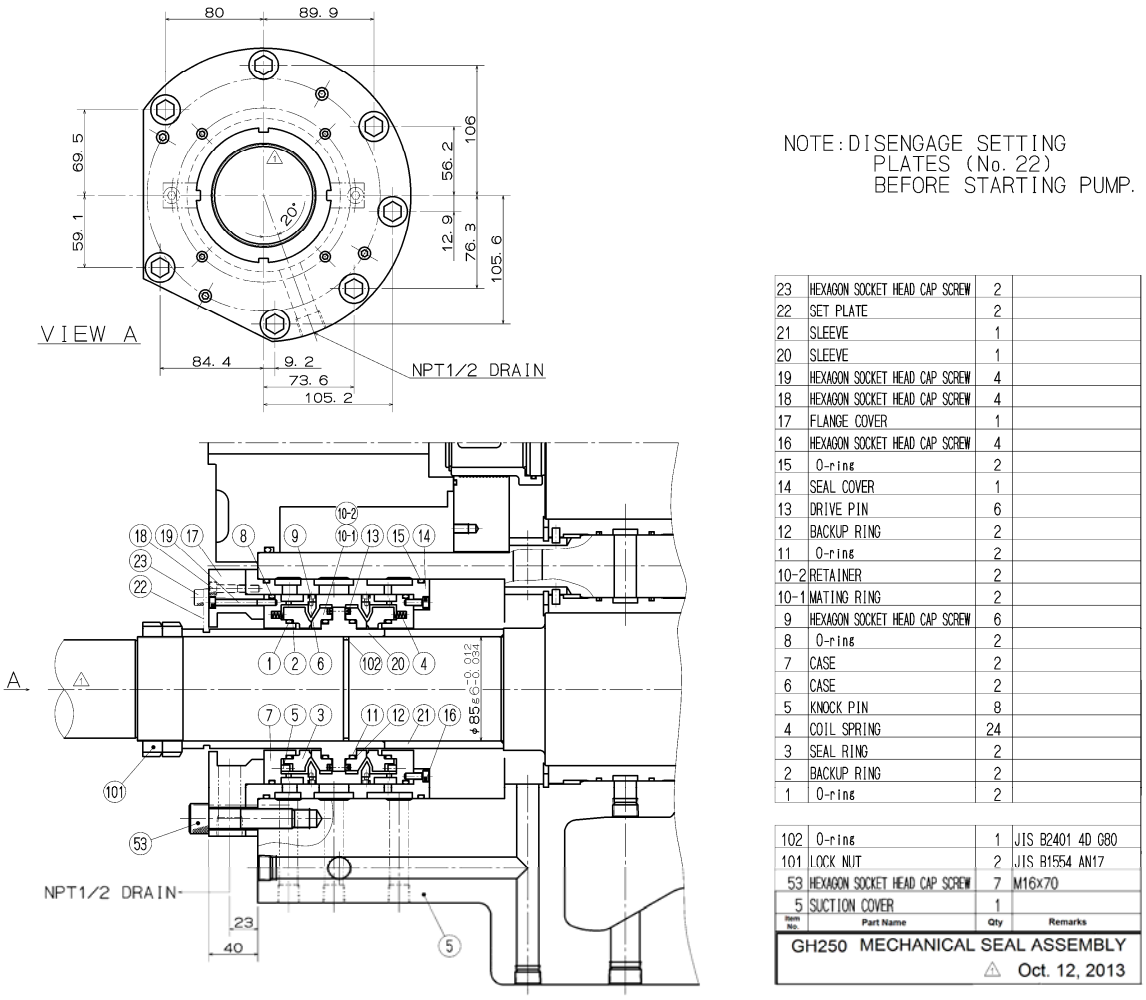


Figure 5-29 GH320S Shaft Seal



Item No.	Part Name	Qty	Remarks
23	HEXAGON SOCKET HEAD CAP SCREW	2	
22	SET PLATE	2	
21	SLEEVE	1	
20	SLEEVE	1	
19	HEXAGON SOCKET HEAD CAP SCREW	4	
18	HEXAGON SOCKET HEAD CAP SCREW	4	
17	FLANGE COVER	1	
16	HEXAGON SOCKET HEAD CAP SCREW	4	
15	O-ring	2	
14	SEAL COVER	1	
13	DRIVE PIN	6	
12	BACKUP RING	2	
11	O-ring	2	
10-2	RETAINER	2	
10-1	MATING RING	2	
9	HEXAGON SOCKET HEAD CAP SCREW	6	
8	O-ring	2	
7	CASE	2	
6	CASE	2	
5	KNOCK PIN	8	
4	COIL SPRING	24	
3	SEAL RING	2	
2	BACKUP RING	2	
1	O-ring	2	
102	O-ring	1	JIS B2401 4D G80
101	LOCK NUT	2	JIS B1554 AN17
53	HEXAGON SOCKET HEAD CAP SCREW	7	M16x70
5	SUCTION COVER	1	

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Figure 5-30 GH320 Mechanical Seal Assembly (Assemble type)

6 Troubleshooting

Table 6-1 Troubleshooting

	Trouble	Causes	Actions
01	Supply oil pressure drops	1) Clogging of oil filter	Replace filter element
		2) Valve in the supply oil line closed	Open valve.
02	Abnormally high discharge pressure	1) Contamination of cooling pipe	Clean cooling pipe for cooling water side.
		2) Insufficient cooling water flow	Add cooling water to cooling tower.
		3) Clogging of cooling water filter	Clean cooling water filter.
		4) High cooling water temperature	Check cooling water line, and take measure as necessary.
			Enlargement is necessary if caused by insufficient capacity of cooling tower.
		5) Refrigerant charge is excessive.	Adjust refrigerant amount.
		6) Discharge valve closed	Open discharge valve.
		7) Non-condensable gases in the system	Purge any non-condensable gas from condenser.
			Check suction line for leakage.
03	Abnormally high discharge temperature	1) Suction superheat is too high.	Check cooling load.
			Adjust expansion valve.
		2) Non-condensable gases in the system	Purge any non-condensable gas from condenser.
			Check suction line for leakage.
		3) High supply oil temperature	Remove causes for insufficient cooling performance of oil cooler.
		4) Insufficient supply oil	Check oil filter and oil heater
04	Motor protection switch activated (Motor overheat)	1) Voltage drop	Check and improve power supply system.
		2) Motor overload	Check cooling load
			Set upper limit to capacity control.
05	Abnormal noises from compressor	1) Refrigerant liquid flow-back	Adjust supply refrigerant flow rate to evaporator.
		2) Foreign substance in compressor	Check suction strainer and oil filter and overhaul compressor if necessary.
		3) Bearing damage	Confirm and eliminate casual factors.
			Overhaul compressor
06	Unloader slide valve not moving	1) The opening of adjusting valve is too small.	Adjust valve opening appropriately.
		2) Refrigerant gas retention in unloader cylinder.	Stop compressor operation.
			Operate oil pump and repeat loading and unloading to purge gas from cylinder.

Note: The contents described above are based on refrigeration cycle packages.

7 Related Documents

7.1 Sectional View

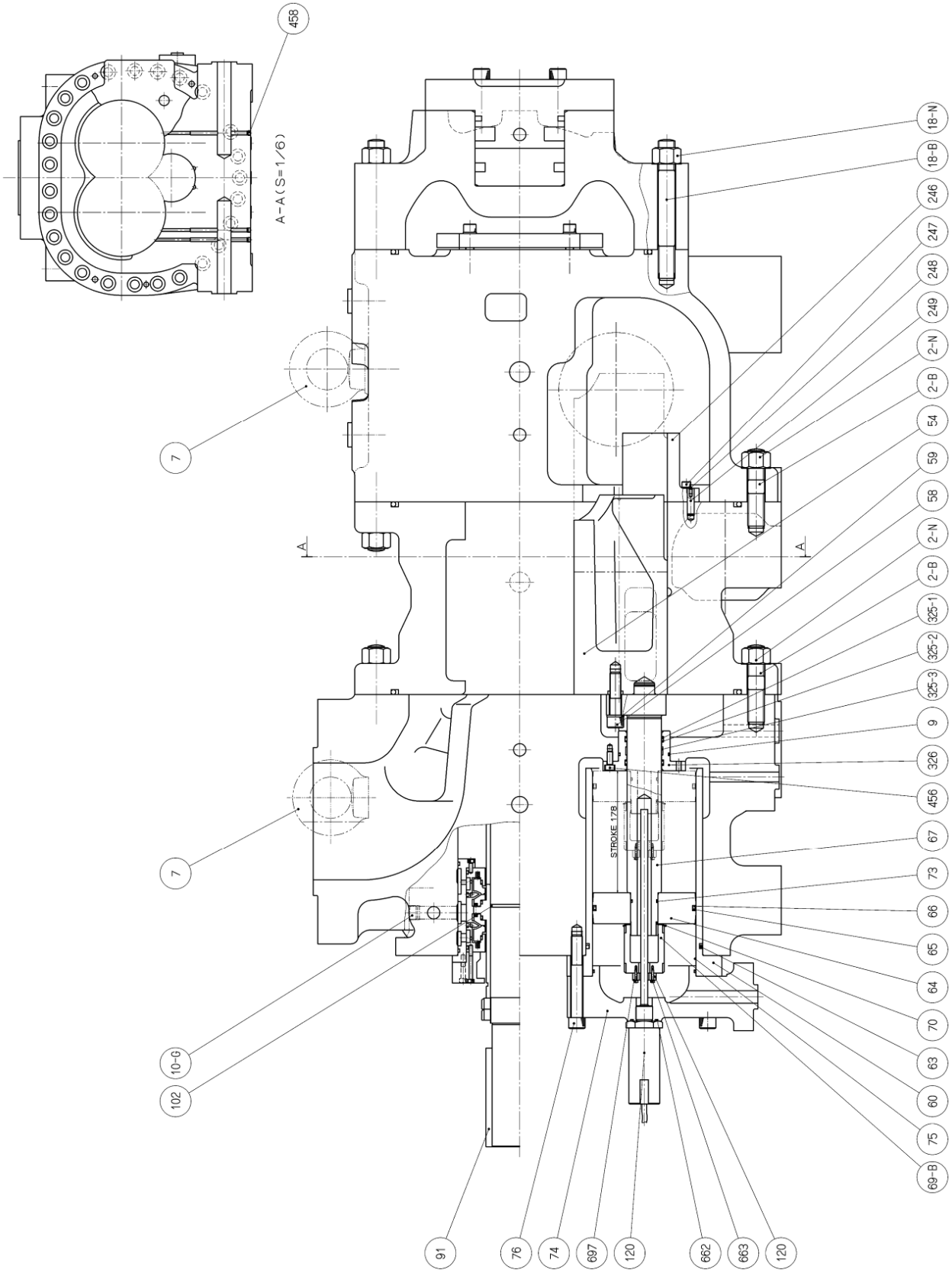

Figure 7-1 Longitudinal Sectional View of GH250S

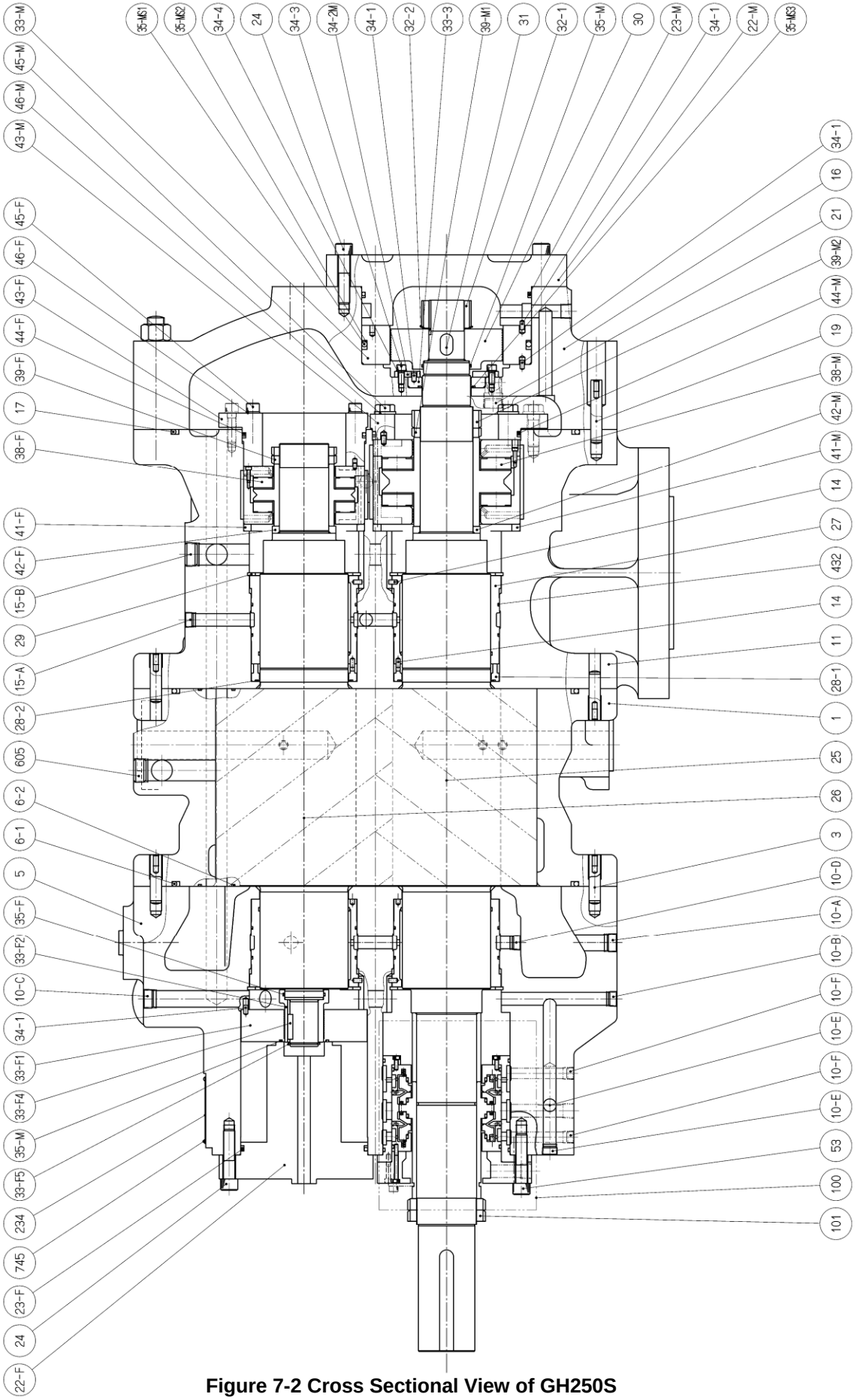

Figure 7-2 Cross Sectional View of GH250S

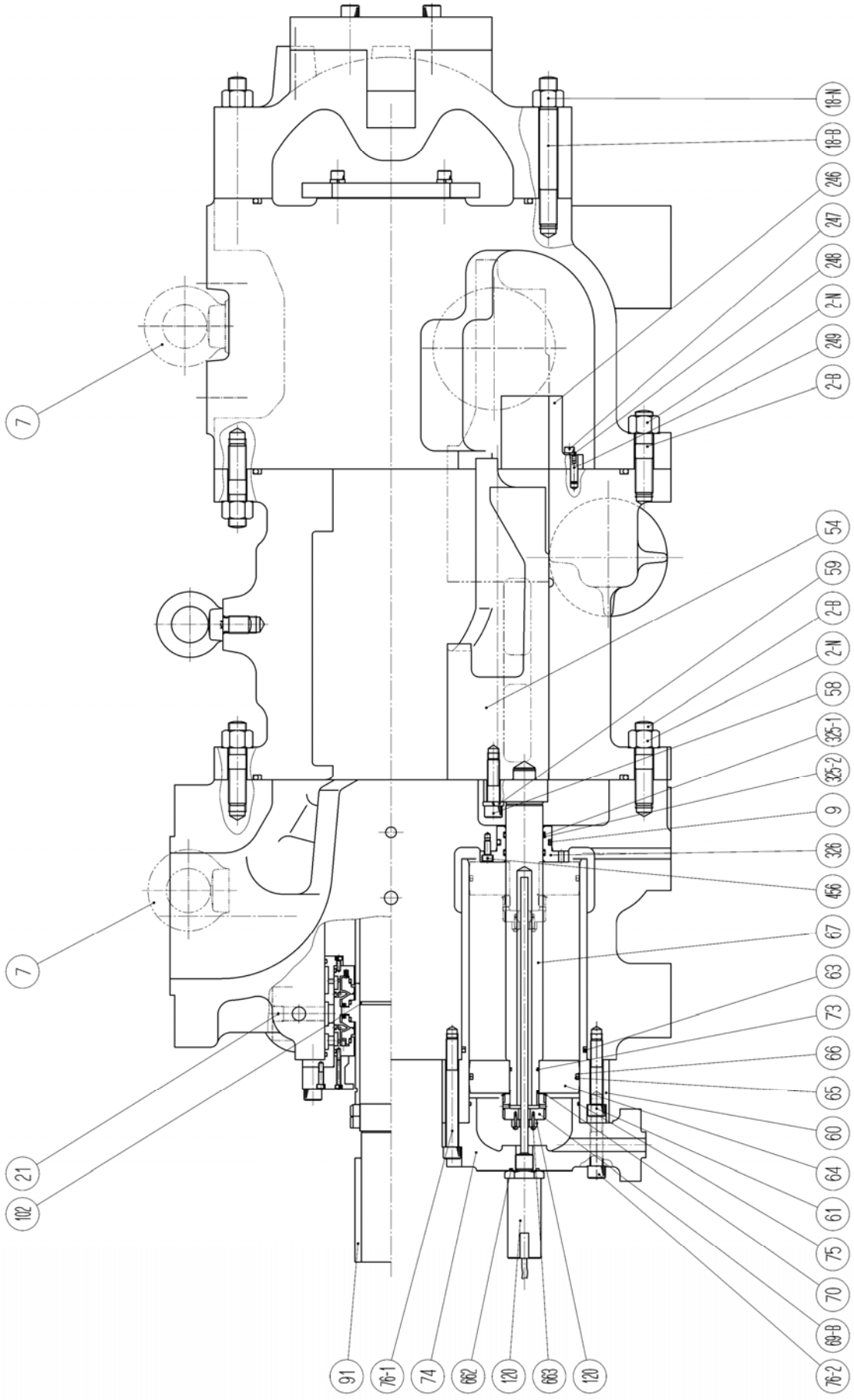

Figure 7-3 Longitudinal Sectional View of GH250L

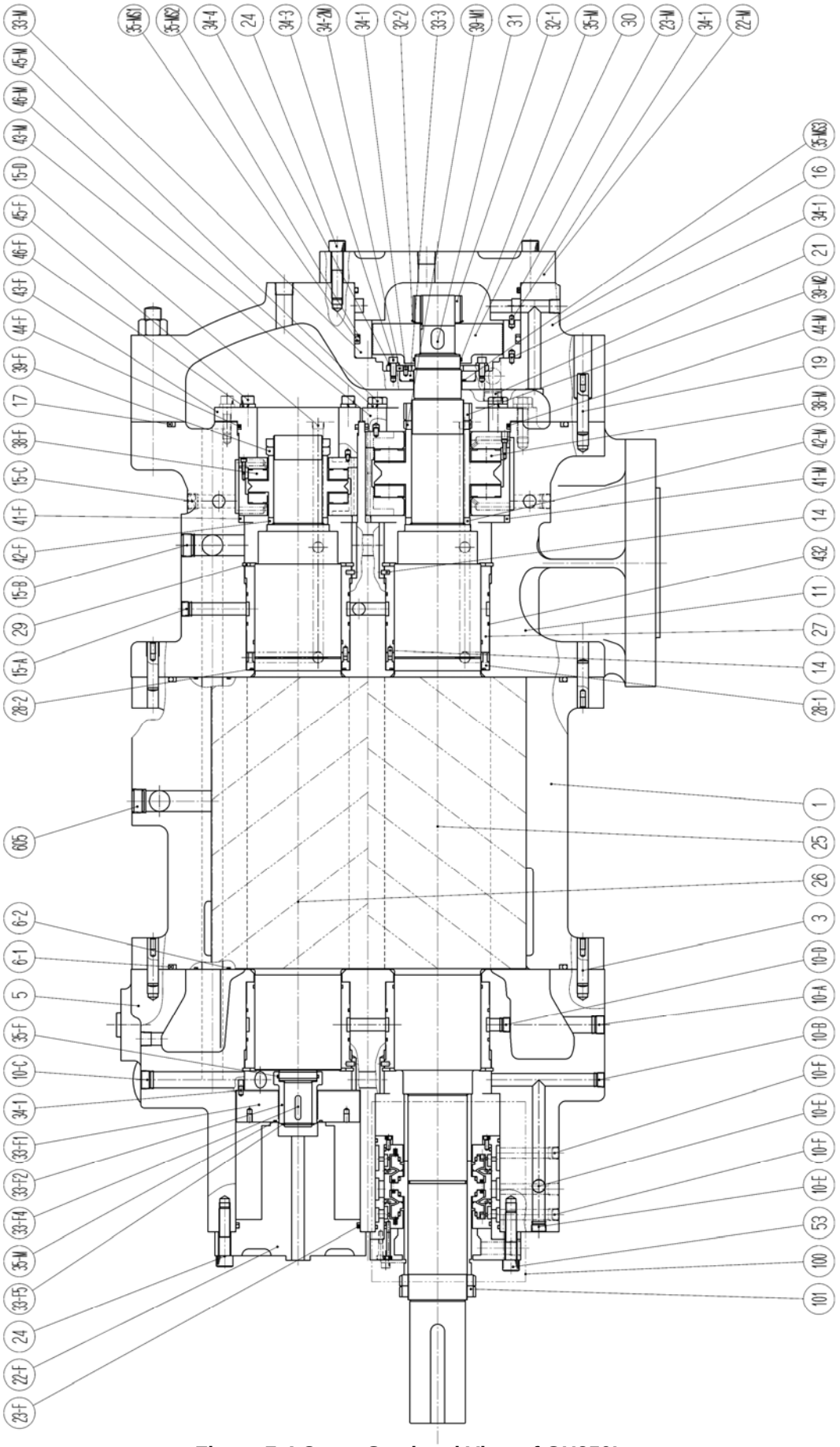

Figure 7-4 Cross Sectional View of GH250L

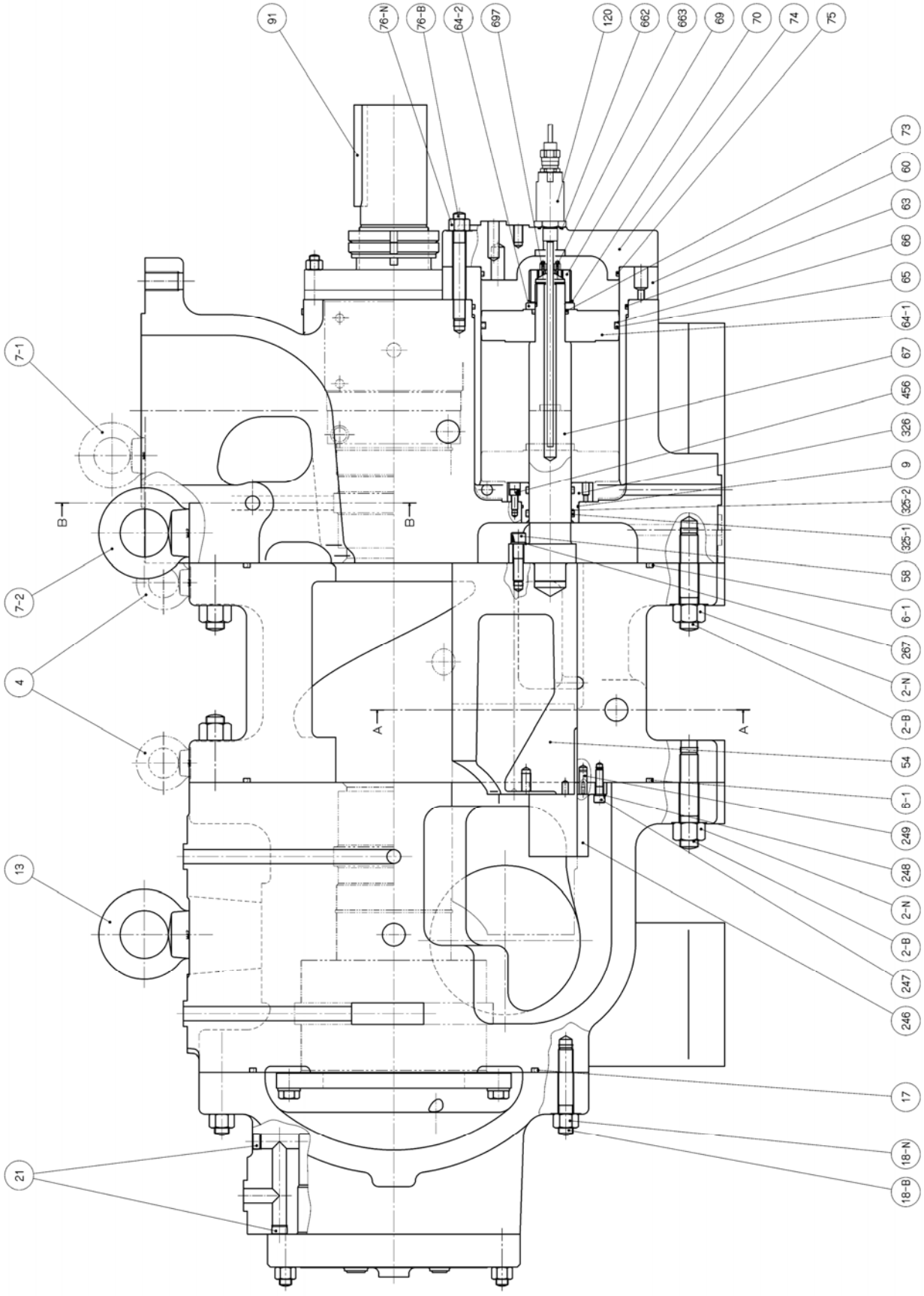

Figure 7-5 Longitudinal (1) Sectional View of GH320S

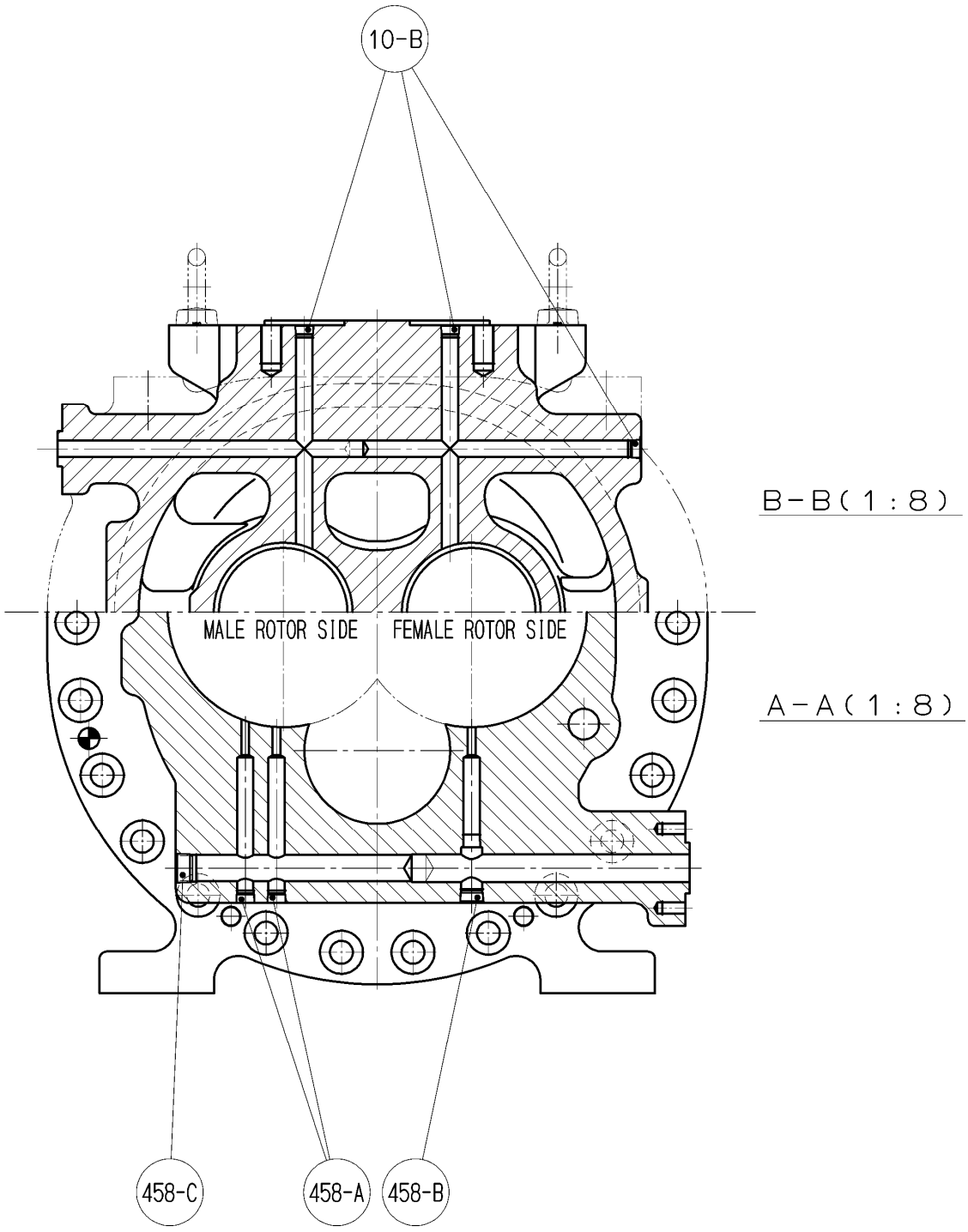

Figure 7-6 Longitudinal (2) Sectional View of GH320S

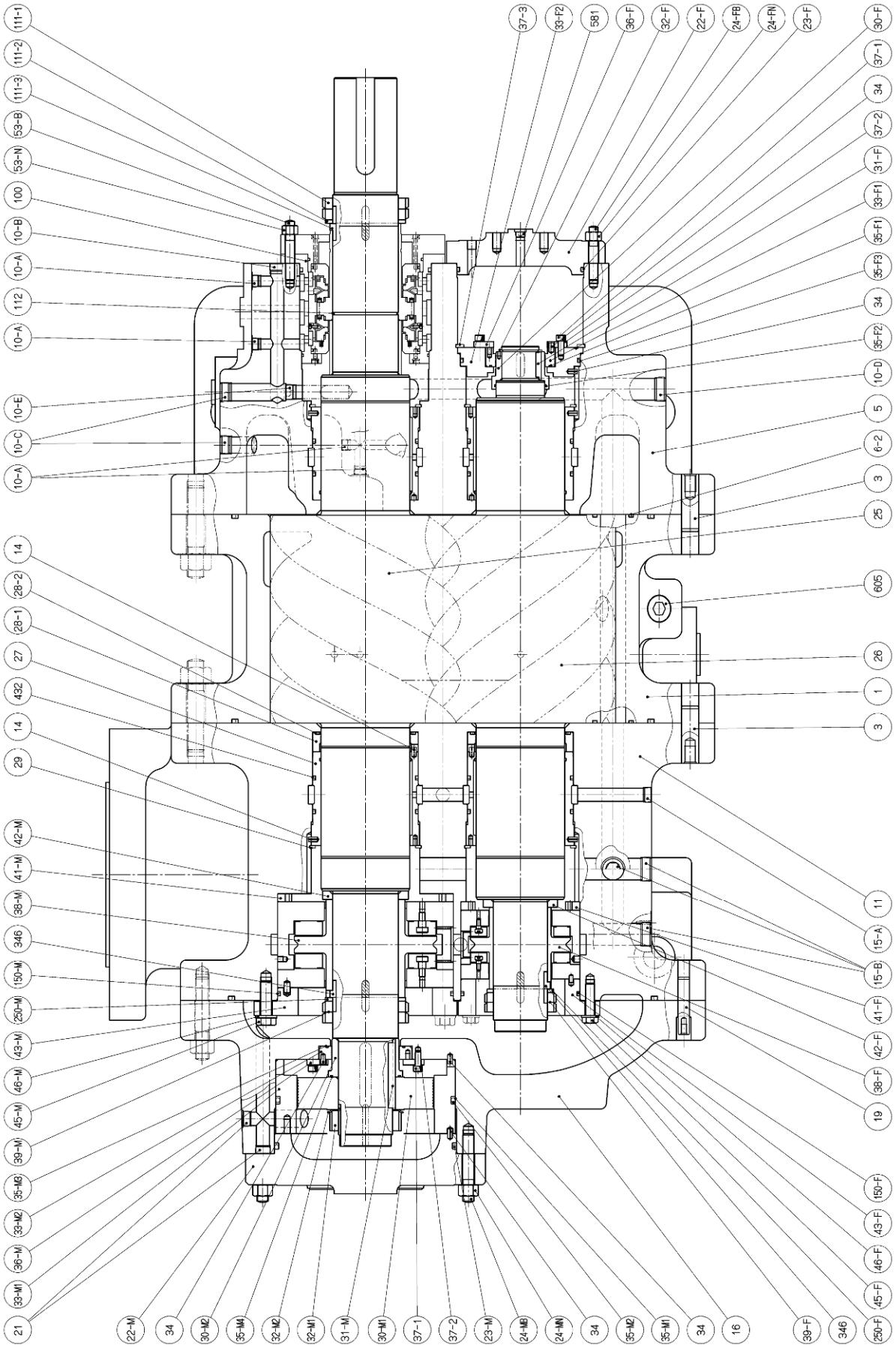

Figure 7-7 Cross Sectional View of GH320S

7.2 Parts Configuration Table

Table 7-1 Parts Configuration Table of GH250S/L

No.	Part Name	Code No.	Remarks	Q'ty
1	Rotor Casing	CS00107-TG250S	GH250S	S:1
1	Rotor Casing	CS00107-TG250L	GH250L	L:1
2-B	Stud Bolt	CS00200-GH250	GH250S M24×115	S:54
2-B	Stud Bolt	CS01800-GH250S	GH250L M24×205	L:54
2-N	Hexagon Nut	NC140-24H	M24, P3	54
3	Parallel Pin with Internal Thread	NE242A16-070A	φ16×70 with groove	4
5	Suction Cover	CS00507-TG250	GH250S	1
5	Suction Cover		GH250L	1
6-1	O-ring	CS00600-GH250	544. 8×8. 4	2
6-2	O-ring	PC11-046	JIS B2401 P46 FKM-70	2
7	Eyebolt	NB600-30	M30	3
9	O-ring	PC12-070	JIS B2401 G70 FKM-70	1
10-A	Plug	NF062-N006	NPT3/4”	1
10-B	Plug	NF062-N004	NPT1/2”	1
10-C	Plug	NF062-N006	NPT3/4”	2
10-D	Plug	NF062-N004	NPT1/2”	3
10-E	Plug	NF062-N004	NPT1/2”	3
10-F	Plug	NF062-N003	NPT3/8”	2
10-G	Plug	NF062-N004	NPT1/2”	1
11	Bearing Head	CS01107-TG250		1
14	Spring Pin	NE3206-012	φ6×12	6
15-A	Plug	NF062-N004	NPT1/2”	1
15-B	Plug	NF062-N008	NPT1”	2
15-C	Plug	NF062-N004	NPT1/2”	6
16	Bearing cover	CS01607-TG250	GH250	1
17	O-ring	CS01700-GH250	497.3×8. 4 FKM-70	1
18-B	Stud Bolt	CS01800-GH250S	M24×205	21
18-N	Hexagon Nut	NC140-24H	M24,P=3	21
19	Parallel Pin with Internal Thread	NE242A16-090A	φ16×90 with groove	2
22-M	Balance Piston Cover (M)	CS02207-TG250M	GH250	1
22-F	Balance Piston Cover (F)	CS02207-TG250F	GH250	1
23-M	O-ring	PC12-230	JIS B2401 G230 FKM-70	1
23-F	O-ring	PC12-170	JIS B2401 G170 FKM-70	1
24	Hexagon Socket Head Cap Screw	NB35416-070	M16×70	15
25	Male Rotor	CS02511-G250SM	GH250S	S:1
26	Female Rotor	CS02511-G250SF		
25	Male Rotor	CS02511-G250LM	GH250L	L:1
26	Female Rotor	CS02511-G250LF		
27	Main Bearing	CS02700-GH250	GH250	4
28-1	Floating Seal (A)	CS02800-GH250A	GH250	2
28-2	O-ring	PC12-130	JIS B2401 G130 FKM-70	2

No.	Part Name	Code No.	Remarks	Q'ty
29	C Type Retaining Ring (Snap Ring)	NG11-155	H155 C type-internal	4
30	Balance Piston (M)	CS03000-GH250M	φ190/φ185/0φ160 choice	1
31	Key, Balance Piston (M)	CS03100-250	250S/LD standard	1
32-1	Lock Nut	CS03200-GH250	M50×1.5 special	1
32-2	Lock Washer	NG32-010	JIS B1554 AW10-A	1
33-3	Floating Seal (B)	CS02800-GH250B	GH250	1
33-M	Balance Piston Sleeve (M)	CS03300-GH250M	φ190/φ185/0φ160 choice	1
33-F1	Balance Piston Sleeve (F)	CS03300-GH250F	GH250 φ55	1
33-F2	Balance Piston (F)	CS03000-GH250F	GH250	1
33-F4	Key, Balance Piston (F)	DM02100-2	same as for M80P	1
33-F5	Snap Ring (Retaining/Stop Ring)	NG12-040	S40 C type-external	1
34-1	Spring Pin	NE3206-012	φ6×12	4
34-2M	Gland, Floating Seal (B)	CS03400-GH250B	GH250	1
34-3	Hexagon Socket Head Cap Screw	NB35408-020	M8×20	4
34-4	Conical Spring Washer	ND160-008H	M8 for Hex head cap screw	4
35-MS1	O-ring	PC11-225	JIS B2401 P225 FKM-70	1
35-MS2	Backup Ring	PG11T2-225	SUN-2BP-225-T2 PTFE	1
35-MS3	O-ring	PC12-070	JIS B2401 G70 FKM-70	1
35-M	O-ring	PC12-065	JIS B2401 G65 FKM-70	2
35-F	O-ring	PC12-055	JIS B2401 G55 FKM-70	1
38-M	Thrust Bearing Assembly (M)	CS038T-H25M-ORI	GH250 TPTB	1
38-F	Thrust Bearing Assembly (F)	CS038T-H25F-ORI	GH250 TPTB	1
39-M1	Lock Nut	NG31-015	AN15	1
39-M2	Lock Nut	CS03900-GH250M2	M75×2.0 special	1
39-F	Lock Nut	NG31-014	AN14	2
41-M	Spacer, Thrust Bearing Outer Race (M)	CS04100-GH250M	GH250	1
41-F	Spacer, Thrust Bearing Outer Race (F)	CS04100-GH250F	GH250	1
42-M	Spacer, Thrust Bearing Alignment (M)	CS04200-GH250M	GH250	1
42-F	Spacer, Thrust Bearing Alignment (F)	CS04200-GH250F	GH250	1
43-M	Thrust Bearing Gland (M)	CS04300-GH250M	GH250	1
43-F	Thrust Bearing Gland (F)	CS04300-GH250F	GH250	1
44-M	O-ring	PC12-195	JIS B2401 G195 FKM-70	1
44-F	O-ring	PC12-160	JIS B2401 G160 FKM-70	1
45-M	Hexagon Head Screw	NB111016-050	M16×50	4
45-F	Hexagon Socket Head Cap Screw	NB35412-045	M12×45	4
46-M	Conical Spring Washer	ND150-016H	M16 for Hex head screw	4
46-F	Conical Spring Washer	ND160-012H	M12 for Hex head cap screw	4
53	Hexagon Socket Head Cap Screw	NB35416-070	M16×70	7
54	Unloader Slide Valve	CS05404-GH250S	GH250S Vi=L/M/H choice	S:1
54	Unloader Slide Valve	CS05404-GH250L	GH250L Vi=L/M/H choice	L:1
58	Hexagon Socket Head Cap Screw	NB35416-065	M16×65	5
59	Conical Spring Washer	ND160-016H	M16 for Hex head cap screw	5
60	Unloader Cylinder	CS06007-TG250	GH250S	S:1
60	Unloader Cylinder	CS06007-TG250L	GH250L	L:1
61	Hexagon Socket Head Cap Screw	NB35416-100	GH250L M16×100	L:5

No.	Part Name	Code No.	Remarks	Q'ty
63	O-ring	PC12-160	JIS B2401 G160 FKM-70	1
64	Unloader Piston	CS06400-GH250	GH250	1
65	O-ring	PC11-140	JIS B2401 P140 FKM-70	1
66	Cap Seal	CS06600-3225	SUNR-BE-140 (S4101)	1
67	Push Rod, Unloader Slide Valve	CS06700-GH250S	GH250S	1
67	Push Rod, Unloader Slide Valve	CS06700-GH250L	GH250L	1
69-B	Lock Nut for Displacement Sensor	CS06900-GH250	GH250S AN08	1
70	Lock Washer	NG32-008	JIS B1554 AW08-A	1
73	O-ring	PC12-035	JIS B2401 G35 FKM-70	1
74	Unloader Cover	CS07400-TG250		1
75	O-ring	PC12-145	JIS B2401 G145 FKM-70	1
76	Hexagon Socket Head Cap Screw	NB35416-120	M16×120	S:9
76-1	Hexagon Socket Head Cap Screw	NB35416-150	M16×150	L:1
76-2	Hexagon Socket Head Cap Screw	NB35416-090	M16×90	L:4
91	Coupling Key	CS09100-GH250	GH250	1
92	Suction Flange	CS741A60-060	ANSI #600 6”	1
93	Suction Flange Gasket	CS747J60-RF060	V/#8596 JPI #600 RF 6"	1
94-B	Stud Bolt	NBU58010-08U	1-8UNC×135	12
94-N	Hexagon Nut	NCU1610-08	1-8UNC	12
95	Discharge Flange	CS741A60-060	ANSI #600 6”	1
96	Discharge Flange Gasket	CS747J60-RF060	V/#8596 JPI #600 RF 6"	1
97-B	Stud Bolt	NBU58010-08U	1-8UNC×135	12
97-N	Hexagon Nut	NCU1610-08	1-8UNC	12
100	Mechanical Shaft Seal Assembly	CS10000-GH250	GH250	1
101	Lock Nut	NG31-017	AN17	2
102	O-ring	PC12-080	JIS B2401 G80 FKM-70	1
120	Unloader Indicator Assembly	CS12000-GH250	Displacement sensor Assy	S:1
120	Unloader Indicator Assembly	CS12000-GH250L	Displacement sensor Assy	L:1
215-A	Cover Flange, Main Bearing Lubrication Port	CS741A60-004	ANSI #600 1/2”	1
215-B	Cover Flange, Side Bearing Lubrication Port	CS741A60-004	ANSI #600 1/2”	1
215-C	Cover Flange, Balance Piston M Lubrication Port	CS741A60-006	ANSI #600 RF 3/4”	1
215-D	Cover Flange, Balance Piston F Lubrication Port	CS741A60-004	ANSI #600 1/2”	1
215-E	Cover Flange, Mechanical Seal Lubrication Port	CS741A60-004	ANSI #600 1/2”	1
215-F	Cover Flange, Unloader Lubrication Port	CS741A60-004	ANSI #600 1/2”	2
216-A	Flange Gasket, 215-A	CS747J60-RF004	V/#8596 JPI #600 RF 1/2"	1
216-B	Flange Gasket, 215-B	CS747J60-RF004	V/#8596 JPI #600 RF 1/2"	1
216-C	Flange Gasket, 215-C	CS747J60-RF006	V/#8596 JPI #600 RF 3/4"	1
216-D	Flange Gasket, 215-D	CS747J60-RF004	V/#8596 JPI #600 RF 1/2"	1
216-E	Flange Gasket, 215-E	CS747J60-RF004	V/#8596 JPI #600 RF 1/2"	1
216-F	Flange Gasket, 215-F	CS747J60-RF004	V/#8596 JPI #600 RF 1/2"	2
217-AB	Stud Bolt	NBU58004-13U	1/2-13UNC×75	4
217-BB	Stud Bolt	NBU58004-13U	1/2-13UNC×75	4

No.	Part Name	Code No.	Remarks	Q'ty
217-CB	Stud Bolt	NBU58005-11U	5/8-11UNC×85	4
217-DB	Stud Bolt	NBU58004-13U	1/2-13UNC×75	4
217-EB	Stud Bolt	NBU58004-13U	1/2-13UNC×75	4
217-FB	Stud Bolt	NBU58004-13U	1/2-13UNC×75	8
217-AN	Hexagon Nut	NCU1604-13	1/2-13UNC	4
217-BN	Hexagon Nut	NCU1604-13	1/2-13UNC	4
217-CN	Hexagon Nut	NCU1505/8-11UNC	5/8-11UNC	4
217-AN	Hexagon Nut	NCU1604-13	1/2-13UNC	4
217-AN	Hexagon Nut	NCU1604-13	1/2-13UNC	4
217-AN	Hexagon Nut	NCU1604-13	1/2-13UNC	8
218	Cover Flange, Oil Injection Port	CS741A60-014	ANSI #600 1-1/2”	2
219	Gasket, Oil Injection Flange	CS747J60-RF014	V/#8596 JPI #600 RF1-1/2"	2
220-B	Stud Bolt	NBU58006-10U	3/4-10UNC×95	8
220-N	Hexagon Nut	NCU1606-10	3/4-10UNC	8
246	Unloader Slide Valve Guide	CS24600-GH250	GH250	1
247	Hexagon Socket Head Cap Screw	NB35408-030	M8×30	4
248	Conical Spring Washer	ND160-008H	M8 for Hex head cap screw	4
249	Parallel Pin with Internal Thread	NE242A10-040A	φ10×40 with groove	2
325-1	O-ring	PC11-050	JIS B2401 P50 FKM-70	2
325-2	Backup Ring	PG11T2-050	SUN-2BP-50-T2 PTFE	4
325-3	Wearing	CS1060-WEARING--GH250	WHR50 PTFE	1
326	O-ring Gland	CS32600-GH250		1
432	O-ring	PC12-140	JIS B2401 G140 FKM-70	8
456	Hexagon Socket Head Cap Screw	NB35408-020	M8×20	4
605	Plug	NF062-N008	NPT1”	3
662	O-ring	PC12-035	JIS B2401 G35 FKM-70	1
663	Hexagon Socket Head Cap Screw	NB35403-016	M3×16	4
697	Spring Washer	ND3200-03	M3	4

Note: The materials of the O-ring may change by use working fluid.

CAUTION

- **The code No. of the O-ring is the one assigned to FKM-70 which is standard material. When the material of the O-ring is other than FKM-70, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

Table 7-2 Parts Configuration Table of GH320S

No.	Part Name	Code No.	Remarks	Q'ty
1	Rotor Casing		GH320S	1
2-B	Stud Bolt		M30×162	48
2-N	Hexagon Nut		M30	48
3	Parallel Pin with Internal Thread		φ30×100 with groove	4
5	Suction Cover		GH320	1
6-1	O-ring			2
6-2	O-ring	PC11-056	JIS B2401 P56 FKM-70	2
7-1	Eyebolt for Suction Cover (alone) lifting	NB600-30	M30	2
7-2	Eyebolt for Compressor lifting	NB600-42	M42	2
9	O-ring	PC12-090	JIS B2401 G90 FKM-70	1
10-A	Plug	NF062-N004	NPT1/2”	4
10-B	Plug	NF062-N006	NPT3/4”	4
10-C	Plug	NF062-N008	NPT1”	2
10-D	Plug		NPT1-1/4”	1
10-E	Plug, Oil Amount Adjustment		NPT3/4” with φ6 hole	2
11	Bearing Head			1
13	Eyebolt for Compressor lifting	NB600-042	M42	2
14	Spring Pin	NE3208-016	φ8×16	6
15-A	Plug	NF062-N006	NPT3/4”	1
15-B	Plug		NPT1-1/4”	3
16	Bearing cover		GH320	1
17	O-ring			1
18-B	Stud Bolt		M24×145	24
18-N	Hexagon Nut	NC140-24H	M24,P=3 S45C-H	24
19	Parallel Pin with Internal Thread	NE242A20-100A	φ20×100 with groove	2
21	Plug	NF062-N006	NPT3/4”	4
22-M	Balance Piston Cover (M)		GH320	1
22-F	Balance Piston Cover (F)		GH320	1
23-M	O-ring	PC11-300	JIS B2401 P300 FKM-70	1
23-F	O-ring	PC12-210	JIS B2401 G210 FKM-70	1
24-MB	Stud Bolt		M20×120	10
24-MN	Hexagon Nut	NC140-20H	M20,P=3 S45C-H	10
24-FB	Stud Bolt		M16×95	8
24-FN	Hexagon Nut	NC140-16H	M16,P=3 S45C-H	8
25	Male Rotor	CS02511-G320SM	GH320S	1
26	Female Rotor	CS02511-G320SF		
27	Main Bearing	CS02700-GH320	GH320	4
28-1	Floating Seal	CS02800-GH320	GH320	2
28-2	O-ring	PC12-165	JIS B2401 G165 FKM-70	2
29	C Type Retaining Ring (Snap Ring)	NG11-190	H190 C type-internal	4
30-M1	Balance Piston (M-1)		φ285/φ240 choice	1
30-M2	Balance Piston (M-2)		GH320S	1
30-F	Balance Piston (F)		GH320S	1

No.	Part Name	Code No.	Remarks	Q'ty
31-M	Key, Balance Piston (M)	CS03100-GH320M		1
31-F	Key, Balance Piston (F)	CS03100-GH320F		1
32-M1	Lock Nut, Balance Piston	CS03200-GH320	GH320 special	1
32-M2	Lock Washer	NG32-019	JIS B1554 AW19A	1
32-F	Snap Ring (Retaining/Stop Ring)	NG12-065	S65 C type-external	1
33-M1	Balance Piston Sleeve (M-1)		φ285/φ240 choice	1
33-M2	Balance Piston Sleeve (M-2)	CS03300-GH320M2	GH320 M-2	1
33-F1	Balance Piston Sleeve (F-1)	CS03300-GH320F1	GH320 F-1	1
33-F2	Balance Piston Sleeve (F-2)	CS03000-GH320F2	GH320 F-2	1
34	Spring Pin	NE3208-016	φ8×16	5
35-M1	O-ring	PC11-300	JIS B2401 P300 FKM-70	1
35-M2	Backup Ring	PG11T2-300	SUN-2BP-300-T2	1
35-M3	O-ring	PC12-130	JIS B2401 G130 FKM-70	1
35-M4	O-ring	PC12-115	JIS B2401 G115 FKM-70	1
35-F1	O-ring	PC12-100	JIS B2401 G100 FKM-70	1
35-F2	O-ring	PC12-085	JIS B2401 G85 FKM-70	1
35-F3	O-ring	PC12-200	JIS B2401 G200 FKM-70	1
36-M	Gland, Balance Piston Sleeve (M)	CS03600-GH320M	GH320S M	1
36-F	Gland, Balance Piston Sleeve (F)	CS03600-GH320F	GH320S F	1
37-1	Hexagon Socket Head Cap Screw	NB35410-025	M10×25	10
37-2	Conical Spring Washer	ND160-010H	M10 for Hex head cap screw	10
37-3	C type Retaining Ring	NG11-220	H220 C type-internal	1
38-M	Thrust Bearing Assembly (M)	CS038T-H32M-ORI	TPTB	1
38-F	Thrust Bearing Assembly (F)	CS038T-H32F-ORI	TPTB	1
39-M	Lock Nut	NG31-023	AN23	2
39-F	Lock Nut	NG31-019	AN19	2
41-M	Spacer, Thrust Bearing Outer Race (M)	CS04100-GH320M	GH320 M	1
41-F	Spacer, Thrust Bearing Outer Race (F)	CS04100-GH320F	GH320 F	1
42-M	Spacer, Thrust Bearing Alignment (M)	CS04200-GH320M	GH320 M	1
42-F	Spacer, Thrust Bearing Alignment (F)	CS04200-GH320F	GH320 F	1
43-M	Gland, Thrust Bearing (M)	CS04300-GH320M	GH320 M	1
43-F	Gland, Thrust Bearing (F)	CS04300-GH320F	GH320 F	1
45-M	Hexagon Head Screw	NB111020-065	M20×65	6
45-F	Hexagon Head Screw	NB111016-060	M16×60	4
46-M	Conical Spring Washer	ND150-020H	M20 for Hex head screw	6
46-F	Conical Spring Washer	ND150-016H	M16 for Hex head screw	4
53-B	Stud Bolt		M16×105	8
53-N	Hexagon Nut		M16	8
54	Unloader Slide Valve (Vi choice)		Vi=E / L / M / H choice	1
58	Hexagon Socket Head Cap Screw	NB35416-065	M16×65	6
60	Unloader Cylinder		GH320S	1
63	O-ring	PC12-250	JIS B2401 G250 FKM-70	1
64-1	Unloader Piston	CS06400-GH320	GH320S	1
64-2	Gland, Unloader Piston O-ring	CS06400-GH320A	GH320S	1
65	O-ring	PC11-215	JIS B2401 P215 FKM-70	1

No.	Part Name	Code No.	Remarks	Q'ty
66	Cap Seal	CS06600-400	SUNR-BE-215	1
67	Unloader Push Rod	CS06700-GH320S	GH320S	1
69	Lock Nut for Unloader Piston	CS06900-GH320	GH320S Special	1
70	Lock Washer	NG32-010	JIS B1554 AW10-A	1
73	O-ring	PC11-050A	JIS B2401 P50A FKM-70	1
74	Unloader Cover		GH320S	1
75	O-ring	PC12-220	JIS B2401 G220 FKM-70	1
76-B	Stud Bolt		M20×180	7
76-N	Hexagon Nut		M16	7
91	Coupling Key	CS09100-GH320	GH320S special size	1
92	Suction Flange		ANSI #600 RF 10”	1
93	Suction Flange Gasket	CS747J60-RF100	V/#8596 JPI #600 RF 10"	2
94-B	Stud Bolt		1-1/4-7UNC×185	16
94-N	Hexagon Nut	NCU1511/4-7UNC	1-1/4-7UNC	16
95	Discharge Flange		ANSI #600 RF 10”	1
96	Discharge Flange Gasket	CS747J60-RF100	V/#8596 JPI #600 RF 10"	1
97-B	Stud Bolt		1-1/4-7UNC×185	16
97-N	Hexagon Nut	NCU1511/4-7UNC	1-1/4-7UNC	16
100	Mechanical Seal Assembly		GH320	1
111-1	Lock Nut	NG31-023	JIS B1554 AN23	2
111-2	Washer	CS11100-GH320S	Mechanical seal side	1
111-3	Rotation Stop Key		Mechanical seal side	1
112	O-ring	PC12-110	JIS B2401 G110 FKM-70	1
120	Unloader Indicator Assembly		Displacement sensor Assy	1
150-M	O-ring	PC12-290	JIS B2401 G290 FKM-70	1
150-F	O-ring	PC12-195	JIS B2401 G195 FKM-70	1
215-A	Cover Flange, Main Bearing Lubrication Port	CS741A60-100	ANSI #600 RF 1”	1
215-B	Cover Flange, Side Bearing Lubrication Port	CS741A60-100	ANSI #600 RF 1”	1
215-C	Cover Flange, Balance Piston M Lubrication Port	CS741A60-100	ANSI #600 RF 1”	1
215-D	Cover Flange, Balance Piston F Lubrication Port	CS741A60-006	ANSI #600 RF 3/4”	1
215-E	Cover Flange, Mechanical Seal Lubrication Port	CS741A60-100	ANSI #600 RF 1”	1
215-F	Cover Flange, Unloader Lubrication Port	CS741A60-006	ANSI #600 RF 3/4”	1
216-A	Flange Gasket, 215-A	CS747J60-RF100	V/#8596 JPI #600 RF 1"	1
216-B	Flange Gasket, 215-B	CS747J60-RF100	V/#8596 JPI #600 RF 1"	1
216-C	Flange Gasket, 215-C	CS747J60-RF100	V/#8596 JPI #600 RF 1"	1
216-D	Flange Gasket, 215-D	CS747J60-RF006	V/#8596 JPI #600 RF 3/4"	1
216-E	Flange Gasket, 215-E	CS747J60-RF100	V/#8596 JPI #600 RF 1"	1
216-F	Flange Gasket, 215-F	CS747J60-RF006	V/#8596 JPI #600 RF 3/4"	1
217-*B	Stud Bolt, 215-A to F Port		5/8-11UNC×86	28
217-*N	Hexagon Nut	NCU1505/8-11UNC	5/8-11UNC	28
218	Cover Flange, Oil Injection Port	CS741A60-014	ANSI #600 RF 1-1/2”	1
219	Flange Gasket, Oil Injection Port	CS747J60-RF014	V/#8596 JPI #600 1-1/2"	1

No.	Part Name	Code No.	Remarks	Q'ty
220-B	Stud Bolt		3/4-10UNC×105	4
220-N	Hexagon Nut	NCU1606-10	3/4-10UNC	4
246	Unloader Slide Valve Guide	CS24600-GH320S	GH320S	1
247	Hexagon Socket Head Cap Screw	NB35412-045	M12×45	4
248	Conical Spring Washer	ND160-012H	M12 type for Cap screw	4
249	Parallel Pin with Internal Thread	NE242A13-040A	φ13×40 with groove	2
250-M	Thrust Washer M	CS25000-GH320M	TPTB side	1
250-F	Thrust Washer F	CS25000-GH320F	TPTB side	1
325-1	O-ring	PC11-070	JIS B2401 P70 FKM-70	2
325-2	Backup Ring	PG11T2-070	SUN-2BP-70-T2	4
326	O-ring Gland	CS32600-GH320	GH320S	1
346	Rotation Stop Key	CS34600-GH320	TPTB side for M and F	2
432	O-ring	PC12-170	JIS B2401 G170 FKM-70	8
456	Hexagon Socket Head Cap Screw	NB35410-025	M10×25	4
458-A	Plug	NF062-N006	NPT 3/4”	2
458-B	Plug	NF062-N008	NPT 1”	1
458-C	Plug		NPT1-1/4”	1
535	Cover Flange, Drain Connect Port	CS741A60-006	ANSI #600 RF 3/4”	2
536	Flange Gasket, 535	CS747J60-RF006	V/#8596 JPI #600 RF 3/4"	2
538	Cover Flange, TPTB Lubrication Port	CS741A60-100	ANSI #600 RF 1”	1
539	Flange Gasket, 538	CS747J60-RF100	V/#8596 JPI #600 RF 1"	1
540-B	Stud Bolt, TPTB Lubrication Port		5/8-11UNC×86	4
540-N	Hexagon Nut, 540-B	NCU1505/8-11UNC	5/8-11UNC	4
542-B	Stud Bolt, Drain Connect Port		5/8-11UNC×86	8
542-N	Hexagon Nut, 542-B	NCU1505/8-11UNC	5/8-11UNC	8
581	Plug, Balance Piston F Lubrication Line		NPT 3/8” with φ2 hole	1
605	Plug	NF062-N008	NPT1-1/2”	2
662	O-ring	PC12-035	JIS B2401 G35 FKM-70	1
663	Hexagon Socket Head Cap Screw	NB35403-016	M3×16	4
697	Spring Washer	ND3200-03	M3	4

Note: The materials of the O-ring may change by use working fluid.

CAUTION

- **The code No. of the O-ring is the one assigned to FKM-70 which is standard material. When the material of the O-ring is other than FKM-70, a different part code is used for each material.**
  If you are using O-rings made from other than the standard material, please contact MAYEKAWA when placing an order.

7.3 Tightening Torque for Bolts and Nuts

Table 7-3 List of Tightening Torques for GH250S/L

Item No.	Tightening point	Torque (N·m)	Qty.	Size
Stud Bolt and Nut				
2-B, 2-N	Rotor Casing for GH250S	190	54	M24 × 115
2-B, 2-N	Rotor Casing for GH250L	190	54	M24 × 205
18-B, 18-N	Bearing Cover	190	21	M24 × 205
Hexagon Socket Head Cap Screw for Covers				
24	Balance Piston Cover M and F	110	15	M16 × 70
53	Seal Cover	110	7	M16 × 70
61	Unloader Cylinder forGH250L	110	5	M16 × 100
76	Unloader Cover for GH250S	110	9	M16 × 120
76-1	Unloader Cover for GH250L	110	1	M16 × 150
76-2	Unloader Cover for GH250L	110	4	M16 × 90
Hexagon Socket Head Cap Screw for Compressor internal				
34-3	Floating Seal (B) Gland	35	4	M8 × 20
45-F	Thrust Bearing Gland (F)	50	4	M12 × 45
53	Mechanical Seal	110	7	M16 × 70
58	Push Rod, Unloader Slide Valve	110	5	M16 × 65
247	Unloader Slide Valve Guide	35	4	M8 × 30
456	O-ring Gland	35	4	M8 × 20
663	Magnet for Indicator Sensor	1.2	4	M3 × 16
Hexagon Head Screw				
45-M	Thrust Bearing Gland (F)	60	4	M16×60
Lock Nut * See next Section 7.4				
32-1	Balance Piston (M)	230	1	AN10
39-M1	Thrust Bearing (M), Machine internal side	805	1	AN15
39-M2	Thrust Bearing (M), Air side	645	1	AN15 special
39-F	Thrust Bearing (F), Machine internal side	645	1	AN14
39-F	Thrust Bearing (F), Air side	515	1	AN14
69-B	Unloader Piston (Displacement Sensor)	140	1	AN08
101	Mechanical Seal, Machine internal side	1000	1	AN17
101	Mechanical Seal, Air side	800	1	AN17

Table 7-4 List of Tightening Torques for GH320S

Item No.	Tightening point	Torque (N·m)	Qty.	Size
Stud Bolt and Nut				
2-B, 2-N	Rotor Casing	1150	48	M30 × 162
18-B, 18-N	Bearing Cover	550	24	M24 × 145
24-MB, 24-MN	Balance Piston Cover (M)	350	10	M20 × 120
24-FB, 24-FN	Balance Piston Cover (F)	170	8	M16 × 95
53B, 53-N	Seal Cover	170	8	M16 × 105
76B, 76-N	Unloader Cover	350	7	M20 × 180
Hexagon Socket Head Cap Screw for Compressor internal				
37-1	Balance Piston Sleeve (M-2)	50	10	M10 × 25
58	Push Rod, Unloader Slide Valve	240	6	M16 × 65
247	Unloader Slide Valve Guide	90	4	M12 × 45
456	O-ring Gland	50	4	M10 × 25
663	Magnet for Indicator Sensor	1.2	4	M3 × 16
Hexagon Head Screw				
45-M	Thrust Bearing Gland (M)	120	6	M20×65
45-F	Thrust Bearing Gland (F)	60	4	M16×60
Lock Nut * See next Section 7.4				
32-M1	Balance Piston (M)	1980	1	AN19
39-M	Thrust Bearing (M), Machine internal side	3500	1	AN23
39-M	Thrust Bearing (M), Air side	3500	1	AN23
39-F	Thrust Bearing (F), Machine internal side	1980	1	AN19
39-F	Thrust Bearing (F), Air side	1980	1	AN19
69	Unloader Piston (Displacement Sensor)	290	1	AN10
111-1	Mechanical Seal, Machine internal side	3500	1	AN23
111-1	Mechanical Seal, Air side	3500	1	AN23

7.4 Tightening Angle Range of Lock Nuts for Rotors

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.

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 7-8.
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 7-5. When measuring the angle, use an angle gauge which is set to the diameter of rotor shaft.

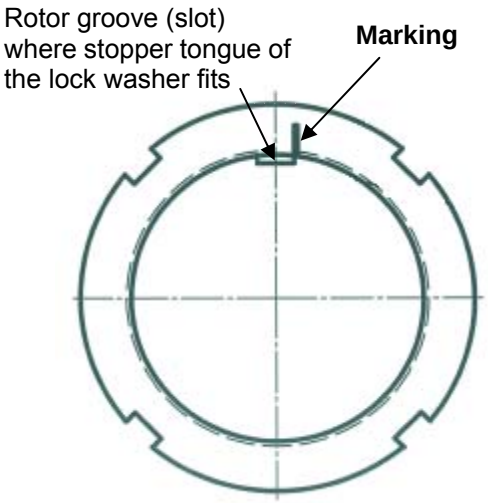

Figure 7-8 Position where mark is put

Table 7-5 Tightening Angles Specified for Lock Nuts of Rotor

	Model	Angle range
First time tightening	GH250S/L	25° to 35°
	GH320S	25° to 35°
Second time tightening	GH250S/L	15° to 25°
	GH320S	15° to 25°

* 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.

MAYEKAWA MFG. CO., LTD.
3-4-15 Botan Koto-ku, Tokyo 135-8482, JAPAN
TEL: (81) -3-3642-8181 FAX: (81) -3-3643-7094
http://www.mayekawa.com/