SERVICE MANUAL

OFFICE PRO W20

SERIAL NUMBER FROM April 2011 (0411) TO PRESENT

MOVINCOOL®
THE #1 SPOT COOLING SOLUTION

DocID: 00G00074E

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1. PRECAUTIONS FOR SAFETY

1.1 Foreword

- This manual has been published to service the MovinCool Office Pro W20. Please use this service manual only when servicing this unit.

1.2 Definition of Terms

⚠ **WARNING**	Describes precautions that should be observed in order to prevent injury to the user during installation or unit operation.
⚠ **CAUTION**	Describes precautions that should be observed in order to prevent damage to the unit or its components, which may occur during installation or unit operation if sufficient care is not taken.
NOTE	Provides additional information that facilitates installation or unit operation.

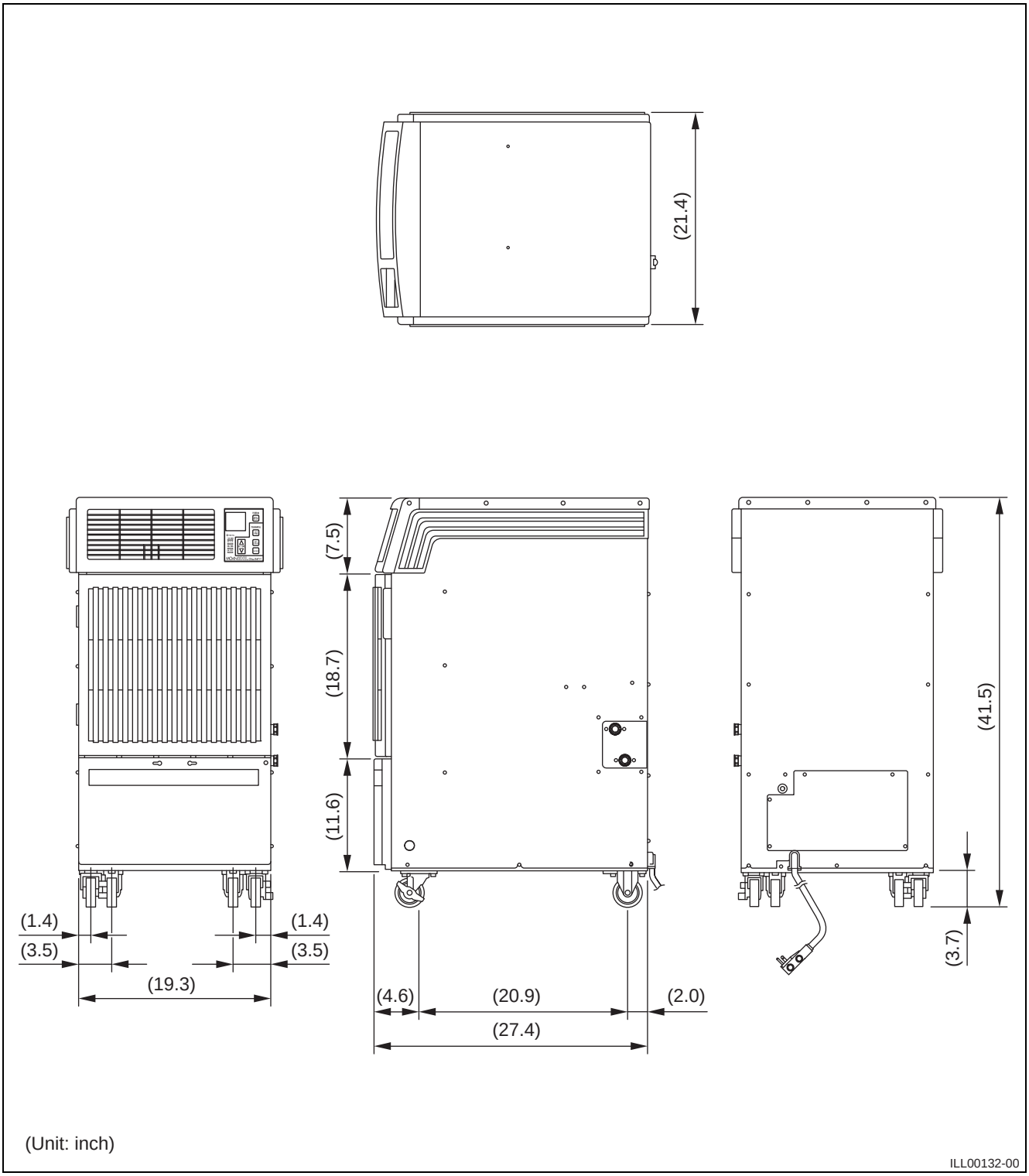
1.3 General Precautions

⚠ WARNING

- **All electrical work should only be performed by qualified electrical personnel. Repair to electrical components by non-certified technicians may result in personal injury and/or damage to the unit. All electrical components replaced must be genuine MovinCool parts, purchased from an authorized reseller.**
- **Before replacing any refrigeration and water system components, recover the refrigerant using standard recovery procedures and equipment, and drain the water from the unit.**
- **When handling refrigerant, always wear proper eye protection and do not allow the refrigerant to come in contact with your skin.**
- **Do not expose refrigerant to an open flame.**
- **The power supply for this unit should be a dedicated single outlet circuit with UL recognized short-circuit and ground-fault protective breaker to prevent electrical shock from the unit.**
- **When brazing any tubing, always wear eye protection, and work only in a well ventilated area.**
- **Disconnect power before servicing unit.**
- **Be careful of any sharp edges when working on unit.**

2. SPECIFICATIONS

2.1 Exterior Dimensions Diagram



(Unit: inch)

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2.2 Technical Specifications

ITEM			SPECIFICATIONS
Electronic Features	Operation		Digital Programmable
Electrical Characteristics	Voltage Requirement		Single-Phase, 115 V, 60 Hz
	Operating Voltage Range	Max.	127 V
		Min.	104 V
	Starting Current		65 A
	Recommended Fuse Size		15 A
	FLA		11.7 A
	LRA		65 A
Cooling Capacity and Power Consumption			
Air: 80 °F (27 °C), 50 %RH Water (EWT/LWT): 85 °F/ 95 °F (29 °C/35 °C)	Total Cooling Capacity		15700 Btu/h (4590 W)
	Sensible Cooling Capacity		10800 Btu/h (3180 W)
	Power Consumption		1.28 kW
	Current Consumption		11.7 A
	EER		12.3
	Power Factor		95 %
Compressor	Type of Compressor		Hermetic Rotary
	Output		1.16 kW
Evaporator	Type of Evaporator		Plate Fin
	Type of Fan		Centrifugal Fan
	Air Flow	High	565 CFM (960 m^3/h)
		Low	540 CFM (918 m^3/h)
	Max. External Static Pressure		0.31 IWG (77 Pa)
	Motor Output	High	112 W
		Low	87 W
Condenser	Type of Condenser		Water Cooled, Coaxial Coil
	Type of Water Control		Refrigerant Discharge Pressure
Refrigerant	Refrigerant Control		Capillary Tube
	Type		R-410A
	Amount		1.76 lb (0.8 kg)
Water Connection	Water Inlet and Outlet (Unit side)		1/2 in (13 mm) NPT Female
	Water Inlet and Outlet Adapters		GHT Female to 1/2 in (13 mm) NPT Male
Signal Connection	Fire Alarm Input (Signal Type)		• No-voltage contact input • Contact resistance less than 100 ohm
	Warning Signal Output		2 A at 30 V (DC/AC) or less (resistive load)
Power Cord	NEMA Plug Configuration		5-15
	Gauge x Length		14 AWG (3-core) x 10 ft (3.0 m)
Dimension	W x D x H		21.0 x 27.0 x 41.5 in (538 x 685 x 1055 mm)

ITEM			SPECIFICATIONS
Weight	Net		178 lb (81 kg)
	Shipping		209 lb (95 kg)
Drain Tank Capacity			5.0 gal (19 L)
Operating Condition Range	Inlet Air Temperature	Max.	95 °F (35 °C), 60 %RH
		Min.	65 °F (18 °C), 50 %RH
	Entering Water Temperature*1	Max.	90 °F (32 °C)
		Min.	40 °F (4.4 °C)
	Water Pressure		150 psi (1034 kPa)
	Recommended Water Flow Rate		4.8 gal/min (18 L/min)
Maximum Duct Length	Cold Duct		25 ft (7.6 m)
Sound Level*2	High		62 dB (A)
	Low		60 dB (A)
Safety Devices	Compressor Overload Protector		Included
	Fan Motor Overload Protector		Included
	Freeze Protection Thermistor		Included
	Full Drain Tank Switch		Included
	Automatic Restart (Power Interruption)		Included
	Compressor Time Delay		120 sec
	High Pressure Interruption		Included
	Signal Input/Output		Included
Control Devices	Temperature Control		Included
	Programmable Timer		Included
	Two Speed Fan		Included

- Specifications are subject to change without notice.

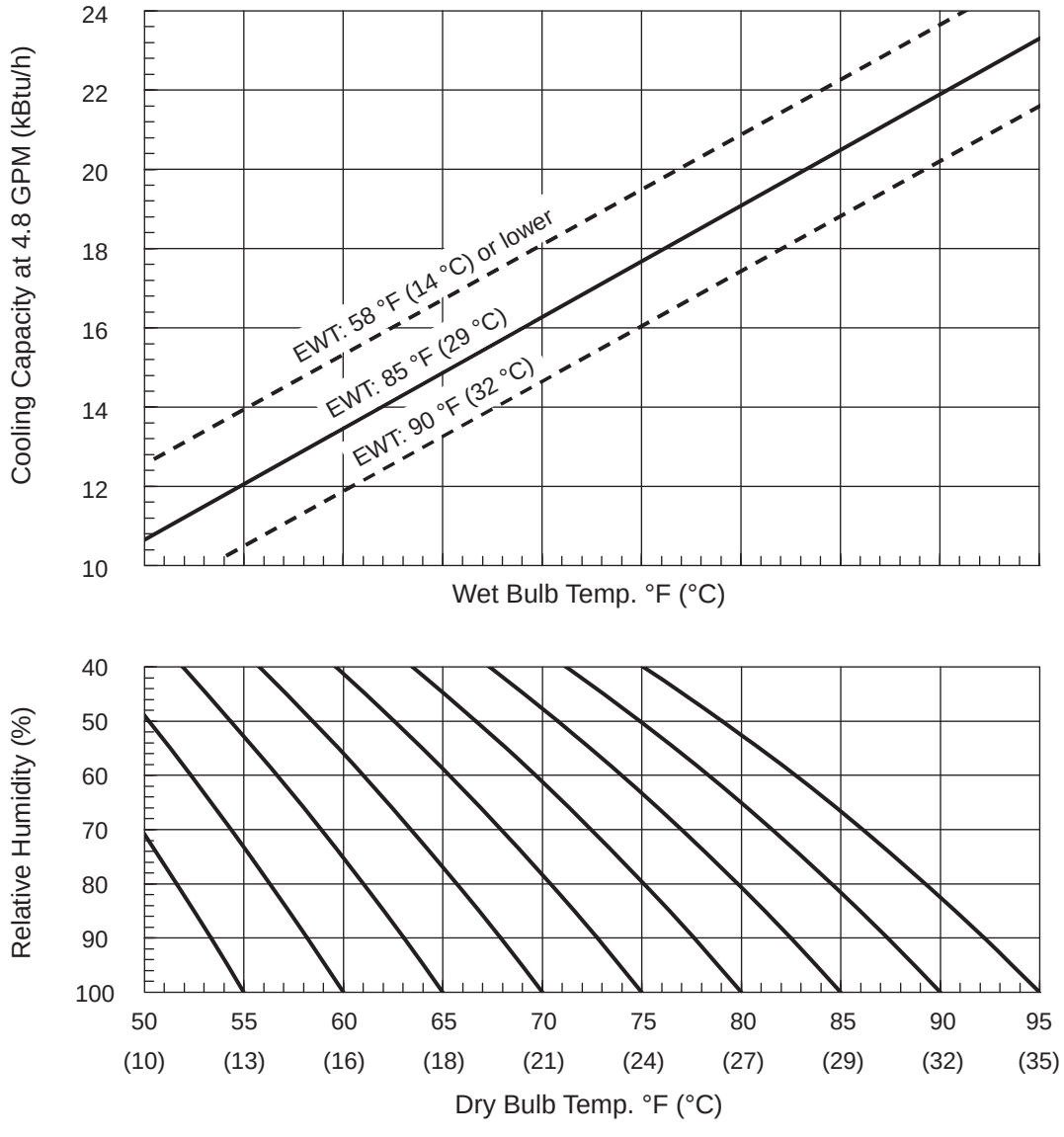
< NOTE >

*1 : If the entering water temperature is below 68 °F (20 °C) or above 86 °F (30 °C), adjustment of the unit's water regulating valve setting is required.
*2 : Measured at 3 feet (1.0 m) from surface of the unit.

2.3 Characteristics

- All characteristic values are within ± 10 % tolerance.
- EWT shown in the graphs is an abbreviation of “Entering Water Temperature”.

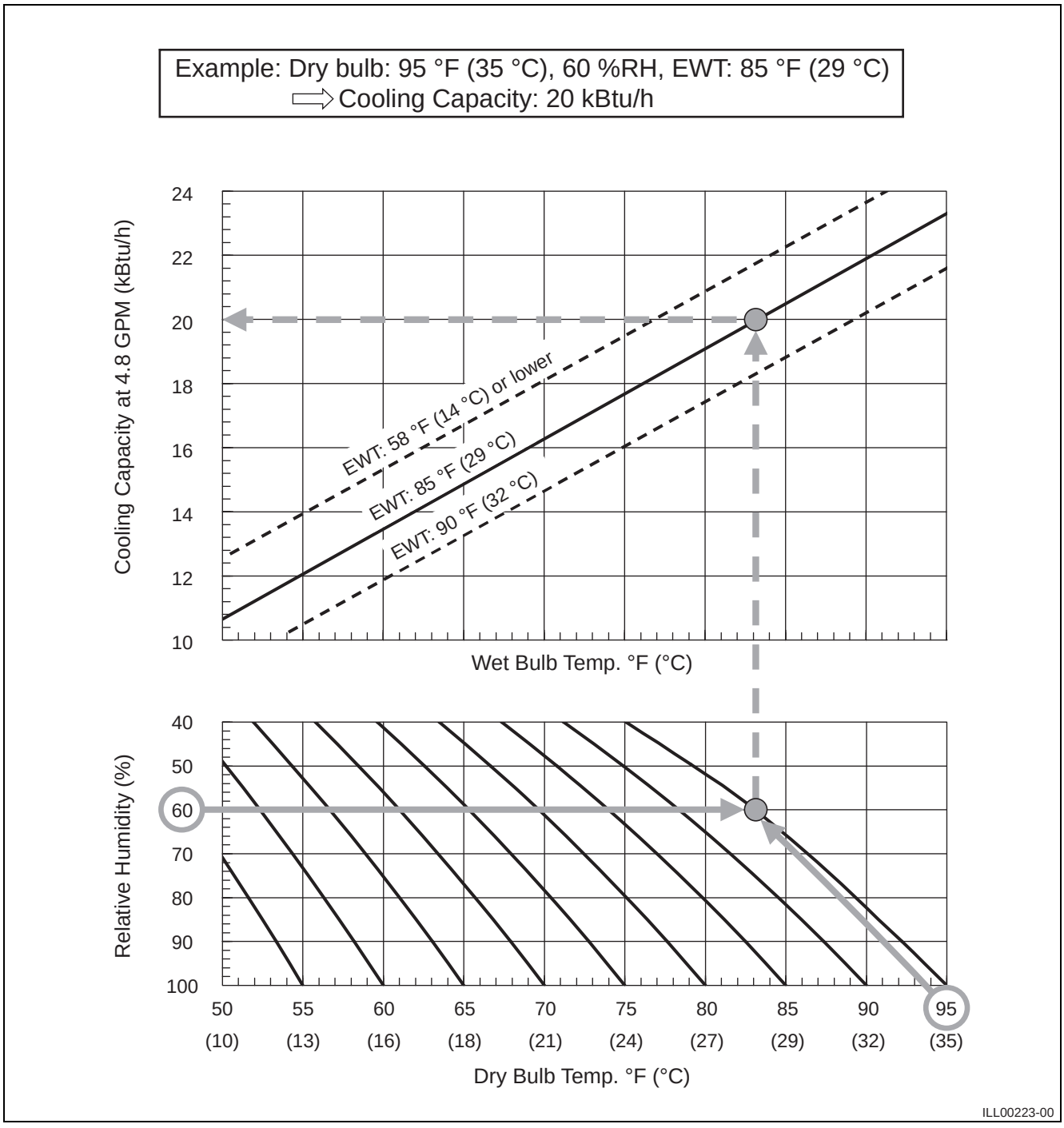
(1) Cooling capacity curve



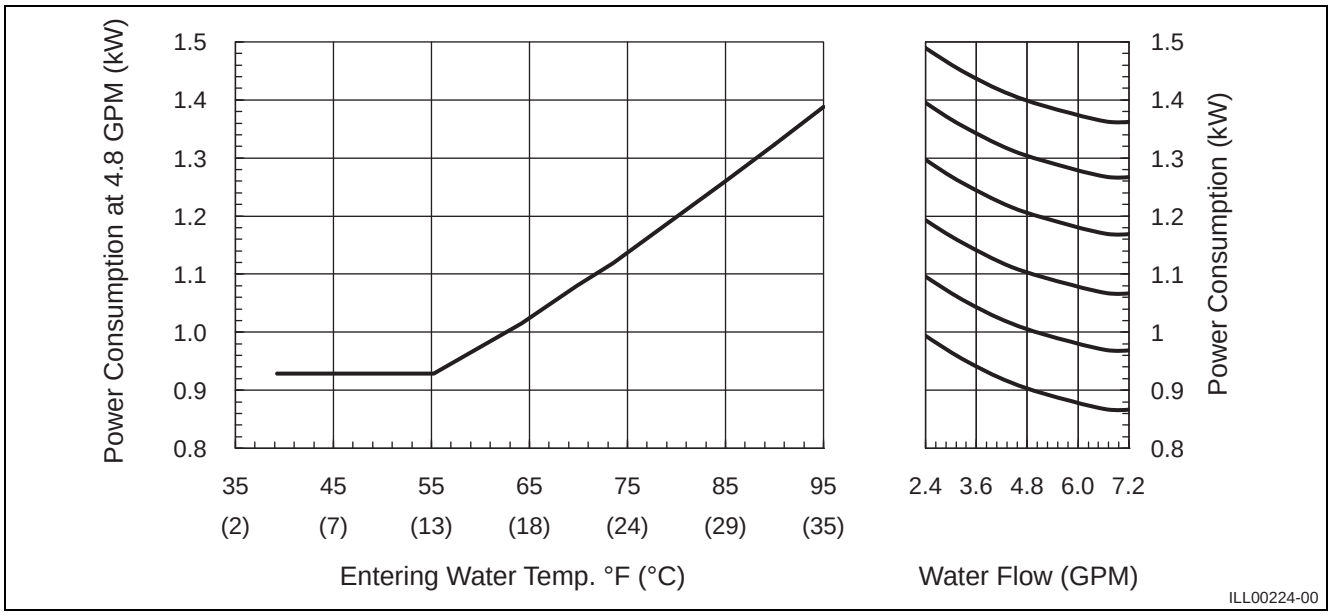
< NOTE >

Cooling capacity listed at water flow rate of 4.8 GPM. Water Flow rate has small effect on cooling capacity. (Approx. 1 % effect at the range from 2.4 to 7.2 GPM.)

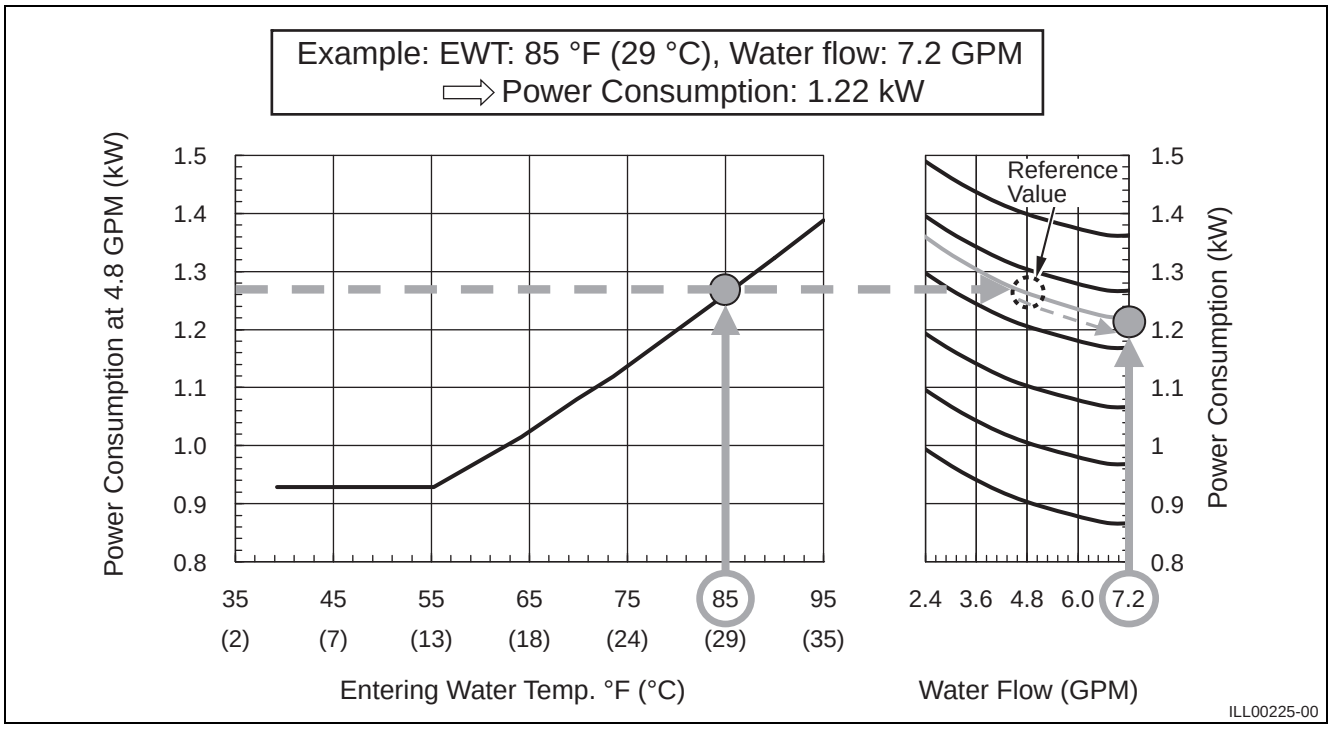
How to read the cooling capacity curve



(2) Power consumption curve



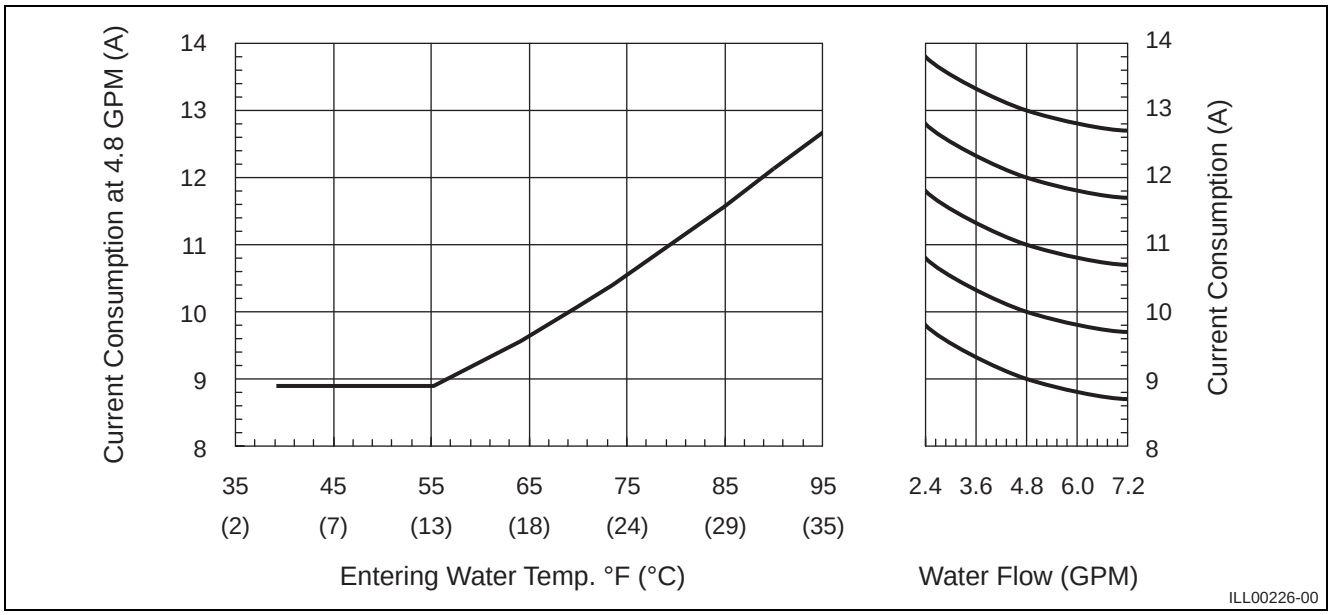
How to read the power consumption curve



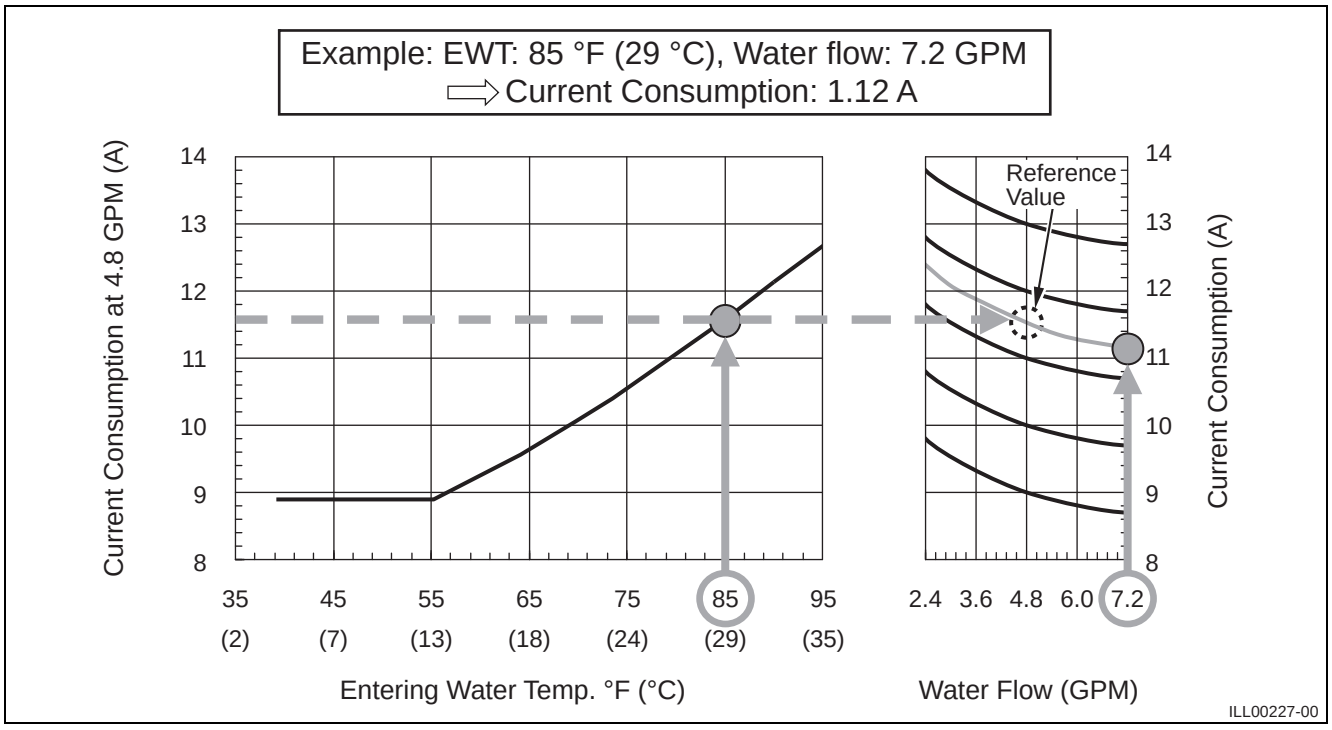
< NOTE >

Water flow rate at 4.8 GPM is a reference value corresponding to various power consumption at various entering water temperature. From reference curve, read power consumption at various water flow rate (see example of how to read power consumption).

(3) Current consumption curve



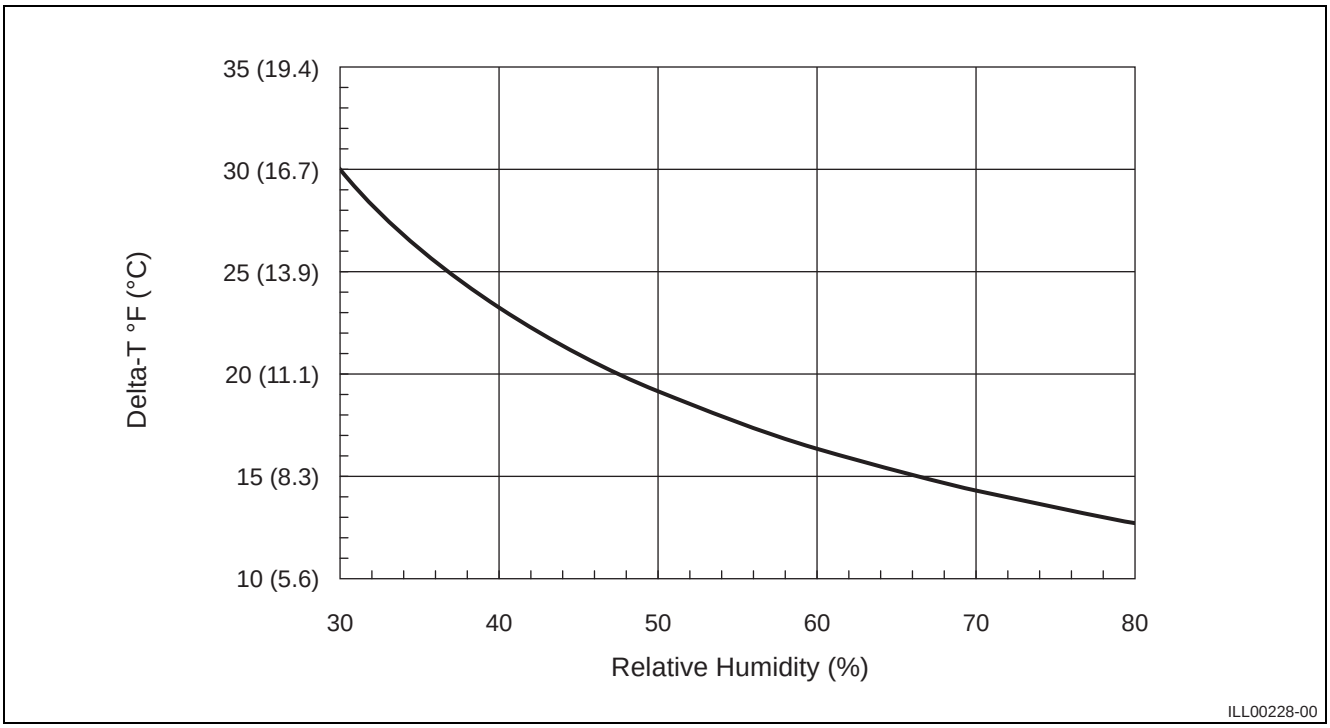
How to read the current consumption curve



< NOTE >

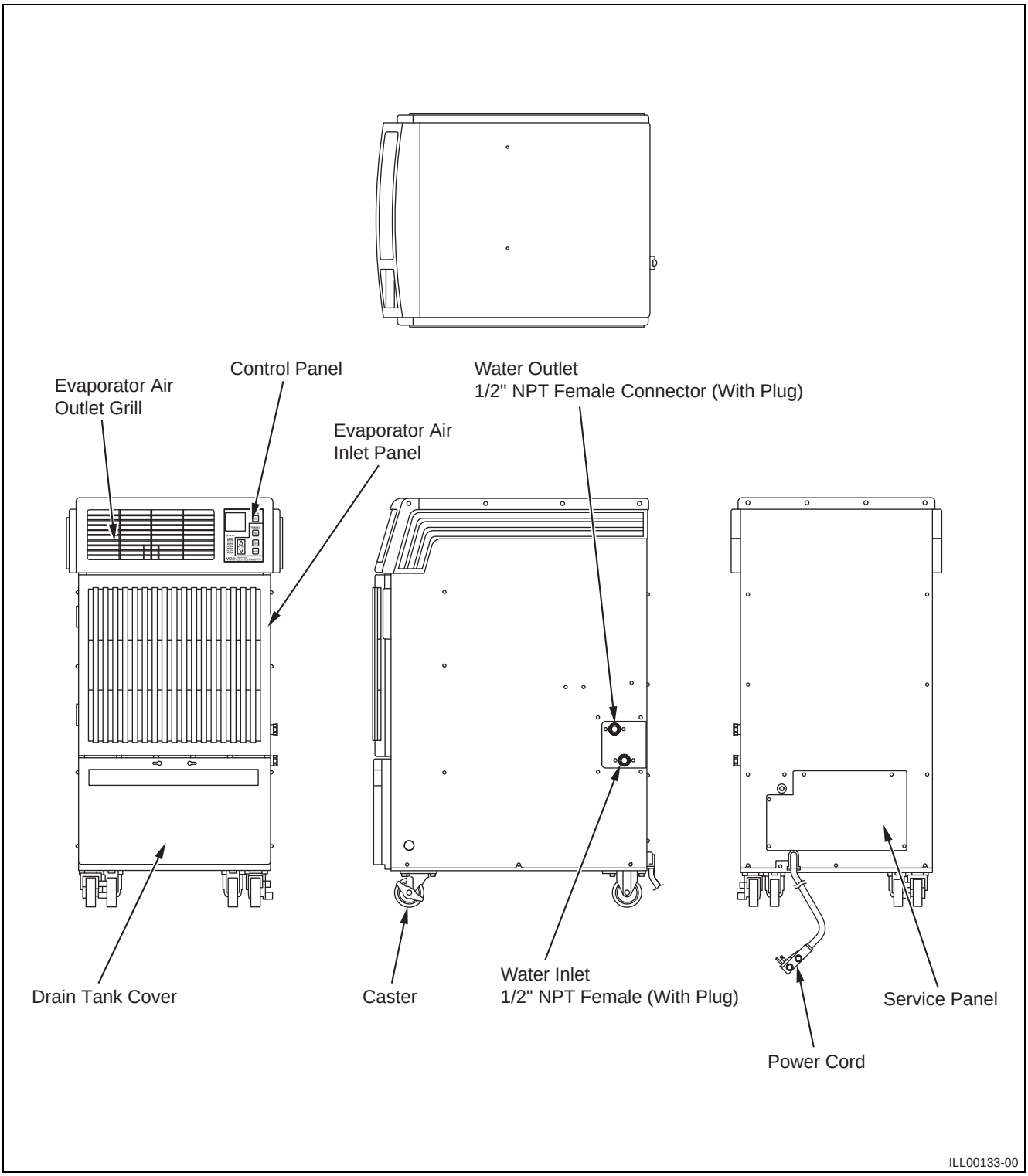
Water flow rate at 4.8 GPM is a reference value corresponding to various current consumption at various entering water temperature. From reference curve, read current consumption at various water flow rate (see example of how to read current consumption).

(4) Cool air temperature difference curve

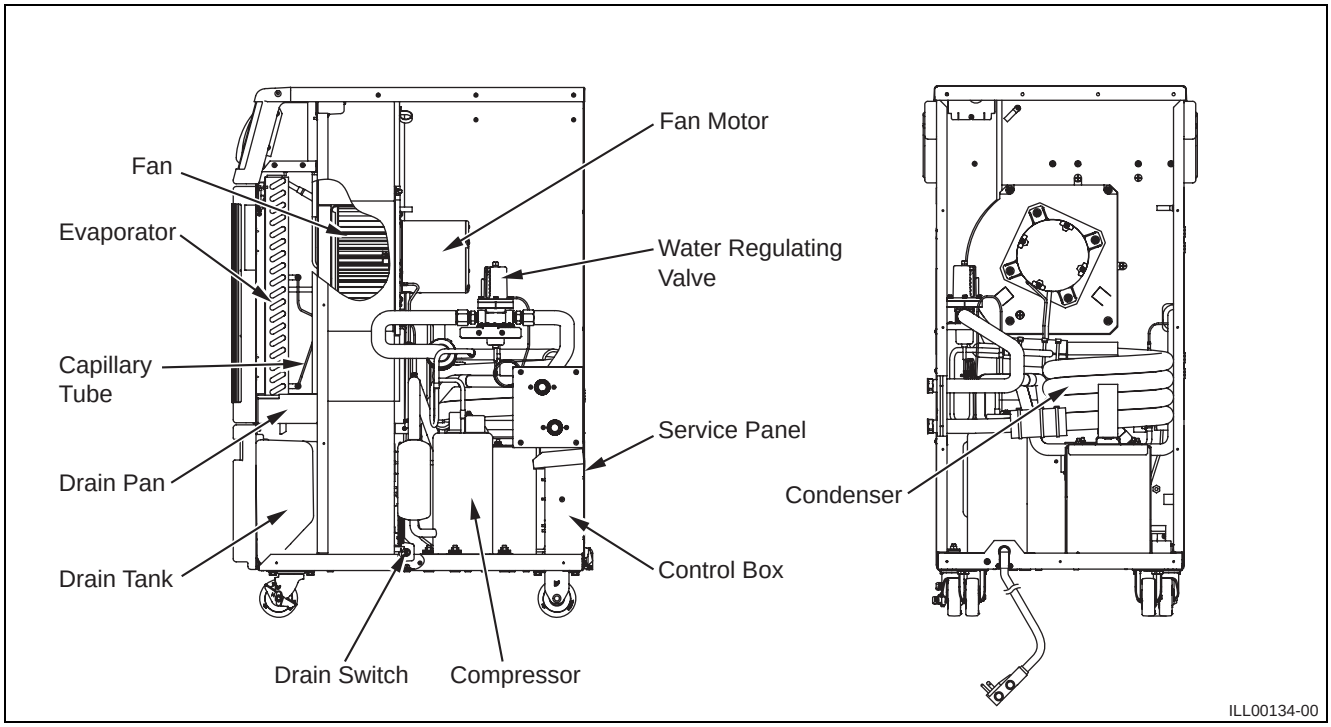


3. CONSTRUCTION

3.1 Exterior Components



3.2 Internal Structure

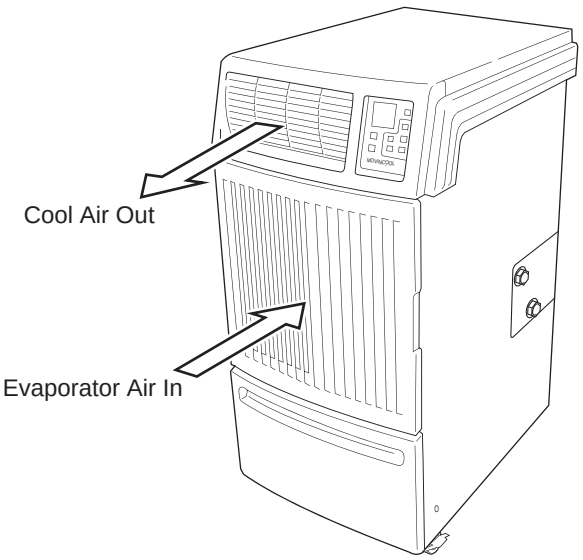


3.3 Basic Construction

- The unit is compact in construction because the condenser and the evaporator are enclosed in one unit. The interior is divided into three sections. The upper front face is equipped with the evaporator, and the lower front face contains the drain tank and condensate pump (Optional). The rear section contains the condenser, the compressor and the control box.

3.4 Air Flow

- Air taken in from the front face is cooled by the evaporator and then blown through the cool air vent. The air inlet is equipped with a filter.



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3.5 Compressor and Fan

- The compressor is hermetically sealed. A two-speed motor with a centrifugal fan is used to draw air across the evaporator.

3.6 Drain Tank

- A 5.0 gal (19 L) drain tank is supplied with the unit. The condensate (water) is collected into the tank.

  The drain switch activates and stops the operation when tank reaches the level of approximately 4.0 gal (15 L).

3.7 Water Flow

- This unit has two water connectors on the right side panel.
- Water is flown in from the water inlet and extracts the heat from the water cooled condenser. Then the water is flown out from the water outlet.

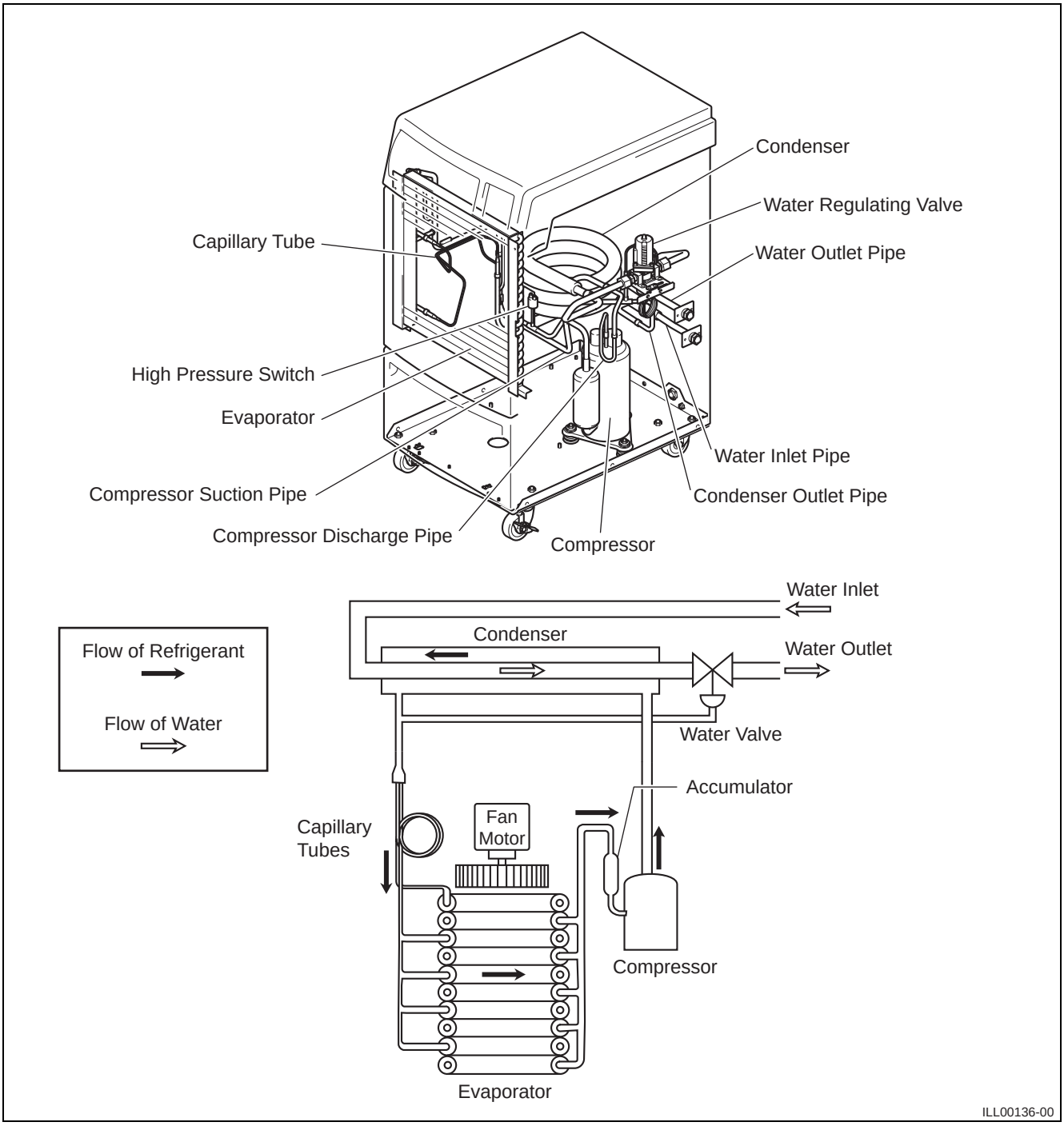
4. REFRIGERATION SYSTEM

4.1 Refrigeration System Construction

The component parts of the refrigeration system include the following:

- Compressor, Evaporator, Condenser, Capillary tube, High pressure switch

These parts are all connected by copper tubing. All the connections have been brazed.

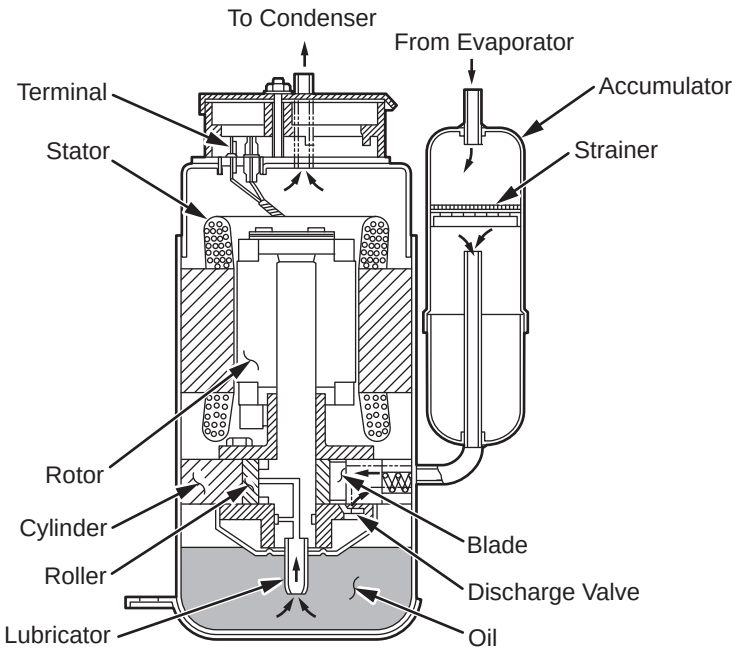


4.2 Compressor

• The compressor used for the unit is hermetically sealed. The compressor and the compressor motor are in one casing.

(1) Compressor construction

•The construction of a rotary type compressor is divided into two mechanisms; the drive mechanism (compressor motor), and the compression mechanism (compressor). When the rotor shaft of the motor (drive mechanism) turns, the roller (compression mechanism) rotates to compress the refrigerant.



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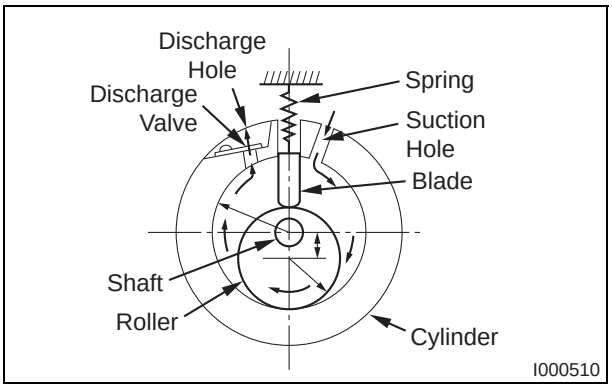
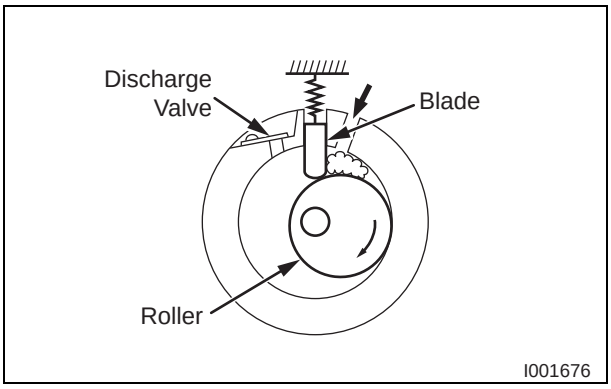
(2) Basic compressor operation



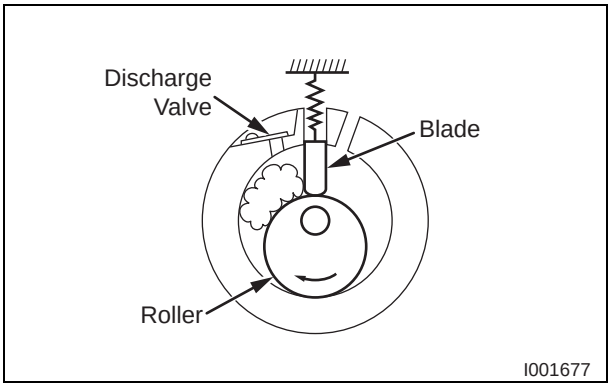
•The roller (compression mechanism) is set eccentrically with a certain distance given from the axis of the center of the cylinder. A spring loaded blade is mounted on the cylinder. The roller turns to compress the refrigerant in the space between the cylinder and eccentrically mounted roller. The blade is in contact with the roller by means of spring force. The blade partitions the space between the suction side and the discharge side to keep compressed refrigerant from returning to the suction side. There is no suction valve. The discharge valve is designed not to open until the pressure of the refrigerant within the cylinder reaches or exceeds discharge side pressure. As a result, the discharge valve prevents the backward flow of refrigerant gas.

(3) Operation



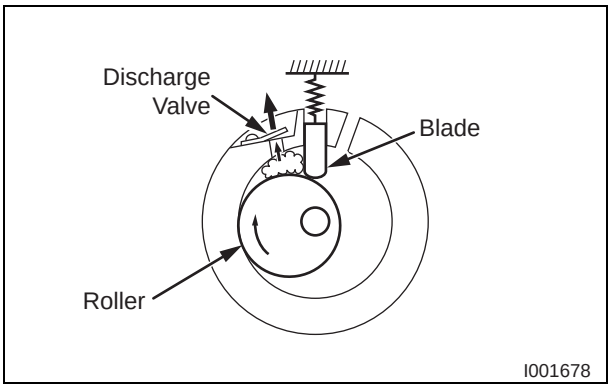
1) Start of compression

1) The cylinder is filled with low pressure gas.
2) Since pressure in the discharge chamber is higher than in the cylinder, the discharge valve is kept closed.



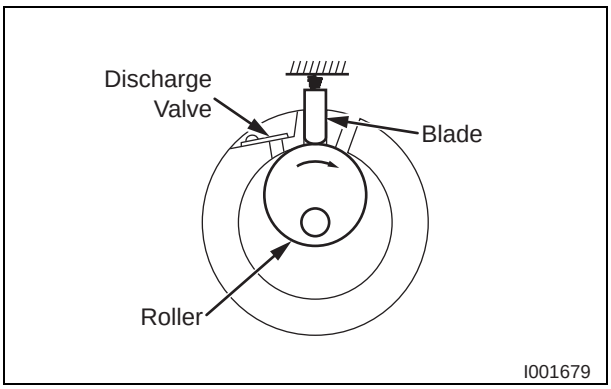
2) Suction and compression

1) The pressure in the cylinder increases gradually.
2) Refrigerant suction begins on the suction side of the cylinder.
3) The discharge valve remains closed.



3) Discharge

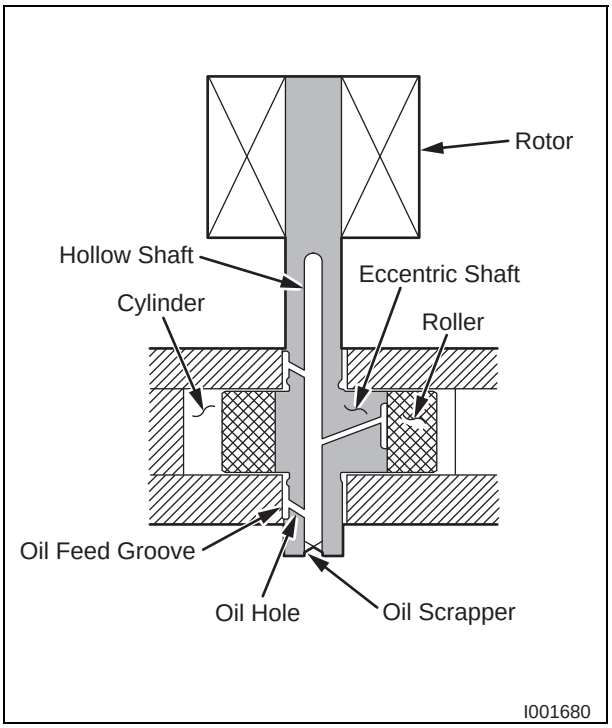
1) The pressure in the cylinder exceeds that in the discharge chamber, and the discharge valve opens.
2) On the suction side, refrigerant suction continues.



4) Completion of compression

1) When compression is completed, all of the refrigerant has been drawn from the suction chamber.
2) Operation then returns to step 1) (Start of compression) and the above process of suction and compression continues repeatedly in succession.

(4) Compressor lubrication

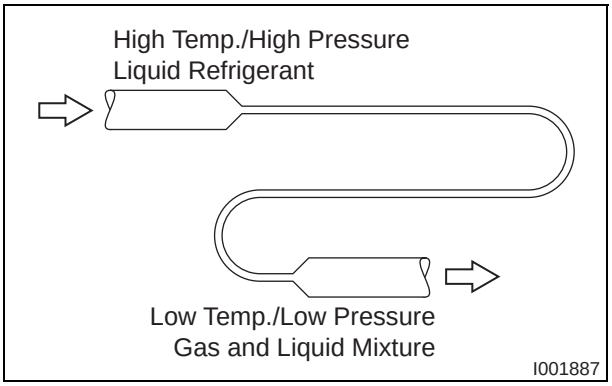


•The lubrication system is comprised of a hollow shaft, an oil scraper mounted at the end face, hollow shaft, a shaft journal (shaft bearing), and the lubrication groove for the shaft journal. The lubrication groove is wider than the oil hole. When the shaft turns, oil is scraped upward by the oil scraper along the inside diameter of the hollow shaft. The oil is fed through the oil hole by centrifugal force, then supplied to the lubrication groove for each shaft journal, lubricating the bearing. In this lubrication system, oil enters into each bearing separately and returns to the oil reservoir. This system effectively prevents bearing temperature increases, and offers high reliability. In addition, the specially treated shaft journal keeps the bearing from being damaged during high temperature operation.

4.3 Condenser

- The condenser is a heat exchanger with coaxial tubes. The inner tube is a copper tube in which the water flows. The outer tube is a steel tube. The refrigerant flows between inner tube and outer tube.
- Heat is given off and absorbed by the water being passed through the condenser and then expelled through the water outlet.

4.4 Capillary Tube

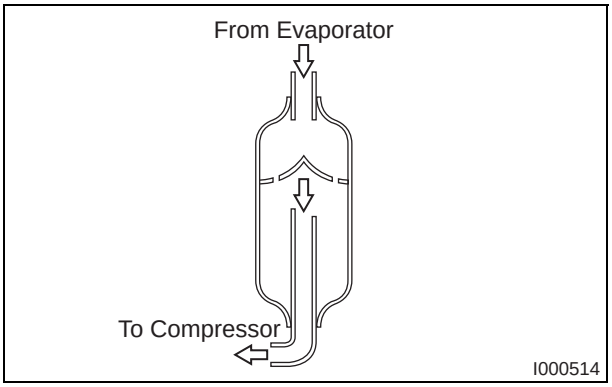


- The capillary tube is a long thin tube utilizing line flow resistance to serve as an expansion valve. The length and the inner diameter of the capillary tube are determined by the capacity of the refrigeration system, specified operating conditions, and the amount of refrigerant. The capillary tube causes the high pressure, high temperature liquid refrigerant sent from the condenser to expand rapidly as the refrigerant is sprayed out through the fixed orifice in the capillary tube. As a result, the temperature and state of the refrigerant becomes low and mist-like respectively, causing it to evaporate easily.

4.5 Evaporator

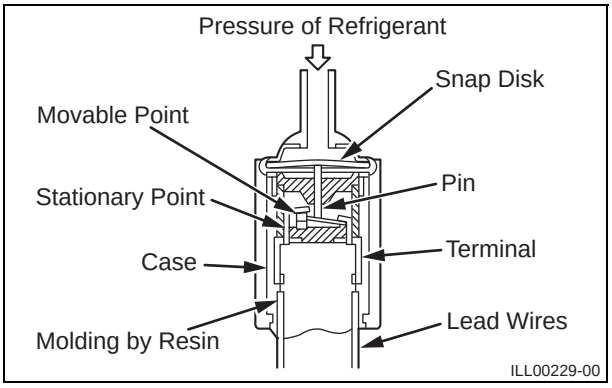
- The evaporator is a heat exchanger covered with plate fins. Heat is removed from the air being pulled across the evaporator by the centrifugal fan and the resulting cool air is expelled through the cool air vent.

4.6 Accumulator



•The accumulator is mounted on the suction gas piping between the evaporator and the compressor. The accumulator separates the liquid refrigerant from the gas refrigerant, allowing only the gas refrigerant to enter the compressor. In the accumulator, suction gas is led into a cylindrical vessel where the speed of the gas is decreased. This process separates the refrigerant contained in the gas by the force of gravity, causing the refrigerant to accumulate at the bottom of the vessel. As a result, the compressor is protected from possible damage caused by liquid refrigerant intake.

4.7 High Pressure Switch

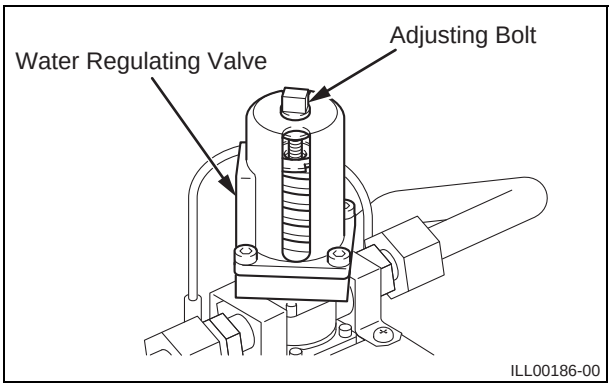


- The high pressure switch prevents the condenser and compressor from being damaged by excessive high pressure in the high pressure line of the refrigeration cycle. The switch is normally closed. The snap disk responds to the variations in pressure and, if pressure is abnormally high, the snap disk moves down to push the pin down, causing the internal contacts to open. This interrupts the ground signal at the control board (J104 connector) which turns the compressor off.

5. WATER SYSTEM

5.1 Water Regulating Valve

- This unit is equipped with a water regulating valve to operate within wide water temperature range. This water regulating valve automatically controls the water flow rate to stabilize the refrigeration system and it has an adjusting bolt to adjust the valve opening temperature.



5.2 Default Water Regulating Valve Setting and Operation Range

- Default setting of the valve opening temperature is 86 °F (30 °C) and marked on the valve housing. If the entering water temperature is below 86 °F (30 °C), there is no loss of water while the unit is not operating. Adjustment of this valve setting is required only when the unit will be used under the following conditions.

  Entering water temperature is below 68 °F (20 °C):
  Valve setting must be adjusted to lower temperature to extend the life of the compressor.

  Entering water temperature is above 86 °F (30 °C):
  Valve setting must be adjusted to higher temperature to prevent wasted water.

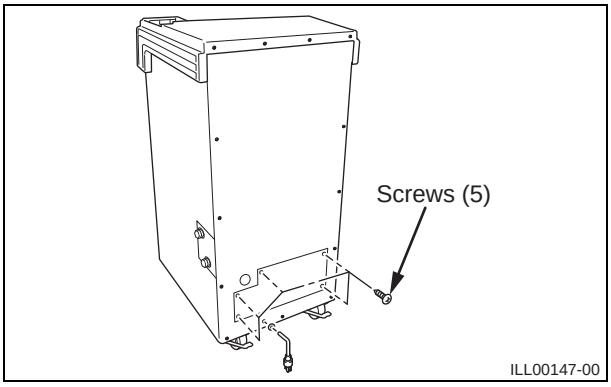
< NOTE >

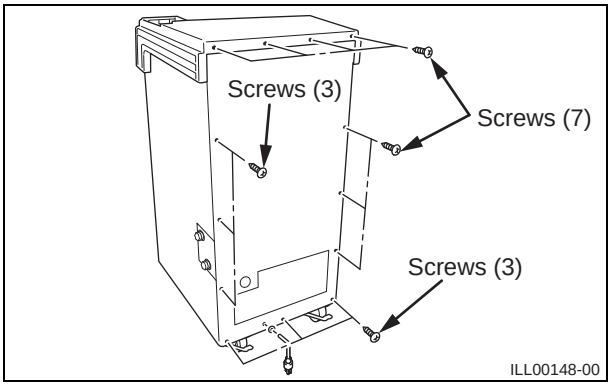
This adjustment expands the minimum water temperature range. Carefully control the operating range.

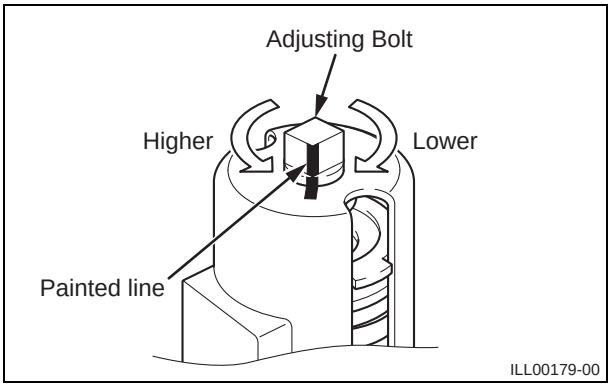
⚠ CAUTION

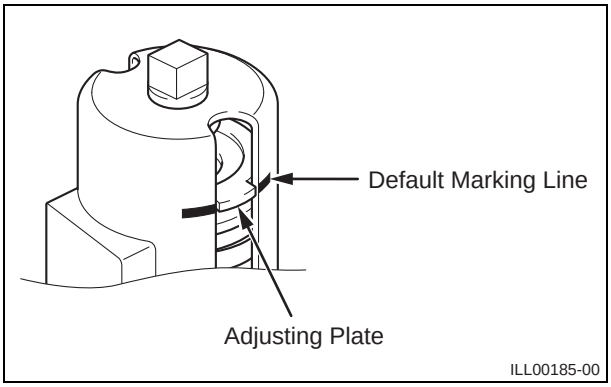
Failure to adjust the water regulating valve or operating the unit with entering water temperature below 68 °F (20 °C) without adjusting the valve setting may damage the unit and void the warranty.

5.3 Adjustment of Water Regulating Valve Setting









1) Stop the unit and unplug the power cord. Then shut off the water supply.

2) Remove five (5) screws from the service panel on the rear side of the unit.

3) Remove thirteen (13) screws from the rear panel.

4) Check the valve setting guide table on the inside panel of the unit to confirm the current valve setting. If the table is blank, it is the first time adjustment. If the table shows the previous value setting, the current setting must be changed back to the original default setting prior to making any adjustment.

5) Make sure the adjusting plate is aligned with the default marking line on the housing. If it is not aligned, rotate the adjusting bolt with a wrench until it is aligned. At this position the water regulating valve is returned to the original default setting.

6) Rotate the adjusting bolt with a wrench to adjust the valve temperature setting according to the “Valve Setting Guide Table” on page 26. The painted line on adjusting bolt and housing is for rotational reference to complete one rotation (360 °).

Direction of Rotation	Temperature Setting
Clockwise	Lower
Counterclockwise	Higher

< NOTE >

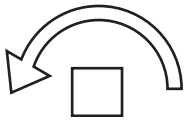
The default marking line on the housing is for adjustment reference. The painted line on adjusting bolt and housing is for rotational reference. Each completed rotation of the adjusting bolt is resulting in about 0.04 inch (1 mm) displacement of the adjusting plate.

7) Write the value setting with a permanent marker on the adjustment record table on the inside panel of the unit.

< NOTE >

Recording the value setting is very important for reference when making future adjustments.

Valve Setting Guide Table

Setting	Direction of Valve Rotation	Number of Rotation	Valve Opening Temperature	Minimum Water Temperature
A	Clockwise 	4	72 °F (22 °C)	40 °F (4.4 °C)
B		3	75 °F (24 °C)	47 °F (8 °C)
C		2	79 °F (26 °C)	54 °F (12 °C)
D		1	82 °F (28 °C)	61 °F (16 °C)
E	Default Setting Point	-	86 °F (30 °C)	68 °F (20 °C)
F	Counterclockwise 	1	90 °F (32 °C)	72 °F (22 °C)
G		2	94 °F (34 °C)	75 °F (24 °C)
H		3	96 °F (36 °C)	79 °F (26 °C)
I		4	100 °F (38 °C)	83 °F (28 °C)

Adjustment Record (Example)

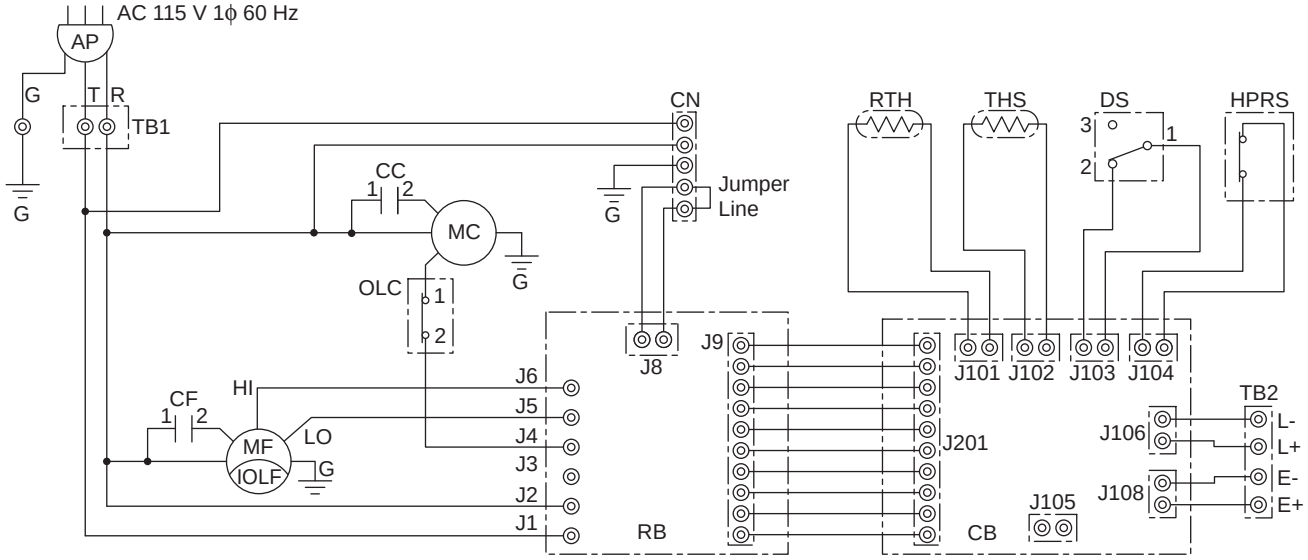
No.	Setting Date	Setting	No.	Setting Date	Setting
0	-	E	11		
•	Dec. 10, 2010	B	•		
•	Apr. 10, 2011	D	•		
•	Aug. 10, 2011	G	•		
10			21		

⚠ CAUTION

Do not forget to write down the value setting with a permanent marker on the adjustment record table. This is the only way to know the current valve setting. It is difficult to exactly adjust the valve without the current valve setting. Failure to adjust the valve may damage the unit and void the warranty.

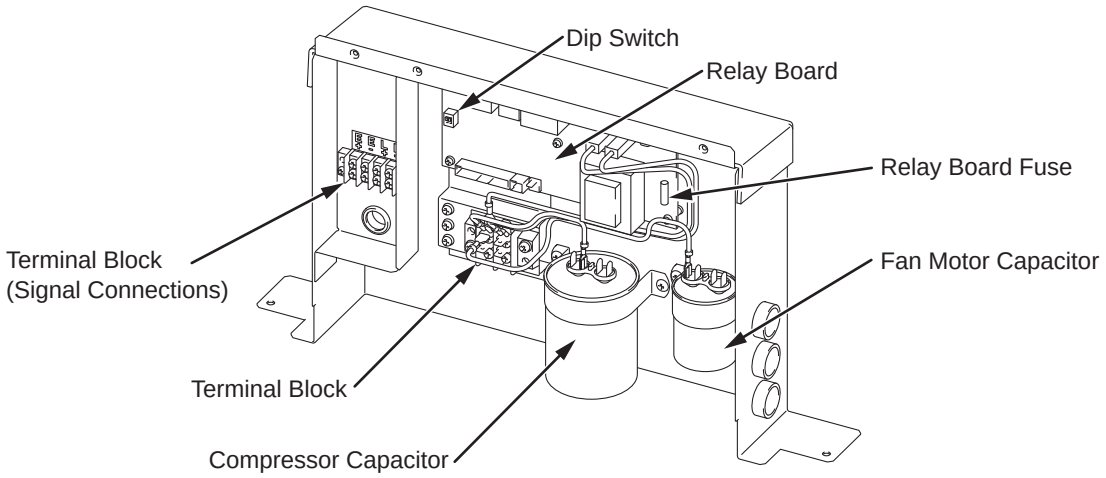
6. ELECTRICAL SYSTEM

6.1 Circuit Diagram and Control Box



A P	Attachment Plug
T B 1	Terminal Block
T B 2	Terminal Block
C B	Control Board
R B	Relay Board
M F	Fan Motor
M C	Compressor Motor
C F	Capacitor for Fan Motor
C C	Capacitor for Compressor

I O L F	Inner Overload Relay of Fan Motor
O L C	Inner Overload Relay of Compressor
D S	Full Drain Warning Switch
T H S	Freeze Protection Thermistor
R T H	Room Thermistor
H P R S	High Pressure Switch
G	Grounding
C N	Connector for Option Drain Pump



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6.2 Basic Operation of Electrical Circuit

- There are two basic components used to control the operation of electrical system:
  - Control panel assembly
  - Control box
- The control panel assembly contains the control panel, control board (with inputs for the freeze and room temperature thermistors), drain switch and a microprocessor.

(1) Fan mode

High Fan Mode

- When the FAN MODE button on the control panel is pressed, the microprocessor turns on “FAN HI” “COOL OFF” indication of LCD and activates both the fan on relay and fan mode relay. This sends line voltage (115 VAC) from the fan on relay to the N.O. (normally open) contacts of the fan mode relay. This output is connected to the J6 terminal (relay board) where the high speed wire of the fan motor is connected.
- When this button is pressed again, fan turns to low mode (see below). Press again, fan stops.

Low Fan Mode

- When the FAN MODE button on the control panel is pressed again, the microprocessor turns on “FAN LO” “COOL OFF” indication of LCD and activates both the fan on relay and fan mode relay. This sends line voltage (115 VAC) from the fan on relay to the N.C. (normally closed) contacts of the fan mode relay. This output is connected to the J5 terminal (relay board) where the low speed wire of the fan motor is connected.
- When this button is pressed again, fan stops.

(2) Cool mode

- In addition to fan mode (as described above), when the COOL ON/OFF button on the control panel is pressed, the microprocessor turns on “COOL ON” indication of LCD and if the temperature set point is less than the current room temperature, activates the compressor relay (relay board) after 120 seconds delay. This sends line voltage (115 VAC) to the J4 terminal (relay board) where compressor wire is connected. Then compressor turns on for Cooling Operation.

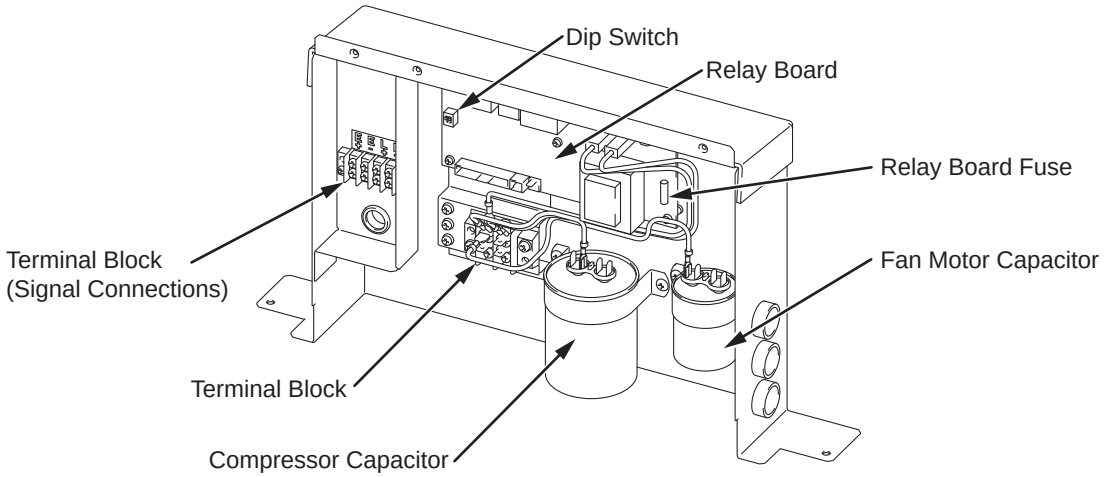
6.3 Control Box

(1) Capacitors

- The capacitors are used to temporarily boost the power output available to the fan motor and the compressor at start-up.
- The specifications of each capacitor are listed below:

Capacitor Application	Voltage	Rating Capacitance
Fan Motor	370 VAC	7.5 µF
Compressor	370 VAC	60 µF

<Control Box>



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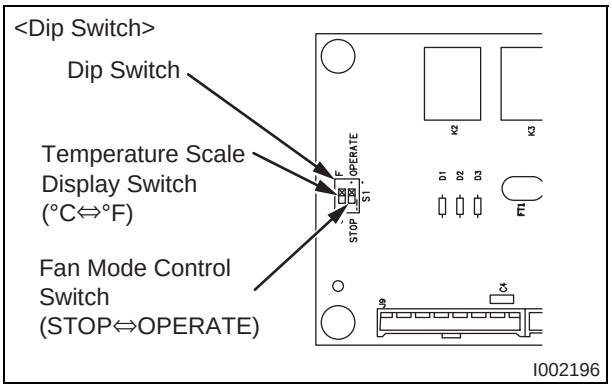
(2) Relay board



- The relay board receives signals and outputs from the control board that contains a microprocessor. The relay board contains the compressor, fan on, and fan mode (speed) relays.
- It also contains a step-down transformer that converts the line voltage (115 VAC) to 12 V.
- This 12 V is then converted from AC to DC and used for relay coil activation. The 12 V (DC) power is sent to the control panel assembly where it is further reduced to 5 V for the system logic.
- The relay board also contains the DIP switch.
- The DIP switch is used to change the fan mode operation from stop to operate and change both the set point and room temperature display from Fahrenheit to Celsius.

< NOTE >

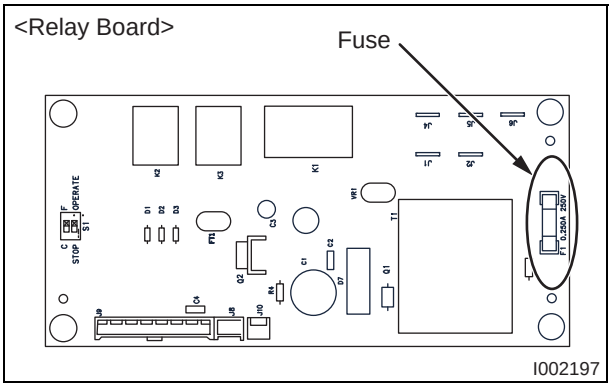
The relay board must be serviced as a complete assembly. It has only one serviceable component, the fuse. (see below)

(3) Relay board fuse

- This fuse provides protection against damage to the step-down transformer. It must be replaced with the exact type of fuse or an equivalent.

Specifications:

- 0.25 A, 250 V

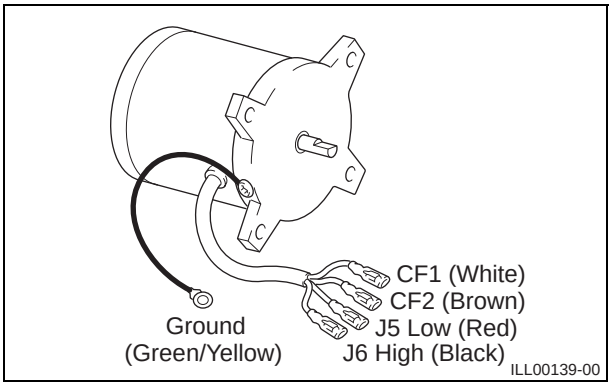


⚠ CAUTION

Failure to use the exact type of fuse could result in personal injury, damage to the unit and/or to the components which may void the warranty.

6.4 Fan Motor

- The fan motor is a single phase, induction type two-speed motor.
  The motor rotates the fan on the evaporator side.



Specifications:

Rated Voltage	115 V, 60 Hz
Rated Output	High: 112 W, Low: 87 W

< NOTE >

An internal overload relay is used to protect the fan motor. This relay is built into the fan motor and interrupts the flow of current when there is an over current situation, or if abnormally high temperature builds up in the fan motor.

6.5 Compressor Motor

- The compressor motor is a single-phase motor and is contained within the same housing as the compressor.

Specifications:

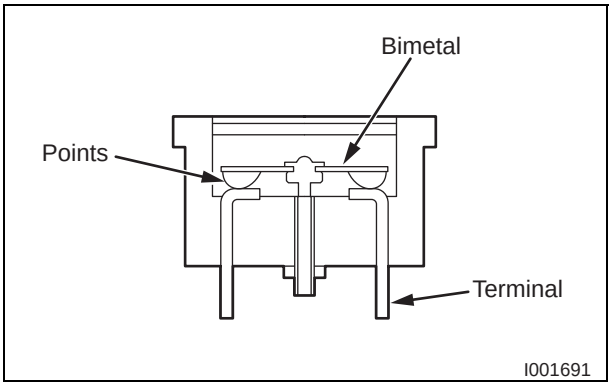
Rated Voltage	115 V, 60 Hz
Rated Output	1160 W

< NOTE >

An internal overload relay is used to protect the compressor motor. This relay is built into the compressor motor. It interrupts the flow of current when there is an over current situation or if abnormally high temperature builds up in the compressor motor.

6.6 Compressor Overload Relay

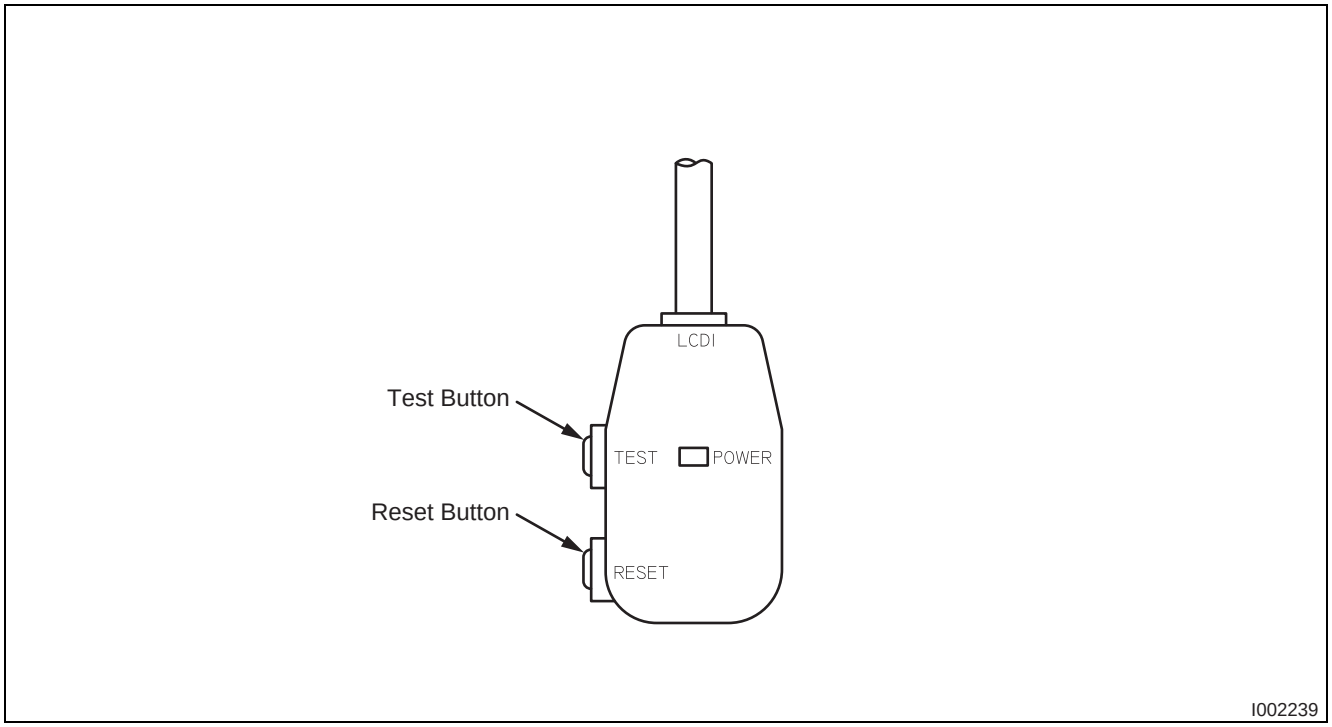
- An external compressor overload relay is used to protect the compressor motor. This relay is mounted within the connector housing that attaches to the top of the compressor. The relay interrupts the flow of current when there is an overload condition and, high temperature builds up in the compressor.



Operating Temperature		Non-Operating Limit at 176 °F (100 °C) (A)	Marking
OFF (Open Contacts)	ON (Closed Contacts)		
302 °F (150 °C)	156 °F (69 °C)	19.0	MRA4720-12027

6.7 Power Cord with LCDI

- This unit is equipped with a UL recognized LCDI cord and NEMA plug configuration (5-15). The appropriate outlet must be used for this plug type. LCDI is used for monitoring leakage current. Once leakage current is detected, LCDI de-energizes the unit.



7. CONNECTION AND SETTING

7.1 Warning Signal Connection (Output Signal Terminal L+ and L-)

- The controller is equipped with a warning signal output relay type (Form C, normal open dry contact) which can be used to monitor the failure conditions.

Relay contactor is closed when any of the following conditions has occurred:

- Tank Full
- Temperature sensor fails
- High pressure switch error

- The relay output contactor is rated 2 A at 30 VDC or 2 A at 30 VAC (resistive load) and it is compatible with various warning devices such as alarm speaker, light indicators, etc.

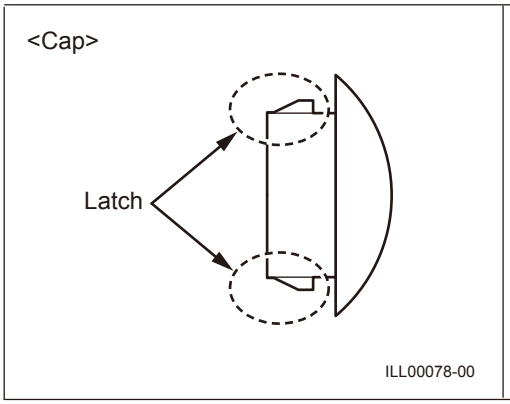
Connecting warning signal from controller

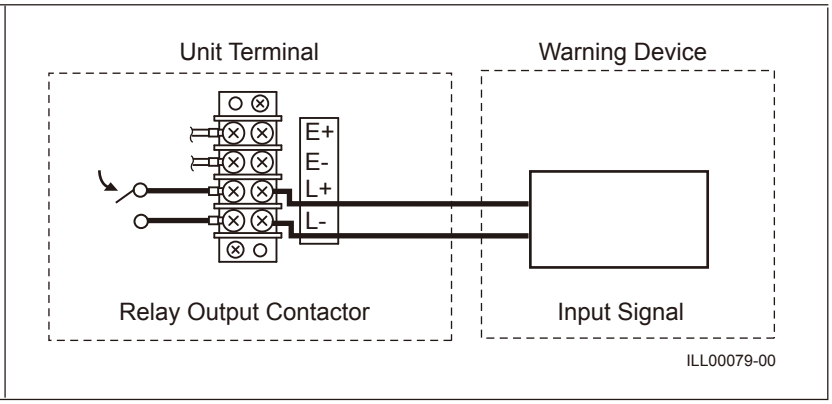
1) Remove service panel from the rear of the unit.

2) Squeeze the inner latches and push out the black cap from inside the panel. (See drawing of cap and inner latch shapes.)

3) Insert the warning signal wire through the hole in the rear panel.
Use recommended warning signal wire size from 16 AWG to 26 AWG or a solid wire, or 16 AWG to 22 AWG for a stranded wire with ring terminal for #6 stud size.

4) Connect warning device to terminal L+ and L- according to its polarities.





7.2 Fire Alarm Control Panel Connection (Input Signal Terminal E+ and E-)

- The controller is equipped with a normal open input signal, which can be connected directly from the fire alarm control panel. When receiving the signal from the fire alarm control panel, the unit turns off and does not turn back until it has been reset.

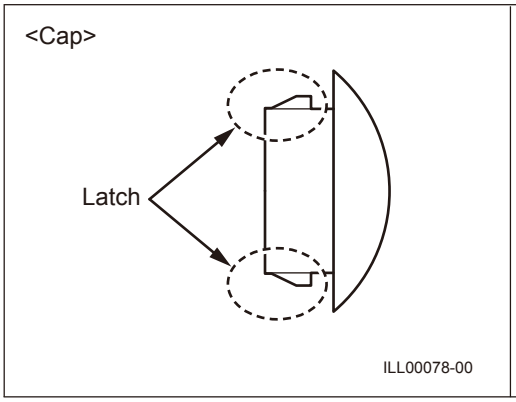
Connecting fire alarm control panel to controller

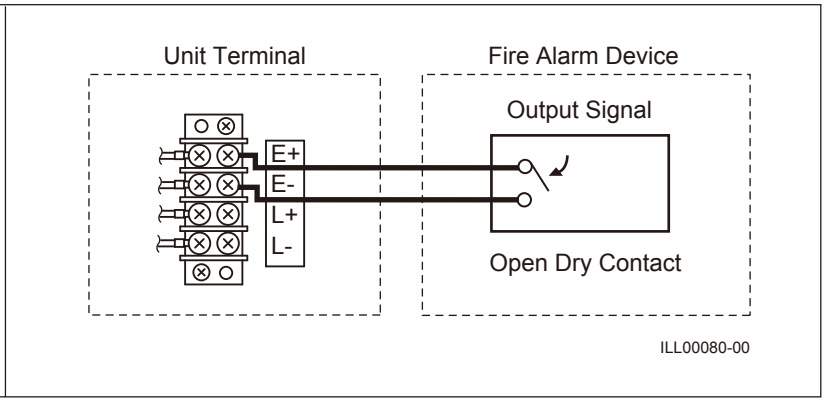
1) Remove service panel from the rear of the unit.

2) Squeeze the inner latches and push out the black cap from inside the panel. (See drawing of Cap and inner latch shapes.)

3) Insert the fire alarm signal wire through the hole in the rear panel.
Use recommended warning signal wire size from 16 AWG to 26 AWG for a solid wire, or 16 AWG to 22 AWG for a stranded wire with ring terminal for #6 stud size.

4) Connect warning device to terminal E+ and E- according to its polarities.





8. OPERATION

8.1 Automatic Restart after Power Interruption (Automatic Recovery Function)

- The program within the microprocessor of this unit contains a feature that automatically restarts the unit after power is lost and then regained. The unit also has memory in order to return itself back to the operating mode (either manual or preset program) it was in prior to the loss of power. All preset programs are retained in the memory in the event power loss occurs.

8.2 Temperature Scale Display Switch

- When the DIP switch is set in the DOWN or "°C" position, the set point and room temperature are displayed in degrees Celsius. "°C" is indicated on the LCD. When the DIP switch is set in the UP or "°F" position, the set point and room temperature are displayed in degrees Fahrenheit . "°F" is indicated on the LCD. (This is the factory default setting.)

8.3 Temperature Control

- The compressor operation cool mode is controlled by the microprocessor which receives input signals from the room temperature thermistor (evaporator inlet air) and the setting of the temperature set point. The temperature set point (desired room temperature) can be adjusted by pressing the △/▽ buttons on the control panel. The adjustment range of the temperature set point is 65 °F to 90 °F (18 °C to 32 °C).

8.4 Compressor Protection

- There is a time delay program within the microprocessor. This prevents a heavy load from being applied on the compressor motor when restarting the unit cool mode after a very short period of time. This delay is in effect any time when the compressor is turned on by either the COOL ON/OFF button, temperature set point (thermostatic control), power interruption restart or condensate pump (optional) operation.

Specifications:

Time delay

- 120 ± 20 sec

8.5 Fan Mode Control Switch

- The fan motor operation is controlled by relays on the relay board through a microprocessor in the control panel assembly. The fan program in the microprocessor can be changed by a DIP switch on the left side of the relay board located in the control box.
- There are two settings:

(1) Cool to stop

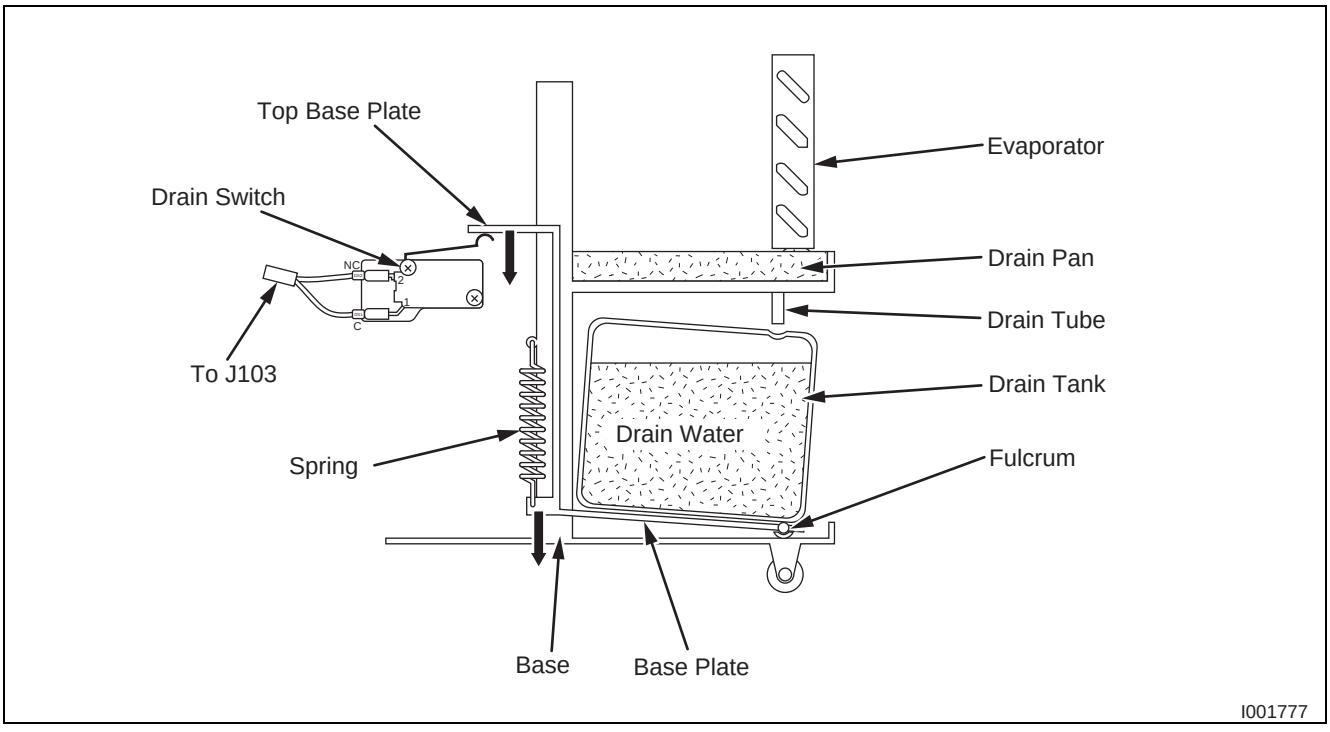
- When the DIP switch is set in the downward or STOP position, the microprocessor controls the fan motor using the same room temperature thermistor that it uses to control the compressor. In this case, both the fan and the compressor stop when the microprocessor receives a sufficiently low intake air (room temperature) signal from the thermistor (equal to or less than the set point). When the temperature increases (exceeds the set point) the microprocessor restarts the fan and compressor automatically. However, if the unit has been off for less than 120 seconds, the fan starts before the compressor (time delay feature).

(2) Cool to operate

- When the DIP switch is set to the upward or OPERATE position, the microprocessor controls the fan operation using control panel inputs only. The fan operates continuously during fan only and cool modes. (This is the factory default setting.)

8.6 Drain Switch

- This unit is equipped with a drain tank switch. When the drain tank accumulates approximately 4.0 gal (15 L) of condensate (water) in the drain tank, the drain tank switch sends a signal to the microprocessor. The microprocessor stops all operation of the unit, flashes the “TANK FULL” LED, indicates “TANK FL” on the LCD and closes the contact of output signal.
- This system utilizes a 0.1 A, 125/250 VAC micro-switch for this function. When drain water accumulates approximately 4.0 gal (15 L) in the drain tank, the drain tank base plate, which is supported at its fulcrum, is pushed down in the arrow direction as shown in the figure below.
- When the drain tank base plate is forced down, the top of the drain tank base plate turns off the contacts #1-#2 of the micro switch. This causes the ground signal at the J103 connector of the control panel assembly to go open. When the microprocessor detects this event, it shuts the unit off, flashes the “TANK FULL” LED, indicates “TANK FL” on the LCD and closes the contact of output signal.
- When the drain tank is removed (or the drain tank is emptied), the top of the drain tank base plate returns to its original position from the tension of the coil spring. Then contacts #1-#2 of the drain tank switch close. This provides a ground to the microprocessor through the J103 connector.



(1) How to re-start the unit

- If the LCD indicates “PROGRAM ON”, press the COOL ON/OFF button to continue running the program. If the LCD indicates “PROGRAM ON” continuously (program activated), no further steps are necessary. If no program exists or the program was deactivated, press the FAN MODE button or the COOL ON/OFF button. The unit returns to the previous temperature set point.

8.7 Condensate Pump Kit (optional)

- This unit comes standard with a drain tank, which collect the water that forms on the evaporator during normal cooling operation. If the unit is required to operate continuously without periodic emptying of this tank, a condensate pump may be needed. A condensate pump kit is available for this unit.

9. TROUBLESHOOTING

9.1 Troubleshooting

- Before troubleshooting the system, the following inspection should be performed.

⚠ WARNING

- **Disconnect power prior to servicing the relay board.**
- **Failure to follow this warning may lead to electrical shock.**

(1) Inspection of power source voltage

- Check the voltage of the power source.
  - Single phase 115 V (60 Hz)
- Check the operation and condition of the fuse or circuit breaker in the power source.

(2) Inspection of air filter

- Remove the air filter and check the element. If the element is dirty, wash it as described in the OPERATION MANUAL supplied with the unit.

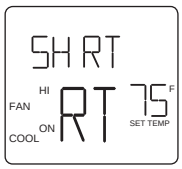
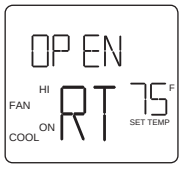
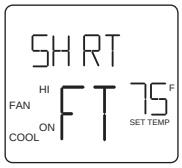
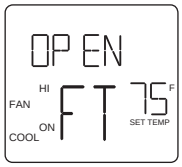
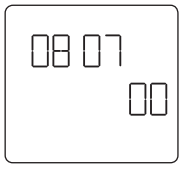
(3) Inspection of drain tank

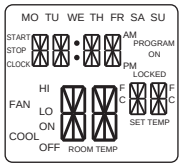
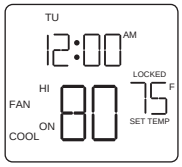
- Make sure tank is fully drained.

The following pages (page 40 to 47) are self-diagnostic codes and troubleshooting information.

9.2 Self-Diagnostic Codes

- Self-diagnostic codes are displayed on the control board under the following conditions. Refer to the troubleshooting chart on page 44 to 46 for the remedies.

LCD Display	Description	Condition
	Drain tank is full	When the drain tank is filled with drain water. ("TANK FL" LED flashes and signal output (J106) turns on.)
	Condensate pump problem	When the (optional) condensate pump stops pumping water due to any kink and/or blockage in the drain line or due to improper routing of the drain line, the compressor shuts off, and LCD indicates "AS". (J8 input of relay board turns to open and signal output (J106) turns on.)
 	Defect (short or open) of room thermistor	When room thermistor (connecting to J101) becomes short or open. (Signal output (J106) turns on.)
 	Defect (short or open) of freeze protection thermistor	When freeze protection thermistor (connecting to J102) becomes short or open. (Signal output (J106) turns on.)
	Show running hours of compressor	Press ON/OFF and ▽ buttons simultaneously for 3 seconds, total operation hours of compressor is indicated by 6-digit (hours). Example in left: 807 hours After 5 seconds, display goes back to normal operation mode.

LCD Display	Description	Condition
	Show LCD and LED all on mode	Press HI/LO and △ buttons simultaneously for 3 seconds to check LCD segments and LED display. After 5 seconds, display goes back to normal operation mode.
	Key lock mode (LCD displays “LOCKED”.)	Press ENTER and SET CLOCK buttons simultaneously for 5 seconds to lock all buttons on the controller panel (except keypad lock and unlock operations). To unlock, press and hold ENTER and SET CLOCK buttons simultaneously for 5 seconds again.
	Indication of model name	Press UP and DOWN buttons simultaneously for 5 seconds to display a model name. After 5 seconds, display goes back to normal operation mode.
	Detection of unit stop signal from fire alarm system	Signal is input from the fire alarm. (Unit stops, output signal (J106) turns on and buzzer sounds.)
	Indication of service code	Press ON/OFF and △ buttons simultaneously for 3 seconds. Indication contents is as follows. LCD / Description / Value DF / Defrost status / ⟍ FZ / Evap. out pipe temperature / 26⇔109F (“26”⇔“X9”) OD / Outdoor temperature / 0 (“00”) To exit service code, press ON/OFF button.
 	Activation of high pressure switch	When high pressure switch (connected to J104) is activated (=J104 input turns to open) for the first 2 times in 24 hours, LCD indicates “HP” but goes away as the high pressure switch resets. If the high pressure switch is activated 3 times in 24 hours, LCD indicates blinking “HP” and signal output (J106) turns on. When the high pressure switch is activated 10 times in 24 hours, LCD indicates “FAIL HP” and signal output (J106) turns on, then buzzer sounds.

9.3 Troubleshooting Chart

- To accurately troubleshoot the problem, it is important to carefully confirm the nature of the problem. Common problems are:
  - Insufficient cooling.
  - Unit does not operate.
  - Overflow of drain water.
  - Abnormal noise or vibrations.
  - Others.

(1) Insufficient cooling

- Cooling system problem generally results from electrical or mechanical components such as fan motor, compressor, control switch.

< NOTE >

- There is a possibility of insufficient cooling due to clogging of the air filter. So make sure to first check if the air filter is clogged or not.
- Check the power supply because of the possibility of power source failure.
- Check the water line to make sure the water source is supplying enough water flow and the entering water temperature is not exceeding 90 °F (32 °C).
- Check the installation site for operating temperature and installation space (unobstructed airflow).

Condition		Check Area	Possible Cause	Remedy
Insufficient Cooling				
Air volume normal	Compressor operates.	1. Usage conditions (high temperature).	Operation near usage limits.	Review the installation place.
		2. Dirt in evaporator.	Insufficient heat exchange.	Clean fins.
		3. Frost in refrigeration cycle.	Clogging at the frost section.	Replace clogged section.
		4. No temperature difference between evaporator and condenser.	Insufficient refrigerant.	Check the leaking part, then repair and charge refrigerant.
		5. Water system (water line, condenser, water regulating valve)	Water system is clogged with accumulated sediment.	Clean the water system to remove accumulated sediment. (See page 52 and 53.)
		6. Water source.	Insufficient water flow.	Adjust flow of the supplied water source. (See page 52.)
	Compressor does not operate.	1. Compressor coil resistance. (0 ohm or ∞ ohm)	Short or open circuit.	Replace compressor. (In case of short, check the compressor relay.)
		2. Compressor relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
		3. Capacitor for compressor motor.	Capacitor malfunction.	Replace capacitor.
		4. Voltage.	Low voltage.	Repair power.
Insufficient air volume	No air.	1. Coil resistance of fan motor. (0 ohm or ∞ ohm)	Short or open circuit.	Replace fan motor.
		2. Fan on-off relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
		3. Fan HI/LO change relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
	Insufficient air volume.	1. Air filter.	Clogged air filter.	Clean air filter.
		2. Evaporator.	Clogged evaporator or crushed fins.	Repair and clean fins or replace it.
		3. Duct connection state.	Improper connection.	Repair duct connection.
		4. Fan motor.	Insufficient rotation.	Replace motor.

(2) Unit does not operate

< NOTE >

- In this case, there is a possibility of safety device activating due to the clogged air filter. So make sure to first clean the air filter and then start up again to confirm if the problem lies with the air filter.
- Check the installation site for operating temperature and installation space (unobstructed airflow).
- If cooling water is not supplied to the unit, a safety device is activated. Check the water flow to confirm if the problem lies with the water flow.

Condition		Check Area	Possible Cause	Remedy
Unit does not operate.				
Unit does not operate.	Control Panel display turns off.	1. Voltage.	Power failure.	Repair power.
		2. Ground fault breaker trip.	Ground fault or defective ground fault breaker.	Repair ground fault section.
				Reset or repair breaker.
		3. LCDI power cord trip.	Leakage current detected.	Reset power cord.
				Replace power cord.
		4. Fuse.	Fuse blown.	Repair shorting section. Replace fuse on the relay board.
Control panel display turns on	Control Panel display shows error codes.	1. Display code “FL”.	Drain tank (optional) is filled with the drain water.	Discharge the drain water. RESET the controller*1.
			Loose drain switch connection.	Reconnect the drain switch and check the connection. RESET the controller*1.
			Defective drain switch.	Replace drain switch. RESET the controller*1.
		2. Display code “AS”.	Optional condensate pump stops pumping water due to any kinks and/or blockage in the drain line or due to improper routing of the drain line.	Remove any blockage or kinks from the drain line or improve hose installation. RESET the controller*1.
			Defective condensate pump.	Replace the condensate pump. RESET the controller*1.
			Missing jumper connector.	Insert the jumper connector and check the connection. RESET the controller*1.

*1 : To RESET the controller, press ON/OFF and HI/LO buttons simultaneously for 5 seconds.

Condition		Check Area	Possible Cause	Remedy
Unit does not operate.				
Control panel display turns on	Control Panel display shows error codes.	3. Display code “RT”.	Loose room thermistor connection.	Reconnect the room thermistor and check the connection. RESET the controller*1.
			Defective room thermistor (short or open).	Replace room thermistor.
		4. Display code “FT”.	Loose freeze protection thermistor connection.	Reconnect the freeze protection thermistor and check the connection. RESET the controller*1.
			Defective freeze protection thermistor (short or open).	Replace freeze protection thermistor.
		5. Display code “HP” and “FAIL HP”.	Operating outside of the operating temperature range.	Check environmental condition. Do not use the unit outside the operating condition range. (See page 9.) RESET the controller*1.
			Insufficient water flow.	Connect water inlet of the unit and water supply line correctly. RESET the controller*1.
				Adjust flow of the supplied water source. (See page 52). RESET the controller*1.
				Clean water system to remove accumulated sediment. (See page 52 and 53.) RESET the controller*1.
			Loose high-pressure switch connection.	Reconnect the high-pressure switch and check the connection.
			Defective high-pressure switch (short or open).	Replace high-pressure switch.
			Refrigerant is over charged.	Charge correct amount of refrigerant. (See page 74.) RESET the controller*1.

*1 : To RESET the controller, press ON/OFF and HI/LO buttons simultaneously for 5 seconds.

Condition		Check Area	Possible Cause	Remedy
Unit does not operate.				
Control panel display turns on	Control Panel display shows error codes.	6. Display code “ALRM”.	Signal is input from the fire alarm.	Check the fire alarm system and confirm there is no signal input to the unit, then RESET the controller*1.
		7. Display code “FZ”.	See “Stops after running for a while” of Troubleshooting on page 46.	
Unit stops immediately after starting.	Control panel display normally.	1. Fan on-off relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
		2. Fan HI/LO change relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
		3. Fan motor insulation resistance.	Insulation failure on fan motor.	Replace fan motor.
		4. Compressor relay on the relay board.	Open circuit or insufficient contact.	Replace relay board.
		5. Compressor insulation resistance.	Insulation failure on compressor.	Replace compressor.
Unit stops after running for a while.	Control panel display normally.	1. Temperature of fan motor (abnormally high).	Operation of safety device (IOLF) due to fan motor malfunction.	Replace fan motor.
		2. Temperature of compressor (abnormally high).	Operation of safety device (IOLC) due to compressor malfunction.	Replace compressor.
		3. Refrigerant leakage.	Insufficient refrigerant or gas leakage.	Repair and charge refrigerant.
		4. Dirt on evaporator.	Insufficient cooling of evaporator.	Clean evaporator.
		5. Duct connection state.	Improper connection.	Repair duct connection.

*1 : To RESET the controller, press ON/OFF and HI/LO buttons simultaneously for 5 seconds.

(3) Overflow of water from the unit

Condition	Check Area	Possible Cause	Remedy
Overflow from the unit.	1. Drain pan.	Cracks in drain pan.	Check and replace.
	2. Water level in drain pan.	Clogged drain hose.	Check and repair.
	3. Drain hole.	Reversed air flow from drain hole.	Insert a trap on discharge drain hose.
	4. Clogged air filter.	Reversed air flow from drain hole due to the excessive negative pressure inside of the unit.	Clean air filter.
	5. Water system.	Water leak from soldering connection, NPT or Flare connection.	Check and repair.
	6. Water regulating valve.	Cracks in the sealed parts in the valve.	Replace the valve.

(4) Abnormal noise or vibration

- To prevent abnormal noise or vibration, carefully determine the source of the problem and come up with proper countermeasures to solve the problem so that it does not occur again.

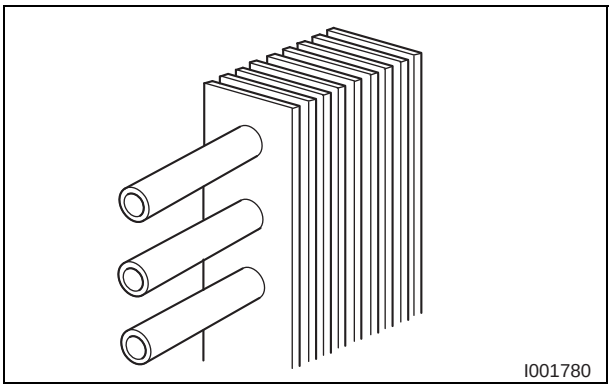
Condition	Check Area	Possible Cause	Remedy
Abnormal noise or vibration.	1. Fan.	Fan interference.	Repair interfering section.
		Fan deformation.	Replace fan.
	2. Compressor fixing nuts.	Loose nuts.	Tighten nuts further.
	3. Piping.	Pipe interference.	Repair interfering section.
	4. Panel fixing screws.	Loose screws.	Tighten screws further.

9.4 Basic Inspection

- Perform the following inspection before disassembly.

(1) Inspection of plate fins

- To inspect the plate fins of the evaporator, open the front panel door, and inspect the plate fins for any dirt, dust, lint, or debris that may have caused insufficient cooling performance of the unit. If cleaning of the fins is necessary, it is recommended that this service be performed by a qualified service technician.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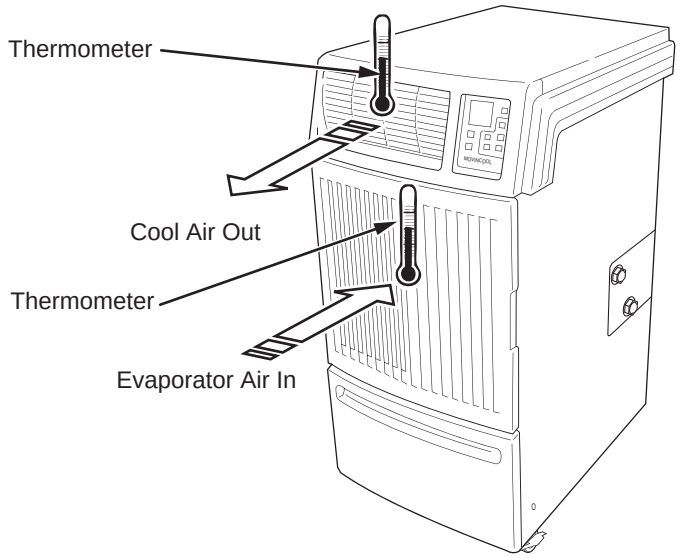
(2) Examination of operating environment

- Operating environments can vary depending on location, climate and surrounding conditions. Installation location also can cause operational problems. Consult your reseller concerning operational environment requirements.

(3) Inspection of cooling capacity performance

- Measure the difference in temperature between the inlet of the evaporator and the cool air vent. If the difference is out of the range given in the graphs on page 14, proceed with the remedy suggested in the troubleshooting chart on page 42 to 46.



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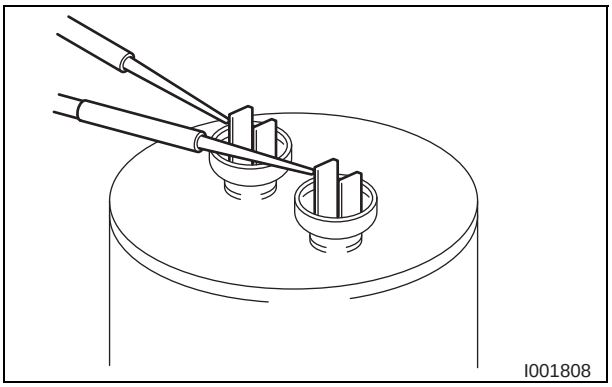
9.5 Inspection of Capacitor (for Fan Motor and Compressor)

(1) Ohmmeter method

- Set the ohm-meter to the 10M range. Place the two probes against the two terminals of the capacitor. At first, the ohm-meter should indicate small value, then the reading should gradually increase towards infinity. This indicates that the capacitor is charging. If the reading indicates infinity right away (open) or the ohm-meter fails to move from 0. (shorted), replace the capacitor.



(2) Capacitance tester method

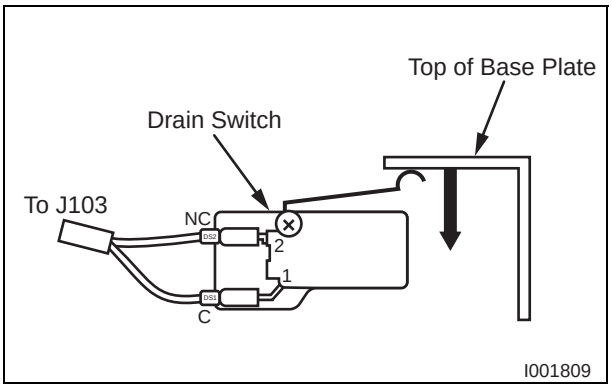
- Using a capacitance tester and the chart on page 29, test the capacitor for the value indicated. If the value tested is not within 10 % of indicated capacitance, replace the capacitor.

⚠ WARNING

- **Properly discharge the capacitor(s) before testing and after testing has been completed.**
- **Failure to do so could cause damage to test equipment or the unit and/or result in personal injury (electrical shock) or death.**

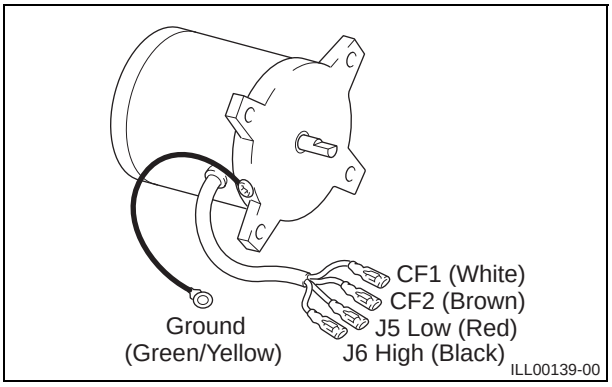
9.6 Inspection of Drain Switch

- Check for continuity between terminals 1 and 2 when drain switch is pressed. With drain switch depressed, there is no continuity between terminals 1 and 2. Replace drain switch if continuity does not satisfy the above condition.



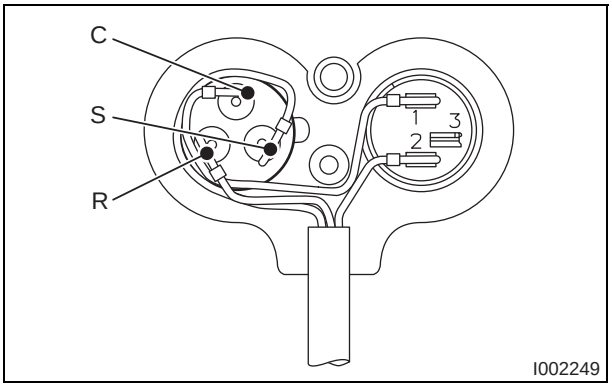
9.7 Inspection of Fan Motor

- Measure resistance across the terminals of the fan motor. (All terminals must be disconnected from the unit.)
- Between terminals (at 77 °F (25 °C))
  - J6-CF1 Approx. 10.6 ohm
  - J6-CF2 Approx. 50.2 ohm
  - J5-J6 Approx. 2.3 ohm
- If the measured resistance is not equal to these standard values, replace the fan motor.



9.8 Inspection of Compressor Motor

- Measure resistance across the terminals of the compressor motor. (All terminals must be disconnected from the unit.)
- Between terminals (at 77 °F (25 °C))
  - R-C Approx. 0.6 ohm
  - C-S Approx. 1.6 ohm
  - S-R Approx. 2.1 ohm
- If the measured resistance is not equal to these standard values, replace the compressor. The overload relay is internal to the compressor.



9.9 Inspection of Thermistor

- Using an Ohm-meter, check the resistance value across the 2-pin connector. At normal temperature (77 °F (25 °C)) either thermistor (room or freeze) should measure approximately 10 k ohm.

9.10 Inspection of Wiring Connection

- Refer to the Wiring Diagrams on page 27 and check for connection of each wire.

9.11 Inspection of Refrigeration System

- In most cases, the probable cause for insufficient cooling is a clog in the system, a leakage or an incorrect amount of refrigerant. In such cases, inspect the system according to the following procedure.

(1) Clogged refrigeration system

- Check the component parts of the refrigeration system, including piping, that could be clogged with refrigerant. If clogged with refrigerant, only the clogged part is partially frosted. If this occurs, change the part in question.

(2) Refrigerant leak

- Carefully check all connections, and each component for leaks whenever the refrigeration system is installed or repaired. Use an electronic gas leak tester to inspect the system.

(3) Insufficient refrigerant

- When the unit is not producing sufficient cooling, follow the troubleshooting chart on page 43 to confirm the cause of the problem. Then, charge the system with the refrigerant to the specified amount as indicated on page 74.

9.12 Inspection of Water System

- In most cases, the cause for insufficient cooling is a clog in the system, a leakage, or an incorrect amount of water in the system. In such cases, inspect the system according to the following procedure.

(1) Insufficient Water flow

Sufficient water flow is required while the unit is operating. Insufficient water flow can activate the high pressure switch causing the unit to stop. The recommended supplied water source should have a minimum flow rate of 4.8 gal/min (18 L/min) at 7psi (50 kPa) or higher.

- Insufficient water flow can be estimated by measuring the leaving water temperature (LWT). During normal operation, the LWT should be less than or equal to 104 °F (40 °C).
- The unit's maximum LWT is 120 °F (49 °C). If the LWT is higher than the maximum value, adjust the supplied water source to meet the recommended minimum flow rate or higher.

(2) Clogged water system

- In case a self-diagnostic code "HP" is displayed, there are two possible causes.
  - Condensing capacity is reduced by accumulated sediment.
  - Water line is clogged with accumulated sediment.
- Clean inside of the water system to remove accumulated sediment. For details, see below.

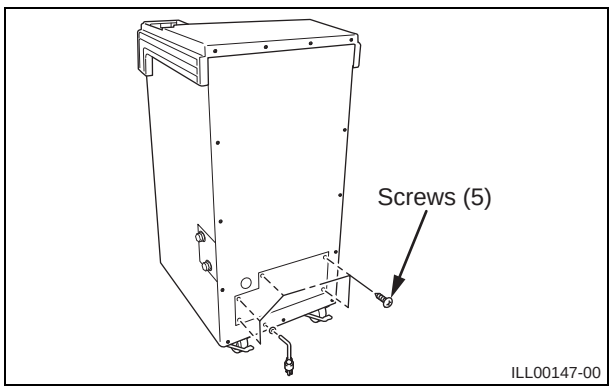
(3) Cleaning inside of the water system

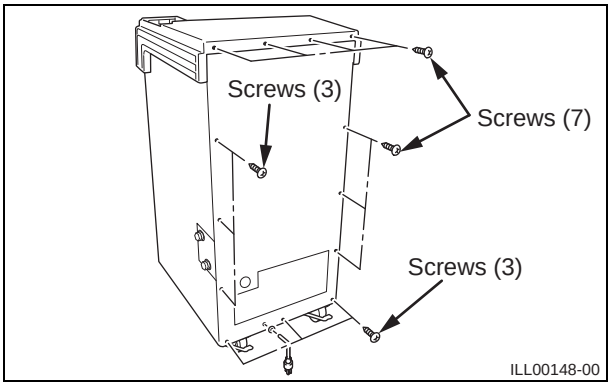
The water regulating valve in the water system can be manually flushed to clear any sediment accumulated inside of the water system.

1) Stop the unit and unplug the power cord. Then shut off the water supply and disconnect the water pipes or hoses.

2) Connect tap water to the water inlet of the unit. Connect water outlet of the unit to drain.

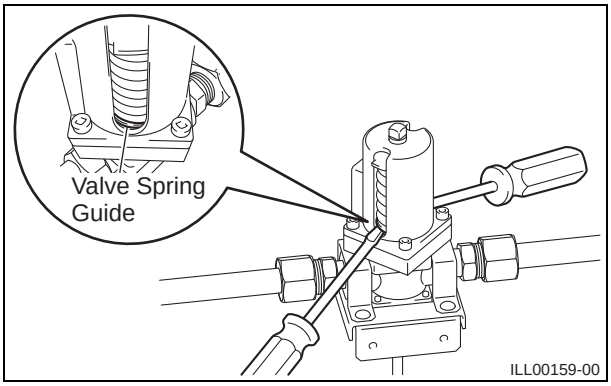
3) Remove five (5) screws from the service panel on the rear side of the unit.





4) Remove thirteen (13) screws from the rear panel.

5) Open the faucet handle to supply water.



6) Insert screwdrivers under both sides of the valve spring guide of the water regulating valve and lift upwards to flush. This manual flushing does not affect valve adjustment.

⚠ CAUTION

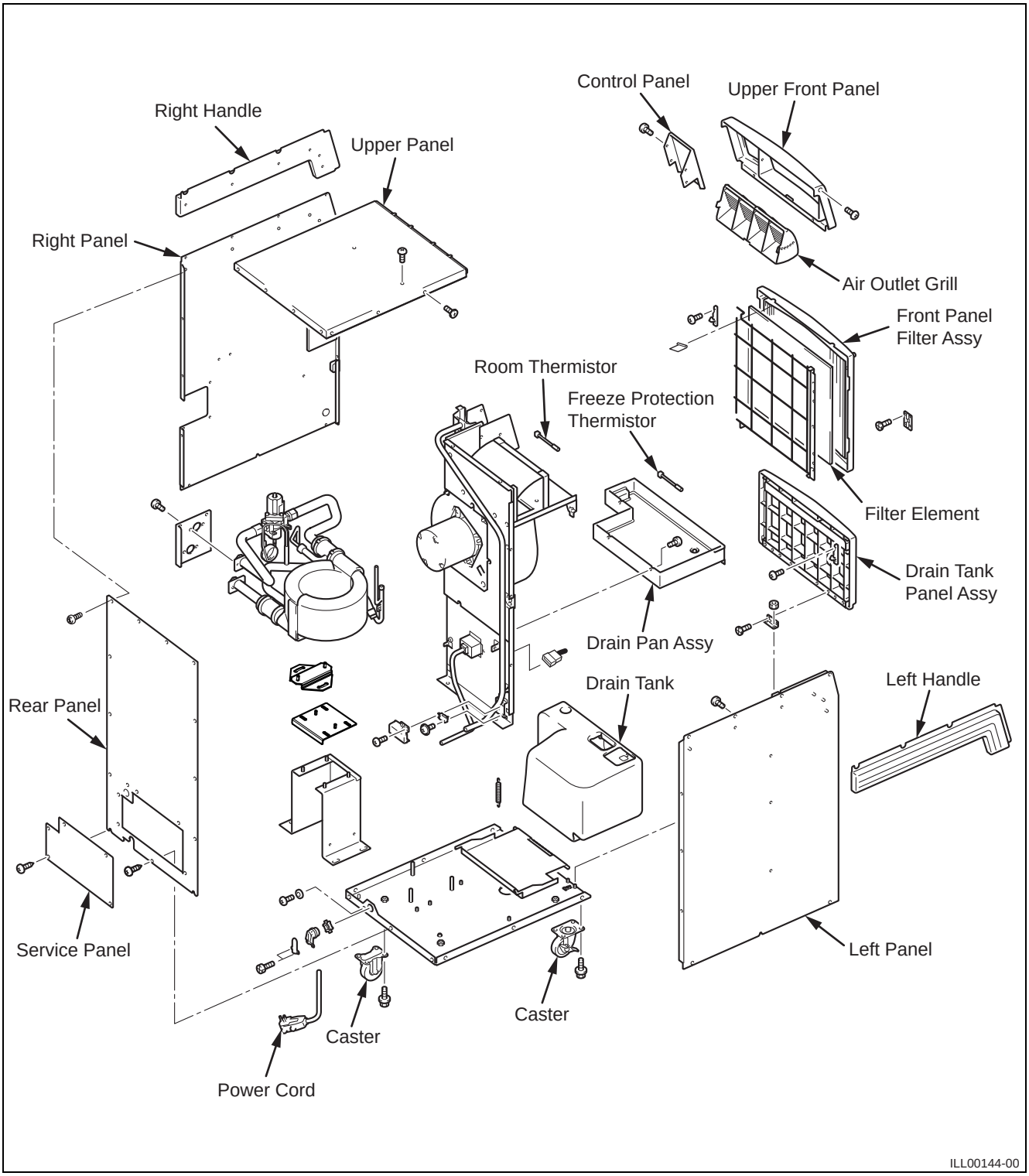
- Do not move the adjusting bolt.
- Take caution to prevent any corrosion inside the copper tube if cleanser is used to clean the water line.

7) Keep flushing the water inside the water line through the drain until the water is clear.

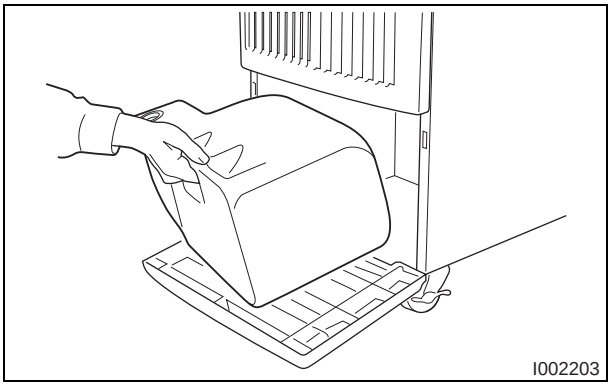
8) Disconnect tap water from the water inlet and outlet of the unit.

10. DISASSEMBLY

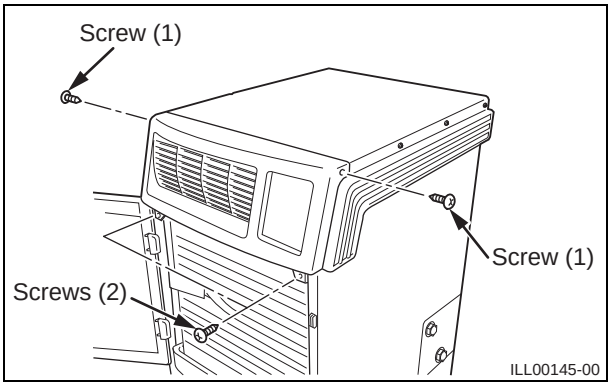
10.1 Parts Construction



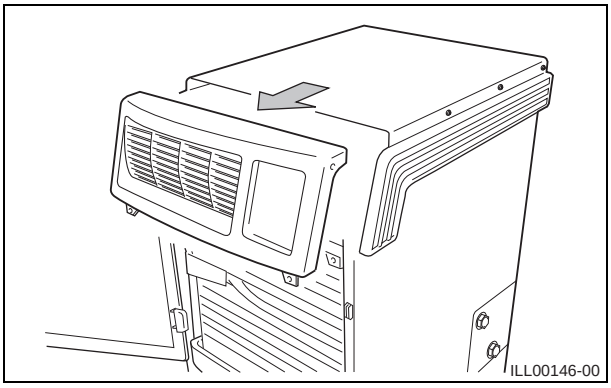
10.2 Disassembly



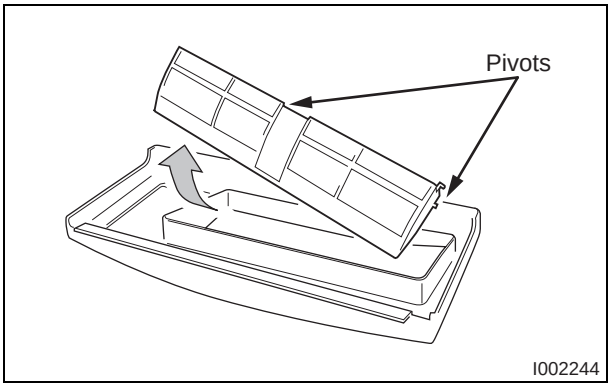
1) Remove drain tank.



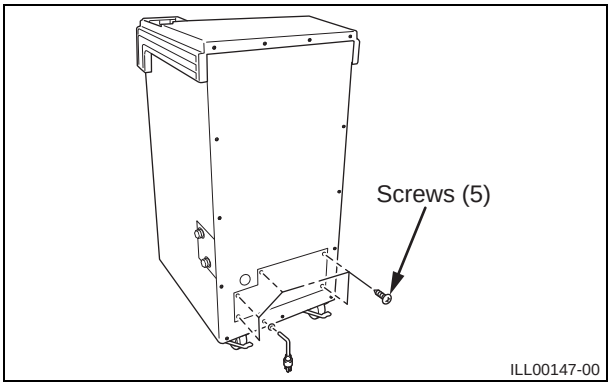
2) Remove four (4) screws from upper front panel.



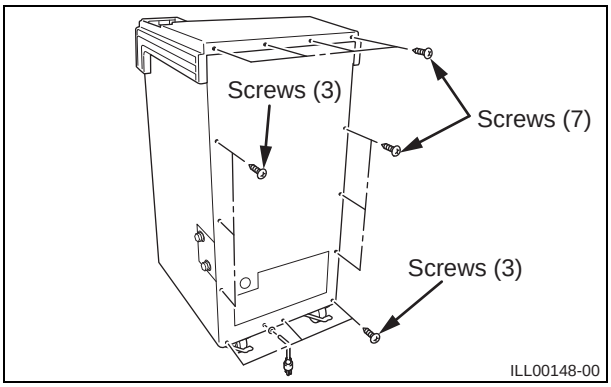
3) Slide upper front panel forward and remove.



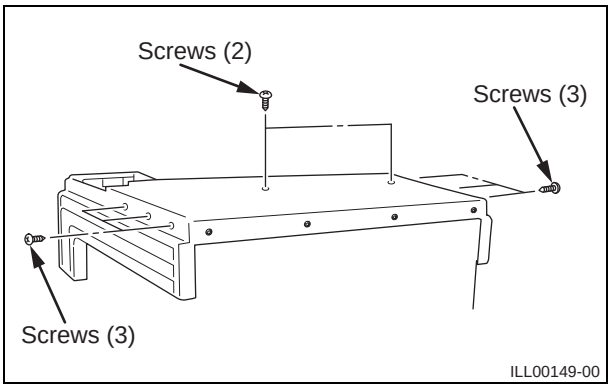
4) Louver can be removed from upper front panel by unsnapping the lock tap and removing the louver from its pivots.



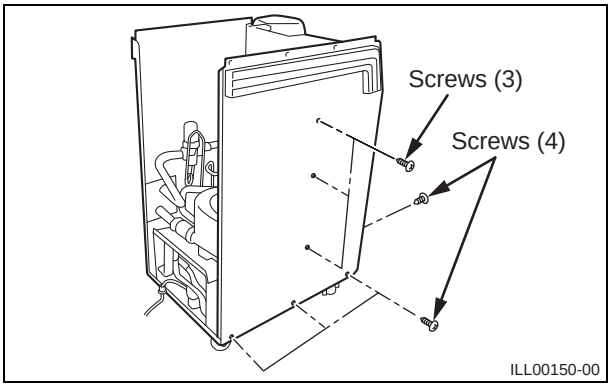
5) Remove five (5) screws from service panel.



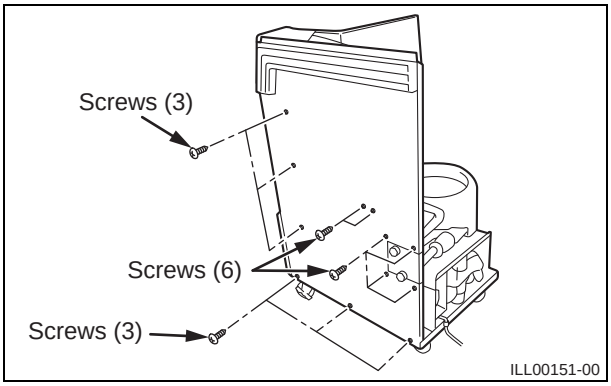
6) Remove thirteen (13) screws from rear panel.



7) Remove eight (8) screws from upper panel.

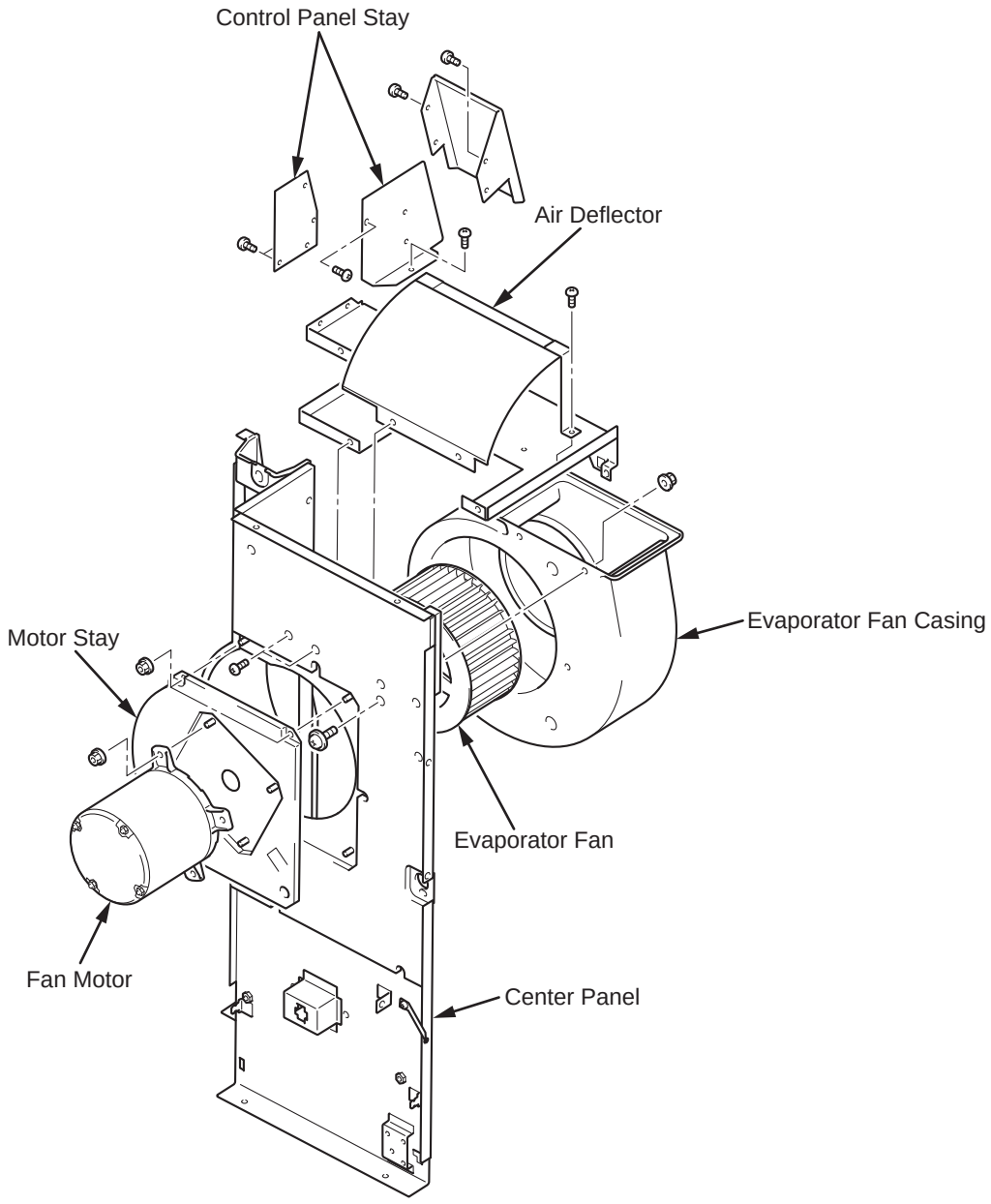


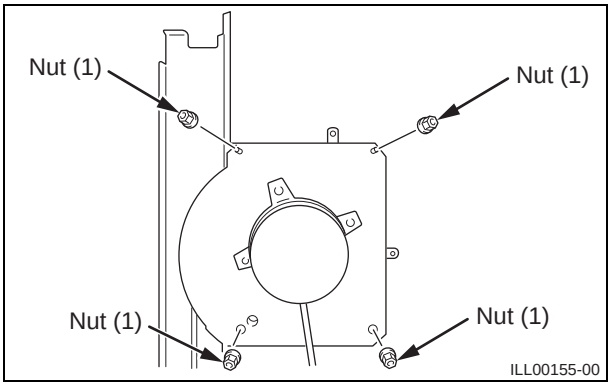
8) Remove seven (7) screws from left panel.



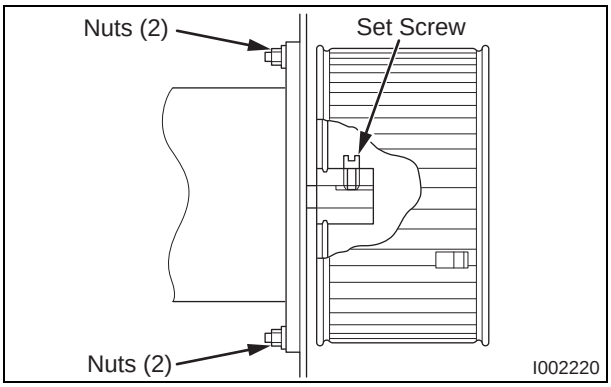
9) Remove twelve (12) screws from right panel.

10.3 Removal of Evaporator Fan Assembly





1) Remove four (4) nuts as shown. Then remove the motor stay together with the fan motor.



2) Loosen the set screw using a hex key. Then remove the fan motor by loosening four (4) nuts.

10.4 Removal of Electrical Components

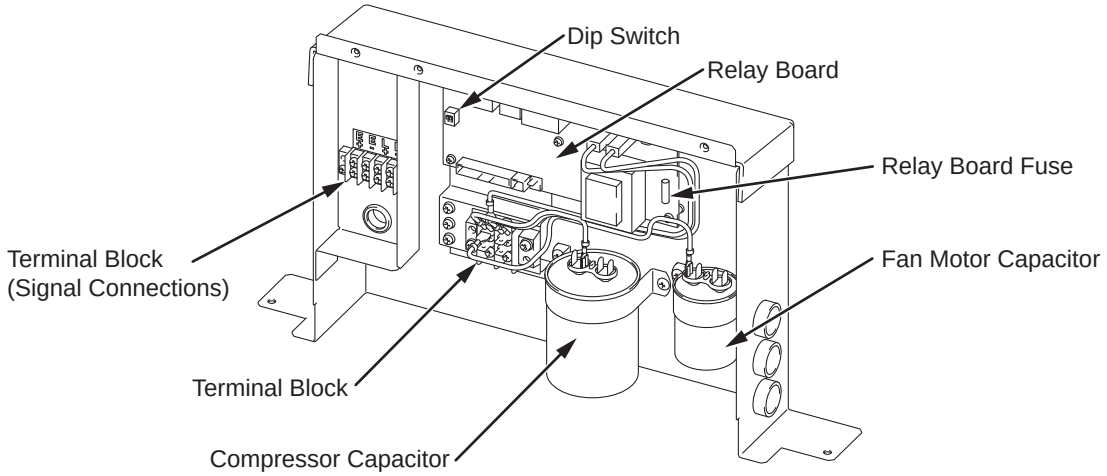
⚠ WARNING

- **Disconnect power prior to servicing the relay board.**
- **Failure to follow this warning may lead to electrical shock.**

(1) Control box

1) Remove five (5) screws from service panel. (See page 56.)
2) Remove electrical parts.
   - Terminal block: Remove two (2) screws from control box.
   - Terminal block (signal connection): Remove two (2) screws from control box.
   - Capacitor: Remove two (2) screws from control box.

<Control Box>



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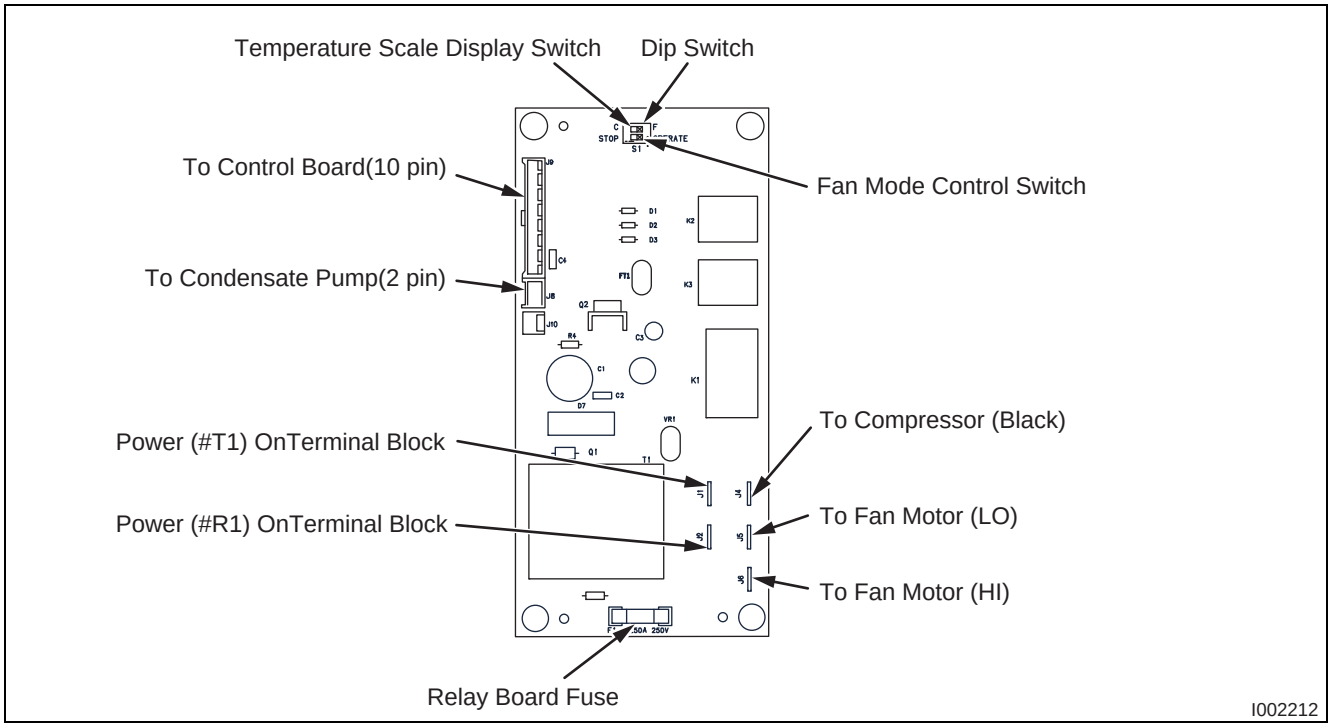
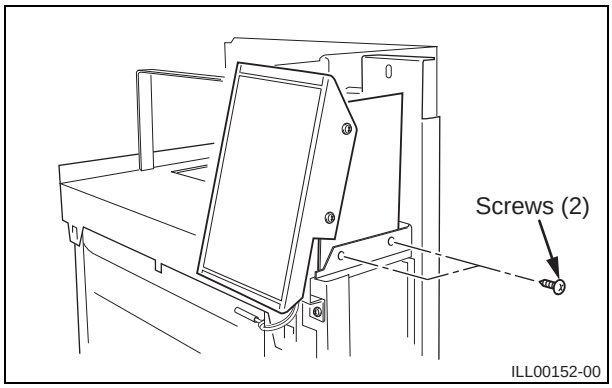
(2) Relay board

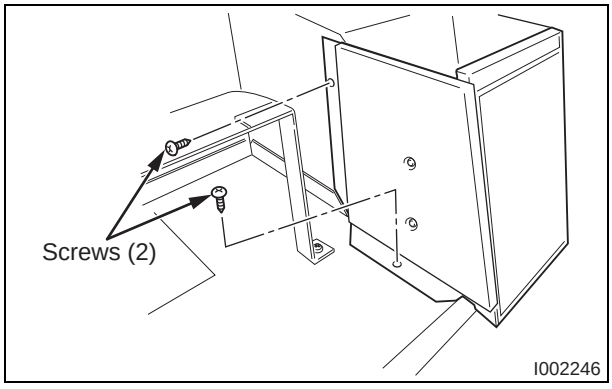
1) Remove five (5) screws from service panel. (See page 56.)
2) Disconnect seven (7) connectors, and remove five (5) screws from relay board.



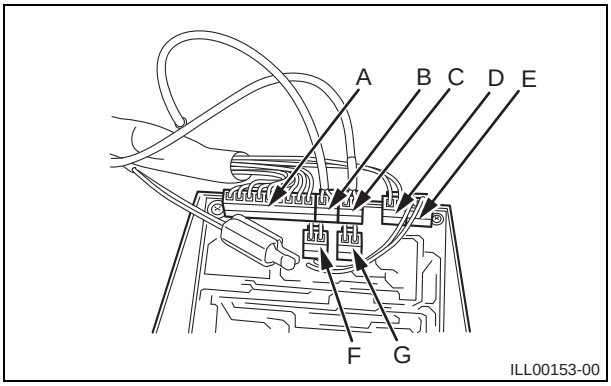
(3) Control board



1) Remove two (2) screws from control panel stay.



2) Remove two (2) screws from the control panel stay.



3) Disconnect the following connectors from the control board:

(A) J201 (10-pin) Wire Harness, Relay Board to Control

(B) J101 (2-pin) Room Temperature Thermistor

(C) J102 (2-pin with black tape) Freeze Protection Thermistor

(D) J103 (2-pin) Drain Tank Switch

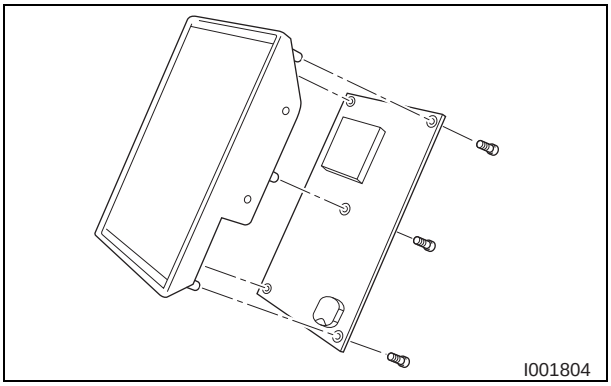
(E) J104 (2-pin) High Pressure Switch

(F) J106 (2-pin) Output signal terminal

(G) J108 (2-pin) Input signal terminal

< NOTE >

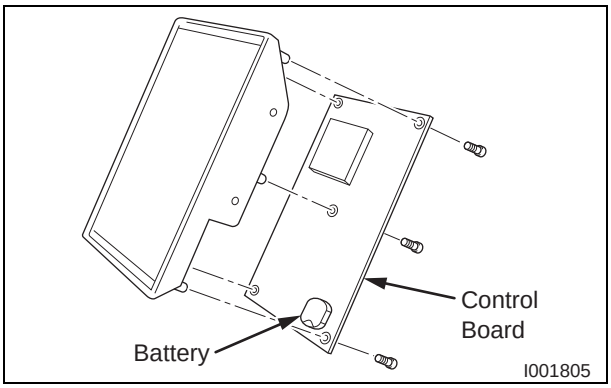
Mark each of the 2-pin connectors with a different color marker to ensure the correct orientation when they are reconnected or label all wire sets with tape. Numbering the wire sets from (A) through (G).



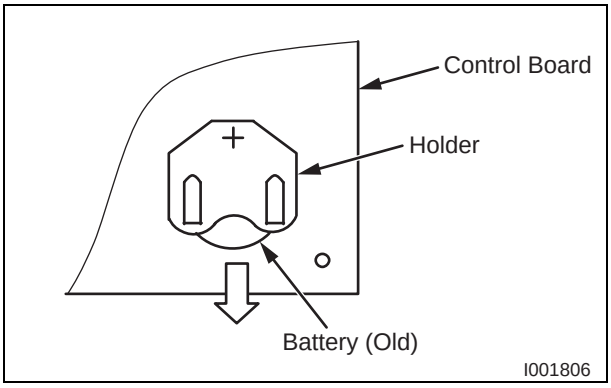
4) Remove the five (5) screws from the control board on the control panel assembly. Remove the control board.

(4) Battery replacement of control board

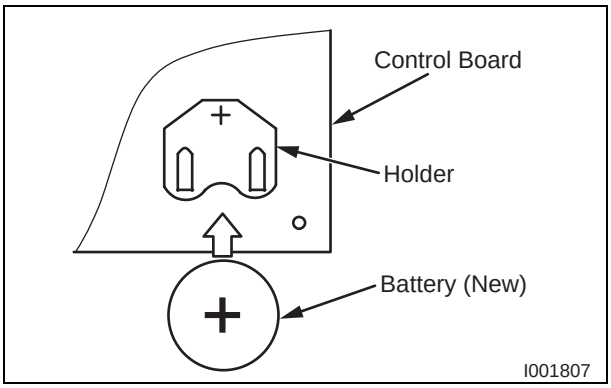
- When the power is disconnected from the unit, and control board is automatically resetting clock and program, it is time to change the battery on the control board to avoid resetting of clock and program.



1) Disassemble control board. (See page 61 and 62.)



2) See diagram for battery removal.



3) Insert new battery securely in the direction shown in the drawing.

Specifications:

- Type: 3 V CR2450 or equivalent

⚠ CAUTION

When inserting the battery, make sure the direction of polarity (plus/minus) is correct (as shown).

11. REFRIGERANT AND WATER SYSTEM REPAIR

11.1 Repair of Refrigerant and Water System

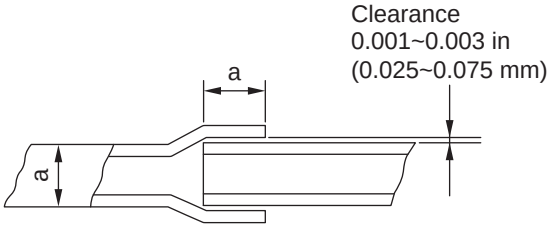
- In case there is a leak, obstruction, or problem in the refrigerant and water system of this unit, replace or repair the part in question. After replacing any component, all connections must be brazed except the flare connections of the water regulating valve.

(1) Proper brazing techniques

- It is desirable to use a slightly reduced flame. Oxyacetylene is commonly used since it is easy to judge and adjust the condition of the flame. Unlike gas welding, a secondary flame is used for brazing. It is necessary to preheat the base metal properly depending on the shape, size or thermal conductivity of the brazed fitting.
- The most important point in flame brazing is to bring the whole brazed fitting to a proper brazing temperature. Care should be taken to not cause overflow of brazing filler metal, oxidization of brazing filler metal, or deterioration due to the overheating of flux.

(2) Brazed fittings and fitting clearance

- In general, the strength of brazing filler metal is lower than that of the base metal. So, the shape and clearance of the brazed fitting are quite important. As for the shape of the brazed fitting, it is necessary to maximize its adhesive area. The clearance of the brazed fitting must be minimized to facilitate brazing filler metal to flow into it by capillary action.



Clearance From The Pipe Fitting and Tubing.

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(3) Cleaning brazing filler metal and pipe

- When the refrigeration system has been opened up, exposure to heat may have caused brazing filler metal to stick to the inside and outside of the pipe. Brazing filler metal may also be compounded with oxygen in the air to form oxide film. Fats and oils may stick to the pipe from handling. All these factors can reduce effectiveness of brazing. It is necessary to eliminate excess brazing filler metal using sand paper and by cleaning thoroughly with a solvent such as trichlene.

⚠ CAUTION

Do not use chlorine cleaner.

(4) Use of dry nitrogen gas

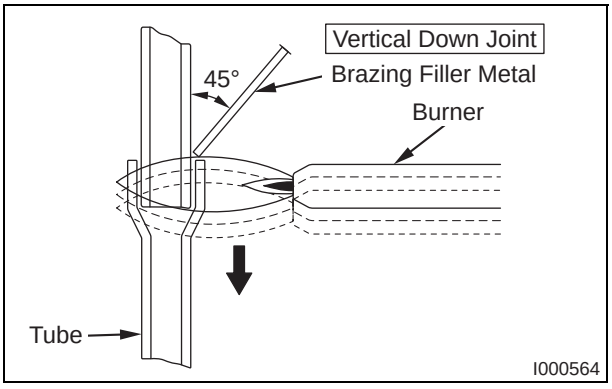
- During brazing, the inside of the pipe undergoes an oxidative reaction due to the brazing flame. Introduce dry nitrogen gas (0.27 gal/min (1 L/min); adjust with the flow regulator) through the pinch-off tube of the refrigerant.

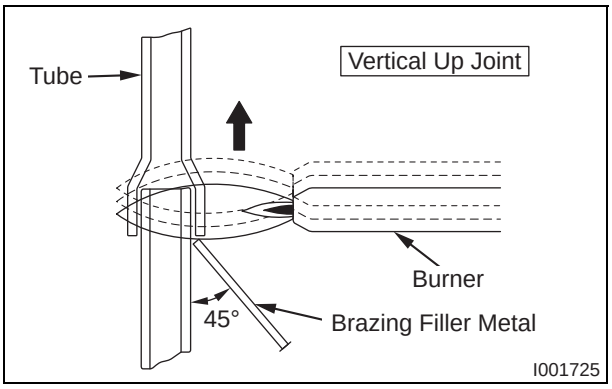
< NOTE >

Take care not to allow dirt, water, oil, etc. to enter into the pipe.

(5) Vertical Joint

- Heat the whole brazed fitting to a proper brazing temperature. Bring the brazing filler metal into contact with the fitting so that the brazing filler metal starts flowing by itself.
- Stop heating the fitting as soon as the brazing filler metal has flown into the clearance. Since the brazing filler metal flows easily into the portion heated to a proper temperature, it is essential to keep the whole fitting at a proper brazing temperature.





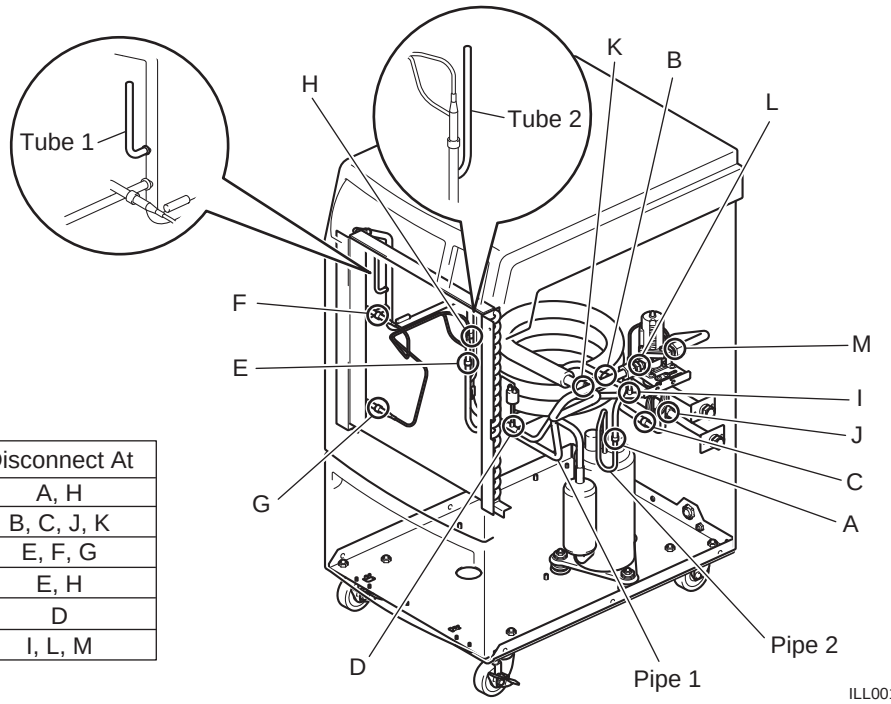
11.2 Removal of Refrigeration and Water System Components

⚠ WARNING

- **Before replacing any refrigeration and water system component, recover the refrigerant using standard recovery procedures and drain the water from the unit.**
- **When recovering the refrigerant, use the pinch-off tubes at the low pressure side (tube 1) and high pressure side (tube 2) as shown in the figure below.**

⚠ CAUTION

- To prevent oxidation, dry nitrogen should be conducted (flow rate 0.27 gal/min (1 L/min)) through the pinch-off tube during any brazing operation.
- During any component replacement involving brazing, shield nearby parts with a steel plate, etc., to protect them from the flame.

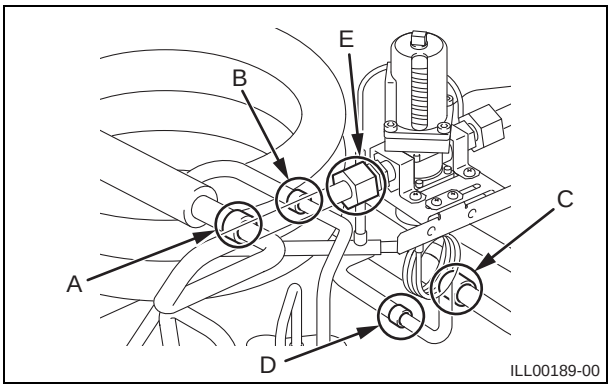


Part to Replace	Disconnect At
Compressor	A, H
Condenser	B, C, J, K
Capillary Tube	E, F, G
Evaporator	E, H
High Pressure Switch	D
Water Regulating Valve	I, L, M

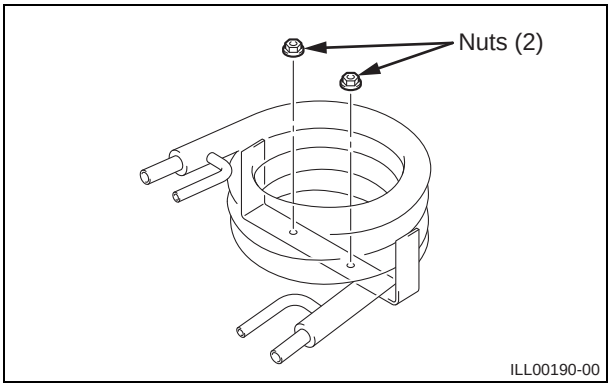
< NOTE >

When replacing the compressor, attach the pipe 1 and the pipe 2 packaged in the compressor assembly.

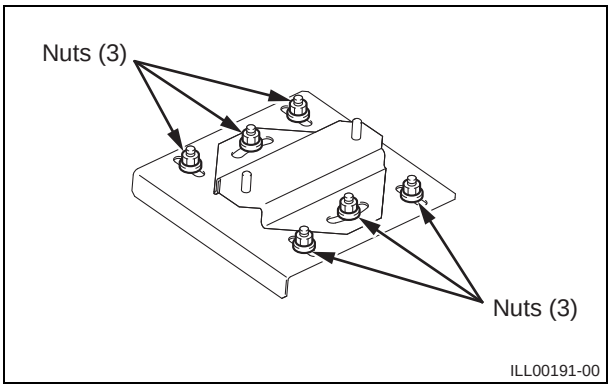
(1) Removal of water cooled condenser



1) Disconnect four brazing points (A ~ D) as shown. When brazing, cover the area E with a wet cloth to prevent damage.

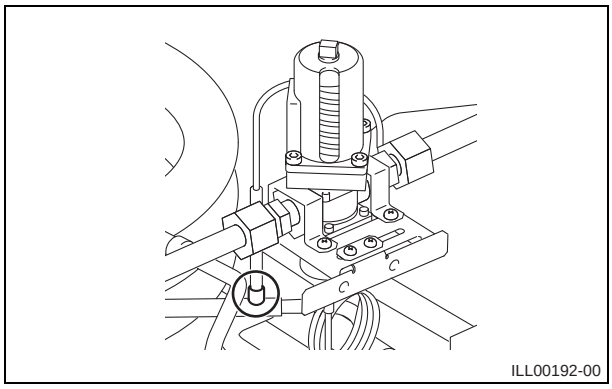


2) Remove two (2) nuts from the bracket. Then remove the water cooled condenser.

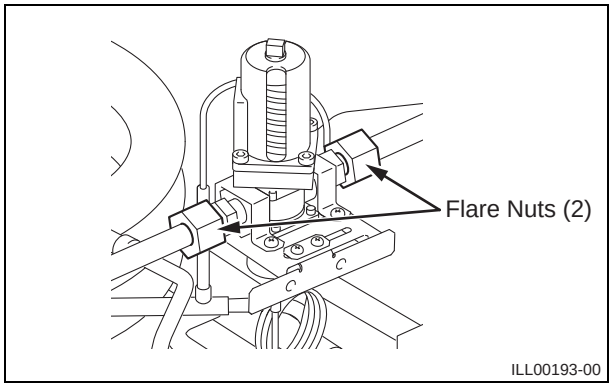


3) Loosen six (6) nuts to move the bracket for adjusting the new condenser position.

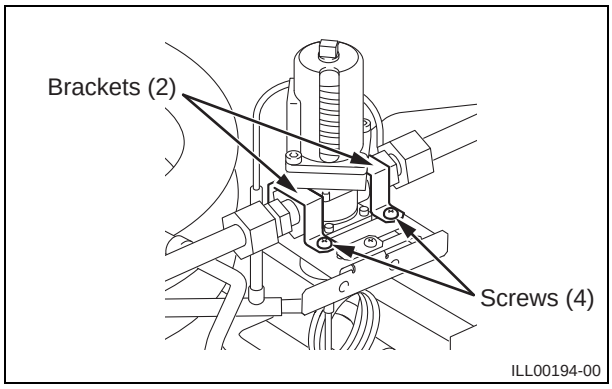
(2) Removal of water regulating valve



1) Disconnect a brazing point as shown.



2) Remove two (2) flare nuts. Then remove the water pipes.



3) Remove four (4) screws and two (2) brackets. Then remove the water regulating valve.

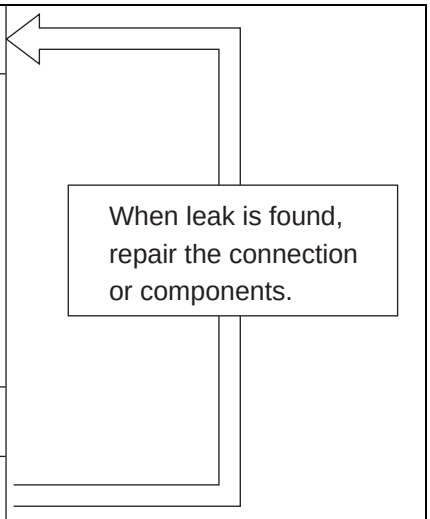
11.3 Charging the System with R-410A Refrigerant

- Always ensure that the refrigeration system has been properly evacuated before charging with the specified amount of R-410A.
- Equipment is for R-410A only.
- Liquid charge (no gas charge).
- Make sure not to use more than 90 % of the initial weight of R-410A in the cylinder.

⚠ WARNING

- **When handling refrigerant (R-410A), the following precautions should always be observed:**
  - **Always wear proper eye protection while handling refrigerant.**
  - **Maintain the temperature of the refrigerant container below 104 °F (40 °C).**
  - **Perform repairs in a properly ventilated area. (Never in an enclosed environment.)**
  - **Do not expose refrigerant to an open flame.**
  - **Never smoke while performing repairs, especially when handling refrigerant.**
  - **Take caution so that the liquid refrigerant does not come in contact with the skin.**
- **If liquid refrigerant strikes eye or skin:**
  - **Do not rub the eye or the skin.**
  - **Splash large quantities of cool water on the eye or the skin.**
  - **Apply clean petroleum jelly to the skin.**
  - **Go immediately to a physician or to a hospital for professional treatment.**

Step 1	Connect manifold gauge.
Step 2	1) Evacuate the system. • 15 minutes or more. • 30 inHg (100 kPa) or more of vacuum. 2) Stop evacuating the system. • Leave for 5 minutes. 3) Check the vacuum.
Step 3	Connect to refrigerant source.
Step 4	Test the system for leaks.
Step 5	Charge the system with R-410A. • See “Technical Specifications” for the specified amount.
Step 6	Remove manifold gauge.



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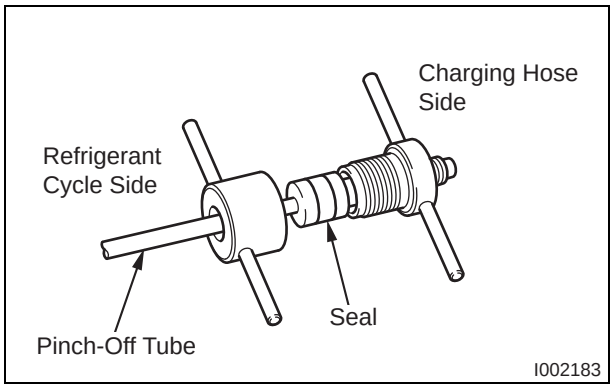
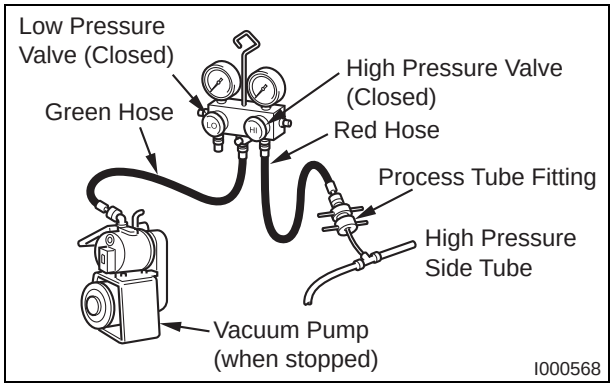
(1) Connection of gauge manifold



1) Properly remove the crushed end of the pinch-off tubes at the high pressure side and the low pressure side of the refrigerant cycle with a pipe cutter.

2) Fit the process tube fitting to the pinch-off tube on both sides.



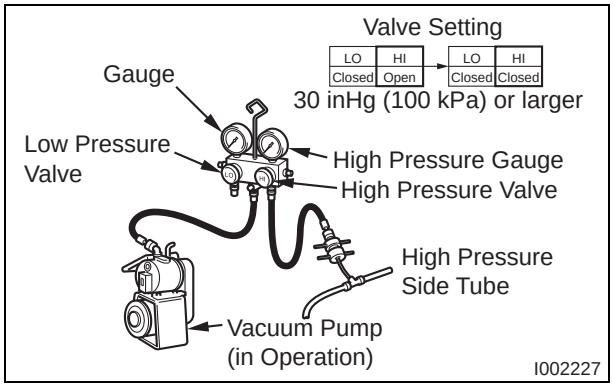
3) Connect the charging hoses (red-high pressure side) for the gauge manifold to the process tube fitting.

< NOTE >

Connect the hoses using care not to mistake the high pressure side for the low pressure side and vice versa.

4) Connect the charging hose (green) at the center of the gauge manifold to the vacuum pump.

(2) Evacuation

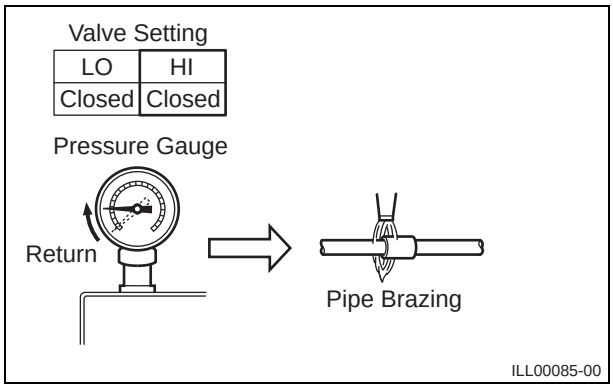


1) Open the high pressure valve (Hl) of the gauge manifold.

2) Turn on the vacuum pump to start evacuation. (Evacuate the system for approximately 15 minutes.)

3) When the low pressure gauge indicates 30 inHg (100 kPa) or larger, turn off the vacuum pump and close the high pressure valves of the gauge manifold.

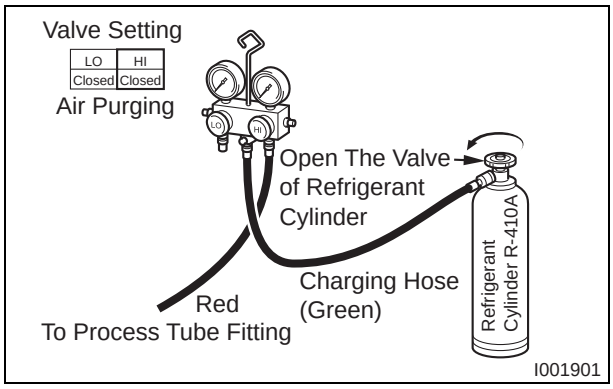
(3) Checking vacuum

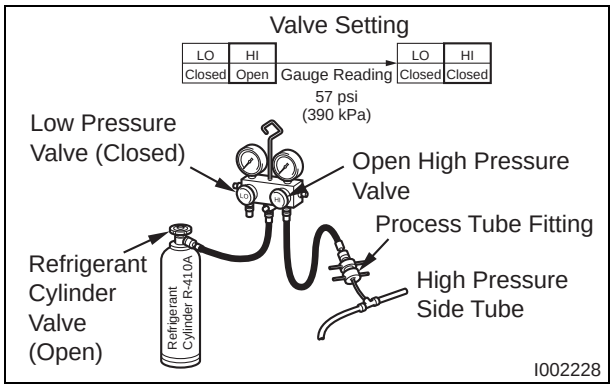


1) Leave the high pressure valve and the low pressure valve of the gauge manifold closed for 5 minutes or more, and confirm that the gauge pointer does not return to zero.

2) If the gauge pointer returns gradually to zero there is a leak somewhere in the system (this could also include gauge manifold). Perform leak check according to procedure indicated in the next step. Once leak has been found and repaired, evacuate the system once more and confirm the system holds vacuum.

(4) Checking gas leak





1) Remove the charging hose (green) from the vacuum pump, and connect the hose to the refrigerant cylinder (R-410A).

2) Loosen the nut on the gauge manifold side of the charging hose (green).

3) Open the valve of refrigerant cylinder perform air purging in the charging hose (green). Then tighten the nut.

4) Open the high pressure valve of the gauge manifold. Charge the system with refrigerant until the low pressure gauge indicates 57 psi (0.39 kPa). After charging is complete, close the high pressure valve.

5) Open the valve of refrigerant cylinder perform air purging in the charging hose (green). Then tighten the nut.

6) Check carefully for gas leaks inside the refrigeration system using the gas leak tester.

7) Repair any leak.

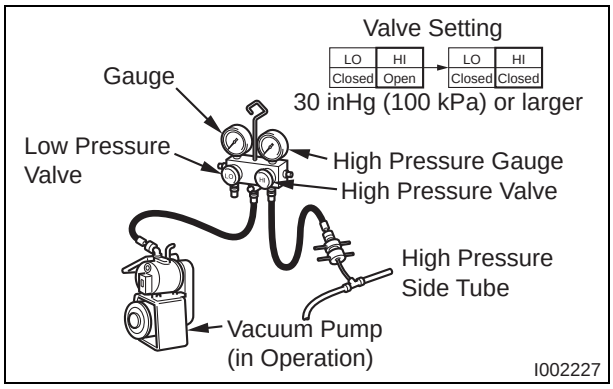
⚠ WARNING

Any repair on a charged system should be performed by a licensed professional only.

⚠ WARNING

Before checking for gas leaks, fully confirm that there is nothing flammable in the area to cause an explosion or fire. Contact of refrigerant with an open fire generates toxic gas.

(5) Evacuation (repeat)



1) Close the valve of the refrigerant cylinder. Then remove the charging hose (green) from the refrigerant cylinder, and connect it to the refrigerant recovery machine.

< NOTE >

Keep the high pressure valve and the low pressure valve of the gauge manifold closed.

2) Using procedure in the “Evacuation”, evacuate the system until the low pressure gauge indicates 30 inHg (100 kPa) or larger. (For 15 minutes or more.)

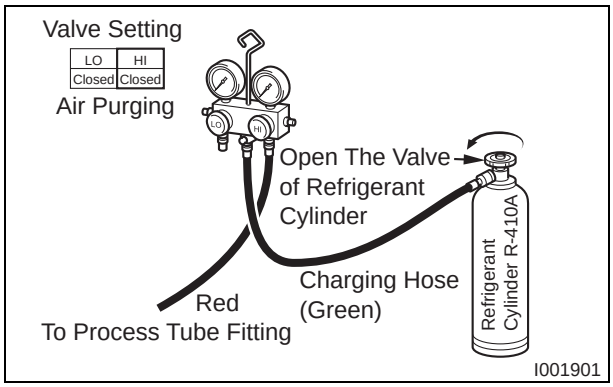
3) After evacuation is complete, close the high and the low pressure valves of the gauge manifold.

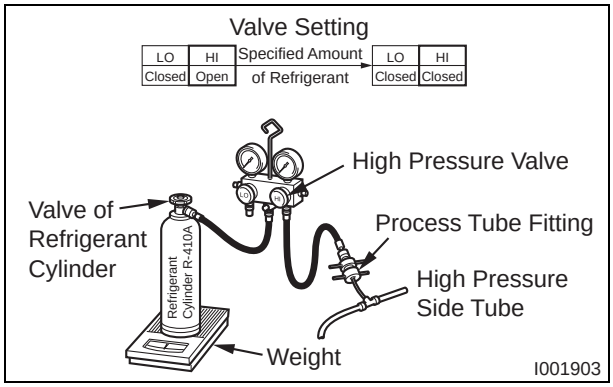
⚠ CAUTION

Make sure to evacuate the system twice or more using the repetitive vacuum method. Evacuate the system an additional time on rainy or humid days.

11.4 Refrigerant Charging Work

(1) Refrigerant charging





1) Remove the charging hose (green) from the vacuum pump, and connect it to the refrigerant cylinder (R-410A).

2) Loosen the nut on the gauge manifold side of the charging hose (green). Open the valve of the charging hose (green). Open the valve of the refrigerant cylinder. After air purging, tighten this nut and close the valve of the refrigerant cylinder.

3) Securely place the refrigerant cylinder on a scale with a weighing capacity of 70 lb (30 kg) that is graduated by 0.2 oz (5 g).

4) Open the high pressure valve of the gauge manifold and the valve of the refrigerant cylinder. Charge the system with refrigerant to the specified amount.

Standard Amount of Refrigerant:

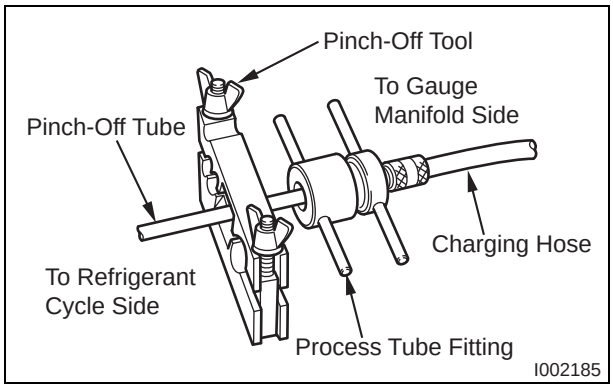
•1.76 lb (0.8 kg)

⚠ CAUTION

The amount of refrigerant charged has a great effect on the cooling capacity of the unit. Charge to the specified amount, always observing the scale graduations while charging.

5) Close the high pressure valve of the gauge manifold and the valve of the refrigerant cylinder.

(2) Removal of gauge manifold



1) Crimp the pinch-off tube with a pinch-off tool.

2) Remove the gauge manifold and the process tube fitting. Crush the end of the pinch-off tube.

3) Braze the end of the pinch-off tube.

4) Ensure that a gas leak is not present at the pinched off portion and the brazed end.

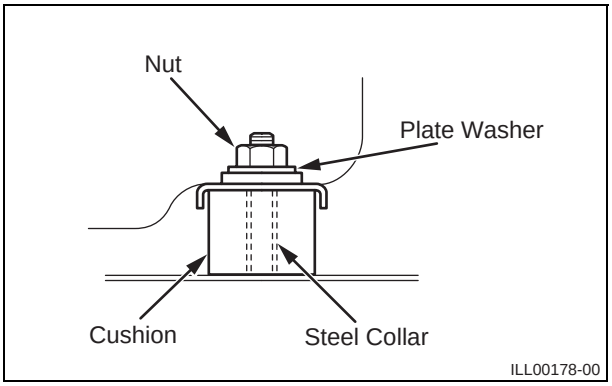
12. REASSEMBLY

12.1 Reassembly of Unit

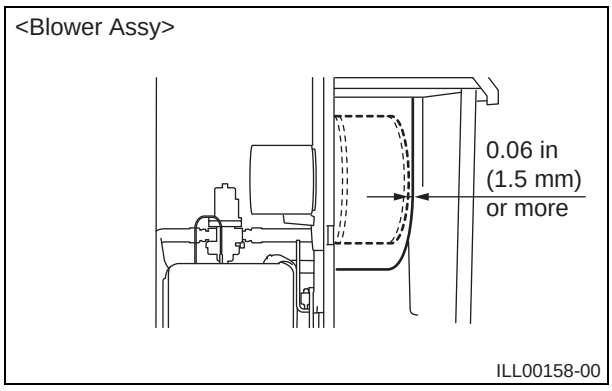
• Reassemble the unit in the reverse order of removal. Described below are the parts that require special care in reassembling the unit. Perform all wiring or rewiring as referenced in the wiring diagram.

12.2 Compressor Mounting

• Mount the compressor on the frame, using cushions, steel collars, plate washers and nuts.



12.3 Evaporator Fan Assembly



• Install the evaporator fan. Allow a clearance of 0.06 inch (1.5 mm) or more between the evaporator fan and the fan casing.

⚠ CAUTION

• Tightening torque:
- 10.84 ± 2.17 ft•lbf (7.4 ± 0.7 N•m)

12.4 Wiring Notice

• Secure the wires using clamps so that they do not come into contact with the edges of the structure, etc. Secure the wires using clamps in the same position they were before removal.

12.5 Perform the Inspection

- Perform the inspection of cooling performance and check for abnormal noise or abnormal vibration.

12.6 Caster Maintenance

- Lubricate bearings in caster as needed with standard bearing grease using the zerk fitting.

< NOTE >

Casters should roll and swivel freely. Check for dirt or dust build up. Remove dust or dirt build up.

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