

COMPRESSOR UNIT

Instruction Manual

C10T

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. Also, when applying a refrigerator system to a cryocooler for optical sensors, the cryocooler falls under row 10(2) of appended table 1 of Japan's Export Trade Control Order as well.

Customers must follow all related rules and regulations such as Foreign Exchange and Foreign Trade Act and take appropriate procedures when exporting or re-exporting those products.

Introduction

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

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

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

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

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

2. Warranty

2.1 Gratis warranty period and Warranty coverage

【Gratis warranty period】

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

【Coverage】

(1) Failure diagnosis

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

However, ULVAC CRYOGENICS or our service network can perform this service for an agreed fee upon the customer's request. There will be no charge if the cause

of the breakdown is found to be a fault of ULVAC CRYOGENICS.

(2) Damage during transportation

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

(3) Breakdown repairs

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

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

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

2.2 Exclusion of opportunity loss from warranty liability

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

2.3 Repair period after production is discontinued

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

3. Service Form

After the products are delivered, please fill out the following information in the blanks. If you have any questions or technical problems, please feel free to contact the nearest Customer Support Center or headquarters. Please refer to “Service Network”.

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

4. Notes for repair and maintenance requests

We may decline your request for the repair or the maintenance of our products if you refuse to give us information about the presence of the hazardous substance and/or contaminant.

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

5. In case of breakdown and accident

When breakdown or accident occurs, we may ask for keeping the product on site as it is or retrieving the product to investigate its cause. Also we may ask for reporting the detailed process and/or the operating condition. When unidentified malfunction was generated, please contact our Service Engineering Division or

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

6. General Precautions

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

Safety Considerations

Our products have been designed to provide extremely safe and dependable operation when properly used. Following safety precautions must be observed during normal operation and when servicing them.



WARNING

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



CAUTION

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



Toxic gas or chemicals used.

There is a risk of severe injury upon contact.



Corrosive chemicals used.

There is a risk of severe injury upon contact.



Flammable gas used.

There is a danger of fire or burn injury.



Explosive gas used.

There is a risk of fire or explosion.



Hazardous voltage .

Electric shock may cause severe injury or loss of life.



Hot heating part present.

There is a risk of burn injury.

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Table of Contents

Safety Instructions	S-1
Disposal Considerations	IW-1
1. COMPRESSOR UNIT DESCRIPTION	1-1
1.1 General	1-1
1.2 Specifications	1-1
2. INSPECTION	2-1
2.1 Shipping List	2-1
2.2 Compressor	2-2
2.3 Connecting Piping (Flexible Hose)	2-2
2.4 Cables	2-2
3. INSTALLATION	3-1
3.1 Installation	3-1
3.2 Connecting Cooling Water Piping	3-2
3.3 Cooling Water	3-2
3.4 Connecting the Compressor Unit to the Cryopump	3-5
3.5 Connecting Electrical Cables	3-7
4. OPERATION	4-1
4.1 Before Operation	4-1
4.2 Normal Operation	4-1
5. Disconnection and Storage	5-1
5.1 Disconnecting Flexible Hose	5-1
5.2 Storage	5-2
6. MAINTENANCE	6-1
6.1 Scheduled and Unscheduled Maintenance	6-1
6.2 Charging Helium Gas	6-1
Appendix A Trouble Shooting	A-1
Appendix B Schematic Diagram	B-1
Appendix C Flexible Hose	C-1
Appendix D Flow Diagram	D-1
Customer Support / Service Office	CS-1

Figures

Figure 1-1	Dimensions	1-3
Figure 1-2	Major Components	1-4
Figure 3-1	Maintenance Space(Unit: mm)	3-1
Figure 3-2	Cooling Water Requirement	3-4
Figure 3-3	Connecting Flexible Hose	3-6
Figure 3-4	Static Pressure and Temperature	3-7
Figure 3-5	Compressor Installation	3-8
Figure 5-1	Disconnecting Flexible Hose	5-2
Figure 6-1	Charging Helium Gas	6-4
Figure B-1	C10T Circuit Diagram	B-3
Figure B-2	C10T Wiring Diagram	B-5
Figure D-1	C10T Flow Diagram	D-2

Tables

Table 1-1	Compressor Unit Standard Specifications	1-1
Table 2-1	Shipping List	2-1
Table 2-2	Optional Parts	2-1
Table 3-1	Recommended Cooling Water for Compressor	3-3
Table 3-2	Input Power Cable Specifications	3-8
Table A-1	Troubleshooting Procedures	A-1
Table A-2	Operating Log	A-3

Compressor Unit Safety Instructions

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

1 . Do not overfill helium gas



Our Cryo-U[®] cryopump and Super trap refrigerator systems make a refrigeration cycle by circulating high pressure helium gas. Filling helium gas more than the defined amount does not improve refrigeration capacity appreciably. Instead, if excessive helium gas is filled and pressure becomes higher than the defined value, gas will release from the safety valve and its sheet may become clogged with dirt. This may even cause a leak as well as overloading of the compressor motor.

Do not fill the helium gas more than the defined amount.

2 . Adding helium gas and charging equipments

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

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

3 . Do not switch between ON and OFF frequently

Do not start/stop the operation frequently.

The number of times that compressor motor can be started / stopped is 6 times or less per hour and each status should be kept for at least 3 minutes. Frequent starting/stopping shortens the insulation life of the compressor motor and may cause a failure of the product.

Do not start/ stop operation to control the temperature of Super Trap.

Please contact us when it is required to control the temperature of super trap.

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 Consideration” 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 CTI adsorbers and our adsorbers.

5 . Electrical wiring connections



- Power supply voltage must be kept within the allowable range(refer to “Section 1 Table1-1 Compressor Unit Standard Specifications” . Applying more than the allowed voltage may damage the equipment.
- Install a ground-fault circuit interrupter(rated current: 10A, rated tripping leakage current:30mA 3 ϕ , rated voltage: 200V).
- Grounding conductor (earth wire) must be connected (D class grounding (with the ground resistance of 100 Ω)).
- Connect the refrigerator cable and remote cables (signal lines) to the compressor before connecting the compressor to the power supply. 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

If there is a water leak, there is a danger of 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 not to exceed the allowable upper limit (lower than 0.7MPG).

If water stain or some products accumulate in the water line inside the heat exchanger, heat exchange effectiveness will be significantly reduced 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. Compressor unit usage environment

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.

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Disposal Considerations

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

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

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

We provide Safety Data Sheet (called SDS) of our products upon your request. Please contact us if necessary.

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1. COMPRESSOR UNIT DESCRIPTION

1.1	General	1-1
1.2	Specifications	1-1

1.1 General

The compressor unit circulates helium continuously in the cryopump system by compressing helium returned from the refrigerator unit (cold head) and supplying high-pressure helium to the refrigerator unit.

This compressor unit consists of: 1) a compressor, 2) a cooling system, 3) an oil separation system and 4) an adsorber.

See Table 1-1 for the compressor specifications.

1.2 Specifications

Table 1-1 Compressor Unit Standard Specifications

◆ Model : C10T

Power Source	Volts × Phase × Hz	AC190 ~ 220V × 3Φ × 50Hz AC190 ~ 230V × 3Φ × 60Hz
	Power (in normal operation) (*1)	1.5kW / 1.7kW(50Hz/60Hz)
	Nominal Operating Current (*1)	5A / 6A(50Hz/60Hz)
Cooling Type		Water cooled
Cooling Water Requirement (See Fig.3-2)		Temperature : 5 ~ 32°C Flow Rate : 1 ~ 5L/min Pressure Drop : 0.01 ~ 0.072MPa
Ambient Temperature		10 ~ 38°C
Compressor Winding Resistance		3.04 Ω ,
Adsorber Periodic Replacement		Not necessary
Weight		69kg
Cooling Water Inlet/Outlet		Rc3/8 female
Helium Gas SUPPLY/RETURN Connector		1/2B self-sealing coupling

(*1) The power consumption or current are higher by around 10% at start up.

The power consumption and current in the above table are standard values when flexible hoses of 3 meters long are used. The maximum allowable length is 20m, and the power consumption and current will be larger by 6% with a 20m hose.

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

Charge Pressure(*2)	1.73±0.04 MPaG
Operating Pressure(SUPPLY) (*3)	1.8~2.0 MPaG

(*2) The charge pressure in the above table is the value when flexible hoses with 20m at largest. If the hose is larger than 20m, the charge pressure will be different. Contact us for the detail.



CAUTION

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

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

◆ Applicable Model of Cryopump and Refrigerator unit

Cryopump	U8HT
Refrigerator	R10RT / RM10T

◆ Connector Specifications (Cable Side)

CONNECTOR	MANUFACTURER	TYPE
INPUT POWER	NANABOSHI	NCS-304-P
COLD HEAD POWER	NANABOSHI	NJC-204-PM
REMOTE/RESPONSE	JAE	SRCN6A25-16P

※The Cold Head Power Cable is dedicated to three-phase motor refrigerator unit.

◆Dimensions

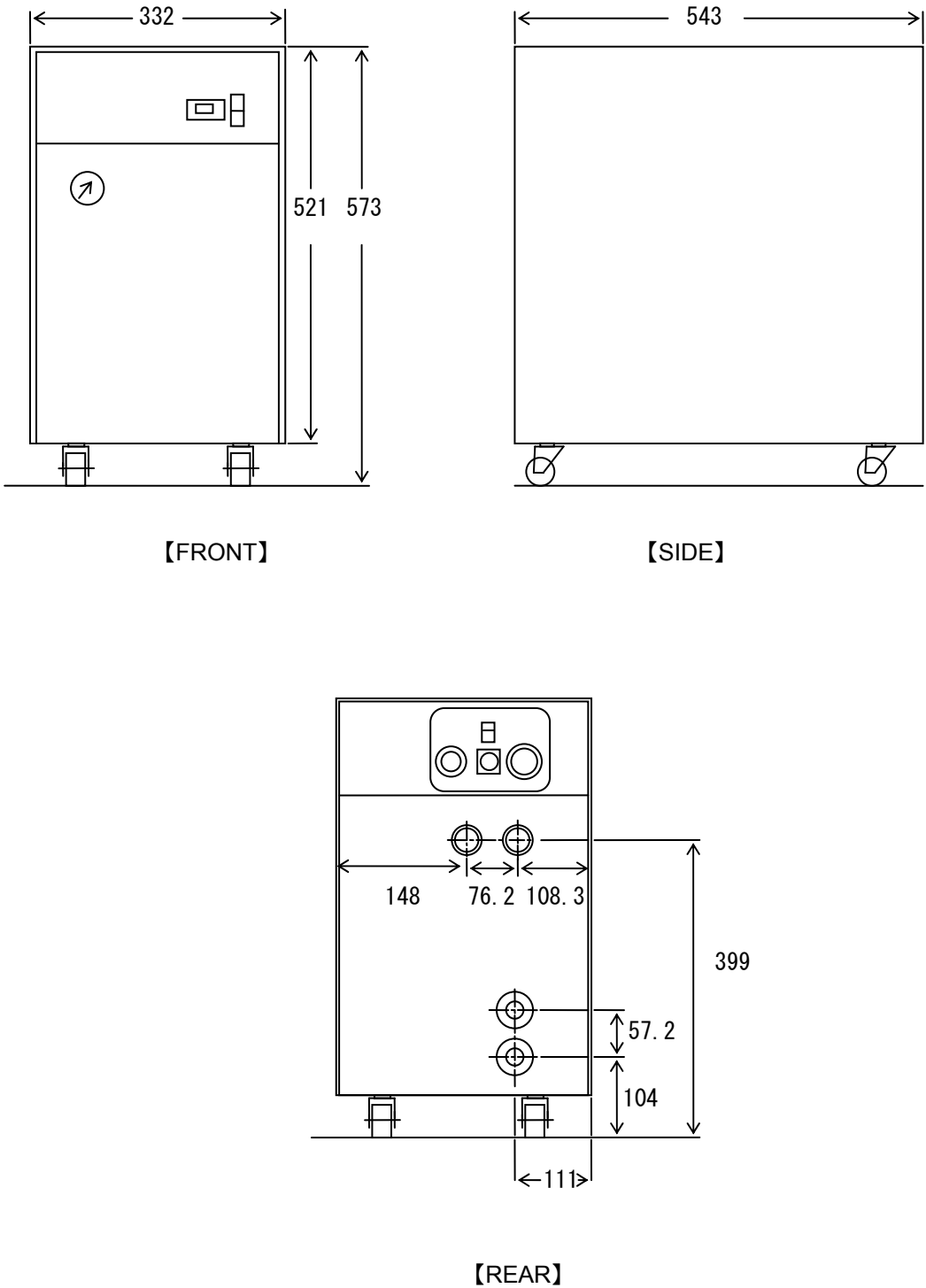
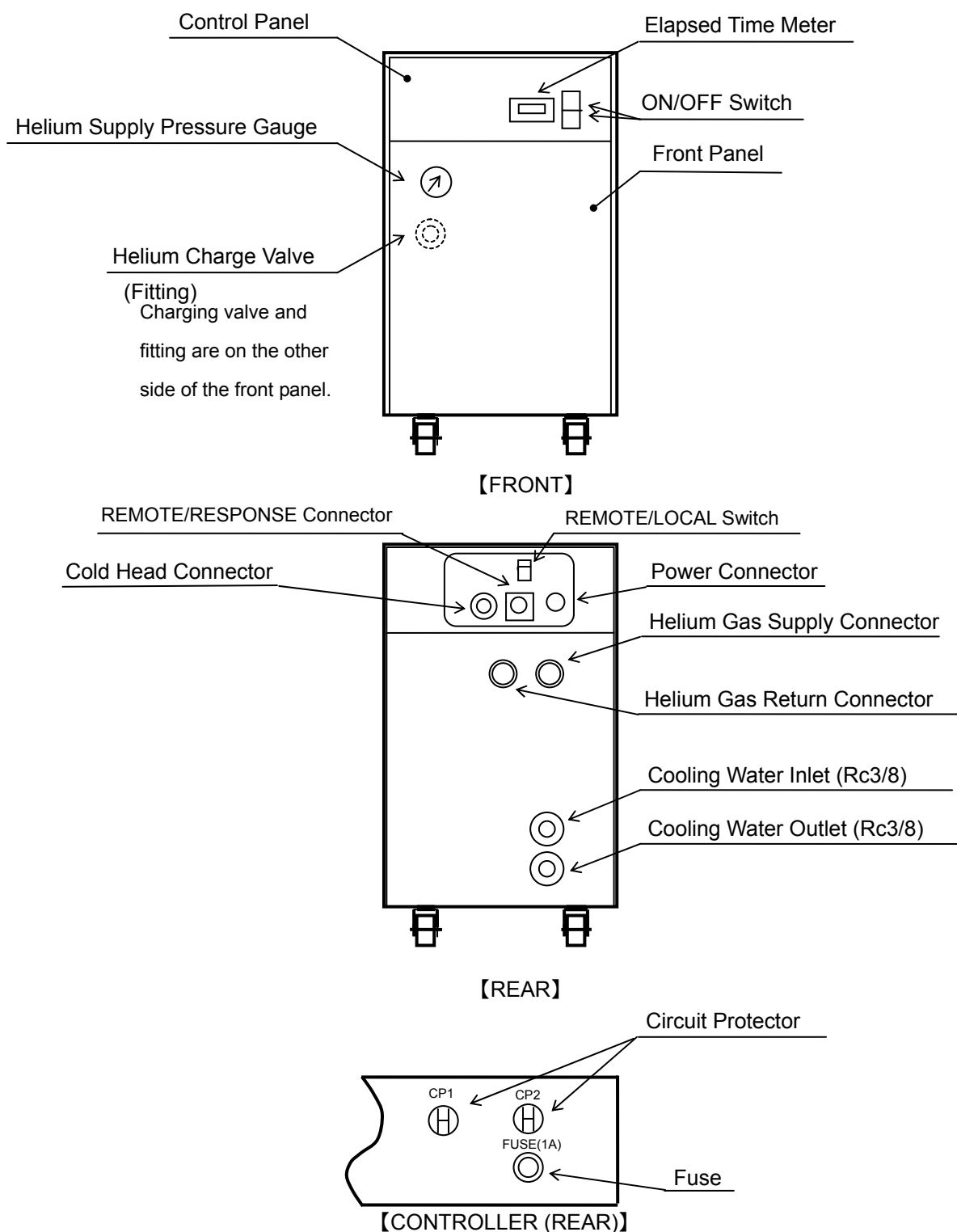


Figure 1-1 Dimensions



* For the operation of a controller switch, remove the control panel on the rear of the compressor unit.

Figure 1-2 Major Components

2. INSPECTION

2.1	Shipping List	2-1
2.2	Compressor	2-2
2.3	Connecting Piping (Flexible Hose)	2-2
2.4	Cables	2-2

2.1 Shipping List

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

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

Table 2-1 Shipping List

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

Table 2-2 Optional Parts

Item	Quantity
Input Power Cable ($1.25\text{mm}^2 \times 4\text{cores} \times 3\text{m}$ or customized length)	1
Three Phase Refrigerator power cable ($0.5\text{mm}^2 \times 4\text{cores} \times 3\text{m}$ or customized length)	1
Flexible Hose (3m or customized length)	2
Lipped Bowl Spanner (Flexible hoses installing tool)	2
Gasket for Helium Coupling(Spare)	4

2.2 Compressor

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

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

When the ambient temperature is 20°C±10°C and the pressure is below 1.82MPaG, charge helium in accordance with instructions in the section 6.2.

If the pressure drops after helium charging, please contact us.

2.3 Connecting Piping (Flexible Hose)



CAUTION

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

Inspect the exterior of the flexible hose for visible signs of damage.

When the flexible hoses are stored or not being used, put dust caps and plugs on as they were shipped.

2.4 Cables

Inspect the cables for damage.

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

3. INSTALLATION

3.1	Installation.....	3-1
3.2	Connecting Cooling Water Piping.....	3-2
3.3	Cooling Water	3-2
3.4	Connecting the Compressor Unit to the Cryopump.....	3-5
3.5	Connecting Electrical Cables.....	3-7

3.1 Installation

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

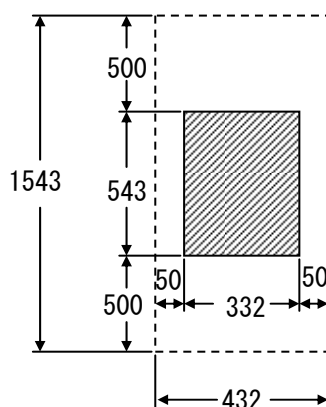


Figure 3-1 Maintenance Space(Unit: mm)

3.2 Connecting Cooling Water Piping

Install the cooling water piping as follows:

1. Cooling water inlet/outlet connector : Rc3/8 female.
2. Water pipes can be vinyl hoses or copper pipes as long as the withstanding pressure of those is 1.5 times higher than cooling water supply pressure.
3. It is recommended that a filter is installed in the water line between the cooling water main valve and the compressor unit to prevent water scales. It is also recommended to install a flow meter (approx.0~15L/min.) between the filter and the compressor unit to check the flow rate.
4. Ensure to connect inlet/outlet to the right place. Do not connect them the wrong way around.



CAUTION

Check water connections for leaks.

3.3 Cooling Water

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



CAUTION

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

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



CAUTION

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

Table 3-1 Recommended Cooling Water for Compressor

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

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

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

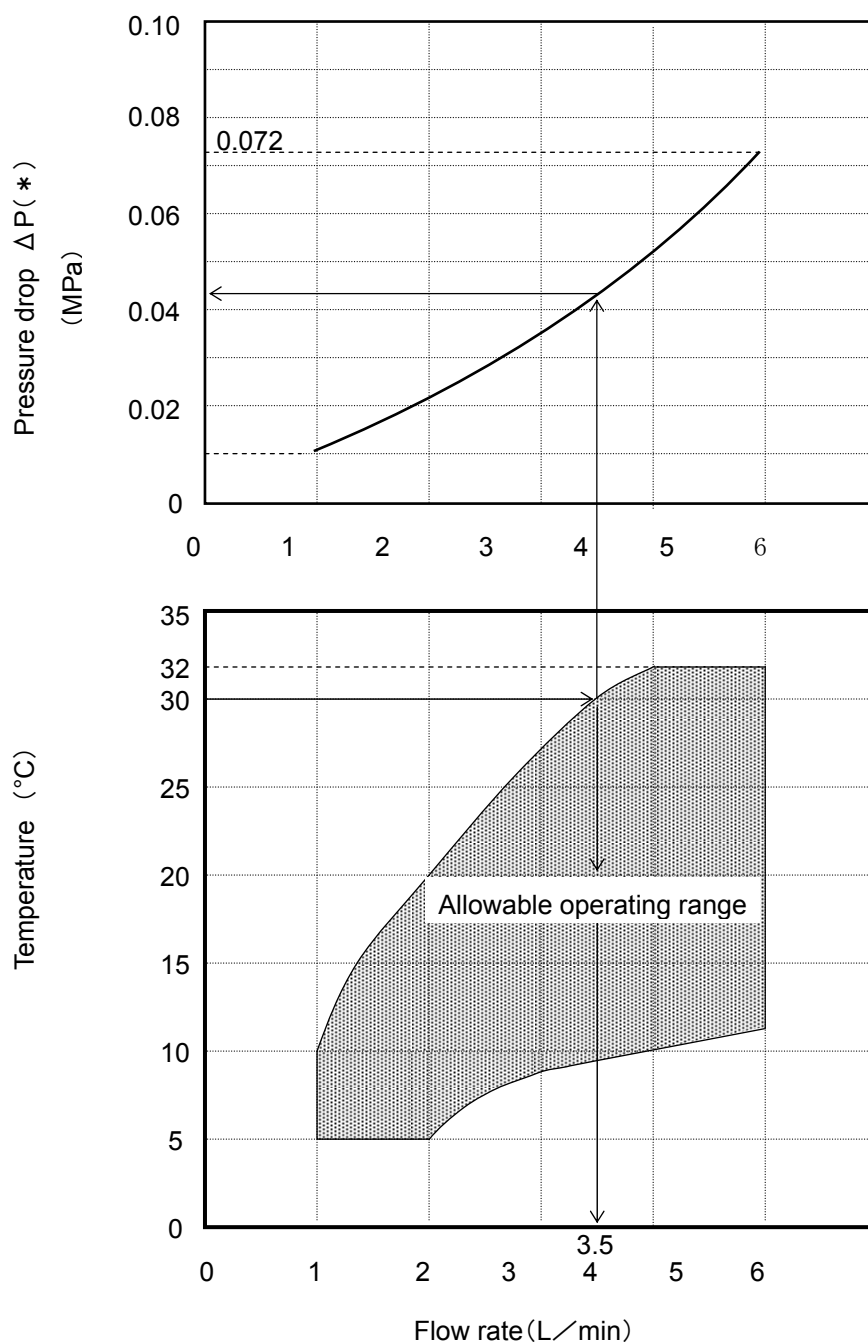
**CAUTION**

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

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

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

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



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

EXAMPLE

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

Figure 3-2 Cooling Water Requirement

3.4 Connecting the Compressor Unit to the Cryopump



CAUTION

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

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

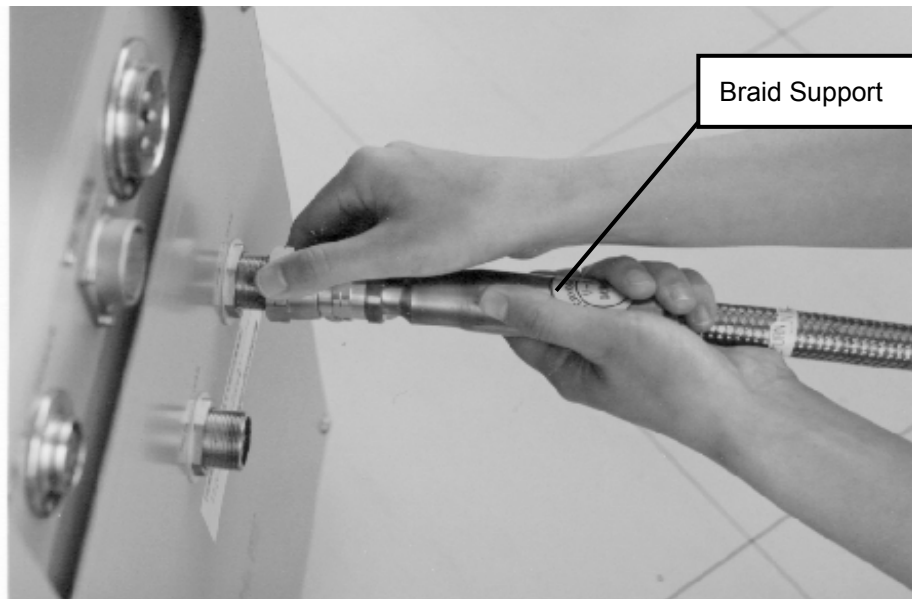
1. Remove all dust plugs and caps from the supply and return flexible hoses, compressor and cryopump. Clean the self-sealing coupling flat rubber gasket to be free from dust and metallic powder.
2. Connect the flexible hose from the compressor unit to the cryopump (See Figure 3-3) .
 - a. Connect the helium gas supply flexible hose to the helium gas supply connector on the compressor. Connect the helium gas return flexible hose to the helium gas return connector on the compressor.
 - b. Connect the helium gas supply flexible hose to the helium gas supply connector on the cryopump. Connect the helium gas return flexible hose to the helium gas return connector on the cryopump.
3. Check the helium gas pressure gauge for proper helium pressure. The standard helium charge pressure is $1.73 \pm 0.04 \text{ MPaG}$ at 20°C . See Figure 3-3. If the indicated pressure is higher than the specified value, allow a slight amount of helium gas to escape by opening the gas charge valve **very slowly**. If the indicated pressure is lower than specified value, add helium gas as described in section 6.2.

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

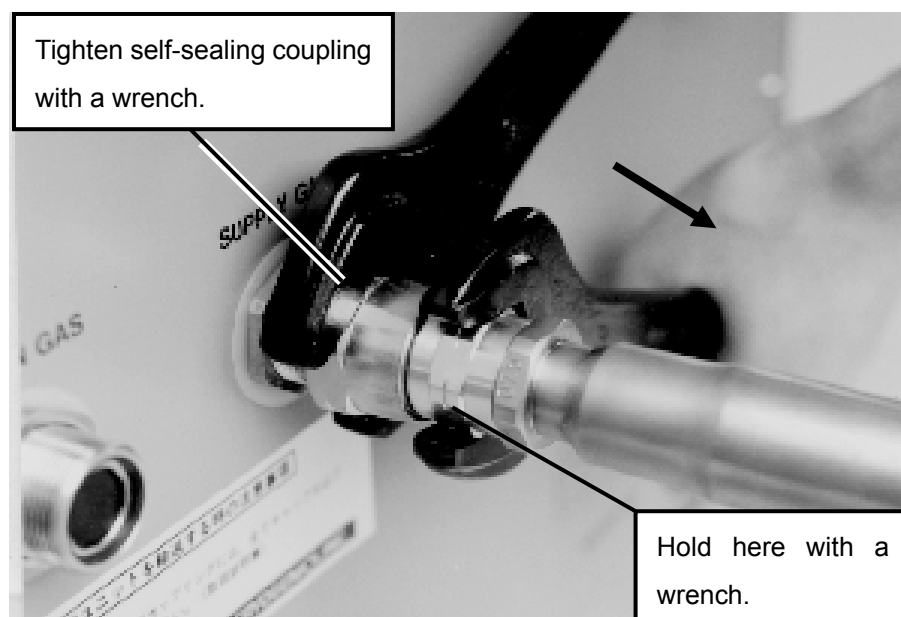


CAUTION

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



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



- ② Tighten the self-sealing coupling using two wrenches until the fittings are firmly sealed. When using torque wrench, torque the connection to 20N·m.

Figure 3-3 Connecting Flexible Hose

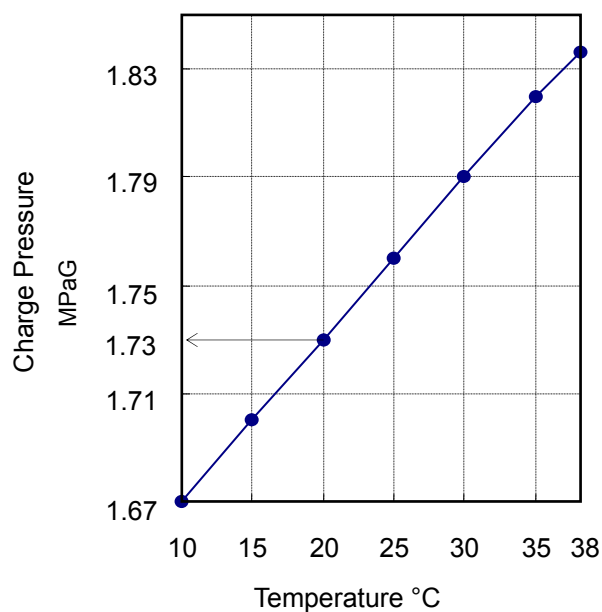


Figure 3-4 Static Pressure and Temperature

3.5 Connecting Electrical Cables

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

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

	WARNING
<p>Disconnect the input power connector at REMOTE/RESPONSE wiring. Failure to observe this precaution could result in damage to, or destruction of, the equipment.</p>	

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

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

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

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

Table 3-2 Input Power Cable Specifications

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

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

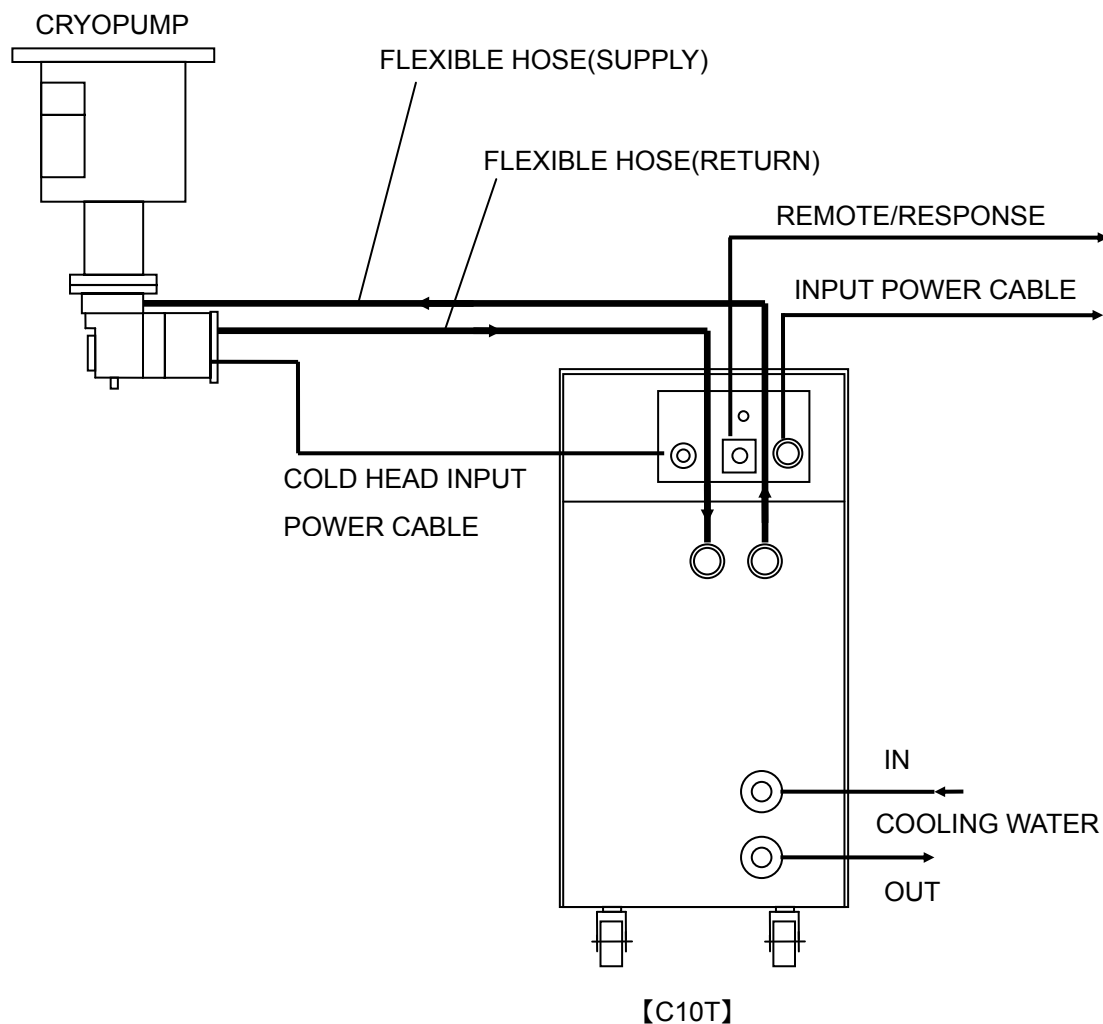


Figure 3-5 Compressor Installation

4. OPERATION

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

4.1 Before Operation

Before operating the compressor, check and verify that:

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

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

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

4.2 Normal Operation



CAUTION

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

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5. DISCONNECTION and STORAGE

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

5.1 Disconnecting Flexible Hose



CAUTION

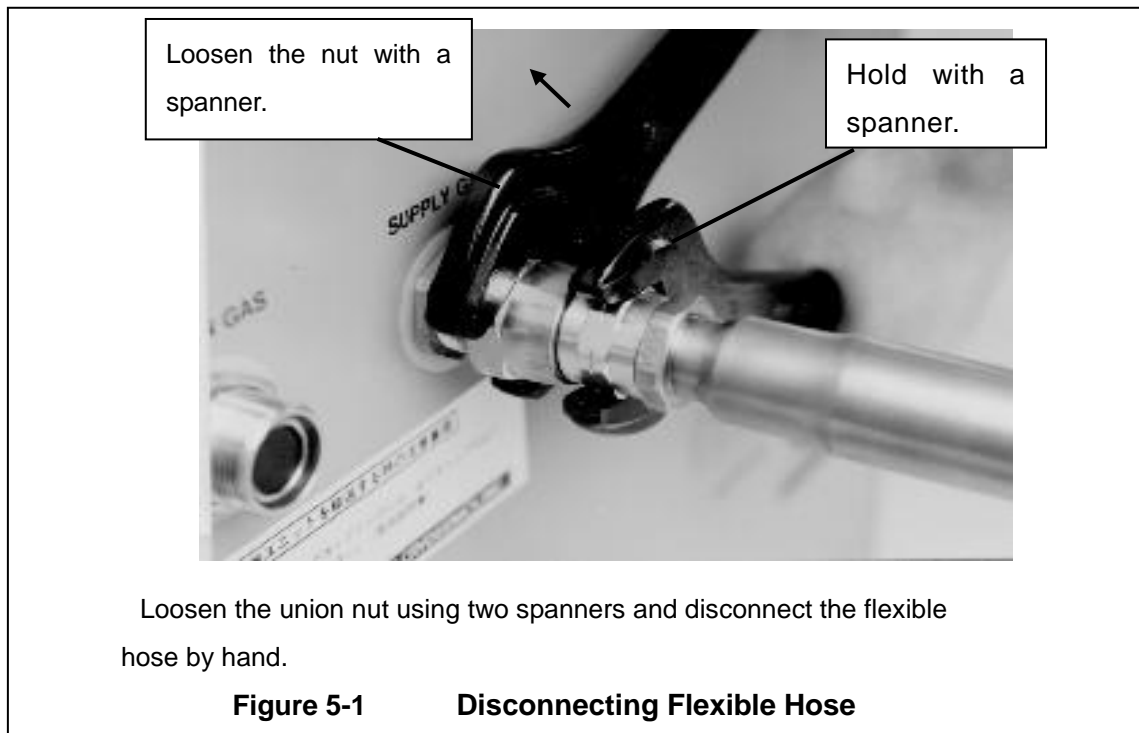
When disconnecting flexible hoses, be sure to use the two single open end spanners with width across flat 26mm and 30mm.

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



CAUTION

- If removing the flexible hoses before the refrigerator reaches room temperature, helium gas shut up into the refrigerator increases pressure with the rise of temperature, and may blow off from a pressure relief valve finally. It might cause a helium leakage also.
- However, only when carrying out helium circuit decontamination procedures for the refrigerator unit, disconnect the flexible hoses from helium gas supply and return connectors at the compressor unit side right after shutdown.



5.2 Storage


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

- ◆ When the compressor unit will be stored for more than three months, follow the instruction below as well as the instructions above.
 - Operate the compressor unit for about an hour every three months to circulate lubricating oil to prevent the damage caused by the lack of the oil when starting the compressor unit again after long-term storage.
- ◆ When shipping the compressor unit, pack as it was shipped from us and avoid extreme shock.

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6. MAINTENANCE

6.1	Scheduled and Unscheduled Maintenance	6-1
6.2	Charging Helium Gas	6-1

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

6.1 Scheduled and Unscheduled Maintenance

- ◇Scheduled Maintenance : Not necessary
- ◇Unscheduled Maintenance: Adding helium gas

6.2 Charging Helium Gas

■Note■

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.



CAUTION

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

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

- ◇We recommend that you use a regulator for helium gas (left screw) which shows the range of 4 - 6 MPaG at lower pressure side.
- ◇The gas charge inlet of the compressor unit is 1/4B male flare.
- ◇Use helium gas with purity of 99.999% or more.

Charge helium gas as follows:

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

**CAUTION**

If the bottle valve is opened ignoring the above procedures (1), the air between the regulator and the bottle valve diffuses into the helium bottle and lowers the purity of helium gas.

2. Remove the front panel of the compressor unit.
3. Connect the helium charging hose as follows:
 - a. Connect the charging hose to the regulator.
 - b. Loosely connect the charging hose to the charge inlet on the compressor unit to allow slight amount of helium gas to escape.
 - c. Open the regulator until the outlet pressure reaches 0.1 to 0.2 MPaG. Allow helium gas to flow out from the charging hose for about half a minute. Meanwhile, open the charge valve slightly in order to drive out the air that exists between the charge valve and the charge inlet.
 - d. Tighten the flair nut at the end of charging hose and close the charge valve. Helium gas charge in the line between the regulator and the charge valve on the compressor has been completed.
4. Adjust the low pressure side of the regulator at 1.8 MPaG.
5. Open the charge valve slowly and perform the following instruction according to the state of the compressor.
 - a. If the compressor unit is running under normal operating conditions, replenish it with the pure helium gas until it reaches the operation pressure shown in table 1-1 in this instruction manual.

- b. If the compressor unit is not running, replenish it with pure helium gas until it reaches the static pressure described in the compressor instruction manual.



CAUTION

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

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

The replenishment work of the gas for the compressor has been completed with this.

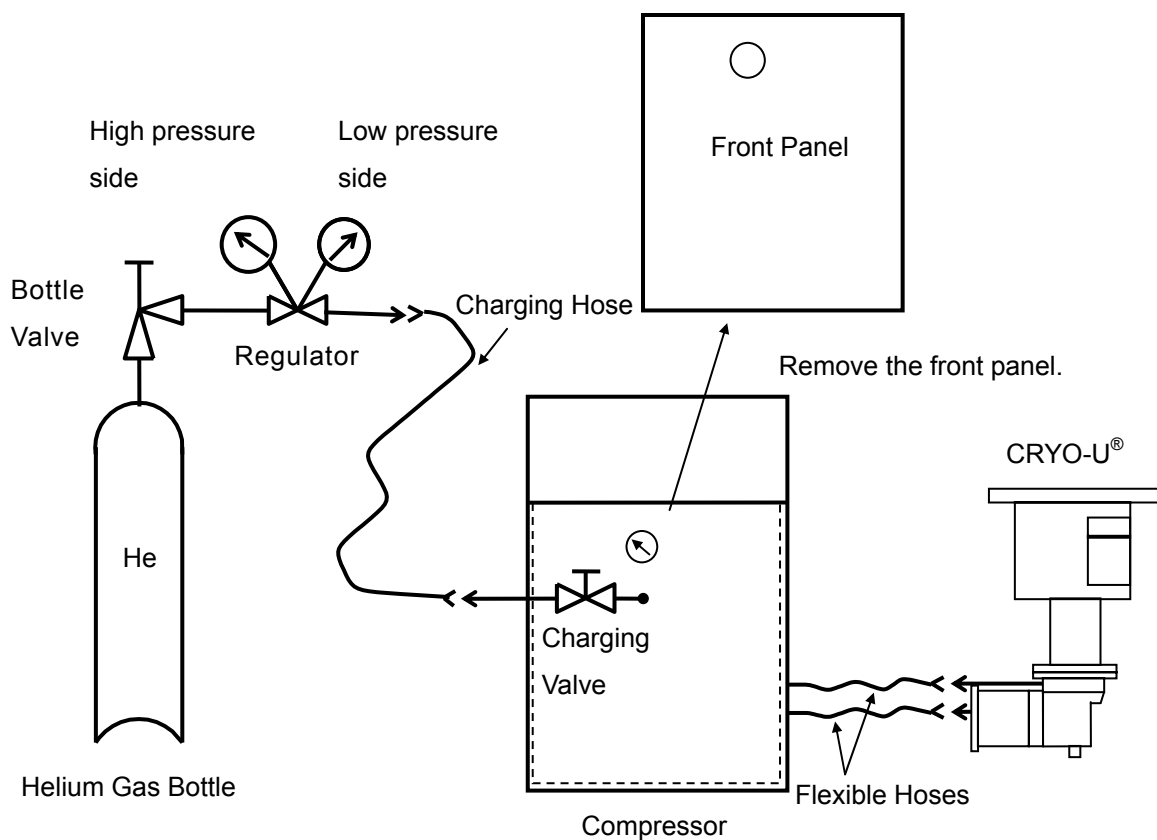


Figure 6-1 Charging Helium Gas

Appendix A

TROUBLESHOOTING




			WARNING
<p>◆ Disconnect the compressor from its power source before performing any troubleshooting procedures.</p> <p>◆ The compressor pump is hot after operating. Wait for the unit to cool down before working on the inside of the compressor.</p>			

Table A-1 Troubleshooting Procedures

No	Problems	Possible Cause	Corrective Action
I	Compressor stops during continuous operation.	1) Thermal protective switches (TS1 and TS2) are ON. 2) Over current protective switches (MPA, MPB) or circuit protectors (CP1, CP2) are active.	Check the cooling water condition (temperature, flow rate). • Check the power supply voltage. • Contact our Service Engineering Division or the nearest CS center.
II	Compressor does not start.	1) No power coming from the source. 2) Circuit protectors (CP1, CP2) are OFF. 3) Reversed phase protective relay (PRR) is active. (STOP light is lit up)	Check wiring and ensure that the power supply connector is connected properly. Turn the circuit protectors ON. Change two phases of power source (Refer to section 4.1).
III	Compressor stops after several minutes' operation.	1) Thermal protective switches (TS1 and TS2) are ON.	Check that cooling water flows properly. Also check the cooling water temperature and flow rate (Refer to Figure 3-2).

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

Table A-2 Operating Log

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

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Appendix B

SCHEMATIC DIAGRAM

◆ Safety Devices (in the control module)

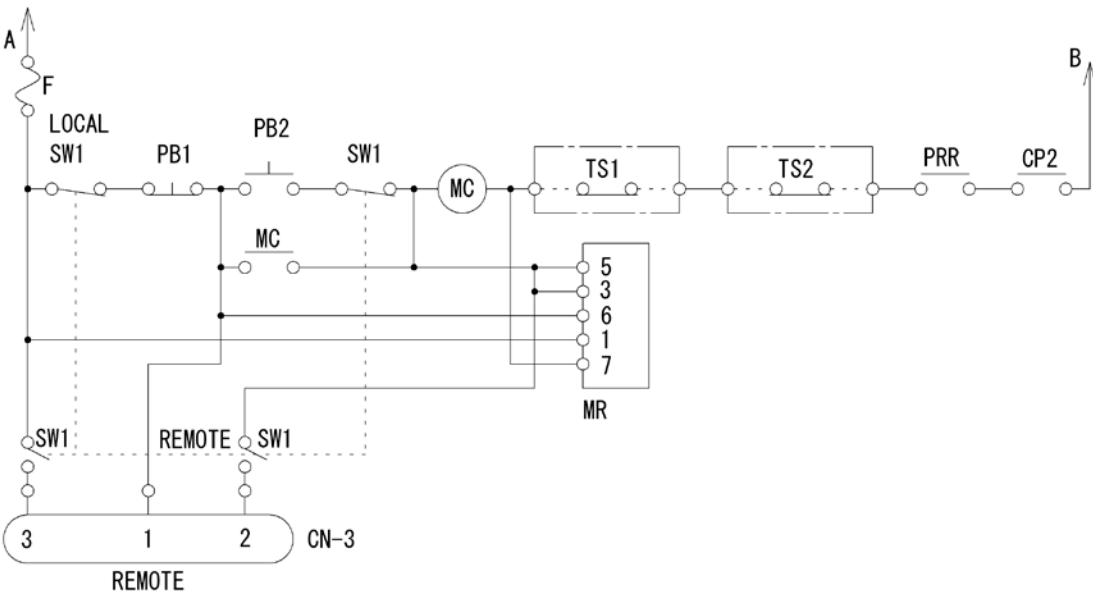
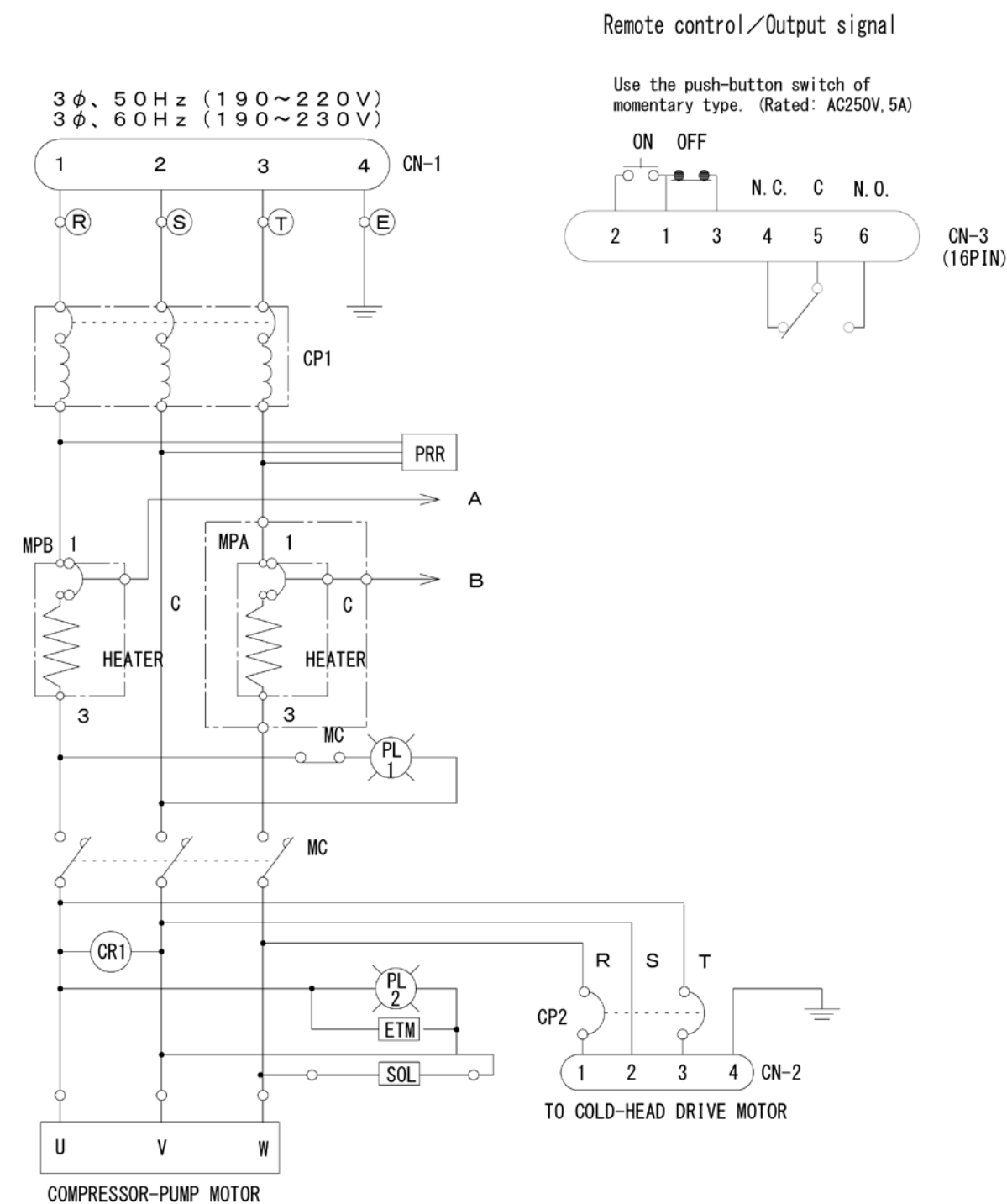
Sign	Item	Function and specification
MPB	Over current protective switch (AUTO RESET)	Automatically stops the compressor operation if a overcurrent occurs due to overloading, or an abnormal rise of temperature inside controller occurs. Both "TOP(PB1)" and "START(PB2) push-button switch" light OFF.
CP1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

◆ Safety Devices (others)

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

◆ Electric Parts

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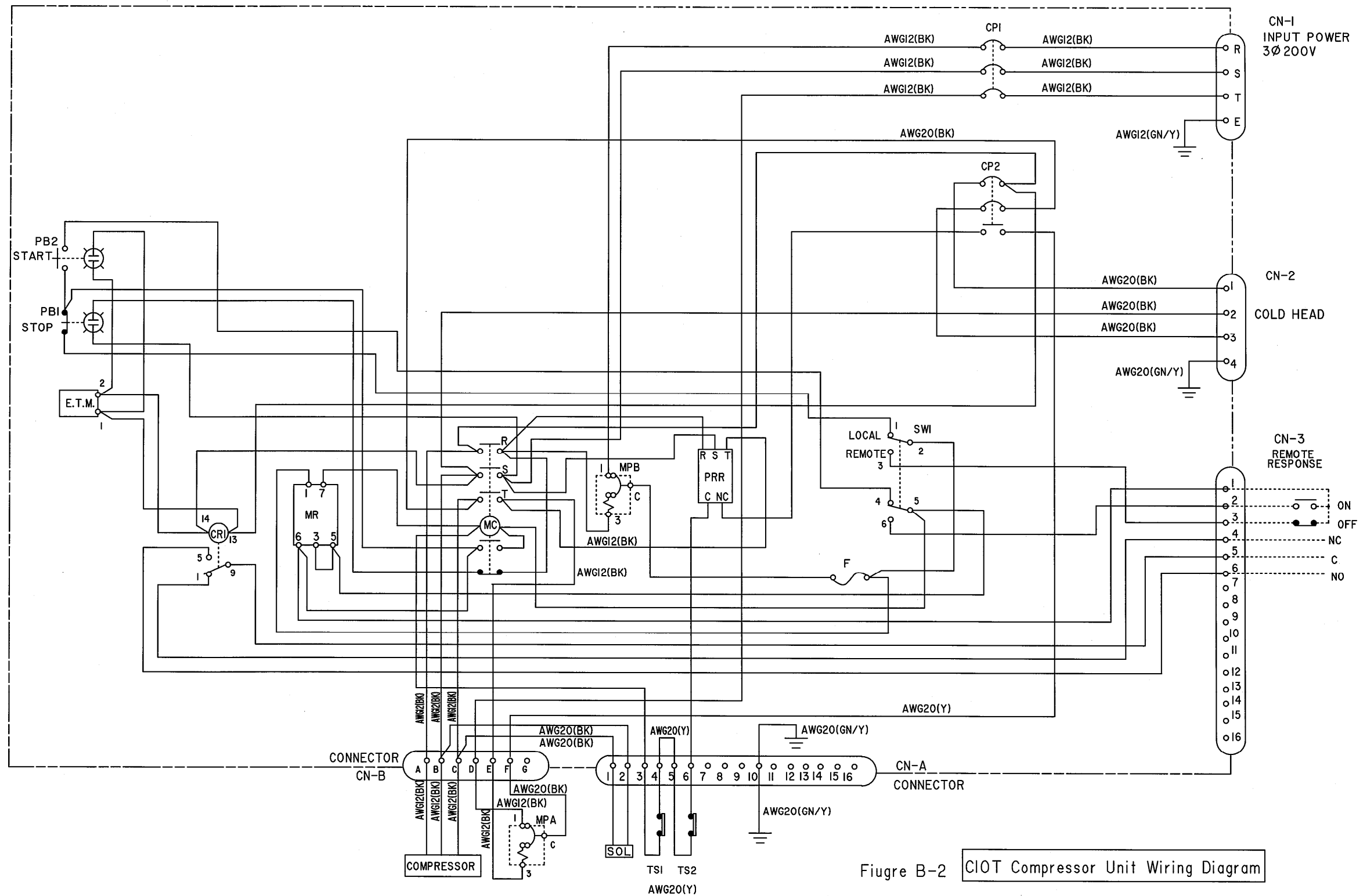


CN-1	Input power connector	MC	Magnetic contactor
CN-2	Cold head power connector	MPA	Over current protective switch (located on compressor pump)
CN-3	Output signal connector	MPB	Over current protective switch (located in control box)
CP-1	Circuit protector	MR	Momentary restart relay
CP-1	Circuit protector	PRR	Reverse phase protective relay
CR1	Relay for output signal	SOL	Solenoid valve
ETM	Elapsed time meter	SW1	REMOTE/LOCAL changeover switch
F	Fuse	TS1	Thermal switch (Compressor pump outlet temperature)
PB1 (PL1)	Stop button switch (Orange)	TS2	Thermal switch (Water cooled heat exchanger outlet temperature)
PB2 (PL2)	Start button switch (Green)		

«NOTE»
(1) This compressor unit is shipped with CP1 and CP2 set in ON position.
(2) REMOTE/LOCAL changeover switch is shipped in LOCAL position.

Figure B-1

C 1 0 T Compressor Unit Circuit Diagram



Appendix C

FLEXIBLE HOSE

1. Specifications

- Gas : Helium Gas (Purity : 99.999% or more)
- Pressure : Max. 2.45MPaG
- Temperature : 0 to 70°C
- Material : SUS304
- Length : 3000mm (standard)
- Minimum Bending Radius : 250mm
- Recommended Torque for Connecting : 20N·m

※It is fastened and crowded until self seal coupling stops turning.

- Connection : 1/2B self-sealing coupling

2. Precaution in Handling



CAUTION

- When carrying the flexible hose, hold the braid support of the hose. If it is bended forcibly at an acute angle, it may be damaged.
- Avoid twisting the flexible hose especially when making final connection.
- Keep away from water and salt to prevent corrosion. Do not put heavy things on the flexible hoses in order to prevent modification and crushing of them.

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Appendix D

FLOW DIAGRAM

Helium returning from cold head is transferred to the compressor with oil injected and then compressed. The oil is pooled at the bottom of the compressor inside and circulated passing through the oil heat exchanger, filter, orifice, solenoid valve and sight glass.

The compressed high-pressure and high-temperature helium is discharged from the compressor pump and transferred to the helium heat exchanger. As passing through the heat exchanger, the heat generated during compression is removed and then the cooled helium enters oil separator. Inside the oil separator, the oil droplet contained in helium is removed and returns to the compressor unit after passing through a filter and a orifice.

At the same time, the helium from oil separator enters an adsorber. As passing through the adsorber, oil mist contained in helium is removed by adsorption and the helium is supplied to the cold head via flexible hose.

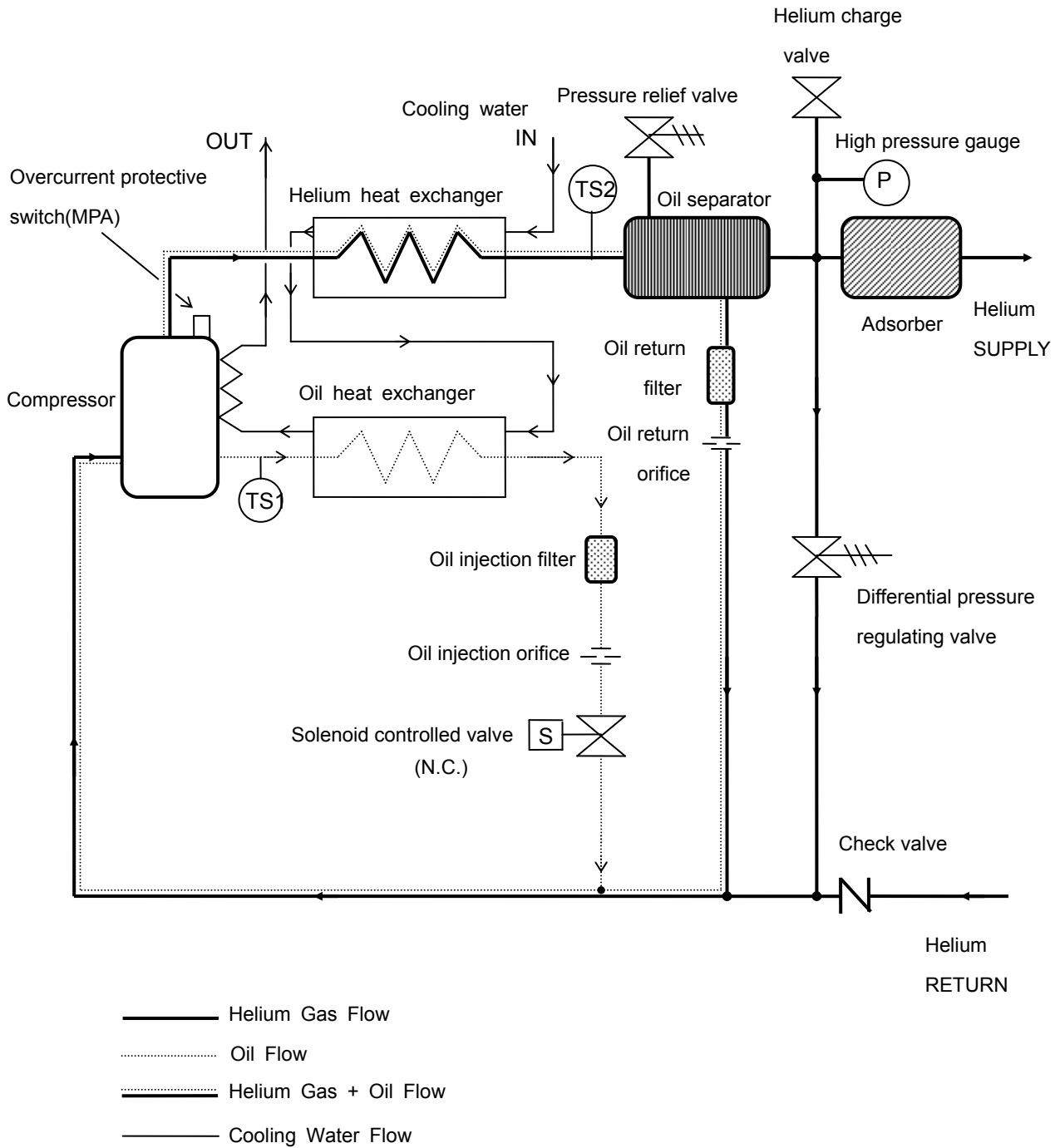


Figure D-1 C10T Flow Diagram

SERVICE NETWORK

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Revision History

Date	Revision No.	Contents
2001-02-26	2001.02	First edition
2007-03-20	2007MH01	Correction of the type of cold head cable connector.
2007-08-08	2007AT02	Deletion of the descriptions related to adsorber replacement.
2011-02-14	2011FY03	Cover: Export control policy has been revised.
2011-05-16	2011MY04	Full-fledged revision.
2011-12-01	2011DR05	P.B-3~6 C10T Compressor unit circuit diagram and wiring diagram have been revised. Service Network has been revised.
2013-03-26	2013MH06	“Safety Instruction” No.3 and No.5 have been revised. “SERVICE NETWORK” has been revised.
2014-04-03	2014AL07	“Introduction” and “SERVICE NETWORK” have been revised.
2016-11-21	2016NR08	“Safety Instructions” and “Maintenance” have been revised.
2019-11-15	2019NR09	Appendix B Figure B-1 Circuit Diagram has been modified. SERVICE NETWORK has been revised.

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