SERVICE MANUAL

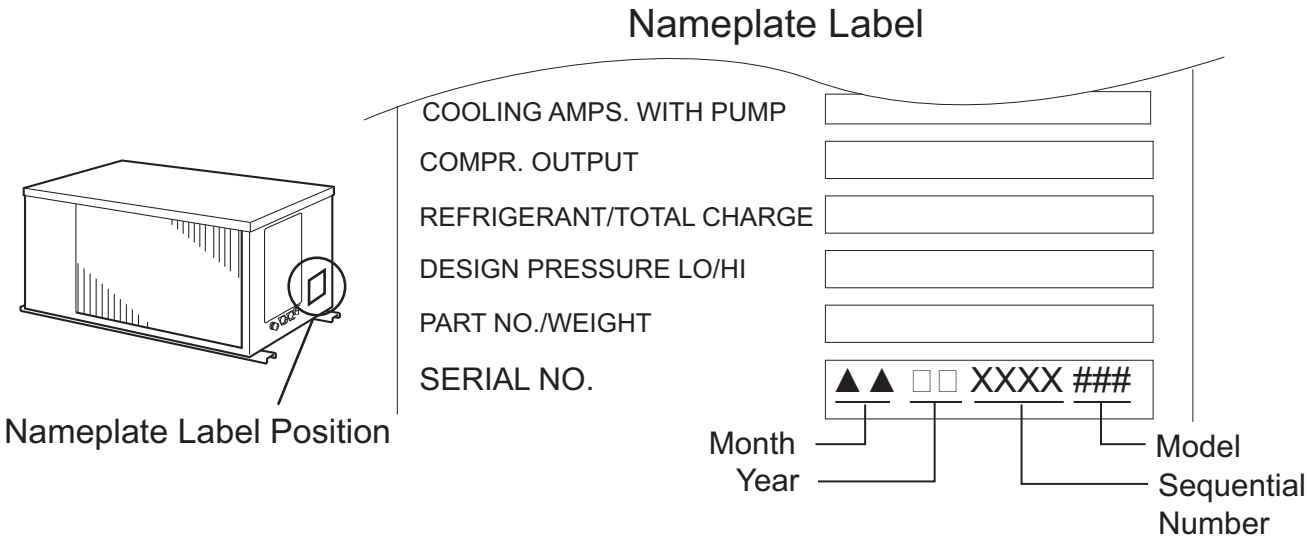
CM 12

Unit Serial Number Range: 0109XXXXC12 to 0111XXXXC12

MOVINCOOL®
THE #1 SPOT COOLING SOLUTION

DocID: 00G00027EC

SERIAL NUMBER LOCATION AND IDENTIFICATION



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1. PRECAUTIONS FOR SAFETY

1.1 Foreword

- This manual has been published to service the MovinCool CM 12. Please use this service manual only when servicing the CM 12.

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.

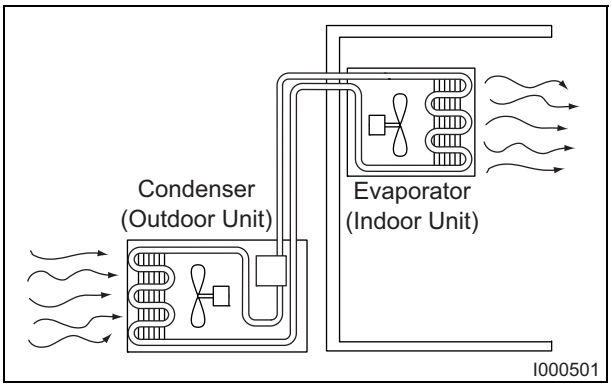
1.3 General Precautions

⚠ WARNING

- **All electrical work if necessary, 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.**
- **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 proper electrical outlet for MovinCool units must be equipped with a "UL" approved ground-fault 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. GENERAL DESCRIPTION

2.1 Spot Cooler



- In general, conventional air conditioners cool the entire enclosed environment. They act as "heat exchangers", requiring an interior unit (evaporator) to blow cool air into the interior and an exterior unit (condenser) to exhaust exchanged heat to the outdoors.
- Unlike conventional air conditioners, the MovinCool CM 12 is a spot cooler which directs cool air to particular areas or objects. The MovinCool CM 12 has the following features:

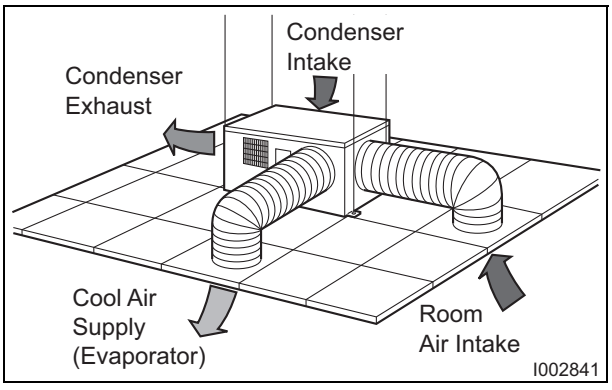
2.2 Lightweight, Compact, Ceiling Mounted

- Since the compact, lightweight, CM 12 can be easily installed in the ceiling, it allows for effective use of floor space without interfering with room design. In addition, effective cooling is achieved through the use of separate intake and discharge ducts within the room.

2.3 Commercial Controller Usage

- The CM 12 can use (Millivolt compatible thermostat) commercially available controllers, allowing the user to select the controller best suited to the room design.

2.4 Energy Conservation



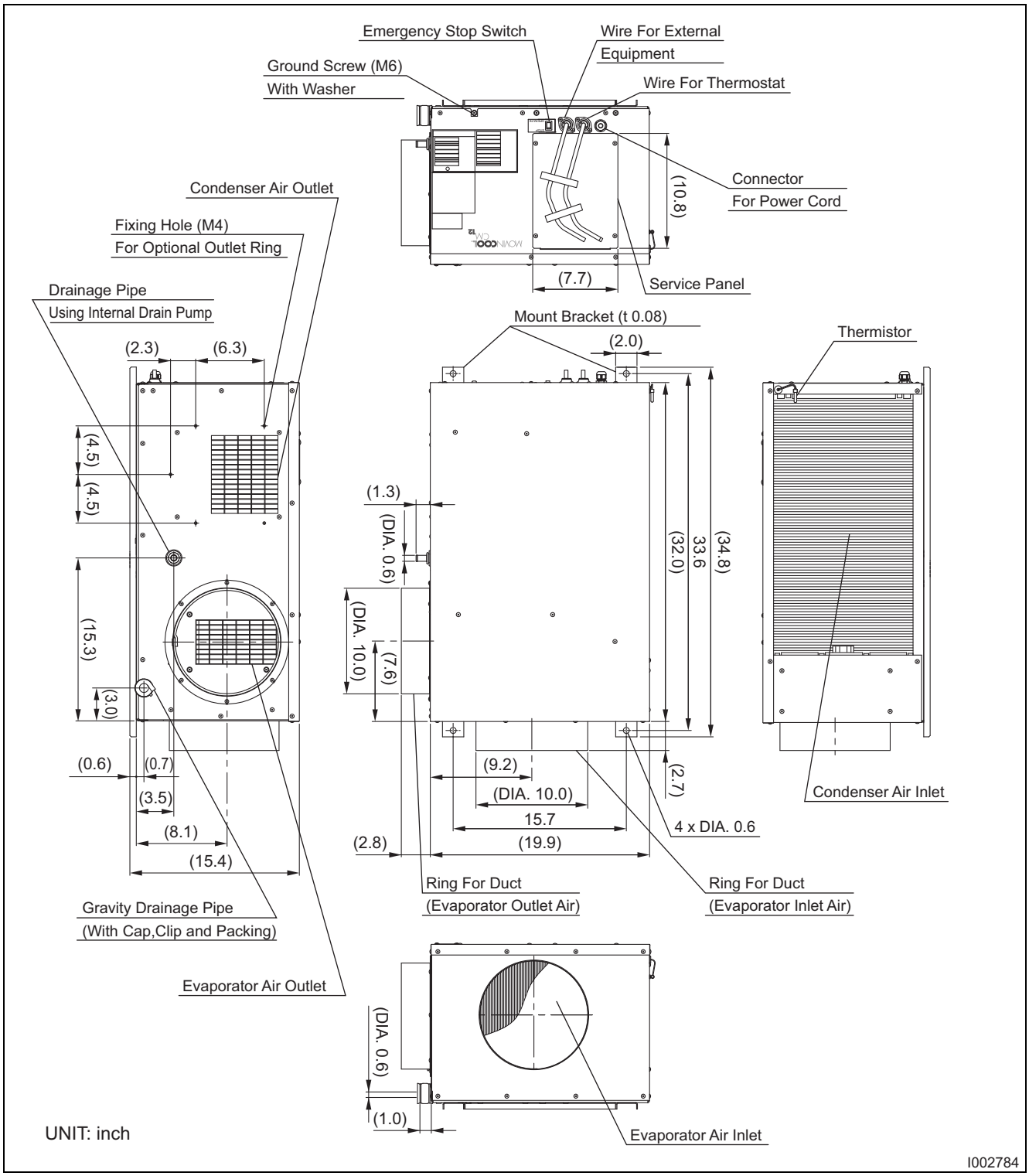
- The MovinCool CM 12 is economical because it cools only the area or objects which need to be cooled.

2.5 Added Safety through the Use of a Fire Alarm

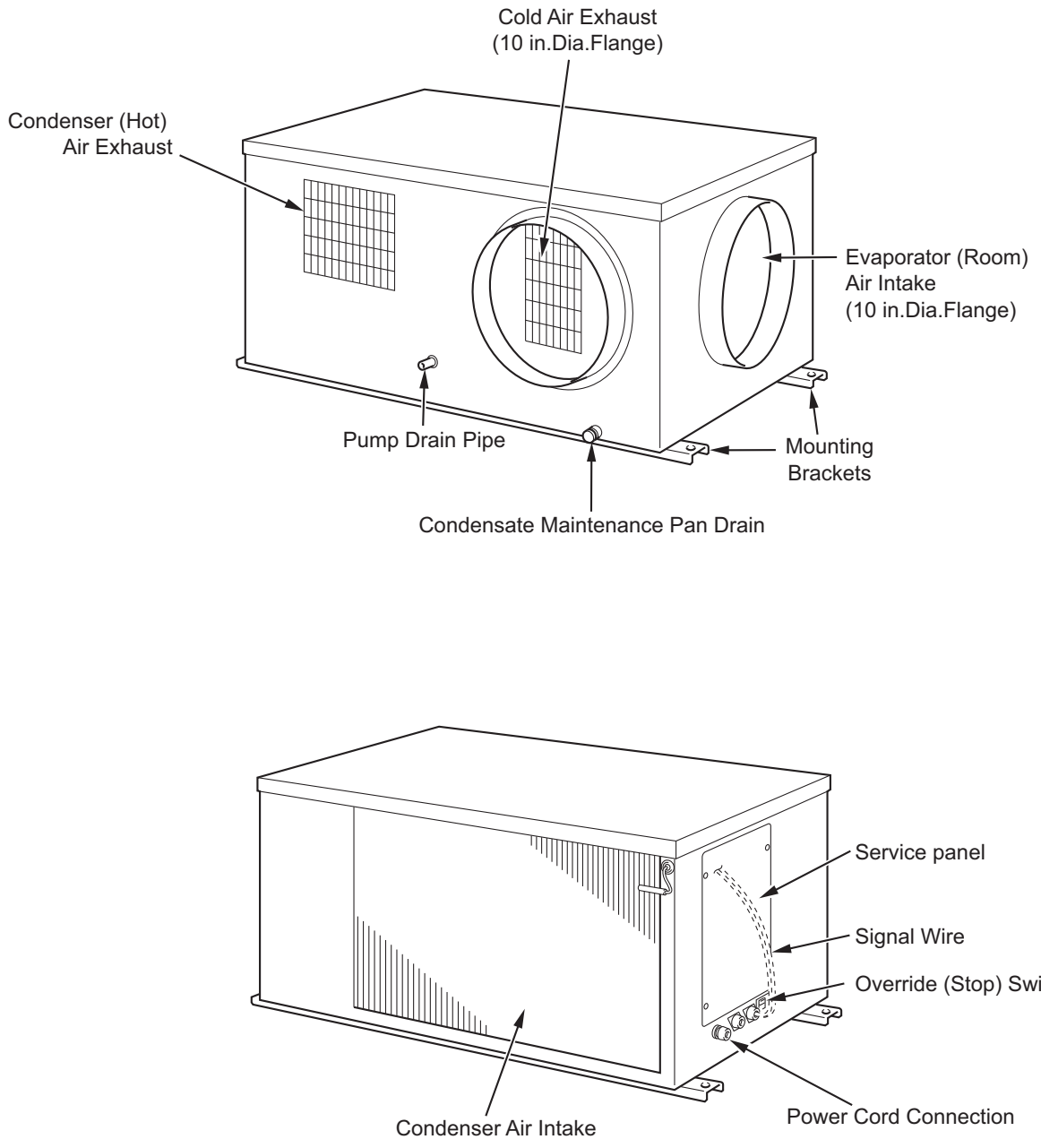
- The CM 12 can be automatically shutdown via signals from a general fire alarm control panel and can also send out signal to monitoring devices such as environmental monitoring systems or annunciator systems.

3. CONSTRUCTION

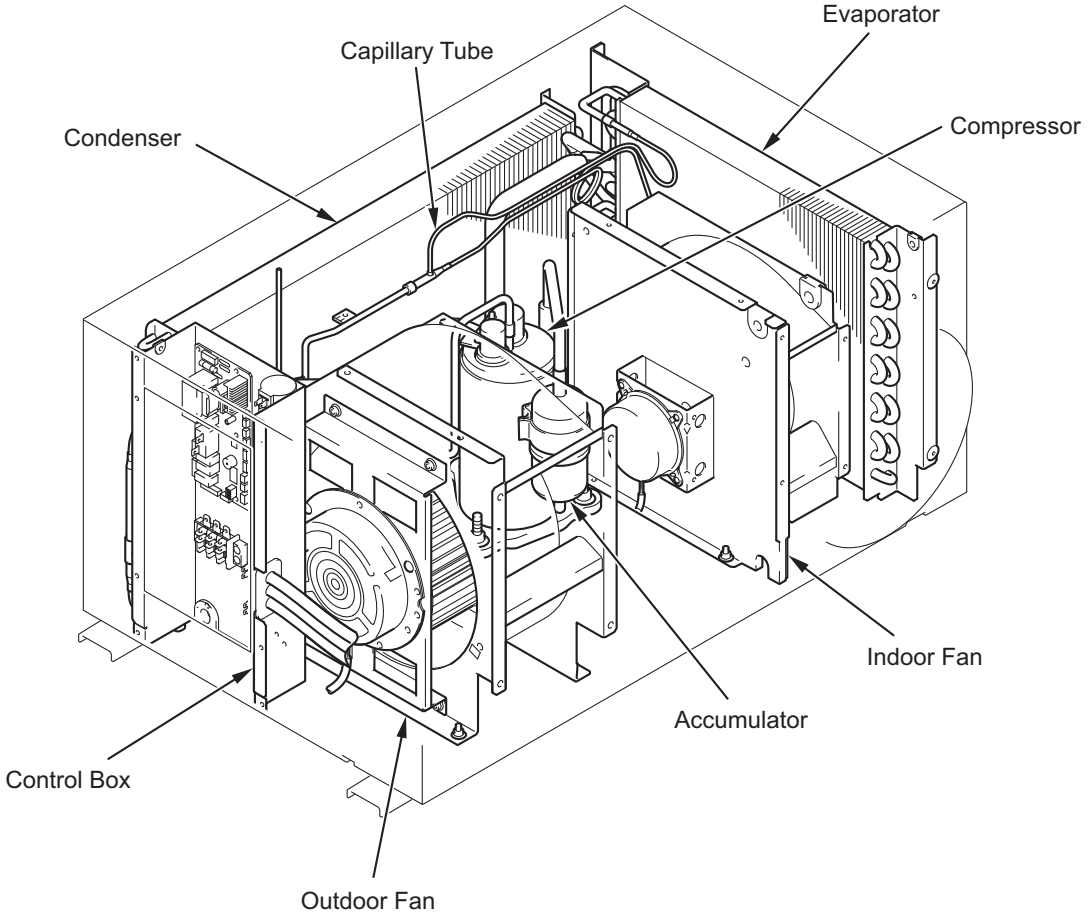
3.1 Exterior Dimensions



3.2 Exterior Components



3.3 Internal Structure



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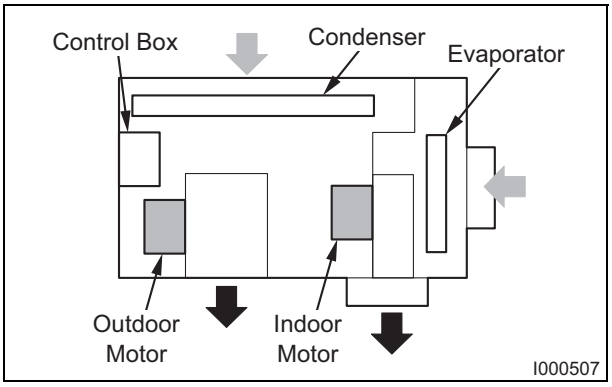
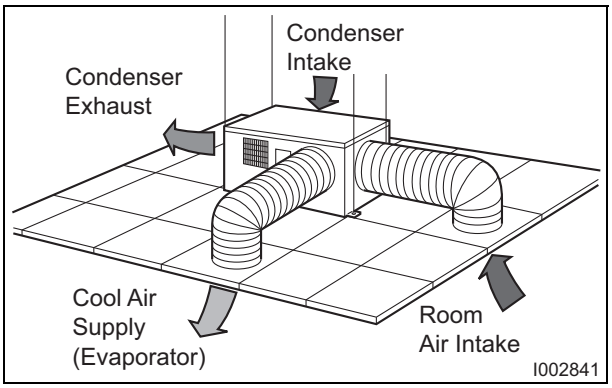
3.4 Basic Construction

• The MovinCool CM 12 is compact in construction due to the condenser and evaporator being enclosed in one unit. The interior of the unit is divided into two sections. One section contains the evaporator which cools room interior air. The other section is comprised of the condenser, compressor and control box.



3.5 Air Flow

• Air drawn from the rear face passes over the condenser which extracts heat from the refrigerant. The hot air is blown out through the front exhaust air vent. Air taken in from the right side face is cooled by the evaporator and then blown through the front cool air duct.



4. SPECIFICATIONS

4.1 Technical Specifications

ITEM			SPECIFICATIONS
Electronic Features	Operation		Wall Thermostat
	Control		Electronic
Electronic Characteristics	Voltage Requirement		Single-Phase 115 V, 60 Hz
	Min.- Max. Voltage		Min. 105 V, Max. 127 V
	Starting Current		50 A
	Recommended Fuse Size		15 A
Cooling Capacity and Power Consumption			
Evaporator: 80°F (27°C), 50% RH/ Condenser: 95°F (35°C), 40% RH	Total Cooling Capacity *1		10500 Btu/h (3090 W)
	Sensible Cooling Capacity *1		7200 Btu/h (2100 W)
	Power Consumption *1		1.23 kW
	Current Consumption *1		11.2 A
	Power Factor		99%
Refrigerant Circuit	Compressor	Compression Type	Hermetic Rotary
		Output	0.91 kW
	Evaporator		Plate Fin
	Condenser		Plate Fin
Evaporator	Type of Fan		Centrifugal Fan
	Air Flow	High	324 CFM (550 m^3/h)
		Low	228 CFM (390 m^3/h)
	Max. External Static Pressure		0.16 IWG (40 Pa)
	Motor Output	High	0.04 kW
		Low	0.01 kW
Condenser	Type of Fan		Centrifugal Fan
	Air Flow	High	700 CFM (1190 m^3/h)
		Low	370 CFM (630 m^3/h)
	Max. External Static Pressure		0.12 IWG (30 Pa)
	Motor Output	High	0.10 kW
		Low	0.03 kW
Refrigerant	Type		R-410A
	Amount		1.23 lb (0.56 kg)

ITEM			SPECIFICATIONS
Signal Connection	Fire Alarm Input		• Dry contact type (recommended) • No-voltage contact input/Contact resistance less than 100 ohm
	Warning Signal Output		2 A at 30 V (DC/AC) or less (resistive load)
Dimension	W x D x H (without flange and mounting bracket)		32.0 x 19.9 x 14.8 in (813 x 505 x 376 mm)
	W x D x H (with flange and mounting bracket)		34.8 x 22.7 x 15.4 in (884 x 577 x 391 mm)
Weight	Net		128 lb (58 kg)
	Shipping		141 lb (64 kg)
Condensate Pump Capacity	Pump Rate		5.0 gal/h (19 L/h)
	Head		4 ft (1.2 m)
Operating Condition Range *2	Evaporator	Max. Inlet Air	95°F (35°C), 50% RH
		Min. Inlet Air	65°F (18°C), 50% RH
	Condenser	Max. Inlet Air	113°F (45°C)
		Min. Inlet Air	65°F (18°C)
Maximum Duct Length	Cold Duct *3		20 ft (6.1 m)
	Hot Duct *3		10 ft (3.0 m)
Maximum Sound Level	Measured at 1 m under the ceiling with evaporator duct and ceiling tile.		52 dB(A)

• Specifications are subject to change without notice.

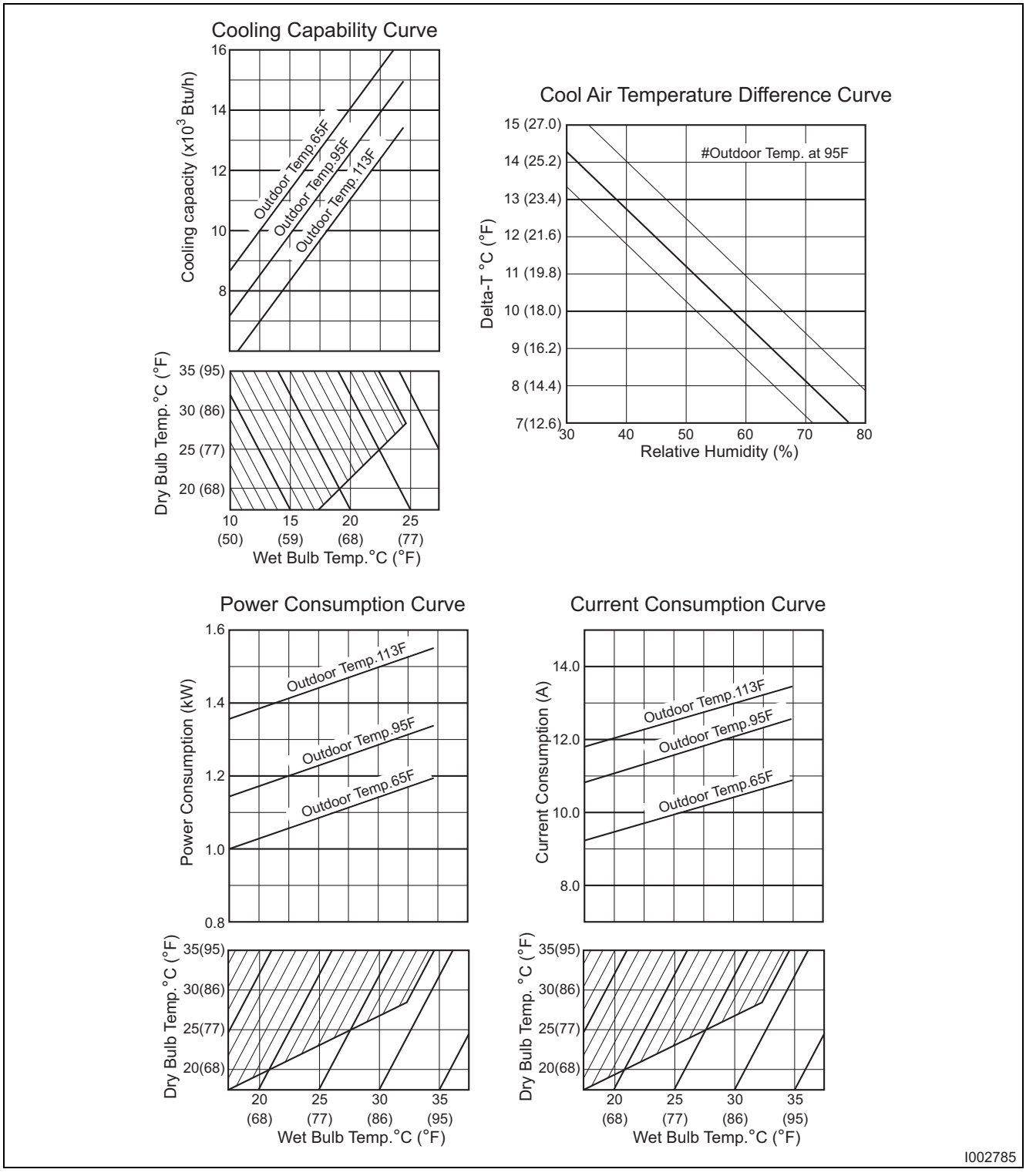
< NOTE >

*1 : With two 6-foot (1.8 m) ducts containing one 90° bend each, supply grill and return grill with filter {0.16 IWG (40 Pa) external static pressure} on high fan speed.

*2 : When ambient temperature is lower than 65°F (18°C), operation may be interrupted due to anti-freeze protection activation.

*3 : Confirm pressure drop of duct, grills, and filter with manufactures specifications.

4.2 Characteristics



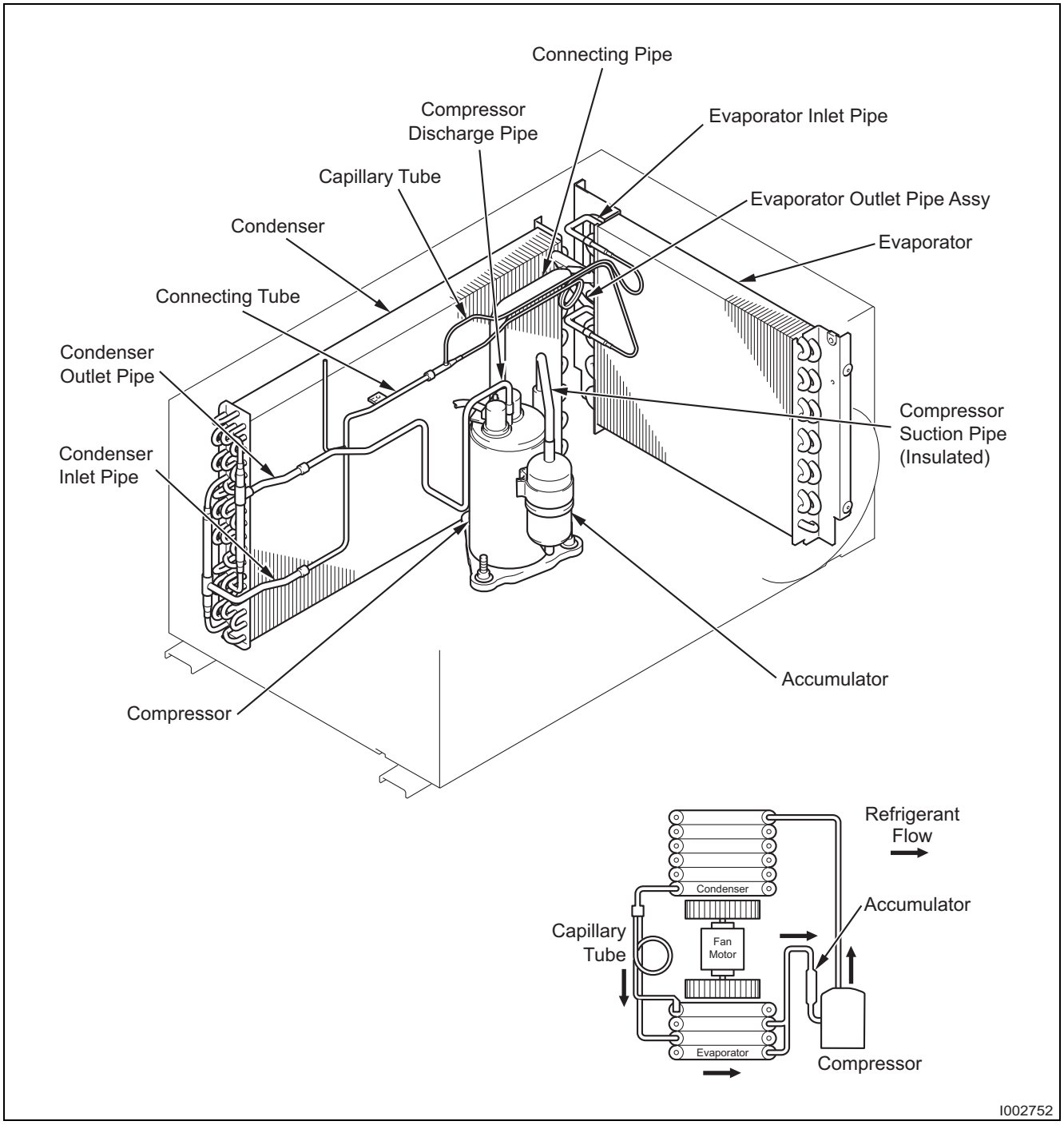
5. REFRIGERANT SYSTEM

5.1 Refrigerant System Construction

The component parts of the refrigerant system include the following:

- Compressor, Evaporator, Condenser, Accumulator, Capillary tube

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

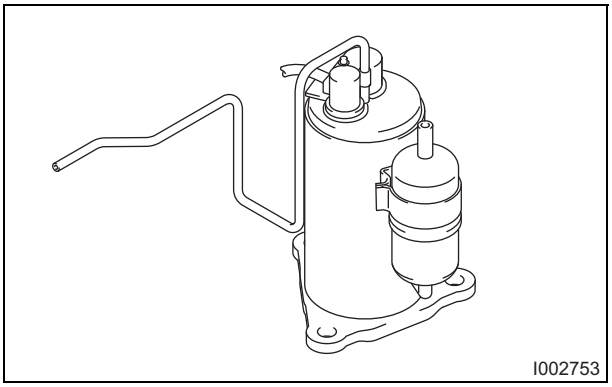


5.2 Compressor

- 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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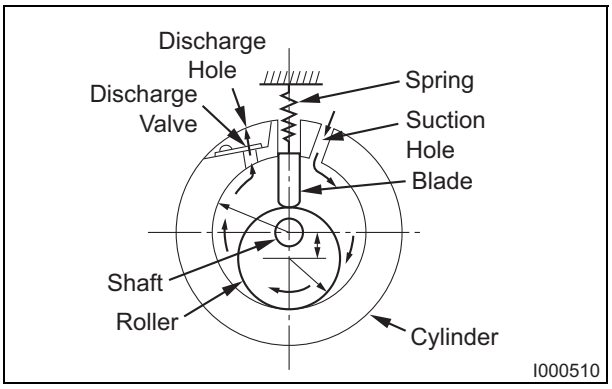
(2) Basic compressor operation

- 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.



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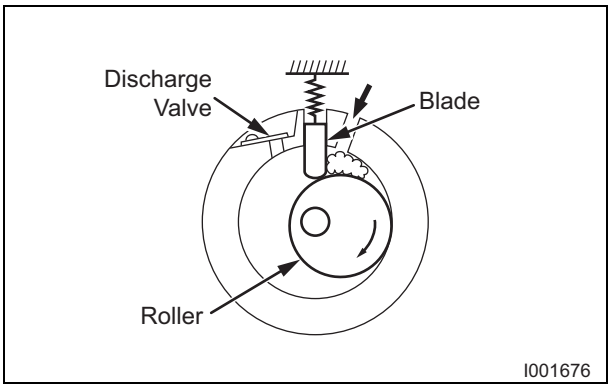
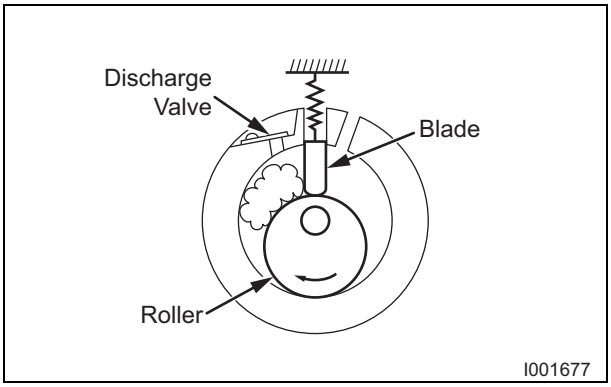
(3) Operation



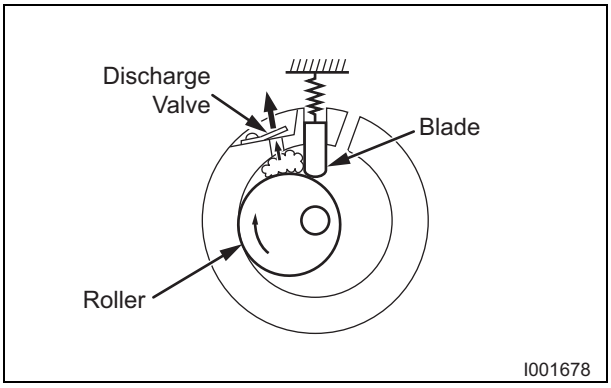
1) Start of compression

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.



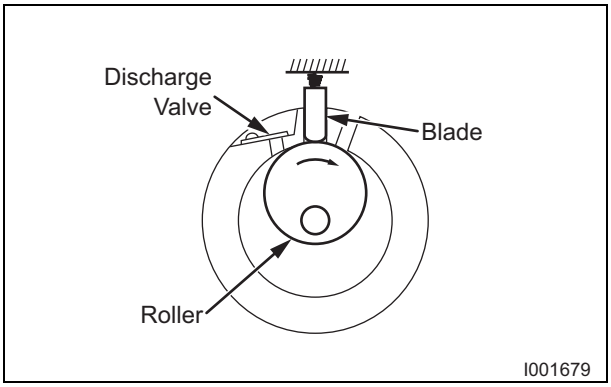
2) Suction and compression

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

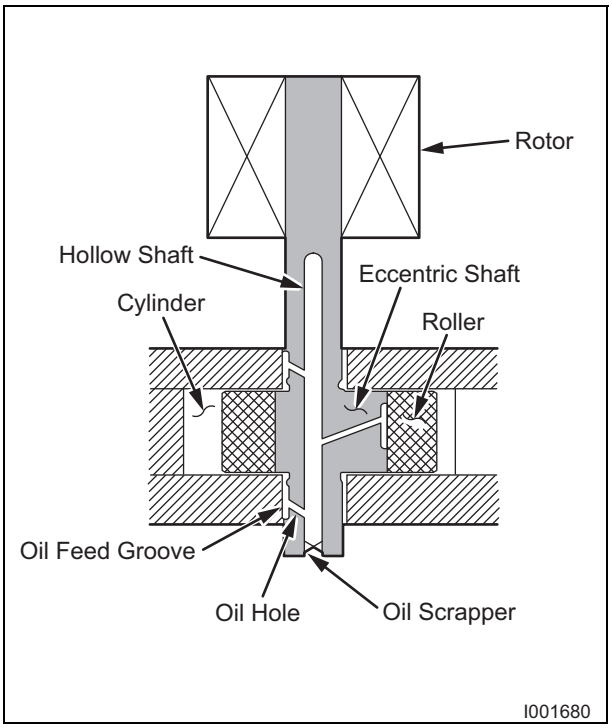
1) The pressure in the cylinder exceeds that in the discharge chamber, and the discharge valve opens.
2) On the suction side, refrigerant suction continues.



4) Completion of compression

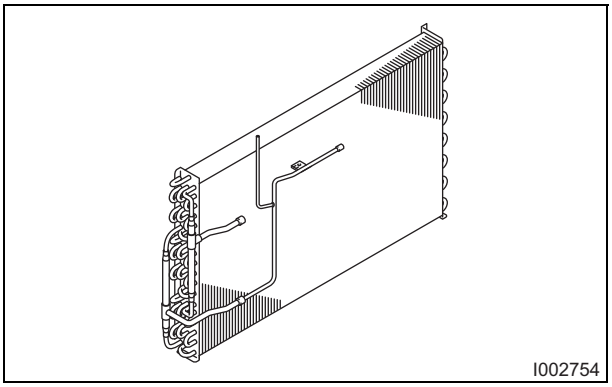
1) When compression is completed, all of the refrigerant has been drawn from the suction chamber.
2) Operation then returns to step 1) (Start of compression) and the above process of suction and compression continues repeatedly in succession.

(4) Compressor lubrication



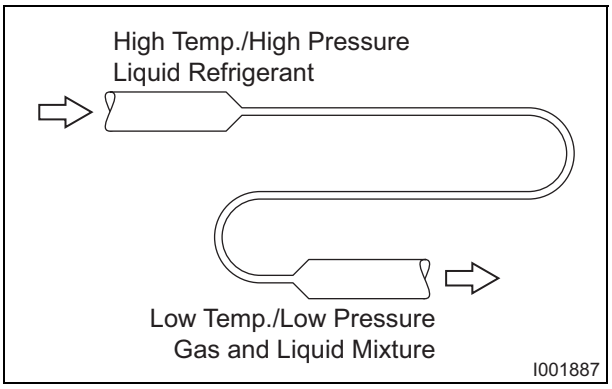
- The lubrication system is comprised of a hollow shaft, an oil scraper mounted at the end face, hollow shaft, a shaft journal (shaft bearing), and the lubrication groove for the shaft journal. The lubrication groove is wider than the oil hole. When the shaft turns, oil is scraped upward by the oil scraper 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.

5.3 Condenser



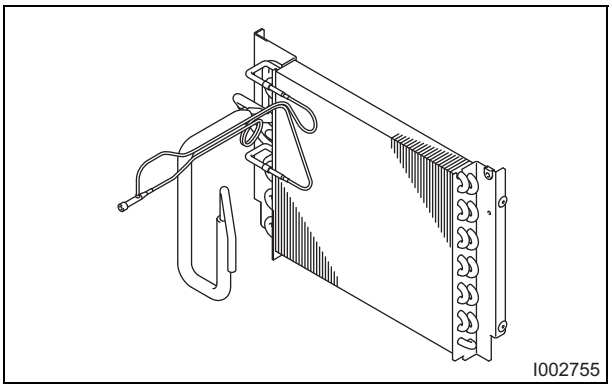
- The condenser is a heat exchanger with copper tubes that are covered with thin aluminum projections called plate fins.
- Heat is given off and absorbed by air being pulled across the condenser fins by the centrifugal fan and then expelled through the exhaust air duct.

5.4 Capillary Tube



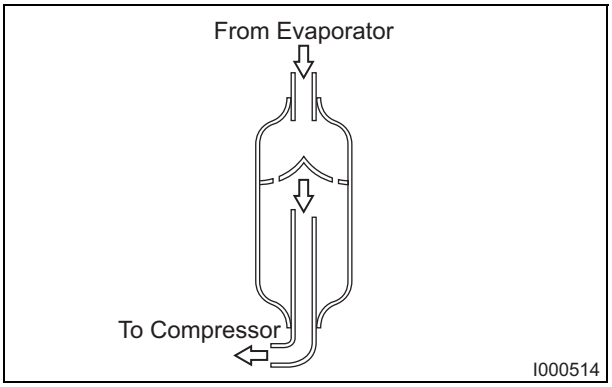
- The capillary tube is a long thin tube utilizing line flow resistance to serve as an expansion valve. The length and the inner diameter of the capillary tube are determined by the capacity of the refrigeration system, specified operating conditions, and the amount of refrigerant. The capillary tube 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.

5.5 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.

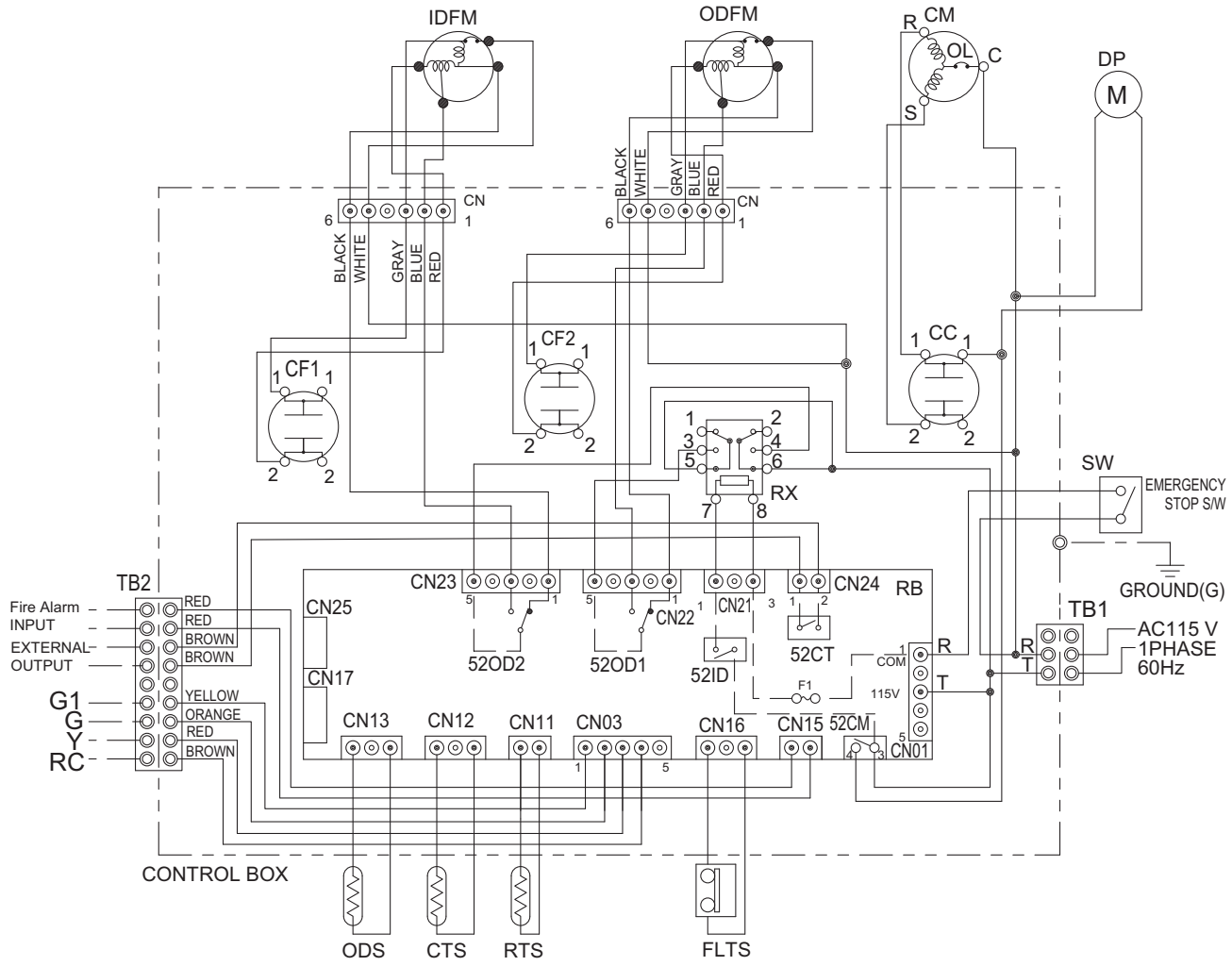
5.6 Accumulator



- 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.

6. ELECTRICAL SYSTEM

6.1 Circuit Diagram



TB1	Terminal Block 1	RTS	Room Thermistor
TB2	Terminal Block 2	CF1	Capacitor For IDFM
RB	Relay Board	CF2	Capacitor For ODFM
IDFM	Indoor Fan Motor	CC	Capacitor For Compressor
ODFM	Outdoor Fan Motor	OL	Overload Protector
MC	Compressor Motor	DP	Drain Pump
RX	Auxiliary Relay	SW	Switch For Emergency
ODS	Outdoor Thermistor	FLTS	Float Switch
CTS	Freeze Protection Thermistor	G	Ground

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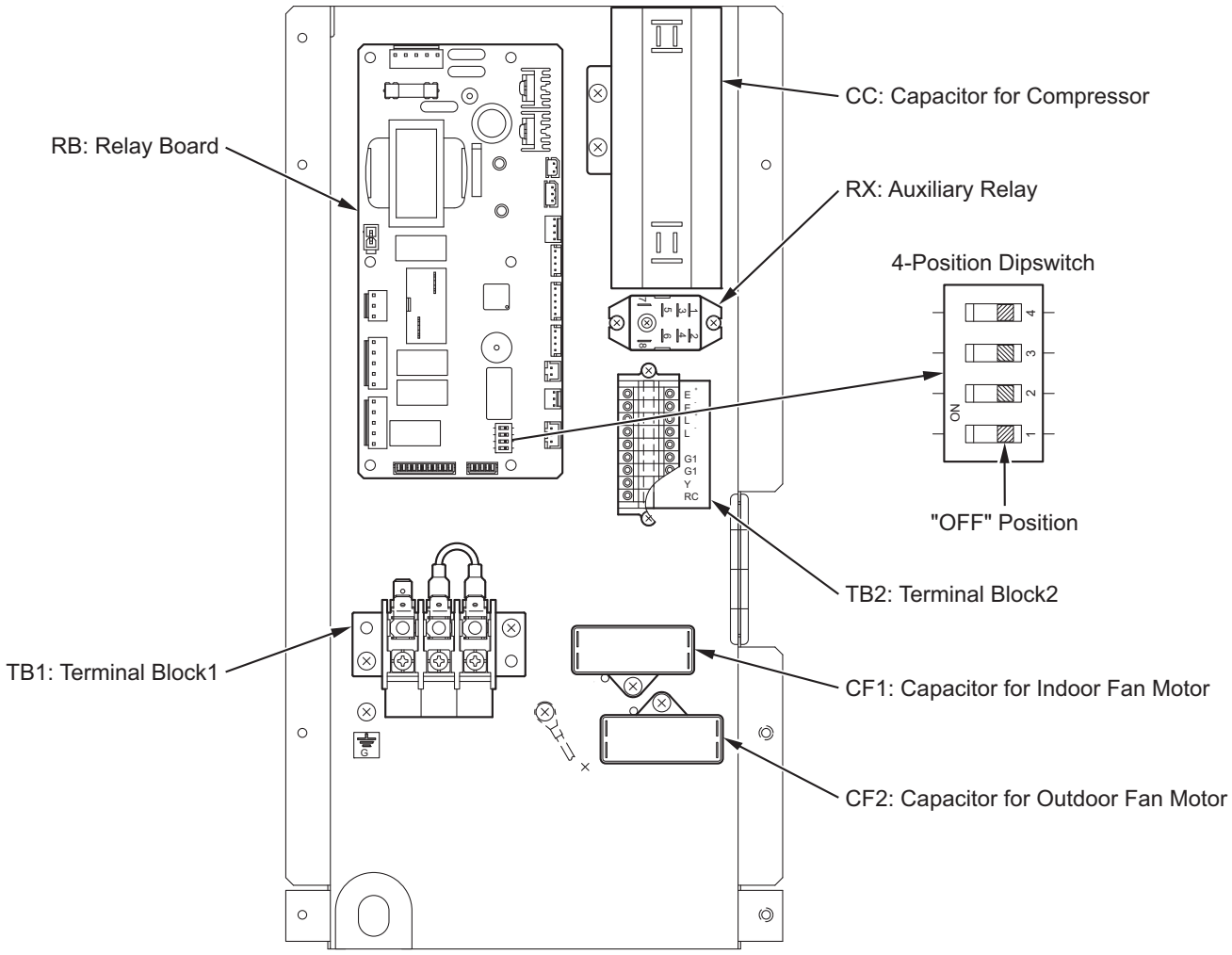
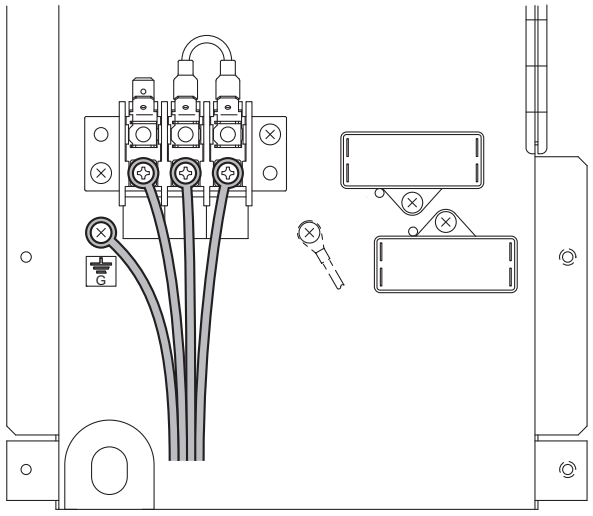
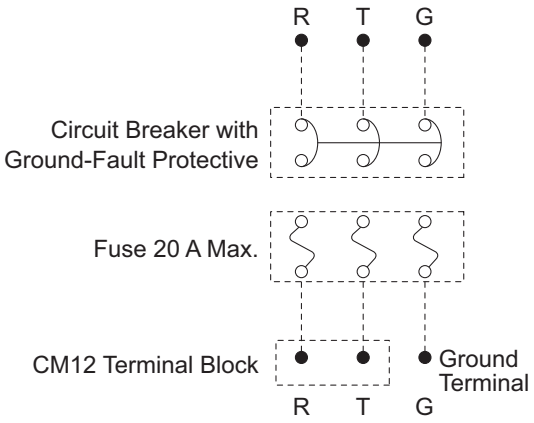
6.2 Control Box



6.3 Power Supply Requirements

- The CM 12 requires a single-phase 115 V, 60 Hz power supply.
- The power supply should be a dedicated single outlet circuit with a UL approved short-circuit and ground fault protective breaker, and a maximum fuse size of 20 A.





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6.4 Input Signal

- Install the wall thermostat in a location inside the room where it can be conveniently accessed.
- Most thermostats provide these basic functions:

Fan Mode: On / Auto (Selects the desired fan mode.)

System: Cool / Heater (Selects Cool only.)

- The CM 12 receives signals from the wall thermostat to perform the following operations..

Connector	Signal Name	Function
Y	Compressor ON / OFF Signal	When both Y and G signals are ON, the compressor comes ON.
G	Indoor Fan ON / OFF Signal	When the G signal is ON, the indoor fan comes ON. (When the signal is OFF, the indoor fan goes OFF.)
G1	Indoor Fan Hi / Lo Signal	When the G1 signal is ON, the indoor fan speed switches to Lo. (When the signal is OFF, the indoor fan speed switches to Hi.)

6.5 Operation

(1) Basic operation

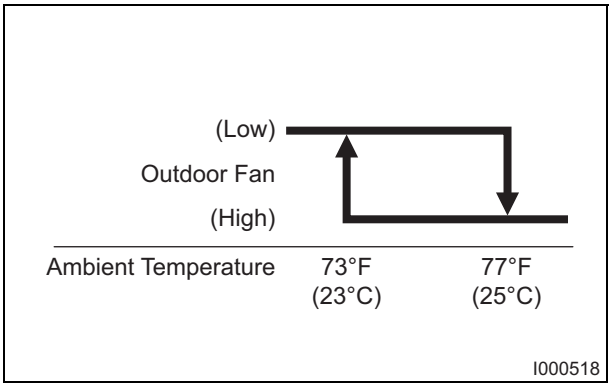
- When a Y signal is input, the 52CM relay located on the relay board comes ON, and the compressor operates.
- When a G signal is input, both the 52ID relay and the RX (auxiliary relay) come ON, and the indoor and outdoor fans operate. However, when the G signal is OFF, both the 52CM and 52ID relays go OFF, stopping the compressor as well as the fans.

(2) Indoor fan speed control

- With a G signal on, the fan will start at high speed. When a G1 signal is input, relay 52ID will become active and fan speed changes from high to low.

(3) Outdoor fan speed control (Air Volume Control)

- Outdoor fan (condenser fan) air volume is controlled by the ODS (Outdoor Thermistor: ambient temperature).
- When room temperature is approx. 77 °F (25 °C) or greater...
  Outdoor Fan Speed switches to high
- When room temperature is approx. 73 °F (23 °C) or less...
  Outdoor Fan Speed switches to low



< NOTE >

However, when the 52ID relay is ON and the ODS temperature is 73 °F (23 °C) or less, the outdoor fan will switch to low speed after running in high speed for five sec.

(4) Anti-frost control

- Anti-frost controls turns the 52CM relay on in accordance with the Freeze Protection Thermistor (CTS) temperature in order to turn the compressor on and off to prevent a decrease in cooling performance resulting from a buildup of frost on the evaporator.
- Compressor off conditions: Freeze protection thermistor (CTS) temperature ≤ 30 °F (-1 °C)
- Compressor on (recovery) conditions: CTS temperature ≥ 50 °F (10 °C) and continuous anti-frost control for 15 min.

(5) Compressor protection (Compressor time delay control)

- Compressor protection consists of a time delay program within the microprocessor which prevents a heavy load from being applied to 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 (after the Y signal goes OFF once and then comes back ON), or power interruption restart. (automatic recovery)

Specifications:
- Time Delay: 120 sec.

(6) Automatic restart after power interruption (Automatic Recovery Function)

- The program within the CM 12 microprocessor contains a feature that will automatically restart 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. Any “preset” program will also be retained in the memory in the event power loss occurs.

6.6 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.

< NOTE >

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

(1) Relay board fuse

- This fuse provides protection against damage to the step-down transformer. The fuse must be replaced with the exact same part, or a suitable equivalent.

Specifications:
- 5 A 250 VAC

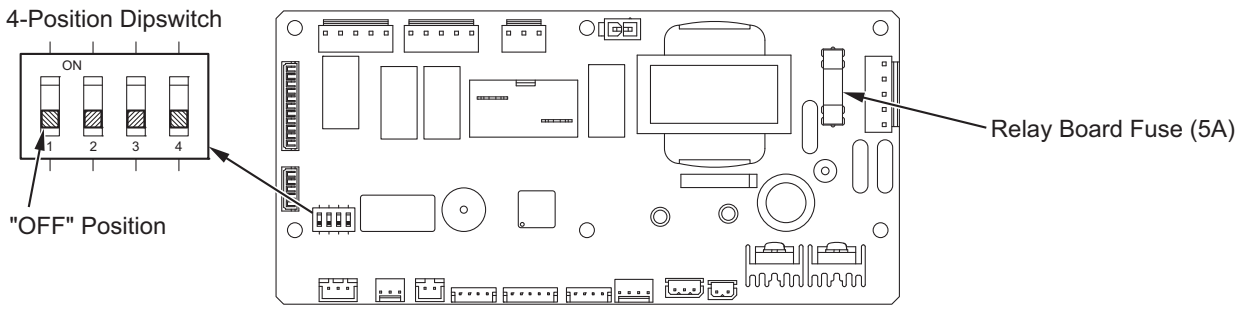
⚠ CAUTION

Failure to use the exact type of fuse could result in damage to the unit and/or to components. It could also void the warranty of the unit.

(2) Dip switch setting

- The controller is equipped with a four position dip switch that defaults in the OFF position. The dip switch can be set to configure the following functions:

Switch	Setting Name	Function
DSW4	Alarm Setting	When DSW 4 is ON, the buzzer sound function is disabled.
DSW3	Compressor Time Delay Cut	When DSW 3 is ON, the compressor delay timer function is disabled.
DSW2	Cooling Test Operation	When DSW 2 is ON, the compressor, evaporator and condenser fan motor will turn ON. This function is used for test purposes and verification.
DSW1	Discharge Air Test Operation	When DSW 1 is ON, the evaporator and condenser fan motor will turn ON. This function is used for test purposes and verification.



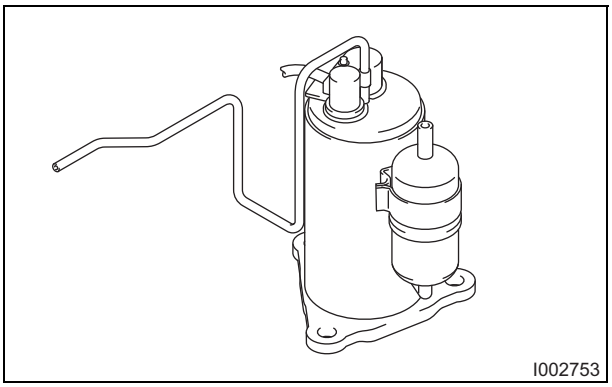
6.7 Compressor

(1) 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
- Rated Output: 890 W

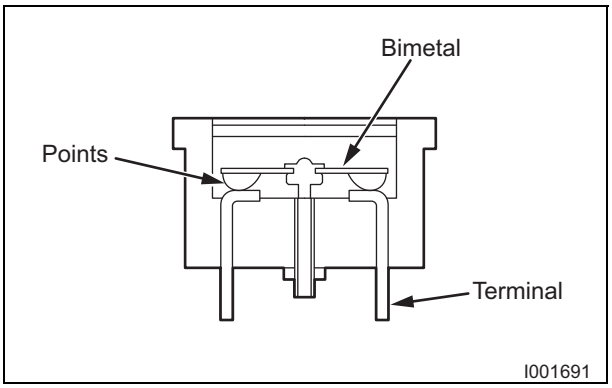


(2) Compressor overload relay

- 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.

Specifications:

	Temperature	Overcurrent
Contact Open	302°F (150°C)	17 A 30 min (at 212°F (100°C))
Contact Close	142°F (61°C)	



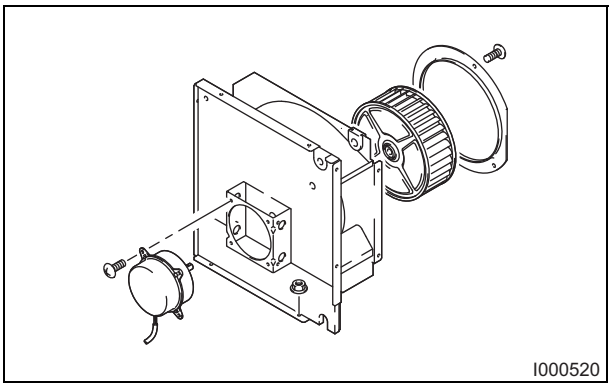
6.8 Fan Motor

(1) Indoor Fan Motor

• The indoor fan motor is a single phase, induction type two-speed motor.

Specifications:

- Rated Voltage: 115 V, 60 Hz
- Rated Output: High - 41.28 W, Low - 12.08 W
- Rotational Speed: High - 1018 rpm, Low - 671 rpm


I000520

< NOTE >

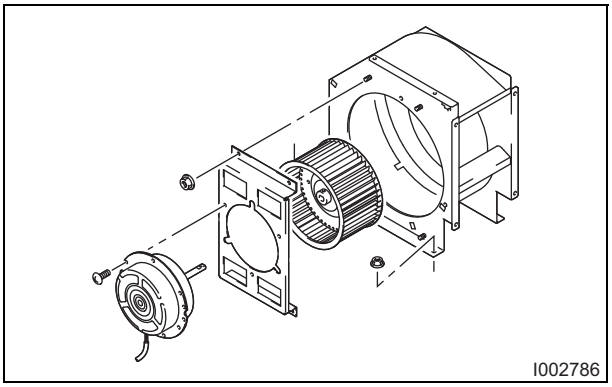
An internal overload relay is used to protect the fan motor. This relay is built into the fan motor and interrupts the flow of current when there is an over current situation, or if abnormally high temperature builds up in the fan motor.

(2) Outdoor Fan Motor

• The outdoor fan motor is a single phase, induction type two-speed motor.

Specifications:

- Rated Voltage: 115 V, 60 Hz
- Rated Output: High - 99.6 W, Low - 27.3 W
- Rotational Speed: High - 1100 rpm, Low - 697 rpm

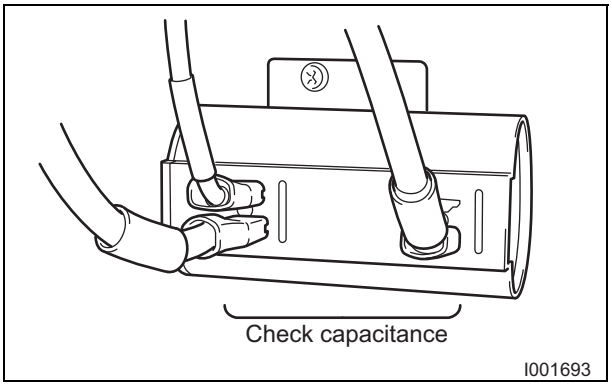

I002786

< 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.

6.9 Capacitor

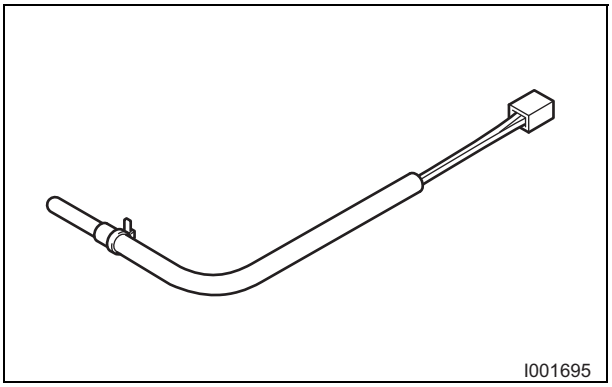
- The capacitor is used to improve the rotational power of the fan motors and compressor at startup. The specification for each capacitor is shown below.



Capacitor	Rated Voltage	Capacitance
Indoor Fan Motor	250 V	7 µF
Outdoor Fan Motor	220 V	9 µF
Compressor	370 V	60 µF

6.10 Temperature Thermistor

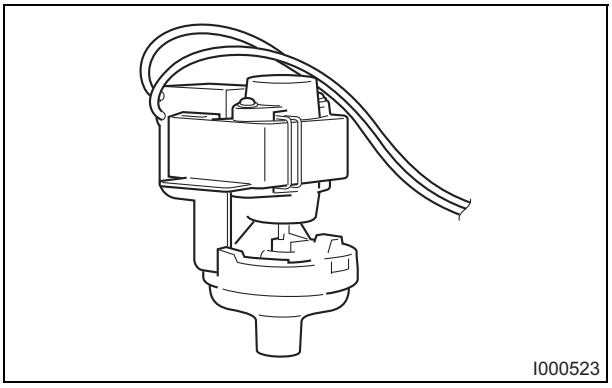
- The room thermistor (RTS) is installed upstream of the evaporator, and detects evaporator inlet temperature as a resistance value.
- The freeze protection thermistor (CTS) is installed in the evaporator outlet piping, and detects low temperature on the evaporator as a resistance value.



Type	Specification		
	Characteristic	“Short” Detection	“Open” Detection
Room Thermistor (RTS)	5 k ohm at 77 °F (25 °C)	181 °F (83 °C) or more	-29 °F (-34 °C) or less
Freeze Protection Thermistor (CTS)	5 k ohm at 77 °F (25 °C)	181 °F (83 °C) or more	-29 °F (-34 °C) or less

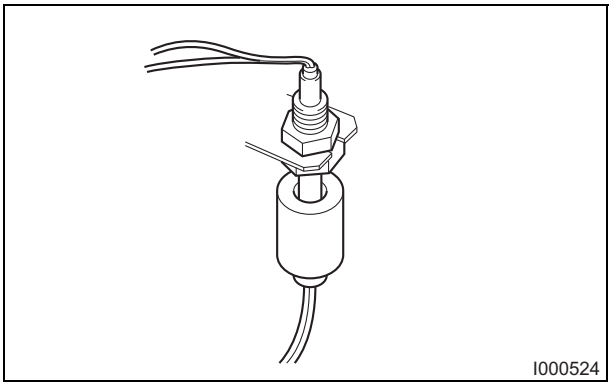
6.11 Drain Pump

- The drain pump evacuates evaporator condensation accumulated in the drain pan. Drain pump operation is coupled with compressor operation.



6.12 Float Switch

- A float switch is installed in the drain pan. The float switch is a normally closed type switch. If evaporator condensation cannot be evacuated and the drain pan becomes full, the float rises, turning the switch OFF, which then halts relay CM 12 operation. This prevents the drain pan from overflowing and alerts the user of an abnormality.


I000524

7. TROUBLESHOOTING

7.1 Troubleshooting Chart

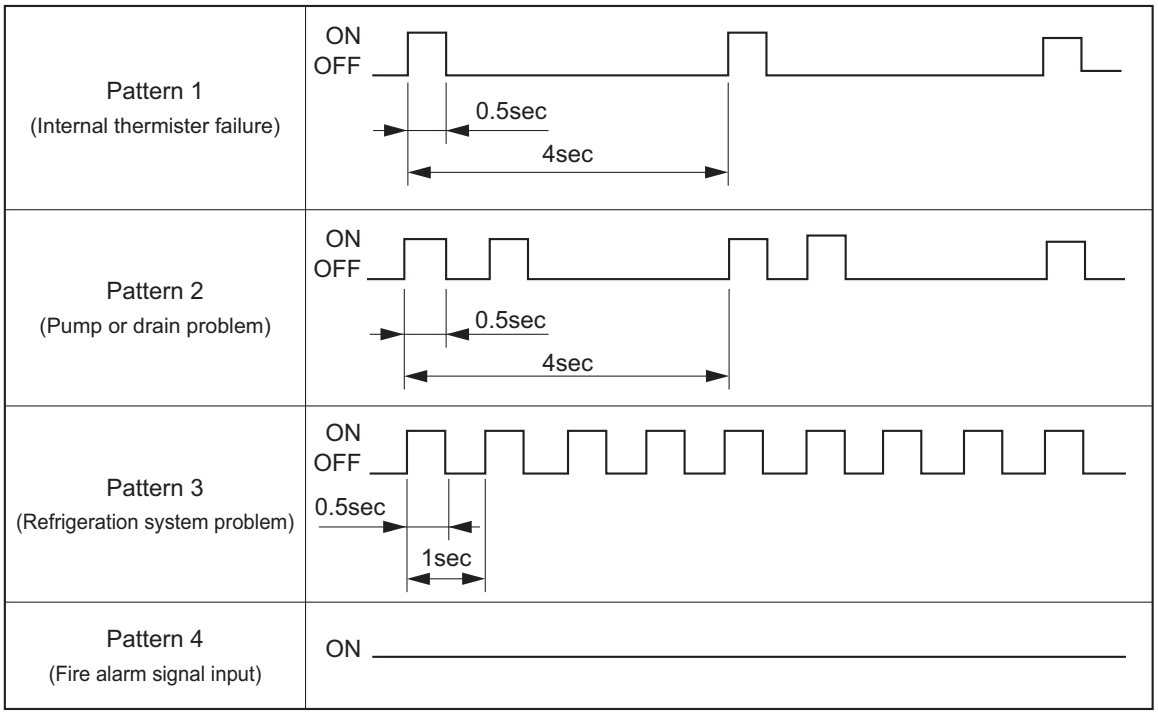
Condition	Possible Cause	Remedy
Unit does not operate.	1. Power supply is off.	Check circuit breaker.
	2. Power interruption.	Unit will turn on automatically when power returns (some thermostats require resetting.)
	3. Air duct blockage.	Check duct for any blockage or excessive kinks.
	4. OFF signal input.	Check for OFF signal input (fire alarm control panel.)
	5. Override (Stop) switch is active	Ensure the switch is in the “OPERATE” position.
	6. Battery depleted by the thermostat.	Change battery.
Insufficient cooling / Unit operation interrupted frequently.	1. Condenser air intake or outlet blockage in the ceiling.	Check for any blockages in the ceiling.
	2. Dirty condenser core surface.	Clean condenser core surface.
	3. Dirty / blocked filters.	Clean / replace air filter.
	4. Excessive evaporator air ducting.	Evaporator ducting should not exceed 30’ and bend radius should be larger than twice the duct diameter.
	5. Condenser air intake or outlet blockage in the ceiling.	Remove the blockage.
	6. Outside operating range.	Use within operating temperature range.
Beeping / Alarm coming from unit and unit stopped. (Buzzer sound pattern indicated on page 31)	1. Internal thermistor failure (Sound pattern 1)	Replace internal thermistor.
	2. Pump or drain problem (sound pattern 2)	Check drain connection. Check for blockage, kink or bend in drain hose.
	3. Refrigeration system problem (sound pattern 3)	Check for leakage. Check compressor relay. Check for refrigerant blockage.

7.2 Alarm

- An alarm is emitted when a system abnormality is detected, stopping the system. The type of abnormality can be recognized by the alarm pattern.
- The CM 12 controller is equipped with a warning signal output-type relay (Form-C, normally open dry contact), which can be used for monitoring the CM 12 abnormality conditions. The relay contactor is closed when the following conditions have occurred:
  - Temperature sensor failure
  - Condensation overflow
  - Cooling function failure
- The relay output is rated for 5 A at 30 VDC or 5 A at 250 VAC (resistive load). The relay can be used to connect to warning devices with compatible outputs such as alarm speakers, light indicators, etc.

< NOTE >

However,when dipswitch no. 4 on the relay board is OFF, an alarm will not sound.



Alarm Pattern	Cause	Detection Details	Alarm Clear Method
1	Temperature sensor failure (Thermistor short / failure)	When an abnormality is detected in either RTS, CTS, or ODS. Detection value: Below 136.5 k ohm (93.2 °F (34 °C)) or above 566 k ohm (181.4 °F (83 °C)).	Unplug the unit and plug it back in. or Reset the power from the breaker.
2	Condensation overflow (Water leak detection)	When the float switch is OFF continuously for 60 sec.	Unplug the unit and plug it back in. or Reset the power from the breaker.
3	Cooling function failure (Refrigeration cycle abnormality)	When the following occurs 3 times. When 20 min from the start of operation has elapsed, RTS - CTS < 23 °F (5 °C) continuously for one minute.	Unplug the unit and plug it back in. or Reset the power from the breaker.
4	Fire alarm	When receiving fire alarm signal input.	Reset the power source or turn the wall thermostat off and on.

7.3 Basic Inspection

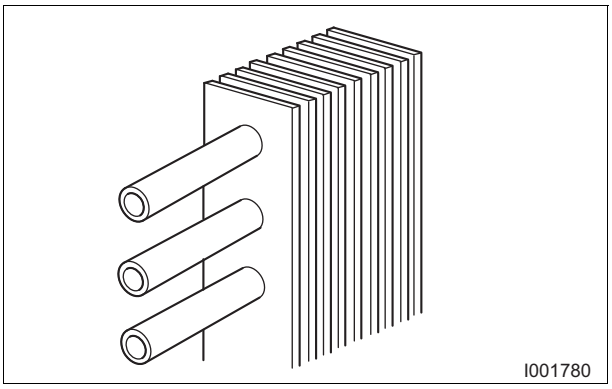
- Perform the following inspections before disassembly.

(1) Power supply voltage inspection

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

(2) Inspection of plate fins

- 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.

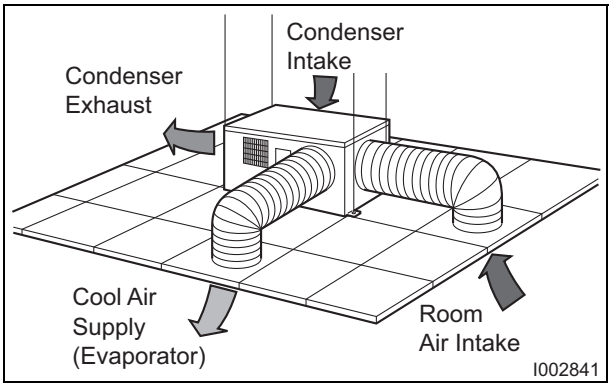


(3) Operating environment inspection

- 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.

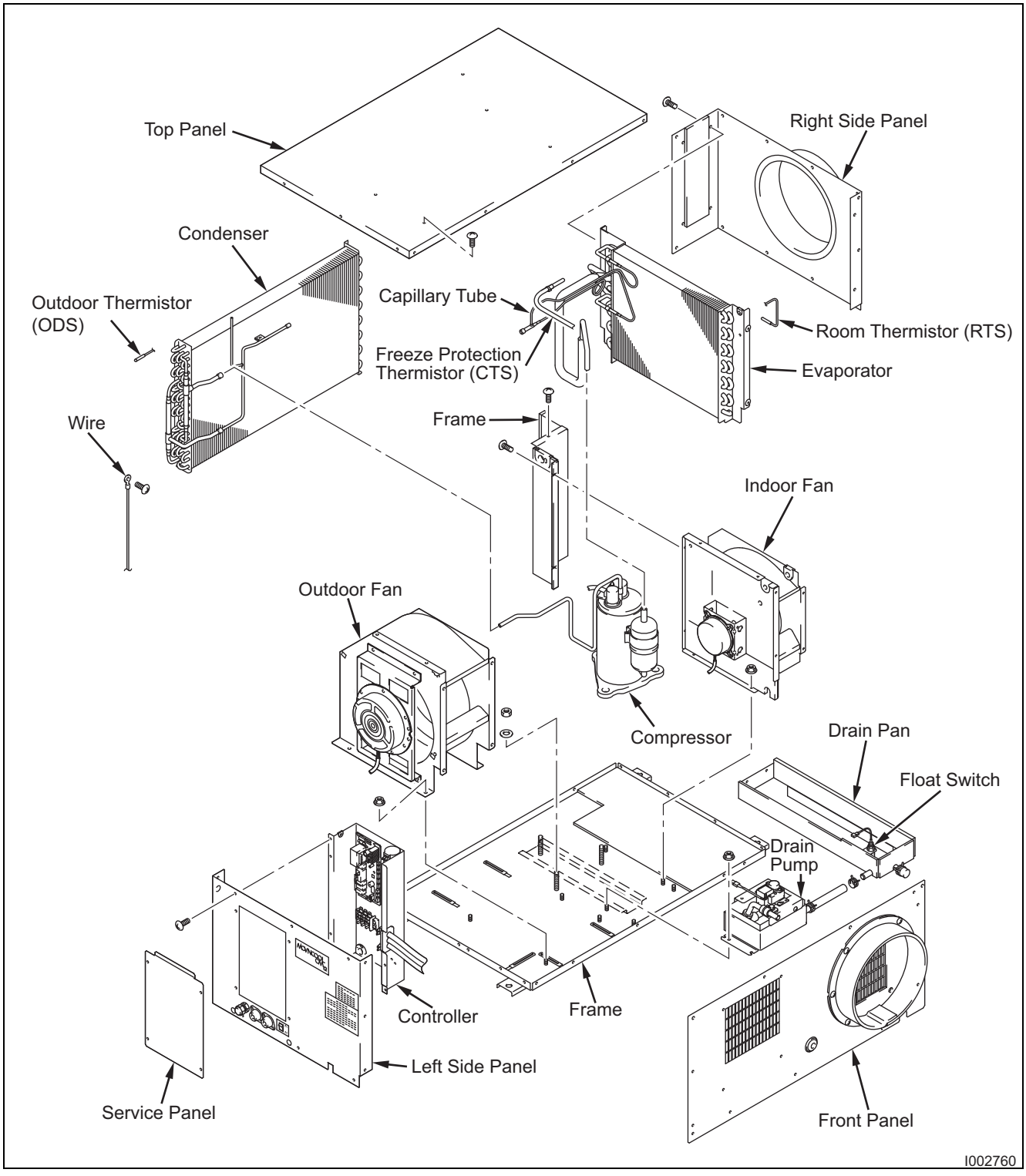
(4) Operating environment examination

- Measure the temperature difference between the evaporator inlet and the cooling air duct outlet. If the difference is out of the range shown in the graphs on page 14, proceed with the remedy suggested in the troubleshooting chart on page 30.

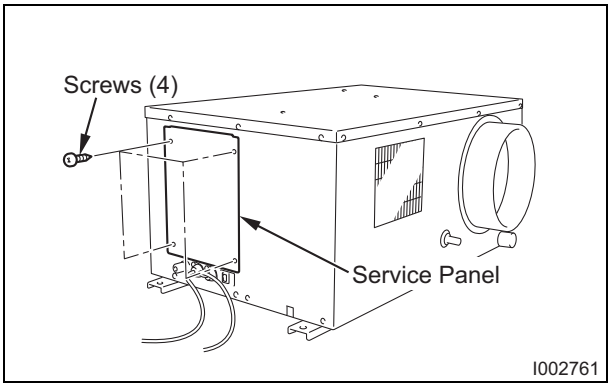


8. DISASSEMBLY

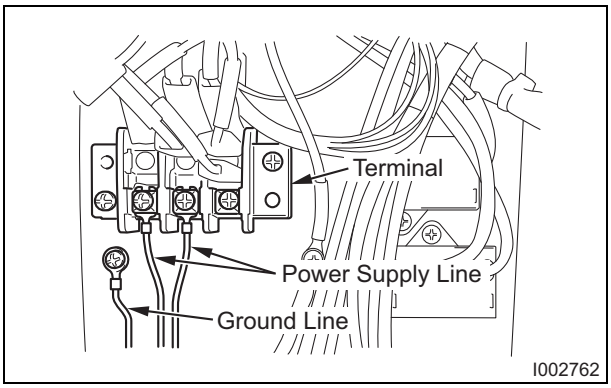
8.1 Parts Construction



8.2 Disassembly



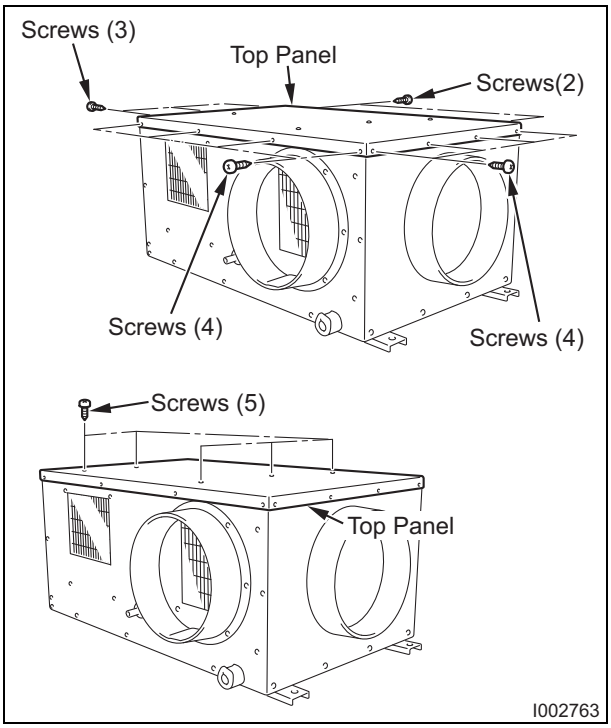
1) Take out the four (4) screws, and then remove the service panel.



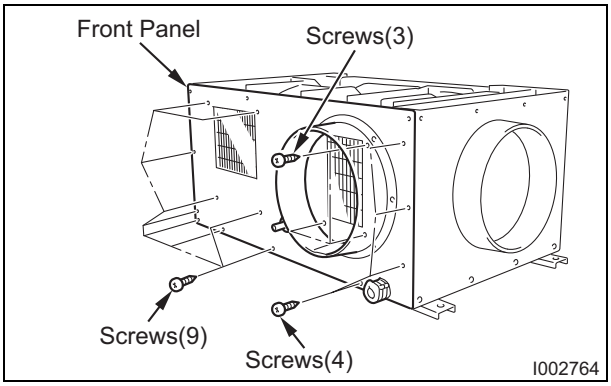
2) Disconnect the two power supply lines from the terminal, and disconnect the ground line.

⚠ CAUTION

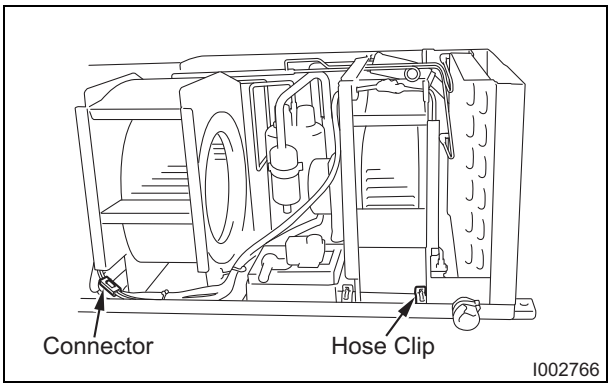
- Ground tightening torque:
  - 0.74 ± 0.15 ft•lbf (1.0 ± 0.2 N•m)



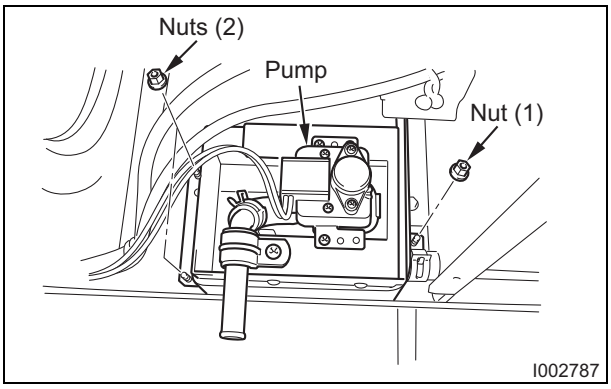
3) Take out the eighteen (18) screws, and then remove the top panel.



4) Take out the sixteen (16) screws, and then remove the front panel.

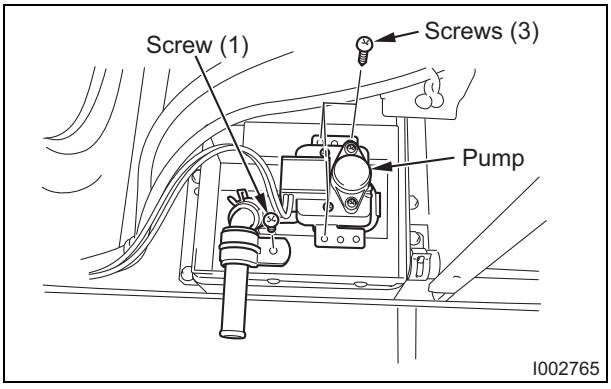


5) After disconnecting the relay connector (white, two-pin), please remove the drain pump referring to pattern 1 or 2.



Pattern 1 :

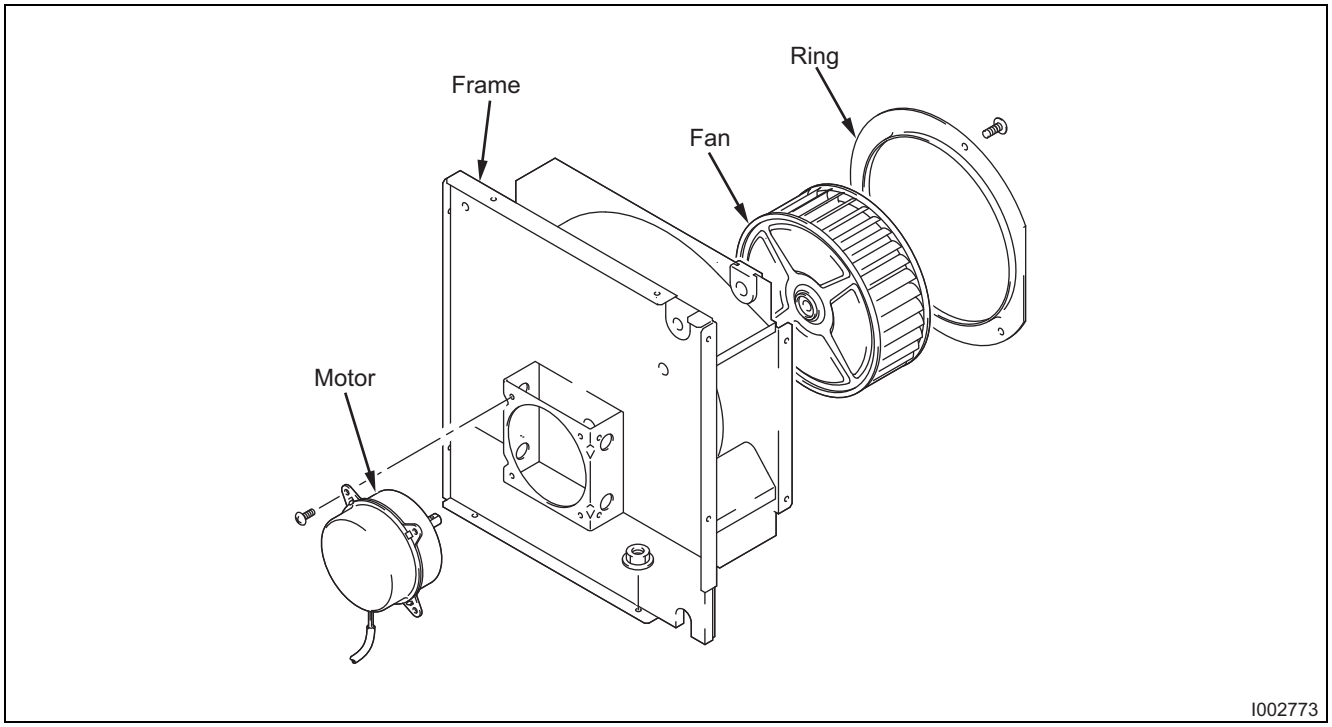
Take off the three (3) nuts, and remove the hose clip, and remove the drain pump assy.

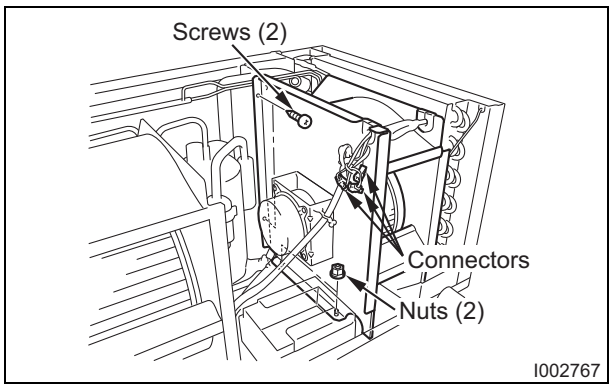


Pattern 2 :

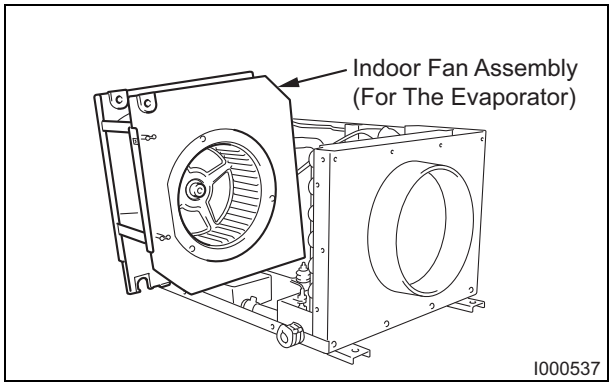
Take out the four (4) screws, and remove the drain pump.

8.3 Removal of Indoor Fan Assembly (for Evaporator)

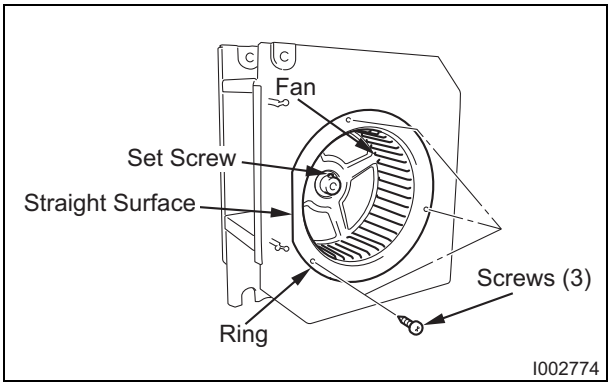




1) Disconnect the three connectors (two white, two-pin connectors; one white, three-pin connector), and then take out the two (2) screws and the two (2) nuts.



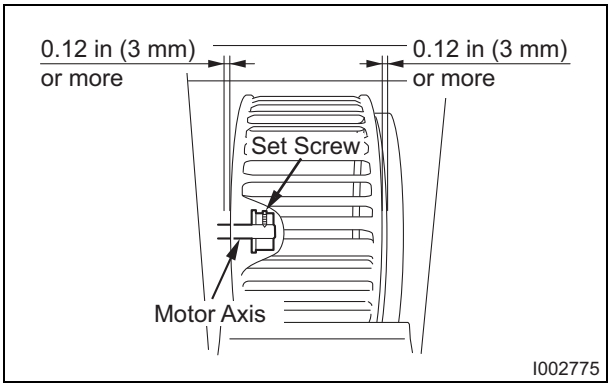
2) Disconnect the motor connector (white, six-pin) from circuit board CN23, and remove the indoor fan assembly (for the evaporator).



3) Take out the three (3) screws, and then remove the ring. Loosen the set screw with an Allen wrench and remove the fan.

⚠ CAUTION

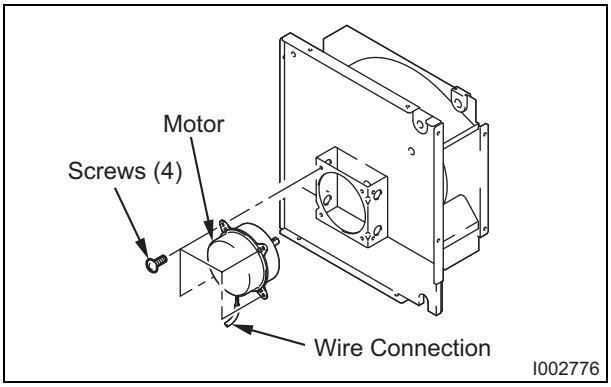
When assembling the ring, ensure that the straight surface of the ring is facing forward.



4) When assembling the fan, ensure that the screws align with the motor axis positioning holes.

⚠ CAUTION

- Tightening torque:
  - 3.7 ± 1.1 ft•lbf (5.0 ± 1.5 N•m)
- Verify the clearance between the fan and case ring. After installing the fan and fan motor, ensure that the clearance between the fan and case ring is at least 0.12 in (3 mm).

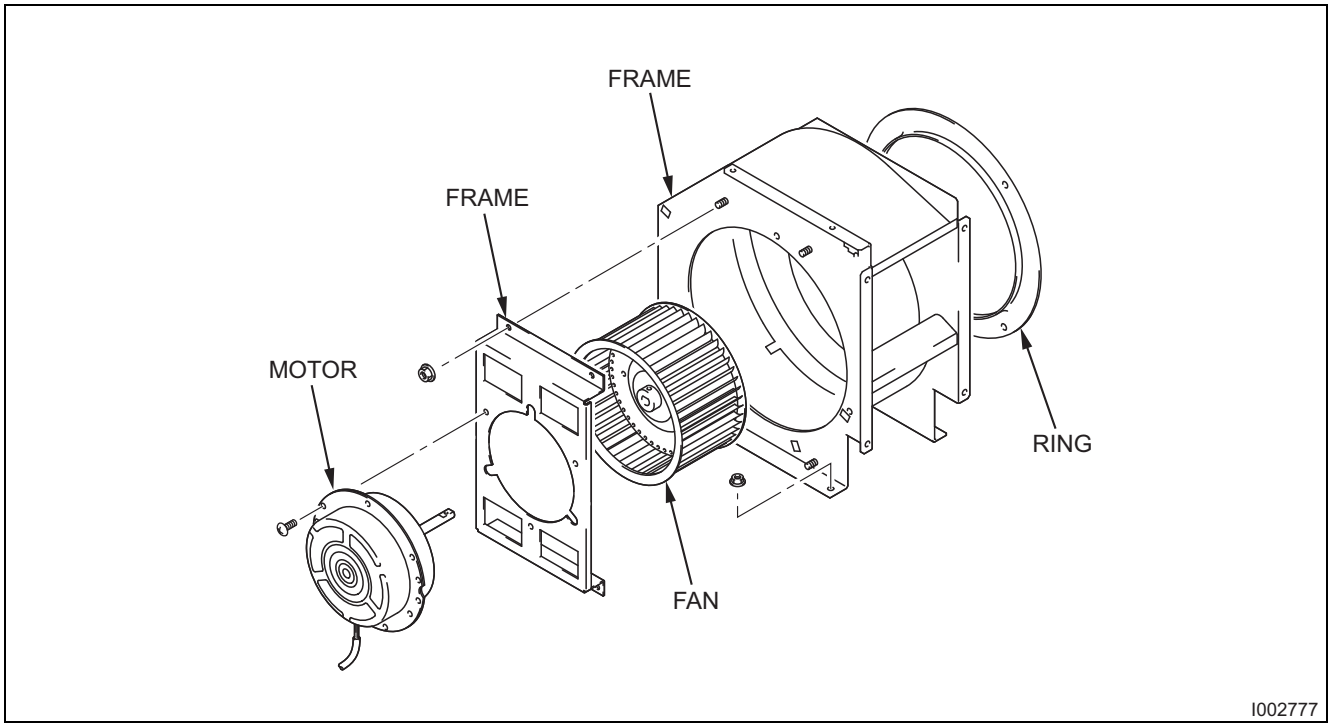


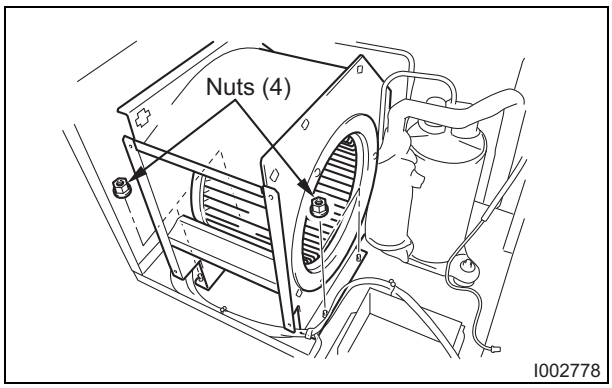
5) Take out the four (4) screws, and then remove the fan motor.

⚠ CAUTION

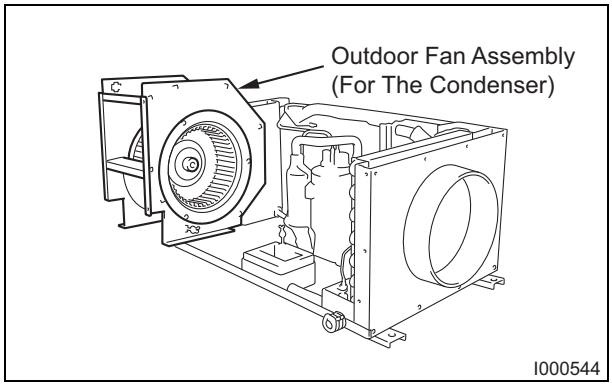
When assembling the motor, ensure that the wire connection ends are facing down.

8.4 Removal of Outdoor Fan Assembly (for Condenser)

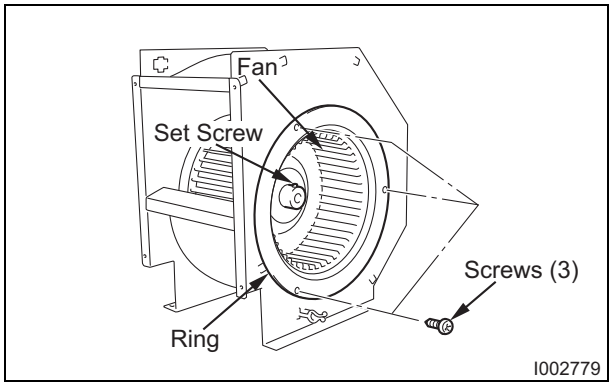




1) Take off the four (4) nuts.



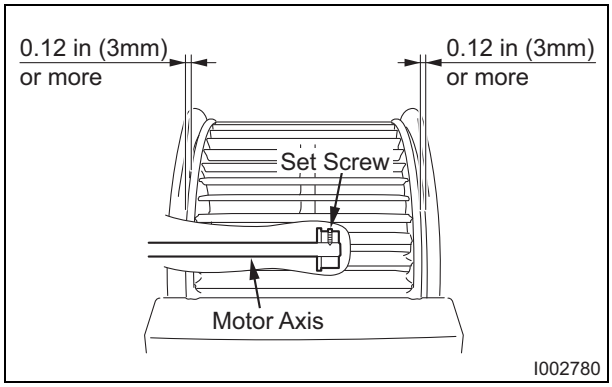
2) Disconnect the motor connector (white, six-pin) from circuit board CN22, and remove the indoor fan assembly (for the condenser).



3) Take out the three (3) screws, and then remove the ring. Loosen the set screw with an Allen wrench and remove the fan.

⚠ CAUTION

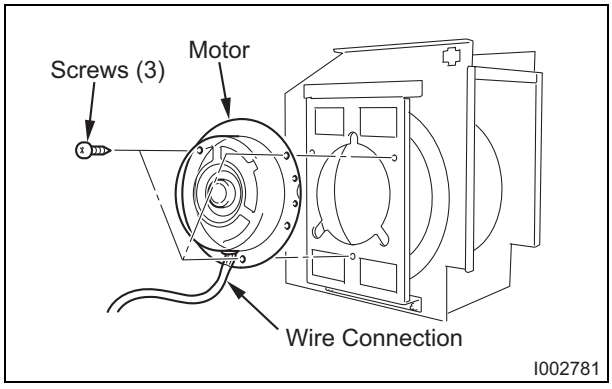
When assembling the ring, ensure that the straight surface of the ring is facing forward.



4) When assembling the fan, ensure that the screws align with the motor axis positioning holes.

⚠ CAUTION

- Tightening torque:
  - 10.80 ± 2.17 ft•lbf (14.7 ± 3.0 N•m)
- Verify the clearance between the fan and case ring. After installing the fan and fan motor, ensure that the clearance between the fan and case ring is at least 0.12 in (3 mm).

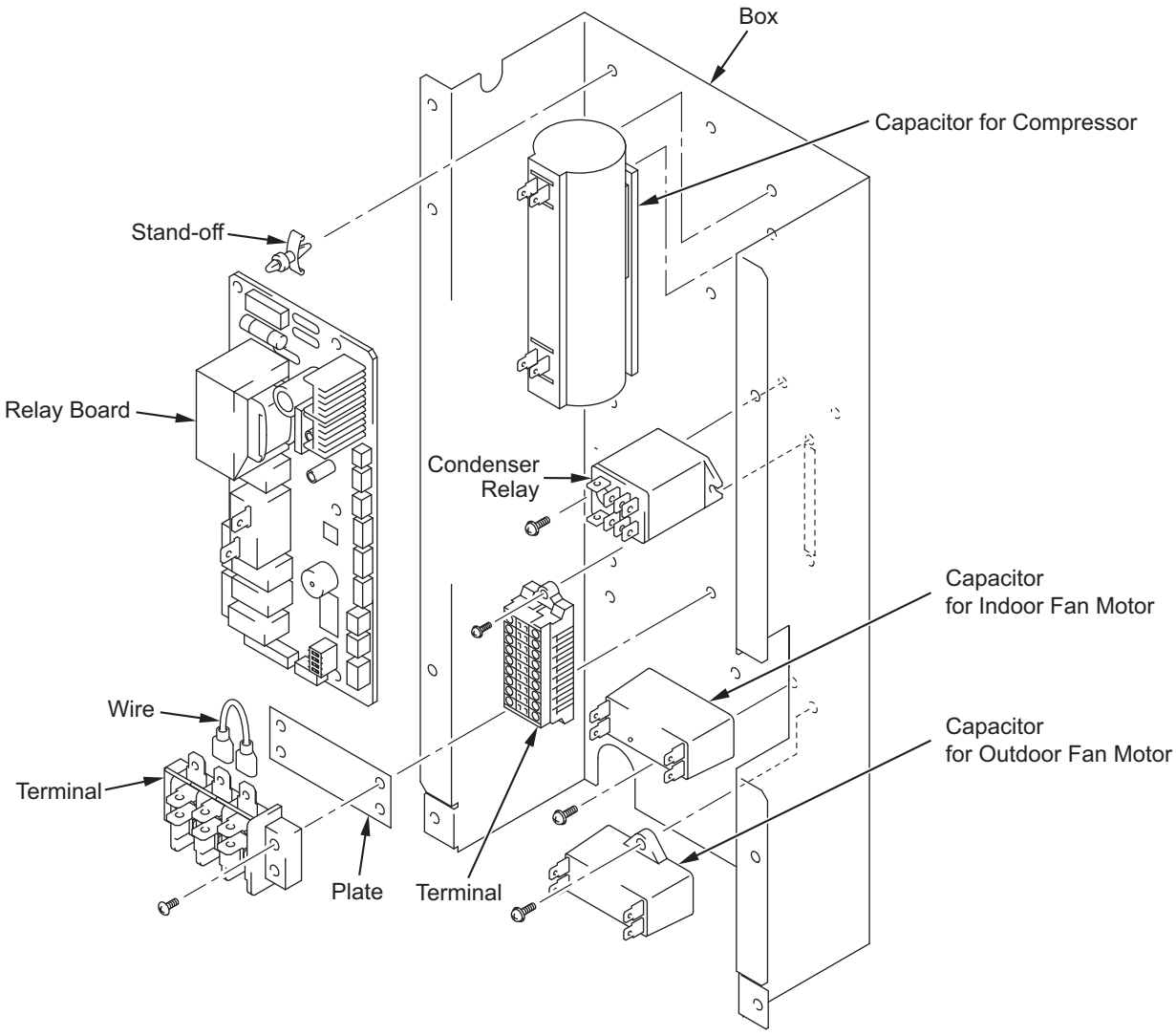


5) Take out the three (3) screws, and then remove the fan motor.

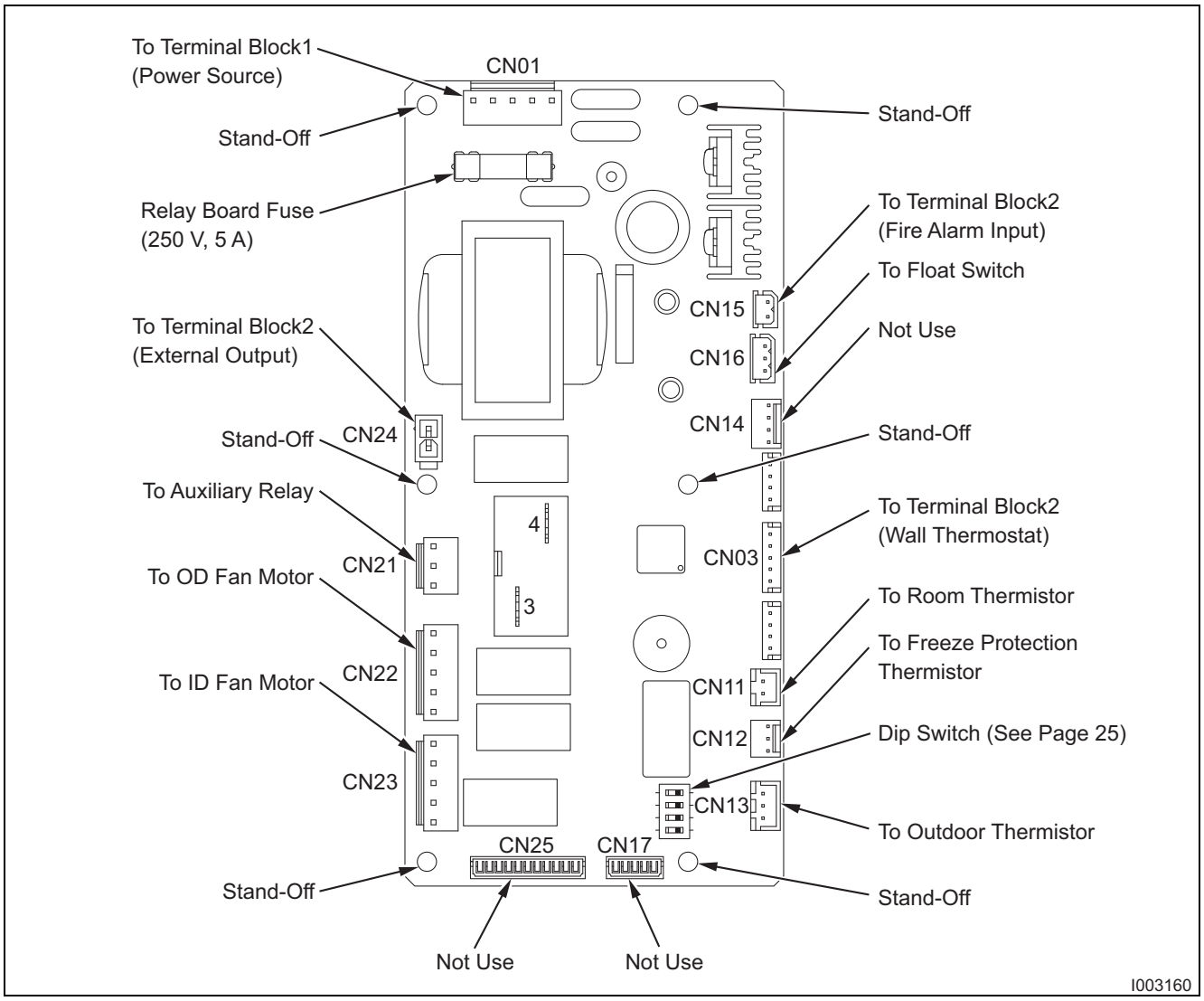
⚠ CAUTION

When assembling the motor, ensure that the wire connection ends are facing down.

8.5 Removal of Electrical Parts



(1) Relay Board



1) Disconnect the power at the source.
2) Take out the four (4) screws, and then remove the service panel. (See page 35.)
3) Disconnect all connectors from relay board (11 connectors, two connections on the relay and ground wire). Refer to the figure “Relay Board” to identify the relay connections and the connectors marked as CN##. (To ensure easy reinstallation, be sure to label each connector wire as you remove them)
4) Remove relay board from plastic stand-off (6 locations). Use needle nose pliers to squeeze all the stand-offs before removing the relay board.
5) Replace the new relay on existing stand-off (Make sure all stand-offs are aligned horizontally). Change the stand-off if damaged during removal process. Make sure that the dip switches on the new relay board are all set to off positions.

6) Reconnect all 11 connectors to the new relay board and make sure connector label 52CM3 is connected to terminal #3 and connector label 52CM4 is connected to terminal #4 of the relay. Also, connect the ground wire and make sure they are all properly connected. Refer to the figure “Relay Board” to identify the connectors that need to be connected.
7) Reconnect the power at the source and turn on the unit to verify the function and operation of the unit. Turn off the unit.
8) Close the service panel and secure with four (4) screws.

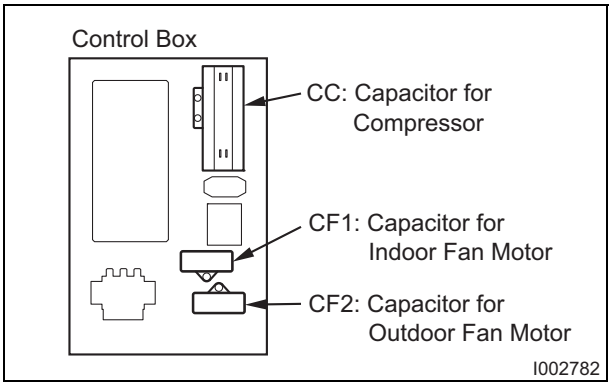
< NOTE >

- Please use the following procedure in case there is no room to remove and replace the relay board.
  - After perform above 1) to 2), Take out the eighteen (18) screws, and then remove the top panel.

8.6 Inspection of Capacitor (For Fan Motor and Compressor)

(1) Ohm-meter 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 28, test the capacitor for the value indicated. If the value tested is not within 10 % of indicated capacitance, replace the capacitor.

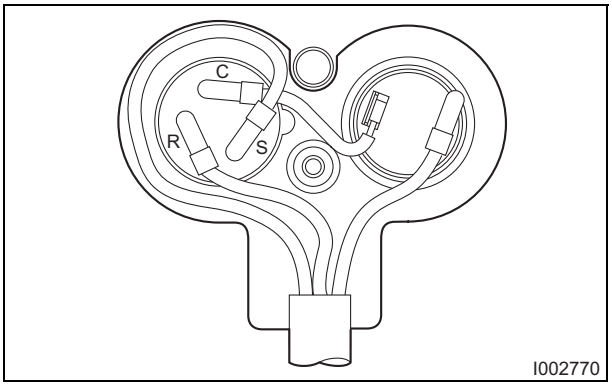
Capacitor Application	Voltage	Rating Capacitance
Indoor Fan Motor	250 V	7 µF
Outdoor Fan Motor	220 V	9 µF
Compressor	370 V	60 µF

⚠ 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.**

8.7 Inspection of Compressor

(1) Compressor motor

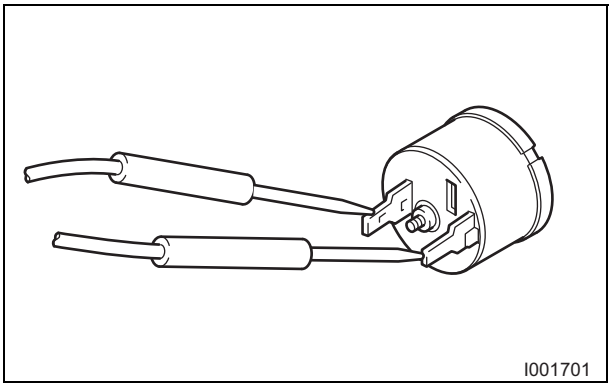


- Measure resistance across the terminals of the compressor motor.
- Between terminals (at 77 °F (25 °C))
  - R-C Approx. 0.49 - 0.8 ohm
  - C-S Approx. 1.9 - 3.3 ohm
- If the measured resistance is not equal to the standard values listed above, replace the compressor. The compressor has an external overload relay. The overload relay should be operational if the above resistance is obtained under normal temperature. For overload relay specifications, see chart on page 26.

(2) Overlord relay

- Check for continuity across two terminals of the overload relay. At normal temperature, there should be continuity across the terminals.

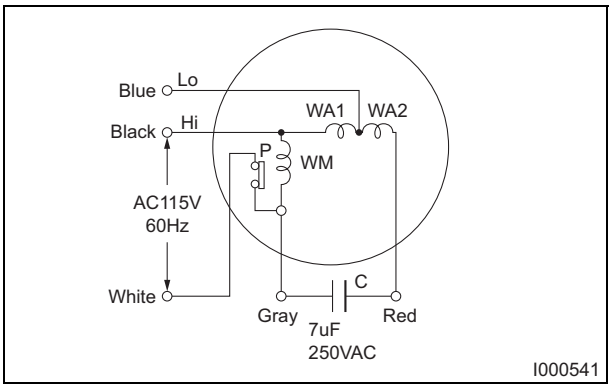
Operating Temperature	
OFF (open contacts)	ON (closed contacts)
302 °F (150 °C)	142 °F (61 °C)



- If there is no continuity across the terminals, replace the overload relay.

8.8 Inspection of Fan Motor

(1) Indoor fan motor



- Measure resistance across the terminals of the fan motor.
- Terminals (at 68 °F (20 °C))
  - Black-White Approx. 35.5 ohm
  - Black-Blue Approx. 23.35 ohm
  - Black-Red Approx. 28.23 ohm
- If the measured resistance is not equal to the standard values listed above, replace the fan motor.

(2) Outdoor fan motor

- Measure resistance across the terminals of the fan motor.
- Between terminals (at 68 °F (20 °C))
  - Black-White Approx. 15.38 ohm
  - Black-Blue Approx. 12.59 ohm
  - Black-Red Approx. 13.09 ohm
- If the measured resistance is not equal to the standard values listed above, replace the fan motor.

8.9 Inspection of Thermistor

- Using an Ohm-meter, check the resistance value across the 2-pin connector. At normal temperature (77 °F (25 °C)) all thermistors (room, freeze, or outdoor) should measure approximately 5 k ohm.

8.10 Inspection of Wiring Connection

- Refer to the wiring diagrams on page 20 and check the connection of each wire.

⚠ CAUTION

Secure the wires using clamps to prevent contact with the edges of the structure, etc. Secure the wires in the same position as prior to removal.

8.11 Inspection

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

(1) Inspection of clogged system

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

(2) Inspection of refrigerant leak

- Carefully check all connections, and each component for leaks whenever the refrigerant system is installed or repaired. Use an electronic gas leak tester to inspect the system. (See page 48 to 57.)

(3) Insufficient refrigerant

- In case the unit is judged to be deficient in cooling capacity, make to perform the inspections on page 48. 9.1 (1) and page 48. 9.1 (2) to confirm the cause of trouble. Following this, charge the system with refrigerant.

9. REFRIGERANT SYSTEM REPAIR

9.1 Repair of Refrigerant System

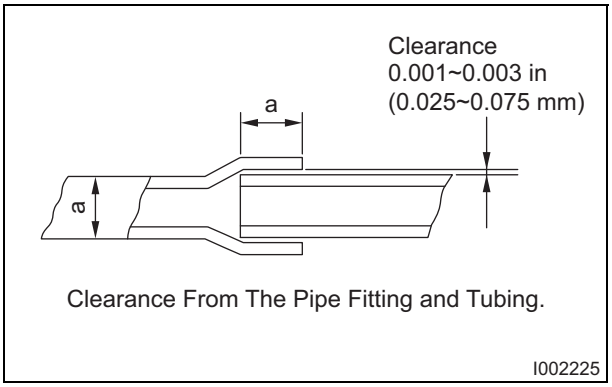
- In case there is a leak, obstruction, or trouble in the refrigerant system, replace or repair the part in question. After replacing any component all connections must be brazed.

(1) Proper brazing techniques

- It is desirable to use a slightly reducing 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.

I002225

(3) Cleaning brazing filler metal and pipe

- When the refrigerant 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

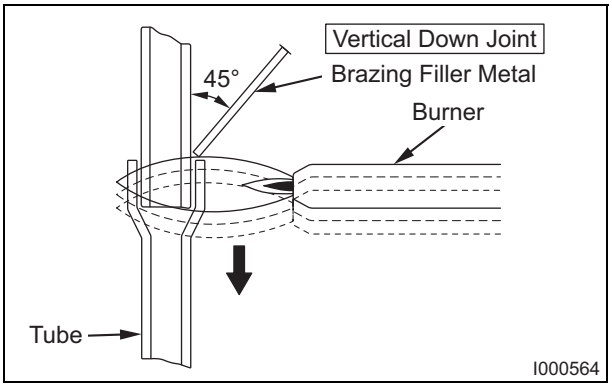
- During brazing, the inside of the pipe undergoes an oxidative reaction due to the brazing flame. Introduce dry nitrogen gas (0.3 gal/min (1 L/min); adjust with the flow regulator) through the pinch-off tube of the refrigerant.

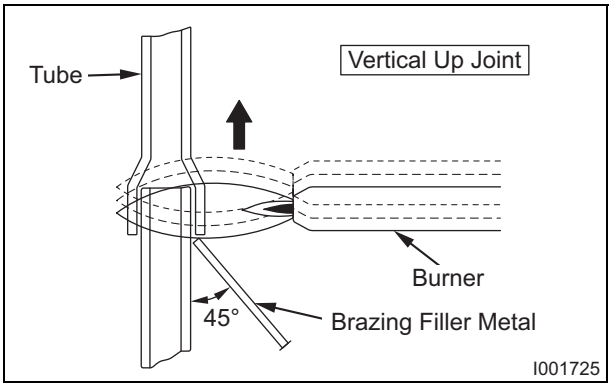
< NOTE >

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

(5) Vertical joints

- 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.





9.2 Removal of Refrigerant System Components

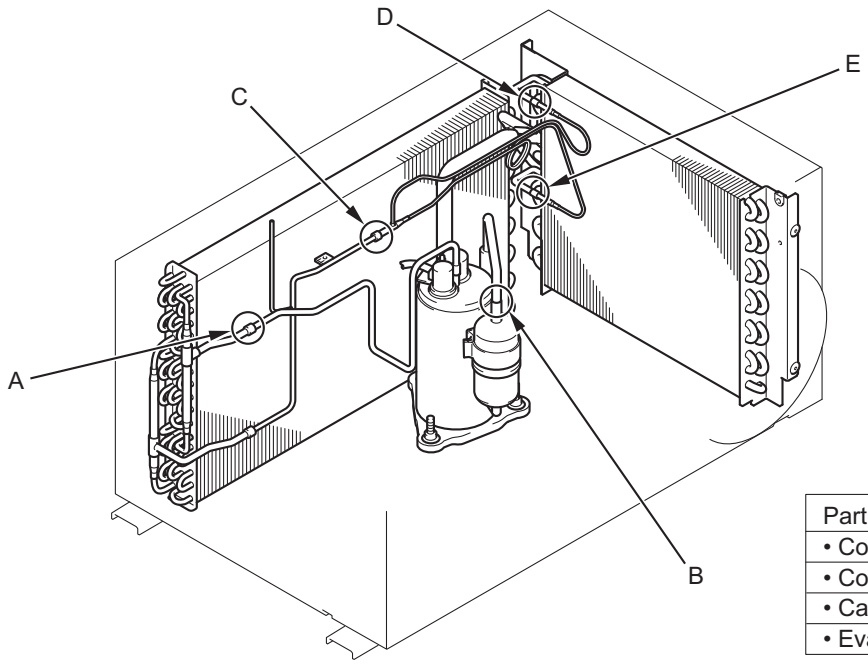
⚠ CAUTION

- Before any refrigeration cycle component can be replaced, it is necessary to recover the refrigerant using standard recovery procedures and equipment.
- To prevent oxidation, dry nitrogen should be conducted (flow rate 0.3 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.

- Evaporator
- Capillary tube
- Condenser
- Compressor

< NOTE >

Hold the compressor body, not the tube, when carrying the compressor.



Part to Replace	Disconnect at
• Compressor	A & B
• Condenser	A & C
• Capillary Tube	C & D& E
• Evaporator	B & C

I002771

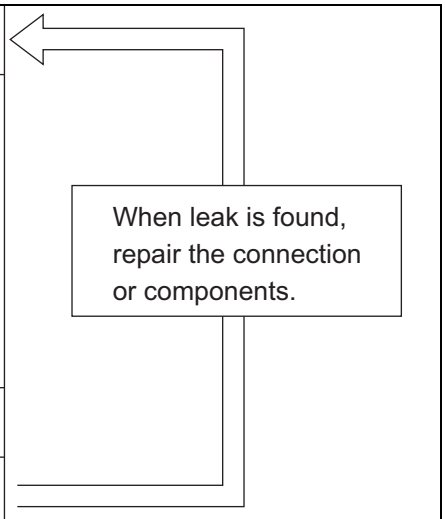
9.3 Charging the System with R-410A Refrigerant

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

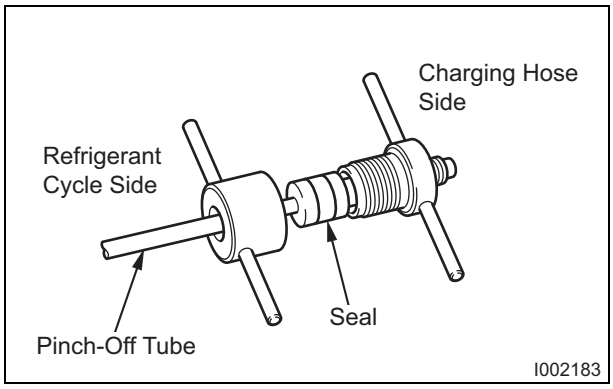
⚠ WARNING

- **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.**
  - **Be careful 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 min or more. • 30 inHg (100 kPa) or more of vacuum. 2) Stop evacuating the system. • Leave for 5 min. 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 specifications on page 12.
Step 6	Remove manifold gauge.

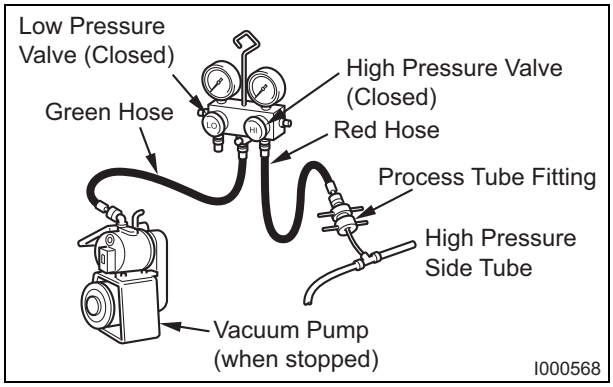


(1) Connection of gauge manifold



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

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



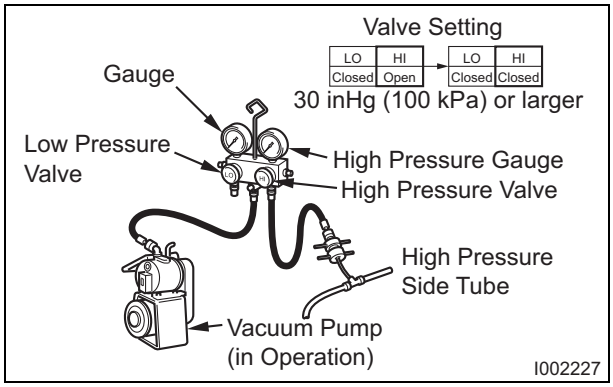
3) Connect the charging hoses (red-high pressure side) for the gauge manifold to the process tube fitting.

< 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

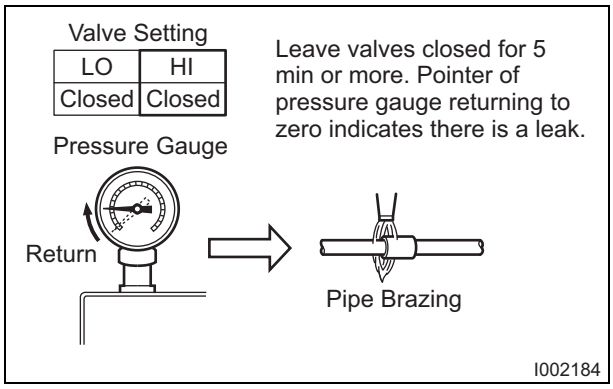


1) Open the high pressure valve (HI) of the gauge manifold.

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

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

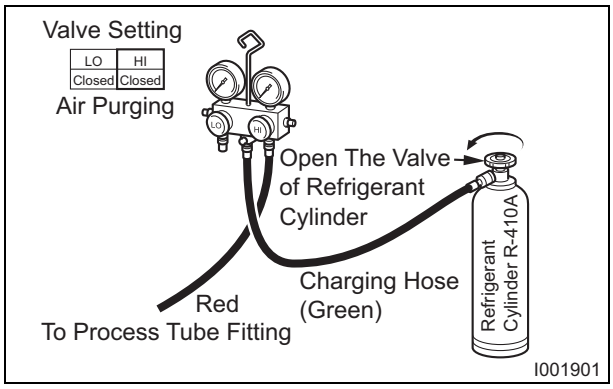
(3) Checking vacuum

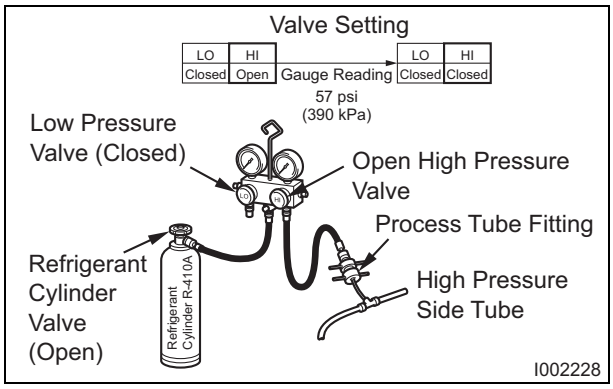


1) Leave the high pressure valve and the low pressure valve of the gauge manifold closed for five min or more, and confirm that the gauge pointer does not return to zero.

2) If the gauge pointer returns gradually to zero there is a leak somewhere in the system (this could also include gauge manifold). Perform a leak check according to the procedure indicated in the next step. Once the leak has been found and repaired, evacuate the system and confirm it will hold a 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 the refrigerant cylinder and 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 high pressure gauge indicates 57 psi (390 kPa). After charging is complete, close the high pressure valve.

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

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

7) Repair any leak.

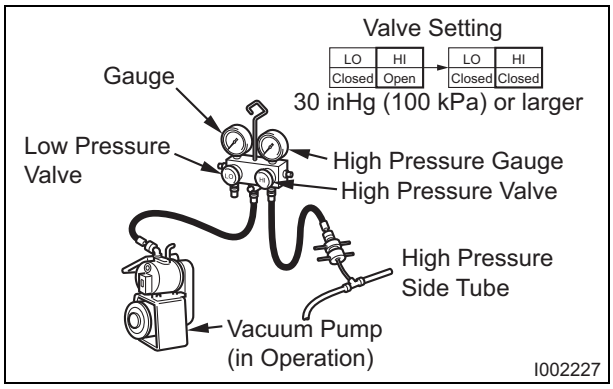
⚠ WARNING

Do not attempt any repair on a charged system.

⚠ 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 high pressure gauge indicates 30 inHg (100 kPa) or larger. (For 15 min or more.)

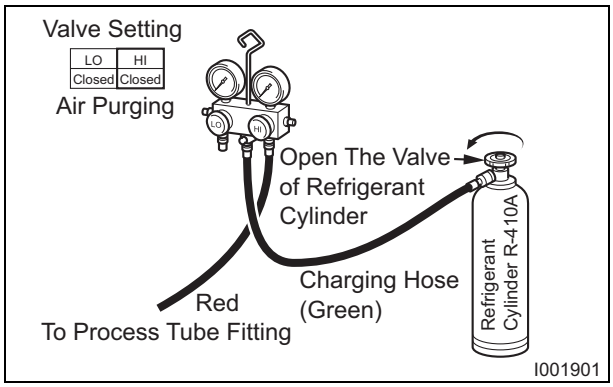
3) After evacuation is complete, close the high pressure valve of the gauge manifold.

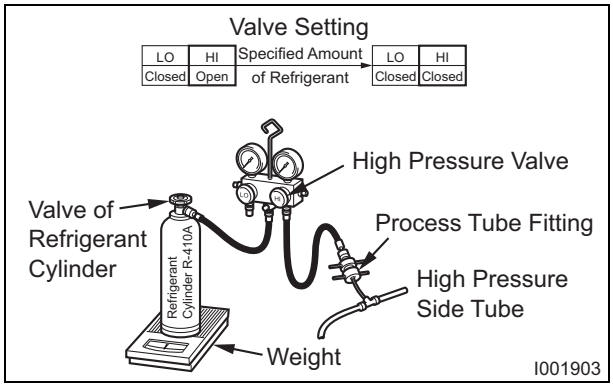
⚠ CAUTION

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.

9.4 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.

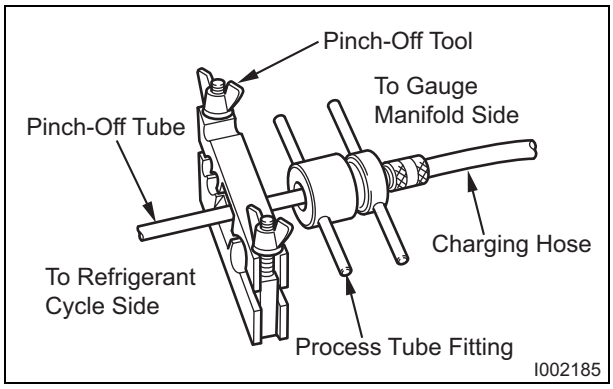
Standard Amount of Refrigerant:1.23 lb (0.56 kg)

⚠ 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.

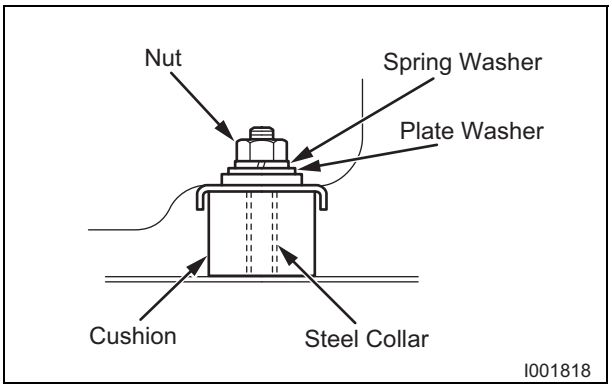
10. REASSEMBLY

10.1 Removal 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.

10.2 Compressor Mounting

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



10.3 Indoor Fan Assembly

- Install indoor fan. Allow a clearance of 0.12 in (3.0 mm) or more on each side of the indoor fan. (See page 38.)

10.4 Outdoor Fan Assembly

- Install outdoor fan. Allow a clearance of 0.12 in (3.0 mm) or more on each side of the outdoor fan. (See page 40.)

10.5 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.

10.6 Perform the Inspection

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

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