

COMPRESSOR UNIT

Instruction Manual

C10

Export Control Policy

Vacuum pumps that pump nitrogen gas at pumping speed of 15000L/s or more fall under row 2(35) of appended table 1 of Japan's Export Trade Control Order, which is based on international export control regimes. Customers must follow all related rules and regulations such as Foreign Exchange and Foreign Trade Act and take appropriate procedures when exporting or re-exporting those products.

Introduction

Thank you for choosing our products. This instruction manual provides information and precautions on handling, installation, operation, and maintenance of the product.

To ensure proper use of the product, read this instruction manual carefully and keep this manual close at hand so that you can use for reference during operation.

If you have purchased other devices from us, read relevant instruction manuals carefully as well.

1. About the personnel who are involved in handling our products

All personnel involved in handling our products should take general safety training which is officially accepted in the country or region where the product is used. Such personnel are also required to have specialized knowledge, skills or qualifications on electricity, machinery, cargo handling or vacuum. Especially, the personnel should be familiar with handling a cryopump in order to use it safely. We offer training program (paid service) as needed for the customers who are not familiar with the use of cryopumps. Please contact us to join the program.

2. Warranty

2.1 Gratis warranty period and Warranty coverage

【Gratis warranty period】

The period of less than one year after installation in your company or your customer's premises, or a period of less than 18 months (starting from the shipment date) after shipment from ULVAC CRYOGENICS INCORPORATED (hereinafter "UCI"), which is shorter, is selected.

【Coverage】

(1) Failure diagnosis

As a general rule, first diagnosis of failure should be done on site by customer.

However, UCI or our service network can perform this service for an agreed fee upon the customer's request. There will be no charge if the cause of the breakdown is attributed to UCI.

(2) Damage during transportation

When damage by transportation is observed at the time of delivery, the product will be repaired without charge based on the scope of the guarantee expressed in the sales contract.

(3) Breakdown repairs

The cost of repairs, replacements and on-site visits for the failures caused by the reasons as follows shall be borne by the customer regardless the product is within the warranty period.

- ① Inappropriate storage or handling, careless accident, software or hardware design by the customer.
- ② Modifications of the product without consent of UCI.
- ③ Performing maintenance of the product using parts or components which are not approved by UCI, or using the product outside the conditions specified for the product.
- ④ Contamination or corrosion occurred during the use by the customer or customer's customer.
- ⑤ Fire, earthquake, flood, lightning or other natural disasters, environmental pollution, salt damage, hazardous gases, irregular voltage, and/or usage of power source other than specified by UCI.
- ⑥ Other reasons which are regarded to be outside the scope of warranty.
- ⑦ Consumables and/or replacement service.

Since the above services are limited inside Japan, diagnosis of failures, etc may not be performed outside of Japan. If you desire the after sale service abroad, please contact ULVAC CRYOGENICS and consult us for details in advance.

2.2 Exclusion of opportunity loss from warranty liability

Regardless of the gratis warranty term, compensation to opportunity losses incurred to your company or your customers by failures of ULVAC CRYOGENICS products and compensation for damages to products other than ULVAC CRYOGENICS products and other services are not covered under warranty.

2.3 Repair period after production is discontinued

ULVAC CRYOGENICS accepts product repairs for seven years after production of the product is discontinued.

3. Service Form

After the products are delivered, please fill out the following information in the blanks. In the event of a fault, please contact us. Refer to SERVICE NETWORK at the end of this book, or visit our web site at www.ulvac-cryo.com to locate our business base close by.

Cryopump/Super Trap Model	:	_____
Cryopump/Super Trap Serial No.	:	_____
Refrigerator Model	:	_____
Refrigerator Serial No.	:	_____
Compressor Model	:	_____
Compressor Serial No.	:	_____
Temperature controller/Thermal display Model	:	_____
Temperature controller/Thermal display Serial No.	:	_____
Optional Part Model	:	_____
Optional Part Serial No.	:	_____

4. Notes for repair and maintenance requests

We cannot accept your request for repair or maintenance of our products if you refuse to give us information about the presence of the hazardous substance and/or contaminant.

Also, please be aware that we do not accept liability for damages by the contaminant, which might be caused during transportation to our office or the nearest customer support center. To avoid such accident, please pay careful attention to packing of the product

5. In case of breakdown and accident

When breakdown or accident occurs, we may ask for keeping the product on site as it is, or sending it back to us to investigate the cause. In addition, you may be asked to provide information on how it progressed in a specific manner or on the

operating condition. When unidentified failure occurs, please contact our Service Engineering Division or the nearest customer support center. Refer to the SERVICE NETWORK at the end of this book or visit our website at www.ulvac-cryo.com for our contact information.

6. General Precautions

- (1) It is prohibited to duplicate or reprint this instruction manual or any of its parts, disclose or transfer to a third party without written permission from ULVAC CRYOGENICS.
- (2) Information in this document is subject to change without notice along with the specification change or the improvement of the product.
- (3) If you have any questions or comments on this document, please contact us.

Safety Icons and Texts

Our products have been designed to provide extremely safe and dependable operation when properly used. Following safety icons indicate cautions, warnings or danger that must be observed during normal operation and when servicing them.



WARNING

A warning describes safety hazards or unsafe practices which could result in severe injury or loss of life.



CAUTION

A caution describes safety hazards or unsafe practices which could result in personal injury or equipment damage.



Toxic gas or chemicals used.

There is a risk of severe injury upon contact.



Corrosive chemicals used.

There is a risk of severe injury upon contact.



Flammable gas used.

There is a danger of fire or burn injury.



Explosive gas used.

There is a risk of fire or explosion.



Hazardous voltage.

Electric shock may cause severe injury or loss of life.



Hot heating part present.

There is a risk of burn injury.

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Compressor Unit Safety Instructions

Read this manual and follow these safety guidelines before installing, operating, or servicing the compressor unit.

1. Do not overfill helium gas



Our cryopump and Super Trap refrigerator systems make a refrigeration cycle by circulating high pressure helium gas. Filling helium gas of more than appropriate amount does not improve refrigeration capacity appreciably. Instead, if too much helium gas is added and helium pressure becomes higher than appropriate, helium will blow out from the pressure relief valve, which can be a cause of helium leak by dust being stuck in the sheet. This may even overload the compressor motor.

Never charge helium gas more than specified in this book.

2. Adding helium gas and charging equipment

When charging helium gas or performing helium line decontamination, refer to the "Maintenance" section and follow the instruction.

Use regulators, charging hoses, or adopters that can be used at the pressure of 2.0MPaG or higher when performing the above work.

3. Do not startup/shutdown frequently

Do not startup/shutdown the compressor unit frequently.

The number of startup and shutdown of the compressor motor must be less than 6 times per hour and ON or OFF condition must be maintained for at least 3 minutes. Frequent startup and shutdown may shorten the insulation life of a compressor motor and may lead to failure.

Do not use startup and shutdown of a compressor unit to control the temperature of the Super Trap.

Please contact us when controlling the temperature of super trap is required.

4. Disposal of used adsorber



Ensure to discharge helium gas and remove either side of the self-sealing couplings from used adsorber before disposing.

When the refrigerator system is not in operation, the helium gas pressure inside the adsorber is as high as the fill pressure of the compressor. Disposing the adsorber with helium gas inside may cause accidents. For example, if the adsorber was thrown in a burner reactor without discharging helium gas by mistake, the inside pressure of the adsorber would rise as the inside temperature rises and it may explode. If the adsorber was pressed with helium gas remaining inside, it may also cause explosion. Refer to “Disposal Considerations” for more information.

Use appropriate charging adaptor to remove helium gas safely.

5. Electrical wiring connections



- Power supply voltage must be kept within the allowable range(refer to “Section 1 Table1-1 Compressor Unit Standard Specifications” . Applying more than the allowed voltage may damage the equipment.
- Install a ground-fault circuit interrupter (rated current: 10A, rated tripping leakage current:30mA 3 ϕ , rated voltage: 200V).
- Grounding conductor (earth wire) must be connected (D class grounding (with the ground resistance of 100 Ω)).
- Connect the refrigerator cable and remote cables (signal lines) to the compressor before connecting the compressor to the power supply. Do not attempt to make these wiring connections while power is supplied to the compressor unit. It could lead to a serious accident such as electric shock and/or damage to the equipment.
- Use wires and cables of recommended sizes.
- The distance between power line and signal line must be larger than 100mm.

6. Cooling water

Water leak may invite electric shock. Ensure there is no water leak from the cooling water piping. If water pressure is too high, water may leak from the cooling water line inside the compressor unit. Adjust and control the cooling water supply pressure to maintain an allowable upper limit (lower than 0.7MpG).

If water stain or some products accumulate in the water line inside the heat exchanger, heat exchange effectiveness will be significantly reduced, resulting in helium temperature rise and shutdown of compressor unit.

We follow the cooling water quality management standard of the Japan Refrigeration and Air Conditioning Industry Association as a standard value of water quality for compressor units. Refer to "Section 3 Table 3-1 Recommended Cooling Water for Compressor".

7. Compressor unit ambient conditions

The upper limit of the ambient temperature for compressor operation is 38°C. Do not use the compressor in inappropriate conditions such as dusty, highly humid environments and/or places that are affected by strong electromagnetic waves. Keep electric terminals free from dust to avoid electrical leakage and/or a short circuit.

8. Maintenance precautions



1. Installation and maintenance of the product must be done by personnel in charge of the equipment or servicing who are familiar with the product structure and risk associated with the operation of the compressor.
2. Input power supply must be disconnected before opening the cover of the compressor to avoid the risk of electrical shock.
3. Also, some parts inside the compressor unit are still hot immediately after shutdown. Wait at least 15 minutes before opening the cover to avoid the risk of burn injury

9. Contact us immediately when the self-sealing coupling is loosened.

When working with a self-sealing coupling, the connection may be accidentally loosened or loosened by co-rotation. In such cases, the refrigerator may encounter faults due to helium leakage or air invasion, resulting in serious failure such as abnormal noise or refrigerator motor malfunction.

At the time of shipment of our products, we conduct the inspection to ensure the connection of self-sealing coupling is appropriate and paste a sealing sticker. The sealing stickers are added to our refrigerators, compressor units, flexible hoses, branch pipes and straight pipe units.

Contact us when the self-sealing coupling is loosened or removed by accident. Servicing for trouble is out of warranty if it occurs while the sealing sticker is not in the original state. The sealing sticker is located inside the panel of the compressor unit.

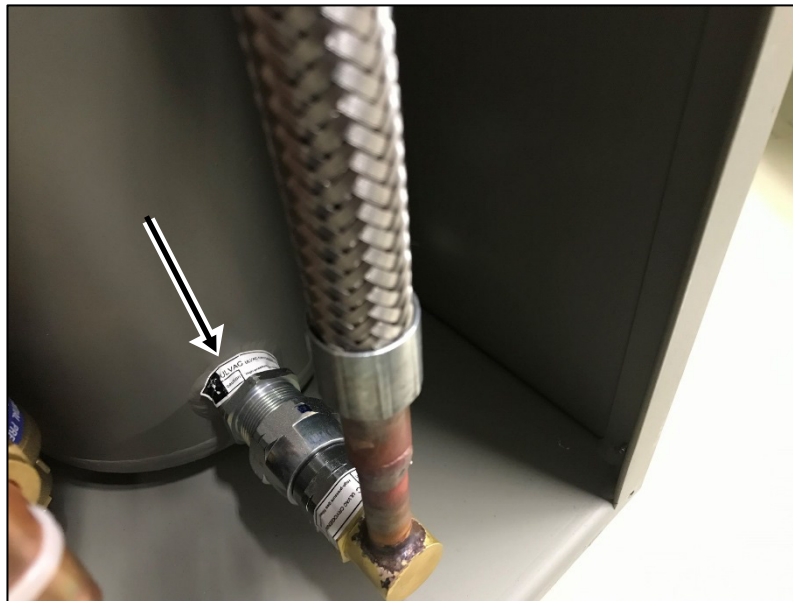








Figure Example of the sealing sticker pasted on the self-sealing coupling

Disposal Considerations

Disposal of our products must be done in accordance with applicable national and local laws and regulations.

				WARNING
<p>The cryopumps or cryocoolers may contain residue of hazardous substances resulting from actual use. Contact your safety supervisor and follow the instructions to remove such toxic substances before disposing</p>				

		WARNING
<p>Do not disassemble, pressurize, heat up a compressor unit, or throw it into fire. Such actions may lead to explosion of the adsorber inside the compressor unit. For safe disposal of an adsorber, follow the procedures below.</p> <ol style="list-style-type: none">(1) Remove high pressure helium gas inside the adsorber to reduce the internal pressure to the level of ambient atmospheric pressure. To do so safely, use tools appropriate to the adsorber coupling such as our charging adaptor (for cryocooler maintenance).(2) Remove the coupling to make it visible that the adsorber has been depressurized before proceeding to the next step.		

We provide Safety Data Sheet (called SDS) of our products upon your request.

Please contact us if necessary.

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1. COMPRESSOR UNIT DESCRIPTION

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1.1. General

The compressor unit circulates helium continuously in the cryopump system by compressing helium returned from the refrigerator unit (cold head) and supplying high-pressure helium to the refrigerator unit. This compressor unit consists of: 1) a compressor, 2) a cooling system, 3) an oil separation system and 4) an adsorber.

See Table 1-1 for the compressor unit specifications.

1.2. Specifications

Table 1-1 C10 Compressor Unit Standard Specifications

Power Source	Volts×Phase×Hz	AC190 - 220V × 3 φ × 50Hz AC190 - 230V × 3 φ × 60Hz
	Power (in normal operation) (*1)	1.5kW / 1.7kW(50Hz/60Hz)
	Nominal Operating Current (*1)	5A / 6A(50Hz/60Hz)
Cooling Type		Water cooled
Cooling Water Requirement (See Fig.3-2)		Temperature : 5 - 32°C Flow Rate : 1 - 5L/min Pressure Drop : 0.01 - 0.072MPa
Ambient Temperature		10 - 38°C
Compressor Winding Resistance		3.04Ω
Adsorber Periodic Replacement		Every 24,000 hours.
Weight		75kg
Cooling Water Inlet/Outlet		Rc3/8 female
Helium SUPPLY/RETURN Connector		1/2B self-sealing coupling

(*1) Input power and current will be larger by 10% at the time of startup.

The power and current above are the standard when the compressor unit runs with flexible hoses of 3meters long. The maximum length of flexible hoses is 20 meters. When 20 meters flexible hoses are used, the power and current will be larger by around 6%.

◆ Helium Gas Pressure: (Ambient temperature : 20°C)

Static Helium Charge Pressure (*2) (When flexible hoses are connected)	1.73±0.04 MPa(gage)
Operating Pressure (*3)	1.8 - 2.0 MPa(gage)

(*2) The values are applicable when the compressor runs with flexible hoses up to 20meters long are connected. The charge pressure will differ when flexible hoses longer than 20 meters are used. Contact us for the detail.



CAUTION

When you use a flexible hose with length of 10m to 20m, chose the hose dedicated to C10. If a standard hose of the same length is used, helium charge pressure will be lower than required, inviting the need for charging helium gas.

(*3) Operating pressure is expected when a flexible hose of 3m are used. The operating pressure will be larger by 10% with a hose of 20m.

◆ Combination of Cryopump and Compressor

The table below shows the number of cryopumps that can be operated with one C10 compressor unit.

		C10
Cryopump	U6H	1
	U8H/U8H-U/U8HSP/U8HL	1
	TORR-8	1
Refrigerator	R10/R10R/RM10	1
Super Trap	6 inches	1
	8 inches	1

◆ Connector Specifications (Cable Side)

CONNECTOR	MANUFACTURER	TYPE
INPUT POWER	NANABOSHI	NCS-304-P
COLD HEAD POWER	NANABOSHI	NCS-254-PM
REMOTE/RESPONSE CONNECTOR	JAE Japan Aviation Electronics Industry, Limited	SRCN6A25-16P

◆Dimensions

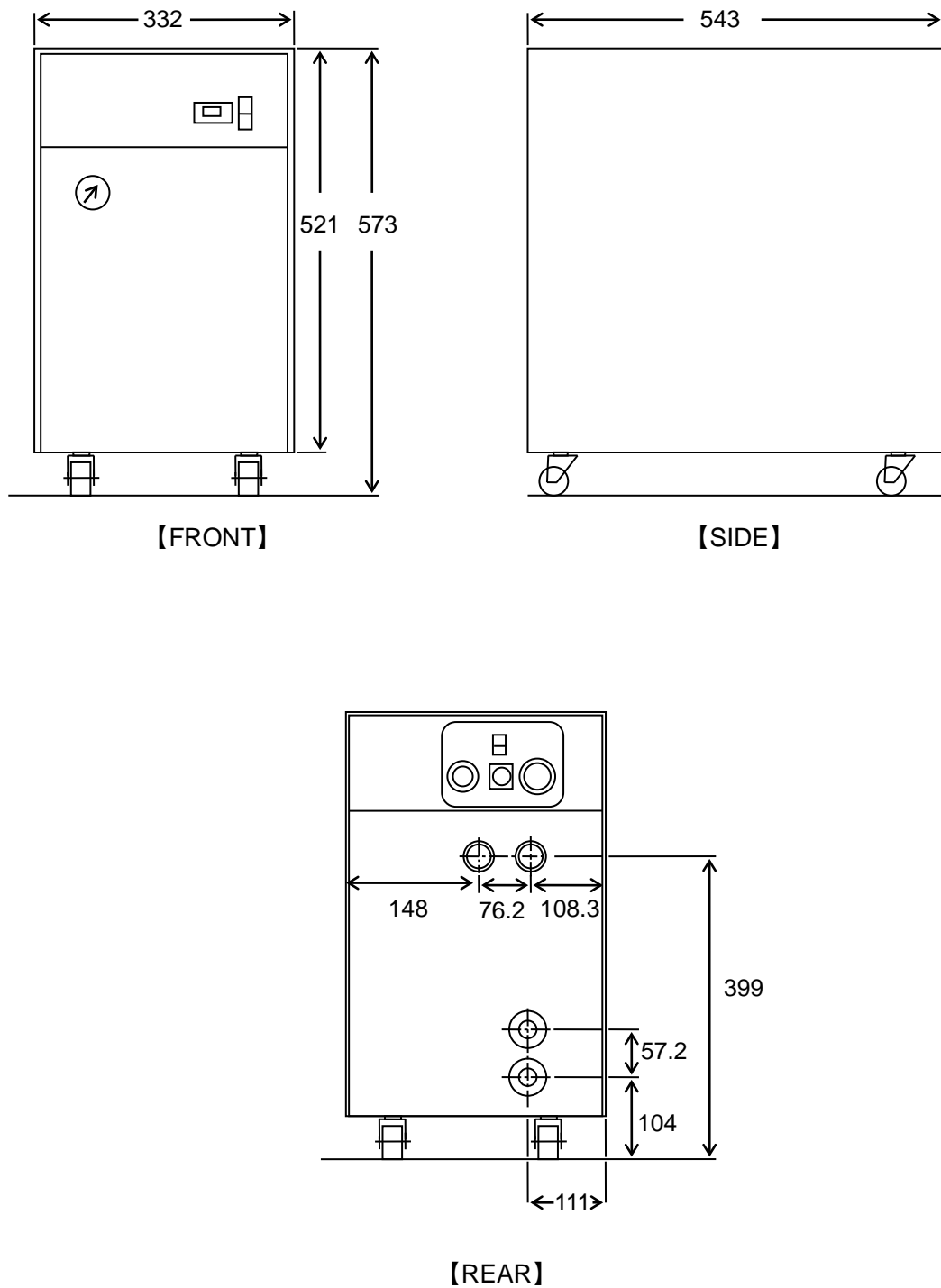
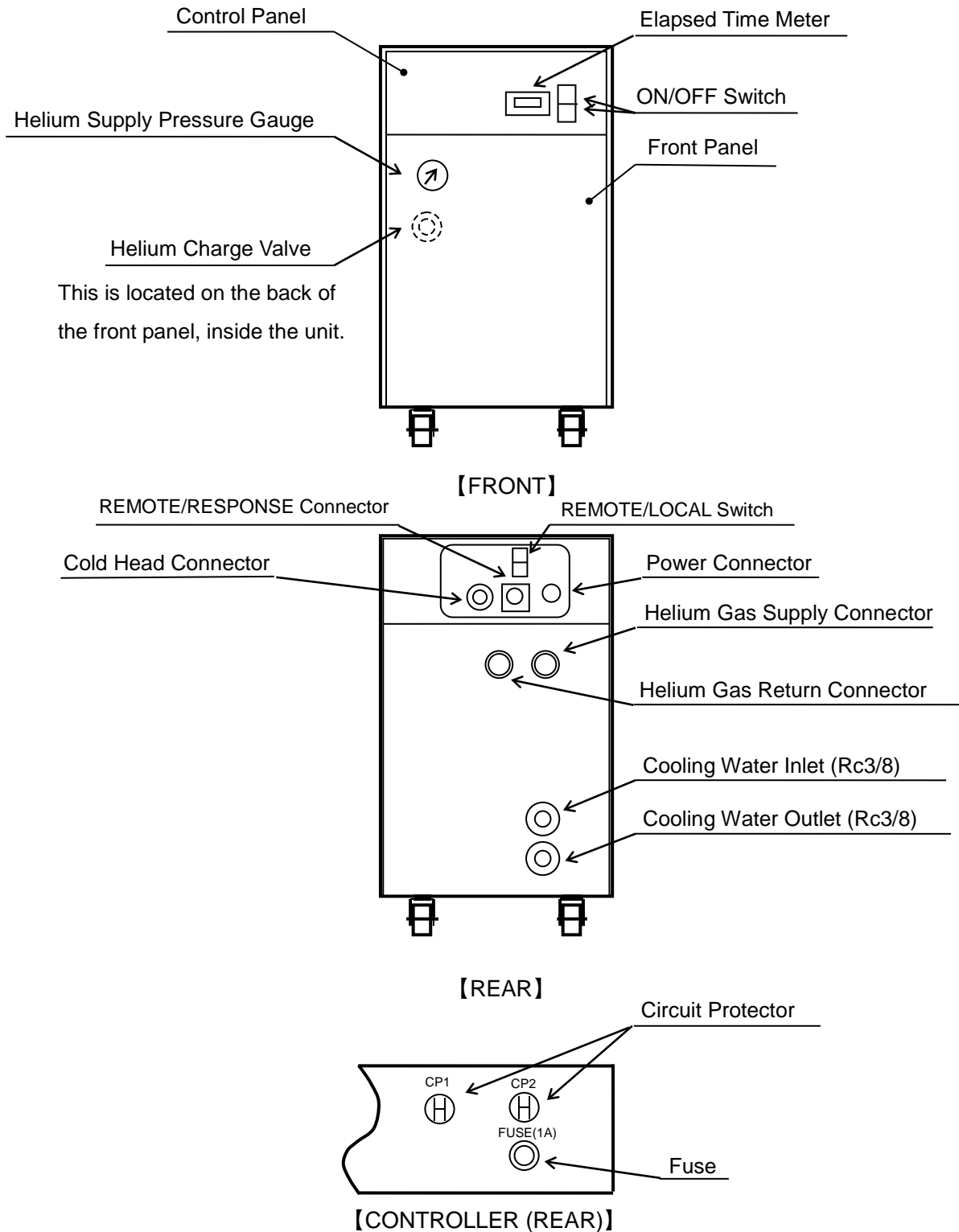


Figure1-1 Dimensions



* When using controller switch, remove the control panel at the rear of the compressor unit.

Figure 1-2 Major Components

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2.1. Shipping List

When a product(s) delivered, make sure that there is no damage or shortage of delivered items by checking the external view of the package and the shipping list attached.

Please read the enclosed cover letter for the details. Depending on your specification, the optional part(s) in Table 2-2 is attached.

Table 2-1 Shipping List

Item	Quantity
Compressor Unit	1
This Instruction Manual	1
Fuse(250V,1A)	1
Metal Connector (External signal, Remote)(*1)	1

(*1)We provide a compatible cable as optional for C10 compressor previous model which has been sold until February 1999.

Table 2-2 Optional Parts

Item	Quantity
Input Power Cable (1.25mm ² ×4cores×3m or customized length)	1
Refrigerator power cable (0.5mm ² ×4cores×3m or customized length)	1
Flexible Hose (3m or customized length)	2
Lipped Bowl Spanner (For connecting flexible hoses)	2
Gasket for Helium Coupling (Spare)	4

2.2. The Compressor Unit

Check the helium gas pressure gauge. The gauge should read 1.82MPa to 1.86MPa(gage) at the room temperature (20°C) before connecting flexible hoses. (Helium is charged at high static pressure in consideration of the pressure drop while connecting flexible hoses.)

The helium static pressure may fluctuate due to the ambient temperature.

When the ambient temperature is 20°C and the pressure is below 1.82MPa(gage), charge helium in accordance with instructions in the section 5.3.

Please contact us if the pressure drops even after charging helium gas.

2.3. The Connecting Piping (Flexible Hose)



CAUTION

- Do not forcibly bend the flexible hose at a sharp angle (the minimum allowable bending radius is 250mm) . Failure to observe this precaution may result in damage to the flexible hose.
- Do not twist connecting part of the flexible hose.
- Refer to Appendix C for more information on handling of the flexible hoses.

Inspect the outside of the flexible hose for a twist or breaks.

When the flexible hoses are stored, put the dust cap and the plug on the self-sealing coupling as they were shipped.

2.4. The Cables

Check the cables for damage.

If there is any shortage or damage, please contact our service engineering department or the nearest customer support center.

3. INSTALLATION

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3.1. Installation

1. Place the compressor unit on a level floor within 5°.
2. The compressor unit must be operated in proper room temperature (10°C~38°C).
Avoid dust and moist.
3. Leave the spaces as shown in Figure 3-1 to make the following maintenance processes easier;
 - Pressure gauge inspection.
 - Gas charge valve operation.
 - Adsorber replacement.

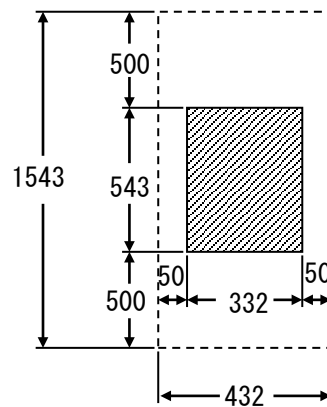


Figure 3-1 Maintenance Space(Unit: mm)

3.2. Connecting Cooling Water Piping

Install the cooling water piping as follows:

1. Cooling water inlet/outlet connectors are Rc3/8 female.
2. Water pipes can be vinyl hoses or copper pipes as long as the withstanding pressure of those is 1.5 times higher than cooling water supply pressure.
3. It is recommended to install a filter in the water line between the cooling water main valve and the compressor unit to prevent water scales. It is also recommended to install a flow meter (approx.0~10L/min.) between the filter and the compressor unit to check the flow rate.
4. Ensure to connect inlet/outlet to the right place. Do not connect them the wrong way around.



CAUTION

Check water connections for leaks.

3.3. Cooling Water

1. Determine the cooling water flow rate within the allowable range as shown in Fig. 3-2. Always use the proper cooling water that meets the requirement. Keep the cooling water supply pressure less than 0.7MPaG.



CAUTION

- If the temperature of cooling water is below 5°C, it can cause overloading or a difficulty in starting the compressor.
- If the temperature of cooling water is higher than 32°C, the thermal switch will be activated due to the overheat and turn off the compressor.
- Excessive flow rate shorten the lifetime of heat exchanger.

2. For the standard quality of cooling water, we refer to the water quality control standard set by The Japan Refrigeration and Air Conditioning Industry Association.



CAUTION

- Usage of poor quality water causes performance degradation of heat exchanger.
- If the water quality does not satisfy the requirement, it shortens the lifetime of the heat exchanger.

Table 3-1 Recommended Cooling Water for Compressor

Item	Unit	Allowable Range
pH (25°C) ^{※1}	pH	6.5 - 8.0
Conductivity (25°C) ^{※1}	mS/m	< 30
Chloride Ion, Cl ⁻ ^{※1}	mg / L	< 50
Sulfate Ion, SO ₄ ²⁻ ^{※1}	mg SO ₄ ²⁻ / L	< 50
Acid Consumption (pH4.8) ^{※1}	mgCaCO ₃ / L	< 50
Total Hardness ^{※1}	mgCaCO ₃ / L	< 50
Total Carbonic Acid ^{※1}	mg / L	< 10
Calcium Carbonate	mg / L	< 75
※1 The values of the items are based on the water quality management standards of Japan Refrigeration and Air Conditioning Industry Association.		

(*) The ground water may contain large amount of total carbonic acid and lower the pH value excessively. Therefore, if the ground water is used in the transient style, accidents may occur by corrosion even in a short-term use of the heat exchanger. Ensure that the density of carbonic acid is less 10mg/L. Since the dissolved ratio of total carbonic acid depends on the temperature and the pressure, analyze the ground water immediately after take it in without exposing to the atmosphere. Check the water supply whether it is the ground water or not before use. It is highly recommended to use cooling tower to circulate the water containing a large amount of carbonic acid.

3. The cooling water should be stopped when the compressor is not running or it may cause corrosion or clogged pipe and damage the heat exchanger.



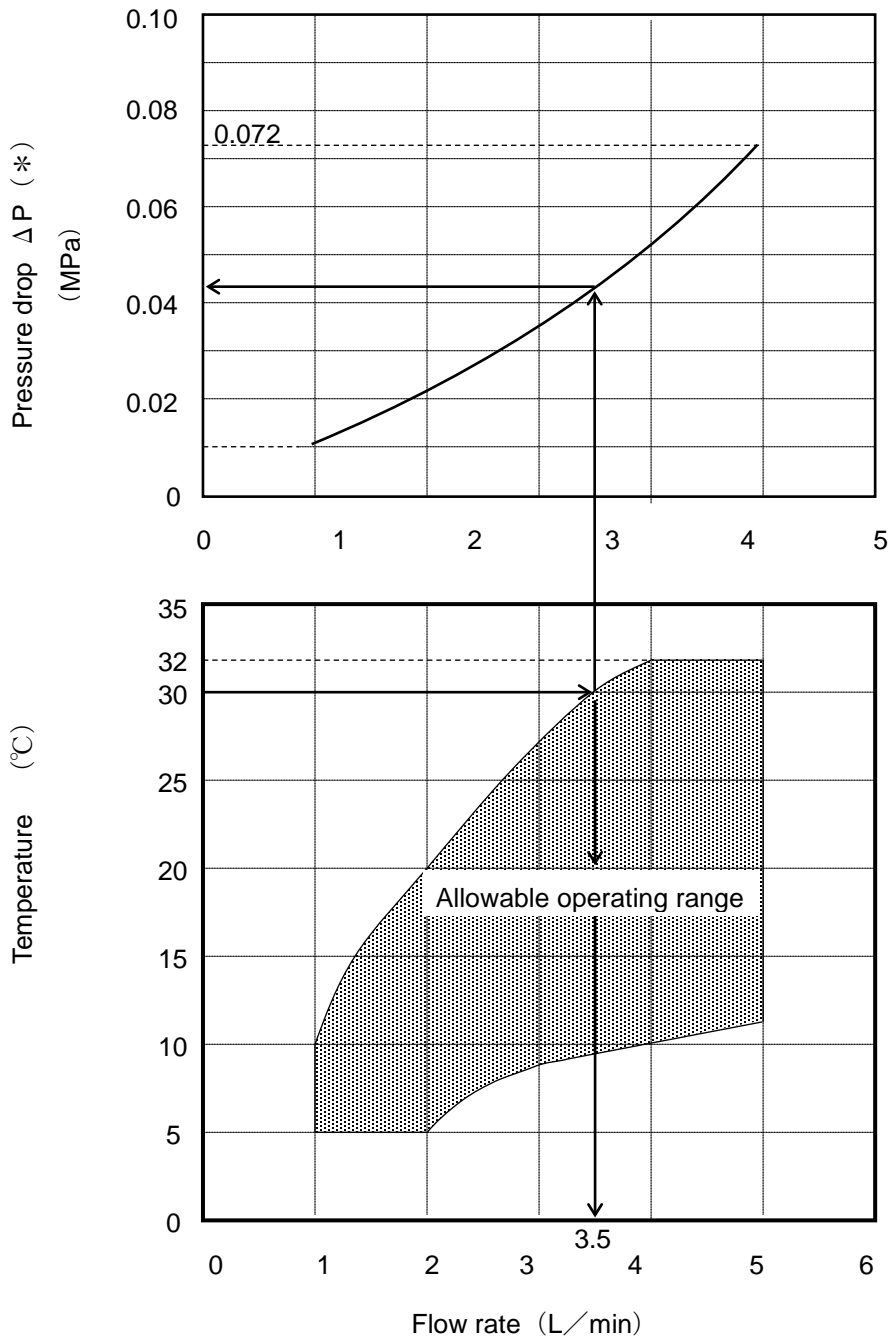
CAUTION

If cooling water below 10°C keeps flowing while the compressor is not in operation, over heat and starting difficulty may occur due to the viscosity rise of the compressor oil.

The cooling water must be drained and purged from the compressor unit when:

- There is a possibility that the cooling water might freeze when the compressor unit is not running. The water pipe can burst.
- The compressor unit will not be turned on for a long time (more than a week).
- Shipping the compressor unit.

Most of the cooling water can be purged from the compressor by blowing air into the compressor for 30 seconds at inlet pressure of 0.2MPaG with the outlet opened.



(*) The water pressure drop (ΔP) means differential pressure between cooling water inlet pressure and outlet pressure.

EXAMPLE

A dashed arrow (\rightarrow) in the graph shows the minimum required water flow rate (3.5L/min.) and water pressure drop (0.04MPa) when the temperature of the water is 30°C.

Figure 3-2 Cooling Water Requirement

3.4. Connecting the Compressor Unit to the Cryopump



CAUTION

- Read the handling notes in appendix C about the connection of the flexible hoses.
- When connecting flexible hoses, always use two single open end spanners with width across flat 26mm and 30mm.
- Do not forcibly bend flexible hoses. They may be damaged and cause helium leakage.
- Do not connect or disconnect self-sealing coupling frequently. It may cause gas leakage.

If there is a leakage, you may have to replace it with a new one according to the situation of the occurrence of leakage.

1. Remove all dust plugs and caps from the supply and return flexible hoses, compressor and cryopump. Clean the self-sealing coupling flat rubber gasket to be free from dust and metallic powder.
2. Connect the flexible hose from the compressor unit to the cryopump (See Figure 3-3).
 - a. Connect the helium gas supply flexible hose to the helium gas supply connector on the compressor. Connect the helium gas return flexible hose to the helium gas return connector on the compressor.
 - b. Connect the helium gas supply flexible hose to the helium gas supply connector on the cryopump. Connect the helium gas return flexible hose to the helium gas return connector on the cryopump.
3. Check the helium gas pressure gauge for proper helium pressure. The standard helium charge pressure is $1.73 \pm 0.04 \text{MPaG}$ at 20°C . See Figure 3-4. If the indicated pressure is higher than the specified value, allow a slight amount of helium gas to escape by opening the gas charge valve **very slowly**. If the indicated pressure is lower than specified value, add helium gas as described in section 6.3.

If there is a helium leakage please contact our customer service.



CAUTION

When you use a flexible hose with length of 10m to 20m, the hose should be dedicated to C10. If a standard hose of the same length is used, helium charge pressure will be lower than required, inviting the need for charging helium gas.

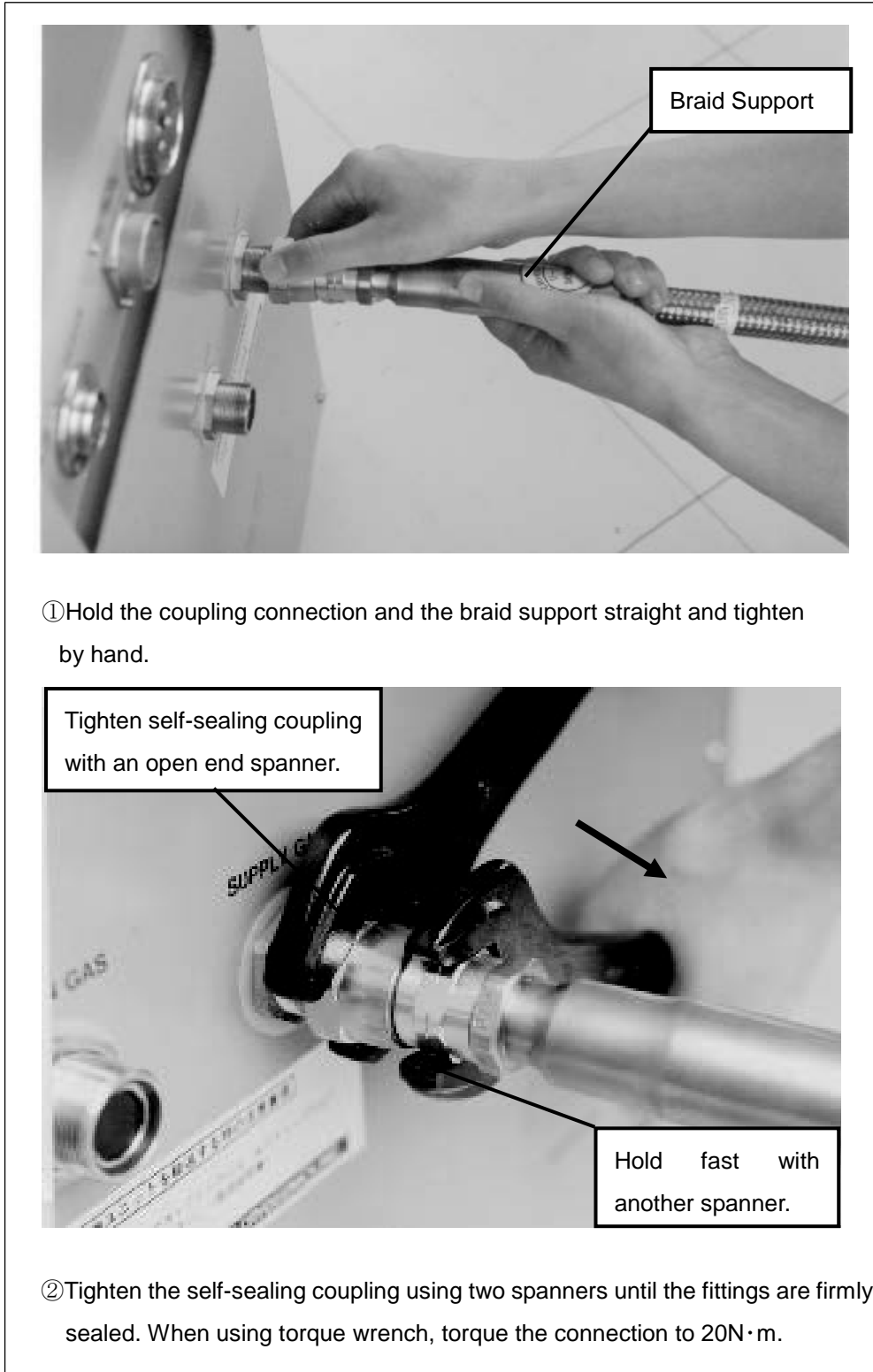


Figure 3-3 Connecting Flexible Hose

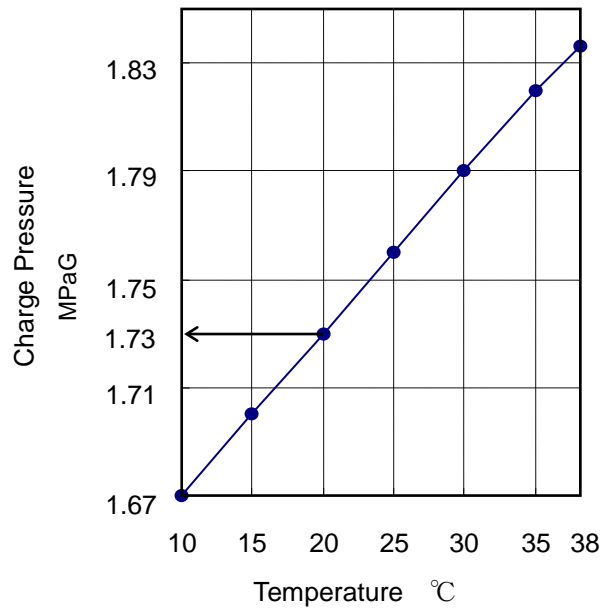


Figure 3-4 Static Pressure and Temperature

3.5. Connecting Electrical Cables

		WARNING
Do not connect the compressor to power supply until all wiring and connections are completed.		

1. Make the REMOTE/RESPONSE wiring, if necessary.

		WARNING
Disconnect the input power connector at REMOTE/RESPONSE wiring. Some of the remote connector pins are energized when the power is supplied. Failure to observe this precaution could result in damage to, or destruction of, the equipment.		

- ◆ **REMOTE WIRING** :Set the REMOTE/LOCAL switch to 「REMOTE」 position.
Make the REMOTE wiring according to the circuit diagram shown in Appendix B. Always use the momentary switch (contact) for setting START/STOP push button switch (PB1, PB2) in remote operation.
- ◆ **RESPONSE WIRING** :Be sure to make wiring for RESPONSE signals according to the circuit diagram. The relay specification of response signals is shown in Appendix B.

2. Connect the refrigerator power cable from the compressor to the cryopump.
3. Connect the ground.
3. Connect the connector side of the input power cable to the compressor.

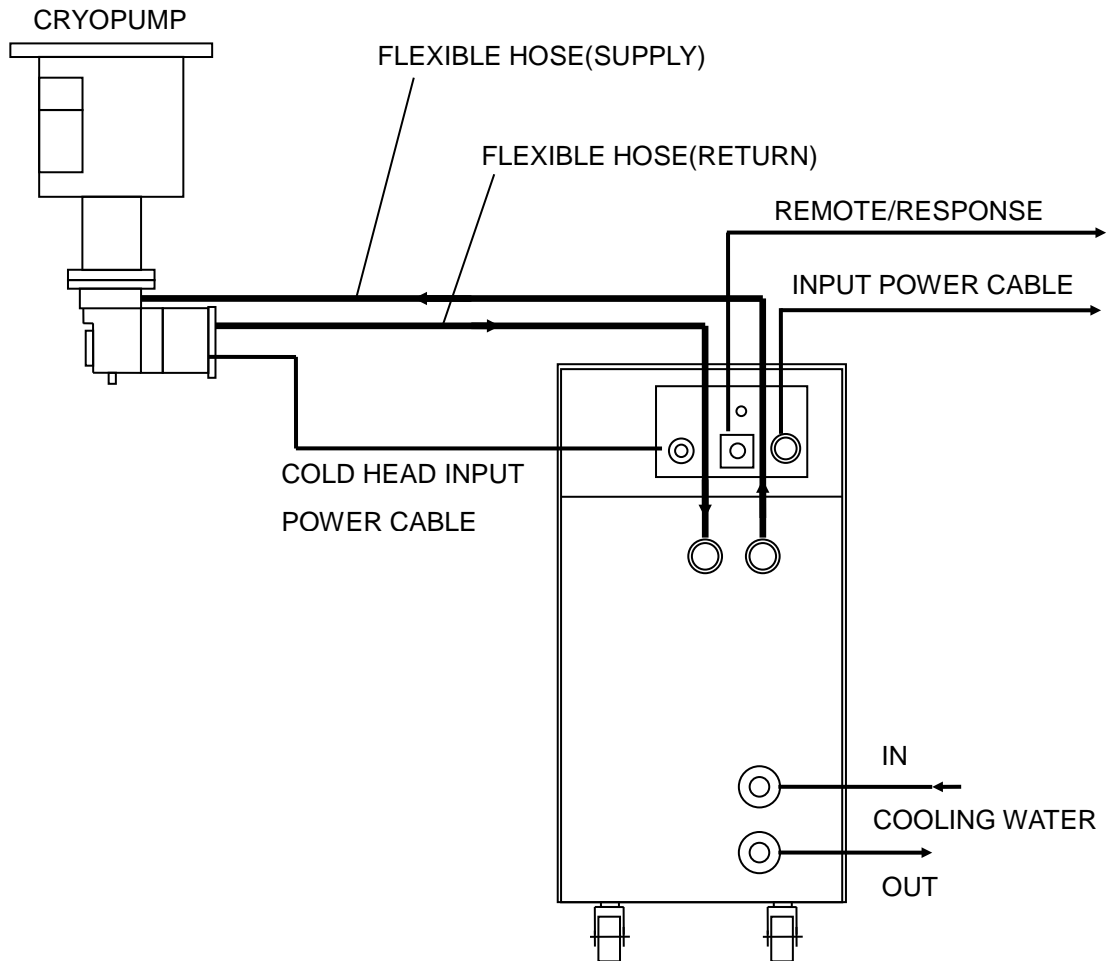
Connect the other side of the input power cable to the power source.

Note : If customer-supplied input power cable is used, be sure that it is equivalent to UCI-supplied cable.

Table 3-2 Input Power Cable Specifications

Item	Symbol	Specifications
Input power cable	INPUT POWER	Copper wire / 600VAC, 3 conductors with ground ^(*) 1.25mm ²

(*) The color of the ground wire is green.



[C10]

Figure 3-5 Compressor Installation

4. OPERATION

4.1. Before Operation	4-1
4.2. Normal Operation	4-1

4.1. Before Operation

Before operating the compressor, check and verify that:

1. Input power requirements are within the specified values shown in Table 1-1.
2. STOP switch (orange) lights up when the power is supplied to the compressor.

Please be noted that the switch will light up (dark light) even the phase is reversed. If the compressor does not start when the START switch has been pressed, there is possibility of reversed phase. Change any one set of RST phases.

3. REMOTE/LOCAL switch is properly set.
4. Cooling water requirements is within the specified values.
5. Helium gas static pressure is within the specified values.

4.2. Normal Operation



CAUTION

Verify that the operating pressure is within the specified values shown in Table 1-1.

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5. DISCONNECTION and STORAGE

5.1	Disconnecting Flexible Hose	5-1
5.2	Storage.....	5-2

5.1 Disconnecting Flexible Hose



CAUTION

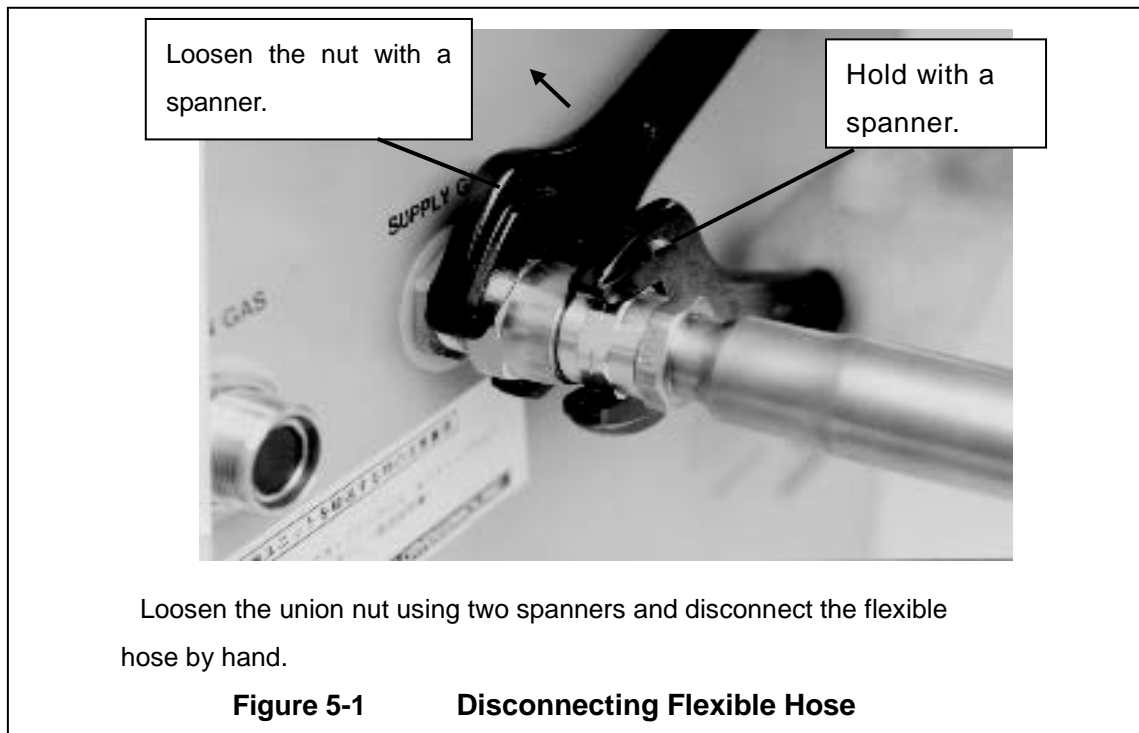
When disconnecting flexible hoses, be sure to use two single open end spanners with width across flat 26mm and 30mm.

1. Shut down the compressor unit.
2. After the Super Trap and/or cryopump (refrigerator unit) has been warmed up to room temperature, disconnect the flexible hoses.



CAUTION

- If flexible hoses are disconnected while the cryocooler is still in low temperature, the pressure inside the cryocooler will rise as it warms up, resulting in helium leakage by activated pressure relief valve.
- Note that when performing helium circuit decontamination of the refrigerator unit, it is required to disconnect the flexible hoses at the compressor unit side immediately after shutdown.



5.2 Storage

- ◆ Follow the instructions below to store the compressor unit.
 1. Disconnect the flexible hoses. Refer to Section 5.1.
 2. Disconnect cables and cooling water piping. Cooling water must be purged from the compressor unit. Refer to Section 3.3.
 3. Put the protective caps back on the helium gas connectors and cover the compressor unit with plastic sheet as they were shipped.
 4. Avoid direct sunlight, heat, humidity, vibration, radiation, dust, wind and rain.
 5. The compressor unit should be placed on level floor (within $\pm 5^\circ$) and fixed not to move and/or fall.
 6. Check the pressure gauge of the compressor unit periodically. Contact our Service Engineering Division or the nearest customer support center if the pressure keeps lower. There is a possibility that a leakage might have occurred.

- ◆ When the compressor unit is to be suspended for more than three months, follow the instructions below in addition to the above.
 - Operate the compressor unit for about an hour every three months to circulate lubricating oil to prevent the damage caused by the lack of the oil when starting the compressor unit again after long-term storage.

- ◆ When shipping the compressor unit, pack in the same way as at the time of shipment and avoid excess impact.

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6. MAINTENANCE

6.1. Scheduled and Unscheduled Maintenance	6-1
6.2. Replacement of Adsorber	6-1
6.3. Charging Helium Gas	6-5

	 WARNING
<p>Always disconnect the compressor from all sources of electrical power before performing any maintenance procedures.</p>	

6.1. Scheduled and Unscheduled Maintenance

- ◇ Scheduled Maintenance : Adsorber replacement
(At least every 24000 operation hours)
- ◇ Unscheduled Maintenance : Adding helium gas

6.2. Replacement of Adsorber

The adsorber must be replaced at least once in every 24000 operation hours. Using the same adsorber for more than 24000 hours may cause a breakage or malfunction of the refrigerator unit.

◆ Removing the Adsorber

1. Close the main valve of high vacuum system.
2. Shut down the refrigerator unit and the compressor unit.
3. Switch off the primary power.
4. Disconnect the flexible hoses from gas-return and gas-supply connectors at the rear of the compressor.
5. Remove the front panel of the compressor. (Figure 6-1 ①②)
*Do Not remove the rear panel.
6. Disconnect the flexible hose from the adsorber inlet and outlet. (Figure 6-1 ③④)

NOTE: When disconnecting or reconnecting the self-sealing coupling, always use two spanners and follow the procedure described in Section 3.4 and 5.1.

7. Remove the adsorber mounting bolt (M6). (Figure 6-1 ⑤)
8. Remove the back leg of the adsorber from the mounting tab and slide the adsorber outward and remove it from the compressor. (Figure 6-1 ⑥)

The old adsorber has been removed from the compressor.

		WARNING
Depressurize the adsorber before disposing of it.		

Always use the charging adapter to depressurize the adsorber.

◆ Installing the Adsorber

1. Remove the dust caps from the self-sealing coupling halves at each end of the replacement adsorber.
2. Install the replacement adsorber following the steps for adsorber removal in reverse order.
3. Connect the flexible hose to the adsorber inlet.
*Ensure that the flexible hose is horizontally placed.
4. Check the helium pressure gauge to see it reads $1.73 \pm 0.04 \text{MPaG}$. If the pressure is higher than the specified value, slightly open the charging valve very slowly to release the helium gas. If the pressure is lower than it should be, follow the instruction in Section 6.3 and add helium gas.
5. Put the front panel back on the compressor.
6. When the adsorber has been replaced, write the date and elapsed time of operation on the adsorber replacement record label at the front panel. Also write elapsed time for the next replacement of adsorber (add 24000 hours to the present elapsed time).



① Remove the nuts from the front panel.
*Do not unscrew the screws and jam nuts on the rear panel.



② Remove the front panel.



③ Disconnect the flexible hose from the adsorber outlet.



④ Disconnect the flexible hose from the adsorber outlet.



⑤ Remove the adsorber mounting bolt.



⑥ Slide the adsorber out and remove it from the compressor.

RECORD SHEET OF THE ADSORBER REPLACEMENT

Replace the adsorber after a maximum operation of 24,000 hours. Write the elapsed-time of the meter (ETM) on this sheet.

Elapsed-Time Hours	Replaced Date	Person Replaced
Hr.	. .	
	. .	
	. .	
	. .	

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Tel. (0467)85-0303

- * Install the replacement adsorber following the steps for adsorber removal in reverse order.
- * When connecting the flexible hose, ensure to place it horizontally as shown in Figure 6-1-③.
- * After the replacement, put the front panel back on the compressor and fill in the table of the record sheet.

Figure 6-1 Replacement of Adsorber

6.3. Charging Helium Gas

NOTE:

When charging helium or performing helium circuit decontamination, equipments (regulators, charging hoses, adapters, etc.) that can be used at 2.0MPaG or above are required.

**CAUTION**

If the helium pressure gauge of the compressor unit shows 0 MPaG, contamination caused by air or moisture may occur in the system. If it occurs, contact our Service Engineering Division or customer support center.

When helium gas pressure is lowered, it is necessary to replenish the gas. Investigate the cause of the pressure reduction before adding helium gas. If there is a leakage, take an adequate measure before charging gas. Improperly connected self-sealing coupling might be one of the causes of the leakage.

- ◇It is recommended to use a pressure regulator for helium gas (left screw), which shows the range of 4 - 6 MPaG on the low pressure side.
- ◇The gas charge inlet of the compressor unit is 1/4B male flare.
- ◇Use helium gas with purity of 99.999% or more.

The filling method of helium gas is as follows:

1. When mounting the regulator on a new helium bottle, perform the following procedures in order to purge the air and fill helium gas in the gas line between the regulator and the bottle valve.
 - a. Open the regulator slightly. Normally, the regulator can be opened by turning the handle clockwise.
 - b. Slowly open the bottle valve, and purge the air in the gas line for several seconds.
 - c. Close the regulator. (It can be closed by turning the handle counter clockwise.)

**CAUTION**

If the bottle valve is opened without performing the procedure 1, the air between the regulator and the bottle valve diffuses into the helium bottle and lowers the purity of helium gas.

2. Remove the front panel of the compressor unit.
3. Connect the helium charging hose as follows:
 - a. Connect the charging hose to the regulator.
 - b. Loosely connect the charging hose to the charge inlet on the compressor unit so that helium gas can be slightly blown out here.
 - c. Open the regulator until the outlet pressure reaches 0.1 to 0.2 MPaG. Allow helium gas to flow out from the charging hose for about half a minute. Meanwhile, open the charge valve slightly in order to drive out the air that exists between the charge valve and the charge inlet.
 - d. Tighten the flair nut at the end of charging hose and close the charge valve. Helium gas replacement in the line between the regulator and the charge valve on the compressor has been completed.
4. Adjust the outlet pressure of the regulator at 1.8 MPaG.
5. Open the charge valve slowly and perform one of the following procedures according to the state of the compressor.
 - a. If the compressor unit is running under normal operating conditions, replenish it with the pure helium gas until it reaches the operation pressure described in the Table 1-1.
 - b. If the compressor unit is not running, replenish it with the pure helium gas until it reaches the static pressure.

**CAUTION**

If helium gas has been charged more than the prescribed pressure of 1.9MPaG or more, the pressure relief valve on the refrigerator may be going to work. Therefore charge helium gas slowly so that the pressure relief valve should not operate. The pressure relief valve in the compressor unit is set to operate at 2.5MPaG.

6. Close the charge valve after charging helium gas.
7. Close the regulator and remove the charging hose from the charge inlet to complete the helium gas charging procedure.

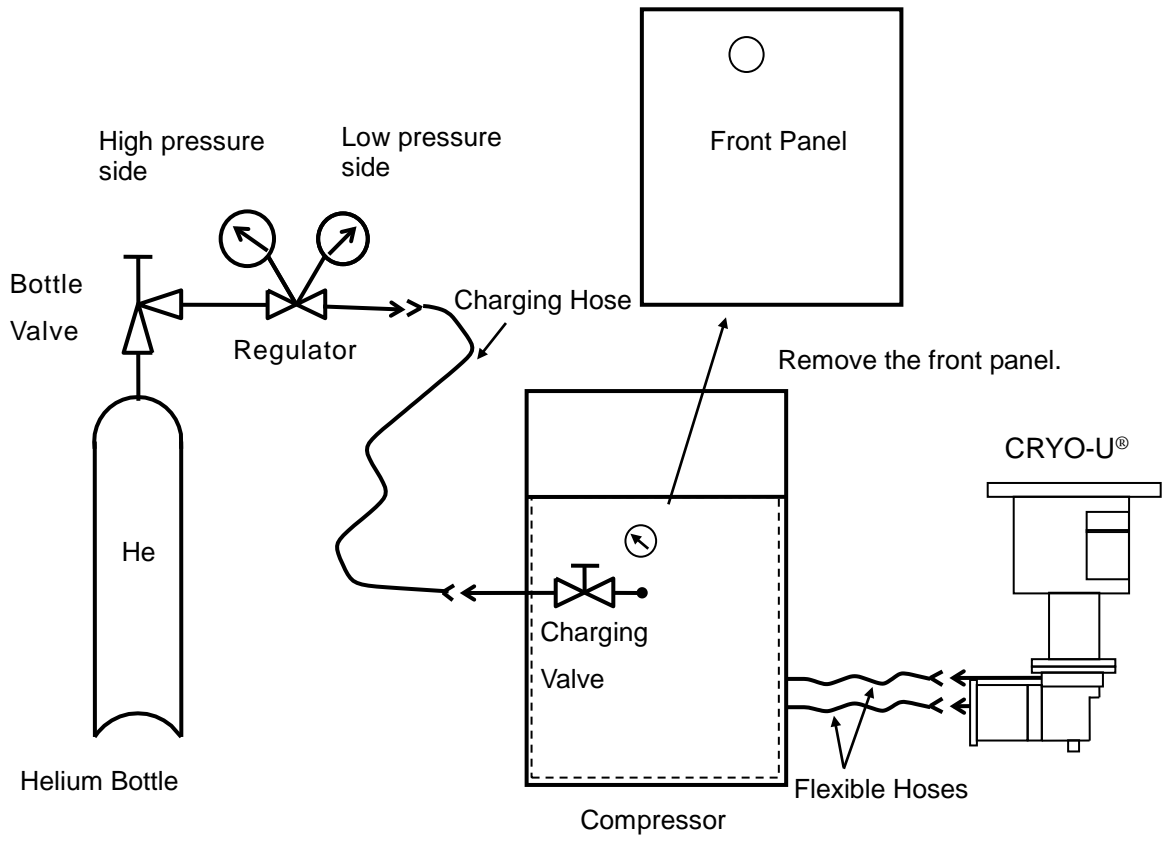


Figure 6-2 Charging Helium Gas

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Appendix A

TROUBLESHOOTING




			WARNING
<ul style="list-style-type: none"> ◆ Disconnect the compressor from its power source before performing any troubleshooting procedures. ◆ The compressor pump is hot after operating. Wait for the unit to cool down before working on the inside of the compressor. 			

Table A-1 Troubleshooting Procedures

No	Problems	Possible Cause	Corrective Action
I	Compressor stops during continuous operation.	1) Thermal protective switches (TS1 and TS2) are ON. 2) Over current protective switches (MPA, MPB) or circuit protectors (CP1, CP2) are active.	Check the cooling water condition (temperature, flow rate). <ul style="list-style-type: none"> • Check the power supply voltage. • Contact our Service Engineering Division or the nearest CS center.
II	Compressor does not start.	1) No power coming from the source. 2) Circuit protectors (CP1, CP2) are OFF. 3) Reversed phase protective relay (PRR) is active. (STOP light is lit up)	Check wiring and ensure that the power supply connector is connected properly. Turn the circuit protectors ON. Change two phases of power source (Refer to section 4.1).
III	Compressor stops after several minutes' operation.	1) Thermal protective switches (TS1 and TS2) are ON.	Check that cooling water flows properly. Also check the cooling water temperature and flow rate (Refer to Figure 3-2).

III	Compressor stops after several minutes' operation. (Continued from the previous page.)	2) Over current protective switches (MPA, MPB) or circuit protectors (CP1, CP2) are active.	<ul style="list-style-type: none"> • Check the power supply voltage. • Contact our Service Engineering Division or the nearest CS center. (The cooling water temperature and the room temperature will be asked.)
		3) Compressor failure.	Contact our Service Engineering Division or the nearest CS center.

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Appendix B

SCHEMATIC DIAGRAM

◆ Safety Devices (in the control module)

Sign	Item	Function and specification
MPB	Over current protective switch (AUTO RESET)	Automatically stops the compressor operation if an over current occurs due to overloading, or an abnormal rise of temperature inside controller occurs. Both "STOP(PB1)" and "START(PB2) push-button switch" light OFF.
CP1	Circuit protector (MANUAL RESET)	Shuts power off if a short circuit of compressor unit occurs. Rated current: 15A
CP2	Circuit protector (MANUAL RESET)	Shuts power off if a short circuit of cold head occurs. Rated current: 1A
PRR	Reverse phase protective relay	Disables to start the unit when the power wires are connected in reverse phase.
F	Fuse	250V, 1A

◆ Safety Devices (others)

Sign	Item	Function and specification
TS1	Thermal switch	Automatically stops the compressor operation if the oil flow rate is insufficient. "STOP push-button switch (PB1)" lights ON.
TS2	Thermal switch	Stops the compressor operation if the cooling water flow rate is significantly lowered, or there is no cooling water inside the compressor unit. "STOP push-button switch (PB1)" lights ON.
MPA	Over current protective switch	Located on top of the compressor. Automatically stops the compressor operation if a over current occurs due to overloading, or an abnormal rise of temperature inside compressor unit occurs. "STOP push-button switch (PB1)" lights ON.
—	Pressure relief valve	Located in the helium supply line. Operates automatically to discharge the high over-pressure helium inside. Set pressure: 2.41MPa(gage) (350psig)
—	Differential pressure regulating valve	Located in the line between the supply and return helium lines. Regulates the maximum differential pressure during operation. Set pressure: 1.34MPa(gage) (195psi)

◆ Electric Parts

Sign	Item	Function and specification																
PB1 PL1	Illuminated STOP push-button switch (MOMENTARY)	Stops the compressor unit and the cold head operation if pressed. “STOP indicator (orange)” lights up when the compressor unit is stopped but still connected to its power source.																
PB2 PL2	Illuminated START push-button switch (MOMENTARY)	When pressed, “STOP” indicator lights OFF and “START” indicator (green) lights ON. Starts both the compressor unit and the cold head.																
SW1	REMOTE/LOCAL switch																	
ETM	Elapsed time meter	Displays the total hours of the compressor unit operation.																
MR	Restart momentary relay for power supply failure	In case of power failure within 2 seconds, the compressor unit can restart. If power failure lasts more than 2 seconds, the compressor unit will not restart.																
CN3	Remote/Response connector	<p>Indicates the Cold Head status of START/STOP.</p> <p>Between pin ④ and pin ⑤ of the connector are open when the compressor unit and refrigerator unit has been stopped. Between pin ⑤ and ⑥ are open when the compressor unit and the refrigerator unit are in operation.</p> <p>Contact capacities of CR1 are as follows:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Maximum voltage</td> <td>AC250V</td> <td>DC125V</td> </tr> <tr> <td>Maximum current</td> <td>5A</td> <td>5A</td> </tr> <tr> <td rowspan="3">Rated load</td> <td colspan="2">Resistance load (Induction load)</td> </tr> <tr> <td colspan="2">AC220V 5A (2A)</td> </tr> <tr> <td colspan="2">DC 24V 5A (2A)</td> </tr> <tr> <td>Minimum applicable load</td> <td colspan="2">DC5V 1mA</td> </tr> </tbody> </table>	Maximum voltage	AC250V	DC125V	Maximum current	5A	5A	Rated load	Resistance load (Induction load)		AC220V 5A (2A)		DC 24V 5A (2A)		Minimum applicable load	DC5V 1mA	
Maximum voltage	AC250V	DC125V																
Maximum current	5A	5A																
Rated load	Resistance load (Induction load)																	
	AC220V 5A (2A)																	
	DC 24V 5A (2A)																	
Minimum applicable load	DC5V 1mA																	

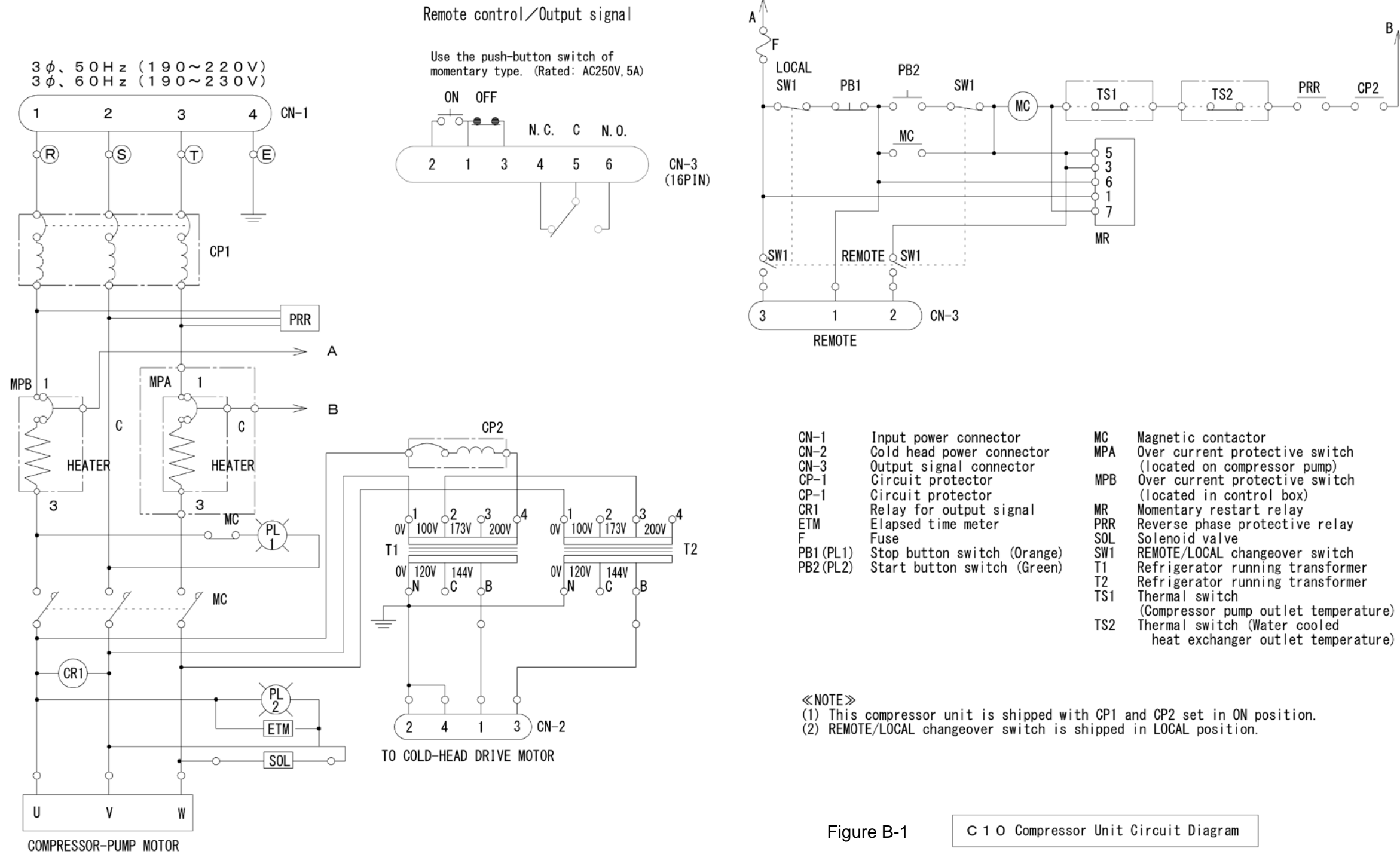


Figure B-1

C 1 0 Compressor Unit Circuit Diagram

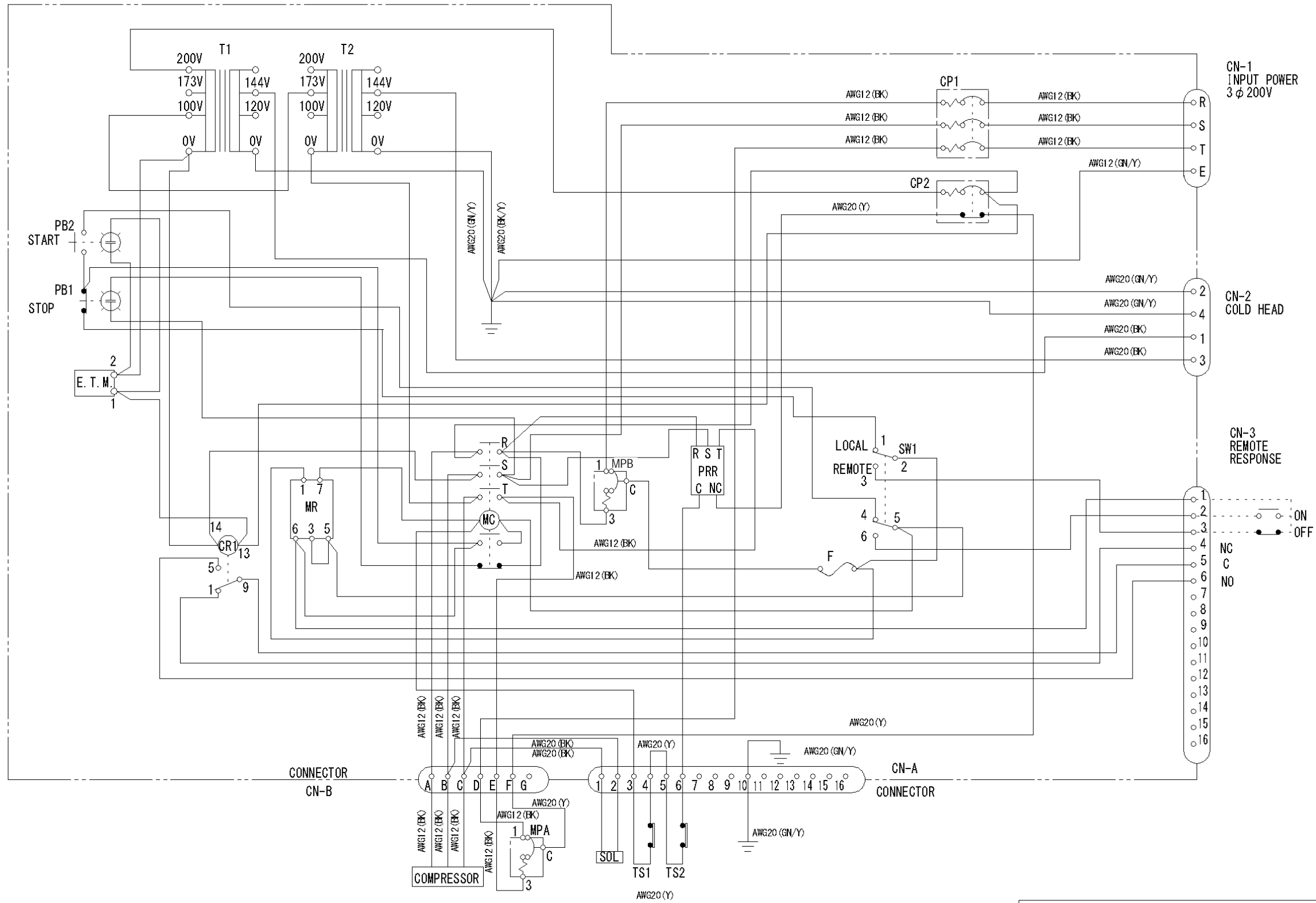


Figure B-2 C 1 0 Compressor Unit Wiring Diagram

Appendix C

FLEXIBLE HOSE

1. Specifications

- Gas : Helium Gas (Purity of 99.999% or above)
- Pressure : Maximum 2.45MPaG

<Note> The content of “Specifications and Drawings” specific to your system supersedes, if provided.

- Temperature : 0 to 70°C
- Material : SUS304
- Length : 3000mm (standard)
- Minimum Bending Radius : 250mm
- Recommended Torque for Connecting : 20N·m

<Note> Fasten the self-sealing coupling until fully tight.

- Connection : 1/2B self-sealing coupling

2. Handling Precautions



CAUTION

- When carrying a flexible hose, hold the braid support of the hose. Bending the flexible part forcibly at an acute angle may damage the hose.
- Do not twist a flexible hose especially when making continuously bent connections.
- Keep away from water and salt to prevent corrosion. Do not place heavy objects on flexible hoses in order to prevent deformation or collapse.

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Appendix D

FLOW DIAGRAM

Low pressure helium gas returning from the refrigerator unit enters the compressor with injected lubricant oil (oil) and then compressed. The oil is pooled at the bottom of the compressor inside and then circulated passing through an oil heat exchanger, filter, orifice, solenoid valve, and sight glass before it returns to the compressor.

The compressed high-pressure and high-temperature helium gas comes out from the compressor, passes through a heat exchanger for removal of compression-caused heat. It is cooled to an ambient temperature and then enters an oil separator. In here, the oil is separated and droplets of separated oil pass through the filter and the orifice to return to the compressor.

At the same time, high pressure helium gas comes out from oil separator enters an adsorber where oil-mist is adsorbed and removed. The helium gas comes out the adsorber passes through a flexible hose and is supplied to the refrigerator unit.

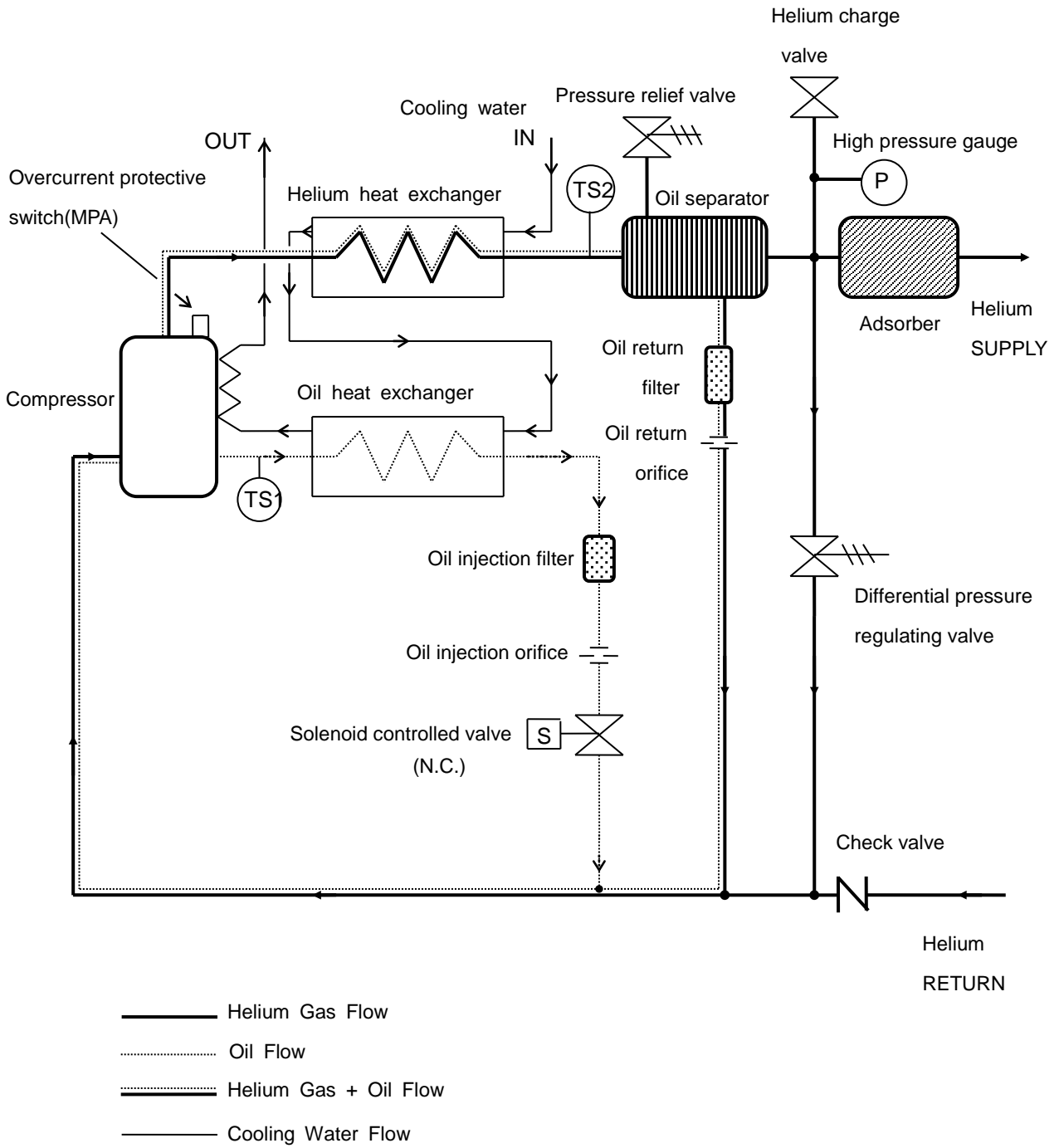


Figure D-1 C10 Flow Diagram

Appendix E

ALTERNATIVE METHOD of ADSORBER REPLACEMENT

As shown in page 6-3/6-4, the adsorber replacement can be performed by removing the front panel of the compressor. But in some cases, the side cover needs to be removed to replace an adsorber since the length of the adsorber is too long to slide it out/in from the front.

In such case, refer to the following instruction and remove the side cover before replacing the adsorber.

1. Adsorber is stuck in the compressor.



2. Remove all screws fixing the side cover.



3. Remove side cover by sliding the cover forward.



4. Slide out/in the adsorber out from right side.



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Revision History

Date	Revision No.	Contents
2007-02-15	2007.02	First edition
2009-06-08	2009JE01	“Introduction” has revised. UCN address has changed. “SERVICE NETWORK” has revised.
2009-11-06	2009NR02	RM refrigerator has added.
2011-02-14	2011FY03	Cover: Export control policy has been revised.
2011-09-14	2011SR04	Full-fledged revision.
2011-11-29	2011NR05	P.B-1 ◆Safety Devices (others) The sign of the differential pressure regulating valve, “SOL” has been deleted. P.B-3~6 The circuit diagram and the wiring diagram have been revised.
2012-06-15	2012JE06	P.1-2 Table 1-1 ◆Helium Gas Pressure Static Helium Charge Pressure has been revised. “SERVICE NETWORK” has been revised.
2013-03-26	2013MH07	“Safety Instruction” No.3 and No.5 have been revised. “SERVICE NETWORK” has been revised.
2013-11-08	2013NR08	“Introduction” has been revised. “SERVICE NETWORK” has been revised.
2016-11-15	2016NR09	“Safety Instruction” has been revised. Section 1.2. “Specifications” and Section 3.4. “Connecting the Compressor Unit to the Cryopump” A caution description has been added. “SERVICE NETWORK” has been modified.
2018-03-06	2018MH10	“SERVICE NETWORK” has been modified.
2019-11-15	2019NR11	Appendix B Schematic Diagram Figure B-1 has been modified.
2020-09-30	2020SR12	Appendix B Schematic Diagram Figure B-2 has been modified.
2023-08-04	2023AT13	“Safety Instructions” Description on the sealing sticker has been added.
2023-10-23	2023OR14	“Safety Instructions” Description on the adsorber disposal has been modified.

		Appendix C A note has been added to flexible hose allowable pressure.
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