

EYELA

FREEZE DRYER

Model FDU-1110(220V)
Model FDU-2110(220V)

Instruction Manual

This manual contains important matters to maintain the functions and to use this product safely.



Important

**Be sure to read “Safety Precautions”
carefully before use.**



Keep this manual with care near the product for quick reference.

Safety Precautions

1. Signal Words for Warnings

This product has a certain section that may cause unexpected injury if contacted in a way other than specified during operation, or misused. However, if you know such risks in advance, you can avoid most of accidents.

Therefore, important safety information on the matters to be noted is defined as follows and indicated with the following alert symbols and signal words. Be sure to follow these instructions and use the product safely.

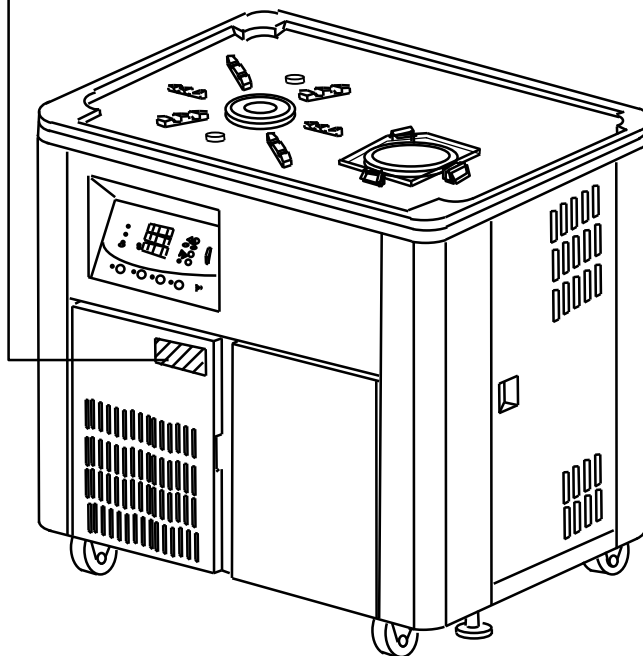
Alert Symbols Signal Words	Definition
 WARNING	Indicates a potential hazardous situation in which mishandling will result in death or serious injury of the user.
 CAUTION	Indicates a potential hazardous situation in which mishandling will result in minor or moderate injury of the user or damage to the property.

Though we have given enough considerations to almost possible hazards during the product use, it is still very difficult to anticipate all of the possible hazards. Therefore, precautions described in this manual may not cover these hazard completely. However, if you follow the instructions in this manual, you can operate the product and perform your tasks more safely.
Be sure to use the product with special care to avoid accidents and product failure.

2. Caution Label on the Product

The caution label that is important especially is attached to the main body of the product. This label is located as in the figure shown below. Follow the instruction on the label with care during the product usage.

* If the caution label become illegible due to damage on them, replace it with the new one. Contact us for spare labels.



Thank you very much for purchasing our **EVELA** product

Introduction

This instruction manual describes the installation, operation, troubleshooting, maintenance and disposal for the Freeze-dryer, Models FDU-1110 and FDU-2100.

Before using this equipment, be sure to read and understand this manual thoroughly.

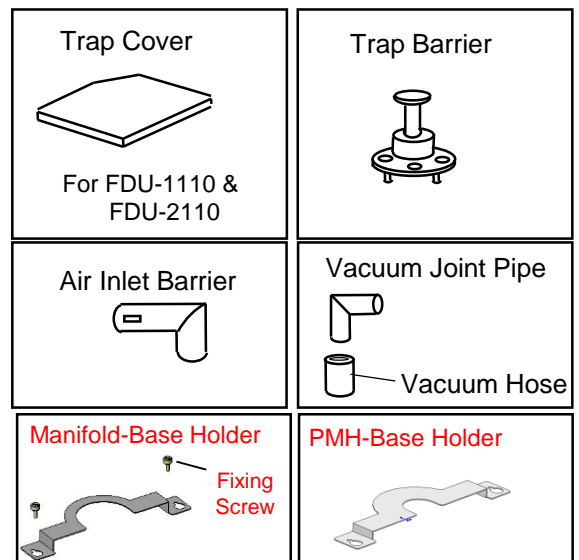
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Items in Package

Before assembling the product, check the types and quantities of the component parts in the package.

Nos.	Parts Names	QTY
1	Main Body	1
2	Trap Cover	1
3	Trap Barrier	1
4	Air Inlet Barrier	1
5	Vacuum Joint Pipe	1
6	Vacuum Hose (Inner 18DIA)	1
7	Fuse (3.15 A) (Spare)	1
8	Manifold-Base Holder	1
9	Fixing Screw	2
10	PMH-Base Holder	1
11	User's Manual	1
12	Guarantee	1



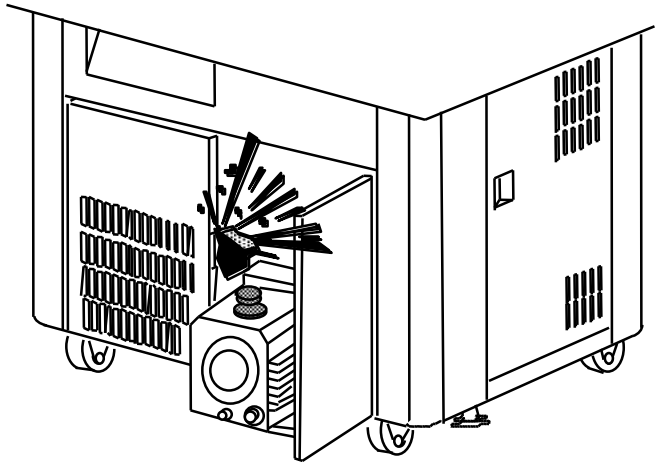
NOTE Check attached parts inside the cold trap and main body.

Since this product is not constructed as an explosion-proof equipment, handle the product with special care for safety.

Be careful of vaporization of specimen such as organic solution and others which contain flammable material.

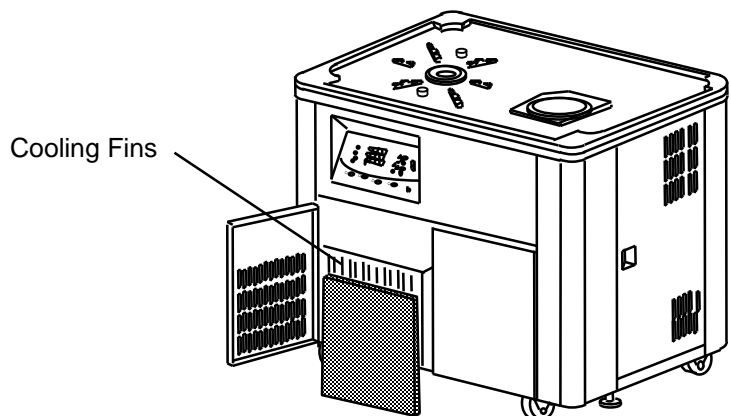
Use extreme caution about vaporization of flammable material such as organic solvent and others. If any solvent not trapped enters into the vacuum pump, it can be ignited and burnt.

- Pre-freeze the container for specimen.
- Never start the vacuum pump before inner walls of Cold Trap has been cooled enough.
Install the container only when the trap has been vacuumed completely.
- Replace the oil in the vacuum pump regularly.



Do not touch the cooling fins with bare hands

Never touch the cooling fins with bare hands during maintenance. Sharp edges of the fins may hurt user's hands.



2 Description of Product

2-1 Application



WARNING

Do not modify the product. Use the product for the intended purpose only.

If you modify the product or use it for purposes other than the intended, it may result in electric shock or equipment failure.

This product is usable for drying dilution or solution such as protein or enzyme. Moreover, the product can be used for drying biological specimens such as extracted solution, urine, blood serum and others.

2-2 Product Specifications

Product Name		Freeze Dryer	
Model No.		FDU-1110	FDU-2110
Cooling System		Vessel cooling system	
Performance	Trap Cooling Temp.	-45° C	-80° C
	Amount of Dehumidification	4 liters/each time	3 liters/each time
Functions	Trap Ice-melting Function	Ice-melting function using hot gas	
	Other Functions	Control of vacuum pump, display for availability of freeze dry	
Components	Refrigerating Machine	600 W	500 W x 2
	Refrigerant	R404A	R404A, R23
Ratings	Displacement of Vacuum Pump	100/120 L/min (50/60 Hz) or more (option)	
	Vacuum Gauge	Pirani Vacuum Gauge	Indication accuracy at 0.4 to 4.0 Pa ±2.0 Pa at 4.1 to 10.0 Pa ±3.0 Pa at 10.1 to 15.0 Pa ±4.0 Pa at 15.1 to 40.0 Pa ±7.0 Pa
	Dimension of Trap (mm)	Inner diameter: 200, height: 300	
	Plug Socket	100 V AC, Max. 3 A	
	Output of Recorder *2	Temp. on trap: 1° C/1 mV	Vacuum: 1 Pa/1 mV
Room Temperature Range		5 to 35° C	
Outer Dimensions *3		700(W) x 550(D) x 930(H)	
Weight		Approx. 100 kg	Approx. 140 kg
Power Supply Input *4		7.7A, 1.7 kVA	5.5A, 2.4 kVA
Rated Power Supply		AC220 V ±5%, single phase, 50/60 Hz	

*1. The values are based on the following conditions: Room temperature at 20 ° C, no load

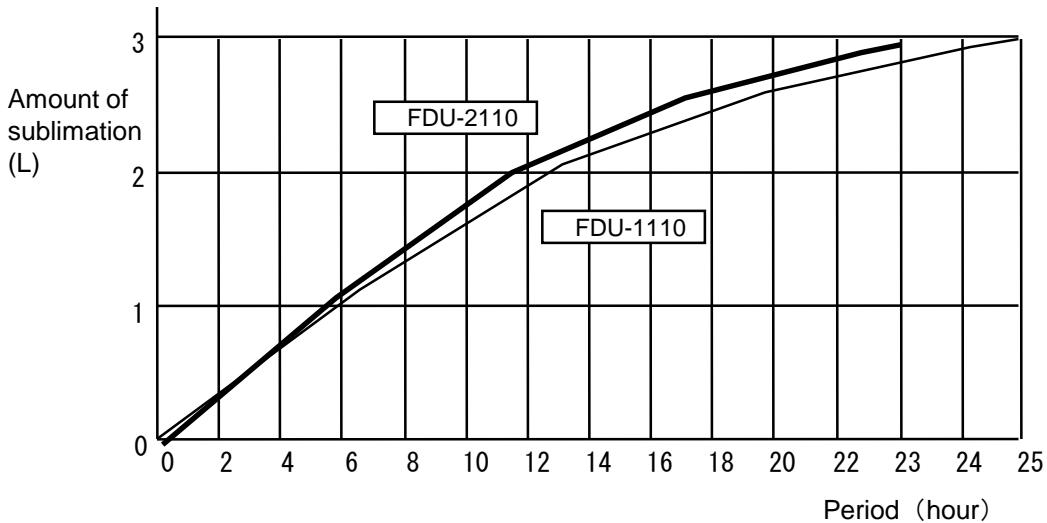
*2. Contact Tokyo Rikakikai about the connecting-cord specified for the recorder in FDU Series with no charge.

*3. Projections are not included in outer dimensions.

*4. Capacity of plug socket is not included in the value of rated power supply input.

2-3 Data for Progress of Sublimation (Informative)

Models FDU-1110 and FDU-2110



Conditions

■ Model FDU-1110

- 6 pieces of flask for specimen, which contain water of 500 cc (pre-frozen) are mounted on the trap. And amount of sublimation is calculated backward based on remaining amount of water in flasks along with time passage.
- Input voltage: AC220 V , 50 Hz
- Room temperature: 20 ° C

■ Model FDU-2110

- 8 pieces of flask for specimen, which contain water of 375 cc (pre-frozen)) are mounted on the trap. And amount of sublimation is calculated backward based on remaining amount of water in flasks along with time passage.
- Input voltage: AC220 V , 50 Hz
- Room temperature: 20 ° C

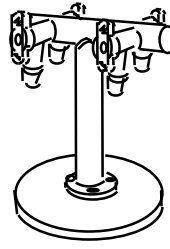
- Progress of sublimation depends on conditions in use such as room temperature, capacity and shape of specimen container (round-bottom flask or bottle), characteristic and amount of specimen, and condition of pre-freezing..

2-4 Option

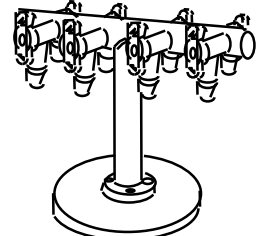
■ Manifold for Flask

T-shaped manifold made of stainless material. 4 ports for mounting specimen-container are provided for Model PMH-4, and 8 ports for PMH-8. Several specimens can be freeze-dried at the same time using multiple port for specimen container.

Models	Code Nos.
PMH-4	119820
PMH-8	119830



PMH-4

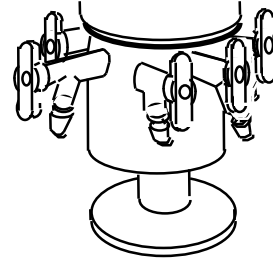


PMH-8

■ Port for Round-bottom Flask

Round-bottom flask made of stainless material. 9 ports for mounting specimen-container are provided for Model PMH-1000. Inside of manifold is washable.

Models	Code Nos.
PMH-1000	197440



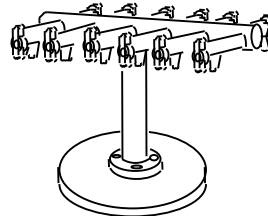
PMH-1000

■ Manifold for Test Tube, Ampul, and Vial Container

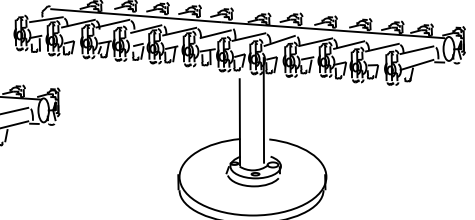
T-shaped manifold made of stainless material. 12 ports for mounting specimen-container are provided for Model PMH-12, and 24 ports for PMH-24. Several specimens can be freeze-dried at the same time using multiple port for specimen container.

* Appropriate adaptors are required to use ampul and test tube respectively.

Models	Code Nos.
PMH-12	119790
PMH-24	119810



PMH-12

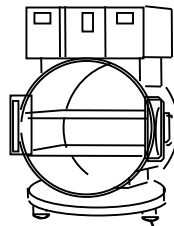


PMH-24

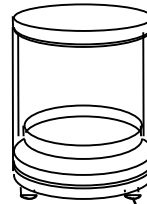
■ Dry Chamber

Performs freeze-drying using vial container or petri dish.

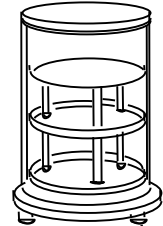
Models	Code Nos.
DRC-1N	119730
DRC-2L	119750
DRC-3L	119770



DRC-1N



DRC-2L



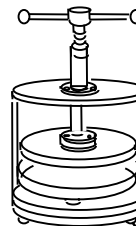
DRC-3L

* To use this device incorporating into the product, remove the base legs.

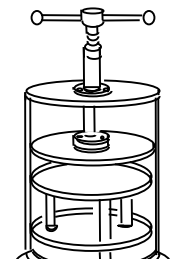
■ Confining Dry Chamber

The top shelf can be confined after freeze-drying is completed. The rest of the shelves can be used as dry chamber.

Models	Code Nos.
BSC-2L	119790
BSC-3L	119810



BSC-2L

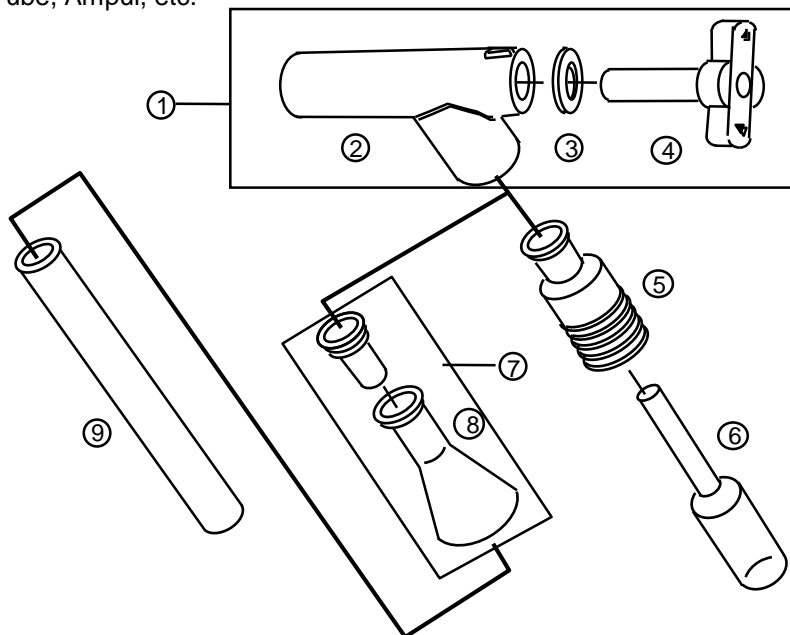


BSC-3L

Base Leg

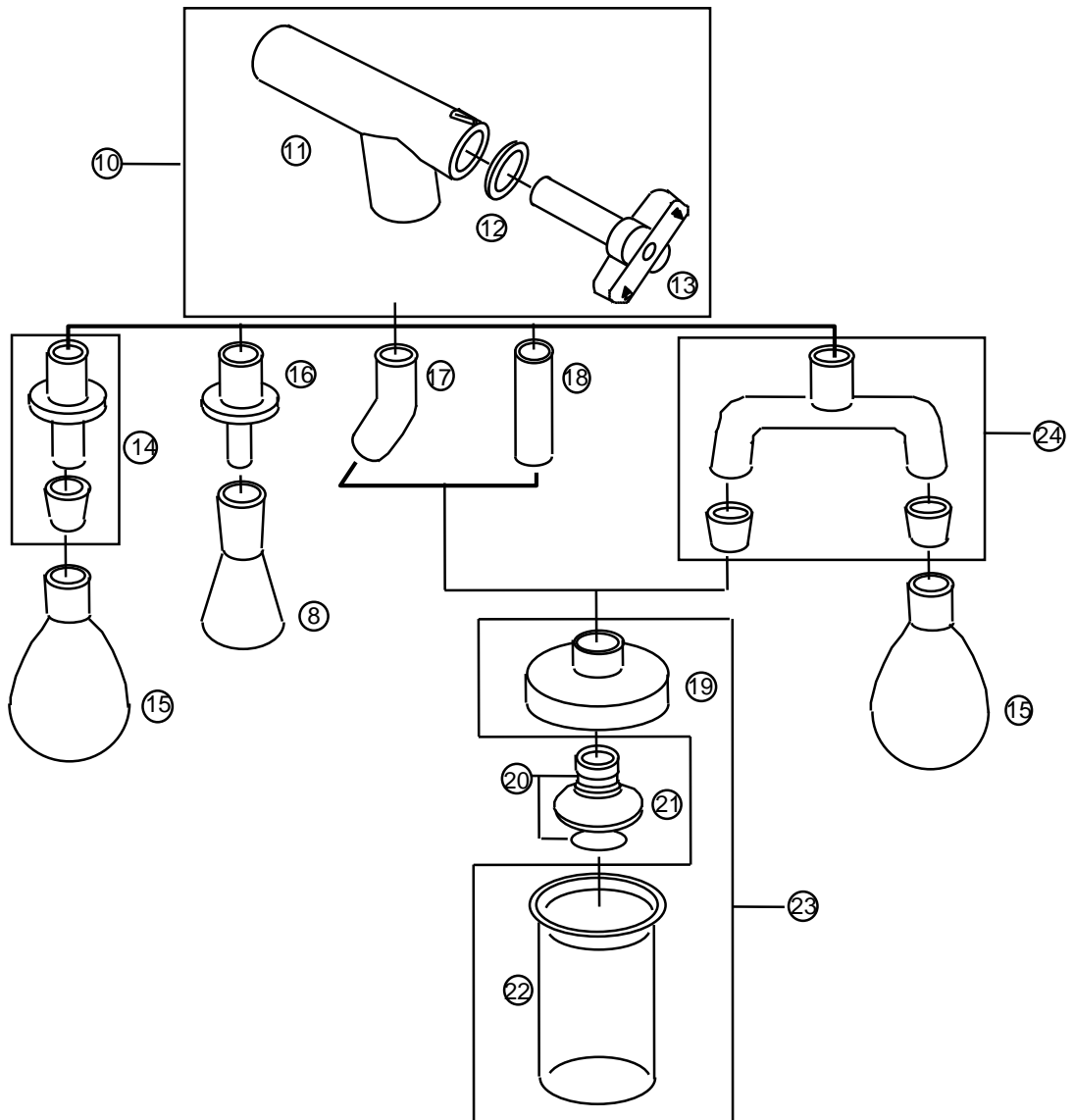
* To use this device incorporating into the product, remove the base legs.

■ Cock B, Test Tube, Ampul, etc.



Nos.	Parts Names	Specifications	QTY	Code Nos.
1	Cock B		1	119930
2	Vacuum Cock Body B		1	144480
3	Liner B		10	143960
4	Vacuum Cock B		5	144490
5	Adapter for Ampul	For Ø8	1	120520
		For Ø6	1	120530
6	Ampul	Eggplant Type (1 mL)	20	120210
		Pencil-type with round bottom (1 mL)	20	120220
		Pencil-type with flat bottom (1 mL)	20	120221
		Flat Bottom (2 mL)	20	120230
		Flat Bottom (5 mL)	20	120240
		Flat Bottom (10 mL)	10	120250
		Round Bottom (2 mL)	20	120260
		Round Bottom (5 mL)	20	120270
		Round Bottom (10 mL)	10	120280
7	B-type Adapter for Test Tube		1	120510
8	Sealing		1	145610
9	Test Tube for Rim	Ø10 x 75 (3 mL)	100	143970
		Ø12 x 75 (4 mL)	100	143980
		Ø 12 x 90 (5 mL)	100	143990
		Ø 12 x 105 (6 mL)	100	144000
		Ø 12 x 120 (7 mL)	100	144010
		Ø 13 x 75 (5 mL)	100	144020
		Ø 13 x 90 (6 mL)	100	144030
		Ø 13 x 100 (7 mL)	100	144040
		Ø 15 x 85 (8 mL)	100	144050
		Ø 15 x 105 (10 mL)	100	144060
		Ø 15 x 150 (15 mL)	50	144070
		Ø 16.5 x 105 (12 mL)	100	144080
		Ø 16.5 x 165 (20 mL)	50	144090
		Ø 18 x 165 (24 mL)	50	144100
		Ø 18 x 180 (27 mL)	50	144110
		Ø 21 x 200 (42 mL)	50	144120

■ Cock D, Freeze-dry Bottle, Flask, etc.



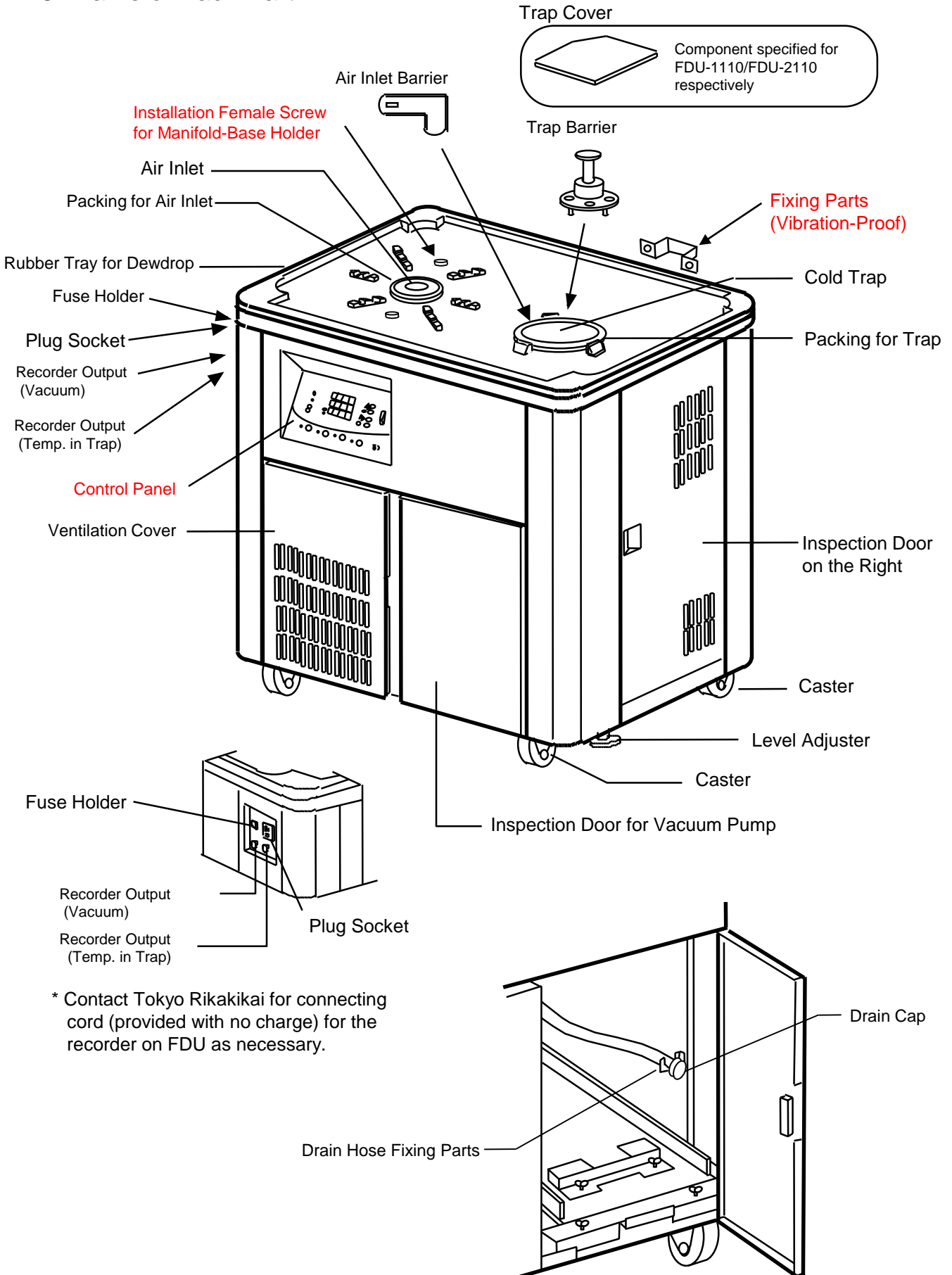
Nos.	Parts Names	Specifications	QTY	Code Nos.
10	Cock D		1	209570
11	Vacuum Cock Body D		1	233480
12	Liner A		10	143950
13	Vacuum Cock D		1	233490
14	Adapter for Flask	Φ 29	1	120470
		Φ 24	1	144500
15	Flask for Specimen	50 mL Φ 29	1	116140
		100 mL Φ 29	1	116150
		200 mL Φ 29	1	116160
		300 mL Φ 29	1	116170
		500 mL Φ 29	1	116180
		1000 mL Φ 29	1	116190

Nos.	Parts Names	Specifications	QTY	Code Nos.
15	Flask for Specimen	50 mL ₹ 24	1	116220
		100 mL ₹ 24	1	116230
		200 mL ₹ 24	1	116240
		300 mL ₹ 24	1	116250
		500 mL ₹ 24	1	116260
		1000 mL ₹ 24	1	116270
16	A-type Adapter for Test Tube		1	120500
17	Adapter for Freeze-dry Bottle		2	120460
18			3	120450
19	Cap (for Adapter for Freeze-dry Bottle)	For Ø45 40/80 mL	1	120020
		For Ø70 120/150/300 mL	1	120030
		For Ø105 600/900/1200m	1	120040
20	Filter Holder		1	120100
21	Filter	100 sheets/1 box	1	120110
22	Freeze-dry Bottle	40 mL Ø45	1	120050
		80 mL Ø45	1	120060
		120 mL Ø70	1	120120
		150 mL Ø70	1	120130
		300 mL Ø70	1	120140
		600 mL Ø105	1	120070
		900 mL Ø105	1	120080
		1200 mL Ø105	1	120090
23	Freeze-dry Bottle Set	40 mL	1	119940
		80 mL	1	119950
		120 mL	1	119960
		150 mL	1	119970
		300 mL	1	119980
		600 mL	1	119990
		900 mL	1	120000
		1200 mL	1	120010
24	Multiple Serial Connection Adapter		1	120490

■ Connecting Cord for the Recorder on FDU
Connecting cord specified for FDU *No charge

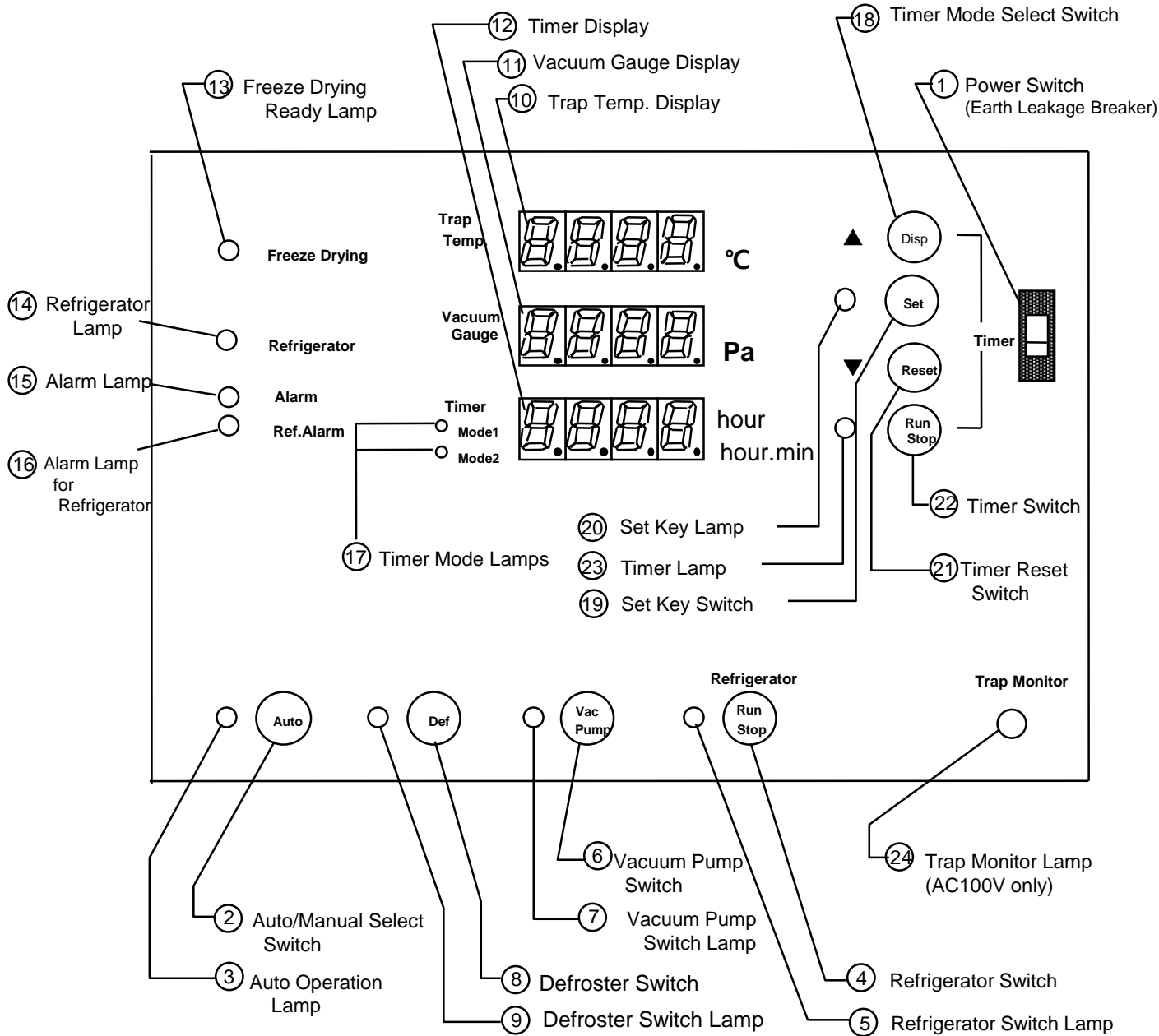
Model	Code No.
Connecting Cord for the Recorder on FDU	240170

2-5 Name of Each Part



3 Names and Functions of Operation Parts

3-1 Control Panel



Nos.	Component Names	Functions
①	Power switch	ON/OFF switch for power supply (earth leakage breaker used)
②	Auto/Manual Select Switch	Press this switch to switchover automatic/manual operation.
③	Auto Operation Lamp	This lamp is lighted when Auto/Manual Select Switch is turned ON, and Auto is selected.
④	Refrigerator Switch	When this switch is turned ON under Auto/Manual operation, the refrigerator is started. In Auto operation, at the time the trap temp. reaches -50°C , vacuum pump is operated automatically. All of the units are stopped when the switch is turned OFF.
⑤	Refrigerator Switch Lamp	This lamp is lighted when the Refrigerator Switch is turned ON.
⑥	Vacuum Pump Switch	When this switch is turned ON under Manual operation, the power will be supplied to the plug socket for vacuum pump. (Ref. 5-1 Preparation for Operation) Plug the power cord of the vacuum pump into this socket. In Auto operation, only the stoppage of the pump is feasible. When the switch is turned OFF, Manual operation is selected.
⑦	Vacuum Pump Switch Lamp	This lamp is lighted when the vacuum pump switch is turned ON, or the pump is started under Auto operation.
⑧	Defroster Switch (Press for 3 min. or more for ON/OFF)	When this switch is turned ON after the completion of freeze-drying, cooling unit is defrosted. The vacuum pump is stopped automatically.
⑨	Defroster Switch Lamp	This lamp is lighted when the Defroster Switch is turned ON. The lamp goes off when defrosting is completed.
⑩	Trap Temp. Display	Displays temperatures measured on Trap Cooling Unit.
⑪	Vacuum Display	Displays Pa value of the vacuum measured on the equipment.
⑫	Timer Display	Displays a time period of measurement by switching the operation mode.
⑬	Freeze Drying Ready Lamp	This lamp is lighted when preset conditions of trap temperature and vacuum are fulfilled in Auto operation, and mounting of the containers for specimen become feasible.
⑭	Refrigerator Lamp	This lamp is lighted when the refrigerator is started.
⑮	Alarm Lamp	This lamp is lighted when any of vacuum failure, vacuum or temperature sensor, or power-failure alarm is activated.
⑯	Refrigerator Alarm Lamp	This lamp is lighted when the overload relay in refrigerator is activated.
⑰	Timer Mode Lamps	This lamp indicates the selected mode for timer. Mode 1: Indicates a time period for operation of vacuum pump. Mode 2: Indicates a time period of measurement for stopwatch function
⑱	Timer Mode Select Switch	This switch selects a timer display Mode1 or Mode 2.
⑲	Set Key Switch	This key switch is used to enter an appropriate preset period of power failure provided as a power-failure-reset feature (factory preset value is 5 minutes). The switch is also used for releasing the alarm lamp and message, and termination of buzzing.
⑳	Set Key Lamp	This lamp is lighted when Set Key Switch is turned ON.

Nos.	Component Names	Functions
⑳	Timer Reset Switch	Press this switch for 5 seconds or more to reset the displayed period for timer.
㉑	Timer Switch	ON/OFF switch for the stopwatch feature executed by Timer Mode 2
㉒	Timer Lamp	This lamp is lighted while the stopwatch feature executed by Timer Mode 2 is active.
㉓	Trap Monitor Lamp (AC100V only)	This lamp blinks when the (optional) trap monitor sensors amount of dehumidified liquid inside the cold trap. (Refer to Trap Monitor in Sec. 2-4, Option)

CAUTION

- *1 Press the switches for vacuum pump, refrigerator, and timer for 3 seconds or more respectively to stop the equipment.
- *2 Press the Defroster Switch for 3 seconds or more for executing ON/OFF operation.
- *3 Press the Timer Reset Switch for 5 seconds or more for executing reset operation.

3-2 Safety Function

This product has the safety functions, and displays alarm messages as described in the table shown below.

When any trouble is occurred, refer to Sec. 6, “Troubleshooting” and take appropriate measures.

Safety Functions

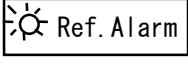
Safety Devices	Functions	Causes of Activations
Earth leakage Breaker	When activated, the breaker is turned off to cut the power supply.	<ul style="list-style-type: none"> • Electric leakage or over-current occurred
Safety Valve for Vacuum Pump (Leak Valve)	This valve prevents the oil contained in the pump flows into the vacuum system where the valve is opened, and the system is subjected to the air.	<ul style="list-style-type: none"> • Activated where the operation of the pump is interrupted by any power failure or accident during experiment. • Activated where freeze-drying is completed, thus Auto operation is terminated. Or defrosting is completed. • Activated where freeze-drying is completed, and then the pump is stopped by manual operation.
Overload relay in Refrigerator	This feature stops the refrigerator and turns off the Defroster Switch Lamp. Also, the power to the plug socket is cut off.	<ul style="list-style-type: none"> • Ambient temperature is too high. • Refrigerator filter is clogged. • Too many specimens are mounted at once. • Refrigerator starts (operates) under overload • Fan for the refrigerator does not operate • Low power supply voltage
High Pressure on Refrigerator Switch	This switch stops refrigerator and turns off the Defroster Switch Lamp. Also, the power to the plug socket is cut off.	<ul style="list-style-type: none"> • Ambient temperature is too high. • Refrigerator filter is clogged. • Too many specimens are mounted at once. • Refrigerator starts (operates) under overload • Fan for the Refrigerator does not operate
Fuse for Plug Socket	The fuse (rated 3.15 A) is blown and the power to the product is interrupted.	<ul style="list-style-type: none"> • Any device rated 3.15 A or more is connected to the equipment.
Self-diagnosis feature for Control Board	This feature detects any abnormal status of the control board. Buzzer is sounded continuously and stops the execution of control.	<ul style="list-style-type: none"> • Failure in the temperature regulator or an abnormal status due to noise emission is detected. So that execution of control is stopped totally. • Ambient temperature is too high (more than 35° C). • Noise affects adversely.

* Once the overload relay in refrigerator is activated, cool down the refrigerator until the relay recovers.

Turn on and off the power switch to restart the refrigerator.

Recovery time for the overload relay depends on conditions in use, so that it differs 3 to 40 minutes

Alarm Functions

Alarm Messages	Displays	Alarm Operations	Causes of Alarms
Refrigerator Alarm	 • Trap Temp. Display blinks measured temp. value.	Ref. Alarm Lamp is lighted, and the buzzer is sounded for 10 sec., Consequently, the whole operation will be stopped.	<ul style="list-style-type: none"> • Holding circuit for overload relay on refrigerator is activated.

Alarm Functions

Alarm Messages	Displays	Alarm Operations	Causes of Alarms
Detection of malfunction in guidewire of temp. sensor	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;">0000</div> Lit Trap Temp. Display Alarm	Alarm lamp is lighted, and "0000" is indicated on the Trap Temp. Display and the buzzer is sounded (for 10 seconds). Control is continued in manual operation. In Auto operation, the mode is switched into Manual operation, and control is continued.	<ul style="list-style-type: none"> • Guidewire of temp. sensor has malfunction. *1
Alarm of malfunction in guidewire of vacuum sensor	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;">PrEr</div> Lit Vacuum Gauge Display Alarm	Alarm lamp is lighted, and "PrEr" is indicated on the vacuum gauge display. Then the buzzer is sounded (for 10 seconds). Control is continued in manual operation. In Auto operation, the mode is switched into Manual operation, and control is continued.	<ul style="list-style-type: none"> • Circuit of vacuum Sensor has malfunction. *1
Power failure alarm	Measured temp. ↑ Current trap temp. and "OFF" are indicated in turn. ↓ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;">oFF</div> Alarm	Alarm lamp is lighted, and current trap temp. and "OFF" are indicated in turn. Then the buzzer is sounded (for 10 seconds). The power recovers according to preset power-failure-recovery settings that had been selected.	<ul style="list-style-type: none"> • The power failed during control, or, the power was turned off without terminating control. *1
Vacuum Error Alarm	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;">PUPm</div> Lit Vacuum Gauge Display Alarm	Alarm lamp is lighted, and "PUPm" is indicated on the vacuum gauge display. Then the buzzer is sounded (for 10 seconds). Vacuum pump is stopped solely in Manual operation. In Auto operation, the pump is stopped solely, other units are switched into manual operation, and their control are continued.	<ul style="list-style-type: none"> • Vacuum range of 533 Pa or more is indicated on vacuum gauge display once. And "Atmo" is indicated for 30 min. or more. *1
Backup Battery Error Alarm	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;">CPAr</div> Lit Vacuum Gauge Display Alarm	Alarm lamp is lighted, and "CPAr" is indicated on Trap Temp. Display. Then the buzzer is sounded (for 10 seconds), and total control is stopped. * Elapsed time for model 1 is cleared. * In case of power failure, total control is stopped despite preset period for operation recovery time in power failure.	<ul style="list-style-type: none"> • Backup Battery failed or runs out * Press [Set] key to release alarm message. By doing this, normal indication recovers. However, backup function for recovery select for power failure and elapsed time for Model 1 do not operate normally.
Control Board Error Alarm	Message not specified	Total control is stopped, and the buzzer is sounded continuously. (Due to abnormal status, no message is specified) Automatic recovery is attempted.	<ul style="list-style-type: none"> • Due to noise interference or others, abnormal status occurred to the control Board. Automatic recovery cannot be executed *2

*1: To release an alarm message, clear the cause of alert, and then press [Set] key. The display returns to normal indication.

*2: Turn on the power to reset the alarm.

4 Installation

4-1. Installation Environment



WARNING

Use extreme caution about installation location, air-conditioning and ventilation

Since this product uses an air-cooled-type refrigerator, heat is discharged from the air outlet. Due to this feature, not to raise ambient temperature, provide sufficient ventilation system for the product.

Otherwise, use the product in air-conditioned space (in which ambient temp.: 5 to 35°C) appropriately.

If ambient temperature is raised, operation efficiency may be deteriorated, and cooling capacity may be dropped too.

Furthermore, operation of refrigerator under hot temperature and high pressure may result in equipment failure.

Install this product in places such as:

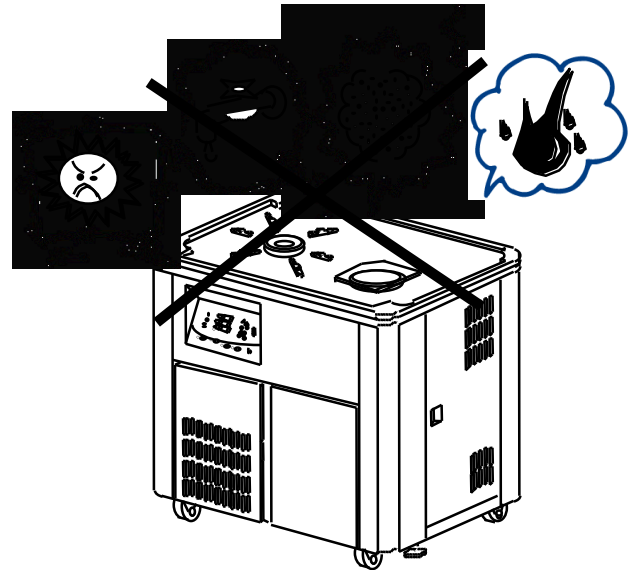
- Not subject to the direct sunlight.
- Room temperature can be maintained within 5 to 35 ° C.
- Well-vented, or venting is ensured.
- No flammable or ignitable substances, liquids, and gases placed around.
- No condensation.
- Low humidity and no splash of water.
- Little dusts.
- Horizontal, stable and solid.
(Check the weight of the product during the operation.)



CAUTION

Be careful of installation environment

If the product is installed in inappropriate environment, It may result in equipment damage in an early stage, or, insufficient exercise of its functions and performance.



4-2. Installation Conditions



CAUTION

Keep enough space around the product

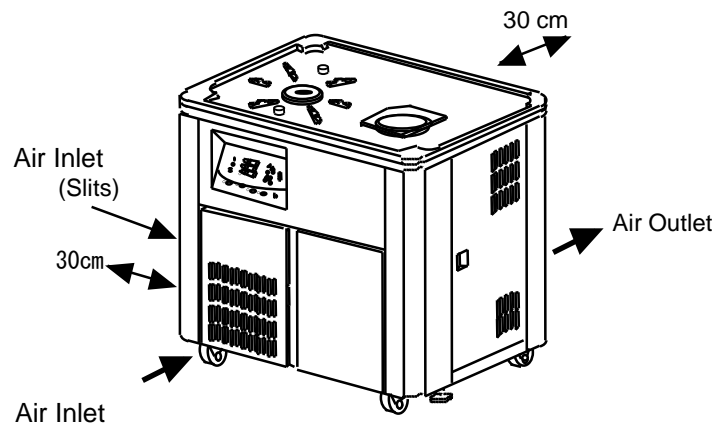
To keep the product's performance, be sure to secure the space between product and wall or ceiling, etc. as shown in the figure on the right.



CAUTION

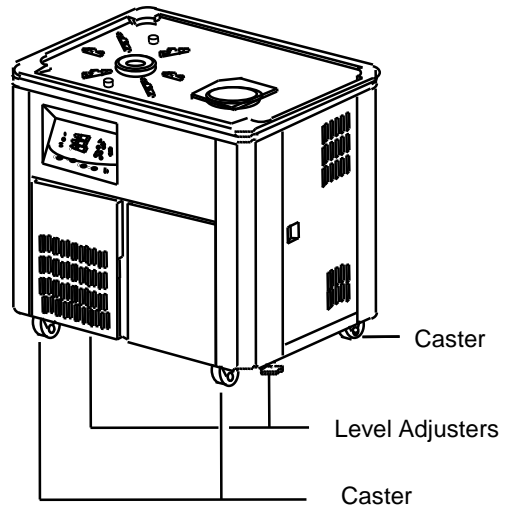
Be careful in carrying the heavy product

Model FDU-1110: Approx. 100 kg
Model FDU-2110: Approx. 140 kg



4-3. Installation Procedures

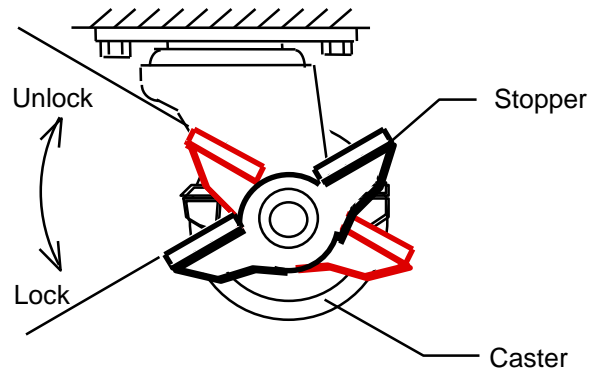
- (1) Release the lock on the caster stopper.
Push down the lever on the caster stopper to unlock it.
Make sure that the level adjusters (2 pieces) are lifted from the floor.



- (2) Move the product to the installation location.

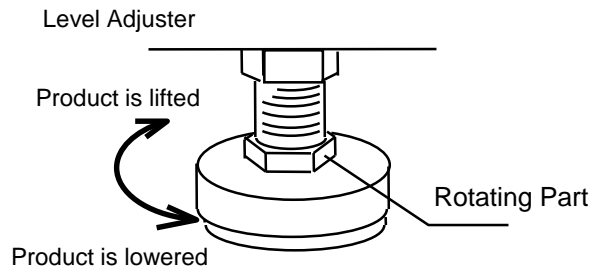
* If the product is carried on uneven ground, the caster may be damaged by excessive impact.

- (3) When the product is placed in an appropriate location, lock the caster stopper.



- (4) If the installation location has uneven level, secure the product using level adjusters.

* Be sure to stabilize the product to a level plane, or, place its front face higher than the rest with the adjusters.



4-4. Connection of Utility



WARNING

Connection should be made confirming voltage, phase, capacity, type of outlet.

Wrong power connection may cause fire or electrical shock.



WARNING

Connect earthing conductor correctly.

To prevent electrical shock, never connect the earthing conductor to the pipes for gas or water.



WARNING

Do not use split socket or power strip.

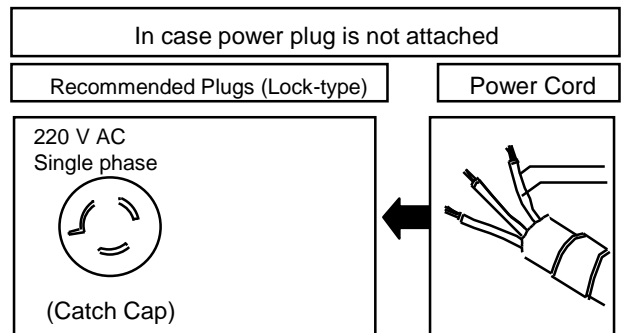
Doing so may cause overcurrent, and result in burnout of cables, or fire.

- (1) Check the model of product, voltage of mains supply to be connected, phase, and ampacity. The rating of mains supply to which the product is connected is as shown on the right.

Product Model	Power necessary for connection	
	Voltages	Ampacity
FDU-1110	AC220 V Single phase	10 A
FDU-2110	AC220 V Single phase	7 A

- (2) Note that no power plug is attached to the product.
Connect the power cord to the power board directly. Otherwise, provide the cord with the locking plug as shown in the figure on the right. Be sure to ground the earth conductor securely in either case.

When connecting the power cord to the power source, do not use split socket or power strip.



5 Operation

5-1. Preparation for Operation

1. Setting of the vacuum pump

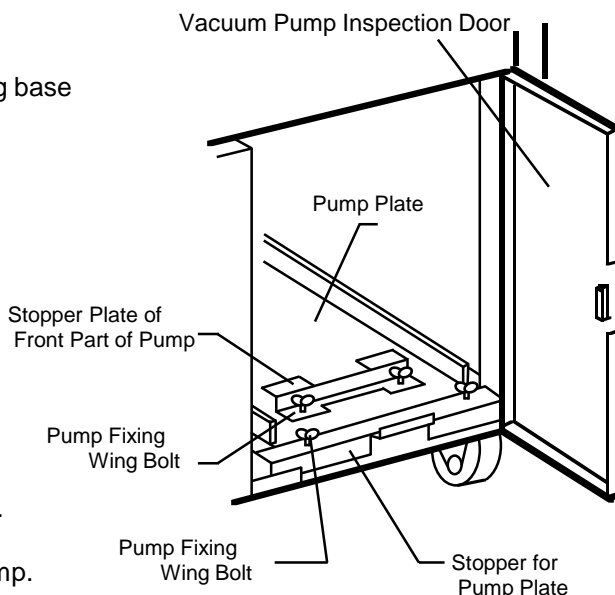
Applicable types of the vacuum pumps are GLD-136N, GCD-136XN and GLD-136CN.

Also, when using the pumps other than the aforementioned types, install the pump outside the FDU main body and use it.

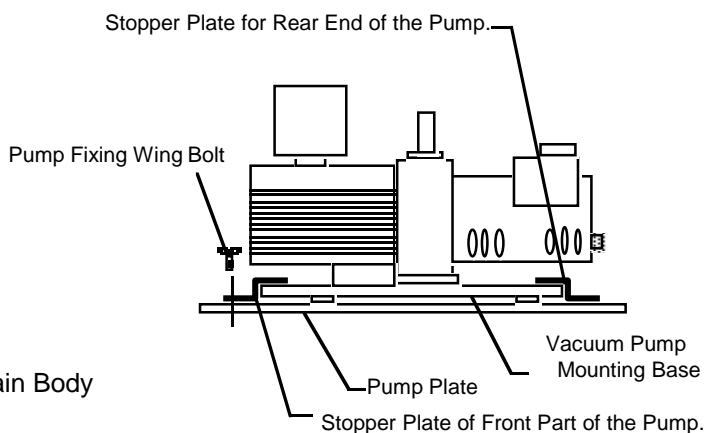
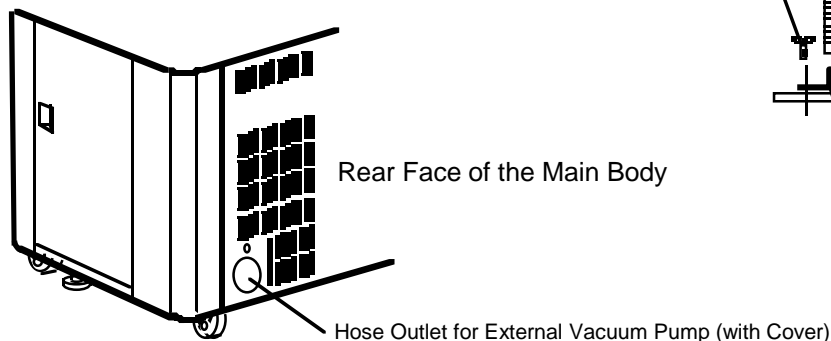
The vacuum tube can be used by drawing it from the outlet of the hose container in the back of the main body. (Refer to the figures on the below.)

In such case, for the vacuum pump, use a different power source from the main body's, then cannot drive automatically.

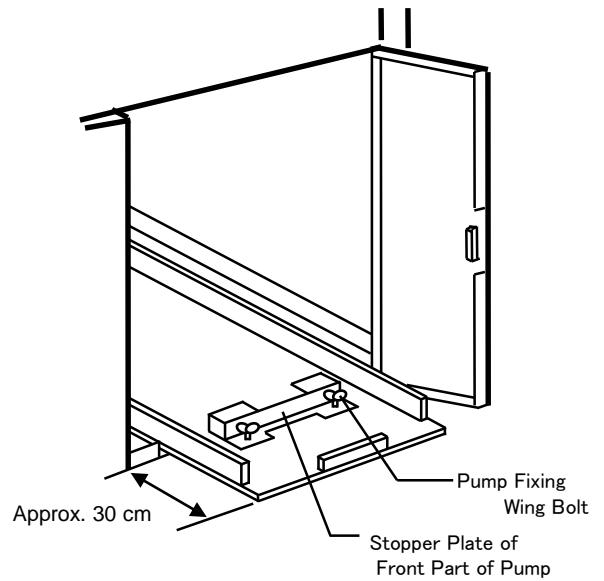
- (1) Open the inspection door for the vacuum pump
- (2) Remove the wing bolts fastening the pump mounting base and the stopper plate of its base.
- (3) Pull the pump mounting base out.
The base can be pulled out for 30 cm or so.
- (4) Remove the wing bolts fastening the pump and the stopper plate of the front part of the pump.
- (5) Mount the vacuum pump on the pump mounting base.
Make sure that the mounting base of vacuum pump is inserted into the stopper plate for rear end of the pump.



* To installed the vacuum pump outside the main body, open the outlet cover for pulling out the hose located at the rear face of the main body. And take the vacuum hose in the main body.



(6) Follow the procedure in (4) to mount the stopper plate of the front part of the pump and tighten the wing bolts to fix the pump.



(7) Follow the procedures in reverse order [(3) to (2)]. Insert the pump plate into the stoppers. Put the stopper on the plate, and tighten the wing bolts to fix the pump base,

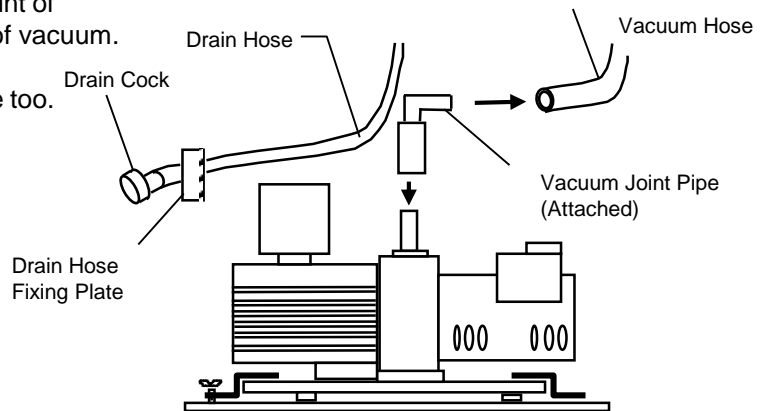
(8) Close the vacuum pump inspection door.

(9) Open the inspection door on the right side of the equipment.

(10) Connect piping of the main body side (FDU) and the vacuum pump with attached vacuum joint pipe and vacuum hose.

Pipe on the main body side (FDU)

*When fixing the vacuum pipe, put a small amount of silicone compound on the joint part for sealing of vacuum. Application of the compound will ease the work of piping, and improve the sealing performance too.

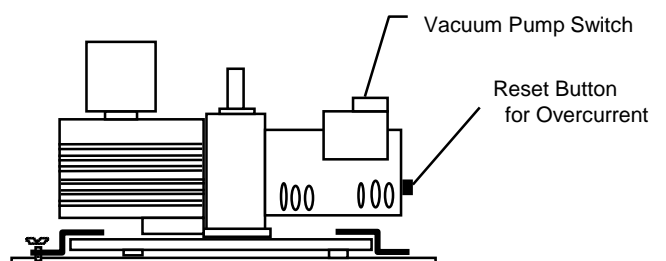
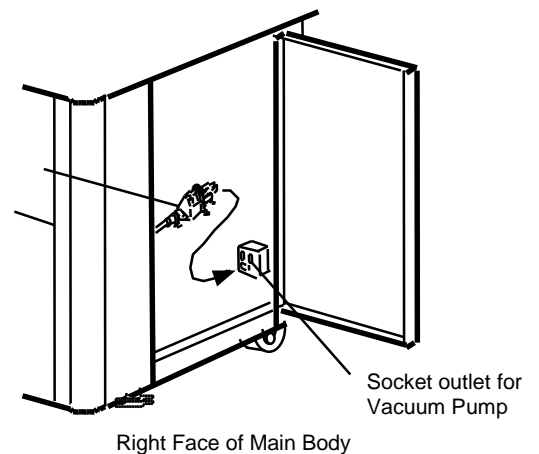


(11) Plug the power plug of the vacuum pump in the socket outlet for the vacuum pump.

Power Plug of Vacuum Pump

(12) Switch on the vacuum pump.

* For further information about proper handlings of the vacuum pump, refer to the user's manual of the pump.

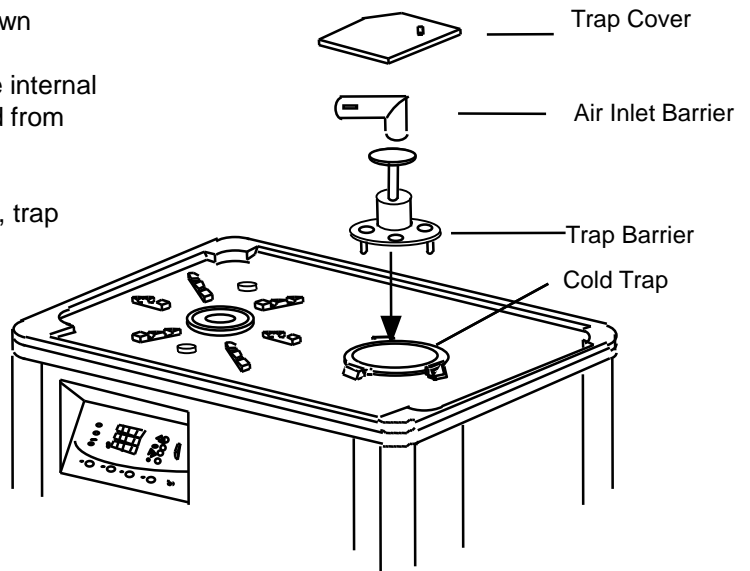


2. Mount the Trap Barrier

Put the trap barrier on the cold trap as shown in the figure on the right.

The barrier executes icing uniformly on the internal walls of the trap, and extracts ice detached from the walls.

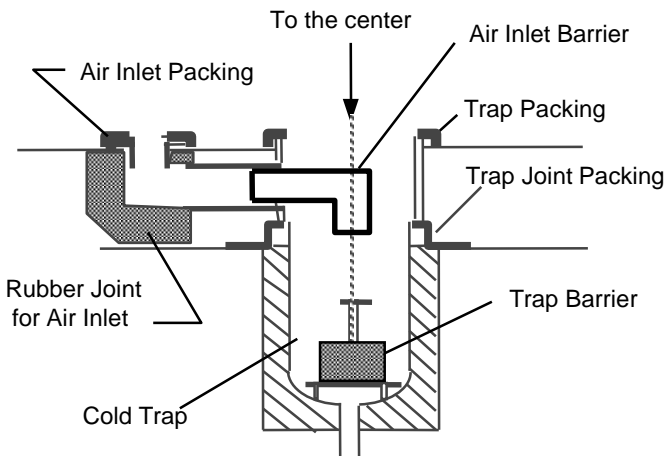
*Where amount of defrosted liquid is small, trap barrier cannot extract any ice.



3. Insert the Air Inlet Barrier

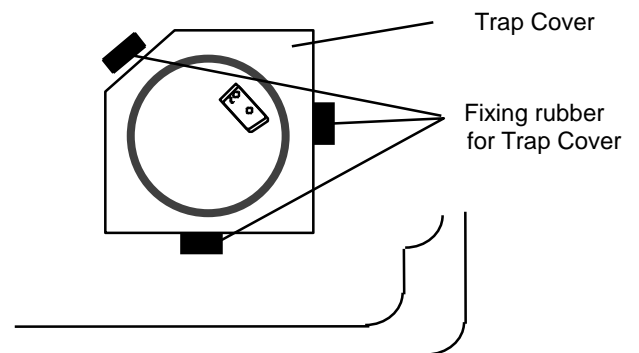
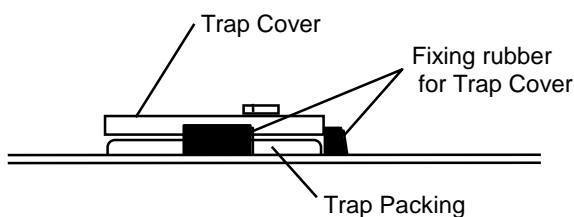
Insert the barrier into air inlet.

Air inlet barrier executes icing uniformly on the internal walls of the trap.



4. Mount the Trap Cover

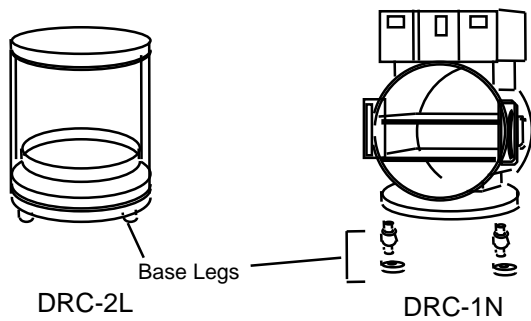
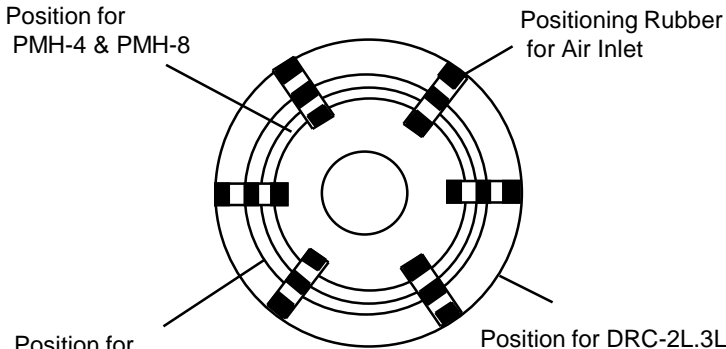
Mount the trap cover positioning with the three pieces of fixing rubber.



* Use the trap cover facing its glass side downward.

5. Mount the Manifold, Dry Chamber, etc.

Mount the manifold or dry chamber, etc. on the center of the air inlet as necessary. To mount the device easily, use 6 pieces of positioning rubber for reference.



* Remove the base legs before mounting DRC-2L.3L.1N and BSC-2L.3L.

6. Plug Socket

Plug socket on the left face of the equipment is used for the dry chamber (max. 3 A).

* The power is supplied to this socket interlocking with activation of the vacuum pump.

* Capacity of the socket is 3 A.
If any load (current) more than 3 A is applied, safety device (fuse) will be activated.
As for replacement of fuse, refer to Sec. 7.3 Fuse Replacement.

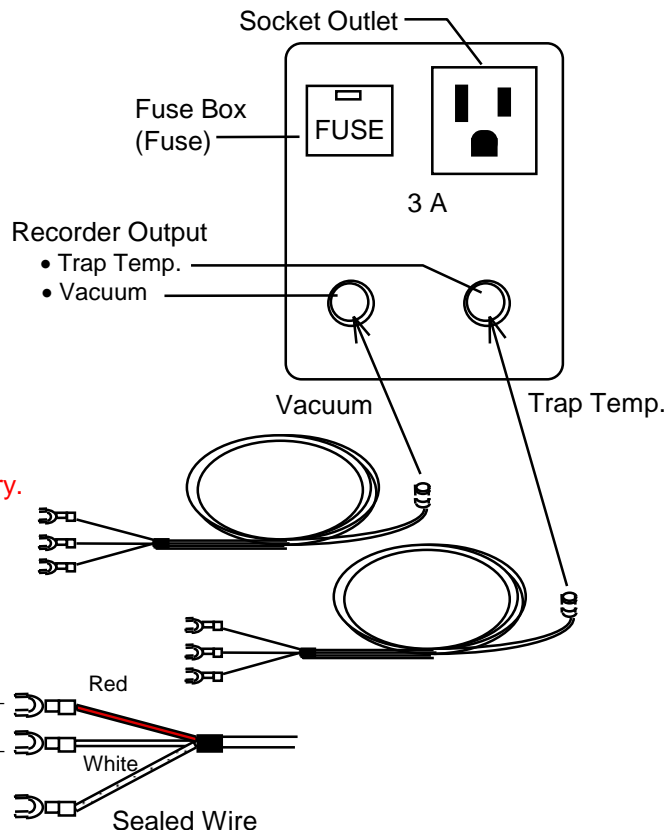
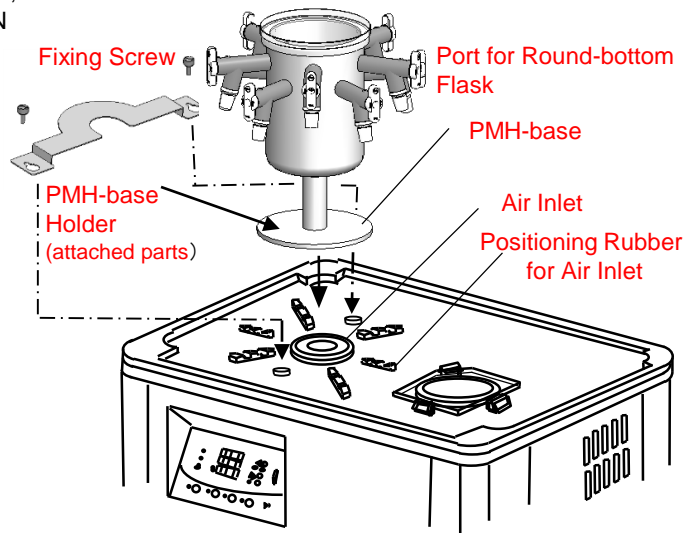
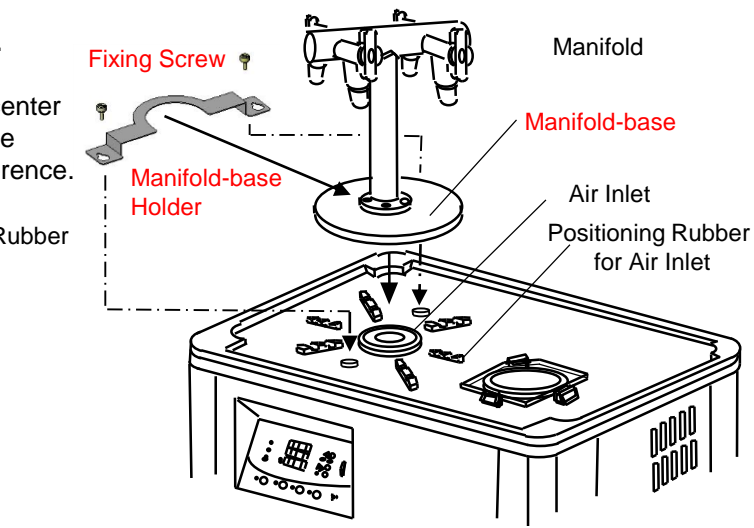
7. Recorder Output (Trap Temp. and Vacuum)

Use recorder output lead wire for connecting the equipment to the recorder.
Contact Tokyo Rikakikai for connecting cord (provided with no charge) for the recorder as necessary.
Refer to the figures shown on the right and below for the output signals for recorder.

Output Signals

Output voltages for recorder are as follows.

For Trap. Temp.	For Vacuum
1°C = 1 mV	1Pa = 1 mV
Ex.) -40mV for -40°C	Ex.) 30 mV for 30 Pa

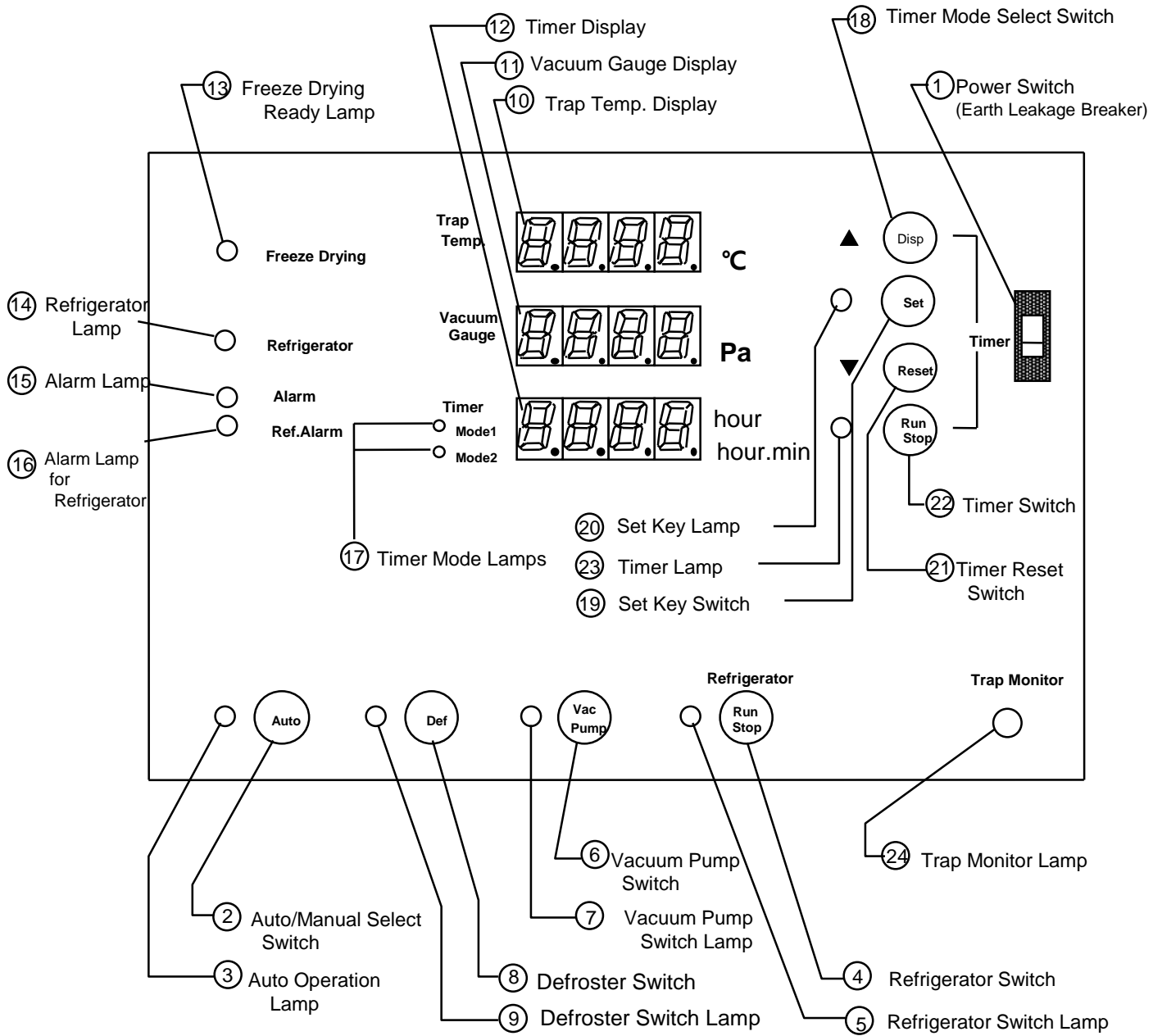


5-2 Operation Procedures

This section describes operation procedures for freeze-drying for flasks using optional manifold. These basic procedures are applicable to other optional devices or containers

Where using optional units such as dry chamber, pre-freeze-drying vessel, pre-freezer, etc., refer to their user's manual too.

Control Panel



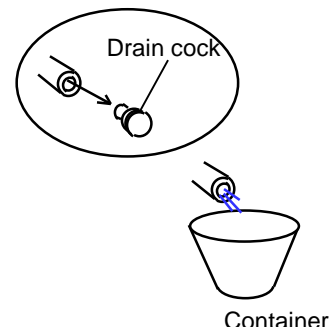
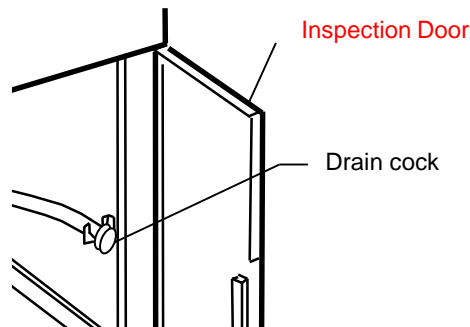
1. Before Operation

* Certain specimens subject to freeze-drying may accelerate deterioration and aging of internal materials.

Refer to Sec. 7.1, Replacement of Consumable Parts, and perform regular inspections.

Make sure that the water in the trap and drain hose is discharged completely in advance of operation. If the equipment is operated with remaining water, it may result in failure in the vacuum pump or pirani vacuum gauge.

Open the inspection door (for vacuum pump) on the right face of the main body and remove the drain cock to make sure that the water in the trap and hose had been discharged completely. When the remaining water have been discharged totally, attach the cock again.



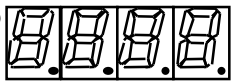
2. Common Procedure for Auto/Manual Operation

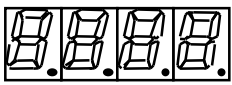
(1) Turn on the power switch (earth leakage breaker)

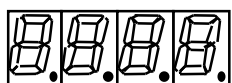
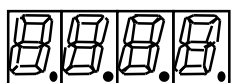
When the switch is turned on, initial indication appears on each display, and then, current measured temperature of the trap appears.

As for vacuum value, where measured value exceeds the range of 533 Pa, "Atmo" is indicated.

On Timer display, operation time for Mode 1 is indicated. Also, Auto Operation Lamp and Timer Mode 1 Lamp are lighted.

T rap temp  °C

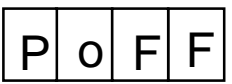
Vacuum  Pa

Timer
 Mode1  hour
 Mode2  hour.min

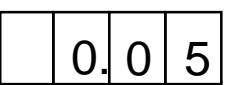
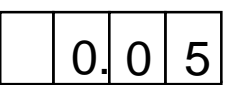
(2) Enter the preset time-period of power failure

as power-failure-reset feature (factory preset value is 5 minutes) .

1. Press Set key on control panel. "PoFF (Parameter Sign OFF)" appears on Trap Temp. display, and "0.05" appears on Timer display (factory preset value is 5 minutes).

Trap temp  °C

Vacuum  Pa

Timer
 Mode1  hour
 Mode2  hour.min

2. Enter the preset time-period of power failure using Up (▲) and Down (▼) key. After that, press Set key. Indication of normal measured value returns.

* Setting is feasible regardless of execution or halt of control.

* Enter an appropriate time-period between 0 to 1 hour and 30 minutes. Numerous values are indicated in the range of 0.00 to 1.30.

* If preset time-period is too long, ice and water in the cold trap may be melted and sucked into the vacuum pump during this period. This may result in equipment failure.

3) Usages of Timer

Press Timer Mode Select Switch serially to switchover Timer Mode 1 or 2.

Mode 1: Operation time of vacuum pump is measured and indicated automatically. This mode is useful to calculate an appropriate period for oil replacement for the pump.

Mode 2: Timer switch is turned on/off by stopwatch function. This mode is useful to measure a period of sublimation. To turn off the stopwatch function, press this switch for 3 seconds or more.

*** Reset of Timer**
Set the applicable mode with Timer Mode Select Switch. press Reset switch for 5 seconds or more.

Timer
 Mode1 9 9 9 9 hour
 Mode2 hour.min

* Indication range for Mode1: 0 to 999 hours
 (The number of last digit presents an hour)

Timer
 Mode1 9 9 5 9 hour
 Mode2 hour.min

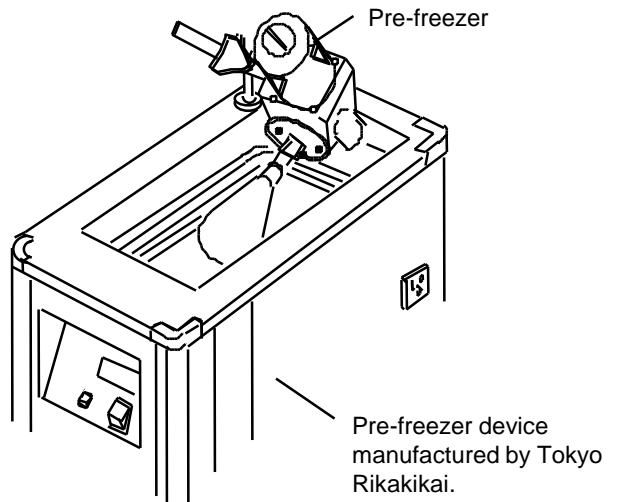
* Indication range for Mode 2: 0 to 99 hours and 59 minutes
 (The number of last digit presents 1 minute, 0 to 99.59)

3. Pre-Freezing

⚠ CAUTION

Do not perform stationary freezing
 If flask or freeze-dry bottle is frozen by stationary devices such as ultra-deep freezer, etc., glass container may be broken by swelling pressure applied by freeze during freeze-drying process.

Specimens in flask or freeze-dry bottle needs to be frozen preparatorily. Container-rotating device for Pre-Freezing, Pre-freezer PFM-1000 (optional) is recommended.



About Pre-Freezing

In pre-freezing, to secure good evaporation efficiency and fine drying, pour the specimen only up to 1/3 or less for the capacity of container. This makes icing of specimen into a form of homogeneous film adhered to the inner walls of the container.

Product Name	Model Nos	Code Nos.	Notes
Low Temp. Tank	PFR-1000	197410	Cooling Temp. -45°C
Pre-freezer	PFM-1000	197420	Fixed to 92/110 rpm

⚠ CAUTION

Be careful in handling glass containers
 Not to hit or drop glass containers, be careful in handling these containers.
 Glass containers may cause injury if they are broken.

4. Auto Operation

- 1) Press Refrigerator Run/Stop switch on control panel while Auto operation lamp is blinking. Refrigerator Switch Lamp is lighted, and the refrigerator is started (when 5 minutes passed since turning on the Power switch.)
- 2) The vacuum pump is started when trap temperature reaches -30°C for FDU-1110, and -40°C for FDU 2100. Further, when vacuum value decreased to 533Pa or less, indication of "Atmo" on vacuum display changes into measured value.
- 3) When vacuum value reaches 20 Pa or less for FDU-1110, and 10 Pa or less for FDU-2110, Freeze Drying Ready Lamp starts blinking for notifying that it is possible to attach the specimen container to the device.
- 4) Attach the freeze-dried specimen in container to the adapter. Turn the vacuum cock from VENT to VAC. The container and the trap are connected at this point. Do not attach all of the containers at once. Attach containers one by one, and check the vacuum value for respective container. (20 Pa for FDU-1000 and 10 Pa for FDU-2110) And 30Pa at maximum operation is recommended. When vacuum level is less than 30Pa, freeze drying ready lamp starts blinking. Below is the number of container possible to attach at once.

	Room Temp. 20°C	Room Temp. 30°C	Room Temp. 35°C
FDU-2110	8	6	4
FDU-1110	6~7	5	4

* If specimen is melted, pre-freeze it again. And then, reattach it to the adapter.

*As drying process proceeds, frost formation on the surface of the specimen container begins to melt. Therefore, adjust the tilt of the container in advance of the process so that the rubber dewdrop tray can receive dripping dewdrops appropriately.

- 5) After attaching the container, Freeze Drying Ready Lamp is lighted where trap temperature and vacuum value are as follows:
 FDU-1110: -30°C or less, and 30 Pa or less
 FDU-2110: -50°C or less, and 30 Pa or less
 While these conditions are kept, it is possible to attach the containers serially.

FDU-1110

* Freeze Drying Ready Lamp goes off where trap temperature exceeds -30°C , and vacuum value exceeds 25 Pa.

The lamp is not lighted until trap temperature and vacuum value reach -30°C and 25 Pa again

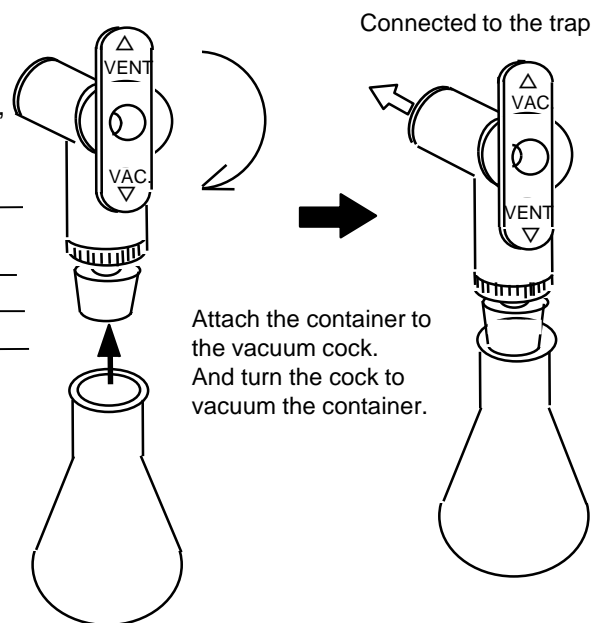
FDU-2110

* Freeze Drying Ready lamp goes off where trap temperature exceeds -50°C , and vacuum value exceeds 15 Pa.
 The lamp is not lighted until trap temperature and vacuum value reach -30°C and 25 Pa again

*Press Auto/Manual Select Switch to switchover automatic/manual operation. Each time the switch is pressed, Auto (Auto Operation Lamp is lighted)/Manual operation (the lamp not lighted) is switched over.

*Refrigerator Protection Timer
 Regardless of Auto/Manual operation, the refrigerator is not started for 5 minutes since the power switch is turned on.
 Also, once the refrigerator is stopped, the refrigerator cannot be started for 5 minutes

* The buzzer is sounded staccato for approx. 5 seconds since Freeze Drying Ready lamp is lighted.



Keep the maximum volume of dehumidification

To minimize the water into the vacuum pump, operate Keeping the volume of dehumidification of specifications. The volume of the dehumidification of FDU- 1100 4L/time (about 4.5cm far from the trap wall), of FDU-2110 3L/time (about 4.5cm far from the trap wall)

* Ice accretion shape is different between FDU-1110 and FDU-2110.

Control the vacuum level in operation

30Pa at max is recommended in operation. Excessive low vacuum level operation causes to get worse quality result and to drop oil quality and short life Attach the sample containers not at once, but one by one at regular intervals while confirming .

3 days operation at most in continuous operation

Long time operation under ice-coating causes to insert water to the vacuum pump. The continuous operation should be within 3 days. In case of over 3 days operation, melt the ice first.

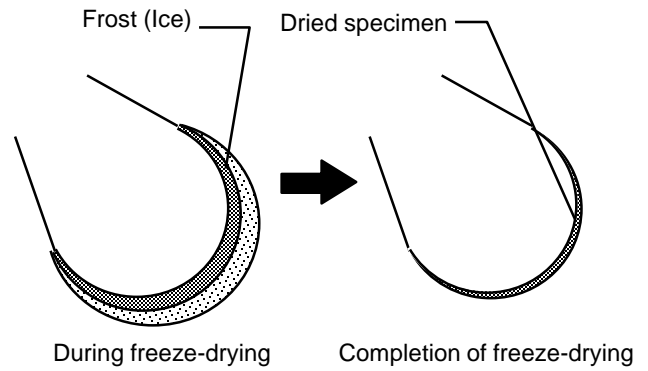
6) Freeze-drying process

After attaching the specimen container, degree of vacuum rises gradually. Frost formation in white on the surface of the container is a desirable status during this processing.

* If granular frost formation is found inside the cold trap, during freeze drying process, vacuum leakage might have been occurred. Check the joint between the specimen container and adaptor.

7) Completion of freeze-drying

As drying process proceeds, frost formation on the surface of the specimen container begins to melt. When the surface is dried sufficiently, turn the vacuum cock with the marking of "VENT" downward to regain normal pressure inside the container. And detach the container.



 CAUTION
Hold the specimen container with hands not to drop it after releasing vacuum

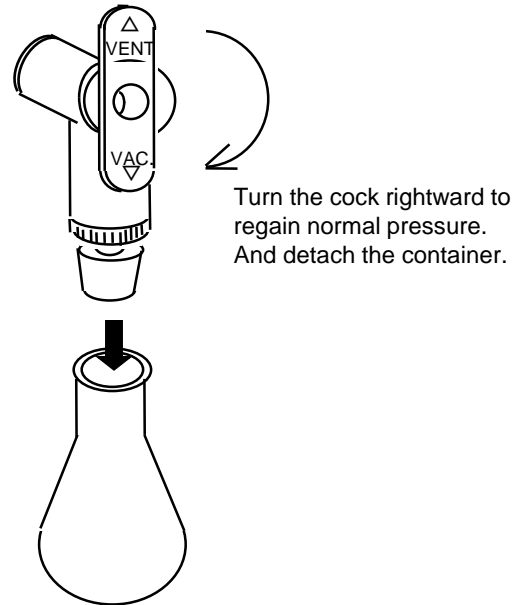
8) Defrost Operation

Press Defrost switch for 3 seconds or more.


Hot gas flows outside the trap to melt the frost adhered inner walls of cold trap. (Defrost processing is started.)

At this point, the vacuum pump stops automatically. When the pump stops, the safety valve (leak valve) operates to regain normal pressure inside the trap simultaneously.

* If normal pressure is not regained in the trap, or, this process is too slow, leak filter may be clogged. In such case, since it may result in reverse flow of oil or other equipment failure, replace the filter referring to Sec. 7-1.3, Leak Filter Replacement



Turn the cock rightward to regain normal pressure. And detach the container.

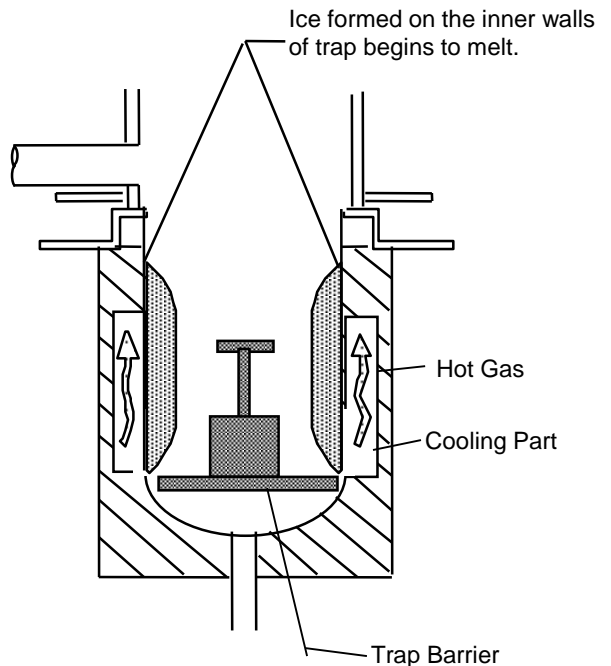
 CAUTION
Be careful of skin burn
Depending on the conditions such as environment temperature in use and amount of dehumidification, inner walls of cold trap may have a very high temperature. Be careful not to touch these walls during operation of hot gas, and right after the operation.

* Do not execute defrosting operation for processes other than ice-melting using hot gas.

After the defrosting operation, make sure that the ice is removed from the cold trap. And turn off the Defrost switch.

To interrupt defrosting, press Defrost switch for 3 seconds or more.

* As for FDU-1110, when approx. 40 minutes passed after turning on the Defrost switch, or trap temperature reaches 40° C, the refrigerator is turned off (automatic stoppage), and the Defrost switch lamp goes off to notify interruption of defrosting operation. As for FDU-2110, when approx. 30 minutes passed after turning on the Defrost switch, or trap temperature reaches 50° C, the same operations as FDU-1110 are executed.

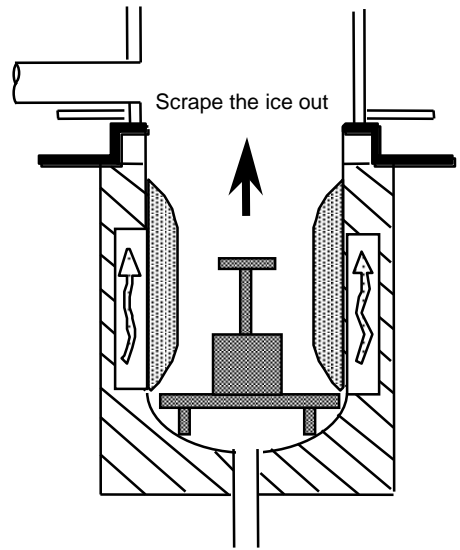



When the ice is removed from the inner walls of the trap, lift the barrier, and scrape off the ice. It takes about 20 to 30 minutes for removing the ice from the walls

Conditions

- Amount of formed ice: 3 liters
- Room Temperature: 20° C
- Power Supply: 220 Vac, 50 Hz for FDU-1110
220 Vac, 50 Hz for FDU-2110

* Depending on the conditions such as environment temperature in use and amount of dehumidification, melting time and status may vary. If the ice is not removed completely by defrosting for one time, execute the operation again, or pour the hot water on the walls to melt the ice.

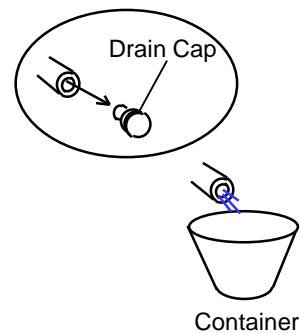
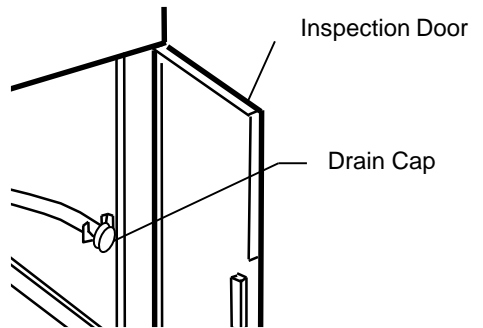


 CAUTION
<p>Do not fill the water up to 5 liters or more in Cold Trap</p> <p>Be careful not to fill the water up to 5 liters or more in the cold trap. Doing so may result in equipment failure in vacuum pump, etc. or leakage current.</p>

8) Completion of defrosting operation

<p>After the defrosting operation, never fail to clean up the inside walls of the trap and drain pipe.</p> <p>Not doing so may leave a small amount of ice at the trap bottom or inside the pipe. Be sure to pour the hot water for a few times to clean up and discharge the remaining ice.</p>

- (1) Turn off the refrigerator and Power switches.
- (2) Open the inspection door on the right face or Inspection Door for Vacuum Pump in front of the equipment. Pull out the drain hose, and rinse off the inside of trap and the pipe.



Treatment after defrosting operation

Where the equipment is expected to be not used for a long period of time, turn off the power switch (earth leakage breaker). In addition, cut off the power source, or unplug the power cord.

5. Manual Operation

Refrigerator and vacuum pump can be started solely. (Auto lamp on the control panel is not lighted during this operation.) In manual operation, Freeze Drying Ready lamp is not lighted, and the buzzer is not sounded.

* Press Auto/Manual Select Switch to switchover automatic/manual operation. Each time the switch is pressed, Auto (Auto Operation Lamp is lighted)/Manual operation (the lamp not lighted) is switched over.

- 1) Press the Refrigerator switch. Refrigerator Switch Lamp is lighted, and the refrigerator is started (when 5 minutes passed since turning on the Power switch.)
- 2) Make sure that Vacuum Cock A is closed completely. (Marking of "VENT" is positioned at the top.)
- 3) Press Vacuum Pump switch. Vacuum Pump lamp is lighted, and the pump is started.
- 4) When vacuum value reaches 20 Pa or less for FDU-1110, and 10 Pa or less for FDU-2110, it is possible to attach the specimen to the adaptor. Attach the freeze-dried specimen in container to the adapter. Turn the vacuum cock from VENT to VAC. The container and the trap are connected at this point. After attaching the specimen container, degree of vacuum rises gradually. Frost formation in white on the surface of the container is a desirable status during this processing.

* Do not attach all of the containers at once. Attach containers one by one, and check the vacuum value for respective container. (20 Pa for FDU-1110, and 10 Pa for FDU-2110)

* If specimen is melted, pre-freeze it again. And then, reattach it to the adapter.

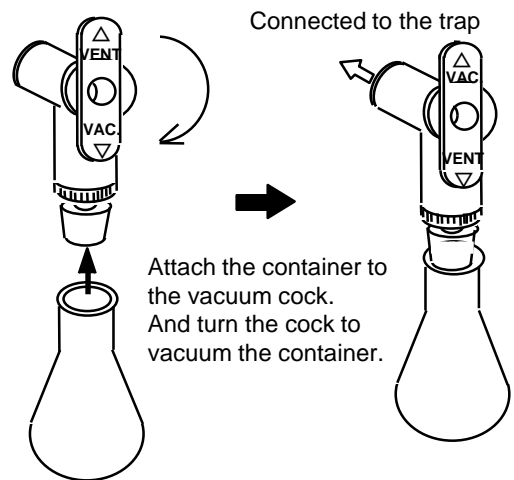
* As drying process proceeds, frost formation on the surface of the specimen container begins to melt. Therefore, adjust the tilt of the container in advance of the process so that the rubber dewdrop tray can receive dripping dewdrops appropriately.

* If granular frost formation is found inside the cold trap, during freeze-drying process, vacuum leakage might have been occurred. Check the joint between the specimen container and adaptor.

- 5) Freeze-drying process
After attaching the specimen container, degree of vacuum rises gradually. Frost formation in white on the surface of the container is a desirable status during this processing.

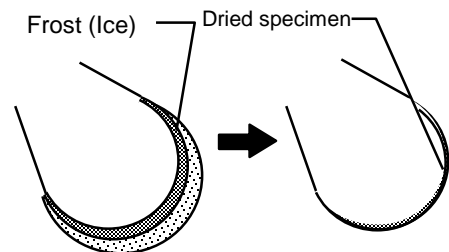
Make sure to check the drainage of trap and drain hose before starting operation. If you start operation while being water in the trap and drain hose, it might be causes troubles of vacuum pump and Pirani gauge.

Start the vacuum pump only when the inner walls of the cold trap is cooled down.
If the pump is started before the walls are cooled down sufficiently, the water remains in the cold trap may flow into the vacuum pump. It may result in equipment failure.



Keep the maximum volume of dehumidification
To minimize the water into the vacuum pump, operate keeping the volume of dehumidification of specifications.
The volume of dehumidification of FDU-1110 is 4L/time(about 4.5cm far from the trap wall), of FDU-2110 3L/time(about 4.5cm far from the trap wall)

3days operation at most in continuous operation
Long time operation under ice-coating causes to insert water to the vacuum pump. The continuous operation should be within 3 days. In case of over 3 days, melt the ice first.

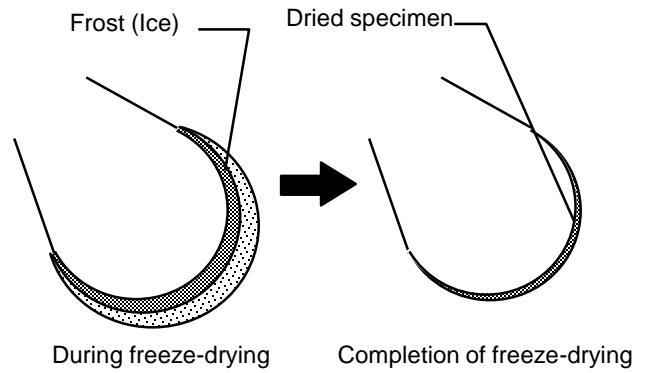


During freeze-drying

Completion of freeze-drying

6) Completion of freeze-drying

As drying process proceeds, frost formation on the surface of the specimen container begins to melt. When the surface is dried sufficiently, turn the vacuum cock with the marking of "VAC." downward to regain normal pressure inside the container. And detach the container.



CAUTION

Hold the specimen container with hands not to drop it after releasing vacuum

7) Stop the vacuum pump

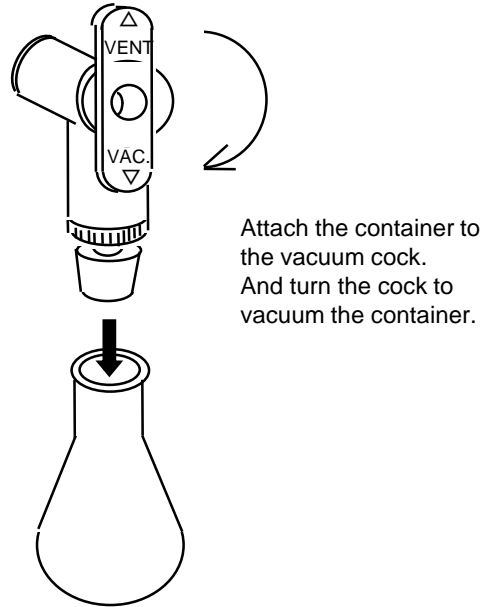
Press Vacuum Pump switch for 3 seconds or more. When the pump stops, the safety valve (leak valve) operates to regain normal pressure inside the trap simultaneously.

* Before stopping the vacuum pump, be sure to detach all of the specimen containers.

* If normal pressure is not regained in the trap, or this process is too slow, leak filter may be clogged. In such case, since it may result in reverse flow of oil or other equipment failure, replace the filter referring to Sec. 7-1.3, Leak Filter Replacement

8) Defrost Operation

Press Defrost switch for 3 seconds or more. Hot gas flows outside the trap to melt the frost adhered inner walls of cold trap. (Defrost processing is started.)



CAUTION

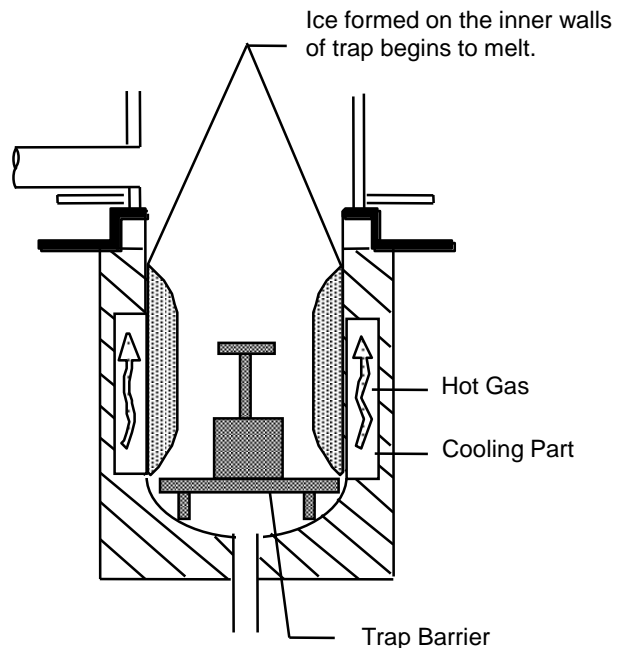
Be careful of skin burn

Depending on the conditions such as environment temperature in use and amount of dehumidification, inner walls of cold trap may have very high temperature. Be careful not to touch these walls during operation of hot gas, and right after the operation.

After the defrosting operation, make sure that the ice is removed from the cold trap. And turn off the Defrost switch.

To interrupt defrosting, press Defrost switch for 3 seconds or more.

* As for FDU-1110, when approx. 40 minutes passed after turning on the Defrost switch, or trap temperature reaches 40° C, the refrigerator is turned off (automatic stoppage), and the Defrost switch lamp goes off to notify interruption of defrosting operation. As for FDU-2110, when approx. 30 minutes passed after turning on the Defrost switch, or trap temperature reaches 50° C, the same operations as FDU-1110 are executed.

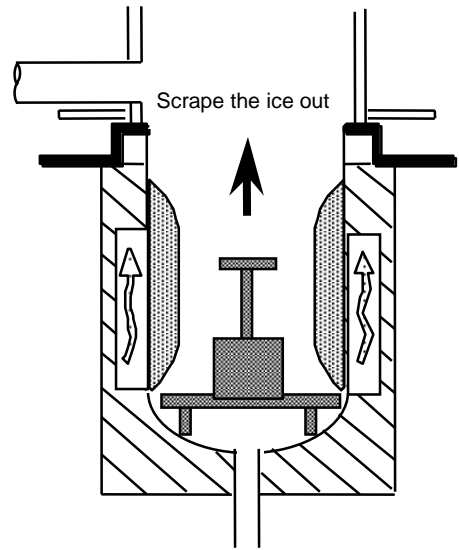



When the ice is removed from the inner walls of trap, lift the barrier, and scrape off the ice. It takes about 20 to 30 minutes for removing the ice from the walls

Conditions

- Amount of formed ice: 31 liters
- Room Temperature: 20° C
- Power Supply: 220 Vac, 50 Hz for FDU-1110
220 Vac, 50 Hz for FDU-2110

* Depending on the conditions such as environment temperature in use and amount of dehumidification, melting time and status may vary. If the ice is not removed completely by defrosting for one time, execute the operation again, or pour the hot water on the walls to melt the ice.

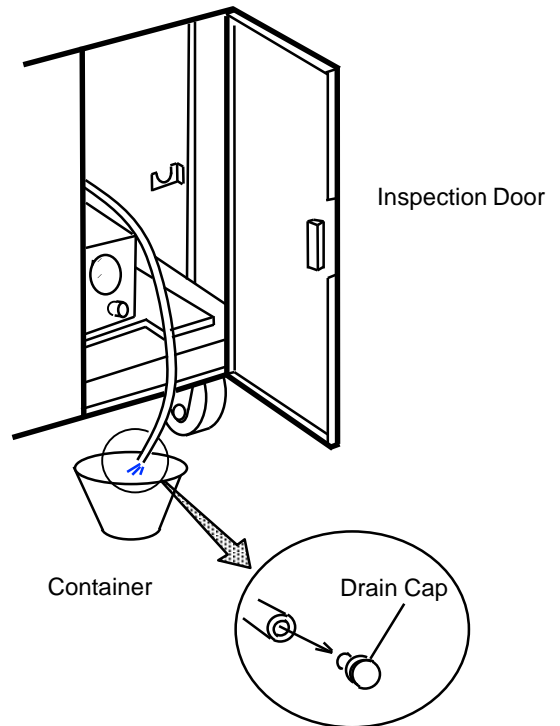


 CAUTION
<p>Do not fill the water up to 4 liters or more in Cold Trap</p> <p>Be careful not to fill the water up to 5 liters or more in the cold trap. Doing so may result in equipment failure in vacuum pump, etc. or leakage current.</p>

8) Completion of defrosting operation

<p>After the defrosting operation, never fail to clean up the inside walls of the trap and drain pipe.</p> <p>Not doing so may leave a small amount of ice at the trap bottom or inside the pipe. Be sure to pour the hot water for a few times to clean up and remove the remaining ice.</p>

- (1) Turn off the Refrigerator and Power switches.
- (2) Open the inspection door on the right face or Inspection Door for Vacuum Pump in front of the equipment. Pull out the drain hose, and rinse off the inside of trap and the pipe.



Treatment after defrosting operation



Where the equipment is expected to be not used for a long period, turn off the power switch (earth leakage breaker). In addition, cut off the power source, or unplug the power cord.

6

Troubleshooting

For troubles other than the ones described in the following table, please contact your dealer or nearest service center of Tokyo Rikakikai.

SYMPTOMS	CAUSES	SOLUTIONS
When turning the Power switch (earth leakage breaker) ON, it is set to OFF immediately.	Current leakage occurred.	Stop the operation immediately, and contact your sales dealer or nearest service center of Tokyo Rikakikai.
	Overcurrent is applied.	
When turning the Power switch (earth leakage breaker) ON, none of the indicators are activated.	Power is not supplied.	Turn ON the breaker on power board.
	Failure in Power switch (earth leakage breaker).	Stop the operation immediately, and contact your sales dealer or nearest service center of Tokyo Rikakikai.
	Failure in the indicators.	
Refrigerator does not operate.	Failure in refrigerator	Stop the operation immediately, and contact your sales dealer or nearest service center of Tokyo Rikakikai.
	Overload relay holding circuit in refrigerator is activated. (Alarm lamp is lighted.)	Heating overload to the refrigerator is too heavy. Lighten the load.
		If ambient temp. is too high, lower the room temp. to 35° C or less.
	Refrigerator protection timer is activated (for approx. 5 minutes)	After the activation of timer, make sure that the refrigerator operates normally.
Cooling is not executed.	Refrigerator does not operate.	Stop the operation immediately, and contact your sales dealer or nearest service center of Tokyo Rikakikai.
	Refrigerator fan does not operate.	
	Gas is leaking.	
Cooling is insufficient.	Gas is leaking.	Lower the room temperature to 35° C or less.
	Refrigerator fan does not operate.	
	Ambient temperature exceeds 35° C	
	Heating overload to the refrigerator is too heavy.	Adjust the heating overload to the appropriate rated load.
	Air outlet on the rear face are blocked. Ventilation is not working.	Keep enough space behind the equipment. (Refer to 4-2. Installation Conditions)
	Refrigerator filter is clogged.	Clean up the filter. Refer to 7.3, Cleaning and Maintenance of Product
Vacuum pump does not operate.	Power plug for vacuum pump is not plugged into the socket outlet for the pump	Insert the plug into the socket outlet for the pump. Refer to 5-1, Preparation for Operation
	The switch on the main body of the vacuum pump is not turned on.	Turn on the switch on the main body of the vacuum pump. Refer to 5-1, Preparation for Operation

SYMPTOMS	CAUSES	SOLUTIONS
Vacuum pump does not emit light exhaust noise when 30 seconds passed since it had been started. (Pressure is not lowered)	Connecting hose between the vacuum pump and the equipment is removed.	Insert the connecting hose into the hose nozzle securely.
	Drain cap is detached.	Fix the drain cap to the drain hose.
	Drain cock is not closed completely.	Make sure that the direction of the drain cock is appropriate. And close the cock tightly
	Cold trap is not mounted securely.	Mount the trap securely again.
	Objects entered into the contact surface between the chamber lid and packing.	Remove the objects.
Vacuum pump emits light exhaust noise. However, pressure is not lowered appropriately.	Performance of vacuum pump is deteriorated due to suction of acid or water.	Replace the oil. If the performance does not recover, repair the equipment
	Water or ice remains in the cold trap.	Remove the ice, and then discharge the water from the drain pipe.
	Specified amount of oil is not filled in the vacuum pump	Check the oil level, and refill the oil up to the specified amount.
	Refrigerator switch is not turned on.	Turn on the refrigerator switch.
	Though refrigerator switch is turned on, cooling is not sufficient.	Refer to the column of "Cooling is insufficient."
Though vacuum pump is stopped, normal pressure can not be regained	Leak filter is clogged.	Replace the leak filter. Refer to 7-1, Consumable Parts Replacement.
Alarm Message	Refrigerator alarm appeared. Refrigerator-overload-relay-holding-circuit activated. <div style="border: 1px solid black; padding: 5px; display: inline-block; margin: 10px 0;">  Ref.Alarm </div> Ref.Alarm lamp is lighted, and refrigerator stops. * Trap Temp. display blinks measured temp. value	<ul style="list-style-type: none"> • Ambient temperature exceeds 35° C. • Used under heating overload exceeding cooling performance. • Air filter is clogged. • Refrigerator fan is not operating. • Power supply voltage dropped. • Refrigerator is started (operated) under overload. * If several causes are considered, conditions of operation differs. <ul style="list-style-type: none"> • Lower the ambient temperature to 35° C or less • Lighten the heating overload within cooling capacity • Clean up the air filter (Refer to 7.3, Cleaning and Maintenance of Product) • Make sure that the refrigerator fan operates normally. • Make sure that the power supply voltage is normal. • Halt the refrigerator for an appropriate period of time, and restart the unit.
	<ul style="list-style-type: none"> • Guidewire of temp. sensor has malfunction. 	Stop the operation immediately, and contact your sales dealer or nearest service center of Tokyo Rikakikai.
	<ul style="list-style-type: none"> • Guidewire of vacuum sensor has malfunction. 	
Alarm for malfunction in guidewire of vacuum sensor <div style="border: 1px solid black; padding: 5px; display: inline-block; margin: 10px 0;"> PrEr Lit </div> Trap Temp. display <div style="border: 1px solid black; padding: 5px; display: inline-block; margin: 10px 0;">  Alarm </div>		

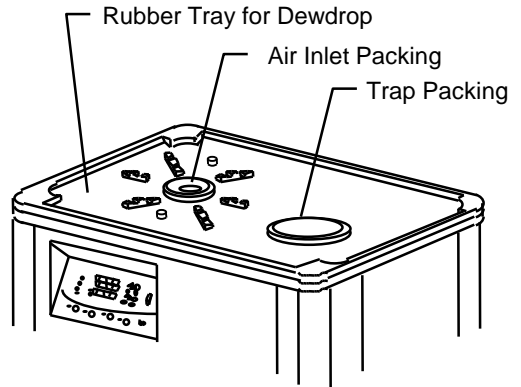
SYMPTOMS	CAUSES	SOLUTIONS
<p>Control Board Error alarmed</p> <p>*Message not specified</p>	<ul style="list-style-type: none"> Control board cannot automatically recover from abnormal status due to noise, etc. 	<p>Make sure that the status of specimen container and connections are appropriate.</p>
<p>Control Board Error alarmed</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;"> PUPm Lit </div> <p>Vacuum gauge display</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Alarm </div>	<ul style="list-style-type: none"> Vacuum range of 533 Pa or more is indicated on vacuum gauge display once. And "Atmo" is indicated for 30 minutes or more. 	<p>Make sure that the status of specimen container and connections are appropriate.</p>
<p>Backup Battery Error Alarm</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;"> CPAr Lit </div> <p>Vacuum gauge display</p> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Alarm </div>	<ul style="list-style-type: none"> Backup Battery failed or runs out 	<p>Contact your sales dealer or nearest service center of Tokyo Rikakikai.</p> <p>Press [Set] key to release alarm message. By doing this, normal indication recovers. However, backup function for recovery select for power failure and elapsed time for model 1 do not operate normally.</p> <p>* In case of power failure, total control is stopped despite preset period for operation recovery time in power failure.</p>
<p>Power failure alarm</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;"> Measured temp. </div> <p>Current trap temp. and "OFF" are indicated in turn.</p> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-bottom: 5px;"> oFF </div> <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Alarm </div>	<p>The power failed during control. Or, the power was turned off without terminating control.</p>	<p>Clear the cause of alarm. Press [Set] key switch to clear the alarm message. Normal indication recovers.</p>

Alarm Message

7 Maintenance/Check

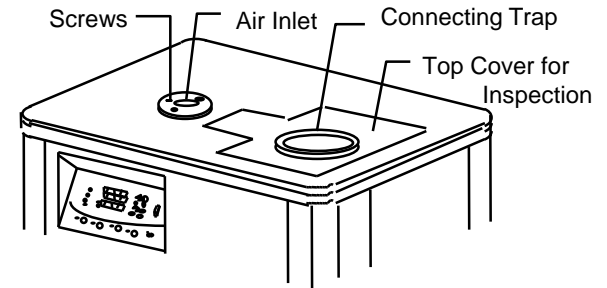
7-1. Replacement of Consumables

Consumables of the pressurized tube are trap packing, air inlet packing, rubber tray for dewdrop, trap connecting packing (material: CR), air inlet connecting rubber (material: silicon), vacuum hose (material: natural rubber), drain valve, leak filter, and vacuum sensor. Since degrees of deterioration and aging depend on specimens and operating conditions, conduct inspections regularly. The followings are the procedures of replacement of these parts.



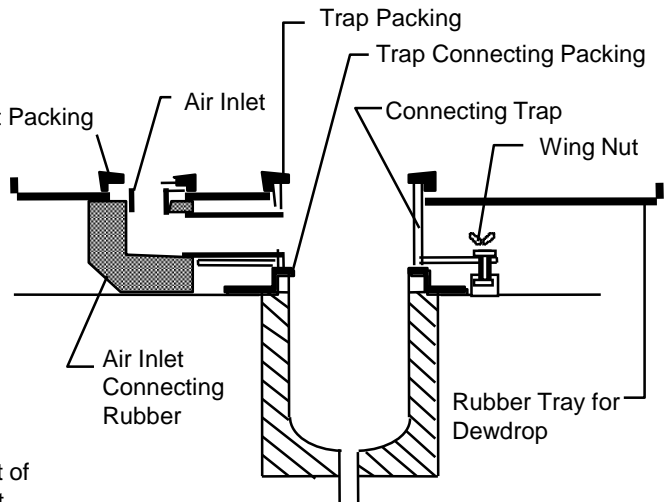
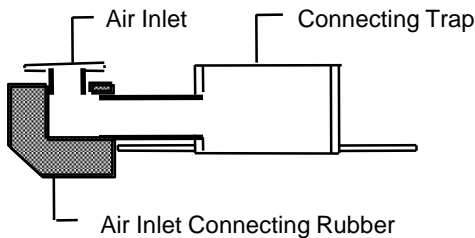
1. Replacement of trap packing, air inlet packing, rubber tray for dewdrop

These parts can be removed and fixed easily utilizing their inherent elasticity.



2. Replacement of air inlet connecting rubber trap connecting packing

- (1) Remove these parts from the equipment.
- (2) Untighten 3 pieces of screws fixing the air inlet.
* Prepare screwdriver by yourself.
- (3) Remove the top cover for inspection, and untighten the wing nuts (4 pieces). Connecting trap rubber and inlet can be removed all together



- (4) Replace trap connecting packing or air inlet connecting rubber. When replacing these parts, put a small amount of silicone compound for vacuum sealing on their joint part. Application of the compound will ease the work of mounting, and improve the sealing performance too.

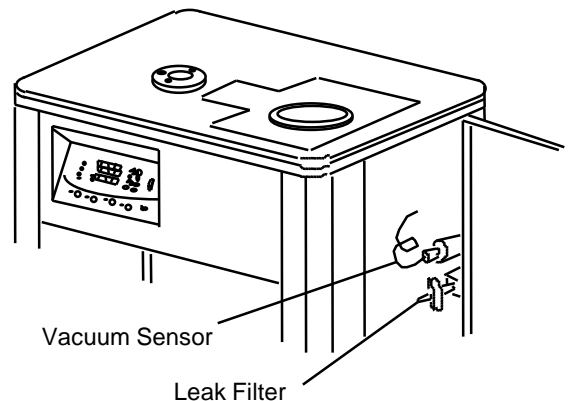
- (5) After replacing the part, reassemble the parts by following the above Step (1) to (3) reversely.

3. Replacement of Leak Filter

Since the filter is only inserted into the silicone tube, it can be removed easily.

4. Replacement of Vacuum Sensor


Replacement of vacuum sensor requires removal and mounting of the sensor and replacement of cable connected to the vacuum meter on control panel. Contact the service center of Tokyo Rikakikai to order this replacement .



4. Replacement of Vacuum Hose

Refer to “Setting of the vacuum pump ” in 5-1.
Preparation for Operation

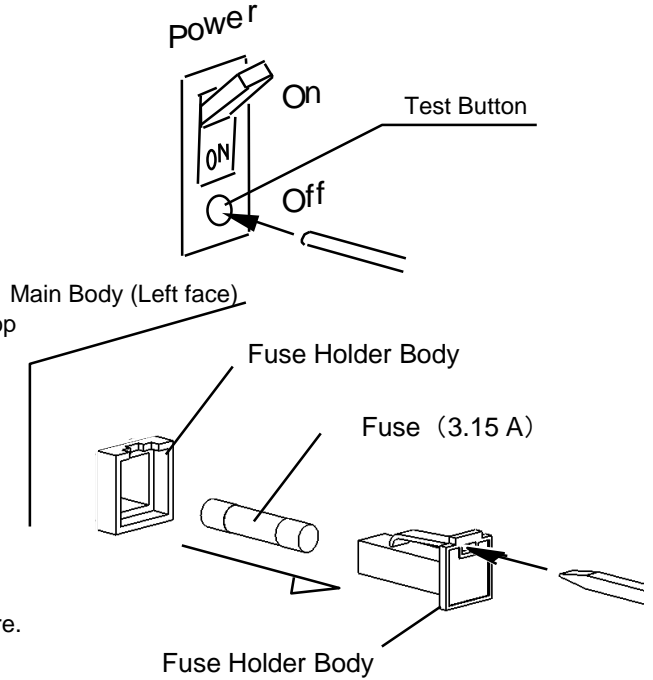
7-2 Operation Test of Leakage Breaker


CAUTION

Operational test of the earth leakage breaker should be made.

Using the failed leakage breaker may cause electrical shocks because of short-circuit. Operational test should be made once a month or more.

Insert the power plug and press the test button of the earth leakage breaker with the leakage breaker is on. It is acceptable when it turns off by the operation of the breaker.



7-3 Replacement of Fuse

Before replacing the fuse, turn off the Power switch (Earth Leakage Breaker) for safety.

- (1) Insert a thin slotted screwdriver into the groove on the top of the holder. Fuse can be removed with the holder.
- (2) Insert an applicable fuse rated for specified capacity. Its capacity is carved on the body of the fuse. The fuse on the market is also available. Optional fuse is tabulated on the left.

* If any unspecified fuse is used, it may not be blown when the overcurrent is flown. This failure may result in fire.

* If the replaced fuse blows again, stop the operation immediately. And inspect the optional devices.

7-4 Control of Vacuum Pump Oil

Oil conditions largely depend on ultimate pressure and the lifespan of the pump. Therefore, to maintain the performance of pump, check the oil level and contamination viewing from the oil gauge window, and replace the oil earlier.

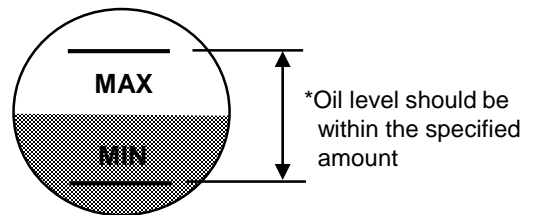
If the water entered into the pump, halt the operation for a while. And discharge the water from the pump drain. By doing this, to a certain degree, vacuum performance is improved, and operation period of time can be prolonged.

Standard interval period for oil replacement is 250 operation hours.

However, replace the oil earlier for the following cases.

- Where oil level reaches almost maximum due to the water or specimen flows into the vacuum pump.

Parts Name	Code No.
Fuse 3.15 A	147670



- Oil becomes cloudy or pale in brown
- Where insufficient vacuum is caused by oil

*** Caution**

Operating continuously under MAX level might cause the damage of vacuum pump.

7-5. Cleaning and Maintenance of Product



WARNING

Do not disassemble the equipment

Energized and heated components are contained in the equipment. Contact with these parts through disassembly may result in electric shock or injury.



CAUTION

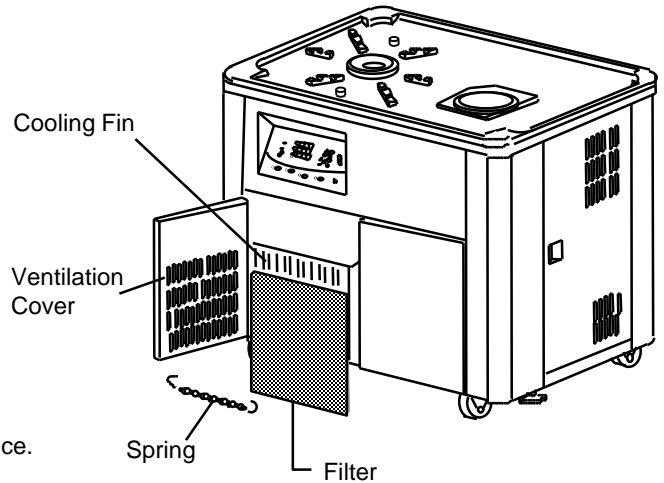
Do not touch the cooling fins with bare hands

Never touch the cooling fins with bare hands during maintenance. Sharp edges of the fins may hurt user's hands.

1. Refrigerator Filter Cleaning

*Before cleaning the filter, be sure to turn off the Power switch (earth leakage breaker) and the power source. If the filter is clogged, cooling performance will be deteriorated. Also, it may cause failure in refrigerator. Since a degree of clogging on the filter depends on environment in use or operating time, clean up the filter regularly as follows.

- (1) Open the Ventilation Cover.
- (2) Remove the spring for the filter mount.
- (3) Take out the filter, and brush the dust.
Then wash the filter using water or a neutral detergent.
- (4) Dry the filter completely. And reattach the filter in place.



- * Do not use the dryer toward the filter.
Doing so may deform the filter material.

2. Main Body Cleaning

*Before cleaning the filter, be sure to turn off the Power switch (earth leakage breaker) and the power source.

Wipe the surface of main body with tightly squeezed soft cloth using water. If any dirt remains, use neutral detergent. After using detergent, wipe the body with a dry soft cloth.



CAUTION

Cleaning and maintenance of the product should be made with appropriate methods and items.

Do not apply water to the coating or inside the product. Also, never use cleanser (polishing powder), thinner, petroleum, kerosene, acid or the like to clean or maintain the product. It may cause electrical shocks or damage to the product.

8 Disposal of Product

Disposal of the product or parts should be in accordance with applicable disposal rules.

Main components and their disposal methods

Members	Specifications	Weights	Outer Dimensions (mm)	Procedure of Disposal
Main Body	FDU-1110	Approx. 100 kg	700W x 550D x 930H	Order a waste collector for disposal of the product.
	FDU-2110	Approx. 140 kg	700W x 550D x 930H	

* Packing materials should be disposed of separately with each material.