

## 4K GM Cryocooler Instruction Manual

HE05

### Export Control Policy

When applying a refrigerator to a cryocooler for optical sensors, the cryocooler falls under row 6.A.2.d.2 of the control list established by The Wassenaar Arrangement, which is equal to row 10(2) of appended table 1 of Japan's Export Trade Control Order.

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 our refrigerators.



## **Introduction**

Thank you for choosing our products. This instruction manual provides 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.

## Safety Considerations

Our products have been designed to provide extremely safe and reliable 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.

**Low-temperature area present.**

There is a risk of frostbite. Do not touch.

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## 1. Safety Instructions

Following precautions contain information regarding the safety of handling this system. Read them carefully and follow the instructions.

### 1. Danger of gas blowout exists. Release gases before disassembling.



The coldhead contains high pressure helium gas inside. When disassembling for baking or piston maintenance, make sure to use the optional charging adopter to release gas from the couplings of both low pressure and high pressure sides before starting the work.

### 2. Danger of explosion exists. Do not expose to corrosive gases.



This system contains high pressure helium gas inside. Make sure to release the gas before disassembling or disposing the equipment or parts. (It is not necessary to do so when you conduct regular maintenance work.) Never install the system in the atmosphere of corrosive gases such as hydrochloric acid or chlorine. Do not twist the flexible hoses, and the bend radius should not be smaller than 200mm.

### 3. Danger of frostbite exists. Do not touch low temperature areas.



The edge of the coldhead (cold stage), parts inside, or samples cooled at the coldhead are in ultra-low temperature when the system is in operation or right after the operation stops.

When you conduct repair or maintenance work or change samples, wait for sufficient time until the inside returns to room temperature. If you start working when the system is still in low temperature, it may result in human damage such as frost bite. Use protective tools like leather gloves if you need to work while the system is in low temperature.

### 4. Danger of electric shock exists. Do not touch the live part.




The system receives high voltage that may cause serious injuries or electrocute. It is extremely dangerous to touch the live part inside the system. Make sure to disconnect the main power source when you conduct installation, maintenance, or repair work. Also, make sure to connect the system to type D earth ground.

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## 2. Disposal Considerations

Regulations and the ordinance concerning industrial waste treatment are provided in the country and region to discard. When disposing our products, please process abandonment according to relevant regulations and ordinance, etc.

			 <b>WARNING</b>
<p>When it seems that the refrigerator has been used to evacuate a toxic or dangerous material, you must contact a safety supervisor before discarding, and discard it after removing the poisonous material according to directions of the safety supervisor.</p>			

We will offer Safety Data Sheet (called SDS) of our products upon your request. If you have any questions, please contact our Service Engineering Division or the nearest customer support center.



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## 3. Principle and Features

### 3.1 4K GM Cryocooler

HE05 cryocooler is the closed cycle refrigeration system that is driven by GM cycle. The system includes a coldhead, compressor, and flexible hoses to connect them. Helium gas is used as refrigerant. Helium gas is compressed at the compressor, and expands adiabatically inside the coldhead to provide cooling, and generate ultra low temperature of below 4K.

Key features are described as follows:

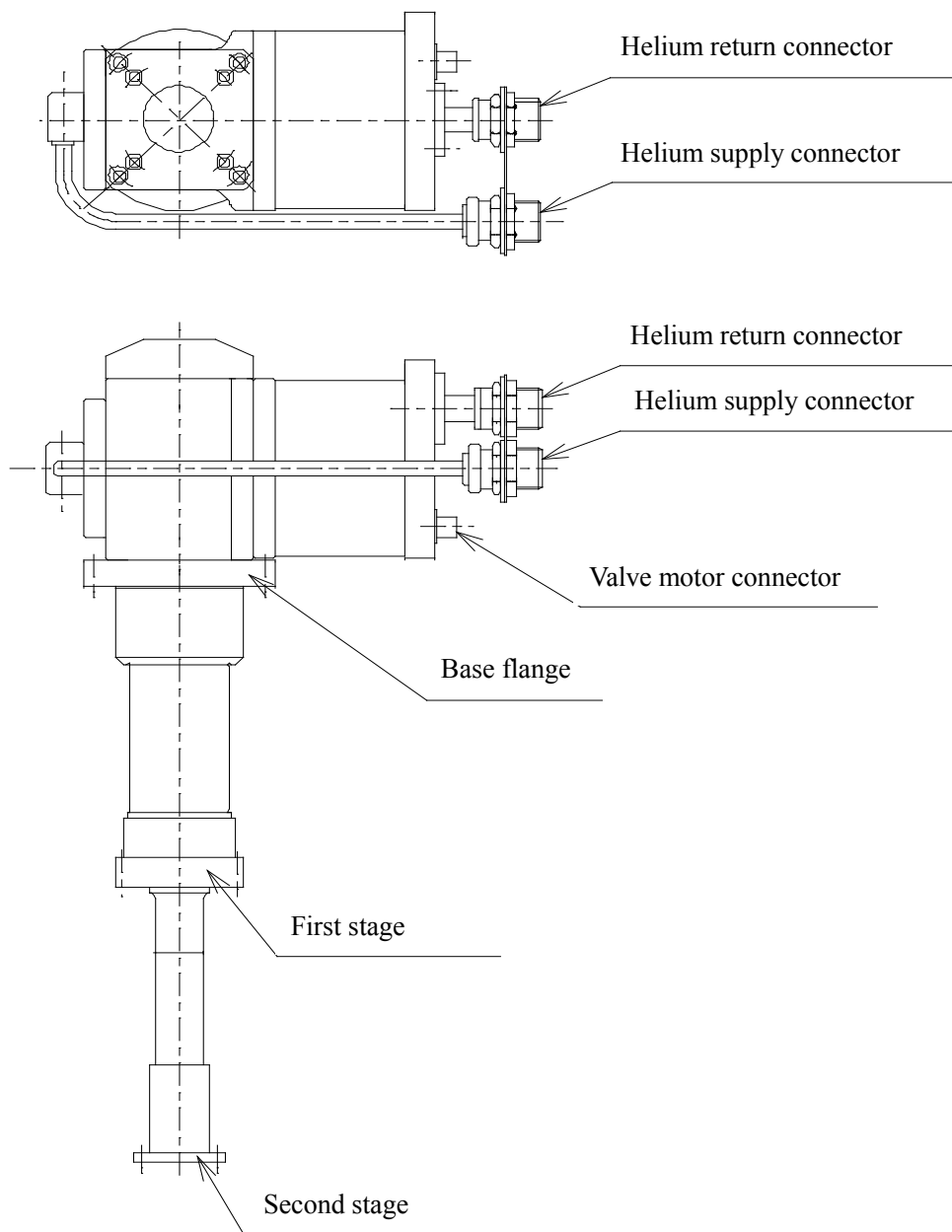
1) Compact and Light weight

As the coldhead is compact, it is easy to incorporate into cryostats.

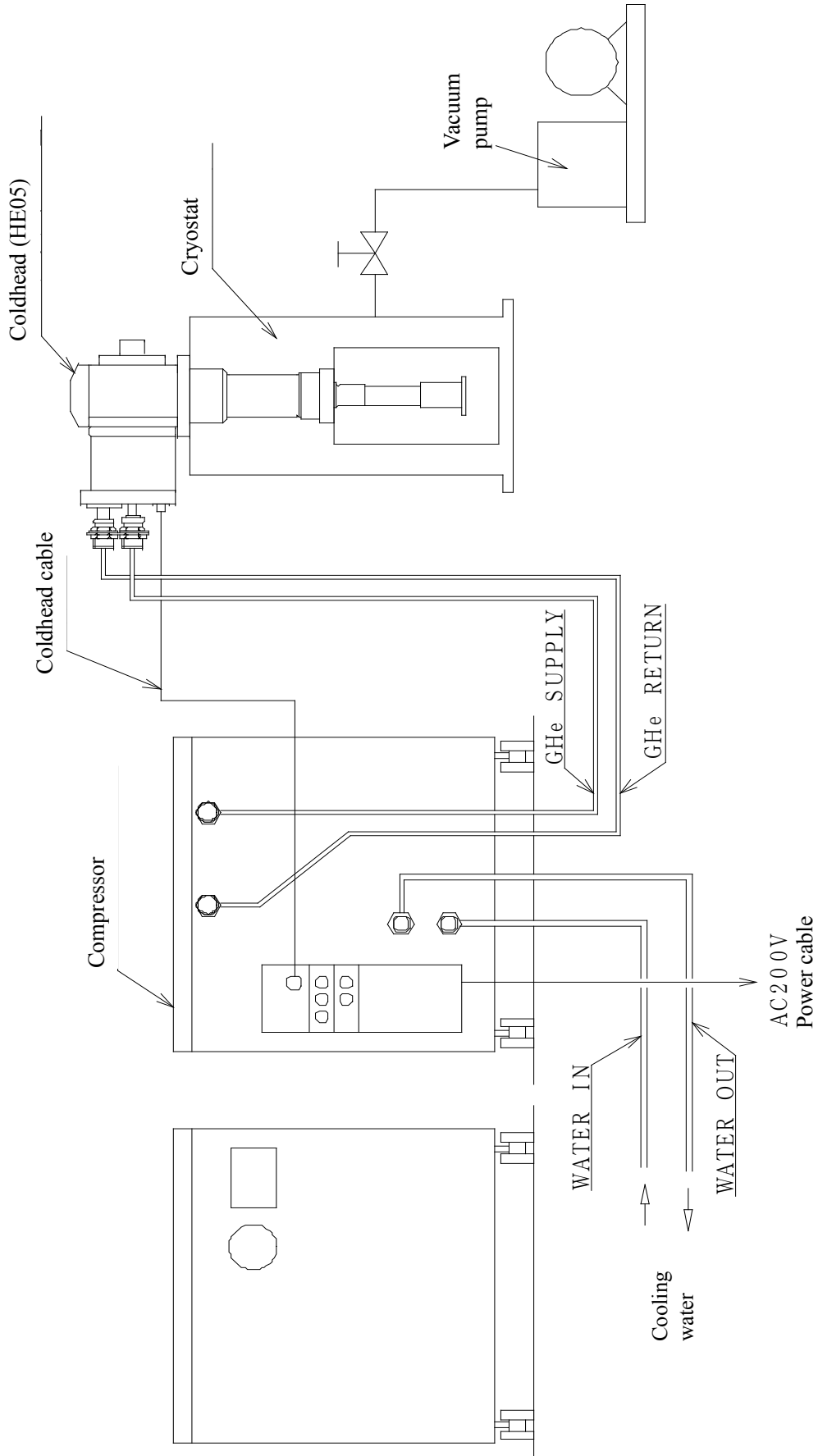
2) Orientation independent

The cryocooler can be installed in any orientation.

## 4. Component Description



### 5. Flow Diagram



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## 6. Specifications



### 6.1 4K Cryocooler Specifications

Model	: HE05
Ultimate Temperature	: Second stage 2.7K (60Hz, 50Hz)
Refrigeration Capacity	: Second stage 0.5W / 4.2K (60Hz, 50Hz) First stage 10W / 40K (60Hz) 10W / 45K (50Hz)
Cool Down Time	: To 4.2K, No load at 2nd stage Approx. 60min (60Hz) Approx. 75min (50Hz)
External Dimensions	: 146(W) x 282(D) x 495(H)
Weight	: 11kg
Ambient Conditions	: Temperature 10°C - 35°C, Relative humidity 85% or below Vacuum level when using the cryostat 0.1Pa or below at startup
Power Source	: Supplied by compressor



## 7. Installation

### 7.1 Installation

- 1) Install this system indoors, on a clean site free of dust.
- 2) The power source should be located close to the equipment.
- 3) The site should be free from direct sun light and well ventilated.

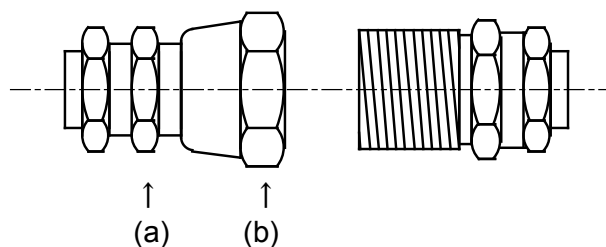
		<b>WARNING</b>
<p>High voltage is applied to the system's power source that can cause serious injuries or electrocute. It is extremely dangerous to touch charging areas inside. Ensure to turn off the power supply before conducting installation, maintenance, or repair works. Ground wire must be connected to the grounding of power source breaker. D-class grounding work is required.</p>		

### 7.2 Flexible Hoses Connections

		<b>WARNING</b>
<p>Danger of explosion exists. Do not dispose to corrosive gases. High pressure helium gas is contained inside this system. Make sure to release the gas when disassembling or disposing. It is not required to release gases at regular maintenance. Never install the system in the atmosphere of corrosive gases such as hydrochloride or chlorine gases. Never twist flexible hoses. The bend radius must be larger than 200mm.</p>		

Both ends of the flexible hoses are self-sealing couplings. Helium gas is enclosed inside. The procedure to connect is as follows;

- 1) Follow the labels on the flexible hoses to connect properly.  
 High pressure side:           SUPPLY  
 Low pressure side:            RETURN
- 2) Support the flexible hose with hands to keep it parallel with the coupling, and fasten the hexagon cap nut (b) with hands until it is firm.
- 3) Fix the hexagon part of (a) with the attached smaller wrench, and fasten the cap nut (b) with the larger wrench rotating clockwise. When there is a slight hit, the connection is completed. Then, fasten a little further. Do not forcibly connect as it may damage the equipment.



## 7.3 Cryocooler and Compressor Connections

Follow the steps below to connect flexible hoses.

- 1) Check that there is no dirt on the connection part, and the gasket has no damage.
- 2) Connect flexible hoses to the helium connectors on the compressor.

Connect the supply flexible hose labeled SUPPLY to the helium supply connector on the compressor.

Connect the return flexible hose labeled RETURN to the helium return connector on the compressor.

- 3) Connect the return flexible hose labeled RETURN to the return connector on the cryocooler.
- 4) Connect the supply flexible hose labeled SUPPLY to the supply connector on the cryocooler.
- 5) Check the pressure gauge of the compressor to confirm the helium pressure is within the appropriate range of 1.70 to 1.80MPa after connecting flexible hoses. If gas leaks during the connection work, the charge pressure declines after the connection is completed. Add helium gas if the pressure is lower than the appropriate range.

When the helium pressure is lower than the above appropriate range although the connection is successful, there may be helium leakage in compressor unit, flexible hoses or cryocooler. Conduct the leak check in such a case.



### CAUTION

When connecting flexible hoses to the cryocooler, make sure to follow the order of above 3) and 4), from RETURN coupling first. If the connection is made in an opposite manner, the valve inside the cryocooler may float, resulting in failure.



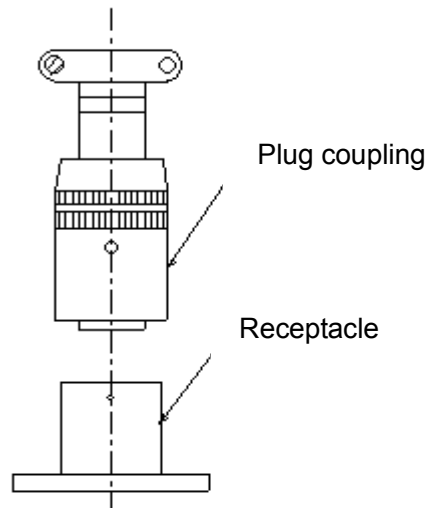
### CAUTION

Be sure to connect the flexible hose to the compressor first, and then connect to the cryocooler as in steps 2), 3) and 4).

#### 7.4 Connecting Coldhead Cable and Connector

##### 1) When connecting

As shown in the figure below, join the plug keys to the grooves of receptacles and push plug coupling into the receptacle while turning the coupling clockwise.



##### 2) When removing

Turn the plug coupling counterclockwise to remove easily.



#### CAUTION

Do not overtighten the fittings as it may result in damage.

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## 8. Operation

### 8.1 Checks prior to the operation

Make sure that the following conditions are met before starting operation.

- 1) The main power source on the compressor is connected correctly.
- 2) The coldhead cables and flexible hoses are connected properly. Refer to 7.3 "Cryocooler and Compressor Connections" steps 3) and 4) for the connection procedure of flexible hoses.
- 3) Helium charge pressure of the compressor unit is within the range of 1.70 to 1.80 MPa.
- 4) The compressor cooling water flows as required.

### 8.2 Start up and shut down

#### 8.2.1 Startup operation

- 1) Press the ON/OFF button on the compressor.  
The compressor and cryocooler (HE05) start up and cooling takes place.

#### 8.2.2 Shut down

- 1) Press the ON/OFF button on the front panel of the compressor. The button illuminates while the compressor is running.  
When an alarm status happens, the compressor stops automatically.  
Refer to the compressor unit instruction manual for the information on each alarm.



### CAUTION

Never attempt to remove flexible hoses immediately after shutting down. By doing so, helium gas of cryogenic temperature inside the cryocooler expands as the temperature rises, resulting in sudden rise of the inner pressure which may invite danger.

Remove flexible hoses after confirming that the inside of the cryocooler returns to room temperature.



## 9. Maintenance

### 9.1 Daily Maintenance

Conduct daily maintenance as follows;

- 1) Check that the operating sound is normal.
- 2) Check that the helium static pressure is within the range of 1.70 to 1.80 MPa.

### 9.2 Scheduled and Unscheduled Maintenance

Refer to the table below for the suggested maintenance schedule.  
It may vary depending on the ambient conditions or frequency of use.

**Table 9-1 Maintenance Intervals**

Action	Content	Maintenance Intervals
Scheduled Maintenance	Adsorber replacement	Refer to the instruction manual of the compressor unit.
	Coldhead maintenance (O-ring, seal, etc.)	Every 10,000 hours (The interval may vary depending on the operating conditions.)
Unscheduled Maintenance	Adding helium gas	When the charge pressure decreases
	Replacing other parts	At appropriate intervals
Inspections	Electrical system, Pipings	Every two years

NOTE: The displacer may be deteriorated faster if a coldhead is repeatedly warmed up to above 50°C. It is recommended to perform maintenance works with shorter intervals.

## 10. Troubleshooting

Problem	Possible Cause	Corrective Action
No working sound	Coldhead cable is not connected	Connect properly
	Flexible hoses are not connected	Connect properly
	Flexible hose has been connected from the SUPPLY side.	Please contact us.
	SUPPLY and RETURN sides of the flexible hoses are connected conversely. (If the connection is made in this state, the compressor may not work properly even after connecting correctly.)	Return the compressor to the proper connection and start operation. If the system does not operate normally, please contact us.
	The circuit protector or fuse of the compressor is blown	Follow the instruction manual of the compressor.
	The compressor power cable is not connected, or the connection is wrong.	Connect the compressor power cable. The system does not startup when the phase connection is wrong. Check and connect each phase properly.
	Motor failure	Please contact us.
Coldhead does not cool down despite the working sound.	Helium pressure drop due to the helium leakage of the compressor.	Refer to the compressor instruction manual and add helium gas.
	Coldhead maintenance time is approaching	Check the elapsed time meter of the compressor. Maintenance work is required after 10,000 hours of operation. Please contact us.
	Contamination inside the system	Possible causes may be the life of oil adsorber of the compressor or contamination of the flexible hoses. Please contact us.
	The ambient temperature is above 35°C, exceeding allowable range and the cooling is not possible.	Bring down the ambient temperature to below 35°C.

Coldhead does not cool down despite the working sound.	Initial vacuum level of the chamber is not sufficient.	Check the vacuum level of the chamber. If the level is not sufficient, pump the refrigerator chamber. If the vacuum level is not improved, there can be leakage in the chamber itself.
	Other coldhead failure	Please contact us.
Coldhead performance declines.	Vacuum level of the chamber declines.	Check the vacuum level of the chamber
	Coldhead maintenance time is approaching	Check the elapsed time meter of the compressor. Maintenance work is required after 10,000 hours of operation. Please contact us.
	Coldhead failure	Please contact us.
Abnormal sound is heard.	Coldhead failure	Please contact us.

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## 11. Standard Accessories

### 11.1 Standard Accessories

The table below shows the standard accessories.

No	Name	Volume	Notes
1	Helium flexible hoses	1 each	SUPPLY 15A x 5m RETURN 20A x 5m
2	Coldhead cable	1	5m
3	Device fitting bolt	2	For attaching cold head.
4	Instruction Manual	1	For HE05

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## 12. Warranty

### 1. Gratis warranty period and Warranty coverage

#### **Gratis warranty period**

Gratis warranty period is one year starting from the date of delivery.

#### **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.

- (i) Breakdowns due to improper storage or handling, careless accident, software or hardware design by the customer.
- (ii) Breakdowns due to modifications of the product without consent of the manufacturer.
- (iii) Breakdowns due to maintenance of the product without authentic parts or breakdowns resulting from using the product outside the specified specifications of the product.
- (iv) Breakdowns due to contamination or corrosion caused by user's use conditions.
- (v) 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.
- (vi) Breakdowns that are outside the terms of warranty.
- (vii) 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. Exclusion of opportunity loss from warranty liability

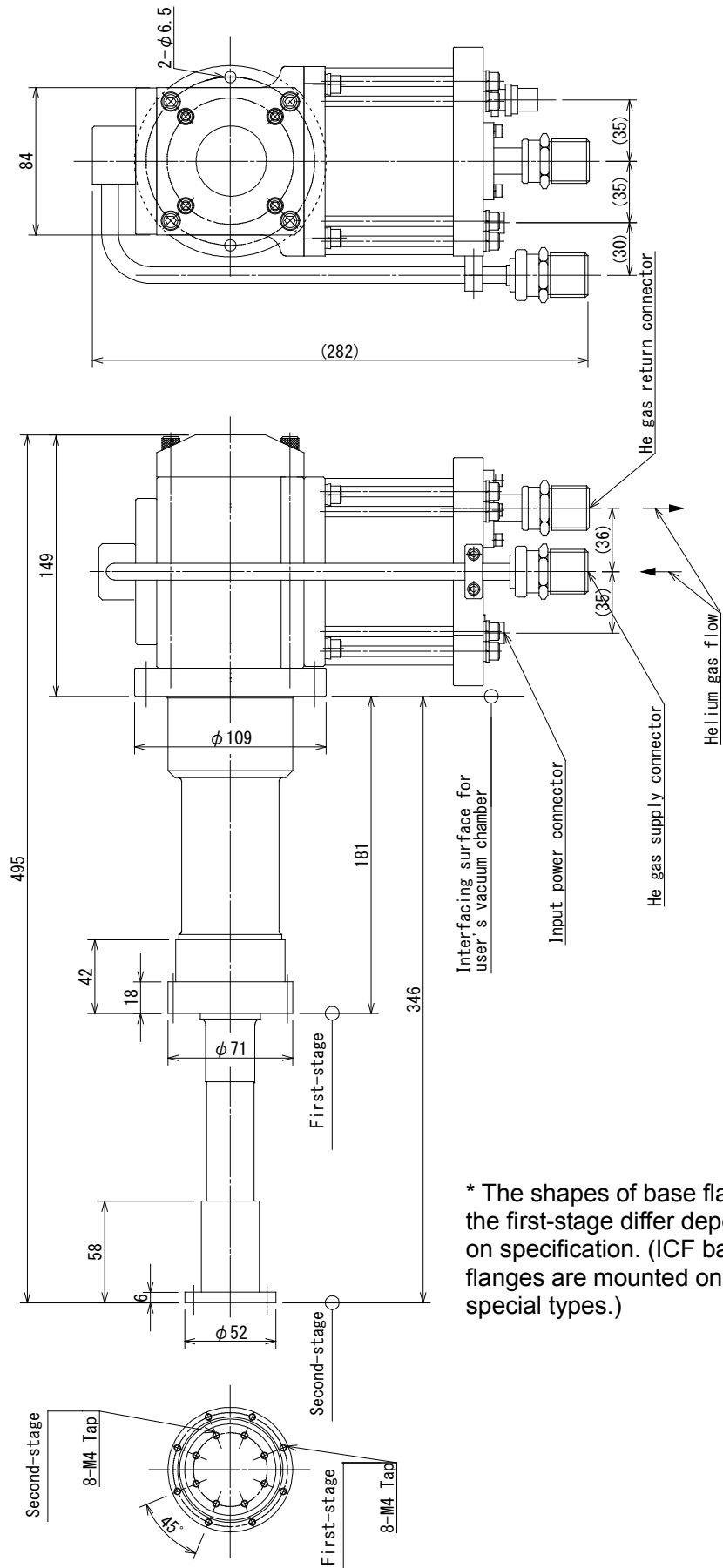
Regardless of the gratis warranty term, compensation to opportunity losses incurred to your company or your customers by failures of ULVAC CRYOGENICS products and compensation for damages to products other than ULVAC CRYOGENICS products and other services are not covered under warranty.

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

[Manufacturer] ULVAC CRYOGENICS INCORPORATED

For our contact information, refer to “**SERVICE NETWORK**” on the back of this document.

### 13. External Dimensions



\* The shapes of base flange or the first-stage differ depending on specification. (ICF base flanges are mounted on special types.)

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## SERVICE NETWORK

- For technical support, servicing or additional contact information, visit us at [www.ulvac-cryo.com](http://www.ulvac-cryo.com).

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**Revision History**

Date	Revision No.	Contents
2016 / 03 / 15	2016.03	First edition
2016 / 09 / 09	2016SR01	"Disposal Consideration" has been added.
2016 / 12 / 26	2016DR02	Helium charge pressure has been changed.
		"9. Maintenance" The table has been changed.
2017 / 12 / 14	2017DR03	"6. Specifications" has been modified.

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