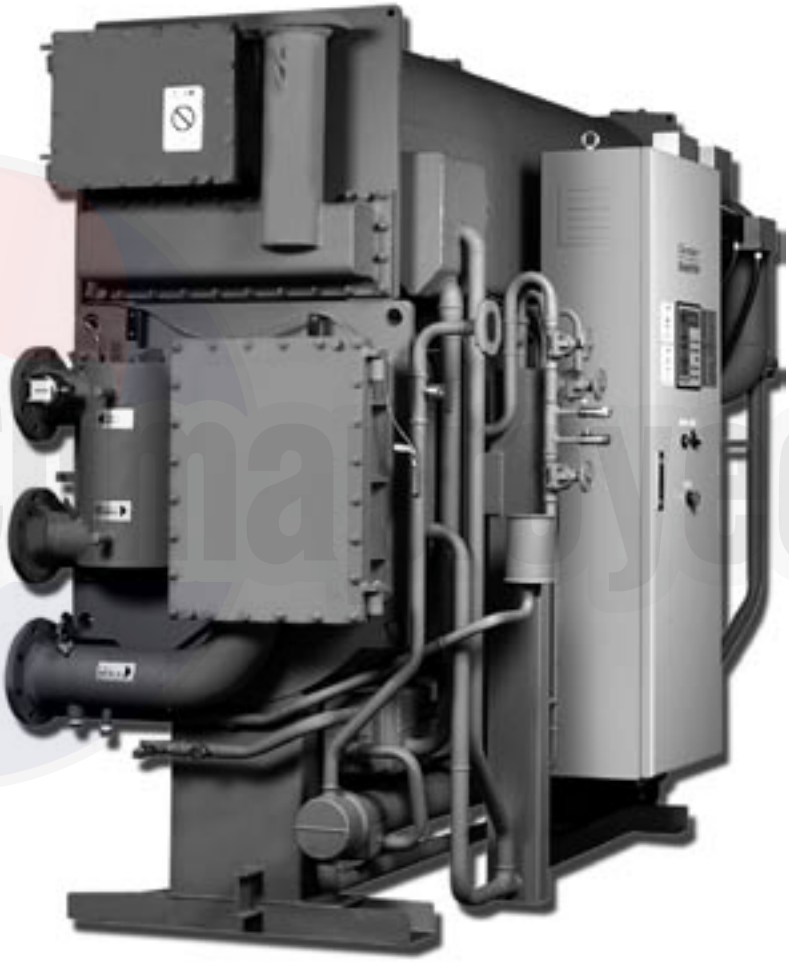
Carrier
SANYO

16TJ
Single-Effect Steam-Fired Absorption Chillers

Nominal cooling capacity 352-2461 kW

50 Hz



Operation and maintenance instructions

GB/T-19001-2000 to ISO9001/2000

NOTES TO USERS

Thank you for purchasing a Carrier/Sanyo absorption chiller.

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

Please utilize the chiller 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. 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.

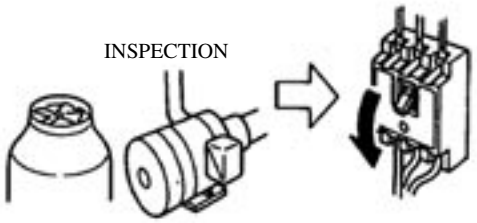
1.1.1 Safety considerations

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, to provide protection from electric shock or possible injury from the rotating fan.

INSPECTION



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.

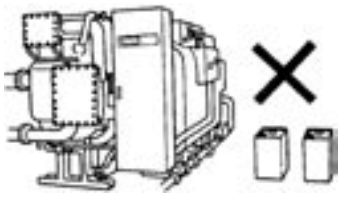
DO NOT TOUCH

WARNINGS

KEEP FLAMMABLE SUBSTANCES AWAY FROM THE CHILLER

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

PROHIBITED



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

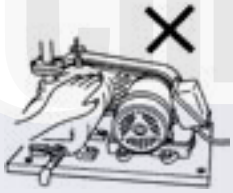
Do not operate the chiller if there is a smell of gas. Do not turn on/off any switch, as this could cause a fire.

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

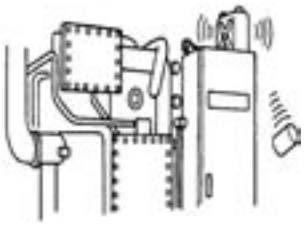
Solve all problems before restarting the chiller after a safety or security device is activated, to prevent fire.

MUST BE OBSERVED

DO NOT PLACE HEAVY OBJECTS ON THE CHILLER OR CONTROL PANEL

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

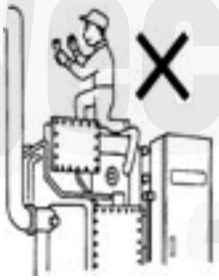
PROHIBITED



DO NOT CLIMB ON THE CHILLER

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

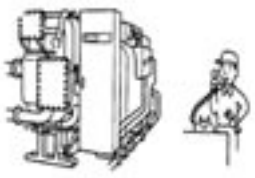
PROHIBITED



CALL SPECIALISTS FOR SERVICE OR MAINTENANCE

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

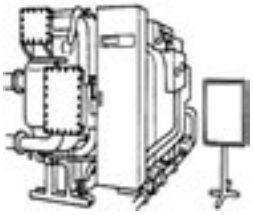
MUST BE OBSERVED



AUTHORIZED PERSONNEL ONLY

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

PROHIBITED



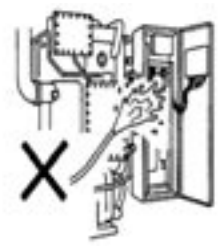
1 - PRECAUTIONS - CONT.

CAUTIONS

DO NOT POUR WATER ON THE CHILLER OR CONTROL PANEL

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

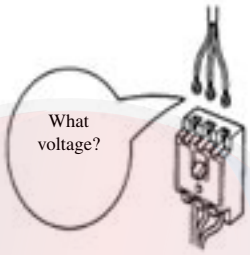
PROHIBITED



USE THE CORRECT POWER SUPPLY

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

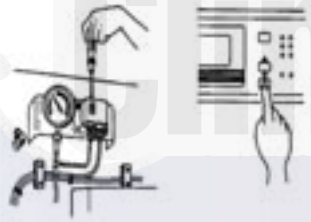
PROHIBITED



NEVER CHANGE THE SET VALUES

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

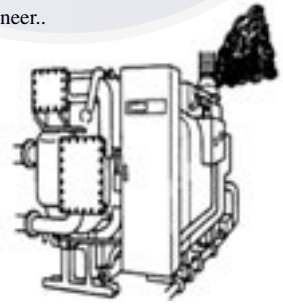
PROHIBITED



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.

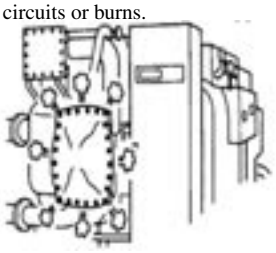
PROHIBITED

OBSERVE THE SPECIFIED WATER AND STEAM PRESSURE

The specified chilled water, steam 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

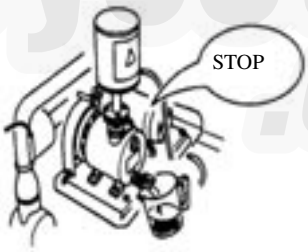
Do not touch high-temperature areas, as they may cause burns. These areas are indicated by caution label.

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

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

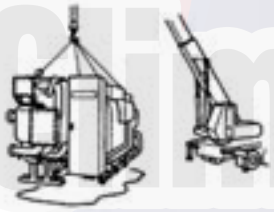
PROHIBITED

CAUTION

ONLY AUTHORIZED PERSONNEL SHOULD REMOVE OR REPAIR THE CHILLER

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

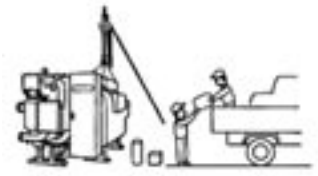
MUST BE OBSERVED



ONLY AUTHORIZED PERSONNEL SHOULD DISPOSE OF THE CHILLER

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

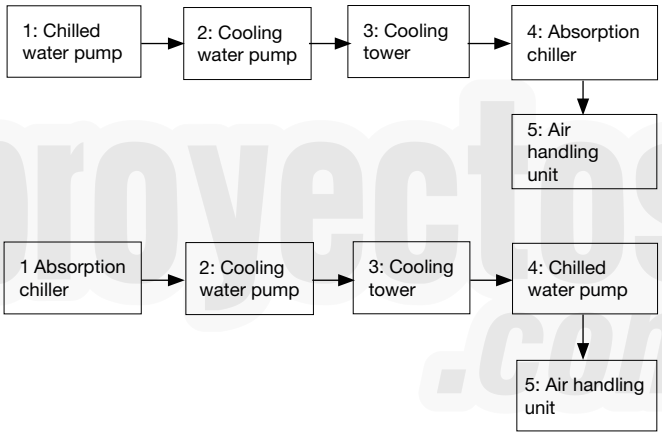
MUST BE OBSERVED



1.1.3 - Operating precautions

1. Keep the purge valve tightly shut to prevent air from leaking into the chiller, which may cause the failure of the chiller.
2. Keep the power supply to the control panel turned on, unless carrying out maintenance or service.
3. During the chiller 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 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. Do not perform an insulation test on the control circuits of the electric controller.
5 . 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



1.2 - High-temperature - high-voltage caution

- Do not touch the chiller 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 16TJ absorption chiller is designed for indoor installation in a machine room. The protection rating of the chiller is IP40. Room temperature should be maintained between 5°C and 40°C to protect against solution crystallization during chiller shutdown. The humidity in the machine room must be kept below 90%.

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

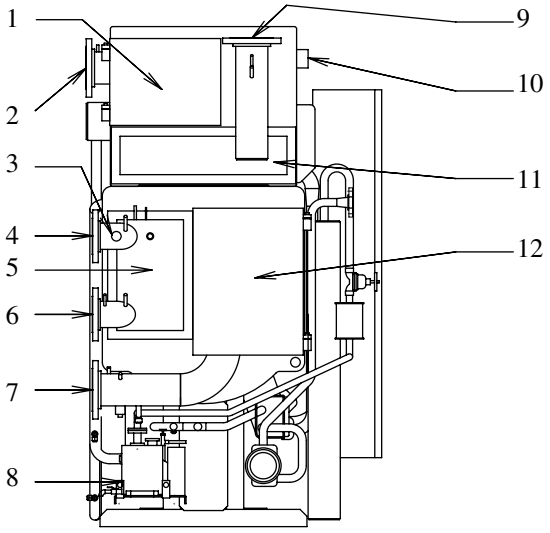
Please install the absorption chiller at a maximum height of 1000 m above sea level. If the location is higher than 1000 m above sea level, please contact your local Carrier office.

1.4 - Water treatment

Refer to chapter 4 "Maintenance".

2.1 - Typical chiller detail

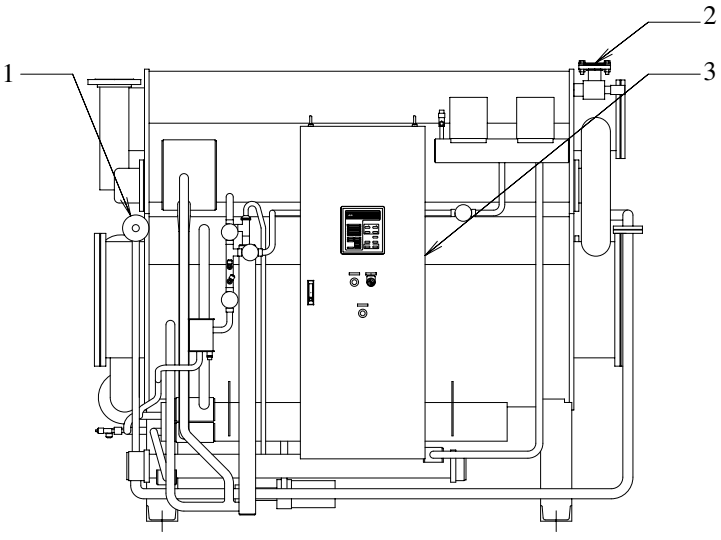
Fig. 2 - Water header side



Legend

1 Condenser
2 Cooling water outlet
3 Chilled water flow switch
4 Chilled water outlet
5 Evaporator
6 Chilled water inlet
7 Cooling water inlet
8 Purge pump
9 Steam inlet
10 Generator pressure switch
11 Generator
12 Absorber

Fig. 3 - Control panel side

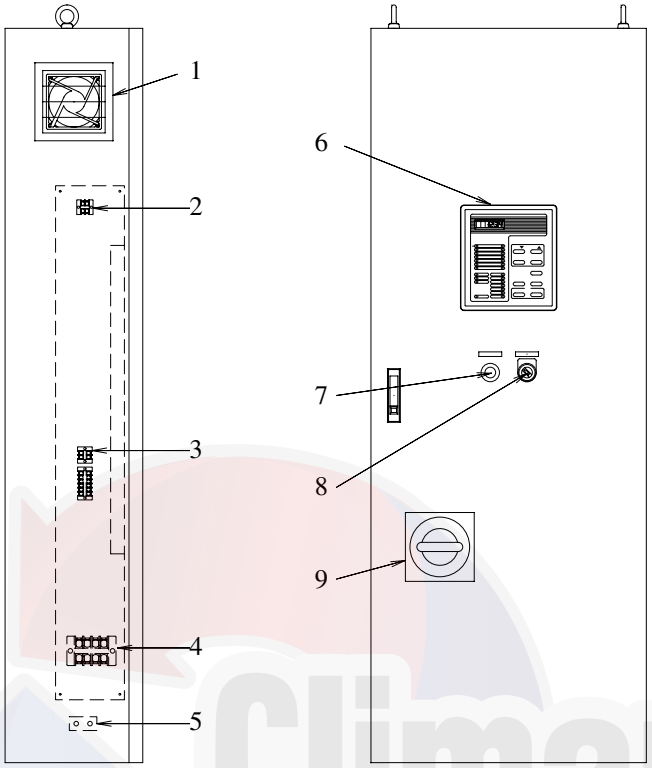


Legend

1 Drain outlet
2 Hot water outlet
3 Control panel

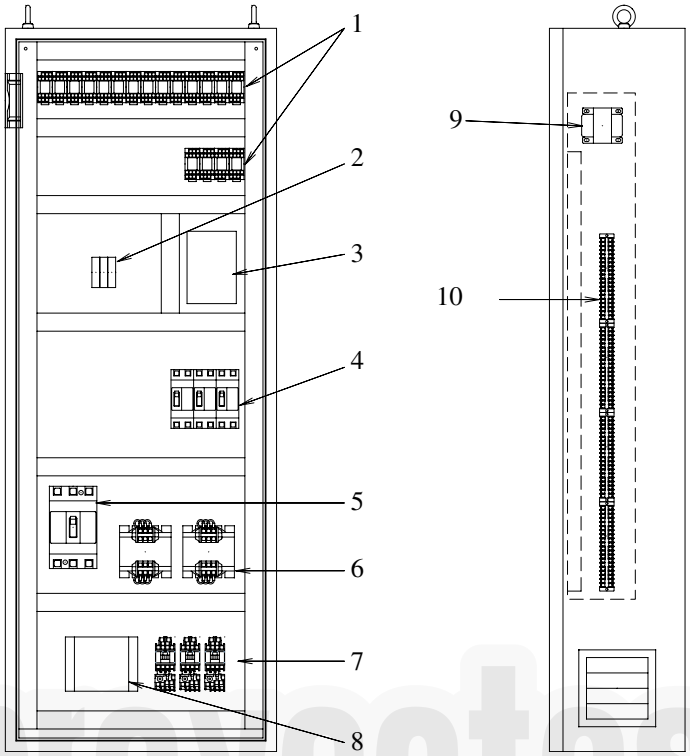
2.2 - Typical control panel

Fig. 4 - Control panel (CE type)



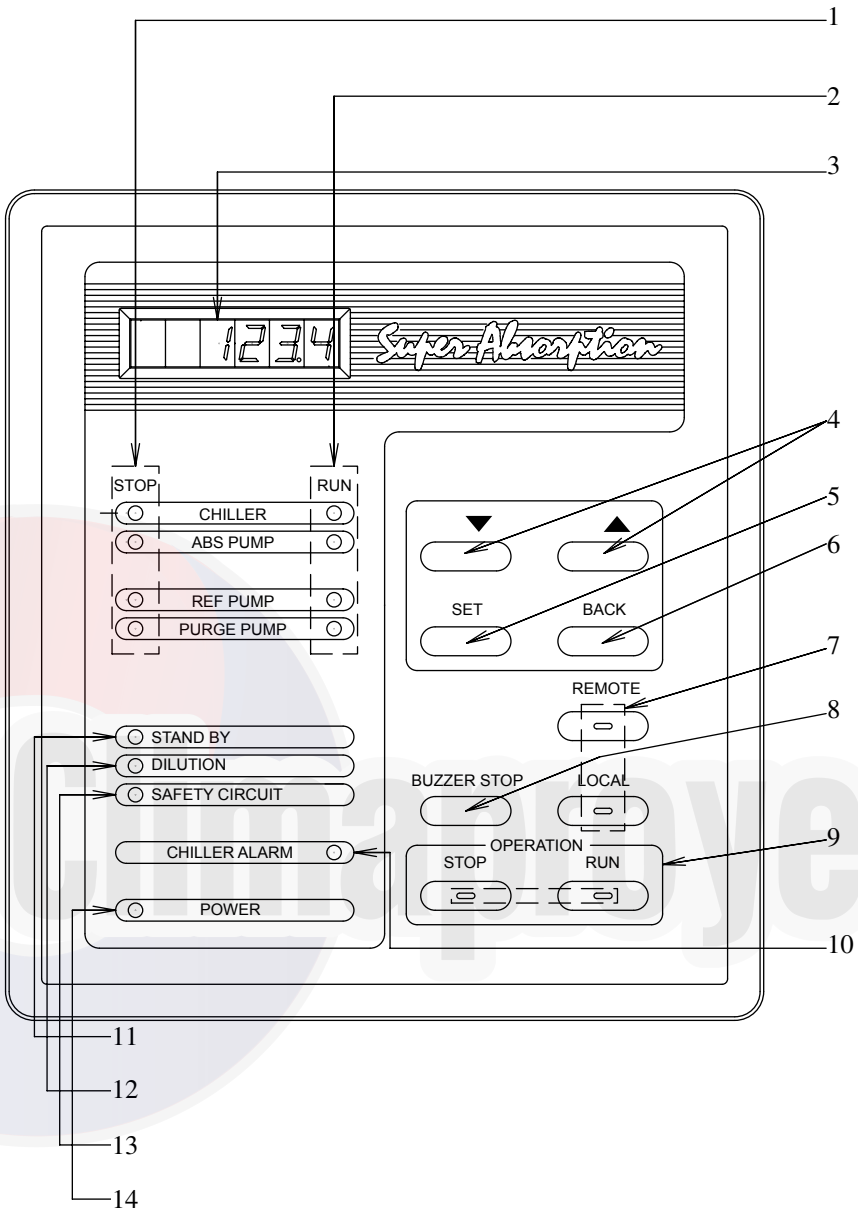
Legend
1 Fan
2 Terminal block
3 Terminal block
4 Terminal block for power supply
5 Earth terminal
6 Control board
7 Purge indication light
8 Purge pump on/off switch
9 Operating handle

Fig. 5 - Control panel inside (CE type)



Legend
1 Control relay
2 Circuit protector
3 I/O board
4 Circuit breaker
5 Main circuit breaker
6 Transformer
7 Electromagnetic contactor
8 Filter
9 Transformer
10 Terminal block

Fig. 6 - Control 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 Remote/local select key with LED
8 Alarm buzzer stop key
9 Operation select key with LED
10 Alarm indication light
11 Stand-by indication light
12 Dilution indication light
13 Safety circuit indication light
14 Power indication light

2.3 - Chiller 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 vaporized refrigerant.

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 exchanger
After leaving the absorber section the diluted solution passes through the heat exchanger, where it is heated by the concentrated solution. The concentrated solution is cooled by the diluted solution. Due to the lower temperature this cooling process of the concentrated solution allows for greater absorbing power.

Generator
The steam passes through the heat transfer tubes of the generator. The diluted solution in the generator is heated by the steam. It releases the refrigerant vapour and is concentrated to become a concentrated solution.

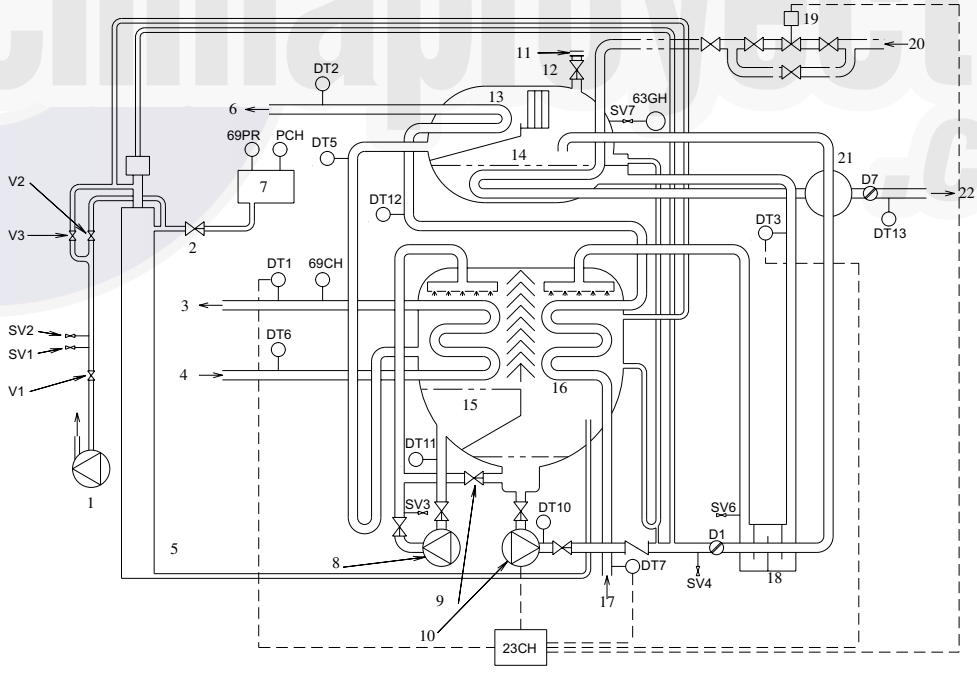
Condenser
The refrigerant vapour from the generator is condensed on the heat transfer tubes of the condenser. Cooling water from the absorber is heated by condensation heat.

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

Sensors

SYMBOL	NAME
DT1	Chilled-water leaving temperature
DT2	Cooling water leaving temperature
DT3	Generator temperature
DT5	Condenser temperature
DT6	Chilled-water entering temperature
DT7	Cooling water entering temperature
DT8	Not used
DT9	Not used
DT10	Diluted solution temperature at absorber outlet
DT11	Evaporator refrigerant temperature
DT12	Cooling water mid-temperature
DT13	Steam drain temperature
23CH	Temperature controller
69CH	Chilled water flow switch
PCH	Palladium cell heater
69PR	Purge tank pressure

Fig. 7 - Flow diagram



Legend

D1: Diluted solution main damper	1: Purge pump	12: Z-valve (rupture disk isolation valve)
D7: Steam drain damper	2: B-valve (manual purge valve)	13: Condenser
SV1: Charge/removal service valve N_2 gas	3: Chilled-water outlet	14: Generator
SV2: Purge unit service valve	4: Chilled-water inlet	15: Evaporator
SV3: Refrigerant service valve	5: Purge unit	16: Absorber
SV4: Diluted solution service valve	6: Cooling water outlet	17: Cooling water inlet
SV6: Concentrated solution service valve	7: Purge tank	18: Heat exchanger
SV7: Generator pressure gauge service valve	8: Refrigerant pump	19: Steam control valve
V1: Manual purge valve	9: Refrigerant blow-down valve	20: Steam inlet
V2: Manual purge valve	10: Absorption pump	21: Steam drain reclaimer
V3: Manual purge valve	11: Rupture disk	22: Steam drain outlet

Sensor
Service valve
Damper
Check valve
Valve

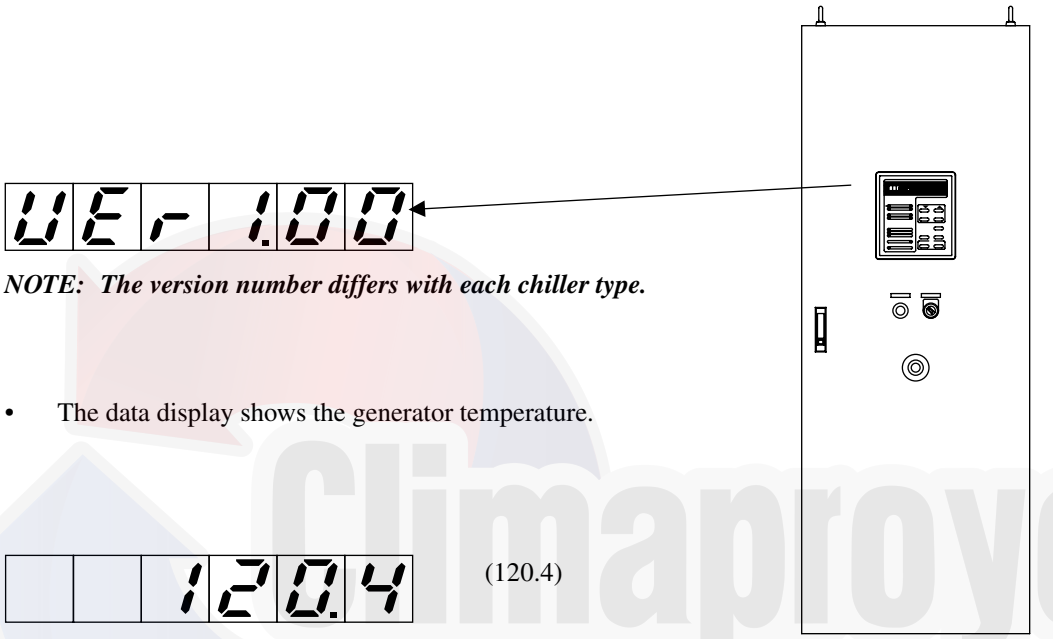
3 - OPERATING INSTRUCTIONS

3.1 - Self-diagnostic function

The self-diagnostic function starts when the breaker inside the control panel of the chiller 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. 8 - Control panel



NOTE: The version number differs with each chiller type.

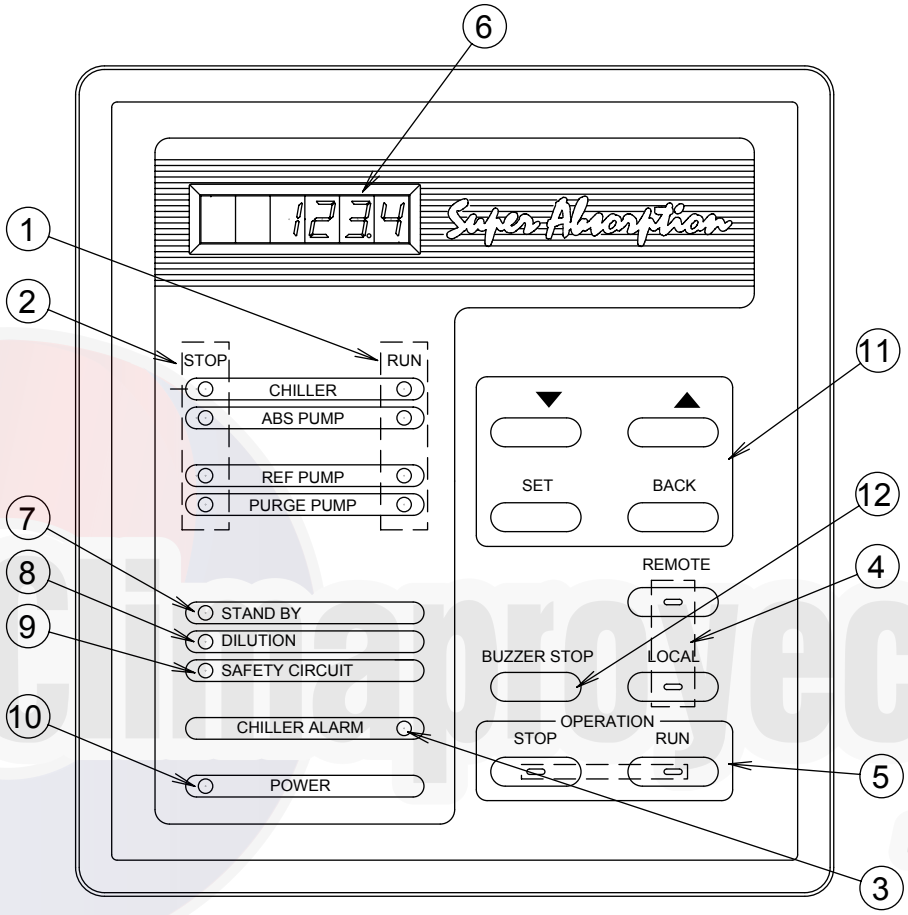
- The data display shows the generator temperature.

(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. 9 - Typical control board



Legend

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

3.3 - Control board settings

3.3.1 -Time setting

Refer to Figures 10 and 11.

Fig. 10 - Display example

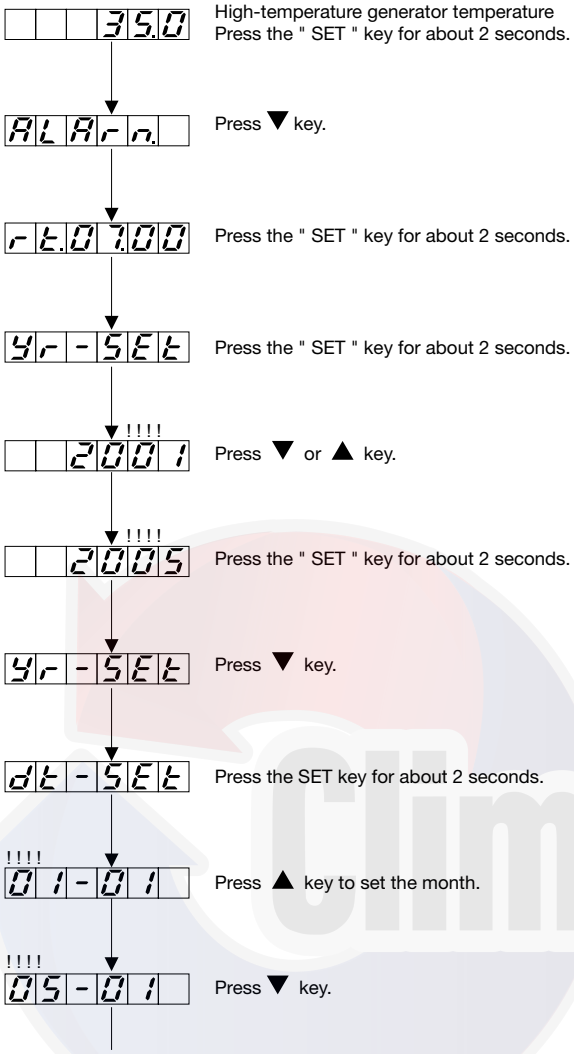
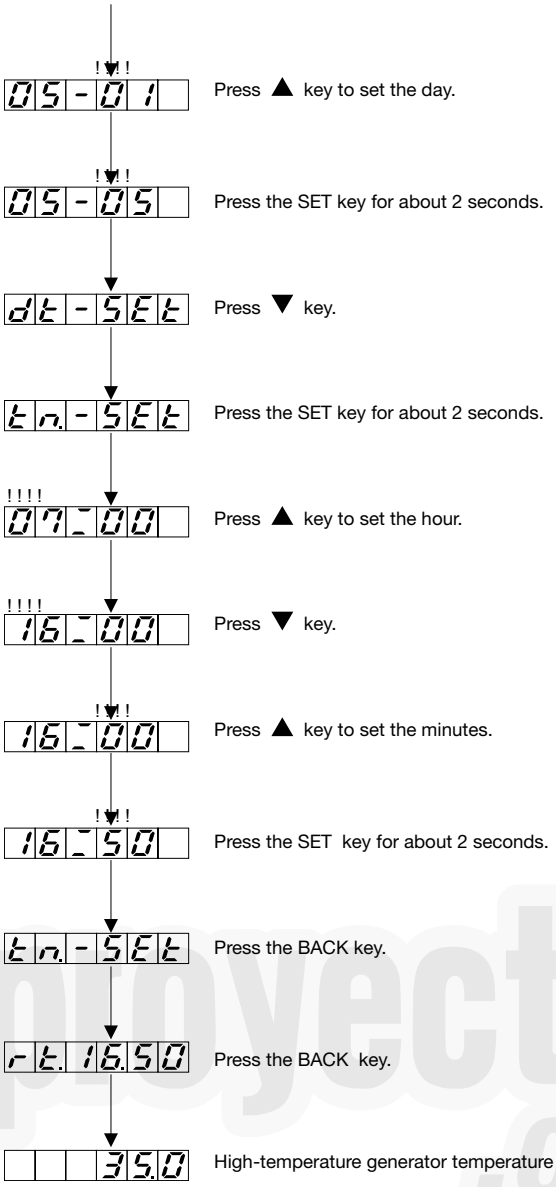


Fig. 10 - Display example (cont.)



3.3.2 - Battery backup

Refer to Figure 12.

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.***

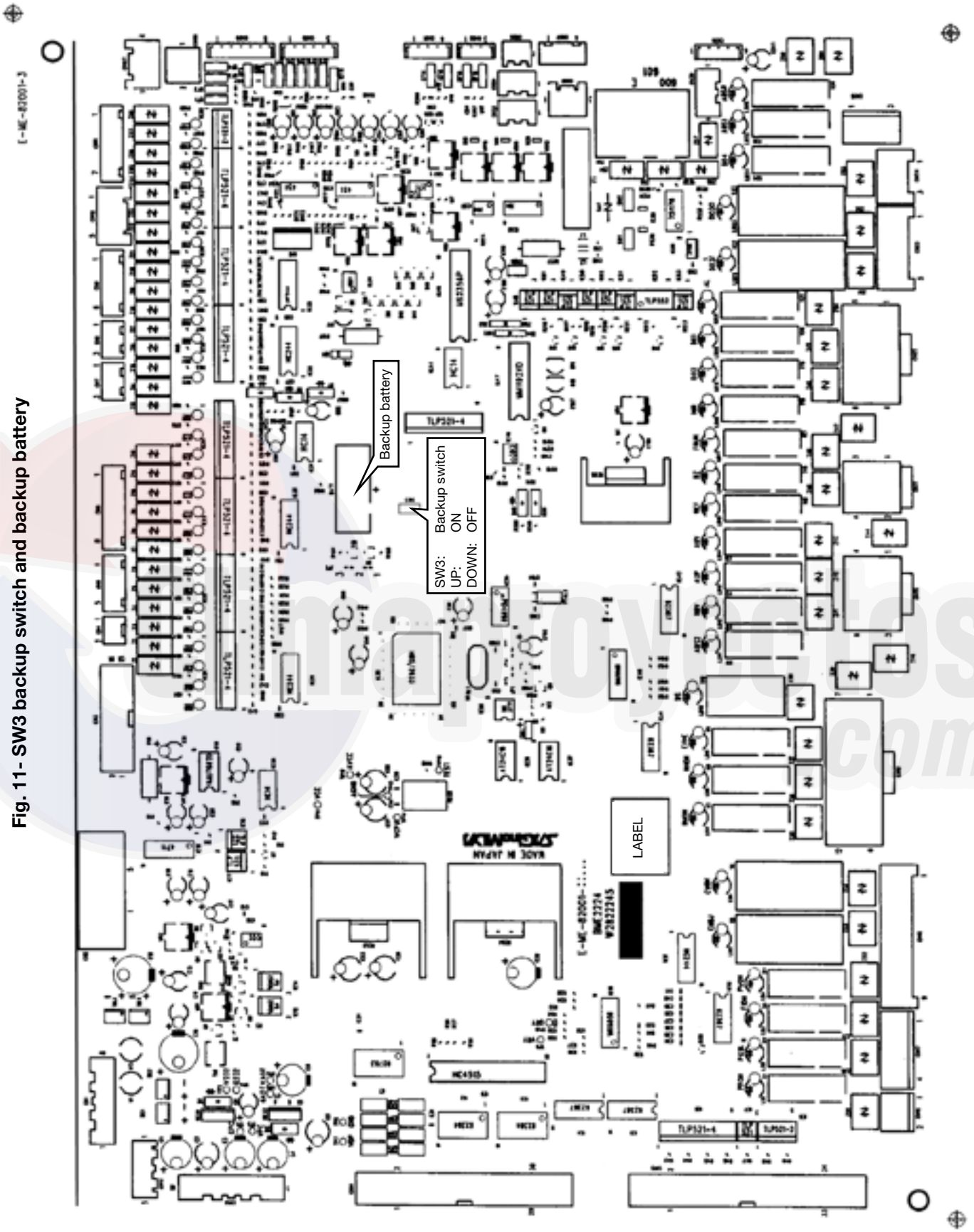
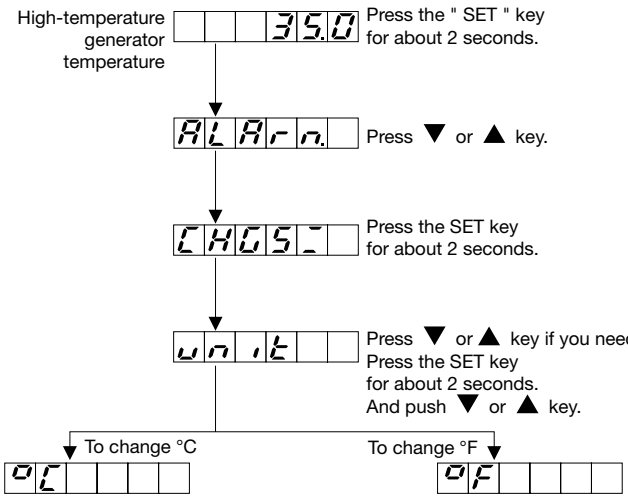


Fig. 11- SW3 backup switch and backup battery

3.3.3 - How to change the temperature unit

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

Fig. 12 - Display example

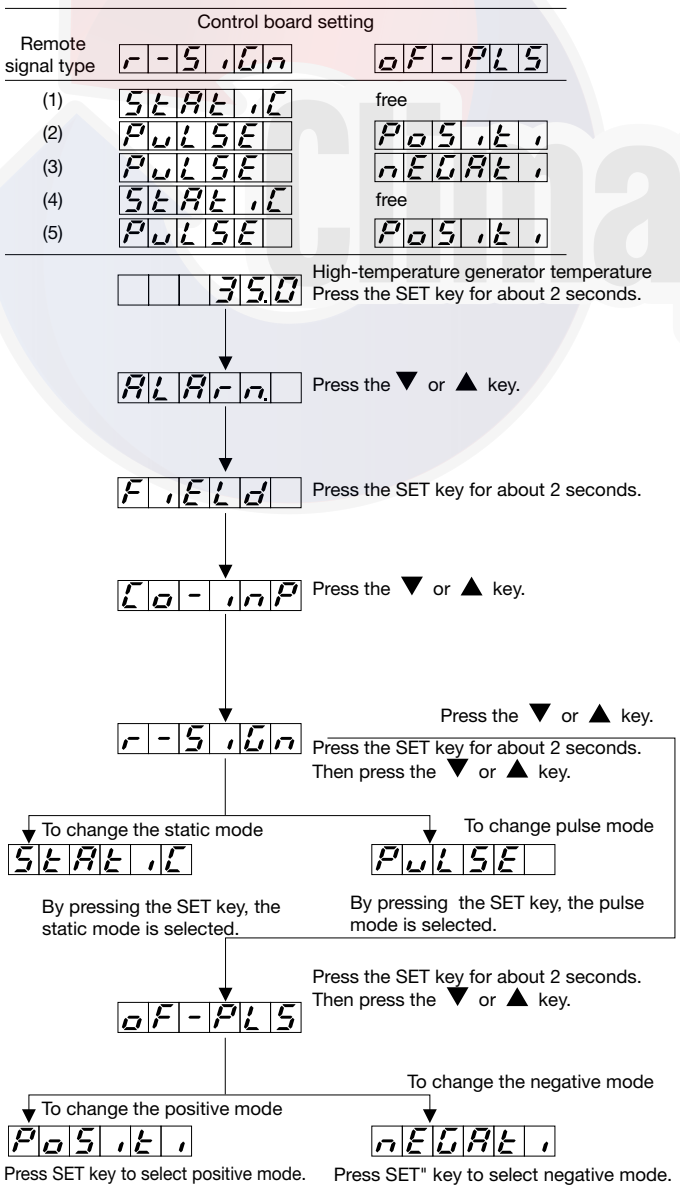


Press the "SET" key to select °C mode and again to select the °F mode

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. 13 - Display example



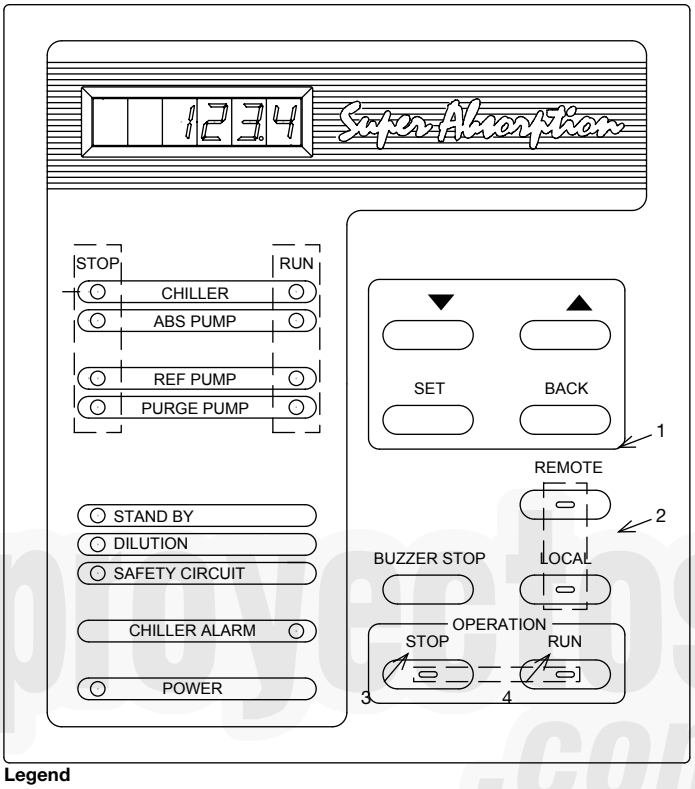
3.4 - Cooling operation

3.4.1 - Pre-operation checks

Please check the following items before starting operation:

- Check the setpoint of the chilled-water leaving temperature. Make sure that the chilled-water leaving temperature is set as specified. For the indication of the set value, please refer to chapter 3.8.
- Check the steam and steam drain equipment
  - Make a daily inspection (refer to chapter 4).
  - Check that the steam valve(s) is (are) open.

Fig. 14 - Control board



Legend

1 Remote key
2 Local key
3 Stop key
4 Run key

NOTE: If the chilled-water pump, cooling water pump, and chiller are interlocked, each pump runs automatically when starting the chiller. If not, the start sequence must be: Chilled-water pump, cooling water pump, chiller.

3.4.2 - Start cooling operation

Refer to Figure 14.

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.

3.4.3 - Stop operation

Refer to Figure 14.

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

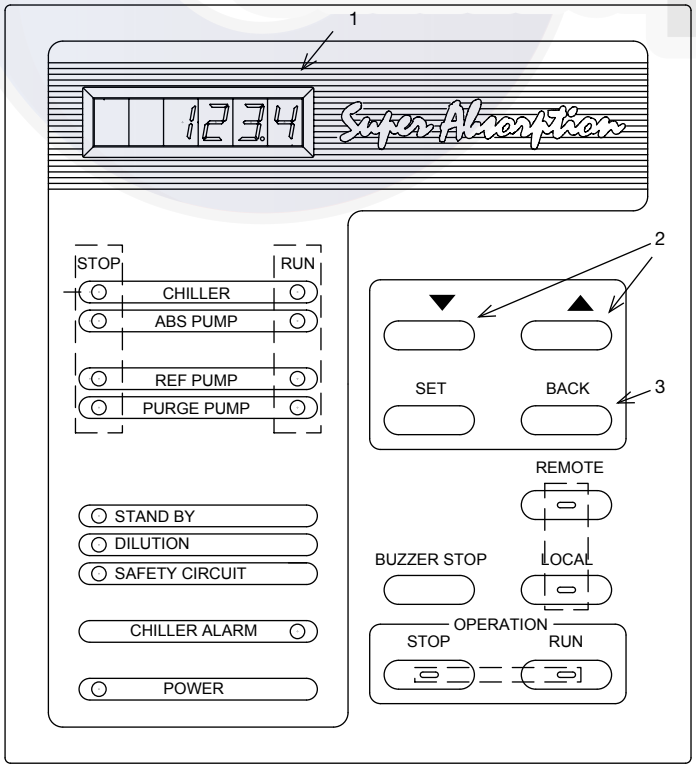
The air handling unit must be stopped after the chilled-water pump is stopped

3.5 - Changing the information on the data display

3.5.1 - Normal display information

Data display on the control board usually shows high temperature generator temperature as follows.

Fig. 15 - Control board



Legend

1 Data display
2 Select key: changes the data display information
3 Back select key

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

3.5.2 - Changing the display

Refer to Figure 15.

If you press the ▲ key, the information on 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.

3.5.3 - 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/hot-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. 16 - Typical display order

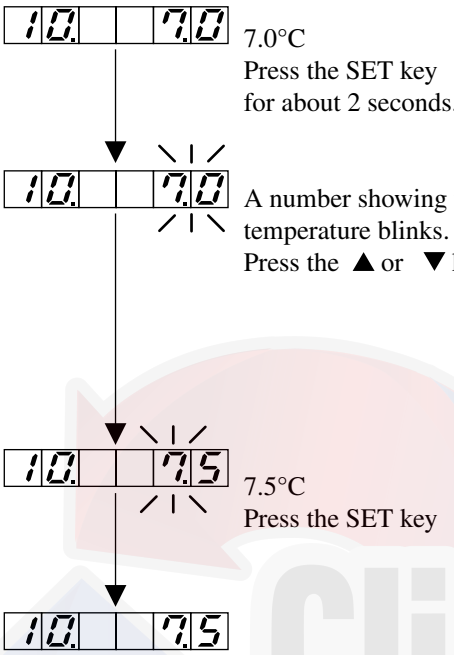
Data code	Data name	Display	Means
-	Generator temperature	135.0	135.0°C
1.	Chiller operating hours	1234	1234 hours
2.	Absorbent pump operating hours	1111	1111 hours
3.	#2 absorbent pump operating hours	- - - -	Not used
4.	Combustion hours	- - - -	Not used
5.	Refrigerant pump operating hours	1201	1201 hours
6.	Purge pump operating hours	107	107 hours
7.	Chiller on/off times	123	123 times
8.	Absorbent pump on/off times	169	169 times
9.	#2 absorbent pump on/off times	- - - -	Not used
A.	Combustion on/off times	- - - -	Not used
B.	Refrigerant pump on/off times	138	138 times
C.	Purge pump on/off times	51	51 times
10.	Chilled-water temperature setpoint	7.0	7.0°C
11.	Hot-water temperature setpoint	55.0	55.0°C
12.	Chilled-water entering temperature	11.9	11.9°C
13.	Chilled-water leaving temperature	6.8	6.8°C
14.	Cooling water entering temperature	31.8	31.8°C
15.	Condenser temperature	34.7	34.7°C
16.	Steam drain/exhaust gas temperature	211.7	211.7°C
17.	Purge tank pressure	8.5	8.5 kPa
-	Generator temperature	135.0	135.0°C

3.6 - Changing display and setpoint

Setpoint display change
Chapter 3.5.2 "Changing the display" describes how the current chilled-water temperature setpoint or hot-water temperature setpoint can be changed.

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.

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. If the chilled-water leaving temperature is set below the rated value, the maximum input rate (gas or oil) needs to be decreased.***
2. ***Setpoints become effective as soon as they have been changed. Be careful when changing setpoints during operation.***

3.7 - 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 Figure 18.

Fig. 18 - 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 cooling water pump, cooling tower, etc.
H-06**	Purge tank high pressure	H-06	Purge tank pressure is high.
H-07**	Cooling water tubes foul	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 a power failure while the chiller 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. 19 - Maintenance message descriptions and actions required

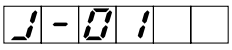
Maintenance message	Display	Action
1 Cooling water tubes foul	H-07 H-03	Cooling water tubes must be cleaned. Contact Carrier service agent to do the job
2 Vacuum rate	H-06 H-01	The purge tank must be purged immediately. If this message is shown frequently, contact your Carrier service agent.
3 Cooling water high temperature	H-08 H-04	Check the cooling water pump, cooling tower, etc.
4 Power failure	H-10	See section 3.8.5.

3.8 - Alarm messages and actions required

3.8.1 - How they are shown

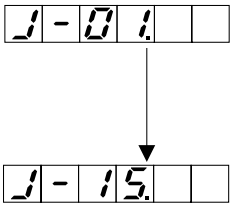
When an alarm is detected, the alarm buzzer sounds (option), and the alarm message is shown on the data display. At the same time, the indication light of the "STOP" key blinks. The chiller stops for safety reasons after the dilution cycle. Depending on the alarm message it may also stop without carrying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

Fig. 20 - 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 (option).

The high-temperature generator solution level is too low.

3.8.2 - Troubleshooting flowchart

Symptoms **Action**

An alarm occurs.

↓

Alarm buzzer sounds (option), and the indication light of the "STOP" key blinks. The alarm message is shown in the data display.

→ Press the "BUZZER STOP" key on the control board.

↓

The alarm buzzer stops (option).

→ Check alarm message and solve the problem.

→ Press the "STOP" key on the control board after the troubleshooting is completed.

↓

The indication light of the "STOP" key stops blinking and remains lit. The alarm code on the data display disappears.

NOTES:

1. ***The data display still shows an alarm, when the "STOP" key is pressed. Check the alarm message, before cancelling the alarm.***
2. ***If a combustion alarm occurs, operation does not restart without pressing the reset button on the burner controller.***

→ Start operation

↓

Operation restarts.

3.8.3 - Alarm message and setpoint

Fig. 21 - 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 after 30 minutes
Prevention of Crystallisation	A-06	Cooling water pump interlock alarm.	-
	A-07	Cooling water flow alarm	50% or below
	A-13	Generator temperature is too high.	105°C
Protection of high temperature generator	A-14	Generator pressure is too high.	101.3 kPa or above
	A-16	High concentration of absorbent	65% or above twice 65.5% or above
Protection of motor	A-04	Absorbent pump overload alarm.	Rated current value or above
	A-10	Refrigerant pump overload alarm.	"
	A-12	Purge pump overload alarm.	"
Others	A-11	Fan interlock etc. alarm.	-
	A-21	Efficiency is too low.	
	A-27	Cooling tower fan overload alarm.	

3.8.4 - Locating and clearing alarm

Fig. 22 - List of alarm messages and their causes and remedies

Display and content of alarm

Alarm of the chilled water and/or cooling water system

A-01
Chilled water temperature is too low.

A-03
Chilled water flow alarm

Check that the discharge pressure of both chillled-water and cooling water pumps is normal.

→ If not, the strainer may be clogged, or there may be an air leak in the piping, etc.

Is the chilled-water setpoint too low?

A-20
Cooling water temperature is too low

→ Correct it to the specified setpoint.

A-07
Cooling water flow alarm (option)

Is the cooling water setpoint too low?

→ Correct it to specified setpoint (e.g. 28°C).

Correct the above causes and restart the chiller.
If the "CHILLER ALARM" continues, check the following and contact your Carrier service agent:

- Entering and leaving chilled/hot water temperature
- Entering and leaving cooling water temperature
- Generator temperature and pressure

Alarm of the motor(s)

A-04
Absorbent pump overload alarm.

A-10
Refrigerant pump overload alarm

First check that the reset button(s) of the overload relay connected to the electromagnetic contactor is not pushed in, and then contact your Carrier service agent.

Reset buttons

Alarm of the auxiliary equipment

A-02
Chilled water pump interlock alarm.

A-06
Cooling water pump interlock alarm.

Check that the chilled/hot water pump and cooling water pump are rotating.
→ Start the pumps
Check the fan and/or other equipment connected to the system interlock.
Correct the above causes and restart the chiller.
If the "CHILLER ALARM" continues, contact your Carrier service agent.

A-27
Cooling tower fan overload alarm.

Generator alarm

A-13
Generator temperature is too high.

Check that the cooling water pump is rotating.
→ Start the pump.
Check that the cooling water line valve is open.
→ Open the valve.

A-14
Generator pressure is too high.

Check that the cooling water pump discharge pressure of is normal.
→ If not, the strainer may be clogged, or there may be an air leak in the piping, etc.

A-16
High concentration of absorbent

Correct the above causes and restart the chiller
If the "CHILLER ALARM" continues, check the following and contact your Carrier service agent:

- Entering and leaving chilled-water temperature
- Entering and leaving cooling water temperature
- Generator temperature and pressure.
- Is the chilled water setpoint too low?

→ Correct it to the specified setpoint.

- Water in the heat transfer tubes may be fouled (especially cooling water).

Sensor alarm

F-01 Entering chilled-water temperature sensor alarm.

F-02 Entering cooling water temperature sensor alarm.

F-03 Leaving cooling water temperature sensor alarm.

F-04 Cooling water intermediate temperature sensor alarm.

F-05 Condenser temperature sensor alarm.

Is the sensorshort-circuited?
→ Check all chiller sensors and contact your Carrier service agent.

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

F-08 Refrigerant temperature sensor alarm (evaporator).

F-12 Diluted solution temperature sensor alarm (absorber outlet).

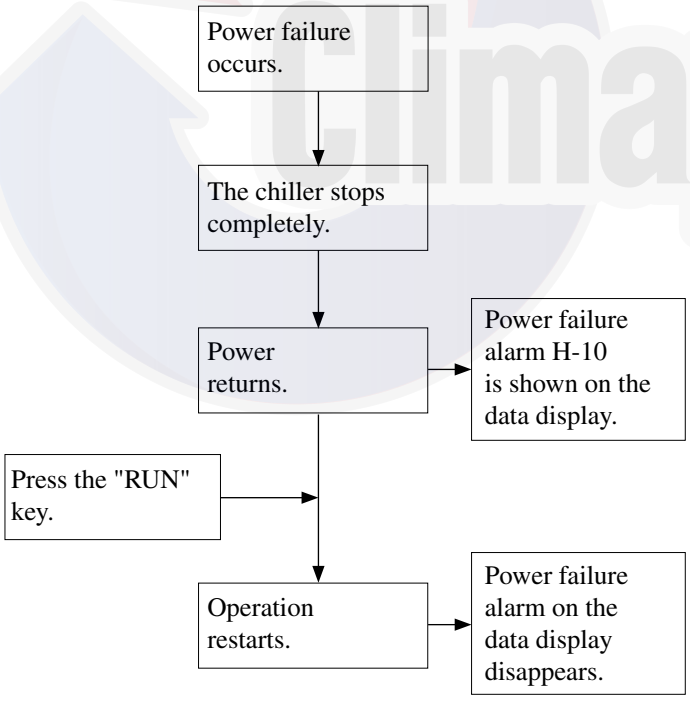
F-25 Leaving chilled-water temperature sensor alarm.

F-26 High-temperature generator temperature sensor alarm.

F-28 Purge tank pressure sensor alarm.

3.8.5 - Action in case of a power failure

Flowchart of actions in case of a power failure



Actions to be taken if a power failure occurs

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

Actions required when a power failure occurs

Operation condition at power failure	Action
Occurred during cooling operation, and power did not return for over an hour	Immediately contact your 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 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 consult your Carrier service agent.

4 - MAINTENANCE

4.1 - Daily maintenance

4.1.1 - Inspection of each chiller component

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

- Smell of gas or oil leak around the chiller
- 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

Trial run data sheet 1/2

Project name : _____
chiller model : TSA-16TJ- _____
Serial number : _____
Accepted by : _____ Date _____
Reviewed by : _____ Date _____
Recorded by : _____ Date _____

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 water entering temperature	°C/°F				
4	Chilled water leaving temperature	°C/°F				
5	Chilled water entering pressure	kPa/psi				
6	Chilled water leaving pressure	kPa/psi				
7	Evaporator pressure drop	kPa/psi				
8	Chilled-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	Steam consumption	kg/h/lb/h				
16	Supply steam pressure	kPa/psi				
17	Supply steam temperature	°C/°F				
18	Generator temperature	°C/°F				
19	Evaporator solution level	n/60 mm n/2-3/8"				
20	Purge tank pressure	kPa				

TEST OPERATION DATA SHEET - cont.

Trial run data sheet 2/2

Project name : _____
chiller model : TSA-16TJ- _____
Serial number : _____
Accepted by : _____ Date _____
Reviewed by : _____ Date _____
Recorded by : _____ Date _____

Unit model/serial No. Operator: Date: / /

No.	Data items	Unit	Spec.	DATA-1 Time:	DATA-2 Time:	DATA-3 Time:
21	Concentration of concentrated solution	%				
	Specific gravity of concentrated solution	-				
	Temperature of concentrated solution	°C/°F				
22	Concentration of diluted solution	%				
	Specific gravity of diluted solution	-				
	Temperature of diluted solution	°C/°F				
23	Concentration of refrigerant	%				
	Specific gravity of refrigerant	-				
	Temperature of refrigerant	°C/°F				
24	Condensed refrigerant temperature	°C/°F				
25	*LTD (See below)	°C/°F				
26	Absorbent pump current	A				
27	Refrigerant pump current	A				
28	Purge pump current	A				

* LTD = Condensed refrigerant temperature minus cooling water leaving temperature

Notes:

4.2 - Periodic maintenance

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

4.2.1 - Purging (Fig. 23)

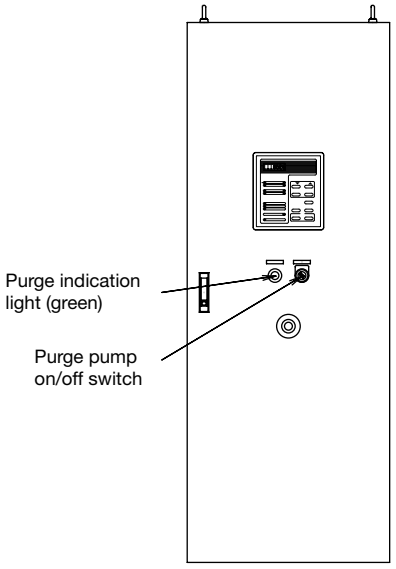
Non-condensable gas inside the machine not only decreases cooling capacity, but also potentially shortens the life of the machine. Therefore purging must be done periodically. This should be done by the Carrier service personnel under the maintenance contract. If customers carry out the purging themselves,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

Purge procedure

When the purge indication light on the control panel comes on, start purging, following the instructions below.

1. Turn on the purge pump on/off switch on the control panel and operate the purge pump for 10 minutes.
2. Open V1 and V2.
3. Press the ▲ key on the control board once to show data code 17 "Purge tank pressure" (refer to chapter 3.5.3) and check if the indicated value drops. If it does not drop, follow the procedure described in steps 6, 7 and 8 below, and contact your Carrier service agent.
4. 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.
5. Close V1 and V2.
6. Turn off the purge pump on/off switch.
7. Check whether the valves are open/closed.

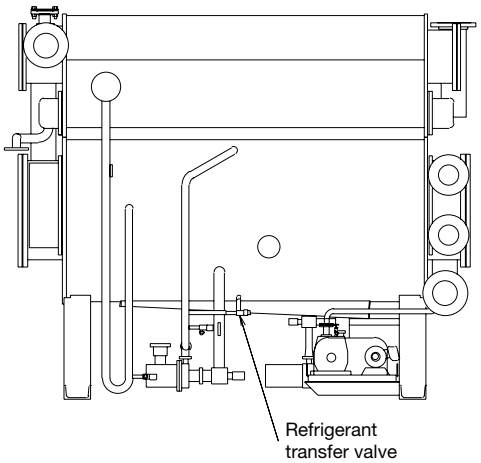
V1	Closed
V2	Closed
V3	Closed
B-valve	Open



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.

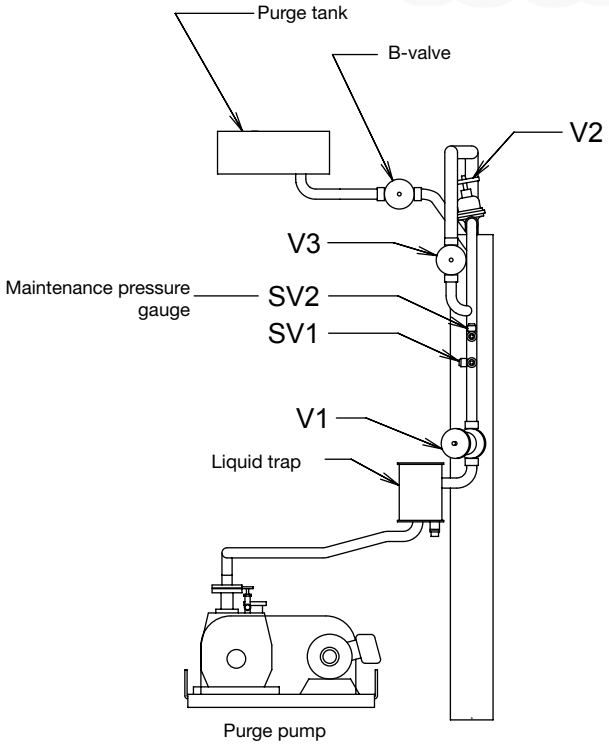
Fig. 24



- 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.

Fig. 24



Component	Type	Area inspection		Inspection			Remarks
		Vacuum area	Non-vacuum area	Item	Method	Interval	
Main shell	Chilled/hot water line pipes	X		Corrosion of the heat transfer tube surface	Visual inspection	As necessary	Random inspection from the bundle (no vaccuum destruction)
			X	Corrosion of the internal surface of the heat transfer tube scale and/or slime adhesion	Eddy-current test/endoscope/visual inspection	Once a year	Idem above
	Cooling water line pipes	X		Corrosion of the heat transfer tube surface	Visual inspection	As necessary	Idem above
			X	Corrosion of the heat transfer tube surface. Scale and/or slime adhesion	Eddy-current test/endoscope/visual inspection	Once a year	Idem above
	Heat exchanger tube	X		Corrosion of the heat transfer tube surface. Reduced metal by abrasion scale and/or slime adhesion	Overhaul	As necessary	Idem above
	Generator		X	Check the inside fouling	Visual inspection etc.	Once a year	Cleaning
Solution	Absorbent	(X)		Solution analysis Concentration Alkalinity Inhibitor ratio Copper dissolution ratio Iron dissolution ratio	Solution random inspection	Two to four times per year	To be adjusted to the standard controls
Pump	Absorbent pump	X		Pump body, impeller, bearing, motor	Overhaul	As necessary	Inspection interval 20000 hours or more
	Refrigerant pump	X		Pump body, impeller, bearing, motor	Overhaul	As necessary	Idem above
	Purge pump	(X)		Pump body	Overhaul	As necessary	-
				V-belt	Periodic replacement	As necessary	-
Safety device	Pressure switch	(X)		Periodic replacement (because of safety device)		Every 3 years	Generator pressure switch for 16DJ
Control device	Flow switch		X	Periodic inspection with a maintenance contract		As necessary	-
	Temperature sensor		X	Periodic inspection with a maintence contract		As necessary	-
	Electro-magnetic contactor		X				-
	Relay		X				-
	Inverter		X	Idem above		Once a year	Option
Others	Sight glass	X		Periodic replacement ((in order to avoid leakage)		Every 3 years	-
	Diaphragm valve packing	X				Every 3 years	-
	Other packing		X			Every 3 years	-
	Palladium cell	X				Every 3 years	-
	Water-line packing		X	Periodic inspection with a maintenance contract.		Every 3 years	-

4.4 - Water treatment

Water treatment is very important for the chiller. 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 27. 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. ***As the water quality range differs depending on the chemicals used, it is not given here. The appropriate water quality values should be set together with a water processing specialist and be checked periodically.***

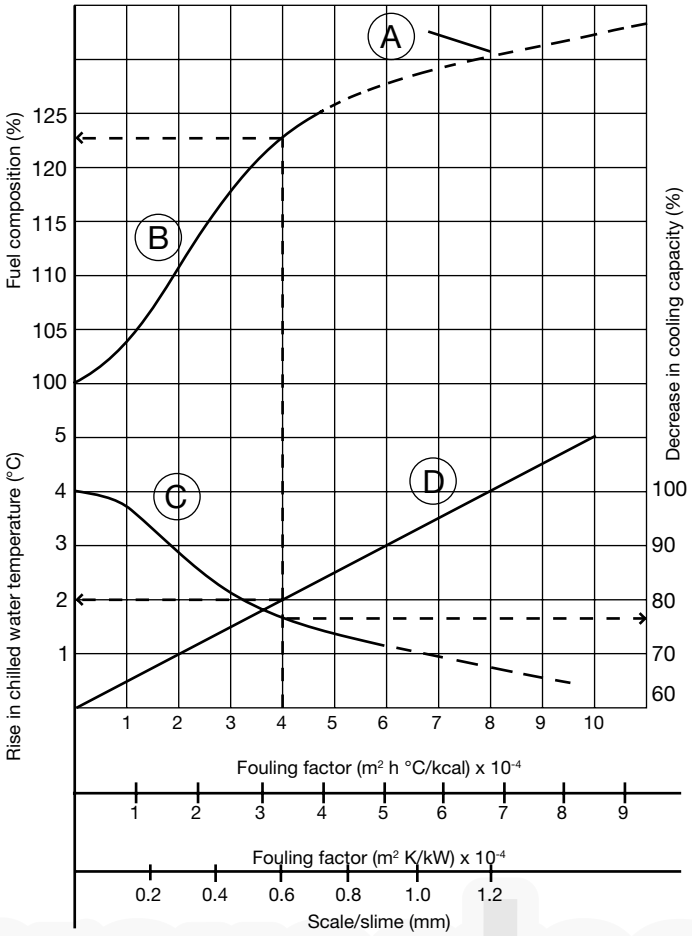
Typical water treatment

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/hot 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. 25 - 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 For constant cooling capacity (ratio at rated fuel consumption)
B Increase in fuel consumption
C Decrease in cooling capacity (for constant chilled water temperature)
D Increase in chilled water temperature (for constant cooling capacity)

Fig. 26 - 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/hot water or cooling water circulates in the chiller. 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. If the cooling water is likely to freeze, drain it from the chiller (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 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, 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.

4.4.3 - Winter season

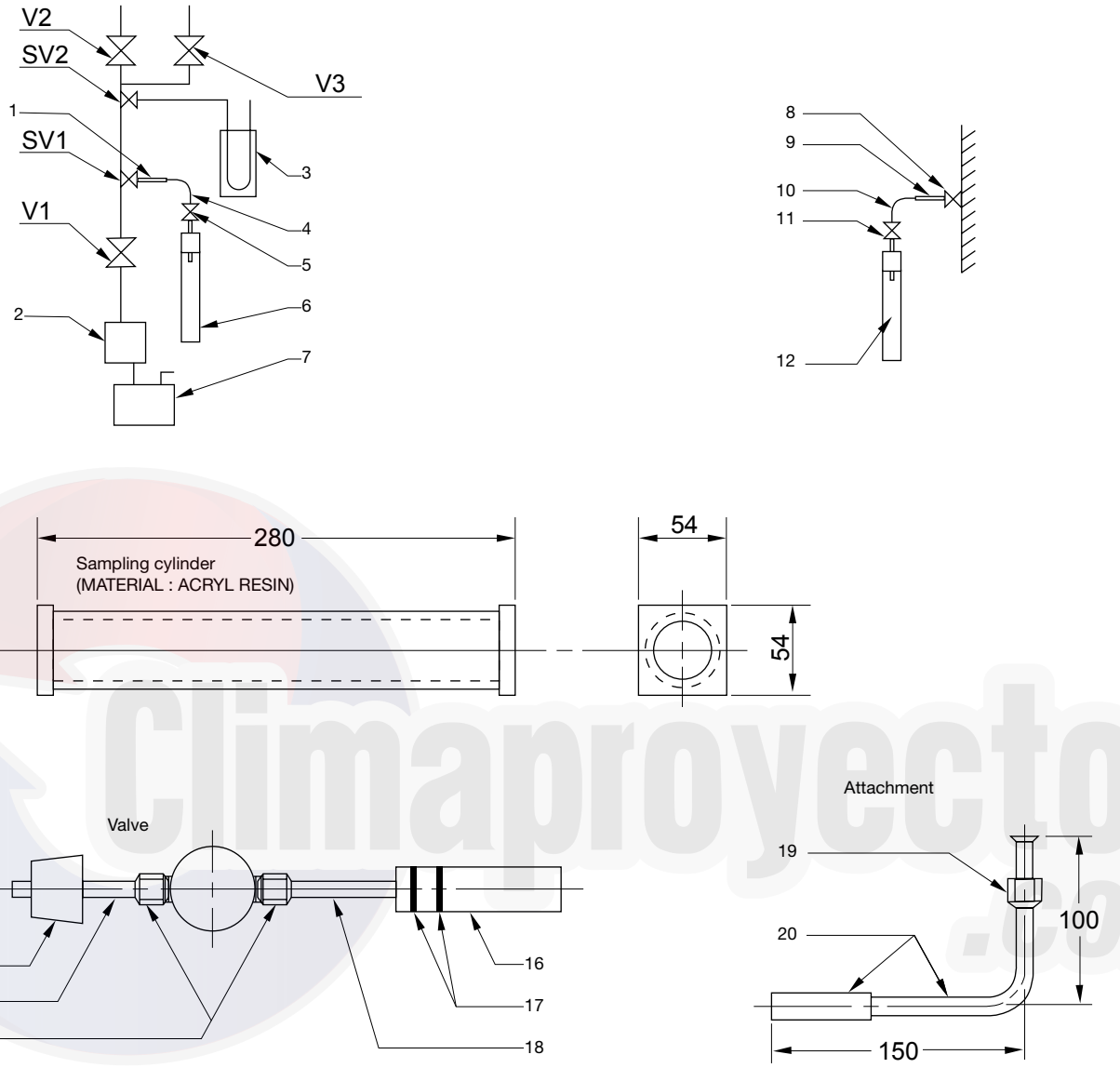
If the ambient temperature of the chiller is likely to be below 0°C in winter, freeze protection is necessary. Consult your Carrier service agent for the details.

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. 27



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, ensure that air never leaks into the chiller 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 7.

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 27.
- 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 27.
- 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 28 below.

Fig. 28

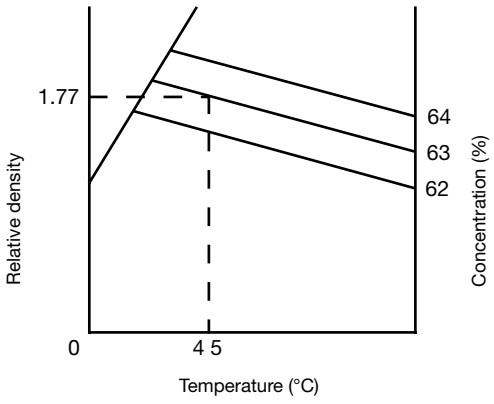
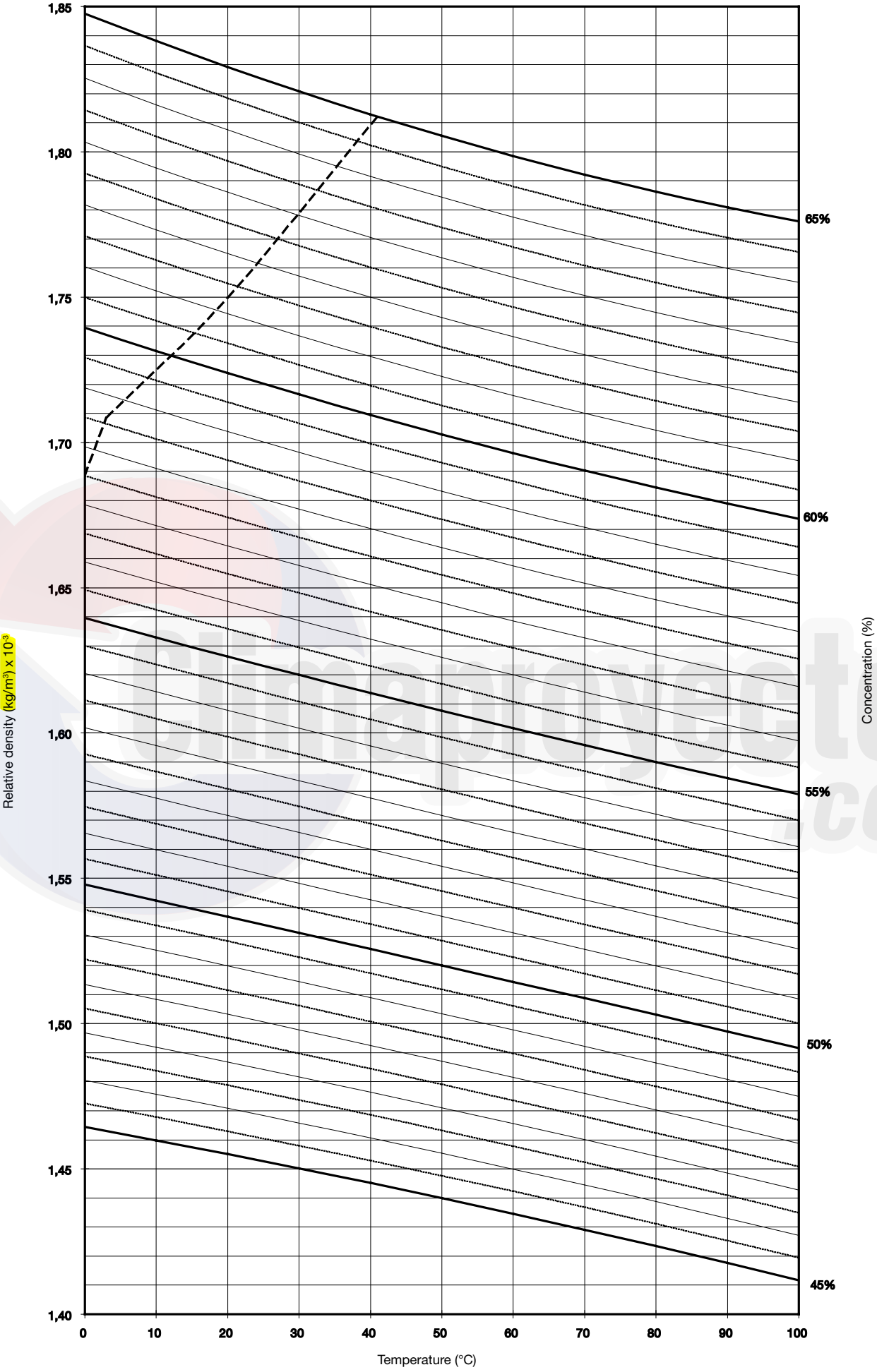


Fig. 29 - Concentration vs temperature vs relative density



7 - MAINTENANCE CONTRACT

To enjoy safe and efficient operation of the chiller 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. Under the contract we provide trained service personnel that will perform the periodic diagnosis and adjustment of the chiller, 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. Under this contract your Carrier service agent will perform maintenance/inspection and adjustment works to keep your chiller in its optimal condition, and you will be given priority for chiller repairs, in case there is a problem.

It is recommended to perform a complete chiller 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

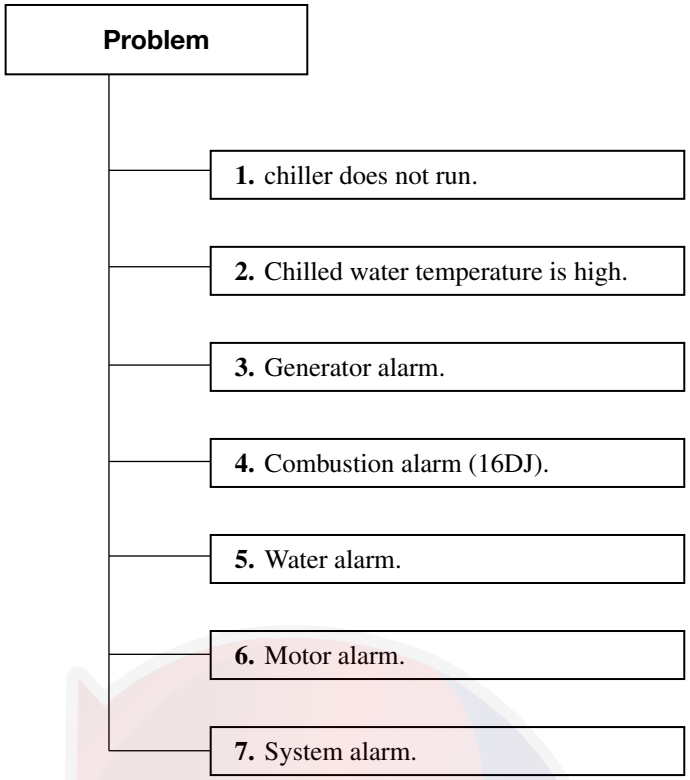
We issue an inspection report for the annual maintenance under the contract. The report contains a thorough description of the inspection/adjustment items and ensures that Carrier service personnel will not overlook any of the inspection items. At the time of inspection the Carrier service personnel 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 fails within the warranty period under normal operating conditions, we will replace all necessary spare parts or repair the chiller 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.

APPENDIX 1 - TROUBLESHOOTING FLOWCHART



APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

1 - Chiller does not run.

- Blower motor runs (16DJ).
  - Gas control valve moves.
    - Motor moves to fully open, but then does not move any more.
      - Protection relay is defective.
      - Check E1 of the solution level electrode.
      - The motor is defective.
      - Check if the air flow switch is ON.
      - Check setting of air flow switch.
      - Check E2 of the solution level electrode.
    - Motor moves to fully closed, but then does not move any more.
      - Protection relay is defective.
      - Check E1 of the solution level electrode.
      - The motor is defective.
      - Check if the air flow switch is ON.
      - Check setting of air flow switch.
      - Check E3 of the solution level electrode.
  - Gas control valve does not move.
    - Protection relay is defective.
    - Check E1, E2 and E3 of the solution level electrodes.
    - The motor is defective.
  - Oil solenoid valve does not open.
    - Protection relay is defective.
    - The solenoid valve is defective.
    - Check if the air flow switch is ON.
    - Check setting of air flow switch.
- Blower motor does not run (16DJ).
  - Check breaker on the burner control panel.
  - If solution level alarm exists at start-up, the blower does not run.
  - Air flow contact is welded.
  - Check if the motor is in fully closed position.
    The motor may stop in the half-way position after a power failure.
  - Protection relay is defective.
- Interlock
  - 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 (16DJ).
- Fuse has blown.

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.)

Crystallization	No.1 absorbent pump cavitation. 25%	Solution flow rate is not adjusted properly.
		Cooling water entering temperture fluctuates strongly
		Vacuum condition in the chiller is poor.
		Insufficient absorbent solution.
		Insufficient octyl alcohol.
	Ambient temperature is too low. 5%	
	Cooling water entering temperature is too low with insufficient air purging. 70%	
Combustion problem (16DJ)	Gas/oil flow rate is insufficient.	Rank up set too low.
		Air/gas/oil linkage has shifted to low combustion.
		Gas supply pressure fluctuates.
		Chilled water set too high.
		Temperature sensor is defective.
		Microprocessor is defective.
Electrical problem	Parts, setting position 20%	Electric parts and sensors are defective.
		Wrong setting on microprocessor and inverter.
		Wrong position of select switches.
	Solution level electrode malfunctions. 80%	Electrode surface is contaminated.
		Electrode is defective.
		Teflon tube on electrode has been removed.

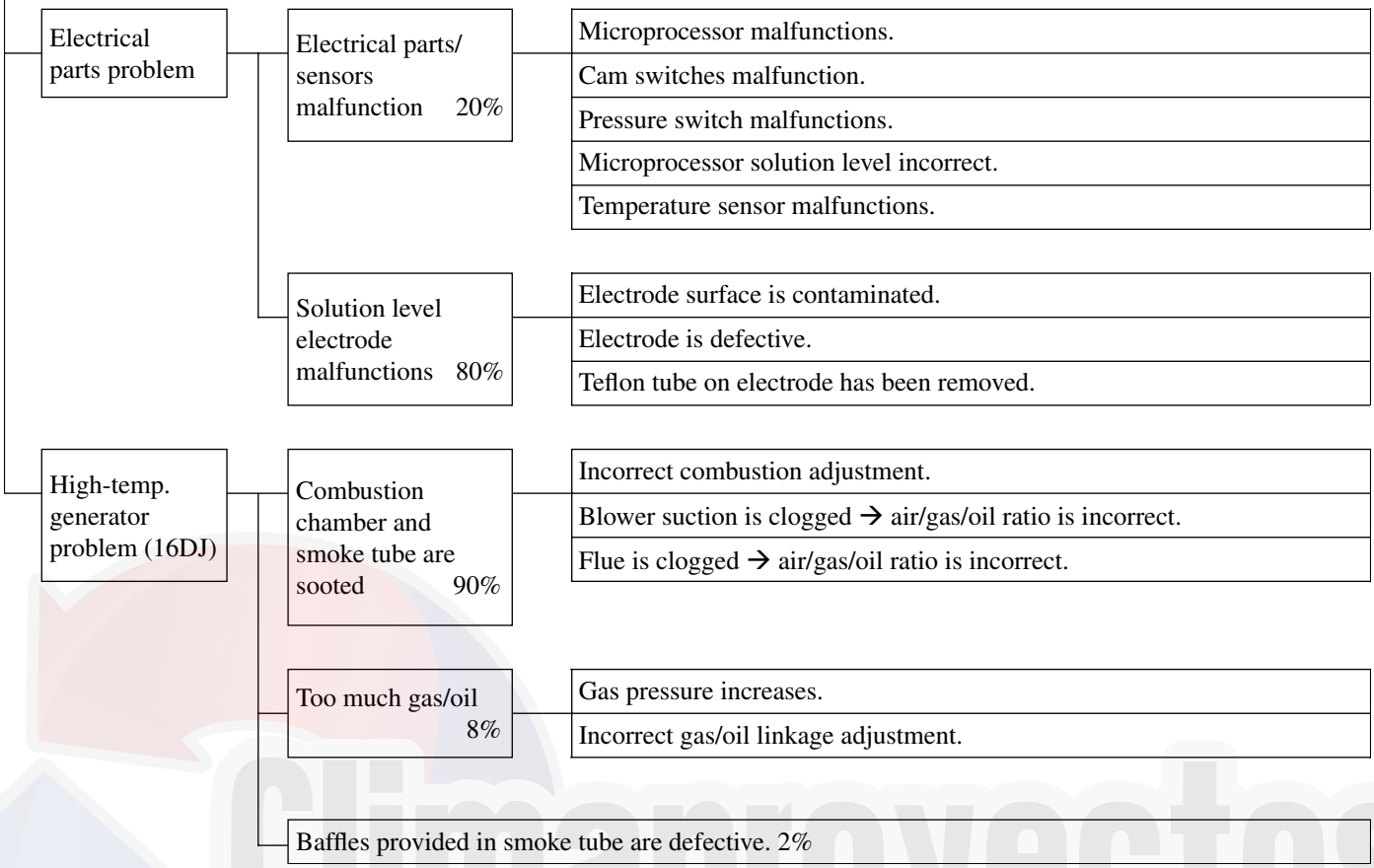
APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

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)

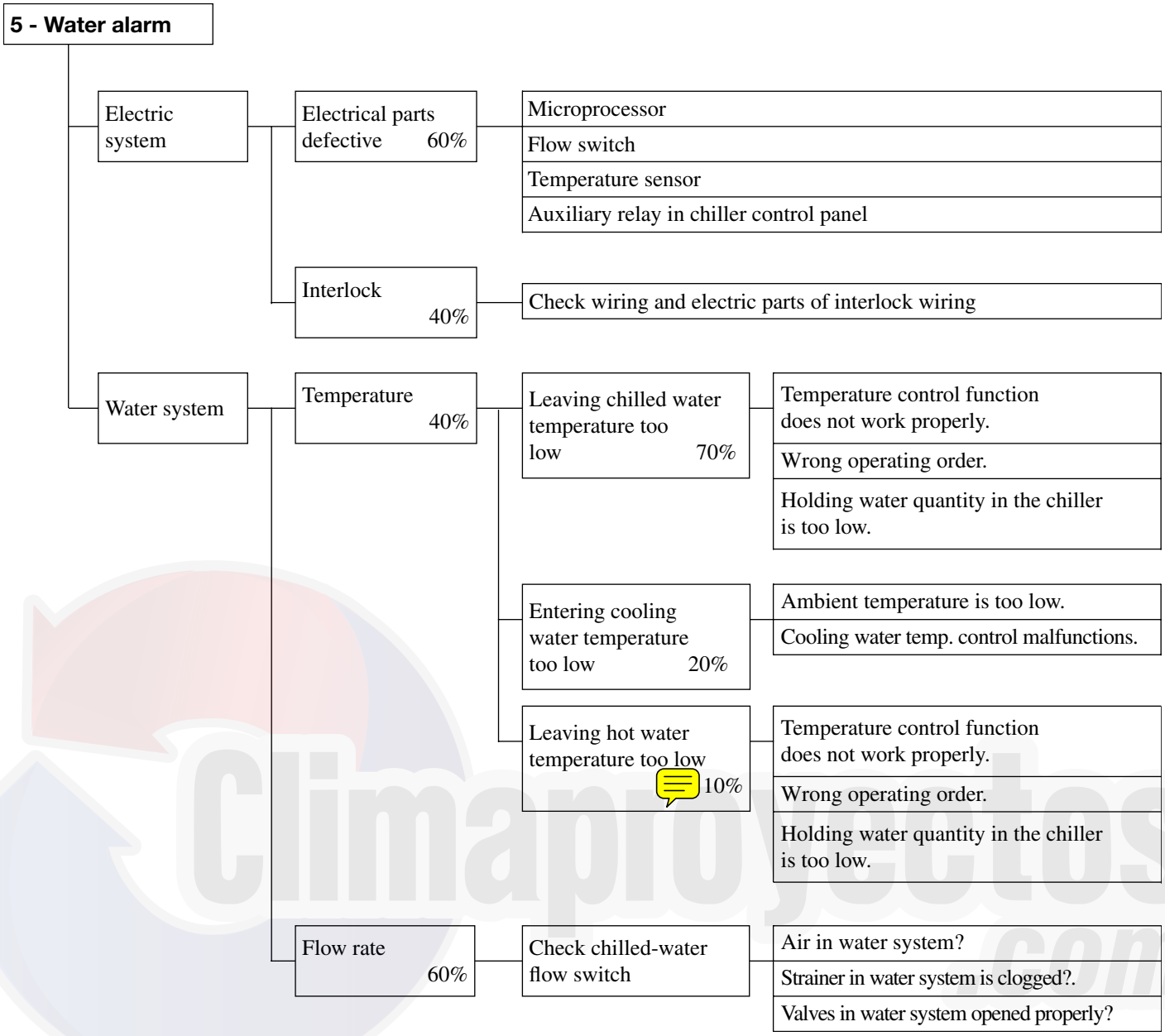


APPENDIX 1 - TROUBLESHOOTING FLOWCHART - CONT.

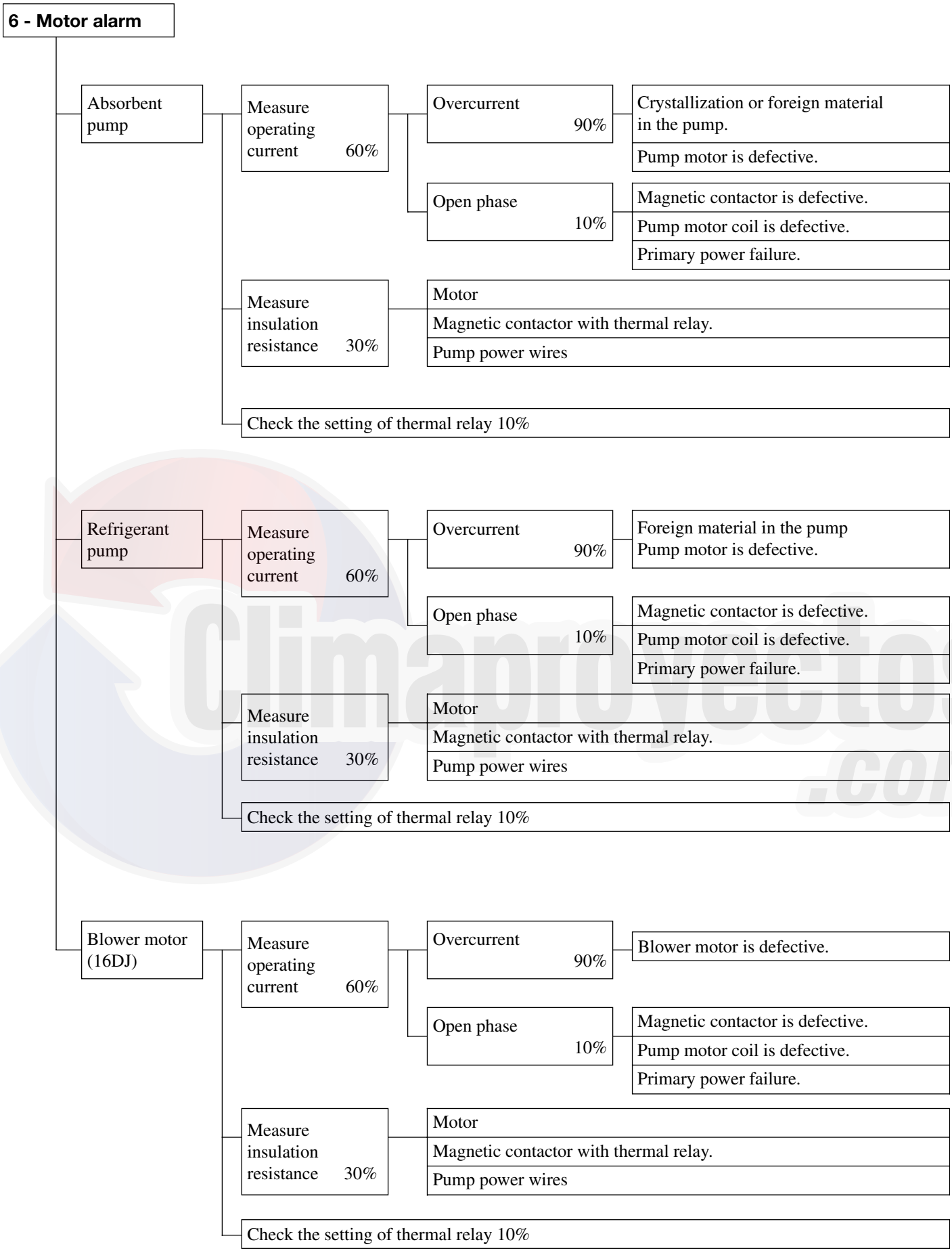
4 - Combustion alarm (16DJ)

- 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 suction side of the wind box 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

SANYO

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