

CRYOPUMP

CRYO-U[®] SERIES

Bakeable Type Cryopump

Instruction Manual

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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1. SPECIFICATIONS

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A bakeable type cryopump has sheathed heater coiled around, degasses the pump by baking its outer shell to 150°C - 250 °C to achieve ultra-high vacuum of lower than 10⁻⁸ Pa easily.



Figure 1-1 Bakeable Type Cryopump

<NOTE> The figure above is provided as an example and may differ from your system.

1.1 Performance of Bakeable type Cryopump

Table 1-1 Ultimate Pressure of Bakeable type Cryopump(Reference only)

Roughing Pressure	Baking Time	Ultimate Pressure
$\sim 10^{-3}$ Pa	0 h	10^{-8} Pa
$\sim 10^{-3}$ Pa	$(150\sim 250^{\circ}\text{C}) \times 3\sim 8\text{h}$	10^{-9} Pa
$\sim 10^{-3}$ Pa	$(150\sim 250^{\circ}\text{C}) \times \text{approx. } 20\text{h}$	10^{-10} Pa

※ The ultimate pressure of vacuum chamber and baking time vary depending on the volume of outgases from the chamber.

1.2 Sheath Heater



Table 1-2 shows the specifications of Sheathed Heater used in Bakeable type Cryopump.

Table 1-2 Sheathed Heater Specifications (per unit)

Pump model	U6H	U8H, U10PU, U10H, U12H, U12HSP, U16, U16P, U16HSP, U20P (*1)
Heater Type	Micro Heater	Micro Heater
Length	5.0m	9.1m
External Diameter	ϕ 1.0	ϕ 1.6
Rated Voltage	AC200V \pm 10%	AC200V \pm 10%
Power	300W	400W

(*1)Two sets of sheathed heater to be connected in parallel for U16, U16P, U16HSP, and U20P.

※ Specifications are subject to change without notice.

	 WARNING
<p>Baking heater has a possibility of aged deterioration of insulation properties. Install a ground-fault circuit interrupter, and conduct periodic inspections of the insulation properties to prevent a short circuit. If any insulation property is deteriorated, please replace the heater.</p> <p>Inspection should be conducted before applying current and check that the insulation resistance between the outside of atmospheric side sleeve and the lead wire is 10MΩ or more (500VDC megger).</p>	

1.3 Flange Specifications

Table 1-3 shows the specifications of flanges.

Table 1-3 Flange Specifications (*)

Cryopump		U6H	U8H	U10H, U10PU	U12H, U12HSP	U16P, U20P
Inlet Flange	Model	UFC203	UFC253	UFC306	UFC406	Special
	Gasket	UFC203G	UFC253G	UFC306G	UFC406G	Special
Accessory Port	Model	UFC034		UFC070		
	Gasket	UFC034G		UFC070G		
Refrigerator Flange	Model	R10R/RM10			R20R/ RM20	R50R/ RM50
	Gasket (For maintenance or repeat of previous models)	E04188DG (MITSUBISHI CABLE INDUSTRIES, LTD)			E04812DG (MITSUBISHI CABLE INDUSTRIES, LTD)	
	Gasket (Current models)	H-311529 (Helicoflex Delta® seal)				

(*) UFC203 and UFC253 flanges are compatible with ICF203 and ICF253 flanges, However, UFC306 is NOT compatible with ICF 305 flange.

(*) A conversion flange is required to mount a U12H or U12HSP to a UFC356 mounting flange at a chamber side. (12 inch cryopump is not available for UFC356 flange)

(*) Conflat flange is recommended as the most appropriate vacuum sealing method for baking process. However, normal VG (VF) flange or special VG (VF) flange are also available for CRYO-U® Cryopump of 16 inch or larger size according to your request. Please check the External Drawing for the details.

(As for specialty VG (VF) flange, the thickness, the number of mounting bolts, size or material are different from JIS (Japan Industrial Standards) specifications.)

<Example of flange selection>

Inlet Flange : Conflat Flange or VG (VF) Flange

Accessory Port : Conflat Flange or VG (VF) Flange

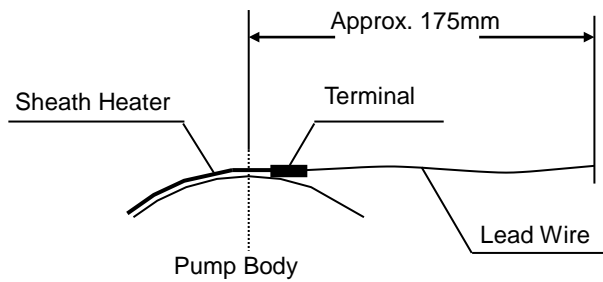
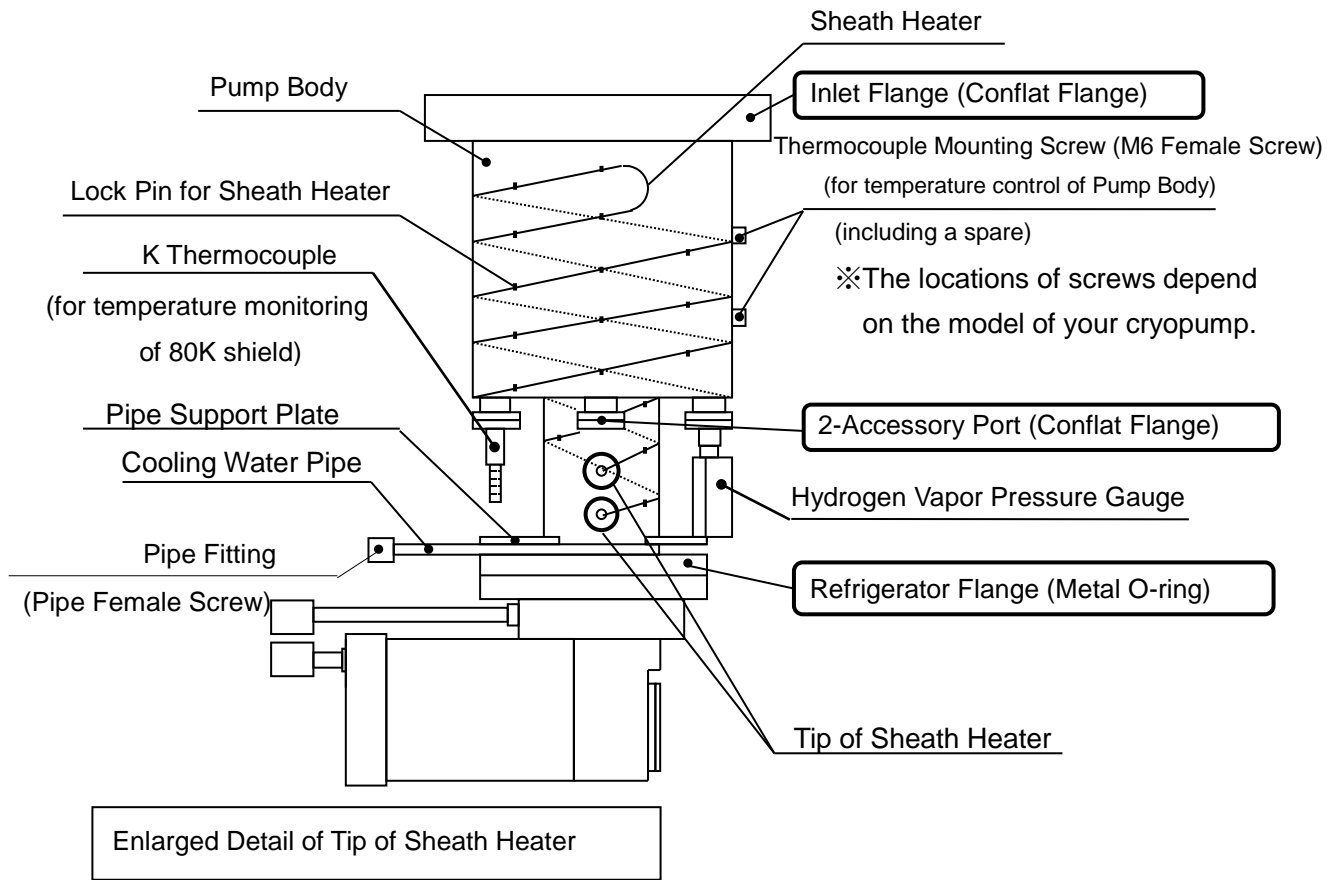
Refrigerator Flange : Metal O-ring Flange or Viton O-ring Flange

(*) The gaskets for refrigerator flanges for previous models are not compatible with the current type.

1.4 Cooling Water Pipe

The Cooling Water Pipe Fitting is G1/8 female pipe parallel thread. The fitting may differ depending on the specifications of the cryopump. Refer to the External Drawing for the detailed information.

1.5 Major Components



Sheath Heater	Lead Wire
φ 1.0	φ 1.0 × 120mm
φ 1.6	φ 1.0 × 120mm

※ The appearance may change depending on the cryopump purchased.

Figure 1-2 Major Components

2. INSTALLATION

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The operation method of Bakeable type Cryopump is substantially equal to that of a standard cryopump. Baking is performed while running the cryopump (Refer to Chapter 3 - Baking). Be sure to install the pump according to Chapter 4 - Installation in the CRYO-U® cryopump instruction manual and perform the following precautions as well.

2.1 Fixing Sheathed Heater

Make sure that the sheath heater is secured to the pump body firmly by lock pins. If not, bend the lock pin gently and fix the heater to the pump body. Be careful not to put too much strength into base of the lock pin.

2.2 Connecting Sheathed Heater to Power Source

Connect the lead wire on the terminal of the Sheath Heater to the power source.

	 WARNING
Cover the uncovered part of the lead wire with heat resistant tube in order to avoid an electric shock when accidentally touched.	

2.3 Preparing Temperature Controllers for Baking and Overheat Protection

Please prepare the two temperature controllers for baking. One is for maintaining the surface temperature of the cryopump body constant. The other is for overheat protection device to protect the components against damage.



CAUTION

Although the maximum allowable working temperature of the refrigerator unit is 70°C, the temperature of the internal components such as 80K shield, 80K baffles, 15K cryopanel or refrigerator unit must be kept lower than 20°C during bake-out. It is required to mount a temperature controller for overheat protection.

Mount a K thermocouple (supplied by customers) to the thermocouple mounting screw on outer surface of the cryopump body (refer to Figure 1-2 of “1. SPECIFICATIONS”). Also adjust the surface temperature of the pump body to prevent the 80K shield from being heated above 20°C by taking the output signal of the K thermocouple mounted on the 80K shield (refer to Figure 1-2 of “1. SPECIFICATIONS”) into the temperature controller for overheat protection.

The set temperature of the surface of the pump body is approximately 250°C. However, the temperature of the components during the warm-up process varies widely depending on the cryopump models and heat insulation methods of the pump body. When baking the pump body for the first time, the temperature setting should be made lower to examine and determine the appropriate temperature setting so that the 80K shield does not exceed 20°C (does not overshoot). Ignoring this process may result in severe damage to the refrigerator unit and the thermocouple.

When using an O-ring for a vacuum seal of the inlet flange and the accessory port, set the temperature for bake-out with attention to the heatproof temperature.

Figure 2-1 shows an example of the control circuit for baking.

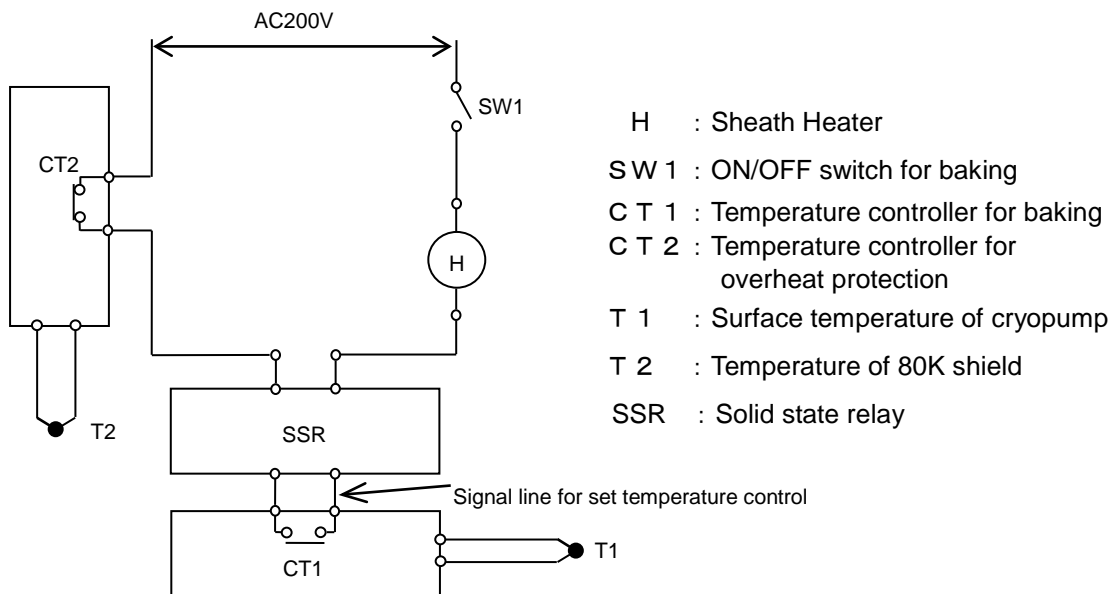


Figure 2-1 Example of Control Circuit for Baking

**CAUTION**

Do not apply solder when mounting thermocouple. Solder may be melt by the heat from heater baking. Use the silver brazed crimping terminal or mount with clamps.

2.4 Connecting Cooling Water

**CAUTION**

Maximum allowable working temperature of the refrigerator unit is 70°C. Cooling water should be flowed through the cooling water pipe to prevent the stage temperature of the refrigerator from exceeding 70°C.

Connect your cooling water piping to the cooling water pipe.

Required flow rate of the cooling water is 2L/min or more.

2.5 Heat Insulation of Cryopump Surface

**WARNING**

Cryopump surface becomes high temperature during bake-out. When installing, appropriate safety measures such as a reminder system to avoid fire and burn injury should be taken.

Covering the surface of the pump body with a nonflammable insulator is recommended to avoid burn injury. It is also effective for warm-up of the pump body using the sheath heater.

**CAUTION**

Do not cover the thermometer, gas introducing pipe, and valves with insulator. It overheats and damages the parts.



CAUTION

A cryopump with travelling base as an optional, the stay bolts connected to the travelling base will be hot. Be careful not to accidentally touch them.

3. BAKING

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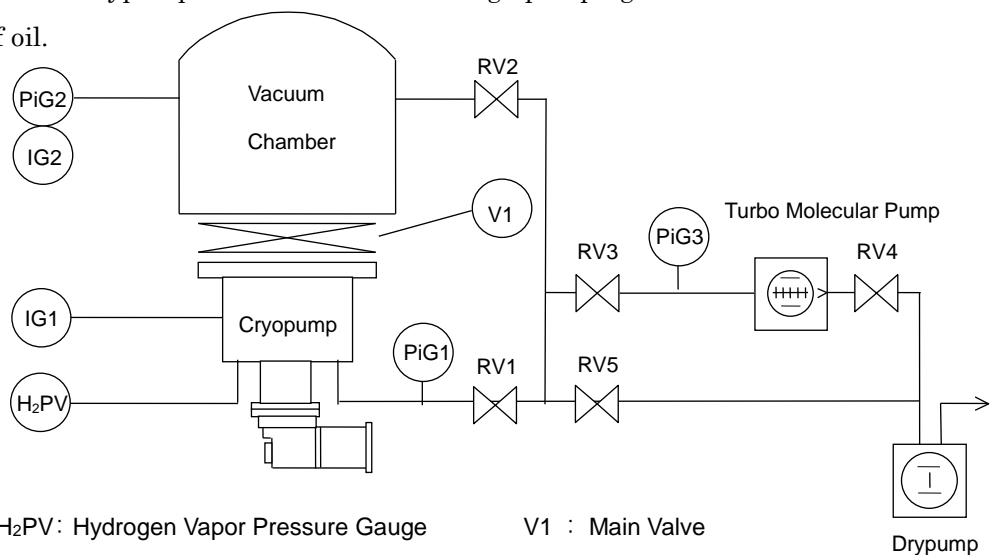
3.1 Outline

In order to obtain high vacuum quickly, it is necessary to degas the cryopump and the vacuum chamber by baking. Prior bake-out is essential to obtain extreme high vacuum in particular.

For bake-out of cryopump itself, pressure inside the pump should be lowered as much as possible before starting cool-down in order to achieve lower ultimate pressure. Thereby installing auxiliary vacuum system (roughing vacuum system), which is able to exhaust at least 0.1Pa or less, is required.

Procedure for baking the cryopump is explained below with an example of vacuum system using a turbo molecular pump and a drypump* (Figure 3-1).

Bake-out is performed while the cryopump in operation. Please carefully read CRYO-U® Cryopump Instruction Manual beforehand and prepare the cryopump to be able to start. ※ Drypump is recommended for rough pumping as it does not cause back diffusion of oil.



H ₂ PV : Hydrogen Vapor Pressure Gauge	V1 : Main Valve
PiG1 : Cryopump Pirani Gauge	RV1 : Cryopump Roughing Valve
IG1 : Cryopump Ionization Gauge	RV2 : Vacuum Chamber Roughing Valve
PiG2 : Vacuum Chamber Pirani Gauge	RV3 : Turbo Molecular Pump Valve
IG2 : Vacuum Chamber Ionization Gauge	RV4 : Turbo Molecular Pump Roughing Valve
PiG3 : Turbo Molecular Pump Pirani Gauge	RV5 : Bypass Valve

Figure 3-1 Example of Baking Vacuum System

**CAUTION**

Although the maximum allowable working temperature of the refrigerator unit is 70°C, control the sheath heater to prevent the internal components such as 80K shield, 80K baffles, 15K cryopanel or refrigerator unit from being heated above 20°C during bake-out. (Refer to “2.3. Preparing Temperature Controllers for Baking and Overheat Protection”.) Also, make sure to supply cooling water to the cooling water pipes.

3.2 Baking Method

The baking procedure below is based on the example of the exhaust system shown in Figure 3-1.

1. Start the drypump. Next, open the cryopump roughing valve (RV1), the vacuum chamber roughing valve (RV2), the bypass valve (RV5) and the turbo molecular pump roughing valve (RV4) sequentially so as to rough pump the vacuum chamber, the cryopump, and the turbo molecular pump at the same time.
2. Start the turbo molecular pump when the pressure of the outlet (PiG3) has reached a required pressure for start-up (Refer to the turbo molecular pump instruction manual for the pressure value). Then, close the bypass valve (RV5) when the pressure of PiG1 and PiG2 has achieved 10Pa or less, and discharge the gas in the vacuum chamber and the cryopump by opening the turbo molecular pump valve (RV3).
3. Pass cooling water into the cooling water pipes.
4. Start the bake-out by turning on electricity to the sheath heater of the cryopump. For the sake of safety, ensure to control the temperature with reference to Chapter 2.3 - Preparing Temperature Controllers for Baking and Overheat Protection. If necessary, perform the bake-out of vacuum chamber alongside.
5. Pressure inside the cryopump increases when warm-up, and gently decreases when the temperature inside the cryopump reaches a condition of thermal equilibrium. Start the cryopump when the pressure inside has achieved 0.1Pa or less (The main valve, V1 is closed at this point).
6. Turn off the electricity to the heater after baking-out as necessary.

7. Stop the rough pumping exhaust system by closing the cryopump roughing valve (RV1), the vacuum chamber roughing valve (RV2), and the turbo molecular pump valve (RV3) sequentially when the temperature of the 15K cryopanel has been cooled down to 20K or lower.

When the temperature of the 15K cryopanel has been cooled to 20K or lower, and the 80K shield cooled to 130K or lower, start exhausting the vacuum chamber by opening the main valve (V1). (Refer to CRYO-U® cryopump instruction manual for detailed information.)

Regarding step 4 of the process above, if a large amount of gas is emitted by the bake-out of the vacuum chamber and the pressure inside the cryopump does not achieve 0.1Pa easily, give priority to the bake-out of the cryopump over that of the vacuum chamber. Subsequently perform baking for the vacuum chamber and then exhaust with the cryopump. By doing so, the best ultimate pressure in clean condition can be achieved.

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- 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
2006-06-07	2006.06	First edition
2009-09-28	2009SR01	Full-fledged revision.
2010-11-04	2010NR02	Cover: Export control policy has been revised.
2011-10-26	2011OR03	“Introduction” and “SERVICE NETWORK” have been revised.
2013-07-25	2013JU04	Cover: Export control policy has been revised. P.1-2 WARNING section has been added. Table1-3 applicable models have been added. Section 2.5 CAUTION sections have been added. “SERVICE NETWORK” has been revised.
2013-11-08	2013NR05	Cover: Export control policy has been revised. “Introduction” and “SERVICE NETWORK” have been revised.
2014-04-18	2014AL06	P.2-2 The content has been modified. P.3-2 “Caution” has been modified.
2018-05-10	2018MY07	SERVICE NETWORK has been revised.
2019-03-11	2019MH08	Cover has been modified. 1. SPECIFICATIONS Table 1-1 Note has been added.

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