ULVAC

COMPRESSOR UNIT

Instruction Manual

C10AT

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.

D/N.MD10AT0E, 2023OR03 **ULVAC CRYOGENICS INCORPORATED**

Introduction

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

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

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

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

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

2. Warranty

2.1 Gratis warranty period and Warranty coverage

【Gratis warranty period】

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

【Coverage】

(1) Failure diagnosis

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

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

(2) Damage during transportation

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

(3) Breakdown repairs

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

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

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

2.2 Exclusion of opportunity loss from warranty liability

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

2.3 Repair period after production is discontinued

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

3. Service Form

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

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

4. Notes for repair and maintenance requests

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

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

5. In case of breakdown and accident

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

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

6. General Precautions

(1) It is prohibited to duplicate or reprint this instruction manual or any of its parts, disclose or transfer to a third party without written permission from ULVAC CRYOGENICS.

(2) Information in this document is subject to change without notice along with the specification change or the improvement of the product.

(3) If you have any questions or comments on this document, please contact us.

Safety Icons and Texts

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

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

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


Toxic gas or chemicals used.
There is a risk of severe injury upon contact.

Corrosive chemicals used.
There is a risk of severe injury upon contact.

Flammable gas used.
There is a danger of fire or burn injury.

Explosive gas used.
There is a risk of fire or explosion.

Hazardous voltage.
Electric shock may cause severe injury or loss of life.

Hot heating part present.
There is a risk of burn injury.

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Compressor Unit Safety Instructions

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

1. Do not overfill helium gas

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

Do not fill helium gas more than specified in this book.

2. Adding helium gas and charging equipment

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

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

3. Do not startup/shutdown frequently

Do not startup/shutdown the compressor unit frequently.

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

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

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

4. Disposal of used adsorber

When disposing used adsorber, ensure to discharge helium gas and remove either side of the self-sealing couplings before disposing 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.

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 3ϕ, rated voltage: 200V).
- Grounding conductor (earth wire) must be connected (D class grounding (with the ground resistance of 100Ω)).
- Connect the refrigerator cable and remote cables (signal lines) to the compressor before connecting the compressor to the power supply. These wiring connections must not be done when the compressor is powered on. It could lead to a serious accident such as electric shock and/or damage to the equipment.
- Follow recommended sizes for wires and cables.
- Power lines and signal lines must be wired at least 10cm separate from one another.

6. Compressor unit ambient conditions

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

7. Maintenance precautions

1. Installation and maintenance of the product must be done by personnel in charge of the equipment or servicing who are familiar with the product structure and risk associated with the operation of the compressor.
2. Input power supply must be shut off before opening the cover of the compressor to avoid the risk of electrical shock.
   Also, parts of inside the compressor unit are still hot just after the compressor has been stopped. Wait at least 15 minutes to open the cover to avoid the risk of burns.

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

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

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

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

The sealing sticker is located inside the panel of the compressor unit.

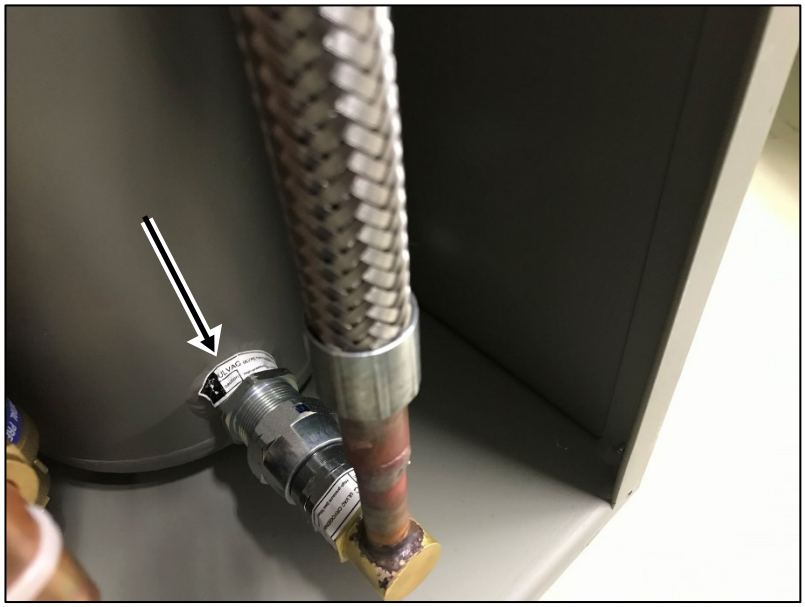

Figure Example of the sealing sticker pasted on the self-sealing coupling

Disposal Considerations

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

WARNING

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

WARNING

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.

(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

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: C10AT

Power Supply	190VAC - 220VACx3ϕ x 50Hz 190-230VAC x 3ϕ x 60Hz
Power (Normal operation)	1.5 / 1.7kW (50Hz / 60Hz)
Current (Normal operation)	5A / 6A (50Hz / 60Hz)
Locked rotor current	27.6A
Cooling Method	Air-cooled
Ambient Temperature	10 - 38°C
Storage Temperature	-10 - 55°C
Humidity	5-90% (no condensation)
Altitude	1000m or below
Compressor Winding Resistance	3.04Ω (20°C)
Adsorber Replacement Interval	24,000 hours
Noise (*2)	70dBA or below
Weight	77kg
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 are used. The maximum allowable length is 20m, and the power consumption and current will be larger by 6% with a 20m hose.

(*2) JIS B8346

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

Charge Pressure (*3) (with flexible hoses connected)	1.73 ± 0.04 MPaG
Operating Pressure(SUPPLY) (*4)	1.8 - 2.0 MPaG

(*3) The charge pressure in the above table is the figure with flexible hoses of 20m or shorter. If hoses are longer than 20m, the charge pressure will be changed. Contact us for the detail.

CAUTION

When you use a flexible hose of 10m - 20m, chose the one dedicated to C10. If a standard hose of the same length is used, helium charge pressure will be lower than appropriate and it will be required to charge helium gas.

(*4) The figures here are expected when flexible hoses of 3m are used. The operating pressure will be larger by 10% if hoses of 20m are used.

✧ Compatible Model of Cryopump and Refrigerator unit

Refrigerator	RMS10T

✧ Connector Specifications

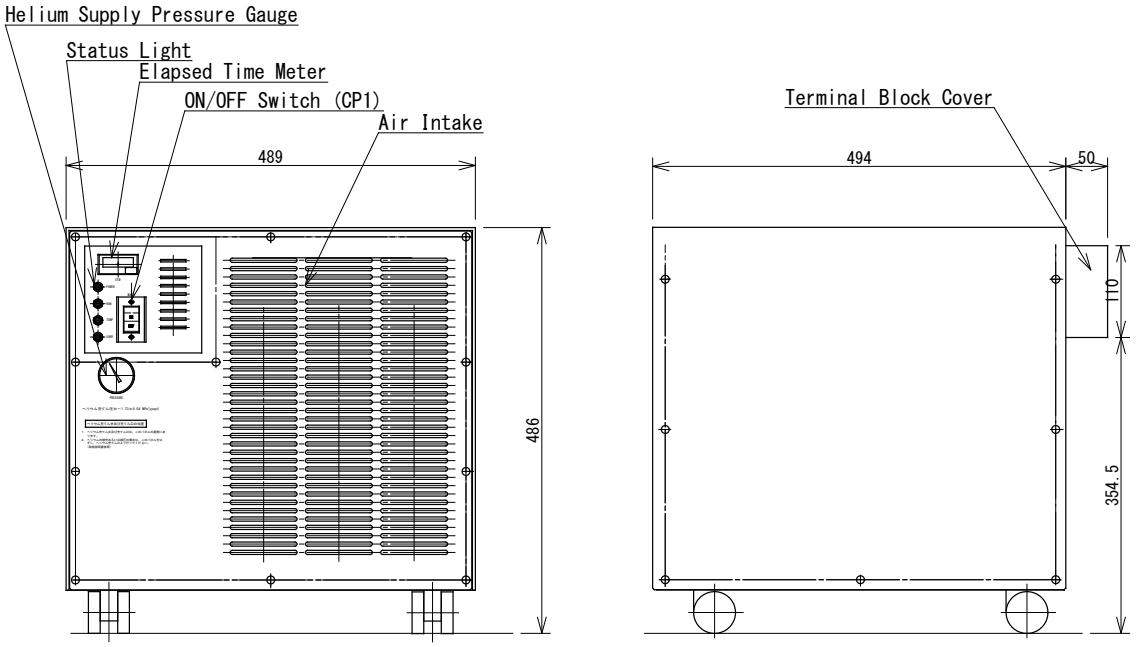
Coldhead Drive Cable	Nanaboshi Electric MFG	NJC-204-PM
REMOTE Connector	JAE	SRCN6A25-16P

✧ Terminal Specifications

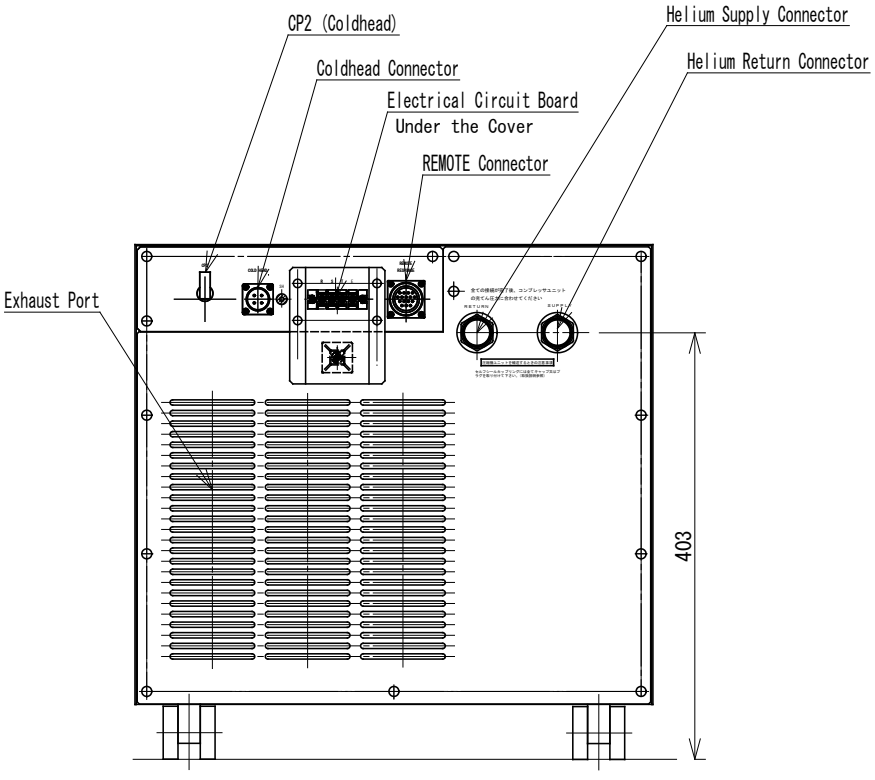
Power Cable (R, S, T, E)	Connection Screw M3.5 Recommended torque to fasten connection screw: 0.8N m Terminal pitch 8.5mm Crimping terminal width 7.0mm or lower

* Use the crimping terminal delivered with the C10AT to connect to the compressor side

<Dimensions>



【FRONT】 【SIDE】



【REAR】

Figure 1-1 Dimensions

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2. UNPACKING AND INSPECTION

2.1. Shipping List

When the shipping carton is delivered, make sure that there is no damage or lacking items by checking the exterior of the package and the shipping list.

Refer to the enclosed cover letter for the details. Depending on your specifications, the optional parts in Table 2-2 are delivered as well.

Table 2-1 Shipping List

Description	Quantity
Compressor Unit	1
Instruction Manual (This book)	1
Metal Connector for external signal or remote operation	1

Table 2-2 Optional Parts

Description	Quantity
Input Power Cable ($2.0mm^2$ x 4cores x 3m or customized length)	1
Refrigerator power cable ($0.5mm^2$ x 4cores x 3m or customized length)	1
Flexible Hose (3m or customized length)	2
Single Head Wrench (For connecting flexible hoses)	2
Gasket for Helium Coupling (Spare)	4

2.2. Compressor Unit Inspection

Check helium charge pressure with the pressure meter on the front panel.

Normal charge pressure is 1.82 – 1.86MPaG at room temperature (about 20ºC) before connecting flexible hoses. The charge pressure is set slightly higher considering the pressure decline at the time of connecting flexible hoses. The pressure may change slightly depending on the ambient temperature.

When the pressure is below 1.82MPaG at 20±10ºC, refer to **6.3 Charging Helium Gas** and follow the procedure. Please contact us if the pressure drop is observed even after charging helium gas.

2.3. Inspection of Flexible Hoses

CAUTION

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

Check exterior of the flexible hose for a twist or breaks.

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

2.4. The Cables

Check the cables for damage.

If any items are not included or damaged, please contact our service engineering department or the nearest customer support center.

3. INSTALLATION

3.1 Installation

1. Place the compressor unit on a floor with the levelness of 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.
   - Check the pressure gauge.
   - Operate gas charge valve.
   - Replace adsorber.

Do not block air intake on the front and exhaust port on the back to keep good air-cooling performance.

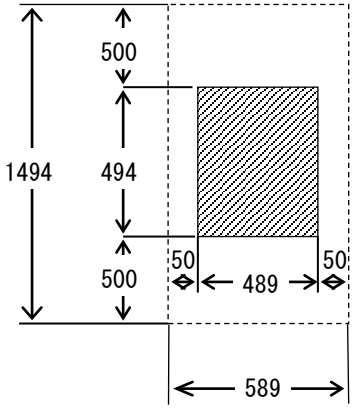


Figure 3-1 Maintenance Space(Unit: mm)

3.2 Connecting the Compressor Unit to the Coldhead

(Connecting the flexible hoses)

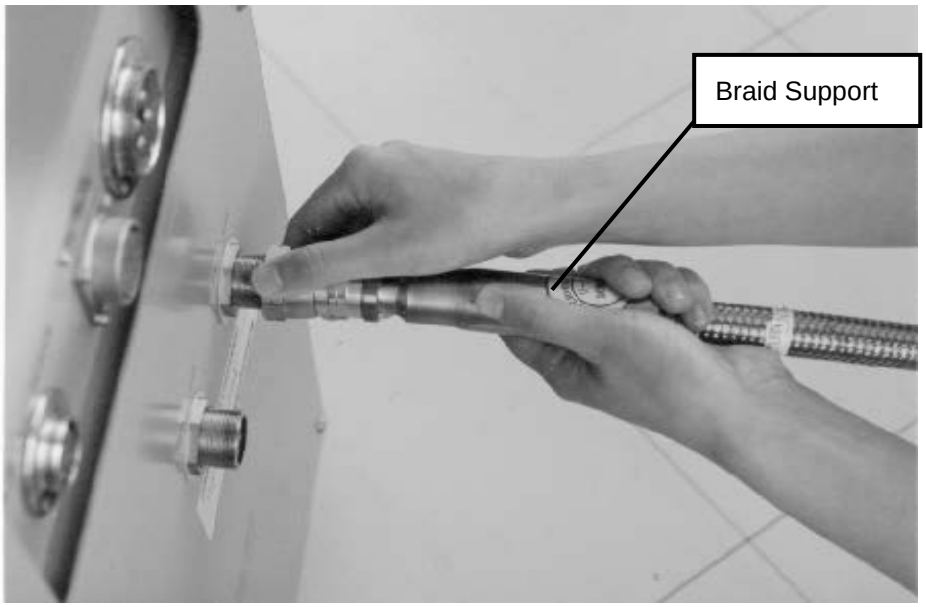
CAUTION

- Read appendix C carefully for the handling of 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 couplings frequently. It may result in helium leakage that requires replacing with a new one.

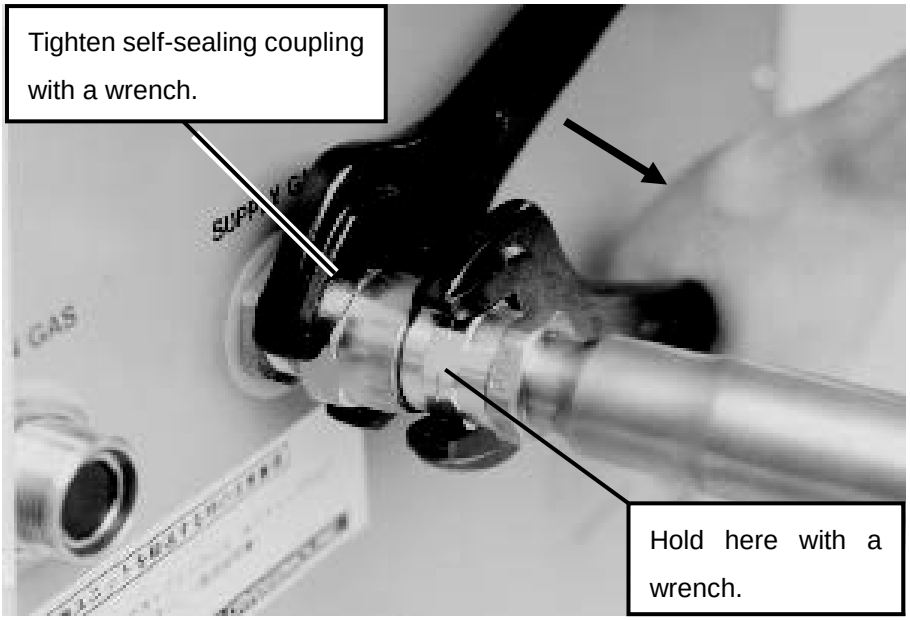
1. Remove all dust plugs and caps from the supply and return flexible hoses, compressor and coldhead. Clean the self-sealing coupling flat rubber gasket to be free from dust or metallic powder.
2. Connect the flexible hoses between the compressor unit and coldhead (See Figure 3-2).
   a. Connect one end of the helium SUPPLY flexible hose to the helium SUPPLY connector on the compressor unit, and connect the other end to the helium SUPPLY connector on the coldhead.
   b. Connect one end of the helium RETURN flexible hose to the helium RETURN connector on the compressor unit, and connect the other end of the hose to the RETURN connector on the coldhead.
3. Check helium pressure gauge for proper helium pressure. The standard helium charge pressure is 1.73±0.04MPaG at 20°C. See Figure 3-3. If the indicated pressure is higher than appropriate value, allow a slight amount of helium gas to escape by opening the gas charge valve **very slowly**. If the pressure is lower than appropriate, add helium gas as described in section 6.3. Contact us if there is helium leakage.

CAUTION

When you use a flexible hose with length of 10m to 20m, chose a 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.



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



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

Figure 3-2 Connecting Flexible Hose

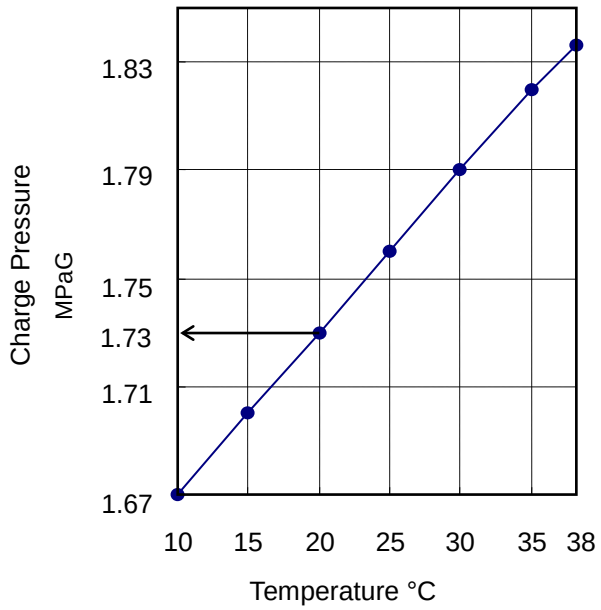


Figure 3-3 Static Pressure and Temperature

3.3 Connecting Electrical Cables

WARNING

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

WARNING

Disconnect the power cable connector when connecting REMOTE/RESPONSE wiring. Failure to observe this precaution could result in damage of the equipment.

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

✧ For REMOTE operation: Make correct wiring following the circuit diagram in Appendix B. Always use the alternate switch (contact) for setting START/STOP switch for remote operation.

✧ For LOCAL operation: Follow the circuit diagram and short-circuit 15-16 pins of the remote connector.

✧ RESPONSE signal wiring: Follow the circuit diagram and make correct wiring. The specification of the response signal contact is shown in Appendix B.

2. Connect the coldhead power cable from the compressor to the cryocooler.
3. Attach crimping terminal to the power cable.
   Terminal block specifications: Screw M3.5, Crimping terminal largest width 7mm
4. Connect one end of the power cable to the compressor unit.
   Connect another end of the cable to the power source.
   Note: If a customer-supplied power cable is used, the cable should have the specifications as the table below.

Table 3-1 Power Cable Specifications

Item	Symbol	Specifications
Input power cable	INPUT POWER	600V Rubber cab tire cable 2PNCT 2.0SQR 4C (Taiyo Cabletec)

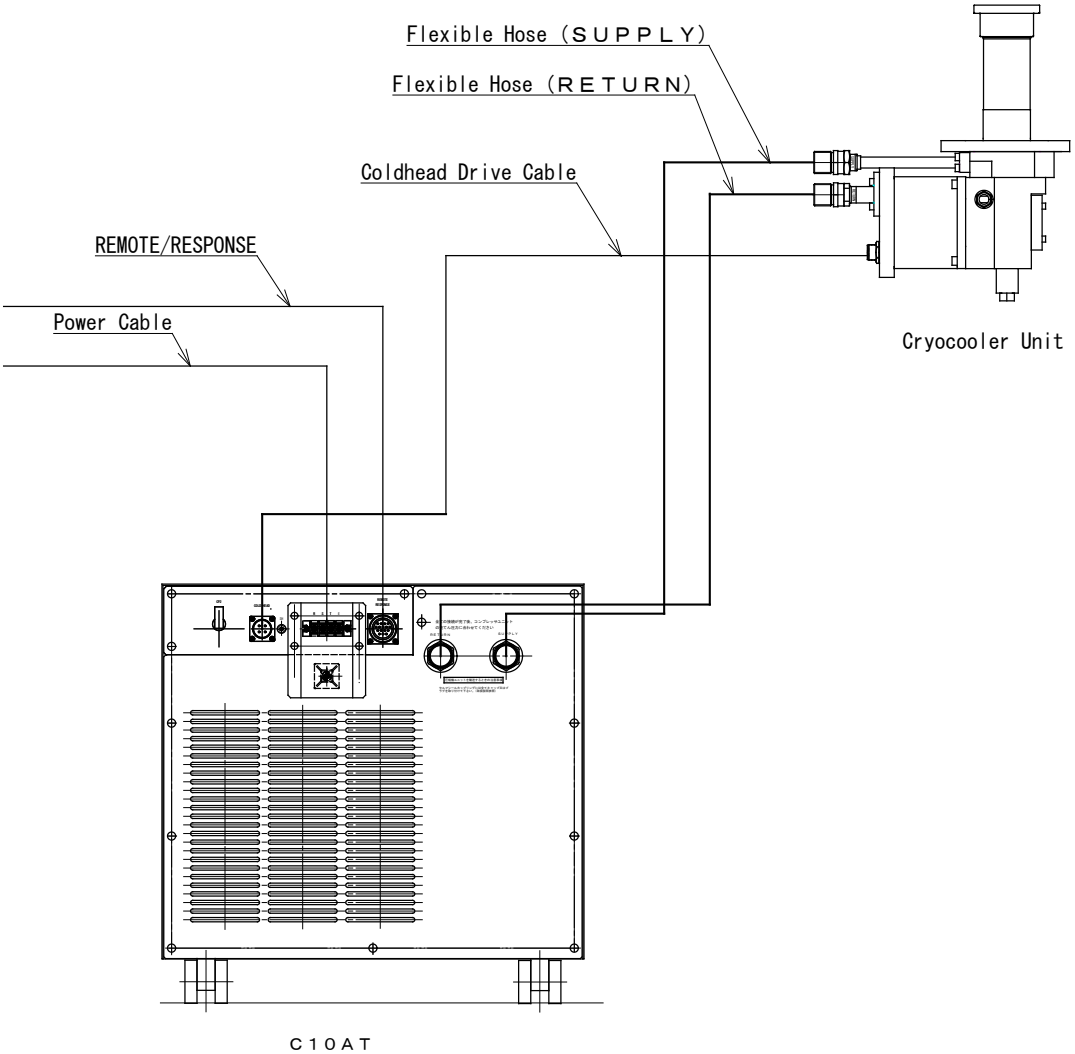


Figure 3-4 Compressor Installation

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4. OPERATION

4.1 Prior to Operation

Before operating the compressor, check and verify that:

1. Power supply voltage is in the range specified in Table 1-1.
2. If power indicator does not light and the compressor does not start-up, chage although the power is turned ON, reverse phase can be the reason. Change any one set of RST phases.
3. REMOTE/LOCAL switch is properly set.
   <Note>Refer to Section 3.3 to wire remote connector appropriately according to operating conditions.
4. Helium gas static pressure is within the appropriate value.

4.2 Start-up

✧ LOCAL Operation

Turn ON the ON/OFF switch on the front panel of the compressor unit. The compressor starts-up in three seconds.

✧ REMOTE Operation

Make sure that the Remote signal is OFF and turn ON the remote signal to start-up the compressor unit.

4.3 Normal Operation

CAUTION

Verify that the operating pressure is within the appropriate range shown in Table 1-1.

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5. DISCONNECTION and STORAGE

5.1 Disconnecting Flexible Hose

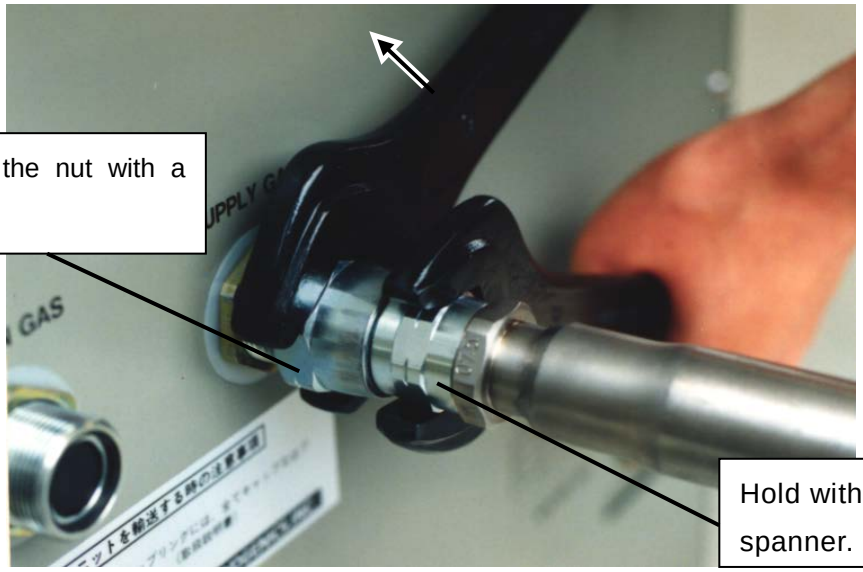
CAUTION

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

1. Shut down the compressor unit.
2. Wait for the cryocooler unit to warm up. Disconnect the flexible hoses after the unit has reached to the room temperature.

CAUTION

- If flexible hoses are removed while the cryocooler is still in low temperature, the internal pressure will rise as the inside of the cryocooler warms up. This may activate the pressure relief valve resulting in helium leakage.
- When performing helium circuit decontamination, disconnect the flexible hoses from the compressor unit immediately after shutdown.



Loosen the union nut using two spanners and disconnect the flexible hose by hand.

Figure 5-1 Disconnecting Flexible Hoses

5.2 Storage

- Follow the instructions below to store the compressor unit.
  1. Disconnect the flexible hoses and store. Refer to Section 5.1.
  2. Disconnect cables.
  3. Put protective caps on the helium gas connectors and cover the compressor unit entirely with plastic sheet in a way it has been delivered.
  4. Avoid direct sunlight, heat, humidity, vibration, radiation, dust, wind and rain while in storage.
  5. The compressor unit should be placed on a level floor (within ±5º) and be fixed to avoid vibration or toppling over
  6. Check the pressure gauge of the compressor unit periodically. Contact our Service Engineering Division or the nearest customer support center if the pressure keeps lower. There is a possibility that a leakage might have occurred.

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

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

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6. MAINTENANCE

WARNING

Disconnect the compressor unit from all sources of electrical power before performing any maintenance procedures.

6.1 Scheduled and Unscheduled Maintenance

- Scheduled Maintenance: Adsorber replacement (At least every 24,000 hours)
- Unscheduled Maintenance: Charge helium gas

6.2 Replacement of Adsorber

The adsorber should be replaced at least once every 24,000 operation hours. Using the same adsorber for more than 24000 hours may result in failure or malfunction of the cryocooler unit. Follow the procedures below to replace adsorber.

- Removing the Adsorber

1. Close the main valve of a vacuum system.
2. Turn OFF the power to the compressor unit to stop operation of the compressor unit and cryocooler unit.
3. Shutdown the primary power source.
4. Disconnect Supply and Return flexible hoses from the compressor unit.
5. Remove the rear panel of the compressor unit (Figure 6-1).
   With a spanner, remove the nuts that fix the SUPPLY and RETURN coupling (male) on the rear panel (two nuts).
6. Remove four flexible hose connected to the port close to adsorber inlet inside compressor unit.

CAUTION

Always use two spanners when connecting and disconnecting flexible hoses.

Refer to 5.1 for the procedures.

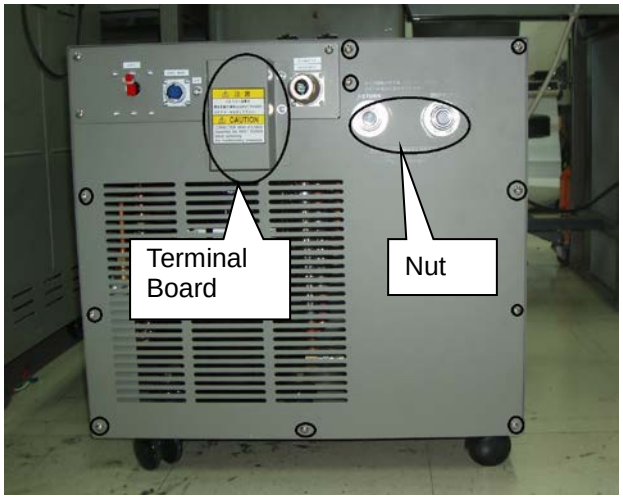


Figure 6-1 **Remove the nuts, screws and terminal board cover on the rear panel. (Left)**

Figure 6-2 **Remove the rear panel. (Right)**

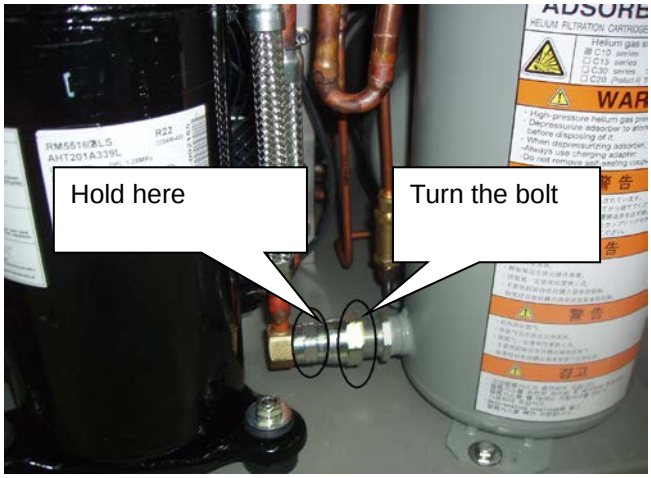
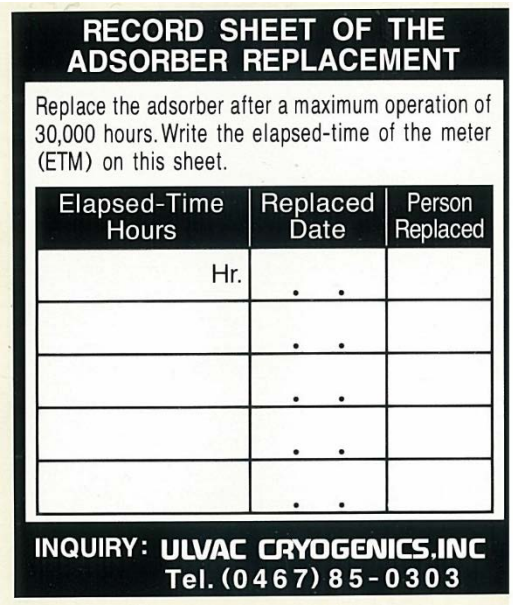


Figure 6-3 **Disconnect the flexible hose at the adsorber inlet. (Left)**

Figure 6-4 **Remove the adsorber mounting bolt, (Right) and slide out the adsorber.**



RECORD SHEET OF THE ADSORBER REPLACEMENT

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

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

INQUIRY: ULVAC CRYOGENICS,INC
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- To attach the adsorber, follow the removing steps in the reverse order (Figure 6-4 to Figure 6-1).
- When attaching the flexible hose to the adsorber, make sure that the flexible hose is placed level to the floor as indicated in Figure 6-3.
- When adsorber replacement is completed and the front panel is in place, record the total operation hours in Adsorber Replacement Record label.

Figure 6-5 Adsorber Replacement Record

7. Remove the bolt that fixes the adsorber (M6 x 1).
8. Pull out the rear side of the adsorber from the plate, and slide it out from the compressor unit


WARNING

When Disposing used adsorber, make sure to remove high pressure helium gas inside completely.

NOTE: Use helium charging adaptor to remove helium gas safely.

➢ **Install a New Adsorber**

1. Remove dust caps from the inlet and outlet port of a new adsorber.
2. Perform the removing procedure in reverse order to install a new adsorber.
3. Connect the flexible hose at adsorber inlet.
   The flexible hose should be level to the floor.
4. Check that the pressure gauge at the return side reads appropriate charge pressure (1.73±0.04MPaG at 20ºC). If the pressure is too high, slowly loosen the charge control valve to slightly release helium gas. If it is too low, follow the procedure in 6.3 Charging Helium Gas to add helium.
5. Attach the compressor rear panel to the original position.
6. Record the time displayed on the elapsed time meter on the record sheet on the front panel when replacing the adsorber. Write the time of next replacement (24,000 hours added to the current elapsed time record) as well.

6.3 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 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 to stop leakage before charging. Improperly connected self-sealing coupling might be one of the causes.

- Recommended regulator is the one 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, regulator opens 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 normally by turning counterclockwise.

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 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 decontamination 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 suspended, replenish it with pure helium gas until it reaches the static pressure.

CAUTION

If helium gas has been charged more than the appropriate pressure of 1.9MPaG, the pressure relief valve on the cryocooler may be activated. Use cautions and charge helium gas slowly so that the pressure relief valve should not operate. The pressure relief valve in the compressor unit is set to work 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.

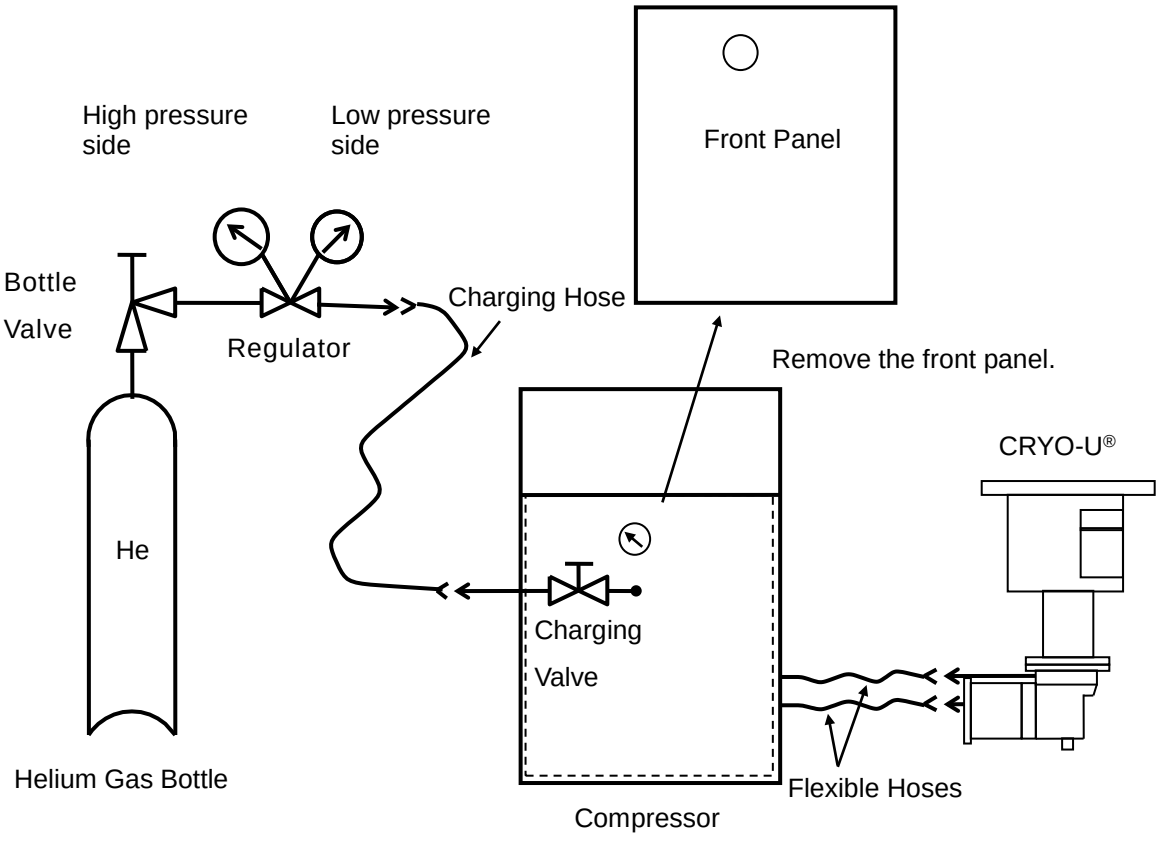

Figure 6-6 Charging Helium Gas

6.4 Cleaning Heat Exchanger

It is required to clean the heat exchanger of the compressor unit to guarantee cryocooler performance and reliability. Perform the cleaning at least once a year although the frequency may vary depending on the installation or operating conditions.
It is recommended to clean when you find dust on the surface of the heat exchanger inside the front panel.

Follow the steps below to clean.

1. Remove the front panel.
2. Use a vacuum cleaner to clean up the dust on the surface of the heat exchanger and the air inlet on the front panel. Use cautions as the heat exchanger has sharp edges on the surface.
3. Attach the front panel.

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Appendix A

TROUBLESHOOTING

WARNING

- Disconnect the compressor from its power source before performing any troubleshooting procedures.
- The compressor pump is hot while in operation. Wait for the unit to cool down before performing work.

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) Overload relay (OL1) or circuit protectors (CP1, CP2[*1]) are active.	● Check that the air intake and exhaust ports are clear. ● Check the power supply voltage. ● Contact us.
II	Compressor does not startup.	1) No power coming from the primary power source.	Check wiring and ensure that the power supply connecter is connected properly.
		2) Circuit protectors (CP1, CP2) are OFF.	Turn the circuit protectors ON.
		3) Phase reversal protective relay (PRR) is active.	Change two phases of primary power source (Refer to section 4.1).
III	Operation stops in a few minutes.	1) Thermal protective switch (TS1, TS2) is activated.	Clear the space of larger than 500mm in front of the air intake and exhaust ports. Check that the surface of the heat exchanger is clean and free from dust or dirt.
		2) Overload relay (OL1) or circuit protector (CP1, CP2[*1]) is active.	● Check the power supply voltage. ● Contact us. (Inform the room temperature of the site.)
		3) Compressor motor failure	● Contact us.

* NOTE 1: When CP2 is activated

1) Cut the cable tie that fixes the protective cover of CP2 and remove the cover. (Figure A-1)
2) Press down the CP2 lever to the OFF position. (Figure A-2)
3) Lift the lever to the ON position (Figure A-3). Put on the protective cover.

If the CP2 is activated repeatedly, please contact us.

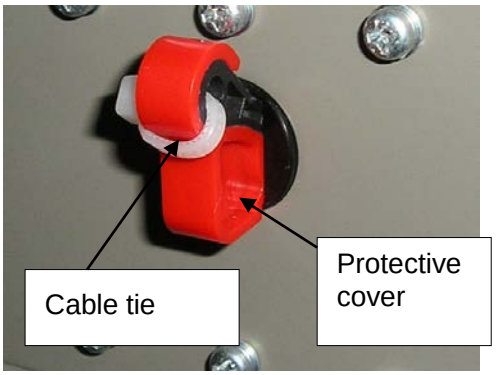

Figure A-1 CP2 Cable tie and protective cover

Figure A-2 CP2 lever down

Figure A-3 P2 lever lifted up

Table A-2 Operating Log

CRYOCOOLER S/N	**OPERATING LOG**	POWER V × ϕ
COMPRESSOR S/N		

Measuring condition					Compressor unit			Cryocooler				Notes
								Temperature			Pressure	
Date	Time	Measurer	Room temp.[°C]	Humidity [%]	ETM	High pressure helium Gas [MPaG]	Current [A]	1st stage K thermocouple	2nd stage MBS-C	2nd stage H_2VP etc	[Pa]	

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

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Appendix B

SCHEMATIC DIAGRAM

◆Safety Devices (inside the control module)

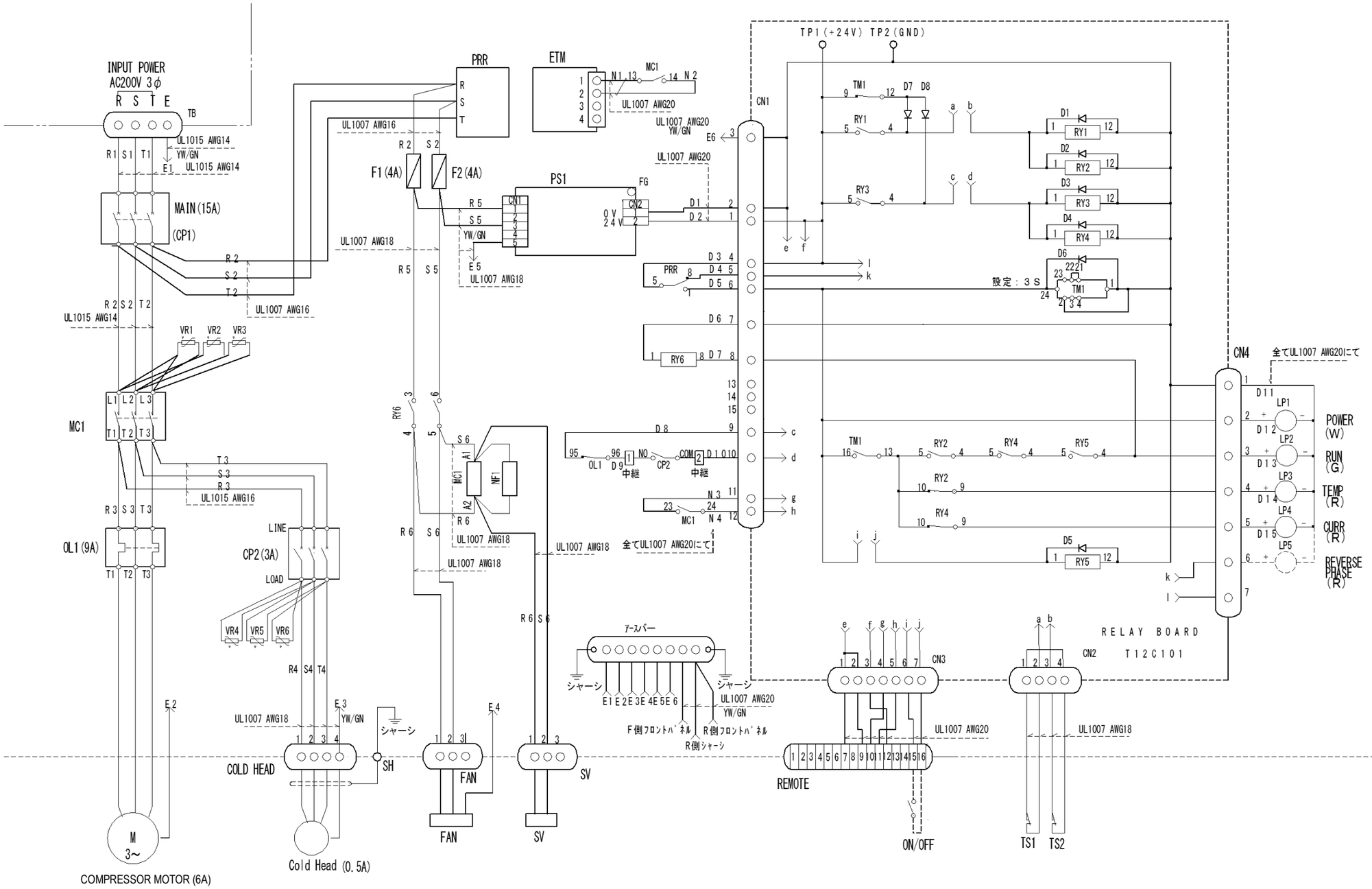
Sign	Item	Function and specification
OL1	Overload relay	Installed inside the compressor unit. When the compressor current exceeds the appropriate value, OL1 shuts down the compressor unit. CURR lights up.
CP1	Circuit protector (MANUAL RESET)	Shuts power off if a short circuit of compressor unit occurs. Rated current: 15A
CP2	Circuit protector (MANUAL RESET)	Shuts power off if a short circuit of cold head occurs. Rated current: 5A
PRR	Phase reversal protective relay	In case of overcurrent of the cryocooler circuit, the power supply is disrupted. CURR lights.
F	Fuse	250V, 4A

◆Safety Devices (outside the control module)

Sign	Item	Function and specification
TS1	Thermal switch	Stops the compressor operation when oil flow rate is insufficient. “TEMP “lights.
TS2	Thermal switch	Stops the compressor operation if the heat exchanger is does not provide sufficient cooling. TEMP lights.
—	Pressure relief valve	Located on the helium supply line. The valve operates automatically when the pressure is above the set value. Set pressure: 2.41MPaG (350psi)
—	Differential pressure regulating valve	Located between the supply and return line. This valve adjusts maximum differential pressure while the compressor is in operation. Set pressure: 1.34MPaG (195psi)

◆Electric Parts

<table>
<tr><th>Sign</th><th>Item</th><th>Function and specification</th></tr>
<tr><td>PB1
PL1</td><td>Illuminated STOP push-button switch (MOMENTARY)</td><td>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.</td></tr>
<tr><td>PB2
PL2</td><td>Illuminated START push-button switch (MOMENTARY)</td><td>When pressed, “STOP” indicator lights OFF and “START” indicator(green) lights ON. Starts both the compressor unit and the cold head.</td></tr>
<tr><td>SW1</td><td>REMOTE/LOCAL switch</td><td>In REMOTE operation, connect a wire to the REMOTE/RESPONSE connector. (See P.B-3/B-4.)</td></tr>
<tr><td>ETM</td><td>Elapsed time meter</td><td>Displays the total hours of the compressor unit operation.</td></tr>
<tr><td>MR</td><td>Restart momentary relay for power supply failure</td><td>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.</td></tr>
<tr><td>CN3</td><td>Remote/Response connector</td><td>Indicates the Cold Head status of START/STOP.
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.
Contact capacities of CR1 are as follows:
<table><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="2">Rated load</td><td colspan="2">Resistance load (Induction load)</td></tr><tr><td colspan="2">AC220V 5A (2A)
DC 24V 5A (2A)</td></tr><tr><td>Minimum applicable load</td><td colspan="2">DC5V 1mA</td></tr></table></td></tr>
</table>



Color of wiring
200VAC: Black,　24VDC: Blue, GND: Green / Yellow
Wires connected to CN1 11,12 and CN3 4,5: Orange

Figure B-1 C10AT Circuit Diagram

REMOTE / RESPONSE Circuit

<For LOCAL operation>

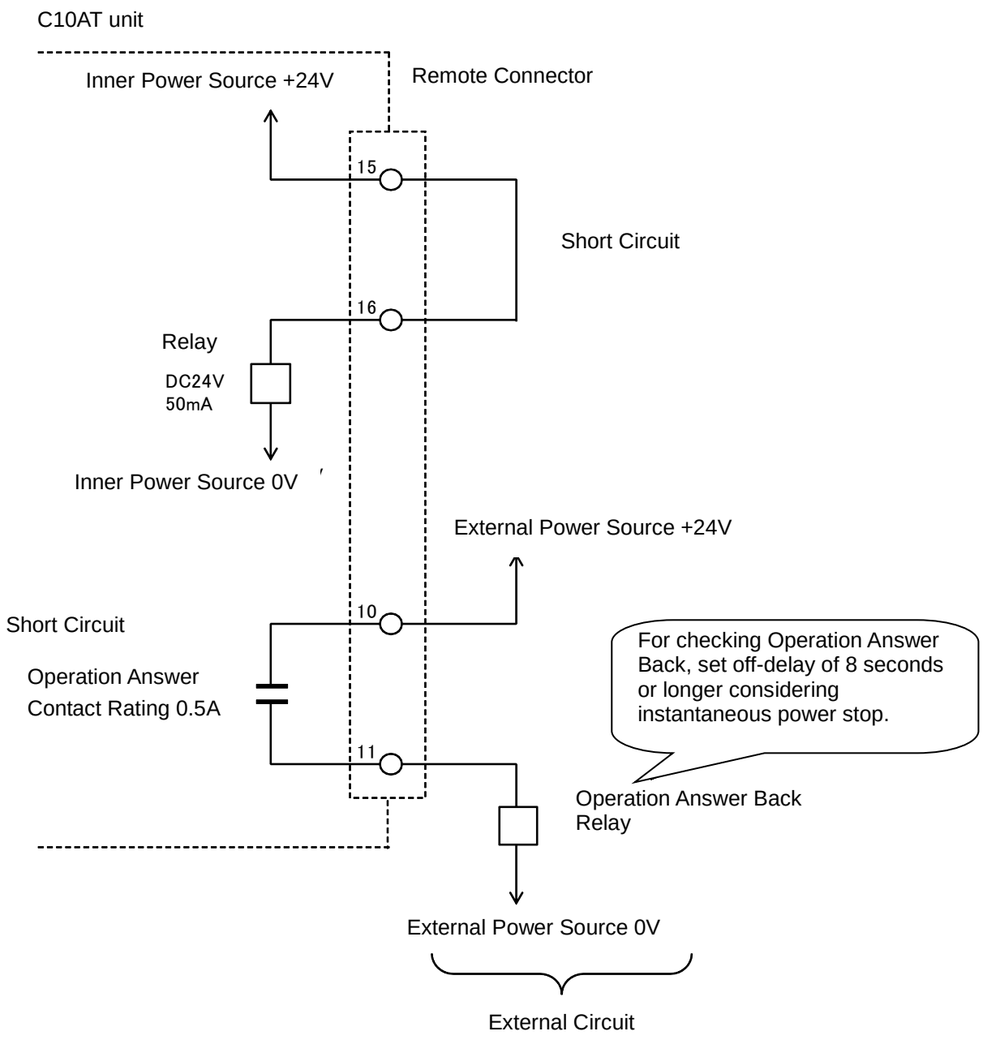


Figure B-2 Connector wiring for LOCAL operation

<For REMOTE operation>

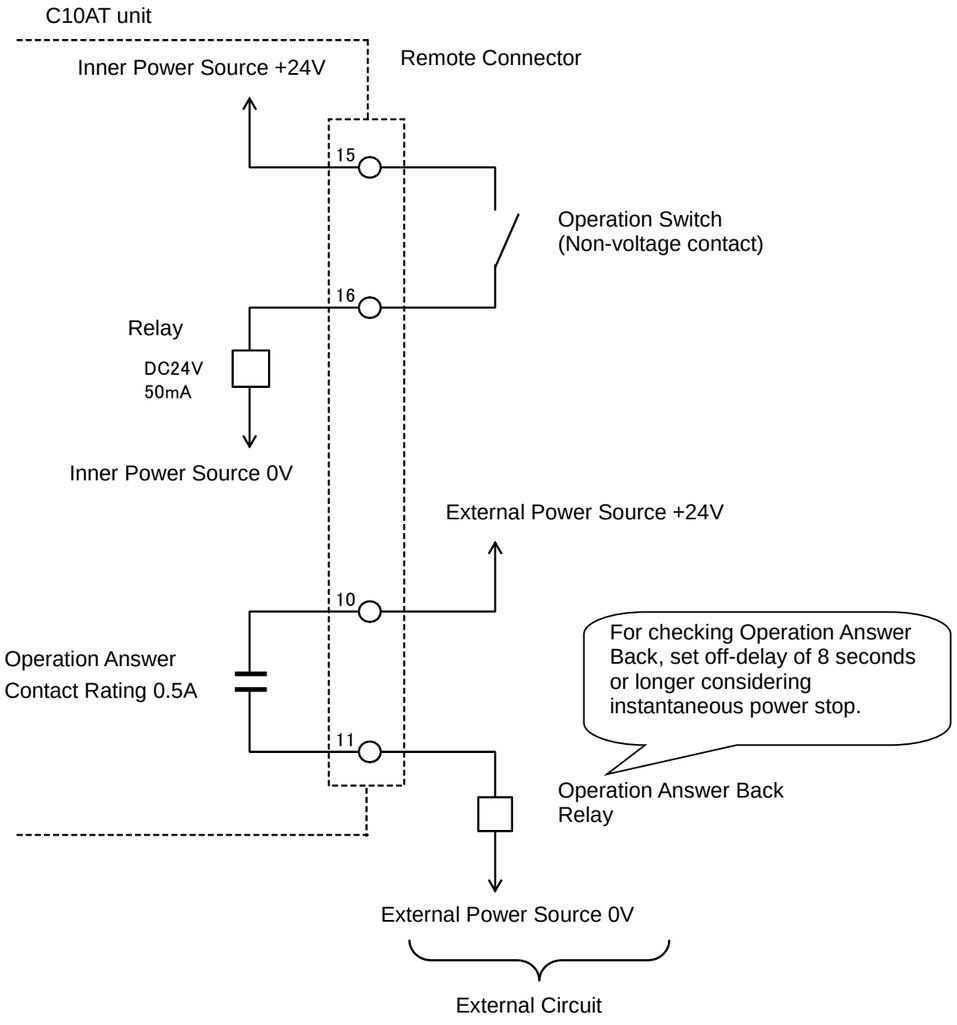


Figure B-3 Connector wiring for REMOTE operation

Appendix C

FLEXIBLE HOSE

1. Specifications

- Gas : Helium Gas (Purity of 99.999% or above)
- Pressure : Maximum 2.45MPaG
  <Note> The content of "Specifications and Drawings" specific to your system supersedes, if provided.
- Temperature : 0 to 70ºC
- Material : SUS304
- Length : 3000mm (standard)
- Minimum Bending Radius : 250mm
- Recommended Torque for Connecting : 20N·m
  <Note> Fasten the self-sealing coupling until fully tight.
- Connection : 1/2B self-sealing coupling

2. Handling Precautions

CAUTION

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

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Appendix D

FLOW DIAGRAM

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.

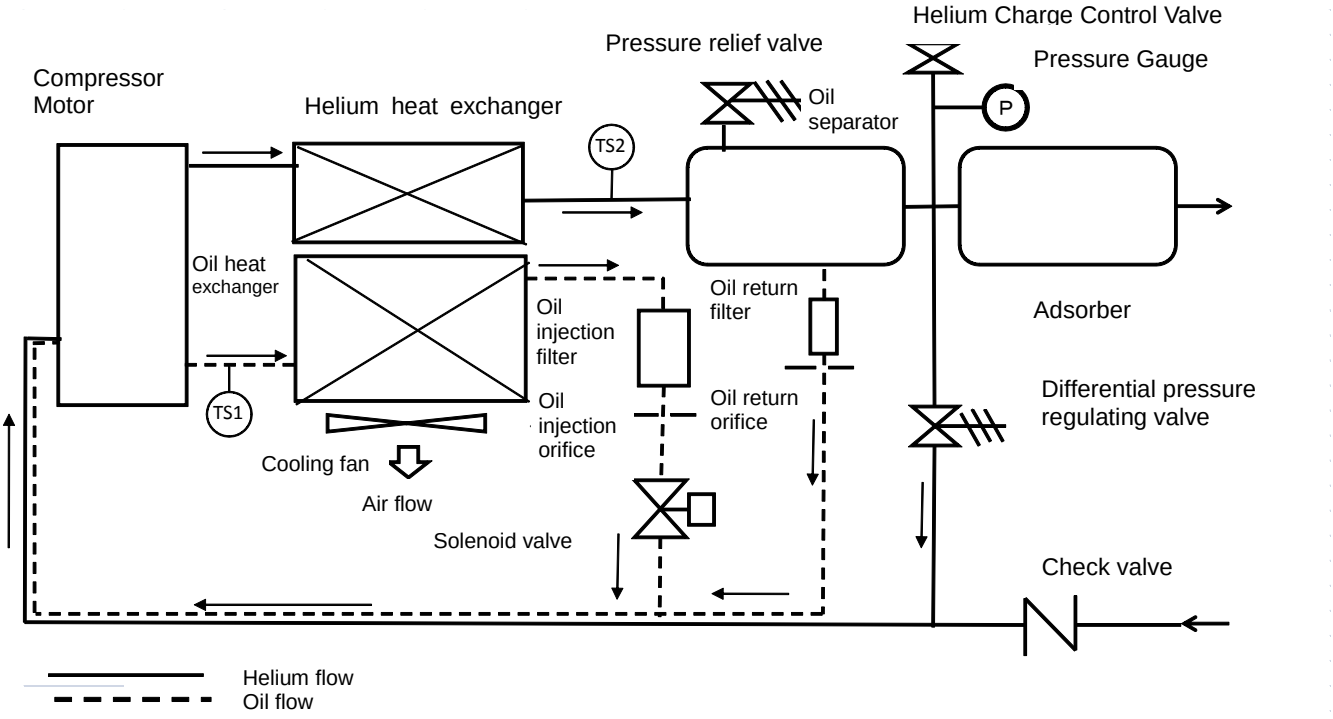

Figure D-1 C10AT Flow Diagram

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
2019/04/15	2019.04	First edition
2020/10/01	2020OR01	Appendix B Circuit Diagram Figure B-1 has been modified.
2023/08/04	2023AT02	"Safety Instructions" Description on the sealing sticker has been added.
2023/10/23	2023OR03	"Safety Instructions" Description on the adsorber disposal has been modified. Appendix C A note has been added to flexible hose allowable pressure.

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