LG
Life's Good

Creating
Value for customer

Safety Issues

A user should observe the safety notices such as "Danger", "Warning", "Caution" marked on the product itself and a manual for safety.

Safety notice consists of "Danger", "Warning", "Caution" and its meaning is as follows.

Danger It means that death or severe injury will result if proper precautions are not taken.

Warning It means that death or severe injury can result if proper precautions are not taken.

Caution It means that personal injury or property damage can result if proper precautions are not taken.

The meaning of pictogram marked on product is defined below

It reminds a user of potential danger in operation. A user should carefully read and follow the indication to prevent danger.

It represents a possibility of electric shock under specific circumstances.

Warning

Electric danger.
Any contact can cause an electric shock or a burn.

Cut off the power when repairing.

Warning Label Attachment Location : Label.ppt

⚠ Warning

Installation) **1. Put to earth as specified.**

It causes an electric shock.

2. Do not modify any circuit.

It causes malfunction or damage on the electrical part.

3. Do not modify wiring or devices inside control unit.

It causes malfunction and a fire, thus product quality can not be assured.

4. Do not install a product under bad exhaust and high humidity.

It causes explosion or reduces the life of product.

5. Use a prescribed bolt/nut and gasket when connecting a flange.

It causes explosion and a fire.

6. Do not place a product at a slanted site.

It causes an upset.

7. Use a rated crane when moving a product.

It causes a drop.

Operation) **8. Do not disconnect a flange during the operation.**

It causes explosion and a fire

9. Do not touch a Generator and Hot water Line during operation.

It causes an injury.

Maintenance) **10. Cut off the power of all the control units which are connected to the control unit of this company.**

It causes an electric shock.

11. Turn the power off when replacing vacuum pump V belt and Fan.

It causes a cutting.

Installation, maintenance)

12. Do not ride on a product while transferring.

It causes a fall.

Operation, maintenance, inspection)

13. Only a qualified person does exercise operation maintenance and inspection.

Otherwise it causes an injury or electric shock.

⚠ Warning

Installation) 1. Connect interlock wiring to operate cooling/chilled water pump during operation/stop of the chiller, which prevents freezing.

It causes damage to the machine.

2. Do not inflict a shock on sensor, gauge, switches and manometer.

It causes malfunction of electrical parts and damage to the machine.

3. Check a circuit diagram when practicing interlock wiring and electric wiring.

It causes damage to the machine or abnormal operation of sub-system.

Operation) 4. Do not modify the setting of safety device, damper, valve and so on without approval of this company.

It causes malfunction of electrical parts and damage to the machine.

5. Do not operate machine with wet hands.

It causes electric shock.

Installation, operation)

6. Be acquainted with a handling guide before operation.

It causes malfunction of electrical parts and damage to the machine.

7. keep the environment within a using condition.

It causes malfunction of electrical parts and damage to the machine.

8. Check the power source.

It causes malfunction of electrical parts and damage to the machine.

Repairing) 9. Stop the machine when repairing.

It causes electric shock, burn, cutting and damage to the machine.

10. Use a qualified goods when replacing parts.

Overheated control unit causes fire or malfunction.

Installation, repairing)

11. Do not mount on the machine. It causes a slip and a fall. And stepping on fragile parts, for example copper piping, can cause a serious problem.

It causes a fall and damage to the machine.

12. Use a specified torque when fastening a bolt and a screw.

It causes overheat, fire and damage to the machine.

Inspeciton) 13. Analyze the water quality at regular intervals.

It causes damage to the machine.

Storage) 14. Even if the smallest quantity of air gets in, it causes serious corrosion.

It causes damage to the machine.

Caution

Be very cautious of instructions below. Otherwise it causes damage or failure to the chiller.

(1) Delivery and installation

1. Use a proper method depending on a product weight. Otherwise, it causes damage to the product.
2. Do not install a machine at a slant site.
3. Observe the specification in the user guide when installing.
4. Do not operate the machine equipped with damaged parts, even after completing installation.
5. Do not get close while delivering a product.
6. Do not place anything prone to firing (a stove) near a product.
7. Do not put screw, metal and any combustible material, such as water and oil inside a control unit.
8. Do not drop nor inflict an impact on precision parts such as sensor, gauge and switches.

(2) Wiring

1. Connect power input terminal(R, S, T) in a specified order.
2. Connect output teminal (U, V, W) of pump motor in a specified order.
3. Separate input signal from output signal.

(3) Setting for trial operation

1. Verify every setting value before operation. In some case it is necessary to modify setting depending on load.

(4) Usage

1. In case of scheduled operation, be aware that operation is automatically resumed after stopping.
2. Power is applied inside control unit even when the stop key is operating. Thus use cut-off switch on front side in emergency.
3. Do not alter the inside of a product.
4. High frequency noise generated in control unit can affect peripheral devices. Use a noise filter to reduce jamming.
5. Install a reactor in case of voltage unbalance.
6. Set parameters necessary for operation once again when initializing setting values. Initialization sets the value to that of manufacturer.

(5) Troubleshooting

1. Refer to Chapter 11 for troubleshooting.
2. A machine can be put into a dangerous state under the uncontrollable situation caused from a damaged MICOM. Install additional safety device, for example, emergency stop switch to avoid this situation.

(6) Maintenance and replacement

1. Refer to chapter 14 for regular maintenance (replacement timing).

(7) Disposal

1. Handle absorption solution as an industrial waste.

(8) Care/storage

1. Refer to chapter 10 for nitrogen filling and discharging.

Table of content

1. Absorption principle

Vacuum maintenance is essential for an absorption chiller since it works in a high-end vacuum state.

1-1 Chilled water generation

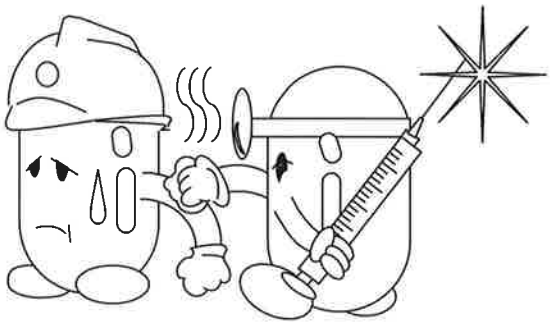
An absorption hot and chilled water generator is a chilled water generating device that uses water (H_2O) as refrigerant and lithium bromide (LiBr) solution as absorbent.

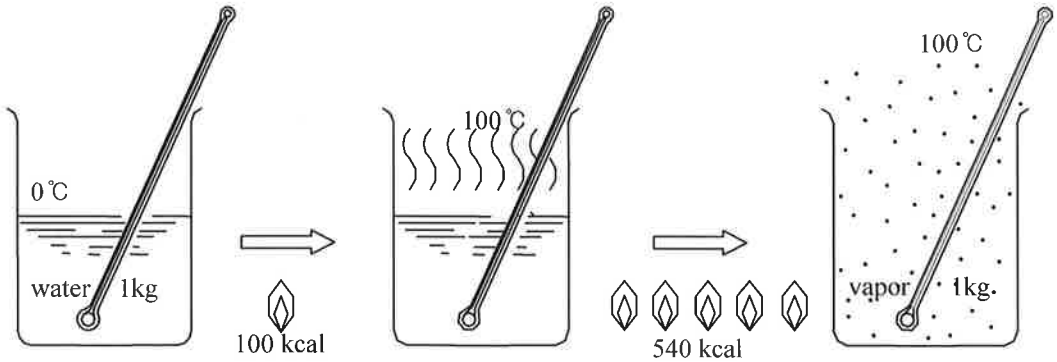
It uses a heated refrigerant vapor for cooling.

When rubbing alcool on the skin after injection, it is getting cooler. Because alcohol takes heat off the skin when being evaporated.

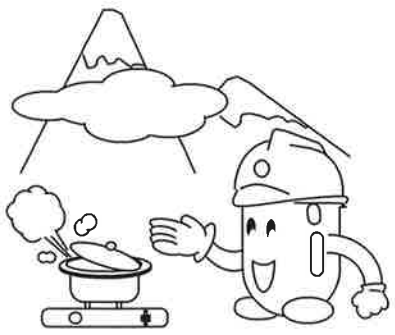
100kcal is needed to heat water 1kg (1ℓ) from 0℃ to 100℃ and this is referred to as sensible heat.

On the other hand, 540kcal is needed to evaporate 1kg (1ℓ) water at 100℃ and this is referred to as latent heat of vaporization.



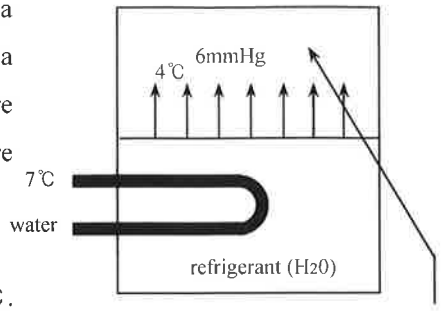


As shown above, using heat of vaporization rather than sensible heat, generated from 1kg (1ℓ) water, can transfer much more heat capacity. And water is normally evaporated at 100℃ but it can be evaporated at a lower temperature when air pressure is lowered. It is why rice is half-cooked on a high mountain.



For example, water is evaporated at around 88℃ on top of a mountain. However the lower air pressure is, the higher a mountain is. Under pressure of about 1/100 air pressure (absolute pressure 6mmHg-air pressure is absolute pressure 760mmHg), water is evaporated at about 4℃.

In this case, heat of vaporization is 588kcal per 1kg of water. Using water as refrigerant produces chilled water at 7℃. Putting refrigerant (water) inside a sealed container and adjusting inside pressure to 6mmHg (that is, only vapor pressure works), refrigerant is evaporated at 4℃ and chilled water is produced by passing water through air. (this container is called evaporator)



Pressure inside a container is getting up, as refrigerant is evaporated.

Figure 1-1 cooling principle (evaporator)

However, inside pressure rise up due to refrigerant vapor, then accordingly refrigerant can't be evaporated at 4℃ and water temperature, after passing through air, gradually rise.

Thus, to produce chilled water of 7℃, refrigerant should be always evaporated at 4℃. For this, pressure inside a container has to be maintained at6mmHg and evaporated refrigerant is to be taken out of a container. For repeating this procedure, a container, which absorptive material, is connected, then it absorbs refrigerant vapor and finally pressure inside a container can be maintained to 6mmHg. As absorbent, 「**Lithium Bromide**」 (LiBr) solution is used. (this container is called "absorber") LiBr solution is a very powerful absorbent, however, absorptive capacity increases under a higher density or a lower temperature.

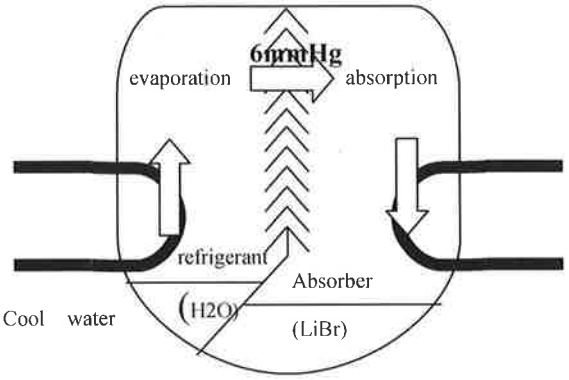


Figure 1-2 Evaporator and absorber

Absorptive capacity can be represented in saturated vapor pressure and the relation between saturated vapor pressure, density and temperature of absorption solution can be represented in duhring diagram as shown in figure 1-3.

1. Saturated vapor pressure is a value representing evaporation level, which is proper depending on a material state. Neither evaporation nor condensation occurs when vapor pressure is lower than a saturated vapor pressure around it. (in this case, relative humidity of air is 100%) on the contrary, water is condensed when vapor pressure is higher than a saturated vapor pressure around it. (dew on a window, for example) In general, the easier evaporation is, the higher saturated vapor pressure is (alcohol) to the contrary, the more difficult evaporation is (that is, the easier condensation is) , the lower saturated vapor pressure is.

Duhring diagram

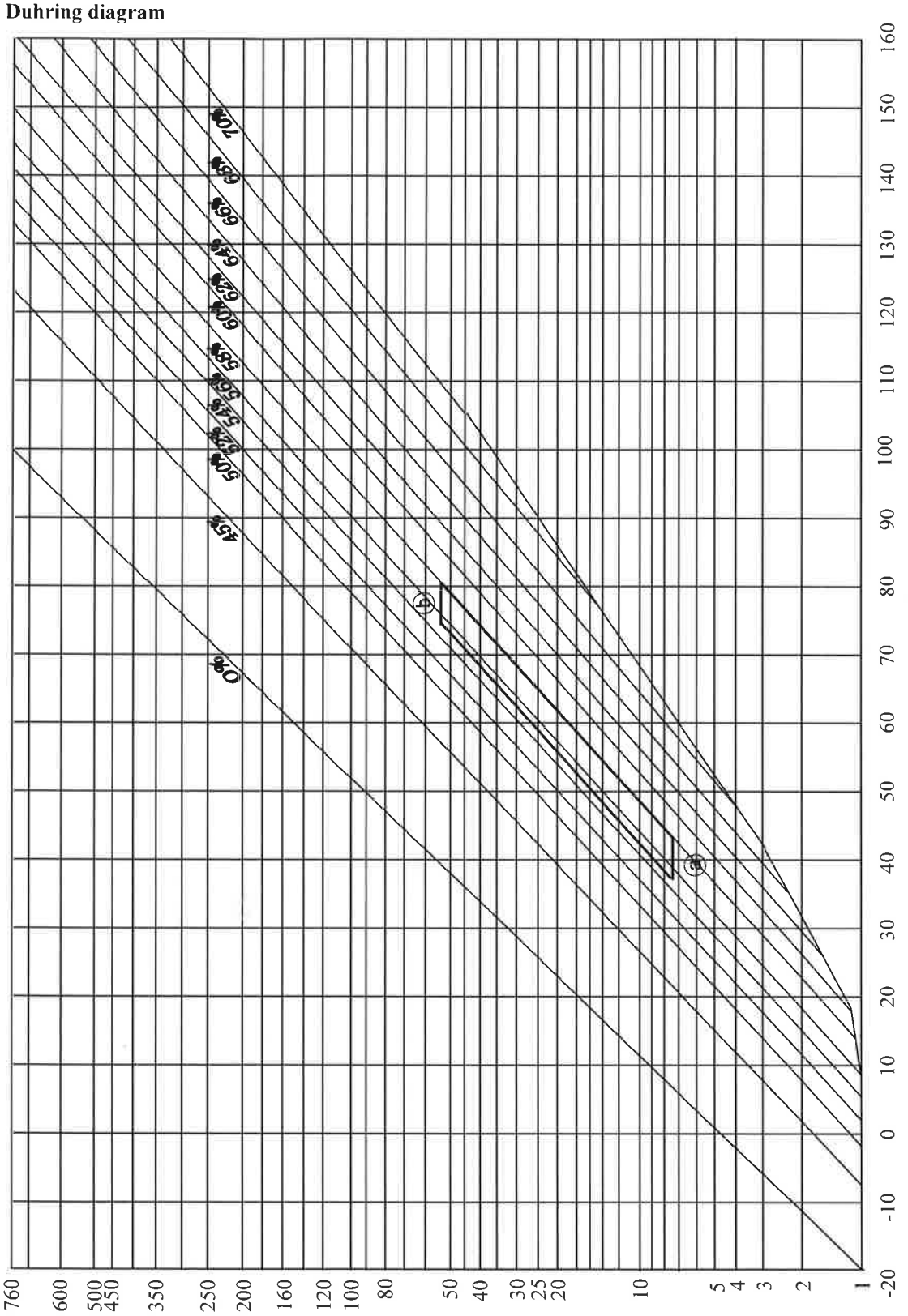


Figure 1-3 Duhring diagram

In the diagram, temperature is represented on horizontal axis, pressure is represented on vertical axis and the first line from the left represents density 0% of LiBr, that is water state. Saturated pressure of water at 4℃is 6mmHg as shown in During graph. That is to say, water at 4℃is evaporated under pressure of 6mmHg.

For absorbing vapor of this 6mmHg pressure, saturated vapor pressure in absorption solution is maintained lower than that. For example, temperature must be maintained less than 18℃ for aqueous solution of 45% density and absorbent liquid of more than about 50% density is needed to maintain temperature at 24℃.

When evaporated refrigerant is absorbed at 4℃, absorbent liquid gives off heat, thus temperature of absorbent liquid rises and absorptive capacity is weakened. Therefore to prevent this, absorbent liquid is cooled with cooling water. This absorbing heat is almost paralleled with heat of vaporization.

That is, heat of cooling water is delivered to refrigerant vapor in evaporator, refrigerant vapor to absorbent liquid in absorber and absorbent liquid to cooling water.

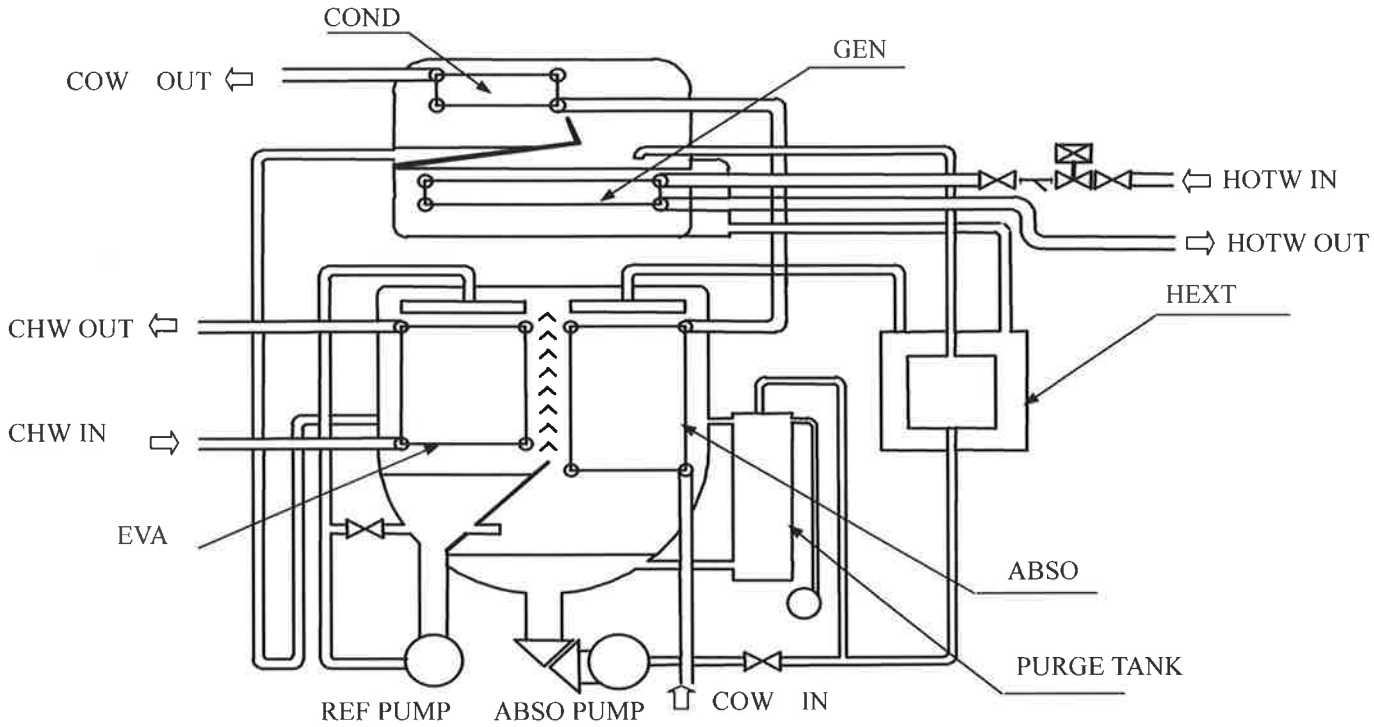


Figure 1-4 basic cycle of absorption chiller

As absorption solution absorbs refrigerant, its density is lowered and thus absorptive power is weakened. For recovering weakened liquid, absorption solution is transferred to somewhere else and heated to evaporate refrigerant. (it is referred to as "regenerator") when absorption solution, condensed by evaporating refrigerant returned to absorber, circulation 『Cycle』 is completed and cooling effect continues.

On the other hand, refrigerant vapor generated in regenerator is transferred to another container, then cooled and condensed by cooling water, producing refrigerant liquid as a result, and finally sent to

evaporator completing circulation 『cycle』 of refrigerant.

It is also efficient to install a heat exchanger that exchanges heat between condensed absorption solution heated in a regenerator and low-condensed absorption solution cooled in absorber.

Figure 1-3(duhring diagram) shows absorption solution change of our absorption chiller.

ⓐ is the area in which refrigerant vapor is absorbed in an absorber, resulting in a low density.

- Cooling effect is gained by keeping the pressure of evaporator low.

ⓑ is the area in which generator evaporates refrigerant, then condensing absorption solution.

- Thus external heating source is needed.

ⓒ is the area in which absorption solution is concentrated using refrigerant vapor as a heating source, generated in a generator, in a low-temperature generator..

- Thus no external heating source is needed.

Since even generator, which has the highest internal pressure, works in less than air pressure of 760mmHg, absorption chiller is safe and requires no qualified person. But it consists of a high-end vacuum container and furthermore 1/100 of air pressure must be maintained in an evaporator and an absorber. In addition, the pressure has to be maintained solely with vapor pressure. If even the smallest quantity of air gets in, then internal pressure rises, resulting in disrupting the cooling effect. And 『Lithium Bromide』 solution gets corrosiveness when it is mixed with oxygen, therefore air infiltration has a bad influence on the life of a machine. So 'Purge', explained later, is very important when handling absorption chiller.

1-2 Nature of absorption solution

Absorption chiller uses a solution of 『Lithium bromide』 (LiBr) as absorption solution. 『Lithium bromide』 (LiBr) is a compound of 『alkali』 metal Lithium(Li) and 『halogen』 Brom(Br), similar to salt(NaCl), its absorptive power is strong, and it, as very stable material chemically, doesn't change in the air, such as resolution, volatility. When mixed with oxygen, it gets corrosiveness on metal but this is not as much as salt.

1)Absorption

Its absorptive power is very strong as described in chilled water generating principle. And its saturated vapor pressure is reasonably low, thus proper for absorption chiller that uses water as refrigerant.

2)Specific heat

Specific heat of 『Lithium Bromide』 (LiBr) of about 60% density is about half of water. It means a smaller heat capacity is needed to raise the temperature of 『Lithium Bromide』 liquid. It is essential for the efficiency of chiller.

3)Specific weight

Specific weight of a solution of 『Lithium Bromide』 (about 60% density) is much greater than that of water(1.0). (about 1.7 times) specific weight is determined by liquid density and its density can be found from the figure 1-7 duhring diagram, measuring temperature and specific weight of absorption solution.

4)Corrosiveness

When 『Lithium Bromide』 is mixed with oxygen, it has corrosiveness. But there is almost no room for oxygen, for absorption chiller is a vacuum container.

Because corrosiveness inhibitor is added in absorption solution and alkali level is adjusted for safety, handling absorption solution requires much attention and regular chemical analysis is practiced to maintain the amount of addition.

5)Nature of absorption solution depending on temperature and density

Absorption solution has an inverse relation between temperature and density. The lower temperature is, the more powerful absorption force is and the higher temperature is, the less powerful absorption force is.

The higher density is, the more powerful absorption force is and the lower density is, the less powerful absorption force is.

And both states have an influence on crystallization. Crystallization is a phenomenon in which absorption solution becomes something like jelly or salt. The higher density is, the easier crystallization is and the lower density is, the more difficult crystallization is. On the other hand the lower temperature is, the easier crystallization is and the higher temperature, the less easier crystallization. This nature has a close relation to the efficiency and performance of absorption chiller and also to crystallization.

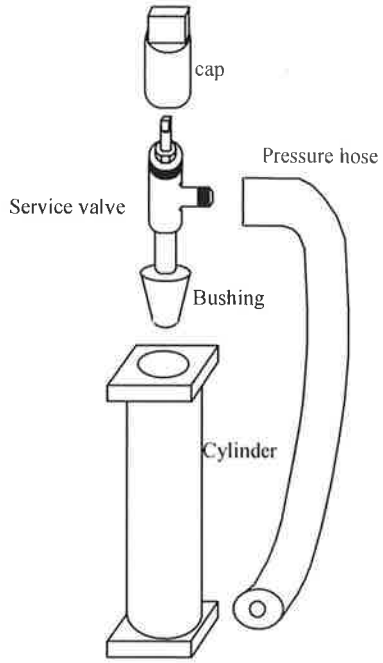
Therefore absorption solution works the best under proper density and temperature. That is, heat capacity of fuel, which has a direct influence on temperature and density of absorption solution, flow or temperature of cooling water is maintained in a proper state. Emergency stop is needed in Dilution operation or abnormal working due to this nature. And crystal resolution is performed

based on this nature. Crystal resolution will be explained in a proper section.

1-3 Measuring absorption solution density

1) Measuring instruments

1. Extracting cylinder
2. A hydrometer(ranging 1.0 ~ 1.8)
3. A thermometer(0 ~ 100℃)
4. Density curve of a solution of Lithium bromide (refer to the figure1-7)
5. Absorption solution and refrigerant



2) Procedure

1. Assemble extracting cylinder, pressure hose and service valve.
2. Connect pressure hose to service valve (lower part of manometer service valve) of extracting device and put extracting pump into operation so as to make a vacuum state inside cylinder.
3. Make the inside of cylinder into vacuum state by opening service valve.
4. Maintain vacuum state bending pressure hose when pulling the hose out of service valve.
5. Connect the end of hose to service valve of solution to measure (diluent solution–discharge part of absorption solution pump, intermediate solution–heat exchanger, a thick solution–heat exchanger).
6. Extract a solution from the cylinder.
7. Extract about 80% of solution from the device into extracting cylinder. (be very cautious so as to prevent air from getting in, when extracting solution.)
8. Remove service valve on the upper part of cylinder after closing a service valve.
9. Measure temperature and specific weight putting hydrometer and thermometer in the cylinder. (be very cautious not to get burn when measuring a thick liquid and intermediate liquid, that are very hot)
10. Store the solution measured in an empty container.
11. Search density line, referring to temperature and specific weight, in density curve of Lithium Bromide.
12. Clean the instrument in water after measuring.

3) Caution

Be very cautious not to break the fragile hydrometer and thermometer.

Do not throw away the solution on the floor and store it in a clean container instead.

Measure both specific weight and temperature at the same time to avoid an error.

Be aware of the fact that the smallest quantity of air causes corrosiveness. Practice purge immediately when air gets in.

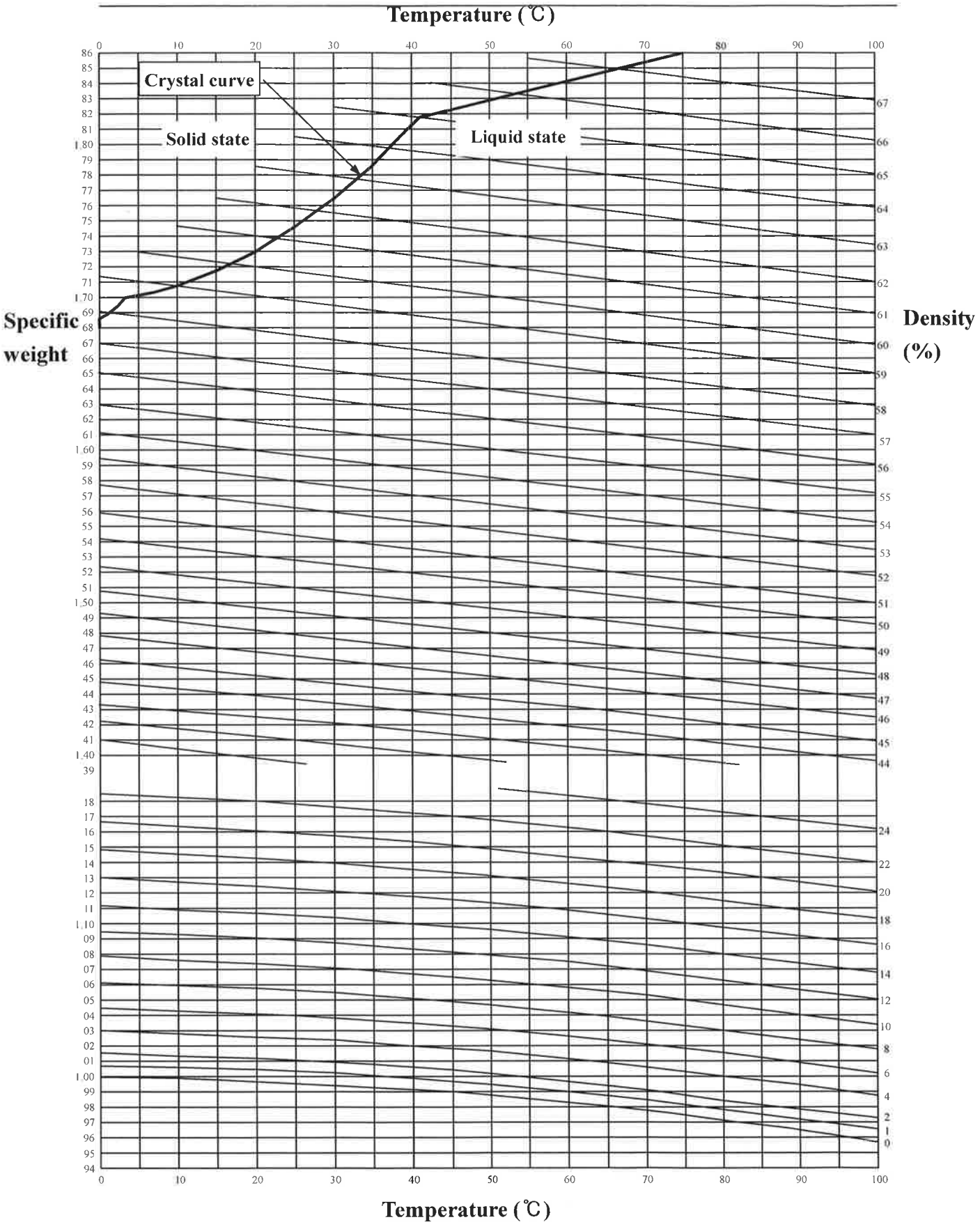


Figure 1-7.Density curve of absorption

1-3-1 Safety issues for absorption solution handling

1. Emergency fundamentals

①Do not inhale dust or powder.

②Do not touch it with eye, skin or clothes.

③Seal a storage container firmly.

④Wash yourself thoroughly after handling.

⑤Use it at a well ventilated place.

2. Emergency measures

1) Skin contact

①Take off contaminated clothes and shoes immediately.

②Wash the contact part with soap or light detergent and a bulk of water until no chemical material remains.

2) Eye contact

①Wash eyes with a bulk of water or a solution of salt.

②Pull an upper and lower eyelid out and wash inside the eyelid until no chemical material remains.(at least for 15~20 minute)

3) Intake

①Lay the head lower than the body to avoid suffocation when a user vomits.

②Give proper treatment depending on the symptoms.

③Give medical treatment if necessary.

3. Handling and storaging

Observe the rule related to environment law when storaging this material.

4. Safety and reactivity

It is stable under the room (normal) temperature and pressure.

5. Disposal of waste

Observe the rule related to environment law when scavenging.

6. Related law

①industrial safety and health act: not enactive

②harmful chemical material handling act : not enactive

③the fire service act: not enactive

2. Exterior view and parts of absorption chiller

2-1 Main body

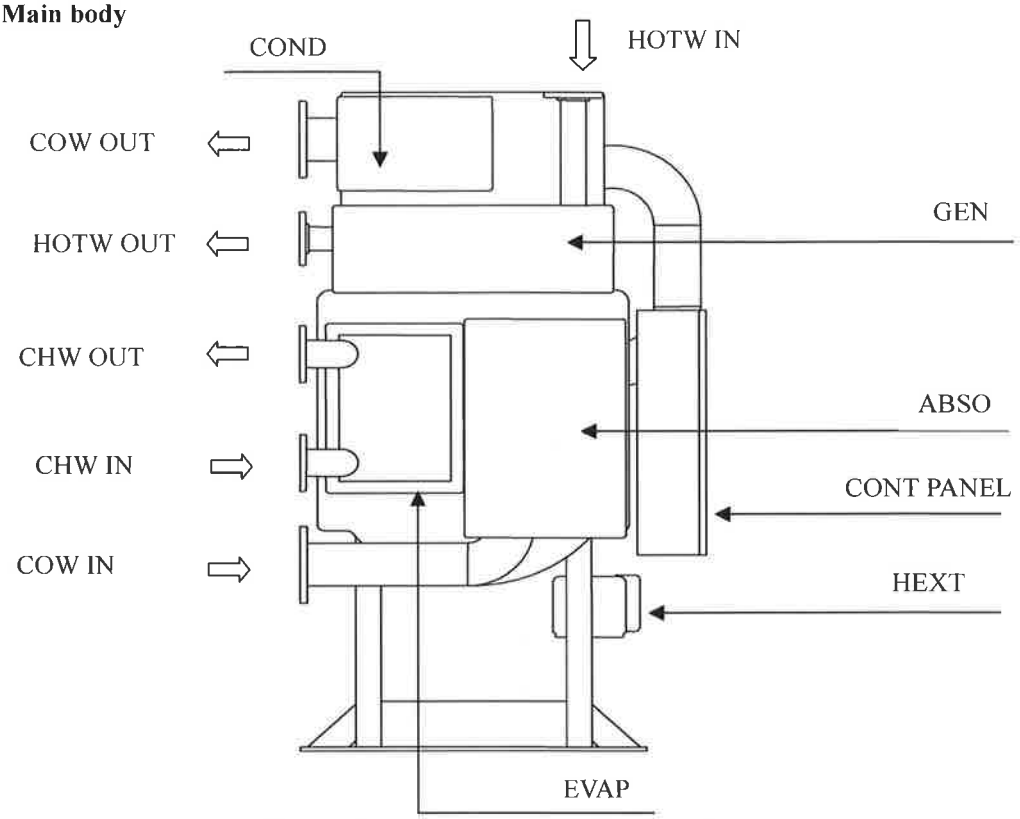
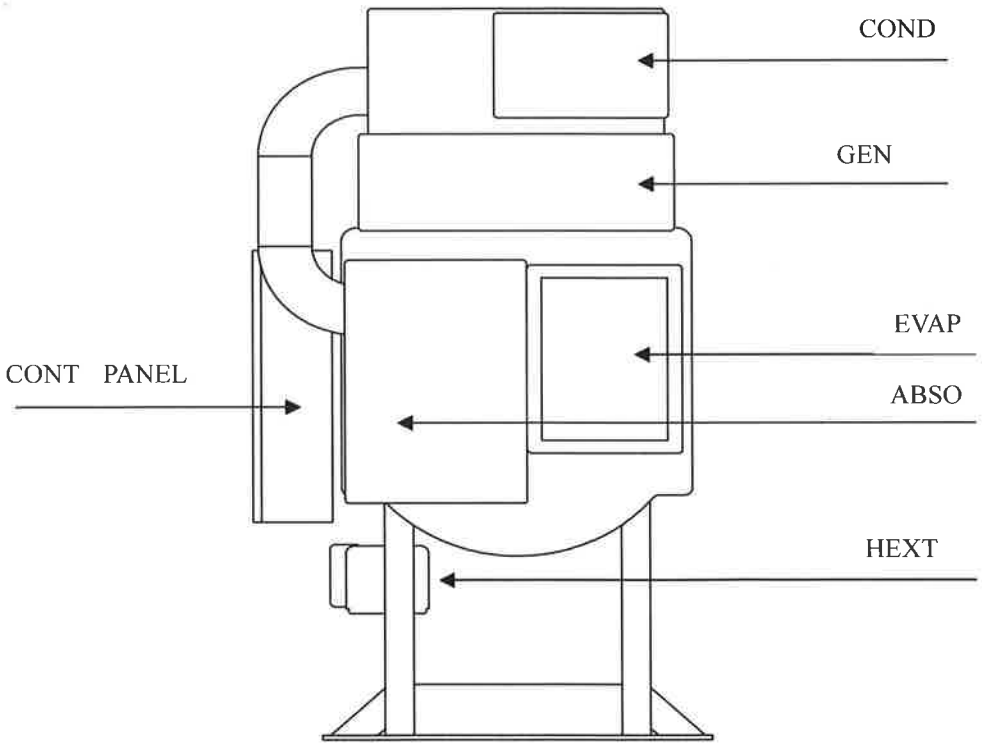
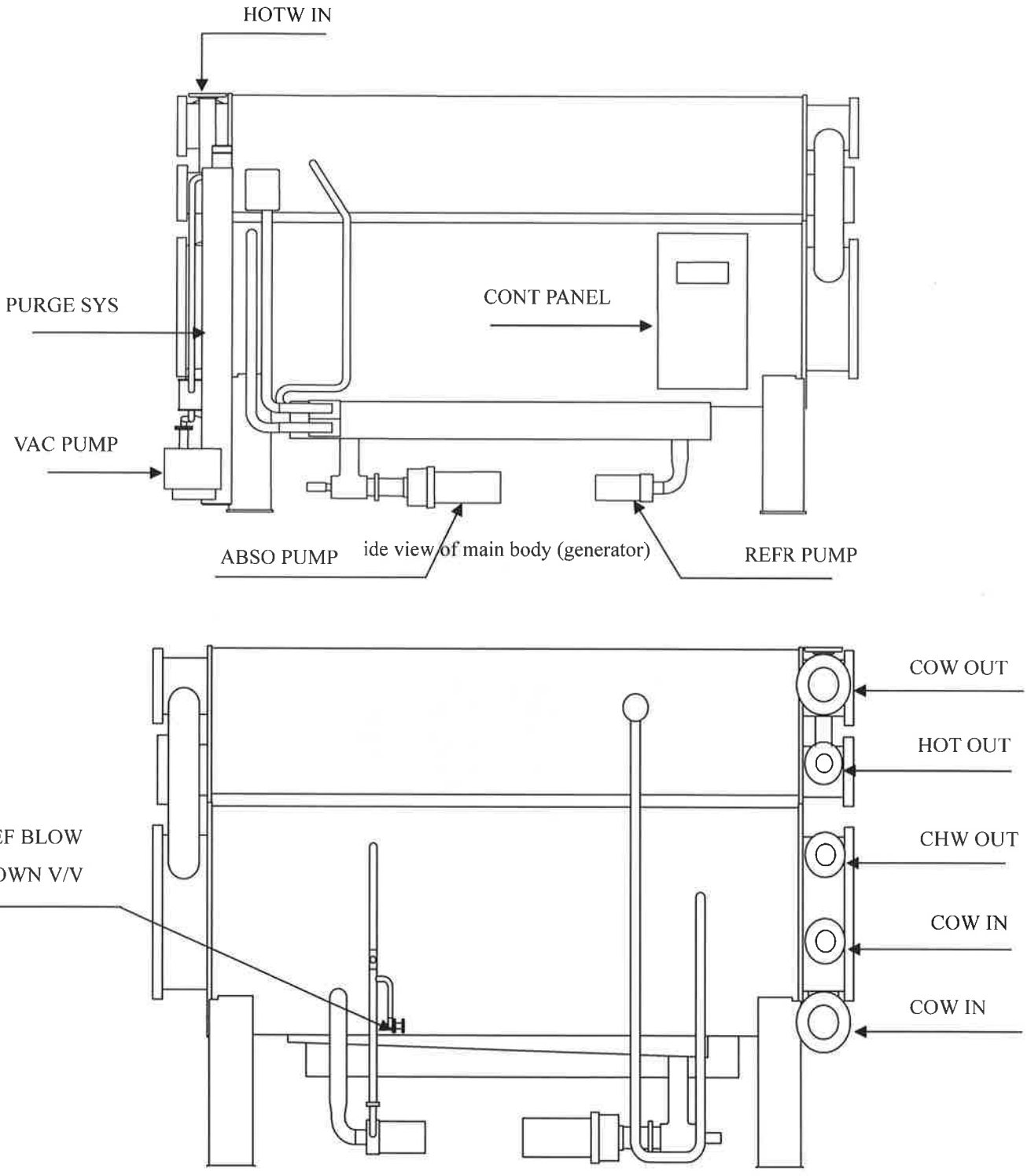


Figure 2-1 Front view of main body

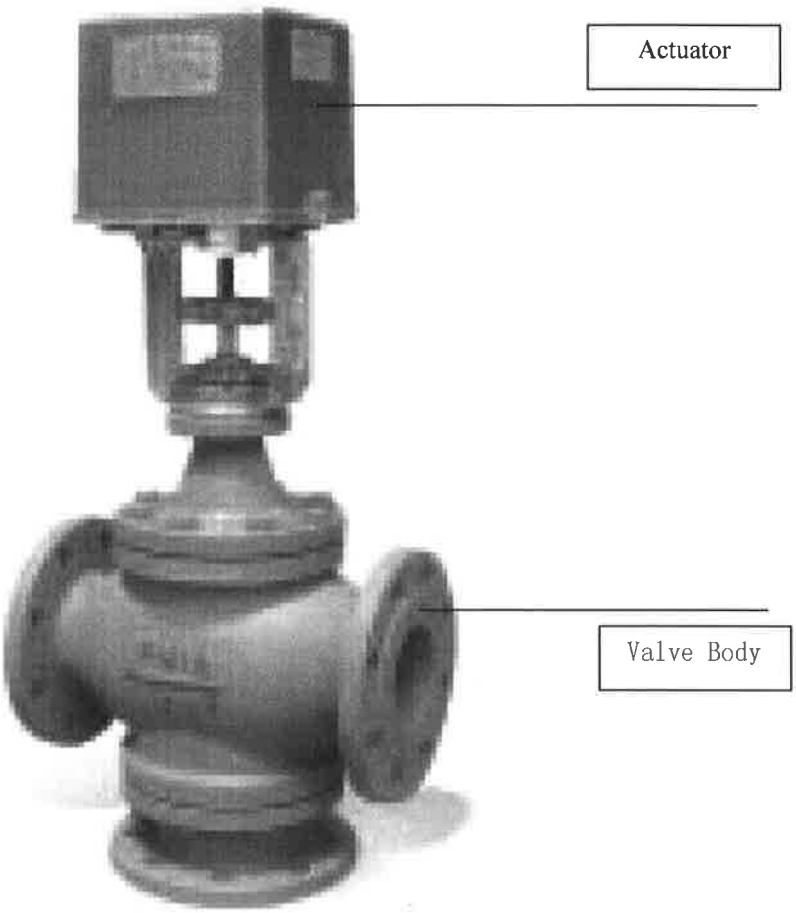


2-2 Main body (side view)



※The arrangement and quantity of parts can vary depending on the model or customer's demand.

2-3 Absorption chiller- Hot Water Control Valve (Beijing ACT M & E Technology Ltd, Co.)



※ The exterior view and arrangement can vary depending on the model.

3. Structure and principle of absorption chiller

An absorption chiller can be regarded as an ensemble of heat exchangers.

3-1 Evaporator

An evaporator consists of a tube (copper pipe), a refrigerant tray, a refrigerant pump, a chilled water chamber and an eliminator linked to an absorber. An evaporator is a kind of heat exchanger in which refrigerant is evaporated at 4℃under internal pressure of 6mmHg and then exchanges heat with chilled water.

Refrigerant pump transfers refrigerant remaining at bottom of evaporator to the upper part and refrigerant tray spreads it evenly over an evaporator in bubble shape.

Scattered refrigerant in bubble shape has the maximum evaporation dimension, thus is prone to be evaporated.

Refrigerant is evaporated at 4℃and at the same time takes heat from chilled water in a tube. Chilled water, which is deprived of heat, becomes cooler. And evaporated refrigerant passes through an eliminator, then over to absorber in which it is absorbed in absorption solution. An evaporator repeats this process.

1) Evaporated refrigerant takes heat out of chilled water and latent heat of vaporization moves to an absorber.
2) Refrigerant pump lifts refrigerant left at the bottom in order that refrigerant falls from the upper part.
3) Refrigerant tray spreads refrigerant evenly and makes a bubble shape of large dimension in order that refrigerant is evaporated easily.
4) Eliminator prevents evaporated refrigerant from going over to an absorber and absorption solution from going over to evaporator. Refrigerant is absorbed very rapidly. It prevents refrigerant in liquid from going directly to an absorber and instead allows refrigerant in vapor to go over to an absorber.

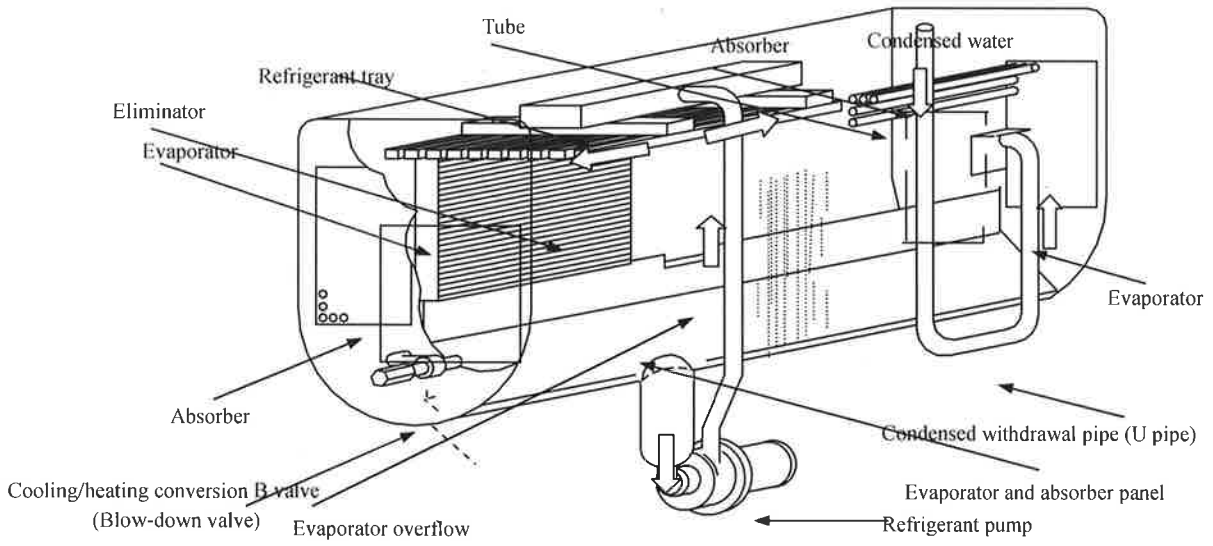


Figure 3-1. Evaporator

3-2 Absorber

An absorber consists of an absorption solution pump, a tray, a cooling water tube and an eliminator linked to an evaporator. An absorber is a heat exchanger in which absorption solution and cooling water exchange heat with each other under the internal pressure of 6mmHg(a high-degree vacuum) as in an evaporator. An absorber drops evenly condensed and low temperature absorption solution from heat exchanger to the absorption solution tray on the upper part of absorber. Scattered absorption solution absorbs refrigerant vapor passing from the evaporator to absorber. Absorption solution, which absorbs refrigerant, becomes watery, and then spreads at bottom and absorption solution pump sends it to a generator via low and high temperature heat exchanger.

1) Absorption solution absorbs latent heat of vaporization (which refrigerant takes from chilled water) and refrigerant vapor.
2) Absorption solution tray spreads condensed absorption solution evenly, then makes it into a bubble shape with the maximum dimension for absorption.
3) Tube of cooling water discharges heat which is generated when absorption solution absorbs refrigerant (latent heat of vaporization which refrigerant takes out of chilled water) and heat generated from generator outside a chiller (cooling tower).
4) Absorption solution pump forces absorption solution to go up from low pressure to high pressure of a pump.
5) Overflow pipe sends absorption solution from low temperature generator to absorber during crystallization or oversupply of absorption solution to low-temp generator to prevent absorption solution from going from low-temp generator to condenser. Specially, this pipe becomes very hot in crystallization. However, oversupply of absorption solution to low-temp generator also makes it very hot. Thus both cases should be considered.

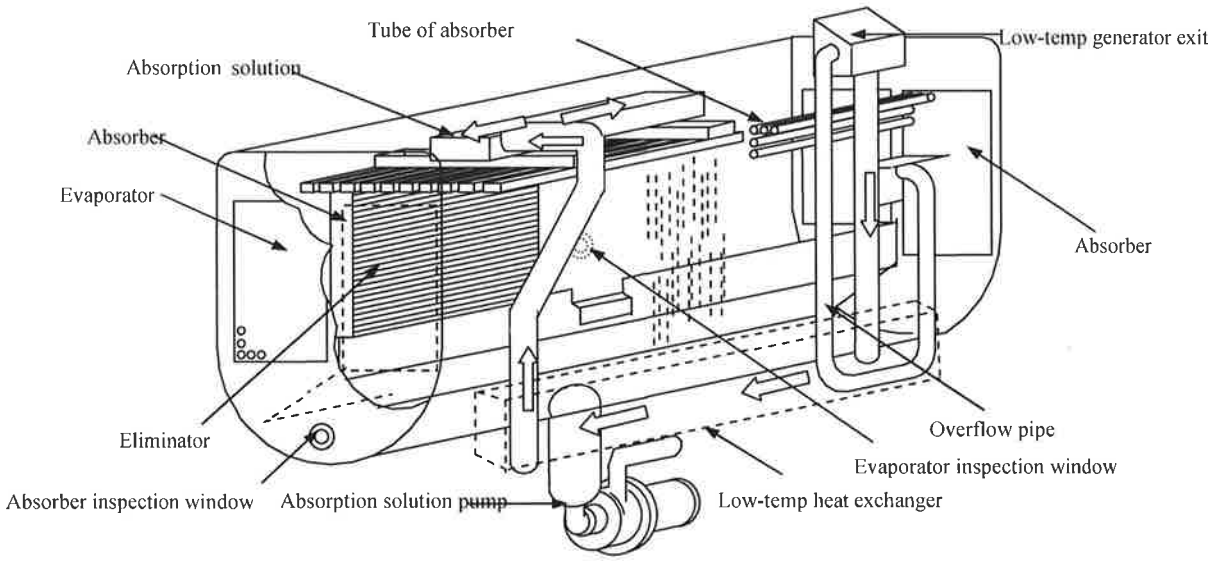


Figure 3 -2. Absorber

3-3 Generator

Low-temp generator consists of a tube and an eliminator connected to a condenser. Absorption solution coming from a generator passes on the surface of a tube exchanging heat with refrigerant vapor, then refrigerant is evaporated and refrigerant vapor, which is transferred from a generator, flows inside a tube, heating intermediate solution. More condensed absorption solution returns to an absorber via a heat exchanger. Refrigerant vapor, which heats absorption solution once again, flows into a condenser by way of an orifice pipe.

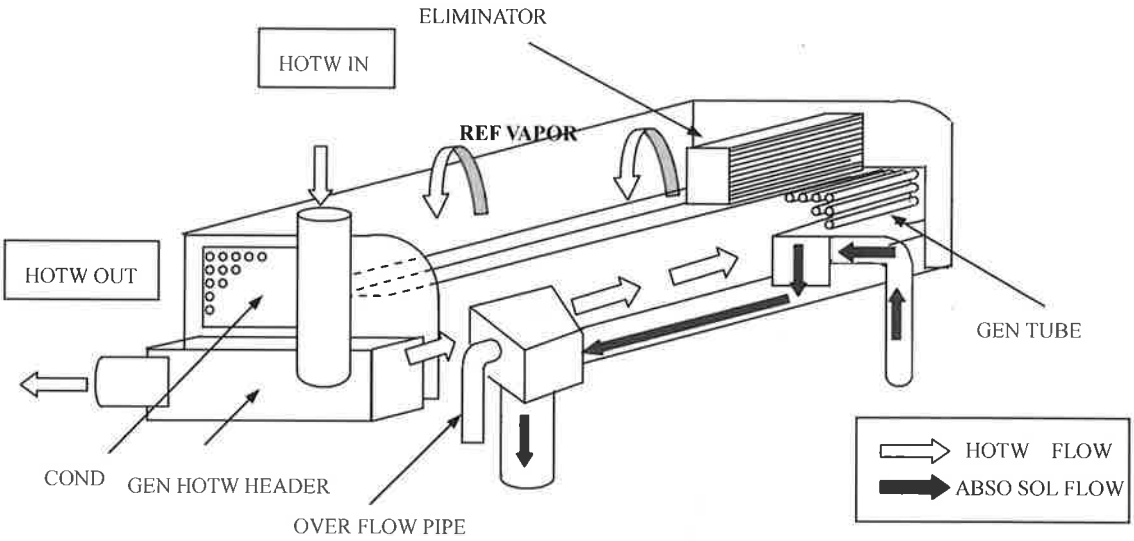


FIG 3-3. GEN(GENARATOR)

3-4 Condenser

A condenser consists of a tube and an eliminator connected to a low-temp generator. A condenser condenses refrigerant vapor coming from a low-temp generator with cooling water. Condensed refrigerant vapor returns to an evaporator.

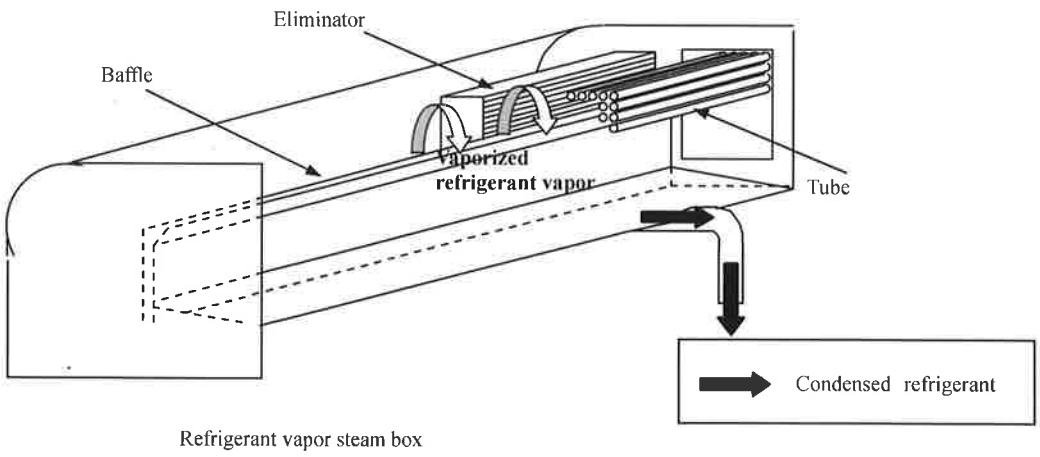


Figure 3-4. Condenser

3-5 Heat Exchanger

Low-temp and heat exchanger each consists of solely a tube. Diluted absorption solution flows inside this pipe, on the other hand intermediate and condensed solution flow outside this pipe. It is a device to increase efficiency to the maximum using absorption solution described earlier. Since absorption solution works the best under a lower temperature, it is necessary to make temperature as low as possible before it returns to an absorber from a generator. On the contrary, since absorption solution works the worst under a higher temperature, temperature of absorption solution should be made as high as possible to separate refrigerant from absorption solution easily. Thus to satisfy both condition at the same time, heat exchange has to be made among low-temp diluted solution, high-temp condensed solution and intermediate solution. It is the role of a heat exchanger. The size and the shape of a heat exchanger can vary depending on the heating surface area and pipe layout.

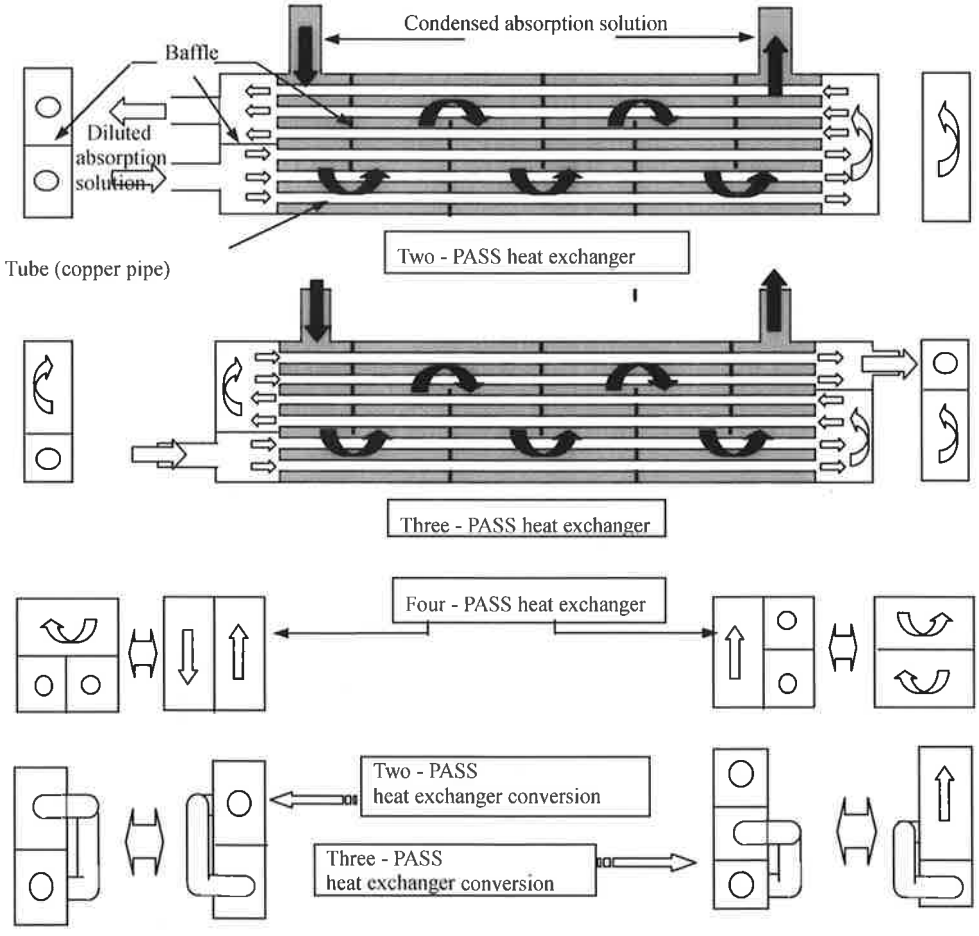


Figure 3-5. Heat exchanger

4. Pipe layout of absorption chiller

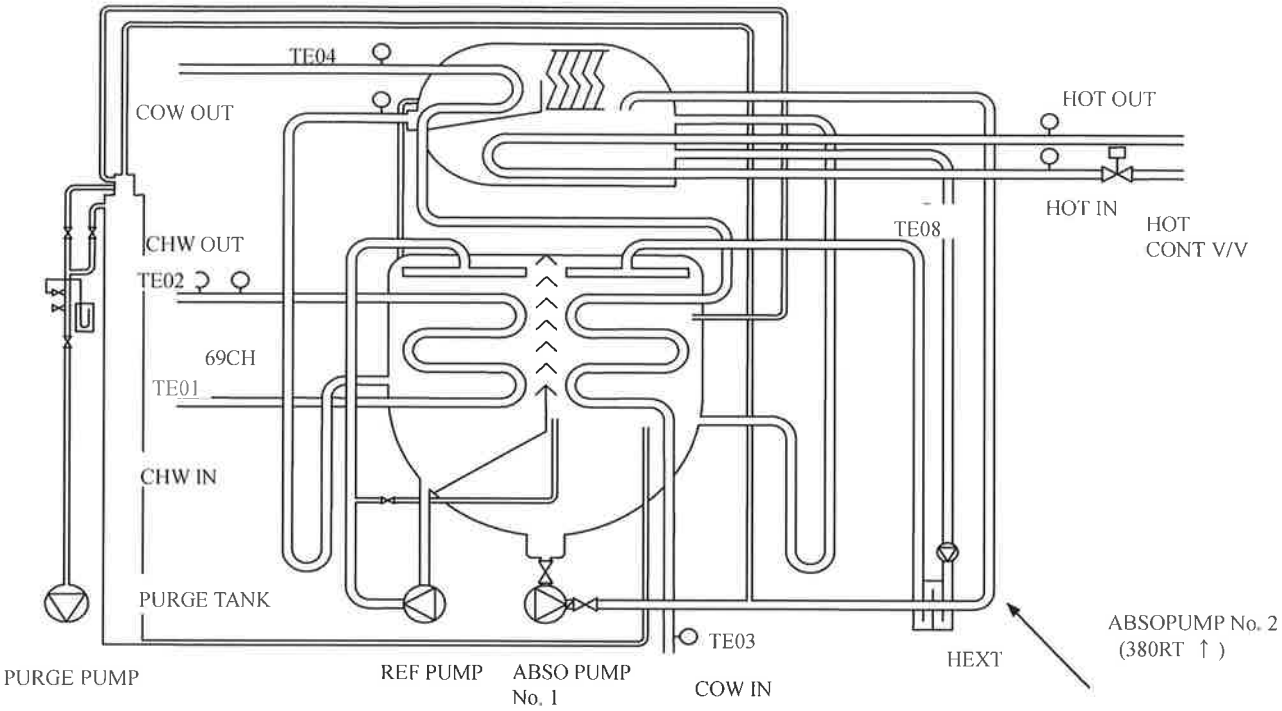


Figure 4-1 Pipe layout of absorption chiller

4-1 Flow of absorption solution in cooling.

Absorption solution drops from a tray on the upper part of absorber onto a tube of cooling water inside absorber and gathers at the bottom, absorbing refrigerant that comes from an eliminator. At this time, absorption solution becomes much more diluted than before it flows onto a tray.

Condensation is about 58% under a normal operation as shown in the duhring diagram. It is called dilute solution. The temperature of dilute solution gathered becomes high(about 120 ~ 130℃) exchanging heat with a low and a heat exchanger, then goes up to a generator. If dilute solution is more heated by heat source in a high –temperature generator, then refrigerant is vaporized out of dilute solution and accordingly its condensation gets higher. Absorption solution, of which condensation is about 61%, is referred to as intermediate solution. This intermediate solution passes by a heat exchanger lowering the temperature of intermediate solution(about 84℃), then goes up to a low-temp generator. Absorption solution is transferred from absorber to generator by the discharging power of absorption solution pump and on the other hand, transferred from generator to low-temp generator by pressure difference between those generators. Pressure of generator is almost 700 ~ 710 mmHg and that of low-temp generator is about 56mmHg as shown in the duhring diagram. By means of this pressure difference, condensed absorption solution in generator is delivered to a low-temp generator. In low-temp generator, hot refrigerant vapor which is separated out of generator passes through a tube, heating intermediate

solution to make it more condensed (about 63%).

It is the most condensed absorption solution and is called condensed solution. Condensed solution returns to an absorber in lower temperature(about 52 ~ 55℃) passing through heat exchanger. Absorption solution flows into an absorber by means of height/pressure difference between low-temp generator and absorber. Absorption solution is circulated absorbing refrigerant again as in this process.

4-2 Circulation of refrigerant in cooling

Refrigerant, which is vaporized in evaporator, cools water in a tube. Vaporized refrigerant is absorbed in absorption solution, then transferred to a generator. If it is heated in generator, then it is separated from absorption solution in the upper part and vaporized refrigerant flows into low-temp generator along a vapor pipe. Vaporized refrigerant flows in a tube as a heat source heating absorption solution, intermediate solution. Vaporized refrigerant heats absorption solution and is condensed into water, refrigerant, at the same time in a low-temp generator. Condensed refrigerant moves to condenser, then returns to evaporator, remaining refrigerant vapor which was not condensed in low-temp generator will be condensed by cooling water in condenser. Refrigerant in condenser returns to evaporator and will be circulated as above.

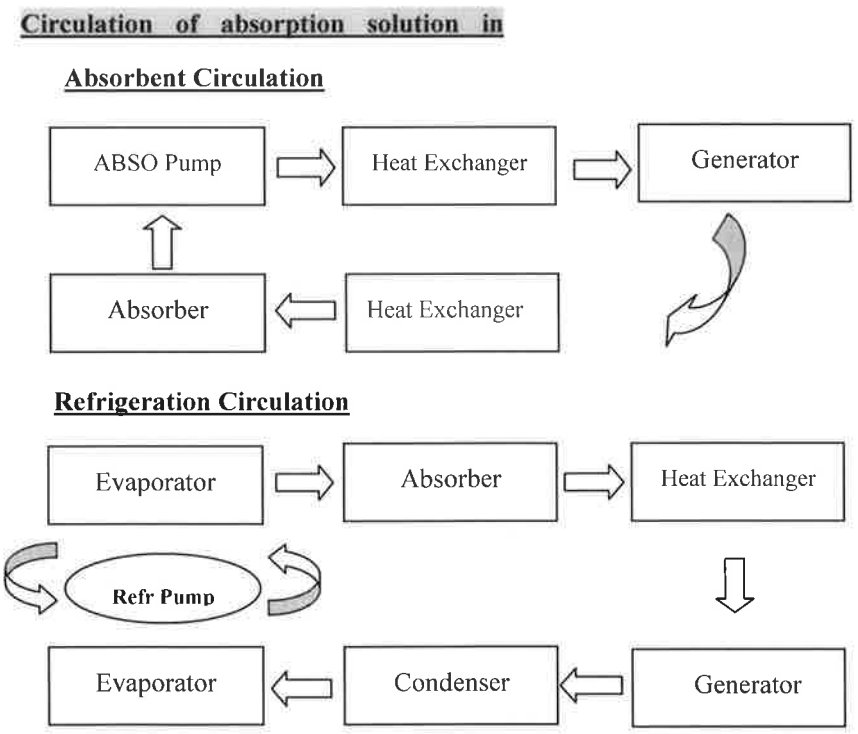


Fig 4-2 Absorbent and Refrigerant Circulation Cycle

5. Operation

5-1 Check point before operation (auto-operation)

An operator should check the issues as below before operating a chiller.

1) Convert a pump operation switch to AUTO, on MCC panel of chilled water, cooling water and cooling tower. (except manual operation, provided that cooling tower has to be auto-controlled)

2) In case control valve manual lamp on control panel is turned on, control valve is in "manual mode". Thus press a control valve switch once again to convert to "auto mode". When control valve is in "manual mode", control valve is kept closed. Accordingly the chiller does not work to produce chilled water

3) Check if the valve of a steam supply pipe is normally open. and steam pressure is higher or lower than usual, if abnormal things is found, correct them.

4) Check if a valve of a pipe connected to a chilled water and cooling water pump is normally open. And check also if head is normally open in case pipe is connected to cooling water head.
(Above all, check the open state of valve once again when operating several chilled water and cooling water pump or spare pump for chilled water or cooling water pump.)

An operator can operate a machine normally after having checked all above.

5-2 How to operate an absorption chiller (remote, auto-operation)

1) Pressing operation key on the control panel of chiller for 3 seconds will automatically put all the system into operation. (in case of remote operation, turn on a remote switch, that is, a computer.)

2) Check the operation of chilled and cooling water pump when chiller is put into operation. Check the water pressure of each part (manometer of chilled water, cooling water pipe) to assure the normal circulation of chilled water and cooling water. When outlet pressure of chilled, cooling water pipe is lower than that of inlet, it is a normal state. If pressure of both outlet and inlet are equal or pressure difference is reduced, stop the chiller immediately and convert chilled/cooling water pump to manual mode for finding and handling causes.
And if the needle of manometer trembles violently or pressure difference is wide, it mainly results from insufficient water in pipe. Then check a refilling pipe of chilled/cooling water and refill it.
(however, in case of finding causes in manual mode, manual operation is available for chilled water, but in case of operation in which cooling water is converted to manual mode, put chilled water into operation together.)

3) Check the normal operation of cooling tower fan.

4) Afterwards, the machine is working automatically.

※ A chiller is not likely to work unless any of check points above is normal.

2) There is no extra handling for auto-operation because it works and stops (under an abnormal situation) automatically but checking a machine in advance prevents an abnormal operation. (however, be aware of the fact that even though FLOW of cooling water is not sufficient or cooling tower fan is not normal, chiller works anyway.)

5-3 How to stop a chiller (auto-operation)

1) Press stop key on the control panel for 3 seconds. (turn a remote stop switch off for remote operation)
2) The Steam control valve will fully closed after chiller stop.
3) A cooling water pump stops to work.
4) A chilled water pump stops to work.
5) Dilution operation for stop will be done for about 5~15 minutes. (Stop time of chilled water and cooling water pump is determined based on the temperature of generator. However, stop time can be adjusted.—refer to the MICOM manual)
6) AHU, FCU and the like stop to work.

2) ~ 5) above stop to work automatically, however checking the normal stop of those prevents abnormal situation in advance.

※Operate load such as AHU, FCU and the like after operating a chiller and stop it after stopping a chiller. In particular, stopping all load such as AHU, FCU and so on at once, while the temperature of cooling water outlet is low, lowers the temperature of cooling water abruptly, then causes ice to form inside and danger of being frozen to burst, therefore turn load off if possible after temperature of cooling water rises sufficiently or cooling water pump stops to work automatically.

5-4 How to operate an absorption chiller (manual operation)

1) Operate a chilled water pump manually.
2) Operate a cooling water pump manually.
3) Check the circulation between chilled water and cooling water pump.
4) Press the operation key on the control panel of chiller for 3 seconds.
5) Check the gradual opening of steam control valve.
6) Check the normal operation of cooling tower fan.
7) After 4), a chiller operates by itself.

5-5 How to stop an absorption chiller (manual operation)

1) Press the stop key on a control panel for 3 seconds.
2) A burner converts to a low combustion mode, then stop to operate in 1 minute automatically.
3) A chiller stops to operate after about 5~15 minutes of dilution operation.
4) Stop a cooling water pump.
5) Stop a chilled water pump.
6) Stop a cooling tower fan automatically. (otherwise, stop it by hand.)
7) Stop AHU, FCU and the like.

※observe the order above for manual operation. Other internal operation is done automatically.

5-6 Safety issues for operation

1) When an operator forgets locking a purge valve, air gets inside a machine causing abnormal

operation. Thus in case vacuum is broken, check the causes and extract air completely. Further information will be described in the purge part.

2) In case gas leaks out immediately lock the gas main cock and consult with the gas company or companies of parts in question. (contact the service department of this company in case leakage occurs in a burner or a gas strainer.)

3) During the dilution operation, operate chilled water and an air conditioner until the end of dilution operation. Because dilution operation has a little cooling power, immediate stop of air conditioner causes a danger of over-cooling. Specially, cooling water pump should not be turned by hand during the operation if possible. It is because when cooling water continues to flow during the stop operation, chilled water which does not move inside copper pipe of evaporator is cooled by latent heat left in a chiller.

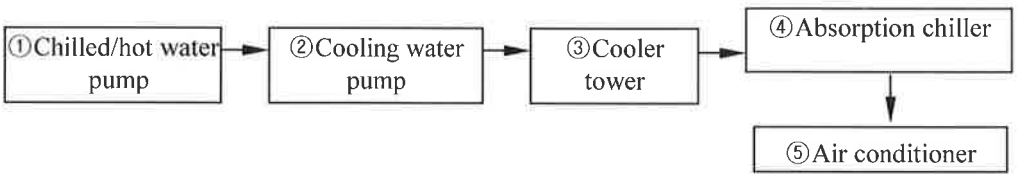
4) In case of the first cooling or heating, check if cooling/heating conversion is done before the operation. Otherwise a chiller can be damaged. In general, it is convenient to ask a technical support for cooling/heating conversion based on the machine repairing contract.

5) Do not test control circuit for temperature adjustment of MICOM in MΩ level.

6) It is desirable that auto-operation and stop of peripheral devices follows the interlocking circuit recommended by this company.

Chilled/hot water pump and cooling water pump operate automatically by interlocking circuit. However, auto-operation is available only when chilled/cooling water interlock, auto joint and cooling tower auto joint are wired. Sequential (interlocking) operation is shown in the figure 5-1.

[Operation process]



[Stop process]

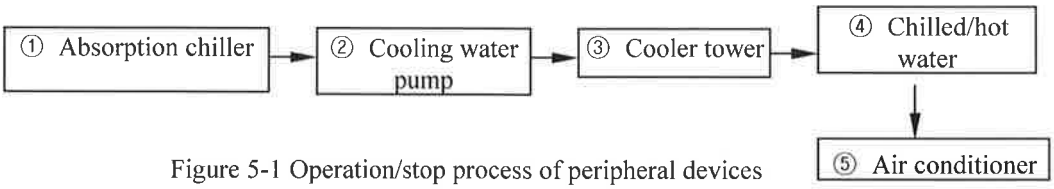


Figure 5-1 Operation/stop process of peripheral devices

1) In case a cooling tower is controlled in other panel than MICOM – cooling tower part is excluded from the sequential operation process and cooling tower has to be controlled automatically based on the temperature in cooling tower MCC panel or other devices (thermostat, DDC panel or computer).

2) In case cooling tower is controlled in MICOM of chiller, an operation joint, which connects cooling tower to the output of MICOM has to be added. Otherwise, cooling tower has to be controlled based on the temperature with other devices such as separate panel or thermostat than MICOM

6. Maintenance.

6-1 Daily routine check

1) Inspection of each part.

Contact us when you find any abnormal situation as below.

① Does it smell gas around a chiller?

② Is there any unusual noise when a burner is firing?

③ Is a link of burner is detached or so loose as to slip?

④ Is there any unusual noise in an absorption solution pump, a refrigerant pump, a ventilator for burner?

Check subsidiary facilities below and take proper measures if necessary.

① Cleanness of a strainer for cooling water system and a cooling tower

② Distribution of cooling water in cooling tower.

③ Air exhaust in water pipe.

2) Writing down the operation data

Write down the operation data at the regular intervals during the operation to know the state of a chiller. (1 ~ 2 hours interval) Data is written and saved by the hour in MICOM by default. (Time interval can be altered. Refer to menu instruction for time setting) But since pressure of generator, chilled water, cooling water and the amount of gas consumption are not written , writing down the data will be useful in A/S, regular inspection , recovery from failure or error prevention.

6-2 Regular inspection.

Regular inspection such as purge task, management of absorption solution and combustion device are needed to operate a machine effectively and maintain the expected life span.

※ Inspecting connection between electrical parts(which are inside a panel) is needed 1 or 2 times per year.

It is convenient to use the maintenance contract.

6-3 Refrigerant blow-down

Refrigerant blow-down is a reproducing method which turns refrigerant in an evaporator into pure refrigerant at the beginning of trial operation or during cooling operation. When absorption solution in an absorber flows into an evaporator or from low-temp generator to a condenser during trial operation or cooling operation, refrigerant gets heavy resulting in lowering the cooling power. Blow-down task should be performed in this case.

The temperature of chilled water outlet goes up during refrigerant bolw-down task, however after the task is done and a normal cycle is recovered, the temperature is getting down.

Blow-down causes chilled refrigerant to flow in an absorber, thus the temperature of dilute solution

in an absorber gets down. This absorption solution (dilute solution) moves to generator via low-temp and heat exchanger. Refrigerant is heated and then vaporized in a generator, this refrigerant vapor will be refined into pure refrigerant through a condenser.

If the temperature of generator is very high during blow-down task, crystallization can occur while chilled dilute solution exchanges heat with condensed solution. Because density of absorption solution in heat exchanger has already been high. Thus the temperature of generator is proper at about 110 ~ 120℃. And if the temperature of generator is very low, the amount of refrigerant can be small resulting in poor blow-down. In this case it is desirable to raise the temperature of generator.

6-3-1 Blow-down task (in case a machine is equipped with a separate blow-down valve)

In this case, a blow-down valve is between a refrigerant pump and an evaporator. It is a diaphragm valve like a purge valve. And it makes blow-down task easy. (it depends on the model whether it has a separate blow-down valve or not.)

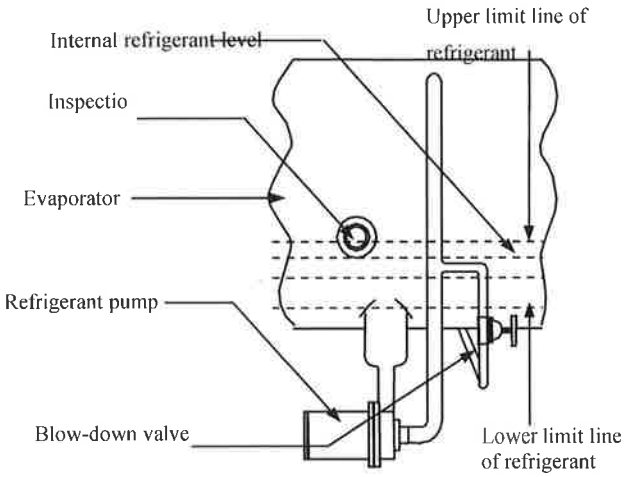


Figure 8-2 Blow-down [2]

①convert 「control valve manual」 switch to **MANUAL** and close the control valve ti;; 30%~50% to make low-input energy state. For this, it is desirable to lower the temperature of generator down to 100~120℃.

②Rotate the blow-down valve counterclockwise as in Figure 8-2 to open it.

③Check the amount of refrigerant through the inspection window of evaporator.

④Close the blow-down valve when the amount of refrigerant reduced down to the bottom level.

⑤Be aware that refrigerant moves over to an absorber through the blow-down valve and then a refrigerant pump performs no-load operation. And in case a refrigerant blow-down valve is attached, do not stop the refrigerant pump. If refrigerant pump stops in auto mode, then convert to **MANUAL** mode before putting it into operation. (when the temperature of chilled water is getting down causing MICOM to be in auto mode, refrigerant pump stops automatically, thus be cautious of the low temperature of chilled water.)

⑥when blow-down task is terminated, open a control valve in turn up to more than 70%, then convert to **AUTO** mode. (it is the same task as Figure above 8-3-1.)

※ Note: Extract refrigerant(H_2O) from an evaporator so as to measure the specific weight if necessary. Standard specific weight for refrigerant is less than 1.02

7. Purge

It is a task of discharging air or non-condensed gas out of a chiller through a purge pump. Inflow of air or hydrogen gas generated inside diminishes the performance and does a chiller harm. Therefore a task of discharging gas or air is absolutely needed. This task is referred to as purge. It is desirable to perform purge, at least, 1 time per week for the main body and 2~3 times for storage tank.

7-1 When to perform purge

It is good to perform purge during or before operation in cooling, however the best is to do during cooling operation.

7-2 Purge frequency

Purge is an important task which has an influence on the performance and life span of machine.

In cooling, it is performed more than 1 time per week for main body and 2~3 times per week for storage tank. **In heating,** 1~2 times per month for main body only. During about 1-2 months after initial operation, purge should be performed regularly.

7-3 Structure and components of purge pump

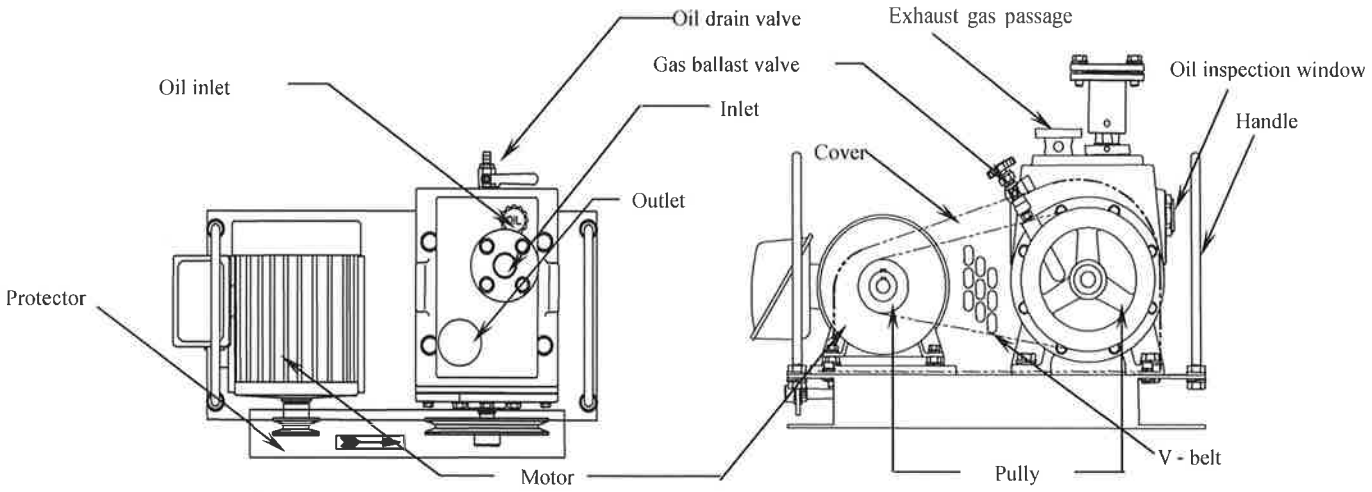


Figure 9-1 Components of purge pump

7-4 Structure and principle of purge system

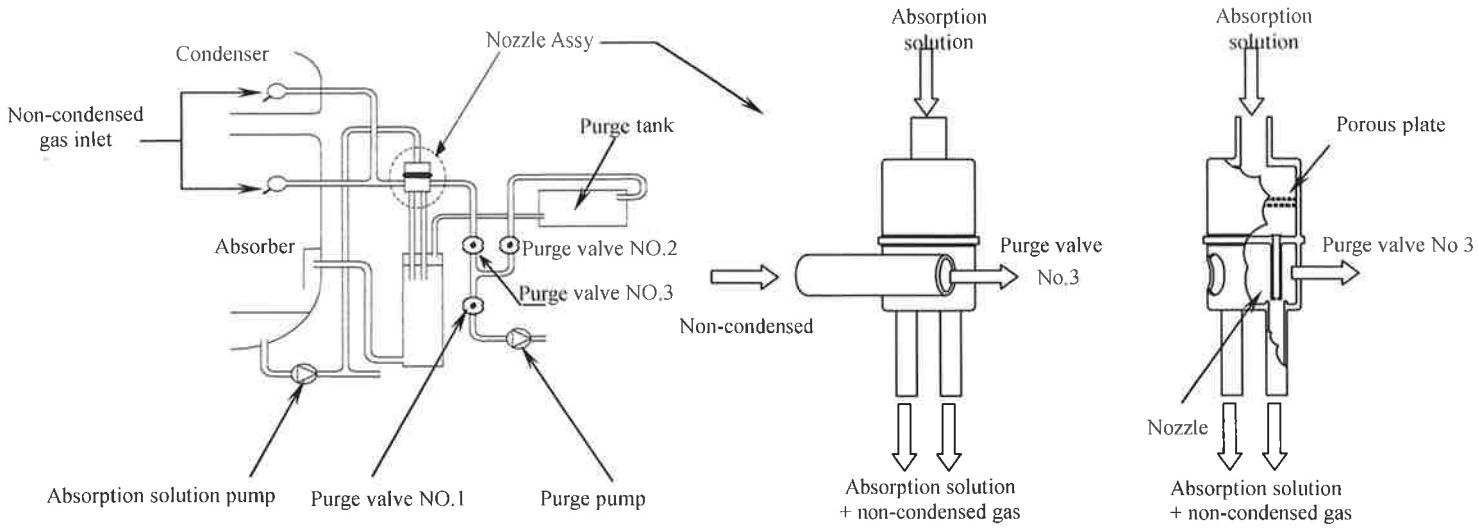


Figure 8-2 Purge system

7-4-1 Principle of purge

Purge is a task of discharging non-condensed gas out of main body.

Absorption solution reacts on the internal surface of main body, producing non-condensed gas or H_2.

Hydrogen gas and air left inside main body should be discharged, which makes pressure stable for the normal cooling and heating operation.

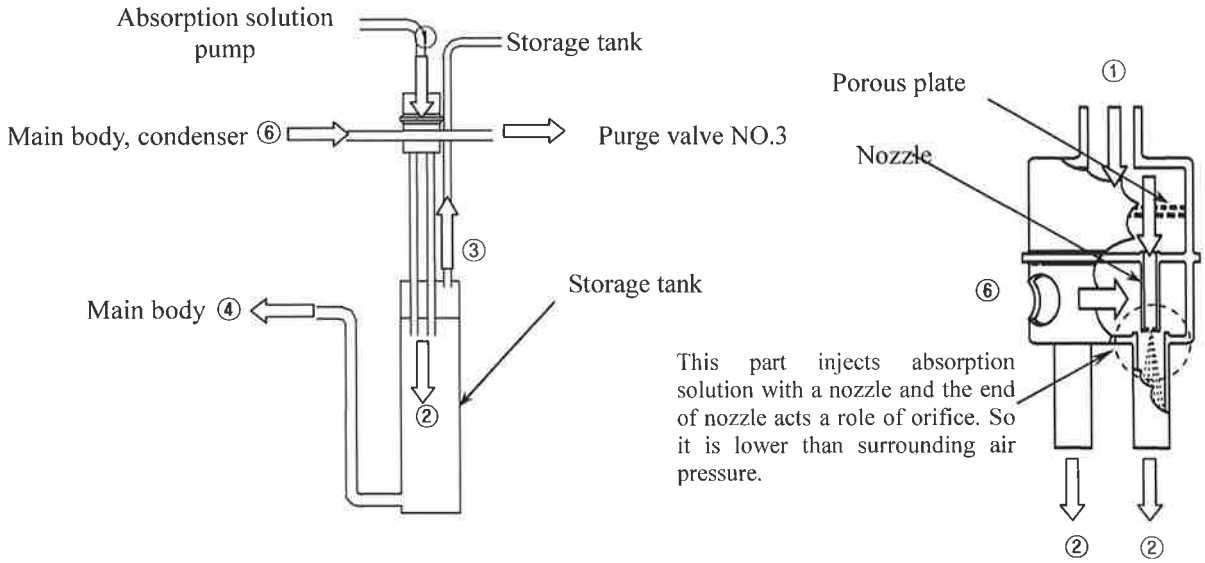


Figure 9-3 Principle of storage tank and purge

①Absorption solution flows from absorption solution pump to header of storage tank.

②Absorption solution is filtered by porous plate(a plate with small holes—used as a filter) and is injected down from the nozzle, which acts as an orifice to make air pressure at the end of nozzle lower than surrounding air pressure. Air of ⑥ goes down in the direction ② with absorption solution, being diluted together.

③Vapor bubble diluted with absorption solution is put together in storage tank, on the other hand air and non-condensed gas gather in a purge tank along the piping. This non-condensed gas gathered in a tank is to be discharged when purge for storage tank is performed. Therefore air bubble is not produced when absorption solution pump does not work.

④ Absorption solution gathered in a storage tank returns to an absorber of main body when it gets at the level of piping of ④.

⑤ It is connected to purge No.3 valve. Non- condensed gas will be discharged directly in this direction in performing a purge for main body.

⑥It is connected to a condenser and an absorber. Non-condensed gas flows through the pipe ⑥, in performing purge for main body or generating air bubble by absorption solution pump.

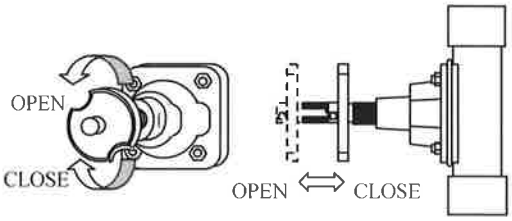


Figure 9-4 Purge valve (diaphragm valve)

7-4-2 Purge task

1) How to read a manometer.

Safety issue in using a manometer

A manometer consists of a glass tube of U shape filled with mercury. If other foreign material or liquid gets in, it is expanded in vacuum. Then a mercurial column can be broken or air can get in on the right side causing a manometer to be useless. Left side in a glass tube of U shape should always be lower than right side Read off the difference between upper and lower value based on '0' at rear side of a manometer and find the sum of both.

As shown in Figure8-5, read off the both ends of mercurial column and then find the sum of both.

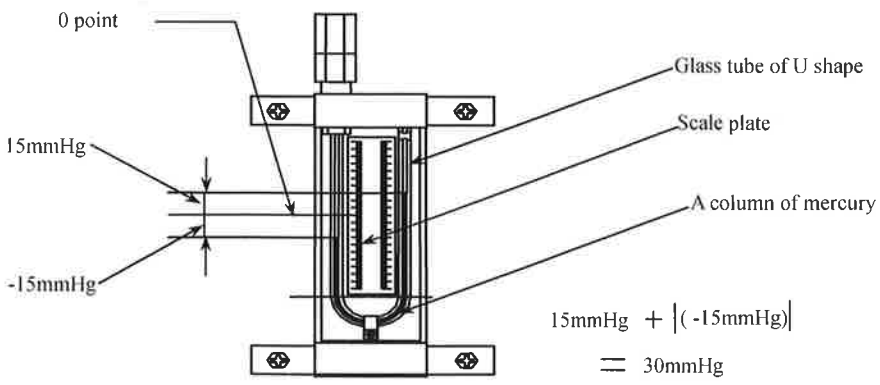


Figure 8-5 Manometer

2) Preliminaries for purge

① Press 'Operation' of manual switch on the control panel to put a purge pump into operation.

② When a purge pump starts working, firstly open a gas ballast valve a little to hear working sound. Then keep it open always a little for use. Air flows into a gas ballast valve at this moment and is discharged from an outlet of a purge pump. So if you block a gas ballast valve with your finger, you will feel air flowing in rapidly. In case oil often flows backward and no more air flows in after a purge pump stops, vacuum inside might be broken. Then close the gas ballast valve and open it little by little for use.

③ Check the oil level in a purge pump.

④ Supplement oil when the level of oil is low. Refill oil while purge pump is still working. The optimum oil level is the red scale on the inspection window.

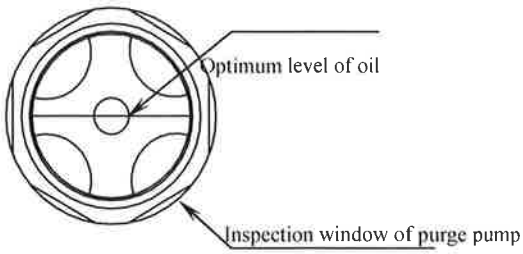


Figure 9-6 Inspection window for oil

⑤ Too much oil, that is, oil level goes over 1/2~2/3, should be discharged by opening an oil drain valve.

⑥ When the color of oil is examined and oil is regarded as contaminated seriously, stop a purge pump and open an oil drain valve to replace all of them. When oil is mixed with water and looks milky, it makes a purge pump to perform no-load operation. No-load operation discharges water out of oil, cleaning oil and drying a trap, an absorbing hose and pipes used for purge automatically to improve the performance of purge pump. (no-load operation usually takes about 2~3 hours even though it depends on.)

⑦ Read off the scale of manometer with a purge valve opened.

⑧ If it is less than 4mmHg, vacuum level in purge pump is very good. On the contrary, if it is more than 4mmHg, that is very poor level of vacuum, another 10 minute of no-load operation will lower the vacuum level less than 4mmHg. If this does not work, oil and water in trap of upper part of purge pump and absorbing hose of pump inlet should be discharged. In case a liquid trap is attached, open a drain stopper on the lower part of a trap with spanner to discharge oil and water. Check if a purge valve NO.1 is closed, then open a stopper of trap with purge pump stopped to discharge oil. When it is made of transparent hose, check oil in hose, then tilt it toward an inlet of purge pump to pour oil into it. It is not necessary to stop purge pump for discharging oil in a transparent hose.

⑨ When nothing failed above, start a purge task.

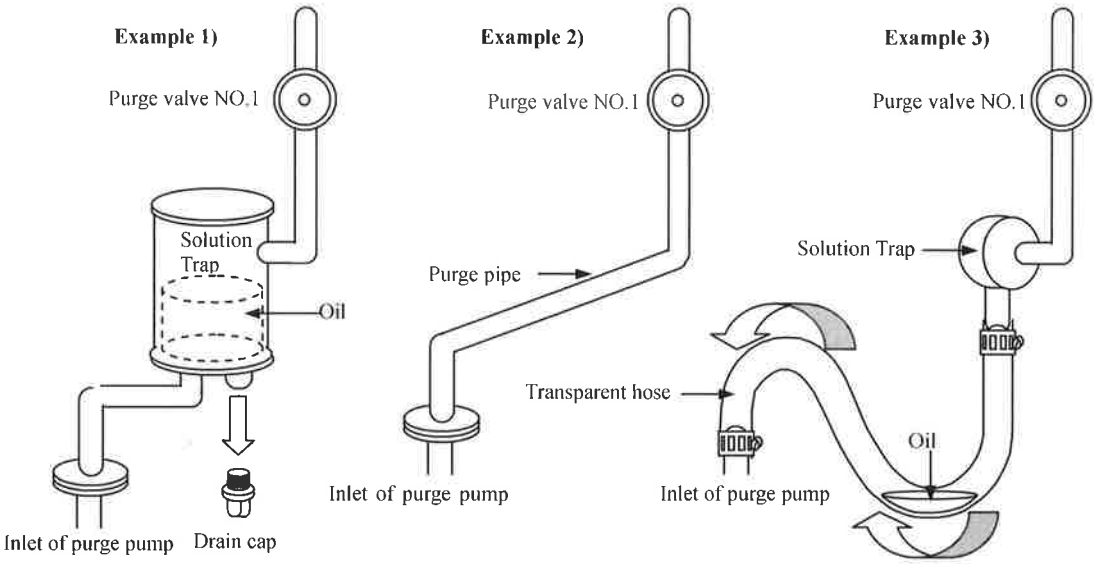


Figure 9-7 Solution trap

※ If the inside of a trap is always kept dried, then vacuum level is good.

Get rid of any oil in a trap or a hose.

7-5 Managing oil in purge pump

Use vacuum pump oil, MR – 200 or ULTRA-200 if possible. When using other oil than this, use any oil with the viscosity of 200. Seriously contaminated oil should be all replaced. Specially, when absorption solution flows into a purge pump, replace all oil and clean the inside of it. Discharge oil through drain valve to clean it. When oil is all taken out, close the drain valve and fill it with water through an oil inlet up to the half of oil inspection. Operate a purge pump for about 20~30 minutes to perform no-load operation. Stop the purge pump to discharge water through a drain valve. Then supplement oil to terminate the cleaning task of purge pump.

7-6 Purge in cooling

It is desirable to perform purge in cooling during operation. It is because non-condensed gas gathers in a storage tank during operation. Purge can be performed for a low-temperatured main body before the operation of storage tank and main body. However, when purge is performed for a high-temperatured main body or during dilution operation, lots of refrigerant vapor comes from the main body and goes into a purge pump, doing purge pump harm. As a result, refrigerant consumption increases.

7-6-1 Purge from main body in cooling

Purge from main body is performed usually when the pressure of main body is high in cooling, air gets into a main body (urgent purge). And it is also performed regularly.

Air in the main body gathers automatically in a storage tank and purge tank. However because a storage tank can't absorb completely non-condensed gas, it is much helpful for the performance and life of machine to practice purge for 20~30 minutes, 1~2 times per week through the main body.

If the pressure of main body is high, then the temperature of generator is also getting high, causing "temperature high" or "density high".

Crystallization can occur with ease due to the bad flow of absorption solution and the temperature of chilled water won't get low easily. Purge for main body absorbs gas in purge pump and discharges it out of a chiller. Thus refrigerant is consumed little by little but it has little influence on the operation.

< Purge from main body >

① Put a purge pump into operation, open the purge valve NO.1. And close the purge valve NO.1 when the scale of manometer indicates less than 4mmHg.

② Open the purge valve NO.3 (main body).

③ Read off the manometer to check the pressure of main body.

④ Open the purge valve NO.1 to perform purge when the pressure of manometer is more than the permitted vacuum level.

⑤ Close the purge valve NO.3 when purge for main body is done or the pressure of manometer is less than the permitted vacuum level.

⑥ Read off the manometer to verify if the scale of manometer indicates less than 4mmHg.

⑦ Close the purge valve NO.1.

⑧ Stop the purge pump.

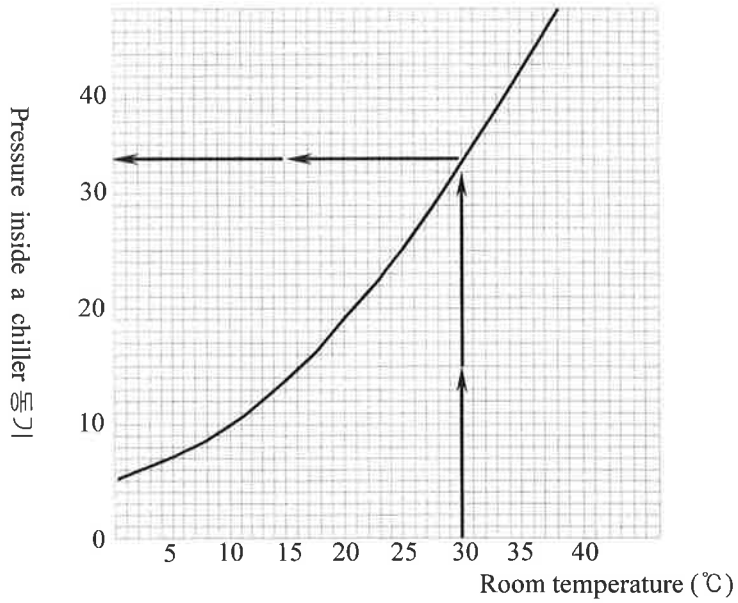


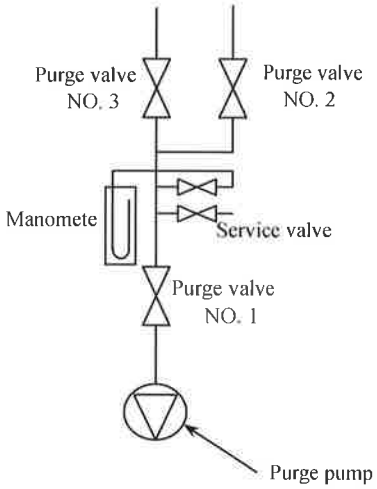
Figure 9-8 Permitted vacuum pressure curve

7-6-2 Purge from storage tank in cooling

When the pressure inside main body is high, absorption solution in a storage tank occasionally comes through a purge pump. Especially when the pressure of main body is more than 40mmHg, never open the storage tank valve. If air gets in or pressure is high in cooling, then perform purge for main body first.

In performing storage tank purge, a storage tank absorbs non-condensed gas or air in the main body before purge, thus little refrigerant is consumed. Air bubble gathers only during operation. This collection can't occur at more than a specific pressure and for too much bubble. So in thins case, purge should be performed.

< Purge from storage tank >



①Put the purge pump into operation.

②Inspect the purge pump.

③Open the valve NO.1

④Check if the scale of manometer indicates less than 4mmHg.

⑤Close the valve NO.1.

⑥Open the purge valve NO.2(storage tank)

⑦Check the pressure of storage tank with manometer. When the pressure is higher than the permitted vacuum level, then open the purge valve NO.1 to perform purge.

⑧Close the storage tank valve NO.2 when purge is done or pressure is low.

⑨When the pressure of storage tank is normal, close the storage tank valve (NO.2 purge valve) and then open the valve NO.1 to check the manometer. When purge is done, check if the scale of manometer indicates less than 4mmHg as soon as the storage valve is closed.

⑩Close the valve NO.1.

⑪Stop the purge pump.

< Simple purge in cooling>

①Put the purge pump into operation.

②Inspect the purge pump.

③Open the valve NO.1.

④Check if the scale of manometer indicates less than 4mmHg.

⑤Open the valve NO.3.

⑥Check the pressure of main body with a manometer. Close the valve NO.3 under the permitted vacuum level. When the regular purge or purge is needed, perform purge for 10~20 minutes with the valve NO.3 opened.

⑦ Close the valve NO.3, then check if the scale of manometer is less than 4mmHg.

⑧ Open the storage valve NO.2 and perform purge for about 1~2 minutes.

⑨ Close the valve NO.2. (perform purge until it is equal to the pressure of main body, then close the valve.)

⑩ Check if the scale of manometer indicates less than 4mmHg.

⑪ Close the valve NO.1.

⑫ Check if the purge valve NO.1, NO.2, NO.3 all are closed.

⑬ Stop the purge pump.

Simple purge above is a simplified procedure. It is used for regular purge, general purge or when there is nothing wrong after checking. But under the high pressure in the main body, perform purge longer than 20 minutes until it reaches the permitted vacuum level before operation.

And simple purge should not be used to get the precise pressure in the main body. Normal purge, that is purge of main body or purge for storage tank should be used for this.

8. Crystallization and de-crystallization

Crystallization means that absorption solution changes from liquid state to solid state.

It occurs mainly in cooling operation. Almost no crystallization will occur in heating because a heat exchanger is not used and overall temperature and density are low.

8-1 Crystallization

It is caused by the high density or the high temperature of absorption solution. Crystallization prevents a chiller from cooling and causes errors; "GEN PRESSURE HIGH" or "GEN TEMPERATURE HIGH", therefore inspect a chiller at any time to check crystallization.

MICOM of a chiller has a program to avoid crystallization and it drives a crystallization avoidance operation. However a chiller does not detect crystallization by itself and instead it performs just a crystallization avoidance operation. Therefore, it is a user that makes decision on crystallization.

8-1-1 Cause of crystallization

Crystallization occurs when the temperature of cooling water is too low or the density of absorption solution is too high.

1) When the temperature of cooling water is too low

When the temperature of cooling water is too low, condensed absorption solution coming from a low-temp generator exchanges heat with low temperatured absorption solution (dilute solution), already exchanged heat with cooling water and the temperature of absorption solution goes below the crystallization point, crystallization occurs. When the temperature of cooling water is too low, MICOM of a chiller closes the control valve on the basis of the inlet temperature of cooling water to prevent crystallization. But if the temperature of generator is already high and the density of absorption solution is high, it is not easy to prevent crystallization. Thus it is recommended to maintain always the temperature of cooling water between 28℃ and 32℃.

2) When the temperature of cooling water is too high

Crystallization can occur, even when the temperature of cooling water is too high. Theoretically, crystallization won't occur when the temperature of absorption solution is high. If the high temperature of cooling water makes that of absorption solution high, the temperature of absorption goes up in the heat exchanger which is the most condensed. Consequently, crystallization won't occur. However, high temperature of cooling water lifts up the overall pressure of a chiller. As a result, the temperature and the pressure of generator go up more. It results in making the density of absorption solution higher. Reduced pressure difference between a low-temp generator and an absorber disturbs a smooth flow of absorption solution.

Finally, absorption solution stays for a long time in a heat exchanger and its density gets high. And reduced absorption power in absorber causes crystallization. It results from mainly trouble of a cooling tower. It is necessary to maintain a cooling tower against water shortage of cooling tower or malfunction of cooling tower.

Inlet temperature of cooling water has so much influence on a chiller that sufficient amount of oil and temperature maintenance are necessary.

3) In case of air inflow or bad purge. (in case pressure inside a chiller is high)

Crystallization can occur easily when the pressure inside a chiller is high. That is, when air gets in or non-condensed gas gathers in machine owing to lack of purge, flow of absorption solution is not smooth and its density gets high, which causes crystallization easily. It is necessary to check the pressure inside a chiller and perform purge if needed. And for leakage, it is also necessary to find the leaking part.

4) In case of cooling water FLOW shortage

Crystallization can also occur when cooling water FLOW is short. The reason for crystallization under cooling water FLOW shortage is same as the 3 cases above. Cooling water FLOW shortage makes so large a temperature difference between the normal inlet and the outlet that flow of absorption solution is not smooth. Cooling water FLOW should be sufficient.

5) In case absorption solution is circulated badly or is short

When a damper which controls cooling cycle of a chiller is too widely opened or closed causing a bad flow of absorption solution, crystallization occurs. It is the same as for absorption solution shortage. If a damper (dilute solution, intermediate solution, condensed solution) of a chiller is too widely opened, then ON/OFF operation of absorption solution pump occurs frequently, solution level of generator goes up but absorber will be empty later and finally absorption solution is not supplement timely. On the contrary, when it is too much closed, absorption solution is not well supplemented. And it causes the temperature and the pressure of generator to go high and further errors.

8-1-2 Symptoms of crystallization

Crystallization makes no temperature difference between the chilled water inlet and outlet and the chilled water temperature is getting higher. The temperature of generator continues to rise up and the density of absorption solution also continues to get up. And refrigerant level of evaporator get higher than usual and the temperature difference between cooling water inlet and outlet is also reduced. And the temperature of piping, which goes low-temp generator through heat exchanger and heat exchanger through absorber, is not normal. (refer to the dhuring diagram) and over flow piping gets hot. (for the model in a large scale, temperature of 3 points of H piping can be all identical.)

Or no-load operation of absorption solution pump makes noise and the temperature and the pressure of generator gets high sounding a buzzer and finally stops it automatically.

Crystallization can be judged on the basis of the conditions above.

8-2 Crystal dissolution procedure

There are several methods for dissolving crystal.

8-2-1 Low input energy operation

Close a hot water control valve till 30% opening in manual mode to perform a low input energy

operation. It is the easiest method. Low input energy operation lowers the overall density of absorption solution and dissolves crystal except when crystallization is not intense. After about 20 minutes ~ 1 hour of low combustion operation, convert a control valve to auto mode to perform a normal operation.

8-2-2 Blow-down

The secondly easiest method is to perform blow-down.

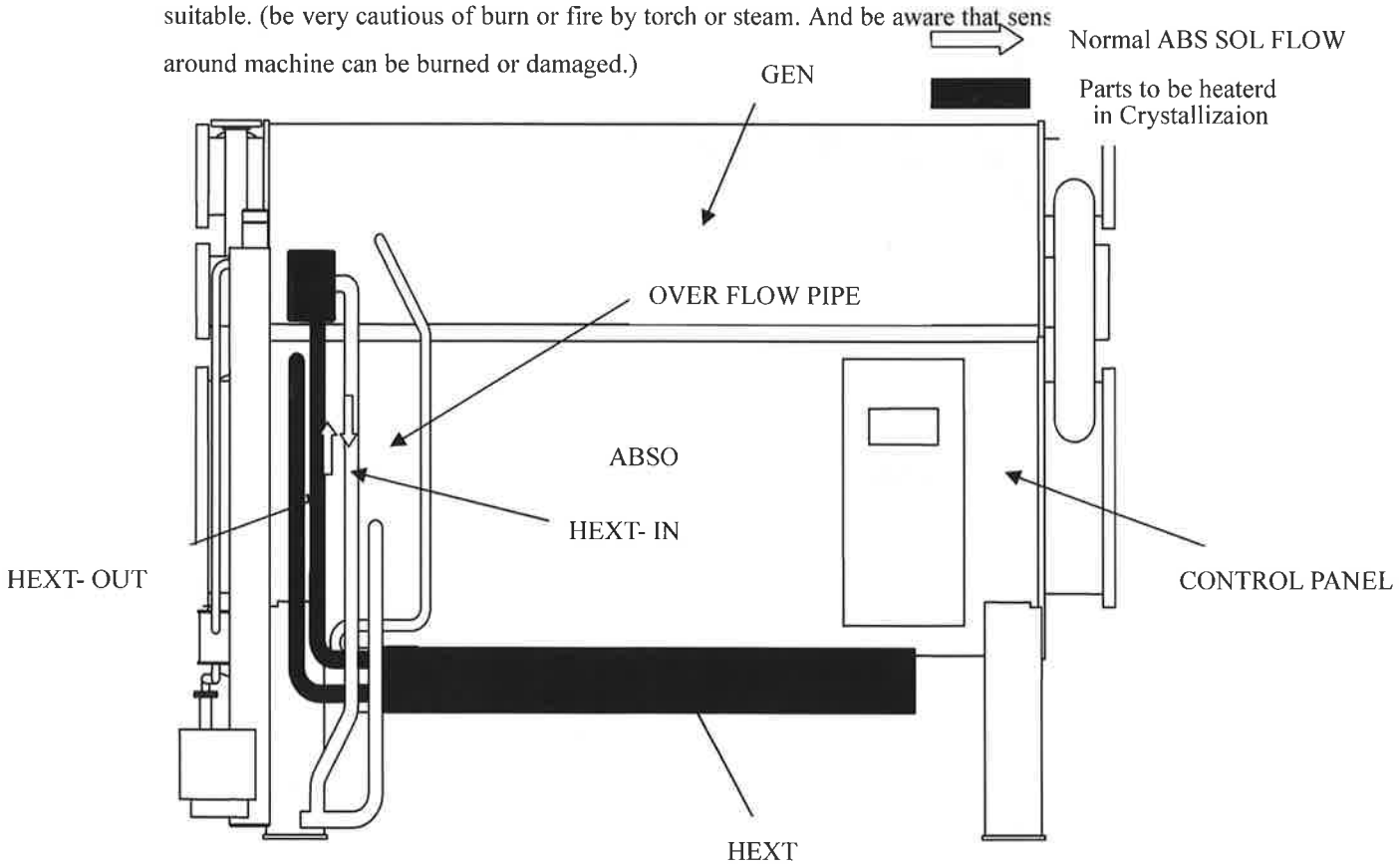
Performing blow-down 2 or 3 times dissolves crystal. Refer to 6-3 **Blow-down** for blow-down task.

It is necessary to perform a low input energy operation thoroughly while performing blow-down.

8-2-3 Heating with torch

The third one is to heat a heat exchanger, a piping linking a heat exchanger with an absorber and another piping going down from a low-temp generator to a heat exchanger with torch or other heating instruments.

Oxyfuel gas welder which has a very strong flame shouldn't be used. Steam or torch is the most suitable. (be very cautious of burn or fire by torch or steam. And be aware that sens around machine can be burned or damaged.)



Heat a heat exchanger or a piping linking a heat exchanger (inlet of heat exchanger and outlet of heat exchanger) with torch slowly. Do not heat a specific part intensely or crystallization can be more

developed. When crystal is dissolved, the temperature difference between the chilled water inlet and outlet and the temperature of parts come back to the normal state. Convert to a normal operation after performing blow-down 1~2 times.

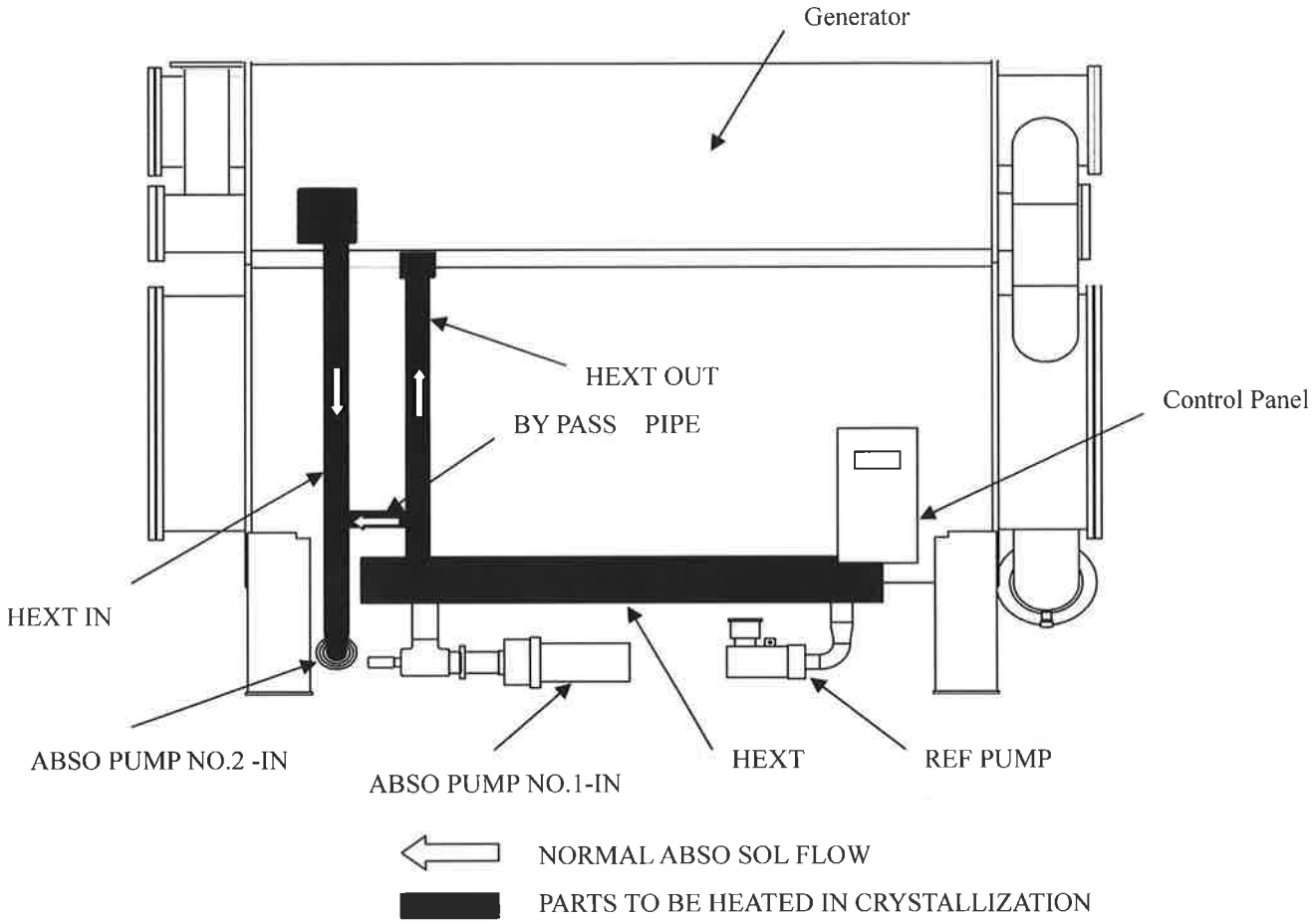


Fig 9-2 Crystallization dissolution(380usRT ↑)

8-2-4 Others

There are other methods than this. For example, heating when stopping a cooling water pump and a chilled water pump, which requires much more attention and can be dangerous, therefore it won't be explained here. **When the solution presented above doesn't work, please contact our service center.**

9. Long-term storage and parts replacement

Fill up nitrogen gas when storing or replacing parts of a chiller.

9-1 Nitrogen gas filling

9-1-1 Filling procedure

Tools used for filling nitrogen gas.

(1) Nitrogen gas

(2) Pressure controller

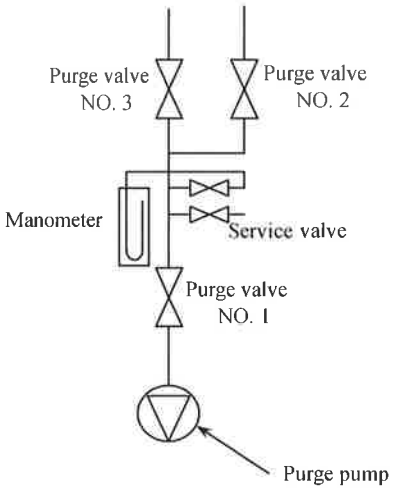
(3) An internal pressure hose in rubber (pressure hose)

(4) Band

(5) Flyer(Monkey spanners)

(6) Service valve hand

(7) Nitrogen gas valve hand



9-1-2 Rated pressure

(1) Pressure for long-term storing: 0.2~0.3kg/㎠ G

(2) Pressure for leakage check: 0.7~1.0 kg/㎠ G

(3) Pressure for replacement: About 0.1 kg/㎠ G

9-1-3 Procedure

(1) Prepare a container for nitrogen and install a gas pressure controller.

(2) Link an internal pressure hose in rubber to a gas pressure controller and open the valve and let nitrogen gas flow to discharge air inside hose.

(3) Link the opposite end of hose to the service valve on the upper part of purge valve NO.1 (the lower part of service valve for manometer connection) and tighten a band.

(4) Check if the service valves linked to the purge valve NO.1, 2, 3 are all closed firmly.

(5) Open the purge valve NO.2.

(6) Open the service valve linked to the hose.

(7) Inject nitrogen gas little by little inside the main body with a pressure controller.

(8) Continue to inject nitrogen gas watching the pressure gauge. Close the service valve NO.2 linked to the hose and the outlet valve of nitrogen container when gas reaches the rated pressure.

(9) Separate the rubber hose from the service valve and cover the service valve with a cap.

(10) Separate the pressure controller.

9-1-4 Caution

When finishing all the procedure above, then a user can do parts replacement, a leakage test or a long-term storing.

Be aware that a container for nitrogen is filled with the pressure of 120 kg/㎠ G. Do not raise abruptly the 1st and 2nd pressure of pressure controller in the nitrogen container. Otherwise it forces the pressure hose to be pulled out of the service valve or the hose may explode. Never open the purge valve **NO.1, 3** during the nitrogen filling task. Absorption solution can flow backward. After replacing parts at the rated pressure, inject extra nitrogen for leakage test on the replaced parts.

9-2 Discharging nitrogen gas out of main body

It explains the procedure to discharge nitrogen gas filled inside for leakage checking or other purpose.

Rated pressure: air pressure (0 kg/㎠ G) on the pressure gauge in the generator.

9-2-1 Procedure

① Open the purge valve NO.3.

② Open the service cap and discharge nitrogen gas inside the main body until it goes down to air pressure.

③ Close the service valve when the pressure gauge of generator indicates air pressure.

④ Close the purge valve NO.3.

⑤ Close the service valve and cover it with a cap.

9-2-2 Caution

Never open **the purge valve NO.1, 2** while discharging nitrogen gas. Operate a ventilation fan while discharging for better exhaust. When the exhaust is poor in an airtight space, suffocation can occur due to the lack of oxygen.

And after discharging nitrogen, normal vacuum state should be made by purge task to enable cooling or heating operation. Otherwise, that is, if a user operates a machine under air pressure state with no purge after discharging nitrogen, it causes crystallization or GENERATOR PRESSURE HIGH and other problem.

10. Repairing and maintaining water system

10-1 Water quality control (chilled, cooling water)

If bad quality water is used in a chiller, it produces scale in the tube lowering the performance and efficiency of a chiller and further causes corrosion and rupture, finally reducing the life of machine. Water quality control and regular inspection on tube and tube cleaning are needed.

On the other hand, if make-up water of cooling water is mixed with purified water or a cooling tower is installed in an air polluted place (around chimney), water quality is getting worse. Especially when concrete heat reservoir is used, bad scale is caused by compounds of calcium. Be very cautious of that.

1. Cooling water quality standard

	Item	Cooling water		Chilled/hot water		Inclination	
		Circulated Cooling water	Make-up water	Circulated Chilled/hot water	Make-up water	Corrosion	Scale
Standard table	PH (25℃)	6.5 ~ 8.0	6.5 ~ 8.0	6.5 ~ 8.0	6.5 ~ 8.0	O	O
	Conductivity (25℃ μS/cm)	Less than 800	Less than 200	Less than 500	Less than 200	O	
	M alkalinity (PPM)	Less than 100	Less than 50	Less than 100	Less than 50		O
	Front inclination (PPM)	Less than 200	Less than 50	Less than 100	Less than 50		O
	Chlorine ion Cl^- (PPM)	Less than 200	Less than 50	Less than 100	Less than 50	O	
	Sulphuric acid SO_4^{2-} (PPM)	Less than 200	Less than 50	Less than 100	Less than 50	O	
	Fe (PPM)	Less than 1.0	Less than 0.3	Less than 1.0	Less than 0.3	O	O
	Sulfide ion S^{2-} (PPM)					O	
	Ammonium ion NH_4+(PPM)	Less than 1.0	Less than 0.2	Less than 0.5	Less than 0.2	O	
	Silica SiO_2 (PPM)	Less than 50	Less than 30	Less than 50	Less than 30		O
	Free carbonic acid (PPM)	3	3	10	10	O	

(Note 1) Any of items in the table has a large influence on inclination of scale or corrosion, therefore regular inspection is required.

(Note 2) Available water quality varies depending on the chemical used for water handling, thus consult with a company specialized in water handling to perform water quality control at regular intervals with a proper standard.

2. Example of water treatment

Even though make-up water for cooling water lies within the water quality standard value, water quality gets bad when circulated cooling water is condensed. Therefore water treatment is needed as below. Refer to the Figure below for water handling considering it depends on chilled water/hot water. In particular, be very cautious when using concrete heat reservoir.

①Blow-down

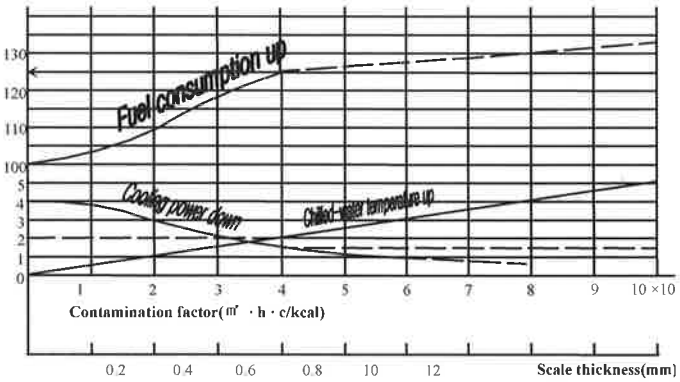
●Regular or consecutive blow-down ●Blow-down based on the conductivity analysis

②Anticorrosive injection

③Algicide injection(slime control)

④Necessary troubleshooting on the basis of regular water analysis

Uncover water tank of chiller regularly, check a tube and clean it if contaminated.



If scale is accumulated up to 0.6mm in a tube, cooling power goes down to 76% and the chilled water temperature rises up by about 2℃.

And fuel consumption ratio increases by 25%.

10-2 Water quality control for long term stoppage

When chilled water, cooling water and hot water is not circulated for a long period, refer to the principle below for water quality control.

1. Cooling water system

Make it a rule to fill a machine to the full in storing cooling water system. But in case cooling water in machine is in danger of being frozen, dry the inside of a tube (water tank) to store. Opening and closing a valve depends on filling storage and drying storage each.

*Filling storage

①Discharge circulated water during operation through a drain pipe.

②Inject anticorrosive.

- Check FLOW and inject a proper amount of water according to the mixture ratio.

③Fill a piping with fresh water.

④Operate a cooling water pump for a while to mix anticorrosive evenly.

⑤Close a cooling water inlet valve (cut-off valve of piping).

⑥Open the cooling/heating conversion D valve of main body.

*Drying storage

- Clean the inside of tube and form an anticorrosive film before drying storage.

①Discharge circulated water during operation through a drain pipe for cooling water.

②Clean the inside of a tube to remove scale and slime.

- Perform a chemical cleaning in addition when a mechanical cleaning is not sufficient.

③Clean the inside of a tube thoroughly, inject anticorrosive and fill it with water.

④Operate a cooling water pump for more than 30 minutes to mix anticorrosive completely.

⑤Discharge water, open cooling water drain valve and store it with the drain valve opened.

2. Chilled water water system

The filling storage is a rule.

10-3 Cautions for winter season

various countermeasures are needed to prevent freezing when the surrounding temperature of chiller gets below 0℃. Keep on a heating operation (use the scheduled operation feature in MICOM to operate a chiller at specific time intervals) or keep a chilled water pump working to prevent freezing. And with drying storage for cooling water system, keep a cooling water drain valve opened to fill a water tank with solidified water or others, which prevents freezing. Antifreezing solution should be used when filling storage is done for cooling water system. However, since facilities condition depends on the site, consult with our service center for further information.

11. Troubleshooting

Precede followings,

1) **Check error messages.**
2) **Click 'Help' in MICOME menu and check the massages it provides.**
3) **Check out the part which 'Help' messages indicate.**
4) **In case of emergency, give first-aid treatment, first.**
5) **Inspect the state of chiller and other peripheral devices (Pressure, Temperature).**

11-1 GENERATOR(Generator) errors

11-1-1 GENERATOR PRESSURE HIGH

1) Symptom

The pressure is over 0kg/㎠ and the temperature is over 165℃. The refrigerant overflow (comparing with standard level) and the temperature of chilled water may not cooled down normally. If this problem goes on, crystal can be formed easily. When it's not operated normally, chiller may stop automatically with staring dilution operation. It makes burner stop, and it makes the pressure down in generator. Pumps of chiller and cooling water stop in order.

2) Causes (In case of Chiller)

①Temperature of the cooling water inlet is too high.
②Crystal is formed.
③The amount of exhausted gas applying to chiller is too much – when it is over supplied. (comparing with standard amount.)
④Cooling cycle is not appropriate.
⑤Absorption solution is not supplemented to the generator

3) Troubleshooting

If you drop the pressure, problems with high-tmep generator may be solved automatically. When it has no special problem, press Cancel button and inspect the peripheral devices after stopping operation, then reset the machine.

①The cooling tower which doesn't work properly causes problems. Check if the temperature of cooling tower is set precisely in MICOM, and set the temperature as a standard value (Operation– 32℃, Stop – 28℃). Check if the automatic switch of the MCC panel works properly. If it is in a manual mode, convert it to automatic mode. Check the cooling tower automatic switch of the panel is in automatic mode normally. If it is in manual mode, convert it to automatic mode. If the cooling tower setting is operated by thermostat or the other devices, inspect the appropriate parts.
②When you find out crystals, melt them down. (Refer to crystal dissolution)
③Measure the gas (oil) wastage, and contact our service center or the burner company.

④If everything above is all right, the cooling cycle has a key problem. Contact with our service center.

⑤At first, inspect if the absorption solution pump is rotating properly. Then, check the circulating system from absorption solution to generator.

11-1-2 GENERATOR TEMPERATURE HIGH

1) Symptom

Same problems may occur with PRESSURE HIGH error in the generator. The pressure of generator may be over 0kg/㎠, and the refrigerant may overflow. Finally it stops operating in the same way as PRESSURE HIGH error of generator.

2) Possible Causes

Cause is the same as that of 'PRESSURE HIGH error of generator' (Except ⑤ of 2) and 3) in 11-1-1)

3) Troubleshooting

The procedure is the same as 11-1-1. The temperature of generator may falls down after dilution operating. Then malfunction state may be canceled automatically. Operate the abnormal stop, and press 'Cancel button'. Then inspect the peripheral devices, and operate the chiller.

11-2 Error in all sorts of temperature sensor system

11-2-1 OOOOO TEMP SENSOR ABNL

1) Symptom

'(All kinds of) Sensor Name + Temperature Sensor Errors' shows up on message window. The temperature '0 or 388.8℃' or '–40 or 140℃' is displayed on the temperature window of abnormal temperature sensor. Some sensors can still work and it depends on the type of sensor. Generally chiller may stop, or can not work. For the option type sensor, it can work even when it has this kind of problems.

2) Cause

①Short circuit or disconnection of each sensor.

②Resistance value is unstable because of a shock.

③The main board can not read the resistance value.

④The sensor's type is not set properly.

3) Troubleshooting

①The sensor should be changed.

②Inspect or change the main board.

③You can set the sensor on the subordinated part on the system menu in Menu window. Change the setting of the sensor you are not using from 'Use' to 'No Use'. When the problems go on after the sensor is installed, contact our service center.

※You can operate the machine for a while with emergency measures, but it is so dangerous that you should operate the machine after proper measures.

11-3 Error in chilled water system

11-3-1 CHLD WATER PUMP INTERLOCK ABNL

1) Symptom

It stops immediately when chilled water pump interlock gets malfunction. All the pumps of chiller include absorber pump and burner stop working. At this time, only dilution operation time may be run. It can be frozen to burst when generator is high and chiller inlet's temperature is low while normal operating. In this case, emergency measures are needed because it is seriously dangerous.

When you try to start operating, the chiller will not get started with the message 'Check chilled water pump'.

2) Cause

①When a chilled water pump stops working suddenly while operating.

②When a user converts a chilled water pump 'MAN' to 'AUTO' in a moment while the chiller is operating.

③When the wire of chilled water pump interlock is not well connected, or the signal is not sent.

3) Troubleshooting

① In this case, it's seriously dangerous, restart the cooled water pump immediately regardless of the state of chiller. Especially when the temperature of the generator is high, and the temperature of cooled water is low (below 10℃), you have to make the cooled water flow into chiller with all methods. And you have to keep the cooling water from flowing in any case, even the cooling water stops flowing when it is abnormal (when it is automatic mode). (When it is manual mode, you should stop the cooling water pump.) However it is not dangerous that much when the temperature of cooled water is high, and the temperature of generator is low(below 80℃). But remember that chilled water should be circulated, and cooling water should not be flowing. When the main pump of chilled water is malfunctioned, get started immediately auxiliary pump to flow chilled water to chiller. If impossible, open the cooling/heating conversion valve A and C to stop the cooling operation, and open the chilled water drain valve to drain water of inner part of water tank and make chilled water flow into the chiller. Being frozen to burst makes rapid progress in following three conditions. **The three facts (the temperature of generator is high, the temperature of chilled water is low and the absorbing power of absorber is strong while cooling water is flowing through absorber.) make rapid being frozen to burst progress.** While operating, be careful as much as you can not to make above three conditions to prevent from being frozen to burst. When chilled water pump stops working, restart the system after you find out causes and take proper measures. When the chilled water main pump is out of order, get started to operate auxiliary pump after inspecting pipe for chilled water to check if circulation is normal. At that time the auxiliary pump must be in 'MAN' or 'AUTO' mode, then reset the chiller system. If there is no switch or

relay to convert a main pump to an auxiliary pump, you must install it.

② Never change chilled water pump mode while operating. If it is converted, return to its previous mode immediately and restart with following two ways. Turn off the power of MICOME and turn it on again, then restart the chiller. The other way is that restart chiller after chiller stops completely and convert manual mode to automatic mode.

Check if the Interlock contact inside MCC operates normally when the pump get started. If the contact point of chilled water is normal, the main board may be defective. In this case contact us.

11-3-2 CHLD WATER LOW FLOW

1) Symptom

When the chilled water FLOW is not enough, chiller stops immediately and operates like when chiller is malfunctioned. It is also seriously dangerous. It is more emergency state than chilled water pump interlock error. When you have started operating, you can only find out the message saying 'Check if chilled water is enough', it may not work until FLOW is enough to flow normally.

2) Cause

①When chilled water can not flow normally and the FLOW is not enough. When a chilled water pump doesn't work properly and it causes no-load operation or when bearing is damaged.

②When there is air in pipes and it interrupt chilled water flowing.

③When the chilled water pipe valve or valve of chilled water head is locked, it interrupts the normal circulation.

④When the differential pressure valve of By-pass pipe doesn't work properly, or By-pass valve of pipe is not handled properly.

⑤When the FLOW pressure control switch or the flow switch of chiller is malfunctioned and the control is abnormal.

⑥When FLOW doesn't flow instantaneously after chilled water pump gets started (when FLOW is changed).

3) Troubleshooting

①Check the pipe for supplying water in chilled water pipe. Check if the drain valve among pipe lines is open or broken and it causes a water leakage or not, then close the valve or fill up the water through the supplying water pump. Check if the pump works normally and any other pumps operate regardless of the chiller you are operating. If the pump is malfunctioned, convert to auxiliary pump. If a pump is working regardless of the chiller you are operating, modify the condition.

②Get rid of the air using the air vent of chilled water pipe or any other devices.

③Open the valve of chilled water pipe or vale of chilled water header. Especially be aware not to close the header valve even though you are not using air handling unit or other FCU, because it causes FLOW shortage. Open all these valves.

④When there is a pressure regulating valve in chilled water header or a 3-way valve in FCU, check

if these valves are normal by manometer test and other methods. Then if the valves are not normal, replace, repair or adjust them.

⑤If above (1) ~ (4) checking point are all normal, the flow switch is malfunctioned or not set properly. Contact us and get proper troubleshooting. The chilled water flow switch and the differential pressure control switch are immediate causes of serious accident such as being frozen to burst problem, so you should not control them as you please.

⑥If there is a fall or change in pressure after operating chiller water pump, the flow switch can stop in an instant or differential pressure control switch can be malfunctioned due to the decrease of pressure difference. That means when you operate two and more chiller and chilled water pipe is laying to header, these problems occur easily. So change the facilities or find out and solve the problems that cause the FLOW change to flow FLOW regularly.

11-3-3 CHLD WATER TEMPERATURE LOW

1) Symptom

As the temperature of chilled water falls to almost set up value, chiller close the control valve automatically in proportion to the chilled water temperature to maintain the temperature. When the temperature is lower than -1.5℃ comparing with the set up value, refrigerant pump may stop. When chilled water is too low (lower than 2.5℃ comparing with set value of chiller), chiller shows the message saying' **CHILLED WATER TEMPERATURE LOW'**, and sounds an alarm buzzer, and stops automatically. At this time refrigerant pump stops automatically, so sometimes you can see the ice made of refrigerant through the evaporator window. Users can modify the set-up value above.

2) Cause

①When the chilled water is too low, cooling load is so small that cooling cycle has formed already even though the chiller controls the temperature. That is why the low temperature causes the problem.

②When you decrease the cooling load at once (air handling unit and FCU) while normal operating, cooling load may be decreased suddenly. Then chiller can not catch up the gap. Furthermore if the chilled water temperature falls, the problems occur.

3) Troubleshooting

To solve ①, ② above, increase the cooling load by operating air handling unit or FCU if chilled water temperature falls too much.

It is not serious that refrigerant is frozen when you look out the evaporator inspection window, but it causes bursting easily. That's why the chilled water pump must not stop working. The refrigerant ice may be melted immediately by operating refrigerant for a moment in 'MAN' mode. (But when chilled water temperature is too low and refrigerant pump stops automatically, do not operate refrigerant pump in a manual mode. In other words, it is the best way to leave refrigerant in stop state.)

11-3-4 CHLD WATER FLOW SENSOR ABNL

1) Symptom

Only for the machine with chilled water FLOW sensor, this kind of problems occur. Stop the operation immediately in the same way as the chilled water FLOW low error in 13-3-2.

2) Cause

When the chilled water FLOW sensor gets malfunctioned or FLOW is abnormal, it causes the FLOW sensor to work.

3) Troubleshooting

Find out and troubleshoot the causes of chilled water FLOW sensor operating. Take measures in the same way as 14-3-2.

11-3-5 ① CHLD WATER PUMP INTERLOCK JUMPED
② CHLD WATER FLOW INTERLOCK JUMPED

1) Symptom

When you operate the chilled water pump in 'MAN' mode and try to start chiller, chiller may not operate with the alarm and alert message. The messages concern the 'chilled water pump jump alarm' or 'chilled water FLOW interlock jump alarm'.

2) Cause

Both ① and ② occur when you are operating the chilled water in 'MAN' mode or other pump flows chilled water before operating a chiller. Because the 'chilled water FLOW interlock' and 'chilled water pump interlock' on MICOM system menu is set to 'Use'.

3) Troubleshooting

If the chilled water pump interlock and chilled water FLOW interlock are set to 'Use', you must convert to 'No Use'. If you set to 'Use', you can operate the chilled water pump in 'MAN' mode, but you can not operate the chiller. Because when the chilled water pump interlock (or chilled water FLOW interlock) is set to 'Use', the state must be input according to the starting order of chiller. At this time, convert the chilled water pump state to 'AUTO' mode and have the pump of chiller started. There is another way, that is, select the system menu on MICOM and input the password (_ _ _ _). Then set the chilled water pump interlock (chilled water FLOW interlock) to 'No Use'. For this condition only, you can operate manually.

11-4 Error in cooling water system

11-4-1 COOLING WATER INTERLOCK ABNL

1) Symptom

When the cooling water pump stops operating, the chiller stops working with the message saying

'**COOLING WATER INTERLOCK ABNL**' and alarm. At this time, the chiller stops performing dilution operation under abnormal stop.

2) Cause

① It happens if a cooling water pump stops while a chiller is operating.

② It happens if a cooling water pump is turned to 'AUTO' from 'MAN' mode or 'MAN' from 'AUTO' mode when chiller is operating.

③ It happens if interlock contact point is bad.

3) Troubleshooting

① Find and remove the cause by which cooling water pump stopped. Thereafter, start up chiller again.

② A user should not switch cooling water pump to 'auto' from 'manual' mode or 'manual' from 'auto' mode. When chiller stopped completely, switch cooling water pump to 'auto' mode and start up chiller again.

③ Check up whether interlock contact point of MCC panel in cooling water pump works according to the start state of the pump.

11-4-2 COOLING WATER TEMPERATURE LOW

1) Symptom

If it operates over 30 minutes under condition that cooling water's temperature is below 18℃, a message of 'Cooling water's abnormal low temperature' is indicated, and buzzer rings, and it stops doing dilution operation. If it operates for a long time under condition that cooling water's temperature is low, it stops automatically to prevent crystallization. (when it operates below the lowest temperature, 18℃ for more than 30 minutes, the conditions of time and temperature can be set by a user.)

2) Causes

① It happens if cooling tower keeps on operating due to the wrong setting of cooling tower's temperature.

② It happens if it keeps on operating in manual mode of cooling tower.

③ It happens if cooling water's temperature lowers because the temperature of the outer air is too low even though cooling tower doesn't operate. So to speak, it happens when the load is too little.

3) Troubleshooting

① In case of setting up cooling tower's temperature at chiller, check up whether cooling tower pan's stop temperature and start temperature are set rightly on user configuration of MICOM main menu. If they are wrong, correct them. In case that cooling tower is controlled through thermostat or DDC panel's auto-control, check up and correct them.

② Switch cooling tower to auto mode.

③ If the outer air's temperature is low and the load is too little, cooling water's temperature does not rise because the amount of heat exchange inside chiller is considerably less than the amount of heat exchange outside cooling tower. In that case, using air handling unit, make natural air environment without chiller's operation, or make a bypass to prevent cooling water from circulating through cooling tower.

11-4-3 COOLING WATER FLOW SENSOR ABNL

1) Symptom

This applies to only machines on which cooling water FLOW sensor is attached. In this case, it stops in the same way as in 'cooling water's low FLOW' of 13-4-5.

2) Cause

The cooling water FLOW sensor is operating

3) Troubleshooting

Find out the cause and resolve it. Troubleshooting is the same as those of section 13-4-5.

11-4-4 ① COOLING WATER PUMP INTERLOCK JUMPED
② COOLING WATER FLOW INTERLOCK JUMPED

1) Symptom

Chiller doesn't operate, and a message of 'cooling water pump interlock jump alarm' is indicated, and buzzer rings.

2) Cause

Cooling water pump operates in manual mode. This is the same as the cause of chilled water pump/FLOW interlock alarm of Section 8.

3) Troubleshooting

Set cooling water pump interlock jump alarm and cooling water FLOW interlock jump alarm to 'no use'.

11-4-5 COOLING WATER FLOW LOW

(This is optional because flow switch or differential pressure switch is generally not on chiller.)

1) Symptom

If cooling water FLOW is not sufficient, it stops in the same way as that of cooling water pump interlock error. In this case, the pressure of cooling water pump shakes or falls. This leads to a rise of chiller's inner pressure, and a steep rise of high temperature generator's pressure comparing to normal times, and errors of 'high temperature generator's high pressure' and the like. In addition, high temperature generator's pressure stays on higher state, and crystallization is likely to happen because the flow of absorption solution is not smooth.

2) Cause

① It happens if dispersed cooling water is too much because cooling tower's fan has some trouble, or the quantity of filling water is less than that of dispersed cooling water.

② It happens if cooling tower is not sufficiently supplied with filling water, or cooling tower lacks water on account of the open drain valve of cooling water.

③ It happens if air is mixed on account of cooling water's low FLOW inside cooling tower when cooling water starts up at the beginning.

3) Troubleshooting

① Consult with the manufacturer of cooling tower about the cause of excessive dispersion.

② Check up filling water pipe, valve and so on in order that the supplement goes on smoothly.

③ Check up whether cooling tower's tank is always filled with water in starting up at the beginning.

11-5 Error in Hot Water Control Valve

11-5-1 ① Control Valve 1 Feed Back Error

② Control Valve 2 Feed Back Error

1) Symptom

The control valve opening of a burner displays error and then 1 feedback error on the control part occurs. The control valve of a burner doesn't work normally in opening and closing.

2) Cause

①When potential meter of burner is not normal.

②When MICOM main board doesn't recognize the opening of burner.

3) Troubleshooting

①Abnormal potential meter in control valve motor of burner causes defective input/output signal. Potential meter should be replaced.

②When an output of resistance value in potential meter is normal, check the terminal contact of wiring.

11-6 Error in the main body and a chiller

11-6-1 STORAGE TANK PRES SENR ABNL

1) Symptom

Only when pressure sensor for storage tank is installed, it can occur.

2) Cause

When an abnormal value of pressure sensor for storage tank is output.

3) Troubleshooting

It is necessary to inspect the pressure sensor for storage tank.

11-6-2 EVAP REFRIGERANT TEMP LOW

1) Symptom

Only when refrigerant temperature sensor is installed in an evaporator, it can occur. When the temperature of refrigerant is less than 2.5℃, a chiller stops working. (temperature setting available)

2) Cause

In general, when refrigerant pump stops and the temperature of refrigerant in an evaporator is less than 2.5℃, it occurs.

3) Troubleshooting

Operate a chilled water pump by hand and raise cooling load for increasing the temperature in an evaporator.

11-6-3 STORAGE TANK PRES ABNL

1) Symptom

Only when a pressure sensor is installed in a storage tank, it occurs. When pressure in a storage tank goes up to more than the setting value, pressure rise alarm message will be displayed.

2) Cause

The pressure inside storage tank is over the designated value.

3) Troubleshooting

Perform purge task for storage tank.

11-6-4 STORAGE TANK PRES HIGH

1) Symptom

This case is only when pressure gauge is installed in storage tank. Alarm for high pressure in storage tank shows up when the pressure inside storage tank is over the designated value.

2) Cause

The pressure inside storage tank is over the designated value.

3) Troubleshooting

Perform purge task for storage tank.

11-7 Error in electric motor system

11-7-1 ① NO SIGNAL-REFRIGERANT PUMP
② NO SIGNAL-PURGE PUMP

1) Symptom

The output signal for refrigerant pump shows up in MICOM but the input signal does not. Chiller is working normally but alarm shows up.

2) Cause

Magnet does not contact properly in refrigerant pump or input contact point is defective in I/O board.

3) Troubleshooting

Check the contact point of magnet in refrigerant pump. Replace magnet or change the contact point if there is a problem.

11-7-2 ① ABS SOL PUMP 1 THR ERR

② ABS SOL PUMP 2 THR ERR

③ REFRIGERANT PUMP THR ERR

④ PURGE PUMP THR ERR

1) Symptom

"**Name of corresponding part + overheating**" message shows up and dilution operation stops when electric current flows excessively in each electric motor, that is each pump motor attached in chiller. In case of absorption solution pump 1, the effect of dilution operation is less as it does not work.

2) Cause

①Foreign material gets in each pump or pump performs no-load operation for a long time.

②Insulation of each pump is bad.

③Thermal relay attached in each pump does not work properly or the current is designated low.

3) Troubleshooting

①Check whether pump performs reverse resolution or no-lead operation when it operates. If pump performs reverse revolution or no-lead operation, it means there are defects, absorbent is insufficient or cooling water flows abnormally (Refer to 13-4-5 "Cooling water's abnormal low FLOW"). Refrigerant pump performs no-lead operation when refrigerant is insufficient or cooling cycle is built abnormally. Perform crystal dissolution when it is due to crystal. Adjust again the cooling cycle or add refrigerant when refrigerant is insufficient. (Excluding the no-lead operation of purge pump).

②Check insulation of each pump by MΩ test on 3 phases of R, S and T. Replace the pump if insulation is bad. The insulation of contact point and each phase must be over 500 MΩ.

③Check whether the current value set in thermal relay of each pump magnet is normal or not. Replace the thermal relay if the current value is normal when it of each pump is measured and thermal relay is defective when the value of it is increased.

11-7-3

① ABS SOL PUMP 1 INTERLOCK JUMPED

② ABS SOL PUMP 2 INTERLOCK JUMPED

③ PURGE PUMP 1 INTERLOCK JUMPED

④ REFRIGERANT PUMP INTERLOCK JUMPED

1) Symptom

Alarm message shows up when the condition signal of each pump attached in chiller is inputted or jumped regardless of the control of chiller.

2) Cause

Condition signal of each pump attached in chiller is inputted or jumped regardless of the control of chiller.

3) Troubleshooting

Release the jumped part if absorption solution pump and refrigerant pump is jumped as they operate according to the control of chiller. Contact our service center as it is possible for MICOM has troubles when there are troubles although releasing them.

11-8 Error in MICOM

11-8-1 Error messages

- **COM1 BCC Error COM1 ETX Error**
- **COM1 Data Length Error**
- **SEND-SENSOR- Error**
- **SEND-SAFESET- Error**
- **REQUEST-INPUT Error**
- **REQUEST-TIMERIEW-Error**
- **SYN Error**
- **MAIN<-**
- **Display Communication Error**

1) Symptom

They show up when communication each other between main board, display board, I/O (Input/Output) board –A, and I/O board (Input/Output) -B is bad.

2) Cause

The contact between main board, display board, I/O board – A and I/O board – B is bad.

3) Troubleshooting

Check jacks in each part as these troubles occur because contact parts of power or communication in each board are bad. Contact our service center when there are troubles after troubleshooting them.

11-8-2 MAIN BOARD RESET

1) Symptom

Message shows up when resetting the system.

2) Cause

The system is reset.

3) Troubleshooting

It is necessary to reset the system. Contact our service center.

11-9 Other errors

11-9-1 Temperature of chilled water does not fall.

1) Cause

① Crystal is formed.

② Cooling does not work when the temperature of cooling water is so high.

③Cooling does not work when refrigerant is mixed with absorption solution or it is contaminated.

④The pressure inside the chiller is high as the purge condition is bad.

⑤The speed that temperature of chilled water falls is slow when the control valve is changed to 'Manual' and low combustion is maintained.

⑥There is very small leakage in some place of chiller.

2) Troubleshooting

①Perform crystal dissolution operation when crystal is formed. (Refer to 9-2 Crystal dissolution).

②The fan of cooling tower does not work properly or water circulation is not normal due to the shortage of cooling water FLOW when the temperature of cooling water is so high. Check cooling water circulation and supply water more or make the fan of cooling tower work properly.

③Evaporation capacity of refrigerant gets down when refrigerant is mixed with absorption solution. Therefore temperature of refrigerant does not fall and absorption capacity is reduced. Perform the Blow-down. (Refer to 7-3 Blow-down).

④Cooling cycle is not formed and crystal is easily formed and pressure and temperature of generator gets high when the pressure inside chiller is high. Perform purge task.

⑤The control valve does not moved in low combustion and the temperature keeps low in generator when the control valve is in Manual. The low temperature of generator means decreasing the cooling capacity of chiller. Convert the control valve of MICOM panel to Automatic.

⑥Cooling does not work and the temperature of chilled water does not fall and the inside of the equipment corrode when there is leakage part. Therefore, contact our service center immediately when there is leakage.

11-9-2 Temperature of cooling water does not fall.

1) Cause

There is a trouble in cooling water FLOW, the fan of cooling tower or cooling tower itself.

It is possible for cooling tower not to work properly due to the troubles in control of cooling tower.

2) Troubleshooting

Check whether cooling water FLOW is enough or not and supplement it more.

Contact the company involved cooling tower when there is a trouble in the fan of cooling tower or

cooling tower itself.

11-9-3 There is too much refrigerant in inspection window.

1) Cause

Too much refrigerant is in inspection window of refrigerant because the temperature of generator is high.

2) Troubleshooting

It is normal as refrigerant is filled by half of the inspection window of evaporator and overflow automatically when the temperature of generator is 156℃. However, perform Blow-down and Crystal Dissolution operation if crystal is formed.

11-9-4 Abnormal noise occurs.

1) Cause

①Pump makes a noise severely when absorption solution pump performs no-load operation.

②Heat exchanger makes a hammering noise when operating cooling. It is caused as circulation cycle of absorption solution is not proper.

2) Troubleshooting

① Absorption solution pump performs no-lead operation if it makes an abnormal noise severely. Bearing of absorption solution pump may be damaged and pump is stuck and broken when absorption solution pump performs no-lead operation. Therefore, perform Blow-down or close the control valve manually to decrease the amount of evaporation in generator and make absorption solution be collected absorber. And then decide to do whether crystal dissolution or re-operation

② The hammering noise is made when the flow of absorption solution is interrupted in a moment between generator and low-temp generator. As it is usually caused before low-combustion goes to high-combustion or does in reverse. Thus, adjust again the cycle with intermediate solution damper or do the entire cycle. However, noise to some extent is normal one as it is impossible to make absorption solution flow perfectly continuously according to the status of chiller. It is recommended to adjust it when the noise occurs often and severely.

12. Emergency troubles

12-1Frozen burst

12-1-1 What is frozen burst?

Frozen burst means a copper pipe inside evaporator, absorber, condenser and so on is frozen to burst. It occurs as volume is increased when water is changed to ice. Usually evaporator is frozen to burst in the season to be cooling. Absorber or condenser is frozen to burst as the remaining water inside it is frozen to make copper pipe burst when it is kept for a long time in winter season. As frozen burst occurs in the water part, it is recommended to control chilled water part thoroughly to prevent frozen burst from happening.

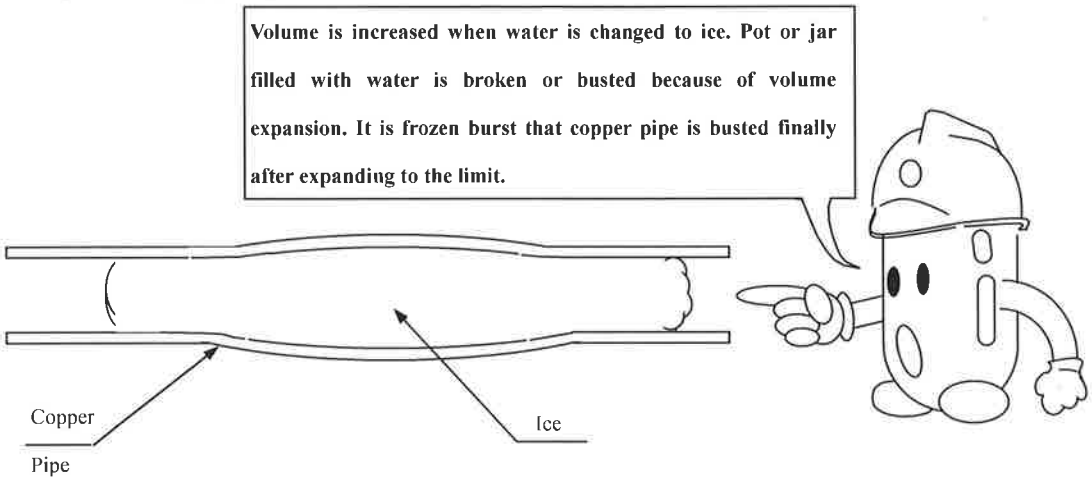


Figure 14-1 Frozen Burst

12-1-2 Cause of frozen burst

1) Chilled water is frozen to burst inside copper pipe when chilled water does not flow normally by sticking foreign materials in water part of evaporator. Therefore check all the time if chilled water flows smoothly when operating chiller. If there is a trouble in it, take an action as soon as possible. Chiller stops operating immediately when chilled water temperature gets so low(under 2.5℃ – Adjustable in MICOM). However it does not stop as MICOM can not detect whether the inside of copper pipe is blocked. Frozen burst occurs in this reason.
2) Temperature of chilled water falls suddenly and chiller starts controlling immediately when load of air-handling unit or other equipment is stopped at a time while operating fully chiller.

However, cooling capacity is maintained with the remaining heat as absorption capacity of absorption solution is maintained in high temperature inside the generator. Therefore, it is recommended not to decrease suddenly the load of air-handling unit (AHU or FCU) or other equipment as it causes copper pipe burst.

3) Chilled water does not circulate if there is air a lot inside the pipe for chilled water. Air inside pipe disturbs circulation of chilled water inside evaporator. It also causes frozen burst as it is the same as sticking foreign material inside copper pipe in 1).
4) Contaminated chilled water or cooling water scales in the pipe and also block it. It also causes frozen burst as it is the same as sticking foreign material inside copper pipe described in 1).
5) Chilled water or cooling water makes copper pipe corrode and cause burst when they are contaminated and water quality gets worse. It is different from pipe burst caused by temperature's lowering but it is important to control water quality as it is also fatal. Especially copper pipe can be corroded with remaining chemical material during cleaning pipe if it is not neutralized enough after cleaning pipe. Therefore, it is recommended to use the contract system for maintenance that we advise.

12-1-3 Frozen burst prevention

1) To prevent against frozen burst, it is important to control thoroughly water circulation. Usually operate the pump after supplying chilled water and cooling water at the beginning of trial run. And then clean perfectly the inside of pipe and remove foreign material thoroughly by draining it out 2~3 times after water circulation. Mainly foreign material (bolt, nut, welding slug, gloves and so on) is stuck inside pipe not to flow chilled water at the beginning of trial run. As shown in Figure 14-2, sensor displays normal temperature but MICOM does not detect that temperature of some part in copper pipe falls down when foreign material is stuck inside it. That is the cause of frozen burst. To remove it, it is very important to clean the inside of pipe at the beginning of trial run.

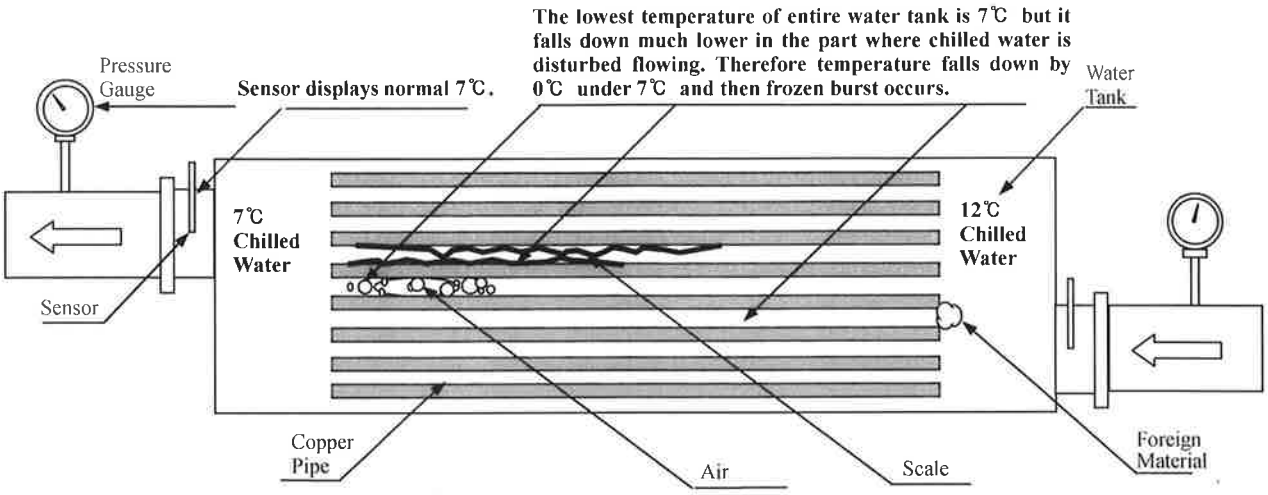


Figure 14-2 Cause of frozen burst in copper pipe

2) High temperature in generator means cooling capacity is at maximum and it has lots of cooling capacity. Temperature of chilled water falls drastically as chiller has lots of cooling capacity and cooling load is small when cooling load is decreased drastically. MICOM start controlling according to the load capacity, but temperature of chilled water falls continuously with cooling capacity regardless controlling in generator. Therefore, it is very dangerous to decrease drastically cooling load in incidental equipment such as air-handling unit, fan coil and so on. To prevent danger, cooling load of incidental equipment such as air-handling unit, fan coil and so on must always be decreased after completion of chiller operation or decreased step by step.

3) Air inside pipe for chilled water must be removed completely and automatic air bent must be installed to remove air as it is generated continuously by pump after purging completely. Also it is necessary to check water circulation by installing pressure gauge in the pipe for chilled water as water does not circulate well when air is filled in it. As shown in Figure 14-2, outlet side always forms lower pressure than inlet side because of the loss of pressure when chilled water flows inside the chiller. A user can check indirectly whether water circulates normally through it or not. Pressure difference is too greatly or little between inlet and outlet when water does not circulates normally. Also the needle of pressure gauge shakes severely as opened status of pressure regulating valve in pipe for chilled water or valve in header is bad or expansion tank operates abnormally. At that time, check it out and take an action to correct the phenomena. Pressure difference is different according to models of chiller. Usually it is normal to be minimum over 0.3~0.5kgf/㎠. It is normal for temperature difference between inlet and outlet for chilled water to be under 5℃. Check water circulation and take an action to correct as FLOW of chilled water is less if temperature difference is

over 5℃. Therefore, install a pressure gauge if possible and check it often while operating.

4) It is necessary to clean periodically as it is a cause of frozen burst when efficiency drops by scaling from contamination of chilled and cooling water.

5) Replace chilled or cooling water perfectly or neutralize it with a proper chemical to avoid corrosion inside of the pipe when chilled or cooling water is contaminated. Especially neutralize it completely to use when pipe is cleaned with a chemical at the beginning of trial run.

12-1-4 Troubleshooting on frozen burst

1) Chilled water is going up to the upper of inspection window for refrigerant in evaporator and cooling does not work when frozen burst occurs. It is also possible for chiller to be deformed by water pressure when pressure of pipe is high.

2) Turn off the power of chiller immediately at frozen burst.

3) Stop pumps of chilled and cooling water. It is stopped as soon as the power of chilled and cooling water is turned off. (Stop it by pressing switches on MCC panel in case pumps are operated manually).

4) Lock off completely valves of chilled and cooling water as soon as possible.

5) Generator can be deformed if the pressure of pressure gauge in it is over 0.5kg/㎠. In this case, put a big container like a drum can under service valve of heat exchanger or generator and discharge absorption solution by opening valves so that the interior pressure of it gets under atmospheric pressure(0kg/㎠).

6) Contact our service center immediately when frozen burst occurs. In case pressure of chilled water is high, contact our service center after doing troubleshooting the above.

12-2 Troubleshooting on power interruption

Chiller is stopped immediately as power is turned off when operating. Chiller operates normally by supplement function of MICOM when power is interrupted instantaneously (0.2 ~0.3 seconds).

Chiller operates normally by operation function for power recovery at power interruption in MICOM when power is interrupted long time. (only when "Select Operation for Power Interruption" is selected).

Chiller operates by operation timer of "Operation and dilution at power recovery" (1 to 360 minutes: default value is 30 minutes). Chiller operates again when it is within the set time and stops and performs dilution operation when it exceeds the set time. Chiller is stopped completely by "Prevention for operation at power recovery" function (1 to 888 minutes: default

value is 60 minutes) when it exceeds the set time in "Prevention for operation at power recovery"

Follow the below in the main menu to select operation at power interruption.

System Menu – Safety Control – Select Operation at Power Interruption

When a user set "Re-operation" instead of "Stop" in "Select Operation at Power Interruption", chiller operates automatically again when power interruption time is within 30 minutes (It is possible to adjust the set time) and performs dilution operation when it exceeds 30 minutes according to the set function. However, chiller is stopped completely by "Prevention for operation at power recovery" when power interruption time is over 60 minutes.

12-2-1 Instantaneous power interruption

Chiller-heater operates continuously by supplement function (within 0.2~0.3 seconds) of MICOM when power is interrupted instantaneously. It operates normally as it does continuously in this case. (But it can be stopped abnormally by closing the electric valve of burner although it is within 0.2 ~0.3 seconds). Chiller-heater operates again after stop when performing dilution operation. Also **operate it again** by pressing operation button immediately when it does not work at all after it is turned off and on and stopped completely. (In case of "Select operation at power interruption").

12-2-2 Long time power interruption

It is easy for crystal to be formed when power is interrupted for a long time. Use the "Select operation at power interruption" function to avoid it. Then chiller-heater operates again or performs dilution operation at power recovery after power interruption described in 14-2. However, take a proper action immediately when power is interrupted for a long time (Usually 20~30 minutes although it depends on the status of outlet for chilled water and high-temp generator) as it can be frozen to burst in this case. Chilled water must be circulated continuously most of all.

①If there is an electric generator, all the incidental equipment (chilled water, cooling water, cooling tower and so on) of chiller-heater must be connected **electric generator** to operate it again by being connected electric generator automatically and turned on the power at power interruption.

②If there is an electric generator but it is impossible for all the equipment to connect it due to the capacity of electric generation, **pump for chilled water** must be connected electric generator to operate automatically(or manually) it immediately. Pipe is not frozen to burst when chilled water circulates continuously.

③If there is no electric generator (or power supply is delayed to pump for chilled water as an electric generator does not operate in a short time), open slowly **valve A for cooling and heating conversion** of chiller-heater to input directly refrigerant steam from the high-temp generator to the main body and lower the pressure inside the high-temp generator and input refrigerant steam to absorber and evaporator to raise the temperature inside of them not to work cooling operation. Or it is also possible to flow chilled water even a little by opening drain valve for chilled water temporarily. However it is complicated as a user must fill again chilled water and operate again chiller-heater after air purge because air goes into the pipe.

Check whether crystal is formed or not when chiller-heater operates normally after power recovery. Perform crystal dissolution operation when crystal is formed. (Refer to "10, Crystal and crystal dissolution" in page 88).

13. About maintenance contract

Daily d regular repair and inspection are necessary for keeping the safety, high efficiency and lengthening the life.

From the trial operation to the term of guarantee, C/S personnel of this company gives a traveling inspection and repairing for preventing breakdown and lengthening the life. And before or after termination of terms of guarantee, yearly repairing contract can be made at the same time when a chiller contract is made.

Main checking points are as below.

1) operation of each safety device and its adjustment
2) operation analysis and measure
3) management of absorption solution and refrigerant
4) management of combustion device
5) maintenance of vacuum
6) diagnosis and repair for absorption solution pump, refrigerant pump and purge pump

13-1 Yearly repair contract convention

Make use of yearly repair contract convention for performing regular inspection/repair and using a chiller safely. With repair contract, repair/inspection/regulation task are performed by this company independently, a chiller is working and being maintained at the optimal state. In case of trouble, parts and service are provided preferentially.

In general, overhaul other than regular check, regulation and repair, is to be performed per 3~5 years for maintaining the performance and life.

In case overhaul is necessary, task time and diagnosis will be handled within yearly repair contract.

And cleaning tube for water system will be handled by a separate contract.

13-2 Inspection Table

Inspection Table is published when task is performed by yearly contract convention. In this table, regular checking point and details are included carefully to prevent any omission.

A service personnel of this company writes down history of inspection and regulation and presents one to the client and the other to this company for diagnosis and history use.

13-3. Operation History Table

(Example) **< Operation History Table >**

year month day machine number production number:

Item	Unit							
Time	:	:	:	:	:	:	:	:
Chilled water Inlet Temp	℃							
Chilled water outlet Temp	℃							
Generator Temp.	℃							
Cooling water Inlet Temp.	℃							
Cooling water Outlet Temp	℃							
Hot Water Inlet Temp	℃							
Hot Water Outlet Temp	℃							
Control valve opening	%							
Level at Sight Glass Of evaporator								
Level at Sight Glass Of absorber								
Vacuum pressure in main body	mmHg							
Vacuum pressure In storage tank	mmHg							
Hot Water Inlet pressure	mmAq							
Hot Water Outlet pressure	mmAq							
Chilled water inlet pressure	kg/㎠							
Chilled water outlet pressure	kg/㎠							
Cooling water inlet pressure	kg/㎠							
Cooling water outlet pressure	kg/㎠							

<note>
Operation history table above can be altered at will for more convenient and practical use

Chilled water FLOW: ㎥/h Cooling water Flow ㎥/h Hot Water Flow kg/h(㎥/h)

THIS PAGE WAS LEFTED BLANK INTENTIONALLY

14. Standard for main components inspection and replacement

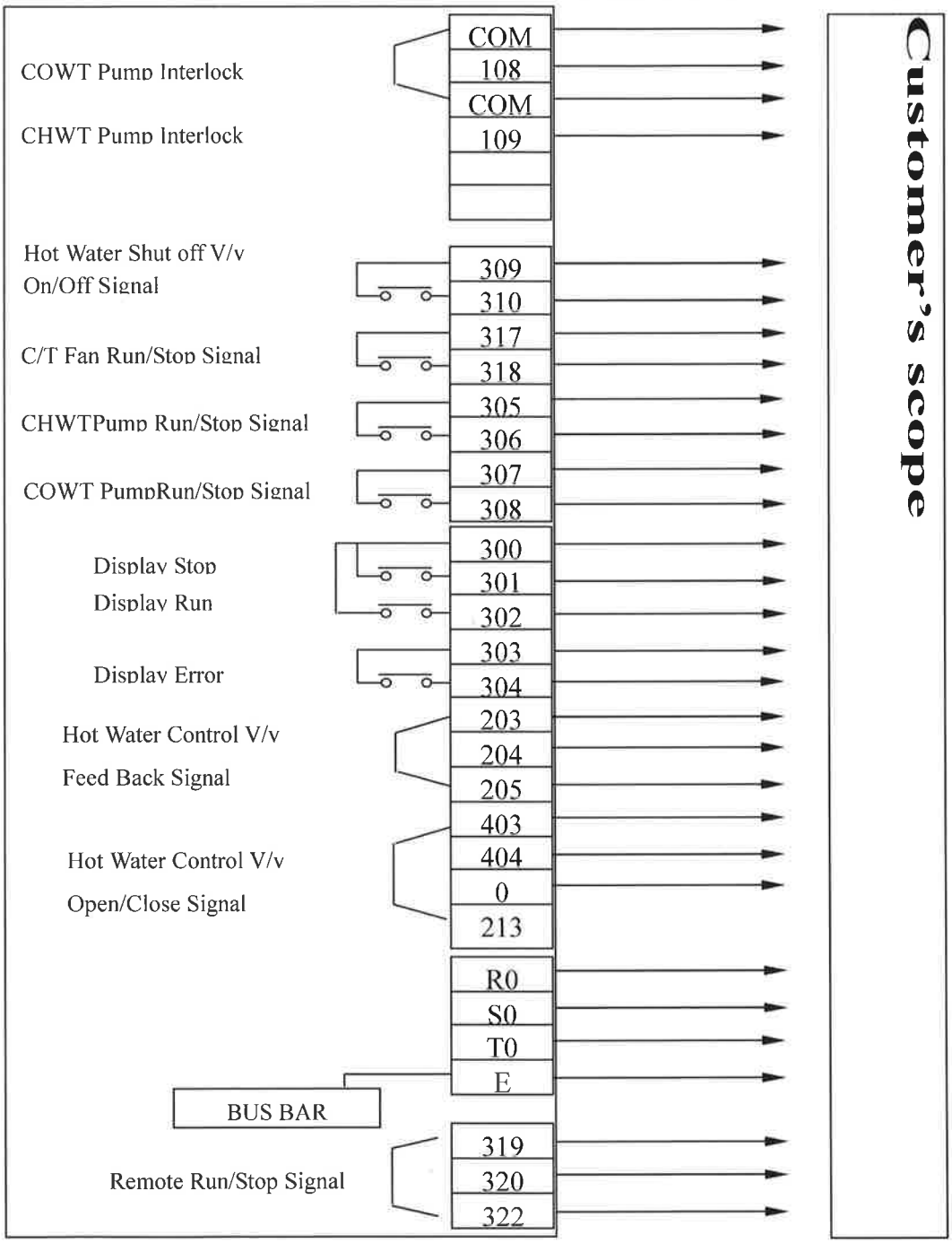
Standard Maintenance table for 24H operation use, standard use(2000 hours/year)

Parts	Part name	Checking part		Checking point	Checking method	Checking time		Note
		Vacuum	Non-vacuum			24 H operation for industrial use	Standard operation (2000H /year)	
Main body	Tube for chilled water system	●		External corrosion of tube	Eddy current test. Tube inner diameter check Visual inspection	3 years	3-5 years	Random sampling test. No vacuum break
			●	Internal corrosion of tube(scale)		1 year	1 year	
	Tube for cooling water system	●		External corrosion of tube	Eddy current test. Tube inner diameter check Visual inspection	3 years	3-5 years	Random sampling test. No vacuum break
			●	Internal corrosion of tube (scale)		1 year	1 year	
	High/low temp. heat exchanger	●		External/internal corrosion of tube(scale)	Cut-Open inspection	3 years	7-10 years	
	High temp. generator		●	Inrernal contamination	Visual inspection	1 year	1 year	Cleaning
Solution	LiBr solution	●		Solution analysis, Density, copper dissolution ratio, Alkalinity, Iron dissolution ratio, Inhibitor density	Solution sampling	6 times / year	1 time / year	.Check regularly .For 24 hours operation chiller, ajust 6 times/year.
Pump	Absorption solution pump	●		Main body, impeller, axis, coil	Disassemble & Check	If necessary	If necessary	More than 30,000 hr(life time)
	Refrigerant pump	●		Main body, impeller, axis, coil	Disassemble & Check	If necessary	If necessary	More than 30,000 hr(life time)
	Purge pump	●		Main body	Disassemble & Check	If necessary	If necessary	
				V-belt	Regular replacement	If necessary	If necessary	

Standard Maintenance table for 24H operation use, standard use(2000 hours/year)

Parts	Part name	Checking part		Checking point	Checking time		Note
		Vacuum	Non-vacuum		24 H operation for industrial use	Standard operation (2000 H /year)	
Safety & Control Device							
	Flow Switch		●	Periodic Check by Maintenance Contract	If necessary.	If necessary	
	Manometer	(●)					
	Temp. Sensor		●	Periodic Check by Maintenance Contract	If necessary.	If necessary	
	Magnet Switch		●				
	Relay		●				
	Timer	●	●				
	Control Valves	●	●				
	Modutrol Motor	●	●				
Others				Regular replacement is a principle			
	Sight Glass	●			3 Years	3~5 Years	
	Diaphragm Valve Packing	●			3 Years	3~5 Years	
	Other Valve Packing	●	●		3 Years	3~5 Years	
	Palladium Cell	●			3 Years	3~5 Years	
	Packings for Water System		●	Periodic Check by Maintenance Contract	In Checking	In Checking	

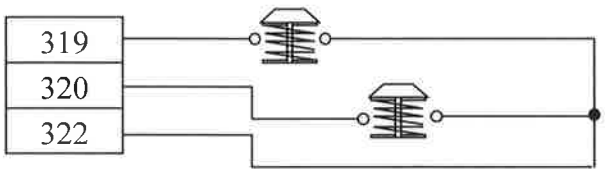
Interface connection diagram (Interlock and auto contact point)



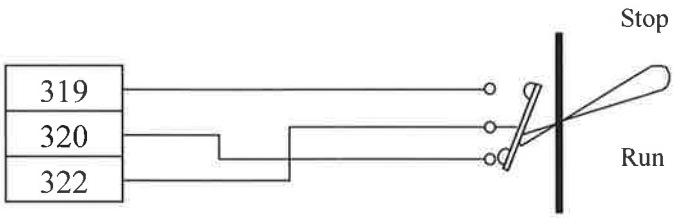
******* Chilled/cooling water pump operation / stop signal and interlock contact point art very important safety devices for preventing frozen burst and safety accident, therefore it should be wired to a chiller for linking. *******

Interface connection diagram(Remote Control Contact)

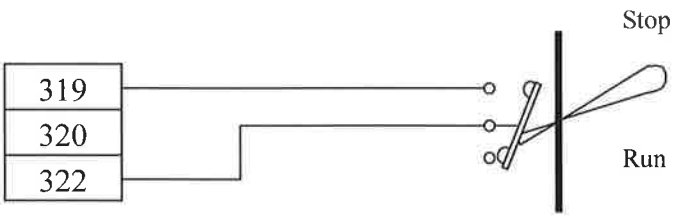
1. PulseSignal (No Voltage Contact)



2. Consecutive Signal (No Voltage Contact)



3. ConsectuveSignal (No Voltage Contact)



LG

乐金电子（中国）有限公司
乐金空调（山东）有限公司
地址. 山东省青岛市城阳区夏庄街道玉皇岭工业园
电话. 0532-80965666
邮编. 266109
网址. www.lge.com / www.lgeqa.com

营业服务中心

北京
地址. 北京市朝阳区建国门外大街乙12号双子座大厦西塔20层
电话. 010-65631061
邮编. 100022

天津
地址. 天津市南开区华苑产业区海泰信息广场G座401-405室
电话. 022-23707805
传真. 022-23707805
邮编. 300040

内蒙古
地址. 内蒙古包头市昆区东源国际大厦公寓楼2单元1704室
电话. 0472-5180955-0
传真. 0472-5180966
邮编. 014010

哈尔滨
地址. 哈尔滨南岗区松花江街15号华驿大厦28层LG电子
电话. 0451-53603071/53603072
传真. 0451-53603071
邮编. 150018

长春
地址. 长春市朝阳西安大路727号中银大厦A座806室
电话. 0431-82957788
传真. 0431-82957677
邮编. 1300616

沈阳
地址. 沈阳市皇姑区宁山中路42号蓝天大酒店5层
电话. 024-86239898
邮编. 110001

大连
地址. 大连市西岗区新开路89号金广大厦B座406
电话. 0411-83787542
邮编. 116035

重庆
地址. 渝北区新南路166号龙湖国际4栋3105
电话. 023-63020385（区域长直线） 63020386 63020387
传真. 023-63020386-606
邮编. 401147

成都
地址. 四川成都福兴街1号华敏翰尊国际大厦12楼
电话. 028-86703435 86703415
邮编. 610000

厦门
地址. 福建省厦门市思明区喜禾路321号
汇腾大厦写字楼1403、1403A
电话. 0592-5399068
传真. 0592-5399068
邮编. 361012

青岛
地址. 青岛市城阳区玉皇岭工业园LG空调
电话. 0532-80965699 80965529
传真. 0532-80965697
邮编. 266109

济南
地址. 济南市天桥区铜元局前街68号铜元大厦302室
电话. 0531-86990911/86991378
传真. 0531-86991660
邮编. 250001

潍坊
地址. 潍坊市胜利东街5011号金融服务区B座1406室
电话. 0536-8211276 13361568677（移动座机）
传真. 0536—8211206
邮编. 261041

广州
地址. 广东省广州市天河区珠江新城华夏路8号国际金融广场7楼
电话. 020-83266723 83266760
传真. 020-83266732
邮编. 510180

武汉
地址. 武汉市江汉区建设大道西北湖新世界国贸大厦1#2808
电话. 027-59337657
传真. 027-59337656
邮编. 430017

长沙
地址. 长沙市韶山北路39号唯一星城国际大厦2110室
电话. 0731-85569580
传真. 0731-85561620
邮编. 410011

南昌
地址. 江西省南昌市八一大道财富广场B座2301室
电话. 0791-6317057
传真. 0791-6317056
邮编. 330003

西安
地址. 西安市碑林区和平路116号金鼎国际大厦805室
电话. 029-85569309
传真. 029-85569309
邮编. 710001

上海
地址. 上海市黄浦区九江路333号金融广场1505室
电话. 021-52372299 52378892（区域长直线）
传真. 021-52378893
邮编. 200050

杭州
地址. 杭州市延安路511号元通大厦510室
电话. 0571-86786368
传真. 0571-86786177
邮编. 310012

南京
地址. 南京市玄武区傅厚岗1号富升大厦5楼A座
电话. 025-84679842
传真. 025-83367085
邮编. 210009

苏州
地址. 苏州市干将东路889号东锦商城508室
电话. 0512-62991501 62991502
传真. 0512-62992512
邮编. 215021

无锡
地址. 无锡市中山路343号东方广场A座10楼D单元
电话. 0510-82031969
传真. 0510-82031970
邮编. 214000

盐城
地址. 江苏省盐城市建军路中茵海华广场11栋808室
电话. 0515-89891191
传真. 0515-89891191
邮编. 224001

合肥
地址. 安徽合肥市新站区站西路1号保文国际大厦501室
电话. 0551-3667566
传真. 0551-3667066
邮编. 230011

太原
地址. 山西省太原市长风街705号和信商座28层C户
电话. 0351-3521503
传真. 0351-3521513
邮编. 030006

石家庄
地址. 石家庄市裕华区槐安东路145号西美五洲天地1802室
电话. 0311-67267336
传真. 0311-67267336
邮编. 050009

郑州
地址. 郑州市郑东新区商务外环路24号中国人保大厦19楼
电话. 0371-66616221 66616223
传真. 0371-66616220