



Freeze Dryer

Model

DC401

Instruction Manual

- First Edition -

- Thank you for choosing DC series freeze dryers from Yamato Scientific Co., Ltd.
- For proper equipment operation, please read this instruction manual thoroughly before use. Always keep equipment documentation safe and close at hand for convenient future reference.

⚠ WARNING!:

Read instruction manual warnings and cautions carefully and completely before proceeding.

**Yamato Scientific America Inc.
Santa Clara, CA**

◆ 1. SAFETY PRECAUTIONS	1
• Explanation of Safety Symbols	1
• Symbol Glossary	2
• Warnings & Cautions	3
• Warnings & Cautions	4
◆ 2. PRE-OPERATION PROCEDURES	5
• Installation Precautions & Preparations	5
• Installation Procedures	8
◆ 3. COMPONENT NAMES & FUNCTIONS	9
• Unit Overview	9
• Control Panel	10
◆ 4. OPERATION PROCEDURES	11
• Pre-freezing	11
• Main Operation	12
• Defrost	16
◆ 5. HANDLING PRECAUTIONS	17
◆ 6. MAINTENANCE PROCEDURES	19
• Inspection & Maintenance	19
◆ 7. STORAGE & DISPOSAL	20
• Disposal Considerations	20
◆ 8. TROUBLESHOOTING	21
• Troubleshooting Guide	21
◆ 9. SERVICE & REPAIR	22
◆ 10. SPECIFICATIONS	23
• Main Unit	23
• Optional Accessories	24
◆ 11. WIRING DIAGRAM	25
• DC401	25
◆ 12. REPLACEMENT PARTS	26
◆ 13. LIST OF HAZARDOUS SUBSTANCES	27

1. SAFETY PRECAUTIONS

Explanation of Safety Symbols

A Word Regarding Symbols

Various symbols are provided throughout this text and on equipment to ensure safe operation. Failure to comprehend the operational hazards and risks associated with these symbols may lead to adverse results as explained below. Become thoroughly familiar with all symbols and their meanings by carefully reading the following text regarding symbols before proceeding.



Warning Signifies a situation which may result in serious injury or death (Note 1)



Caution Signifies a situation which may result in minor injury (Note 2) and/or property damage (Note 3)

- (Note 1) Serious injury is defined as bodily wounds, electrocution, bone breaks/fractures or poisoning, which may cause debilitation requiring extended hospitalization and/or outpatient treatment.
- (Note 2) Minor injury is defined as bodily wounds or electrocution, which will not require extended hospitalization or outpatient treatment.
- (Note 3) Property damage is defined as damage to facilities, equipment, buildings or other property. (Note 1) Serious injury is defined as bodily wounds,

Symbol Meanings



Signifies warning or caution.
Specific explanation will follow symbol.



Signifies restriction.
Specific restrictions will follow symbol.



Signifies an action or actions which operator must undertake.
Specific instructions will follow symbol.

1. SAFETY PRECAUTIONS

Symbol Glossary

Warning



General
Warning



Danger!: High
Voltage



Danger!:
Extremely Hot



Danger!: Moving
Parts



Danger!: Blast
Hazard

Caution



General Caution



Caution:
Shock Hazard!



Caution: Burn
Hazard!



Caution: Do Not
Heat Without
Water!



Caution: May
Leak Water!



Caution: Water
Only



Caution: Toxic
Chemicals

Restriction



General
Restriction



No Open Flame



Do Not
Disassemble



Do Not Touch

Action



General Action
Required



Connect Ground
Wire



Level Installation
Required



Disconnect Power



Inspect Regularly

1. SAFETY PRECAUTIONS

Warnings & Cautions

WARNING!



Never operate equipment near combustible gases/fumes.

Do not install or operate DC series unit near flammable or explosive gases/fumes. Unit is NOT fire or blast resistant. Negligent use could cause a fire/explosion. See "List of Hazardous Substances" (P.28).



Always ground equipment.

Always ground this unit properly to avoid electric shock.



DO NOT operate equipment when abnormalities are detected.

If smoke or unusual odors begin emitting from unit, or if any other abnormalities are detected, terminate operation immediately, turn off main power switch (Earth Leakage Breaker - "ELB") and disconnect power cable. Continued operation under such conditions may result in fire or electric shock.



DO NOT operate with bundled or tangled power cable.

Operating unit with the power cable bundled or otherwise tangled, may cause power cable to overheat and/or catch fire.



DO NOT damage power cable.

Damaging the power cable by forcibly bending, pulling or twisting may cause fire or electric shock to the operator.



DO NOT handle flammable substances without proper ventilation.

Be sure there is adequate ventilation when working with certain flammable substances (such as ethanol, etc.), which evaporate quickly at or below room temperature, and emit flammable fumes. Insufficient ventilation may cause a fire or explosion. See "List of Hazardous Substances" (P.28).



DO NOT disassemble or modify equipment.

Attempting to dismantle or modify unit in any way, may cause malfunction, fire or electric shock.

1. SAFETY PRECAUTIONS

Warnings & Cautions

CAUTION!

DO NOT operate equipment during thunderstorms.

In the event of a thunderstorm, terminate operation and turn off main power switch (ELB) immediately. A direct lightning strike may cause damage to equipment, or result in fire or electric shock.

DO NOT touch ice in cold trap.

Handling ice in the cold trap during or after operation with bare hands/fingers may result in severe frostbite.

DO NOT touch cooling fins.

Edges of cooling fins are very sharp. Do not contact with bare hands or skin. Laceration injuries may result.

2. PRE-OPERATION PROCEDURES

Installation Precautions & Preparations

WARNING!

1. Equipment **MUST** always be grounded properly.



- Always connect power cable to a grounded outlet to prevent electric shock from power surges.
- Never connect ground wire to gas lines, water pipes, telephone grounding lines or lightening rods. Doing so may result in fire or electrical shock.



- Do not use branched outlets or extension cords, which may cause power cable to overheat and/or catch fire.

2. Choose an appropriate installation site.

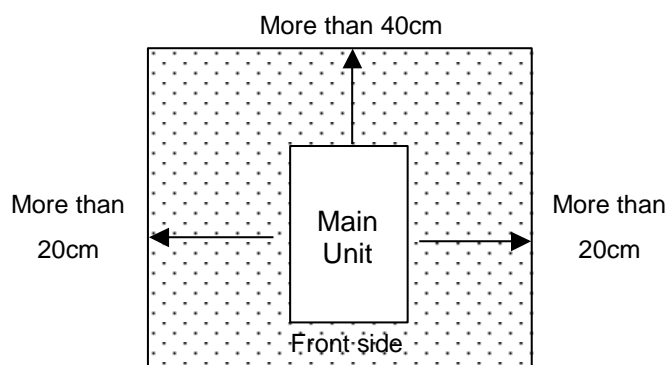


- Do not install DC series unit:

- where flammable or corrosive gases/fumes will be generated.
- where external temperature will exceed 35°C, will fall below 5°C or will fluctuate.
- in excessively humid or dusty locations.
- where there is constant vibration.
- where power supply is erratic.
- in direct sunlight or outdoors



- Install DC unit in a location with sufficient space, and venilation as specified as below.



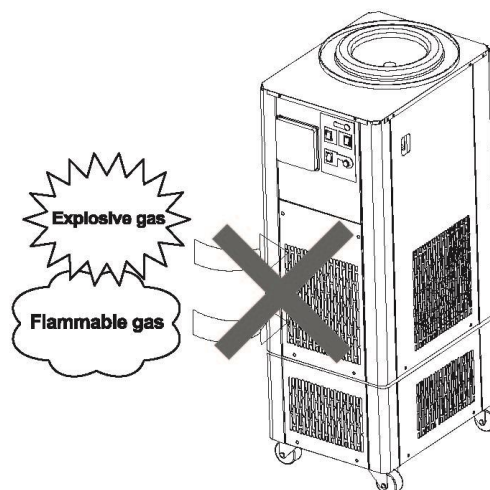
3. Install in a location free of flammables and explosives.



- Never install near flammables or explosives. This unit is NOT fire or blast resistant. Simply switching the main power switch (ELB) "ON" or "OFF" can produce a spark, which can relay during operation, causing a fire or explosion when near flammable or explosive fluids, chemicals or gases/fumes.



- See "List of Hazardous Substances" (P.28).



2. PRE-OPERATION PROCEDURES

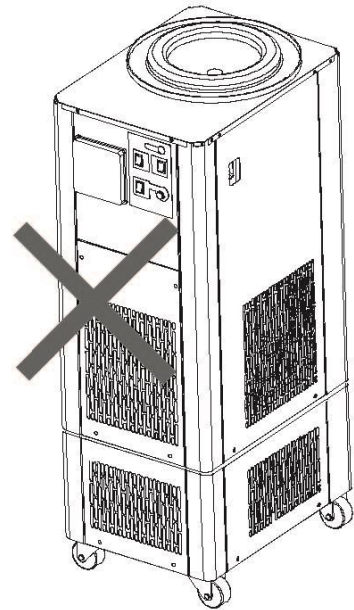
Installation Precautions & Preparations

4. Never disassemble or modify.



- Attempting to disassemble or modify this unit in any way may result in malfunction, fire or electric shock.

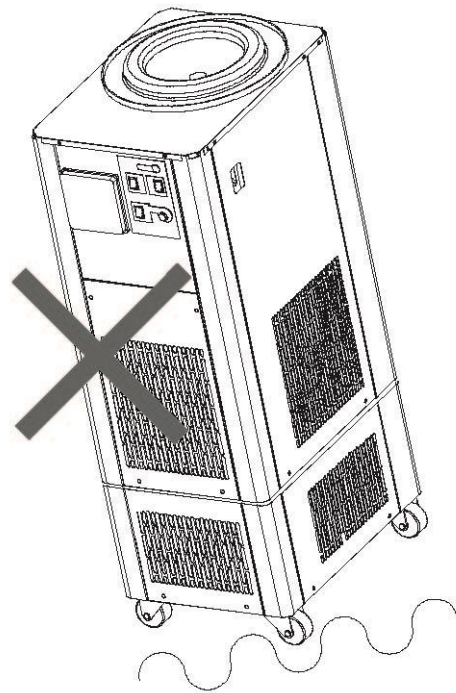
Modification



5. Install on a level surface.



- Install unit on a level and even surface. Failure to do so may result in abnormal vibrations or noise and damage to the refrigeration system.



Approximate unit weight:

DC401: 47kg.

Handle with care. Transport and installation should always be performed by two or more people.

2. PRE-OPERATION PROCEDURES

Installation Precautions & Preparations



6. Connect to a proper power supply.



- Connect power cable to a suitable facility outlet or terminal, according to the following electrical requirements.

Electrical
requirements:
NOTE)

DC401: 220V AC, 50/60Hz, 2.6A (When used with pump & heater: 12A)

- Check the line voltage on outlet or terminal to be used and properly evaluate whether to utilize a line being shared by other equipment. If the unit is not activated by turning on the main power switch (ELB), take an appropriate course of action, such as connecting the unit to a dedicated power source.
- If multiple power cables are connected to a single outlet, input voltage to unit may drop, causing degraded cooling and temperature control performance.

7. Install in a safe location.



- In the event of an earthquake or other unforeseen incident, equipment may unexpectedly shift or fall, causing injury. Taking preventative steps to install unit in a safe location, away from room access doors and out of other danger is strongly recommended.

8. Handle power cable with care.



- Never operate unit with power cable bundled or tangled; and do not modify, bend, forcibly twist or pull on power cable. Doing so may cause fire and/or electrical shock.
- Do not risk damage to power cable by positioning it under desks or chairs, or by pinching it between objects. Doing so may cause fire and/or electrical shock.
- Do not place power cable near kerosene/electric heaters or other heat-generating devices. Doing so may cause power cable insulation to overheat, melt and/or catch fire, which may result in electric shock.
- Turn off main power switch (ELB) immediately and disconnect from facility terminal or outlet, if power cable becomes partially severed or damaged in any way. Failure to do so may result in fire or electric shock.
Contact a local dealer or Yamato sales office for information about replacing power cable if it is damaged.
- Always connect power cable to appropriate facility outlet or terminal.

2. PRE-OPERATION PROCEDURES

Installation Procedures

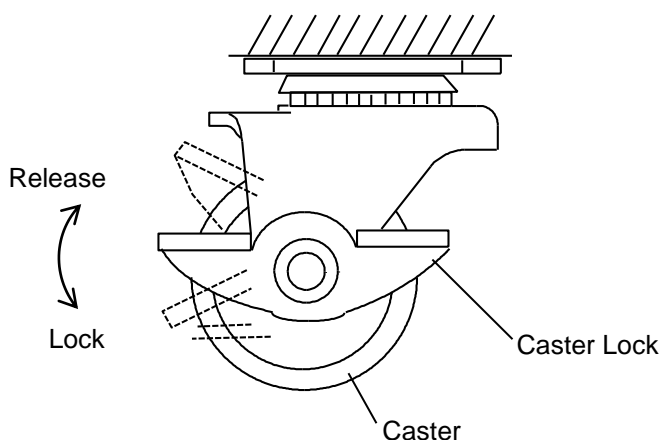
1. Unlock caster.

Pull up on lever to release caster lock (only two front casters are equipped with locks).

2. Move unit in place for installation.

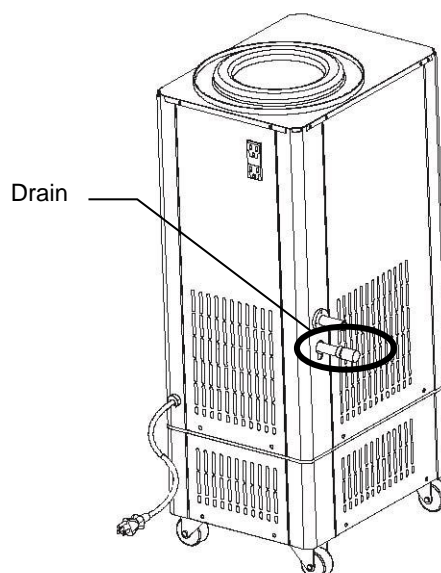
- ❖ Wheeling unit over large bumps or crevices may cause excessive shock to unit or damage to casters. Use care when moving unit and obtain assistance, when necessary, to lift unit over bumps and crevices.

3. When unit is in place, push down on lever to lock caster.



4. Check drain cap

- Check to make sure cap is installed on drain outlet hose.



5. Connect power cable

Be sure main power switch (ELB) is turned OFF. Connect power cable to grounded outlet.

6. Use a vacuum pump having a displacement of 50/min or more, maximum pressure of 1.0×10^{-1} Pa and a check-valve.

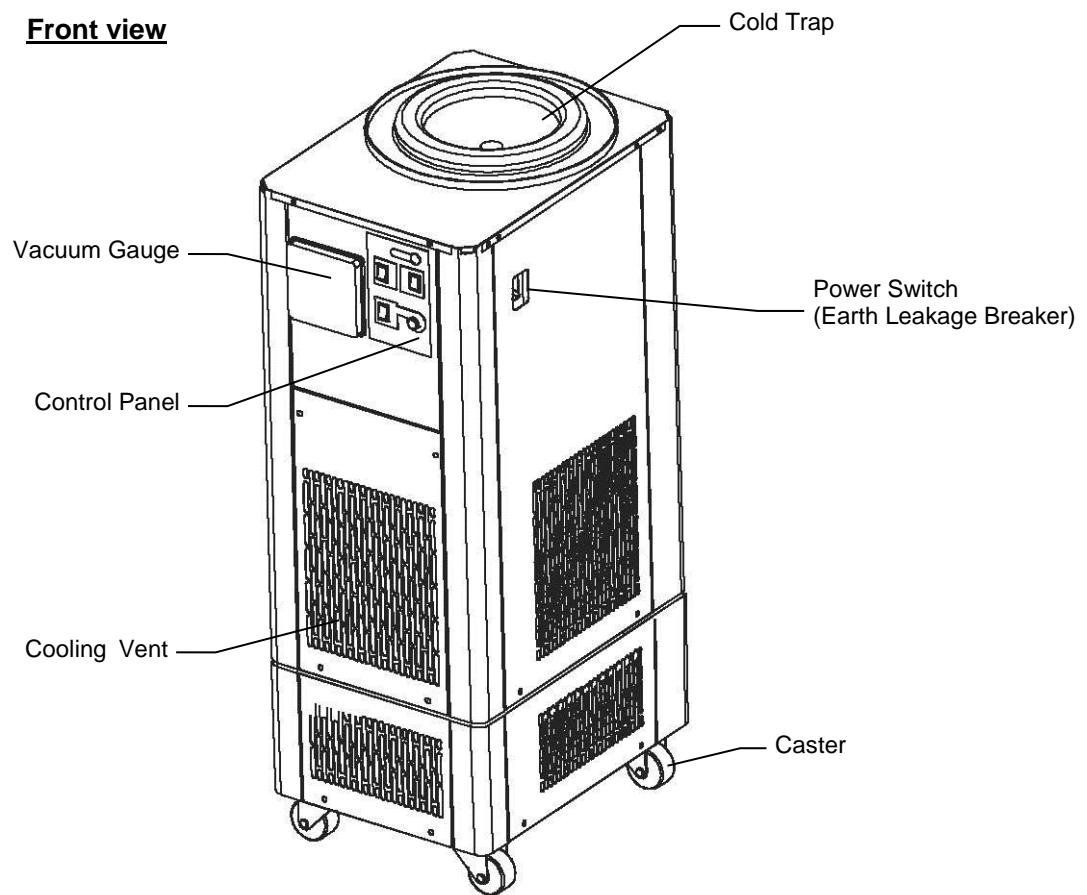
7. Install vacuum valves on all valve openings in the flask mount vacuum chamber.

8. Be sure a freezer is available which can maintain samples sufficiently below their eutectic (solidification) point. Refer to P.11 for explanation on eutectic point.

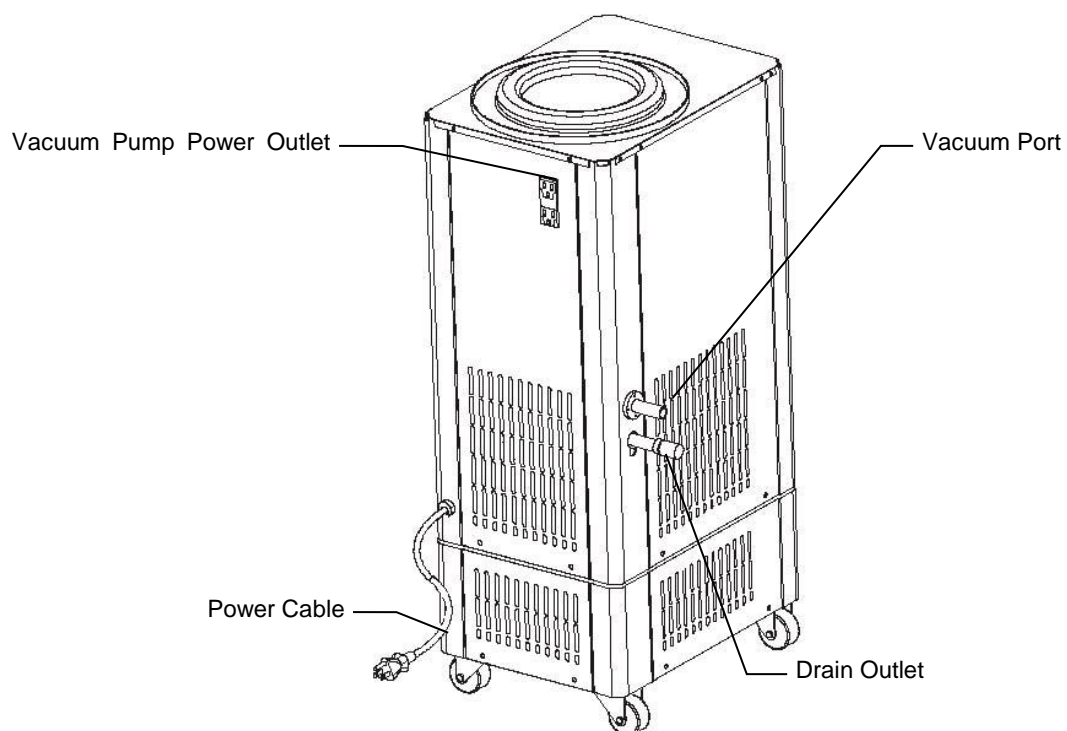
3. COMPONENT NAMES & FUNCTIONS

Unit Overview

Front view

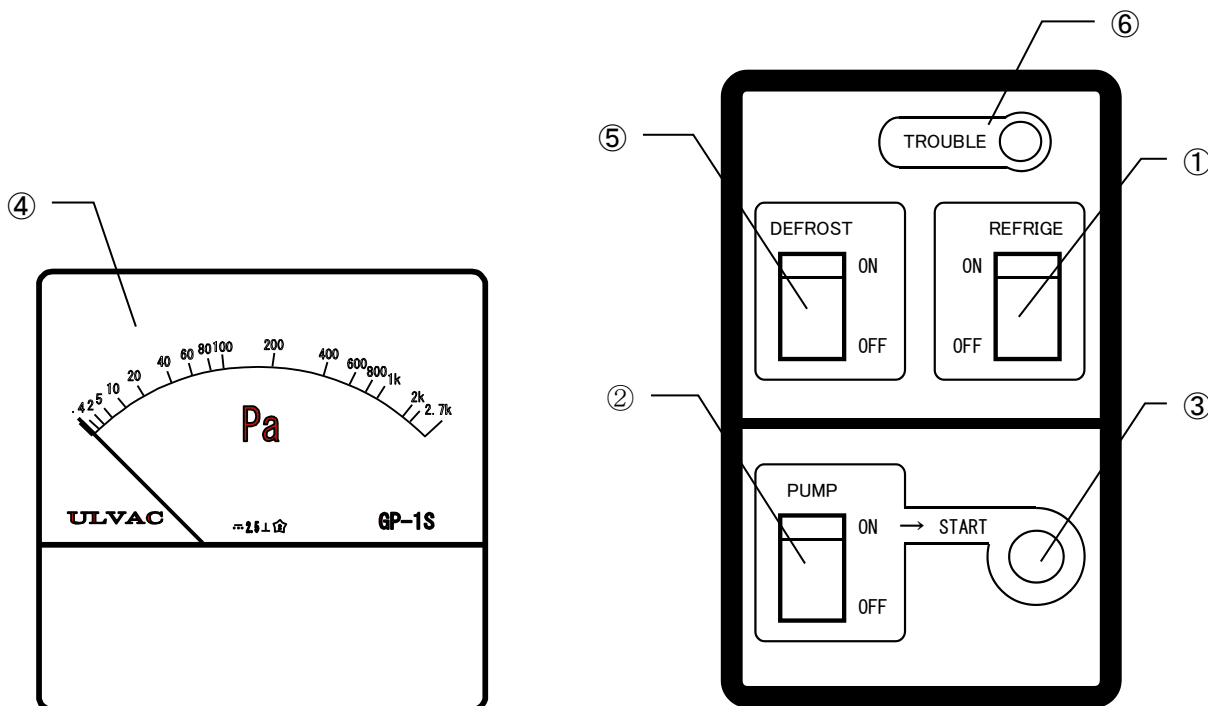


Rear view



3. COMPONENT NAMES & FUNCTIONS

Control Panel



Part Name		Function
①	Refrigeration Switch	Activates/deactivates refrigeration system.
②	Vacuum Pump Switch	Enables/disables pump operation.
③	Pump Start Switch	Starts pump operation.
④	Pirani Vacuum Gauge	Decompression (vacuum) strength meter.
⑤	Defrost Switch	Loosens ice buildup in cold trap.
⑥	Refrigeration Error Lamp	Lights when refrigeration system is in overload.

4. OPERATION PROCEDURES

Pre-freezing

For the pre-freezing process, freeze samples quickly and completely through, at a temperature sufficiently lower than sample eutectic (solidification) point*. Freeze as thinly as possible so that sample will not have a chance to melt before the drying process can dry it. Likewise, external heat may influence and begin melting samples with a low eutectic table, if it is frozen too thickly in the container.

Be advised that if throughput is too high, or if the eutectic point of samples is low, melting may give way to sudden boiling (bumping) which may scatter samples.

- When installing containers during a freeze-dry process, following pre-freeze, wait 3-4 minutes (varies with container and sample types) before installing the next container and opening the next valve for the next process, and so on until the whole process for all containers is complete. Making intervals shorter between each individual container process or attempting to install all containers at once, will cause samples to melt before vacuum pressure is able build again to dry them.

Eutectic (solidification) Point

- If pure water freezes at 0 degree Celsius, a mixed solution of water and other fluids may not freeze immediately below 0 degrees Celsius, and may simply become soft ice, or not freeze at all, because of being mixed with fluid(s) having a freezing point below 0. If temperature continues to fall, the value at which the entire solution uniformly freezes solid is called the "eutectic point" of that solution.

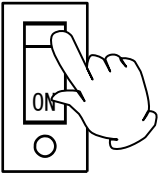
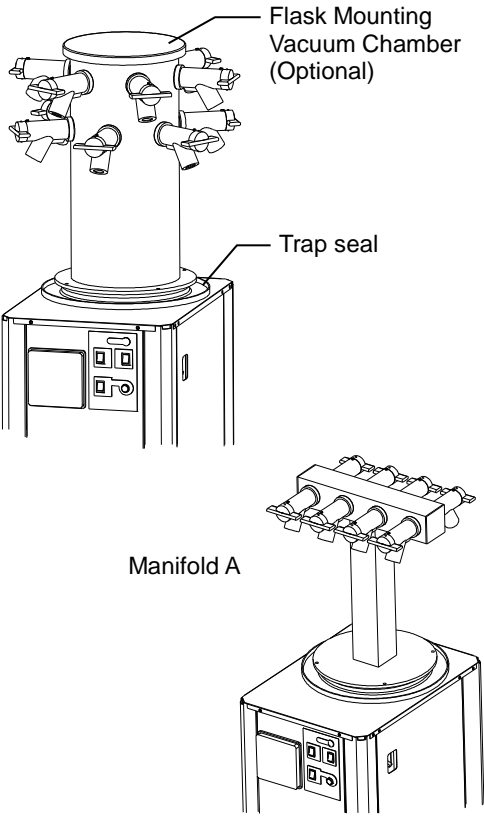
4. OPERATION PROCEDURES

Main Operation

Prepare dryer manifold, vacuum pump, vacuum hose, tandem tube, and other equipment necessary to operation process.

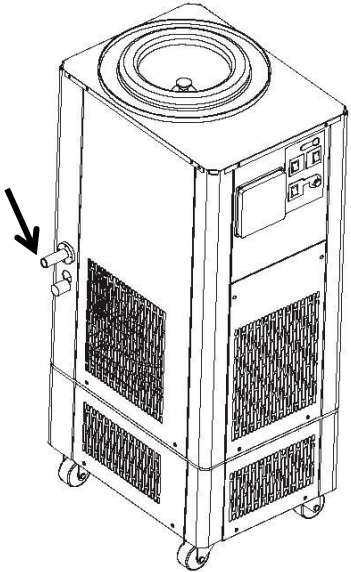
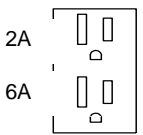
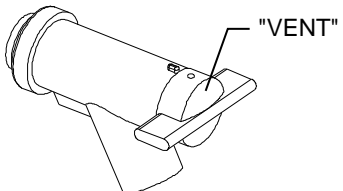
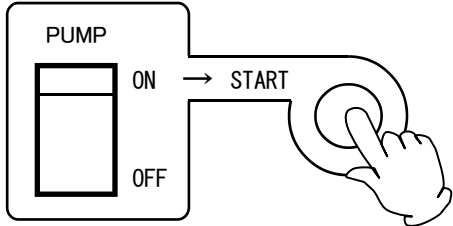
Example vacuum pump: PD52 (from YAMATO Scientific)

Displacement volume: 50/min, maximum vacuum pressure: 6.7×10^{-2} Pa,
inlet pipe diameter: 18mm (or equivalent)

<p>1. Turn power ON</p> 	<ul style="list-style-type: none"> • Turn "ON" main power switch (ELB).
<p>2. Start refrigeration</p> <div style="display: flex; justify-content: space-around;"> <div> <p>DEFROST</p> <p>ON</p> <p>OFF</p> </div> <div> <p>REFRIGE</p> <p>ON</p> <p>OFF</p> </div> </div>	<ul style="list-style-type: none"> • Turn "ON" refrigeration switch. Refrigeration system activates. ❖ In some cases, sound of the refrigeration unit may be higher or lower, depending on initial operation status and surrounding temperature. This phenomenon is not abnormal.
<p>3. Install vacuum chamber.</p>  <p>Flask Mounting Vacuum Chamber (Optional)</p> <p>Trap seal</p> <p>Manifold A</p>	<ol style="list-style-type: none"> 1. Be sure there is no dust or other contaminants on the trap seal or vacuum chamber before flask installation. <ul style="list-style-type: none"> ❖ Damage to or contaminants on chamber and seal weaken vacuum pressure. 2. Gently place flask mounting vacuum chamber on trap seal. <ul style="list-style-type: none"> ❖ If vacuum chamber does not sufficiently adhere to trap seal, a vacuum leak may result. ❖ The above holds true for Manifolds A & B, etc. as well

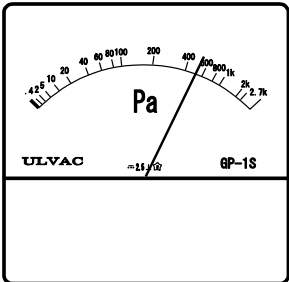
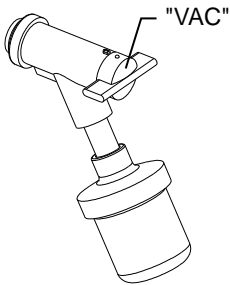
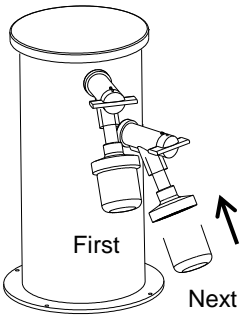
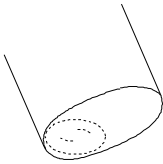
4. OPERATION PROCEDURES

Main Operation

<p>4. Connect vacuum pump</p> 	<ul style="list-style-type: none"> • Connect vacuum hose from pump to the vacuum port on left side of unit. (Exhaust port outer diameter: 17mm) (Inside dia. of applicable vacuum hose: 12mm X outer diameter 30mm) Connect the opposite end of the vacuum hose to vacuum pump inlet. ❖ Seal strength may be improved by applying vacuum seal grease (silicon grease compound manufactured by TORAY, H.V.G, etc) to the inside of vacuum hose opening.
<p>5. Connect vacuum pump to power outlet on back of unit</p> 	<ul style="list-style-type: none"> • Connect vacuum pump power cable to the 6A power outlet on back of DC unit. • Keep vacuum pump switch ON. ❖ Do not go above 8A total on 6A outlet.
<p>6. Close valves.</p> 	<ul style="list-style-type: none"> • Turn all valves so that surface reading "VENT" is in the top position, closing chamber side path.
<p>7. Turn pump switch ON and press START</p> 	<ul style="list-style-type: none"> • When the trap is sufficiently cooled (time required to reach minimum temp has passed), start the vacuum pump. • Time required to minimum temperature: (external temperature: 20°C, no load) DC401: 50min. This time is a guideline and may vary. (There will be condensation near the bottom of vacuum chamber when sufficient time has passed)

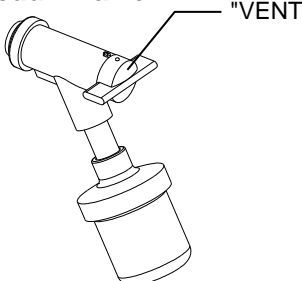
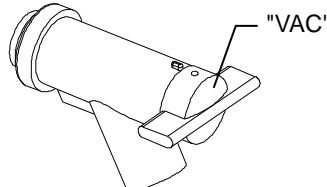
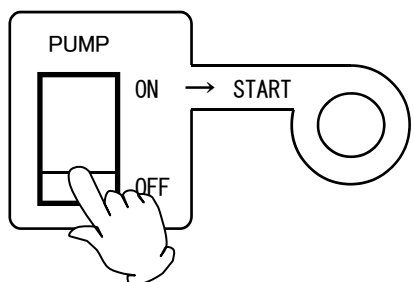
4. OPERATION PROCEDURES

Main Operation

<p>8. Check vacuum gauge</p> 	<ul style="list-style-type: none"> Confirm by looking at the vacuum gauge, that vacuum chamber has sufficiently decompressed. (10Pa-20Pa)
<p>9. Install sample container and open valve</p> 	<ul style="list-style-type: none"> Install the pre-frozen sample container on the vacuum valve, turn the valve knob so that "VAC" is in the top position, opening the chamber side path. Sample container is decompressed and drying process begins.
<p>10. Install the next container</p> 	<ul style="list-style-type: none"> When a vacuum valve is set from "VENT" to "VAC", the chamber interior is pressurized. To process multiple samples, wait (approx. 3-4 min.) until the pressure has returned before turning the next vacuum valve from "VENT" to "VAC". ❖ If multiple samples are processed at one time, decompression will decrease and pre-frozen samples will begin melting.
<p>11. End process</p> 	<ul style="list-style-type: none"> Process may be ended after confirming sample status and making sure process has finished normally.

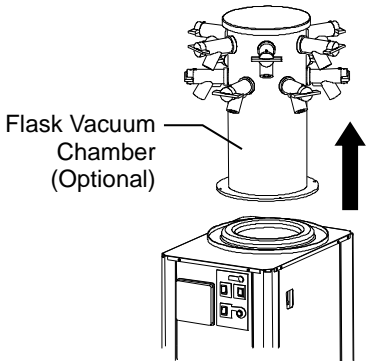
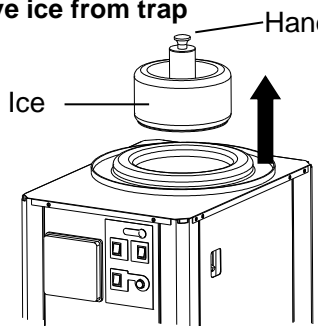
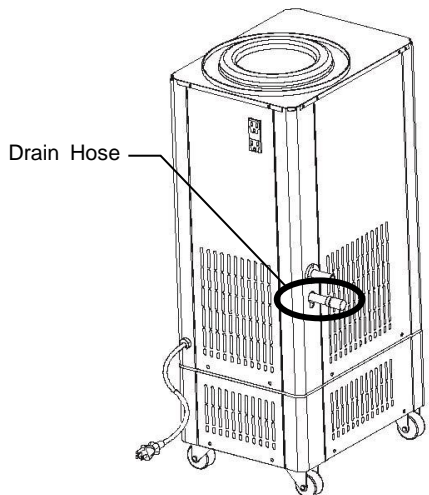
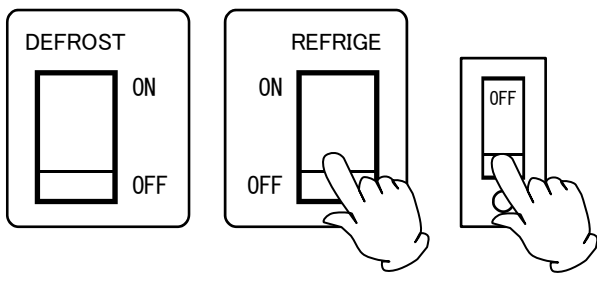
4. OPERATION PROCEDURES

Main Operation

<p>12. Close vacuum valve</p> 	<ul style="list-style-type: none">When process has finished, turn valve from “VAC” to “VENT” (“VENT” in the top position) to normalize pressure in the sample container and remove the container. Hold container securely when removing, so that it is not dropped.
<p>13. Normalize chamber pressure</p> 	<ul style="list-style-type: none">When the drying process has completed for all samples, and all containers have been removed, turn one of the vacuum valves gradually until “VAC” is in the top position. This returns pressure inside the chamber to normal.
<p>14. Turn vacuum pump OFF</p> 	<ul style="list-style-type: none">Turn the vacuum pump switch OFF, after chamber pressure has normalized.

4. OPERATION PROCEDURES


Defrost

<p>1. Remove chamber</p>  <p>Flask Vacuum Chamber (Optional)</p>	<ul style="list-style-type: none"> Remove the flask mounting vacuum chamber from the trap. If ice has formed on trap wall, turn ON the defrost switch.
<p>2. Remove ice from trap</p>  <p>Ice</p> <p>Handle</p>	<ul style="list-style-type: none"> When ice has melted sufficiently to remove, do so by pulling up on handle and turn OFF the defrost switch. Defrost auto stop. DC401: Approx. 20min. ❖ Turn OFF defrost switch manually.
<p>3. Drain water</p>  <p>Drain Hose</p>	<ul style="list-style-type: none"> Remove the drain hose cap, and drain remaining water from the trap into a drain basin or other receptacle.
<p>4. Stop refrigeration system</p>  <p>DEFROST</p> <p>ON</p> <p>OFF</p> <p>REFRIGE</p> <p>ON</p> <p>OFF</p> <p>ELB</p>	<ol style="list-style-type: none"> Turn "OFF" the refrigeration switch. Turn "OFF" the main power switch (ELB).


5. HANDLING PRECAUTIONS

WARNING!

DO NOT operate equipment when abnormalities are detected.


-  If unit begins emitting smoke or abnormal odors for reasons unknown, turn off main power (ELB) immediately, disconnect power cable from power supply, and contact a local dealer or Yamato sales office for assistance. Continuing to operate without addressing abnormalities may cause fire or electric shock, resulting in serious injury or death. Never attempt to disassemble or repair unit. Repairs should be always be performed by a certified technician.

DO NOT handle flammable substances without proper ventilation.


-  Be sure there is adequate ventilation when working with certain flammable substances (such as ethanol, etc.), which evaporate quickly at or below room temperature, and emit flammable fumes. Little or no ventilation may cause a fire or explosion resulting in serious injury or death.

CAUTION!


Trap capacity.

-  Maximum cold trap capacity for DC401 is approx. 0.6ℓ /1.0ℓ respectively. Exceeding this capacity may severely degrade performance.


DO NOT climb on equipment.

-  Do not attempt to climb onto unit or substitute it for a proper step ladder. Units are not designed to support bodily weight and damage may result. In addition, unit may become unstable and tip over or fall resulting in equipment damage, serious injury or death.


DO NOT place objects on equipment.

-  Do not place any objects on unit. Doing so may cause unit to become unstable and tip over, resulting in possible equipment damage, injury or death.


DO NOT operate equipment during thunderstorms.

-  In the event of a thunderstorm, turn off main power switch (ELB), and disconnect power cable immediately. A direct lightning strike may cause equipment damage fire or electric shock, resulting in serious injury or death.


Overnight and extended storage.

-  Whenever unit is not in operation, stored overnight or placed in storage, always turn off main power switch and disconnect power cable. Drain any fluid collected in the cold trap.


Power supply voltage.

-  Power supply voltage must be within +/-10% of the rated voltage.

DO NOT use solvents.

-  The seals contained in DC series units are made from chloroprene rubber and may be damaged by acids, halogens, aromatics, esters, and oxo solvents. Do not use these compounds with unit.

Restarting

-  To restart, wait more than 5 minutes after unit has been turned off before turning back on.

5. HANDLING PRECAUTIONS

Upper limit of inside bath temperature.



Do not run successive operations when cold trap temperature is above -20°C.

Vacuum grease application.



Vacuum pressure is weakened and vacuum leaks may occur if any contaminants are allowed to build up on vacuum connection components. If contaminant buildup is found in any vacuum connection joints, clean and reapply vacuum grease as needed.

If vacuum valve stem tubes become difficult to rotate, remove the stem tube, apply vacuum grease, and reinstall.

Normalizing pressure.



Before turning OFF the vacuum pump, following an operation run, confirm that pressure in the vacuum chamber has returned to normal. If vacuum pump is turned OFF while chamber is decompressed, oil from the pump may back up into the chamber. Refer to P.15 for pressure normalization procedure.

Ampule neck size.



Ampule adapter inner diameter is 7mm. Use ampules with a connection neck size of 7-9mm.

Teardrop flask.



Use TS29 for teardrop flask fitting.

6. MAINTENANCE PROCEDURES

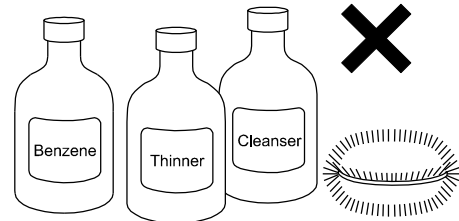
Inspection & Maintenance

WARNING!

- Always disconnect the power cable when performing inspection or maintenance, unless otherwise necessary.
- Perform daily inspection and maintenance after unit temperature has returned to normal (room temp).
- Do not disassemble unit.
- Do not touch cooling fins with bare hands or fingers.

CAUTION!

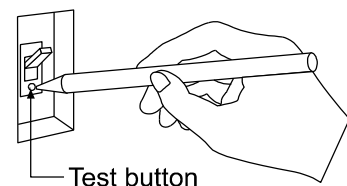
- Clean with a soft, damp cloth. Never use benzene, paint thinner, scouring powder, scrubbing brushes or other abrasives and solvents to clean unit. Superficial damage and/or discoloration, as well as deformity to some components may result.



Monthly maintenance

Inspect main power switch (ELB) ON and OFF function.

- Prepare unit for inspection by connecting power cable to a facility outlet or terminal.
- Confirm that main switch (ELB) is "OFF" then, turn main switch (ELB) back "ON".
- With the main switch "ON", depress the test button on the main switch (ELB) using a ball-point pen or other fine-tipped object. If main switch (ELB) shuts off, it is functioning normally.



Cleaning cooling fins

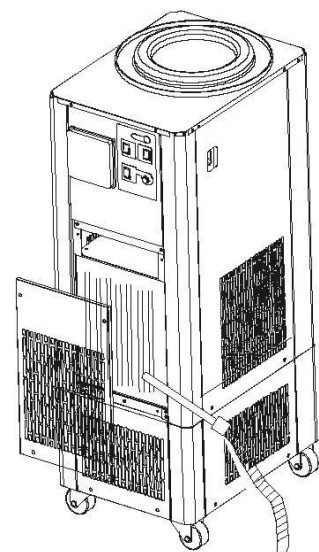
- If cooling fins are allowed to become clogged with dust, degraded performance and refrigeration system malfunction may result. Inspect and clean cooling fins periodically.
- ❖ Loosen (4) vent cover mounting screws and remove. Clean dust from cover/filter using a vacuum cleaner.
- ❖ After cleaning the cooling fins in the same way, reinstall vent cover.



Be careful not to bend or crush the fins while cleaning.



Do not contact cooling fins with bare hands or fingers.



Contact a local dealer, or Yamato sales office for further assistance.

CAUTION!

Extended storage

- Turn off power switch and disconnect power cable before putting unit in storage or out of service.
- Drain all fluid and wipe remaining remnants from cold trap.

WARNING!

Disposal

- Place out of reach of children.
- Dispose of main unit and cold trap as bulky or industrial waste.
- Refrigeration unit utilizes flammable refrigerant. Dispose of refrigerant by draining in small amounts at a time in a well-ventilated area, away from flames.

Disposal Considerations

Dispose of or recycle this unit in a responsible and environmentally friendly manner.

Yamato Scientific Co., Ltd. strongly recommends disassembling unit, as far as is possible, in order to separate parts and recycle them in contribution to preserving the global environment.

Major components and materials, comprising DC series units are listed in the table below:

Component	Material/Compound
Main	
Casing	Galvanized steel with baked-on melamine resin coating
Inner trap, Cover	Stainless steel SUS304, Acrylic
Name plate	Polyester (PET) resin film
Corner protectors	Alkylbenzenesulfid (ABS) resin
Trap seal	Silicon rubber
Electrical	
Switches, Relays	Composite of resin and other
Power cable, wiring materials and other	Composite of synthetic rubber, copper, nickel and other
Refrigeration System	
Refrigeration unit	Iron, Synthetic oil and other
Cooling fins	Aluminum, Copper
Parts of Piping	
Drain hose	Natural rubber
Drain tap	Polyacetal resin
Drain tap holder	Galvanized steel with baked-on melamine resin coating
Pipe cover	Polyurethane sponge
Pipe	Copper
Sealed Cooling Medium for Refrigerator	
Coolant	DC401: R404A,225g

8. TROUBLESHOOTING

Troubleshooting Guide

Symptom	Possible Causes/Solutions
Unit will not power on.	<ul style="list-style-type: none">• Power cable is not connected properly or securely.• Power failure in progress.• Main power switch (ELB) is "OFF"
Temperature does not fall.	<ul style="list-style-type: none">• Cooling fins are clogged with dust or debris.• Too many samples are being processed at once.• External temperature exceeds 30°C.• Cooling vent(s) are obstructed.

Error lamps

Error symptom	Cause	Remedy
Refrigeration error lamp on	Refrigeration system overload	<ul style="list-style-type: none">• Turn power off immediately, eliminate error source (refer to "Trouble Shooting" – "temperature does not fall", above) and restart after 5 minutes.• If lamp stays lit after restart, call for service.

If problem persists, turn off power immediately, disconnect power cable and call for service.

Requests for Repair

When a problem occurs, terminate operation immediately, turn off main power switch (ELB) and disconnect power cable.

Contact a local dealer or Yamato sales office for assistance.

The following information is required for all repairs.

- Model name
 - Serial Number
 - Date (year/month/day) of purchase
 - Description of problem in as much detail as possible
- } Refer to serial no. and rating sticker on unit.

Guaranteed Supply Period for Repair Parts

Guaranteed maximum supply period for repair parts is 7 (seven) years from date of discontinuation for DC401 freeze dryer models. "Repair parts" is defined as components which, when installed, allow for continued unit operation.

10. SPECIFICATIONS

Main Unit

Model		DC401
Method		Cooled container system
Performance	Drying capacity	Max. 0.6kg
	Minimum temperature ※	-45°C
	Time required to reach minimum temperature ※	50min. (20°C to -45°C)
Configuration	Refrigeration	Air cooling, 400W
	Coolant	R404a
	Pressure meter	Pirani gauge
	Vacuum port	φ 17mm
	Chamber material	SUS304, Cylindrical
	Dimensions of chamber	φ 153 × H235mm
	Capacity	Approx. 4L
	Usable external temperature	5 to 30°C
Standard measurements	External dimensions	W340 × D450 × H920 mm
	Weight	Approx. 53Kg
	Power requirements	220V AC, 50/60Hz, 2.6A
Included items		Vacuum silicon grease (TORAY H.V.G), Vacuum hose (φ 12 × φ 30 × 1.5m), DC401 instruction manual, Pirani gauge instruction manual

※Performance based on operation room temperature (20°C), no load

10. SPECIFICATIONS

Optional Accessories

Name	Specification		Product code
Flask Mounting Vacuum Chamber	Mounting valve	Inner dia.: 18.5mm	212560
	Mounting valve pitch	96mm	
	Number of ports	12	
	Dimensions	φ 195 × H303 mm	
Manifold A	Mounting valve	Inner dia.: 18.5mm	212561
	Mounting valve pitch	80mm	
	Number of ports	8	
	Dimensions	W304 × D60 × H263 mm	
Manifold B	Mounting valve	Inner dia.: 18.5mm	212562
	Mounting valve pitch	80mm	
	Number of ports	16	
	Dimensions	W624 × D60 × H263 mm	
Dry chamber	Number of shelves	1	212563
	No. of 60mm petri dishes supplied	7	
	Temperature adjustment	30°C±2°C ※	
	Dimensions	φ 252 × H240 mm	
Stopper plug type dry chamber	Number of shelves	1	212564
	No. of 60mm petri dishes supplied	7	
	Temperature adjustment	30°C±2°C ※	
	Dimensions	φ 252 × H425 mm	
Dry flask	120mℓ ・ 5 pcs.		212820
	250mℓ ・ 5 pcs.		212821
Dry flask cap (with glass joint)	Straight ・ 5 pcs.		212570
	45° bent ・ 5 pcs.		212571
Serum bottle (Vial)	50mℓ ・ 10 pcs.		212814
	30mℓ ・ 10 pcs.		212815
	10mℓ ・ 10 pcs.		212816
Ampule adapter	Single ・ 5 pcs.		212572
	Double ・ 5 pcs.		212573
	Triple ・ 5 pcs.		212574
Test tube adapter (with glass joint)	Straight		212590
	Angled 45°		212591
Teardrop flask adapter (female)	TS29 fitting or equivalent		212569
Teardrop flask adapter (male)	TS29 grinding		212597
Glass joint	Straight		212598
	Angled 45°		212599
Micro tube holder	1.5mℓ × 16 pcs. mountable		212580

※Performance based on operation at 20°C, no load

DC401



ELB	Earth leakage breaker	X3	Relay (refrigeration)	PASw	Switch (vacuum gauge)	CN	Power receptacle
P	Terminal block	X4	Relay (refrigeration stop)	PSsw	Pressure switch	T1	Timer (auto defrost)
FM	Fan motor (refrigeration)	X5	Relay (pressure error)	VAC	Lamp (VACsw built-in)	T2	Timer
MV1	Solenoid valve (refrigeration)	X6	Relay (solenoid valve)	DEF	Lamp (DEFsw built-in)	PTC-ASM	Start relay
Mv2	Solenoid valve (defrost)	VACsw1	Switch (pump)	REF	Lamp (REFsw built-in)	OVR	Overload relay
Mv3	Solenoid valve (VAC)	VACsw2	Switch (pump start)	PS	Lamp (pressure)	C1	Operation condenser
X1	Relay (VAC)	DEFsw	Switch (defrost)	PA	Pirani gauge	C2	Start condenser
X2	Relay (refrigeration, pump stop)	REFsw	Switch (refrigeration)	TH	Sensor (vacuum gauge)	RF	Refrigeration unit

12. REPLACEMENT PARTS

DC401

Symbol	Part Name	Specification	Manufacturer	Code No.
MV1	Solenoid valve (refrigeration)	NEV-603DXF	Saginomiya	3020060004
MV2	Solenoid valve (defrost)	SEV-502DXF	Saginomiya	3020060003
MV3	Solenoid valve (VAC)	AG33022 AC100V	CKD	3200010018
ELB	Earth leakage breaker	BJS2032N 20A	Panasonic	2060050002
X3, 4, 6	Relay	LY1F AC100V	OMRON	LT-00000992
X1, 2	Relay	LY3F AC100V	OMRON	LT00000993
T2, 3	Timer (auto defrost)	ADX11134	Matsushita	2050000053
T1	Timer	ADX11184	Matsushita	LT00000994
DEFsw PEFsw	Switch	CW-SB21NMKZMEF	Nihon Kaiheiki	2550000011
VACsw2	Switch	CW-SB21NYKZYEF	Nihon Kaiheiki	2550000017
VACsw1	Switch	A3CT-90A0-Y	OMRON	LT00000995
PS	Lamp (pressure)	BN5665L AC100V	Satoh Parts	LT00021961
CN	Receptacle	AC-R02MB12	ECHO	LT00033205
PA	Pirani gauge	GP-1 (WP-02 with sensor)	ULVAC	LT00001004
PSsw	Pressure switch	VHP-F	Fuji Kohki	3180000006
RF	Compressor	RL4075HA	Hitachi	LT00028782
FM	Fan motor	SE4-C041NP	Sanyo C&C	3010060006
P	Terminal block	MKH-250ABC-4P	Terminal	LT00035672
X5	Relay	LY2F AC100V	OMRON	2050000035
TF	Transformer	AD21-02KB	Toyozumi	2180020010

13. LIST OF HAZARDOUS SUBSTANCES



Never process any explosive, flammable samples and also samples contained with those substances.

Explosive Substance	①Nitroglycol, Glycerine trinitrate, Cellulose Nitrate and other explosive nitrate esters
	②Trinitrobenzen, Trinitrotoluene, Picric Acid and other explosive nitro compounds
	③Acetyl Hydroperoxide, Methyl Ethyl Ketone Peroxide, Benzoyl Peroxide and other organic peroxides
	④Metallic Azide, including Sodium Azide, etc.
Explosive Substances	①Metal "Lithium" ②Metal "Potassium" ③Metal "Natrium" ④Yellow Phosphorus
	⑤Phosphorus Sulfide ⑥Red Phosphorus⑦Phosphorus Sulfide
	⑧Celluloids, Calcium Carbide (a.k.a, Carbide)⑨Lime Phosphide⑩Magnesium Powder
	⑪Aluminum Powder ⑫Metal Powder other than Magnesium and Aluminum Powder
	⑬Sodium Dithionous Acid (a.k.a., Hydrosulphite)
Oxidizing Substances	①Potassium Chlorate, Sodium Chlorate, Ammonium Chlorate, and other chlorates
	②Potassium Perchlorate, Sodium Perchlorate, Ammonium Perchlorate, and other perchlorates
	③Potassium Peroxide, Sodium Peroxide, Barium Peroxide, and other inorganic peroxides
	④Potassium Nitrate, Sodium Nitrate, Ammonium Nitrate, and other nitrates
	⑤Sodium Chlorite and other chlorites
	⑥Calcium Hypochlorite and other hypochlorites
Flammable Substances	① Ethyl Ether, Gasoline, Acetaldehyde, Propylene Chloride, Carbon Disulfide, and other substances with ignition point at a degree 30 or more degrees below zero.
	②n-hexane, Ethylene Oxide, Acetone, Benzene, Methyl Ethyl Ketone and other substances with ignition point between 30 degrees below zero and less than zero.
	③Methanol, Ethanol, Xylene, Pentyl n-acetate, (a.k.a.amyl n-acetate) and other substances with ignition point between zero and less than 30 degrees.
	④Kerosene, Light Oil, Terebinth Oil, Isopenthyll Alcohol(a.k.a. Isoamyl Alcohol), Acetic Acid and other substances with ignition point between 30 degrees and less than 65 degrees.
Combustible Gas	Hydrogen, Acetylene, Ethylene, Methane, Ethane, Propane, Butane and other gases combustible at 15°C at one air pressure.

(Source: Appendix Table 1 of Article 6 of the Industrial Safety and Health Order, Japan)

Limited Liability

Always operate equipment in strict compliance to the handling and operation procedures set forth by this instruction manual.

Yamato Scientific Co., Ltd. assumes no responsibility for malfunction, damage, injury or death, resulting from negligent equipment use.

Never attempt to disassemble, repair or perform any procedure on DC401 units which are not expressly mandated by this manual. Doing so may result in equipment malfunction, serious personal injury or death.

Note

- ◆ Instruction manual descriptions and specifications are subject to change without notice.
- ◆ Yamato Scientific Co., Ltd. will replace flawed instruction manuals (pages missing, pages out of order, etc.) upon request.

Instruction Manual

Freeze Dryer
Model DC401

First Edition June 7, 2017

Revision

Yamato Scientific America Inc.
925 Walsh Avenue, Santa Clara, CA 95050
Phone: 800.292.6286 / 408.235.7725
<http://www.yamato-usa.com>