ULVAC

Liquid Nitrogen Generator

Instruction Manual

EMP-07A/07W

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.

Introduction

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

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

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

- (1) It is prohibited to duplicate or distribute this instruction manual or any of its parts to a third party without permission from ULVAC CRYOGENICS.
- (2) Information in this document is subject to change without notice due to specification change or the improvement of the product.
- (3) If you have any questions or comments on this document, please contact us. Our contact detail is listed at the end of this book.



Safety Conventions

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





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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 equipment 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 level 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 parts.

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: Do not expose to corrosive gases.

High-pressure Helium gas is filled in the EMP. 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.



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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.



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-07A/07W)

EMP-07A/07W Liquid Nitrogen Generator produces liquid nitrogen by cooling down, condensing and liquefying nitrogen gas with the cold head (S030Z). Liquid nitrogen is stored in the dewar inside, and can be dispensed to another container with easy operation. With the optional automatic transfer system, liquid nitrogen can be automatically transferred to the Dewar of customers' equipment. Refer to the Specifications and Drawings tailored to your system for the detail of optional devices.

Nitrogen gas source can be selected from two types; (1) PSA nitrogen generator, (2) Customer's nitrogen supply.

Liquid nitrogen generator is hereafter referred to as "EMP-07A/07W" or "EMP" in this book. It is also called "EMP-07A" for the model with air-cooled compressor SA112-C, and "EMP-07W" with water-cooled compressor SW112-C when needed to be specified.

1.2 Helium compressor (SA/SW112-C)

This unit is installed at the bottom inside the EMP-07A/07W, compresses 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-07A/07W. Helium compressor is hereafter referred to as SA112-C for air-cooled type and SW112-C for water-cooled type in this book. It may be described as SA/SW112-C when it does not need to be distinguished.

1.3 PSA (Pressure Swing Adsorption) Nitrogen Generator (type: GN-10i)

PSA Nitrogen Generator GN-10i generates highly concentrated nitrogen from the air using adsorber and supply the gas to EMP-07A/07W. 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-10i" in this manual.

1.4 Pressure regulator set (when nitrogen gas is supplied from the customer's system)

A set of nitrogen pressure regulator is equipped when the system is supplied nitrogen gas from customer's system.



2. Component Description



Figure 2-1 Front view of EMP-07A







| 2.1 | Front view of EMP-07A/07W (Figure 2-1) | | |
|-----|--|--|--|
| | Emergency off button | :Press this button to interrupt power supply to the | |
| | | control circuit to stop operations such as liquid | |
| | | nitrogen transfer, etc. Do not use the emergency | |
| | | off button except for emergency. | |
| | Front 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. | |
| | LN2 manual dispense port | :Press the panel to open. Inside the panel, there is | |
| | | a tube connector to connect flexible hose to | |
| | | dispense liquid nitrogen. The port may reach | |
| | | extremely low temperature during or immediately | |
| | | after dispensing liquid nitrogen. | |
| | Pressure Gauge | : Displays the pressure inside the dewar. | |
| | SA/SW112-C Display | :Displays the status of SA/SW112-C. When | |
| | | SA/SW112-C encounters an error state, press | |
| | | RUN/STOP button to reset. | |
| | Air inlet port | :Port to intake air for cooling SA112-C. This | |
| | | port must not be blocked. SW112-C does not have | |
| | | this port. | |
| | | | |

2.2 Operation panel of EMP-07A/07W (Figure 2-2)

| 1 1 | () |
|-------------|--|
| RUN/STOP | :Use this button to start or stop the main unit. |
| | Green light turns on during normal operation, and |
| | blinks when an error occurs. The light will turn |
| | off when the system is in "eco"-mode standby. |
| RESET | : This switch is used to reset the error state after |
| | eliminating the cause of error. |
| AUTO READY | :Use this button to use automatic transfer function. |
| | While the AUTO READY is turned ON, the |
| | system is in the stand-by mode, and auto-dispense |
| | to the set destination is possible by receiving the |
| | signal. The button lights green while waiting for |
| | automatic transfer. When the level sensor of the |
| | dewar encounters any trouble, green light blinks. |
| AUTO SUPPLY | : Use this button to start dispensing liquid |
| | nitrogen using the optional automatic transfer |



| | function with our level sensor. When automatic |
|-------------------|---|
| | supply is activated, white light turns on. |
| MANU START | : Press this button to manually dispense liquid |
| | nitrogen from LN2 manual dispense port. (To be |
| | referred to as "manual dispense") The manual |
| | dispense is terminated automatically in 10 |
| | minutes. This button lights in green during manual |
| | dispense and starts blinking 30 seconds in |
| | advance to automatic termination. Press this |
| | button once again while it is blinking to extend 10 |
| | minutes. |
| MANU STOP | : Press this button to interrupt manual dispense. |
| Indicator | : Displays the approximate amount of remaining |
| | liquid nitrogen in the dewar. |
| eco | : Press this button to switch to eco-mode |
| | operation. The button lights in blue while in eco |
| | mode. Refer to "12. eco mode" for the detail. |
| COMP. AL. | : Red light turns on when the SA/SW112-C |
| | encounters trouble. The RUN/STOP button blinks |
| | at the same time. |
| GN2 AL. | : Red light turns on when nitrogen gas generator |
| | stops due to an error. RUN/STOP switch also |
| | blinks. |
| Maintenance | : This light turns on when the maintenance |
| | interval is reached. The interval is determined |
| | depending on the nitrogen source; for the system |
| | with GN-10i, the operating hours of GN-10i, and |
| | for the system with nitrogen gas supply, the |
| | operating hours of compressor. |
| Temperature meter | : This shows the temperature inside the dewar. |
| | A blank panel is set when the system has no |
| | temperature meter. |





Figure 2-3 Inside view of EMP-07A front door and lower panel



Port for automatic transfer piping



Figure 2-5 Electrical circuit



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

| Liquid nitrogen dewar | :Stores liquid nitrogen (Maximum 40 litters). |
|-----------------------|--|
| Cold head (S030Z) | :The cold head works in conjunction with the |
| | compressor to generate ultra-low temperature. |
| | The cold head needs maintenance services |
| | according to the time in operation. |
| Pressure gauge | :Displays the pressure inside the dewar. |
| He PRESSURE METER | :Displays the pressure of helium gas filled in |
| | the compressor unit. |
| He GAS CHARGE port | :Used when charging helium gas. Do not touch |
| | this port except when needed, as touching it |
| | may result in helium leakage. |
| RUN/STOP switch | :Use this button to switch between ON and |
| | OFF SA/SW112-C. Normally, turn this |
| | button to "RUN" position. This button is |
| | also used to reset when the compressor |
| | encounters an error. |
| L/R Switch | :This button is to switch between REMOTE |
| | and LOCAL operation. When in REMOTE |
| | mode, turning ON and OFF the SA/SW112-C |
| | is done by the EMP control circuit. When in |
| | LOCAL mode, it is done by RUN/STOP |



| | switch on SA/SW112-C. Normally, set this |
|----------------|--|
| | button to REMOTE position. Do not turn to |
| | LOCAL as it disables controlling from the |
| | EMP. |
| RUN light | :This lights in green when SA/SW112-C is in |
| | operation. |
| TEMP.AL light | :This lights in red when SA/SW112-C is |
| | suspended due to abnormal temperature. |
| PRESS.AL light | :This lights in red when SA/SW112-C is |
| | suspended with abnormal helium gas pressure. |
| Hour meter | :Displays the total operating hours of |
| | SA/SW112-C. Use this information to |
| | conduct maintenance work properly. |



EMP-07A/07W Electrical circuit (Figure 4-4) 2.4

| Circuit breaker | :This is a protective breaker for control circuit of |
|------------------------|---|
| | the EMP. 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 the |
| | EMP system. 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 the dewar. 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. |
| | |

2.5 EMP-07A/07W top surface

Port for automatic supply piping :3/8" Swagelok connector to connect liquid nitrogen automatic transfer tube. Do not touch during and immediately after dispensing liquid nitrogen as it is in extremely low temperature.

3. Flow Diagram

The figure below shows the standard system.

Refer to your Specifications and Drawings for the detail.





4. Specifications

| 4.1 | Liquid nitrogen generator | | | |
|-----|---------------------------|-----------------|----------------------------------|--|
| | Model | | : EMP-07A/07W | |
| | Amount of liquid nitrog | en generated | : 6L/day (50Hz), 8L/day (60Hz) | |
| | High pressure gas proce | essing capacity | : 5.2 m ³ /day | |
| | Dimensions | | : 600[W]x750 [D]x1628 [H](mm) | |
| | Weight | EMP-07A | : Approx. 220 kg (excluding LN2) | |
| | | EMP-07W | : Approx. 230 kg (excluding LN2) | |
| | LN2 capacity | | : Maximum 40L | |
| | Cold head | | : S030Z | |
| | Compressor | EMP-07A | : SA112-C Air-cooled (Air intake | |
| | | | from front, exhaust from back) | |
| | | EMP-07W | : SW112-C Water-cooled (Cooling | |
| | | | water hose attached on the back) | |
| | Ambient conditions | | : Ambient temperature: 10 – 35°C | |
| | | | Relative humidity: 80% or less | |
| | | | (Non-condensation other than LN2 | |
| | | | manual dispense port) | |
| | | | | |

O The EMP must be installed indoors.

O EMP-07A is air-cooled type. Clear the space of 600mm from the air intake and 300mm from the exhaust port.

4.2 PSA (Pressure Swing Adsorption) nitrogen gas generator

| Туре | : GN-10i |
|----------------|-----------------------------------|
| Dimensions | : 400[W] ×460[D] ×900[H] (mm) |
| Weight | : Approx.60kg |
| Cooling method | : Air-cooling (inhale from front, |
| | exhaust from back) |

O GN-10i must be installed indoors.

O GN-10i must not be used in the atmosphere of organic solvents or corrosive gases.

O Air inhaled from the front is discharged to the backside. Clear the space of 600mm from the air intake and 300mm from the exhaust port.

5. Utilities

5.1 Power source (for EMP-07A/07W)

Voltage Power capacity Power consumption Connection 100 VAC±10%, single-phase 20 A or above 1.2/1.4 kW (50/60Hz)

Round type crimping terminal for M5



Use Class-D earthing for safety.

5.2 EMP-07W Cooling water (for water-cooled SW112-C only)

| Recomm | ended flow rate | 2-5L/min |
|--------|-----------------|----------|
| Maximu | m use pressure | 0.8MPa |
| D | 1 1 | 2000 |

Recommended temperature 20°C

- Water quality Tap water equivalent
- Water quality should be regularly checked following the guidelines of water quality for refrigerator and air conditioners fixed by the Japan Refrigeration and Air Conditioning Industry Association.
- Cooling water main valve that meet the above requirements should be supplied within the length of cooling water hose (5m) from the EMP-07W.
- > Coupling of cooling water main valve should have Rc3/8 female screw.



temperature rise, or damaging cooling water line



5.3 Power source (for GN-10i)

| Voltage | : 100 VAC±10%, single-phase |
|-------------------|--------------------------------|
| Power capacity | : 15 A or above |
| Power consumption | : Approx. 400W (50/60 Hz) |
| Connection | : 3 pin plug with earth ground |
| | |



Use Class-D-type earthing for safety.

5.4 Nitrogen supply

| Flow rate | : 10NL/min |
|-----------|---------------------------|
| Pressure | : 0.3 – 0.99MPa |
| Purity | : Oxygen level below 1.2% |
| Dew point | : -60°C or below |
| | |

- > For connection on main valve coupling, customers are requested to supply $\Phi 6$ pneumatic tube fitting.
- Adjust the supply pressure to be kept above 0.2MPa.



Keep continuous supply of nitrogen while the EMP-07A/07W is in operation. Suspending the supply may lead to the equipment failure.

6. Installation

- 6.1 Conditions for installation site
 - Install the equipment at a place where level and stable indoor, with no direct sunlight, and well-ventilated. Power supply or other utilities should be available nearby.
 - (2) The ambient temperature should be $10 35^{\circ}$ C and humidity should be below 80%.
 - (3) Secure the following spaces for maintenance work.



Note: Spaces other than on the back are required only at the time of maintenance and check, and do not need to be cleared all the time.

Figure 6-1 Maintenance space for EMP-07A/07W

(4) Lock the wheels to fix the equipment.

Use the attached fixing bracket as necessary.



6.2 Connect GN-10i to power source



WARNING

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



Carefully read this instruction manual or other necessary documents before performing the work to ensure safety and stable system performance.



Only the qualified personnel for electric connections who have sufficient knowledge on the structure and the risk accompanied to this equipment can perform the following works. Ignoring this caution may result in serious body injury or death.

- (1) Use a circuit tester to check that the supply voltage is within the scope described in Section 5.3.
- (2) Plug the power-supply cable which comes from the back of GN-10i.
- (3) Turn on the power breaker on the back of the GN-10i.

6.3 Utility connection of EMP-07A/07W

Remove the back panel of EMP-07A and locate holes for utility connection on the bottom. Connect cables through these holes including power-supply, Nitrogen tube and remote cables of Nitrogen generation system, signal cables for automatic supply destination.



6.3.1 Connect EMP-07A/07W to power source





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



Carefully read this instruction manual or other necessary documents before performing the work to ensure safety and stable system performance.



WARNING

Only the qualified personnel for electric connections who have sufficient knowledge on the structure and the risk accompanied to this equipment can perform the following works. Ignoring this caution may result in serious body injury or death.

- (1) Use a circuit tester to check that the supply voltage is within the scope described in Section 5.1.
- (2) Open the lower back panel.
- (3) Connect the crimping terminal side of power cables to EMP-07A/07W through the holes on the bottom. Make sure that the numbers on the terminal block (X0, Y0, E) correspond to the numbers of power cables and connect them to the terminal block. If the connection is inadequate, it may result in damage by a fire while in operation.
- (4) Loosen the two bolts on the right of front panel to open the upper front panel.
- (5) When the connection to the primary side terminal board is made, turn ON the breaker in the electric circuit part of the EMP-07A/07W. Confirm that the power is supplied to the sequencers or other parts in the electric circuit.





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



Do not connect the EMP-07A/07W and other devices to the same circuit breaker.



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

6.3.2 Connect cooling water hoses (for SW112-C only)

- (1) On the back of SW112-C, remove the black nut of the couplings connected to the cooling water inlet (IN) and outlet (OUT) and remove the sealing plug.
- (2) On the cooling water source and the flow meter, connect the cooling water coupling included in the package. The screw size of the cooling water coupling is R3/8. Use seal tape onto the screw part.
- (3) Connect the cooling water hoses between the water source and cooling water inlet of EMP-07W, and between drain side and EMP-07W cooling water outlet of.
- (4) Open the cooling water main valve and check that the flow direction is correct and no leakage is observed from the connections of couplings or hoses.
- (5) When using a cooling water circulating device, set water temperature to 20°C.

6.3.3 Connect Nitrogen gas tube

<With GN-10i>

Pass the nitrogen gas tube through the bottom hole of EMP-07A/07W and connect it to the gas connector on the back of the Dewar along Helium gas pipe. Connect the other end of the tube to the Nitrogen gas supply port of a Nitrogen gas generator.

<With N2 gas supply>

Pass the nitrogen gas tube through the bottom hole of EMP-07A/07W and connect to the N2 pressure reducing valve connector on the front. Connect the other side of the tube to the customer supplied $\Phi 6$ pneumatic valve connector.

6.3.4 Connect the Nitrogen gas generator remote cable

Connect a remote cable to the remote connector inside EMP-07A/07W and the signal connector on the back of GN-10i

Attach the back panel of EMP-07A/07W when all the connections are made.



<NOTE> This figure shows a typical example.







<NOTE> This figure shows a typical example.

Figure 7-2 EMP-07A Electric wiring-2 (Sequencer)

8. Operation

8.1 Checks prior to operation

Check the following items before starting operation.

- (1) The power source of the EMP-07A/07W and GN-10i is connected correctly.
- (2) The air inlet and outlet opening of GN-10i is cleared.
- (3) (EMP-07W) Cooling water hoses are connected properly and cooling water that meet the requirements flows.
- (4) The nitrogen gas tube is connected correctly between EMP-07A/07W and the nitrogen generators.
- (5) The RUN/STOP switch of EMP-07A/07W is turned off (lights off).
- (6) The main power source of EMP-07A/07W and GN-10i are ON.
- (7) If the system is supplied N2 gas from the customer's equipment, a tube is properly connected to the N2 gas supply main valve.
- (8) Nitrogen generator remote cables are properly connected between EMP-07A/07W and Nitrogen gas generators.

8.2 Operation preparation

8.2.1 Start supplying nitrogen gas

<When supplying nitrogen with GN-10i>

(1) Press RUN/STOP button of EMP-07A/07W (not of GN-10i).

GN-10i starts up. When it starts operation normally, the POWER switch on
EMP-07A/07W flashes with longer light-on and shorter light-out.
<Note> Once operation starts, RUN/STOP switch does not work for the
following six minutes. If you have to stop, press the emergency off button.

- (2) 6 minutes later from the start of GN-10i, 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 10 NL/min. When shifted, please refer to the operation manual of GN-10i and adjust the flow rate by control valve.
- <When supplying nitrogen from customer's equipment>
 - Press RUN/STOP switch of EMP-07A/07W. GL2 ALARM lights. Follow the steps below.
 - (2) Inside the EMP-07A/07W, use the nitrogen gas pressure regulator to adjust the pressure to 0.25MPa or above. When GN2 ALARM light on the front panel turns off, adjust the pressure to 0.2MPa. Set the nitrogen gas flow rate to 10NL/min.



If the nitrogen gas supply is outside the scope of Section 5.4, it may hinder LN2 generation.

8.2.2 Start-up

- When nitrogen gas is supplied to the EMP-07A/07W, the RUN/STOP button lights in green, SA/SW112-C starts-up and LN2 production starts.
- (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 takes about 12 hours.) When dewar is cooled-down, liquid nitrogen begins to be accumulated. LN2 production continues until it reaches 40L (litters) (100%) in the dewar. After that, LN2 production starts when the LN2 level goes below 30L (75%), and stops when it reaches 40L (100%).

8.3 Shutdown

When EMP-07A/07W is turned OFF with the RUN/STOP button, the RUN/STOP light flashes with shorter light on and longer off for 10 seconds and RUN/STOP button lights off and all the operations stop including LN2 production, nitrogen gas supply or LN2 transfer.

8.4 When suspending for long time (for 1 to 2 weeks) and resuming



When the equipment 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.

(When used with GN-10i)

- Take the remote cable off from GN-10i before you press the RUN/STOP switch of EMP-07A/07W and open the right panel of GN-10i.
- (2) Unplug the cable from the "REMOTE" connector located in the middle of inside GN-10i, and connect it to the "LOCAL" connector.
- (3) Press the button on the front side of GN-10i to startup and keep supplying nitrogen to EMP-07A/07W for at least one hour.

- (4) Stop GN-10i, unplug the cable from the "LOCAL" connector and connect it to the "REMOTE" connector, and attach the remote cable for nitrogen gas generator on the right panel.
- (5) Press RUN/STOP button of EMP-07A/07W to reboot the entire system.

(For the system with N2 gas supply)

- (1) Open the N2 gas main valve to supply nitrogen gas to EMP-07A/07W.
- (2) Continue nitrogen gas supply to EMP-07A/07W for at least one hour.
- (3) Press the RUN/STOP switch of EMP-07A/07W to restart 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 equipment, please follow the procedure below and in "14. Trouble Shooting".

8.5.1 Corrective action when electric power failure occurs

EMP-07A/07W and GN-10i 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 restarting)

8.5.2 Corrective action when COMP. AL. occurs

(1) Check the electric supply voltage and capacity.

(2) Remove the transparent panel from the compressor display part of EMP-07A/07W, turn the RUN/STOP button to the OFF position, and again turn it to ON position.

(3) Press the RESET button on EMP-07A/07W.

(4) When the trouble is temporary, SA/SW112-C 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 SA/SW112-C does not start but COMP.AL lights up again, check each part following "14. Trouble Shooting."

8.5.3 Corrective action when GN2 AL. occurs

(For GN-10i)

(1) Turn off the RUN/STOP switch of EMP-07A/07W.

(2) Conduct reset operation of GN-10i.



(3) Turn ON the RUN/STOP switch to re-start EMP-07A/07W.

(4) When Nitrogen gas begins to flow from GN-10i, GN2 AL. lights off.

(For the system with N2 gas supply)

(1) Turn OFF the RUN/STOP switch of EMP-07A/07W.

(2) Check that the supply pressure of N2 gas is between 0.3MPa and 0.99MPa.

(3) Use the N2 gas pressure regulator inside EMP-07A/07W to bring the pressure to above 0.25MPa. When the G2 ALARM on the front panel lights off, adjust the pressure to 0.2MPa and flow rate to 10NL/min, turn ON the RUN/STOP switch of EMP-07A/07W to restart.

8.5.4 Emergency off

In case of an emergency, press the Emergency Off button on the front of EMP-07A/07W to disconnect the control power supply and stop the entire operation.



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



9.1 Connecting liquid nitrogen manual dispense flexible hose

Connect the joint (coupler joint) of attached flexible hose to LN2 manual dispense port located at the front of EMP-07A/07W. When connecting to the coupler joint, do so while pushing the outer ring part of the EMP-07A/07W side.

9.2 Dispense liquid nitrogen

To manually dispense liquid nitrogen, insert the head end of flexible hose in liquid nitrogen container, press and <u>hold the MANUAL START button for 3</u> <u>seconds</u>, and liquid nitrogen will be dispensed from the flexible hose. The dispense operation stops automatically in 10 minutes from the start of dispense. The MANUAL START button blinks from 30 seconds in advance of the 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.



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

- ♦ LN2 producion 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 Disconnect flexible hoses for manual dispense



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 reverse order of connecting procedure. Push down the outer ring of the EMP side joint 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 transfer. Do not touch it directly. Caution is also advised for the extremely cold gas released from the nitrogen gas release port on the target container.

10.1 Inspection before starting automatic transfer

Before starting automatic transfer, make sure the following:

(1) The level indicator cable is correctly connected between EMP-07A/07W and

the level sensor of the target device.

(2) Liquid nitrogen supply tube is correctly connected between EMP-07A/07W and the dewar 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-07A/07W AUTO READY (Automatic-transfer 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 TRANSFER button. AUTO TRANSFER button lights up in white during automatic transfer.
(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-07A/07W are turned

OFF, the LN2 level of EMP-07A/07W is 0%, or transfer 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 fixed time (defaulted to 10 minutes) passes from the start and the AUTO READY and the AUTO SUPPLY blink alternately. Blinking stops by pressing the AUTO READY button. Check the LN2 level in the target dewar and contact us when any abnormal conditions are found. Refer to the "Service Network" at the end of this book for the contact detail.



11. eco Mode

11.1 eco mode

The operation of EMP-07A/07W will be turned to eco mode by pressing "eco" button in the operation panel. EMP-07A/07W is operated as follows in eco mode.

- When EMP-07A/07W does not receive any requests of liquefaction and 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-07A/07W 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-07A/07W goes down to 30L (75%) or less, it resumes liquefaction operation automatically. Ten minutes later than the liquid nitrogen level reaches 40L (100%), EMP-07A/07W returns to eco mode.



When resumed after long-term suspension or newly purchased, do not turn to "eco" mode immediately after starting operation as it may resu**CAUTION** ilure.

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



12. Maintenance and Inspection

12.1 Daily inspection

Check for the following items for daily inspection.

- (1) The operating sound of each device is normal.
- (2) The pressure and flow rate of nitrogen gas are 0.2 MPa and 10 NL/min. respectively.
- (3) He gas pressure of SA/SW112-C is within the proper range.

When in operation: 1.90 - 2.30 MPa

At the initial operation or immediately after starting-up after suspending for long term, the operating pressure may be above 2.30MPa to cooldown the refrigerator. If the pressure does not go down to 2.3MPa, refer to the compressor unit instruction manual to adjust the helium charge pressure.

(4) The alarm light of EMP-07A/07W is not lit.

12.2 Periodical maintenance/inspection

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

(1) EMP-07A/07W, GN-10i

- ♦ Check total operation time of EMP-07A/07W with the hour meter on SA/SW112-C.
- *1 Normally replacement interval is 10,000hours. As the parts or components inside may deteriorate, replace every 5 years even the total operation is below 10,000hours.
 - *2...Clean the filter of the air inlet of GN-10i once a month.
 - *3...Maintenance intervals may vary depending on the condition of operation. When the system is in continuous operation, replacement is to take place every two years.





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



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

In Japan, EMP-07A/07W is high pressure gas manufacturing equipment and the High Pressure Gas Safety Act is applied. Customers are requested to follow the laws or regulations of applicable 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 | The main power source (breaker) is turned OFF. | Turn ON the main power source. |
| switch is turned on (The RUN/STOP switch | The power cord is not | Connect the power cord |
| lamp fails to come on.) | The circuit breaker of the EMP is turned OFF. | Turn ON the circuit breaker. |
| | The fuse of electrical circuit of the EMP 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. | GN-10i is suspended. | Check the electric wiring of GN-10i, or Suspend and resume the EMP and GN-10i. |
| | Nitrogen gas supply stops. | Check the supply pressure of nitrogen gas. |
| | Nitrogen gas supply decreases, or the pressure is lowered temporarily. | Refer to "9-5-3. Corrective action when GN2 AL. occurs" and restart the EMP. |
| (5) COMP.AL lights on, and | The voltage is lowered and power supply fell short as | Engage one power source per one device Fix the power |
| the liquefaction does not | multiple devices run | supply to meet the specified |
| start. | simultaneously with one power source. | value when it is not sufficient. |
| (RUN/STOP button starts | The ambient temperature is too high. | Ventilate well around the EMP. |



| Drohlom | Desciple Course | Compative Action |
|--|---|--|
| to blink.) | Possible Cause | Keep the ambient temperature below 35 °C by installing fans or air conditioners. |
| | Electric parts of SA/SW112-C break down. | Please contact us. |
| (6) RUN/STOP blinks and EMP does not start liquefying operation (Alarm light is not lit). | Level sensor of the EMP 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 |
| | Solenoid valve breaks down (Solenoid 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 | Cold head and oil adsorber | Conduct the maintenance |
|---------------------------|-----------------------------|----------------------------------|
| Nitrogen generation is | exceed the recommended | according to the operation time. |
| lowered. | maintenance interval. | |
| | | |
| | Helium charge pressure of | Add helium to the specified |
| | SA/SW112-C is low. | pressure. Please contact us |
| | | when this trouble occurs |
| | | frequently. |
| | Amount of evaporation | Please contact us. |
| | from dewar increased. | |
| | EMP absorbs special gas | Please contact us. |
| | such as helium. | |
| | | |
| | Ice or frost adheres to | Please contact us. |
| | inside the dewar or around | |
| | the cold head. | |
| | The purity of Nitrogen gas | Check the purity of nitrogen |
| | is not sufficient. | gas supplied. |
| (10) AUTO READY button | The level sensor cable of | Check the level sensor cable of |
| blinks. | the target device is | the target device. |
| | disconnected or not | |
| | connected. | |
| | The level sensor of the | Please contact us. |
| | target device breaks down. | |
| (11) MANU START button | Only 30 seconds left until | Press MANU START button |
| blinks. | the time limit of 10 | again to continue dispending |
| | minutes of manual | manually. |
| | dispense. | |
| (12) AUTO READY button | The level sensor of the | Press AUTO READY button to |
| and AUTO TRANSFER | target device continues | cancel automatic transfer mode |
| button blink alternately. | sending the signal to | and check the amount of liquid |
| | supply although the time | nitrogen in the target device. |
| | limit of automatic transfer | Please contact us if any |
| | is over. | problem is found. |
| (13) Other failures | | Please contact us. |
| | | |



14. Accessories

The accessories below are included in the carton.

| EMP-07A/07W | | | |
|---------------------------------------|---------------------------------|--|--|
| Flexible Hose for Dispensing LN2 | 1 (0.8m) | | |
| (*) Power Cable | 1 (5m) | | |
| (*) GN Remote Cable (for EMP side) | 1 (2m) | | |
| Nitrogen Gas Tube | 1 (5m) | | |
| Single Head Wrench 1 set (25A, 30A) | | | |
| Glass Fuse | 1 set (for EMP: 3A x 2, 2A x 1, | | |
| | for SA/SW112-C: 3A x 2) | | |
| Instruction Manual | 1 (This book) | | |
| For EMP-07W alone | | | |
| Cooling Water Hose | 2 (5m) | | |
| Cooling Water Joint | 4 (screw size Rc3/8) | | |
| Simple Cooling Water Flow Meter | 1 | | |
| GN-10i | | | |
| (*) Power Cable | 1 (1.5m) | | |
| (*) GN Remote Cable (for GN-10i side) | 1 (5m) | | |
| Instruction Manual | 1 | | |

Items with (*) are attached to the equipment.

• The above accessories may vary depending on 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 transportation is observed at the time of delivery, the product will be repaired without charge based on 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) Inappropriate storage or handling, careless accident, software or hardware design by the customer.
- (2) Modifications of the product without consent of UCI.
- (3) Performing maintenance of the product using parts or components which are not approved by UCI, or using the product outside the conditions specified for the product.
- (4) Contamination or corrosion occurred during the use by the customer or customer's customer.
- (5) Fire, earthquake, flood, lightning or other natural disasters, environmental pollution, salt damage, hazardous gases, irregular voltage, and/or usage of power source other than specified by UCI.
- (6) Other reasons which are regarded to be outside the scope 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.

- Repair period after production is discontinued ULVAC CRYOGENICS shall accept product repairs for seven years after production of the product is discontinued.
- 4. Outside the scope of warranty All the items that are not described in this book.
- 5. Others

If the operation or specifications of the customer's equipment are altered, it may be expected to be outside the design scope of this system. In such cases, the specification change or system modification will be determined based on discussion.

Manufacturer: ULVAC CRYOGENICS INCORPORATED

Please refer to the SERVICE NETWORK at the end of this book for our contact information.



SERVICE NETWORK

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

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