

COMPRESSOR UNIT

Instruction Manual

C30F4

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.

Original Instructions

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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Safety Instructions

The following precautions must be observed before installing, operating, or servicing the Compressor.

1. Do not Charge Compressor with Excessive Helium



For refrigeration, the UCI cryopumps use high-pressure helium gas circulated in the refrigerator system. Charging helium gas more than the specified value does not improve the refrigerating performance appreciably. Conversely, excessive charging can cause the gas to be released from the safety valve and dust to be caught at the safety valve seat, resulting in a leak.

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

2. Adding Helium Gas and Charging Equipments

When charging helium gas or performing helium line decontamination, please read the "Maintenance" section carefully and follow the instruction.

Please supply the equipments (regulators, charging hoses, adopters, etc.) that can be used at the pressure of 2.0MPaG or above.

3. Do Not Switch between ON and OFF Frequently

Switching between ON and OFF should be less than 6 times per hour, and ON and/or OFF condition should be maintained longer than 5 seconds.

If the Compressor gets so many start-stop operations in a short period, it may cause the Compressor failure such as the compressor motor life to be shortened extremely.

Do not turn on and off the compressor to control the temperature of 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 it may explode. If the adsorber was pressed with helium gas still inside, it may also cause an explosion. Refer to "Disposal Considerations" for more information.

Use appropriate charging adaptor to remove helium gas safely.

☆We collect used adsorbers. If there is any used absorber, please contact a person in your local dealership or Ulvac Techno Ltd. to have it picked up or send it directory to our Service Engineering Division. We only accept adsorbers from CTI or us.

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. Refer to Table 1-2 "Power Supply Rating" in Section 1 for the electrical input specifications.
- 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.
- Power lines and signal lines must be wired at least 10cm separate from one another.

6. Cooling Water

Water leak may lead to 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

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 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.

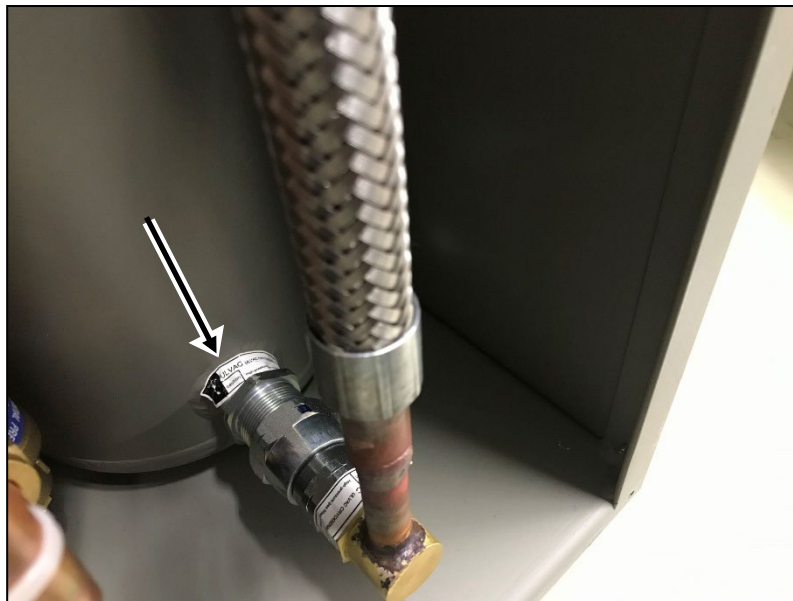


When working with a self-sealing coupling, the connection may be accidentally loosened or loosened by co-rotation. In such cases, the refrigerator may encounter faults due to helium leakage or air invasion, resulting in serious failure such as abnormal noise or refrigerator motor malfunction.

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. 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.



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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Section 1. Compressor Description

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1.1 Introduction

C30F4 is compressor unit for cryopump systems.

NOTE: All personnel involved in installation, operation, adjustment, maintenance and servicing must be familiar with the contents of both the C30F4 compressor and related components.

To ensure safe, reliable system performance, read this manual as well as other relevant manuals completely to gain a thorough understanding before beginning work.

Table 1-1 C30F4 Compressor General Operating Specifications

Model	Number of refrigerators per unit	Coldhead motor	Helium charging pressure	Input power
C30F4	Up to 2 (multiple)	Three-phase	1.2-1.5MPaG	AC380V 3 ϕ ,50Hz AC400V 3 ϕ ,50Hz AC415V 3 ϕ ,50Hz AC480V 3 ϕ ,60Hz Select one of the above from the connectors on rear panel.

1.2 Terminology

- 1) We offer two types of cryopumps; CRYO-U[®] cryopumps that remove almost all kinds of gases, and CRYO-T cryotrap which are designed specifically to remove water. The term "Cryopump" normally refers to both types unless otherwise specified.
- 2) The term "Compressor" means compressor assembly. The helium compressor which is a part of the assembly is sometimes called "compressor pump" to differentiate from the assembly.
- 3) The cryopump system does not start by itself but by the command from a customer's equipment or high-order system. Thus, the cryopump system is one of the components of a customer's whole system.
Henceforth, an interface between the cryopump system and a customer's equipment or high-order system is called "equipment-side" for short.

1.3 Refrigerator System Documents

The refrigerator system documents basically consist of two manuals: the refrigerator manual and the compressor manual. They are shipped with the purchased products.

Accessories for the system and manuals for optional devices are enclosed depending on the product specifications that the customer orders.

1.4 Roles of a Compressor in Cryopump System

A cryopump system consists of a cryopump and a compressor unit (hereinafter called “the system”)

A Compressor provides high pressure helium gas for a cryocooler of a cryopump through helium supply flexible hose. The cryocooler expands high pressure helium gas and provides cooling. Lowered pressure helium gas returns to the compressor through the helium return flexible hose. The compressor compresses the low pressure helium gas to turn it into high pressure gas and supply it to the cryocooler again.

This helium line is a closed circuit and helium gas is cycled to use. Therefore refilling helium gas is not necessary for long time.

C30F4 Compressor compresses helium gas in a highly-reliable oil injection type helium compressor. Helium gas recovers its purity as it flows through an oil separator and an adsorber, where contaminants are removed.

It is necessary to check the elapsed time of operation and replace adsorber regularly (every 24,000 hours) to maintain cryocooling capacity as well as prevent breakdown of the refrigerator.

Refer to “Section 6.2 Replacement of adsorber”.

Refer to the instruction manual of refrigerator units for the information on the maintenance of refrigerators.

Note: CRYO-T series super traps are cryopumps that are specifically designed for pumping water vapor.

1.5 Compressor Specifications

1.5.1 External view

Figure 1-1 shows external view of C30F4.



Figure 1-1 C30F4 External View

1.5.2 Dimensions

Figure 1-2 shows the dimensions. (unit:mm)

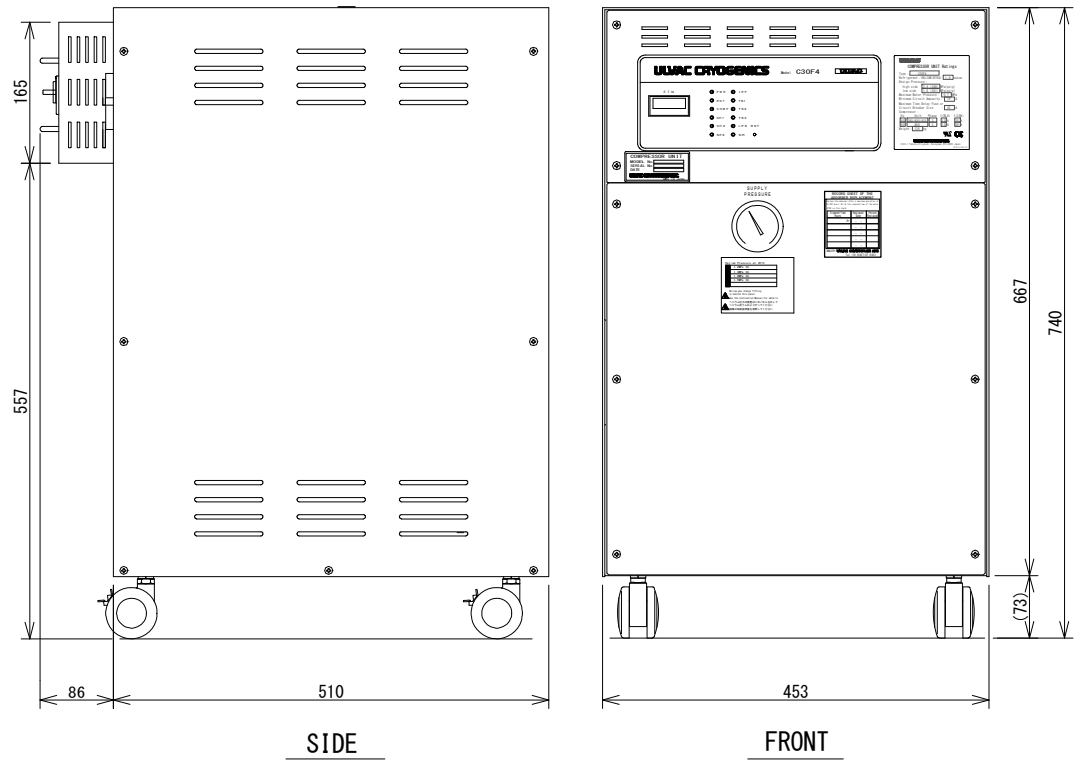


Figure 1-2 C30F4 Compressor Dimensions

**CAUTION**

Do not place objects or equipments on top of a compressor. It prevents heat to be released from compressors as well as applying unnecessary heat to the equipments placed on it.

1.5.3 Weight

C30F4 Compressor : 136kg

1.5.4 General Specifications

The tables below show power supply rating, cooling water requirements, installation environment, operation requirements. (Tables 1-2 to 1-5)

Table 1-2 Power Supply Ratings

Item	Functions
Rated working voltage	AC380V 3 ϕ ,50Hz AC400V 3 ϕ ,50Hz AC415V 3 ϕ ,50Hz AC480V 3 ϕ ,60Hz
Allowable variation range of the input voltage ^{(*)1}	+/-10%
Stationary power consumption	8.2kVA(6.4kW) at 400V,50Hz 8.8kVA(7.7kW) at 480V,60Hz
Power factor	0.79 at 400V,50Hz 0.88 at 480V,60Hz
Maximum current	19A
Locked rotor electric current (Starting current)	75A at 50Hz 80A at 60Hz
Customer-supplied rated electric current (minimum) ^{(*)2}	30A
Overvoltage category	II
<p>(*)1 Ensure that voltage at the terminal of main circuit protector (MCP) does not exceed the allowable variation range of the input voltage. Do not use the voltage higher or lower than the allowable variation range. Damage caused in consequence will not be covered under warranty.</p> <p>(*)2 Attach an appropriate circuit breaker to protect the power cable. The circuit breaker should have appropriate rated breaking capacity that suits the short circuit current of the power supply.</p> <p>(*)3 Refer to the "Delivery Specifications" first, if provided.</p>	



Table 1-3 Cooling Water Requirements

Item	Requirements
Water temperature (Cooling water inlet)	5 - 32°C
Flow rate	5 - 15 L/min
Cooling water supply pressure	Max. 0.7MPaG
Pressure drop (water inlet to water outlet)	0.02 – 0.17MPa (See Fig. 2-3)
Alkalinity (pH)	6.5 – 8.0 pH
Calcium Carbonate	< 75ppm
<p>(*)1 Refer to "Section 2.4 Cooling water requirements" for more details.</p> <p>(*)2 Refer to the "Delivery Specifications" first, if provided.</p>	

Table 1-4 Installation Environment and Operation Requirements

Item	Requirements
Ambient operating temperature	10 – 38 °C
Ambient storage temperature	-10 – 55 °C
Humidity	5 - 90% (non-condensing)
Altitude	< 1000m
Vibration	< 0.6G, 10 – 55 Hz
Atmosphere	C30F4 must be installed indoors, it cannot be installed outdoors. Install in a place where free from metal powder, dust, flammable and corrosive gas
Pollution degree	2
Static helium pressure at 20 °C (*1)	1.2 - 1.5MPaG
Sound pressure level during operation	< 70 dBA
(*1) Refer to “Section5.1 Verification of helium static pressure” for details. (*2) Refer to the “Delivery Specifications” first, if provided.	

Table 1-5 Approved Regulations

Symbol	Approved Regulations	File No. Certification
	UL471 : 10 th Ed	File No. SA44290
	Low Voltage Directive (LVD):2006/95/EC • EN 61010-1:2010 Machinery Directive(MD):2006/42/EC • EN ISO 12100: 2010 • EN 60204-1:2006+A1:2009 Electro Magnetic Compatibility Directive (EMC): 2014/30/EC • EN 61000-6-4:2007+A1:2011 • EN 61000-6-2:2005 • EN 61000-3-2:2014 • EN 61000-3-3:2013 • EN 60601-1-2:2007 • EN 55011:2009+A1:2010 RoHS Directive:2011/65/EU • EN 50581:2010	CE marking by self declaration

NOTE: Refer to Appendix F for information on “Hazardous Substances in the Product” restricted by China RoHS.

1.6 Component Descriptions

This section describes components which need adjustments and/or verifications during operation and maintenance.

Compressor front view is shown in Figure 1-3 and rear view in Figure 1-4.

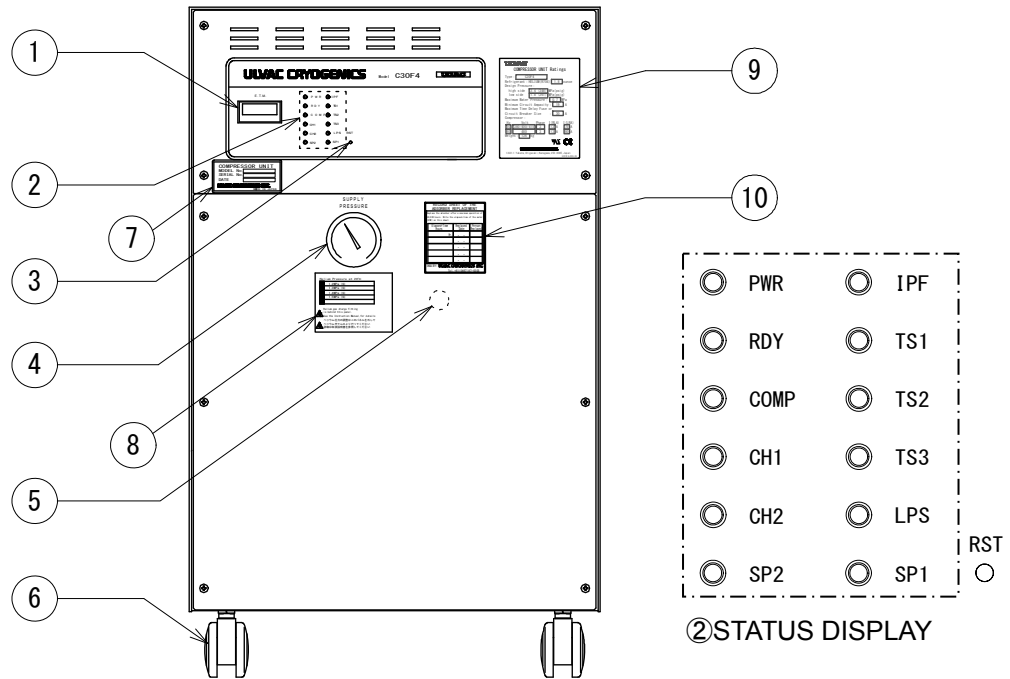


Figure 1-3 Compressor Front View

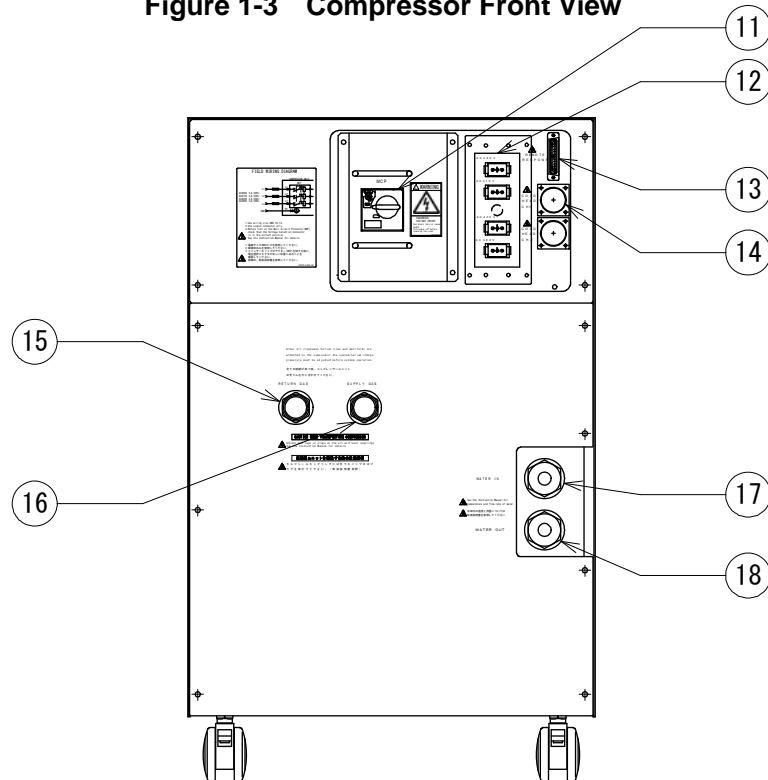


Figure 1-4 Compressor Rear View

No.	Name	Function	
1	ELAPSED HOUR METER	It displays the elapsed time of operation (when it is in operation). The displayed value cannot be changed.	
2	STATUS DISPLAY	PWR (white)	Illuminates when the compressor is powered ON.
		RDY (green)	Illuminates when the compressor is ready for operation.
		COMP (green)	Illuminates when the compressor is in operation.
		CH1 (green)	Illuminates when coldhead 1 is in operation.
		CH2 (green)	Illuminates when coldhead 2 is in operation.
		IPF (yellow)	Illuminates when the compressor is in Input Power Fail alarm status. Refer to Section7 for detail.
		TS1 (yellow)	Illuminates when the compressor is in TS1 Over Temperature alarm state. Refer to Section7 for detail.
		TS2 (yellow)	Illuminates when the compressor is in TS2 Over Temperature alarm state. Refer to Section7 for detail.
		TS3 (yellow)	Illuminates when the compressor is in TS3 Over Temperature alarm state. Refer to Section7 for detail.
		LPS (yellow)	Illuminates when the compressor in is LPS Low Helium Pressure alarm state. Refer to Section7 for detail.
		SP1	Spare
SP2	Spare		
3	RESET SWITCH	After eliminating the cause of the alarm status, press the button inside this hole with a thin insulating stick of less than 2mm in diameter to cancel the alarm.	
4	HELIUM GAS SUPPLY PRESSURE GAUGE	This indicates the static helium charge pressure when the compressor is suspended and the supply line helium pressure when the compressor is in operation. Refer to “Section 5.1 Verification of helium static pressure” to verify the helium pressure when the compressor is not in operation. This gauge is referred to as “Helium pressure gauge” hereinafter.	
5	HELIUM GAS CHARGE VALVE (BEHIND THE FRONT PANEL)	Use this to adjust helium gas pressure when needed. When adding helium gas, use only helium gas with purity of 99.999% or above. Refer to “Section 6.3 Adjusting system helium pressure” for details.	
6	CASTER	Use them to move the compressor unit. Lock the casters except when the compressor is being moved. Refer to “Section 3.7 Maintenance at Storage Site” for the detail.	
7	SERIAL NUMBER LABEL	Model, serial number, and manufactured date are listed.	
8	HELIUM FILLING LABEL	Helium charge pressure at the time of shipment	
9	RATING PLATE	Rated values of C30F4 are listed.	
10	RECORD SHEET OF THE ADSORBER REPLACEMENT	Write the dates when adsorbers are replaced.	

No.	Name	Function
11	MCP (MAIN CIRCUIT PROTECTOR)	Use this knob to turn on the electricity to the compressor. Turn right to turn ON, and return to the original position to turn OFF. ON and OFF positions are labeled around this knob to show the status of the breaker.
12	VOLTAGE SELECTION CONNECTOR	Choose the correct rated voltage of the compressor unit from the following; AC480V 3φ(60Hz) AC415V 3φ(50Hz) AC400V 3φ(50Hz) AC380V 3φ(50Hz) The factory default is AC480V. Please change to the correct connector if you use with other voltages. Refer to Section 4 for the procedures to change.
13	REMOTE RESPONSE	With D-SUB connectors, hoods and cables, refer to “Section 4. Installation, Piping and Wiring” to make connection to the customer’s system. The status of compressor unit or cryopumps, answer back signals, or alarm signals to inform the abnormal condition of compressors are conveyed to the customer’s system through this cable. D-SUB connectors and hoods are available from us at your option. Refer to Table 3-1 Carton Contents.
14	COLD HEAD CONNECTOR CH1,CH2	Output connectors for the coldheads of cryopumps. Connect COLD HEAD DRIVE CABLE to connect the compressor unit and coldheads.
15	HELIUM GAS RETURN CONNECTOR (Low Pressure)	Connect the flexible hose for low pressure helium gas from cryocooler to this connector. A 1/2 self-sealing coupling is used. Refer to “Section 1.4 Roles of compressor in cryopump system” to understand the operation of helium closed-loop cryocooler system. Also refer to “Section 4.3 connecting and disconnecting helium flexible hoses” for connection method of helium lines.
16	HELIUM GAS SUPPLY CONNECTOR (High Pressure)	High pressure helium gas is supplied to the cryocooler through this connector. A 1/2 self-sealing coupling is used. Refer to “Section 1.4 Roles of compressor in cryocooler system” to understand the operation of helium closed-loop cryocooler system. Also refer to “Section 4.3 connecting and disconnecting helium flexible hoses” for connection method of helium lines.
17	COOLING WATER INLET	Cooling water from customer’s system is supplied through this inlet to cool the compressor during operation. Customers are requested to set up cooling water piping as a part of the customer’s system. Refer to “Section 4 Installation, Piping and Wiring” for connection of cooling water.
18	COOLING WATER OUTLET	Cooling water used in the compressor returns from this outlet to customer’s system. Customers are requested to set up cooling water piping as part of the customer’s system. Refer to “Section 4. Installation, Piping and Wiring” for connection of cooling water.

**CAUTION**

All casters of the compressor unit must be locked after the compressor unit has been placed at a proper position or storage site. This is to avoid injury to persons from an unexpected slippage of the compressor.

**CAUTION**

The Compressor unit is supplied main power from the distribution panel of the customers' system. The distribution panel must have an appropriate circuit breaker for the compressor in accordance with the national and local codes and standards of the applicable country.

**WARNING**

Circuit protector must be operated by authorized electrician familiar with the structure and the risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.

1.7 Connection with CRYO-U Cryopumps

Figure 1-5 shows the system consists of C30F4 compressor unit and one cryopump. The descriptions on the components are in table 1-5.

Refer to "Section 4.4 Single cryopump connections" and "4.5 Multiple cryopump connections" for more information on the connection between compressors and cryopumps.

Table 1-6 Minimum Configuration of C30F4 System

Component	Description
Compressor	C30F4 compressor unit
Cryopump unit	Attached to a vacuum chamber
Refrigerator unit	A part of cryopump unit
Flexible hose (Helium line)	Helium supply line and helium return line
Cold head drive cable	Cable for driving refrigerator motor

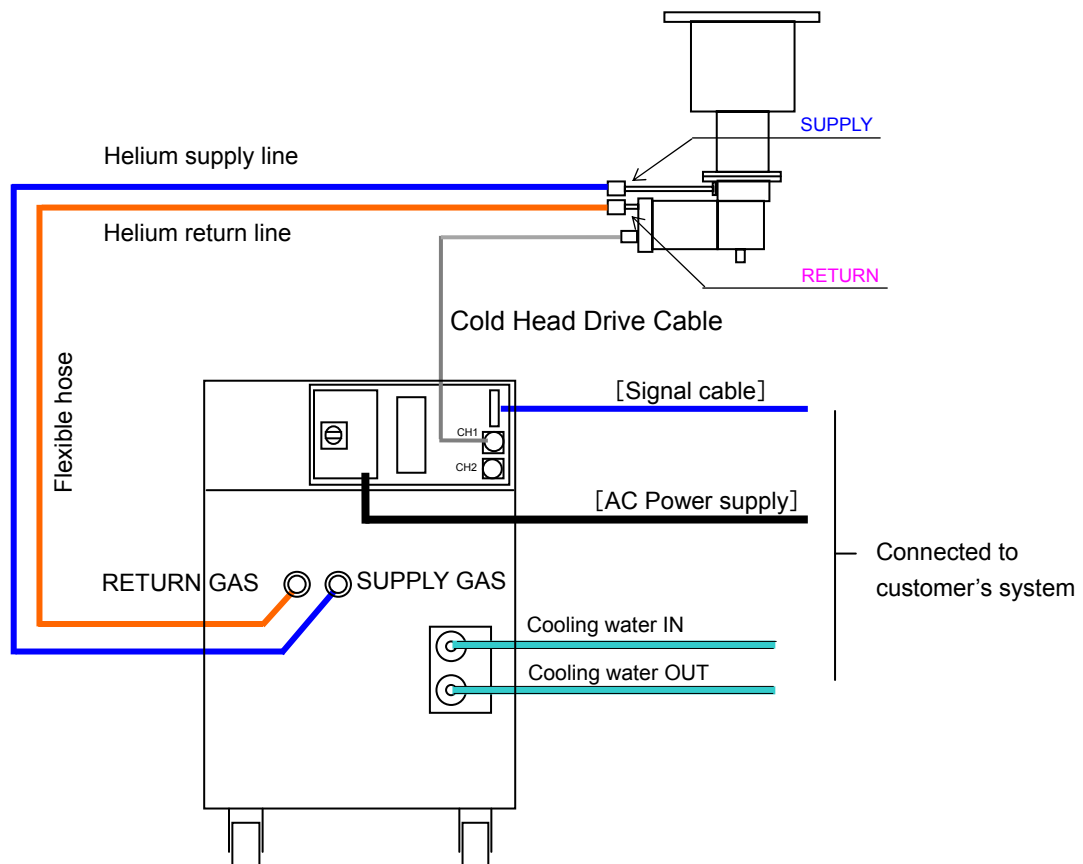


Figure 1-5 Configuration and the Connection with a Cryopump System

Accessories

- Cold head drive cables and flexible hoses will be delivered along with the system upon request from customers.
- D-sub connectors for operation signals, AC power supply cables, signal lines, or cooling water lines are not included in the shipping carton. These are to be supplied by customers.
- The signal wiring of D-sub connectors for operation signals is to be provided by customers.

Section 2 Considerations before Installation

2.1	Installation Environment.....	2-1
2.2	Wiring Requirements	2-2
2.3	Cooling Water Requirements.....	2-4
2.4	Length of Cables and Flexible Hoses	2-7
2.5	Main Circuit of the Compressor	2-7
2.6	Remote Functions.....	2-8
2.7	Notes for Normal Operation	2-10

This section provides the information, which should be considered before installing the compressor unit.

Below are the explanations of combination with cryopump, installation environment requirements, wiring requirements, cooling water requirements, length of cables and flexible hoses, remote functions, and subsidiary functions.



CAUTION

Users are responsible for complying with applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of the equipment.

2.1 Installation Environment

Refer to Table 1-4 in Section 1 and check the installation environment and operating conditions to ensure there is no problem. The environment should be free from contaminants such as oil, coolant and other suspended solids. Compressor should be installed in a space with appropriate ventilation to avoid suffocation in case of helium leakage. Figure 2-1 shows the dimensions of installation space and levelness of the floor required to maintain the performance of a compressor. The compressor should be installed on a flat floor surface.



CAUTION

Clear the back, front and sides of the compressor to maintain cooling by natural air flow. Also, a space of 500mm back and front of the compressor is needed for maintenance. Around the power cable in the back, keep space for working easily. In addition, easy access to the handle of main circuit protector (MCP) on the back must be ensured.

Refer to Figure 1-2 in Section 1 for the dimensions of the compressor.

The Cryopump system is installed as Permanently Connected Equipment.

The environmental condition to be applied for the system is **Overvoltage Category II** and **Pollution Degree 2**.

Refer to IEC 61010-1, and IEC 60664-1 for the above items.

Protective structure of the compressor case is IP2X. If stronger seal protection is needed, customers are requested to take appropriate measures.

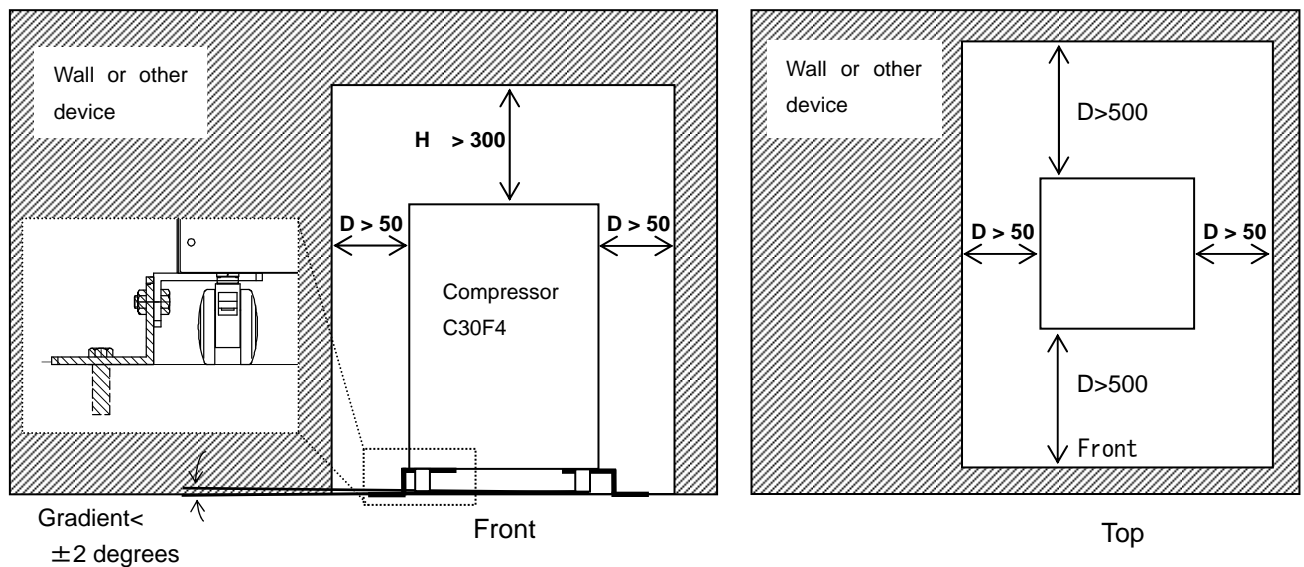


Figure 2-1 Required Space for Compressor Installation (unit: mm) and Levelness

2.2 Wiring Requirements

Table 2-1 shows the specifications of input power cables. For connecting procedures of the input power cable, refer to "Section 4.6 Electrical connections".

Table 2-1 Input Power Cable Specifications

Name	C30F4
Input power cable	Copper wire / 600VAC, 4 lead wires with yellow and green lines ^(*) #12 AWG or #10 AWG Outer diameter: 19mm or less
^(*) Use yellow/green for earth ground ⁽²⁾ Current capacity is determined depending on the standards or necessity to reduce the rated value for installation.	

Supply AC power for compressor from the equipment-side distribution panel. The distribution panel should have a circuit breaker branched for each compressor (see Figure 2-2). Follow the descriptions below to choose and install a circuit breaker.

- Use components that are appropriate and meet the international and the national codes and standards of the country installed (Refer to UL489, IEC60947-1, IEC60947-2, and IEC60947-3).
- Install a circuit breaker in a place close to the compressor unit and can be easily accessed.
- Do not install in a way that hinders easy operation.
- Indicate that the circuit breaker is for the compressor unit.
- OFF position should be easily located.
- Refer to Table 1-2 in section 1 for circuit breaker current rating.

**CAUTION**

In most standards, it is required to install a branch breaker to protect power cables connected to the equipments. A circuit breaker must be installed. Failure to follow this procedure could seriously damage the equipment.

Table 2-2 shows wire gauges of cold head drive cable and remote cable for use.

Table 2-2 Control and Signal Wire Gauges

No.	Item	Symbol	Connection type	Wire size	Note
1	Cold head drive cable	COLD HEAD CH1 COLD HEAD CH2	Connector 4 pin	#14 AWG	Option
2	Control and signal lines	REMOTE RESPONSE	D-SUB 25pin	#22 – #20 AWG	Supplied by customer

NOTE: Refer to “Section 4. Installation, Piping and Wiring” for the procedure to wire the above cables.

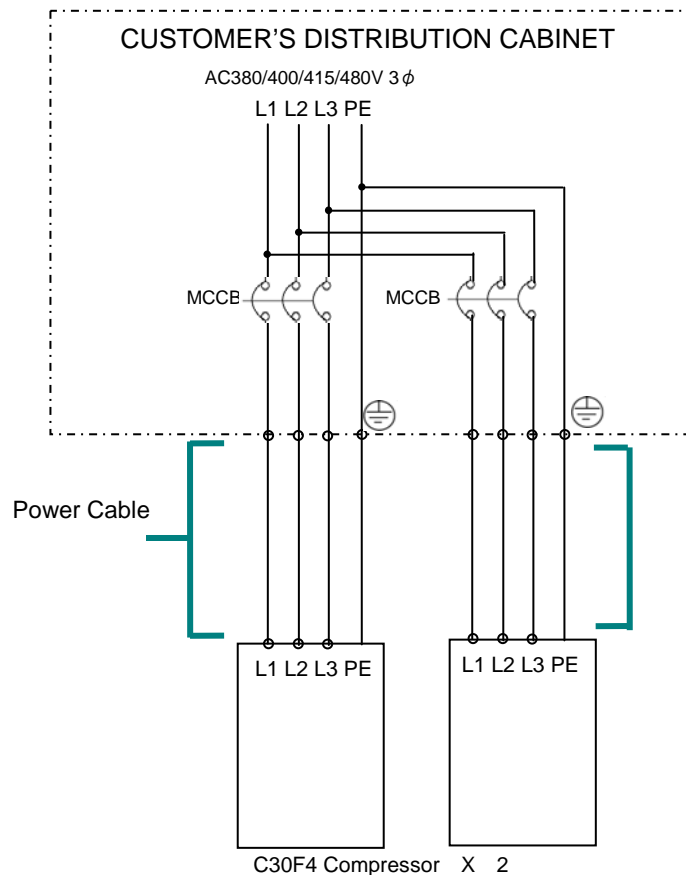


Figure 2-2 Customer's Power Circuit

2.3 Cooling Water Requirements

Cooling water must meet the requirements indicated in the following subsections. It is necessary to maintain the performance of the compressor for extended periods without malfunction.

2.3.1 Checking chemicals and quality of water

Table 2-3 indicates recommended quality of water. Ensure that cooling water meets the requirements in the table. If the quality of water is not in allowable ranges, water quality improvement may be needed.

Table 2-3 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.		

Note1: Table 2-3 is based on the water quality management standards of Japan Refrigeration and Air Conditioning Industry Association. It is necessary to check chemicals and water quality to avoid corrosion, clogging, and other faults caused by low quality of water and/or chemicals.

Note2: Ground water may contain a great quantity of carbonate acid which facilitates corrosion. Ensure to perform carbonate check as soon as water is taken from ground without exposing water to atmosphere. Otherwise the result may be false.

2.3.2 Determining pressure, temperature and flow rate of cooling water

Refer to Table 1-3 in Section 1 for typical cooling water requirements.
The pressure of cooling water for supply lines must be 0.7MPaG or less.

Figures 2-3 and 2-4 show the relation of water flow rate, water temperature, and water pressure drop. Refer to Figure 2-3 when helium charge pressure is from 1.2 to 1.3 MPa and refer to Figure 2-4 when the charge pressure is 1.4 to 1.5 MPa. Determine the water flow rate from these charts.

For example, when the charge pressure is from 1.2 to 1.3 MPa, refer to Figure 2-3 and set the flow rate within the range from 7L/min to 15L/min at water temperature of 30°C. It can also be read that when the water flow rate is 7L/min, the pressure drop from the cooling water inlet to outlet is 0.04MPa. Water flow rate while in operation and pressure drop should be set in a range that works out with the temperature change of cooling water throughout the year.

When your cooling water does not satisfy the above requirements, measures to improve water quality may be necessary.

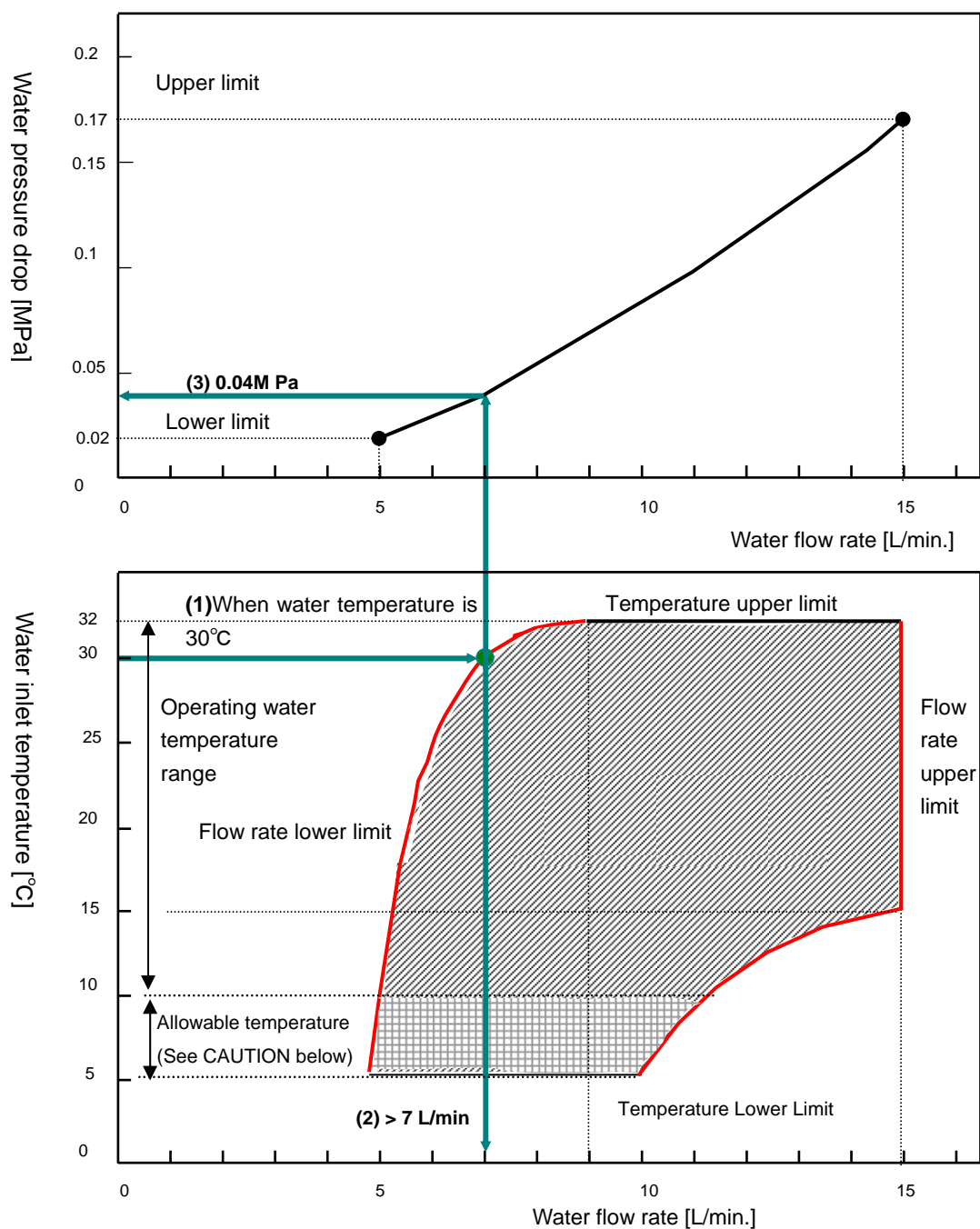
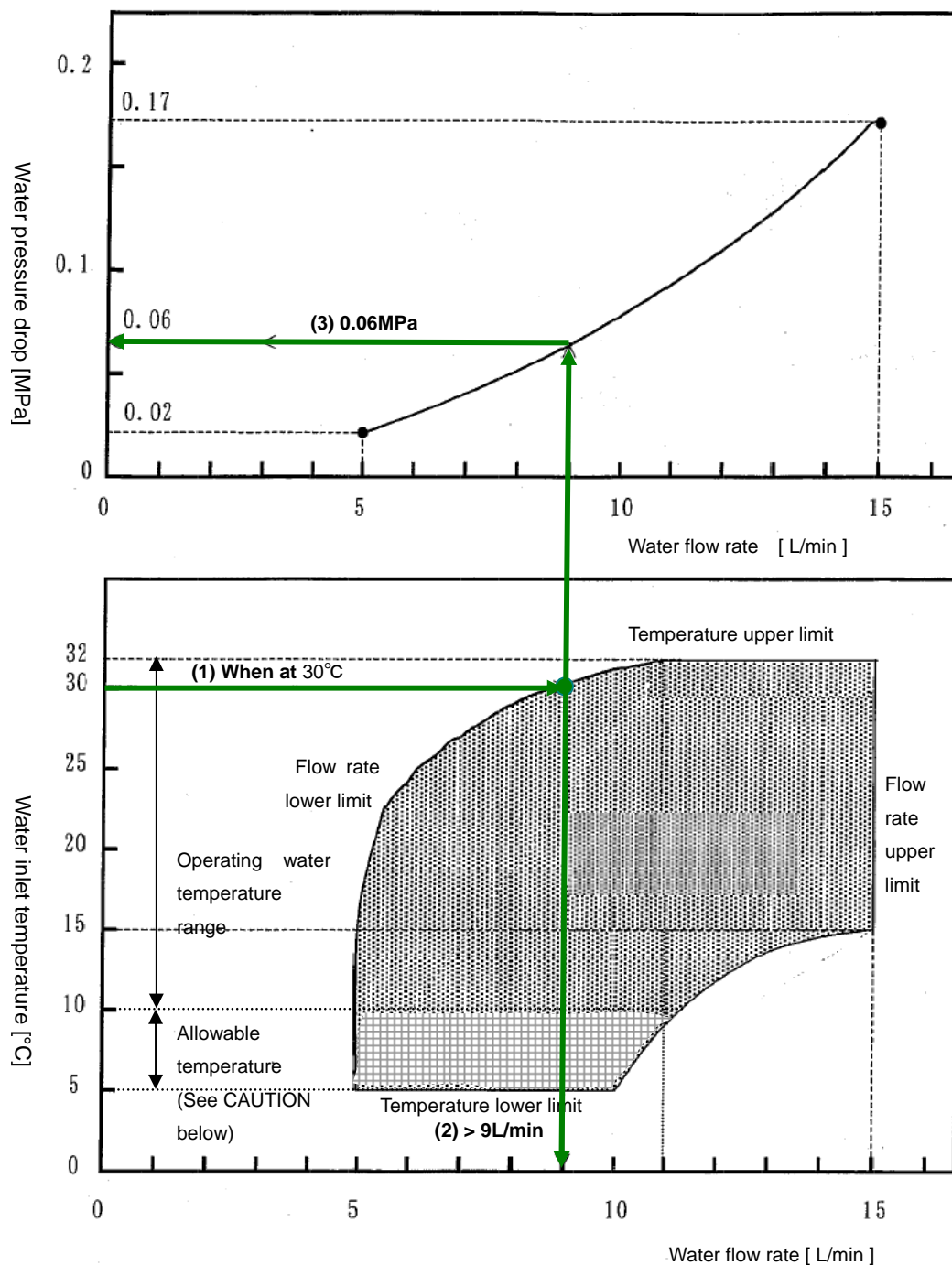


Figure 2-3 Cooling Water Flow Rate, Water Supply Temperature, and Water Pressure Drop (Helium Charge Pressure: 1.2-1.3MPa)



CAUTION

If the cooling water is cooler than 10°C, stop the water flow when the compressor is suspended. If the cooling water of below 10°C is kept flowing, it may raise viscosity of lubricant oil and the compressor may fail to startup when turned on.



**Figure 2-4 Cooling Water Flow Rate, Supply Temperature, and Pressure Drop
(Helium charge pressure: 1.4 to 1.5MPa)**



CAUTION

If the cooling water is cooler than 10°C, stop the water flow when the compressor is suspended. If the cooling water of below 10°C is kept flowing, it may raise viscosity of lubricant oil and the compressor may fail to startup when turned on.

2.3.3 Using cooling water

Rc 3/8 female pipe thread is used for both “Cooling water inlet” and “Cooling water outlet”. It is recommended to install a filter in the “Cooling water inlet” line in order to remove contaminant in the cooling water.

Installing a water flow meter in the cooling water line of the compressor is also recommended.

It is recommended to have an air blower in your facility to drain the compressor. To use an air blower, connect the hose for the air blower to the “Cooling water inlet” fitting instead of the cooling water pipe which is used usually.

Refer to “Section 5.2 Compressor operation” for detail.

2.4 Length of Cables and Flexible Hoses

Standard length of optional cables and flexible hoses are listed in Table2-4.

Table 2-4 Standard Cables and Flexible Hoses

Item	Standard length [m]	Quantity
Cold head drive cable	5,10,15,20,25	1(*1)
Flexible hose	5,10,15,20,25	2 x N(*2)
(*1) shows the number of cables delivered with compressor when the system includes one refrigerator unit.		
(*2) “N” is the number of refrigerators that one compressor unit runs.		

NOTE: Please contact us for different length of cables and/or flexible hoses.

2.5 Main Circuit of the Compressor

Fig. 2-5 shows main circuit of the Compressor.

Compressor body, a component in the unit includes an induction motor inside the body. MCP, the main circuit protector has a short circuit protection, also has a motor overload and a phase loss protection. When any fault as above occurs, main power is turned off for MCP tripping.

In addition, the Compressor has 4 detectors with helium and oil flow. If there is not any fault with the detectors, RDY light on the front panel of the Compressor turns on.

When OP_EN signal issued by the customer turns on in the above condition, MC in the Compressor turns on by the activation. This means that the Compressor goes into running operation.

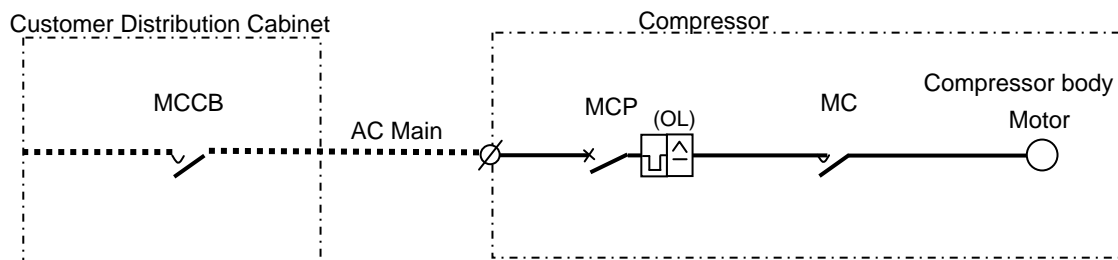


Figure 2-5 Compressor Main Schematic

2.6 Remote Functions

Table 2-5 shows the remote response specifications.

Table 2-5 Remote Response Specifications

Items		Specifications
形式		
Input	3	Input by relay coil DC24V / MAX 20mA
Output	4	Dry contact (relay output) Contact specifications: DC30V / MAX 100mA Minimum applicable load: DC5V / 1mA

Select the contact as follows;
Contact specifications : Above DC30V /0.1A
Minimum applicable load: DC24V/5mA or lower

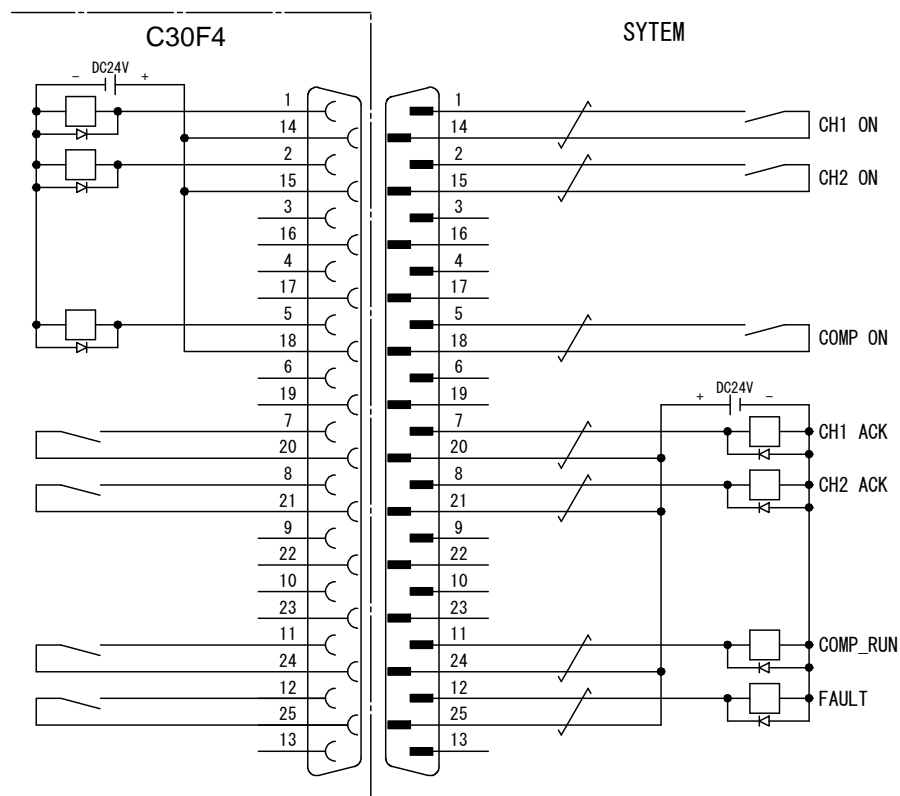


Figure 2-6 Wiring of Input and Output Lines

When the "REMOTE RESPONSE" D-sub connector on the rear panel is wired, the compressor status can be monitored while in operation

CH1 ON, CH2 ON

They are coldhead start commands. While the compressor is in operation, turn on these signals to drive corresponding coldheads, and turn them off to stop.

NOTE: The coldheads will not start by turning on these signals while the compressor is suspended.

COMP ON

This is the start command of the compressor unit. Turn on this signal to start the compressor, and turn it off to stop.

NOTE: This command is for operating the compressor, not the coldheads. It is required to turn on the above coldhead start commands to start the coldheads.

CH1 ACK, CH2 ACK

These signals show the acceptance of the coldhead start commands (CH1 ON, CH2 ON). They are activated when the corresponding coldhead start commands (CH1 ON, CH2 ON) are turned on.

NOTE: The coldheads will not start while the compressor is suspended.

COMP RUN

This is an answer-back signal of the compressor. This signal is turned on when the compressor starts operation.

/FAULT

When this signal is ON, meaning that the contact output is closed, the compressor is ready for operation, or in operation. When failure or malfunction occurs to the compressor, this signal turns OFF, in other words, the contact output opens and the signal is not conducted. To reset this state, push the "RST" button on the front panel of the compressor. Make sure that the failure or malfunction is cleared before the manual reset. Figure 2-8 shows the behavior at the time of powering on and after momentary power failure.

2.6.1 Signal timing charts

Figure 2-7 shows a timing chart (example) when the compressor runs two refrigerators.

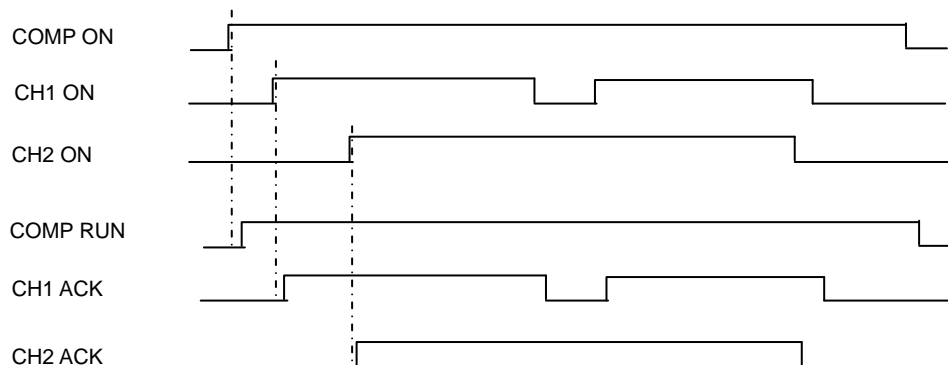


Figure 2-7 Run Two Refrigerator Units in "Level Signal Operation Mode"

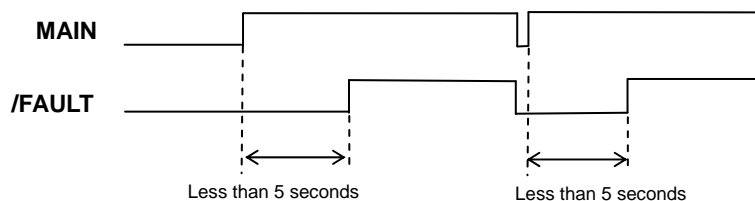


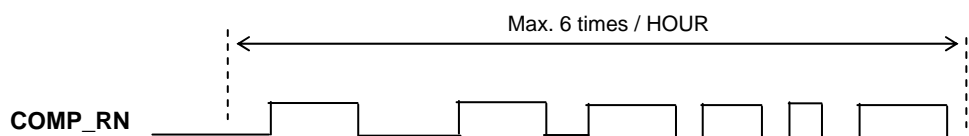
Figure 2-8 /FAULT Behavior at Powering On and after Momentary Power Failure

2.7 Notes for Normal Operation

Follow the instructions below for the smooth operation of compressor units.

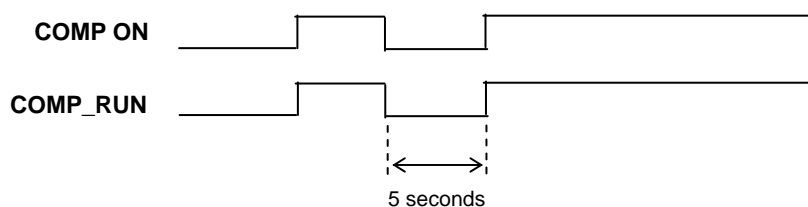
2.7.1 Switching between Start and Stop should be less than 6 times per hour.

This is the limitation of the compressor unit. If this is not observed, it may result in damage or failure of compressor unit.



2.7.2 Start operation should be delayed 5 seconds or more after the latest Stop.

The delay helps to avoid overload fault of the Compressor.



Section 3 Unpacking, Inspection and Storage

3.1	Compressor Carton.....	3-1
3.2	Shipping Inspection.....	3-1
3.3	Unpacking	3-2
3.4	Carton Contents	3-3
3.5	Inspection of the Compressor and Accessories.....	3-4
3.6	Flexible Hoses and Specifications	3-4
3.7	Cautions for Transportation and Storage	3-5

3.1 Compressor Carton

Compressors are shipped in a carton with wooden frame at the bottom.



CAUTION

Do not throw, jolt, push down on or tip over the cartons. It may result in damaging the equipment.

3.2 Shipping Inspection

Inspect the carton before unpacking for evidence of damage such as dents, breakage, wetness and/or signs that the carton has been tipped over. If there is any damage please contact the delivery company immediately.



Figure 3-1 Appearance of a Compressor Carton

3.3 Unpacking

Use handling equipment such as a forklift for carrying the compressor.



CAUTION

Compressor weighs about 136kg. Use handling equipment such as a forklift to move or lift the compressor. Only authorized personnel familiar with handling and risks of the equipment can operate the handling equipment. Personnel except for the operator of the handling equipment must keep away from the handling equipment and the compressor during the handling. There are risks of dropping and/or tipping over of the compressor. Failure to observe this warning may result in severe bodily injury or fatal accident.

Forklift is needed to remove the compressor from its shipping carton.
The procedure is shown below.

1. Cut the two straps of the carton.



CAUTION

When cutting the straps, handle a cutter with care and be aware of the flailing movement of the cut straps. Failure to observe this warning may result in severe bodily injury.

2. Lift the cardboard straight up and remove it from the bottom plate.
3. Insert the forks of the forklift between the bottom of the compressor and the bottom plate from the side of the compressor. (See Figure 3-2)
4. Ensure that the forks are inserted far enough to protrude from the other side and are well balanced.
5. Lift the compressor smoothly and move to a flat floor surface and bring down the compressor without shaking and/or jolting. After putting down the compressor on the floor, move it to the installation site by hand using the casters provided.



CAUTION

Bring down and place the compressor on the flat floor to avoid the compressor slipping. If the floor is sloped the compressor may move this could result in severe bodily injury or fatal accident.



CAUTION

After the compressor has been placed at an installation site, ensure to lock all casters of the compressor to prevent bodily injury by from unexpected movement or slipping of the compressor.

It is highly recommended to keep the package cardboard box, wooden bottom plate, and other packaging materials. The packages can be used for storage and transport of the compressor or for returning it to us for servicing.

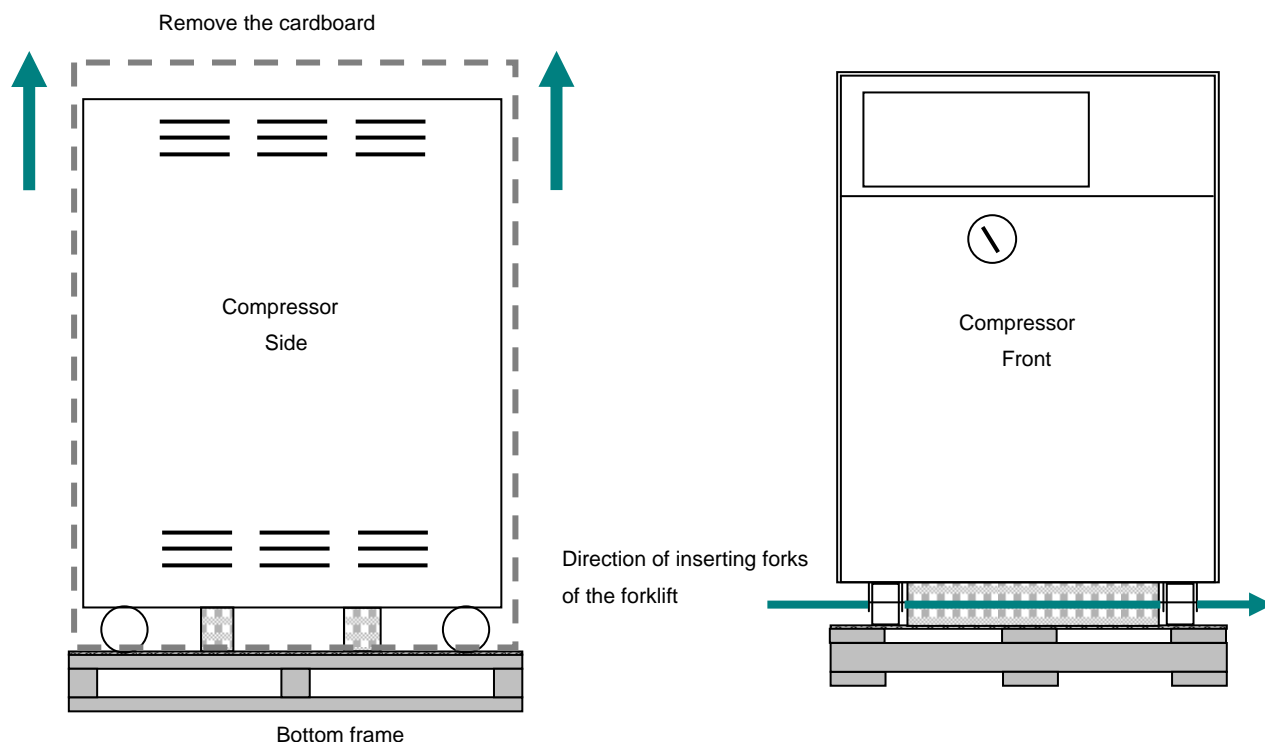


Figure 3-2 Remove Cardboard and Insert Forks underneath the Compressor

3.4 Carton Contents

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 3-2 is attached.

Table 3-1 Carton Contents

Mark(*1)	Item	Quantity
	Compressor unit	1
A1	Instruction Manual (this book)	1
A1	D-SUB connector_XM3A-2521 for remote operation Hood_XM2S-2511 ^{(*)4} for remote operation	1
A1	Cold head drive cable	1 - 2 ^{(*)2}
A1	Flexible hose	2 - 4 ^{(*)2}
A1	Helium manifold (For multiple refrigerator operation)	2 ^{(*)3}
A1	Gasket for aeroquip	-
A1	Single head wrench (Flexible hoses installation tool)	-
^{(*)1} The items of A1 will be shipped only when customers place orders independently. Contact us when they are necessary. ^{(*)2} The quantity depends on the number of cold heads. When two cold head units are used, two cold head drive cables and four flexible hoses are necessary. ^{(*)3} The model of helium manifold is determined by how helium lines branch. ^{(*)4} XM2S-2511 is not compliant to UL.		

3.5 Inspection of the Compressor and Accessories

Compressor

Inspect and visually confirm that there is no evidence of damage, oil leak and/or helium gas leakage to the compressor. If there is a problem, please contact our Service Engineering Division or the nearest customer support center.

Also check the value of helium pressure gauge on the front panel of the compressor to confirm that there is no helium gas leakage (Refer to "Section 5.1 Verification of helium static pressure").

Helium pressure gauge

If the value of the helium pressure gauge indicates lower than -0.04MPaG, the lowest appropriate charge pressure shown in figure 5-1, adding helium gas is required. For the procedures of adding helium gas refer to "Section 5 Operation".

Please contact our Service Engineering Division or the nearest customer support center if the helium static pressure is significantly low.

Accessories

Inspect and visually confirm the accessories that there is no evidence of damage. If any damage is found, please contact our Service Engineering Division or the nearest customer support center.

3.6 Flexible Hoses and Specifications

Flexible hose (Helium flexible line) consists of helium gas filled flexible hose, and self-sealing couplings at both ends.

Listed below are the specifications of flexible hoses.

Table 3-2 Flexible hose specifications

Item	Specification
Helium gas	99.999% pure or more
Allowable helium pressure	Max.2.65MPaG
Maximum operating temperature	75°C
Material	SUS304
Standard length	5,10,15,20,25m
Minimum bending radius	250mm
Coupling	1/2inch self-sealing coupling
Tightening torque of coupling	20N·m



CAUTION

Minimum bend radius of the flexible hose is 250mm.

Do not twist the flexible hose especially at both ends. Also, when bending the flexible hose ensure that no part of it becomes flattened.

Do not put any objects on the flexible hose.

Leave the dust caps on the self-sealing couplings of the compressor until the flexible hoses are connected to the couplings.

Failure to observe this warning may result in damage and/or break down of the equipment.

**CAUTION**

When carrying flexible hoses, keep appropriate bend radius. When storing them, avoid corrosion and condensation in the same manner to handle other equipments.

3.7 Cautions for Transportation and Storage

Compressor units must be transported and stored indoors. See “Table 1-4 Environmental and Operating Conditions” in Section 1 and check the ambient temperature, humidity, atmosphere, vibration, and altitude for the best place to keep. Also, keep away from oil, coolants, or other contaminants.

The storage site for the Compressor also should be flat-floored and have a proper ventilation system to avoid danger of suffocation.

Be sure that all connections to the Compressor have been disconnected and couplings are covered with dust caps or plugs. Refer to “Section 4 Installation, Piping, and Wiring” for the removing procedure.

Make sure that water inside the Compressor has been removed.

Record the value of the Helium Pressure Gauge.

Cover the Compressor with a plastic sheet as it was shipped.

Lock all casters of the Compressor at the storage site.



Lock released



Locked

Put accessories such as flexible hoses and cables into boxes, and keep them close to the Compressor. You may use shipping packages as the whole covering. Check the value of the Helium Pressure Gauge once a month. If the value is decreasing, there is a possibility of leakage. Please contact us.

NOTE: When transferring the Compressor to outside, it is recommended to pack it in cartons as it was shipped from our factory.

**CAUTION**

Do not throw, give shock, push down, or roll down the packages. Failure to observe this precaution could result in damage of the equipment.

Please reconfirm the transferring method of the Compressor and risks referring to “Shipping Carton Inspection” in this section.

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Section 4 Installation, Piping, and Wiring

4.1	Before Installation	4-1
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4.3	Connecting and Disconnecting Helium Flexible Hoses	4-2
4.4	Single Cryopump Connection	4-5
4.5	Multiple Cryopump Connections	4-6
4.6	Electrical Connections	4-7
4.7	Points to be Checked after Installation	4-14
4.8	Disconnecting Wirings and Lines	4-15

4.1 Before Installation

This section describes appropriate procedure for installing C30F4 and connecting the compressor to a CRYO-U[®] cryopump. The procedure of connecting the compressor to a CRYO-T super trap is the same as connecting to a cryopump; however please refer to the relevant manual.

Figure 4-1 is the block diagram for the compressor installation.

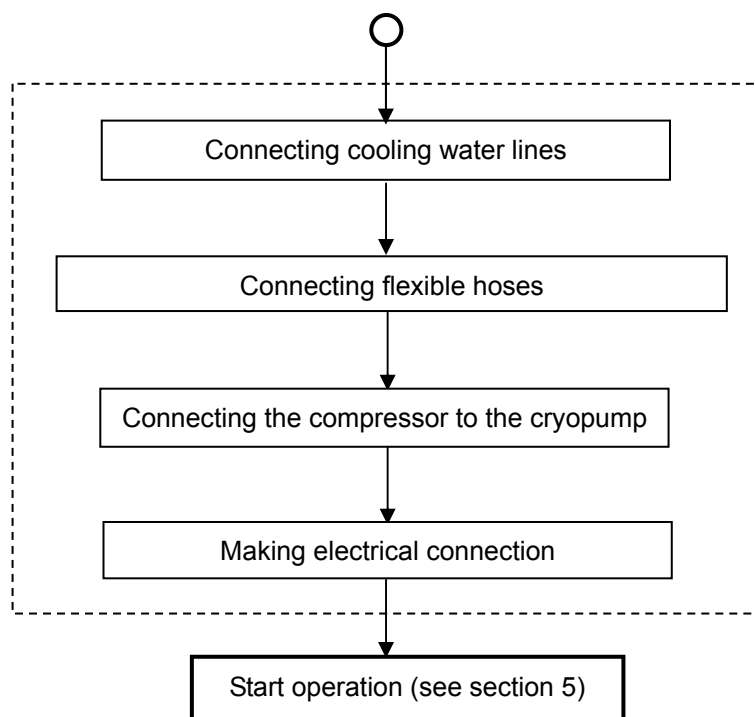


Figure 4-1 Installation Procedure



CAUTION

To ensure safe, reliable system performance, read this manual as well as other relevant manuals completely to gain a thorough understanding before beginning work.

**CAUTION**

Following procedure must be undertaken by an authorized electrician familiar with the structure and risk of the product. Failure to observe this warning may result in severe bodily injury or fatal accident.

4.2 Connecting Cooling Water Lines**CAUTION**

Cooling water for this compressor must meet the requirements described in “Section 2-3 Cooling water requirements”. Failure to observe this warning may result in damage to and/or break down of the equipments.

Rc 3/8 female pipe threads are used for both cooling water inlet and outlet of the compressor.

The connecting procedures using fitting and hose (tube) are shown below.

1. Apply plumbing pipe sealing tape properly to screw side of the fitting.
2. Connect the fittings to “WATER IN” and “WATER OUT” with a spanner.
3. Connect the hoses to the fittings and fix the hoses properly with hose clamps.

**CAUTION**

Do not over-torque the hose fittings. It may damage the cooling water inlet or outlet.

4. Connect the water supply tube to the “WATER IN” connector and fix the hose with hose clamp.
5. Connect the water return line to the “WATER OUT” connector and fix the hose with hose clamp.
6. Make sure that water does not leak by flowing water at the actual flow rate.

To connect cooling water piping in any other way, follow the manual of the component.

NOTE: Water lines should have sufficient strength to the largest possible water pressure.

4.3 Connecting and Disconnecting Helium Flexible Hoses**CAUTION**

Follow the procedures below to connect and disconnect flexible hoses. Failure to observe this warning may result in damage to the O-ring seals of the coupling and/or leakage of helium gas.

Connecting procedures

1. Remove all dust plugs and caps from the compressor, couplings and flexible hoses of the refrigerator. Check the connections and ensure that there is no dust or dirt on helium coupling gasket and around it. If there is any dust, remove it. Ensure that helium coupling gasket goes in the male coupling and there is no gasket for female coupling.
2. Return flexible hose is labeled "RETURN" with red letters. Connect the return flexible hose to "RETURN GAS" connector on the rear panel of the compressor. Then connect the other end of the return flexible hose to the connector labeled "RETURN" with red letters on the refrigerator side.
3. Supply flexible hose is labeled "SUPPLY" with red letters. Connect the supply flexible hose to "SUPPLY GAS" connector on the rear panel of the compressor. Then connect the other end of the supply flexible hose to the connector labeled "SUPPLY" with green letters on the refrigerator side. Connecting method is the same as the return flexible hose.

(Connecting method)

As shown in Figure 4-2, hold the braid support straight so that the connection parts fit properly and tighten by hands as tight as possible. Then tighten the coupling with two spanners as shown in Figure 4-3. See Figure 4-4 for usage of two spanners.

The torque value is 20N·m for both couplings. Complete the procedure as quick as possible to minimize helium gas leakage.

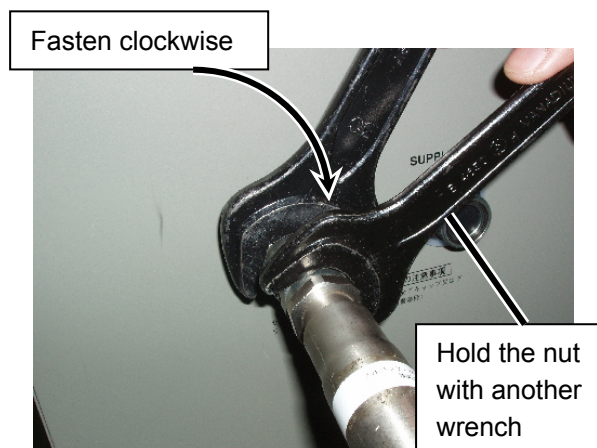
**CAUTION**

Tightening the couplings too much may result in breakage of the equipment.

4. Verify the helium filling pressure referring to "Section5.1 Verification of helium static pressure".



Figure 4-2 Tighten with Hands First



4-3 Tighten with Two Spanners

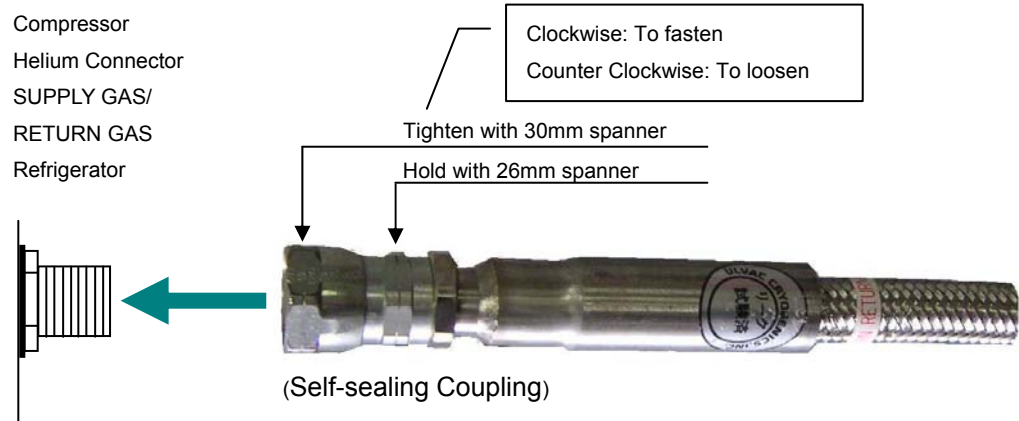


Figure 4-4 Connecting and Disconnecting Helium Flexible Hoses to Compressor and Refrigerator

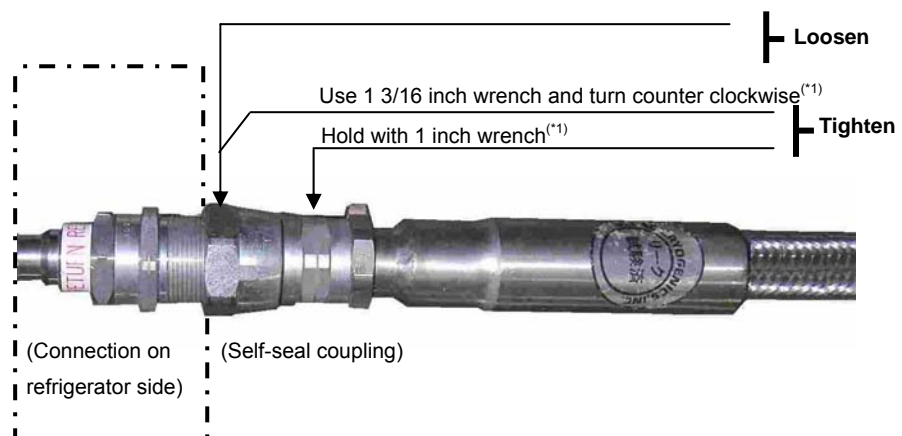


Figure 4-5 Connecting and Disconnecting Helium Flexible Hoses to Refrigerator

Disconnecting procedures



CAUTION

If the flexible hoses are disconnected while the cryopump is still cold, the pressure inside the refrigerator will rise as its goes up and cause helium leakage via the pressure relief valve.

To disconnect flexible hoses from the connectors, use only two lipped bowl spanners (bolt width 26mm, 30mm). Do not use other spanners.

Loosen the couplings with two spanners and then take them off by both hands. Complete the procedure as quick as possible to minimize helium gas leakage

**CAUTION**

Refer to “Section 6 Maintenance” for the conditions that connecting or disconnecting work can be done. Failure to observe these cautions may result in damaging O-ring seal of couplings or helium leakage.

4.4 Single Cryopump Connection

Figure 4-6 shows the connection of the compressor and one cryopump.

1. Follow the procedures in “Section 4.3 Connecting and disconnecting helium flexible hoses” to connect the flexible hoses to the compressor and cryopump.
2. Connect the cold head drive cable from the rear panel of the compressor to the coldhead.

Connect the cold head drive cable plug to the compressor receptacle. Turn the plug clockwise to fasten. Turn it until it won't turn further to fix it.

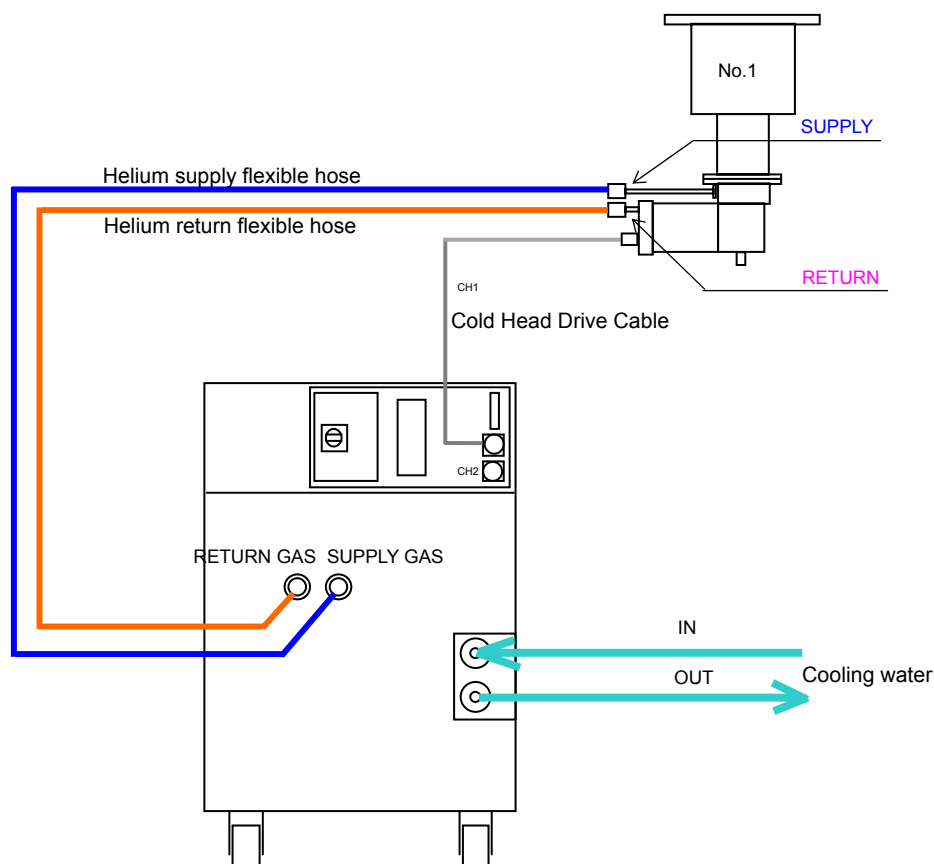


Figure 4-6 A Compressor Connected to One Cryopump

4.5 Multiple Cryopump Connections

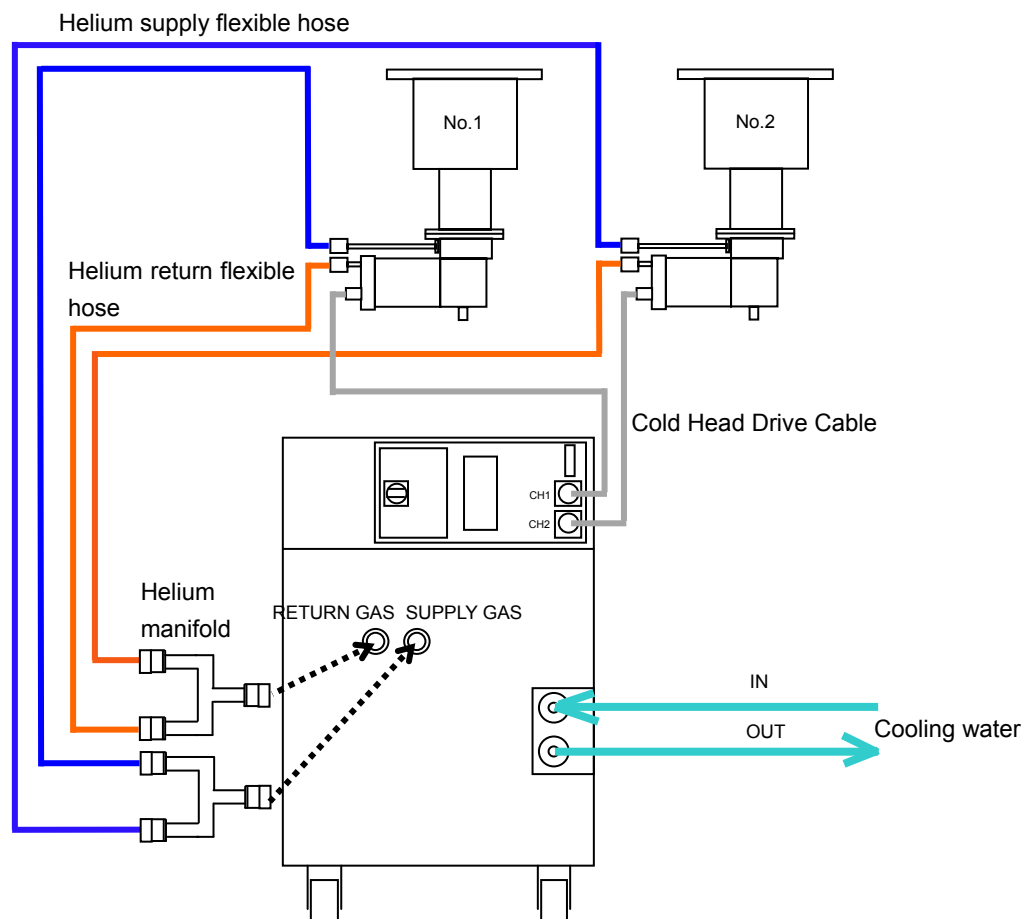
Figure 4-6 shows the connection of the compressor and multiple cryopumps.

1. First, install helium manifolds to the compressor connectors to connect multiple flexible hoses.

Refer to “Section 4.3 Connecting and disconnecting helium flexible hoses” for the method of installing manifolds as it is the same as connecting flexible hose to the compressor.

Connect flexible hoses to manifolds and to the refrigerators.

2. Connect the cold head drive cables from the rear panel of the compressor to multiple cryopumps. The cables can be connected in the same way as in “Section 4.4 Single cryopump connection”



**Figure 4-7 Connections of A Compressor and Multiple Cryopumps
(example with two cryopumps)**

4.6 Electrical Connections

Refer to “Single cryopump connections” on previous page for the connection of cold head drive cables.

Below are the connecting procedures of input power cable and remote input/output cable.



CAUTION

The electrical wiring must be done in accordance with all applicable local, national, and international standards. Failure to observe this warning may result in damage to and/or break down of the equipments.



WARNING

There is a danger of high voltage. Ensure that the input power source is OFF and locked before connecting or disconnecting input power cable. The wiring work must be undertaken only by an authorized electrician familiar with the structure and the risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.

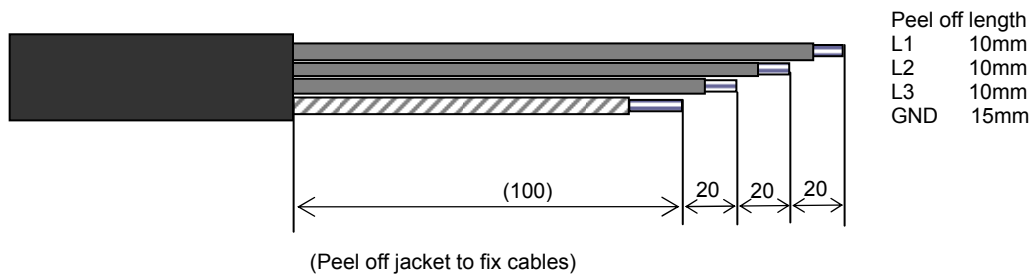
Refer to “Section 2.2 Wiring requirements” and confirm the specifications of the input power cable and the customer-supplied power circuit at the equipment side.

Ensure that the breaker which supplies power to the compressor has been turned off on the distribution board at the equipment side before connecting the input power cable.

To use a lock key to keep the power off status is effective as a fail safe.

4.6.1 Connecting the input power cable and switching the connector to the desired voltage

1. Peel off cable jacket and insulation coating of electric wire. (Figure 4-8)
2. Open the cover of main circuit protector. (Figure 4-9)
3. Fix electric cables on the tie mount. (Figure 4-10)
4. Connect yellow and green earth wires to earth terminal. (Figure 4-11)
5. Wire power cable with main circuit protector terminal. (Figure 4-12)
6. Close the cover of main circuit protector. (Figure 4-13)
7. When necessary, switch the connector to the desired voltage. (Figure 4-14)



NOTE: Insert mark tubes, etc. as necessary.

Figure 4-8 Peel off cable jacket and insulation coating of electric wire

Remove seven screws to open the cover.

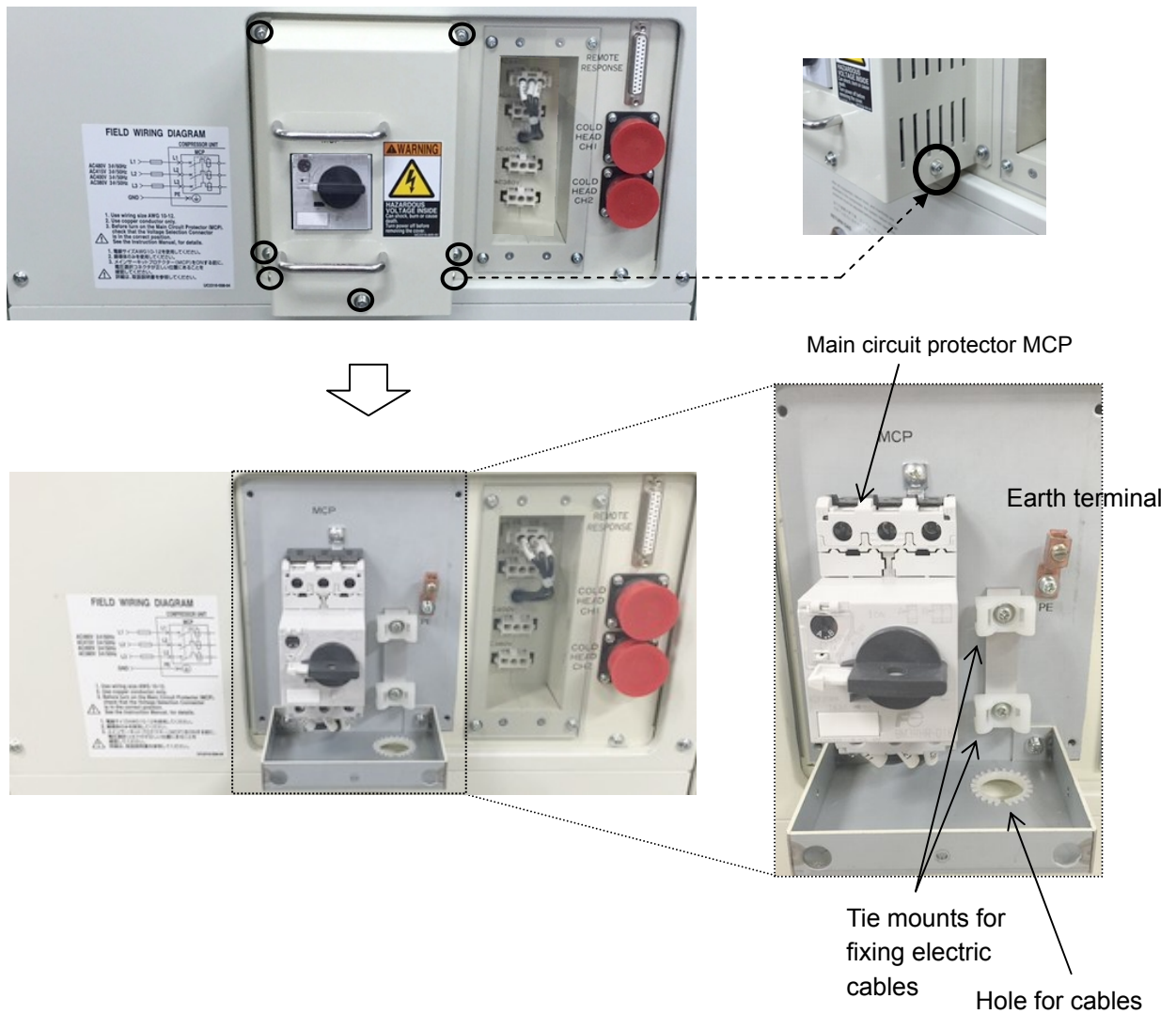


Figure 4-9 Open the cover of main circuit protector

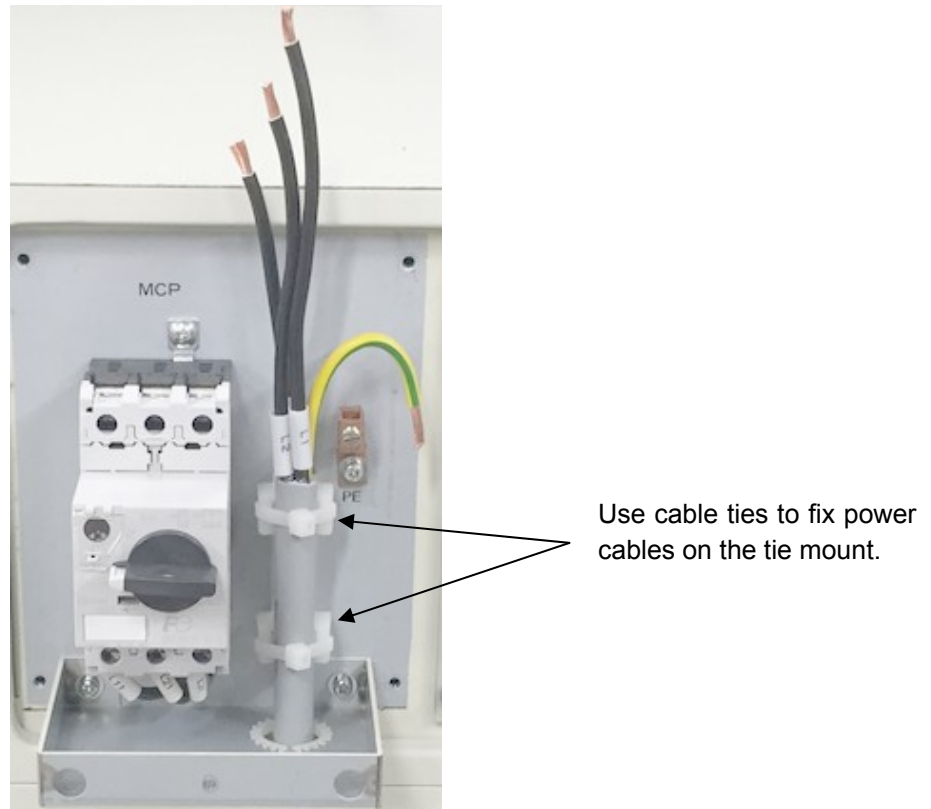


Figure 4-10 Fix the Power Cables

Use flathead screwdriver (6mm width)
and tighten with the torque below;
Necessary torque: $2.7\text{N} \cdot \text{m}$ ($20\text{ lbf} \cdot \text{in}$)

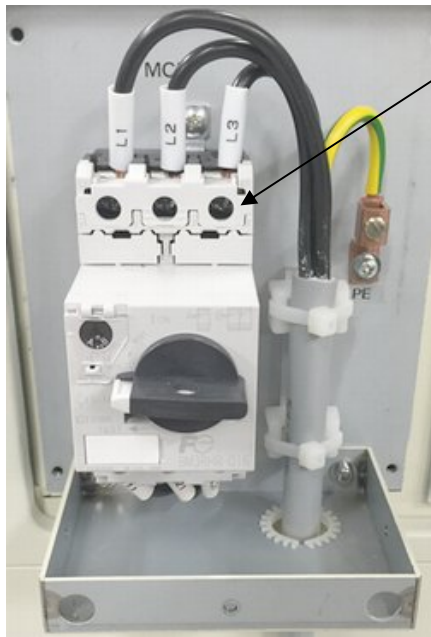


With crimping terminal

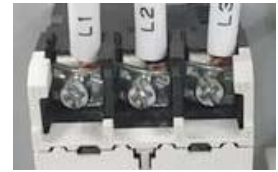
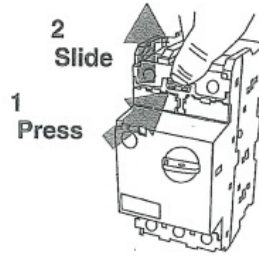


- Remove the grounding lug and connect with PE terminal directly.
- Use a cross slot screwdriver #2.
- Torque: $1.7\text{N} \cdot \text{m}$
- Crimping terminal: Size R5.5-4

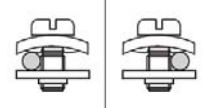
Figure 4-11 Connect Yellow and Green Earth Wires to Earth Terminal



Remove the terminal cover as in the picture below.

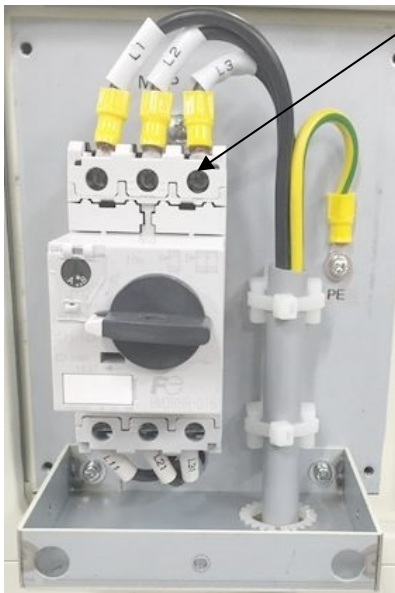


Insert wire as shown in the right picture and tighten with the following torque.

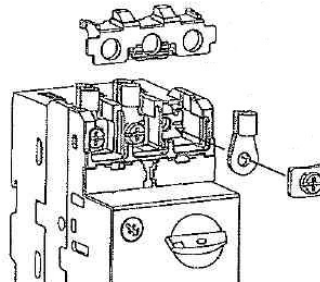


Tightening torque: 2 N · m

When you use crimping terminal

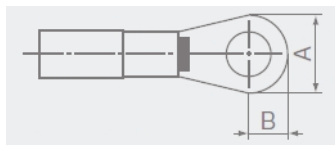


Remove terminal cover and connect to crimping terminal.



Tightening torque : 2 N · m

Crimping terminal size: R5.5-4



$A \leq 11\text{mm}$

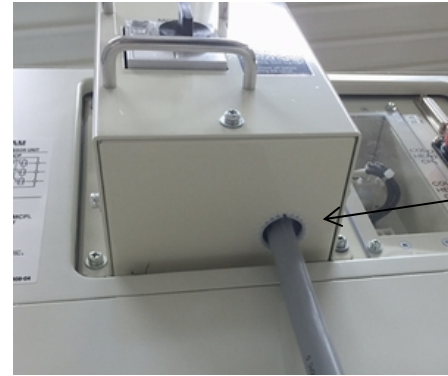
$B \leq 4.8\text{mm}$

Figure 4-12 Wire Power Cables to Main Circuit Protector Terminal



CAUTION

Use an appropriate size (6mm in width) flathead screwdriver when connecting electric wires to the main circuit protector terminals. Do not use Phillips screwdriver as it may damage the screws.



Flexible bushing

Figure 4-13 Close the Cover of Main Circuit Protector



CAUTION

Flexible bushing on the cover of main circuit protector is attached to protect power cables. Use caution not to drop it.



Remove four screws and clear cover.



Remove electric connector while pressing the lock on both sides



Locate the voltage and insert the connector to the terminal below.
(AC415V in the picture above)


Figure 4-14 Switching Connectors to Choose the Desired Voltage.

4.6.2 Installing the Remote Controls/Signals cable

Figure 4-15 shows pin assignments for the control and signal lines.

The connector is required soldering for wiring.

Refer to “Section 2 Considerations before Installation” for the information on wiring specifications and remote functions.



CAUTION

Only qualified electrical personnel familiar with the construction and operation of this equipment performs the wiring. Failure to observe this precaution could result in damage to, or destruction of the equipment.

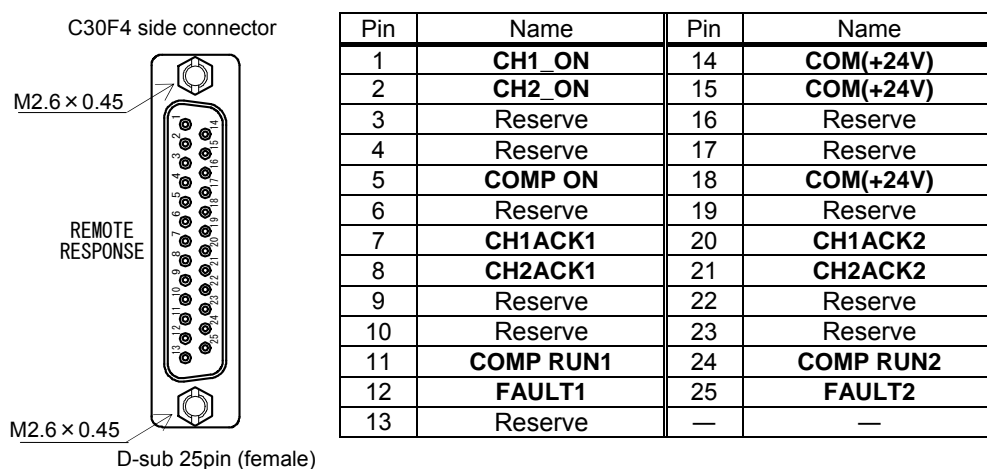


Figure 4-15 Remote Connector Pin Assignments – (viewed from rear panel)

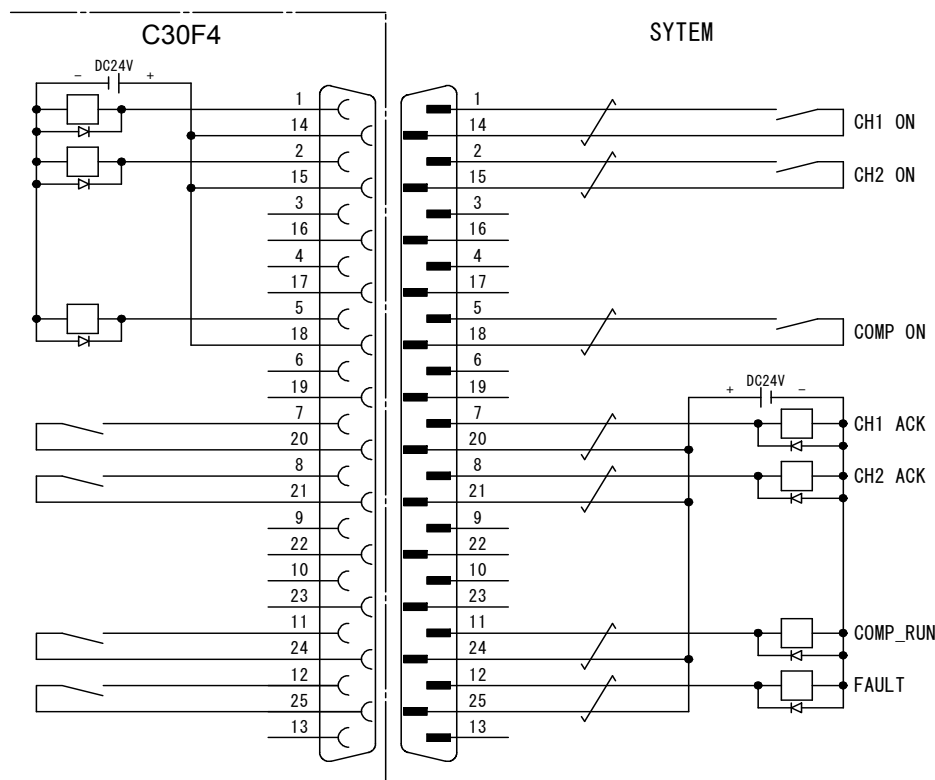


Figure 4-16 Wiring of Input and Output Cables

Refer to Figure 4-16 and solder cables to D-sub plug.
Then, insert the D-sub plug to the REMOTE RESPONSE connector on the rear panel and fix it with two screws with Phillips-head screwdriver. (Figure 4-17)

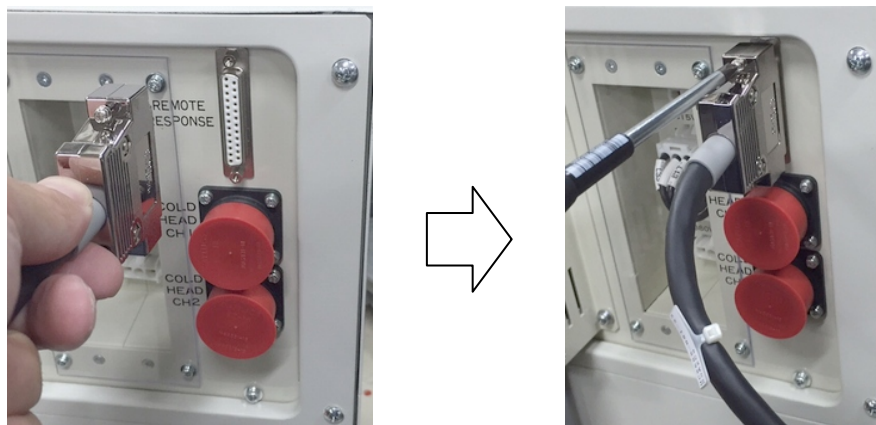


Figure 4-17 Connect the Remote Connector

Solder Identification

Attach the identification label of the solder used on the connector or cable.



CAUTION

For lead-free soldering, use only specified lead-free solder iron and tip. Do not mix lead eutectic solder with lead-free solder. Failure to observe this warning may result in decreasing the life of soldered parts severely.

NOTE: Clear identification of solder: Listed below are the recommended abbreviations for identifying solders. Labeling the kind of solder clearly helps you to perform proper maintenance.

Lead eutectic solder	SnPb or SP
Lead-free solder (Sn-Ag)	SnAgCu or SAC
Lead-free solder (Sn-Cu)	SnCuNi or SCN



CAUTION

Connector must be soldered by authorized personnel familiar with the kinds of solder and soldering procedure. Failure to observe this warning may result in breakdown of the product, or decrease the life of soldered parts severely.

4.6.3 Connecting Cold Head Drive Cable

Turn the coupling nut of the optional Cold Head Drive Cable clockwise while pressing the connector to the direction of the arrow.

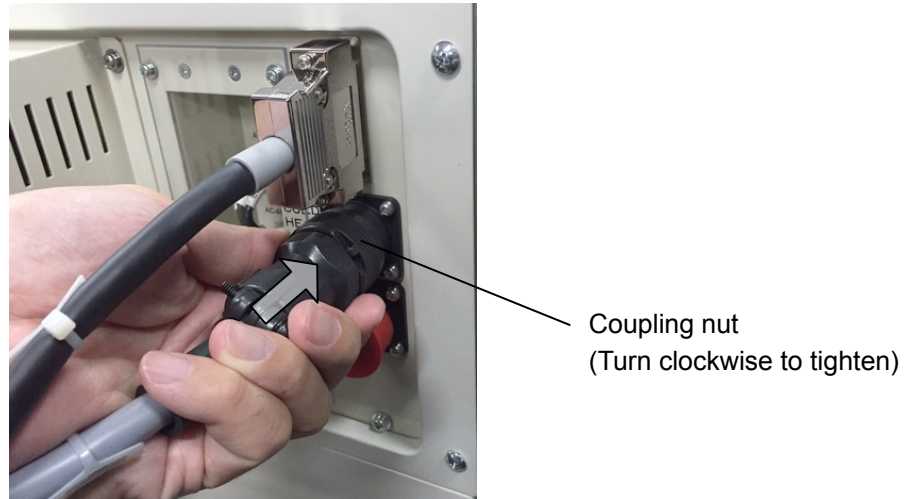


Figure 4-18 Connecting Cold Head Drive Cable

4.6.4 Wire Routing for Compressor and Other Equipments

The compressor and other equipments must be wired in accordance with applicable local and national standards where the equipments are installed as well as international standards. Signal wires, sequence control wires, and power wires for connecting equipments must be wired in separate conduits to prevent interference during the operation.



CAUTION

The remote wires must not be either put in the same conduit or routed with the power wires. It may cause interference with the compressor operation. Failure to observe this warning may result in damage to and/or break down of the equipment.

If it is not possible to wire in separated conduits, keeping enough distance between those wires can be effective as “separating wires”. Interference between wires depends on electromagnetic force but in general it is effective to keep the distance of 100mm or more between each wiring.

4.7 Points to be Checked after Installation

When installation is completed, check that the necessary space is taken around the compressor unit. Refer to **Figure2-1** in **Section 2 Considerations before Installation** for the required space.

4.8 Disconnecting Wirings and Lines

Disconnection of helium lines, water lines, and electrical wirings from the Compressor are required when changing the installation place or removing the system.



CAUTION

Only qualified personnel familiar with the principles and functions of the Compressor should perform this procedure. Read and understand this manual and other applicable manuals in their entirety before proceeding.



CAUTION

Only qualified mechanical and electrical personnel familiar with the construction and risks of this equipment should perform the procedure below.

Failure to observe this precaution could result in severe bodily injury or loss of life

Confirm and lock the source power to the Compressor to be OFF in the customer's cabinet before proceeding the disconnecting procedure.

The cooling water flow for the Compressor also should be stopped.

Confirm that the Compressor circuit breaker is OFF position, and key-lock is recommended for disabling of the Compressor power-on action.

1. Before disconnecting water lines, be sure to remove water inside the Compressor. Refer to "Section 5 Operation / Cooling Water and the Compressor Operation / When Removing the Water from the Compressor" for the procedure.
2. For disconnecting flexible hoses from the Compressor, see "Connecting and Disconnecting Helium Flexible Hoses" in this section.
3. Put dust caps and plugs at the end connections of the Compressor and flexible hoses as they were shipped.
4. Disconnect the cold head drive cable from the cold head connector. Do not disconnect it of the compressor side.
5. Disconnect Signal cable from the Compressor.
6. Disconnect the input power cable from the Compressor. Disconnect it in reverse order described in "Electrical Connections / Installing the Input Power Cable" in this section.
7. Unlock the casters of the Compressor.
8. Refer to "Section 3 Unpacking, Inspection and Storage / Maintenance at Storage Site" for moving the Compressor.

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Section 5 Operation

5.1	Verification of Helium Static Pressure	5-1
5.2	Compressor Operation	5-2
5.3	Inspection after Replacing Helium Circulation Components	5-4
5.4	Precautions for when the Compressor Unit is Suspended	5-5
5.5	When Removing Water from the Compressor Unit	5-5
5.6	Maintenance Operation for a Compressor Suspended for a Long Period	5-6

5.1 Verification of Helium Static Pressure

Before starting cryopump system operation, verify the helium static pressure.

Main components that make a system such as a compressor, flexible hoses, and a refrigerator have been charged with helium gas before they are shipped from the factory. However the helium pressure may be changed at the time of connecting the components.

Pressure verification procedure is shown below.

1. Stop the compressor if it is in operation and wait until the whole system reaches to the room temperature (It takes about three hours after the shutdown).
2. Ensure that the flexible hoses between the compressor and the refrigerator are connected properly.
3. See Figure 5-1 and check the proper charge pressure value at the actual room temperature.
4. Make sure that the helium pressure shown in the high-pressure side pressure gauge on the front panel is 0.04MPaG above or below the above proper value.
It is possible to start operating the compressor when the helium pressure is in the proper range. If it is out of range, see "Section 6.3 Adjusting system helium pressure" and adjust it.



CAUTION

Improper helium pressure may make the performance unstable, shorten the compressor motor life, and/or cause malfunction of the product.



CAUTION

If the helium filling pressure is higher than the set pressure for the pressure relief valve described in Appendix D, the pressure relief valve of the compressor or refrigerator may vent the surplus helium gas.

If the pressure relief valve blows, stop the operation and leave the compressor for several hours to ensure that the helium filling pressure is in the range which can be still operated. If the helium filling pressure is reduced, please contact us for maintenance.

Helium Charge Pressure [MPaG]

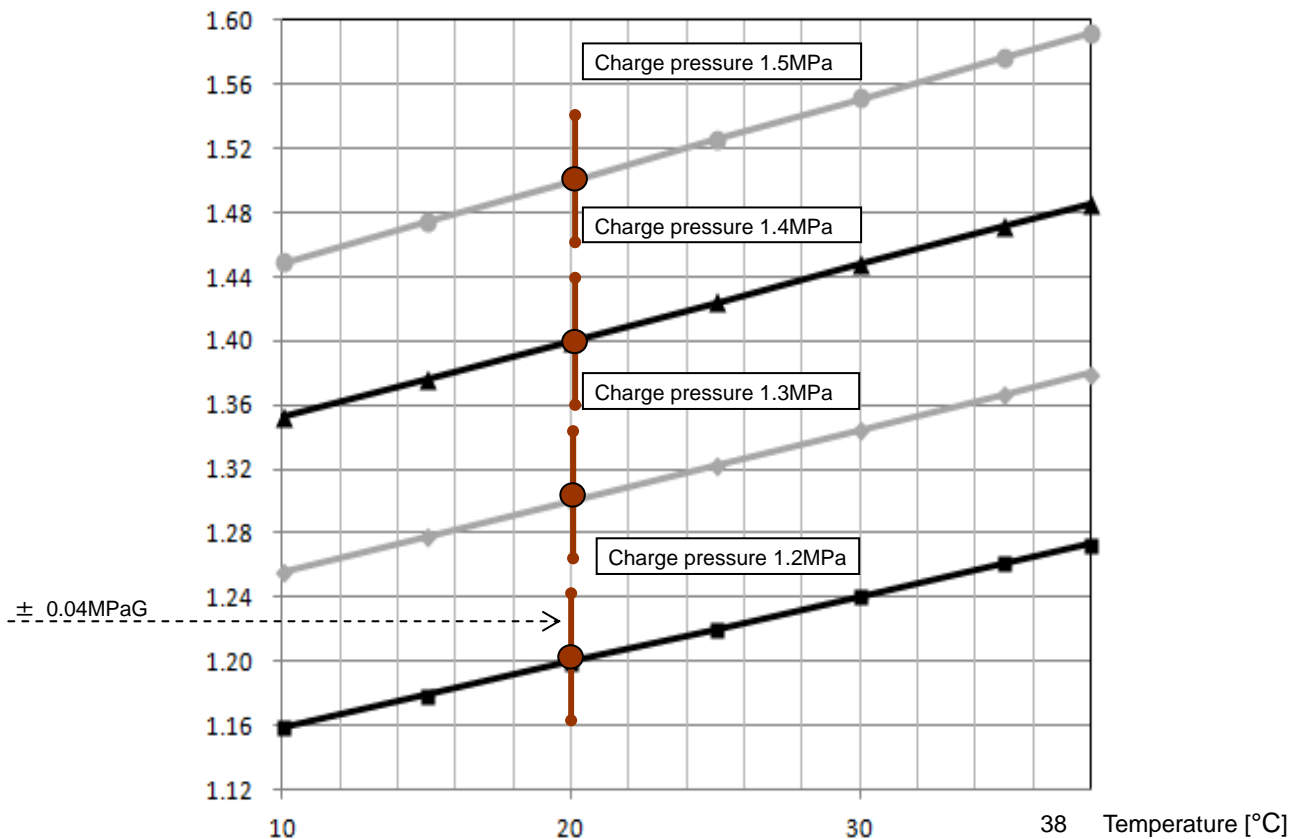


Figure 5-1 Helium Static Charge Pressure and Ambient Temperature

5.2 Compressor Operation

(1) Supply water to the cooling water piping

Supply water to the cooling water piping. After supplying cooling water, check that the water flow rate and the pressure are in the proper range (See “Section 2.3 Cooling water requirements”).

(2) Check VOLTAGE SELECTION CONNECTOR

Make sure that the voltage selection connector is on the right position before turning ON the main circuit protector (MCP) of the compressor unit.

(3) Power-On the compressor



CAUTION

Power-On procedure and checking the main power phase sequence must be undertaken by an authorized electrician familiar with the construction and risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.

- 1) Check that the main power supply of the customer's system (equipment side) is turned on.
- 2) Turn the main circuit protector (MCP) knob from OFF to ON position to turn on the power to the compressor unit.

(4) Check the STATUS DISPLAY on the front panel

Check the STATUS DISPLAY on the front panel of the compressor unit a few seconds after turning the power on.

Refer to “Section 7. Troubleshooting” when 「IPF」, 「TS1」, 「TS2」, 「TS3」, 「LPS」 light up.

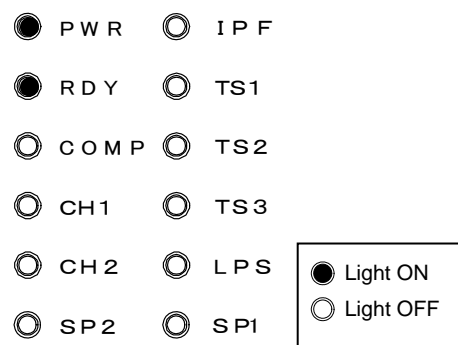


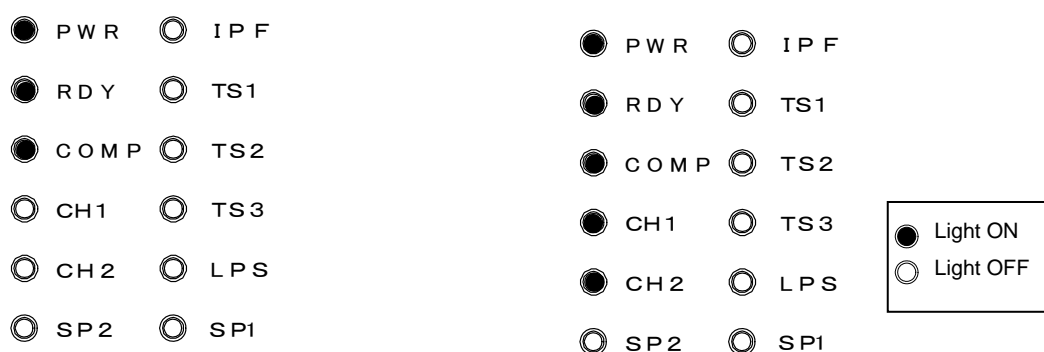
Figure 5-2 STS (Status) Lights

WARNING

There is a danger of hazardous voltage. Only qualified electrical personnel familiar with the construction and risks of this equipment should perform procedure above.
Failure to observe this precaution could result in severe bodily injury or loss of life

(5) Operation Status

When Input power of the Compressor is on and COMP ON command from the customer is turned on, then the Compressor unit goes in running operation (0). Turn CH1 ON, or CH2 ON to start the operation of refrigerator units (0).



Compressor unit in operation

Compressor unit and
cold head 1 and 2 are in operation

Figure 5-3 Compressor Unit in Operation

(6) Cryopump operation

The cryopump (refrigerator) operation can be started after pumping down the cryopump below 40Pa by a roughing pump (refer to cryopump manual for details). The cryopump condenses and adsorbs the gas molecules on its cryogenically-cooled panels (cryopanel). The compressor operates continuously throughout the cryo process.

**CAUTION**

The compressor is intended for continuous, not intermittent operation. The number of starting/stopping of the compressor pump must be six or less times per hour. Failure to observe this warning may result in damage to and/or life shortening of the compressor.

(7) Recording the helium pressure during operation

Helium high-pressure side pressure gauge on the front panel indicates the pressure of the helium supply line of the compressor.

Read the maximum pressure value at the time of starting the compressor operation.

Keep the cryopump system operating and read the pressure value of helium pressure gauge when the system is pumping steadily.

Write down these values in the Appendix A Table A-1, operating log sheet.

These two recorded values depend on the length of flexible hoses and a kind of the refrigerator mounted on the cryopump system. The recorded values are used as reference value for maintenance or replacement of the product explained in the following.

5.3 Inspection after Replacing Helium Circulation Components

After replacing a component such as a cryopump, a flexible hose, and a compressor refer to "Section 5.1 Verification of helium static pressure" and check that the helium filling pressure is almost equal to the value before replacing the component.

In addition, if the system installation condition has been changed, conduct "**Recording the helium pressure during the operation**" described above.

5.4 Precautions for when the Compressor Unit is Suspended

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

Also, if the compressor will be stopped for long period, it is recommended to stop supplying cooling water to avoid corrosion or clogging of the pipes inside the compressor and the heat exchanger. In addition remove the water from the compressor when needed (Refer to "Section 6.1.1 Removal of cooling water piping" to remove the water from the compressor).

5.5 When Removing Water from the Compressor Unit

Remove the water from the Compressor under the conditions listed below. Be sure that the Compressor is turned OFF or in power-off status. For removing process, see procedure below "(Cooling Water Removing Method)" for reference.

FREEZING: Frozen water in the pipes may cause destruction of the product.

LONG HOLIDAYS: The system is suspended for longer than a week for holidays or other reasons.

MOVE: Relocation of the Compressor, or removing of the system.

(Cooling Water Removing Method)

1. Stop supplying cooling water to the Compressor.
2. Disconnect the SUPPLY water line from the "COOLING WATER IN" fitting. DO NOT disconnect the RETURN water line.
3. Connect an appropriate hose for air blowing to the "COOLING WATER IN" fitting.
4. Increase the air pressure inside the hose from 0 to 0.2MPaG. And then keep air blowing for more than 30 seconds to blow out the water inside the Compressor. (The water comes out from the Compressor through the RETURN water line.)
5. Decrease the air pressure inside hose to 0 MPaG.
6. Disconnect the air hose from the "COOLING WATER IN" fitting.
7. If there is a possibility of "FREEZING" or "HOLIDAYS", leave the lines disconnected. When the transferring to other locations, disconnect the pipes from "COOLING WATER IN".

Refer to "Section 4.2 Connecting Cooling Water Piping" for the connection.



CAUTION

Do not perform procedure above when the Compressor is ON or the cooling water is flowing. Failure to observe this precaution could result in severe bodily injury or loss of life

**CAUTION**

Only qualified electrical personnel familiar with the construction and risks of this equipment should perform disconnecting procedure above.

Failure to observe this precaution could result in severe bodily injury or loss of life.

5.6 Maintenance Operation for a Compressor Suspended for a Long Period**CAUTION**

When the cryopump system is suspended for a long period, operate the compressor for an hour every three months. This will supply lubricant oil to all the components inside the compressor. Also, operate the refrigerator for ten minutes at a time every six months.

Failure to observe this precaution may result in damage to the compressor when restarting operation.

NOTE: Circulate cooling water as well during the maintenance operation of the compressor.

Section 6 Maintenance

6.1	Scheduled Maintenance	6-1
6.2	Replacement of Adsorber	6-1
6.3	Adjusting System Helium Pressure	6-5
6.4	Regular Maintenance of Helium Lines, Cooling Water Piping and Electrical Wiring.....	6-10
6.5	Maintenance Parts.....	6-10
6.6	Lockout-Tagout	6-11
6.7	Fuse Replacement	6-12

6.1 Scheduled Maintenance

The table below shows the required maintenance on the cryopump system. Refer to the following paragraph for details of adsorber replacement.

For maintenance of refrigerator or other components of the cryopump, see cryopump instruction manual.

Table 6-1 Scheduled maintenance

Item	Maintenance Cycle (h)
Adsorber replacement	Max. 24000h
Refrigerator maintenance	Refer to the instruction manual of refrigerator unit.
Inspection of Piping and Wiring.	12000h



CAUTION

Neglecting the scheduled maintenance may shorten the product life, cause damage, and/or destruction of the cryopump system.

NOTE: If a special maintenance plan for your specific application is needed please consult with our Service Engineering Division or the nearest customer support center.

NOTE: Refer to "Disposal Considerations" when disposing used components.

6.2 Replacement of Adsorber



CAUTION

The following replacing procedure must be undertaken by authorized personnel familiar with the structure and risk of the product. Failure to observe this warning may result in severe bodily injury or fatal accident.

**WARNING**

Inside the compressor unit, some areas remain hot immediately after the shutdown. Wait for at least 15 minutes in order to perform maintenance work safely. Failure to observe this warning may result in severe body injury.

When adjusting helium pressure, it is necessary to perform the work while inside of the compressor unit is in room temperature. Perform this work after cooling down the compressor for three hours.

Follow the steps below to replace adsorber

1. Ensure that each equipment and device in cryopump system is safe to replace adsorber.
2. Turn off the compressor unit by turning OFF the breaker inside the distribution panel at the equipment side. Make sure that the power is off, and lockout –tagout the breaker for safety.
3. Disconnect the flexible hoses from the “SUPPLY GAS” and “RETURN GAS” connectors at the rear panel of the compressor. Observe the disconnecting requirements below. Refer to “Section 4.3 Connecting and disconnecting helium flexible hoses” for disconnecting method.

**CAUTION**

Do not disconnect flexible hoses while the cryopump is in low temperature. Doing so may raise the internal pressure as inside of the refrigerator unit warms up, resulting in helium leakage by activated safety valve.

NOTE: When disconnecting flexible hoses from the connectors, use two single-ended wrenches (bolt width 26mm, 30mm).

4. Remove the nuts of the connectors at the rear panel of the compressor with the spanner (Figure 6-1).
5. Remove the seven screws of the rear panel with a proper screw driver and remove the rear panel (Figure 6-2 and 6-3).
6. Disconnect the self-sealing coupling from the adsorber with two spanners. The coupling is connected to the flexible hose above the bottom plate inside the compressor chassis (Figure 6-4). See Figure 6-5 for usage of spanners to disconnect the coupling.
Disconnect the coupling quickly to minimize helium leakage.
7. Remove the bolts that secure the adsorber to the base of the compressor with the proper spanner (Figure 6-6).

8. Slide the adsorber outward and remove it from the mounting tab on the base of the compressor. And then remove the adsorber from the compressor (Figure 6-7).



Figure 6-1 Remove Two Nuts from the Helium Gas Connectors



Figure 6-2 Remove All Seven Screws from the Rear Panel



Figure 6-4 Remove the Rear Panel

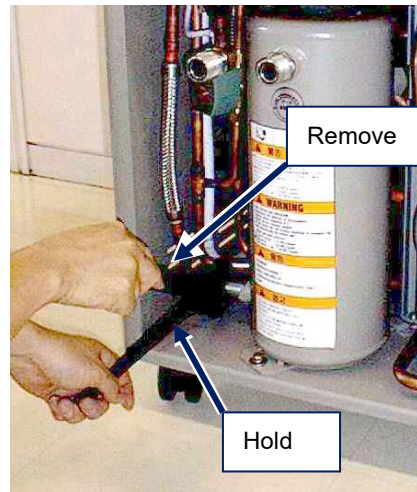
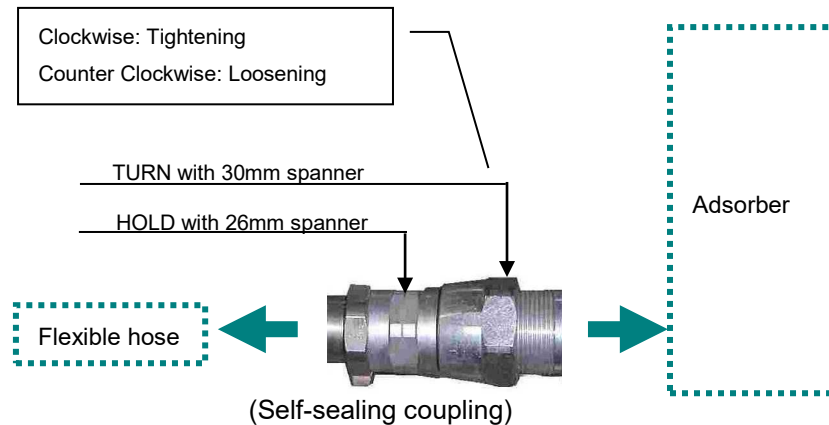


Figure 6-3 Remove Self-Sealing Coupling

**Figure 6-5 Connecting and Disconnecting Self-Sealing Coupling with Two Spanners****Figure 6-6 Remove the Bolt****Figure 6-7 Slide out Adsorber Bottle**

9. Install the replacement adsorber. Remove the two dust caps from the replacement adsorber. Put the adsorber into the compressor so as to place it at the mounting tab on the base of the compressor. Secure the adsorber with the mounting bolt temporarily.
10. Connect self-sealing coupling to the adsorber with the two spanners. Tighten the coupling referring to Figure 6-5. Recommended tightening torque is $20\text{N}\cdot\text{m}$. Connect the coupling quickly to minimize helium leakage.
11. Put the rear panel back on the compressor to align the helium connector of the adsorber with the hole of the rear panel and then remove the rear panel again. Fix the adsorber mounting bolt firmly this time.
12. Replace the rear panel and secure it by tightening the seven screws.

13. Put the two removed nuts back on to the "SUPPLY GAS" and "RETURN GAS" connectors at the rear panel of the compressor and tighten each nut using the two spanners.
14. Connect the flexible hoses to the "SUPPLY GAS" and "RETURN GAS" connectors at the rear panel of the compressor. Refer to "Section 4.3 Connecting and disconnecting helium flexible hoses" for connecting method.
15. Check the helium static pressure. Refer to "Section 5.1 Verification of helium static pressure".
If the pressure is higher or lower than it should be, adjust it referring to the following "Section 6.3 Adjusting system helium pressure".
16. Record the date and accumulated operation time when the adsorber was replaced in the adsorber replacement record label on the front panel of the compressor.
As a guide for the next replacement, it is recommended to make a note of the value that the current accumulated operation time added to the adsorber replacement cycle hours in Table 6-1.

Refer to "Disposal Considerations" for disposing of used adsorber.

6.3 Adjusting System Helium Pressure

System helium pressure must be adjusted when the compressor is not in operation.

Refer to "Section 5.1 Verification of helium static pressure" for appropriate pressure value when the compressor is not in operation.

Appropriate pressure value while the compressor is in operation is the value recorded at "Section 5.2 Compressor operation, (7) Recording the helium pressure during the operation".

If the pressure has changed by more than 0.04MPaG from the listed value, follow the procedure below and adjust the system pressure.



CAUTION

All helium circulation components must be connected when adjusting the pressure of the cryopump system.



WARNING

Following procedure must be undertaken by authorized electrician and mechanical personnel familiar with the construction and risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.

**WARNING**

Immediately after the compressor is shut down, some areas inside may remain hot. Wait at least 15 minutes until it cools down to conduct the work safely. Failure to observe this warning may result in severe bodily injury.

Pressure adjustment must be done when the equipment inside the compressor are at room temperature. Wait for about three hours until it cools down before performing this work.

The following describes how to adjust the helium pressure.

(1) Reducing helium pressure

1. Using an appropriate screw driver, unscrew the six screws at the front panel of the compressor and remove the panel (See Figure 6-8).
2. Open the Helium fill valve inside the compressor slowly by turning its knob counter-clockwise. Allow a slight amount of helium gas to escape.
3. Wait until the helium pressure gauge reads the appropriate value described above. When the pressure reaches the desired value, close the valve by turning its knob clockwise.
4. Attach the front panel of the compressor with the six screws removed in the above step.

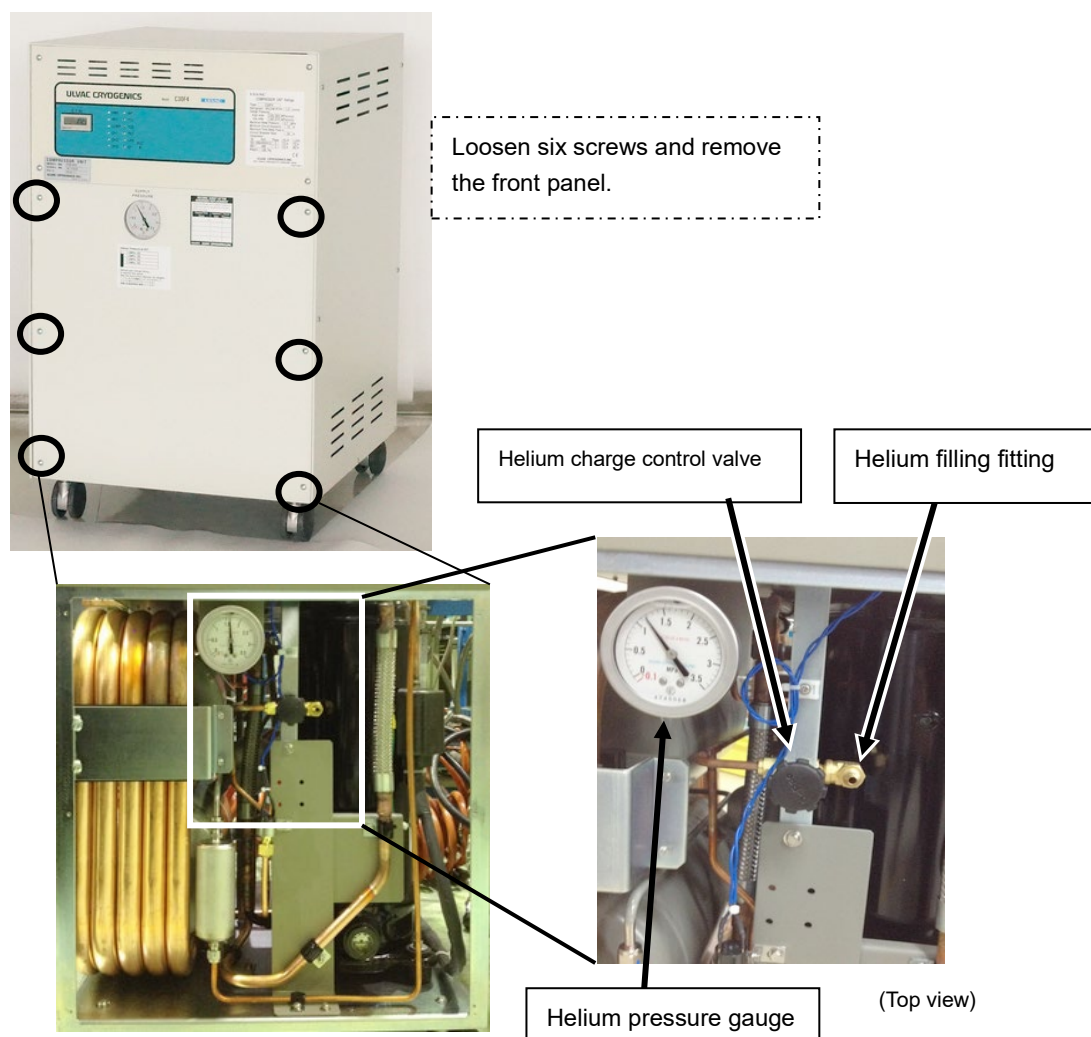


Figure 6-8 Locations of Front Panel Screws and Components inside the Compressor

(2) Raising Helium Pressure

When the helium pressure gauge reads a value lower than the appropriate value, adding helium gas is required.

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

Table 6-2 shows items and devices required for adding helium gas.

Table 6-2 Preparation for Adding Helium Gas

Item	Specification
Helium bottle	99.999% pure or above
Pressure regulator	For Helium gas (left-hand screw), 0-20MPaG / 0-6MPaG
Helium charging hose	Terminating in a 1/4 inch female flare fitting

NOTE: If you need a pressure regulator and/or helium charging hose described in Table 6-2 for adding helium gas, please contact our Service Engineering Division or the nearest customer support center.

**CAUTION**

The purity of helium gas to be charged must be above 99.999%. If the purity is lower, it may result in deterioration of the cryopump system or performance degradation.

**CAUTION**

If the helium pressure of the cryopump system becomes 0, there is a risk that air or moisture in the air invade into the system and contaminate helium. In such a case, please contact our Service Engineering Division or the nearest customer support center.

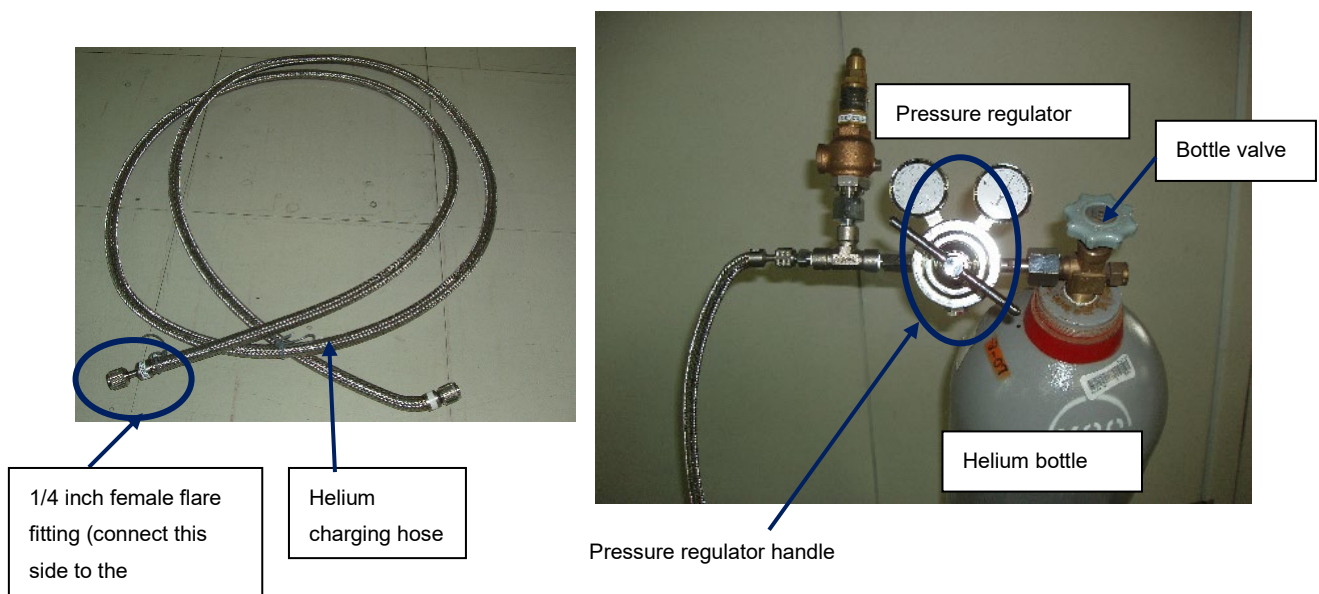


Figure 6-9 Items for Adding Helium Gas to the Compressor

Connecting helium supply line and air purging procedures

1. Remove the front panel of the compressor.
2. Attach the pressure regulator to a helium bottle.
3. Purge the pressure regulator and helium charging hose.
 - 3-1 Turn the pressure regulator handle in clockwise ^(*) slowly until it is felt hit. Then turn approximately 1/8 to 1/6 further to slightly open the pressure regulator.
 - 3-2 Slowly open the bottle valve, and confirm the helium gas is flowing out from the pressure regulator exit. After confirming the gas flow, close the pressure regulator by turning its handle counter-clockwise and then connect the helium charging hose to the pressure regulator.
 - 3-3 Turn the handle clockwise again and confirm the lower side pressure gauge indicates 0.1MPaG to 0.2MPaG. At this time, helium gas is flowing out from the flared fitting of the charging hose. Allow helium gas to flow for 30 seconds to purge the charging hose of air.

(*) In general, a pressure regulator opens by turning its handle clockwise.
4. Purge the helium filling fitting of the compressor and connect the charging hose.
 - 4-1 While doing the procedure in 3-3, open the helium filling valve slightly (turn it counter-clockwise). Allow a small amount helium gas to flow through the helium filling valve and the helium filling fitting to purge the air between them.
 - 4-2 Connect the 1/4 inch female flare end of the charging hose to the helium filling fitting of the compressor while the helium gas flows out from both the helium filling fitting and the charging hose.
 - 4-3 After connecting them, close the helium filling valve by turning its knob clockwise.

Filling helium gas to the compressor

1. Turn the pressure regulator handle attached to the helium bottle clockwise and adjust the pressure until the lower side pressure gauge shows 1.8MPaG.
2. Open the helium filling valve by turning its knob slowly counter-clockwise. At the same time monitor the value indicated on the helium pressure gauge of the compressor goes up slowly.
3. When helium pressure reaches the appropriate value, close the helium filling valve by turning its knob clockwise.
4. Confirm that the valve is closed firmly. Turn the handle of the pressure regulator counter-clockwise to stop the gas flow. Then disconnect the charging hose from the helium filling fitting of the compressor.
5. Return the front panel of the compressor unit to the original position.

6.4 Regular Maintenance of Helium Lines, Cooling Water Piping and Electrical Wiring

Conduct inspection on helium lines, cooling water piping and electrical wiring every 12000 hours.

Inspect connection parts of helium lines and cooling water piping for evidence of leakage. Also check that there is no damage in these plumbing.

		<h3 style="margin: 0;">WARNING</h3>
<p>Following procedure must be undertaken by authorized electrician and mechanical personnel familiar with the construction and risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.</p>		

For electrical wiring, check the cold head drive cable of the compressor and remote input-output cable to ensure that they are connected firmly. At the inspection, turn off the compressor unit by turning OFF the breaker on the distribution panel at the equipment side. After confirming that the power is off, lockout-tagout the breaker for safety.

6.5 Maintenance Parts

Table 6-3 shows parts that need replacement during maintenance. Replace them when needed referring the replacing cycle in the table.

Table 6-3 Maintenance Parts

Parts and Devices	Type (*1)	Replacement cycle
Adsorber	S	Shorter than 24000h
Gasket for Helium Coupling	U	When scratch or dirt is detected
(*1) Maintenance Cycle S: Scheduled U: Unscheduled		

NOTE: For more information on planning maintenance, purchasing maintenance parts, diagnosis, and servicing, please contact our Service Engineering Division or the nearest customer support center.

6.6 Lockout-Tagout

When turning OFF the main circuit protector (MCP) for maintenance or other purposes, make sure to conduct lockout-tagout to prevent electric shock.

To lockout, padlock the MCP switch as shown in Figure 6-10.

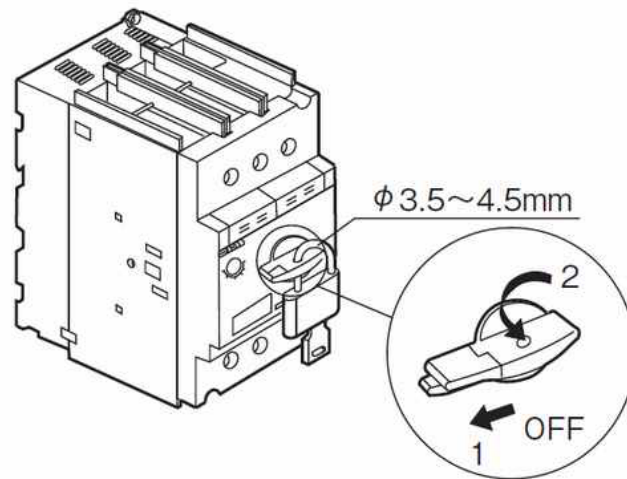


Figure 6-10 Lockout



WARNING

This process must be undertaken by authorized electrician and mechanical personnel familiar with the construction and risk of this equipment. Failure to observe this warning may result in severe bodily injury or fatal accident.

6.7 Fuse Replacement

6.7.1 Specification of Fuses

The substrate of the compressor unit (PCB1) has three fuses as shown below. When the fuse is blown, replace it following the procedures below.

Table 6-4 Fuse Specifications

Name	Model	Rating	Size	Maker
FU1	216.002.P	2A AC250V	5 × 20mm	LITTLE FUSE
FU2				
FU4	216.001.P	1A AC250V		

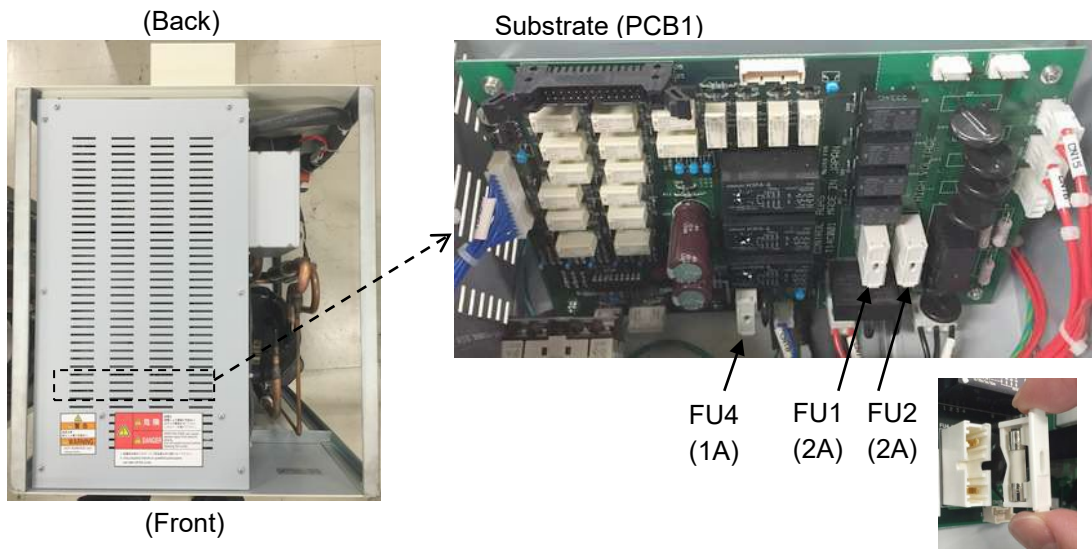


Figure 6-11 Fuse Locations

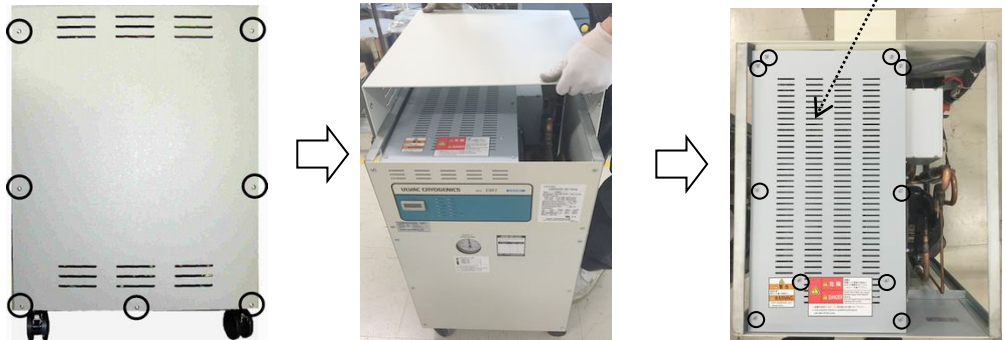


CAUTION

When replacing fuses inside the compressor, Main circuit protector (MCP) must be turned OFF, and lockout-tagout must be performed. Refer to “6.6 Lockout-Tagout” for detail.

6.7.2 How to replace fuses

1. Remove side and top cover of the control box.

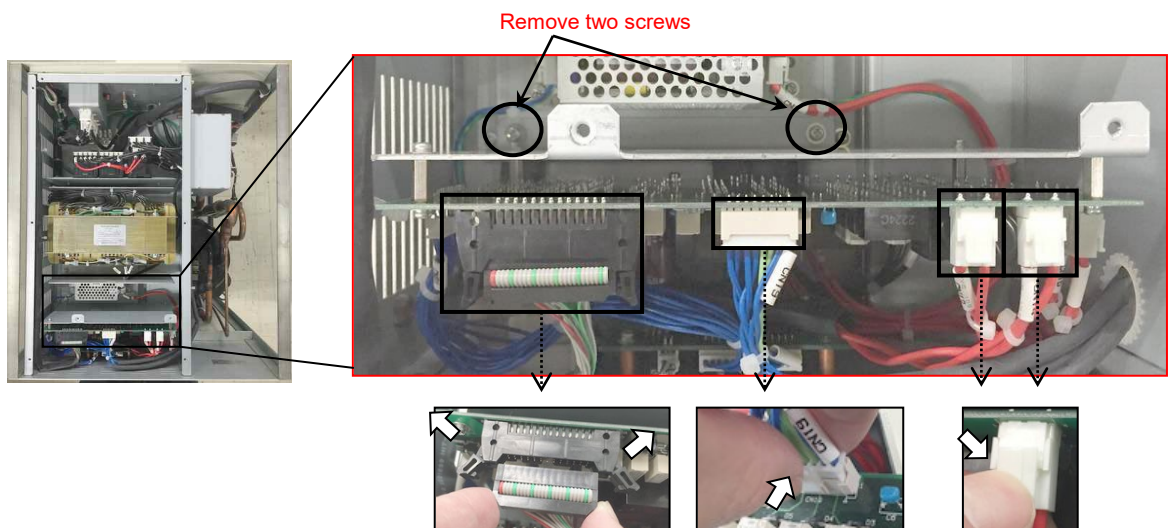


Remove the screws on the side cover. (14 in total)

Remove the side cover.

Remove ten screws and take out the top panel.

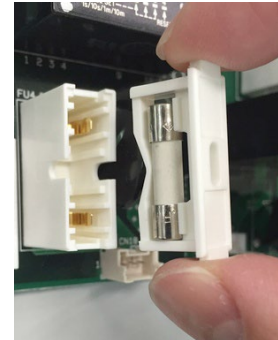
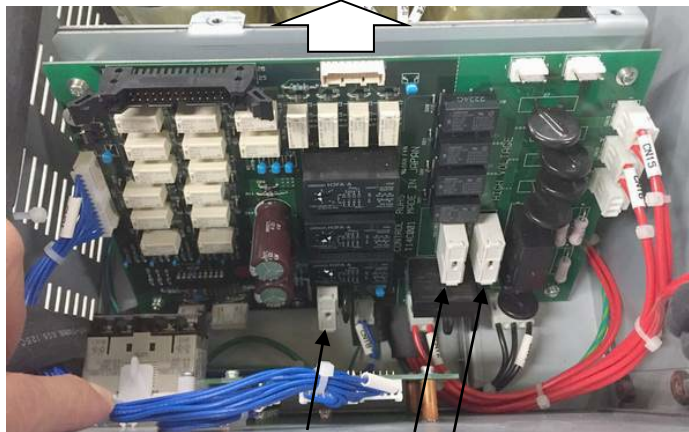
2. Remove two screws of the sheet metal and remove connectors (four).



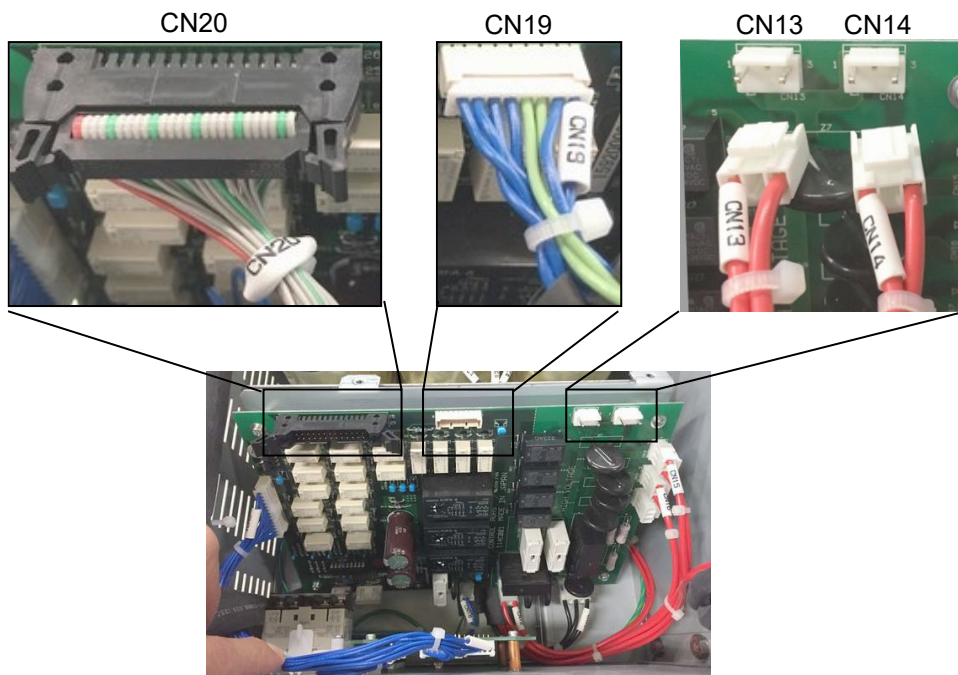
Remove four connectors.

(*)Release the lock mechanism by pressing it in the direction of the arrows above.

3. Bring the substrate down to the arrow direction, and pull out the fuse from the holder.



4. After replacing fuses, insert the connector to the original position. Insert until the lock mechanism makes a click sound.



5. Fasten two screws to fix the substrate.



Section 7 Troubleshooting

7.1	Problem Types.....	7-1
7.2	Troubleshooting Procedures	7-1
7.3	STATUS DISPLAY Descriptions	7-3

7.1 Problem Types

C30F4 compressor indicates the state of warning or breakdown with the lights of STATUS DISPLAY.

NOTE: When a problem occurs, check the STATUS DISPLAY lights. Also, make sure that the power-supply voltage, cooling water flow rate and its temperature, helium gas pressure, input power cable connections, and the remote cable connections are all in an appropriate state.

There are twelve lights on the front panel of the compressor. Please refer to “7.3 STATUS DISPLAY Descriptions” on the alarm types of warnings and faults.

NOTE: Ensure that all the operation commands of the compressor are OFF while trouble shooting the compressor.

7.2 Troubleshooting Procedures

1. Troubles occurred before operation

Table 7-1 List of Troubleshooting before Operation

Problem	Point	Possible Cause	Action
Elapsed Time Meter display is dark when in power-off state.	Displayed values can be read.	Backup battery is weak.	Record the current elapsed time and contact us.
	Displayed values cannot be read.	Backup battery is depleted.	Contact us.
“PWR” light does not turned ON. (Rear panel)	CB breaker trips or not.	Lower input power than rated voltage, or 0V.	Check input power cable, customer’s breaker or AC mains.
		CB is turned OFF.	Turn it ON.
		CB trip	Turn it ON. When it trips again, contact us.
	Fuse inside controller.	Blown fuse	Refer to “Section 6.7 Replacing fuses”
	DC24V P/S	Malfunction of DC24V P/S	Contact us.

2. Troubles during operation

Table 7-2 List of Troubleshooting During Operation

Problem	Point	Possible Cause	Action
Cannot start operation although RDY light on the rear panel light ON.	Signal from the customer's system	The customer's signal is not in on position. (The contact is open.)	Check the signal is OK or not.
	"COMP" lamp lights OFF.	The signal cable is not connected, or the connection is wrong.	Check cables and their connections. Make sure that references from customer's equipment are correct.
	"COMP" lamp lights ON.	Fault of compressor motor, disconnection of the wirings, or unusual interlock.	Please contact us.
Cold heads cannot be started although compressor is in operation.	Cables are not connected	Coldhead Drive cable is not connected.	Verify that the connections are correct.
	Contact us for the detail.		
After a short power interruption, compressor does not start running operation.	CB Trip	Power supply is interrupted due to instant over current.	Please contact us.
	FUSE of relay circuit	Blown fuse	Please contact us.
	Compressor body	Compressor motor is damaged	

※ If the problem is not solved, please contact our Service Engineering Division or the nearest customer support center.



CAUTION

Troubleshooting procedures described above must be undertaken by an authorized electrician or mechanical personnel familiar with the structures and the risks of the compressor and its related components. To ensure safe, reliable system performance, read this manual as well as other relevant manuals completely to gain thorough understanding before beginning work.

When a compressor does not need power supply to follow the procedure, shut down the power of the compressor and lock it in the OFF status. Failure to observe this caution may result in severe bodily injury or fatal accident.

7.3 STATUS DISPLAY Descriptions

There are twelve indicators on the front panel of the Compressor unit.
Each indicator explanation is shown below.

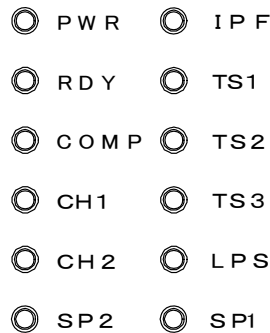


Figure 7-1 STATUS DISPLAY indicators

PWR (White): Control circuit is powered on

Indicates that power is turned on.

RDY (Green): Ready for Operation

Lights when the compressor is ready for operation.

COMP (Green): Compressor unit is in Operation

Lights when the compressor unit is in operation.

CH1 (Green): Cold head 1 is in Operation

Lights when the cold head No.1 is in operation.

CH2 (Green): Cold head 2 is in Operation

Lights when the cold head No.2 is in operation.

IPF (Yellow): Input Power Fail (Abnormal power supply)

Lights when the voltage of the main power source for the compressor is low, or the phase sequence is wrong. Check that the line voltages (R-S, S-T, T-R) of the power supply cable are within the range of rated values. If these are within the rated values, reverse phase is the possible cause. Check that the wiring of main power source is correct. If the input voltage is low, check the input and output cables and the customer's power supply that distributes electricity to the compressor.

TS1 (Yellow): Over Temperature (Overtemperature)

TS1 monitors the temperature of helium supply line. When TS1 is working, the compressor has unrecoverable abnormal condition. Please contact us immediately.

TS2 (Yellow): Over Temperature (Overtemperature)

TS2 monitors the temperature of the compressor motor. When TS2 is working, the compressor has unrecoverable abnormal condition. Please contact us immediately.

TS3 (Yellow): Over Temperature (Overtemperature)

Works when the cooling water and its lines are in an abnormal condition. Check the temperature and flow rate of cooling water. Refer to "Section 2.4 Cooling Water Requirements" for proper temperature and flow rate. Wait for 15 minutes until the switch will recover.

LPS (Yellow): Low Helium Pressure (Reduced helium pressure)

This pressure switch monitors the pressure reduction in the helium return line. When there is helium leakage or the helium filling pressure is lower than the set value, the switch will operate (The set pressure of this switch is 0.1 ± 0.02 MPaG). Check the connections of the flexible hoses and the helium filling pressure referring to "Section 4.3 Connecting and disconnecting helium flexible hoses" and "Section 5.1 Verification of helium static pressure". If the alarm is not cleared by the procedures above, please contact us immediately.

Table A-1 Operating log

(*) Measure cooling water flow rate with flow meters for each compressor unit.

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Appendix B Combination of C30F4 Compressor and Cryopump / Super Trap

Table B-1 Combination of C30F4 series compressors and cryopumps

Cryopump, Super Trap Specifications					Maximum number of refrigerator which can be connected to single compress
Type	Model	Size (inch)	Refrigerator		Charge Pressure
			Model	Unit	1.3MPa
SUPER TRAP	T12	12	RMS503T	1	1

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Appendix C Compressor 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
Safety valve *1	Located on the helium supply line and releases gas automatically when pressure exceeds the set value.	Set pressure : 2.55MPaG
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 : 1.74MPa

*1 The set pressure of safety valve at the refrigerator is 1.9MPaG. Please note that the refrigerator safety valve releases gas before the compressor safety valve in actual system.

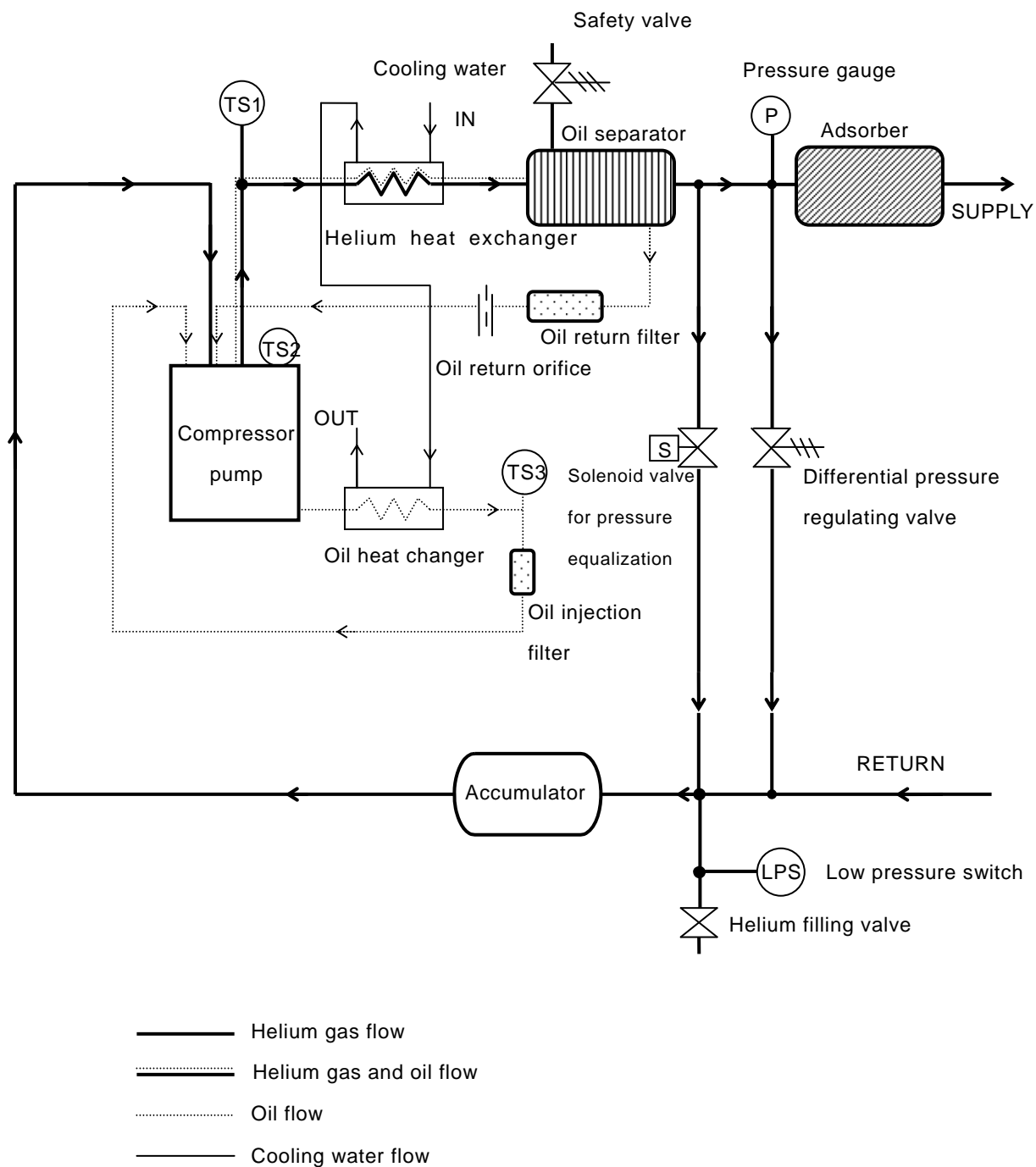


Figure C-1 Compressor flow diagram

Appendix D C30F4 Schematic Diagram

Schematic diagrams of the C30F4 compressor units are shown in Figure D-1 on the next page.

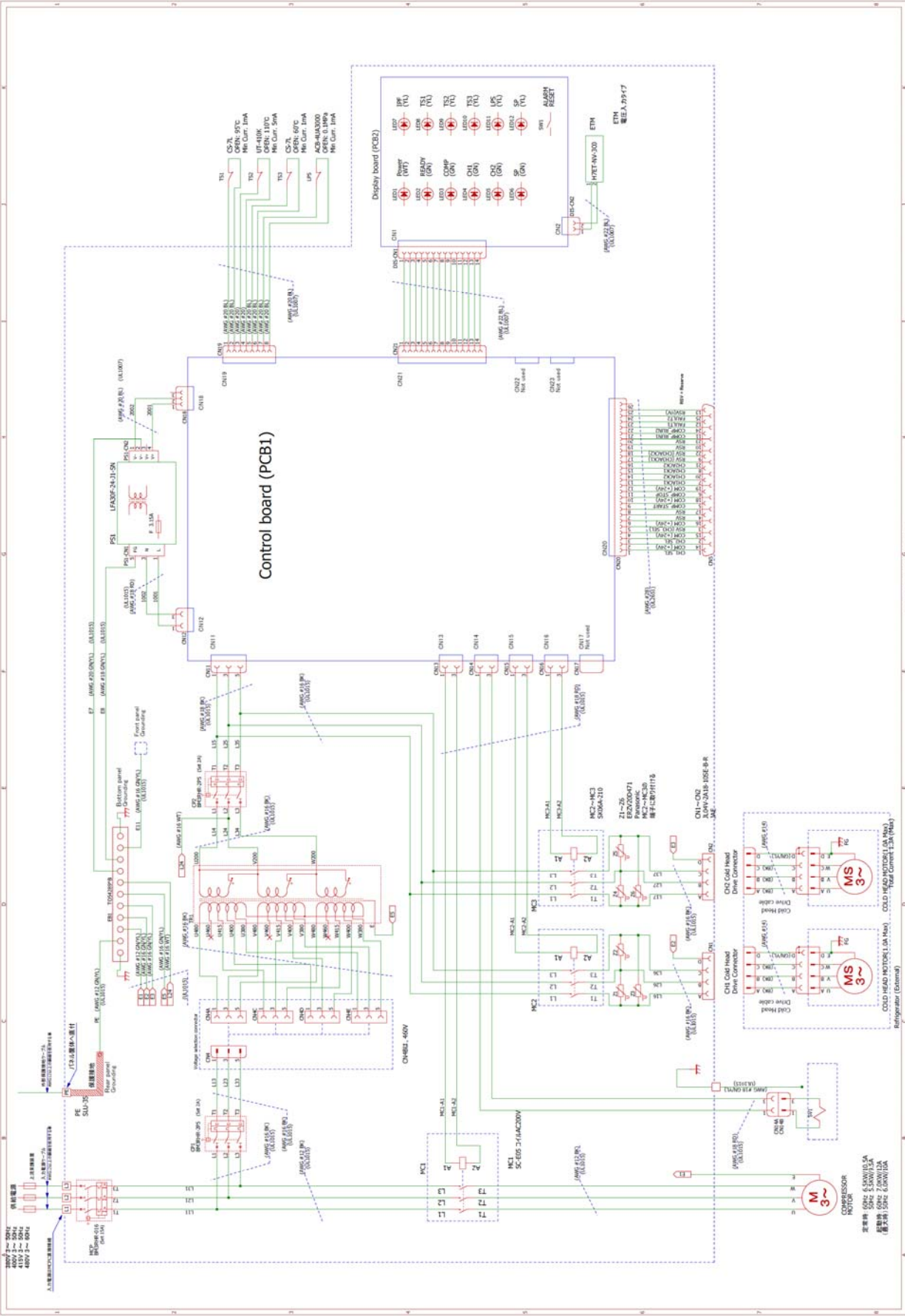


Figure D-1 C30F4 Connection Diagram

Appendix E C30F4 Self-Certification

Self-certification of CE marking of C30F4 is posted on the next page.

Declaration of Conformity

We, **ULVAC CRYOGENICS INCORPORATED**

1222-1 Yabata, Chigasaki, Kanagawa, 253-0085, Japan

declare in our sole responsibility that the following product conforms to all the relevant provisions.

Product Name : Compressor Unit

Model Name : **C30F4**

Council Directives : Machinery Directive (MD) : 2006/42/EC

Electro Magnetic Compatibility Directive (EMC) : 2014/30/EU

RoHS Directive : 2011/65/EU

Applicable Harmonized
Standards

: Machinery Directive,

EN ISO 12100 :2010

EN60204-1 :2006+A1 :2009

EMC Directive,

EN 61000-6-4:2007+A1:2011

EN 61000-6-2:2005

EN 61000-3-2:2014

EN 61000-3-3:2013

EN 60601-1-2:2007

EN 55011:2009+A1:2010

RoHS Directive,

EN 50581:2012

We keep the following Technical Documentation on file for review.

Technical Documentation File No. TC16-39-759

Authorized Representative in EU : Mutsuki Odawara

Parkring11, 85748, Garching, (Munch), Germany

Place : Kanagawa, Japan

Date : May 8 , 2019

Signature



Takeshi Haginouchi / President



Appendix F China RoHS Hazardous Substances in the Product

中国 RoHS 产品中有害物质的名称及含量

压缩机 产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
控制箱	X	O	O	O	O	O
压缩泵	X	O	O	O	O	O
配管·配件	X	O	O	O	O	O
压力表	X	O	O	O	O	O
阀	X	O	O	O	O	O
吸附器	X	O	O	O	O	O
低压报警器 (LPS)	X	O	O	O	O	O
本表格依据 SJ/T 11364 的规定编制。 O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。 此表中所有名称中含 “X” 的部件均符合欧盟 RoHS 立法。						

同上用附件 (*1) 产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
D-sub 连接器	X	O	O	O	O	O
冷冻机电缆	X	O	O	O	O	O
金属软管	O	O	O	O	O	O
氮分歧管 (*2)	X	O	O	O	O	O
单头扳手 (工具)	O	O	O	O	O	O
密封垫圈	O	O	O	O	O	O
本表格依据 SJ/T 11364 的规定编制。 O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。 X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。 此表中所有名称中含 “X” 的部件均符合欧盟 RoHS 立法。						

(* 1) 列出了与产品有关的附件。在购买产品时并不是所有的附件被附带出厂。

(* 2) 氮分歧管包括三路分歧管、二路分歧管、L 型管道，直线管道。

<English Translation for Reference>

Hazardous Substances in the Compressor Unit

Component	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Control Box	X	O	O	O	O	O
Compressor	X	O	O	O	O	O
Hose, Coupling	X	O	O	O	O	O
Pressure Meter	X	O	O	O	O	O
Valve	X	O	O	O	O	O
Adsorber	X	O	O	O	O	O
Low Pressure Switch (LPS)	X	O	O	O	O	O

This table has been prepared according to the standard SJ/T 11364.

O: The amount of restricted substance in homogenized materials of the components is below the required level defined in GB/T26572.

X: The amount of hazardous substances in at least one of the homogenized materials of the components is above the required level defined in GB/T26572.

(The companies can add technical reasons on the substance marked "X" in the above table based on the actual circumstances.)

Hazardous Substances in the Accessories (*1)

Accessory	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
D-sub Connector	X	O	O	O	O	O
Coldhead Cable	X	O	O	O	O	O
Flexible Hose	O	O	O	O	O	O
Helium Manifold (*2)	X	O	O	O	O	O
Open-ended Wrench (tool)	O	O	O	O	O	O
Gasket	O	O	O	O	O	O

This table has been prepared according to the standard SJ/T 11364.

O: The amount of restricted substance in homogenized materials of the components is below the required level defined in GB/T26572.

X: The amount of hazardous substances in at least one of the homogenized materials of the components is above the required level defined in GB/T26572.

(The companies can add technical reasons on the substance marked "X" in the above table based on the actual circumstances.)

(*1) The list contains accessories that are likely to be shipped along the compressor unit. Note that all the listed accessories are not always included in the package.

(*2) The term "Helium Manifold" refers to three valve manifold, fork manifold, L-shaped pipe, or straight pipe.

SERVICE NETWORK

- For technical support, servicing or additional contact information, visit us at www.ulvac-cryo.com.

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Revision History

Date	Revision No.	Contents
2015-10-15	2015.10	First edition
2016-05-30	2016MY01	Section 1 - Section 7 Full-fledged revision Appendix D Figure D-1 has been revised. Appendix E has been added.
2017-04-07	2017AL02	Section 1 Table 1-5 has been modified. Appendix E "Declaration of Conformity" has been renewed. Appendix F "China RoHS Hazardous Substances in the Product" has been added. "Disposal Considerations" has been moved to before Section 1.
2018-05-23	2018MY03	SERVICE NETWORK has been revised.
2019-07-26	2019JU04	Appendix E "Declaration of Conformity" has been renewed.
2022-10-19	2022OR05	Safety Instructions has been revised. Section 6 Errors have been corrected.

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