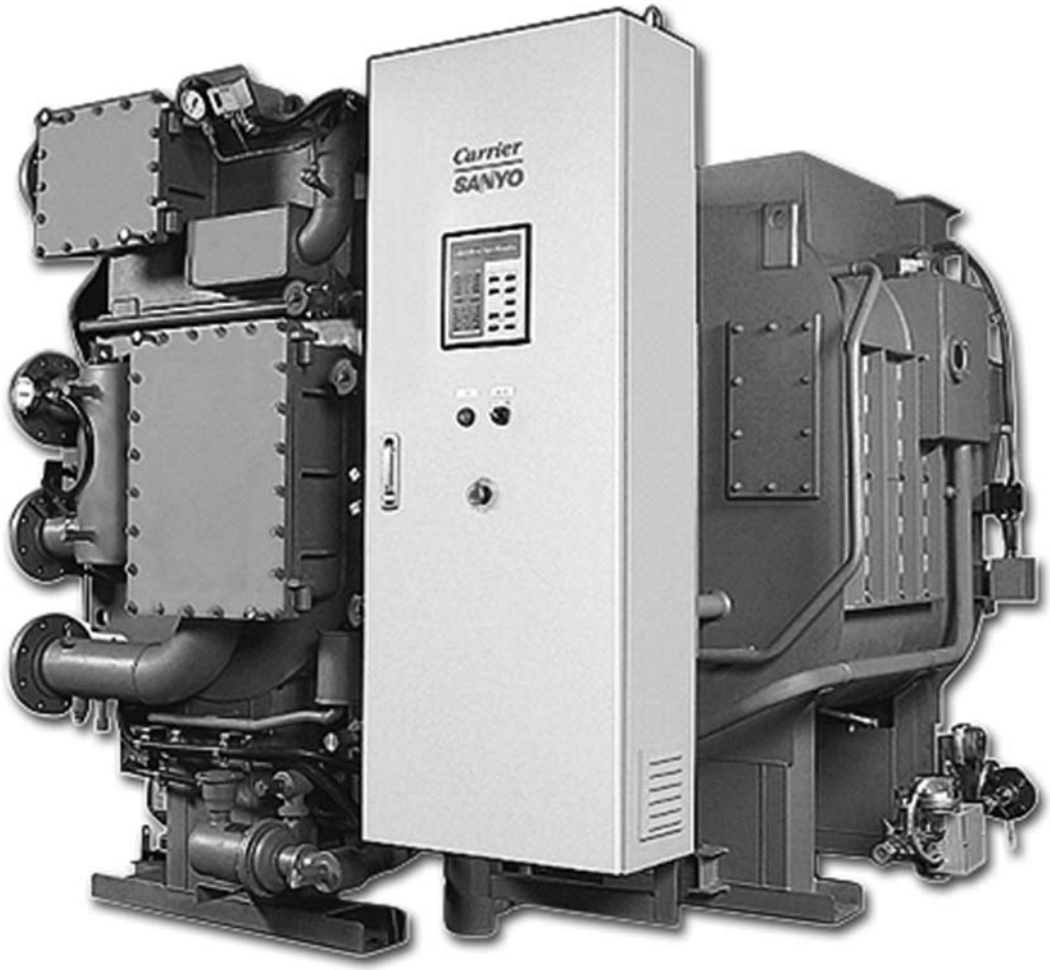
Carrier
SANYO

16DJ
Double-Effect Direct-Fired Absorption Chillers/Heaters

Nominal cooling capacity 352-5274 kW

50 Hz



Operation and maintenance manual

GB/T-19001-2000 to ISO9001/2000

NOTES TO USERS

Thank you for purchasing a Carrier/Sanyo absorption chiller/heater.

Read this manual carefully before operating the unit. It contains instructions for the operation and maintenance of the chiller/heater.

Please utilize the chiller/heater to its optimum performance by carrying out the recommended daily maintenance and handling instructions as well as the periodic service.

If you need any information about maintenance contracts or have any other enquiries, please contact your Carrier service agent.

CONTENTS

The cover photograph is for illustrative purposes only, and are not contractually binding.

1 - PRECAUTIONS

1.1 - Safety precautions

- Before operating this chiller, first carefully read the following instructions.
- All precautions are classified as either WARNING or CAUTION.

WARNING: Failure to observe this instruction may result in serious injury or death.

CAUTION : Failure to observe this instruction may cause an injury or failure of chiller/heater. Depending on circumstances, this may result in serious injury or death.

This symbol denotes danger, a warning or a caution. The illustration in this symbol shows the specific description of the item.

This symbol prohibits an action. The illustration next to this symbol shows the specific description of the item.

This symbol instructs an action to be done. The illustration in this symbol shows the specific description of the item.

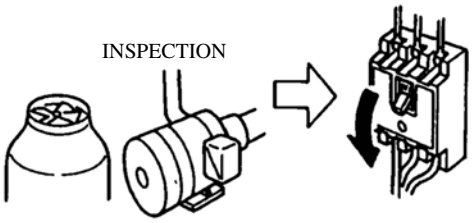
- After reading this manual, it should be kept in a safe place to be available for any user at any time.

1.1.1 Safety considerations

WARNINGS

TURN OFF THE BREAKER BEFORE CLEANING AND CHECKING

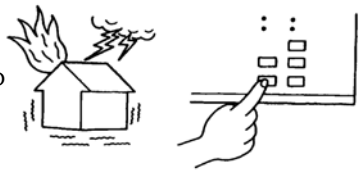
Always turn off the circuit breaker before cleaning and checking the cooling tower fan, chilled water pump, or other components linked to the chiller/heater, to provide protection from electric shock or possible injury from the rotating fan.



STOP OPERATION IN CASE OF FIRE, EARTHQUAKE OR ELECTRICAL STORMS

Stop operation in case of fire, earthquake or an electrical storm, to prevent fire or electric shock.

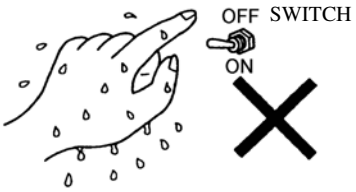
MUST BE OBSERVED



DO NOT TOUCH THE CONTROL PANEL SWITCH WITH WET HANDS

Do not touch the switch inside the control panel with wet hands to avoid electric shock.

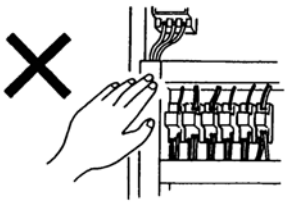
DO NOT TOUCH



DO NOT TOUCH THE WIRING INSIDE THE CONTROL PANEL

Do not touch the wiring inside the control panel to avoid electric shock.

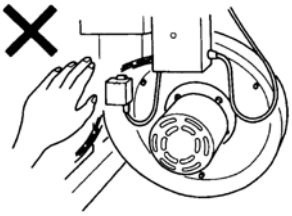
DO NOT TOUCH



DO NOT TOUCH HIGH-VOLTAGE CABLES

Do not touch high-voltage cables to avoid electric shock.

DO NOT TOUCH

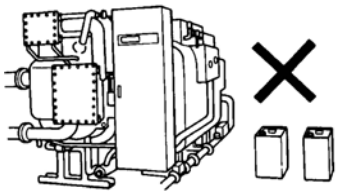


WARNINGS

KEEP FLAMMABLE SUBSTANCES AWAY FROM THE CHILLER/HEATER

Do not place any flammable substances (e.g. gasoline, thinner) close to chiller/heater, flue, chimney and oil tank to prevent fire.

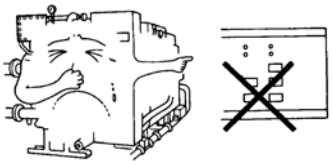
PROHIBITED



DO NOT OPERATE THE CHILLER/HEATER IF THERE IS A SMELL OF GAS

Do not operate the chiller/heater if there is a smell of gas. Do not turn on/off any switch, as this could cause a fire.

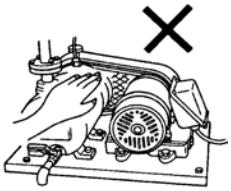
PROHIBITED



DO NOT TOUCH ROTATING PARTS OF FANS

Keep away from rotating part of fans or pumps to avoid possible injury.

PROHIBITED

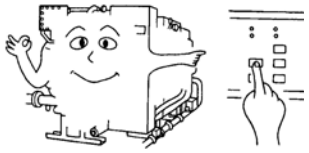


CAUTIONS

SOLVE ALL PROBLEMS BEFORE RESTARTING THE CHILLER/HEATER

Solve all problems before restarting the chiller/heater after a safety or security device is activated, to prevent fire.

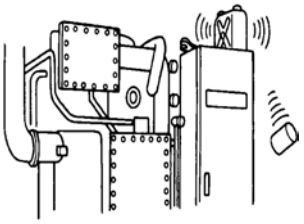
MUST BE OBSERVED



DO NOT PLACE HEAVY OBJECTS ON THE CHILLER/HEATER OR CONTROL PANEL

Do not place heavy objects on the chiller/heater or control panel as these may fall off and cause injuries.

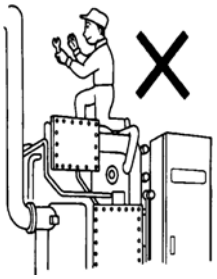
PROHIBITED



DO NOT CLIMB ON THE CHILLER/HEATER

Do not climb on the chiller/heater as you may fall off.

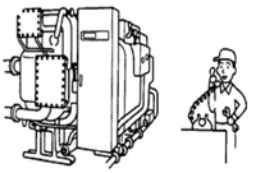
PROHIBITED



CALL SPECIALISTS FOR SERVICE OR MAINTENANCE

Call specialists for service or maintenance. Incorrect service/maintenance may cause electric shocks, fire or burns.

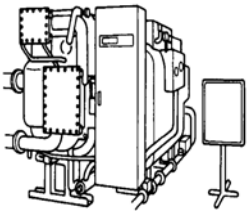
MUST BE OBSERVED



AUTHORIZED PERSONNEL ONLY

A notice, "For Authorized Personnel Only" must be affixed to the chiller/heater to stop unauthorized personnel from touching it. If necessary surround the chiller/heater by a protective fence. Misuse of the chiller/heater may cause injury.

PROHIBITED

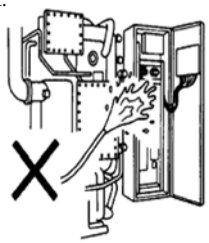


CAUTIONS

DO NOT POUR WATER ON THE CHILLER/HEATER OR CONTROL PANEL

Do not pour water on the chiller/heater or control panel to avoid electric shock.

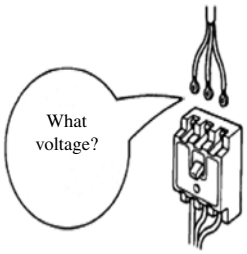
PROHIBITED



USE THE CORRECT POWER SUPPLY

This is indicated on the chiller/heater name plate. Use of an incorrect power supply may cause fire or electric shock.

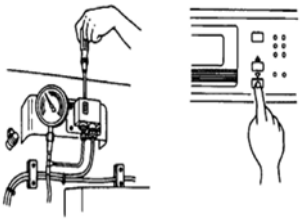
PROHIBITED



NEVER CHANGE THE SET VALUES

Never change the set values of the safety and/or protective devices. Wrong settings may damage the chiller/heater or cause fire.

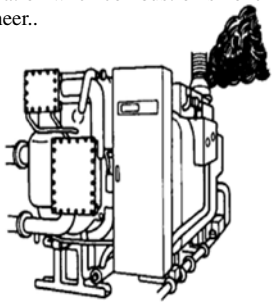
PROHIBITED



STOP THE OPERATION WHEN COMBUSTION SMOKE IS BLACK

Stop the operation when combustion smoke is black and call a service engineer..

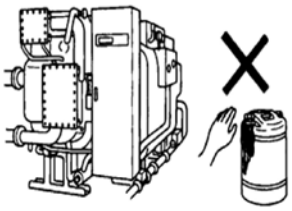
MUST BE OBSERVED



DO NOT TOUCH THE ABSORBENT

Do not touch the spare or leaked absorbent, as this can cause metal corrosion or skin disease.

PROHIBITED

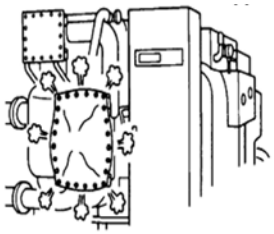


OBSERVE THE SPECIFIED WATER AND PRESSURE

The specified chilled/hot water, and cooling water pressure must be strictly observed.

Incorrect pressure may cause the water to leak/spray which can lead to short circuits or burns.

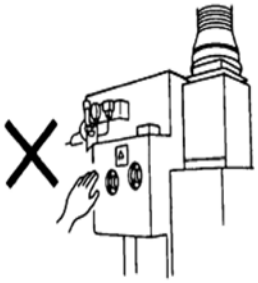
MUST BE OBSERVED



DO NOT TOUCH HIGH-TEMPERATURE AREAS

Do not touch high-temperature areas, as they may cause burns. These areas are indicated by caution label.

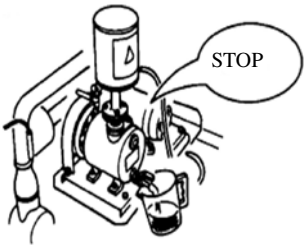
PROHIBITED



STOP THE PURGE PUMP TO REPLACE OIL

Stop the purge pump when replacing oil to avoid possible injury by fuel spillage.

MUST BE OBSERVED



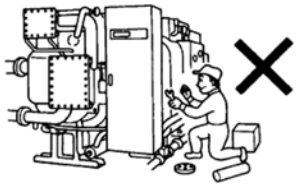
1.1.2 - Safety precautions for repair, moving or disposal

WARNINGS

ONLY AUTHORIZED PERSONNEL SHOULD SERVICE THE CHILLER/HEATER

Only authorized personnel should service the chiller/heater. Incorrect service could result in electric shock or fire.

PROHIBITED

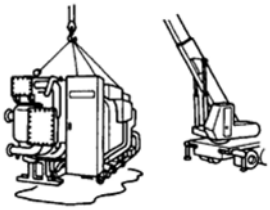


CAUTION

ONLY AUTHORIZED PERSONNEL SHOULD REMOVE OR REPAIR THE CHILLER/HEATER

Any relocation or moving of the chiller/heater should only be done by authorized personnel. Incorrect work could result in water leaks, electric shock or fire.

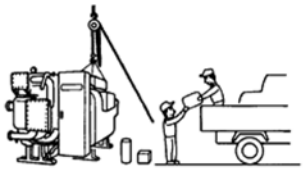
MUST BE OBSERVED



ONLY AUTHORIZED PERSONNEL SHOULD DISPOSE OF THE CHILLER/HEATER

To dispose of the chiller/heater, contact local specialists. Incorrect disposal may result in absorbent leaks and cause metal corrosion or skin disease, electric shock or fire.

MUST BE OBSERVED

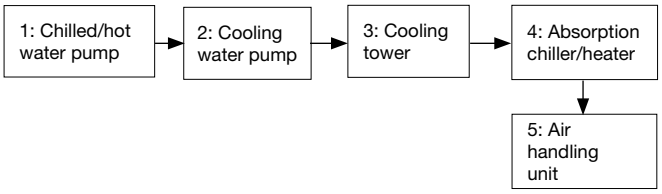


1.1.3 - Operating precautions

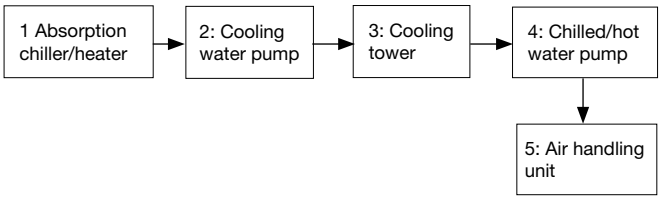
1. Keep the purge valve tightly shut to prevent air from leaking into the chiller/heater, which may cause the failure of the chiller/heater.
2. Keep the power supply to the control panel turned on, unless carrying out maintenance or service.
3. During the chiller/heater dilution cycle the chilled-water pump (both the primary side and the secondary side) and air handling unit must be operated for the required time. The chiller/heater has some cooling capacity, even in the dilution cycle. Do not stop the air handling unit before the required time to prevent possible subcooling.
4. Before operating the chiller/heater at the beginning of the cooling or heating season, make sure that necessary cooling/heating changeover is done. Failure in the changeover may cause damage to the chiller/heater. We recommend that you take out a maintenance contract with a Carrier service agent and leave the changeover to them.
5. Do not perform an insulation test on the control circuits of the electric controller.
6 . Use a Carrier recommended interlock system to stop/start the auxiliary equipment. The interlock system automatically stops/starts the chilled-water pump and cooling water pump. Please follow the start procedure in Figure 1 below.

Fig. 1 - Auxiliary equipment start/stop sequence

Start sequence



Stop sequence



1.2 - High-temperature - high-voltage caution

- Do not touch the chiller/heater during operation since its surface becomes hot.
- Do not touch the absorbent pump, the refrigerant pump, and the purge pump during operation, since their surface becomes hot.
- Do not touch the junction box during operation, since it contains high-voltage wiring.
- Do not touch the terminal box during operation, since it contains high-voltage wiring.

1.3 - Environmental requirements

1.3.1 - Installation considerations

The 16DJ absorption chiller/heater is designed for indoor installation in a machine room. The protection rating of the chiller/heater is IP40. Room temperature should be maintained between 5°C and 40°C to protect against solution crystallization during chiller/heater shutdown. The humidity in the machine room must be kept below 90%.

Ensure that the machine room is sufficiently ventilated. The required fresh air rate for combustion is a minimum of 0.28 l/s per kW fuel consumed.

1.3.2 - Field wiring

The machines should be connected to a power source that complies with overvoltage category III (IEC 60664). All other wiring should comply with overvoltage category II.

1.3.3 - Altitude

Please install the absorption chiller/heater at a maximum height of 1000 m above sea level. If the location is higher than 1000 m above sea level, please contact your local Carrier office.

1.4 - Water treatment

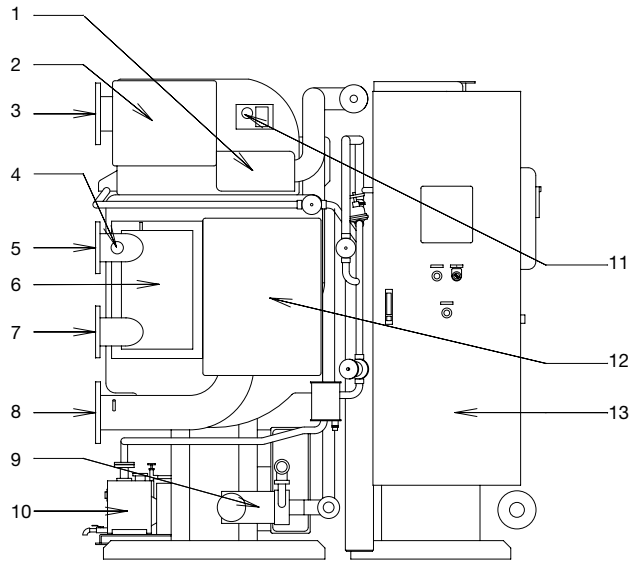
Refer to chapter 4 "Maintenance".

2 - MACHINE ILLUSTRATIONS

2.1 - Typical chiller/heater detail

2.1.1 - DJ-11 to DJ-42

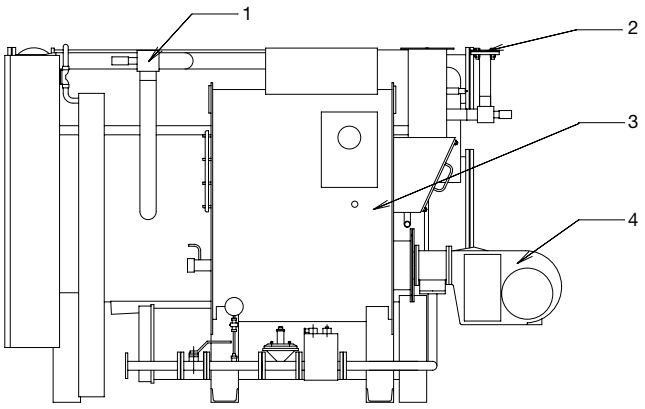
Fig. 2 - Water header side



Legend

1 Low-temperature generator
2 Condenser
3 Cooling water outlet
4 Chilled water flow switch
5 Chilled water outlet
6 Evaporator
7 Chilled water inlet
8 Cooling water inlet
9 Absorbent pump 2
10 Purge pump
11 Generator pressure switch
12 Absorber
13 Control panel

Fig. 3 - High-temperature generator side

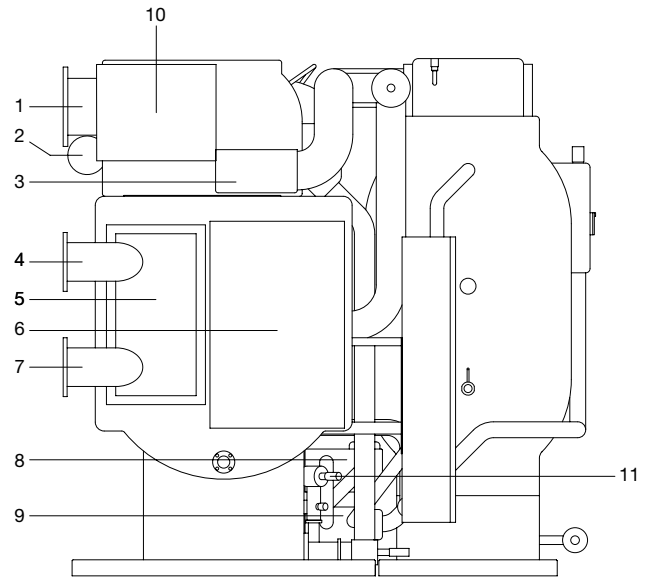


Legend

1 A valve
2 Rupture disk
3 High-temperature generator
3 Burner

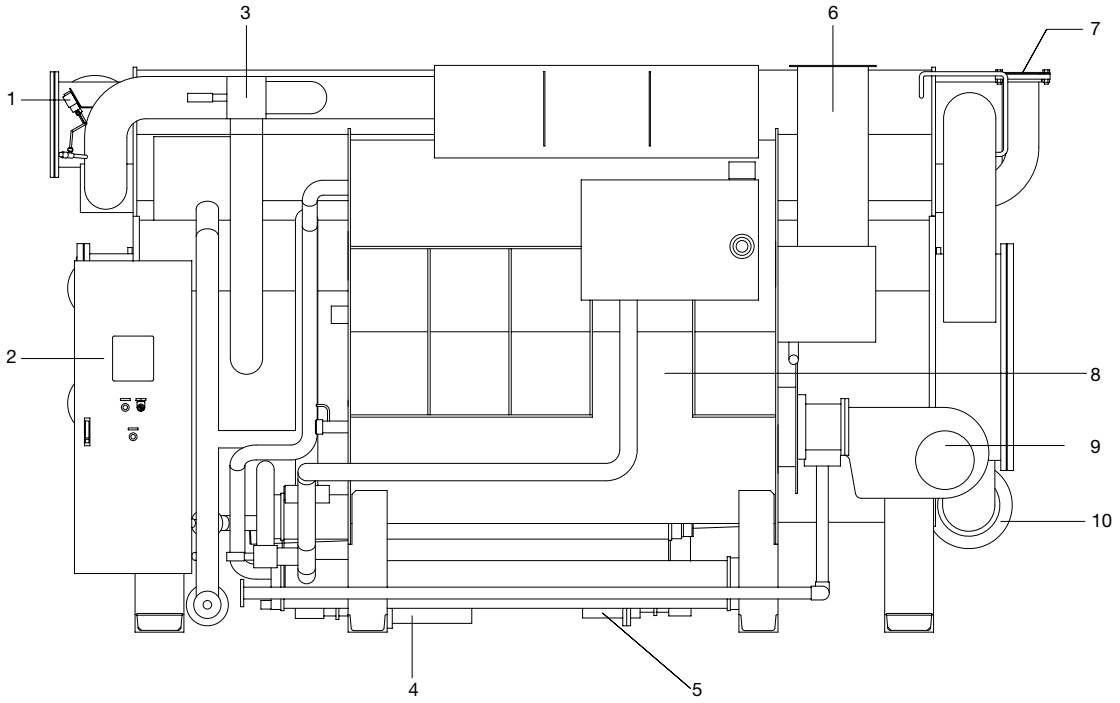
2.1.2 - DJ-51 to DJ-63

Fig. 4 - Water header side



Legend
1 Cooling water outlet
2 Purge tank
3 Low-temperature generator
4 Chilled water outlet
5 Evaporator
6 Absorber
7 Chilled water inlet
8 Low-temperature heat exchanger
9 High temperatrure heat exchanger
10 Condenser
11 C valve

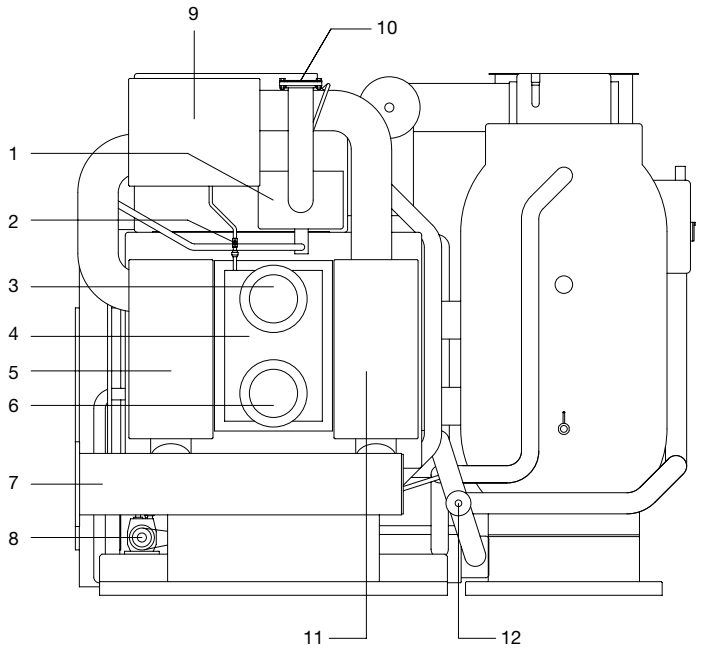
Fig. 5 - High-temperature generator side



Legend
1 Generator pressure gauge
2 Control panel
3 A valve
4 Absorbent pump 1
5 Refrigerent pump
6 Exhaust gas outlet
7 Rupture disk
8 High-temperature generator
9 Burner
10 Cooling water inlet

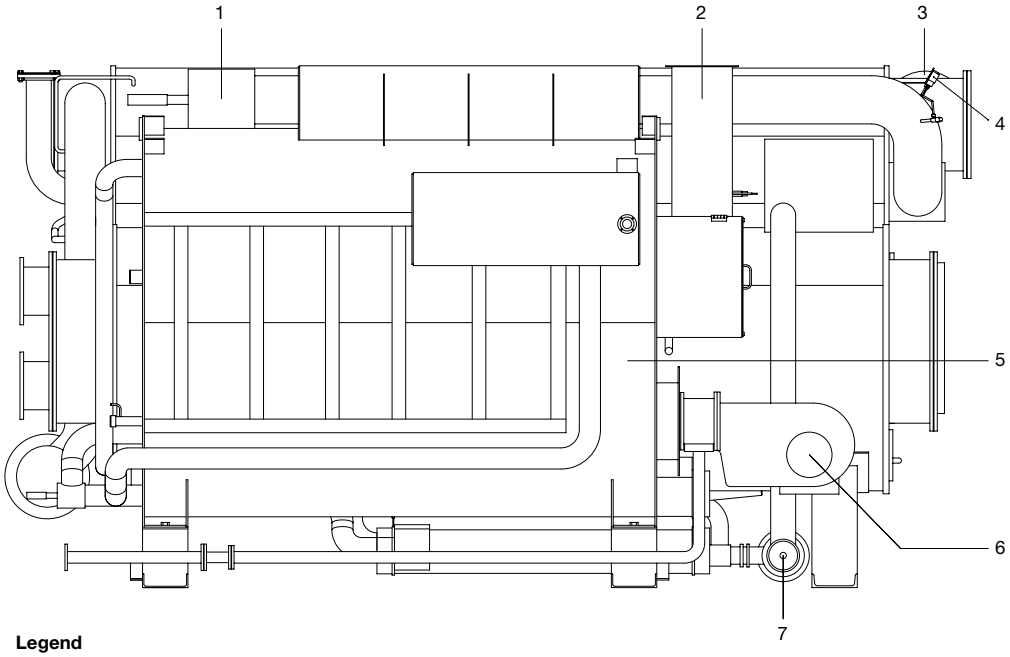
2.1.3 - DJ-71 to DJ-82

Fig. 6 - Water header side



Legend
1 Low-temperature generator
2 D valve
3 Chilled water outlet
4 Evaporator
5 Absorber
6 Chilled water inlet
7 Cooling water inlet
8 Purge pump
9 Condenser
10 Rupture disk
11 Absorber
12 C valve

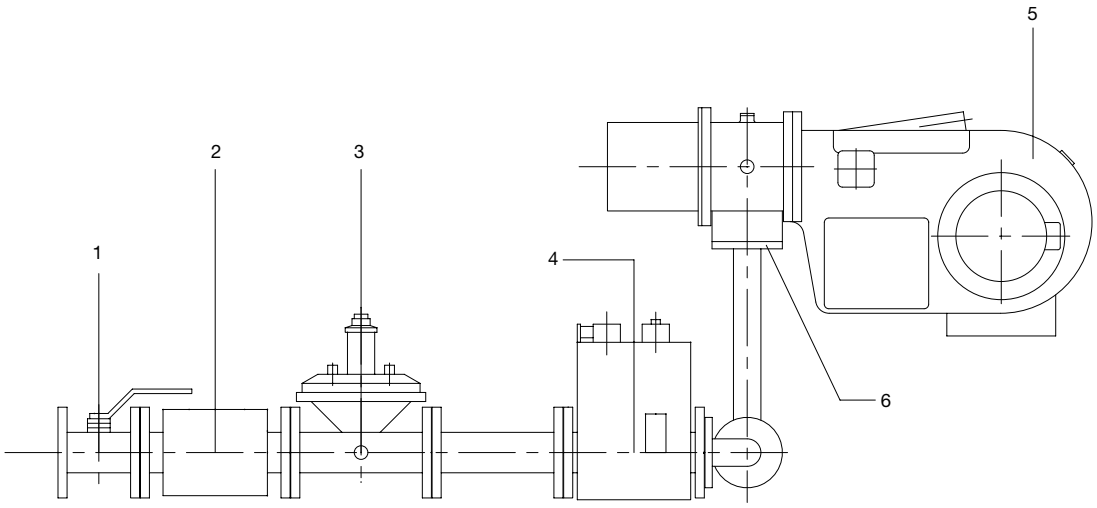
Fig. 7 - High-temperature generator side



Legend
1 A valve
2 Exhaust gas outlet
3 Cooling water outlet
4 Generator pressure gauge
5 High-temperature generator
6 Burner
7 Absorbent pump 2

2.2 - Typical burner and gas train

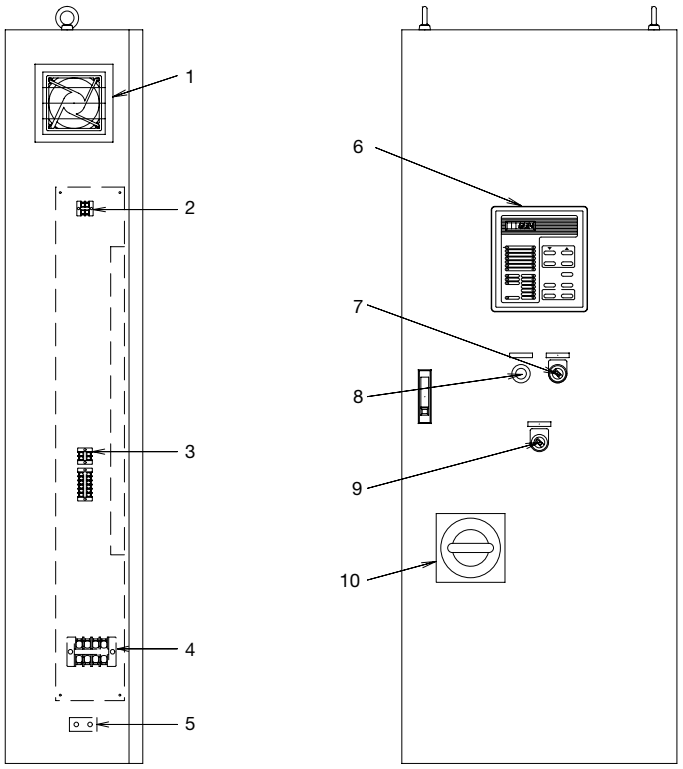
Fig. 8 - Typical burner



Legend
1 Ball valve
2 Filter
3 Pressure regulator
4 Shut-off valve
5 Blower
6 Gas control valve

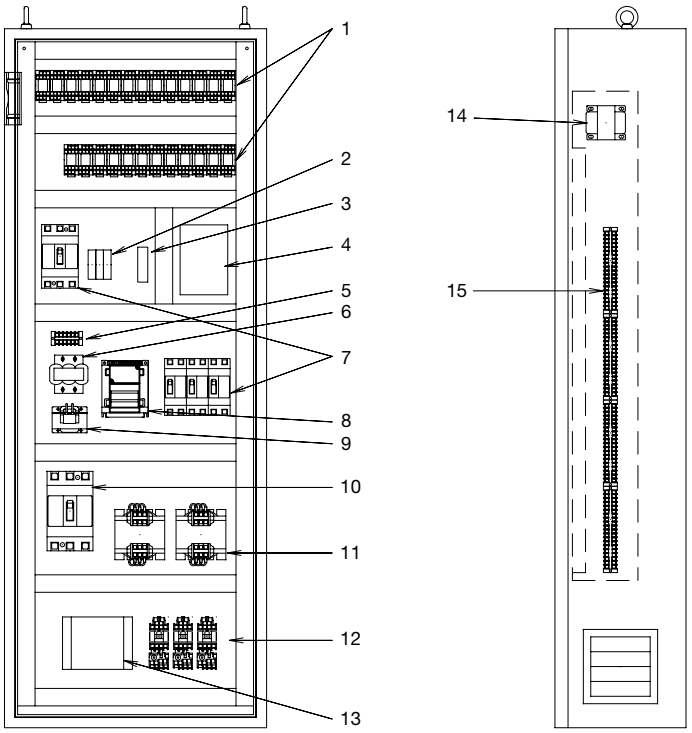
2.3 - Typical control panel

Fig. 9 - Control panel (CE type)



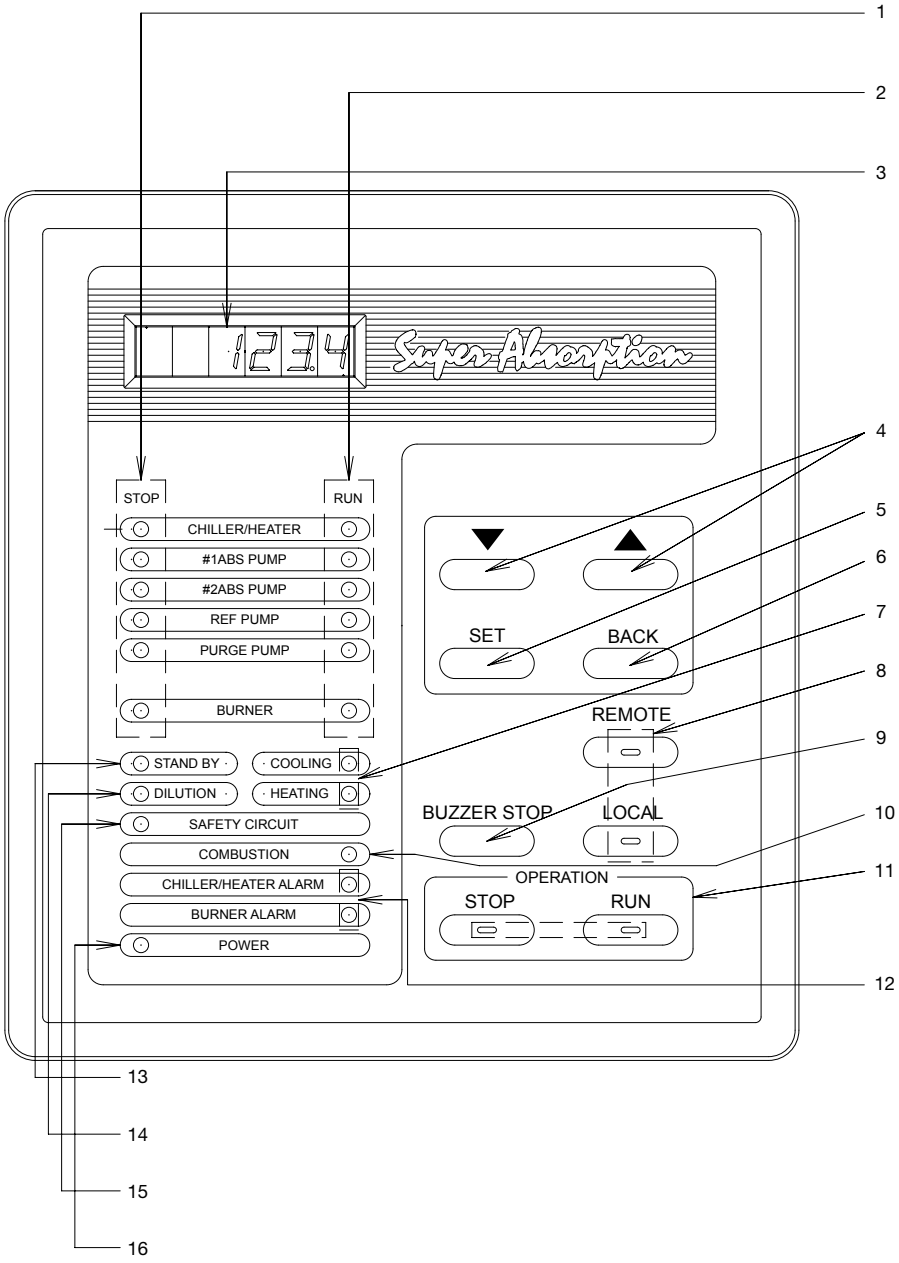
Legend
1 Fan
2 Terminal block
3 Terminal block
4 Terminal block for power supply
5 Earth terminal
6 Control board
7 Purge pump on/off switch
8 Purge/indication light
9 Cooling/heating changeover switch
10 Operating handle

Fig. 10 - Control panel inside (CE type)



Legend
1 Control relay
2 Circuit protector
3 Isolator
4 I/O board
5 Terminal block
6 AC reactor
7 Circuit breaker
8 Inverter
9 DC reactor
10 Main circuit breaker
11 Transformer
12 Electromagnetic contactor
13 Filter
14 Transformer
15 Terminal block

Fig. 11 - Interface board



Legend

1 Stop indication light
2 Operation indication light
3 Data display
4 Select key
5 Function set key
6 Back select key
7 Cooling/heating light
8 Remote/local select key with light
9 Alarm buzzer stop key
10 Combustion indication light
11 Operation select key with light
12 Alarm indication light
13 Stand by indication light
14 Dilution indication light
15 Safety circuit indication light
16 Power indication light

2.4 - Chiller/heater flowchart and component function description

Evaporator
The refrigerant is dispersed on the heat transfer tubes of the evaporator. Chilled water running through the heat transfer tubes of evaporator is cooled by the latent heat of the vaporized refrigerant. In the heating mode, the evaporator functions as a hot water heater. Hot water in the heat transfer tubes of the evaporator is heated by the refrigerant and used for heating.

Absorber
The concentrated solution is dispersed on the heat transfer tubes of absorber. The refrigerant vapour from the evaporator is absorbed on the heat transfer tubes of the absorber by the concentrated solution. Cooling water running through the heat transfer tubes of the absorber is heated by the absorption heat.

Heat exchangers
After leaving the absorber section the diluted solution passes through the low-temperature heat exchanger, where it is heated by the concentrated solution. The diluted solution then passes through the high-temperature heat exchanger, where it is further heated by the intermediate solution. The intermediate and concentrated solutions are cooled by the diluted solution. This cooling process of the concentrated solution allows for greater absorbing power due to its lower temperature.

High-temperature generator
The diluted solution from the heat exchangers is heated in the high-temperature generator. It releases the refrigerant vapour and is concentrated. It becomes intermediate solution.

Low-temperature generator
The refrigerant vapour from the high-temperature generator passes through the heat transfer tubes of low-temperature generator. The intermediate solution in the low-temperature generator is heated by the refrigerant vapour. It releases the refrigerant vapour and is concentrated. It becomes concentrated solution. The condensed refrigerant in the heat transfer tubes of low-temperature generator flows to the condenser.

Condenser
The refrigerant vapour from the generator is condensed on the heat transfer tubes of the condenser. Cooling water from the absorber is heated by condensation heat.

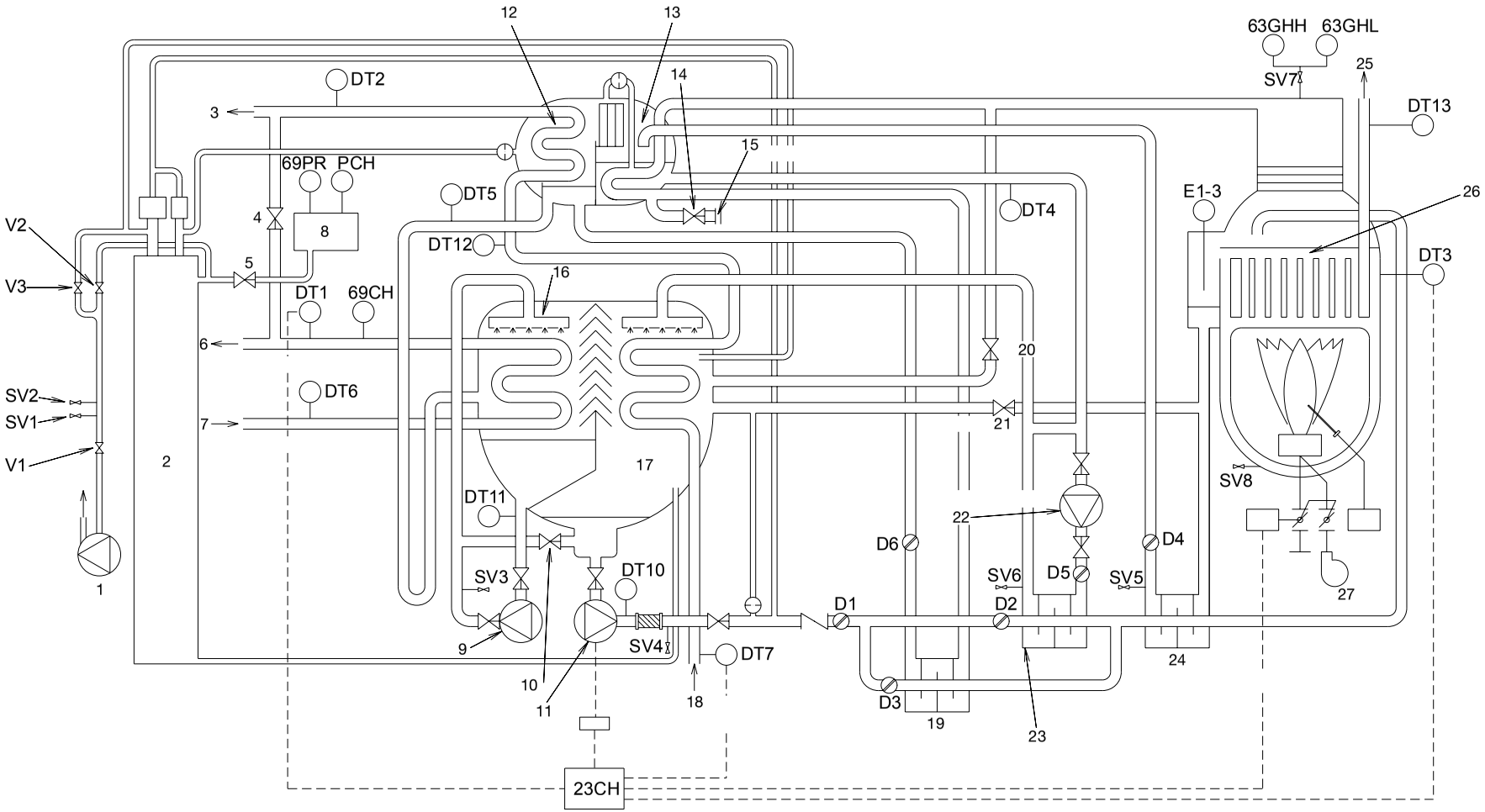
Purge unit
The purge unit collects the non-condensable gas in the chiller/heater and stores it in the purge tank.

Refrigerant heat recovery exchanger
Heat the low-temperature absorbent using the heat of the refrigerant drain condensed in the low-temperature generator.

Sensors

Symbol	Name
DT1	Chilled/hot water outlet temperature
DT2	Cooling water outlet temperature
DT3	High-temperature generator temperature
DT4	Low-temperature generator temperature
DT5	Condenser temperature
DT6	Chilled/hot water inlet temperature
DT7	Cooling water inlet temperature
DT8	Not used
DT9	Not used
DT10	Diluted solution temperature at absorber outlet
DT11	Refrigerant temperature at evaporator
DT12	Cooling water mid temperature
DT13	Exhaust gas temperature
E1-3	High-temperature generator solution level electrode
63GHH	High-temperature generator pressure switch for cooling.
63GHL	High-temperature generator pressure switch for heating (CE only)
69CH	Chilled/hot water flow switch
69PR	Purge tank pressure

Fig. 12- Flow diagram (DJ-11-42)



Legend

Sensor
Service valve
Strainer
Damper
Check valve
Orifice
Valve

D1: Diluted solution damper
D2: Diluted solution low-temperature heat exchanger damper
D3: Diluted solution refrigerant heat recovery exch. damper
D4: Intermediate solution damper
D5: Consentrated solution damper
D6: Refrigerant solution damper
SV1: Charge/discharge N_2 gas service valve
SV2: Purge unit service valve
SV3: Refrigerant service valve
SV4: Diluted solution service valve
SV5: Intermediate solution service valve
SV6: Concentrated solution service valve
SV7: Generator pressure gauge service valve
SV8: Generator maintenance service valve

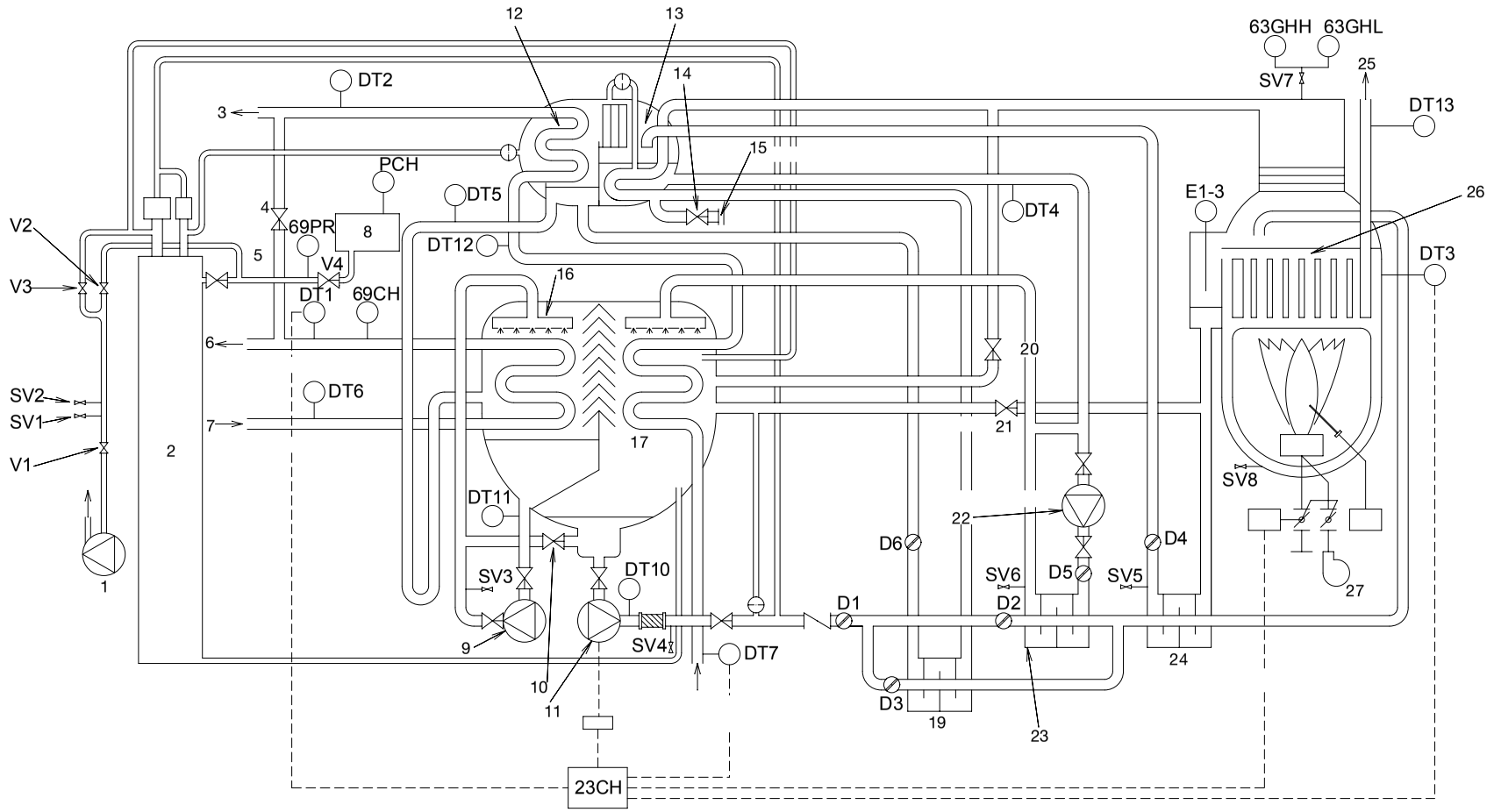
V1: Manual purge valve
V2: Manual purge valve
V3: Manual purge valve

1: Purge pump
2: Purge unit
3: Cooling water outlet
4: D valve (cooling/heating changeover valve)
5: B valve (cooling/heating changeover valve)
6: Chilled/hot water outlet
7: Chilled/hot water inlet
8: Purge tank
9: Refrigerant pump
10: Refrigerant blow-down valve

11: Absorbent pump 1
12: Condenser
13: Low-temperature generator
14: Z valve (rupture disk isolation valve)
15: Rupture disk
16: Evaporator
17: Absorber
18: Cooling water inlet
19: Refrigerant heat recovery exchanger
20: A valve (cooling/heating changeover valve)
21: C valve (cooling/heating changeover valve)
22: Absorbent pump 2
23: Low-temperature heat exchanger
24: High-temperature heat exchanger

27: Burner
26: High-temperature generator
25: Exhaust gas

Fig. 13- Flow diagram (DJ-51-82)



Legend

- Sensor
- Service valve
- Strainer
- Damper
- Check valve
- Orifice
- Valve

D1: Diluted solution damper
D2: Diluted solution low-temperature heat exchanger damper
D3: Diluted solution refrigerant heat recovery exch. damper
D4: Intermediate solution damper
D5: Consentrated solution damper
D6: Refrigerant solution damper
SV1: Charge/discharge N_2 gas service valve
SV2: Purge unit service valve
SV3: Refrigerant service valve
SV4: Diluted solution service valve
SV5: Intermediate solution service valve
SV6: Concentrated solution service valve
SV7: Generator pressure gauge service valve
SV8: Generator maintenance service valve

V1: Manual purge valve
V2: Manual purge valve
V3: Manual purge valve
V4: Manual purge valve
1: Purge pump
2: Purge unit
3: Cooling water outlet
4: D valve (cooling/heating changeover valve)
5: B valve (cooling/heating changeover valve)
6: Chilled/hot water outlet
7: Chilled/hot water inlet
8: Purge tank
9: Refrigerant pump
10: Refrigerant blow-down valve

11: Absorbent pump 1
12: Condenser
13: Low-temperature generator
14: Z valve (rupture disk isolation valve)
15: Rupture disk
16: Evaporator
17: Absorber
18: Cooling water inlet
19: Refrigerant heat recovery exchanger
20: A valve (cooling/heating changeover valve)
21: C valve (cooling/heating changeover valve)
22: Absorbent pump 2
23: Low-temperature heat exchanger
24: High-temperature heat exchanger

27: Burner
26: High-temperature generator
25: Exhaust gas

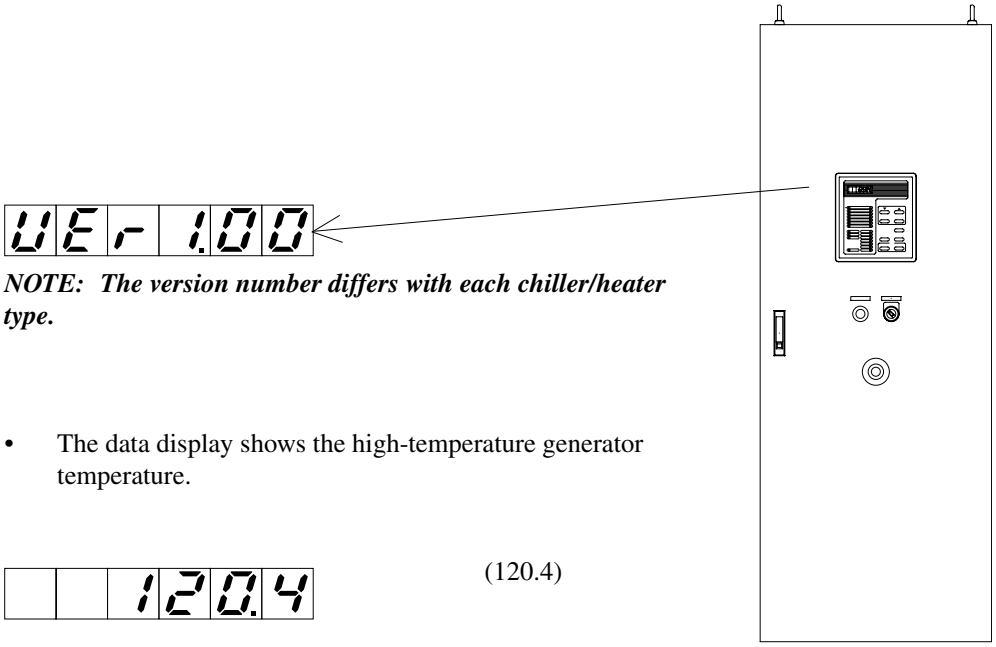
3 - OPERATING INSTRUCTIONS

3.1 - Self-diagnostic function

The self-diagnostic function starts when the breaker inside the control panel of the chiller/heater is turned on. After self-diagnosis is completed, the data display on the control board shows the following information.

- Data display (7-segment LED) and all LEDs light up.
- If there is no abnormality the data display shows the version number. If there is a power failure, H-10 is displayed after the power is restored.

Fig. 14 - Control panel



NOTE: The version number differs with each chiller/heater type.

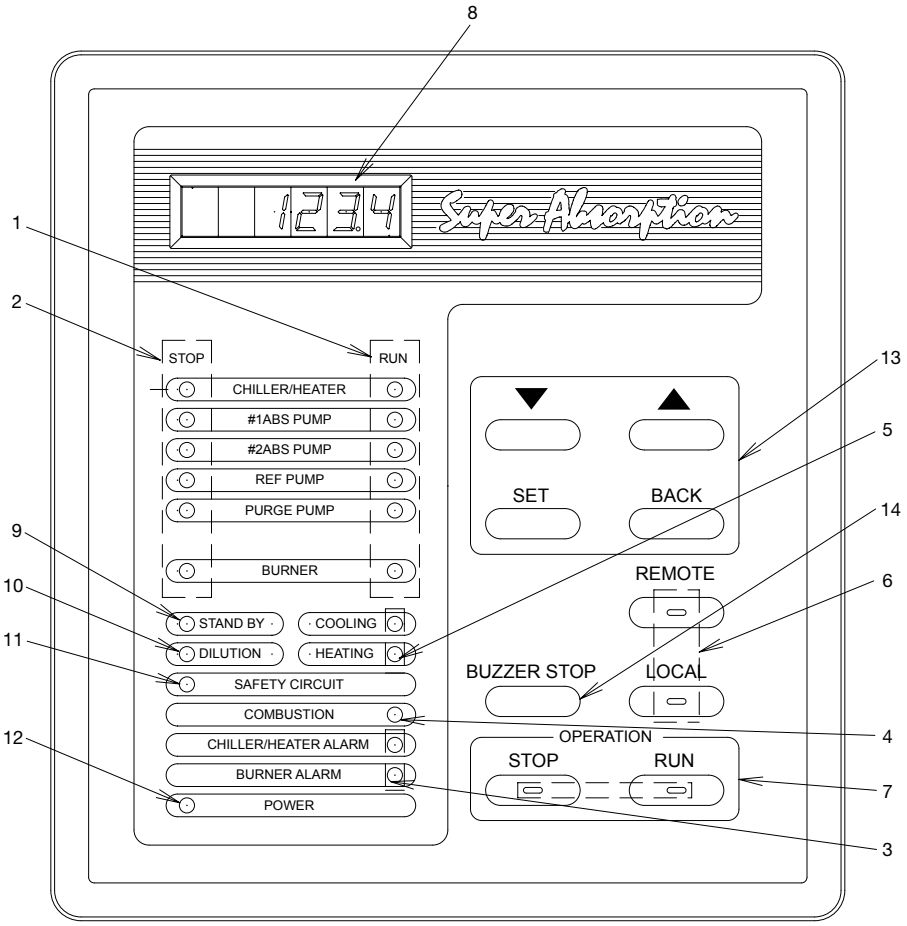
- The data display shows the high-temperature generator temperature.

(120.4)

If the self-diagnosis function detects an error, this will be shown on the data display. For the alarm indication, please refer to chapter 3.8.

3.2 - Description of keys and their functions

Fig. 15 - Typical control board



Legend

1	Operation indication light:	The operation indication light is on when the chiller/heater is running.
2	Stop indication light:	The stop indication light is on when the chiller/heater is shut down.
3	Alarm indication light:	The alarm indication light is on when an alarm occurs.
4	Combustion indication light:	Combustion indication lamps light through out burner burning.
5	Cooling/heating light:	The indication light indicates cooling or heating mode.
6	Remote/local select key with LED:	To select remote operation or local operation.
7	Operation select key with LED:	Key used to run/stop the chiller/heater. The stop key is also used for alarm reset.
8	Data display (7-segment LED):	Shows the temperature, setpoint, etc.
9	Standby indication light:	On when the chiller/heater is waiting for the interlock signals form the chilled water and the cooling water pump.
10	Dilution indication light:	On during the dilution cycle.
11	Safety circuit indication light:	On when power is supplied to the control circuit.
12	Power indication light:	On when power is supplied to the control circuit.
13	Data select key:	To change the menu and set a new value.
14	Alarm buzzer stop key:	To stop the alarm buzzer.

3.3 - Control board settings

3.3.1 -Time setting

Refer to Figure 16.

Fig. 16 - Display example

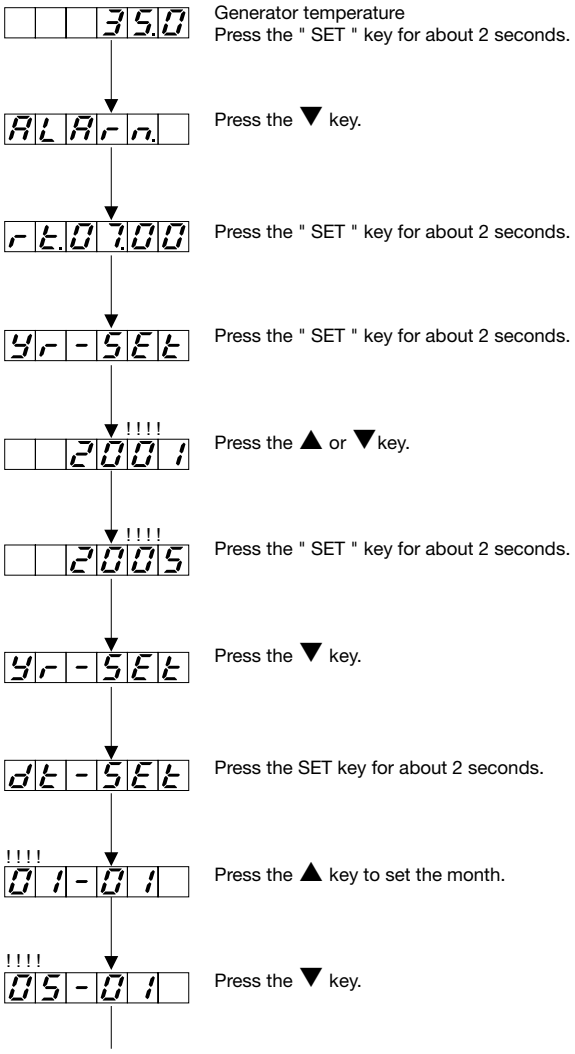
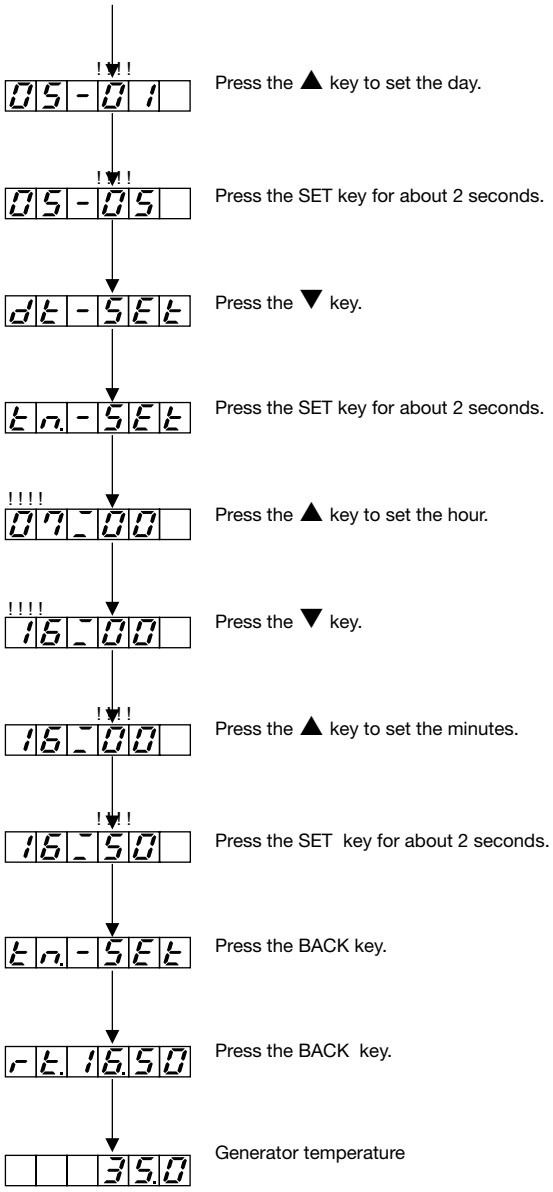


Fig. 16 - Display example (cont.)



3.3.2 - Battery backup

Refer to Figure 17.

SW3

Connect a backup battery which is used to maintain the time setting when a power failure occurs. Turn it ON after installing the equipment. CR-2025 is used as the backup battery and has an accumulative operating period of about six months.

NOTES:

1. ***SW3 (battery backup) is set to OFF at the factory to avoid using battery power.***
2. ***If SW3 (battery backup) is set to OFF when a power failure occurs, F-21 (CPU alarm) or F-23 (Time set alarm) is displayed. Please reset the time setting.***
3. ***If SW3 (battery backup) is set to ON and F-21 or F-23 is displayed, it is necessary to replace the battery.***

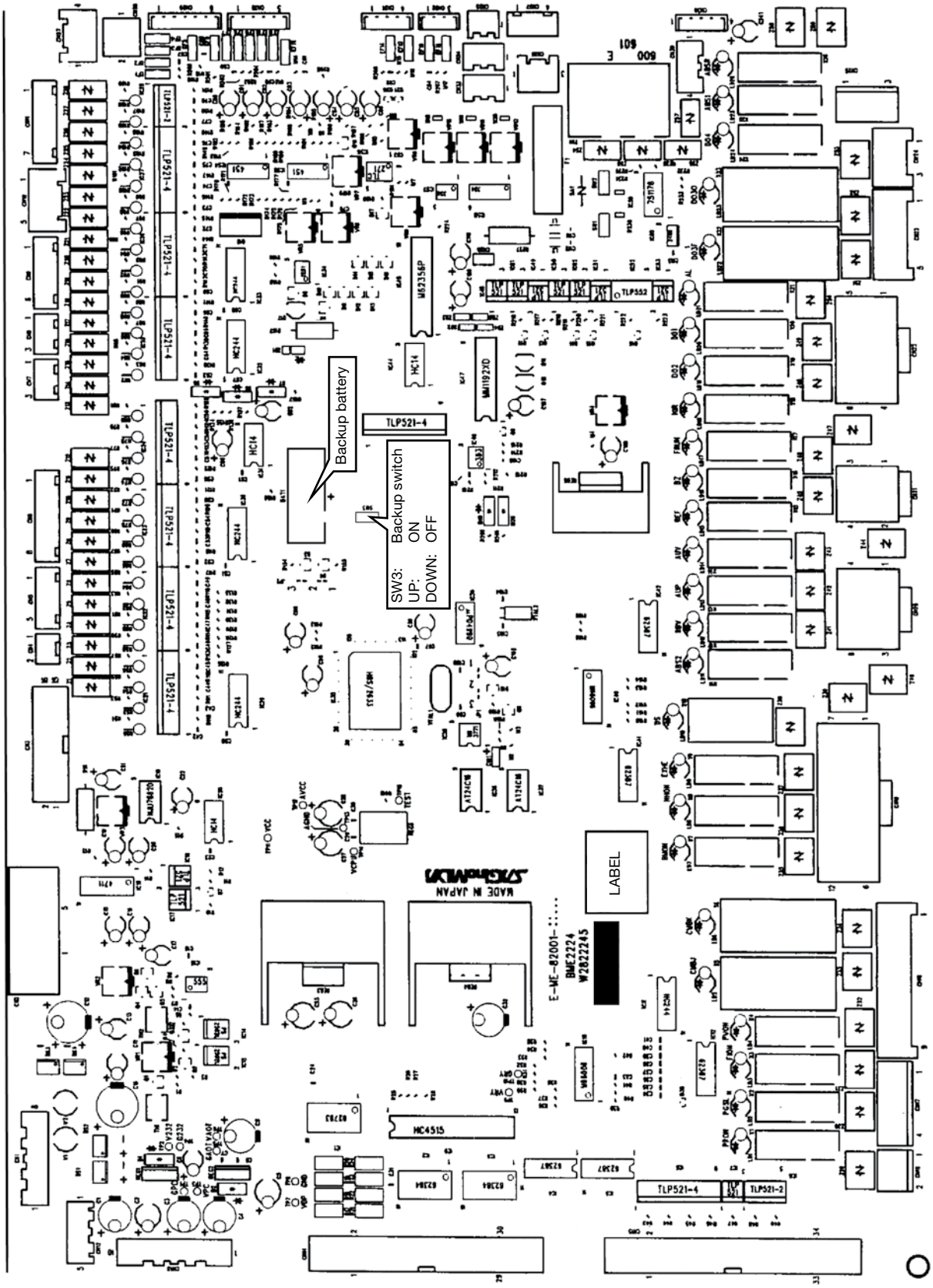
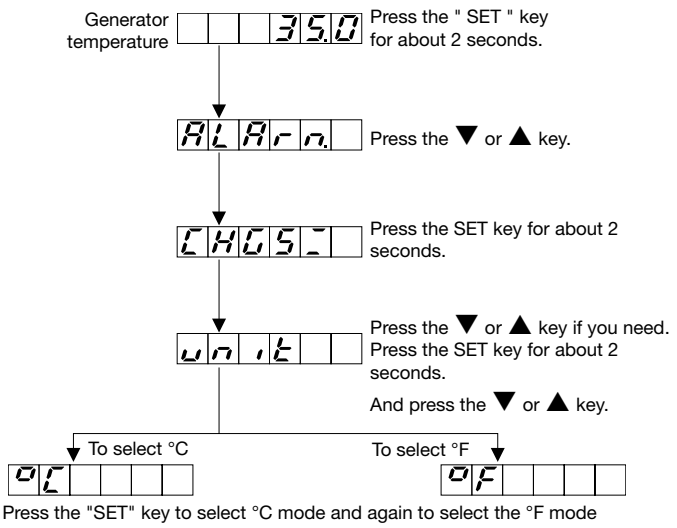


Fig. 17- SW3 backup switch and backup battery

3.3.3 - How to change the temperature unit

The temperature unit can be changed as follows, even while the chiller/heater is operating.

Fig. 18 - Display example

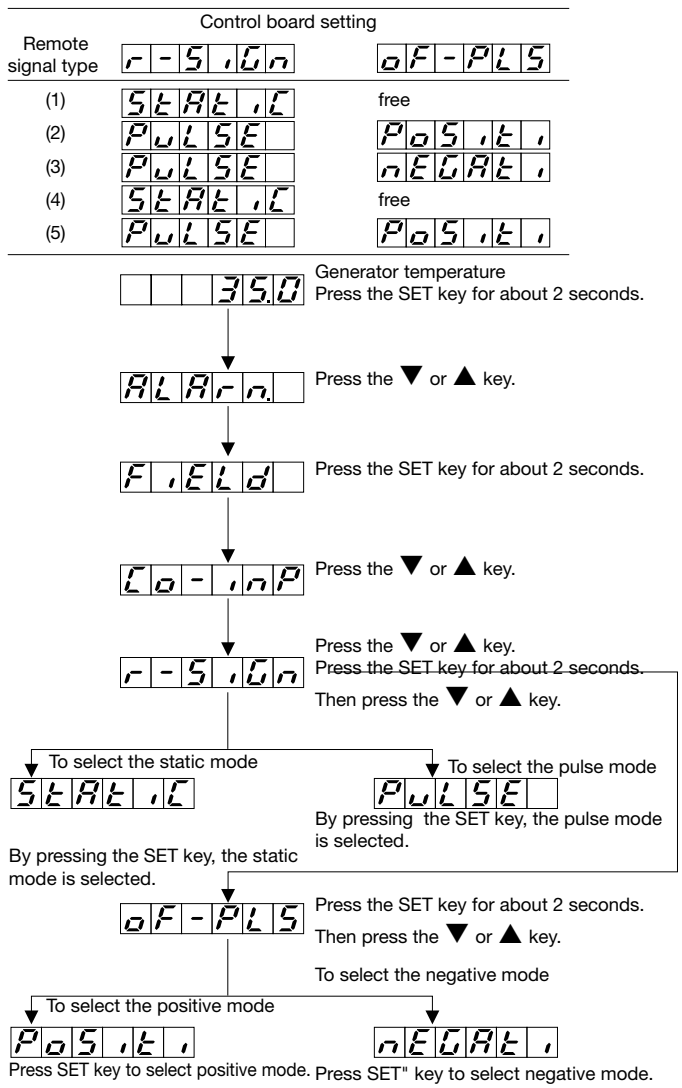


Press the "SET" key to select °C mode and again to select the °F mode

3.3.4 - Changing remote signal setting (continuous, pulse etc.)

After wiring of the remote signal, the control board shown below should be set. Refer to field wiring diagram.

Fig. 19 - Display example



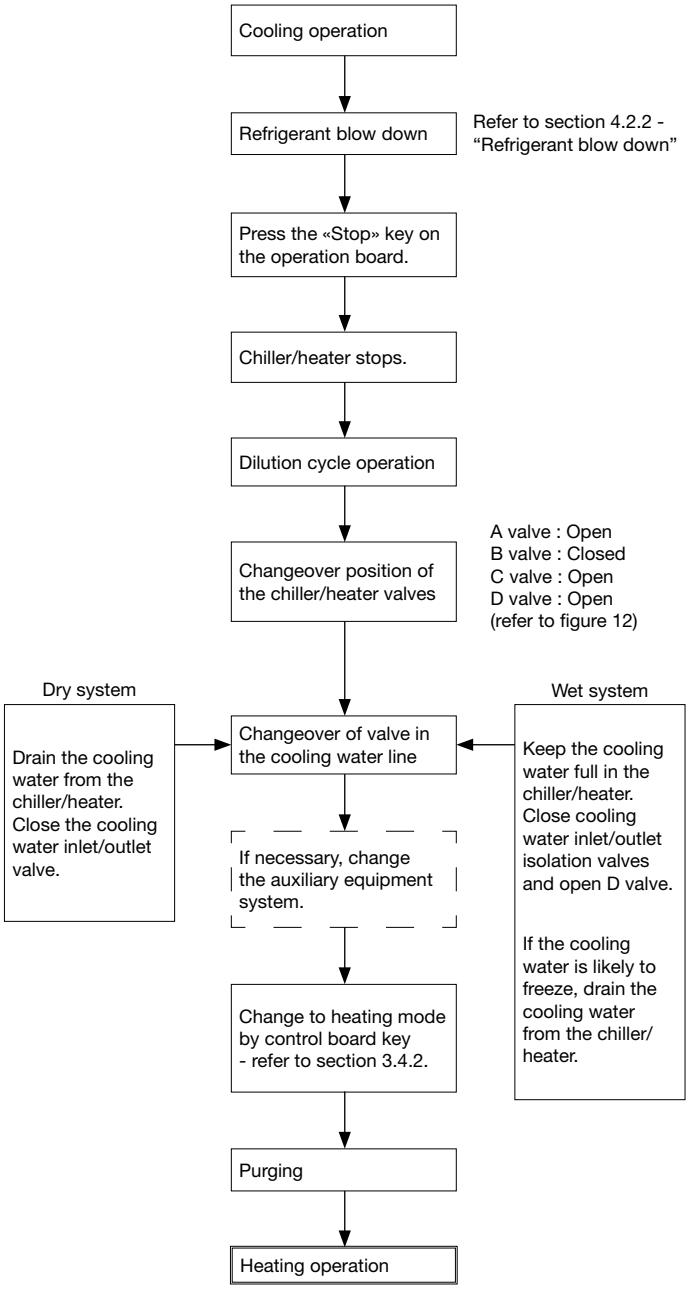
3.4 - How to change cooling/heating mode

Purging is necessary at each changeover process. Please contact your Carrier service agent.

3.4.1 - Cooling/heating changeover

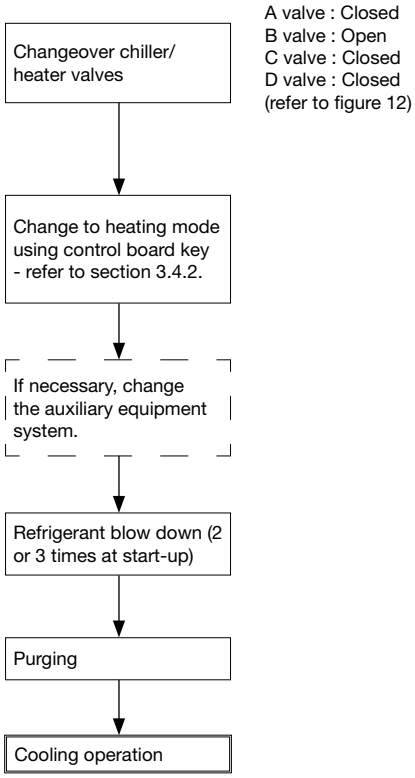
Before you change the operation mode from cooling to heating, please perform refrigerant blow down and dilution cycle.

1. Cooling → heating procedure



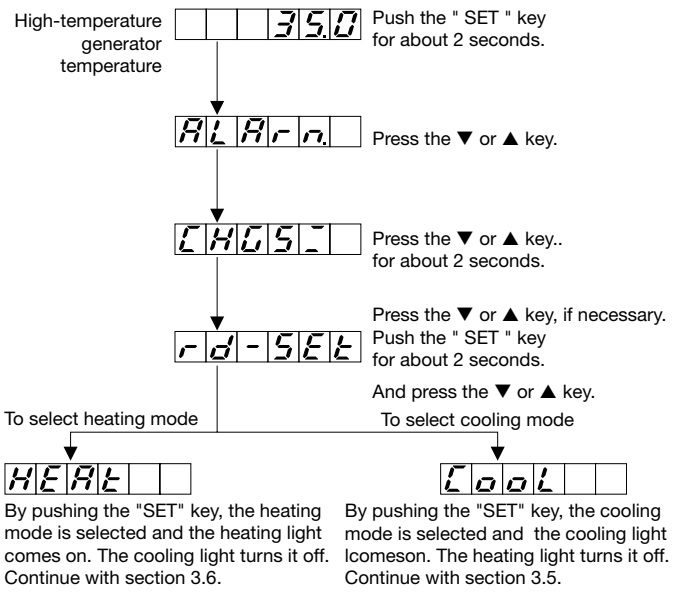
2. Heating → cooling procedure

Changeover must be done with chiller/heater switched off..



3.4.2 - Change the cooling/heating mode using the key while checking the data display.

Fig. 20 - Display example

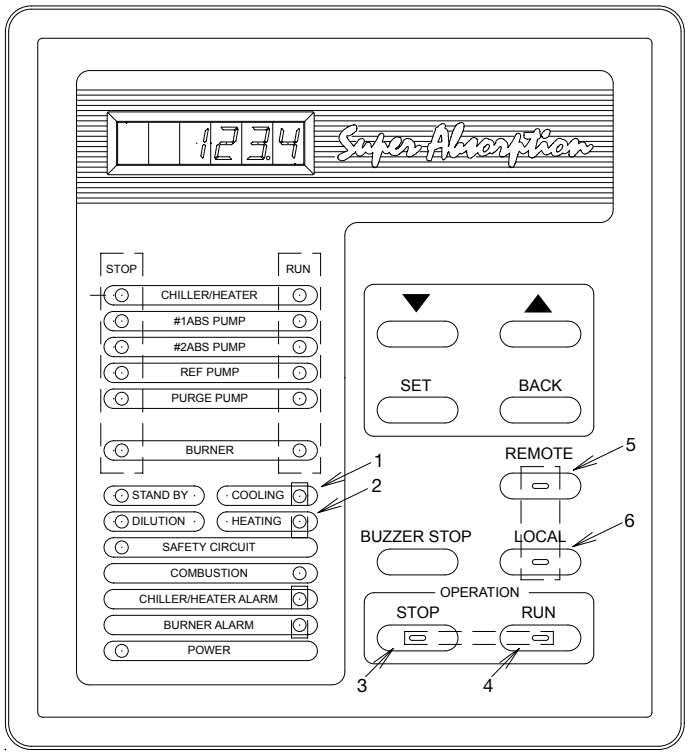


3.4.3 - Cooling/heating changeover switch (for CE)

There are two high-temperature generator pressure switches for cooling and heating. It is possible to select the pressure switch using the cooling/heating changeover switch. The operation mode on the control board and the operation mode of the pressure switch must be the same.

Otherwise the high-temperature generator high-temperature alarm (J-14) is activated, preventing the operation. Ensure that the mode on the control board is the same as that of the pressure switch. Refer to Fig. 9.

Fig. 21 - Typical control board



Legend

1 Cooling light
2 Heating light
3 Stop key
4 Run key
5 Remote key
6 Local key

3.5 - Cooling operation

3.5.1 - Pre-operation check

Refer to Fig. 21.

Check the following items before starting operation.

- Verify the operation mode. Confirm that the cooling light on the control board is on.
- Check the chilled water leaving temperature setpoint. Make sure that the chilled water leaving temperature is set as specified. For the display of the set value, please refer to section 3.8.
- Check the combustion equipment
  - Make a daily inspection. (refer to section 4.)
  - Check that the valve(s) is (are) open.
- Check the valves on the chiller/heater.

A valve	Closed
B valve	Open
C valve	Closed
D valve	Closed

Refer to Fig. 12

NOTE: If the chilled/hot water pump, cooling water pump, and chiller/heater are interlocked, each pump runs automatically when starting the chiller/heater.

If not, the start sequence must be: chilled/hot water pump, cooling water pump, chiller/heater.

3.5.2 - Start cooling operation
Refer to Fig. 22.

Local operation mode
- Press the "LOCAL" key on the chiller control board. The "LOCAL" indication light of the key is on.
- Keep pressing the "RUN" key for more than a second and make sure that the "RUN" indicator lightp of the key is on.
- Automatic operation starts.

Remote operation mode
- Press the "REMOTE" key on the chiller control board. The "REMOTE" indicaton light of the key is on.
- Turn on the start switch on the remote control panel for the field supply. The indicator light of the "RUN" key on the chiller control board is on.
- Automatic operation starts.

NOTE: In local operation mode the signal from the remote control panel does not work. In remote operation mode the "RUN" key of the chiller control board does not work.

3.5.3 - Stop operation
Refer to Fig. 22.

Local operation mode
- Keep pressing the "STOP" key on the chiller control board for more than a second.
- Make sure that the "RUN" indication light goes off and the "STOP" indication light comes on.

Remote operation mode
- Turn on the stop switch on the field supply remote control panel.
- Another way to stop the chiller is to press the "STOP" key on the chiller control board during remote operation.

NOTE: If the chilled-water pump, cooling water pump, and chiller are interlocked, each pump stops automatically when the chiller stops.

If not, the stop sequence must be: chiller, cooling water pump, chilled-water pump.

The air handling unit must be stopped after the chilled-water pump is stopped.

3.6 - Heating operation

3.6.1 - Pre-operation check
Refer to Fig. 22.
Check the following items before starting operation.
- Verify the operation mode. Confirm that the heating light on the control board is on.
- Check the hot water temperature setpoint. Make sure that the hot water leaving temperature is set as specified. For the display of the set value, please refer to section 3.8.
- Check the combustion equipment
  - Make a daily inspection (refer to section 4.)
  - Check that the fuel valve(s) is (are) open.

4. Check the chiller/heater valves.

A valve	Open
B valve	Closed
C valve	Open
D valve	Open

Refer to Fig. 12

NOTE: If the chilled/hot water pump and chiller/heater are interlocked, the pump runs automatically when starting the chiller/heater.

If not, the start sequence must be: chilled/hot water pump, chiller/heater.

3.6.2 - Start heating operation
Refer to Fig. 22.

Local operation mode
- Press the "LOCAL" key on the chiller control board. The "LOCAL" indication light of the key is on.
- Keep pressing the "RUN" key for more than a second and make sure that the "RUN" indicator lightp of the key is on.
- Automatic operation starts.

Remote operation mode
- Press the "REMOTE" key on the chiller control board. The "REMOTE" indicaton light of the key is on.
- Turn on the start switch on the remote control panel for the field supply. The indicator light of the "RUN" key on the chiller control board is on.
- Automatic operation starts.

NOTE: In local operation mode the signal from the remote control panel does not work. In remote operation mode the "RUN" key of the chiller control board does not work.

3.6.3 - Stop heating operation

Refer to Fig. 22.

Local operation mode

- Keep pressing the "STOP" key on the chiller control board for more than a second.
- Make sure that the "RUN" indication light goes off and the "STOP" indication light comes on.

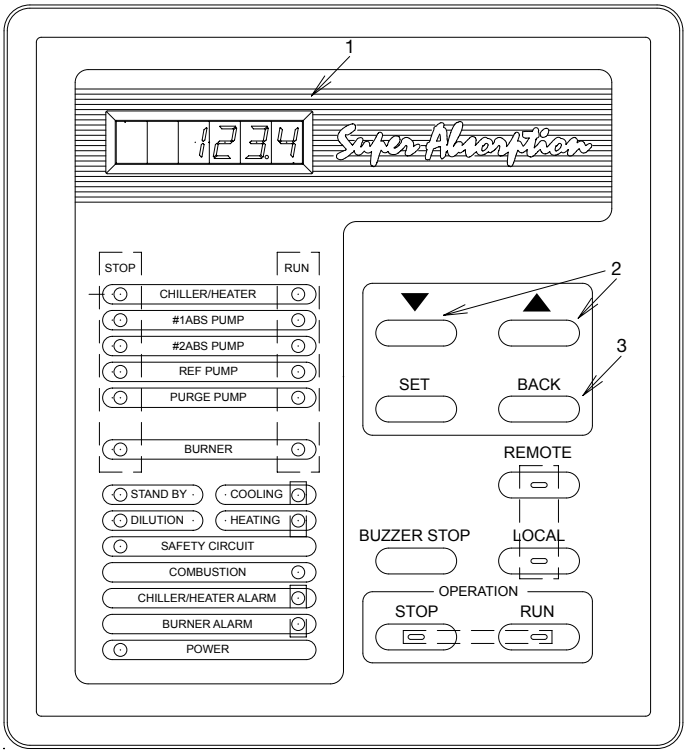
Remote operation mode

- Turn on the stop switch on the field supply remote control panel.
- Another way to stop the chiller is to press the "STOP" key on the chiller control board during remote operation.

NOTE: If the chilled-water pump, cooling water pump, and chiller are interlocked, each pump stops automatically when the chiller stops. If not, the stop sequence must be: Chiller, cooling water pump, chilled-water pump

The air handling unit must be stopped after the chilled-water pump is stopped.

Fig. 22 - Typical control board



Legend

1 Data display
2 Select key: changes an indication of a data display
3 Back select key

3.7 - Changing the information on the data display

3.7.1 - Normal display information

The data display on the control board usually shows the generator temperature as follows (refer to Fig. 22).

It returns to the generator temperature display when no key is pressed for 1 minute.

3.7.2 - Changing the display

Refer to Fig. 22.

If you press the ▲ key, the information on the data display changes in the correct order, and pressing the ▼ key, it changes in reverse order. If you press the ▲ key again when the last information is shown, the display returns to the normal display information.

3.7.3 - Typical display order

Real-time data is shown in the data display (7-segment LED and 6 figures). The display shows a data code (content distinction by code number) and various operating times, on/off time, component temperatures, chilled-water temperature setpoints and alarm codes. A data code is sent in turn from the ▲ ▼ keys and displayed. An alarm code is only shown when one or several abnormalities occur. The alarm code is shown in order of importance, and a dotted "." is shown under the number to the right of the alarm code. When several faults occur, use the ▲ ▼ keys to display the additional alarm codes. If no key including the "BACK" key is pressed for 1 minute, the display returns to the generator temperature display.

Fig. 23 - Typical indication flow

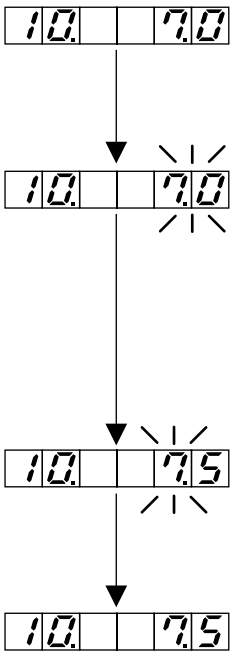
Data code	Data name	Means
-	Generator temperature	135.0°C
1.	Chiller/heater operating hours	1234 hours
2.	Absorbent pump 1 operating hours	1111 hours
3.	Absorbent pump 2 operating hours	1230 hours
4.	Combustion hours	1100 hours
5.	Refrigerant pump operating hours	1201 hours
6.	Purge pump operating hours	107 hours
7.	Chiller/heater on/off times	123 times
8.	Absorbent pump 1 on/off times	169 times
9.	Absorbent pump 2 on/off times	123 times
A.	Combustion on/off times	189 times
B.	Refrigerant pump on/off times	138 times
C.	Purge pump on/off times	51 times
10.	Chilled water temperature setpoint	7.0°C
11.	Hot water temperature setpoint	55.0°C
12.	Chilled/hot water entering temperature	11.9°C
13.	Chilled/hot water leaving temperature	6.8°C
14.	Cooling water entering temperature	31.8°C
15.	Condenser temperature	34.7°C
16.	Steam drain/exhaust gas temperature	211.7°C
17.	Purge tank pressure	8.5 kPa
-	Generator temperature	135.0°C

3.8 - Changing display and setpoint

Setpoint display change

Select the current setpoint temperature and change it as follows.

To change the chilled-water temperature:



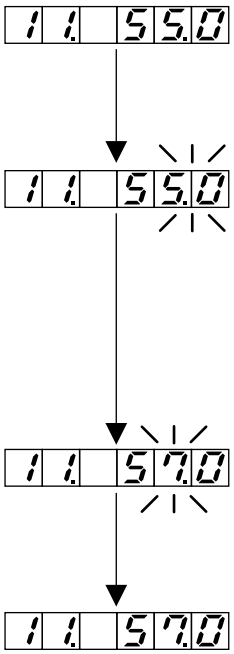
7.0°C
Press the "SET" key
for about 2 seconds.

A number showing the setpoint
temperature blinks.
Press the ▲ or ▼key.

7.5°C
Press the "SET" key

The setpoint change has been made.

To change the hot water temperature



55.0°C
Press the "SET" key
for about 2 seconds.

A number showing the setpoint
temperature blinks.
Press the ▲ or ▼key.

57.0°C
Press the "SET" key

The setpoint change has been made.

If no key including the "BACK" key is pressed for 1 minute, the display returns to the generator temperature.

NOTES:

1. ***Incorrect setting may cause chiller failure. If you need to change the setpoint, always consult your Carrier service agent.***
2. ***Setpoints become effective as soon as they have been changed. Be careful when changing setpoints during operation.***

3.9 - Maintenance message

If a problem that could affect the efficient operation of the chiller is predicted, a warning message is given. This includes a comment on the data display as shown in Fig. 24

Fig. 24 - Maintenance message

Data code	Data name	Display	Means
H-01*	Operate purge pump	H-01	Operate purge pump.
H-03*	Clean cooling water tubes	H-03	Fouling of cooling water tubes.
H-04*	Check cooling water system	H-04	Check the cooling water pump, cooling tower, etc.
H-05*	Clean chamber	H-05	Fouling of combustion chamber.
H-06**	Purge tank high pressure	H-06	Purge tank pressure is high.
H-07**	Cooling water tube fouling	H-07	Fouling of cooling water tubes.
H-08**	Cooling water high temperature	H-08	Cooling water temperature is high.
H-10	Power failure	H-10	There was power failure when the chiller/heater was operating

Legend

* When this appears, immediate action is required.

** When this appears, no immediate action is required, but as this might lead to a higher code, attention should be paid. Consult Carrier service personnel at the next periodic maintenance.

NOTE: These displays disappear when the problem has been corrected.

Fig. 25 - Maintenance message descriptions and actions required

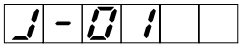
	Maintenance message	Display	Action
1	Cooling water tube fouling	H-07 H-03	Clean cooling water tubes. Contact Carrier service agent to do the job
2	Vacuum rate	H-06 H-01	The purge tank must be purged immediately. If this display is shown frequently, contact a Carrier service agent.
3	High cooling water temperature	H-08	Check the cooling water pump, cooling tower, etc.
4	Combustion chamber fouling (for oil-fired type)	H-04 H-05	Clen the combustion chamber. Contact Carrier service agent to do the job
5	Power failure	H-10	See section 3.10.5.

3.10 - Alarm indications and actions

3.10.1 - How they are shown

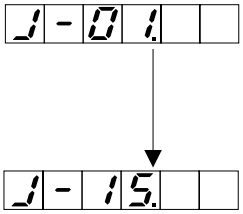
When an alarm is detected, the alarm buzzer sounds, and the alarm message is shown on the data display. At the same time, the indication light of the "STOP" key blinks. The chiller stops for safety reasons after the dilution cycle. Depending on the alarm message it may also stop without carrying out the dilution cycle.

Fig. 26 - Display example



Chilled-water low temperature

An alarm code is only shown when one or several abnormalities occur. If several errors have occurred, the most important one is shown with a dot ".".

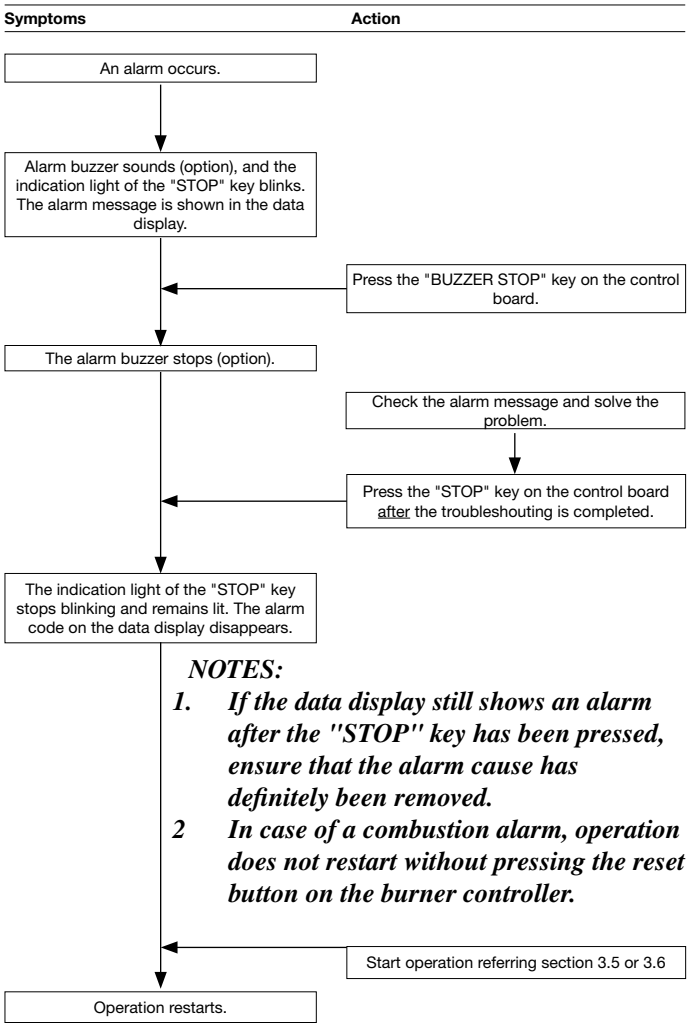


Chilled-water low temperature

The other alarm codes are shown by pressing the ▲ key.

The high-temperature generator solution level is too low.

3.10.2 - Troubleshouting flowchart



3.10.3 - Alarm message and setpoint

Fig. 27 - List of alarms and setpoints in cooling operation

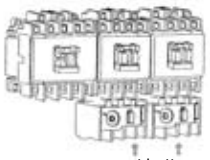
Purpose	Display	Alarm message	Setpoint
Protection of chilled water system	A-01	Chilled water temperature is too low.	2.5°C or below
	A-02	Chilled water pump interlock alarm.	-
	A-03	Chilled water flow alarm	50% or below
	A-20	Cooling water temperature is too low.	24°C or below for 30 minutes
Prevention of crystallisation	A-06	Cooling water pump interlock alarm.	-
	A-07	Cooling water flow alarm	50% or below
	A-13	High-temperature generator temperature is too high.	162°C or above for 10 minutes 165°C or above
High-temperature generator protection	A-14	High-temperature generator pressure is too high.	101.3 kPa or above
	A-15	High-temperature generator solution level is too low	-
	A-16	High concentration of absorbent	65.0 % or above twice 65.0 % or above
	A-17	Exhaust gas temperature is too high (gas)	300°C or above
		Exhaust gas temperature is too high (oil)	350°C or above
Combustion alarm	A-18	Flame failure and burner failure	-
Motor protection	A-04	Absorbent pump 1 overload alarm.	Rated current value or above
	A-05	Absorbent pump 2 overload alarm.	
	A-10	Refrigerant pump overload alarm.	"
	A-12	Purge pump overload alarm.	"
	A-28	Absorbent pump 3 overload alarm.	"
Others	A-11	Ventilation fan interlock etc. alarm	-
	A-21	Capacity is too low.	-
	A-25	Changeover during operation: heating → cooling	-
	A-27	Cooling tower fan overload alarm.	-

Fig. 28 - List of alarms and setpoints in heating operation

Purpose	Display	Alarm message	Setpoin
Protection of hot water system	A-22	Hot water temperature is too high.	70°C or above
	A-23	Hot water pump interlock alarm.	-
	A-24	Hot water flow alarm	50% or below
	A-13	High-temperature generator temperature is too high.	130°C or above
	A-14	High-temperature generator pressure is too high.	101.3 kPa or above
	A-15	High-temperature generator solution level is too low.	-
	A-17	Exhaust gas temperature is too high (gas)	300°C or above
		Exhaust gas temperature is too high (oil)	350°C or above
Combustion alarm	A-18	Flame failure or burner failure.	-
Motor protection	A-04	Absorbent pump 1 overload alarm.	Rated current value or above
	A-05	Absorbent pump 2 overload alarm.	
	A-10	Refrigerant pump overload alarm.	"
	A-12	Purge pump overload alarm.	"
	A-28	Absorbent pump 3 overload alarm.	"
Others	A-11	Ventilation fan interlock etc. alarm.	-
	A-21	Capacity is too low.	-
	A-25	Changeover during operation: Cooling → heating	

3.10.4 - Locating and clearing an alarm

Fig. 29 - List of alarm indications and their causes and remedies

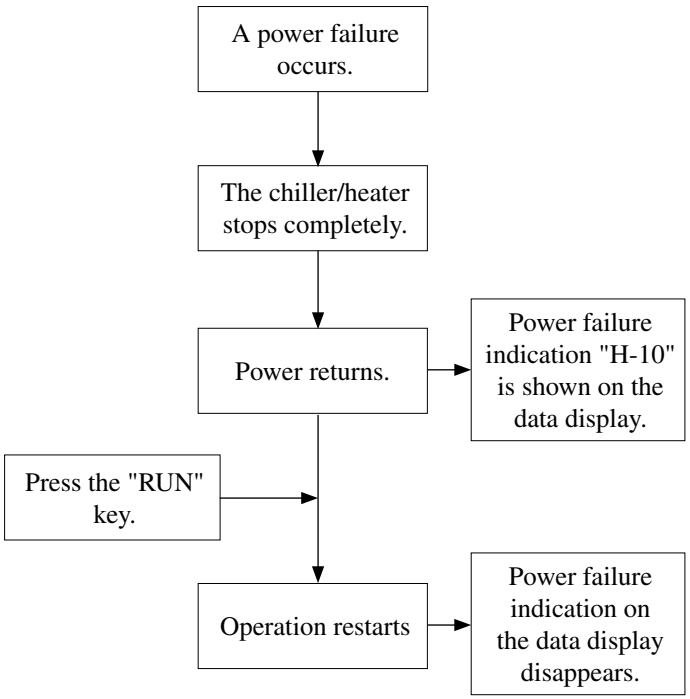
Display and content of alarm	
Alarm of the chilled/hot water and/or cooling water system	
A-01 Chilled/hot water temperature is too low.	Check that the discharge pressure of both chilled/hot water and cooling water pumps is normal. → If not, the strainer may be the clogged or there may be an air leak in the piping, etc.
A-03 Chilled water flow alarm	
A-22 Hot water temperature is too high.	Is the chilled water setpoint too low? Is the hot water setpoint too high? → Correct them to the specified setpoint.
A-24 Hot water flow alarm	
A-20 Cooling water temperature is too low	Is the cooling water setpoint too low? → Correct it to specified setpoint. (e.g. 28°C)
A-07 Cooling water flow alarm (option)	
	Correct the above causes and restart the chiller/heater. If the "ALARM STOP" continues, check the following and contact your Carrier service agent. • Entering and leaving chilled/hot water temperature • Entering and leaving cooling water temperature • High-temperature generator temperature and pressure
Alarm of the motor(s)	
A-04 Absorbent pump 1 overload alarm.	Check that the reset button(s) of the overload relay connected to electromagnetic contactor is (are) not pushed in, then contact your Carrier service agent.
A-05 Absorbent pump 2 overload alarm.	
A-10 Refrigerant pump overload alarm	
A-28 Absorbent pump 3 overload alarm.	 reset buttons
Alarm of the auxiliary equipment	
A-02 Chilled water pump interlock alarm.	Check that the chilled/hot water pump and cooling water pump are rotating. → Start the pumps
A-06 Cooling water pump interlock alarm.	Check the ventilation fan and/or other equipment connected to the system interlock.
A-11 Ventilation fan interlock etc. alarm.	Correct the above causes and restart the chiller/heater. If the "ALARM STOP" continues, contact your Carrier service agent.
A-27 Cooling tower fan overload alarm.	
Alarm of the high-temperature generator	
A-13 High-temperature generator temperature is too high.	**COOLING OPERATION** Check that the cooling water pump is rotating. → Start the pump.
A-14 High-temperature generator pressure is too high.	Check that the cooling water line valve is open. → Open the valve.
A-15 High-temperature generator solution level is too low.	Check that the discharge pressure of cooling water pump is normal. → If not, the strainer, may be clogged, there may be an air leak in the piping, etc.
A-16 High concentration of absorbent	Check that the "Cooling" light is on. → To change cooling operation refer to section 3.4.
A-17 Exhaust gas temperature is too high.	Correct the above causes and restart the chiller/heater. If the "ALARM STOP" continues, check the following and contact your Carrier service agent. • Entering and leaving chilled water temperature • Entering and leaving cooling water temperature • High-temperature generator temperature and pressure, and exhaust gas temperature. • Is the chilled water setpoint too low? → Correct it to specified setpoint. • There may be the fouling of heat transfer tube in the water (especially cooling water) piping.

Display and content of alarm	
Alarm of the high-temperature generator	
A-13 High-temperature generator temperature is too high.	**HEATING OPERATION** If the chiller/heater shows "ALARM STOP" right after it starts, try to re-start it. If it occurs again, contact your Carrier service agent.
A-14 High-temperature generator pressure is too high.	
A-15 High-temperature generator solution level is too low.	If the chiller/heater shows "ALARM STOP" during operation, check the following.
A-16 High absorbent concentration	
A-17 Exhaust gas temperature is too high.	Check that the hot water pump is rotating. → Start the pump.
	Check that the hot water line valve is open. → Open the valve.
	Check that the delivery pressure of the hot water pump is normal. → If not, the strainer may be clogged, or there may be an air leak in the piping etc.
	Check that the "Heating" light is on. → To change heating operation refer to section 3.4.
	Correct the above causes and restart the chiller/heater. If the "ALARM STOP"continues, check the following and contact your Carrier service agent. • Entering and leaving hot water temperature • High-temperature generator temperature and pressure, and exhaust gas temperature. • Is the hot water setpoint too low? → Correct it to specified setpoint. • Linkage between gas control valve and damper (disconnected and/or loose). • There may be the fouling of heat transfer tube in the hot water line.
Alarm of sensor	
F-01 Chilled/hot water inlet temperature sensor alarm.	Do the sensors measuring each area of the chiller/heater have short-circuits or open circuits? → Check all the sensors of the chiller/heater and contact your Carrier service agent.
F-02 Cooling water inlet temperature sensor alarm.	
F-03 Cooling water outlet temperature sensor alarm.	
F-04 Cooling water intermediate temperature sensor alarm.	
F-05 Condenser temperature sensor alarm.	
F-07 Low-temperature generator's temperature sensor alarm.	
F-08 Refrigerant temperature sensor (Evaporator) alarm.	
F-12 Diluted solution temperature sensor (absorber outlet) has failure.	
F-15 Concentrated solution temperature sensor (low-temperature heat exchanger) alarm.	
F-25 Chilled/hot water outlet temperture sensor alarm.	
F-26 High-temperature generator's temperature sensor alarm.	
F-27 Exhaust gas temperature sensor alarm.	
F-28 Purge tank pressure sensor alarm.	

NOTE: The chiller/heater automatically stops for safety reasons when either the high-temperature generator temperature sensor or the chilled/hot water temperature sensor has an alarm. It does not stop when other sensors have an alarm, but this could cause a control failure. Please contact your Carrier service agent as soon as possible.

3.10.5 - Action in case of power failure

1. Flowchart of action in case of power failure



2. Actions to be taken if a power failure occurs

If a power failure occurs, the chiller/heater stops completely without carrying out a dilution cycle. Special attention should be paid to the following.

Operating condition at power failure	Action
Occurred during cooling operation, and power did not return for more than an hour	Immediately contact Carrier service agent. Do not restart operation.
Occurred during cooling operation, and power returned in less than an hour	Contact Carrier service agent after restarting operation.
Occurred during heating operation	Contact Carrier service agent after restarting operation.
Occurred during purging operation	Immediately close the purge valve completely and turn the purge pump switch on the control panel off. After the power is restored, restart purging, and and consult your Carrier service agent.

4 - MAINTENANCE

4.1 - Daily maintenance

4.1.1 - Inspection of each chiller/heater component

If you find an abnormal condition, contact your Carrier service agent:

- Smell of gas or oil leak around the chiller/heater
- Abnormal noise at the start of the burner
- Abnormal noise of absorbent pump and refrigerant pump

For the following items please consult the system manufacturer:

- Cleaning of cooling tower and cooling water line strainer
- Check the condition of the cooling tower
- Check for air leaks in the piping

4.1.2 - Operation data record

Please record the operation data regularly, as this is useful for troubleshooting and alarm prevention. Show the record to the Carrier service personnel when they visit you for the service or the periodic inspection.

On the next page you will find a sample of the operation data sheet.

TEST OPERATION DATA SHEET

Unit model/serial No.		Operator:		Date: / /		
No.	Data items	Unit	Spec.	DATA-1 Time:	DATA-2 Time:	DATA-3 Time:
1	Ambient temperature	°C/°F				
2	Room temperature	°C/°F				
3	Chilled/hot-water entering temperature	°C/°F				
4	Chilled/hot-water leaving temperature	°C/°F				
5	Chilled/hot-water entering pressure	kPa/psi				
6	Chilled/hot-water leaving pressure	kPa/psi				
7	Evaporator pressure drop	kPa/psi				
8	Chilled/hot-water flow rate	l/s/gpm				
9	Cooling water entering temperature	°C/°F				
10	Cooling water leaving temperature	°C/°F				
11	Cooling water entering pressure	kPa/psi				
12	Cooling water leaving pressure	kPa/psi				
13	Pressure drop in absorber & condenser	kPa/psi				
14	Cooling water flow rate	l/s/gpm				
15	High-temperature generator temperature	°C/°F				
16	High-tempersture generator pressure	kPa/psi				
17	Evaporator solution level	n/60 mm n/2-3/8”				
18	High-temperature generator solution level	n/60 mm n/2-3/8”				
19	Solution level in bottom of absorber	n/60 mm n/2-3/8”				
20	Purge tank pressure	kPa				
21	Concentration of concentrated solution	%				
	Relative density of concentrated solution	-				
	Temperature of concentrated solution	°C/°F				
22	Concentration of diluted solution	%				
	Relative density of diluted solution	-				
	Temperature of diluted solution	°C/°F				
23	Concentration of refrigerant	%				
	Relative density of refrigerant	-				
	Temperature of refrigerant	°C/°F				
24	Condensed refrigerant temperature	°C/°F				
25	LTD *	°C/°F				
26	Absorbent pump 1 current	A				
27	Absorbent pump 2 current	A				
28	Refrigerant pump current	A				
29	Purge pump current	A				

* LTD = Condensed refrigerant temperature minus cooling water leaving temperature

Notes

4.2 - Periodic maintenance

To optimize performance, the chiller/heater requires purging, refrigerant blow down, absorbent control and management of the combustion equipment etc. We recommend that you arrange a maintenance contract with your Carrier service agent.

4.2.1 - Purging

Non-condensable gas inside the machine not only decreases cooling/heating capacity, but also potentially shortens the life of the machine. Therefore purging must be done at cooling/heating changeover. This should be done by the Carrier service personnel under a maintenance contract. If customers carry out the purging themselves, they should take instruction from our service personnel.

Purge procedure (DJ-11-42)

Refer to Figs. 30 and 31. When the purge indication light on the control panel comes on, start purging, following the instructions below. Do not purge during the heating mode.

- Turn on the purge pump on/off switch on the control panel, and operate the purge pump for 10 minutes.
- Open V1 and V2.
- Press the ▲ key on the control panel once to show data code 17 "Purge tank pressure" (refer to chapter 3.7.3) and check if the indicated value drops. If it does not drop, follow the procedure described in steps 1, 2 and 3 below and contact your Carrier service agent.
- Purge for 10 minutes. Even if the purge indication light goes off before 10 minutes have elapsed, continue purging for the full 10 minutes. If the light does not go off, continue purging until it does.
  1. Close V1 and V2.
  2. Turn the purge pump on/off switch off.
  3. Check whether the valves are open/closed.

V1	Closed
V2	Closed
V3	Closed
B valve	Open

2. Purge procedure (DJ-51-82)

Refer to Figs. 30 and 32. When the purge indication light on the control panel comes on, start purging, following the instructions below.

- Turn on the purge pump on/off switch on the control panel and operate the purge pump for 10 minutes.
- Close B valve and V4, and open V1 and V2.
- Press the ▲ key on the control panel once to show data code 17 "Purge tank pressure" (refer to chapter 3.7.3) and check if the indicated value drops. If it does not drop, follow the procedure described in steps 1, 2 and 3 below and contact your Carrier service agent.
- Open B valve and V4, and purge for 10 minutes. Even if the purge indication light goes off before 10 minutes have elapsed, continue purging for the full 10 minutes. If the light does not go off, continue purging until it does.
  1. Close V1 and V2.
  2. Turn the purge pump on/off switch off.
  3. Check if the valves are open/closed.

V1	Closed
V2	Closed
V3	Closed
V4	Open
B valve	Open

Fig. 30

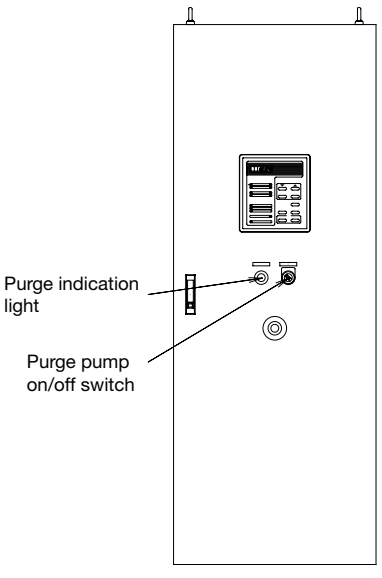


Fig. 31

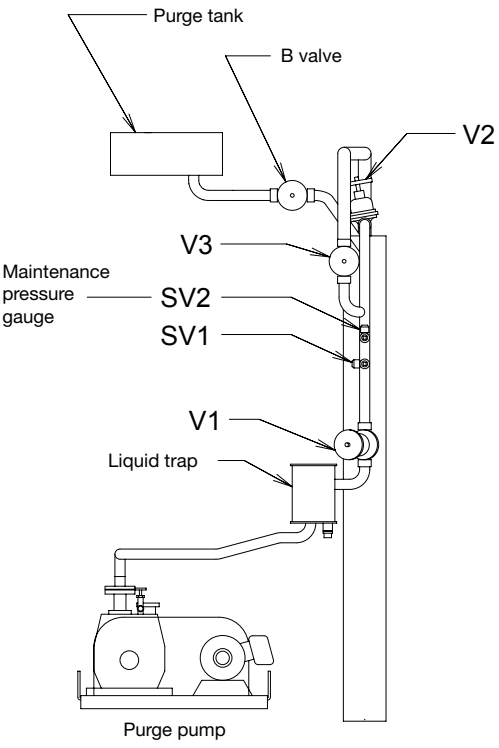
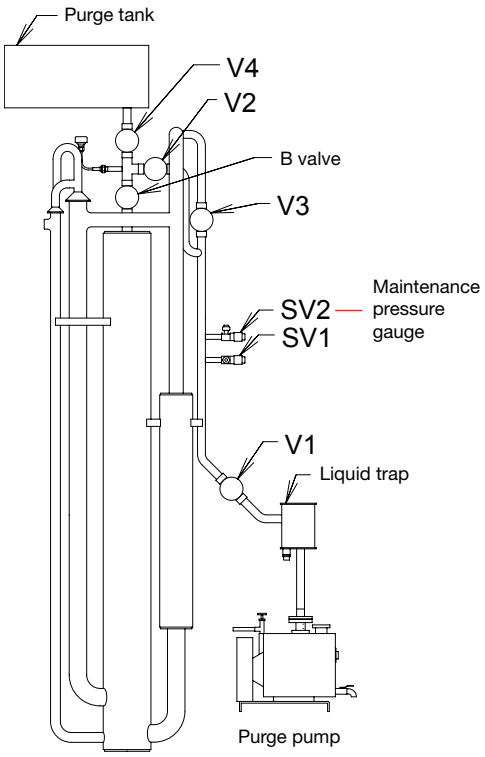


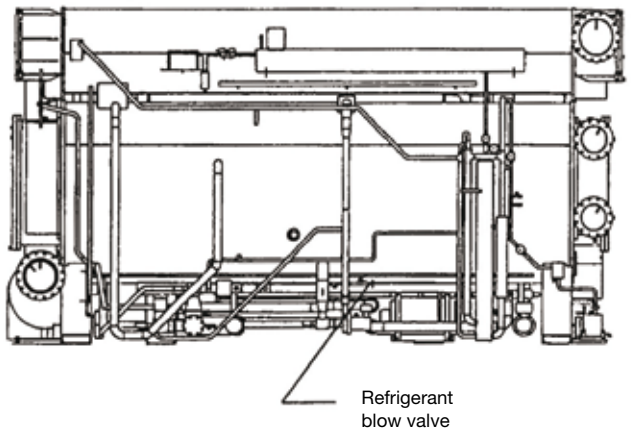
Fig. 32



4.2.2 - Refrigerant blow down

During cooling operation a small quantity of absorbent can mix with the refrigerant. This amount can increase over time and result in a reduced cooling capacity. Therefore refrigerant blow-down must be performed once during the cooling season. By doing this the dirty refrigerant is transferred to the absorber side and new, clean refrigerant is regenerated.

Fig. 33



- Make sure the refrigerant pump is rotating and that the solution level is visible through the evaporator sight glass.
- Open the transfer valve completely.
- When the solution level is no longer visible, close the transfer valve tightly.

The above blow-down procedure should be repeated a few times, as necessary. We recommend that you arrange a maintenance contract with your Carrier service agent which will include refrigerant blow-down.

Component	Name	Inspection area		Inspection			Remarks
		Vacuum area	Non-vacuum area	Item	Method	Interval	
Main shell	Chilled/hot water line pipes	X		Corrosion of the surface of the heat transfer tube	Eddy-current test/endoscope/visual inspection	Every 3 years	Random inspection from the bundle (no vacuum destruction)
			X	Corrosion of the internal surface of the heat transfer tube Scale and/or slime adhesion		Once a year	
	Cooling water line pipes	X		Corrosion of the surface of the heat transfer tube	Eddy-current test/endoscope/visual inspection	Every 3 years	Random inspection from the bundle (no vacuum destruction)
			X	Corrosion of the internal surface of the heat transfer tube Scale and/or slime adhesion		Once a year	
	High/Low temp. heat exchanger tube	X		Corrosion of the surface of the heat transfer tube. Reduced metal by abrasion scale and/or slime adhesion	Overhaul	Every 3 years	
	High temp. generator		X	Check fouling inside	Visual inspection etc.	Once a year	Cleaning
Solution	Absorbent	(X)		Solution analysis Concentration Alkalinity Inhibitor ratio Dissolved copper ratio Dissolved iron ratio	Solution random inspection	6 times per year	To be adjusted to the control standards
Pump	Absorbent pump	X		Pump body, impeller, bearing, coil	Overhaul	As necessary	Inspection interval 20000 hours or more
	Refrigerant pump	X		Pump body, impeller, bearing, coil	Overhaul	As necessary	Inspection interval 20000 hours or more
	Purge pump	(X)		Pump body	Overhaul	As necessary	
				V-belt	Periodic replacement	As necessary	
Fuel	Flame detector		X	Customer will keep spare parts for one unit		Once a year	
Safety device	Pressure gauge	(X)		Periodic replacement (because of safety device)		Every 3 years	Generator pressure gauge
Control device	Flow switch		X	Periodic inspection with a maintenance contract		As necessary	
	Temperature sensor		X	Periodic inspection with a maintence contract (service agent will keep spare parts)		As necessary	
	Electro-magnetic contactor		X				
	Relay		X				
	Inverter		X			Once a year	
Others	Solution level relay electrode	X		Periodic replacement ((maintaining the vacuum)		Every 3 years	
	Sight glass	X				Every 3 years	
	Diaphragm valve packing	X				Every 3 years	
	Other packing	X	X			Every 3 years	
	Palladium cell	X				Every 3 years	
	Smoke chamber cover		X	Periodic inspection with a maintenance contract (service agent will keep spare parts)		As necessary	
	Water line packing		X			All inspection	

4.4 - Water treatment

Water treatment is very important for the chiller/heater. As this requires specialised technical knowledge, please consult your Carrier service agent.

4.4.1 - Water treatment for chilled water and cooling water

The cooling water temperature in an open-type recycling cooling tower is decreased using vaporized latent heat, and the cooling water is reused. At this time, the water is evaporated, and the concentration of the remaining dissolved salts increases. This means that the water quality will gradually deteriorate.

As the water and air are always in contact with each other in the cooling tower, the sulfurous acid gas, dust, sand, etc. in the atmosphere will mix with the water, further degrading the water quality.

These factors cause problems in the cooling water system, such as corrosion, scale and slime.

Water quality standard

The water quality standard is shown in the example in Figure 35. This is an extract from JRA-GL 02-1994.

NOTES:

1. ***If any item deviates from the standard values it may cause failure due to corrosion or scale. Therefore the water quality should be checked periodically.***
2. ***The water quality range that can be used after chemical treatment is not given here, as the range depends on the chemicals used. The appropriate water quality values should be set together with a water processing specialist and be checked periodically.***

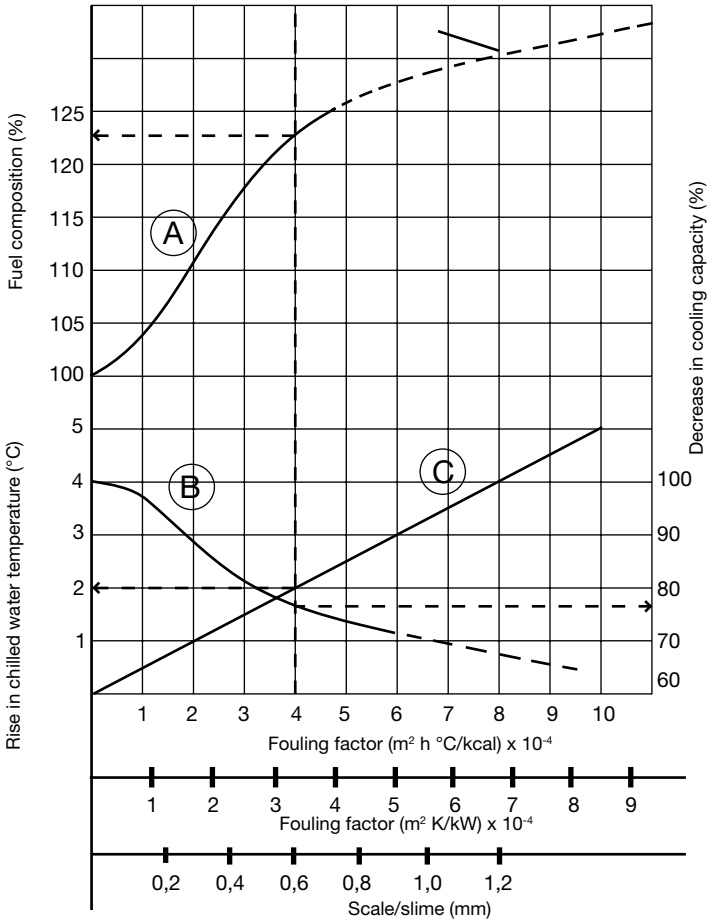
Typical water treatment

Even if the make-up water for the cooling water complies with water standards, the water quality will deteriorate due to its concentration. Therefore the following water treatment is necessary. Depending on the degree of deterioration, chilled-water also requires this treatment.

If a concrete heat storage tank is used, special attention should be paid to water treatment.

- Regular manual blow-down of the tower sump water
- Automatic blow-down by measuring electric conductance
- Addition of the anti-corrosion inhibitor
- Slime control
- Periodic water analysis
  Service the water header periodically, check the heat transfer tube and clean it as necessary.

Fig. 34 - Example of the effect of tube fouling



For example, if 0.6 mm of scale clings to the tubes, the cooling capacity drops to 76%, the chilled-water temperature rises by 2°C and fuel consumption rises by 23%.

A Increase in fuel consumption (for constant cooling capacity, ratio at rated fuel consumption)

B Decrease in cooling capacity (for constant chilled water temperature)

C Increase in chilled water temperature (for constant cooling capacity)

Fig. 35 - Water quality standard values for cooling water, chilled water, mid-range temperature water and make-up water++

			Cooling water systems****			Chilled water systems		Mid-range temperature (20-90°C) water systems***				Tendency**	
								Lower mid-range temperature water system		Higher mid-range teperature water system***			
			Recirculating water	Make-up water	Once through water	Recirculating water (T 20°C)	Make-up water	Recirculating water (20<T<=60°C)	Make-up water	Recirculating water (60<T<=90°C)	Make-up water	Corrosive	Scale-forming
Standard items (see footnotes)													
	pH (25°C)		6.5 - 8.2	6.0 - 8.0	6.8 - 8.0	6.8 - 8.0	6.8 - 8.0	7.0 - 8.0	7.0 - 8.0	7.0 - 8.0	7.0 - 8.0	X	X
	Electrical conductivity (25°C)	mS/m	<= 80	<= 30	<= 40	<= 40	<= 30	<= 30	<= 30	<= 30	<= 30	X	X
		µS/cm	<= 800	<= 300	<= 400	<= 400	<= 300	<= 300	<= 300	<= 300	<= 300		
	Chroride ion	mg Cl^-/l	<= 200	<= 50	<= 50	50	<= 50	<= 50	<= 50	<= 30	<= 30	X	
	Sulfate ion	mg SO_4^{2-}/l	<= 200	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50	<= 30	<= 30	X	
	Acid consumption (pH 4.8)	mg $CaCO_3$/l	<= 100	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50		X
	Total hardness	mg $CaCO_3$/l	<= 200	<= 70	<= 70	<= 70	<= 70	<= 70	<= 70	<= 70	<= 70		X
	Calcium hardness	mg $CaCO_3$/l	<= 150	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50	<= 50		X
	Ionic silica	mg SiO_2/l	<= 50	<= 30	<= 30	<= 30	<= 30	<= 30	<= 30	<= 30	<= 30		X
Reference items (see footnotes)													X
	Iron	mg Fe/l	<= 1.0	<= 0.3	<= 1.0	<= 1.0	<= 0.3	<= 1.0	<= 0.3	<= 1.0	<= 0.3	X	
	Copper	mg Cu/l	<= 0.3	<= 0.1	<= 1.0	<= 1.0	<= 0.1	<= 1.0	<= 0.1	<= 1.0	<= 0.1	X	
	Sulfide ion	mg S^{2-}/l	Not detected			Not detected		Not detected				X	
	Ammonium ion	mg NH_4^+/l	<= 1.0	<= 1.0	<= 1.0	<= 1.0	<= 0.1	<= 0.3	<= 0.1	<= 0.1	<= 0.1	X	
	Residual chlorine	mg Cl/l	<= 0.3	<= 0.3	<= 0.3	<= 0.3	<= 0.3	<= 0.25	<= 0.3	<= 0.1	<= 0.3	X	
	Free carbone dioxide	mg CO_2/l	<= 4.0	<= 4.0	<= 4.0	<= 4.0	<= 4.0	<= 0.4	<= 4.0	<= 0.4	<= 4.0	X	
	Ryzner stability index	-	6.0 - 7.0	-	-	-	-	-	-	-	-	X	X

NOTES

* The nomenclature of items, definition of terms and units shall comply with the JIS K 0101. The units and values in ( ) are conventional ones put here for reference.

** The mark X indicates factors affecting the corrosive or scale-forming tendency.

*** When temperature is high (above 40°C), corrosiveness generally increases. Especially, when iron/steel surface has no protective film and is in direct contact with water, it is desirable to take adequate countermeasures against corrosion, such as addition of corrosion inhibitor and deaeration treatment

**** For the cooling water system using a closed-type cooling tower, the water quality standard for the mid-range temperature water sysem shall be applied to the closed-circuit recirculating/spray water and its make-up water, while the water quality standard for the recirculating cooling water system shall be applied to the spray water and its make-up water, respectively.

++ City water, industrial water and ground water shall be used as source water, and demineralized water, reclaimed water, softened water, etc. shall be excluded.

+++ The 15 items listed above show typical factors of corrosion and scale problems.

4.4.2. Water treatment for long-term shut-down

Perform the following procedure during long-term shut-down when no chilled-water or cooling water circulates in the chiller/heater. Please consult your Carrier service agent for the details.

Cooling water

The usual system is a wet system with the cooling water kept in the chiller/heater. If the cooling water is likely to freeze, drain it from the chiller/heater (dry system). The valve operation is different between wet and dry systems.

Long-term shut-down (wet system)

- Drain the cooling water from its discharge port on the cooling water outlet.
- Add anti-corrosion inhibitor to the water.
  Check the holding water quantity and decide the inhibitor quantity so that the ratio is appropriate.
- Charge the chiller/heater with cooling water.
- Operate the cooling water pump until the inhibitor is evenly mixed.
- Close the cooling water line inlet and outlet isolation valves.

Dry system

Before draining the cooling water from the chiller/heater, clean the inside of the tubes and provide a corrosion protection covering.

- Drain the cooling water from its discharge port on the cooling water inlet.
- Remove the scale and/or slime from the tubes with a brush. If scale and/or slime cannot be removed with a brush use chemical cleaning.
- After sufficient cleaning, add anti-corrosion inhibitor to the water, and circulate the water with the inhibitor for 30 minutes or more. The inhibitor concentration should be even.
- Drain the water from the discharge port on the cooling water inlet.
- Keep the discharge port open during shut-down.

Chilled water

The usual system is a wet system with the chilled water kept in the chiller/heater.

4.4.3 - Winter season

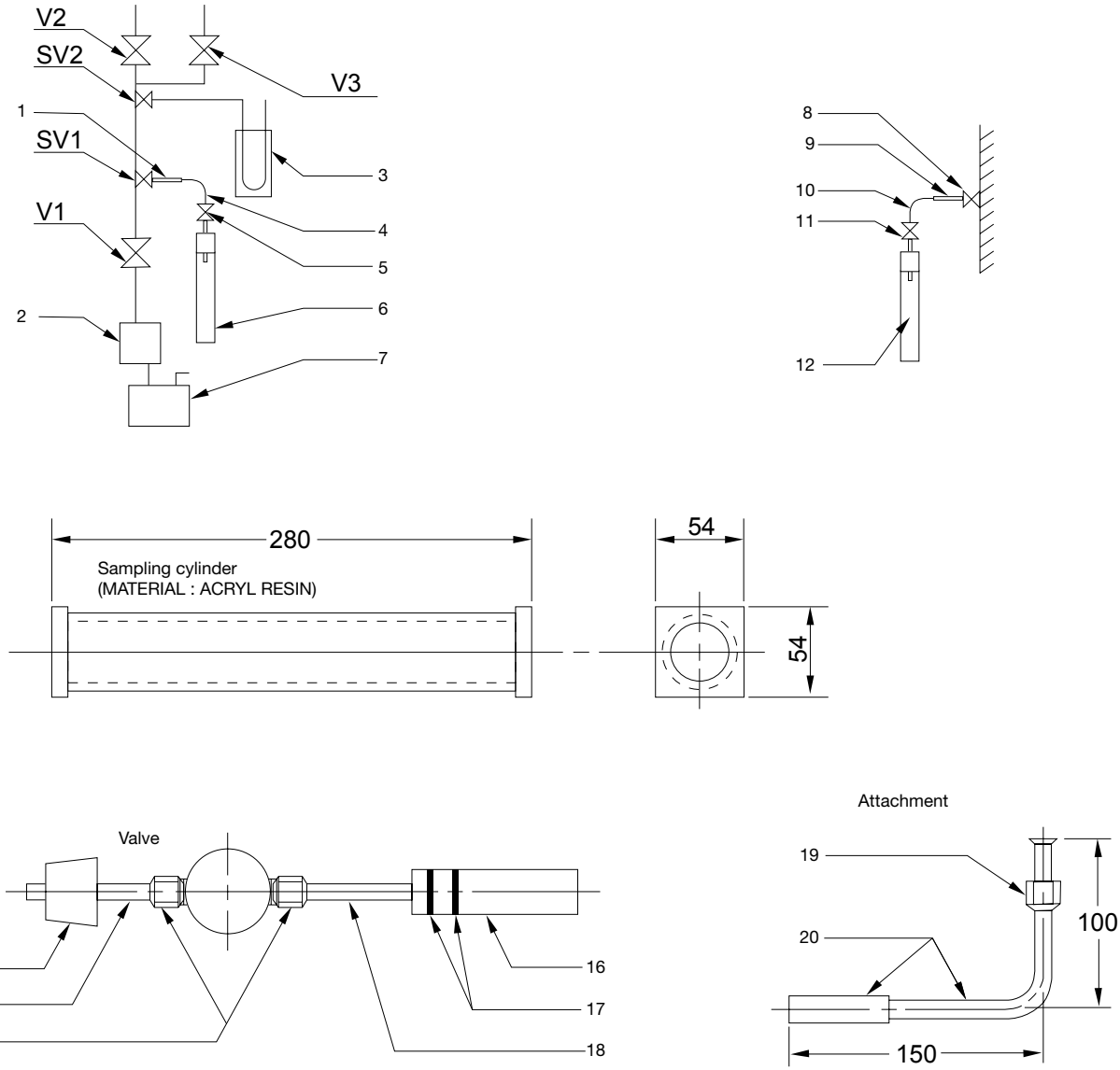
If the ambient temperature of the chiller/heater is likely to be below 0°C in winter, freeze protection is necessary. Consult your Carrier service agent for the details.

5 - TROUBLESHOOTING

For identifying and eliminating the causes of machine failure, please refer to the following chapters:

3.7 - Maintenance message
3.8 - Alarm indication and actions
Appendix 1 - Flowchart (at the end of that document)

Fig. 36



Legend

1 Attachment
2 Liquid trap
3 Vacuum gauge
4 Vacuum rubber hose
5 Vacuum valve
6 Sampling cylinder
7 Purge pump
8 Sampling service valve
9 Attachment
10 Vacuum rubber hose
11 Vacuum valve
12 Sampling cylinder
13 Rubber plug
14 Copper tube
15 Flare nut (brass)
16 Rubber hose
17 Steel wire
18 Copper tube
19 Flare nut (brass)
20 Copper tube

6 - INSTRUCTIONS

6.1 - Absorbent sampling method

This instruction describes the procedure for sampling a small amount of the absorbent.

6.1.1. Equipment to use
- Sampling cylinder and attachments for service valve
- Vacuum rubber hose
- Pliers
- Vacuum gauge (0-1 kPa)

6.1.2 - Precautions
- Because of the high vacuum condition inside the chiller/heater, ensure that air never leaks into the chiller/heater during this work.
- Handle the vacuum valve carefully so as not to damage it.
- Solution (absorbent and refrigerant) is sampled at SV5, SV6 and SV3 in the same manner.
- Pour the sampled solution into a container.

Refer to Figure 12.

6.1.3 - Procedure
- Confirm that manual purge valves (V1, V2 and V3) are closed.
- Remove the flare nut and the bonnet of SV1, and connect the attachment to the service valve.
- Connect the vacuum gauge to SV2 and open SV2.
- Remove the flare nut and the bonnet of SV4 when absorbent is sampled, and connect the attachment to the sampling service valve.
- Connect the vacuum rubber hose and the sampling cylinder to the attachment as shown in Figure 37.
- Run the purge pump and open up V1.
- Open SV1 and the vacuum valve.
- Once the vacuum gauge shows about 0.5 kPa, close the vacuum valve.
- Close SV1 and V1.
- Remove the vacuum rubber hose from SV1, and connect it to the attachment connected to SV4, as shown in Figure 36.
- Open the vacuum valve.
- Open SV4.
- When the sampling cylinder is filled with absorbent, close SV4.
- Close the vacuum valve and remove the vacuum rubber hose from the attachment on SV4 .
- Upon completion of this work, remove the attachment, and replace the bonnets and flare nut. Also replace the caps of both service valves after checking their packing.
- Stop the purge pump.
- Finally, wash all tools with water.

6.2 - Concentration measurement method

This is the procedure used to measure the absorbent and refrigerant concentration.

6.2.1 - Equipment to use
- Sampling cylinder
- Gravimeter
  Scale: 1.0-1.2 (for refrigerant)
  Scale: 1.4-1.6 (for diluted absorbent)
  Scale: 1.6-1.8 (for diluted, intermediate and concentrated absorbent)
- Thermometer

6.2.2 - Precautions
- Take care not to damage the gravimeter and thermometer.
- Be careful not to spill any solution. Do not fill the sampling cylinder more than about 80%.
- Perform this measurement quickly.

6.2.3 - Procedure
- Fill the sampling cylinder to about 80% with the solution to be measured.
- Keep the sampling cylinder vertical, and insert the gravimeter into it.
- When the gravimeter stops moving up and down, read its scale which shows the gravity of the solution.
- Remove the gravimeter and put it aside. Then insert the thermometer into the sampling cylinder and stir the solution thoroughly.
- When the temperature stabilizes, read the scale on the thermometer.
- Remove the thermometer and put it aside.
- Store the solution in another bottle.
- Using the concentration diagram of the lithium bromide solution, read the concentration.
- Upon completion of the measurement, wash the gravimeters, thermometer and sampling cylinder with water, and store them so that they are not damaged.

Example:
The horizontal axis represents temperature and the vertical axis represents relative density. The lines going down from left to right represent the fixed concentrations.

For example, if the relative density is 1.77 and the temperature is 45°C, the concentration given by the point of intersection of the lines projected from these values will be 63%, as shown in Figure 37 below.

Fig. 37

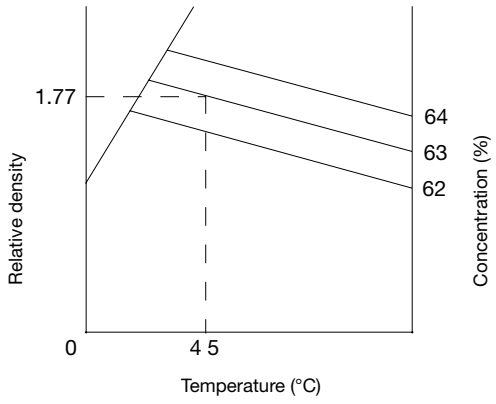


Fig. 38a - Concentration vs temperature vs relative density

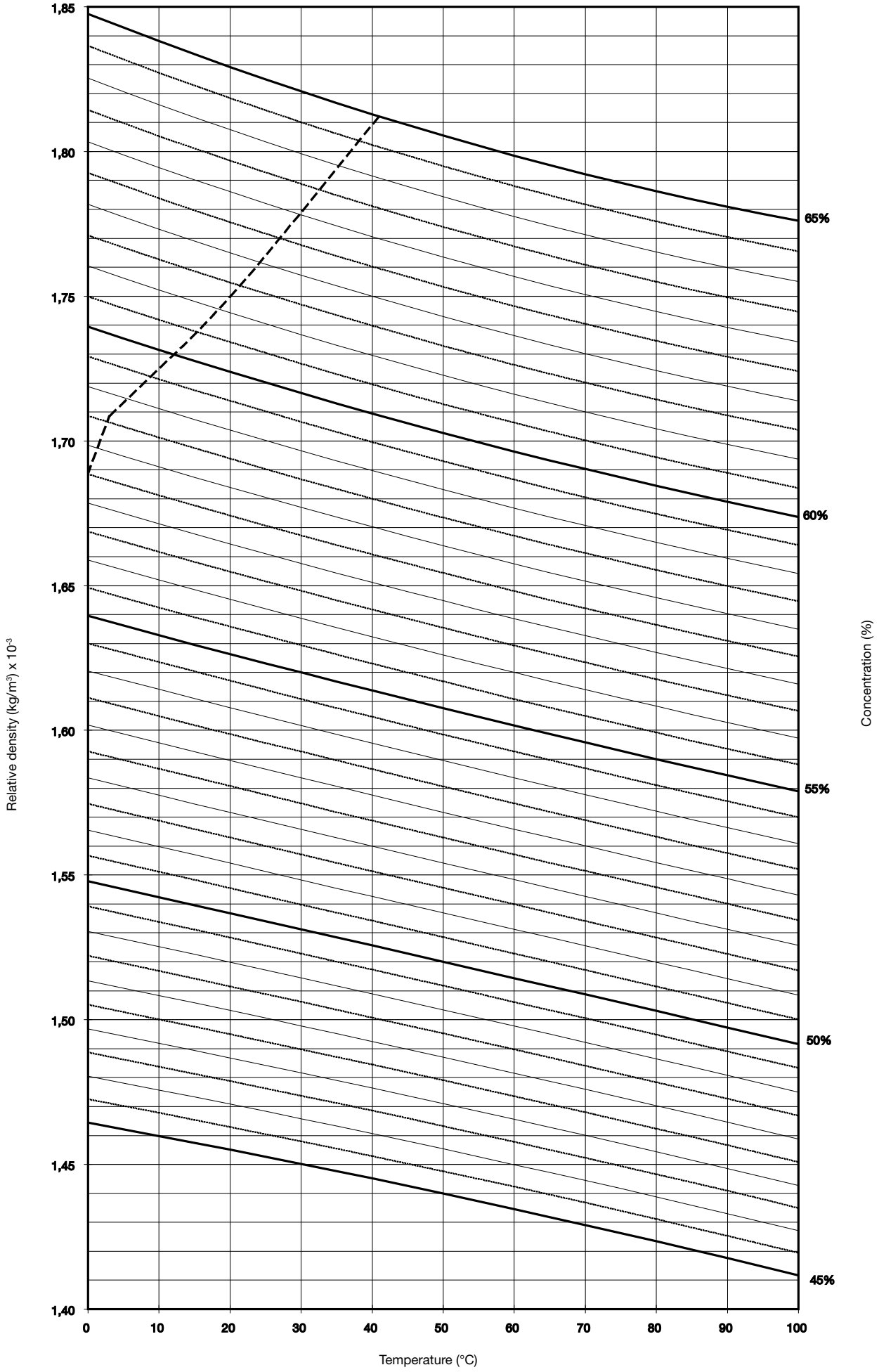
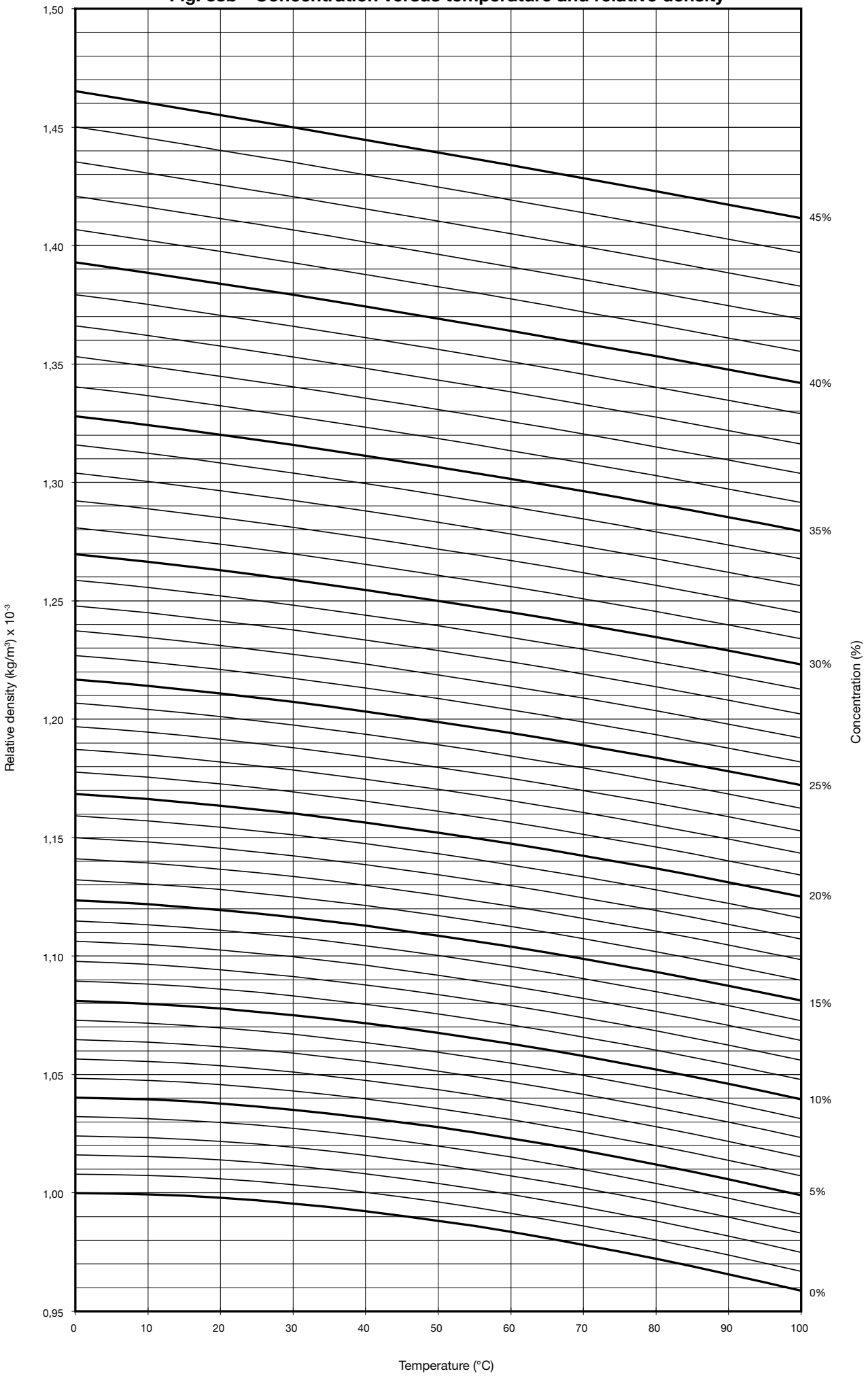


Fig. 38b - Concentration versus temperature and relative density



7 - MAINTENANCE CONTRACT

To enjoy safe and efficient operation of the chiller/heater for a long time, daily maintenance and periodic inspection are essential. The main items are as follows:

- Verification of the function of safety devices and their adjustment
- Checking the operating conditions and recording the data

These procedures require special tools and a special skills.

We offer an annual maintenance contract to users of the chiller/heater. Under the contract we provide trained service personnel that will perform the periodic diagnosis and adjustment of the chiller/heater, using the latest technology. Consult your Carrier service agent for details.

7.1 - Annual maintenance contract

We offer an annual maintenance contract to our customers with periodic inspection and maintenance of the Carrier absorption chiller/heater. Under this contract your Carrier service agent will perform maintenance/inspection and adjustment works to keep your chiller/heater in its optimal condition, and you will be given priority for chiller/heater repairs, in case there is a problem.

It is recommended to perform a complete chiller/heater overhaul every few years to keep it in its optimal condition. Under the maintenance contract we advise our customers of the timing and the parts to be overhauled. There is an additional contract for water quality control and cleaning of the heat transfer tubes in the water system. We recommend that you also take out this contract.

7.2 - Inspection report

We issue an inspection report for the annual maintenance under the contract. The report contains a thorough description of the inspection/adjustment items and ensures that Carrier service personnel will not overlook any of the inspection items. At the time of inspection the Carrier service personnel will fill in the report, leave one copy with the customer, and take one copy back to the office to be available for future maintenance works.

We will not re-issue this report, so please be sure to keep it in a safe place. Show it to the Carrier service technicians when they visit you.

7.3 - Warranty

- Your Carrier service agent will fill in the warranty and leave it with you. Please check the warranty period, read the document carefully and keep it in a safe place.
- If the chiller/heater fails within the warranty period under normal operating conditions, we will replace all necessary spare parts or repair the chiller/heater free-of-charge.
- After the warranty period expires, all repair costs will be charged. Consult your service agent.
- For all other items please read your warranty document.

8. - CHILLER/HEATER DISPOSAL/REPLACEMENT

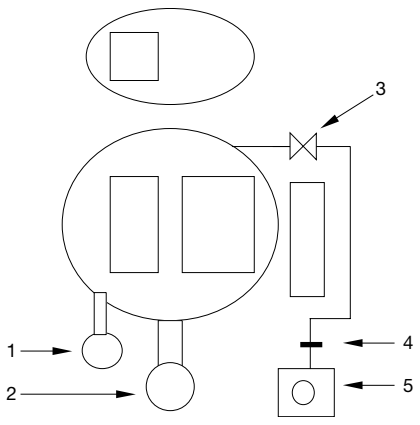
8.1 - Precaution

Only qualified personnel should perform welding and cutting operations.

8.2 - Procedure

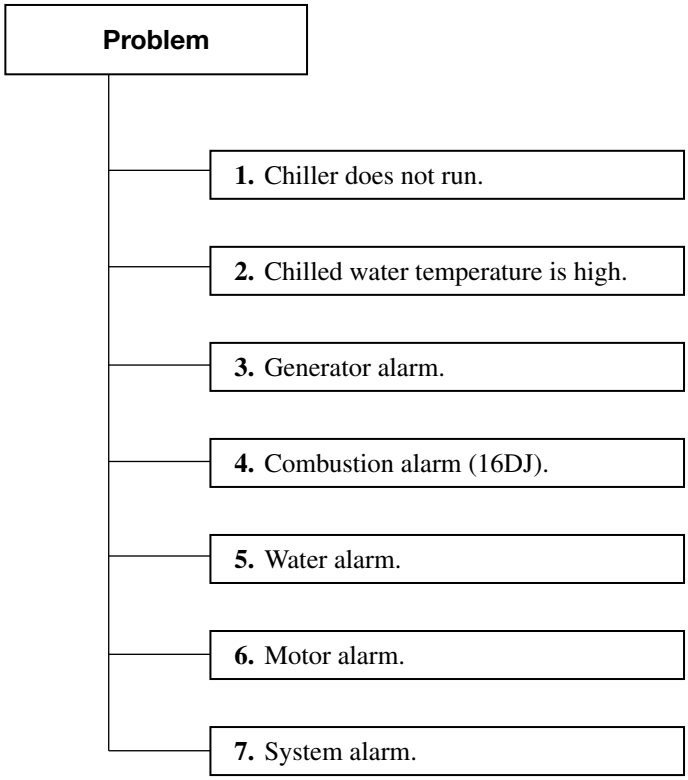
1 Power supply circuit, gas piping, and oil piping of the absorption chillers/heaters are separated from each other.
2 Chilled/hot water and cooling water remaining in heat transfer tubes should be drained by opening the water header provided for this purpose and draining it from one side of the header. Safety measures should be taken to prevent drained water from spattering.
3 By closing the valve at the point where a purge pump of a purge circuit is connected to a service valve, the path of the purge circuit is separated from that of the purge pump. Nitrogen gas of 50 kPa should be charged through the service valve shown in Fig. 39.
4 A hose should be attached to SV3, SV4, SV5, SV6 and SV8. Use a bottle to collect the drained absorbent.
5 Open SV3, SV4, SV5, SV6 and SV8, and remove the absorbent.
6 After the absorbent has been drained through each valve, the absorbent pump and the refrigerant pump should be removed to drain the absorbent remaining at the bottom of the heat exchanger.
7 If it is difficult to remove the replaced absorption chiller/heater due to limited space, the chiller/heater can be cut into individual components. If gas is used to separate the machine, alwways wear a protective mask and protective goggles to prevent injuries which may be caused by the gas.
8 Dispose of the chiller/heater according to the local regulations.

Fig. 39



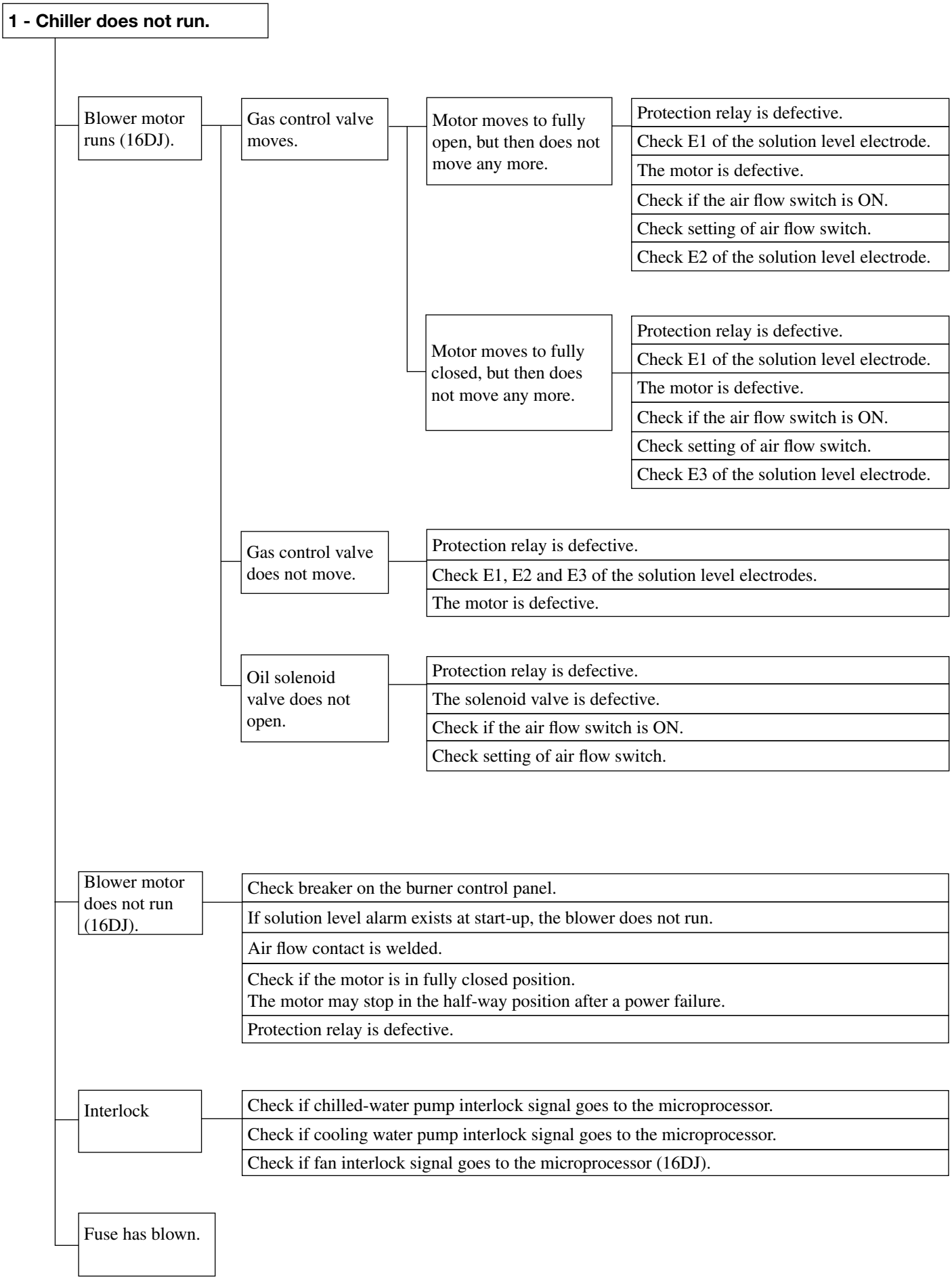
Legend
1 Refrigerant pump
2 Absorbent pump
3 Service valve
4 Plate to separate the purge pump
5 Purge pump

APPENDIX 1 - TROUBLESHOOTING FLOWCHART



NOTE: The troubleshooting charts apply to all 16 series absorption chillers, and the service engineer should determine if the failure mode is relevant to the specific machine.

APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.



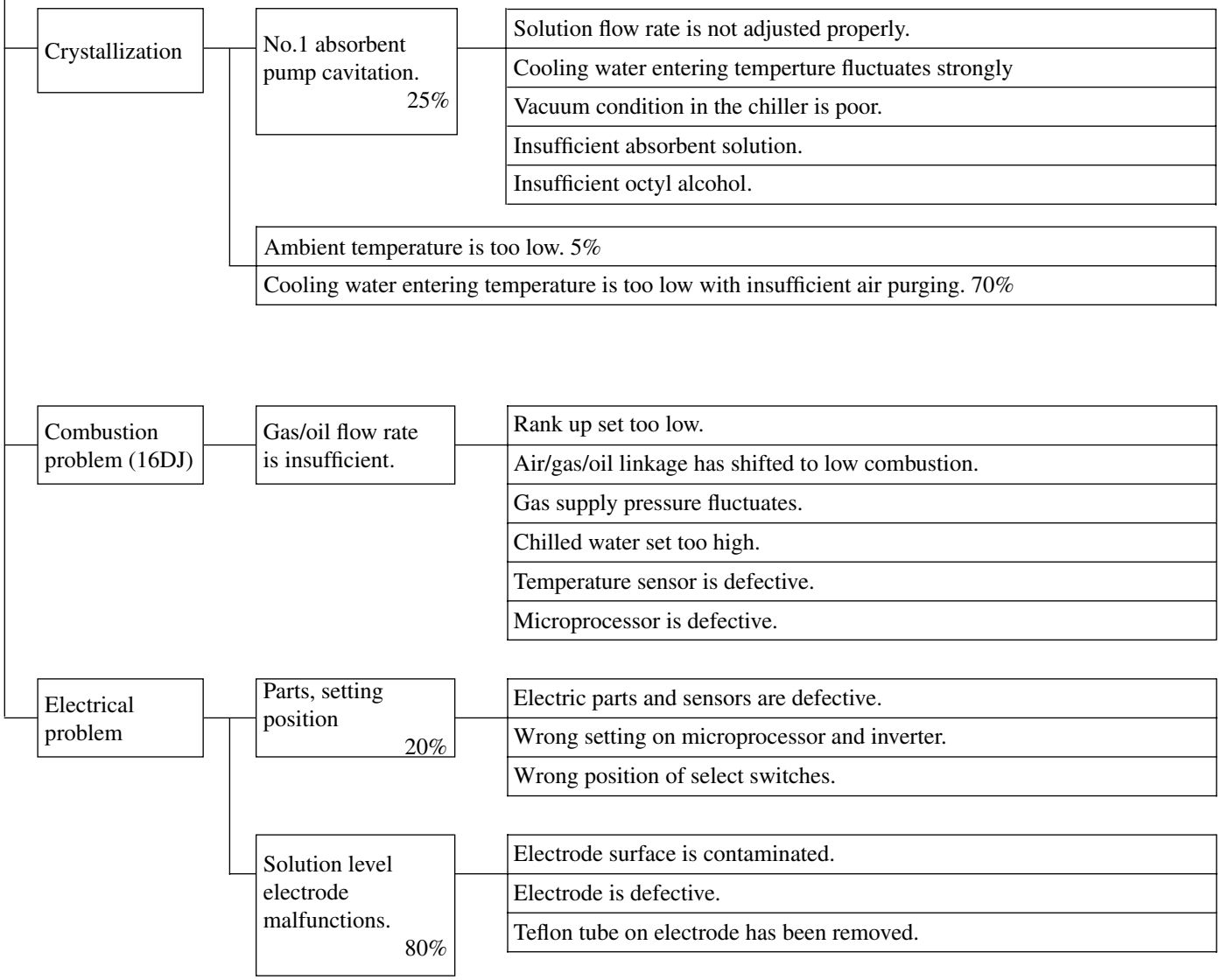
APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

2 - Chilled-water temperature is high.

- Vacuum problem
  - Generating hydrogen gas 60%
    - Insufficient inhibitor.
    - Pd cell is defective.
    - Pd cell heater is defective.
  - Air leakage 30%
  - Insufficient air purging. 30%
- Chilled water problem
  - Chilled-water flow rate is too high.
- Cooling water problem
  - Flow rate is inadequate. 30%
    - Cooling water pump control malfunctions.
    - Strainer is clogged.
    - Insufficient feed water.
    - Air in the cooling water line.
  - Cooling water temp. is too high. 50%
    - Ambient temperature and/or humidity are too high.
    - Cooling water control valve malfunctions.
    - Cooling tower water spray malfunctions.
    - Cooling tower fan malfunctions.
    - Cooling tower fan belt is broken.
    - Cooling water temperature control thermostat malfunctions.
  - 20%
    - Partition plate in water box is removed.
    - Absorber and condenser tubes are fouled.
- Solution problem
  - Insufficient absorbent flow rate. 30%
    - Solution flow rate is not adjusted properly.
      - Wrong inverter setting.
      - Check valve malfunctions.
      - Wrong damper adjustment.
    - Condensed refrigerant pipe connected between the low-temperature generator and condenser is clogged.
    - Heat transfer tubes in high/low-temperature heat exchangers leak.
    - Heat exchanger is clogged with foreign material.
  - Insufficient refrigerant amount. 5%
  - Insufficient octyl alcohol. 10%
  - Refrigerant contamination 25%
    - Cooling water entering temperature is too low.
    - Refrigerant blow-down is needed.
    - Heavy foaming condition in high-temperature generator due to absorbent contamination with foreign material.

APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

(Chilled-water temp is high.)



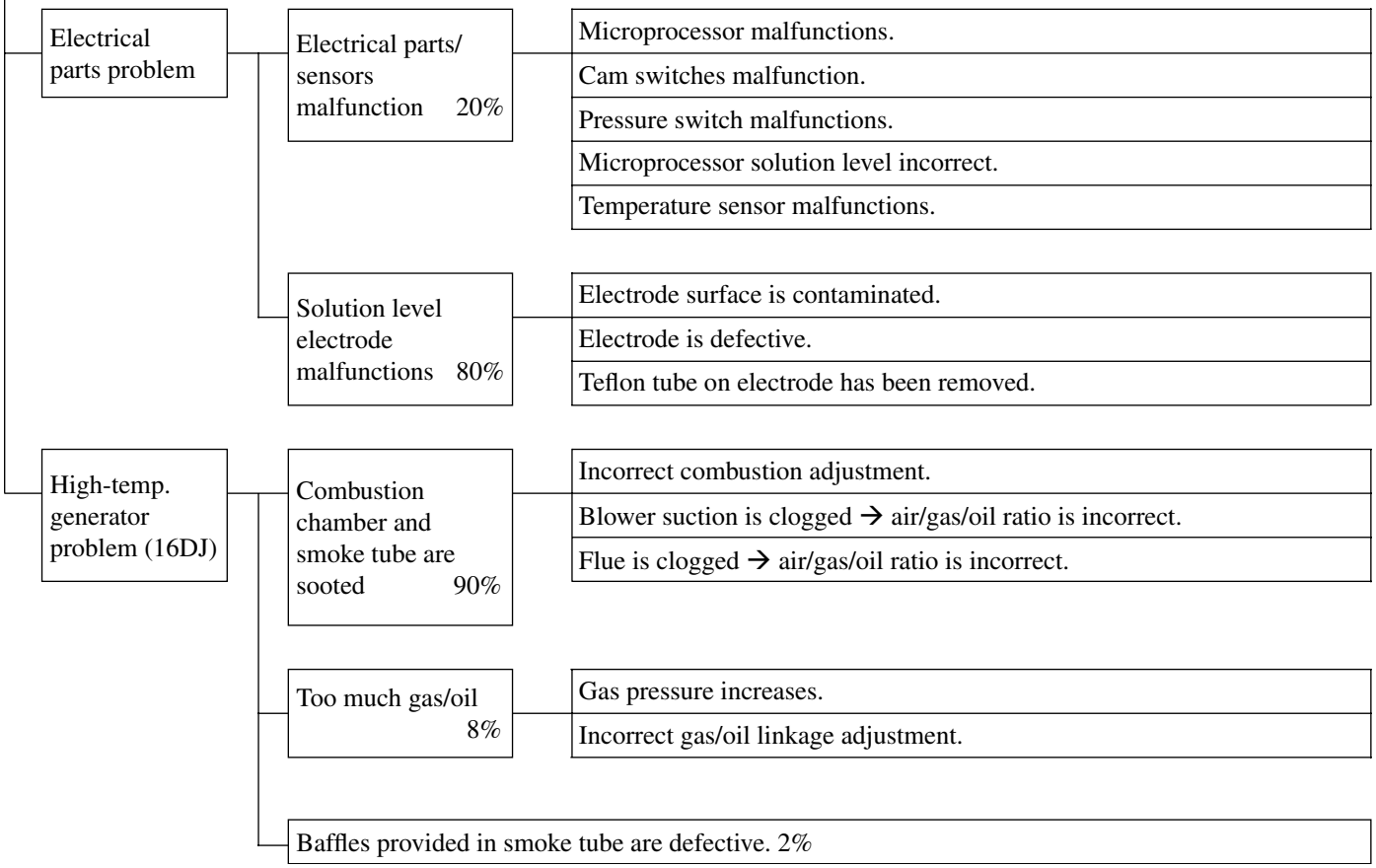
APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

3 - Generator alarm

- Vacuum problem
  - Hydrogen gas is generated. 60%
    - Insufficient inhibitor.
    - Pd cell heater is defective.
    - Pd cell is defective.
  - Air leakage 30%
  - Purging is inadequate. 10%
- Cooling water problem
  - Flow rate is inadequate. 30%
    - Cooling water pump control malfunctions.
    - Strainer is clogged.
    - Insufficient feed water.
    - Air in cooling water line.
  - Cooling water pump is too high. 50%
    - Ambient temperature and/or humidity are too high.
    - Cooling water control valve malfunctions.
    - Cooling tower water spray malfunctions.
    - Cooling tower fan malfunctions.
    - Cooling tower fan belt is broken.
    - Cooling water temperature control thermostat malfunctions.
  - 20%
  - Partition plate in water box is removed.
  - Absorber and condenser tubes are fouled.
- Absorbent flow problem
  - Absorbent flow rate is inadequate 75%
    - Wrong adjustment
      - Wrong inverter setting.
      - Check valve malfunctions.
      - Wrong damper adjustment.
    - Heat exchanger(s) tubes are damaged.
    - Heat exchanger(s) is (are) clogged.
    - Orifice in pipe betw. LT generator + condenser is clogged (16DJ/NK).
  - Refrigerant is contaminated by absorbent 24%
    - Cooling water temperature is too low.
    - Refrigerant blow-down is inadequate.
    - Heavy absorbent foaming condition in HT generator because there is foreign material in the absorbent (16DJ/NK).
  - LT generator tubes are damaged (16DJ/NK). 1%
- Crystallization
  - Absorbent pump cavitation 25%
    - Ambient temperature and/or humidity are too high.
    - Cooling water control valve malfunctions.
    - Cooling tower water spray malfunctions.
    - Cooling tower fan malfunctions.
    - Cooling tower fan belt is broken.
  - Ambient temperature is too low. 5%
  - Cooling water entering temperature is too low with insufficient air purging. 70%

APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

(Generator alarm)

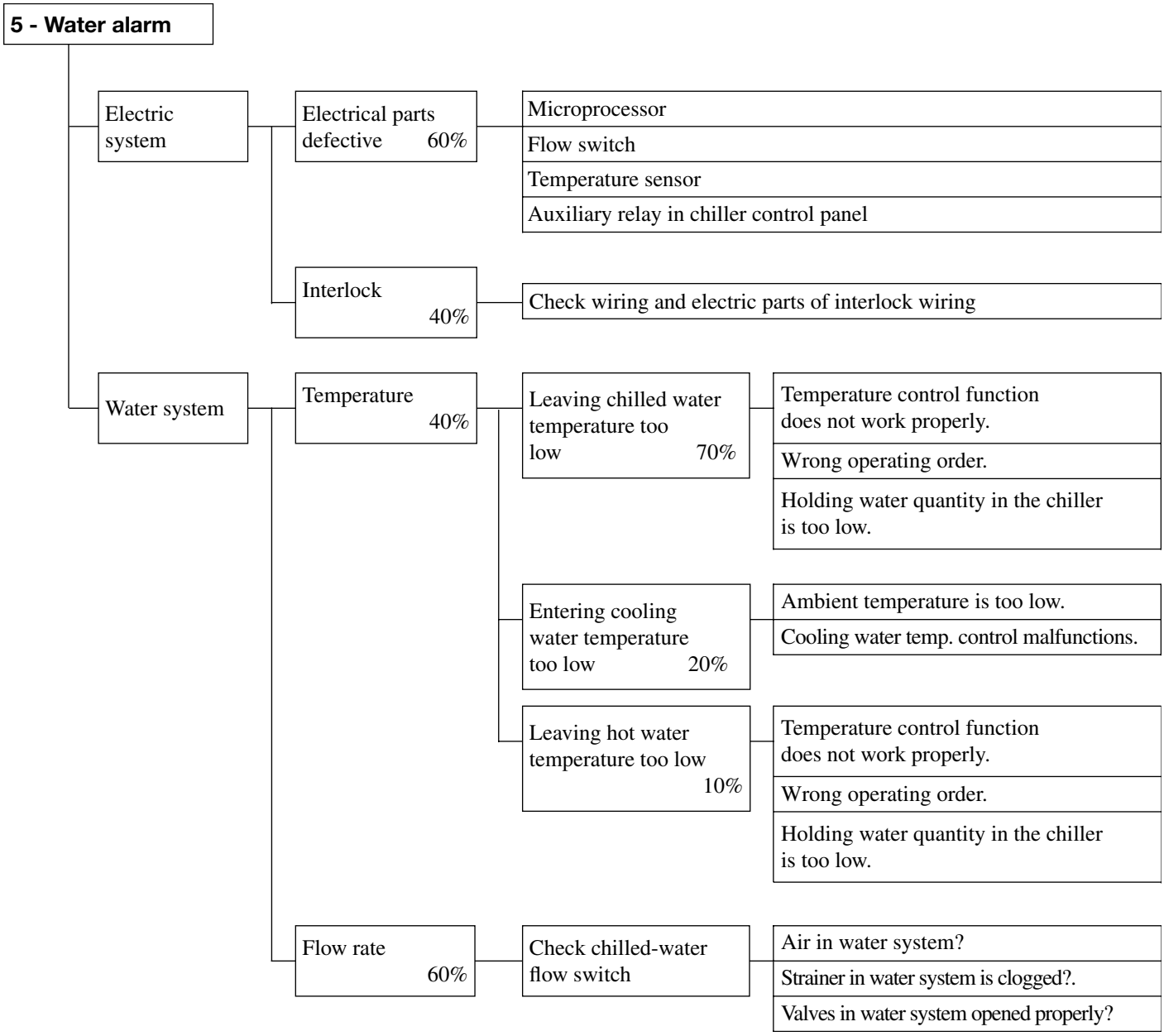


APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

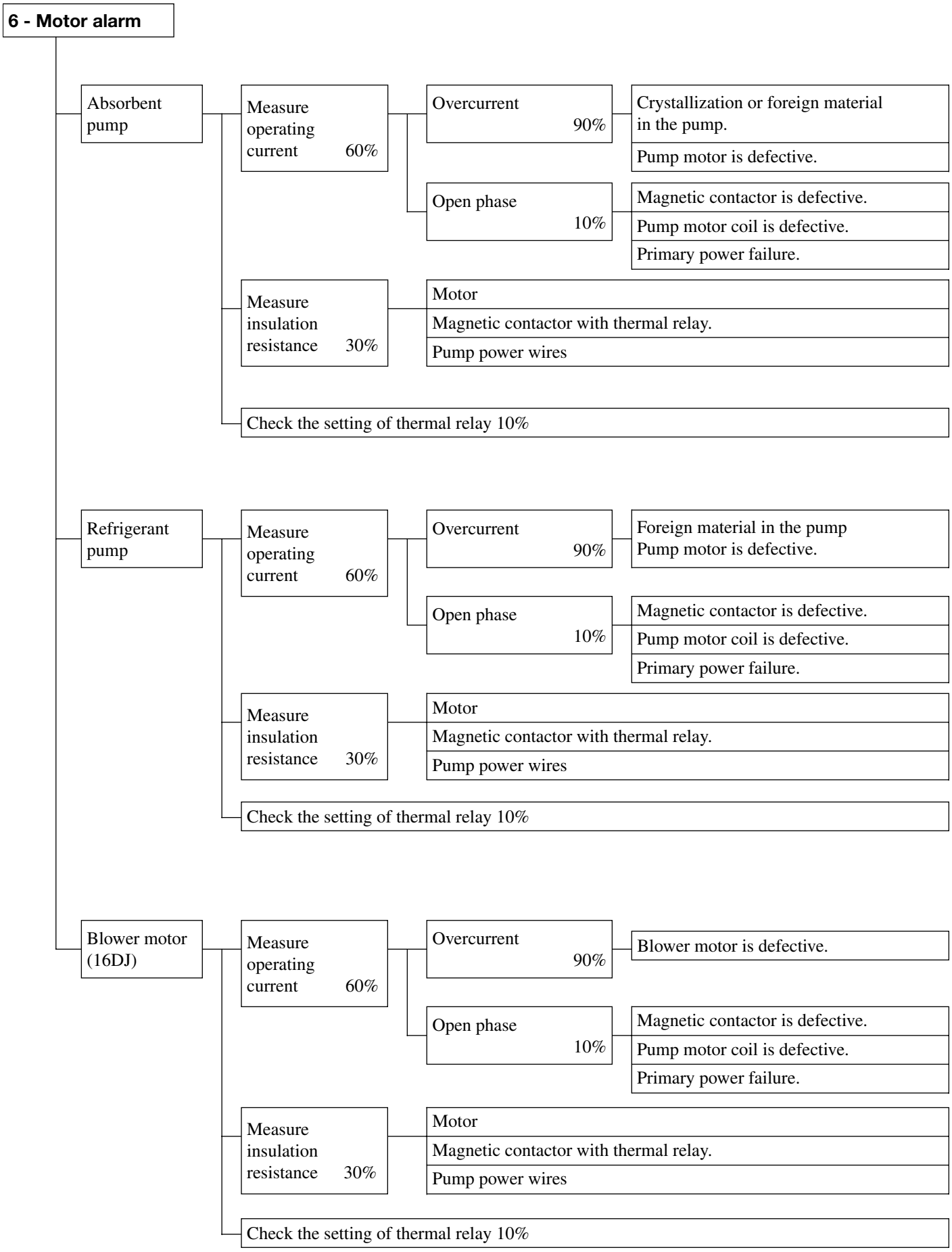
4 - Combustion alarm (16DJ)

- Flame failure (spark OK)
  - Flame failure occurs at the end of ignition spark.
    - Protection relay is defective.
    - Pilot burner is not properly adjusted.
    - Pilot solenoid valve is defective.
    - Pilot gas regulator is defective.
    - Flame detector (UV tubes) is defective.
- Flame failure (pilot burner ignites)
  - Flame failure occurs during main flame trial 50%
    - Protection relay is defective.
    - Pilot burner is not properly adjusted.
    - Main gas regulator is defective.
    - Flame detector cannot detect a flame.
    - Main gas shut-off valve is defective.
    - Gas supply pressure fluctuates.
    - Flue is clogged.
  - Pilot burner is OK. 50%
    - Flame failure occurs after main flame was ignited for a while 30%
      - Protection relay is defective.
      - Gas/air linkage is not properly adjusted.
      - Main gas regulator is defective.
      - Gas/oil flow meter is locked.
      - Flue is clogged.
      - Voltage drops.
    - Main burner does not ignite 70%
      - Protection relay is defective.
      - Check if test cock opens or not.
      - Check if gas/oil/air linkage is loose.
      - Main gas shut-off valves are defective.
- Flame failure (no spark)
  - Ignition transformer is defective.
  - Microprocessor is defective.
  - Position of spark rod is not properly adjusted.
  - Insulation of spark rod is defective.
  - Ignition spark wire is removed or broken.
  - Protection relay is defective.
  - Flame detector is defective.
  - Flame remains after stop of combustion.
- Gas pressure alarm
  - Measure gas supply pressure 80%
    - Check gas regulator in main gas pipe line.
    - Check gas strainer.
    - Check other equipment installed in main gas pipe line.
    - Check gas regulator installed in gas train.
  - Check gas pressure switch 20%
    - Confirm movement of the switch.
    - Check the setting.
- Air flow alarm
  - Confirm air flow switch 80%
    - Check the setting.
    - Check the contact of the air flow switch.
    - Check if the air flow switch is installed correctly.
  - Measure pressure inside the wind box 20%
    - Check the wind box suction side for obstruction by foreign material.
    - Check the tube between the box and the air flow switch for obstruction by foreign material.

APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.



APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.



APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

7 - System alarm

- Check if chilled water pump interlock signal goes to the microprocessor.
- Check if cooling water pump interlock signal goes to the microprocessor.
- Check if fan interlock signal goes to the microprocessor (16 DJ).

GB/T-24001 to ISO14001:1996

Carrier

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