

COMPRESSOR UNIT

Instruction Manual

C15R

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 gives information and precautions on handling, installation, operation, and maintenance of the product.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. To ensure proper use of this product, read this instruction manual carefully and keep this manual close at hand so that you can use for reference during operation.

If you purchased our other products and/or optional devices with this product, read relevant instruction manuals carefully.

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

All personnel involved in handling our products should take a general safety education and training that is officially accepted in the country where our product is used. The personnel are also required to have specialized knowledge/skills and qualification on the electricity, the machinery, the cargo handling, and the vacuum. Especially, the personnel should be familiar with handling a cryopump in order to use it safely. Since we offer a training session (which is subject to fees) as needed for people who use cryopumps for the first time, please do not hesitate to contact our Service Engineering Division to join the training session.

2. Warranty

2.1 Gratis warranty period and Warranty coverage

【Gratis warranty period】

Note that an installation period of less than one year after installation in your company or your customer's premises or a period of less than 18 months (counted from the date of production) after shipment from our company, which is shorter, is selected.

【Coverage】

(1) Failure diagnosis

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

However, ULVAC CRYOGENICS 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 found to be a fault of ULVAC CRYOGENICS.

(2) Damage during transportation

When damage by delivery/transportation is admitted, the product will be repaired free of charge within the range of the guarantee expressed in the sales contract.

(3) Breakdown repairs

There will be a charge for breakdown repairs, replacements and on-site visits for the following seven conditions. In those cases the cost shall be your own expense even though the product is within the warranty period.

- ① Breakdowns due to improper storage or handling, careless accident, software or hardware design by the customer.
- ② Breakdowns due to modifications of the product without consent of the manufacturer.
- ③ Breakdowns due to maintenance of the product without authentic parts or breakdowns resulting from using the product outside the specified specifications of the product.
- ④ Breakdowns due to contamination or corrosion caused by user's use conditions.
- ⑤ Breakdowns due to natural disasters (such as fire, earthquake, flood, lightning, salt damage, and so on) , environmental pollution, irregular voltage, and /or usage of undesignated power source.
- ⑥ Breakdowns that are outside the terms of warranty.
- ⑦ Consumables and/or replacement service.

Since the above services are limited to within Japan, diagnosis of failures, etc are not performed abroad. If you desire the after 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 shall accept 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. If you have any questions or technical problems, please feel free to contact the nearest Customer Support Center or headquarters. Please refer to “Service Network”.

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.	:	_____
Option Part Model	:	_____
Optional Part Serial No.	:	_____

4. Notes for repair and maintenance requests

We may decline your request for the repair or the 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 retrieving the product to investigate its cause. Also we may ask for reporting the detailed process and/or the operating condition. When unidentified malfunction was generated, please contact our Service Engineering Division or

the nearest customer support center with reference to the chapter of Service Network. We ask for cooperation about the above.

6. General Precautions

- (1) It is strictly prohibited to duplicate, open, and transfer this instruction manual or any of its parts to a third person without written permission from ULVAC CRYOGENICS.
- (2) Information in this document might be revised without a previous notice for the specification change and the improvement of the product.
- (3) If you have any questions or comments on this document, please do not hesitate to contact us. The phone numbers of local customer support centers are listed at the end of this manual.

Safety Considerations

Our products have been designed to provide extremely safe and dependable operation when properly used. Following safety precautions 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 filled 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 dirt being stuck in the sheet. This may even overload the compressor motor.

Never charge helium gas more than specified in Table 1-1.

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.

The equipment (regulators, charging hoses, adopters, etc.) that can be used at the pressure of 2.0MPaG or higher are required to perform the above work.

3. Do not shutdown / startup operation frequently

Do not switch between ON and OFF frequently.

The number of startup and shutdown of the compressor motor must be less than 6 times per hour and ON or OFF state should be maintained for at least 3 minutes. Starting up and shutting down too frequently reduces the insulation life of compressor motor and may result in failure. When operating multiple refrigerators, the number of startup and shutdown of the refrigerator motors must be also 6 times or less per hour.

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

Please contact us when you need to control the Super Trap temperature.

4. Disposal of used adsorber



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

When the refrigerator system is not in operation, helium gas pressure inside the adsorber is as high as the charge 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 rises as the inside temperature rises and may result in explosion. If the adsorber was pressed with helium gas remaining inside, it may also cause explosion. Refer to “Disposal Consideration” 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 allowable voltage may damage the equipment.
- Install a ground-fault circuit interrupter (rated current: 20A, rated tripping leakage current:30mA 3Ø, rated voltage: 200V).
- Grounding conductor (earth wire) must be connected. (D class grounding (with the ground resistance of 100Ω)).
- Connect the refrigerator cable and remote cables (signal lines) to the compressor before connecting the compressor to the power supply. These wiring connections must not be done when the compressor is powered on. It could lead to a serious accident such as electric shock and/or damage to the equipment.
- Follow recommended sizes for wires and cables.
- 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 the water pressure is too high, a leak may occur in the cooling water line inside the compressor unit. Adjust and control the cooling water supply pressure to maintain an allowable upper limit indicated in “Section 3 Figure 3-2 Cooling Water Requirement”

If water stain or some products accumulate in the water line inside the heat exchanger, heat exchange effectiveness will be significantly reduced and helium gas temperature will rise, this may shut down the compressor unit.

We employ 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. Please refer to “Section 3 Table 3-1 Recommended Cooling Water for Compressor”.

7. Ambient conditions of the compressor unit

The upper limit of the compressor operating ambient temperature is 38 °C. Do not use the compressor in unsuitable environments 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.

Also, parts inside the compressor unit are still hot immediately after shutdown. Wait at least 15 minutes to open 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.

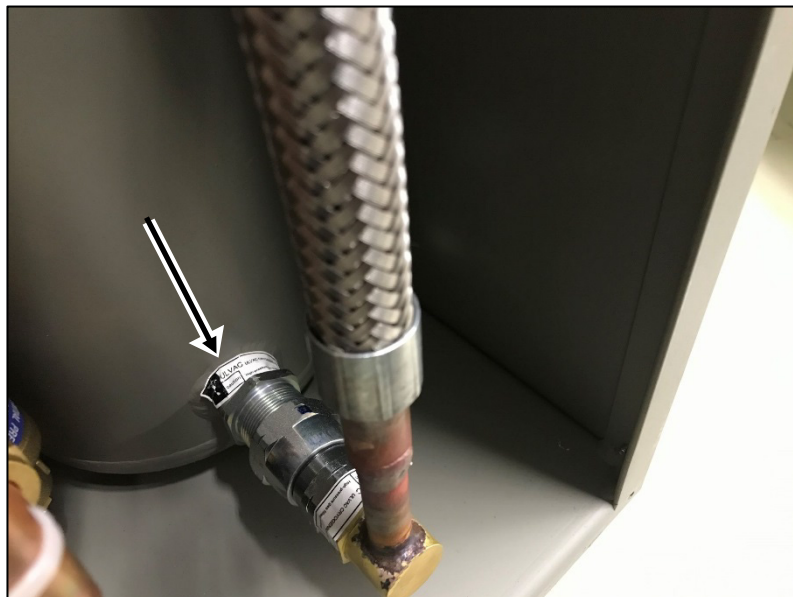








Figure Example of the sealing sticker pasted on the self-sealing coupling

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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1.2. Specifications	1-1

1.1. Introduction

The compressor unit compresses the return helium gas from the refrigerator unit (cold head) and feeds it back to the refrigerator unit as high-pressure helium gas.

This compressor unit consists of:

1) a compressor, 2) a cooling system, 3) an oil separation system and 4) an adsorber. A controller to control the electric operation of compressor and refrigerator is installed.

1.2. Specifications

Table 1-1 Compressor Unit Standard Specifications

◆ Model : C15R

Power Source	Volts×Phase×Hz	AC190 ~ 220V × 3Φ × 50Hz AC200 ~ 230V × 3Φ × 60Hz
	Power (in normal operation) (* 1)	3.3kW / 4.1kW(50Hz/60Hz)
Cooling Type		Water cooled
Cooling Water Requirement (See Fig.3-2)		Temperature : 5 ~ 32°C Flow Rate : 2 ~ 6L/min Pressure Drop : 0.04 ~ 0.17MPa
Ambient Temperature		10 ~ 38°C
Compressor Winding Resistance		1.63Ω
Adsorber Service Schedule		30000 h
Nominal Operating Current (* 1)		13.0A (200V, 60Hz)
Weight		100kg
Cooling Water Inlet/Outlet		Rc3/8 female
Helium Gas SUPPLY/RETURN Connector		1/2B self-sealing coupling

(* 1) Rate is under the condition of connecting piping (flexible hose): 3m and helium gas pressure: 1.60MPaG.

The value grows about 10% for 5 minutes after startup

Table 1-1 Compressor Unit Standard Specifications (Continued)

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

Static (*1)	1.60±0.04 MPaG
Operating (SUPPLY) (*2)	1.7~1.9 MPaG

(*1) Helium gas pressure depends on the length of connecting piping (flexible hose).

Consult Section 3.4 for proper static pressure referring the length of your connecting piping.

(*2) Rate is in the normal operating. It is different from the above value just after startup. It becomes approx. 1.7MPaG in order to do by-pass operation in the inside of compressor unit during 30 seconds after startup.

◆ Combination of Cryopump and Compressor

CRYO-U10H,U10HL,U10PU, U10PU-S,U10HSP
CRYO-U12H, U12HSP, U12HL (*3)

(*3) 12-inches cryopumps are usable only for light load. Use our C30V/C30VR compressor in case of high load.

◆ Connector Specifications (Cable Side)

No.	CONNECTOR	MANUFACTURE R	TYPE
1	INPUT POWER	NANABOSHI	NCS-404-P
2	COLD HEAD POWER CABLE	NANABOSHI	NCS-254-PM
3	METAL CONNECTOR (EXTERNAL SIGNAL, REMOTE)	JAE	SRCN6A25-16P

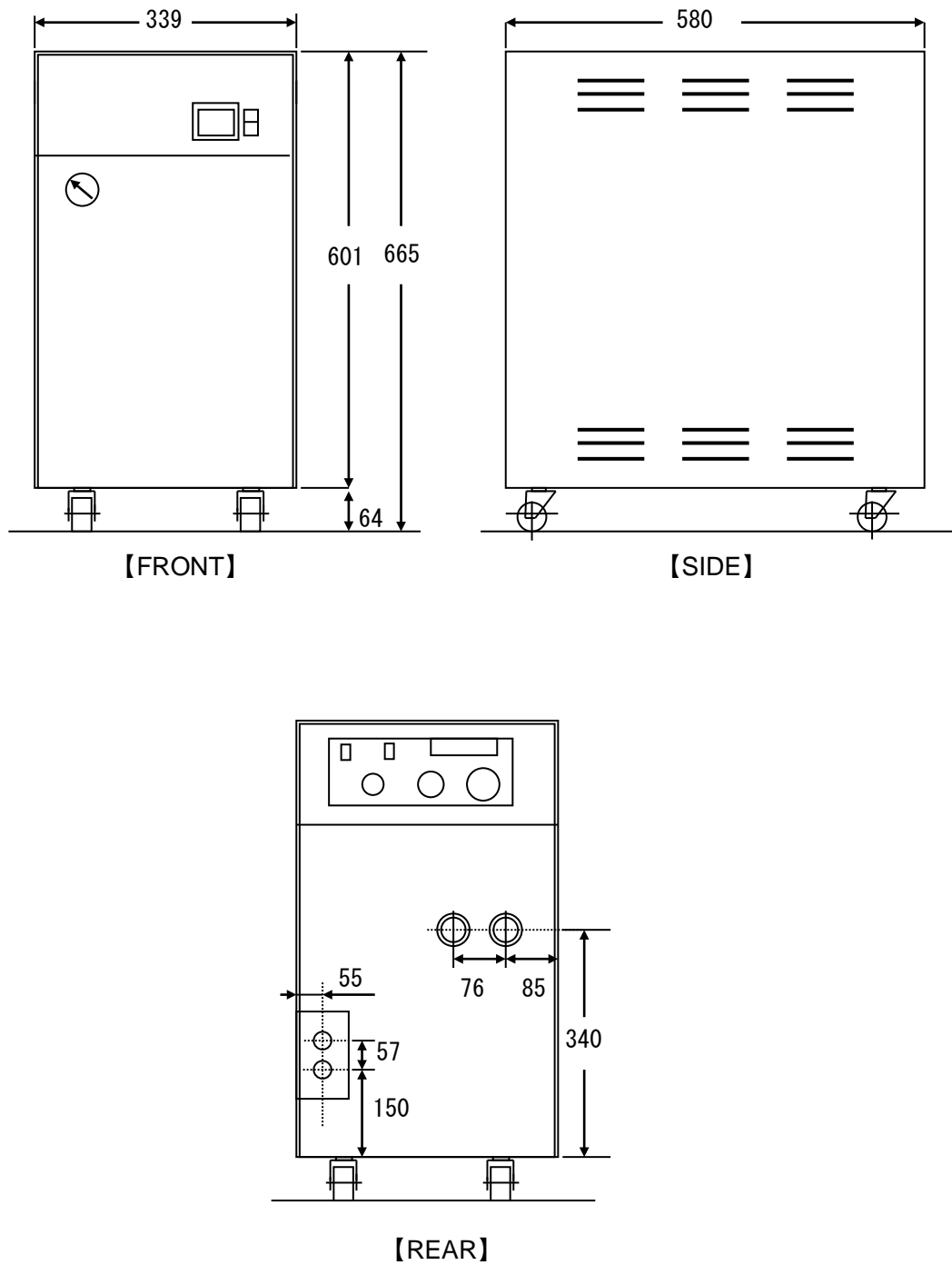


Figure 1-1 Dimensions

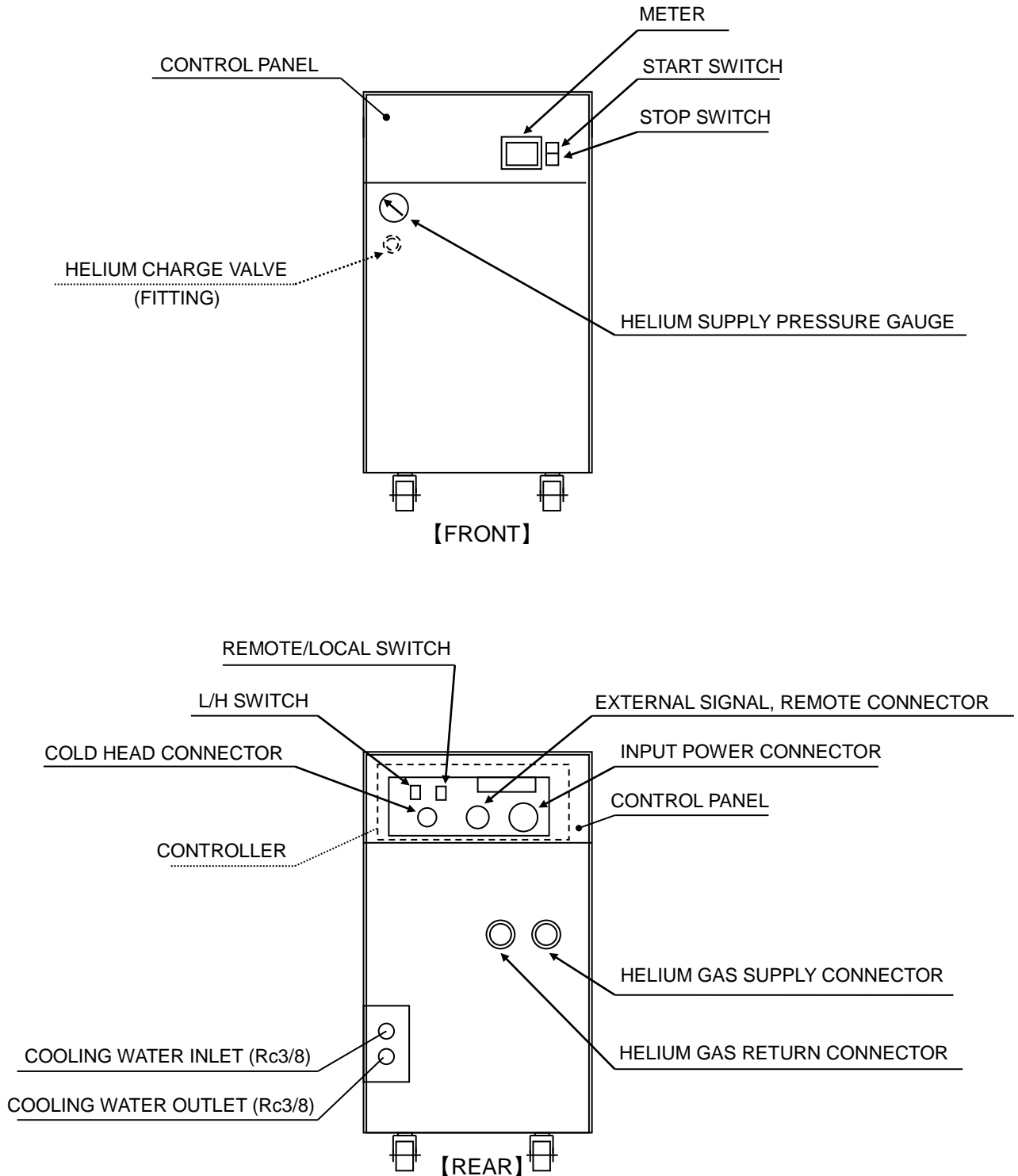
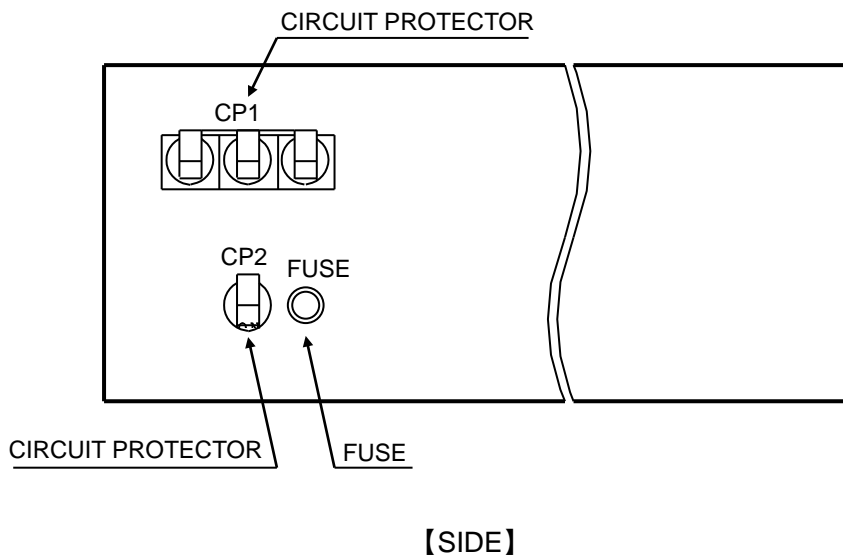
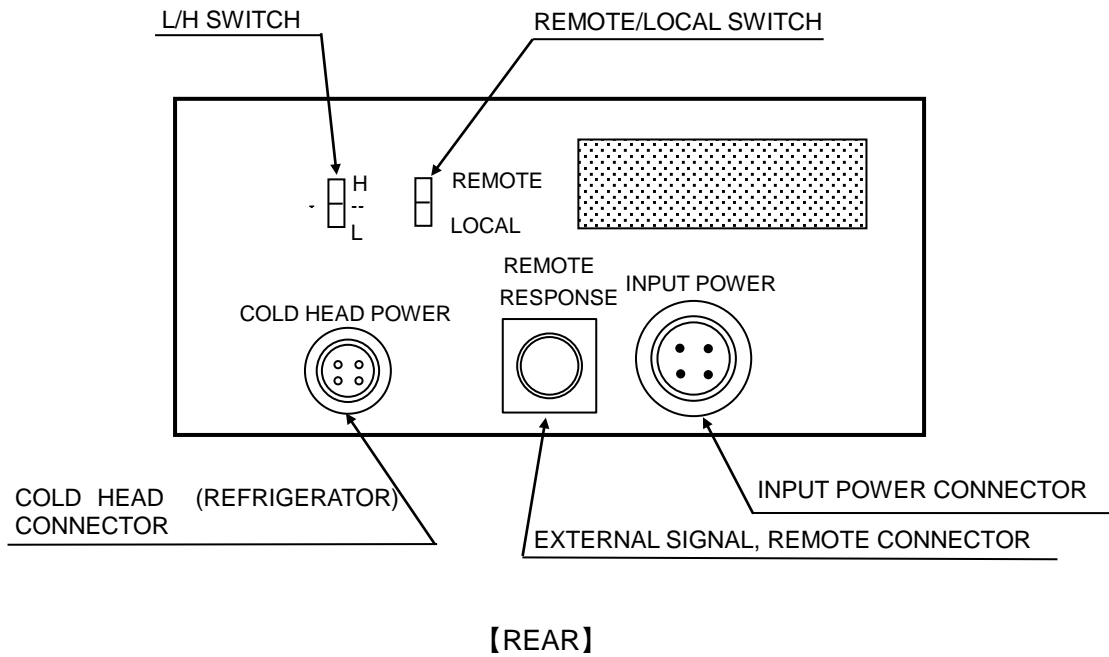


Figure 1-2 Major Components



※Remove the rear control panel for the switches of controller side.

Figure 1-3 Controller

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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 option 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

Table 2-2 Optional Parts

Item	Quantity
Input Power Cable (5.5mm 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 (Flexible hoses installing tool)	2
Gasket for Helium Coupling(Spare)	4

2.2. Compressor Unit

Check the helium gas pressure gauge.

If additional gas pressure is required, follow the instruction in the section 6.3.

Contact our Service Engineering Division or the nearest Customer Support Center, if it reduces pressure in spite of adding the gas.

2.3. Connecting Piping (Flexible Hose)



CAUTION

- Do not forcibly bend the flexible hose less than the minimum radius (250mm) or in a way that may damage the hose.
- Do not twist the connection of the flexible hose.
- Handle the hose with care and read Appendix C before use.

Check the flexible hose to ensure that there is no twist or break.

Leave the dust cap or plug as it is fixed when the flexible hose is not connected to the compressor unit and the cryopump.

2.4. Cables

Check the cables to ensure that they are intact.

If you find any missing parts or damages of the product, please contact our Service Engineering Division or the nearest Customer Support Center.

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3.1. Installation

1. The compressor must be installed on a flat floor with an inclination angle of less than 5°.
2. The compressor must be installed in a room where the ambient temperature is 10°C to 38°C. Avoid dust and moisture.
3. The compressor must be installed in such a position that pressure gauge inspection, charge valve operation and adsorber replacement can be easily made as Fig.3-1.

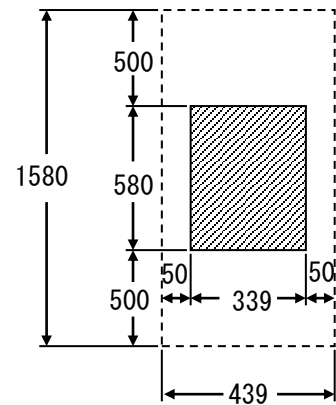


Figure 3-1

Maintenance Space

3.2. Connecting Cooling Water Piping

Install the cooling water lines as follows:

1. Cooling water inlet/outlet connector : Rc3/8 female
2. Water pipes should have be may use plastic hoses or copper pipes, provided that their pressure capacity is 1.5 times higher than cooling water supply pressure.
3. It is recommended that a filter is installed in the water line between the cooling water main valve and the compressor unit to remove water scales which can prevent cooling water flow. A flow meter (approx.0 - 10L/min.) is also recommended between the filter and the compressor unit for coolant observation purposes.
4. Make sure that the inlet and outlet of cooling water lines are correct.



CAUTION

Check water connections for leaks.

3.3. Cooling Water

1. The water used to cool the compressor must meet the specifications outlined in Table 1-1 and 3-1. Refer to Figure 3-2, the cooling water requirement.

The cooling water supply pressure must be below 0.7MPaG.



CAUTION

- Cooling water lower than 5°C can cause a difficulty in starting up the compressor or compressor overloading. If the ambient temperature exceeds 32°C, the thermal switch will operate to stop the compressor due to overheating.
- The over flow rate of cooling water may damage the heat exchanger.

2. We referred the cooling water standard quality of The Japan Refrigeration and Air-conditioning Industry Association. See Table 3-1.



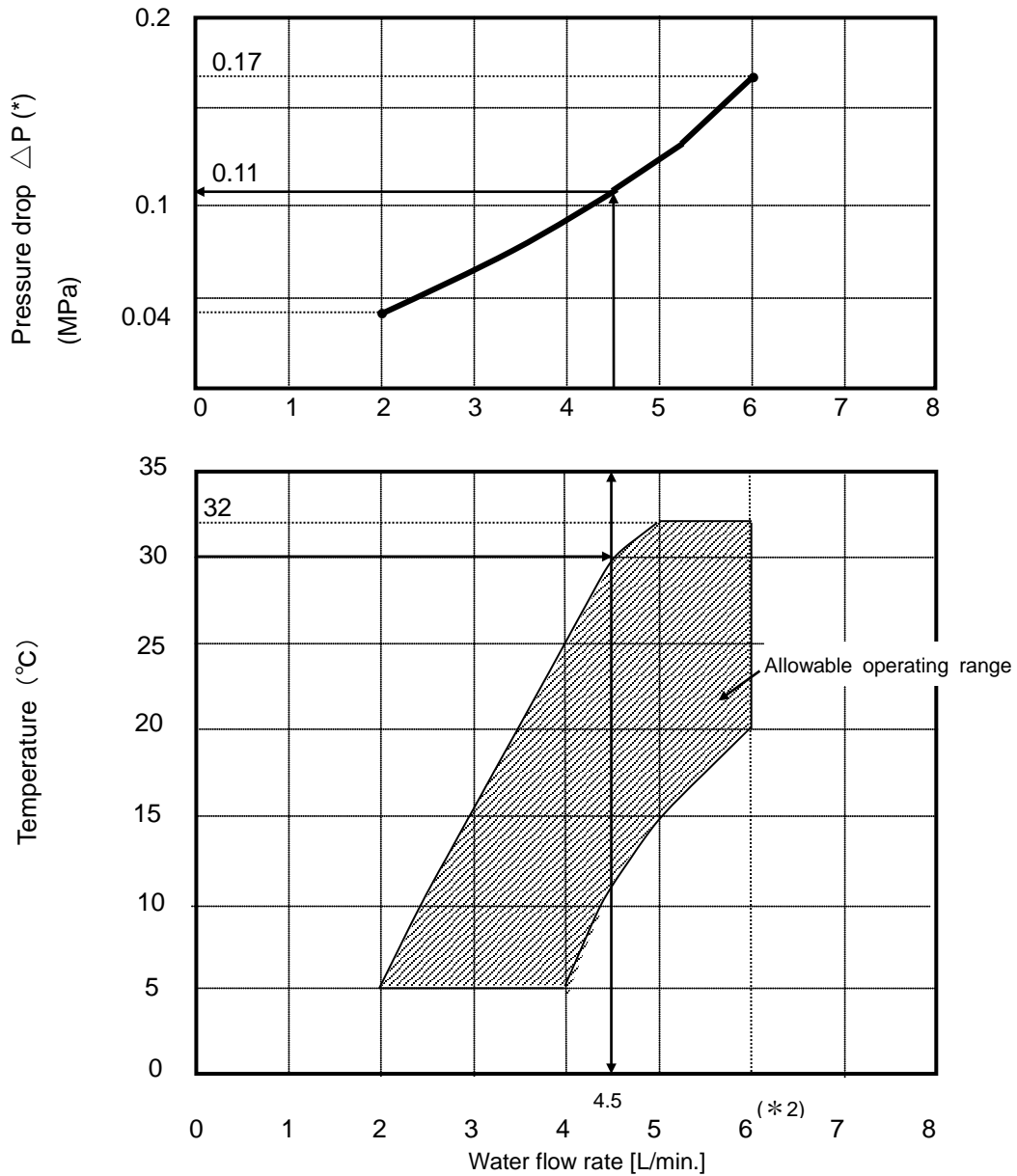
CAUTION

- The cooling water quality must meet the specification outlined in Table 3-1. If the water quality is out of the table, it may damage 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 total carbonic acid abundantly and pH value may be abnormally lowered. Therefore, corrosion accident of the heat exchanger may arise in the short-period when the ground water is used in the transient style. Check that the density of carbonic acid is less 10mg/L. Analyze the carbonic acid immediately after water-intake with airlessness in order to avoid changes by temperature and pressure. Confirm that the water supply is the ground water or not. Recommend using circulation style with cooling tower for the water containing abundantly carbonic acid.



(* 1)The water pressure drop (ΔP) means differential pressure between cooling water supply pressure and return pressure.

(* 2)The flow rate should be under 6.0 L/min to avoid the damage of corrosion of the heat exchanger.

EXAMPLE

A dashed arrow (\rightarrow) in the graph shows the minimum required water flow rate (4.5L/min.) and water pressure drop (0.1MPa) at the water supply temperature of 30 $^{\circ}\text{C}$.

3. The cooling water should be shut off when the compressor is not running, or it may allow corrosion or stuffing up of piping (heat exchanger).

**CAUTION**

If the temperature of the cooling water is below 10°C, stop the cooling water when the compressor has been stopped. If the cooling water of temperature below 10°C is supplied continuously while stopping the compressor, it may increase viscosity of lubricant oil and cause start up failure of the compressor when the operation command is sent.

Drain and purge water from the compressor when

- the compressor is subjected to freezing conditions.
- the compressor is not run more than one week.
- the compressor unit is shipped.

Purge water from the compressor by blowing air for 30 seconds at inlet pressure of 0.2MPa(gage) into the compressor with the outlet opened to the air.

3.4. Connecting the Compressor Unit to the Cryopump

(Connecting the Flexible Hose)

**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 dust and metallic powder.
2. Connect the flexible hose from the compressor to the cryopump. (See Figure 3-4)
 - 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 that the helium gas pressure gauge on the compressor reads 1.60 ± 0.04 MPa G at 20° C. If the indicated pressure is higher than the specified value, allow a slight amount of helium gas to discharge 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. See Figure 3-3.

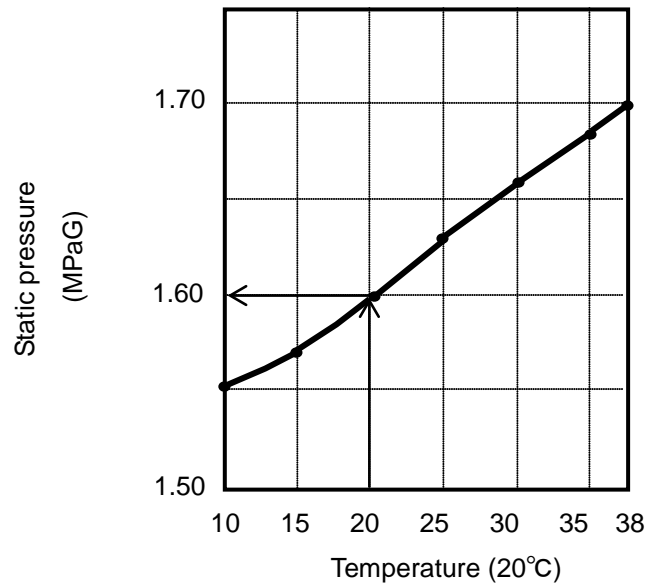
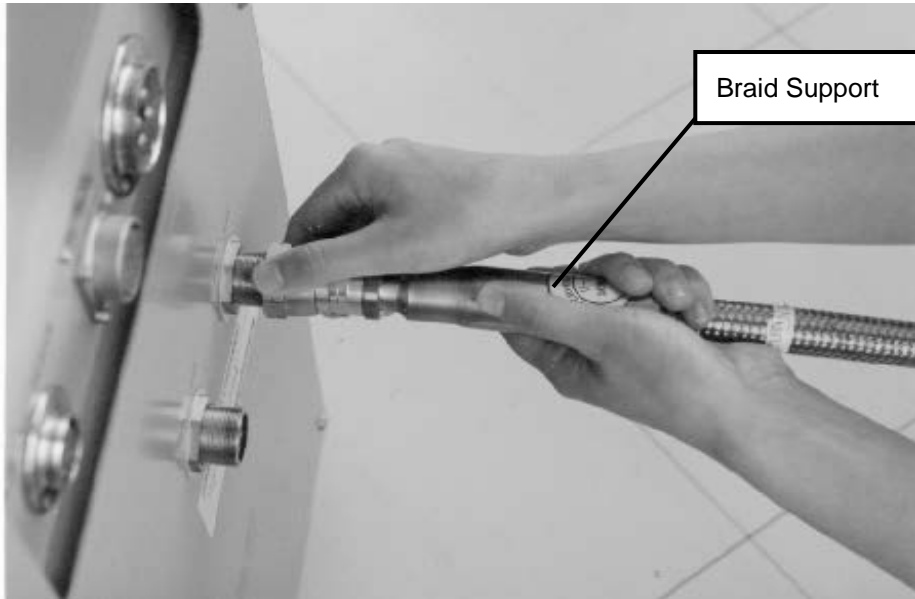
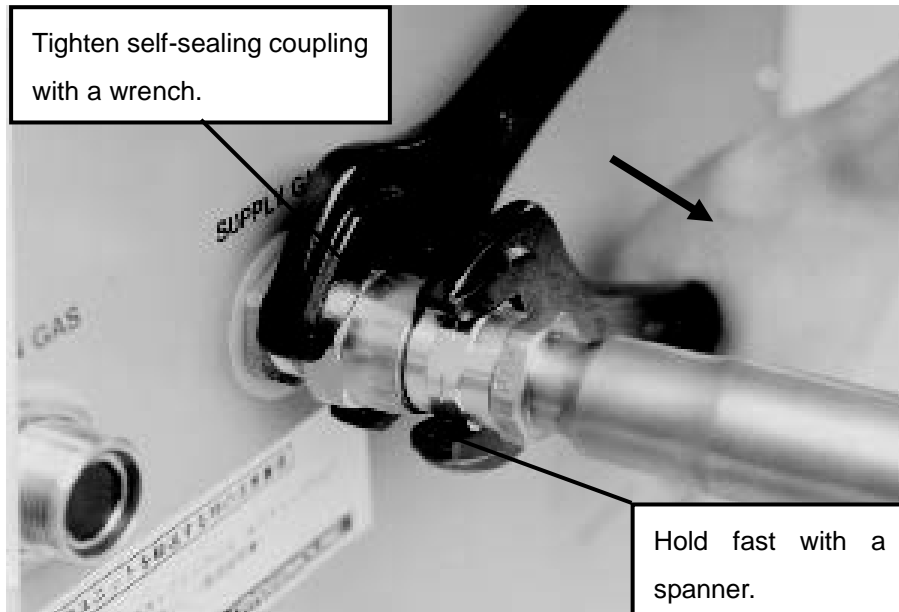


Figure 3-3 Static Pressure and Temperature



① Hold the coupling connection and the braid support straight and tighten by hand.



② Tighten the self-sealing coupling using two spanners until the fittings are firmly sealed. When using torque wrench, the recommended torque value is 20N·m.

Figure 3-4 Connecting Flexible Hose

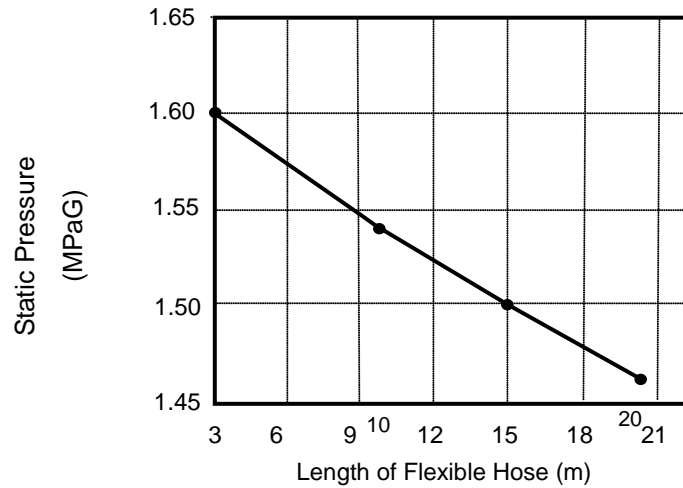


CAUTION

Do not operate the compressor with over static pressure, 1.65MPaG at room temperature 20° C and power is OFF.



In case of using the flexible hose of length over 3m, operating pressure is inclined to high. Standard pressure related with the length of flexible hose is as follows:

Flexible hose	3m(Standard)·····	1.60MPaG
	10m·····	1.53MPaG
	15m·····	1.50MPaG
	20m·····	1.47MPaG



【Contrast with Pressure and Length】

3.5. Connecting Electrical Cables

	 WARNING
Do not connect the compressor power cable until all connections have been made between the components and the cryopump system.	

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

	 WARNING
Disconnect the input power connector at REMOTE/RESPONSE wiring. 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, Appendix B. Certainly use the momentary switch (contact) with the circuit diagram for setting START/STOP push button switch (PB1, PB2) of compressor unit's remote operation.

◆ **RESPONSE WIRING** :Verify that the RESPONSE wiring and its relay specification is correct as shown in Appendix B.

2. Connect the refrigerator(cold head) power cable from the compressor to the cryopump.
3. Connect the ground.
4. 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 : Verify that the cable specification is equal to our attached cable's, if the input power cable is prepared by the customer.

Table 3-2 Input Power Cable Specifications

Item	Symbol	Specifications
Input power cable	INPUT POWER	Copper wire / 600VAC, 3 conductors with ground ^(*) 5.5mm ²

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

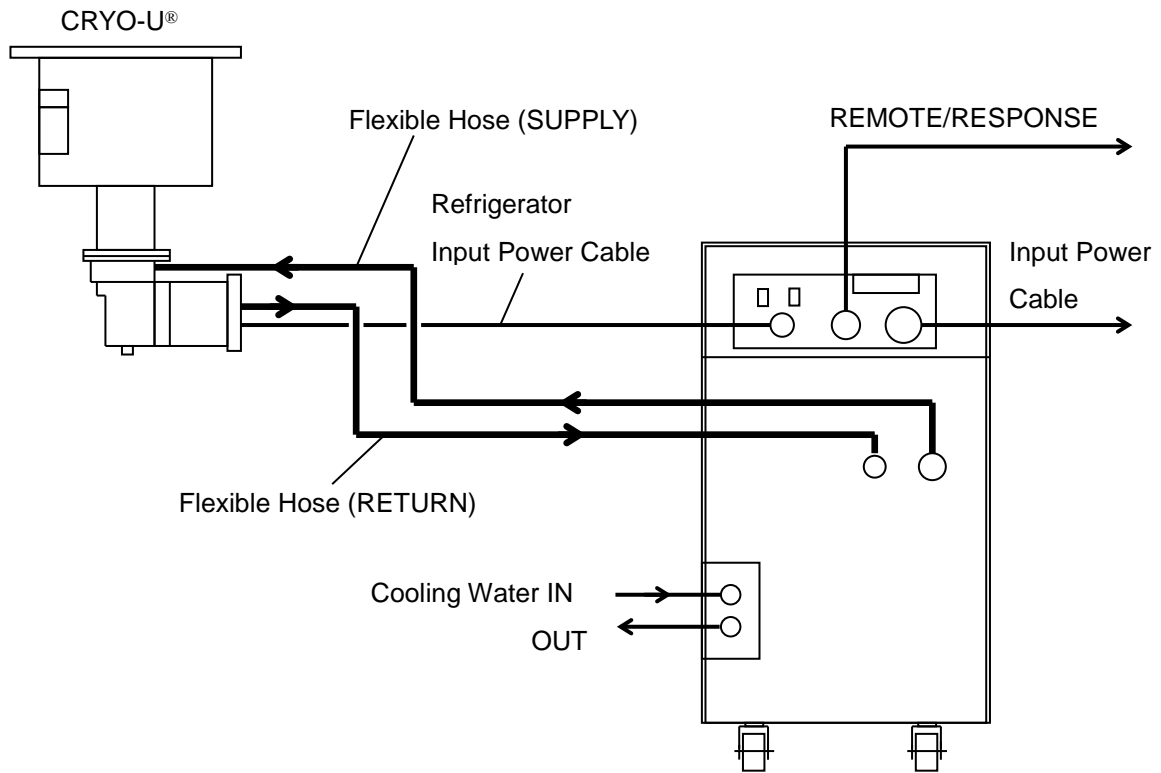


Figure 3-5 Compressor Installation

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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 is within the specified values shown in Table 1-1.
2. STOP switch (orange) lights when the power is supplied to the compressor.
If not light, reversed phase is considered. Change any one set of RST phase.
3. REMOTE/LOCAL switch is properly set.
4. L/H switch is properly set (generally L side).
5. All connections are tight.
6. Cooling water requirements is within the specified values shown in Table 1-1.
7. Helium gas static pressure is within the specified values shown in Table 1-1.

Compressor and refrigerator are now ready for operation.

4.2. Normal Operation

Push the START switch of the compressor to start operation.



CAUTION

Verify that the helium gas static pressure is within the specified values shown in Table 1-1.
The helium gas pressure during the operation will be changed by the length of flexible hose.
In case of using the flexible hose over 3m, the operating pressure becomes very high.
Discharge the helium gas by opening the gas charge valve very slowly.

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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

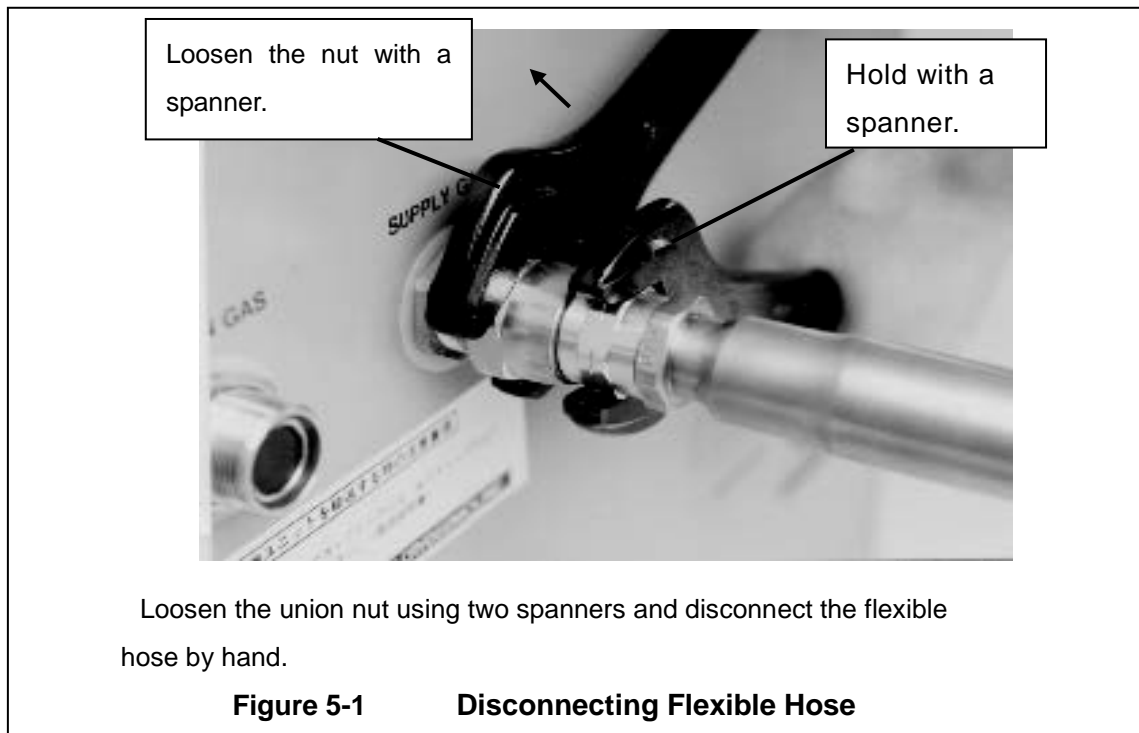
When disconnecting flexible hoses, be sure to use two single open end spanners with width across flat 26mm and 30mm.

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 : Replacement of the adsorber (after every 30,000 hrs)
- ◇ Unscheduled Maintenance : Adding helium gas

6.2. Replacement of Adsorber

One of the scheduled maintenance required on the compressor is the replacement of the adsorber within every 30,000 hours. Use more than 30,000 hours cause to be a machine trouble on refrigerator unit. Keep to remove and replace the adsorber proceed within every 30000 hours as following procedures:

◆ 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 jam nuts holding the self-sealing coupling (male) .(Figure 6-1 ①)
6. Remove the rear panel from the compressor by unscrewing 7 screws.(Figure 6-1 ①)
7. Disconnect the flexible hose from the adsorber inlet. (Figure 6-1 ②)

**CAUTION**

When disconnecting and reconnecting the self-sealing coupling, always use two spanners as described in Section 3.4 and 5.1.

8. Remove the adsorber mounting bolt (M6). (Figure 6-1 ③)
9. Remove the adsorber from the compressor. (Figure 6-1 ④)

**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 adsorber to the compressor internal piping.
4. Ensure that the helium pressure gauge reads 1.60 ± 0.04 MPaG. If additional gas pressure is required, follow the instructions in Section 5.1.
5. Replace the rear panel.
6. Write installation date and elapsed time on the adsorber label. Also write elapsed time for the next replacement of adsorber (plus 30000 hours to the present elapsed time).



① Remove the jam nuts. Remove the rear panel from the compressor unit by unscrewing 7 screws.



② Disconnect the flexible hose from the adsorber inlet.



③ Remove the adsorber mounting bolt.



④ Draw the adsorber out of the compressor unit.



※ Draw the adsorber out of the compressor unit by learning it. (Do not touch the piping.)

RECORD SHEET OF THE ADSORBER REPLACEMENT

Replace the adsorber after a maximum operation of 30,000 hours. Write the elapsed-time of the meter (ETM) on this sheet.

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

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* Install the replacement adsorber following the steps for adsorber removal in reverse order.

* Record on the label the elapsed time.

Figure 6-1 Replacement of Adsorber

6.3. Charging Helium Gas

Please supply the equipments for charging helium gas (regulators, charging hoses, adapters) that can be used at 2.0MPaG or above.



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. Improperly connected self-sealing coupling might be one of the causes of the leakage.

- ◇It is recommended to use the regulator which shows the range of 4-6 MPaG as outlet pressure.
- ◇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 a little. The regulator can be opened commonly 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.



CAUTION

If the bottle valve is opened ignoring the above procedures (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 charge in the line between the regulator and the charge valve on the compressor has been completed.
- 4 . Adjust the low pressure side of the regulator at 1.8 MPaG.
 - 5 . Open the charge valve slowly and perform the following instruction 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 compressor instruction manual.
 - b. If the compressor unit is not running, replenish it with the pure helium gas until it reaches the static pressure described in the compressor instruction manual.

**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. On the other hand, the pressure relief valve in the compressor unit is set to 2.85MPaG.

6. Close the charge valve after charging helium gas.
 7. Close the regulator and remove the charging hose from the charge inlet.
- The replenishment work of the gas for the compressor has been completed with this.

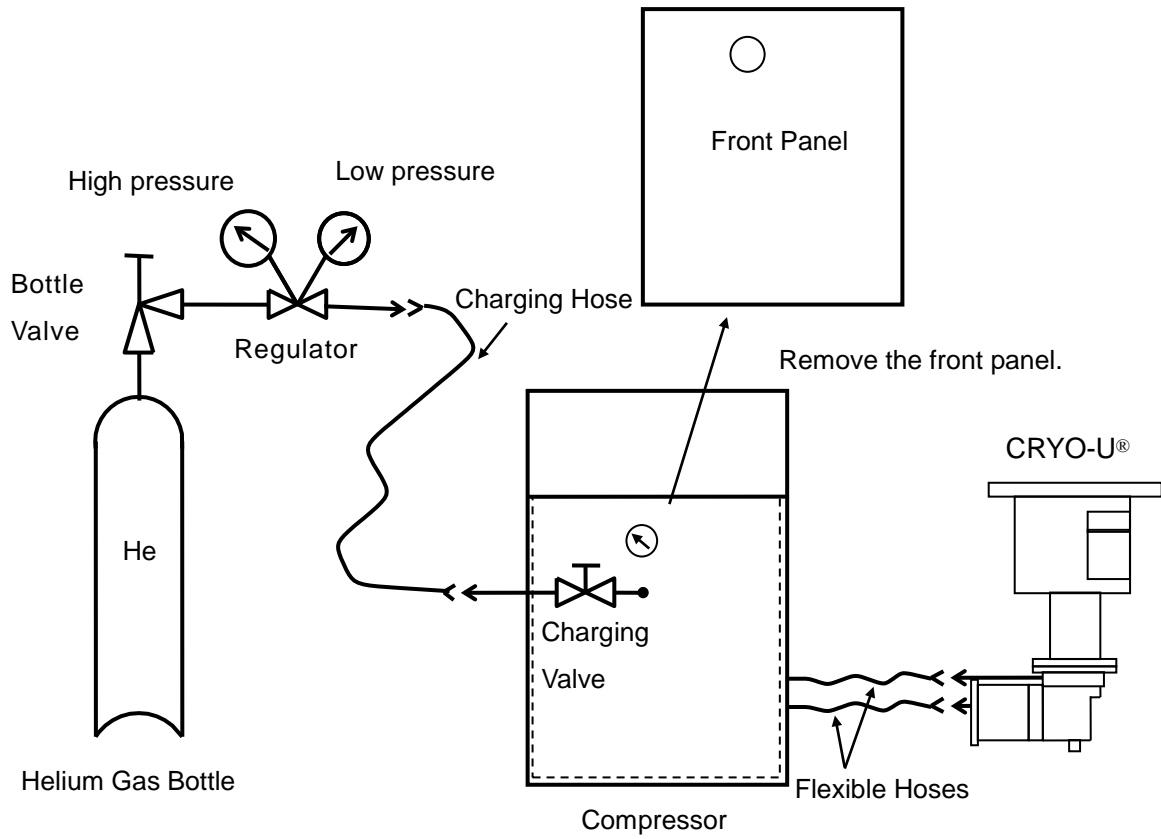


Figure 6-2 Charging Helium Gas

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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 does not start.	1) No power coming from the source.	Check wiring and ensure that the power supply connector is connected properly.
		2) Circuit protectors (CP1, CP2) are OFF.	Set circuit protector to ON. (See Fig.1-3)
		3) Phase reverse relay (PRR) is active. (STOP lamp lights off)	Interchange primary power phase II. (Refer to Section 4.1)
II	Compressor stops during continuous operation.	1) Thermal protective switch (TS3) is ON.	Check the cooling water condition (temperature, flow rate). (See Fig.3-2).
		2) Circuit protectors (CP1, CP2) or thermal relay (OL) are active.	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 needed.)
		3) Thermal protective switches (TS1 and TS2) are ON.	Contact our Service Engineering Division or the nearest CS center.
III	Compressor stops after several minutes'	1) Thermal protective switch (TS3) is ON.	Check that the cooling water is flowing and its flow rate. (See Fig.3-2)

III	operation. (continued from the previous page)	2) Low pressure switch (LPS) is ON.	Add helium gas till the static pressure.
		3) Circuit protectors (CP1, CP2) or thermal relay (OL) are active.	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 needed.)
		4) Thermal protective switches (TS1 and TS2) are ON.	Contact our Service Engineering Division or the nearest CS center.
		5) Compressor failure.	Contact our Service Engineering Division or the nearest CS center.
IV	Compressor makes unusual noise during operation.	Helium gas pressure is too high.	Check the helium gas pressure. The pressure must not exceed 1.65MPaG (at room temperature 20°C).

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Appendix B

CIRCUIT DIAGRAM

◆ Safety Devices (inside of the controller)

	Name	Function and specification
OL	Thermal relay (AUTO RESET)	This relay is set up in the controller and automatically stops the compressor if the current flowing in the compressor is higher than specified value due to overloading, etc. STOP pushing button (PB1) lights up. <ul style="list-style-type: none"> • Rated current: 14A
CP1	Circuit protector (MANUAL RESET)	This device shuts off power if any line in the compressor circuitry is shorted. <ul style="list-style-type: none"> • Rated current: 25A
CP2	Circuit protector (MANUAL RESET)	This device shuts off power if any line in the refrigerator circuitry is shorted. <ul style="list-style-type: none"> • Rated current: 1A
PRR	Reverse phase protective relay	This relay does not allow the compressor to start when the compressor power wires are connected reverse phase.

◆ Safety Devices (outside of the controller)

	Name	Function and specification
TS1	Thermal switch	This switch automatically stops the compressor if the oil flow rate is insufficient or the compressor is overloaded. STOP push button (PB1): lights-out
TS2	Thermal switch	This switch is set up on the top of compressor and automatically stops the compressor if the compressor pump temperature is excessively high due to overloading, etc. STOP push button (PB1): lights-out
TS3	Thermal switch	This switch stops the compressor if there is no cooling water supply or cooling water temperature is excessively high. STOP push button (PB1): lights-out

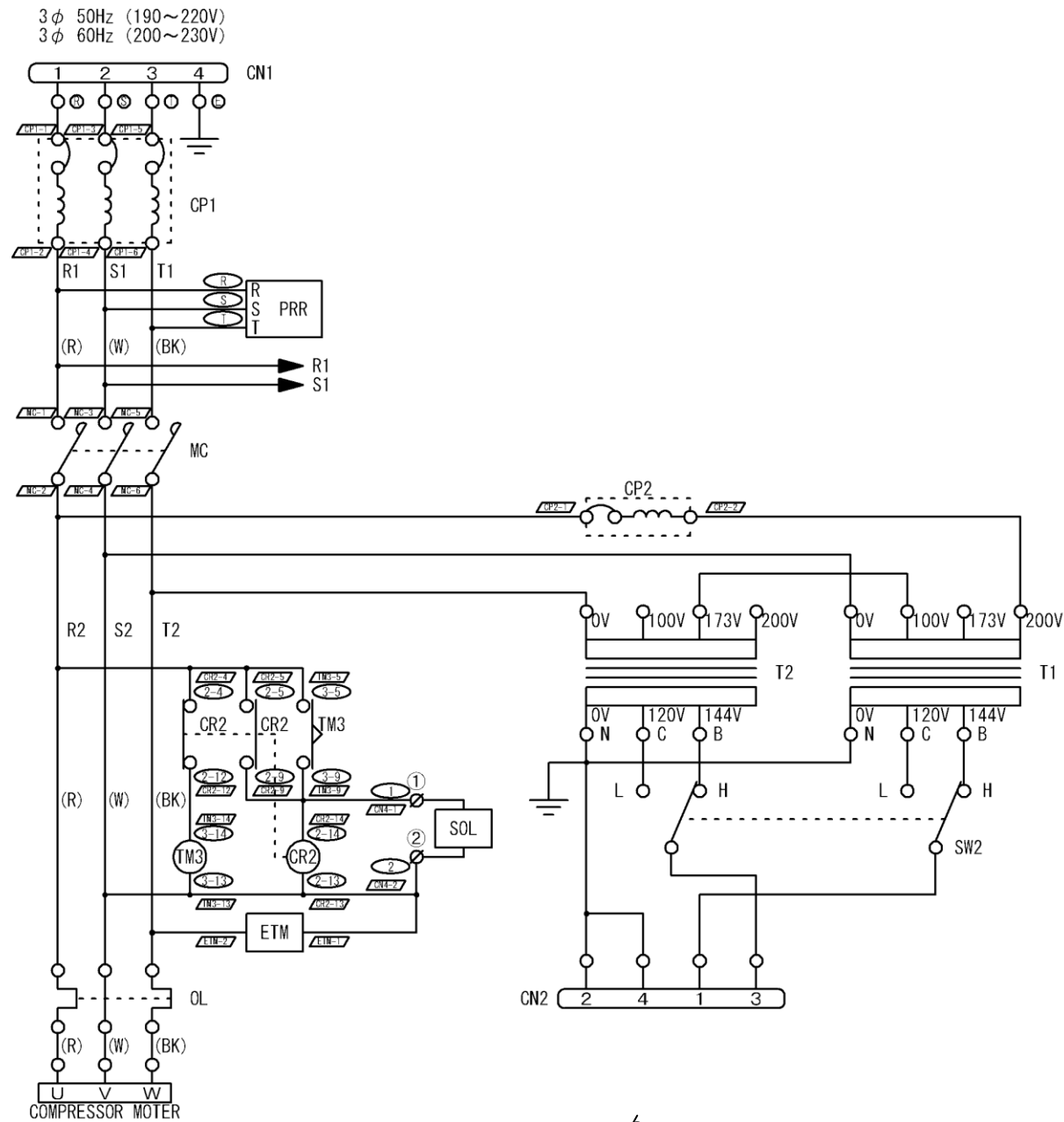
—	Safety valve	This valve is set up in the helium supply line and automatically opens when the pressure is higher than static value. Set pressure: 2.85MPaG (413psig)
—	Differential pressure regulating valve	This valve is set up in the helium line between helium supply and return. The valve keeps the difference of pressure at the constant pressure rate. Set pressure: 1.60MPa
LPS	Low pressure switch	This switch stops the compressor when the pressure drops below a set value (due to leakage, etc.). Set pressure: 0.1±0.3MPaG
SOL	Solenoid valve	This valve opens when the compressor is turned off.

◆ Electrical equipment function

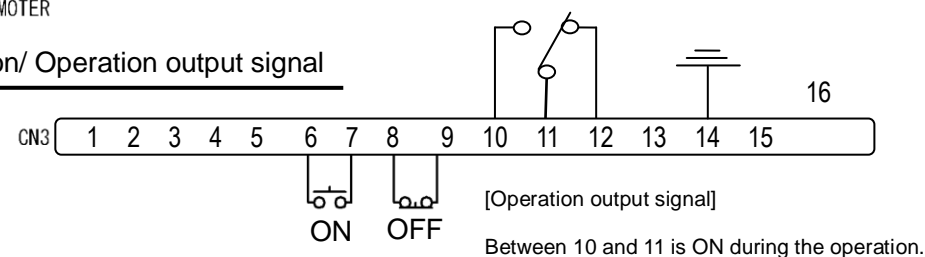
	Name	Function and specification
PB1 (PL1)	STOP push button switch (ON: lighting) (Momentary)	Push to turn off the compressor and refrigerator. The compressor connected to the power supply but not operating ↓ ORANGE lamp lighting
PB2 (PL2)	START push button switch (ON: lighting) (Momentary)	Push to turn on the compressor. The compressor starts the operation. ↓ GREEN lamp lighting / STOP switch lamp lights-out
SW1	REMOTE/LOCAL switch	Depends on your selection, START/STOP of the compressor operation and ON/OFF of the refrigerator operation by a remote location or switching of the compressor unit. Need to connect with REMOTE/external signal connector when you select a remote location.
SW2	L/H switch	Set the switch in H position at the shipment. (If the cryopump vibrates excessively, set this switch to the L position but only the case of using the compressor in 50Hz.)
ETM	Elapsed time meter	This meter displays the elapsed operating hours of the compressor unit.
MR	Instant restart relay	<ul style="list-style-type: none"> • Instant power cut within 2 seconds ⇒ Automatically restart • Instant power cut over 2 seconds ⇒ Not restart

CR1	Output signal relay to control the unit	<p>Use to start the operation of compressor unit & refrigerator by pushing START(PB2), STOP(PB1) and to indicate the operating status.</p> <p>1C-contact of the relay is connected to REMOTE connector on the rear panel, therefore you will know the compressor status by using REMOTE connector.</p> <p>The following table shows the specification of the relay cont-act.</p> <p style="text-align: center;">CONTACT SPECIFICATIONS</p> <table border="1" data-bbox="598 616 1353 896"> <tr> <td data-bbox="598 616 943 660">Maximum voltage</td> <td data-bbox="943 616 1153 660">AC250V</td> <td data-bbox="1153 616 1353 660">DC125V</td> </tr> <tr> <td data-bbox="598 660 943 705">Maximum current</td> <td data-bbox="943 660 1153 705">5A</td> <td data-bbox="1153 660 1353 705">5A</td> </tr> <tr> <td data-bbox="598 705 943 846" rowspan="2">Rated load</td> <td colspan="2" data-bbox="943 705 1353 750">Resistance load (Induction load)</td> </tr> <tr> <td colspan="2" data-bbox="943 750 1353 846"> AC220V 5A (2A) DC 24V 5A (2A) </td> </tr> <tr> <td data-bbox="598 846 943 896">Minimum applicable load</td> <td colspan="2" data-bbox="943 846 1353 896">DC5V 1mA</td> </tr> </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															
CR2	Solenoid valve (SOL) relay	This relay is ON when the compressor is powered on.														
TM1	OFF delay timer	This timer delays stopping the compressor for 5 seconds to pre-vent overloading.														
TM2	ON delay timer	This timer delays restarting the compressor for 5 seconds to prevent overloading.														
TM3	On delay timer for SOL	This timer keeps the solenoid valve open for 30 seconds to prevent overloading.														

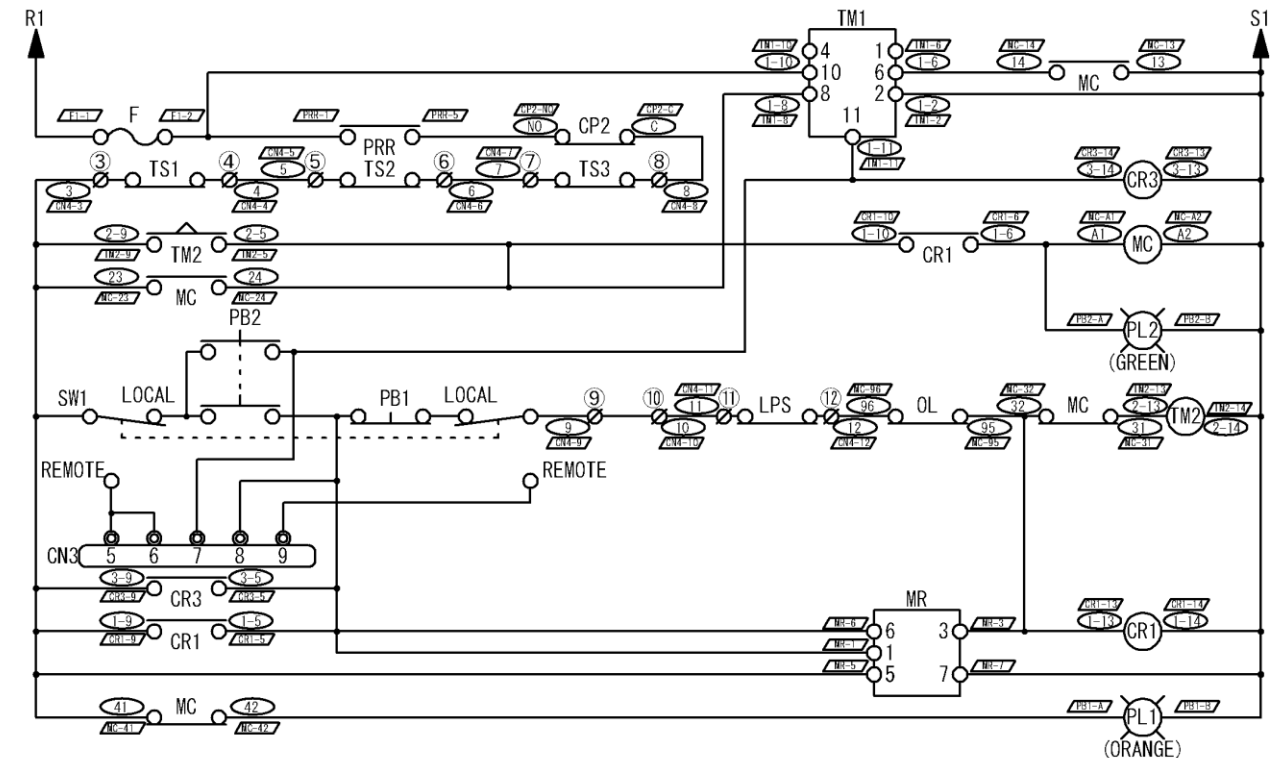
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Remote operation/ Operation output signal



Use 1a contact momentary pushbutton to turn the compressor ON.
 Use 1b contact momentary pushbutton to turn the compressor OFF.
 Switches and wires should be prepared by customer. (Recommended rating: 220V, 5A)



- | | | | |
|-----------|---|--------|---|
| CN1 | Input power connector | MC | Electromagnetic contactor |
| CN2 | Refrigerator connector | MR | Instant restart relay |
| CN3 | Output REMOTE connector | PRR | Reverse phase protective relay |
| (CN4) | Internal connector | SOL | Solenoid valve |
| CP1 | Circuit protector | SW1 | REMOTE/LOCAL switch |
| CP2 | Circuit protector | SW2 | L/H switch |
| CR1 | Output signal relay to control the unit | TM1 | OFF delay timer (Set 5 sec.) |
| CR2 | Solenoid valve (SOL) relay | TM2 | ON delay timer (Set 5 sec.) |
| CR3 | Relay | TM3 | ON delay timer for Solenoid valve (SOL) (Set 30 sec.) |
| ETM | Elapsed time meter | T1, T2 | Transformer |
| F | Fuse | OL | Thermal relay |
| LPS | Low pressure switch | TS1 | Thermal protective switch (He discharging) |
| PB1 (PL1) | STOP push button switch (Orange) | TS2 | Thermal protective switch (Compressor motor) |
| PB2 (PL2) | START push button switch (Green) | TS3 | Thermal protective switch (Oil temperature) |

NOTE

- ① ⊙ : CN3 (For output signal, REMOTE), inside is pin No.
- ② ⊘ : CN4 (Internal connector), inside ○ is pin No.
- ③ Wire number: Numbered inside of . Terminal block number: Numbered inside of .
- ④ Color of wiring: (R)--Red, (W)--White, (BK)--Black
- ⑤ CP1, CP2 are "ON" position in the shipment.

*This circuit diagram will be applied after S/N DE1498B.

Figure B-1 C15R CIRCUIT DIAGRAM

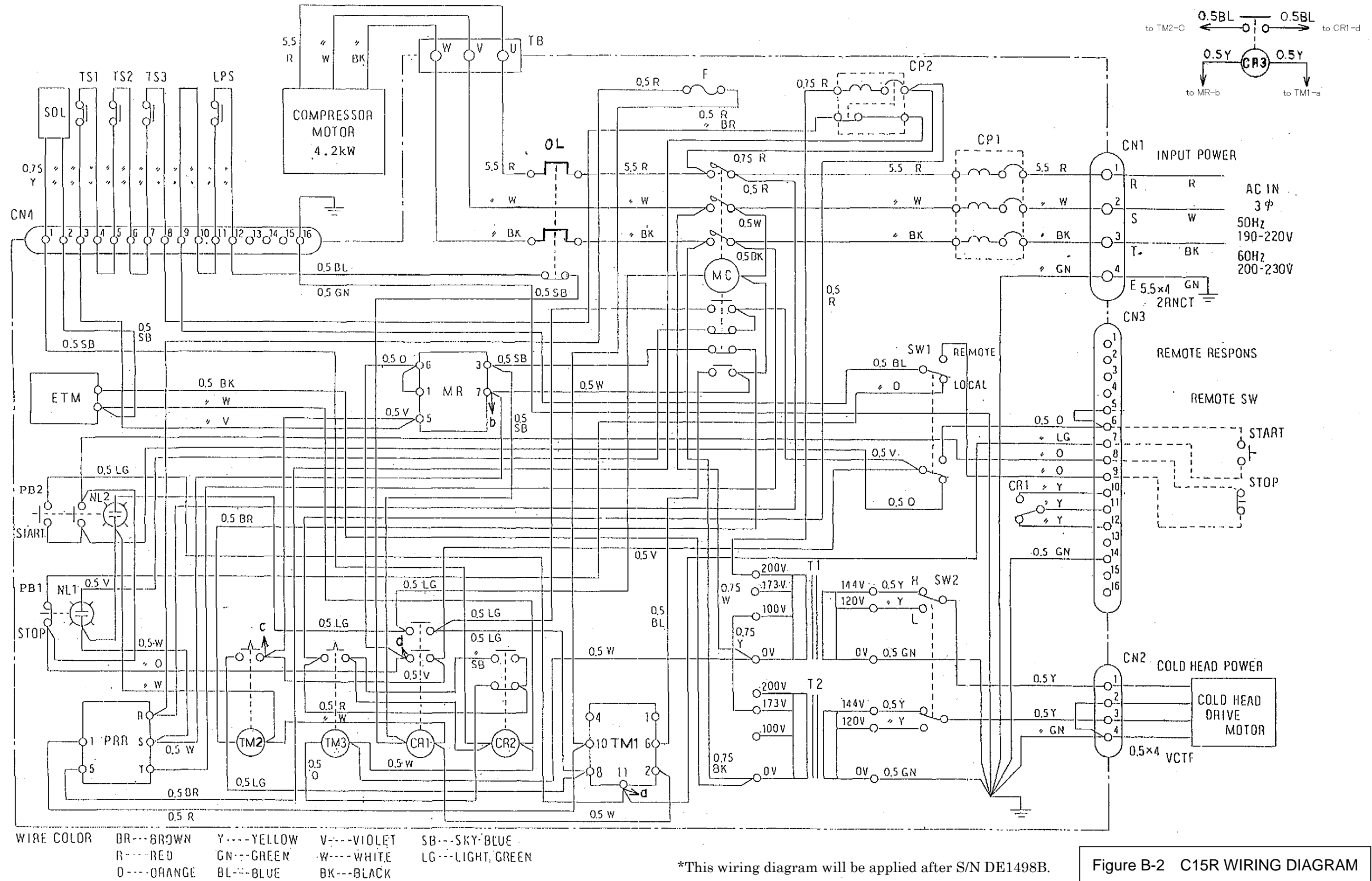


Figure B-2 C15R WIRING DIAGRAM

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.

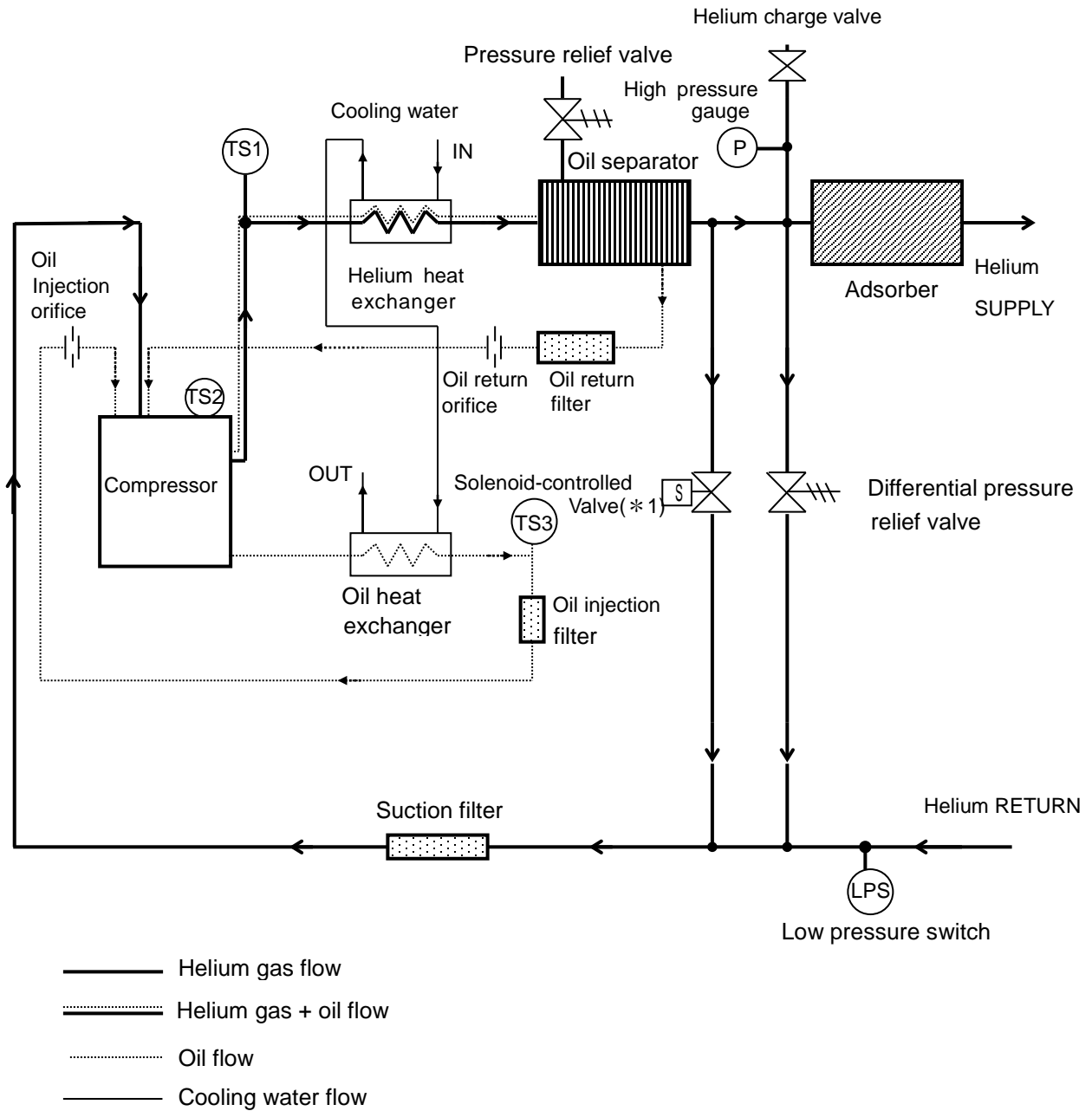
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Appendix D

FLOW DIAGRAM

Low pressure helium gas returning from the refrigerator unit enters the compressor. Lubricant oil is injected into the compressor with the low pressure helium; the gas containing the oil is then compressed by the compressor pump turning it into high temperature high pressure helium gas. Most of the lubricant oil returns to droplet form and is separated within the compressor. This lubricant oil is pooled at the bottom and lubricates the inside of the compressor. It follows the circulating system where it comes out from the compressor and cooled down at an oil heat exchanger before being injected back into the compressor through an oil injection filter.

High temperature high pressure helium gas comes out from the compressor, passes through a water cooled helium 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 the droplets of separated oil pass thorough an oil return filter and oil return orifice before joining the low pressure helium gas and being returned to the compressor. High pressure helium gas comes out from the 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.



(* 1): Open when the compressor unit is in operation.

Figure D-1 C15R Flow Diagram

SERVICE NETWORK

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Revision History

Date	Revision No.	Contents
2007/07/11	2007.07	First edition
2007/12/21	2007DR01	Collection of the Table of Contents. Collection of the Table A-1 troubleshooting procedure.
2009/04/21	2009AL02	In the “2.INSPECTION 2.1 shipping List”, COLD HEAD POWER cable quantity has been corrected (2→1) and Single handed wrench quantity has been corrected (3→2) .
2009/11/16	2009NR03	“Introduction” has been revised. UCN address has changed. “SERVICE NETWORK” has been revised.
2010/07/28	2010JU04	Full-fledged revision.
2011/02/10	2011FY05	Cover: Export control policy has been revised. P. B-5~8 The Circuit Diagram and the Wiring Diagram have been changed.
2011/04/26	2011AL06	Table 2-1 Shipping List The item “Gasket for Helium Coupling (Spare) x 4” has been moved to Table 2-2 Optional Parts. Table 3-1 Recommended Cooling Water for Compressor The unit and allowable range of conductivity has been changed.
2012/06/07	2012JE07	P.B-5/6 Figure B-1 C15R Circuit Diagram has been revised. “SERVICE NETWORK” has been revised.
2013/03/26	2013MH08	“Safety Instruction” No.3 and No.5 have been revised. “SERVICE NETWORK” has been revised.
2013/10/02	2013OR09	“Introduction” has been revised. Appendix A TableA-1 has been corrected. “SERVICE NETWORK” has been revised.
2013/11/08	2013NR10	“Introduction” has been revised. “SERVICE NETWORK” has been revised.
2015/06/23	2015JE11	“Compressor Unit Safety Instructions” has been revised. Section 6.3 Charging Helium Gas The description on charging procedure has been modified. “SERVICE NETWORK” has been revised.
2019/08/19	2019AT12	“SERVICE NETWORK” has been revised.

2023/10/23	2023OR13	<p>“Safety Instructions” Description on the adsorber disposal has been modified.</p> <p>“6. Maintenance” P.6-4 Caution has been modified.</p> <p>Appendix C A note has been added to flexible hose allowable pressure.</p>
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