

COMPRESSOR UNIT

Instruction Manual

C40R

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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TABLE OF CONTENTS

Safety Instructions	S-1
Disposal Consideration	IW-1

SECTION 1 Compressor unit Description

1.1 Introduction	1-1
1.2 Specifications	1-2
1.3 Helium Gas Pressure	1-3
1.4 Dimensions	1-4
1.5 Components Names and Descriptions	1-5

SECTION 2 Inspection

2.1 Shipping List	2-1
2.2 Compressor Unit	2-2
2.3 Flexible Hose (optional)	2-2
2.4 Cables (optional)	2-2

SECTION 3 Installation

3.1 Installation	3-1
3.2 Connecting Cooling Water Piping	3-1
3.3 Cooling Water	3-2
3.4 Connecting the Compressor Unit to the Cryopump (Connecting Flexible Hose)	3-5
3.5 Connecting Electrical Cables	3-8
3.6 Before Operation	3-10

SECTION 4 Maintenance

4.1 Scheduled and Unscheduled Maintenance	4-1
4.2 Replacement of Adsorber	4-1
4.3 Charging Helium Gas	4-5

SECTION 5 Disconnection and Storage

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

APPENDIX

A	Troubleshooting	A-1
B	Circuit Diagram	B-1
C	Flexible Hose	C-1
D	Flow Diagram	D-1

FIGURES

Figure	1-1	Dimensions	1-4
	1-2	Components Names (Front)	1-5
	1-3	Components Names (Rear)	1-7
	1-4	Components Names (Side of control box)	1-8
	3-1	Maintenance Space	3-1
	3-2	Cooling Water Requirement	3-3
	3-3	Static Pressure and Temperature	3-7
	3-4	Connecting Flexible Hose	3-8
	3-5	Remote operation connecting Diagram	3-11
	4-1	Replacement of Adsorber	4-3
	4-2	Charging Helium Gas	4-7
	5-1	Disconnecting Flexible Hose	5-2
	B-1	C40R Circuit Diagram	B-1
	D-1	C40R Flow Diagram	D-2

TABLES

Table	1-1	Compressor Unit Standard Specifications	1-2
	1-2	Specifications for Connections	1-3
	1-3	Helium Gas Pressure	1-3
	3-1	Recommended Cooling Water for Compressor	3-3
	A-1	Troubleshooting Procedures	A-1
	A-2	Operating Log	A-3

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, please read the "Maintenance" section carefully and follow the instructions.

Regulators, charging hoses, adapters, or other necessary equipment that can be used at the pressure of 2.0MPaG or above are required.

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 shutdowns and startups may shorten the insulation life of a compressor motor and may lead to failure. When operating multiple refrigerators, startup/shutdown of the refrigerator motors must also be less than 6 times per hour.

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 the used adsorber before disposing of it.

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 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 allowed voltage may damage the equipment.
- Install a ground-fault circuit interrupter(rated current: 40A, 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. 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.
- Power lines and signal lines must be separated by at least 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 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 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. 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 inappropriate conditions such as dusty, too humid 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 shut off before opening the cover of the compressor to avoid the risk of electrical shock.

Also, parts of inside the compressor unit are still hot just after the compressor has been stopped. Wait at least 15 minutes to open the cover to avoid the risk of burns.

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.

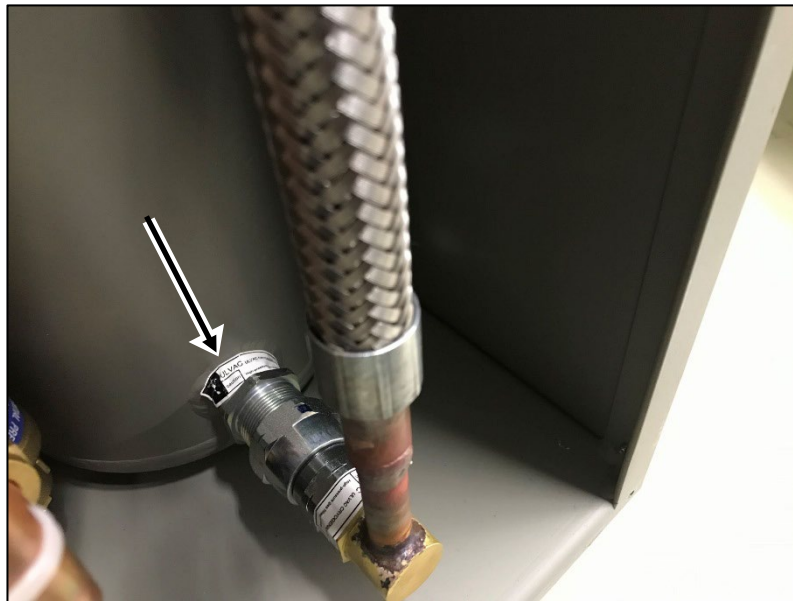








Figure Example of the sealing sticker pasted on the self-sealing coupling

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

1.1	Introduction	1-1
1.2	Specifications	1-2
1.3	Helium Gas Pressure (Room temperature : 20°C)	1-3
1.4	Dimensions	1-4
1.5	Components Names and Descriptions	1-5

1.1 Introduction

C40R is a product that pursued the high compatibility with C40.

The performance (cryopump performance), power consumption and electrical interface are generally the same as C40.

Please note that only the refrigerator connector is different from that of C40.

To replace C40 with C40R, compressor harnesses type-U are needed separately.

The compressor unit supply high pressure helium to the coldhead unit of CRYO-U cryopumps.

This compressor unit consists of:

1) a compressor motor, 2) a water cooling system, 3) an oil separation system and 4) an adsorber.

1.2 Specifications

Table 1-1 shows Standard Specifications and Table 1-2 shows Specifications for Connections.

Table 1-1 Compressor Unit Standard Specifications

Item		C40R	
3 ϕ Power supply voltage	50Hz	190–220VAC	
	60Hz	200–230VAC	
Power consumption (50Hz/60Hz)	kW	6.0 / 8.5 (*1)	
Operation current (50Hz/60Hz)	A	22.0 / 25.5 (*1)	
Start up current (200V 50Hz/60Hz)	A	140 / 126	
Nominal output	kW	3.58	
Cooling water flow rate (at 20°C)	L/min	5.0 - 15	
Helium gas charging pressure (at 20°C)	MPaG	1.50	
Dimension	Height	mm	740
	Width	mm	453
	Depth	mm	510
	Weight	kg	130

(*1) Power consumption and Operation current values shown above are at steady state of four U8 type cryopumps in multiple operation.

During cooling down of the cryopump, until it stabilizes at a low temperature, the electric current value is about 10% larger than the stationary electric current.

Table 1-2 Specifications for connections

Item		C40R	
Connection	Cooling water inlet and outlet (female pipe thread)	Rc 3/8 female pipe thread	
	Flexible hose	#8 self-sealing coupling	
	INPUT POWER	Terminal block (electric wire size 8AWG) (*1)	
	(*2) Refrigerator connector	Output	3φ、200VAC
		Model	NJC-204-RF
		Quantity	4
	Remote connector	Model	MS3102A20-27S (Attached cable clamp:MS3106B20—27P)
		Input signal	Operation (4 refrigerators)
		Output signal	Operation and alarm
		Voltage	DC24V
Helium fill fitting		1/4 flared	
Adsorber replacement	Cycle	Max. 24000h	

(*1) Please refer to "Section 3.4 Electrical connections" for wire connection of INPUT POWER.

(*2) To replace C40 with C40R, compressor harnesses type-U (UC2800-009-18) are needed.

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

The table below shows examples of helium gas pressure during operation when flexible hoses are standard length (3m). The operation pressures in the table are of operating U8 type cryopump. Operation pressure depends:

1. The length of flexible hose. (Please use flexible hoses between 3m and 20m in length.)
2. Cryopump model and the number of cryopump in operation.

Table 1-3 Helium Gas PressureUnit : MPa(G)

Helium Static Pressure		1.50±0.04	
Operation Pressure (SUPPLY)	Just after start up	Below 2.30	
	The number of cryopump in operation	Single operation	4 cryopumps multiple operation
	After cooldown (in steady state)	2.20	1.90

The pressure after cooldown (in steady state) depends on the temperature of cryopump and operation frequency. It will be slightly differ from the value in the table 1-3. Approximately ±0.07Mpa.

1.4 Dimensions

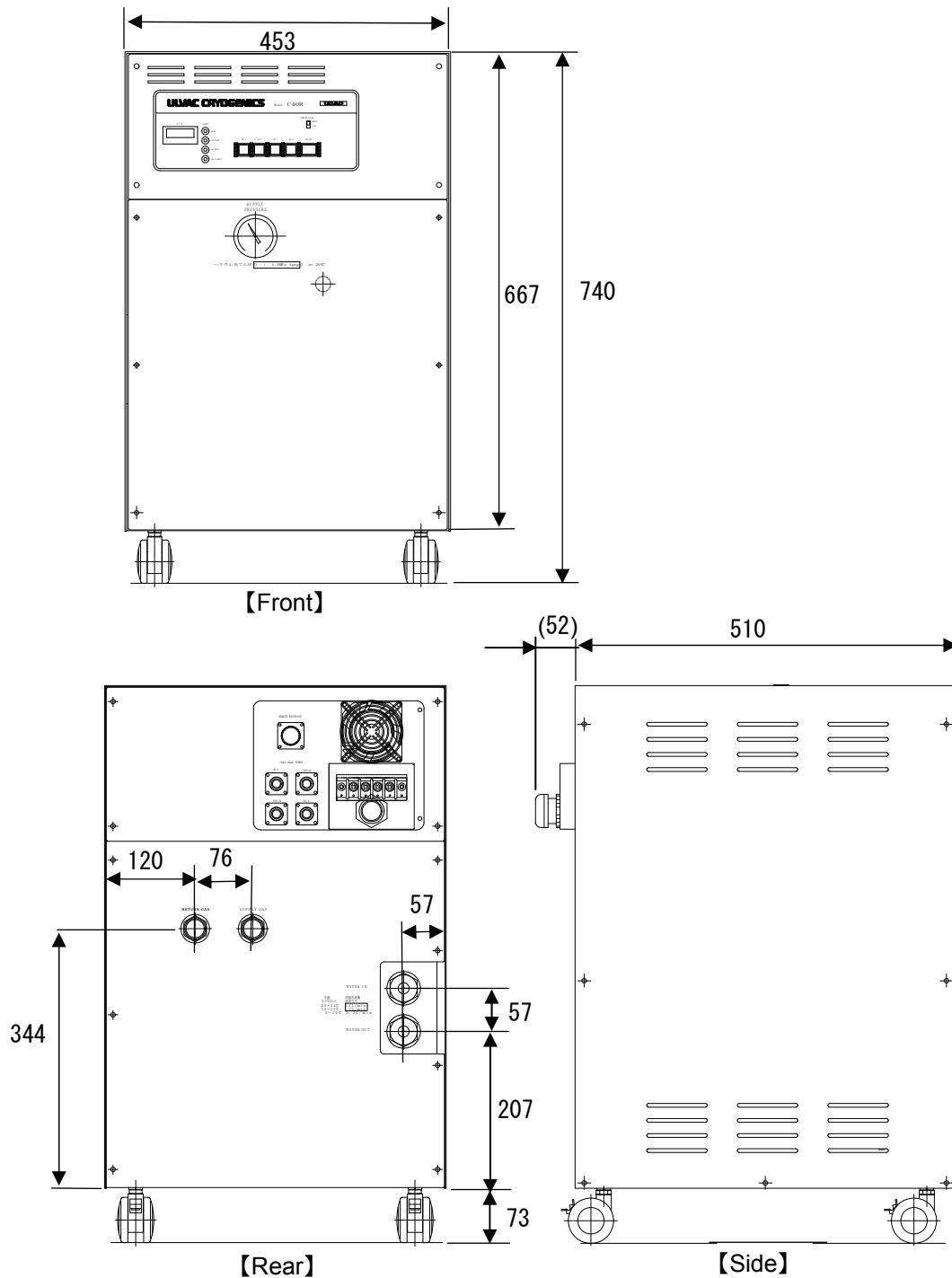


Figure 1-1 Dimensions



CAUTION

Before using crane or forklift to lift or move the compressor, make sure where the center of gravity is.

1.5 Components Names and Descriptions

(Front)

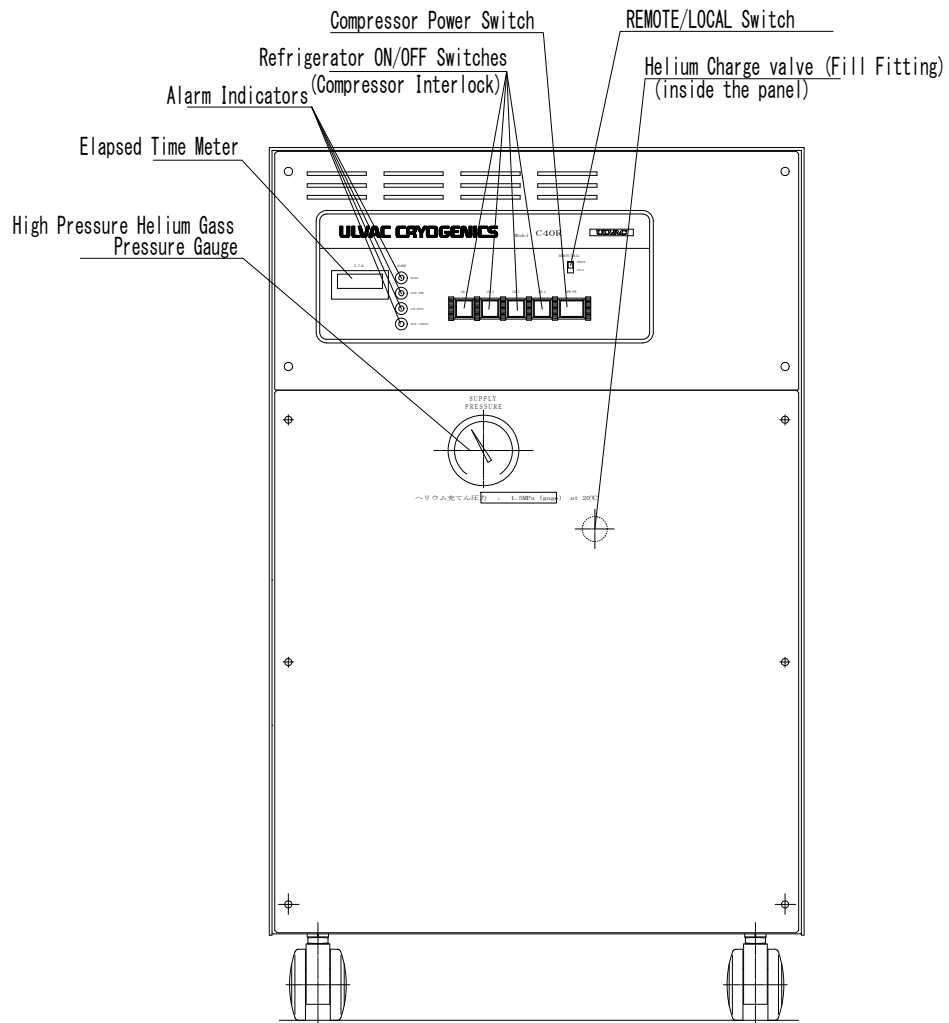


Figure 1-2 Components Names (Front)

Name	Signage	Function
Compressor Power Switch	OPE-PWR	<ul style="list-style-type: none"> ▪ It turns ON/OFF the compressor. Press once to light it up and it will be ready for operation. ▪ When protective device activates, turn this switch OFF to reset.
REMOTE/LOCAL Switch	REMOTE/LOCAL	<ul style="list-style-type: none"> ▪ It switches remote control and Local control (control by switch (CH1~CH4) on main unit).
Refrigerator ON/OFF Switches	CH1~CH4	<ul style="list-style-type: none"> ▪ They are illuminated type switches for local operation. Each switch lights up when a corresponding refrigerator is in operation. ▪ Each switch controls a corresponding refrigerator and compressor operation. E.g.) When CH1 is turned ON, it outputs power to the refrigerator Connector No.1 on the rear panel. ▪ Turn them OFF during the remote operation and use them as operation display.
Alarm Indicators	ALARM	<ul style="list-style-type: none"> ▪ They indicates the abnormal stop of the compressor. ▪ Please refer to “Appendix A” for troubleshooting.
Elapsed Time Meter	ETM	<ul style="list-style-type: none"> ▪ It displays the elapsed time of operation of the compressor.

(Rear)

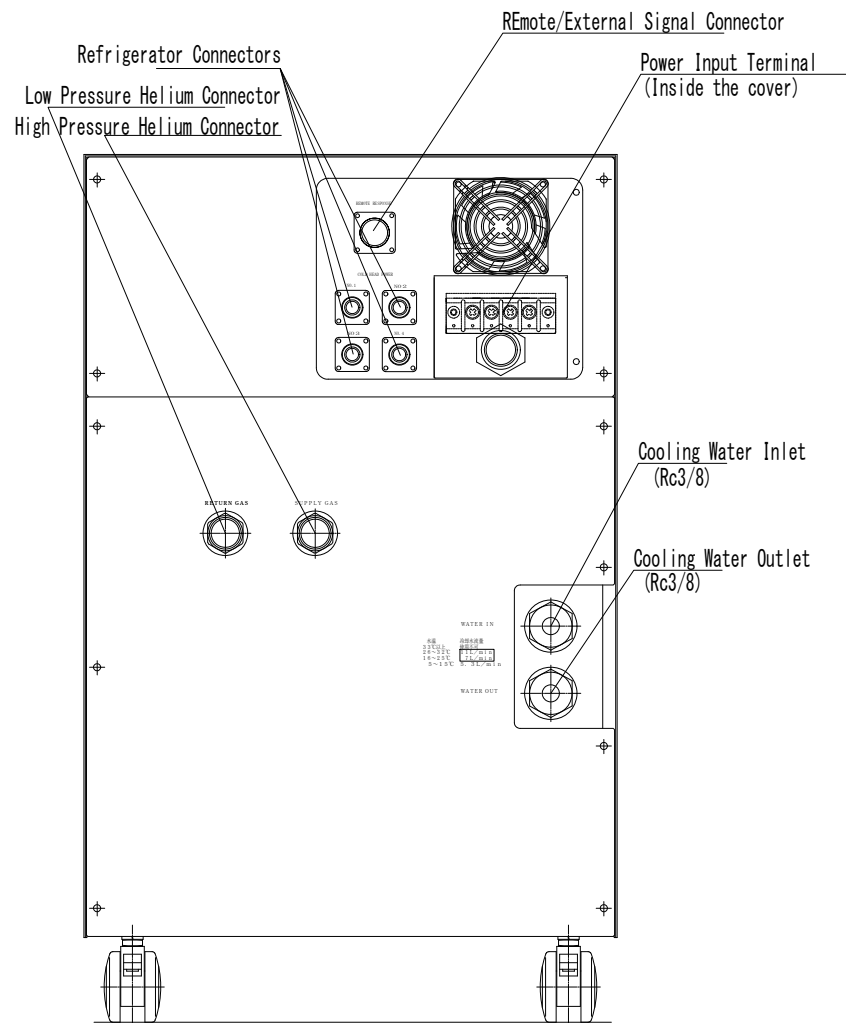


Figure 1-3 Components Names (Rear)

Please refer to “Section 3 Compressor installation” for connecting cooling water piping, flexible hoses, remote input/output wires and input power cable.

(Side of control box)

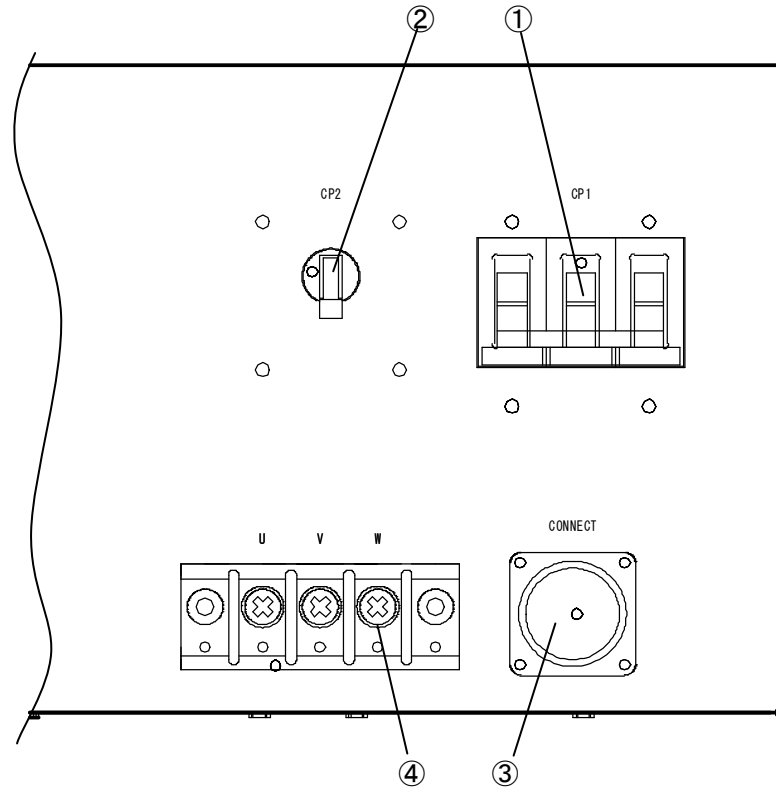


Figure 1-4 Components Names (Side of control box)

No.	Signage	Function
1	CP1	It is a circuit protector to protect compressor from overcurrent.
2	CP2	It is a circuit protector to protect refrigerator motor (cryopump) from overcurrent.
3	CONNECTOR	It is an input power supply connector for thermal switch, low-pressure pressure switch and solenoid valve.
4	UVW	It is an input power supply terminal for compressor motor.

2. INSPECTION

2.1	Shipping List.....	2-1
2.2	Compressor Unit.....	2-2
2.3	Flexible Hose (optional).....	2-2
2.4	Cables (optional)	2-2

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.

- ◇ Delivered items will be different whether the compressor is purchased as cryopump system or just a compressor alone.

To replace C40 with C40R, ①compressor harnesses type-U, listed in “(2) Optional Parts” below, are needed separately.

(1) Standard accessories (purchased only compressor unit)

Item	Quantity
Compressor Unit Instruction Manual	1
Connector for Remote Control (a clamp attached) MS3106B20-27P (attached clamp MS3057-12A) DDK product	1

(2) Optional parts

- ① Compressor harness type-U (UC2800-009-18)
Please use it when replacing C40 with C40R.
- ② Input power cable: 600V cabtyre cable (standard length 3m)
4cores × 8mm² Crimping terminal (8-6) is attached on one side.
- ③ Flexible Hose (standard length 3m)
- ④ Manifold (two-way or three way)
- ⑤ Gasket for Aeroquip x 4

2.2 Compressor Unit

Check the helium gas pressure gauge on the front panel.

Helium pressure should be 1.50 ± 0.04 MPa(gage) at the room temperature (20°C).

The pressure may slightly differ depending on the room temperature.

2.3 Flexible Hose (optional)



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.

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

2.4 Cables (optional)

Check the cables to ensure that they are intact.

3. INSTALLATION

3.1	Installation.....	3-1
3.2	Connecting Cooling Water Piping	3-1
3.3	Cooling Water	3-2
3.4	Connecting the Compressor Unit to the Cryopump Refrigerator)	3-5
3.5	Connecting Electrical Cables.....	3-8
3.6	Before Operation	3-10

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 high humidity.
- 3.The compressor must be installed in a place as shown in Fig.3-1 that is easy to inspect the pressure gauge, operate helium charging valve, and replace adsorber.

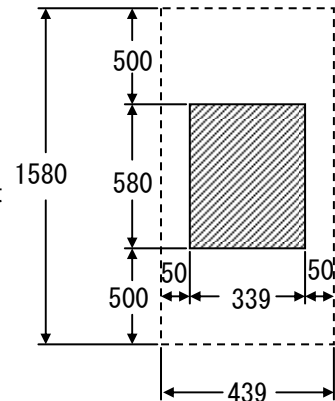


Figure 3-1 Maintenance Space (unit:mm)

3.2 Connecting Cooling Water Piping

Refer to the followings to install the cooling water lines.

1. Rc3/8 female pipe threads are used for both cooling water inlet and outlet of the compressor.
2. For water pipes, use materials that withstanding pressure is 1.5 times higher than cooling water supply pressure such as pressure resistant vinyl hose or copper pipe.
3. It is recommend installing a filter in the water line between the cooling water main valve and the compressor unit to remove water scales which can block the cooling water flow. Installing a flow meter (approx.0~15L/min.) between the filter and the compressor unit is also recommended for checking cooling water flow rate.
4. Do not connect the pipe for inlet to the outlet or the other way around.

**CAUTION**

Ensure that there is no leakage at the connection of the pipes.

3.3 Cooling Water

1. Cooling water for this compressor must meet the requirements and be used within the allowable range shown in Figure3-2.

The cooling water supply pressure must be below 0.7MPaG.

**CAUTION**

- Cooling water lower than 5°C can cause a difficulty in starting the compressor or compressor overloading.
- If the cooling water temperature exceeds 32°C, it may overheat the compressor and the thermal switch may activate to stop the compressor.
- The over flow rate of cooling water may damage the heat exchanger.

2. Our water quality standard of the compressor unit for the cryopump system is based on the water quality management standards of Japan Refrigeration and Air Conditioning Industry Association.

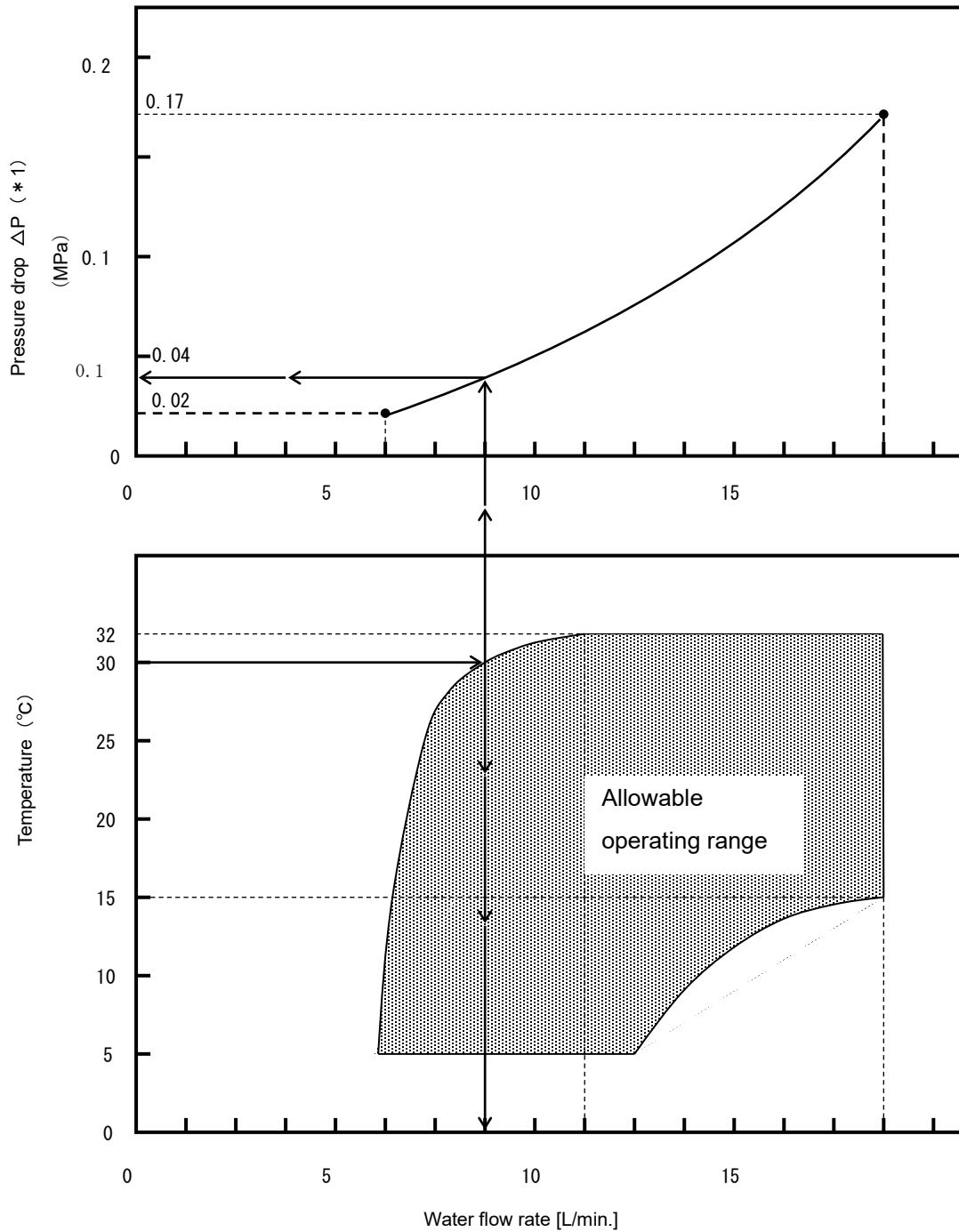
**CAUTION**

- Using low quality water may cause performance degradation of the heat changer by water scales.
- If the water quality doesn't meet the requirement in Table 3-1, it may shorten life of the heat changer.

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

(*) Ground water may contain a great quantity of total carbonic acid and it may lower the pH value abnormally. Therefore, corrosion accident of the heat exchanger may occur in the short-period when ground water is used in the transient style. Ensure that the density of carbonic acid is less than 10mg/L. Perform carbonate check as soon as water is taken from ground without exposing water to atmosphere because the quantity of dissolved total carbonic acid will change by temperature and pressure. It is recommended to check whether the water supply is ground water or not. Water containing a great quantity of total carbonic acid must be used in circulation system with a cooling tower.



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

E.g.) A dashed arrow (\rightarrow) in the graph shows the minimum required water flow rate (7L/min.) and water pressure drop (0.04MPa) at the water supply temperature of 30 $^{\circ}\text{C}$.

Figure 3-2 Cooling Water Requirement

3. It is recommended to stop cooling water to extend life of the heat exchanger.

If cooling water is constantly run, the heat changer may be clogged or have a hole by corrosion.

**CAUTION**

Especially when the temperature of cooling water is below 10°C, Cooling water must be stopped when the compressor has been stopped. If cooling water below 10°C is supplied while the compressor is stopped, it may increase viscosity of lubricant oil in the compressor and cause start up failure.

Drain water out from the compressor under the condition listed below.

Most of the water can be purged from the compressor by blowing air for 30 seconds at inlet pressure of 0.2MPa(gage) into the compressor with the outlet open to the air.

- (1) When there is a danger of freezing of the cooling water while the compressor is stopped. (Cooling water piping may burst.)
- (2) When compressor unit is stopped for more than a week.
- (3) When relocating or shipping the compressor.

3.4 Connecting the Compressor Unit to the Cryopump (Refrigerator)

(Connecting Flexible Hose)

■ About flexible hose

The length of flexible hose should be from 3m to 20m.

(In multiple operations the length described above is the total length of SUPPLY lines or RETURN lines)

Please contact our Service Engineering Division or the nearest customer support for different length of flexible hoses.

**CAUTION**

- Read "Appendix C" before connecting the flexible hoses.
- To connect flexible hoses, only use two single open end spanners (one each 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. Flexible hose may need a replacement depending on the condition of it.

1. Remove all dust plugs and caps from the cryopump(refrigerator), compressor, and supply and return flexible hoses. Clean the self-sealing coupling flat rubber gasket and avoid 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 high-pressure helium gas supply connector (SUPPLY) on the compressor. Connect the helium gas return flexible hose to the low-pressure helium gas return connector (RETURN) on the compressor.
 - b. Connect the helium gas supply flexible hose to the high-pressure helium gas supply connector (SUPPLY) on the cryopump. Connect the helium gas return flexible hose to the low-pressure helium gas return connector (RETURN) on the cryopump.
3. Verify the helium filling pressure. The standard helium filling pressure is $1.50 \pm 0.04\text{MPa(G)}$ at 20°C . Please refer to Figure3-3. If the indicated pressure is higher than the specified value, open the helium fill valve **slowly** and release the small amount of helium gas. If the indicated pressure is lower than specified value, add helium gas as described in section 4.3. If there is helium gas leakage, please contact the nearest customer support.

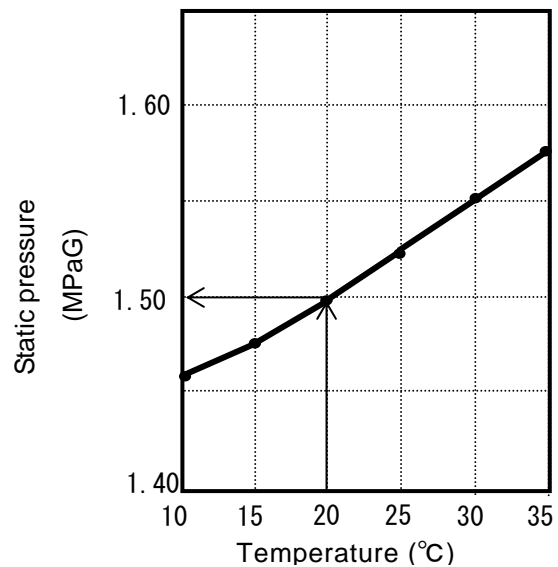
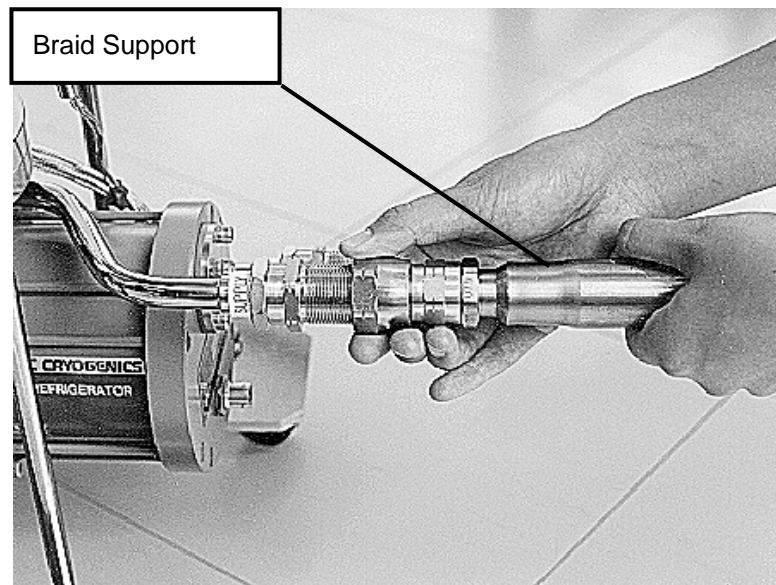
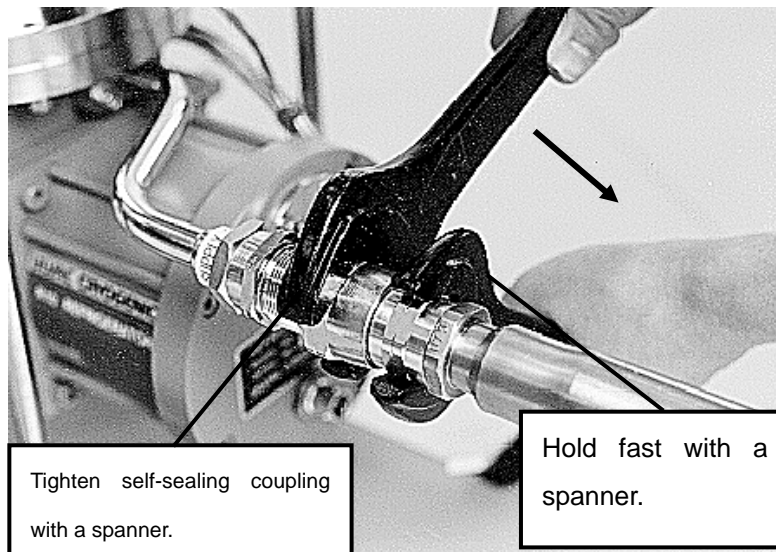


Figure 3-3 Static Pressure and Temperature





- ① Hold the braid support straight so that the connection parts fit properly and tighten by hands as tight as possible.



- 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

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. Connecting REMOTE input/output cables

The connection diagram for REMOTE operation is shown in Figure3-5.

Connect remote cables on the REMOTE/RESPONSE connector on the rear panel of the C40R.


In remote operation, REMOTE/LOCAL selector switch must be set to "REMOTE".

	 WARNING
During remote operation, all the illuminated local switches (CH1~CH4) on the front panel of the compressor must be OFF to prevent the compressors(s) from being turned ON automatically when REMOTE operation is switched to LOCAL operation.	

(1) START/STOP the operation of the compressor and cryopump

To stop the compressor, turn "OFF" all the remote operation switches of the cryopumps.

A compressor will start operation by turning "ON" a corresponded remote operation switch of the cryopump.

 CAUTION
Do not start/stop the operation frequently.
The compressor motor must not be started / stopped more than 6 times per hour and each status should be kept for at least 3 minutes. Do not use these switches to control the temperature of the super trap. Failure to observe this caution may cause malfunctions of the compressor motor and/or electrical control parts.

(2) Operation monitoring signal

This signal (contact output) will be output when any of the compressors and cryopumps are turned on.

The timeout time should be set as 6 seconds or longer.

If a short power interruption (5 seconds or shorter) occurs, the compressor restarts the

operation automatically 5 seconds after the power interruption (only when the remote operation switch is ON).

Actual operation status is synchronized with operation monitoring signal.

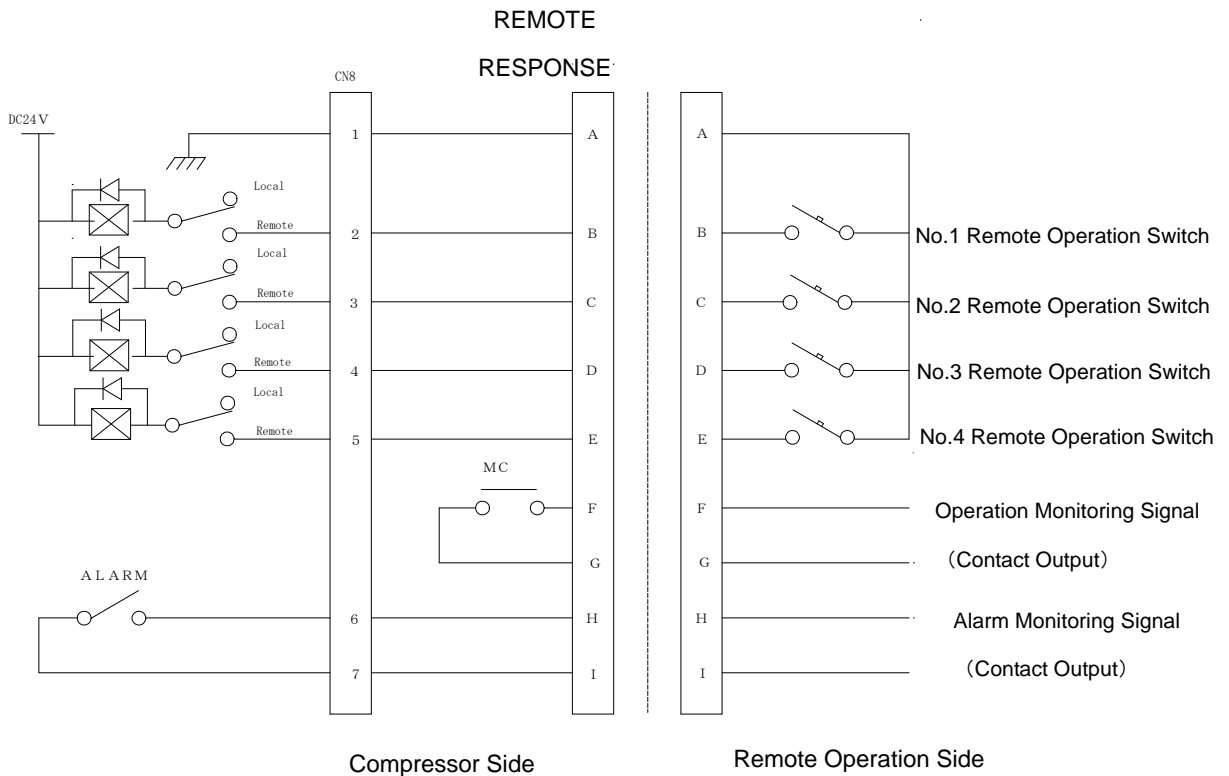
When cryopumps are in multiple operation, the operation monitoring signal doesn't specify which cryopump is in operation.

(3) Alarm monitoring signal (contact output) when abnormal stopping

This signal will be output when any of the alarm indicators (WATER, LOW PRESS, OVER CURRENT, and OVER TEMP) on the compressor front panel is lit up.

Please refer to table A-1 in "Appendix A Troubleshooting" for possible cause and corrective action.

Remote operation connecting Diagram



Between the connector terminal A and terminals B,C,D, and E : DC24V

MC contact capacity : DC24V 5A / AC240V 8A (resistance load)

ALARM contact capacity : DC30V 2A / AC125V 0.5A resistance load)

Connector (Product of Japan Aviation Electronics Industry, Limited) : Plug MS3106B20-27P

Figure 3-5 Remote operation connecting Diagram

2. Connecting refrigerator cable

Connect the refrigerator (cold head) power cable from the compressor to the cryopump.

3. Connecting input power cable

Use 4-core cable with diameter of 8 AWG (8mm²).



CAUTION

Connecting screw for the connecting terminal block of the input power: Tightening torque is 2.4N · m.

4. Turn ON the OPE-PWR switch and the compressor will be ready for operation.

Turn ON the OPE-PWR switch on the front panel of the compressor **after supplying power**. The switch will light up and the compressor will be ready for operation.

3.6 Before Operation

Before operating the compressor, check and verify that:

1. The rotating part of the refrigerator connector is rotated until it won't turn clockwise any more.
2. The cooling water is in an appropriate range of temperature and flow rate.
3. The helium gas static pressure is within an allowable range.
4. The power-supply voltage is in an allowable range.
5. The LOCAL/REMOTE switches are properly set.
6. When power source is supplied to the compressor and **turned ON the OPE-PWR switch, it lights up and stays lighted.**



CAUTION

- Ensure that the helium pressure during operation is within the specified values shown in Table 1-3.
- Adjust the helium pressure at start up not to exceed 2.3MpaG.
- The helium pressure during operation depends on the length of flexible hoses. Especially with the long flexible hoses, the pressure tends to get higher. If it exceeds 2.3MpaG, release helium gas from the Helium fill fitting and adjust the helium pressure.

4. MAINTENANCE

4.1	Scheduled and Unscheduled Maintenance	4-1
4.2	Replacement of Adsorber	4-1
4.3	Charging Helium Gas	4-5

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

4.1 Scheduled and Unscheduled Maintenance

- ◇ Scheduled Maintenance : Replacement of the adsorber (after every 24,000 hrs)
- ◇ Unscheduled Maintenance : Adding helium gas

4.2 Replacement of Adsorber

One of the scheduled maintenance required on the compressor is the replacement of the adsorber within every 24,000 hours. Use the compressor more than 24,000 hours without changing the adsorber may cause a failure or malfunction of refrigerator unit.

◆ Removing the Adsorber

1. Close the main valve of the cryopump(s).
2. Turn OFF all the switches No.1 ~ No.4 and stop the compressor unit.
3. Switch off the primary power.
4. Disconnect the flexible hoses from return-gas and supply-gas connectors at the rear panel of the compressor.
5. Remove the two jam nuts holding the self-sealing couplings (male). (Figure 4-1 ①)
6. Remove the rear panel from the compressor by unscrewing 7 screws. (Figure 4-1 ②③)
7. Disconnect the flexible hose from the adsorber inlet. (Figure 4-1 ④)

**CAUTION**

When connecting and disconnecting 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 4-1 ⑤)
9. Remove the adsorber from the mounting tub on the base of the compressor and Slide it outward to remove from the compressor. (Figure 4-1 ⑥)

**WARNING**

Depressurize the adsorber before disposing of it.

Always use the charging adapter to depressurize the adsorber safely.

◆ Installing the Adsorber

1. Remove the two 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.
4. Replace the rear panel.
5. Check the helium static pressure on the pressure gauge ($1.50 \pm 0.04 \text{ MpaG}$ at 20°C). If the pressure is higher, loosen the helium fill fitting **slowly** and release helium gas. If the pressure is lower than it should be, follow the procedure described in Section 4.3 and add the helium gas.
6. Record the accumulated operation time in the adsorber replacement record label on the front panel. As a guide for the next replacement, make a note of the value that the current accumulated operation time added to the adsorber replacement cycle hours (24,000h).



①Remove the two jam nuts.



②Unscrew the 7 screws on the rear panel.



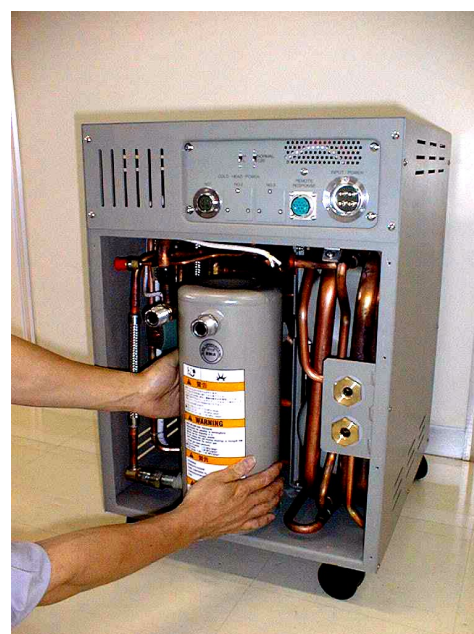
③Remove the rear panel.



④Disconnect the flexible hose from the adsorber inlet.



⑤Remove the adsorber mounting bolt.



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

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 (⑥→③).

* Record on the label the elapsed time.

Figure 4-1 Replacement of Adsorber

4.3 Charging Helium Gas

When charging helium gas, regulators, charging hoses, adapters or other necessary equipments that can be used at 2.0MPaG or above are required.



CAUTION

If the helium pressure of the compressor system becomes 0 MPaG, there is a risk that air or moisture in the air enters the system and contaminates it. If system contamination occurs, please contact our Service Engineering Division or the nearest customer support center.

When helium gas pressure becomes lower than the prescribed standard value, it is required to add helium gas.

Before adding helium gas, inspect the products and connecting parts for the possible cause. If there is any leakage, fix it before adding helium gas. Improperly connected self-sealing coupling might be one of the causes of the leakage.

- ◆ Recommended regulator is for helium gas (left-handed screw) and has a pressure meter rated at 4-6 MPaG on the lower pressure side.
- ◆ The gas charge inlet of the compressor unit is 1/4B male flare.
- ◆ Only use helium gas with purity of 99.999% or above.

The filling method of helium gas is described below.

1. Attach the regulator to new helium bottle, purge the air between the regulator and the helium bottle valve with helium gas as follows.
 - a. Open the regulator slightly by turning the handle clockwise slowly.
 - b. Slowly open the bottle valve, and purge the air in the gas line for several seconds.
 - c. Close the regulator by turning it counter-clockwise.



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 helium fill fitting on the compressor unit.
 - 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 30 seconds. Meanwhile, open the charge valve slightly and allow a small amount helium gas to flow through the charge valve and the helium fill fitting to purge the air between them.

- d. Complete helium gas charging between the regulator and the fill fitting through the charging hose.
4. At the regulator, adjust the outlet pressure to 1.8 MPaG.
 5. Open the charge valve **slowly** and charge helium gas as follows depending on the state of the compressor.
 - a. When the compressor unit is running normally, charge the helium gas until the pressure reaches the operation pressure described in Table 1-3.
 - b. When the compressor unit is not running, replenish it with 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 might start releasing the gas. To avoid the pressure relief valve release the gas, charge helium gas slowly. However, the pressure relief valve in the compressor unit is set to release the gas at 2.85MPaG.

6. Close the charge valve after charging helium gas.
7. Close the regulator and remove the charging hose from the helium fill fitting.

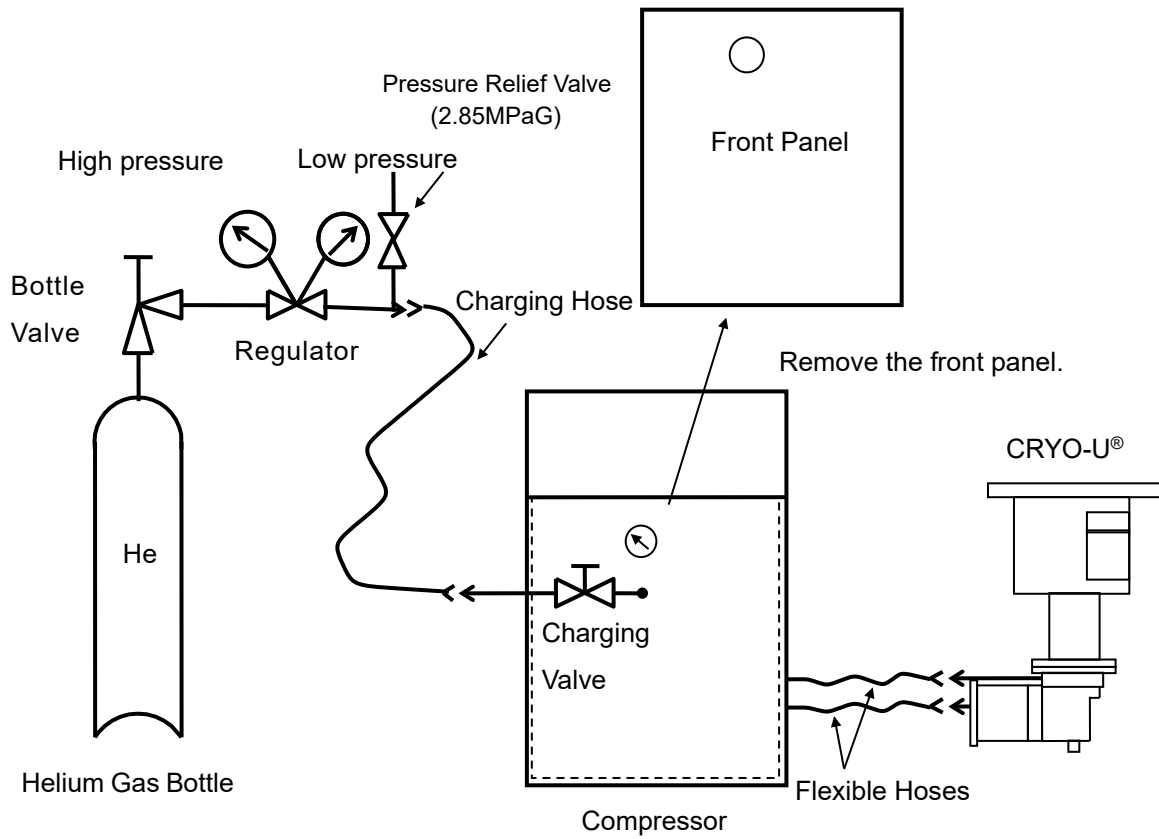


Figure 4-2 Charging Helium Gas

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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

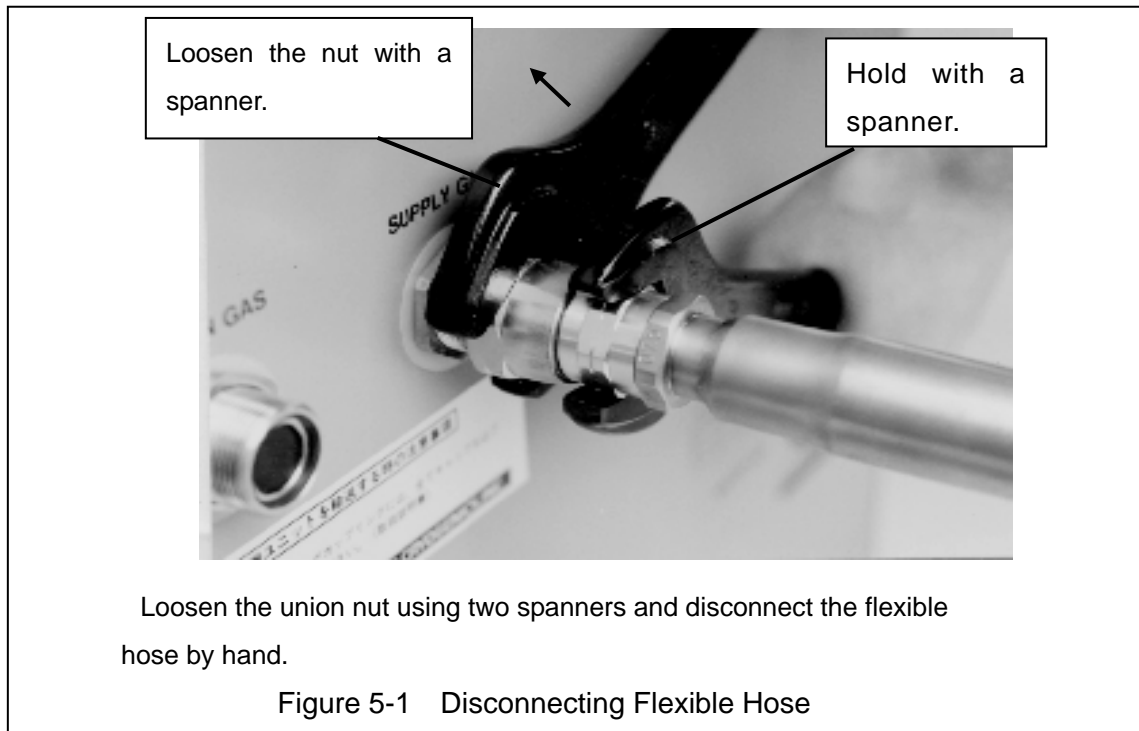
When disconnecting flexible hoses, always use two single open end spanners with width across flat 26mm and 30mm.

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

- Removing the flexible hoses before the super trap and/or cryopump (refrigerator unit) reaches room temperature increases the pressure inside the refrigerator as the temperature rises and the helium gas may blow off from a pressure relief valve. It may cause a helium leakage.
- However, only when carrying out helium circuit decontamination procedures for the refrigerator unit, disconnect the flexible hoses from helium gas supply and return connectors on the compressor unit right 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 vinyl 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 will be stored for more than three months, follow the instruction below as well as the instructions 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 as it was shipped from us and avoid extreme shock.

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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.1-4)
		3) Phase reverse relay (PRR) is active. (STOP lamp lights on)	Interchange primary power phase II.
II	Compressor stops during continuous operation.	1) Thermal protective switch (TS3) is ON.	Check the cooling water condition (temperature, flow rate).
		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' operation.	1) Thermal protective switch (TS3) is ON.	Check that the cooling water is flowing and its flow rate. (See Fig.3-2)
III		2) Low pressure switch (LPS) is ON.	Add helium gas till the static pressure.

	(continued from the previous page)	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 1.54MPaG (at room temperature 20°C).

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Appendix B

C40R Circuit Diagram

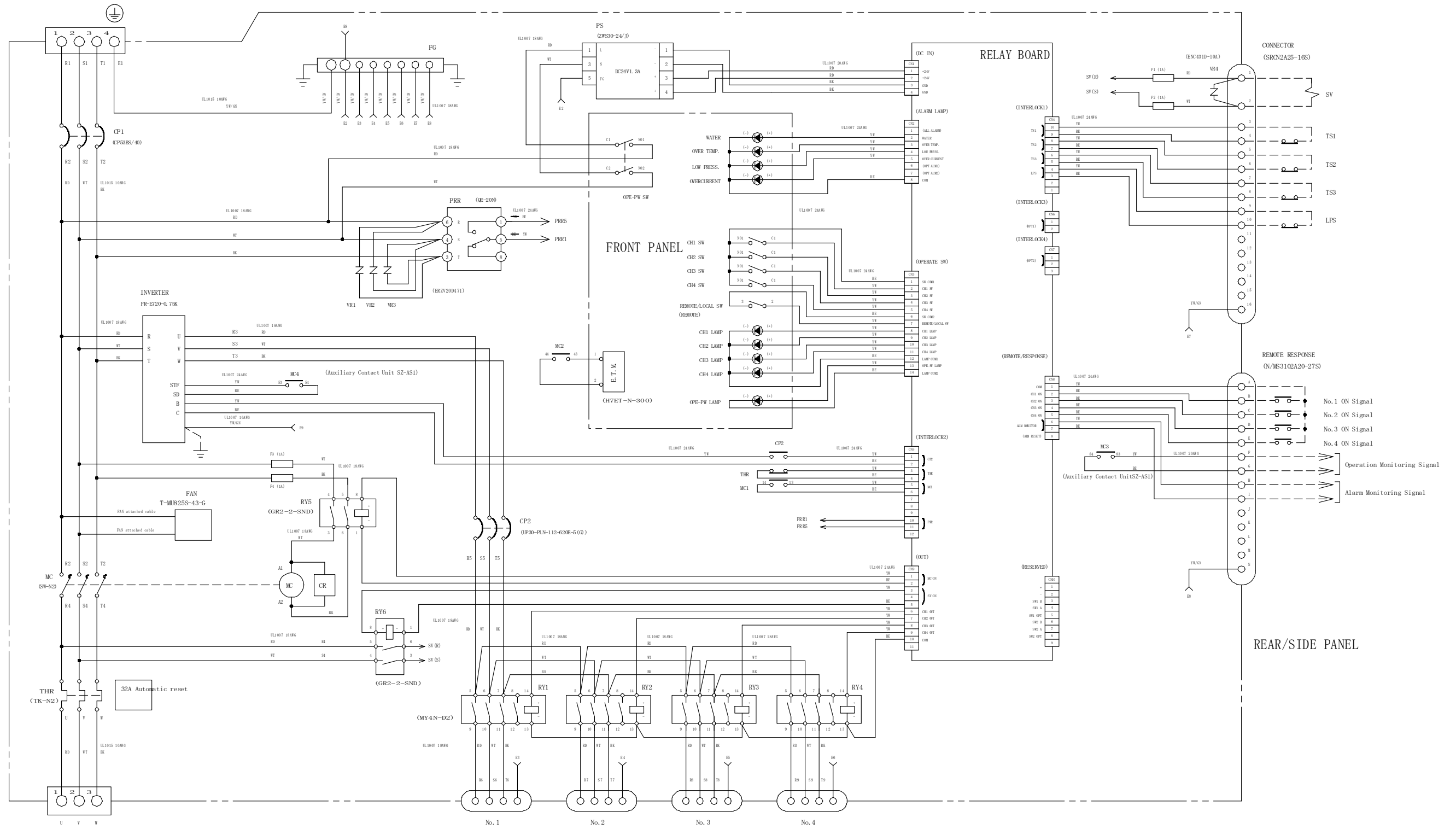


Figure B-1 C40R Circuit Diagram

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.

◆ Compressor safety devices

Name	Function	Specification
Pressure relief valve	Located in the helium supply line and releases gas automatically when pressure exceeds the set value.	Set pressure : 2.85MPaG
Differential Pressure regulating valve	Located on the line connecting helium supply and return lines and automatically keeps the high – low differential pressure under the set value.	Set pressure : 1.60MPa

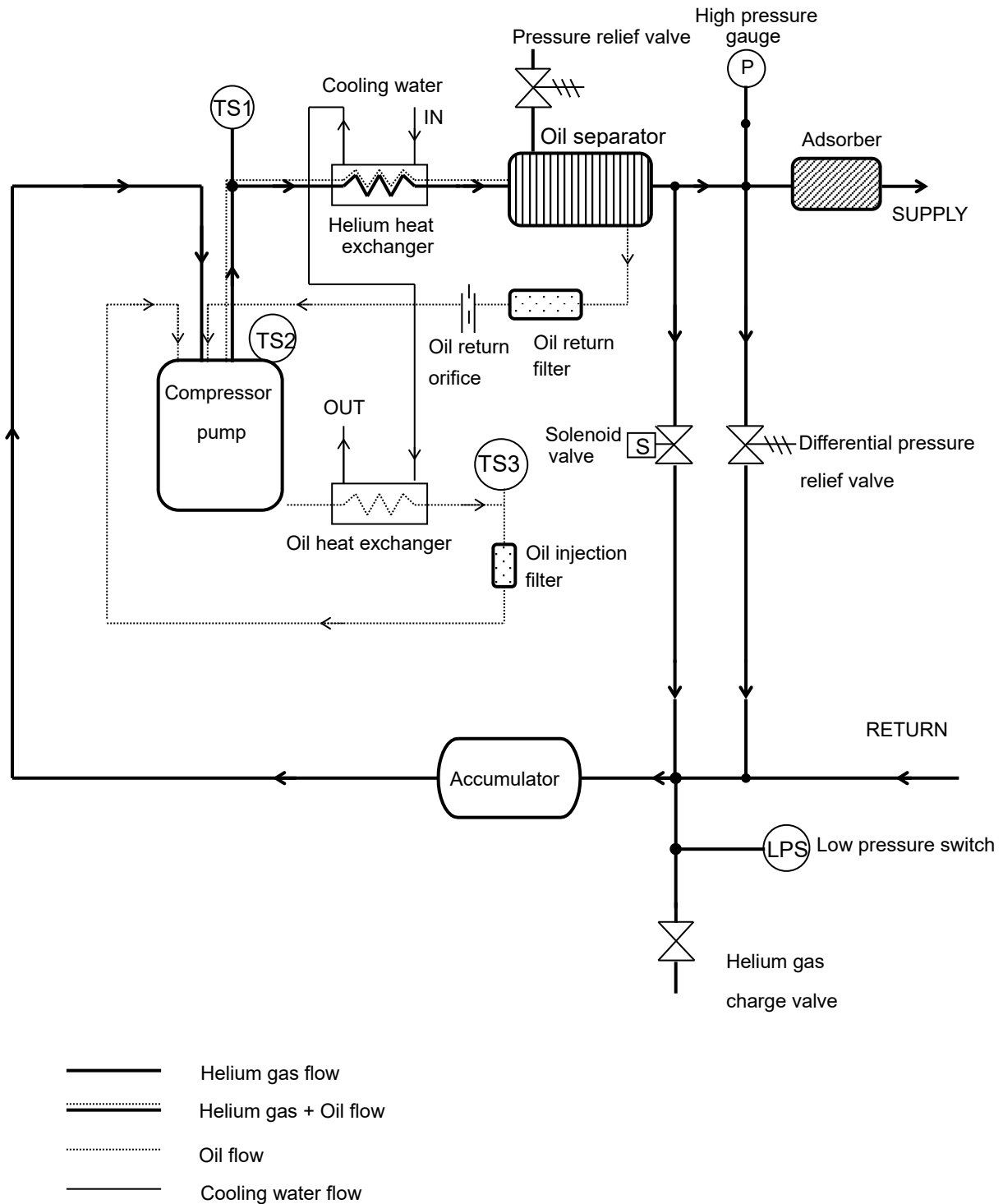


Figure D-1 C40R Flow Diagram

SERVICE NETWORK

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Revision History

Date	Revision No.	Contents
2010/10/15	2010.10	First edition.
2011/05/11	2011MY01	P.2-1 (1) Standard accessories The item "Gasket for Aero quip x 4" has been moved to (2) Optional parts.
2011/09/30	2011SR02	Compressor unit safety instruction has been revised. Service network has been revised.
2012/05/25	2012MY03	Yokkaichi CS contact information has been changed.
2013/03/26	2013MH04	"Safety Instruction" No.3 and No.5 have been revised. "SERVICE NETWORK" has been revised.
2013/09/10	2013SR05	P.1-3 Table 1-2 Description of note 2 has been revised.
2014/01/06	2014JA06	"Introduction" and "SERVICE NETWORK" have been revised.
2014/02/20	2014FY07	P.1-1, P.2-1 "refrigerator converting harness" has been changed to "compressor harnesses type-U"
2015/11/26	2015NR08	"Compressor Unit Safety Instructions" has been revised. "1. Compressor Unit Description" Table1-2 has been modified. "4. 3 Charging Helium Gas" has been revised. "SERVICE NETWORK" has been modified.
2017/10/02	2017OR09	"1. Compressor Unit Description" Table1-2 has been modified. "SERVICE NETWORK" has been modified.
2023-08-04	2023AT10	"Safety Instructions" Description on the sealing sticker has been added.
2023-11-07	2023NR11	"Safety Instructions" Description on the adsorber disposal has been modified. Appendix C A note has been added to flexible hose allowable pressure. Appendix D has been modified.

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