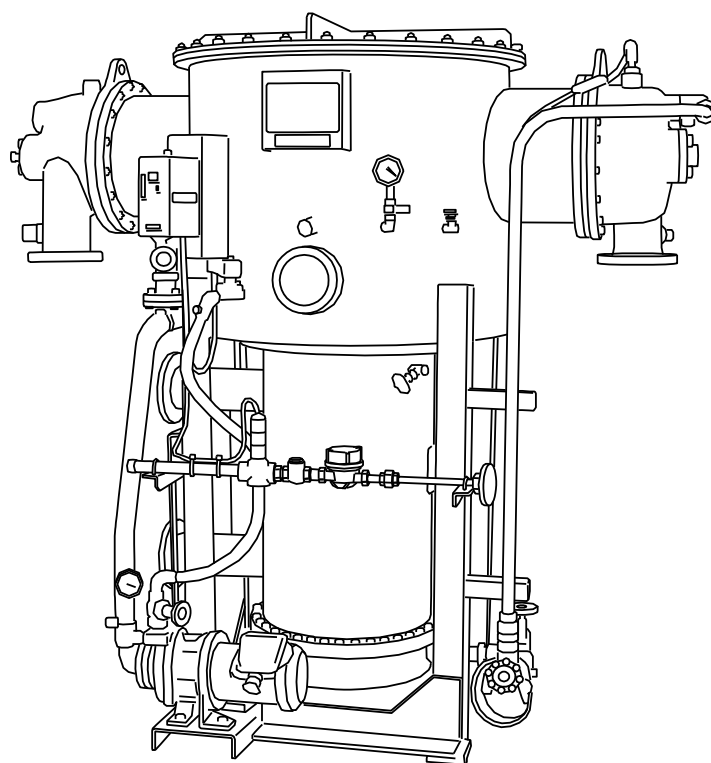


FRESH WATER GENERATOR X SERIES

INSTRUCTION MANUAL



 **SASAKURA**
ENGINEERING CO.,LTD.

Preface

This Instruction Manual serves as a guidebook about correct use of the Fresh Water Generator. The Fresh Water Generator, it must be operated by a technician only who has carefully studied and fully understood the instructions in this Instruction Manual or a technician who has an experience of operating this equipment.

Safety Precautions

Before operating, maintaining or inspecting the Fresh Water Generator, carefully study the Safety Precaution statements given below, as well as this Instruction Manual itself to be able to use the Equipment correctly. Also, before using the Equipment, get fully familiar with the knowledge and safety-related instructions in this manual. After reading, safely keep this manual at a location where it is readily accessible.

About Hazard Indications

This Instruction Manual contains WARNING and CAUTION statements to attract the attention of the readers to the particularly important instructions in order for them to be able to use the product safely and avoid damages to the users and other people and their properties. These statements have the following symbols and meanings. Before beginning to read this manual, fully understand the meanings of these statements.



This statement means that, if the product is erroneously handled without following it, personal death or severe injury can result.



This statement means that, if the product is erroneously handled without following it, personal injury or physical damage can result.

Note, however, certain  statements can imply a case where if the instructions in the statements are disregarded, a severe consequence can result depending on the situation.

<<Before Using the Fresh Water Generator>>

⚠ WARNING		
Instruction		(Page referred to in this manual)
1	Never touch the evaporator and the heater to avoid burn during the Fresh Water Generator operation.	11, 14, 18
2	Never pinch finger in the hinge bolt hole. (Otherwise, finger may be injured.)	35
3	When transferring the Fresh Water Generator, use the lifting holes on its top cover as well as the wires suitable for the weight specified in the assembly outline drawing.	36
4	Do not install any valve to the steam drain discharge line. If a valve is installed to the drain discharge line, and when the Fresh Water Generator is run with this valve closed, the Fresh Water Generator may be damaged.	36

⚠ CAUTION		
Instruction		(Page referred to in this manual)
1	Make sure that the ejector pump inlet is filled with seawater.	11, 14
2	When running the distillate pump for the first time, discharge the distillate overboard for at least 30 minutes.	12, 15, 19
3	Before the ship comes close to a port, land or river mouth, stop running the Fresh Water Generator. The seawater in such locations may be contaminated with bacteria, and bacteria may be mixed in the generated distillate. Also, note that the Fresh Water Generator may malfunction when the ship is in a dirty sea.	12, 15
4	Do not open the bottom blow valve (V3) to restore the atmospheric pressure in the evaporator. Otherwise, the seawater in the heater may be blown up and damage the deflector etc.	12, 15, 19
5	Please check the condition of inner coating periodically and when the coating damage is found out, repair work shall be done immediately. If Fresh Water Generator is operated without repair of the inner coating, pinhole can be got by corrosion of the carbon steel.	23, 30
6	When pressure test is done, remove the evaporator vacuum gauge or fully close the root valve.	24
7	Follow the instruction manual of the manufacturer for cleaning agent preparation.	25
8	Other manufacturers offer various cleaning agents. For details, refer to their instruction manual and SDS.	25
9	Please ventilate enough in work, wear suitable protective materials such as protective spectacles and the protective gloves, and prevent the direct contact to skin.	26, 39
10	Please wash your hands and face, etc., and gargle after finished handling.	26, 39
11	For this rinsing work, do not use steam because the inside surface of the evaporator is covered with a coating.	29
12	Very carefully handle the epoxy resin and hardening agent. In the case of skin contact, immediately wash away with a plenty of water.	31
13	Never loosen or remove the bolts that secure the tube plate. (Otherwise, leakage may occur.)	33, 35
14	To protect the coating layer inside the equipment, never cause heating on the Fresh Water Generator by welding or with an open flame.	36
15	Please avoid mixing up or contacting with the sulphite, nitrite & alkaline liquid. Please be careful not to breathe the vaporized odor and the mist generated from SASABIT.	39

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1 OVERVIEW OF THE FRESH WATER GENERATOR

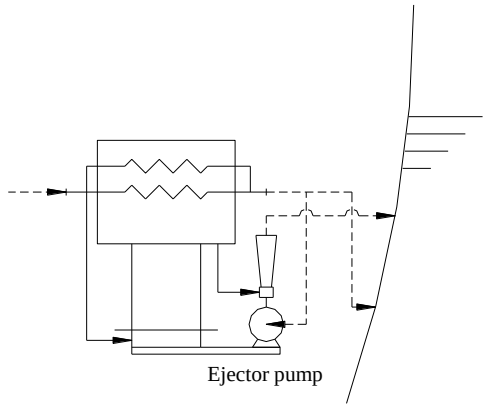
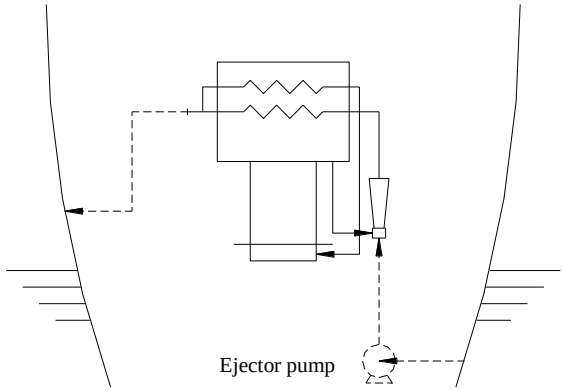
1.1 Terminology

The terms used throughout this manual to describe the Fresh Water Generator are explained below:

Ejector Pump	A pump that feeds driving water to the Water Ejector of the Fresh Water Generator.
Heater	Heat exchanger that heats feed water to generate vapor.
Hot Water (Heating Hot Water)	Heating medium that heats and evaporates seawater in the Heater.
Feed Water	Seawater that is a source of distillate.
Feed Water Preheater	A heat exchanger that further heats a portion of cooling water delivered from the Condenser.
Deflector	A plate that separates seawater particles being transported together with the vapor generated in the Evaporator.
Driving Water	Water necessary for driving the Water Ejector.
Evaporator	Being composed of the Evaporation Chamber, Deflector and Mesh Separator, the Evaporator evaporates seawater.
Distillate (Product Water)	Water generated by condensation of vapor generated in the Evaporator.
Distillate Pump	A pump that transfers the distillate produced in the Fresh Water Generator to the Fresh Water Tank.
Steam Injector	An equipment that adds steam to fresh water to generate hot water, and circulates hot water.
Fresh Water Generator	A unit that produces distillate from fresh water or seawater.
Vent Air	A gas such as non-condensable gas and leaking air that is extracted to maintain the degree of vacuum needed for evaporation.
Inner Coating	Seawater resistant coating that prevent the carbon steel from corrosion.
Generated Vapor	Vapor evaporating from seawater in the Evaporator.
Hinge	The parts for turning (remove, reassemble) a heater
Condenser	A heat exchanger that condenses vapor into distillate.
Corrosion Bar	A sacrifice anode material that protects the pipes and other corrosive parts of the Fresh Water Generator by utilizing the electric potential difference.
Brine	Concentrated seawater remaining after evaporation of water content.
Water Ejector	A device that evacuates the Evaporator and discharges cooling seawater and brine overboard.
Mesh Separator	Wire mesh that separates the brine mist that is being transferred together with the vapor generated in the Evaporator.
Chemicals Injection Unit	A unit for injecting a scale inhibitor that prevents seawater-derived scale from occurring on the inside wall of the piping of the Heater.
Cooling Water (Cooling Seawater)	A cooling medium that cools down the vapor in the Condenser.

1.2 Summary of the Fresh Water Generator

The Fresh Water Generator consists of the evaporator, heater and condenser, and incorporates accessories that include the water ejector, ejector pump, distillate pump, deflector, mesh separator, salinity indicator, solenoid valve and distillate integrating flowmeter. The X Series Fresh Water Generator products can be categorized into subtypes—XM and XE. These subtypes are explained below:

Type	Schematic diagram	Explanation
XM type	 Ejector pump	This is an energy-saving type, with which a part of the condenser cooling water is utilized as the water ejector driving water. The installation work for this type is simple and easy because its components are unit-built.
XE type	 Ejector pump	The ejector pump driving water is used as the cooling water for the condenser. Thus, supply of the cooling water from the outside the Fresh Water Generator is not needed. The ejector pump is needed to install under draught waterline.

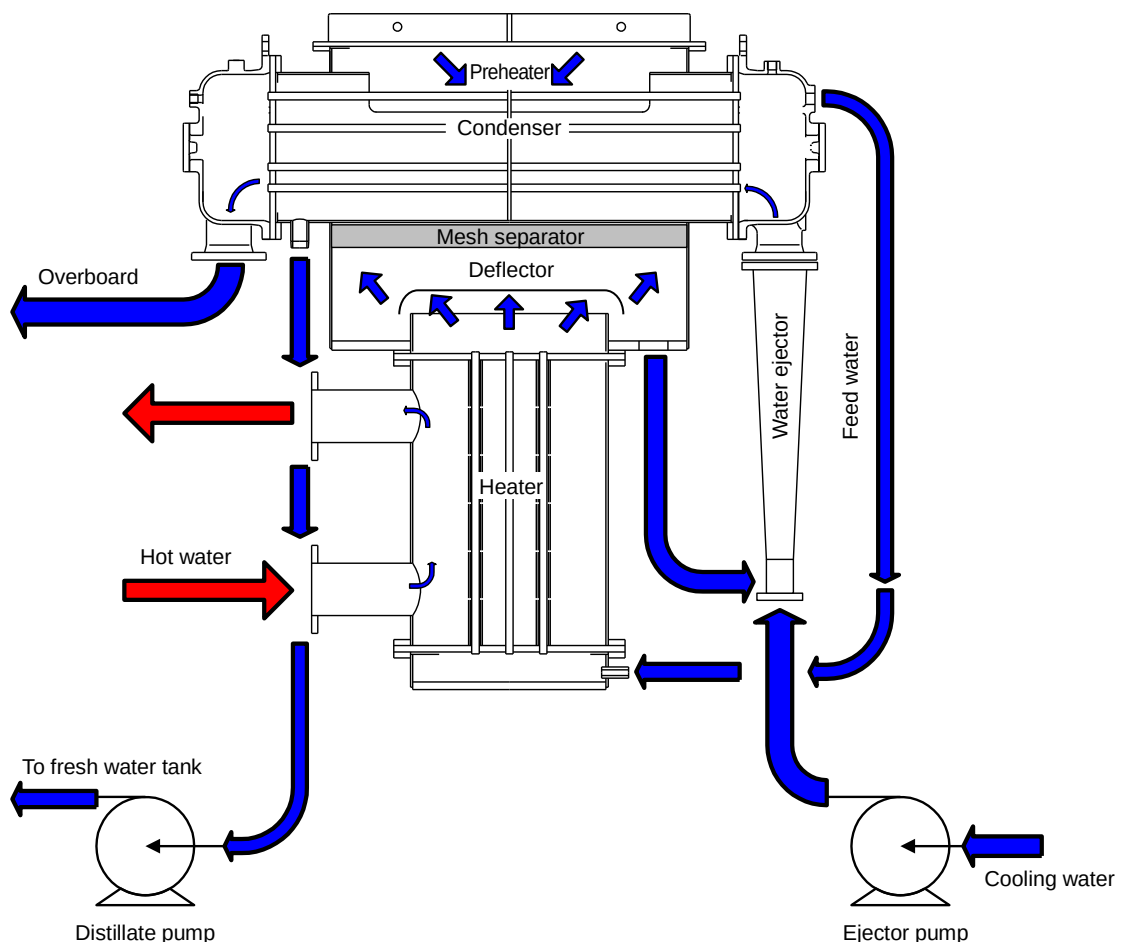
1.3 Operating Principle of the Fresh Water Generator

By utilizing the jacket cooling water which has absorbed the heat of the main diesel engine of the ship, the Fresh Water Generator evaporates seawater in high vacuum to produce highly pure distillate. The explanation below is for XE Type.

- [1] The inside of the Fresh Water Generator is always kept at high vacuum by means of the water ejector. The seawater fed by the ejector pump drives the water ejector, and then enters the cooling tubes in the condenser and is used as cooling water, and then discharged overboard.
- [2] A part of the jacket cooling water having waste heat is introduced into heater, flows outside the heating tubes to transfer the heat to the feed water (seawater) flowing inside the heating tubes.
- [3] Seawater, which has been heated by the feed water preheater in the condenser, is used as feed water.

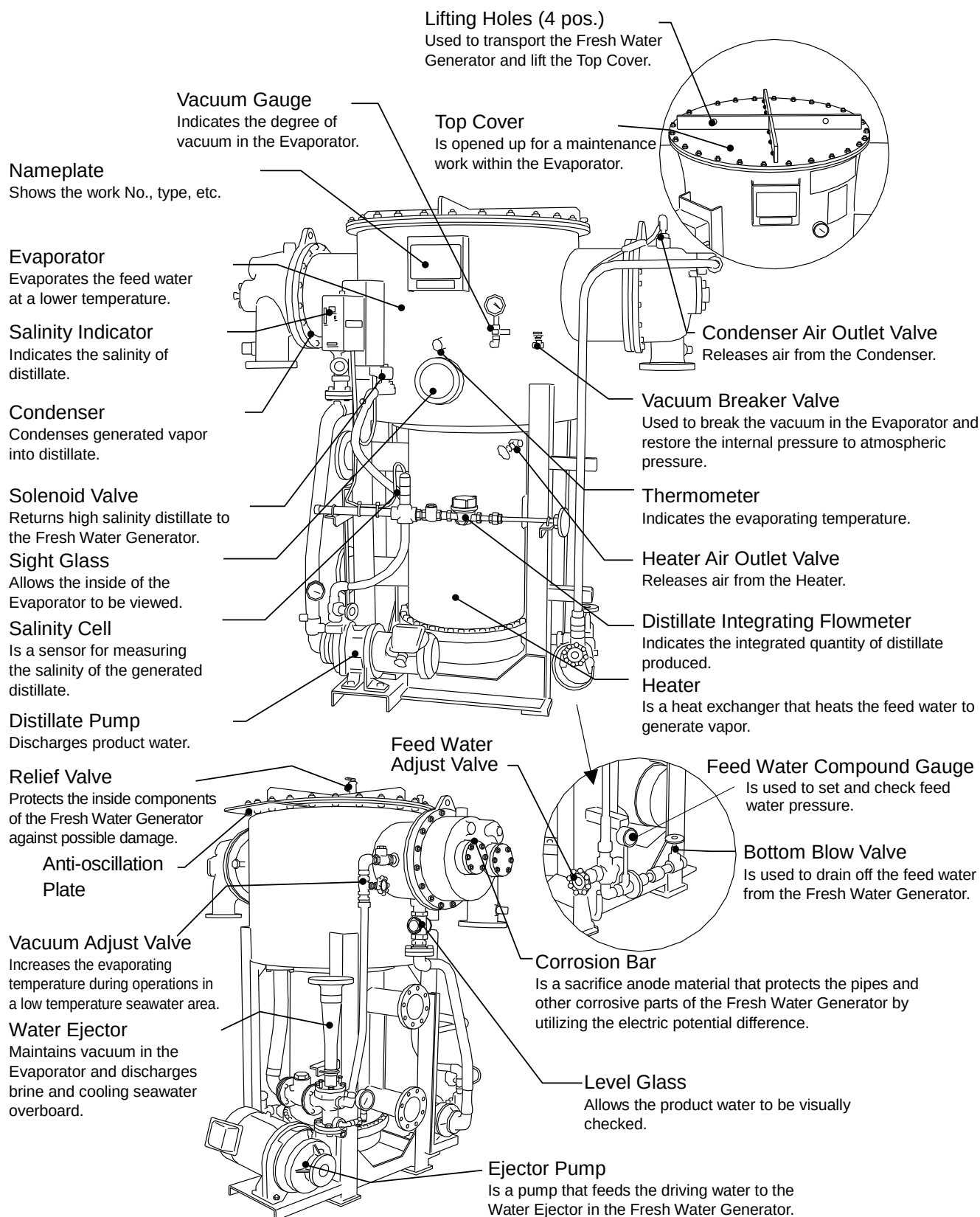
From the generated vapor, seawater mist is separated by the deflector and mesh separator, and the vapor enters the condenser. The separated seawater mist, together with the remaining seawater (brine) which has not been evaporated, is discharged overboard by the water ejector.

- [4] The generated vapor entering the condenser is condensed into distillate by the cooling water flowing inside the condenser cooling tubes, and the resultant distillate is transferred into the fresh water tank.
- [5] The salinity of the distillate is continuously monitored with the salinity indicator. If the specified salinity level is exceeded, the solenoid valve in the distillate pump outlet line is actuated to automatically direct the high salinity water to the evaporator, preventing the high salinity water from flowing into the fresh water tank.



1.4 Names & Functions of the Components

* The illustrations below show the XM Type.

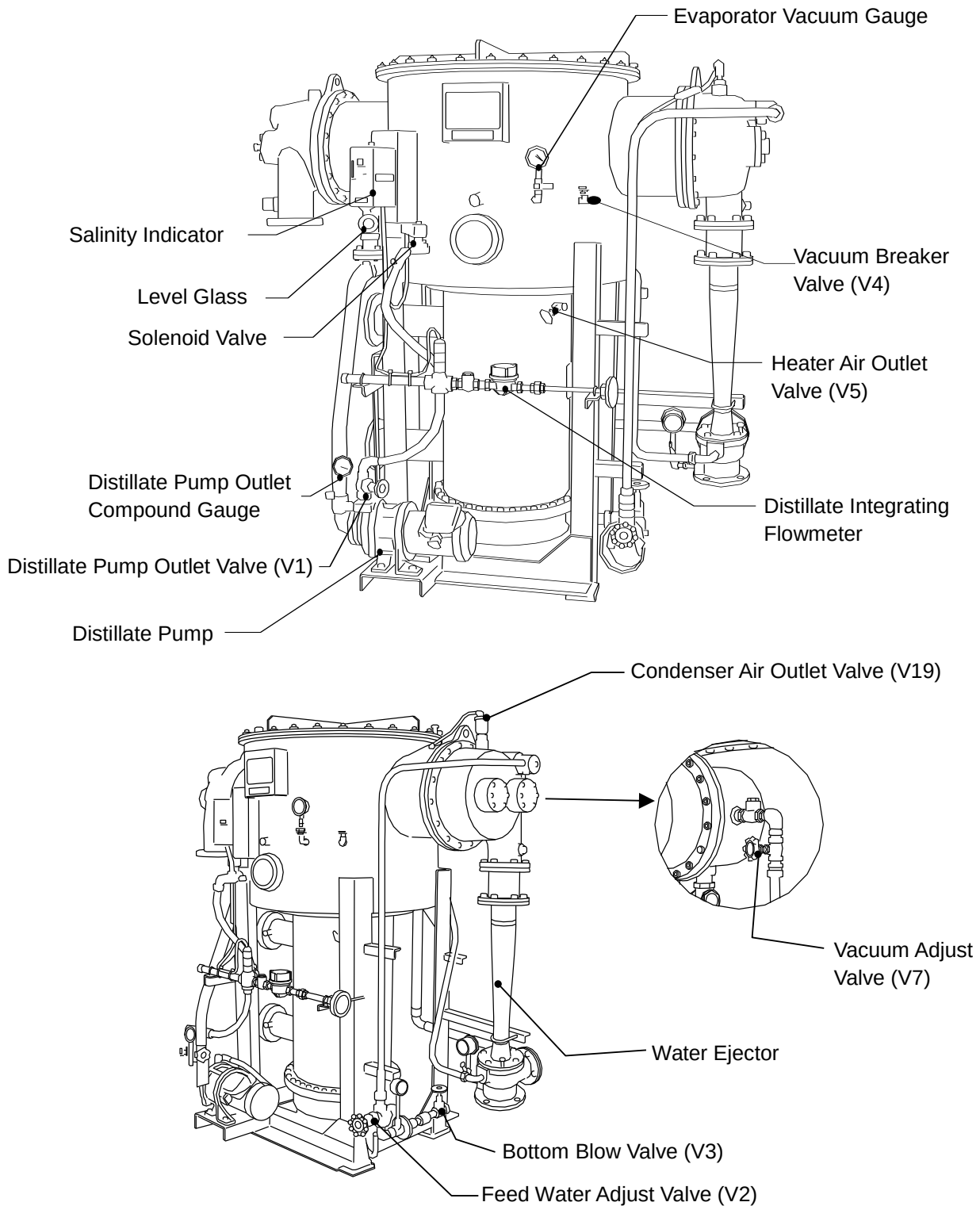


2 OPERATION

2.1 Operating Procedure for XE Type

Use the valves specified below when operating the Fresh Water Generator.

(The valve locations can somewhat vary depending on the type of the Fresh Water Generator.)



2.1.1 How to start running (XE type)

<Confirmation before startup>

Before startup, check that the following valves are in the closed position:

- 1 Hot water inlet/outlet valves (furnished by the Shipbuilder) and heater air outlet valve (V5)
- 2 Vacuum breaker valve (V4)
- 3 Distillate pump outlet valve (V1)
- 4 Feed water adjust valve (V2)
- 5 Bottom blow valve (V3)
- 6 Other valves and cocks connecting to the atmosphere

[1] Starting the ejector pump

- 1 Fully open the ejector pump inlet valve as well as the cooling water overboard discharge valve.

 CAUTION : Make sure that the ejector pump inlet is filled with seawater.

- 2 Start the ejector pump.
- 3 Slowly open the ejector pump outlet valve.
(Be careful not to rapidly exert pressure to the condenser and the water ejector.)
* Check that the inlet pressure on the water ejector is 0.4 MPa or higher.
Check that the condenser air outlet valve (V19) is functioning correctly.

[2] Feeding the feed water

- 1 Open the feed water adjust valve (V2).
- 2 Adjust the feed water pressure so that it falls in a range defined by a green mark (0.04 to 0.06 MPa).
* If the feed water pressure fails to increase, slowly close the cooling water outlet valve to adjust the feed water pressure. Note, however, that the back pressure at the condenser cooling water outlet must be adjusted to 8 mAq or lower.

[3] Starting the chemical injection unit

[4] Checking the degree of vacuum in the evaporator

Check that the pressure in the evaporator has dropped to approx. -0.092 MPa (70 cmHgV).

[5] Injecting the hot water

- 1 Slowly open the hot water inlet valve to the fully opened position.
* Be careful not to heat the heater very rapidly.
- 2 Through the air outlet valve (V5) situated on the top of the shell of heater, fully release the air from the heater shell.
- 3 Slowly open the hot water outlet valve to the fully opened position.
- 4 Adequately close the hot water bypass valve to adjust the hot water flow rate.
* Adjust the flow rate so that the temperature difference across the inlet and outlet of the hot water is set to the designed value.

 WARNING : Never touch the evaporator and the heater to avoid burn during the Fresh Water Generator operation.

[6] Powering ON the salinity indicator

[7] Checking the generated distillate

Check that the distillate is visible through the level glass on the distillate pump suction pipe.

[8] Starting the distillate pump

- 1 Start the distillate pump.
- 2 Open the distillate pump outlet valve (V1).
- 3 Adjust the outlet pressure to a range of 0.14 to 0.22 MPa.
* Prevent the sight glass from being filled with water. Otherwise, the heat transmission area of the condenser can be decreased.

[9] Checking the amount of distillate

Approximately 30 minutes after the Fresh Water Generator begins stably running, measure the amount of generated distillate with the distillate integrating flowmeter.

*Run the Fresh Water Generator so that the amount of generated distillate is at maximum the rated capacity of the Fresh Water Generator.

 CAUTION : When running the distillate pump for the first time, discharge the distillate overboard for at least 30 minutes.

2.1.2 How to stop running (XE type)

 CAUTION : Before the ship comes close to a port, land or river mouth, stop running the Fresh Water Generator. The seawater in such locations may be contaminated with bacteria, and bacteria may be mixed in the generated distillate. Also, note that the Fresh Water Generator may malfunction when the ship is in a dirty sea.

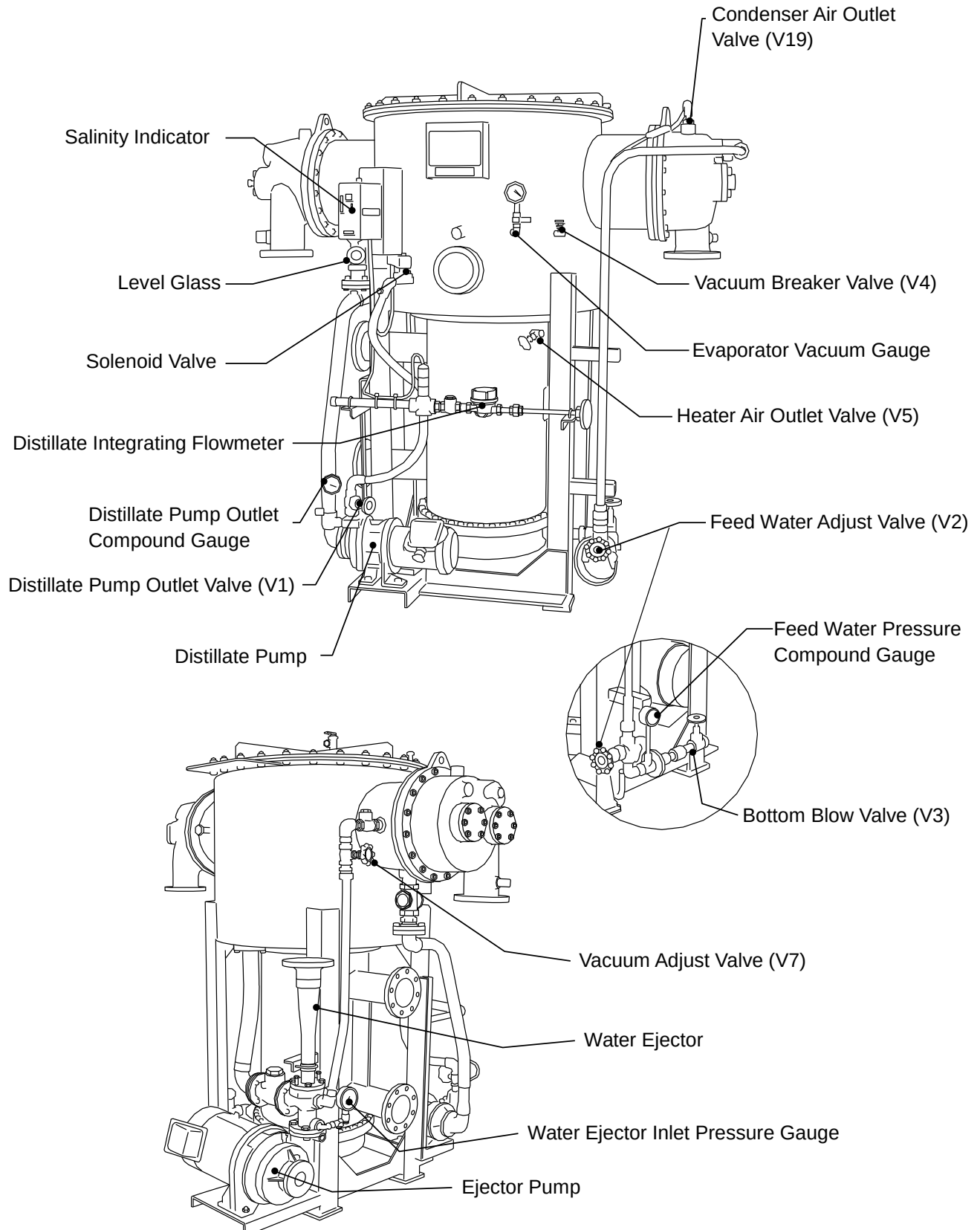
- [1] Fully opening the hot water bypass valve
Slowly open the hot water bypass valve to the fully open position.
* The amount of generated distillate will decrease.
- [2] Fully closing the hot water outlet valve
Slowly close the hot water outlet valve to the fully closed position.
- [3] Fully closing the hot water inlet valve
Slowly close the hot water inlet valve to the fully closed position.
- [4] Stopping the distillate pump
 - 1 Fully close the distillate pump outlet valve (V1)
 - 2 Stop the distillate pump.
- [5] Cooling down the heater
Run the ejector pump for at least 30 minutes to supply feed water to the heater to cool down the heater.
- [6] Stopping the chemical injection unit
- [7] Powering OFF the salinity indicator
- [8] Fully closing the feed water adjust valve (V2)
 - 1 Check that the heater has cooled down.
 - 2 Fully close the feed water adjust valve (V2).
- [9] Stopping the ejector pump
 - 1 Fully close the ejector pump outlet valve.
 - 2 Stop the ejector pump.
- [10] Fully closing the related valves
Fully close the cooling water overboard discharge valve and other related valves.
- [11] Breaking vacuum in the evaporator
Open the vacuum breaker valve (V4) to turn the vacuum in the evaporator to the atmospheric pressure.

 CAUTION : Do not open the bottom blow valve (V3) to restore the atmospheric pressure in the evaporator. Otherwise, the seawater in the heater may be blown up and damage the deflector etc.

2.2 Operating Procedure for XM Type

By using the valves specified below, operate the Fresh Water Generator.

(The valve locations can somewhat vary depending on the type of the Fresh Water Generator.)



2.2.1 How to start running (XM type)

<Confirmation before startup>

Before startup, check that the following valves are in the closed position:

- 1 Hot water inlet/outlet valves (furnished by the Shipbuilder) and heater air outlet valve (V5)
- 2 Vacuum breaker valve (V4)
- 3 Distillate pump outlet valve (V1)
- 4 Feed water adjust valve (V2)
- 5 Bottom blow valve (V3)
- 6 Other valves and cocks connecting to the atmosphere

[1] Injecting the cooling water

Open the condenser cooling water inlet and outlet valves to allow the cooling water to flow into the condenser.

[2] Starting the ejector pump

- 1 Fully open the ejector pump inlet valve as well as the cooling water overboard discharge valve.

 **CAUTION** : Make sure that the ejector pump inlet is filled with seawater.

- 2 Start the ejector pump.

* Check that the condenser air outlet valve (V19) is functioning correctly.

[3] Feeding the feed water

- 1 Open the feed water adjust valve (V2).
- 2 Adjust the feed water pressure so that it falls in a range defined by green marks (0.04 to 0.06 MPa).

* If the feed water pressure fails to increase, slowly close the cooling water outlet valve to adjust the feed water pressure. Note, however, that the back pressure at the condenser cooling water outlet must be adjusted to 8 mAq or lower.

[4] Starting the chemical injection unit

[5] Checking the degree of vacuum in the evaporator

Check that the pressure in the evaporator has dropped to approx. -0.092 MPa (70 cmHgV).

[6] Injecting the hot water

- 1 Slowly open the hot water inlet valve to the fully opened position.
* Be careful not to heat the heater very rapidly.
- 2 Through the air outlet valve (V5) situated on the top of the shell of heater, fully release the air from the heater shell.
- 3 Slowly open the hot water outlet valve to the fully opened position.
- 4 Adequately close the hot water bypass valve to adjust the hot water flow rate.
* Adjust the flow rate so that the temperature difference across the inlet and outlet of the hot water is set to the scheduled value.

 **WARNING** : Never touch the evaporator and the heater to avoid burn during the Fresh Water Generator operation.

[7] Powering ON the salinity indicator

[8] Checking the generated distillate

Check that the distillate is visible through the level glass on the distillate pump suction pipe.

[9] Starting the distillate pump

- 1 Start the distillate pump.
- 2 Open the distillate pump outlet valve (V1).
- 3 Adjust the outlet pressure to a range of 0.14 to 0.22 MPa.
* Prevent the sight glass from being filled with water. Otherwise, the heat transmission area of the condenser can be decreased.

[10] Checking the amount of distillate

Approximately 30 minutes after the Fresh Water Generator begins stably running, measure the amount of generated distillate with the distillate integrating flowmeter.

* Run the Fresh Water Generator so that the amount of generated distillate is at maximum the rated capacity of the Fresh Water Generator.

 CAUTION : When running the distillate pump for the first time, discharge the distillate overboard for at least 30 minutes.

2.2.2 How to stop running (XM type)

 CAUTION : Before the ship comes close to a port, land or river mouth, stop running the Fresh Water Generator. The seawater in such locations may be contaminated with bacteria, and bacteria may be mixed in the generated distillate. Also, note that the Fresh Water Generator may malfunction when the ship is in a dirty sea.

[1] Fully opening the hot water bypass valve

Slowly open the hot water bypass valve to the fully open position.

*The amount of generated distillate will decrease.

[2] Fully closing the hot water outlet valve

Slowly close the hot water outlet valve to the fully closed position.

[3] Fully closing the hot water inlet valve

Slowly close the hot water inlet valve to the fully closed position.

[4] Stopping the distillate pump

1 Fully close the distillate pump outlet valve (V1)

2 Stop the distillate pump.

[5] Cooling down the heater

Run the ejector pump for at least 30 minutes to supply feed water to the heater to cool down the heater.

[6] Stopping the chemical injection unit

[7] Powering OFF the salinity indicator

[8] Fully closing the feed water adjust valve (V2)

1 Check that the heater has cooled down.

2 Fully close the feed water adjust valve (V2).

[9] Stopping the ejector pump

Stop the ejector pump.

[10] Fully closing the cooling water inlet valve

[11] Fully closing the related valves

Fully close the cooling water overboard discharge valve and other related valves.

[12] Breaking vacuum in the evaporator

Open the vacuum breaker valve (V4) to turn the vacuum in the evaporator to the atmospheric pressure.

 CAUTION : Do not open the bottom blow valve (V3) to restore the atmospheric pressure in the evaporator. Otherwise, the seawater in the heater may be blown up and damage the deflector etc.

2.3 Procedure after Completion of Operation (Common to All the Types)

- [1] After completion of operation, recheck that all the valves and cocks are in the fully closed position. If the hot water inlet/outlet valves leaks while the Fresh Water Generator is stopped and the hot water flows in, the heater may be remaining hot and as a result, salt deposition and scale formation may occur in the heater tubes in a short period.
- [2] If the Fresh Water Generator is scheduled to remain inoperative for one week or longer, drain off the feed water contained in it through the bottom blow valve (V3) situated at the bottom of the heater.

2.4 Cautions during Operation (Common to All the Types)

2.4.1 Adjusting the amount of product water

The amount of product water is adjusted by increasing or decreasing the flow rate of hot water supplied to the heater. By referring to the reading on the distillate integrating flowmeter, the hot water flow rate must be adjusted so that the rated fresh water generation capacity is fulfilled.

An excessively high evaporating temperature (approx. 60°C) leads to an increased scale occurrence in the heater tubes. Additionally, an excessively low evaporating temperature (approx. 45°C) leads to an excessively large specific volume of the generated vapor, possibly causing seawater mist to enter the condenser to increase the salinity of the obtained distillate.

While the interior of the heater tubes remains clean, the Fresh Water Generator can produce fresh water in an amount exceeding its rating. Note, however, overproduction of distillate can promote scale occurrence in the heater tubes. Therefore, at maximum, run the Fresh Water Generator at its rated fresh water generation capacity.

2.4.2 Condenser

To be able to most efficiently condense the vapor occurring in the evaporator, it is necessary to feed cooling water, which is kept as cold as possible, to the condenser. It is necessary to confirm that based on the cooling water temperature difference across the inlet and outlet of the condenser, the cooling water is flowing at the scheduled flow rate. An excessively high flow rate can lead to a higher flow speed within the condenser that triggers turbulence-induced corrosion of the components in the condenser. In contrast, a much lower flow rate can lead to decrease in the cooling performance that can cause an increase in evaporating temperature and insufficiency in the amount of generated distillate. An approximate required cooling water flow rate on the condenser can be calculated with the formula below:

D: daily generated distillate (T/day)

t_1 : inlet temperature on the condenser (°C)

t_2 : outlet temperature on the condenser (°C)

Q: required cooling water flow rate (T/h)

$$Q = \frac{D \times 22.4}{(t_2 - t_1)} \quad (\text{T/h})$$

The maximum required cooling water flow rates (t/h) for the XM type is summarized in the table below:

XM type	10	15	20	25	30	35	40	50	60
Max. flow rate (t/h)	27	49	49	52	67	79	90	95	133

* On the XE type, the cooling water flow rate cannot be adjusted since the cooling water (driving water) is supplied from the ejector pump.

2.4.3 Confirmation of feed water rate

At regular intervals, confirm that the feed water rate is at the specified level in order to inhibit build-up of scale as low as possible.

*Adjust the feed water pressure so that it falls in a range defined by a green mark (0.04 to 0.06 MPa).

2.4.4 Injecting the scale inhibitor

To control build-up of scale as low as possible, continuously inject the scale inhibitor into the feed water while the Fresh Water Generator is running. For the concentration and amount injected of the scale inhibitor, observe the instructions in the instruction manual of the scale inhibitor supplier. Also, measure the chemical level in the scale inhibitor injector tank to make sure that the scale inhibitor is being injected into the feed water.

2.4.5 Salinity of distillate

If, while the Fresh Water Generator is running, the salinity of distillate exceeds the specified level, the salinity indicator will signal an alarm. At the same time, the salinity indicator lights the alarm LED lamp and actuates the solenoid valve to cause the high salinity water to be automatically returned to the evaporator. If the salinity drops to the normal level, the alarm circuit automatically resets and the alarm LED turns OFF, the solenoid valve closes, and the distillate of high purity again flows into the fresh water tank. If the Fresh Water Generator is run in a low temperature seawater area, the evaporating temperature will be lower, and, as a result, the salinity of distillate can be higher. If this situation occurs, adequately close the vacuum adjust valve (V7) to increase the evaporating temperature slightly (approx. 1°C) so as to stabilize the salinity. In such a case, the vacuum adjust valve should be fully shut. And then, the valve should be opened gradually. By this method, it is easier to adjust. In addition, it is possible to use the vacuum breaker valve (V4) attached on the evaporator to adjust the vacuum. If the temperature or flow rate of the cooling water and hot water fed to the Fresh Water Generator is unstable, the salinity of distillate can fluctuate greatly. If this problem occurs, decrease the flow rate of the hot water and temporarily run the Fresh Water Generator at a lower fresh water generation rate (approximately 60 to 80% the rated capacity).

2.4.6 Confirmation of evaporating temperature

The thermometer of the evaporator will indicate an accurate evaporating temperature when the Fresh Water Generator is running stably after having been run for 15 to 30 minutes. While the Fresh Water Generator is running stably, check for the heat balance and confirm that the heat balance remains unchanged.

2.4.7 Operation logbook

It is recommended that the operation logbook be maintained by entering daily records about the amount of generated distillate, temperatures and pressures on various components. Various types of data recorded at regular intervals will offer a useful reference when determining the cause of an accident or problem occurring from operation of the Fresh Water Generator.

*Inquiring into the cause of trouble and the remedy, inform the data in the abnormal operating condition (refer to data sheet at 41page).

2.5 Operation Using the Optional Steam Injector System

Study this section carefully only when the Fresh Water Generator is equipped with the optional steam injector. With this optional system, it is possible to produce distillate by utilizing steam when the ship is lying at anchor and/or the hot water from the main engine is not available.

2.5.1 How to start running

<Confirmation before startup>

Before startup, check that the following valves are in the closed position:

- 1 Hot water inlet/outlet valves (furnished by the Shipbuilder) and heater air outlet valve (V5)
- 2 Vacuum breaker valve (V4)
- 3 Distillate pump outlet valve (V1)
- 4 Feed water adjust valve (V2)
- 5 Bottom blow valve (V3)
- 6 Other valves and cocks connecting to the atmosphere
- 7 Steam valve

Check that the following valve is in the fully opened position:

Butterfly valve (V20 steam injector piping)

[1] Preparation before running the steam injector system

XE type

- 1) Start the ejector pump.
- 2) Feed the feed water.
- 3) Start the chemical injection unit.
- 4) Confirm the degree of vacuum in the evaporator

XM type

- 1) Feed the cooling water
- 2) Start the ejector pump.
- 3) Feed the feed water.
- 4) Start the chemical injection unit.
- 5) Confirm the degree of vacuum in the evaporator

Check that the degree of vacuum in the Fresh Water Generator is 70 cmHgV or higher, the feed water pressure is in a range defined by a green mark and the feed water is normally fed, and a sufficient amount of the cooling water is flowing into the condenser.

* For details, refer to the starting method for the intended type.

[2] Feeding the circulating fresh water

- 1 Check that the hot water inlet and outlet valves on the Fresh Water Generator are in the closed position, and drain off the jacket cooling water remaining in the heater and piping.
* This step is intended to avoid use of the main engine cooling water as the boiler feed water since the main engine cooling water usually contains an anticorrosive agent.
- 2 Open the fresh water injection valve to fill the heater and piping with fresh water.
- 3 Open the heater air outlet valve (V5) to release the air, and then close this valve (V5). Check that the heater and piping are filled with fresh water, and then close the fresh water injection valve.

[3] Injecting steam

- 1 Slowly operate the steam valve in front of the steam injector to attain the specified pressure. The temperature of the recirculating fresh water in the piping will gradually rise. (Do not heat the heater too rapidly.)
- 2 Fully release the air from the heater through the air outlet valve (V5) on the heater.

 WARNING : Never touch the evaporator and the heater to avoid burn during the Fresh Water Generator operation.

[4] Powering ON the salinity indicator

[5] Checking the generated distillate

Check that the distillate is visible through the sight glass on the distillate pump suction pipe.

[6] Starting the distillate pump

- 1 Start the distillate pump.
- 2 Open the distillate pump outlet valve (V1).
- 3 Adjust the outlet pressure to a range of 0.14 to 0.22 MPa.

* Prevent the sight glass from being filled with water. Otherwise, the heat transmission area of the condenser can be decreased.

[7] Checking the amount of distillate

Approximately 30 minutes after the Fresh Water Generator begins stably running, measure the amount of generated distillate with the distillate integrating flowmeter.

* Run the Fresh Water Generator so that the amount of generated distillate is at maximum the rated capacity of the Fresh Water Generator.

 **CAUTION :** When running the distillate pump for the first time, discharge the distillate overboard for at least 30 minutes.

2.5.2 How to stop running

[1] Fully closing the steam valve

- 1 Fully close the steam valve.
- 2 The amount of distillate will decrease.

[2] Stopping the distillate pump

- 1 Fully close the distillate pump outlet valve (V1).
- 2 Stop the distillate pump.

[3] Cooling down the heater

Run the ejector pump for 30 minutes or longer to supply feed water to the heater to cool down the heater.

[4] Stopping the chemical injection unit

[5] Powering OFF the salinity indicator

[6] Fully closing the feed water adjust valve (V2)

- 1 Check that the heater has cooled down.
- 2 Fully close the feed water adjust valve (V2).

[7] Stopping the ejector pump

- 1 Fully close the ejector pump outlet pump.
- 2 Stop the ejector pump.

[8] Fully closing the cooling water inlet valve (XM type only)

[9] Fully closing the related valves

After stopping the ejector pump, fully close the following valves:

- 1 Cooling water inlet and outlet valves (XM type only)
- 2 Cooling water overboard discharge valve

[10] Breaking vacuum in the evaporator

Open the vacuum breaker valve (V4) to restore the vacuum in the evaporator to the atmospheric pressure.

 **CAUTION :** Do not open the bottom blow valve (V3) to restore the atmospheric pressure in the evaporator. Otherwise, the seawater in the heater may be blown up and damage the deflector etc.

2.5.3 Cautions for operating the steam injector system

[1] Before running the steam injector system, drain off the hot water, and fill the heater and piping with fresh water.

[2] If air remains trapped in the heater, the temperature in the heater will excessively rise, possibly causing the heater mounting gasket and associated components to be damaged. The internal water can surge into the drain tank, possibly causing abnormal noise and vibration.

[3] Do not open the steam valve rapidly.

[4] Set the steam pressure to the specified level. If the steam pressure is below the specified level, abnormal noise or vibration can occur.

[5] If the steam drain piping outlet pressure (back pressure) is higher than the specified pressure, abnormal noise or vibration will occur. Keep the back pressure as low as possible.

3 TROUBLESHOOTING

Problem	Cause	Solution
Distillate generation rate has dropped.	Inside the heating tube is fouled up.	Clean the heater piping.
	Inside the condenser piping is fouled up.	Clean the condenser piping.
	Hot water temperature is low.	See the relevant instruction.
	Hot water flow rate is too low.	Increase the hot water flow rate.
	Cooling water flow rate is too low.	Increase the cooling water flow rate.
	Sight glass is filled with water.	See the relevant instruction.
	Degree of vacuum in the evaporator has dropped.	See the relevant instruction.
Evaporating temperature has dropped.	Hot water temperature is low.	Increase the temperature to the specified level.
	Hot water flow rate is too low.	Increase the hot water flow rate.
Degree of vacuum in the evaporator has dropped.	Air is leaking.	Repair the leaking area, and perform air test at 0.05 MPa.
	Water ejector has malfunctioned.	See the relevant instruction.
Water ejector has malfunctioned.	Nozzle is clogged.	Clean the nozzle
	Diffuser has been corroded or worn out.	Replace with a new one.
	Nozzle has been worn out.	Replace with a new one.
	Outlet pressure is 0.08 MPa or higher.	Check for the clogging of the ejector outlet piping; check the valve opening of the overboard discharge valve.
	Outlet pressure is negative.	Somewhat close the overboard discharge valve.
Sight glass is filled with distillate.	Distillate pump has failed.	Repair the distillate pump.
	Distillate pump outlet valve (V1) is in the closed position.	Open the distillate pump outlet valve (V1).
	Outlet piping is clogged.	Clean the outlet piping.
	Distillate pump is drawing air.	Replace the mechanical seal; or see the instruction for the pump.
Salinity of distillate is too high.	Distillate generation rate is too high.	Decrease the hot water flow rate.
	Evaporating temperature is too low (50°C or lower).	Somewhat close the vacuum adjust valve (V7) to increase the evaporating temperature.
	The Fresh Water Generator has been used in a port or river mount, and the feed water is dirty.	Stop running the Fresh Water Generator.
	Indication on the salinity indicator is faulty.	Check using the salinity indicator test switch.
		Clean the cell (electrode).
	Condenser piping has been damaged.	Plug a failed pipe.
Feed water flow rate is lower than the specified level.	Opening of the feed water adjust valve (V2) is insufficient.	Adjust the opening of the feed water adjust valve (V2).
	Feed water orifice is clogged.	Open and clean the feed water orifice.
	Internal pressure on the condenser piping is insufficient.	Somewhat close the condenser cooling water outlet valve.
Feed water flow rate is higher than the specified level.	Opening of the feed water adjust valve (V2) is excessively large	Somewhat close the opening of the feed water adjust valve (V2).
	Feed water orifice has been worn.	Replace the feed water orifice.

Problem		Cause	Remedy	
			Solution	Verification
Pump has failed.	Pump does not start.	Motor or electrical system has failed.	Inspect and repair.	
		Impeller has seized with the casing ring. The pump has seized.	Replace or repair the impeller; replace the casing ring.	Check centering of the motor with the pump. Check the eccentricity of the shafts. Inspect the bearings. Inspect balance on the impeller. Inspect the ring groove on the casing. Inspect the shaft coupling.
	Pump fails to attain the specified capacity and head.	Pump is drawing air.	Check the suction system. Retighten.	Inspect and retighten the joint for the included instrumentation as well as the valve spindle.
		Suction pipe strainer is clogged.	Clean.	
		Impeller passage is blocked.	Clean.	Check the casing, impeller, etc. for any damage. Clean the strainer. Clean the suction and discharge piping. Consider replacement of the strainer mesh.
		Motor is running in the reverse direction.	Correctly connect the wires.	
		Motor speed has dropped.	Check the electrical system.	
		Clearance to the casing ring has increased.	Replace the casing ring; repair or replace the impeller.	Adjust the centering with the motor. Inspect the ball bearing. Inspect balance on the impeller. Check the eccentricity of the shafts. Inspect the shaft coupling.
		Impeller has been damaged.	Replace the impeller.	Inspect the casing. Inspect the shaft. Inspect the inside of the casing.
	Water flows immediately after startup, but stops soon.	Air is trapped in the suction pipe.	Correct the piping.	Check the air outlet valve. Inspect the suction pipe.
		Air is drawn through the stuffing box.	Inspect the mechanical seal.	Inspect the seal line.

Problem		Cause	Remedy	
			Solution	Verification
Pump has failed.	Motor is overloaded.	Bearing has been damaged.	Replace the bearing.	Adjust the centering between the motor and the pump. Inspect the shaft coupling. Inspect and resupply the lubricant.
		Motor is misaligned with the pump.	Adjust the centering.	Inspect the shaft coupling. Inspect the bearing.
		Shaft has been deformed.	Replace the shaft.	Adjust the centering between the motor and the pump. Inspect the shaft coupling. Inspect the bearing.
		Motor or electrical system is faulty.	Inspect and repair.	
		Amount of discharge is too much.	Somewhat close the valve on the discharge side.	
	Pump is vibrating.	Impeller is not balanced.	Repair or replace the impeller.	Inspect the casing ring. Inspect the balance of the impeller. Inspect the bearing.
		Bearing has been damaged.	Replace the bearing.	Adjust the centering between the motor and the pump. Inspect the shaft coupling. Inspect and resupply the lubricant.
		Motor is misaligned with the pump.	Adjust the centering.	Inspect the shaft coupling. Inspect the bearing.
		Shaft has been deformed.	Replace the shaft.	Adjust the centering between the motor and the pump. Inspect the shaft coupling. Inspect the bearing.
		Pump has been incorrectly installed.	Investigate into the state of installation, and correctly install the pump.	Check the alignment of motor with the pump.
	Bearing is overheated.	Bearing has been poorly assembled.	Open and adjust the bearing.	Inspect the shaft. Fill fresh lubricant.
		Motor is misaligned with the pump.	Adjust the centering.	Inspect the shaft coupling.
		Shaft has been deformed.	Replace the shaft.	Adjust the centering between the motor and the pump. Inspect the shaft coupling. Inspect and resupply the lubricant.
		Thrust being exerted onto the bearing is greater than planned.	Repair or replace the impeller.	Inspect the casing ring. Check if the balance hole of the impeller is blocked. Inspect the bearing.

4 MAINTENANCE GUIDELINE

4.1 Maintenance & Inspection Table

Item	Component	Contents	Intervals		
			Every 3 months or 1,500 hours	Every 6 months or 3,000 hours	Every 12 months or 5,000 hours
Heater	Inside of heater tube	Check by scale checker or visual, and cleaning to be done by following section 4.4, if scale formation is heavy.		○ *1	
	Inside of bottom cover	Remove the bottom cover and check for damage and pinhole on the coating. Repair, as necessary, by following section 4.7.		○ *4	
Condenser	Cooling Tube	Remove the water box and check for erosion state on the tube end. Check if there is scaling inside the tube, and rinse as necessary.			○ *1
	Tube plate	Remove the water box and check for flaw and erosion. Repair if any irregularity is found.			○
	Corrosion bar on water box	Inspect the state of installation and degree of abrasion. Replace, as necessary.	○ *2		
	Inside of water box	Remove the water box and check for damage and pinhole on the coating. Repair, as necessary, by following section 4.7.		○ *4	
Evaporator	Coating surface	Remove the top cover, heater and mesh separator. Check for damage and pinhole. Repair, as necessary, by following section 4.7.		○ *4	
	Deflector and mesh separator	Remove the top cover, heater and mesh separator. If any damage is found, replace or repair. If scaling is found, rinse as necessary. *Mesh separator is installed by stainless wire as shown in sectional drawing.			○
Feed water pipe	Feed water orifice	Remove the orifice and clean, confirm the inside diameter.			○
Sight glass	Glass	Remove the glass and clean it.		○	
Water ejector	Nozzle and inside surface of diffuser	Remove the water ejector and check. Replace the excessively worn or damaged nozzle or diffuser with a new one.			○
Salinity indicator	Cell (electrode)	Carefully clean the salinity indicator, being careful not to damage the electrode.	○		
Ejector pump / Distillate pump	Impeller	Inspect and replace, if necessary.			○*3
	Casing ring	Inspect and replace, if necessary.			○
	Mechanical seal	Check the leakage and replace, if necessary.	○		
	O-ring	Check the leakage and replace, if necessary.	○		

*1 Refer to Sec. 4.4 "Cleaning the Heat Exchanger Tube (Removing the Scale)".

*2 Degree of consumption of the corrosion bar varies depending on the physical properties of the sea water and other conditions. Therefore, the inspection schedule in your ship needs to be established through the experience from operation with your Fresh Water Generator on your ship.

*3 If the ejector pump impeller is made of case bronze, the impeller will get worn during its prolonged operation and its surface will become rough. When the ejector pump fails to perform as rated, replace the impeller with a new one.

*4  CAUTION: Please check the condition of inner coating periodically and when the coating damage is found out, repair work shall be done immediately. If Fresh Water Generator is operated without repair of the inner coating, pinhole can be got by corrosion of the carbon steel.

For the inner coating, degree of deterioration varies depending on operating situation and other conditions. Therefore, the inspection schedule in your ship needs to be established through the experience from operation on your ship.

4.2 Leakage Test for the Fresh Water Generator

Perform a leakage test after the Fresh Water Generator has been opened up for inspection, or it fails to maintain the rated degree of vacuum. For this purpose, fill air into the evaporator and maintain the internal pressure in the evaporator at 0.05 MPa. Then, apply soap water onto the gasket and joint to detect a leaking point.

 **CAUTION:** When pressure test is done, remove the evaporator vacuum gauge or fully close the root valve.

4.3 Pressure Test for the Condenser and Heater

[1] Cooling tube and tube plate

Remove the condenser water box, fill air into the evaporator and maintain the internal pressure in the evaporator at 0.05 MPa. Then, apply soap water onto the gasket and joint to detect a leaking point.

If a problem such as a hole occurs on a cooling tube, do not remove the tube in question; instead, plug the tube. Remove tubes only when replacing them with new ones. Special heat transfer tubes are applied for the condenser. Contact us when considering a cooling tube replacement work. The capacity of distillate will be reduced if normal tubes are applied.

[2] Heating tube and tube plate

Remove the heater lower cover, and apply a water pressure of 0.53 MPa to the shell to detect a leaking point on the expanded tubes. Detect a crack or pinhole on a tube by forming a film of soap water and apply an air pressure of 0.05 MPa to the shell to allow a possible leaking point to be apparent.

If a problem such as a hole occurs on a heating tube, do not remove the tube in question; instead, plug the tube. Remove tubes only when replacing them with new ones. Spacer pipes are provided outside certain heating tubes to secure the baffle plate. For this reason, if the broken heating tube is removed, the spacer tubes around it can come loose and the baffle plate is no longer securely locked. The locations of spacer tubes vary depending on the Fresh Water Generator type. Contact us when considering a heating tube replacement work.

4.4 Cleaning the Heat Exchanger Tube (Removing the Scale)

4.4.1 Timing for rinsing

The Fresh Water Generator contains the heater, condenser and feed water preheater. Scaling typically occurs inside the heating tube. Boiling and evaporating feed water readily generates scale inside the heater. The recommended intervals for rinsing inside the heating tube are two or three times a year. However, depending on the frequency of operation with the Fresh Water Generator and/or characteristics of seawater it handles, the intervals for rinsing the heating tube can vary. As a guideline, rinse the heating tube when any of the following situations occurs:

- [1] The fresh water generation rate has been gradually decreasing to below the 70% the rated capacity.
- [2] The temperature difference between hot water inlet and outlet at the designed flow rate has dropped to 70% or less as the planned difference.
- [3] The salinity has rapidly increased, and remains unstable for a long time.

If any of the phenomena above occurs, remove the sight glass on the front side of the evaporator, and insert the scale checker (supplied as a standard tool) into the heating tube as far as it goes. If the scale checker fails to go into the heating tube, scale of thickness 1 mm or greater has deposited inside the tube. If this case occurs, immediately rinse inside the heating tube.

As long as the Fresh Water Generator is run under normal conditions, much scaling does not occur in the cooling pipe of the condenser. Note, however, that chemical cleaning of all the piping system is possible by installing the adaptor (optional) to the seat for corrosion bar in the condenser water box.

4.4.2 Method for rinsing

There are two categories of methods available for scale removal:

- [1] Physical stripping
This category includes scale removal with a brush or drill, and scale removal with high pressure water jet. However, scale removal with these techniques is highly difficult. For condenser, special tubes are used. So, brush of nylon should be used to prevent from damage during cleaning.
- [2] Chemical cleaning
Scale removal techniques using a cleaning agent are available.
The methods using a cleaning agent that efficiently removes scaling are described below.

4.4.3 Preparation for rinsing

- [1] Drain off the sea water in the equipment through the bottom blow valve (V3).
- [2] Fully open the bottom blow valve (V3), and open up the sight glass on the evaporator.

4.4.4 Preparation for cleaning agent

In a drum can, prepare a solution of cleaning agent necessary for cleaning the Fresh Water Generator. To prepare the dilution, be sure to pour water first, and then add the cleaning agent.

 CAUTION : Follow the instruction manual of the manufacturer for cleaning agent preparation.

4.4.5 Available cleaning agents and manufacturers

Brand name	Supplier
DSC	Chiyoda Kigas Oil Co., Ltd. Japan Mitsukane Japan
KURIPAEL S-232	Chemical Division, Kurita Water Industries Ltd.
SAF-ACID	Drew Marine Inc.

 CAUTION : Other manufacturers offer various cleaning agents. For details, refer to their instruction manual and SDS.

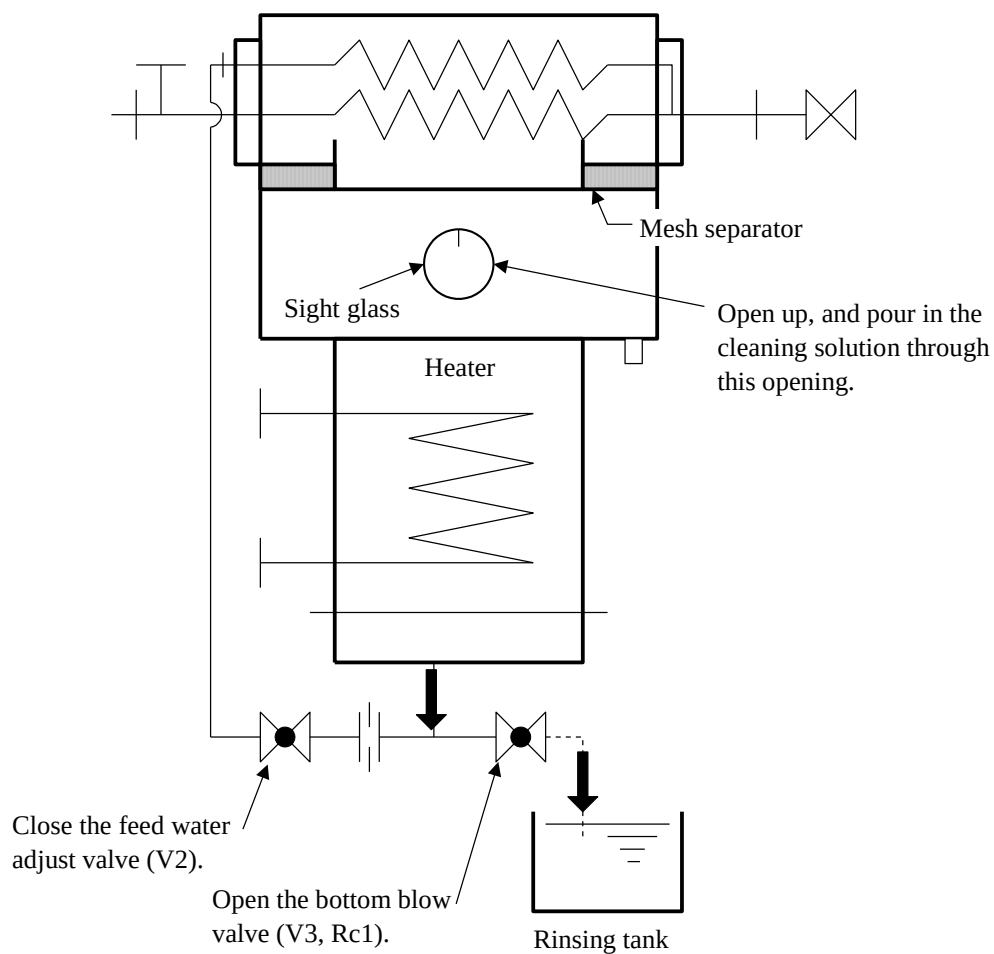
- ⚠ CAUTION : Please ventilate enough in work, wear suitable protective materials such as protective spectacles and the protective gloves, and prevent the direct contact to skin.
- ⚠ CAUTION : Please wash your hands and face, etc., and gargle after finished handling.

4.4.6 Rinsing by immersion

Through the opening formed after the sight glass is removed, pour in the cleaning solution until the tube plate in the upper portion of the heater is immersed with the liquid. Allow the liquid to stand. The necessary cleaning time varies depending on the thickness of scale. When reaching saturation, the cleaning solution loses its cleaning power. Therefore, it will be necessary to replace with fresh cleaning solution several times.

Necessary amounts of cleaning solution by Fresh Water Generator type

Type XM or XE	5	10	15	20	25	30	35	40	50	60
Condenser (L)	10	22	37	47	52	64	77	93	110	150
Heater (L)	22	37	55	69	85	105	115	146	180	206



Cleaning method by immersion

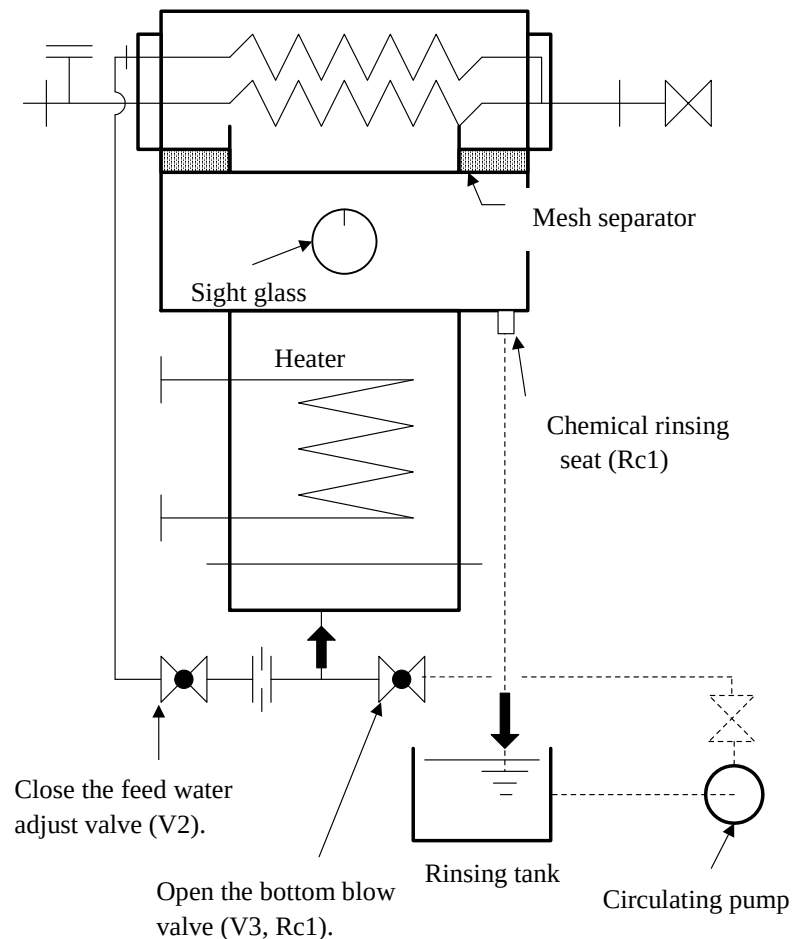
4.4.7 Rinsing by circulation

Use the socket joint on the bottom plate of the Fresh Water Generator as the outlet for cleaning solution. With this arrangement, rinse the piping system in the heat exchanger of the Fresh Water Generator. The amounts of cleaning solution needed for various types of the Fresh Water Generator are as summarized below.

Type XM or XE	5	10	15	20	25	30	35	40	50	60
Amount circulated(L)	32	59	92	116	137	169	192	239	290	356

*For rinsing by circulation, add the capacity of rinsing tank to the whole amount.

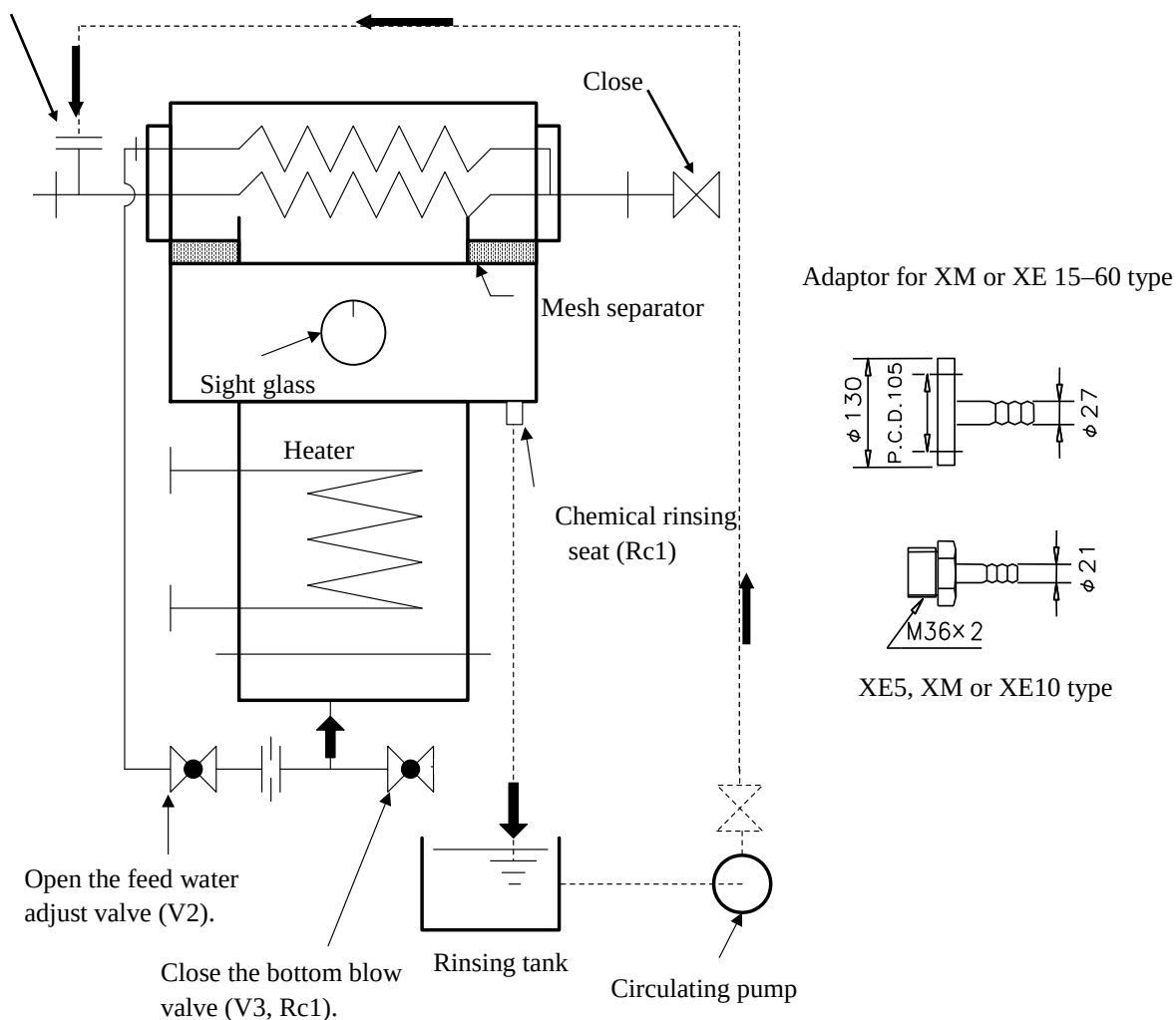
- [1] Rinse the tubing system in the heater of the Fresh Water Generator by circulating the cleaning solution.
Use bottom blow valve (V3) as the inlet for cleaning solution and the bottom plate of the Fresh Water Generator as the outlet for cleaning solution.



Cleaning method by circulation [1]

- [2] Rinse the whole tubing system in the condenser and heater of the Fresh Water Generator by circulating the cleaning solution.
- By referring to the diagram below, install the relevant adapter (illustrated below; optional) to the seat for corrosion bar on the cooling water inlet on the condenser cover. Use this adapter as the inlet for cleaning solution and the bottom plate of the Fresh Water Generator as the outlet for cleaning solution.

Install relevant adapter



Cleaning method by circulation [2]

4.4.8 Draining the cleaning solution

Drain the cleaning solution away from the bottom blow valve (V3). By referring to the instructions in the instruction manual supplied from the cleaning agent manufacturer, neutralize and dispose the drained cleaning solution.

4.4.9 Flushing the Fresh Water Generator to complete rinsing operation

After draining away the cleaning solution, flush the whole Fresh Water Generator system with seawater. Then, feed cooling water to the condenser to fill the Fresh Water Generator and discharge the feed water overboard through the water ejector. Repeat this cycle until the inside of the Fresh Water Generator system is clean.

4.4.10 Inspection after the rinsing operation

Scaling most often occurs on an area at approximately 1/5 to 1/4 the distance from the lower tube plate to the tube plate. Through the opening remaining after removal of the sight glass, lower the "Scale Checker" sensor heads to several lower points on the heating tube and scan the heating tube to check that the entire inside surface of the heating tube has been satisfactorily cleaned.

 **CAUTION** : For this rinsing work, do not use steam because the inside surface of the evaporator is covered with a coating.

4.5 Method for Prolonging Rinsing Intervals

To prolong the rinsing intervals as long as possible, observe the following instructions for operation of the Fresh Water Generator:

- 1) Whenever possible, run the Fresh Water Generator below the rated water generation capacity.
- 2) Continuously inject the scale inhibitor into the feed water by using the chemicals injection unit.
- 3) Feed water as much as the discharge capacity of the water ejector permits.
- 4) Do not run the Fresh Water Generator in a dirty sea water area such as in a bay.
- 5) When shutting down the Fresh Water Generator, feed water until the heater shell is cool enough and the operator can touch the heater shell by hand to allow the heater to be filled with fresh (not concentrated) seawater up to the heater top tube plate.

4.6 Regarding the inner coating

For the tubular type Fresh Water Generator (K series / X series), the inner coating is applied for the purpose of protecting the base metal of carbon steel. Since the inner coating is damaged over time, the condition of inner coating to be checked periodically according to section 4.1 in this manual and to be repaired if necessary. If the Fresh Water Generator is continued operating with damage (blisters, peelings, or pinholes) on the inner coating, corrosion of the carbon steel may progress and it will be punctured.

⚠ CAUTION: Please check the condition of inner coating periodically and when the coating damage is found out, repair work shall be done immediately. If Fresh Water Generator is operated without repair of the inner coating, pinhole can be got by corrosion of the carbon steel.

If any damage on the inner coating is found during regular maintenance (open check) or daily check (visual check from a sight glass), carry out repair work according to section 4.7 in this manual, and another technical manual “How to repair the inner coating of F. W. Generator”.

【Example of blister, peeling and pinhole】

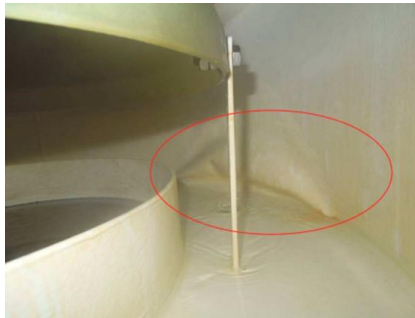


Photo 1. Blister on the evaporator



Photo 2. Peeling and pinhole of the bottom cover



4.7 Repair work of the inner coating

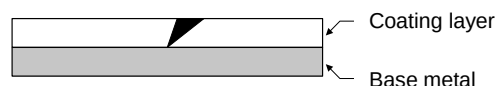
If damage on the coating on inside is found in the course of inspection on the Fresh Water Generator, repair according to the instructions given below. Remove the damaged coating layer, thoroughly dry the exposed surface, polish the coating layer up to the area 20 mm apart from the rim of exposed steel surface as well as the exposed steel surface with a piece of emery paper, and then rinse the whole polished area. Apply epoxy resin 2145 to the whole polished area according to the instructions given below.

4.7.1 Coating material for repair work

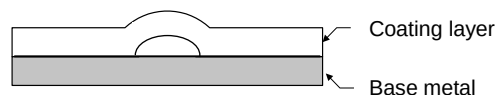
Epoxy resin	2145 (gray)	3,000 g/can
Hardening agent	2145 (colorless)	900 g/can

4.7.2 Modes of damaged coating

- Damaged coating

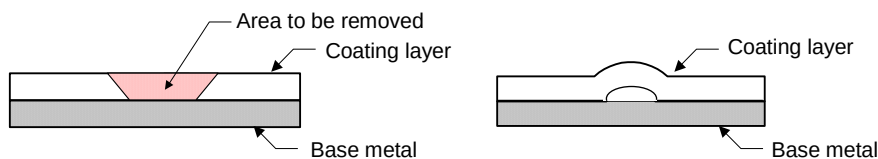


- Blistered coating

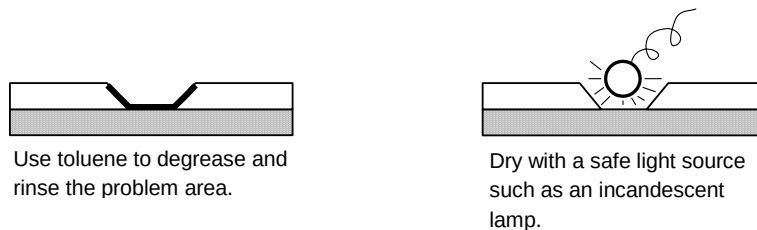


4.7.3 Repair method

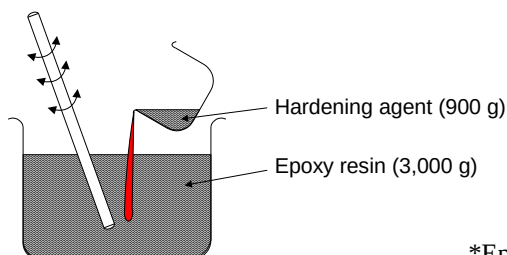
- 1) Remove the failed area with a grinder.



- 2) Rinsing and drying



- 3) Preparation of epoxy resin 2145.



*Epoxy resin: hardening agent = 10:3

After the problem area has been dried, add the hardening agent to epoxy resin 2145 in a vessel as instructed above to prepare epoxy resin 2145. Once stirred, epoxy resin 2145 begins curing in approximately 40 minutes at a room temperature (approximately 30°C). For this reason, when intending to applying a second layer onward, do not open the cans for the epoxy resin and hardening agent until next coating application is possible.

- 4) After a previous layer has been fully cured (it will take approximately 6 hours), apply next layer. Form a total of 3 to 6 layers.
 - When repairing the horizontal surface of the evaporator bottom plate, bottom cover etc., apply 3 times.
 - When repairing the vertical surface of the evaporator shell, bottom cover shell etc., apply 4 to 6 times to compensate for the lack of thickness due to the dripping of the coating.
- 5) Keep Fresh Water Generator for 1 day after final layer coating work without reassembling.
- 6) It is possible to operate the Fresh Water Generator 3 days after final layer coating.

* For details, please refer to the another manuals "PROCEDURE OF INSPECTION FOR EVAPORATOR" and "How to repair the inner coating of F. W. Generator".

⚠ CAUTION : Very carefully handle the epoxy resin and hardening agent. In the case of skin contact, immediately wash away with a plenty of water.

4.8 Distillate Pump Mechanical Seal

The mechanical pump is a precision component, and, therefore, must be handled with an utmost care. At the same time, the equipment incorporating the mechanical seal must be handled with an extreme care so that such equipment can perform satisfactorily. To be able to use the distillate pump correctly, the names and handling methods for the components in the mechanical seal, as well as the instructions for maintaining the distillate pump are described below.

Step	Procedure for assembling	Instructions	Illustrations
1	Inspection of mechanical seal	[1] Make sure that all the components are ready. [2] Check the sliding surface for any foreign matter. If any foreign matter is found on the sliding surface, remove it with soft clean cloth moistened with methyl ethyl ketone (MEK) or alcohol. [3] If a detrimental crack or chipping is found on the sliding surface, replace the sliding surface with a new one. [4] Check if the sealing surface of the cushion rubber and packing has any foreign matter. If a foreign matter is found, remove it with soft clean cloth.	Sliding surface Packing seal section Sliding surface Cushion rubber seal section
2	Inspecting the distillate pump that incorporates the mechanical seal	[1] Check that the seating for the mechanical seal has the specified dimensions and has been finished per the specified accuracy. [2] Check that the seating for the cushion rubber and packing is free from any damage and foreign matter. [3] Check that the bearing does not have an excessive play in the radial and thrust directions. Replace a bearing having an excessive play with a new one.	Chamfering R 2 1 - 2 30° Chamfering R
3	Insert the fixing ring (cushion rubber/floating rubber) into the housing. When inserting the fixing ring, leave the cushion rubber and floating sheet as one body (FIG. 2) or insert the cushion rubber into the housing first, and then insert the floating sheet next (FIG. 1).	[1] For easy insertion, apply fresh water to the area on housing that accepts the fixing ring. [2] For easy and efficient insertion work, use an insertion tool (a length of pipe made of PVC or any other material that does not damages the floating sheet). [3] The inserted cushion rubber must not have burrs. [4] The inserted floating sheet must be free from inclination. [5] If the sliding surface is fouled with a foreign matter including oil from hands, clean with soft cloth moistened with MEK or the like.	Insertion jig Figure 1 Insertion jig Figure 2
4	Fit the rotation ring (seal ring, packing, case, and drive ring) over the shaft.	[1] For easy insertion, apply fresh water to the area on housing that accepts the fixing ring. [2] For easy and efficient insertion work, use an insertion tool. [3] The inserted packing must not have burrs. [4] During insertion work, be extremely careful not to hit the shaft with the sliding surface so that the sliding surface does not develop chipping or any damage. [5] Insert the rotation ring until the sliding surface of seal ring comes into contact with that of floating sheet.	Insertion jig CAUTION: Carefully insert.
5	Insert and lock the coil spring, impeller, etc.	[1] Check that the coil spring has been correctly mounted.	
6	Operation	[1] Check that the mechanical seal has been correctly fitted. [2] Check that the circulation liquid piping has been correctly laid and connected. [3] Apply hydraulic pressure to the stuffing box to check that there is no leakage from the mechanical seal. [4] NEVER dry-run the distillate pump. [5] Turn the shaft by hand to check that there is no leakage or any other problem. If no problem is found, then the distillate pump is ready for operation.	—

4.9 Heater Removal Procedure

4.9.1 Heater removal procedure without using the hinge

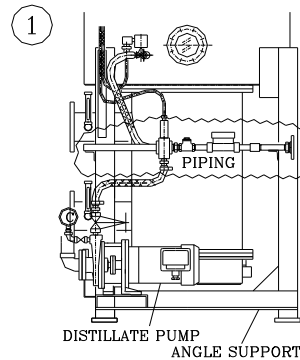
By following the instructions below, remove the heater.

* Remove the thermometers beforehand to prevent damage.

* Be careful not to get fingers caught during work.

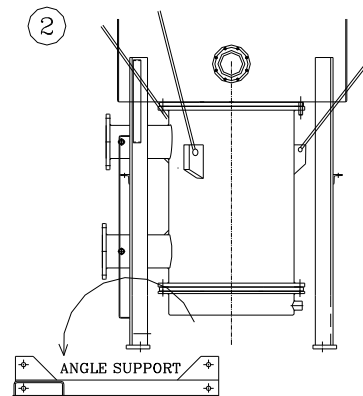
- [1] Remove the distillate pump and the distillate outlet piping.

* If the hose is removed and reused, leakage may occur due to deterioration of the hose end. When the hose was removed, cut the insertion part to the hose nipple or replace the hose.



- [2] By referring to the diagram in the right, remove the angle support. Install the chain blocks to the three eye plates on the heater.

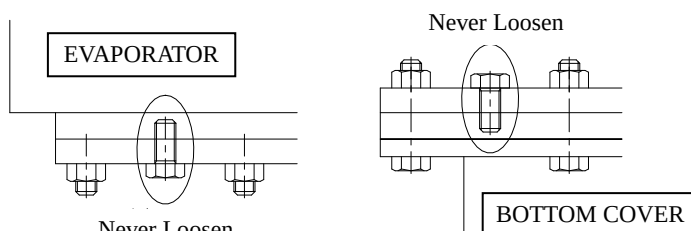
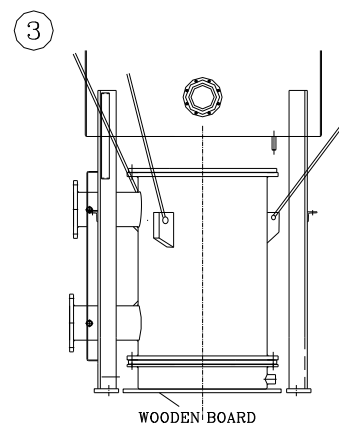
* A qualified person should be engaged in the work.



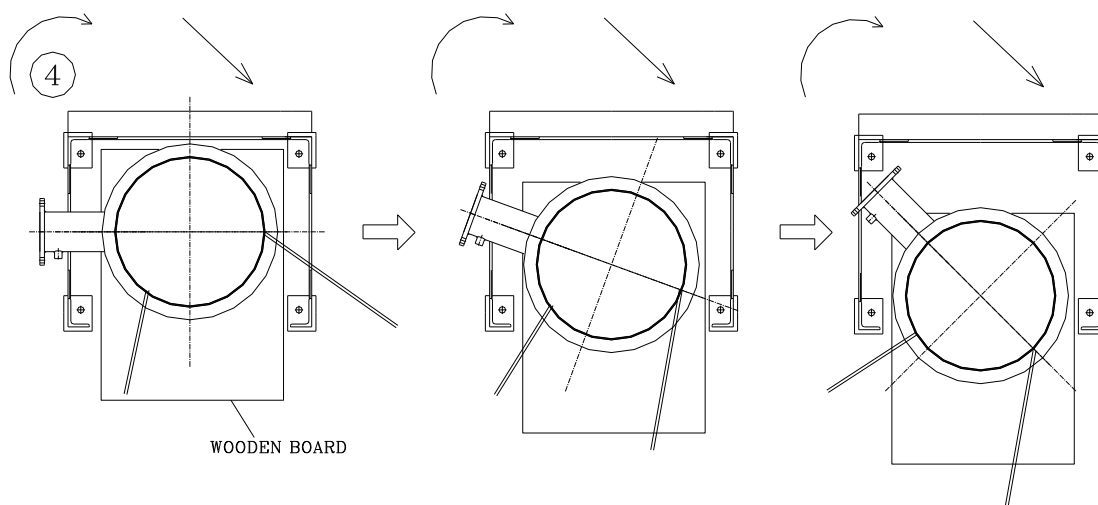
- [3] Place a wooden board below the heater. Remove the bolts and nuts that secure the evaporator to the heater, and carefully untighten the chain blocks to lower the heater onto the wooden board.

⚠ CAUTION :

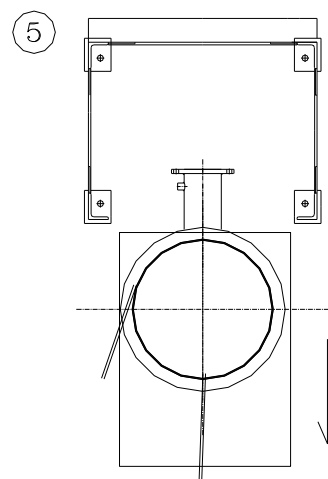
Never loosen or remove the bolts that secure the tube plate. (Otherwise, leakage may occur.)



[4] While turning the heater as illustrated below, carefully draw it out to the near side.



[5] As shown in the diagram in the right, after turning the heater by 90 degrees, draw it out to the near side.



Weight table for the heater complete by Fresh Water Generator type

Fresh Water Generator type	Heater complete weight (kg)
XE5	110
XM, XE10	180
XM, XE15	210
XM, XE20	250
XM, XE25	270
XM, XE30	310
XM, XE35	360
XM, XE40	440
XM, XE50	490
XM60	550

4.9.2 Heater removal procedure by using the hinge

By following the instructions below, check of heating tubes and removal of the heater is possible.

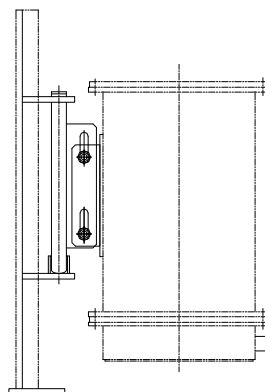
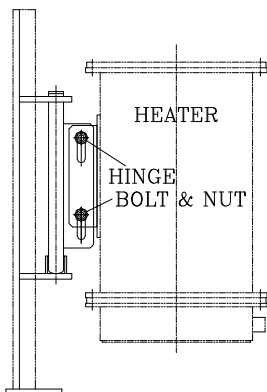
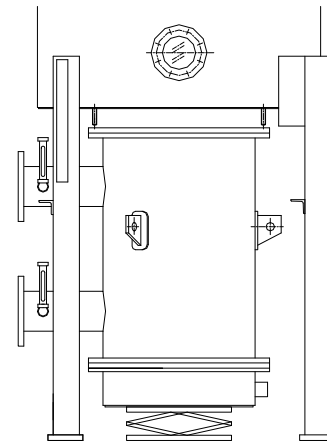
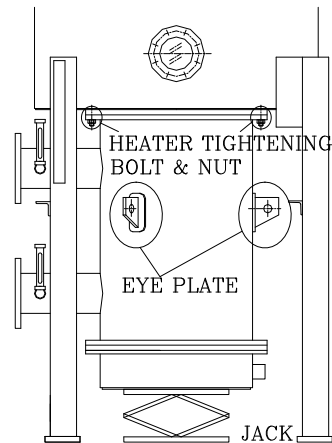
* Remove the thermometers beforehand to prevent damage.

* Be careful not to get fingers caught during work.

[1] Remove the distillate pump, piping and the support angle.

[2] Set the jack as shown in a figure. Otherwise, hang the heater by chain blocks using three eye plates.

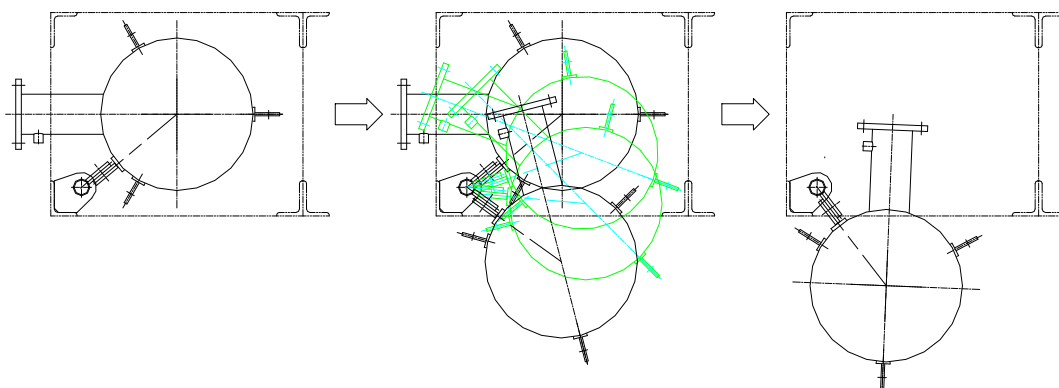
[3] Loosen and remove the heater tightening nuts. Loosen the hinge bolts & nuts. And then, lower the heater by loosening a jack gradually.



⚠ CAUTION :
Never loosen or remove the bolts that secure the tube plate. (Otherwise, leakage may occur.)

⚠ WARNING :
Never pinch finger in the hinge bolt hole. (Otherwise, finger may be injured.)

[4] Fasten and set the hinge bolts & nuts. Turn the heater carefully as the figure shows.



5 INSTALLATION PROCEDURE

5.1 General Precautions

- | |
|--|
| ⚠ WARNING : When transferring the Fresh Water Generator, use the lifting holes on its top cover as well as the wires suitable for the weight specified in the assembly outline drawing. |
| ⚠ CAUTION: : To protect the coating layer inside the equipment, NEVER cause heating on the Fresh Water Generator by welding or with an open flame. |

- [1] Providing a work space around the Fresh Water Generator necessary for replacement of the condenser cooling pipe, disassembly of the water ejector and taking-out of the heater proper, install the Fresh Water Generator to a location where vibration from the ship hull is minimal.
- [2] Before commissioning the Fresh Water Generator, remove the protective shipping tapes and moisture-proofing agent from it.
- [3] When connecting the piping to the attached pumps, align the flanges correctly, weld the flanges to the piping, and then tighten the flanges with both bolts and nuts. (Do not allow an excessive tightening torque to be applied to the Fresh Water Generator side.)

5.2 Installation Work

- [1] Install the Fresh Water Generator and attached pumps to locations where least vibration occurs.
- [2] So that the back pressure on the water ejector outlet [XM type] or on sea water outlet [XE type] is 8 mAq (0.08 MPa) or lower, install the Fresh Water Generator, considering the resistance in piping and the full-load waterline.
- [3] Situate the ejector pump below the light waterline and make sure that the pressure on the pump inlet pipe remains at an atmospheric pressure (0 MPaG) or higher while the ejector pump is running. (Applicable to XE type)
- [4] So that driving pressure of the water ejector is 0.4 MPa and higher, install the Fresh Water Generator, considering the resistance in piping and the light waterline.
- [5] Maintain the pressure of hot water to the heater from 0.1 to 0.5 MPa.
- [6] Maintain the pressure of cooling water inlet on the condenser from 0.06 to 0.35 MPa.
- [7] Maintain the back pressure on the outlet of the distillate pump to 18 mAq (0.18 MPa) or lower. (In the case of standard distillate pump specification)
- [8] Install an eye plate for mounting an opening-up suspension tool to the ceiling of the ship hull immediately above the top cover of the Fresh Water Generator. Be sure to provide a work space to enable removal of the top cover and a work inside the evaporator.

5.3 In Case the Steam Injector Is Incorporated

- | |
|---|
| ⚠ WARNING : Do not install any valve to the steam drain discharge line. If a valve is installed to the drain discharge line, and when the Fresh Water Generator is run with this valve closed, the Fresh Water Generator may be damaged. |
|---|

- [1] The maximum back pressures on the drain discharge line are as summarized below:

Heating steam pressure [MPa (kgf/cm ²)]	Back pressure [mAq]
0.3 (3.0)	Max. 3
0.4 (4.0)	Max. 4
0.5 (5.0)	Max. 5
0.6 (6.0)	Max. 6
0.7 (7.0)	Max. 7
0.8 (8.0)	Max. 8
0.9 (9.0)	Max. 9
1.0 (10.0)	Max. 10

- * If an excessive back pressure is exerted to the steam drain discharge line, abnormal vibration and noise can occur on the Fresh Water Generator.

- [2] Install a pressure gage to the steam inlet on the steam injector.
- [3] The riser pipe for steam drain discharge is necessary only when the drain tank is situated below the Fresh Water Generator. The height of the rise pipe must be at least 1500 mm above the baseplate of the Fresh Water Generator.
- [4] To extract air and drain from steam supply line, a valve must be provided before steam inlet stop valve of steam injector. This valve is to be installed at a lower part of the pipe.

5.4 Piping Work

5.4.1 Piping for hot water inlet and outlet on the heater

- [1] Feed hot water to the heater from the high temperature section of the engine jacket cooling system that is connected in series with the fresh water cooler.
- [2] The connection pipes must be large enough to satisfy the flow rate defined in the separate specification sheet.
- [3] The pressure loss in the heater is about 0.03 MPa under design flow rate.
- [4] Run the connection pipe below the floor so that it does not interfere with operation and maintenance on the Fresh Water Generator.
- [5] For better operability, situate the inlet and outlet valves of the heater near the Fresh Water Generator.

5.4.2 Ejector pump inlet and outlet piping (cooling water system)

- [1] Determine the locations and piping resistance of the ejector pump and the Fresh Water Generator so that the pressure of the water ejector driving water delivered from the ejector pump is 0.4 MPa and higher at the water ejector inlet mounted onto the Fresh Water Generator. In case it is difficult to ensure 0.4 MPa and more at the water ejector inlet, contact us. Total head of our standard ejector pump is 48 mAq for XE type and 39 mAq for XM type.
- [2] Provide the ejector pump inlet piping with a strainer that has an element whose perforations measure dia. about 4 mm.
- [3] To prevent corrosion on the ejector pump inlet connection, insert a length of steel pipe measuring 200 mm or longer as a sacrifice anode. This arrangement also provides a provision of pump opening-up space.

5.4.3 Condenser cooling water inlet piping

- [1] Run the connection piping in a manner that it does not pose difficulties in operating or maintaining the Fresh Water Generator.
- [2] If the cooling water is separately fed from the seawater G.S. pump, the supply route must be branched from a point where the temperature is lowest. In addition, cooling water quantity to the Fresh Water Generator must be ensured at any operating condition.
- [3] Piping size should follow instructions specified in an external arrangement drawing and in a piping diagram.
- [4] The pressure loss in the condenser is about 0.06 MPa under normal flow rate.
- [5] XM type: Determine the locations and piping resistance so that the back pressure on the water ejector outlet must be 8 mAq (0.08 MPa) or lower at any condition.
XE type: Determine the locations and piping resistance so that the back pressure on sea water outlet must be 8 mAq (0.08 MPa) or lower at any condition.
In case it is difficult to ensure 0.08 MPa or lower, contact us.
- [6] For better operability, situate the inlet and outlet valves of the condenser near the Fresh Water Generator.
- [7] Avoid a bend in piping route whenever possible. The piping must be independent of other seawater piping.

5.4.4 Distillate outlet piping

- [1] Determine the location and piping resistance of the product water tank so that the back pressure at the distillate outlet is 18 mAq (0.18 MPa) or lower. (If the back pressure is scheduled to exceed 18 mAq, contact us for technical assistance.)
- [2] Product water (distillate) delivered from the Fresh Water Generator is highly pure fresh water (hungry water) that is characterized by extremely low TDS and dissolved oxygen concentration. Within water of extremely low dissolved oxygen concentration, formation of an oxide film is inhibited; water of low TDS is unstable so that it seeks stabilization by dissolving a substance in contact with it. If pipes for flowing hungry water are made from steel pipes, Zn-coated pipes or plated pipes, rusty water (red water) can result. Therefore, to flow hungry water, it is recommended to use stainless steel pipes or non-ferrous pipes.

5.4.5 Chemical injection piping

Mount the check valve of chemical injection unit, which we furnish, to the chemical injection port provided on the feed water piping.

(If the chemical injection unit is not mounted, the port remains plugged.)

5.4.6 Other piping

- [1] Bottom blow valve is provided to discharge sea water from the Fresh Water Generator when operation is stopped for a long term. This valve can also be used as in/outlet valve of cleanser during chemical cleaning of the heater. Piping for sea water discharge must be done if necessary.
- [2] Discharge piping for the safety valve and the air vent valve must be done if necessary.

5.4.7 Operating pressure and temperature on each connection piping (standard)

Piping designation	XE Type (MPa)	XM Type (MPa)	Temperature (°C)
1. Ejector pump inlet pipe	0 – 0.2 (static press. at waterline)	0.06 – 0.2	5 – 50
2. Ejector pump outlet pipe	0.5 – 0.7	0.4 – 0.6	5 – 50
3. Cooling water inlet pipe	0.4 – 0.6	0.1 – 0.35	5 – 35
4. Cooling water outlet pipe	0 – 0.1	0.06 – 0.2	5 – 50
5. Water ejector outlet pipe	–	0 – 0.1	5 – 50
6. Distillate outlet pipe	0 – 0.3	0 – 0.3	5 – 50
7. Hot water inlet pipe	0.1 – 0.5	0.1 – 0.5	75 – 90
8. Hot water outlet pipe	0.1 – 0.5	0.1 – 0.5	65 – 80

5.5 Wiring Work

5.5.1 Ejector pump and distillate pump

- [1] Connect these pumps to the specified power supply with the specified cables.
* A qualified person should be engaged in the work.

5.5.2 Salinity indicator

- [1] Power supply: Connect the salinity indicator to the specified AC control power supply. Make sure that the connected voltage selection tap terminals in the salinity indicator panel match the supply voltage.
- [2] Solenoid valve: Wired in the factory before the Fresh Water Generator is shipped.
- [3] Electrode: Wired in the factory before the Fresh Water Generator is shipped.
- [4] Alarm: Make wiring connections as specified. (No-voltage contact)

6 SCALE INHIBITOR “SASABIT”

- ⚠ CAUTION : Please ventilate enough in work, wear suitable protective materials such as protective spectacles and the protective gloves, and prevent the direct contact to skin.
- ⚠ CAUTION : Please avoid mixing up or contacting with the sulphite, nitrite & alkaline liquid. Please be careful not to breathe the vaporized odor and the mist generated from SASABIT.
- ⚠ CAUTION : Please wash your hands and face, etc. , and gargle after finished handling.

6.1 General

SASABIT has been developed as a scale inhibitor of polymaleic acid for the Fresh Water Generator. Generally, anti-scale formation mechanism of scale inhibitor is to prevent adhering of the scale deposits on the heat transfer surface by restraining crystallization of the scale of which formation reaction has dispersed as well as formation reaction has delayed.

SASABIT has higher critical effect than existing scale inhibitor, so that its performance of preventing scale formation has been much improved. SASABIT prevents scale formation of calcium carbonate and magnesium hydroxide which are born of heated and concentrated sea water.

SASABIT ensures stable fresh water production in long term without frequent cleaning of the tubes (heat transfer section) by means of injection to the feed water line.

Typical Physical Properties

Main components	: Polymaleic acid aqueous, Macromolecule
Appearance	: Amber liquid
Specific gravity	: 1.16~1.19(at 20°C)
Vaporizing pressure	: 17.5mmHg(at 20°C)
Boiling point	: 100~102°C
Solubility	: Easily dissolves in water.

6.2 First aid

When SASABIT came into the eyes	Wash face and eyes at once by fresh clean water enough, and consult eye doctor soon.
When SASABIT contacted the skin	Wash the skin by water with soap sufficiently. If skin surface changes and/or pain continues, consult the doctor.
When inhaled the vaporized gas and/or mist	Move the sufferer to suitable area in clean & fresh air, and keep him warm & rest. Watching his condition, consult the doctor, if needed.
When swallowed	Wash mouth by clean water and drink one or two cups of water or milk. Then, consult the doctor at once. If the sufferer comes into unconsciousness, do not give him anything from his mouth and do not spit out SASABIT forcibly.

6.3 Protective materials

Protective spectacles: Protection glasses with shroud or goggle type protection glasses

Protection gloves : Impermeable protection gloves

Protection clothes : Long sleeve work wear

6.4 Dosage

The injection rate to the Tubular type Fresh Water Generator is 3.3ppm against amount of feed water quantity.

Please refer to the below table for reference.

6.5 Precautions on handling

Stock should not be exposed to the direct rays of sun and should be kept in the place where the ventilation is good.

When SASABIT spilled on the floor or equipments, wash by water or mop with cloths.

Recommended Injection rate of Scale inhibitor "SASABIT"
Fresh Water Generator (FWG)

No.	F.W.G.		Kind of FWG Model								
			XE5	XE10	XE15	XE20	XE25	XE30	XE35	XE40	XE50
	Item			XM10	XM15	XM20	XM25	XM30	XM35	XM40	XM50
1	Production Capacity of FWG 造水量	ton/day	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	50.0
2	Injection rate of stock solution SASABIT ササビット原液注入量	mL/h	2.30	4.61	6.91	9.21	11.52	13.82	16.12	18.43	23.03
3	Total injection of Diluted SASABIT 希釈後の総注入量	mL/min.	2.40	4.80	4.11	5.48	4.80	4.80	4.48	5.12	4.80
		(liter/hr)	0.144	0.288	0.247	0.329	0.288	0.288	0.269	0.307	0.288
4	Mixture ratio of chemical solutions ササビットの注入混合比	%	1.63%	1.63%	2.88%	2.88%	4.17%	5.04%	6.38%	6.38%	8.70%
	Filling ratio of “SASABIT : Water”for 25L tank 25L タンクの“水＋ササビット”充填量	Sasabit (L)	0.4	0.4	0.7	0.7	1.0	1.2	1.5	1.5	2.0
		Water (L)	24.6	24.6	24.3	24.3	24.0	23.8	23.5	23.5	23.0
		Total(L)	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
5	Adjusted value of IWAKI'S Pump イワキ製ポンプ注入量設定値	Stroke Rate	45	91	78	104	91	91	85	97	91
		Stroke Length	50%								

SASAKURA FRESH WATER GENERATOR
FWG XM / XE MFD. NO. 114-
 DATA SHEET

SHIP BUILDER: _____

INSPECTOR: _____

SHIP NO.: _____

DATE: _____

SHIP NAME: _____

MEASURED BY: _____

No. OF DATA			DESIGN	MEASUREMENT			
				1	2	3	4
MEASURING TIME			h : min				
SHELL TEMP.		°C					
HEATER	JACKET COOLING WATER INLET	°C					
	JACKET COOLING WATER OUTLET	°C					
	*STEAM PRESSURE	MPa (kgf/cm ² G)					
CONDENSER	COOLING WATER INLET TEMP.	°C					
	COOLING WATER OUTLET TEMP.	°C					
DISTILLATE	METER READING	Liter					
	CAPACITY	l/h					
	CAPACITY	Ton/24 h					
	SALINITY	PPM					
SHELL VACUUM PRESSURE		MPa (cmHgV)					
FEED WATER PRESSURE		MPa (kgf/cm ² G)					
WATER EJECTOR INLET PRESSURE		MPa (kgf/cm ² G)					
COOLING WATER OUTLET PRESSURE		MPa (kgf/cm ² G)					
DISTILLATE PUMP DEL. PRESSURE		MPa (kgf/cm ² G)					
EJECTOR PUMP SUC. PRESSURE		MPa (cmHgV)					
EJECTOR PUMP DEL. PRESSURE		MPa (kgf/cm ² G)					

Contacts:

Sasakura Engineering Co., Ltd.

Head Office

7-32 Takejima 4-chome, Nishiyodogawa-ku, Osaka 555-0011 Japan

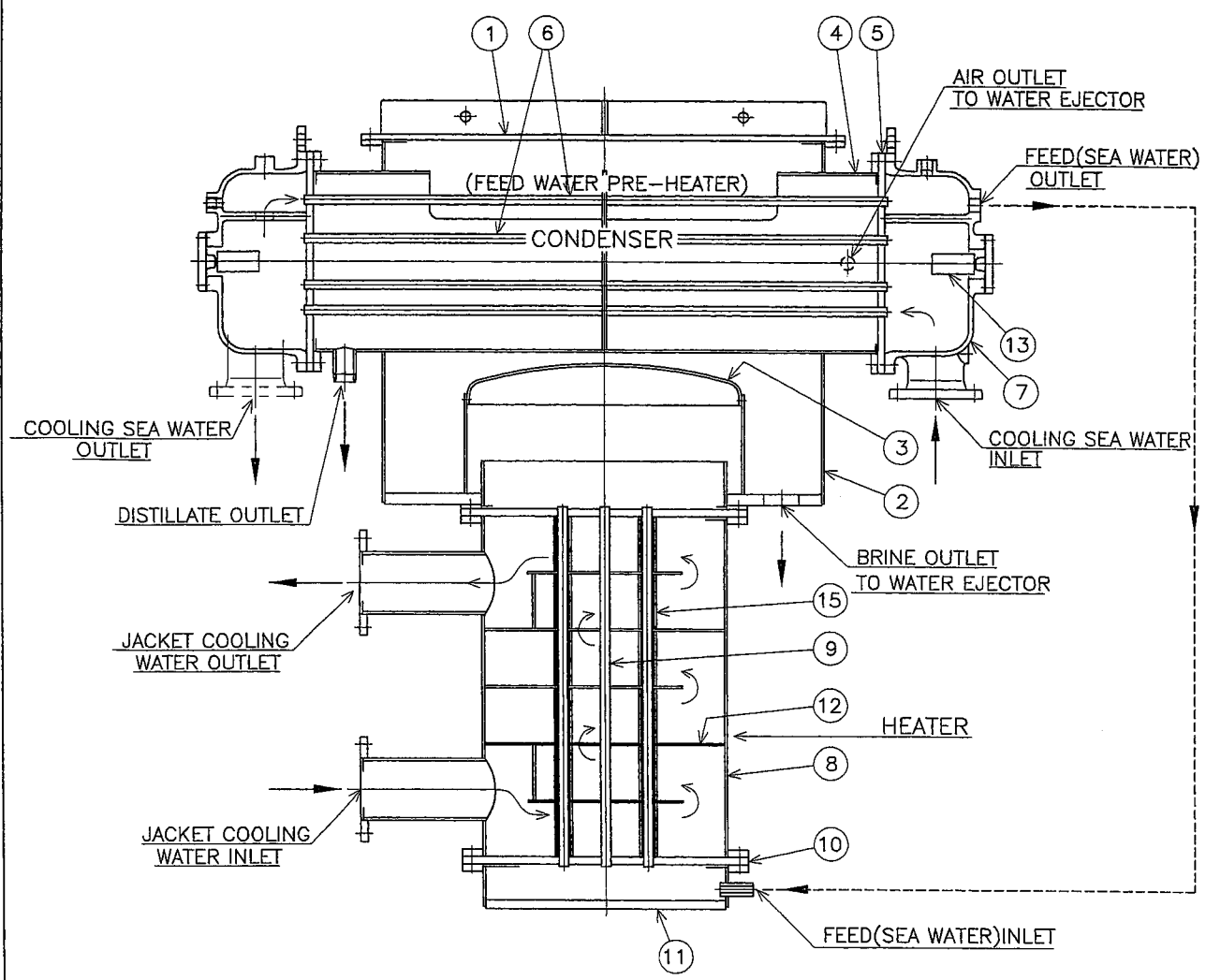
Machinery Marketing Sect.,	Tel +81-6-6473-2134	Fax +81-6-6473-5540
Marine Engineering Sect.,	Tel +81-6-6473-2131	Fax +81-6-6475-2839

Tokyo Branch Office

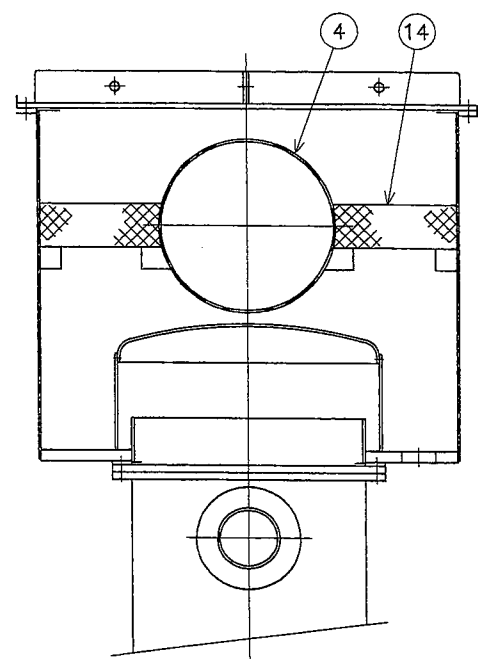
6F Huli Hatchobori Dai-ni Building, 10-4, Hatchobori 4-chome, Chuo-ku, Tokyo 104-0032 Japan

Machinery Marketing Sect.	Tel +81-3-5566-1212	Fax +81-3-5566-1233
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SECTIONAL ARRANGEMENT

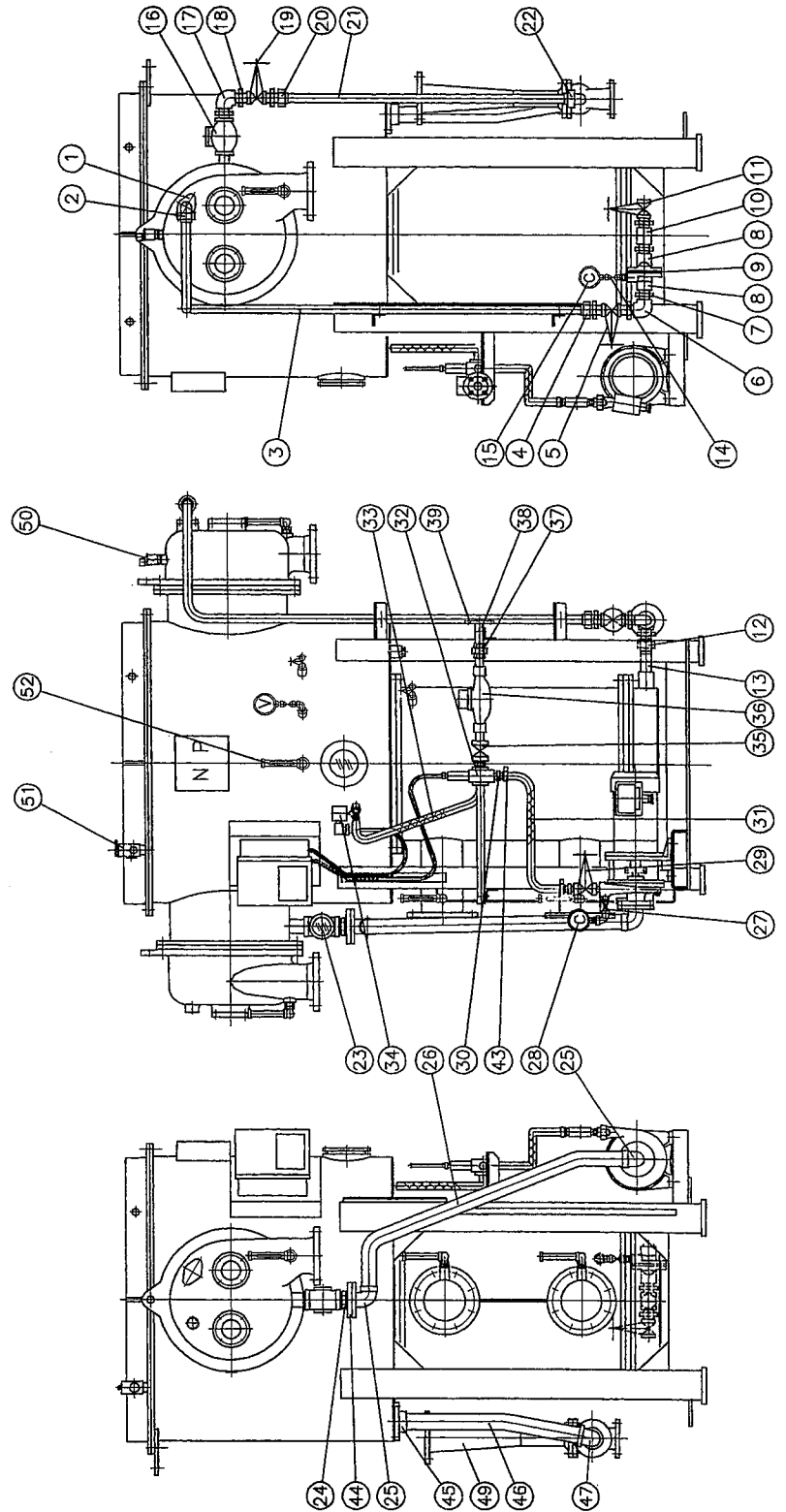
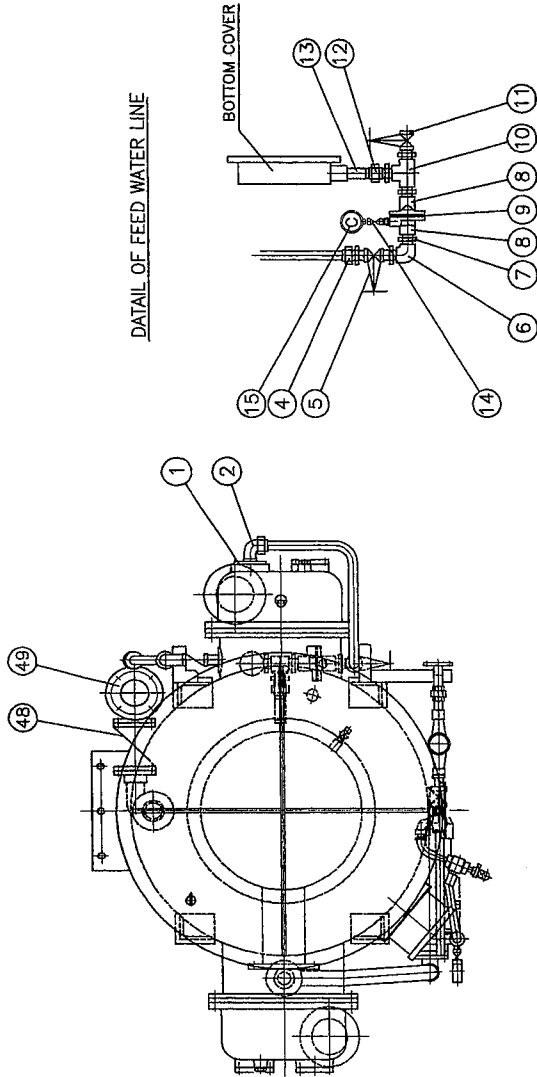
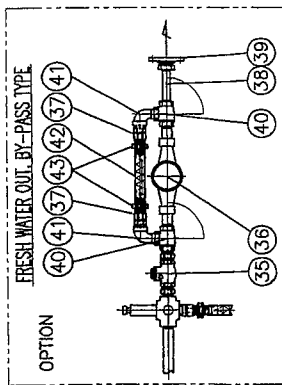


PART NO.	NAME OF PART	MATERIAL
1	TOP COVER	STEEL
2	EVAPORATOR SHELL	STEEL
3	DEFLECTOR	FIBER GLASS REINFORCED PLASTIC
4	CONDENSER SHELL	STAINLESS STEEL
5	COND. TUBE SHEET	NAVAL BRASS
6	COOLING TUBE (SPECIAL HEAT TRANSFER TUBE)	ALUMINUM BRASS TITANIUM
7	COND. WATER CHAMBER	CAST IRON
8	HEATER SHELL	STEEL
9	HEATING TUBE	ALUMINUM BRASS TITANIUM
10	HEATER TUBE SHEET	NAVAL BRASS
11	BOTTOM COVER	STEEL
12	BAFFLE PLATE	STEEL
13	CORROSION PLATE/BAR	ZINC OR IRON
14	MESH SEPARATOR	STAINLESS STEEL
15	DISTANCE PIPE	STEEL



SASAKURA ENGINEERING CO.,LTD.

適用機種
Model:XM/XE 5~40

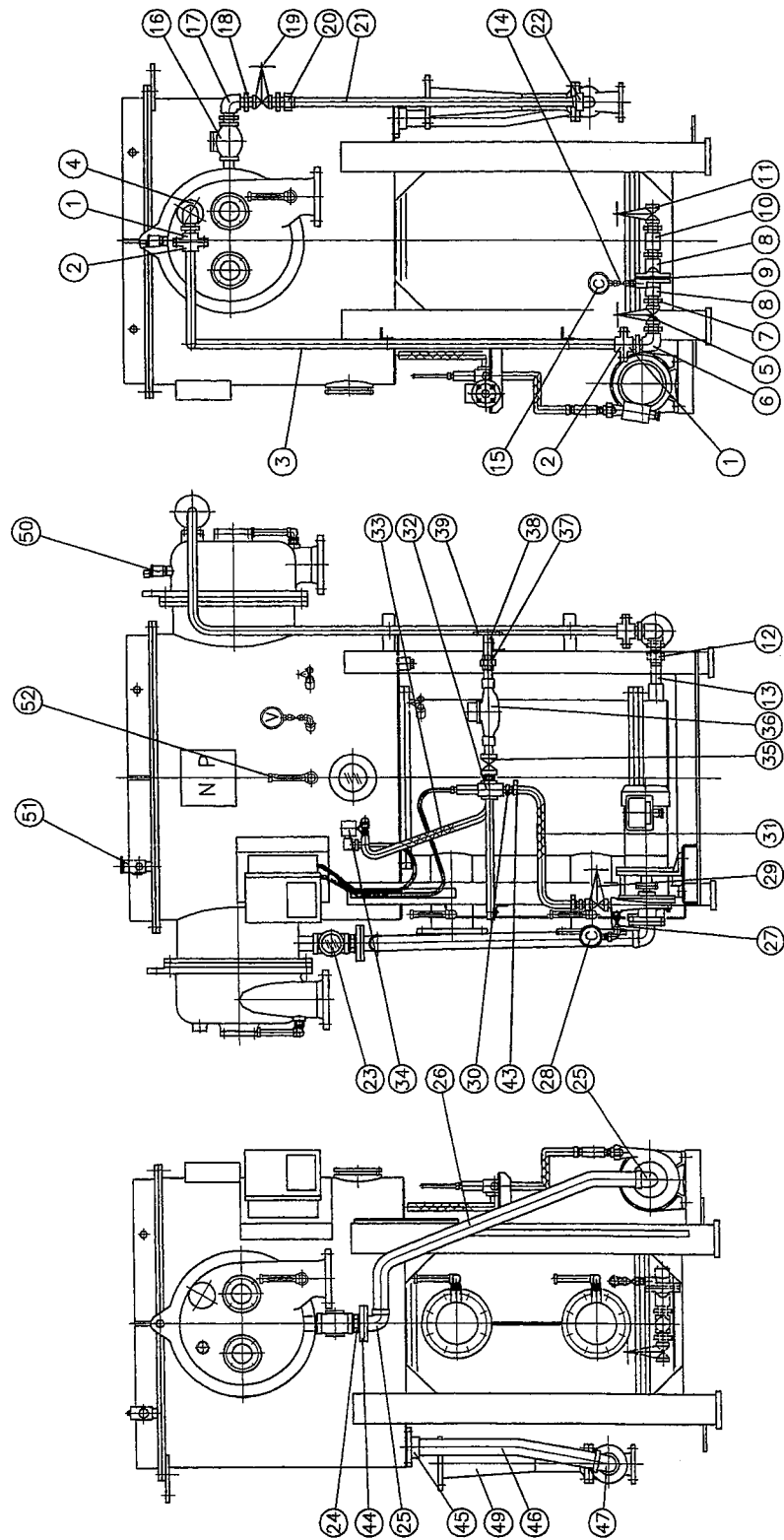
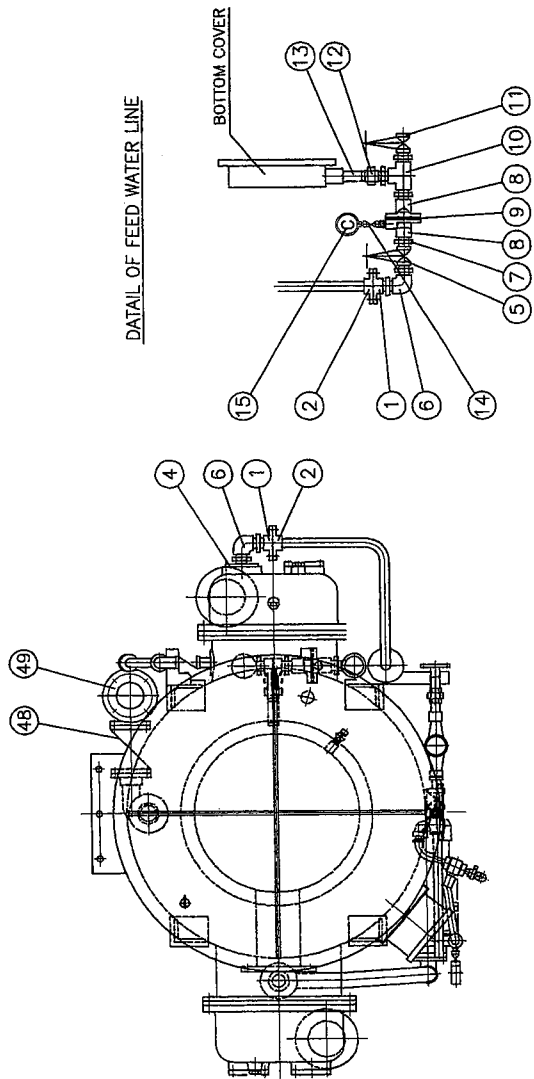
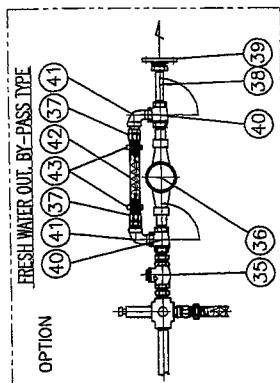


52	THERMOMETER	
51	RELIEF VALVE	
50	AIR VENT VALVE	
49	WATER EJECTOR	
48	SWING CHECK VALVE	
47	ELBOW	
46	BRINE PIPE	
45	FLANGE	
44	FLANGE	
43	HOSE BAND	
42	BRIDED HOSE	
41	ELBOW	
40	3-WAY BALL VALVE	
39	FLANGE	
38	DISTANCE PIPE	
37	HOSE NIPPLE	
36	FLOW METER	
35	LIFT CHECK VALVE	WITH SPRING
34	SOLENOID VALVE	
33	SPRING HOSE	
32	CELL BOX	
31	BRIDED HOSE	
30	HOSE NIPPLE	
29	GLOBE VALVE	DIST.PUMP
28	COMPOUND GAUGE	DIST.PUMP
27	GLOBE VALVE	ROOT VALVE
26	SUCTION PIPE	
25	90° FLANGE ELBOW	
24	NIPPLE	
23	WATER LEVEL GLASS	
22	90° UNION JOINT	
21	AIR PIPE	
20	UNION JOINT	
19	GLOBE VALVE	
18	NIPPLE	
17	ELBOW	
16	SWING CHECK VALVE	
15	COMPOUND GAUGE	GREEN MARK
14	GLOBE VALVE	ROOT VALVE
13	LONG NIPPLE	
12	UNION	
11	GLOBE VALVE	BOTTOM BLOW
10	TEE	
9	ORIFICE	
8	ORIFICE FLANGE	
7	NIPPLE	
6	ELBOW	
5	GLOBE VALVE	FEED W.VALVE
4	UNION JOINT	
3	FEED WATER PIPE	
2	90° UNION JOINT	
1	LOZENGE FLANGE	
NO.	N A M E	REMARKS
FRESH WATER GENERATOR		
PIPING PARTS LIST		

SASAKURA ENGINEERING CO., LTD JAPAN
DWG.NO.11401307
REV.

03 : FIG. PART 1

適用機種
Model:XM/XE 50, 60



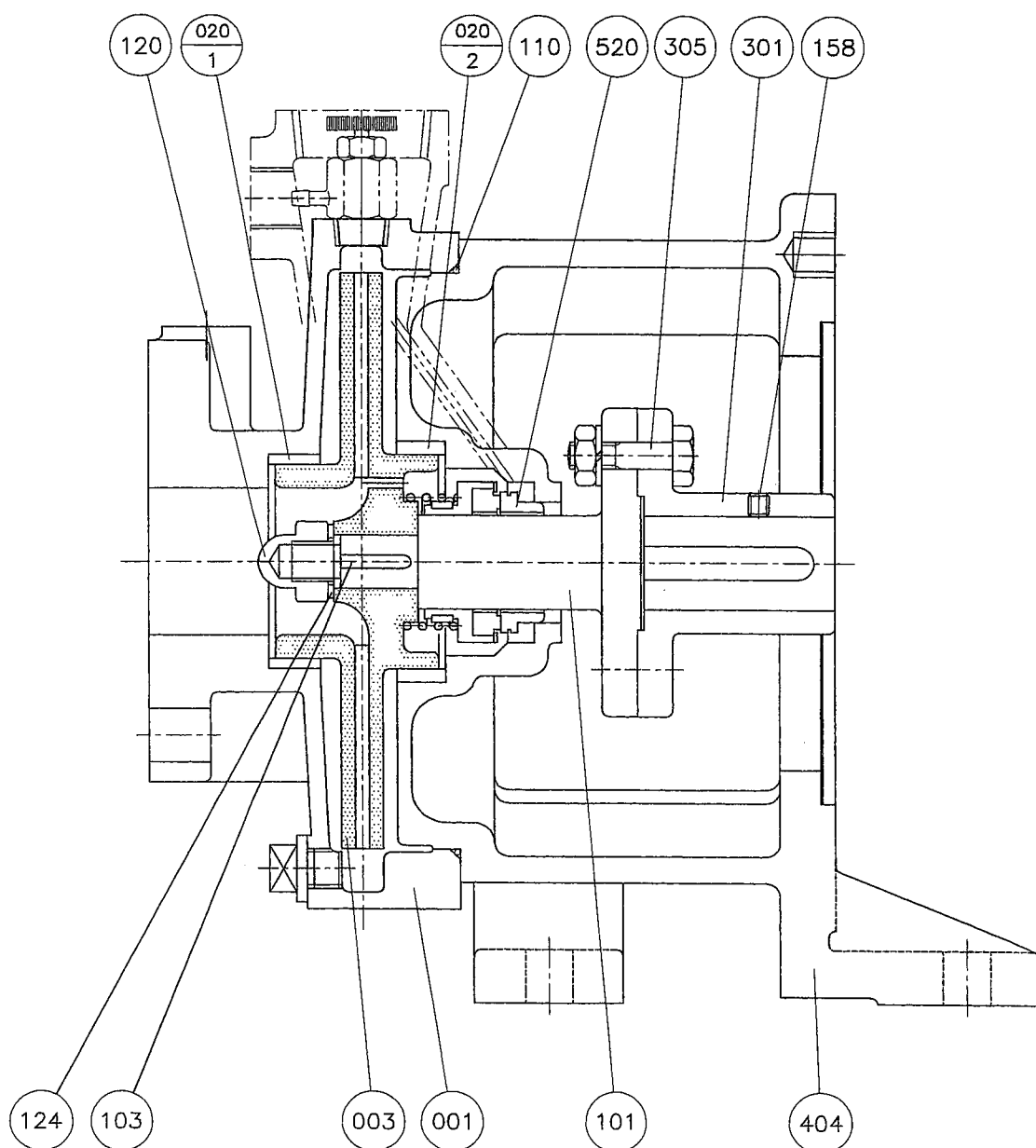
NO.	N A M E	REMARKS
52	THERMOMETER	
51	RELIEF VALVE	
50	AIR VENT VALVE	
49	WATER EJECTOR	
48	SWING CHECK VALVE	
47	ELBOW	
46	BRINE PIPE	
45	FLANGE	
44	FLANGE	
43	HOSE BAND	
42	BRIDED HOSE	
41	ELBOW	
40	3-WAY BALL VALVE	
39	FLANGE	
38	DISTANCE PIPE	
37	HOSE NIPPLE	
36	FLOW METER	
35	LIFT CHECK VALVE	WITH SPRING
34	SOLENOID VALVE	
33	SPRING HOSE	
32	CELL BOX	
31	BRIDED HOSE	
30	HOSE NIPPLE	
29	GLOBE VALVE	DIST.PUMP
28	COMPOUND GAUGE	DIST.PUMP
27	GLOBE VALVE	ROOT VALVE
26	SUCTION PIPE	
25	90° FLANGE ELBOW	
24	NIPPLE	
23	WATER LEVEL GLASS	
22	90° UNION JOINT	
21	AIR PIPE	
20	UNION JOINT	
19	GLOBE VALVE	
18	NIPPLE	
17	ELBOW	
16	SWING CHECK VALVE	
15	COMPOUND GAUGE	GREEN MARK
14	GLOBE VALVE	ROOT VALVE
13	LONG NIPPLE	
12	UNION	
11	GLOBE VALVE	BOTTOM BLOW
10	TEE	
9	ORIFICE	
8	ORIFICE FLANGE	
7	NIPPLE	
6	ELBOW	
5	GLOBE VALVE	FEED W.VALVE
4	SCREWED FLANGE	
3	FEED WATER PIPE	
2	FLANGE	
1	SCREWED FLANGE	

FRESH WATER GENERATOR
PIPING PARTS LIST

SASAKURA ENGINEERING CO., LTD. JAPAN
DWG.NO.11451340
REV.

P25 : FWGPART2

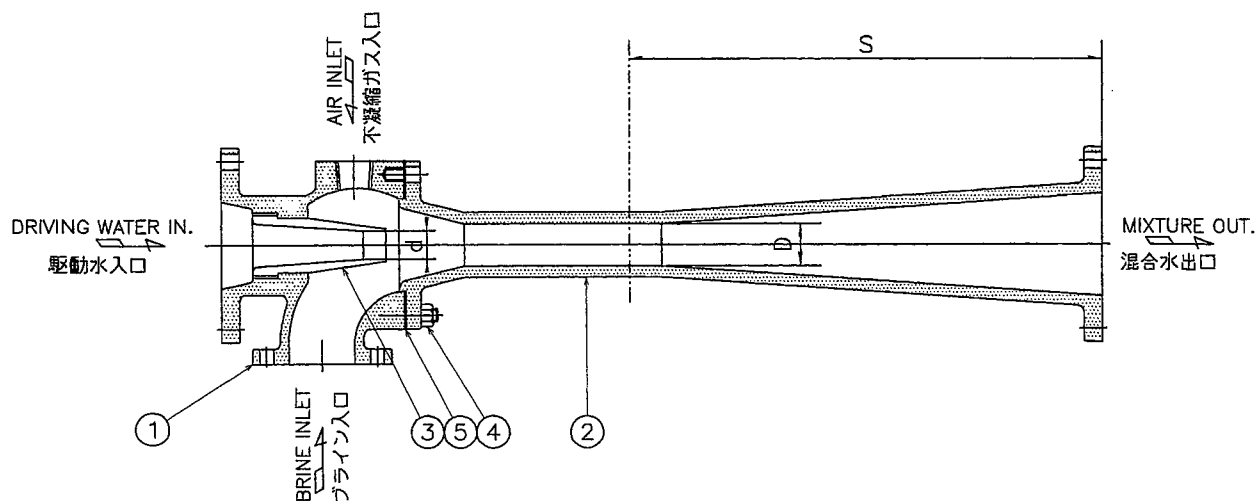
DISTILLATE PUMP



PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	PART NO.	NAME OF PART	MATERIAL	QUAN-TITY
001	CASING	CAST IRON	1	305	COUPLING BOLT,NUT & WASHER	ROLLED STEEL	3 SET
003	IMPELLER	(PHOS. BRONZE)	1	404	PUMP FRAME	CAST IRON	1
020-1	CASING RING	BRONZE	1				
020-2	CASING RING	BRONZE	1	520	MECHANICAL SEAL	EA560-25(SP)	1 SET
101	SHAFT	STAINLESS STEEL	1				
103	IMPELLER KEY	STAINLESS STEEL	1				
110	"O" RING	RUBBER	1				
120	IMPELLER NUT	STAINLESS STEEL	1				
124	IMPELLER WASHER	STAINLESS STEEL	1				
158	COUPLING SET SCREW	Cr-Mo STEEL	1				
301	COUPLING	CAST IRON	1				

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03 : DISTPUMP_R0



(mm)

		5	10	15	20	25	30	35	40	50	60
XM	CHECK POINT S:	—	235	290	290	290	290	320	320	320	400
	DIFFUSER DIA D:	—	22.5	30	30	30	30	32	32	32	39
	NOZZLE DIA. d:	—	12	15	15	15	15	17	17	17	21
XE	CHECK POINT S:	235	290	320	320	320	400	400	400	—	—
	DIFFUSER DIA D:	22.5	30	32	32	32	40	42	42	—	—
	NOZZLE DIA. d:	12	16.5	19	22.5	22.5	27	28	30.1	—	—

記事

チェックポイント "S" 部分の放射筒径を計測し、放射筒の正規寸法 "D" より 20% 以上、磨耗しているようであれば放射筒を新替えること。

—NOTE—

RENEW DIFFUSER IF DIAMETER "D" IS FOUND WORN MORE THAN 20%.

PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	PART NO.	NAME OF PART	MATERIAL	QUAN-TITY
1	SUCTION CHAMBER	BRONZE	1				
	吸入室	青銅铸件					
2	DIFFUSER	BRONZE	1				
	放射筒	青銅铸件					
3	NOZZLE	STAINLESS STEEL	1				
	ノズル	ステンレス鋼					
4	STUD BOLT	STEEL	4				
	植込ボルト / ナット	軟鋼					
5	GASKET	NON-ASBESTOS	1				
	ガスケット	ノンアスベスト					

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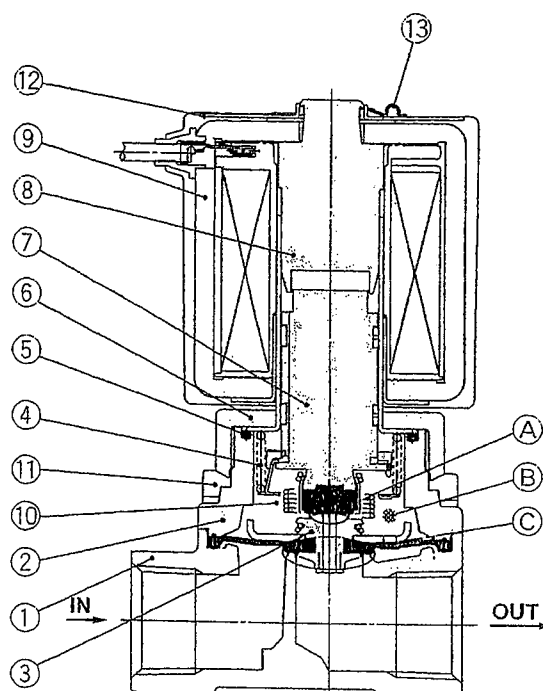
03 : WEJECTOR

• Solenoid Valve
(Type : VXZ)

Construction

Normally closed (N.C.)

Body material: Brass (C37), Stainless steel



Working principles

<Valve opened – when there is pressure>

When the coil ⑨ is energized, the armature assembly ⑦ is attracted into the core of the tube assembly ⑧ and the pilot valve ⑤ is opened.

When the pilot valve is opened and the pressure inside the pilot chamber ⑥ decreases, resulting in the pressure difference from the inlet pressure. Then the diaphragm assembly ③ is lifted and the main valve ③ is opened.

<Valve opened – when there is no pressure or under low minute pressure>

The armature assembly ⑦ and the diaphragm assembly ③ are connected with each other with the lift spring ⑩. When the armature assembly is attracted, the diaphragm assembly is pulled up and the main valve ③ is opened.

<Valve closed>

When the coil ⑨ is de-energized, the armature assembly ⑦ returns by the reacting force of the return spring ④ and the pilot valve ⑤ is closed. When the pilot valve is closed, the pressure inside the pilot chamber ⑥ increases, resulting that the pressure difference from the inlet pressure is lost and the main valve ③ is closed.

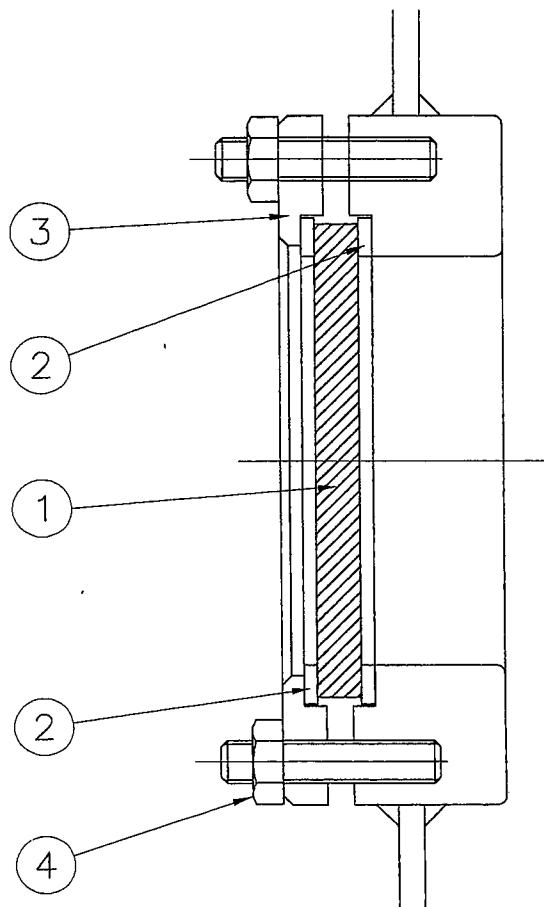
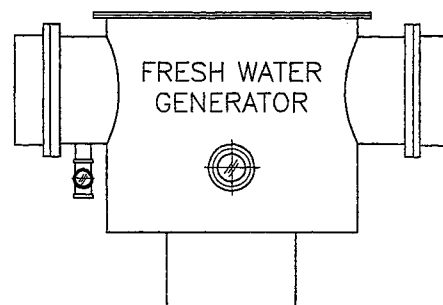
Component Parts

No.	Description	Material	
		Body material brass (C37) specification	Body material stainless steel specification
1	Body	Brass (C37)	Stainless steel
2	Bonnet	Brass (C37)	Stainless steel
3	Diaphragm assembly	Stainless steel (NBR, FKM, EPDM)	
4	Return spring	Stainless steel	
5	O-ring	(NBR, FKM, EPDM)	
6	Nut	Brass (C37)	Brass (C37), Ni plated
7	Armature assembly	Stainless steel	
8	Tube assembly ^{Note)}	Stainless steel, Cu	Stainless steel, Ag
9	Solenoid coil	—	
10	Lift spring	Stainless steel	
11	Hexagon socket bolt	Stainless steel	
12	Name plate	Aluminum	
13	Clip	SK	

The materials in parentheses are the seal materials.

Note) Cu and Ag are inapplicable to the DC spec and to the AC spec with built-in full-wave rectifier.

LOCATION : EVAPO. SHELL



PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	部品番号	部 品 名 称	材 質	個 数
1	* SIGHT GLASS	GLASS	1	1	* 視窓ガラス	硬質ガラス	1
2	* GASKET	RUBBER	2	2	* ガスケット	ゴ ム	2
3	COVER	STEEL	1	3	視窓カバー	鋼 板	1
4	BOLTS & NUTS	STEEL	8sets	4	ボルト及びナット	鋼 棒	8 組
5				5			
6				6			
7				7			
8				8			
9				9			

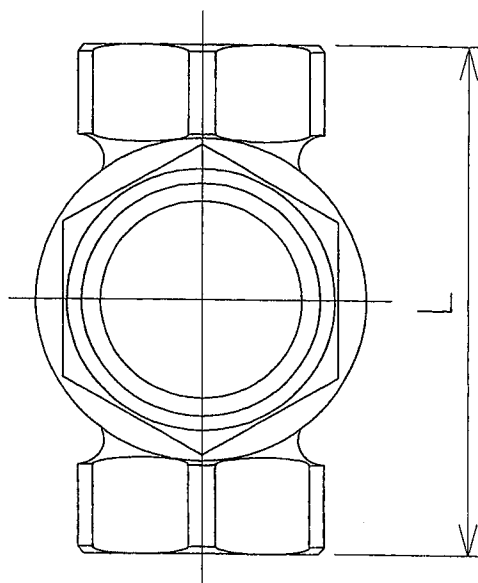
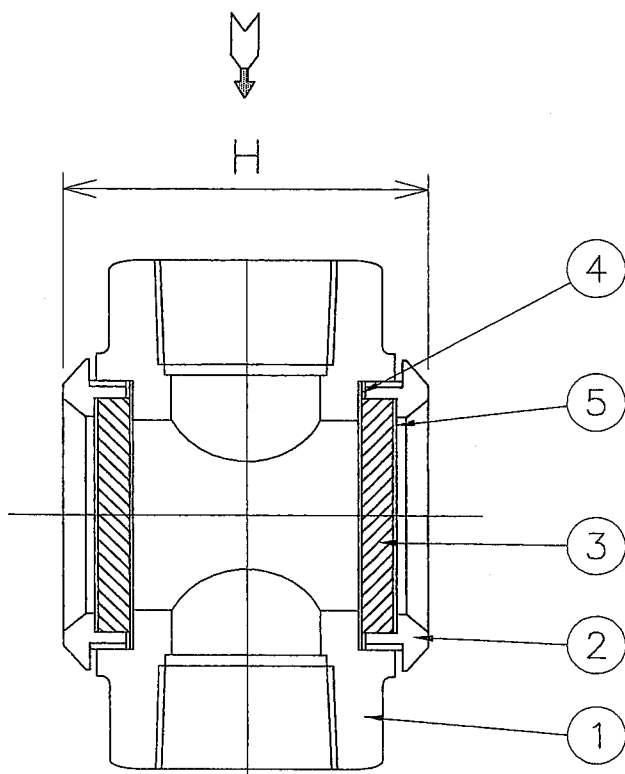
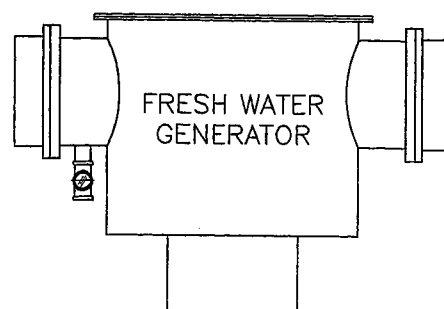
(*SPARES OF THESE PARTS ARE INCLUDED IN OUR STANDARD SPARE PARTS.)

(*印は、標準予備品として装備しています。)

SASAKURA ENGINEERING CO., LTD.

03 : SIGHTG

LOCATION : F.W. OUTLET



MODEL	L	H	③	E	WEIGHT	TYPE OF F.W.G
GMS-25	90	62	φ 36×5	Rc1	0.8kg	XE5
GMS-32	120	78	φ 52×7	Rc11/4	1.7kg	
GMS-40	120	86	φ 52×7	Rc11/2	1.9kg	XM/XE10~60
GMS-50	140	102	φ 65×8	Rc2	3.1kg	

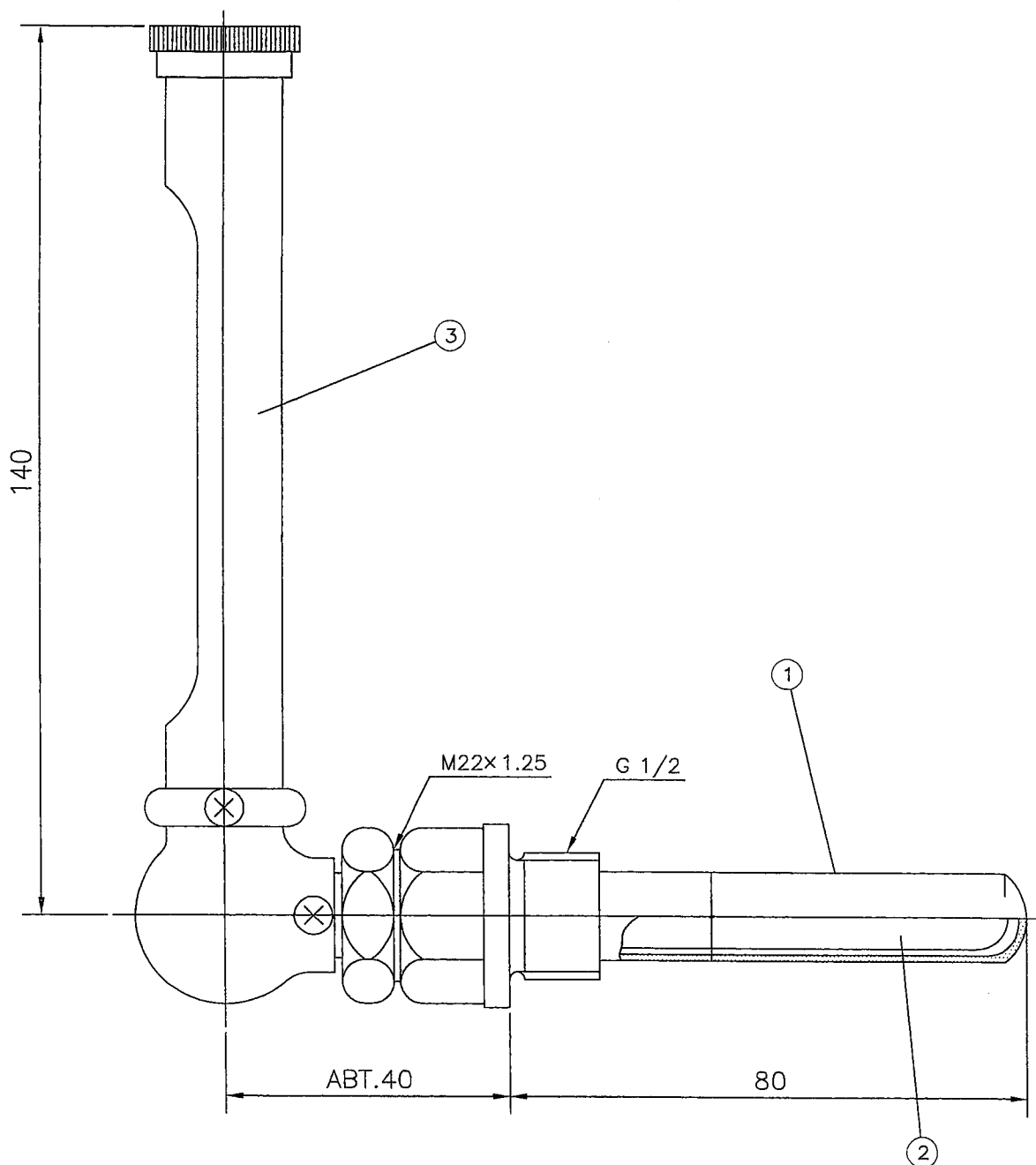
PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	部品番号	部 品 名 称	材 質	個 数
1	BODY	CAST IRON	1	1	本 体	鋳 物	1
2	RING NUTS	CAST IRON	1	2	リングナット	鋳 物	1
3	* SIGHT GLASS	GLASS	1	3	* サイトガラス	耐熱ガラス	1
4	* GASKET	RUBBER	1	4	* ガスケット	ゴ ム	1
5	* GASKET	RUBBER	1	5	* ガスケット	ゴ ム	1
6				6			
7				7			
8				8			
9				9			

(*SPARES OF THESE PARTS ARE INCLUDED IN OUR STANDARD SPARE PARTS.)

(*印は、標準予備品として装備しています。)

SASAKURA ENGINEERING CO., LTD.

03 : LEVELG



THERMOMETER	GRADUATION		WEIGHT	REMARKS
L TYPE THERMO. L型 温度計	0 ~ 100	℃	0.2kg	ALCOHOL アルコール

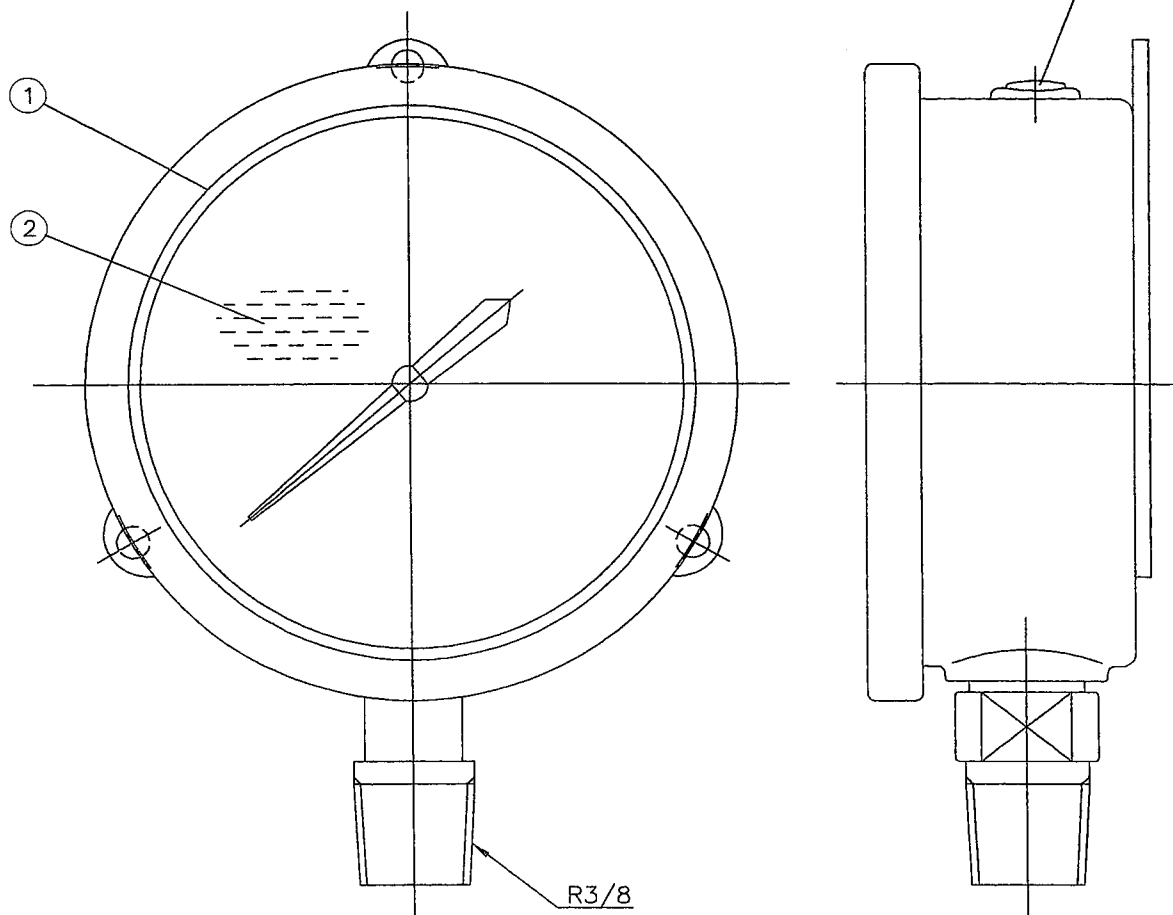
PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	部 品 番 号	部 品 名 称	材 質	数 量
1	WELL	BRASS	1	1	外部保護筒	真ちゅう	1
2	INNER TUBE	BRASS	1	2	内部保護筒	真ちゅう	1
3	COVER	BRASS	1	3	保 護 枠	真ちゅう	1
4	*	*	*	4	*	*	*

SASAKURA ENGINEERING CO.,LTD.

03 : TH-GAUGE

(GV51-283)

VENT THE AIR
 WHEN USE
 使用時は
 エアー抜きをして下さい。



GAUGE	GRADUATION		WEIGHT	REMARKS
PRESSURE G. 圧力計	0 ~ 10 & 0 ~ 1.0	(kgf/cm ²) MPa	0.4kg	
COMPOUND G. 連成計	76cmHgV.~4.0 & -0.1 ~ 0.4	(kgf/cm ²) MPa	0.4kg	
COMPOUND G. 連成計	76cmHgV.~4.0 & -0.1 ~ 0.4	(kgf/cm ²) MPa	0.4kg	WITH GREEN MARK グリーンマーク付
VACUUM G. 真空計	76cmHgV.~0 & -0.1 ~ 0	(kgf/cm ²) MPa	0.4kg	

PART NO.	NAME OF PART	MATERIAL	QUAN-TITY	部 品 番 号	部 品 名 称	材 質	数 量
1	BODY	STAINL.STEEL	1	1	本 体	ステンレス	1
2	INNER LIQUID	GLYCERIN	-	2	内部封入液	グリセリン	-
3	PLUG	PLASTIC	1	3	プラグ	プラスチック	1
4	*	*	*	4	*	*	*

SASAKURA ENGINEERING CO.,LTD.

03 : TH-GAUGE

INSTRUCTION MANUAL

for

SK 101 Salinity Indicator

Sasakura Engineering Co., Ltd.

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2.	Outline -----	2
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7.	Maintenance -----	8
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Notes on safety indications

The user is requested to read these instructions and the attached documents carefully before the installation, operation and inspections or maintenance of the Salinity Indicator so that it will be used properly.

Please be sure to get accustomed thoroughly to the knowledge of, and the safety information and notes about, the indicator prior to use it.

[Safety notes in this Instruction Manual will be indicated by any one of the following three levels:]



indicates a case where an erroneous operation of the machine would produce a dangerous situation which could result in death or serious injury and the level of emergency is high when such a situation occurs. This note will appear limitedly for very dangerous cases.



denotes a case where an erroneous operation of the machine would produce a dangerous situation which could result in death or serious injury.



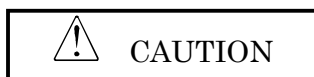
represents a case where an erroneous operation of the machine would produce a dangerous situation which could result in slight injury or material damage.

Please note, however, that a  case could result in more serious consequences than assumed above by the synergy of different conditions. So, it is important to live up to the instructions herein to forestall any factor which would inhibit safety operation.

1. Notes for safety operation

These Operating Instructions must be read through carefully for the proper and safe use of this product.

Any erroneous operation could cause a breakdown and/or a disaster resulting in injury and/or material damage.



- 1.1 Turn off the power source prior to wiring or inspecting the inside of the indicator; otherwise the worker could suffer an electric shock.
The main source must be turned off at both ends.
- 1.2 Prior consultation with the manufacturer is necessary if the indicator is intended for uses where its breakdown or erroneous operation could endanger a human life or lives or cause hazards to people.
- 1.3 No excessive load, vibration or impact must be given to the body or the cell.
- 1.4 The indicator must be used within the specified temperature range.
- 1.5 In case of detaching the cell, stop the pump and lower residual pressure by closing the pipeline valve(s) beforehand.
- 1.6 Do not adapt the indicator to add a new function to it or for any other purposes. For repairs, call the manufacturer.
- 1.7 To wire the indicator, strictly follow instructions in the "Wiring and connection" part of this brochure.
- 1.8 Prior to use, make sure that the correct voltage has been chosen on the voltage selector.

2. Outline

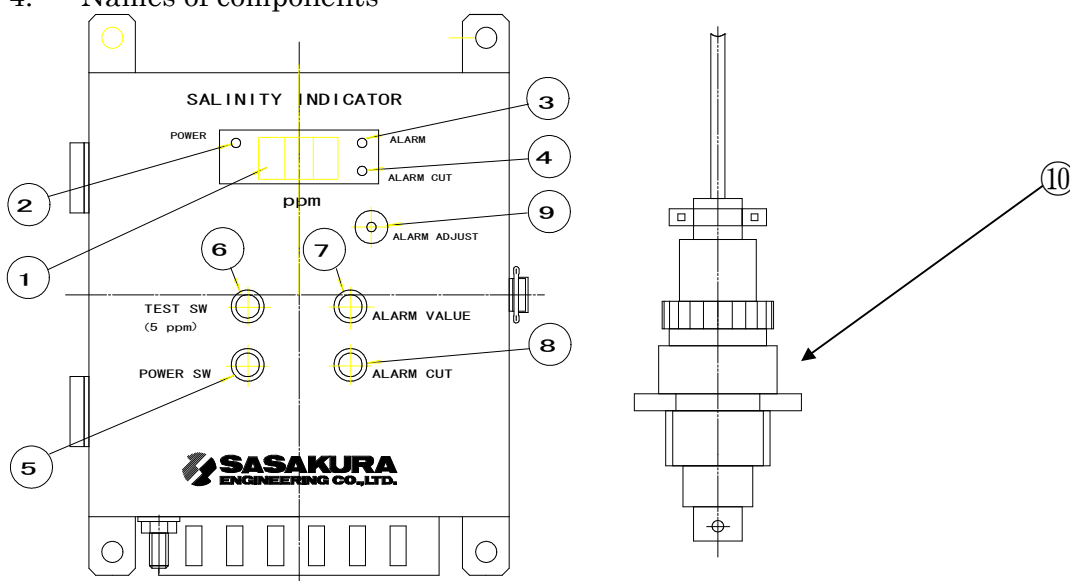
The SK101 Salinity Indicator continuously measures the saline concentration of high-purity water, such as distilling plant water, drain water and feed water for boilers, and indicates the outcome therefrom in ppm. In case the saline content level goes higher than a preset value, the indicator will light up an alarm lamp and send out error signals (no-voltage and voltage signals). Some types of the measuring unit would automatically activate a solenoid valve to discharge high salty water outside the system.

The alarm is automatically canceled when the saline concentration is back to a level below the preset value.

3. Specifications

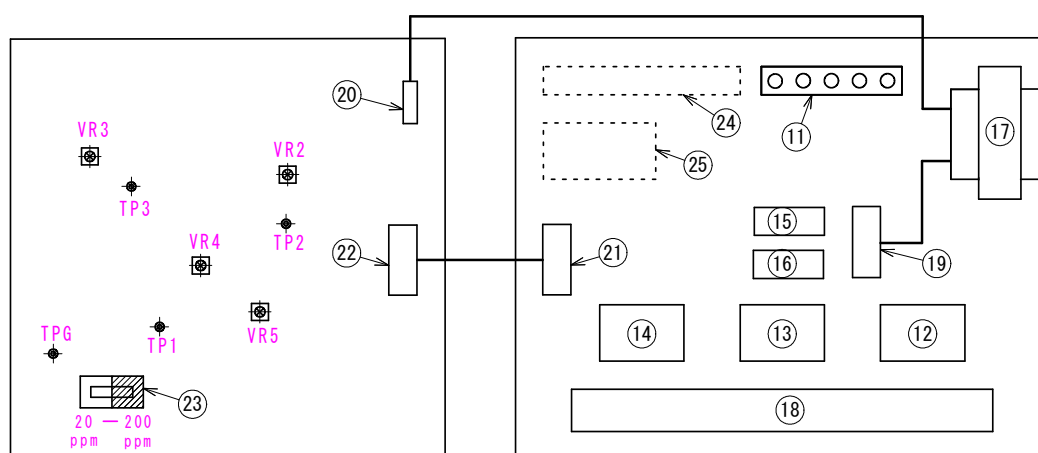
Measurable range:	0.1 to 20.0 ppm or
(with selection switch)	1 to 200 ppm.
Measuring accuracy:	±2.5%.
Temperature compensation:	30 to 80 °C.
LED lamps	Power: green.
	Alarm: red.
	External alarm cut: orange.
Power source:	100/110/115/220 VAC,
(switchable on voltage taps)	50/60 Hz; (200 V optional)
Finishing color:	Munsell 7.5 BG 7/2.
Pressure durability of cell:	0.5MPa (5 kg/cm ²)
Cell mounting screws:	M30×2.

4. Names of components



MAIN P.C. BOARD

POWER P.C. BOARD



- | | | | |
|------|--|------|------------------------------|
| (1) | Display | (14) | RL1 (Relay 1) |
| (2) | Power LED (green) | (15) | F1 (Fuse 1,) 0.2 A |
| (3) | Alarm LED (red) | (16) | F2 (Fuse 2) 3.0 A |
| (4) | External alarm cut LED (amber) | (17) | Transformer |
| (5) | Power switch | (18) | TB3 Terminal block |
| (6) | Test switch | (19) | CN1 Connector (Power P.C.B.) |
| (7) | Alarm value check switch | (20) | CN1 Connector (Main P.C.B.) |
| (8) | External alarm cut switch | (21) | CN2 Connector (Power P.C.B.) |
| (9) | Alarm value adjustment variable resistor (VR) | (22) | CN2 Connector (Main P.C.B.) |
| (10) | Cell | (23) | Full range selection switch |
| (11) | TB1 Terminal block (with voltage selection taps) | (24) | TB2 Terminal block * |
| (12) | RL2 (Relay 2) | (25) | RL4 (Relay 4) * |
| (13) | RL3 (Relay 3) | | |

Marked(*) is optional, not included in a standard Salinity Indicator.

5. Operations and functions

The indicating section

5.1 Display

Indicates measured values, a preset alarm value and test values (5/50 ppm) in ppm.

5.2 POWER (Power lamp)

Green LED on: power has been turned on.

Green LED off: power has been turned off.

5.3 ALARM (Alarm lamp)

Red LED on: measurement exceeds alarm value.

Red LED off: measurement remains below alarm value.

5.4 ALARM CUT (Alarm cut lamp)

Amber LED on: no alarm signal sent even if exceeded alarm value.

Amber LED off: alarm signals sent if exceeded alarm value.

The switching section

5.5 POWER (Power switch)

Operations:

- Press when Salinity Indicator turned off — Indicator on, power LED on, value displayed.
- Press when Indicator turned on — Indicator off, power LED off, display dead.

5.6 TEST SW (Test switch)

Operations:

Press the 20 ppm side of measuring range selection switch — 5.0±0.2 ppm displayed.

This switch is used to test the checking of function of the SK 101 Salinity Indicator except its measuring cell.

5.7 ALARM VALUE (Alarm value switch)

Operations:

Press the switch — preset alarm value displayed.

To revise a set value, see 5.9 Alarm adjustment below.

5.8 ALARM CUT (Alarm cut switch)

Operations:

Press when the switch off — alarm cut function on; alarm cut lamp on.

Press when the switch on — alarm cut function off; alarm cut lamp off.

While the alarm cut function is activated, no alarm will be output.

Turn on the alarm cut switch soon after the distilling plant starts to operate because salinity in the distilled water remains unstable.

After the salinity is stabilized, turn off the alarm cut switch.

5.9 ALARM ADJUST (Alarm value adjustment VR)

To revise a preset alarm value, while pressing the alarm value check switch (7), slowly turn the alarm value adjustment VR (9) until a desired value is displayed. Then, release both switches and now the new value has been set.

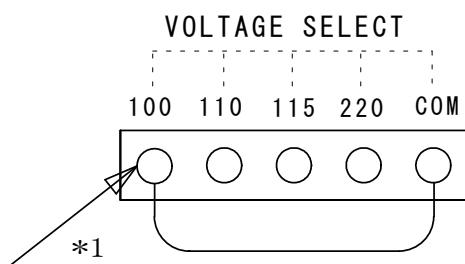
5.10 Cell

Dipped in distilled or fresh water to measure saline content in it.

6. Wiring and connection

Break the power source during wiring work and the linking of connectors

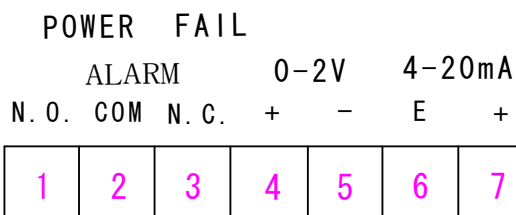
6.1 TB1 terminal block with voltage selection taps (11)



*1 Choose the voltage to be used for this Salinity Indicator from the voltage selection taps on the terminal block.

Connect the COM tap and the desired voltage tap with a jump wire.

6.2 TB2 terminal block (option) (24)

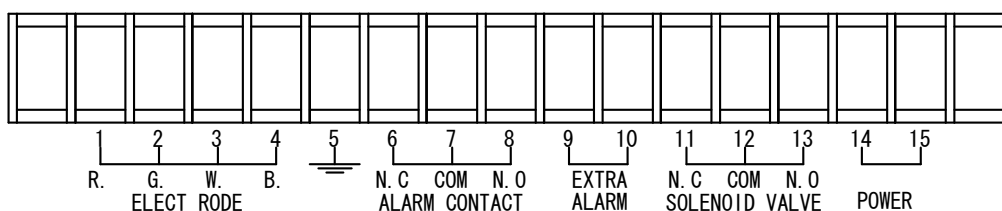


Used for a power failure alarm and the measured value output of 0-2 V, 4-20 mA.

The power failure alarm contact is a no-voltage contact.

* The TB2 terminal block is optional and not equipped in a standard Salinity Indicator.

6.3 TB3 terminal block (18)



In standard equipment, the alarm contact is a no-voltage contact and the external alarm contact is with voltage.

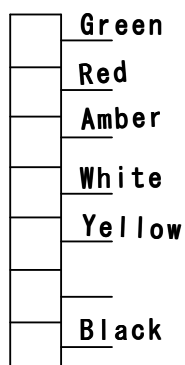
Make sure that the Cell is connected with the correct cables in accordance with the colors shown above.

6.4 Main P.C.B. — Power P.C.B. connection (CN1)

Check up the Main and Power P.C.B. to confirm if the connectors are connected as follows:

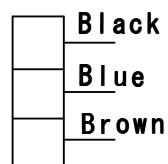
(19) Power P.C.B.

①9 CN1



(20) Main P.C.B.

②0 CN1



6.5 Main P.C.B. — Power P.C.B. connection (CN2)

Check up the Main and Power P.C.B. to see if the connectors are connected as follows:

(21) Power P.C.B.

(22) Main P.C.B.

②① CN2

	White
	Gray
	Purple
	Blue
	Green
	Yellow
	Orange
	Red
	Brown
	Black

②② CN2

	Black
	Brown
	Red
	Orange
	Yellow
	Green
	Blue
	Purple
	Gray
	White

7. Maintenance

7.1 Cleaning of Cell

To keep the indicator operating accurately all the time, detach the Cell and clean the Cell at least once a month.

In cleaning the Cell, carefully wipe off dust and scale from its surface with soft cloth. Do not use sandpaper, a file or other material which may hurt the surface.

8. Errors and remedies

Error	Cause	Remedy
Powered but fails to operate; power LED dead.	Error in power source or F1 fuse (0.2A) blown by abnormal current flow in the circuit.	Remove the cause(s) of abnormal current and replace F1 fuse (0.2A) with a spare.
	Excess current flows in external alarm.	Remove the cause(s) of abnormal current and replace F2 fuse (3.0A) with a spare.
Alarm LED fails to light.	The set alarm value is inadequate.	Check the set alarm value. See Item 5.9 in this brochure for changing set values.
	Broken relay	Replace the power P.C.B. with a new one because the relay is directly bonded on the board.
Displayed value unusually low.	Foreign matter deposited on sensor surface working as insulator.	Clean the Cell.
	Sensor out of the water.	Dip the Cell in the water completely.
	Cell fastening screws loosened.	Fasten the screws.
	Broken wire in the Cell.	Renew the Cell.
Displayed value unusually high.	Foreign matter deposited on sensor surface increases conductivity.	Clean the Cell.
Alarm LED remains lit.	The set alarm value is inadequate.	Check the set alarm value. See Item 5.9 in this brochure for changing set values.
	Broken relay	Replace the Power P.C.B. with a new one because the relay is directly bonded on the board.
Alarm output error.	Broken relay	Replace the Power P.C.B. with a new one because the relay is directly bonded on the board.
Test SW pressed but neither 5 ± 0.2 ppm displayed.	Power not turned on.	Turn on power.
	Error in Main P.C.B. circuitry	Renew the Main P.C.B.
	Error in LED lamp circuit.	Renew the Main P.C.B.
Test SW pressed but displayed value exceeds 5 ± 2 ppm limitations.	Chosen power tap not matching supplied voltage.	Check the connected tap voltage. [Choose the correct tap and connection ?]

9. Note

This Salinity Indicator has been developed for the purpose of detecting the salt content in the distilled water produced by the Fresh Water Generator installed on the ships. Its measuring principle is the Salinity Indicator detects electric conductivity in the liquid and its conductivity is converted to NaCl(salt)ratio in the seawater and it is indicated as ppm.

This detection method has the characteristic to detect the ionic dissolved gas(such as carbon dioxide, ammoniac gas and the gas and dissolved ion generated from deoxidizer for boiler feed water),and these dissolved gas content is added on the ppm indication.

In the case the liquid which contains the ionic dissolved gas is detected by “Chloride test kit” its ppm indication is smaller than that by the Salinity Indicator.

This ionic dissolved gas has no bad influence for boiler feed water, but it is indicated just like high salinity (NaCl).It is impossible to avoid such indication as long as this Salinity Indicator is used as like “simple conductivity meter”.

The ionic dissolved gas content is different from each application and each ship.

Therefore, dissolved gas content should be analyzed individually.

Especially, following measuring points contained dissolved gas remarkably.

- Ejector drain of Distilling Plant
- Heating steam drain
- Boiler feed water line

Iwaki ETU-25NR-B11N-37 Chemical Tank Unit (FWG/PL-FWG)

Instruction manual

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This instruction manual should be kept on hand by the end user for quick reference.

Contact us or your nearest dealer if you have any questions.

Important instructions

For the Safe and Correct Handling of the Tank Unit

- "Safety Instruction" section deals with important details about handling of the product. Before use, read this section carefully for the prevention of personal injury or property damage.
- Observe the instructions accompanied with "WARNING" or "CAUTION" in this manual. These instructions are very important for protecting users from dangerous situations.
- The symbols on this instruction manual have the following meanings:

 WARNING	Nonobservance or misapplication of "Warning" sections could lead to a serious accident which may result in death.
 CAUTION	Nonobservance or misapplication of "Caution" sections could lead to personal injury or property damage.

Types of Symbols



Indicates that "Warning" or "Caution" must be exercised. Inside this triangle, a concrete and practical image provided as a warning or caution message is depicted.



Indicates a prohibited action or procedure. Inside or near this circle, a concrete and practical image of the activity to be avoided is depicted.



Indicates an important action or procedure which must be performed or carried out without fail. Failure to follow the instructions herein can lead to malfunction or damage to the product.

For exportation

Information contained within this instruction manual may be considered controlled technology as set by the Japanese Ministry of Economy, Trade and Industry (METI). An export license issued by METI may be required when exporting or providing the manual to a 3rd party.

Safety instructions

WARNING

- **Qualified personnel only**

This product should be handled or operated by qualified personnel with a full understanding. Any person not familiar with the product should not take part in the operation or maintenance of this product.



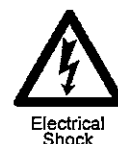
- **Do not mix different chemicals**

Otherwise, chemical reaction may give out heat or harmful gas.



- **Turn off power before Service**

Risk of electrical shock. Be sure to turn off power to stop the pump and related devices before service is performed.



- **Wear protective clothing**

Always wear protective clothing such as an eye protection, chemical resistant gloves, a mask and a face shield during disassembly, assembly or maintenance work.



- **Stop operation**

If you notice any abnormal or dangerous conditions, suspend operation immediately and inspect/solve problems.



- **Do not use the product in any condition other than its intended purpose**

The use of the product in any conditions other than those clearly specified may result in failure or injury. Use this product in specified conditions only.



- **Do not handle the pump with wet hand**

Risk of electrical shock.



- **Do not modify the product**

Alterations to the product carries a high degree of risk. It is not the manufacturer's responsibility for any failure or injury resulting from alterations to the pump and tank.



- **Keep electric parts and wiring dry**

Risk of fire or electric shock. Install the pump where it can be kept dry.



- **Do not stand on the tank**

Do not use the tank as a platform. Injury or damage may result when the tank turns over.



- **Do not operate the product in a flammable atmosphere**

Do not place explosive or flammable material near the product.



Safety instructions

CAUTION

- **Use specified power only**

Do not apply power other than that specified on the nameplate. Otherwise, failure or fire may result. Ensure the pump is properly grounded.



- **Do not run pump dry**

A long period of dry running may cause a leak.



- **Ventilation**

Fumes or vapours can be hazardous with certain solutions. Ensure proper ventilation at the operation site.



- **Spill precautions**

Ensure protection and containment of solution in the event of plumbing or pump damage (secondary containment).



- **Non-freezing**

Liquid in the tank may freeze and consequently damage the tank in winter. Drain liquid before leaving it for a long period.



- **Do not place the product on a wobbly and an inclined pedestal**

Otherwise, it may fall down, causing personal injury or property damage.



- **Do not drain a chemical directory onto a floor.**

Always collect drainage in a suitable container. Observe applicable codes for hazardous waste disposal.



- **Do not install or store the product in the following places:**

- Under direct sunlight or vibration.
- Under a flammable or a corrosive atmosphere.
- Where ambient temperature exceeds 40°C or falls below 0°C.
- In a dusty place or a humid place.
- In wind and rain.



- **Do not use a damaged product**

Use of a damaged product could lead to personal injury.



- **Disposal of the product**

Dispose of any used or damaged product in accordance with local rules and regulations. If necessary, consult a licensed industrial waste disposal company. Clean the tank in advance.



Safety Instructions

CAUTION

- **Before product return**

Be sure to drain chemicals and clean the inside of the pump and tank before return so that a harmful chemical does not spill out in transit.



- **Keep a maintenance space**

Allow sufficient space around the product for easy access and maintenance.



- **Do not damage the power cable**

Do not pull, knot, or crush the power cable. Damage to the power cable could lead to a fire or electrical shock if cut or broken.



Caution

- **Grounding**

Risk of electric shock! Always properly ground the pump. Conform to local electric codes.



Earthing

- **Install a GFCI (earth leakage breaker)**

An electrical failure of the pump may adversely affect other devices on the same line. Purchase and install a GFCI (earth leakage breaker) separately.



Electrical Shock

- **Preventative maintenance**

Follow instructions in this manual for replacement of wear parts. Do not disassemble the product beyond the extent of the instructions.



- **Do not use a damaged pump**

Using a damaged pump could lead to an electric leak or shock.



Prohibited

- **Tighten the pump head**

Liquid may leak if pump head fixing bolts are loose. Tighten the bolts evenly to 2.16 N•m in diagonal order before initial operation and at regular intervals.



Caution

- **Install relief valve**

Install a relief valve on a discharge line near the pump so as to release the discharge pressure when it exceeds the maximum level.



Outline

1. Specification

■ Model code

ETU-25NR-B11N-37

■ Pump specification

Model	EHN-B11VC1R-37
Maximum flow rate	38m ³ /min
Maximum discharge pressure	1.0MPa
Stroke length	50-100%
Stroke rate	1-360spm
Power voltage (50/60Hz)	100-240VAC, single phase
Insulation class/ Thermal protection/ Power cord	B class/ Built-in thermal protector/ 5m length
Standard accessories	CA-1VC-4 check valve, 5m PVC braided tube (ø4×ø9), Liquid name label
Wet end materials	PVC pump head, Alumina ceramic valve, PTFE/EPDM diaphragm, FKM O ring

*The max flow rate is based on pumping clean water at the maximum discharge pressure.

*Use a check valve for the prevention of overfeeding.

■ Check valve specification

Model	Connections		Materials		
	IN	OUT	Body	Spring	O ring
CA-1VC-4	ø4×ø9 braided tube	R3/8 or R1/2	PVC	Hastelloy C276	FKM

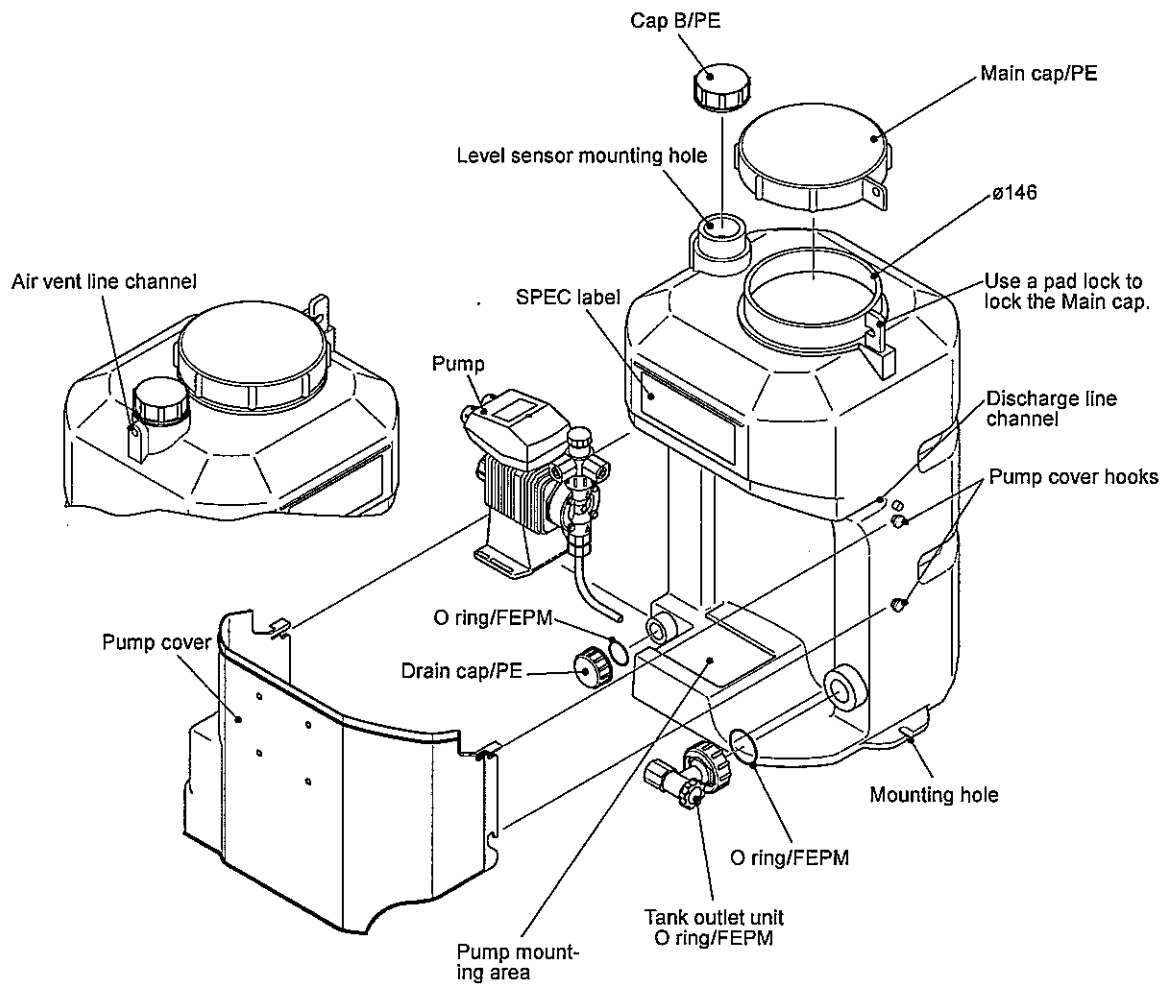
■ Tank specification

Model	Capacity	Dimensions	Weight
CT-U25NR	25L	380×332×567mm	3.7kg

Outline

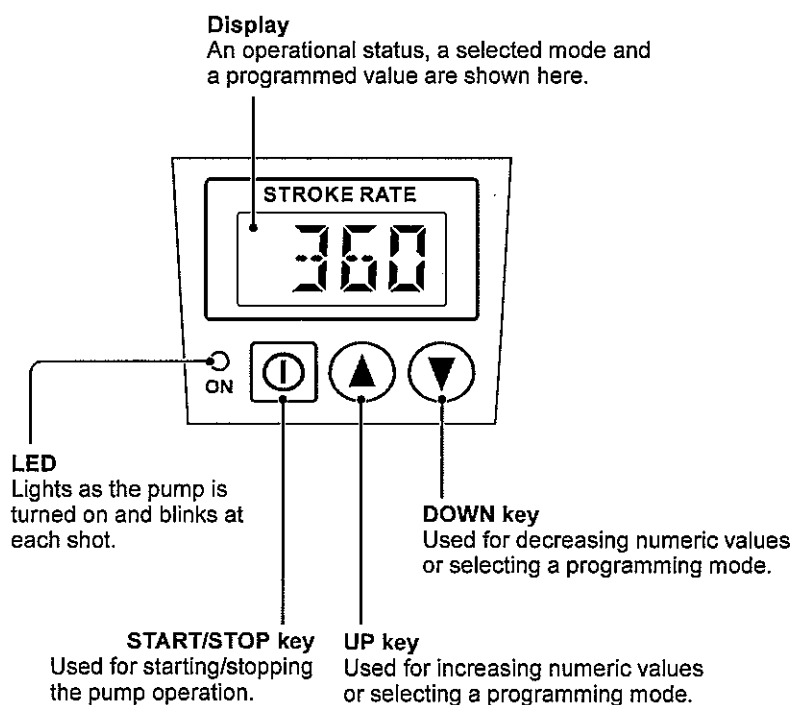
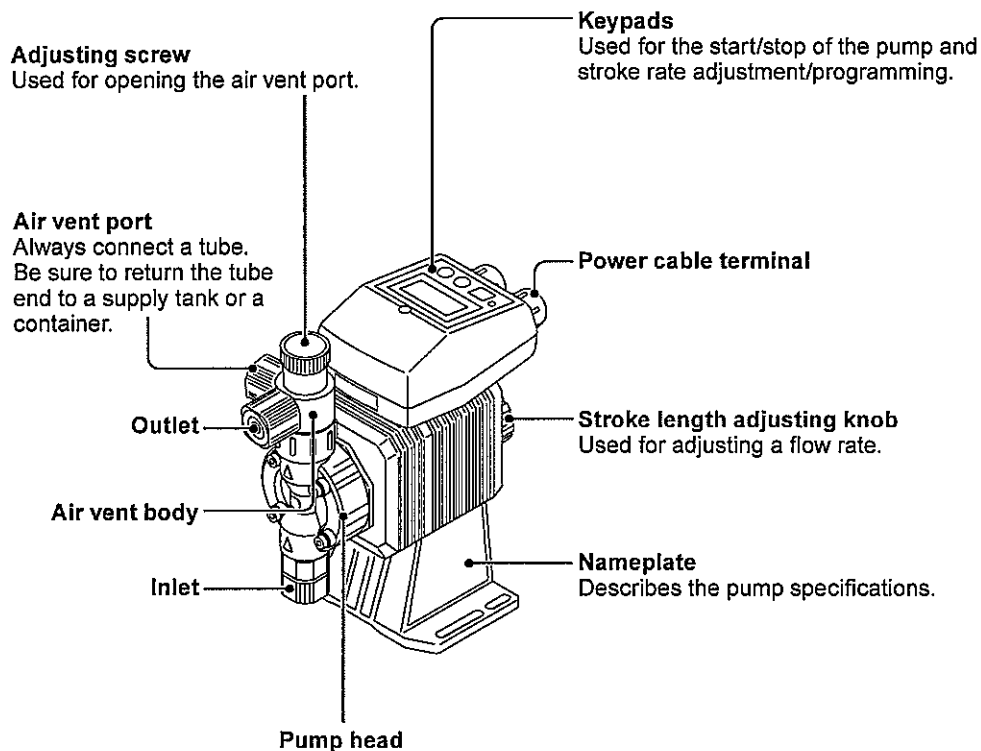
2. Overview

■ Pump and Tank



Outline

■ Pump



Installation

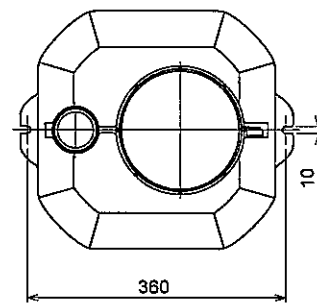
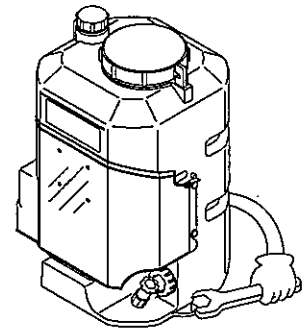
1. Installation location

1. Place the tank in a level and flat foundation.
2. Keep a maintenance area (tank length plus 2m × tank width plus 2m).
3. Do not place the tank under...
direct sunlight, high-temperature and humidity, a corrosive atmosphere or vibration.
*Protect the tank with a cover when installing it out of doors.

⚠ CAUTION

- Liquid in the tank may freeze and consequently damage the tank in winter. Drain liquid before leaving it for a long period.
- Install a Surge Protective Device if there is a high probability of a lightning strike.

4. Anchor the tank
Use two M8 bolts. Purchase separately.



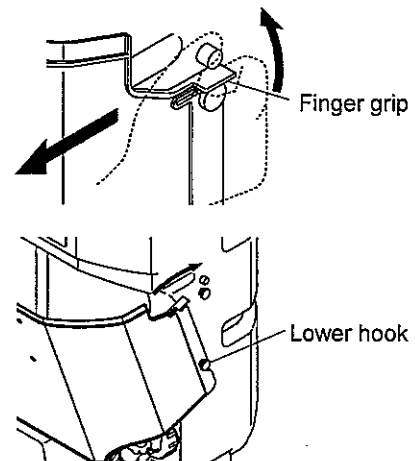
Anchor pitch (mm)

2. Pump cover

1. Pump cover removal
Slightly pull up both left and right finger grips to unhook the pump cover and pull it away.
2. Pump cover mounting
First, catch both left and right lower hooks with the cover. And then catch the upper hooks to retract it.

⚠ CAUTION

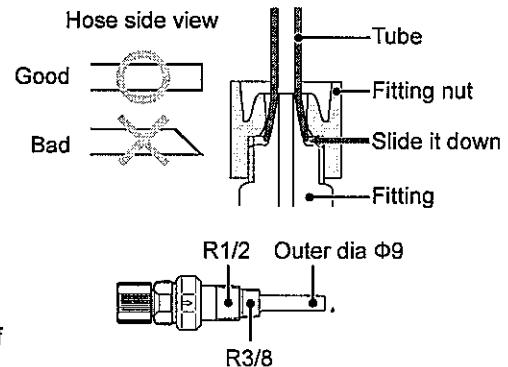
Do not give excessive stress to the pump cover. Or the cover may break.



3. Piping

Connect tubes to the pump and install a check valve.

1. Cut the tube ends flat.
2. Pass a tube into the fitting nut and slide it down to the fitting as far as it will go. Then hand tighten the fitting nut.
3. Retighten the fitting nut by turning it 180 degrees with an adjustable wrench or spanner.
*The plastic fitting nut may be broken if it is tightened too much.
*The CA check valve has R1/2 and R3/8 thread connections. Cut off and adjust the ø9 tube connection length as necessary.



Installation

4. Wiring

⚠ WARNING

Electrical work should be performed by a qualified electrician. Otherwise, personal injury or property damage could result. Conform to local electric codes.

Risk of electric shock! Always properly ground the pump while power is off.

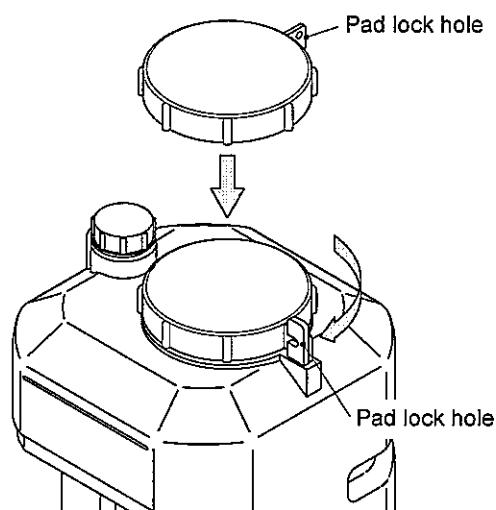
5. Chemical refilling

1. Open or close the Main cap

Rotate the main cap 90 degrees clockwise to close it and anticlockwise to open. Always make both pad lock holes coming together when the cap is closed.

2. Check the drain port and the tank outlet

Start to fill the tank with liquid if the drain port and the tank outlet are closed. Be careful not to spill liquid.



⚠ CAUTION

- Wear protective clothing such as a protective mask, goggles and gloves along with chemicals to be handled.
- Observe the maximum liquid level of 25L. Avoid a sharp rise and fall of a liquid level in the tank.

3. Before operation

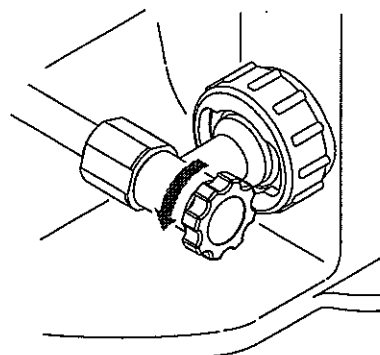
Check every joint for a leak. Hold tubing so as not to move around along with pulsation.

4. Start the pump

Rotate the tank outlet knob more than 180(max. 360) degrees from the closed position and then start the pump. Do not run the pump before opening the knob, or the pump may be damaged.

⚠ CAUTION

Do not rotate the tank outlet knob 540 degrees or more from the closed position. Or the knob will come off and chemical liquid may gushes out from the outlet.



Open the knob more than 180 (max. 360) degrees from the closed position.

Operation

1. Operation

⚠ CAUTION

- **Closed-discharge operation is not allowed**

Do not close a discharge line during operation. Otherwise, liquid may leak or tubing may break.

- **Do not run pump dry**

Optimise your system in order for the pump not to run dry. If the pump runs dry for a long period (for more than 30 minutes), the pump head fixing screws may loosen and the pump head & the valve cases may deform by friction heat, causing leak problems.

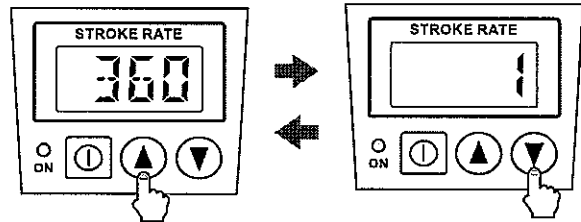
- **Tighten the pump head**

Liquid may leak if pump head fixing bolts are loose. Tighten the bolts evenly to 2.16 N•m in diagonal order before initial operation and at regular intervals.

■ Stroke rate adjustment

Use the UP or DOWN key to adjust stroke rate. spm increases/decreases as pushing the UP/DOWN keys.

Press and hold either key for three seconds for quick change. Quick change stops at 1 or 360spm. 1 or 360spm skips to 360 or 1spm when the key is released and pushed again.

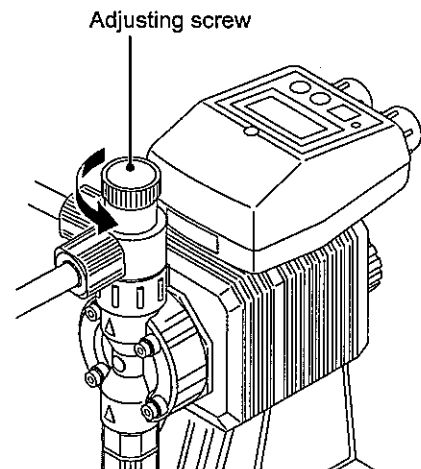


■ Degassing

The gas needs to be expelled from the pump and tubing by degassing. Normal performance can not be obtained with gas in the pump. Conduct degassing when the pump starts to run for the first time or when liquid is replaced in a supply tank.

1. Turn on power.
2. Program a stroke rate to 360spm.
3. Rotate the adjusting screw two revolutions anticlockwise to open the air vent port.
*Do not rotate it three revolutions. Otherwise, liquid may come out from the air vent port.
4. Push the start/stop key and run the pump for more than ten minutes.
5. Rotate the adjusting screw clockwise to close the air vent port.
6. Check liquid is discharged through the discharge line.

*Degassing is required again if the pump does not discharge liquid.



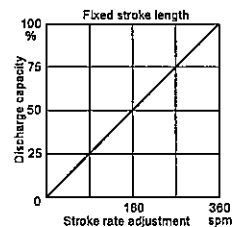
Operation

■ Flow rate adjustment

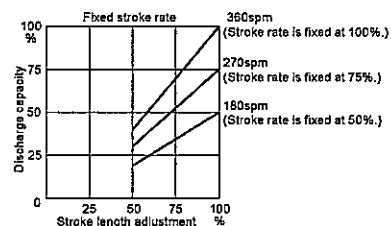
A flow rate can be adjusted by changing a stroke rate and stroke length.

The stroke rate is indicated in spm (stroke per minutes). Stroke rate adjustment is a main way to adjust a flow rate. Stroke length is the moving distance of the plunger. A flow rate per shot can be controlled by changing stroke length. The widest moving distance is defined as 100% stroke length. First adjust a flow rate by stroke rate adjustment. Use stroke length adjustment for the range where stroke rate adjustment can not reach. Determine a suitable stroke rate and a stroke length, taking account of operating conditions and liquid characteristics. The following procedure is recommended.

1. Change a stroke rate in the range of 1-360spm with stroke length of 100%. See the right diagram.



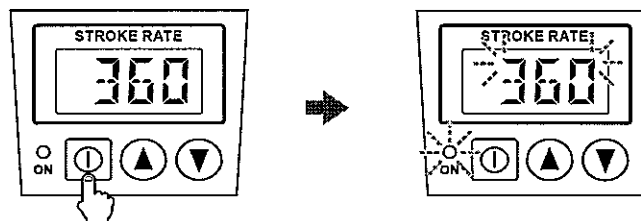
2. Change a stroke length for fine adjustment in the range of 50-100% while the pump is running. See the left diagram



■ Start of operation

Turn on power and push the start/stop key to run the pump. The LED and spm indication blink during operation.

*Push the start/stop key once to enter the wait state in manual mode when "EXT" or ".0"-".360" is on the screen.



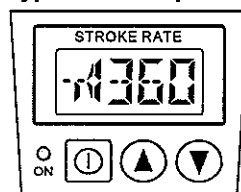
■ Keypad lock

Keypad lock can be active for the prevention of erroneous key operation.

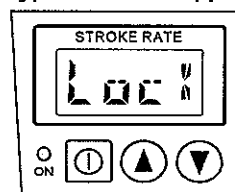
Press and hold the start/stop key for 3 sec to activate/release keypad lock. The following indication appears while keypad is locked.

*Any key operation is not acceptable when the keypad lock is active. In an emergency, turn off the main power to stop operation. In this case, keypad lock state is recalled when the pump is turned on.

Keypad lock in operation



Keypad lock in stoppage



Maintenance

1. Maintenance & Inspection

Make daily and periodic inspection. Upon sensing any danger or abnormality, stop operation immediately and determine the root cause. See "3. Troubleshooting" section.

WARNING

- **Wear protective clothing**
Coming in contact with a harmful chemical liquid may cause eye or skin trouble. Wear protective clothing such as a protective mask, goggles and gloves during work.
- **Turn off power during maintenance work**
Risk of electrical shock. Make sure the power source is turned off and the pump and devices are stopped prior to work.
- **Release line pressure before removing a tube or dismantling the pump,**
Or chemical liquid gushes out. Always use a valve on an air vent line to release pressure.

■ Daily inspection

No.	States	Points to be checked	How to check
1	A supply tank	• If a liquid level is proper.	Visual inspection
		• If liquid hasn't deteriorated.	Visual inspection
		• If tank shape hasn't been deformed.	Visual inspection
2	Pumping	• If liquid is pumped.	Flow meter or visual inspection
		• If the suction and discharge pressure are normal.	Check specifications.
		• If liquid hasn't deteriorated, crystallized or settled.	Visual inspection
		• If abnormal noise or vibration doesn't take place.	Visual or audio inspection
3	Air ingress from pump head joints and a suction line	• If leakage hasn't occurs. • If pumped liquid includes air bubbles, check lines for leakage and retighten as necessary.	Visual or audio inspection

■ Periodic inspection

Retighten the pump head mounting bolts evenly to the following torque in diagonal order.

*Mounting bolts may loosen in operation. How fast the bolts start to loosen is depending on operating conditions.

Tightening torque

Model code	Torque	Bolts
EHN-B11	2.16 N·m	M4 Hex. socket head bolt

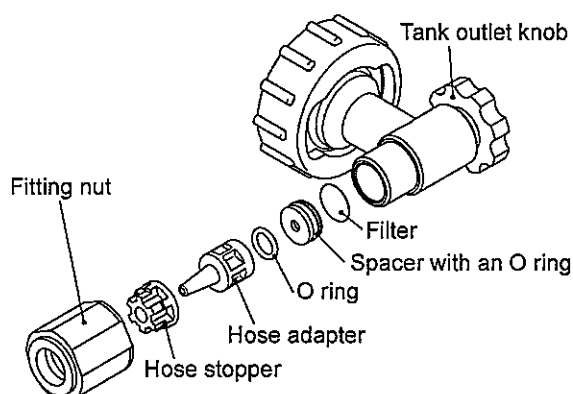
■ Before leaving the pump and the tank stopped for long time

- Run the pump with clean water or cleaning liquid for about 30 minutes.
- Turn off and cover the pump & the tank to protect them from dust or corrosive gas.
- Check for poor liquid volume in the tank, line disconnection or miswiring when resuming operation.

Maintenance

2. Filter cleaning

Take apart the tank outlet unit and clean an internal filter to prevent clogging.



1. Stop the pump and close the tank outlet knob.

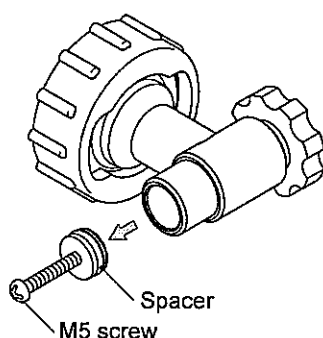
Remove the fitting nut and take out the tube.

⚠ CAUTION

Wear protective clothing such as a protective mask, goggles and gloves along with chemicals to be handled.

⚠ CAUTION

Do not remove the whole tank outlet unit from the tank body.



2. Remove the hose adapter. Use a 20mm length M5 screw to catch and pull out the spacer in the unit.

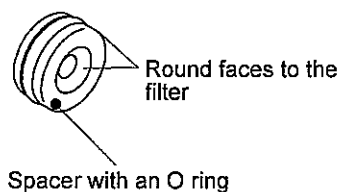
3. Take out the filter and clean it with water.

⚠ CAUTION

The filter is flimsy. Handle it with care.

⚠ CAUTION

Dry off the filter after cleaning.



4. Attach the spacer.

a. Do not forget to fit the filter and O ring.

b. Always fit the filter onto the round surface of the spacer.

Maintenance

3. Troubleshooting

Upon sensing any danger or abnormality, stop operation immediately and determine the root cause.

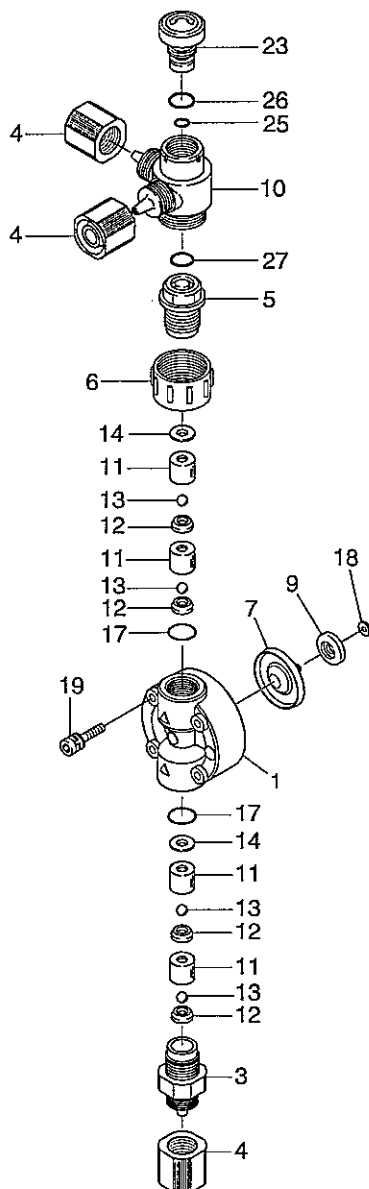
If you can not find out the root cause of failure, contact us.

Trouble	Cause	Troubleshooting
The pump does not run.	• Power voltage is too low. • The pump is not powered. • An electronic circuit in the control unit is failed.	◦ Observe the allowable voltage range of 90-264VAC. ◦ Check power is supplied to the pump. ◦ Replace the control unit.
Liquid can not be pumped up.	• Tank outlet knob is closed. • Tubing is disconnected. • Liquid volume in the tank is too low. • Filter clogging • Air lock in the pump • A valve set is installed upside down.	◦ Open the knob. ◦ Secure every tube joint. ◦ Replenish the tank. ◦ Clean the filter and tank. ◦ Expel air. ◦ Reinstall the valve set.
Discharge capacity is too low.	• Tank outlet knob is almost closed. • Filter clogging • Crushed tube • A leak from tubing • Air ingress • Diaphragm is broken.	◦ Rotate the knob anticlockwise 180° (max. 360°) from the closed position. ◦ Clean the filter. ◦ Correct a crushed area. ◦ Replace tubing. ◦ Expel air. ◦ Replace diaphragm.
Liquid leaks.	• Clogging or jamming of tubing by foreign matters • Loose fitting nut • Degraded or scratched tubing • O ring is out of place. • The pump head is mounted loose.	◦ Take apart and clean tubing. ◦ Tighten the nut. ◦ Replace damaged tubing. ◦ Refit the O ring or replace with new one. ◦ Retighten the pump head to 2.16N•m.

Maintenance

4. Exploded view

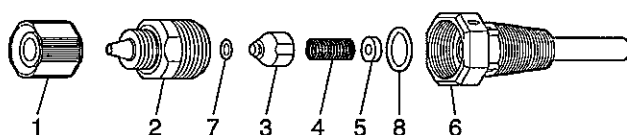
■ Pump head



No.	Part names	# of parts
1	Pump head	1
3	Fitting	1
4	Fitting nut	3
5	Air vent body B	1
6	Lock nut	1
7	Diaphragm	1
9	Retainer	1
10	Air vent body A	1
11	Valve guide	4
12	Valve seat	4
13	Valve	4
14	Valve gasket	2
17	O ring	2
18	Diaphragm spacer	*
19	Hex. socket head bolt [PW•SW]	4
23	Adjusting screw	1
25	O ring	1
26	O ring	1
27	O ring	1

*The number of diaphragm spacers varies with pump model.

■ Check valve



No.	Part names	# of parts
1	Fitting nut	1
2	Valve case	1
3	Poppet	1
4	Spring	1
5	Spacer	1
6	Valve fitting A	1
7	O ring	1
8	O ring	1