ULVAC

Liquid Nitrogen Generator

Instruction Manual

EMP-20W

Export Control Policy

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

Customers must follow all related rules and regulations such as Foreign Exchange and Foreign Trade Act and take appropriate procedures when exporting or re-exporting our refrigerators.

D/N.MJOM117E, 2016SR03 **ULVAC CRYOGENICS INCORPORATED**

Introduction

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

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. To ensure proper use of this product, read this instruction manual carefully and keep this manual close at hand so that you can use for reference during operation.

If you purchased our other products and/or optional devices with this product, read relevant instruction manuals carefully.

Safety Conventions

Our products have been designed to provide extremely safe and dependable operation when properly used. Following safety precautions must be observed during normal operation and when servicing them.

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

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

Toxic gas or chemicals used.

There is a risk of severe injury upon contact.

Corrosive chemicals used.

There is a risk of severe injury upon contact.

Flammable gas used.

There is a danger of fire or burn injury.

Explosive gas used.

There is a risk of fire or explosion.

Hazardous voltage .

Electric shock may cause severe injury or loss of life.

Hot heating part present.

There is a risk of burn injury.

Low-temperature area present.

There is a risk of frostbite. Do not touch.

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Safety Instructions

1. Danger of electric shock: Do not touch the live part.

To this unit, voltage that would cause electrocution or serious injuries is applied. It is extremely dangerous to touch the live part inside the unit. Make sure to turn OFF the main power source before performing installation, maintenance or repair. Contacting the internal parts that are not insulated may damage human body or equipments such as electrical shock.

Connect the earth wire to D type grounding.

2. Danger of oxygen deficiency: Ventilate well.

Nitrogen gas itself is not toxic to human bodies but it reduces the oxygen concentration in the atmosphere (the oxygen concentration of 18% or below is defined as an oxygen-depleted state).Choose a well-ventilated and good-air-circulated location to install the present unit, and install a ventilator with a capacity of at least 2000 m3/Hr airflow. In addition, do not stay together with a dewar containing liquid nitrogen in a sealed space, such as an elevator or a car.

3. Danger of explosion: Do not seal LN2.

The volume of nitrogen gas is 700 times of liquid nitrogen. Confining atmospheric pressure liquid nitrogen in an airtight space produces high-pressure gas as high as 700 Atm, possibly resulting in explosion. Use liquid nitrogen in the condition constantly open to air.

4. Danger of burns or frostbites: Never touch high temperature and ultra-low temperature area.

Liquid nitrogen provides temperature as low as -196°C. If liquid nitrogen is directly handled, frostbites, loss of sight, and others are foreseen. Be sure to wear leather gloves, goggles, trousers without turnips, etc. to handle liquid nitrogen. In addition, take care of liquid nitrogen transport piping, too. In this unit, there is a part with danger of burns if it is touched directly. Carry out maintenance, repair, etc. at least 30 minutes after the unit is stopped.

5. Danger of Explosion: DON'T expose to corrosive gases.

In this unit, high-pressure Helium gas is filled. To disassemble or dispose of the unit, parts, and others, be sure to discharge gas (under regular maintenance, there is no need to discharge gas). In addition, never attempt to install the apparatus under the atmosphere of hydrochloric acid-based, chlorine gas-based, and other corrosive gases.

Disposal Considerations

Disposal of industrial waste is regulated by national or local governments. Follow all applicable local or national laws, regulations or guidelines when disposing of our products.

WARNING

When the refrigerator unit may have pumped toxic or dangerous gases, you must contact your safety supervisor at the time of disposal, and follow the instructions to remove hazardous substances before disposing.

We provide Safety Data Sheet (SDS) of our products upon your request.
Please contact us when necessary.

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1. General Description of the System

1.1 Liquid nitrogen generator (EMP-20W)

EMP-20W Liquid Nitrogen Generator provides liquid nitrogen by cooling down, condensing and liquefying nitrogen gas with the cold head (Model:S050).

Liquid nitrogen is stored the inside the dewar, and can be dispensed to another container with easy operation. With the optional automatic transfer system, liquid nitrogen can be automatically transferred to the dewars of customers' equipments.

Nitrogen gas source can be selected from two types; (1) PSA nitrogen generator, (2) Membrane nitrogen generator.

Liquid nitrogen generator is hereafter referred to as "EMP-20W" in this manual.

1.2 Helium gas compressor (model:UW404)

This unit is in the right side of EMP-20W, compress Helium gas to supply to the cold head to provide cryogenic temperatures. It is automatically turned on and off by the control circuit of EMP-20W.

Helium gas compressor is hereafter referred to as "UW404" in this manual.

For details of this equipment, please refer to the operation manual for "UW404".

1.3 PSA (Pressure Swing Adsorption) Nitrogen Generator (type GN-15i)

PSA Nitrogen Generator GN-15i generates highly concentrated nitrogen from air using adsorber and supply the gas to EMP-20W. The nitrogen generated here is used as the material for liquid nitrogen and is also used to take out liquid nitrogen.

PSA nitrogen generator is hereafter called "GN-15i" in this manual. When we describe things that are in common with membrane nitrogen generators, they are collectively referred to as "nitrogen generators".

Please refer to the operation manual of GN-15i for details.

1.4 Membrane Nitrogen Generator (type IM-120)

Membrane Nitrogen Generator IM-120 takes in dry air from user's equipments and generates highly concentrated nitrogen with membrane separation technology. The nitrogen generated here is used as the material for liquid nitrogen and is also used to take out liquid nitrogen.

Membrane nitrogen generator is hereafter called "IM-120" in this manual. When we describe things that are in common with PSA nitrogen generators, they are collectively referred to as "nitrogen generators".

Please refer to the operation manual of IM-120 for details.

2. Component Description

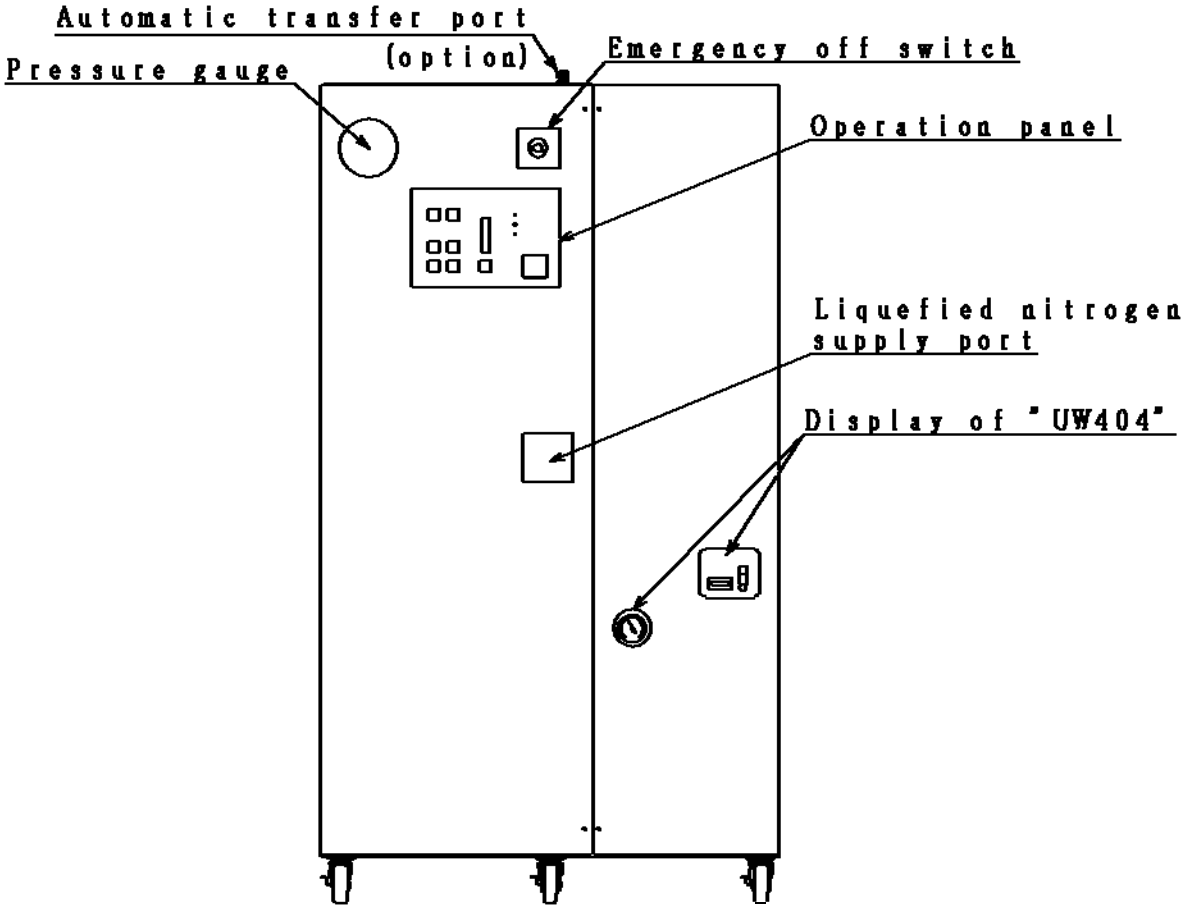

Figure 2-1 Front view of EMP-20W

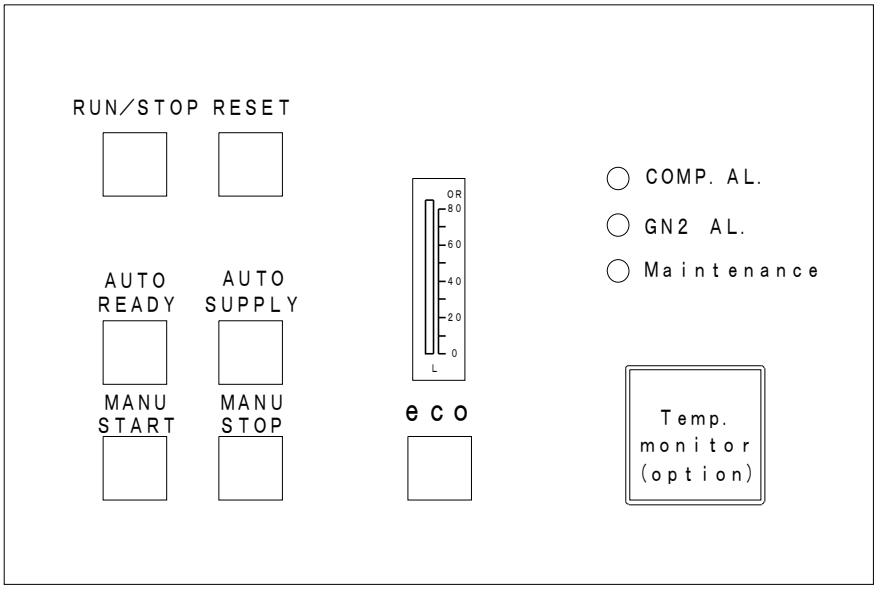

Figure 2-2 Operation panel of EMP-20W

2.1 Front view of EMP-20W (Figure 2-1)

Emergency off button	:Press this button to interrupt power supply to the control circuit to stop such operations as liquid nitrogen supplying, etc. Do not use the emergency off button except for emergency.
Front left door	:Remove two screws to open this door. Inside the door, there are a liquid nitrogen dewar, a cold head and electric circuits. Open this door only for periodic inspection, maintenance and repair services.
Front right door	:Remove two screws to open the front right door. Inside the door, there is UW404. Open this door when you adjust helium gas pressure.
LN2 manual dispense port	:Press the panel to open. Inside the panel, there is a tube connector used to connect liquid nitrogen supply flexible hose. Since the port may reach extremely low temperature, be careful not to touch such port during or right after supply of liquid nitrogen.
Automatic transfer port	:This port is an optional Swagelok coupling to connect LN2 automatic transfer tube.
(Optional)	Note that the port reaches to extremely low temperature during and immediately after dispensing LN2.
Display of “UW404”	:Displays the status of UW404.

2.2 Operation panel of EMP-20W (Figure 2-2)

RUN/STOP	:Use this button to start or stop the main unit. Green light turns on during normal operation, and flickers when the error occurs. In addition, the light will turn off when the machine is in “eco”-mode standby.
RESET	: This switch is used to reset the EMP-20W error.
AUTO READY	: Use this button when you wish to use automatic transfer function. When you wish to use the automatic transfer, turn this on. While waiting for automatic transfer, green light turns on. When the level sensor of the supplied dewar detects any trouble, green light blinks.

AUTO SUPPLY	: Use this button to start dispensing liquid nitrogen at your convenience when using the optional automatic transfer function with our level sensor. This button illuminates in white while automatic transfer is taking place.
MANU START	: Press this button to manually dispense liquid nitrogen from LN2 manual dispense port. (To be referred to as “Manual supply”) The manual supply is terminated automatically. This button lights in green while liquid nitrogen is manually supplied and blinks from pressing 30 seconds in advance to automatic termination. When you wish to supply more, press this button once again while it is blinking to extend the supply time by 10 minutes..
MANU STOP	: Push this button to interrupt the manual supply of liquid nitrogen supply operation.
Indicator	: Displays the guideline amount of liquid nitrogen in liquid nitrogen dewar.
eco	: Press this button to switch to eco-mode operation and the button lights in blue. For eco mode, please refer to "13.eco mode".
COMP. AL.	: Turns on red when the UW404 is stopped due to error. In this case, the RUN/STOP button flickers at the same time.
GN2 AL.	: The lighting is turn on red when nitrogen gas generator stops due to faults, or when the supply pressure of nitrogen gas declines. Then RUN/STOP switch flickers.
Maintenance	: This light turns on in orange when it approaches the maintenance of S050 or UW404.
Temperature meter	:This shows the temperature inside the dewar.

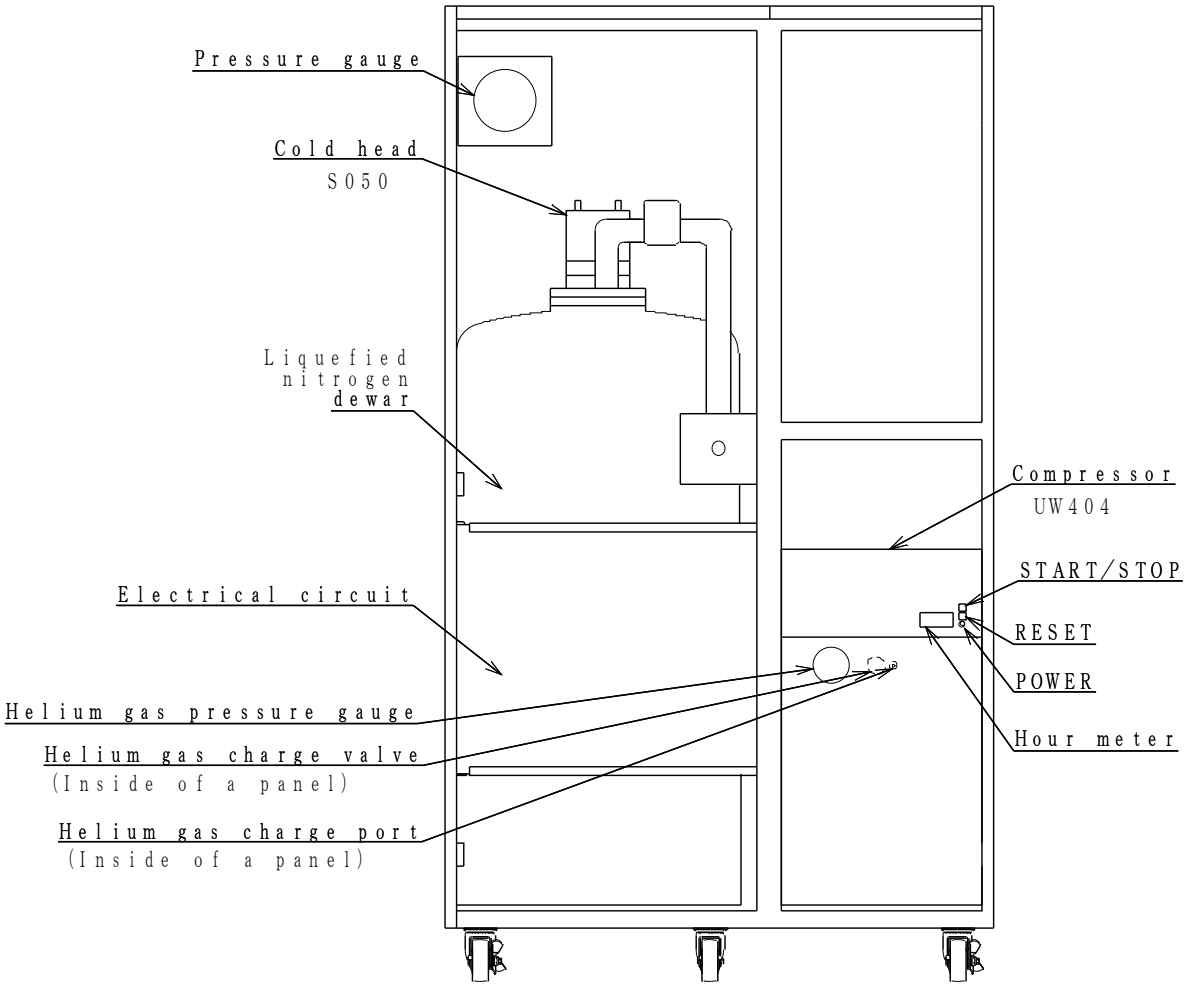

Figure 2-3 Inside view of EMP-20W front door and lower panel

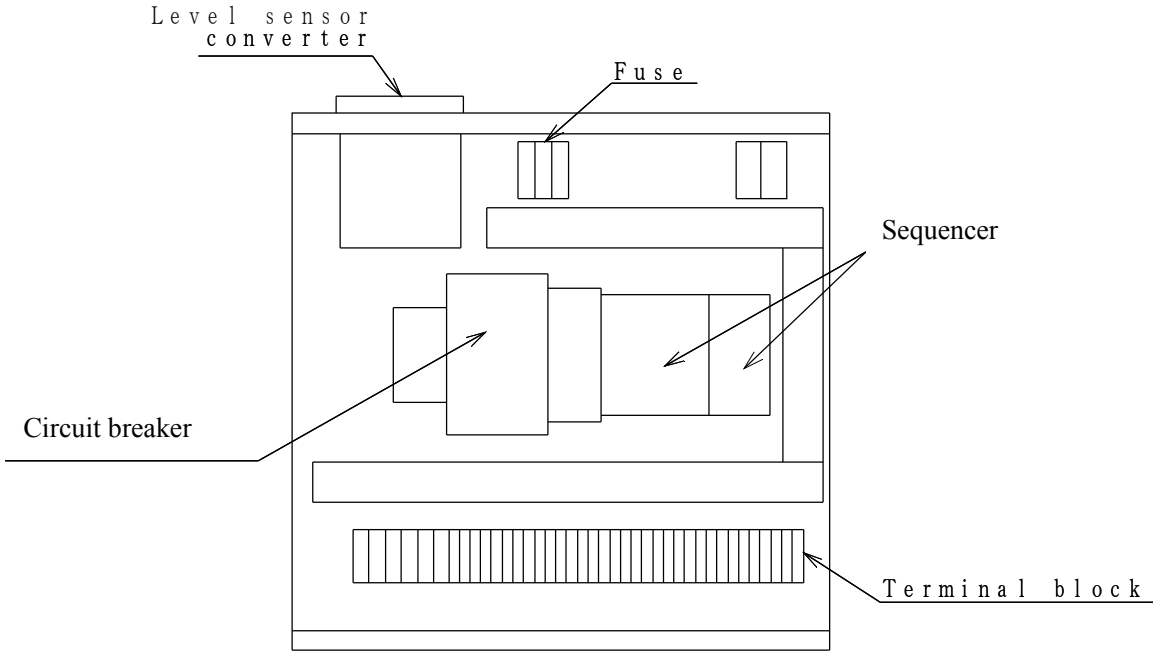

Figure 2-4 Electrical circuit

2.3 Inside view of EMP-20W front door and lower panel (Figure 2-3)

Liquid nitrogen dewar	:Stores liquid nitrogen (Maximum 80 litters).
Cold head (S050)	:The cold head works in conjunction with the compressor to generate ultra-low temperature and liquefy nitrogen. The cold head needs maintenance services according to the time in operation.
Pressure gauge	:Displays the pressure inside the dewar.
He PRESSUREMETER	:Displays the pressure of Helium gas filled in UW404. When suspended: 1.85 – 1.95 MPa When in operation: 2.10 – 2.30 MPa
He Gas charge port	:This port is inside the front panel of UW404. Connect the charging hose to this port to charge Helium gas. Do not touch this port except when needed.
He Gas charge valve	:Used when charging Helium gas. Do not touch the valve except when needed, as touching it may result in Helium leakage.
START/STOP switch	:This button lights in green when UW404 is in operation. This does not work to turn on and off UW404 as it is remotely controlled in this configuration.
RESET button	:This button lights in red when UW404 is suspended with some fault. Use this button to reset the abnormal state.
POWER light	This lights in red when UW404 is turned on.
Hour meter	:Displays the total operation time of UW404. Use this information to conduct maintenance work properly.

2.4 EMP-20W Electrical circuit（Figure 2-4）

Circuit breaker	:This is a protective breaker for control circuit of EMP-20W. It is tripped when an electric leak or short-circuit occurs.
Fuse	:There are protective fuses (F-1, 2: 3A) for AC circuit and protective fuses (F3: 2A) for DC circuit.

Sequencer	:A controller used to control the operation of EMP-20W. This functions to operate the necessary unit upon reception of signal from each sensor. In the event of an error in this unit, please inform us of the status of input or output lights of the sequencer when contacting us.
Level sensor converter	:It is the electric parts for detecting the amount of liquid nitrogen in EMP-20W. Since it is adjusted precisely, please do not touch any button.
Terminal blocks	:These connect the wiring of signal reception of the electric appliances and automatic transfer destination containers.

3. Flow Diagram

This may vary depending on the customers' specifications.

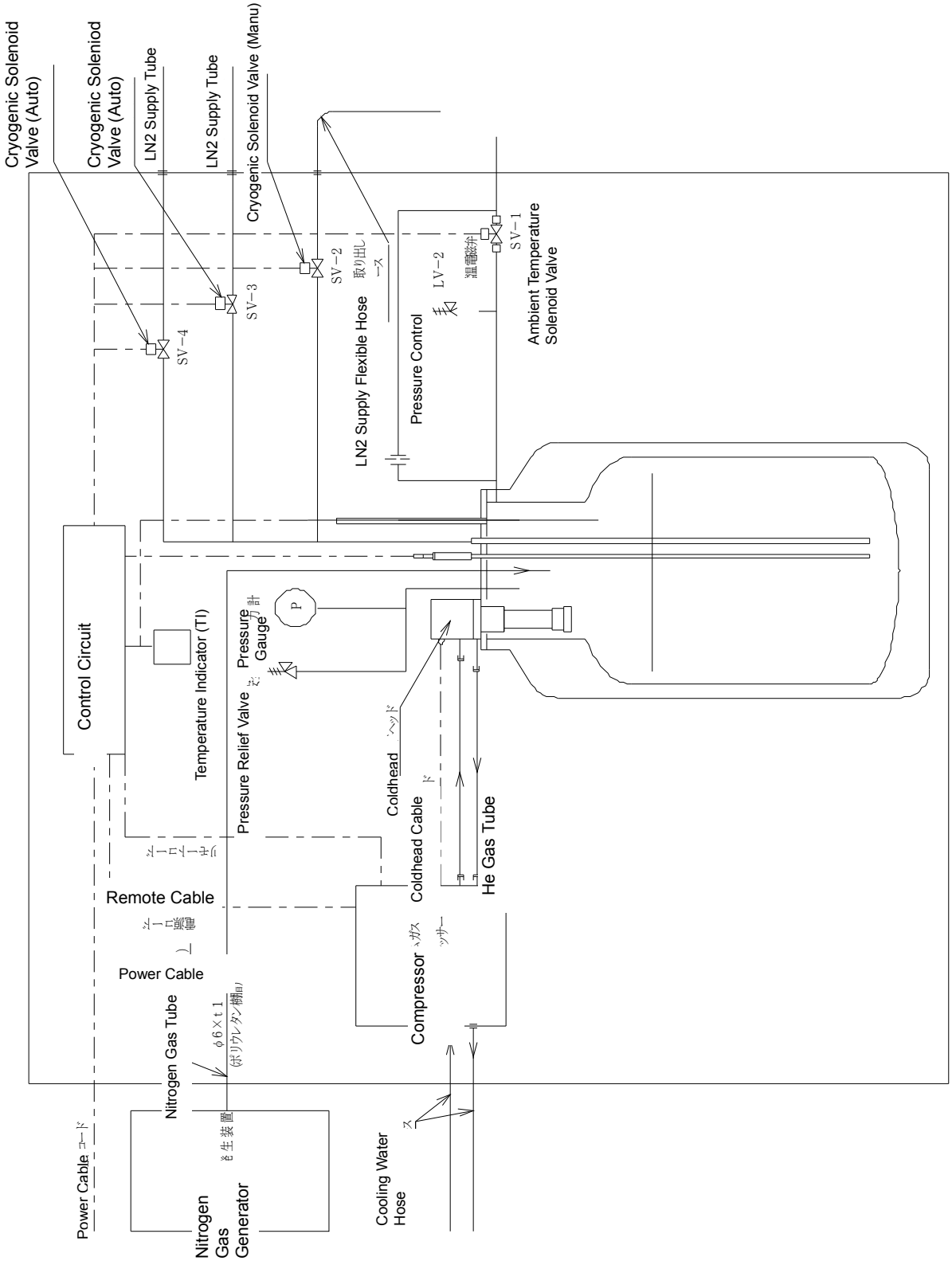

Figure 3-1 Flow Diagram

4. Specifications

4.1 Liquid nitrogen generator

Type	: EMP-20W
Amount of liquid nitrogen generated	: 19L/day (50Hz), 20L/day (60Hz)
High pressure gas processing capacity	: 13.0 m^3/day
Dimensions	: 930[W]*740 [D] * 1661 [H]
Weight	: Approx. 340 kg
Cold head type	: S050
Compressor type	: UW404
Cooling method	: Water-cooling
Ambient conditions	: Ambient temperature: 10 – 35°C Relative humidity: 80% or less (Non-condensation except on LN2 manual dispense port)

○ EMP-20W must be installed indoors.

○ EMP-20W must not be used in the atmosphere with organic solvents or corrosive gases.

4.2 PSA (Pressure Swing Adsorption) nitrogen gas generator

Type	: GN-15i
Dimensions	: 480[W] ×620[D] ×1015[H]
Weight	: Approx.90kg
Cooling method	: Air-cooling (Inhale from the front, exhaust from the back)

○ GN-15i must be installed indoors.

○ GN-15i must not be used in the atmosphere with organic solvents or corrosive gases.

○ Air inhaled from the front is discharged to the backside. Do not block the front and backside.

4.3 Membrane nitrogen gas generator

Type	: IM-120
Dimensions	: 150[W] ×300[D] ×800[H]
Weight	: Approx.20 kg

○ IM-120 must be installed indoors.

○ IM-120 must not be used in the atmosphere with organic solvents or corrosive gases.

5. Utilities

5.1 Power source (for EMP-20W)

Voltage	: 200 VAC , 3-phase
Power capacity	: 30 A or above
Power consumption	: 3.3/4.1 kW (50/60 Hz)
Connection	: Round type crimping terminal for M5

CAUTION

Use Class-D earthing for safety.

5.2 Cooling water (for EMP-20W)

Flow rate	: 180 – 330L/hour (recommended: 270L/h)
Pressure	: 0.04 – 0.17 MPa (recommended: 0.1MPa)
Temperature	: 10 – 30°C (recommended: 20°C)
Water quality	: Tap water equivalent
	* Check the water quality on a regular basis.

CAUTION

The flow rate of cooling water should be within the following allowable range. When the flow rate or pressure is too low, it may result in abnormal suspension, failure, or damaging cooling water pipes due to the temperature rise.

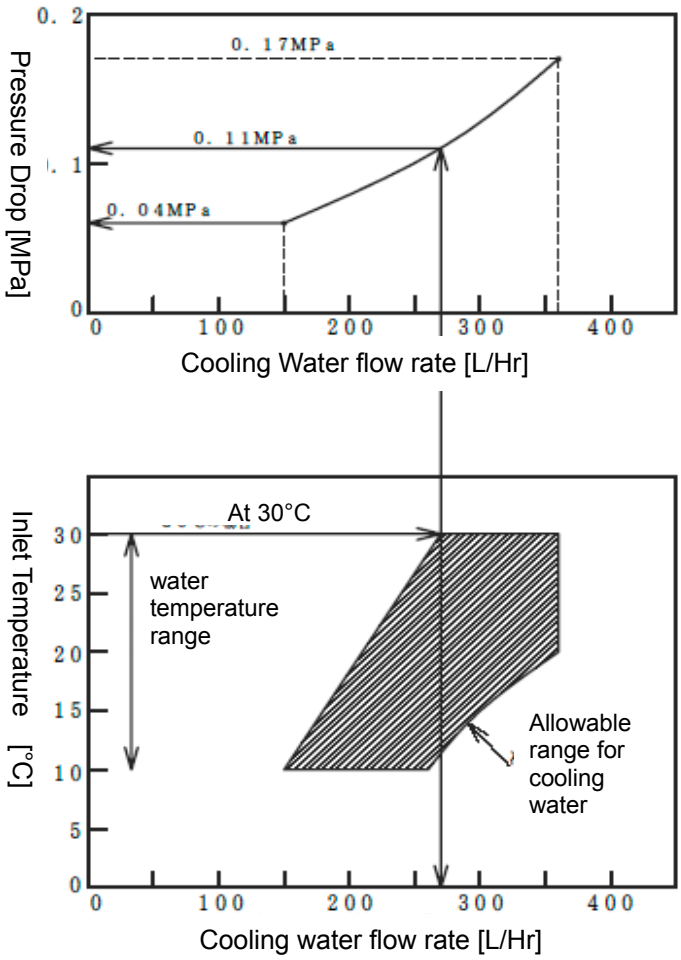

Figure 5-1 Allowable range of cooling water for EMP-20W

5.3 Power source for GN-15i (when using GN-15i)

Voltage	: 100 VAC, single phase
Power capacity	: 15 A or above
Power consumption	: 0.8 kW (50/60 Hz)
Connection	: 3-pin outlet plug with ground wire

CAUTION

Use Class-D earthing for safety.

5.4 Dry air for IM-120 (when using IM-120)

Pressure	: 0.5MPa – 1.0MPa
Flow Rate	: 120L/min or more
Dew Point	: -17 °C or below (at the atmospheric pressure)
Air Quality	: Oil-free

NOTE: Use compressors equipped with a dryer.

Supply dry air continuously.

6. Installation

6.1 Conditions for installation place

(1) Install the equipment indoors, at a level and stabilized place. Power supply or other utilities should be located nearby.

(2) Install the equipment at a well-ventilated place where the ambient temperature is 10 – 35°C and humidity is 80% or less (without condensation in other than cooling-water hoses).

(3) Secure the following spaces for maintenance work.

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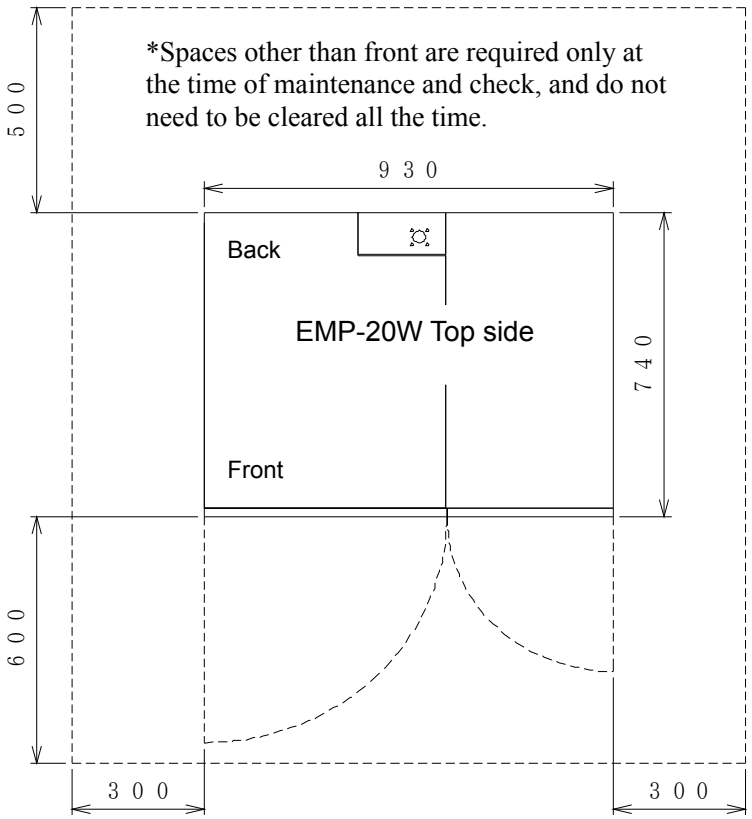

Figure 6-1 Maintenance space for EMP-20W

(4) Lock the wheels to fix the equipment.

6.2 Connection of GN-15i to power source


WARNING

Ensure that main power source is disconnected before making the connection to power-supply.

- Supply Voltage :100 VAC ± 10% (50/60Hz)
- Power capacity :15 A or more
- Power consumption :Approx.0.8kW (50/60 Hz)

(1) Use a circuit tester or others to confirm that the .supply voltage is within the scope of the above.

(2) Plug the power-supply cable which comes out from the back of GN-15i

(3) Turn on the power breaker inside the GN-15i.

6.3 Dry air connection of IM-120

(1) Attach the connector for tubes to the dry air valve. Screw size is R1/4.

(2) Onto the connector attached as in the step (1), attach the tube for dry air supply. Connect the other side of the tube to "AIR IN" connector on the back side of IM-120.

6.4 Utility connection of EMP-20W

Remove the back panel of EMP-20W and locate holes for utility connection on the bottom. Connect cables of power-supply, nitrogen tube and remote cables of nitrogen gas generation system through these holes.

6.4.1 Power-supply connection of EMP-20W


WARNING

Ensure that main power source is disconnected before making the connection to power-supply.

- Supply Voltage :190–220 VAC (50Hz), 3 phase, 200–230 VAC (60Hz), 3 phase,
- Power capacity :30 A or more
- Power consumption :3.3 / 4.1kW (50/60 Hz)

(1) Confirm that the power-supply voltage is within the above scope by using testers or other devices.

(2) Connect the crimping terminal side of power cables to EMP-20W through the holes on the bottom. Make sure that the marks on the terminal block (R, S, T, E) correspond to the marks of power cables, and connect them to the terminal block. If the connection is inadequate, it may result in damage by a fire while EMP-20W is in operation.

(3)When the connection to the terminal board is made, attach the power cable to the circuit breaker and supply electricity by turning on the breaker in the electric circuit part of EMP-20W. Be sure to confirm that the power is supplied to the sequencers or other parts in the electric circuit of EMP-20W.

WARNING

Do not connect the earth ground wire to power lines. It may result in electric shock or electric leakage.

CAUTION

When you operate multiple devices with one power source, be aware of the total capacity. Lack of capacity invites overcurrent (voltage drop) and may result in damaging the equipments.

CAUTION

Only the personnel who have sufficient knowledge and skill on electric connections or cables can perform the work to extend power cables.

6.4.2 Connection of EMP-20W Cooling Water Hoses

CAUTION

Depending on the water, scale might accumulate inside the cooling water tube, or the tube might be corroded. It is recommended to use water circulation system when there is such concern.

1) Connect the attached cooling water joint to the cooling water IN and OUT connectors. The screw size of the connector is R3/8. Place seal tape on the screw part.
2) Connect the cooling water joint to the cooling water supply side.
3) Connect the cooling water hose to the water supply side and the EMP-20W water IN connector, and water discharge side and EMP-20W water OUT connector.
4) When the connections are made, open the main valve of cooling water supply to check that the water flow is correct and no leak is seen in the coupling or hoses in the joint part of couplings or hose.
5) When you use cooling water circulation system, set the water temperature at 20°C.

CAUTION

Water may leak if the connection between cooling water joint and hose is too loose.

CAUTION

Be sure to connect the hose to the correct port. Wrong connection may result in breakage of cooling water tube and leakage of water.

(*)Refer to “7. Utility” for the allowable range of cooling water.

6.4.3 Connection of Nitrogen gas tube

Place Nitrogen gas tube from the bottom hole and connect it to the gas connector of Dewar along Helium gas pipe. Connect the other side to the Nitrogen gas supply port of a Nitrogen gas generator.

6.4.4 Connection of “Nitrogen gas generator” remote cable

Connect a remote cable to the remote connector inside EMP-20W and the signal connector from the back of GN-15i or “PRESSURE SWITCH OUT” connector on the back of IM-120.

7. Electric Wiring

Symbol	Name
ELB	Earth Leakage Breaker
	Terminal Cover
NF	Noise Filter
PWS	Power Supply
PLC	Programmable Controller
LDC	Capacitance Level Meter Converter
LI	Level Indicator
TIC	Temperature Indicator
E-S	Emergency Off Switch
F-1,2,3	Fuse Holder
R1	Relay
R2, (R3)	Relay
PBL1,4	Lighting Button
PBL2	Lighting Button
PBL3	Lighting Button
PBL5	Lighting Button
PB1, 3	Button Switch
PB2	Button Switch
PL1, 2	Indicator Light
PL3	Indicator Light
C1	Condenser
C2	Condensor
R-R	Register
SV1, (SV2)	Cryogenic Electromagnetic Valve
SV3	Room Temperature Electromagnetic Valve

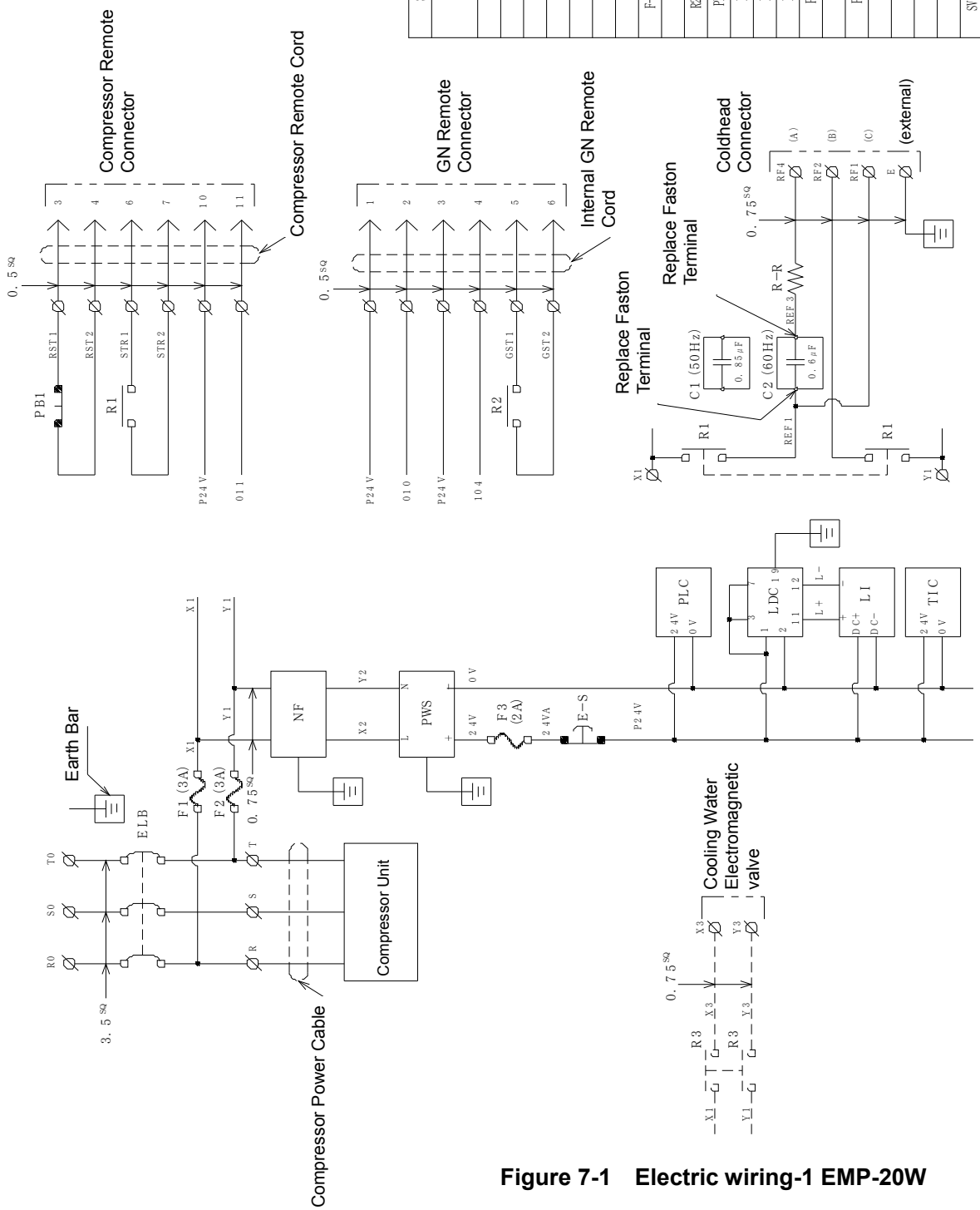

Figure 7-1 Electric wiring-1 EMP-20W

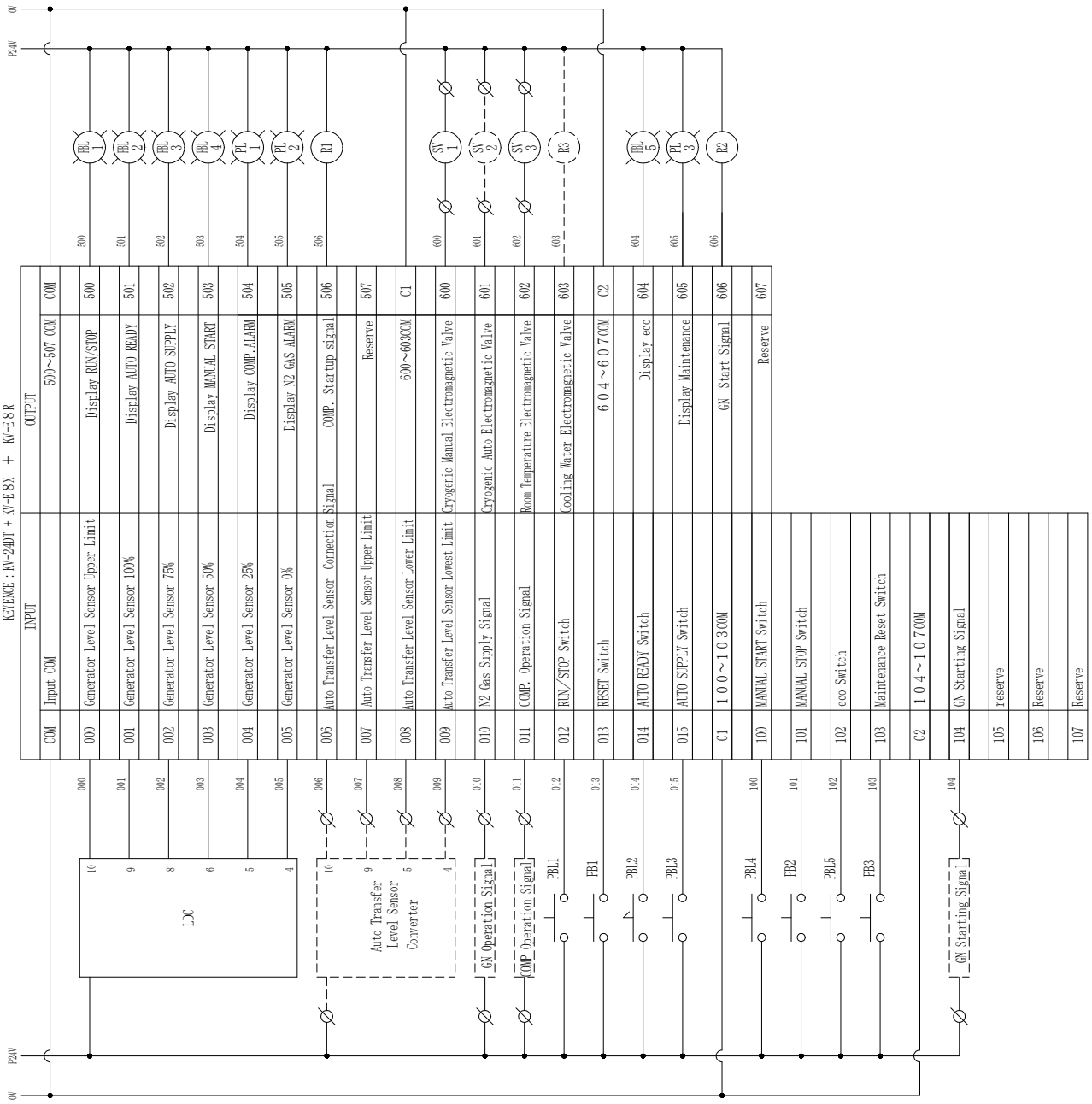

Figure 7-2 EMP-20W Electric wiring-2 (Sequencer)

8. Operation

8.1 Checks prior to operation

Check the following before starting the operation.

(1) The power source of the EMP-20W and GN-15i is connected correctly.

(2) The air inlet and outlet opening of GN-15i is cleared.

(3) Cooling water hose is connected correctly between EMP-20W and water supply.

(4) The nitrogen gas tube is connected correctly between EMP-20W and the nitrogen generators.

(5) The RUN/STOP switch of EMP-20W is turned off (lights off).

(6) The main power source of EMP-20W and GN-15i are ON.

(7) If IM-120 is used, a tube is properly connected between IM-120 and the dry air main valve

(8) Nitrogen generator remote cables are properly connected between EMP-20W and Nitrogen generators.

8.2 Preparation for operation

8.2.1 Start supplying nitrogen gas with GN-15i

(1) Press RUN/STOP button of EMP-20W (not of GN-15i).

GN-15i starts up. When it starts operation normally, the POWER switch on EMP-20W flashes with long term light-on and short term light-off.

Note: Once operation starts, RUN/STOP switch does not work for the following six minutes. If you wish to stop, press the emergency off button.

(2) 6 minutes later from starting of GN-15i, the ball in the flow meter in the front rises, and nitrogen-gas supply starts. Check that the center of the ball is in the position of 15 NL/min. When shifted, please refer to the operation manual of GN-15i and adjust the flow rate by control valve.

・When supplying nitrogen with type IM-120

(1) Open the dry air valve and supply dry air to IM-120. The supply air pressure gauge "AIR INLET PRESSURE" shows dry air supply pressure.

(2) At nitrogen gas pressure regulator, adjust the nitrogen gas pressure gauge "GN2 OUTLET PRESSURE" to 0.2 MPa. Also, adjust nitrogen gas flow meter "GN2 OUTLET FLOW" to 15 NL/min

CAUTION

Use nitrogen gas with recommended flow rate and pressure. Otherwise, liquid nitrogen generation may be hindered.

8.2.2 Start-up

(1) When nitrogen gas is supplied to EMP-20W, the RUN/STOP button lights in green and UW404 starts to liquefy nitrogen.

If liquefaction does not start and the COMP.AL. illuminates, the power supply may be connected in reverse phase. In such a case, turn OFF the breakers of main power source and the electric circuit of EMP-20W, alternate two cables out of three on the main power source, and turn on the power again.

(2) Since inside of liquid nitrogen dewar is at room temperature at the initial start-up, it is necessary to take the time to cool inside of the dewar. (It normally requires about half a day.) When the temperature of the dewar goes down, liquid nitrogen begins to be accumulated. The liquefaction continues until liquid nitrogen in the dewar reaches 80 litters (100%). After that, liquefying operation starts when the amount of remaining liquid nitrogen is below 60L (75%), and stops when it reaches to 80L (100%). This cycle goes on repeatedly.

8.3 Shutdown

When EMP-20W is turned OFF with the RUN/STOP button, the RUN/STOP light flashes with shorter light on and longer off, and RUN/STOP button lights off and all the operations stop including liquefying, supplying nitrogen gas, or dispensing liquid nitrogen.

Due to the residual heat of UW404, stop the cooling water supply ten minutes later or more after turning OFF the RUN/STOP of EMP-20W

8.4 When suspending for long time (for 1 to 2 weeks) and resuming EMP-20W

CAUTION

When the system is suspended operation for a long time, liquid nitrogen in the dewar will be replaced by the air. If the device is resumed in such a condition, the liquefaction efficiency deteriorates due to the moisture in the air. Follow the procedure below when resuming.

(For GN-15i)

(1) Take the remote cable off from GN-15i before you press the RUN/STOP switch of EMP-20W and open the front panel of GN-15i.

(2) Turn the REMOTE/LOCAL switch to “LOCAL”.

(3) Press the button on the front side of GN-15i to startup and keep supplying nitrogen to EMP-20W for at least one hour.

(4) Stop GN-15i, turn the REMOTE/LOCAL switch to “REMOTE”, and connect the remote cables for nitrogen generators.

(5) Press RUN/STOP button of EMP-20W to reboot the entire system.

（For IM-120）

(1) Open the dry air valve to supply dry air to IM-120.

(2) Supply nitrogen gas to EMP-20W for at least one hour.

(3) Press the RUN/STOP switch of EMP-20W to reboot the entire system.

NOTE: Please inform us in advance when the system is to be suspended for longer than two weeks.

8.5 Corrective action in the event of an error

When errors occur in the equipments, please follow the procedure below and in “14. Trouble Shooting”.

8.5.1 Corrective action when electric power failure occurs

EMP-20W and GN-15i will be automatically restored in the event of a power-failure and they will be rebooted automatically when the electricity comes back. However, when the amount of liquid nitrogen inside is 75% or more, liquefying operation may not be resumed at the time of rebooting. (These are the common precautions when rebooting)

8.5.2 Corrective action when COMP. AL. occurs

(1) Check the electric supply voltage and capacity.

(2) Press RESET button of EMP-20W.

(4) When the trouble is temporary, UW404 re-starts. When it stops due to abnormal temperature, it may be unable to re-start about 30 minutes until the temperature of a detection part falls.

When UW404 does not start at all, but COMP.ALARM lights up again, check each part according to "14.Trouble shooting."

8.5.3 Corrective action when GN2 AL. occurs

(For GN-15i)

(1) Turn off the RUN/STOP switch of EMP-20W.

(2) Conduct reset operation of GN-15i.

(3) Turn ON the RUN/STOP switch to re-start EMP-20W.

(4) When Nitrogen gas begins to flow from GN-15i, GN2 AL. lights off.

(For IM-120)

(1) Turn OFF the RUN/STOP switch of EMP-20W.

(2) Check that the supply pressure of dry air is 0.5 MPa or above.

(3) When the nitrogen gas pressure is 0.2MPa and flow rate is 15NL/min, turn ON the RUN/STOP switch of EMP-20W to restart.

8.5.4 Emergency off

In case of an emergency, press the emergency off button on the front to disconnect the control power supply and stop all the operation of EMP-20W.

CAUTION

An emergency shutdown might damage the equipment. Do not use this button except in emergency.

To restart, turn the emergency off button to the right.

9. Dispense Liquid Nitrogen Manually

WARNING

- When dispensing liquid nitrogen, make sure to keep the room well ventilated in order to prevent oxygen shortage.
- Never attempt to seal liquid nitrogen.
- When dispensing liquid nitrogen, be sure to put on protective fittings such as leather gloves. Also, use caution with handling liquid nitrogen supply flexible hose as it is in extremely low temperature right after dispensing.

9.1 Connecting liquid nitrogen supply flexible hose

Connect the joint (coupler joint) of attached flexible hose to LN2 manual dispense port located at the front of EMP-20W. When connecting to the coupler joint, do so while pushing the outer ring part of the EMP-20W side.

9.2 Supply of liquid nitrogen

To manually dispense liquid nitrogen, insert the head end of flexible hose in your liquid nitrogen container, and press-and-hold the MANUAL START button for 3 seconds. With the above steps, liquid nitrogen flows out of head end of flexible hose.

The dispense operation stops automatically in 10 minutes from the start of supply. The MANUAL START button flickers 30 seconds in advance of the automatic termination. When more liquid nitrogen is needed, press MANUAL START button again to extend the operation for another 10 minutes. Press MANUAL STOP button to stop dispensing.

CAUTION

Never leave the place while manually dispensing liquid nitrogen. Keep the place well ventilated for prevention of lack of oxygen.

- ✧ Liquefynig operation stops during the manual dispense operation.
- ✧ When nitrogen-gas supply stops, liquid nitrogen cannot be supplied.
- ✧ When the automatic supply is selected (when the AUTO READY is turned on), manual dispense is limited to 25%. Also, you cannot manually dispense liquid nitrogen while automatic transfer is taking place. Manual dispense can be started after the automatic transfer finishes.

9.3 Disconnection of flexible hose

CAUTION

When disconnecting flexible hoses, make sure that they return to room temperature. Note that disconnecting hoses right after dispensing liquid nitrogen may result in damaging the O-ring inside the coupler joint.

Disconnect flexible hoses in the opposite procedure to connecting. Push down the outer ring of the joint on the side of EMP-20W and pull out the flexible hose to disconnect.

10. Automatic Transfer of Liquid Nitrogen

WARNING

- While liquid nitrogen is being dispensed, be sure to ventilate the room to prevent a decrease in oxygen levels.
- Never seal liquid nitrogen in the target devices.
- Liquid nitrogen supply pipes reach extremely low temperature during and right after the supply. Caution is also advised for the extremely cold gas released from the nitrogen gas release port in the target container.

10.1 Inspections before starting automatic transfer

Before starting automatic supply, make sure of the following:

(1) The level indicator cable is correctly connected between EMP-20W and the level sensor of the target device.

(2) Liquid nitrogen supply tube is correctly connected between EMP-20W and the container of the target device.

(3) The nitrogen gas exhaust port of the target device is open to the atmosphere.

10.2 Automatic transfer

(1) Turn ON the EMP-20W AUTO READY (Standby mode).

(2) Automatic transfer will start when the level sensor of the target device detects the LN2 level is 25% or lower. If our level sensor is used, Automatic transfer can be started forcibly by pressing AUTO SUPPLY button.

AUTO SUPPLY button lights up in white while automatic transfer is taking place.

(3) When the level sensor of the target device detects the LN2 level reaches 100%, automatic transfer will be terminated. Automatic transfer will also be terminated when the RUN/STOP or AUTO READY of EMP-20W are turned OFF, the LN2 level of EMP-20W is 0%, or supply of nitrogen gas stops.

- ✧ Liquid nitrogen cannot be dispensed manually during automatic transfer.
- ✧ When the device is in standby mode by pressing AUTO READY button, manual dispense of liquid nitrogen will be limited to 25%.

10.3 Time limit of automatic transfer

Automatic transfer is suspended when the fixed time (defaulted to 10 minutes) passes from the start and the AUTO READY and the AUTO SUPPLY blink alternately. Blinking will stop by pressing the AUTO READY button. Check the amount of liquid nitrogen of the target dewar, and contact us when any abnormal conditions are found. Please refer to the “Service Network” at the end of this manual for the contact detail.

11. eco Mode

11.1 eco mode

The operation of EMP-20W will be turned to eco mode by pressing “eco” button in the operation panel. EMP-20W is operated as follows in eco mode.

- ✧ When EMP-20W does not receive any requests of liquefaction or the automatic transfer, it drives the nitrogen gas generator in a cycle of suspending for 22 hours and driving for two hours.
- ✧ When the signal to request automatic transfer is input during ECO mode, EMP-20W will start automatic transfer to the target device six minutes later than signal input.
- ✧ Manual dispense is not available during eco mode. To dispense manually, reset the eco mode and wait for 6 minutes until the nitrogen gas generator resumes operation.
- ✧ When the liquid nitrogen level of EMP-20W goes down to 60L (75%) or less, it resumes liquefaction operation automatically. Ten minutes later from the time liquid nitrogen level reaches to 80L (100%), EMP-20W returns to eco mode.

CAUTION

When resumed after long-term suspension or newly purchased, do not turn to “eco” mode immediately after starting operation as it may result in failure.
Set to eco mode after operating continuously for 2 weeks to 1 month. When the suspended term is about 6 months, operate 2 weeks. If it has been suspended longer, operate 1 month before setting to eco mode.

12. Maintenance and Inspection

12.1 Daily inspection

Check for the following items for daily inspection.

(1) The operation sound generated from each unit is normal.

(2) The pressure and flow rate of nitrogen gas are 0.2 MPa and 15 NL/min. respectively.

(3)The He gas pressure of UW404 is within the proper range.

When suspended: 1.85 – 1.95 MPa

When in operation: 2.10 – 2.30 MPa

(4) The alarm light of EMP-20W is not lit.

12.2 Periodical maintenance/inspection

Parts	10,000 hours	30,000 hours	40,000 hours	8,000hours or 2 years (Shorter)	20,000 hours *3
Coldhead Cylinder *1	○				
Oil adsorber		○			
Helium tube joint			○		
GN-15i Air Compressor				○	
GN-15i Filter *2				○	
GN-15i Solenoid valve					○

Parts	1year	2years	5years
IM-120 Membrane			○
IM-120 Prefilter	○		
IM-120 tube, joint		○	
IM-120 Fixed throttle valve		○	
IM-120 Check Valve		○	

- ✧ Please confirm the total operation time of EMP-20W with the hour meter on UW404.
- ✧ The total operation time of GN-15i is shown in the sequencer display in the electric circuit of EMP-20W. The operation light of GN-15i blinks when the maintenance time approaches.

*1… Maintenance parts are normally to be replaced “Once every 10,000 hours of operation”, however, even if 10,000 hours is not reached, replace them with new ones once every 5 years as the internal parts may become deteriorated.

*2… In addition to the table above, clean the filter of the air opening of GN-15i once a month.

*3… Maintenance period varies according to the operating situation. As an example, in the case of use by consecutive running, it replaces them with new ones every two years.

NOTE: For coldhead and oil absorber, it is requested to return a complete set of parts (after replacement) to us. Please return the set of parts after the replacements.


WARNING

Be sure to turn off the main power source before performing the maintenance work.


WARNING

Since helium is filled in this equipment as well as in the maintenance parts (cold head, oil adsorber), do not disassemble these parts. When you have to disassemble or dispose such parts, discharge helium using the optional charging adapter kit.

12.3 Regular customer inspection

The EMP-20W is a high pressure manufacturing equipment. Please follow the laws or regulations of your countries or regions when operating and maintaining this equipment.

13. Troubleshooting

When any failure or unusual phenomenon occurs in the equipment, execute at first the fault diagnosis shown in the following table. When making contact with or making an inquiry to us, please check the lighting status of PLC lamp arranged to the electrical circuit in advance.

WARNING

Ensure that main power is disconnected before inspecting the power source or inside of the equipment. Some parts of the equipment may remain in high temperature right after stopping operation. Use caution to avoid burn injury.

Problem	Possible Cause	Corrective Action
(1) Equipment fails to start even if the RUN/STOP switch is turned on (The RUN/STOP switch lamp fails to come on.)	The main power source (breaker) is turned OFF.	Turn ON the main power source.
	The power cord is not connected.	Connect the power cord correctly.
	The circuit breaker of EMP-20W is turned OFF.	Turn ON the circuit breaker.
	The fuse of electrical circuit of EMP-20W is blown.	Replace the fuse with a new one. If the fuse is blown repeatedly, please contact us.
	The emergency stop button is pressed.	Reset the emergency stop switch by turning it in direction of arrow, and close the power source again.
(2) Equipment fails to start even if the RUN/STOP switch lights up.	The remaining LN_2 level is not decreased down to the re-starting level.	When the remaining LN_2 is decreased to 75% or less, the liquefaction starts automatically.
(3) Power breaker is tripped.	Short-circuit or electric leakages occur.	Please contact us.
(4) GN2 AL. lights on. The RUN/STOP lamp flickers at the same time.	GN15i is suspended.	Check the electric wiring of GN-15i, or Suspend and resume EMP and GN-15i.
	IM-120 is suspended.	Check the dry air supply pressure.
	Nitrogen gas supply decreases, or the pressure is lowered temporarily.	Refer to “9-5-3. Corrective action when GN2 AL. occurs” and restart EMP-20W.

Problem	Possible Cause	Corrective Action
(5) COMP.AL lights on, and the liquefaction does not start. (RUN/STOP button starts to blink.)	Power supply is connected with reverse phase.	Turn OFF the main power source, and alternate two cables out of three.
	The voltage is lowered and power supply fell short as multiple devices run simultaneously with one power source.	Engage one power source per one device. Fix the power supply to meet the specified value when it is not sufficient.
	Cooling water supply is being suspended.	Check the pressure and flow rate of cooling water and adjust them to the normal range. After adjusting, press RESET button of EMP-20W to restart.
	The ambient temperature is too high.	Ventilate well around EMP-20W.
		Keep the ambient temperature below 35 °C by installing fans or air conditioners.
(5) COMP.AL lights on, and the liquefaction does not start. (RUN/STOP button starts to blink.)	Electric parts of UW404 break down.	Please contact us.
	Helium charge pressure of UW404 is lower than specified.	Charge helium gas to the specified pressure of UW404. Contact us for more information on charging.
(6)RUN/STOP blinks and EMP does not start liquefying operation (Alarm light is not lit).	Less than 6 minutes have passed since RUN/STOP switch is pressed.	Wait for 6 minutes until GN2 is filled from GN-15i.
	Condensation occurs in the level sensor of EMP-20W.	Check the connection between EMP-20W and nitrogen generator, and also check flow rate or nitrogen gas. The level sensor needs to be dried. Please contact us.
	Level sensor of EMP-20W is damaged.	Please contact us.
(7)Liquid Nitrogen cannot be dispensed.	No liquid nitrogen such as at the time of initial start-up. (LN2 amount is displayed as 0 %)	Please wait until liquid nitrogen is accumulated.
	Level sensor malfunctions due to ice or frost in the dewar.	Please contact us..

Problem	Possible Cause	Corrective Action
	Electromagnetic valve breaks down (Electromagnetic valve does not sound operating.)	Please contact us.
	AUTO READY is turned OFF (When LN2 cannot be supplied automatically.)	Turn ON the AUTO READY switch.
	eco mode is ON. (When LN2 cannot be dispensed manually.)	Cancel Eco mode and wait for 6 minutes.
(8) Liquid Nitrogen does not increase.	The equipment is in initial start-up.	Wait for about 12 hours until the dewar temperature is lowered enough to store liquid nitrogen.
	The helium gas piping and refrigerator cables are not connected correctly.	Connect the helium gas lines and refrigerator cables correctly.
	The level sensor fails to detect correctly.	Please contact us.
(9) The rate of Liquid Nitrogen generation is lowered.	Cold head and oil adsorber exceed the recommended maintenance interval.	Conduct the maintenance according to the operation time.
	Helium charge pressure of UW404 is lowered.	Add helium to the specified pressure. Please contact us when this trouble occurs frequently.
	Amount of evaporation from dewar increased.	Please contact us.
	EMP absorbs special gas such as helium.	Please contact us.
	Ice or frost adheres to inside the dewar or around the cold head.	Please contact us.

Problem	Possible Cause	Corrective Action
	The purity of Nitrogen gas is not sufficient.	Check the purity of nitrogen gas supplied.
(10) AUTO READY button blinks.	The level sensor cable of the target device is disconnected or not connected.	Check the level sensor cable of the target device.
	The level sensor of the target device breaks down.	Please contact us.
(11) MANU START button blinks.	Only 30 seconds left until the time limit of 10 minutes of manual dispense.	Press MANU START button again to continue dispending manually.
(12) AUTO READY button and AUTO SUPPLY button blink alternately.	The level sensor of the target device continues sending the signal to supply although the time limit of automatic supply is over.	Press AUTO READY button to cancel automatic supply mode and check the amount of liquid nitrogen in the target device. Please contact us if any problem is found.
(13) Other failures		Please contact us.

14. Accessories

The accessories below are delivered along with the equipments.

EMP-20W

Flexible Hose for Dispensing LN2	1 (0.8m)
Cooling Water Hose	2 (5m)
Cooling Water Joint	2 (Screw size R1/2)
Nitrogen Gas Tube	1 (5m)
Single Head Wrench	1
Glass Fuse	3 (3A x 2, 2A x 1)
Instruction Manual	1 (This book)

GN-15i

Remote Cable for Nitrogen Generator	1 (5m)
Instruction Manual	1

IM-120

Remote Cable for Nitrogen Generator	1 (5m)
Connector for Tubes	1 (Screw size: R1/4)
Dry Air Supply Tube	1 (5m)
Instruction Manual	1

- The above accessories may be changed according to the directions by customers.

15. Warranty

1. Gratis warranty period and warranty coverage

Gratis warranty period

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

Coverage

(1) Failure diagnosis

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

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

(2) Damage during transportation

When damage by delivery/transportation is admitted, the product will be repaired free of charge within the range of the guarantee expressed in the sales contract.

(3) Breakdown repairs

There will be a charge for breakdown repairs, replacements and on-site visits for the following seven conditions. In those cases the cost shall be your own expense even though the product is within the warranty period.

1) Breakdowns due to improper storage or handling, careless accident, software or hardware design by the customer.
2) Breakdowns due to modifications of the product without consent of the manufacturer.
3) Breakdowns due to maintenance of the product without authentic parts or breakdowns resulting from using the product outside the specified specifications of the product.
4) Breakdowns due to contamination or corrosion caused by user's use conditions.
5) Breakdowns due to natural disasters (such as fire, earthquake, flood, lightning, salt damage, and so on), environmental pollution, irregular voltage, and /or usage of undesignated power source.
6) Breakdowns that are outside the terms of warranty.
7) Consumables and/or replacement service.

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

2. Exclusion of opportunity loss from warranty liability

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

3. Repair period after production is discontinued

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

Manufacturer: ULVAC CRYOGENICS INCORPORATED

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

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SERVICE NETWORK

- For technical support, servicing or additional contact information, visit us at www.ulvac-cryo.com.

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Revision History

Date	Revision No.	Contents
2014 / 12 / 26	2014.12	First edition
2015 / 05 / 12	2015MY01	9-5-3 has been partially modified.
2015 / 08 / 05	2015AT02	The model of PSA nitrogen generator has been changed. The format of Warnings and Cautions has been changed.
2016 / 09 / 14	2016SR03	“Disposal Consideration” has been added. 15. Warranty The company address has been changed.

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