

# Rooftop Air Conditioner

## Installation and Operation Manual



### **WARNING**

This manual must be carefully read and understood before installation, adjustment, repair or maintenance. The equipment must be installed by qualified technicians. Transformation of this product is an extremely dangerous operation, which may lead to personal injury or property loss. Important: please keep this manual with the product.

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# 1 Safety Information

## 1.1 Safety Definitions

This manual has safety information and instructions to help you eliminate or reduce the risk of accidents and injuries.



### DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



### WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.



### CAUTION

Indicates a hazardous situation which, if not avoided, could result in property damage and minor or moderate injury.



### NOTICE

This symbol indicates important information where there is no risk to people or property.

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety.

Children should be supervised to ensure that they do not play with the appliance.

- That the appliance shall be installed in accordance with national wiring regulations.

## 1.3 Supplemental Directives



A2L Appliance filled with flammable gas R32.



Before install and use the appliance, read the owner's manual first.



Before install the appliance, read the installation manual first.



Before repair the appliance, read the service manual first.

## 1.2 Information introduction

This air conditioner (hereinafter referred to as "unit" or "product") is designed and intended for installation on the roof of a Recreational Vehicle (hereinafter referred to as RV Air conditioner) during or after the time it is manufactured.

This unit can be installed by one person with brief help from additional personnel. Use these instructions to ensure a properly installed, and properly functioning product.

We reserves the right to modify appearances and specifications without notice.

This manual has safety information and instructions to help you eliminate or reduce the risk of accidents and injuries.



A2L

## 1.4 General Safety Messages

Failure to obey the following warnings could result in death or serious injury:

- This product **MUST** be [installed / serviced] by a qualified service technician.
- Do **NOT** modify this product in any way. Modification can be extremely hazardous.
- Do **NOT** add any devices or accessories to this product except those specifically authorized in writing by We.



### WARNING

If the power cuts off suddenly during the operation of the device, please do not turn it on immediately. The device must stop running for 1 minute before turning it on; otherwise, excessive current may cause the damage of the device.



### WARNING

During the use of this product, due to the great change of air temperature in the vehicle, when the temperature drops rapidly, part of condensate will adhere to the surface of objects near the air outlet, which is a normal phenomenon. After the air conditioner works normally for a certain period, it will be automatically dried and detached from the surface of objects. Therefore, when the air conditioner works, please close the doors and windows as much as possible to reduce the coagulation of water vapor on the surface of objects inside the vehicle.



### WARNING

This product can expose you to lead, which is known to the state of California to cause cancer and birth defects or other reproductive harm. For more information, go to [www.P65warnings.ca.gov](http://www.P65warnings.ca.gov).

## 2 General Information

### 2.1 Table - Unit Data

\* For wire length over 24 ft., consult the National Electrical Code for proper sizing.

\*\* We gives GENERAL guidelines for generator requirements. These guidelines come from experiences people have had in actual applications. When sizing the generator, the total power usage of your RV Air conditioner must be considered. Keep in mind generators lose power at high altitudes and from lack of maintenance.

\*\*\* CIRCUIT PROTECTION: Time Delay Fuse or Circuit Breaker Required.

### 2.2 Roof Requirements

- A 14-1/4" x 14-1/4" (±1/8") square opening (hereinafter referred to as "roof opening") is required for installing this unit. This opening is part of the return air system of the unit and MUST be finished in accordance with NFPA1192.
- Roof construction with rafters/joists support frames on a minimum of 16 inch centers.
- Minimum of 1.5 inches and maximum of 5 inches distance between roof to ceiling of RV air conditioner.

## 2.3 Introduction of Air Conditioner

The design and installation of this machine is suitable for RV to improve its internal temperature and provide a comfortable environment.

## 2.4 User Guide

The performance of air conditioner is related to the heating condition of insulation box of RV itself. Users can take some preventive measures to reduce heat entry, so as to improve the refrigeration performance of air conditioning equipment.

When outdoor temperature is high, the following methods can be adopted to reduce the heat entry of RV and improve work efficiency:

- Park the RV in a cool place.
- Strengthen thermal insulation of the compartment, remove or block the opening in the vehicle.
- Block the window with shade curtains (shutters or hanging curtains).
- Close doors and windows or avoid frequent opening and closing of them.
- Avoid using heating devices inside the vehicle.

Turn on the air conditioner in advance to achieve better effect. When indoor or outdoor temperature is high, set the air conditioner in cooling mode and turn on high wind speed will bring the performance of air conditioner into full play.



### WARNING

The manufacturer will not be responsible for any damage arising from condensation on the ceiling or the surface of other objects caused by the condensate of this product.

## 2.5 Tools and Materials

Included Parts	Quantity
Duct divide	1
Ceiling template	1
Rooftop air conditioner installation and operation manual	1
Air distribution box	1
Long screw (5.5*203.5 mm)	4
Aluminum foil tape (40*1000 mm)	1
Screw (4.2*30 mm)	12
Screw (M4*10 mm)	6

Recommended Tools	
Angle Grinder	Impact Gun
Cutting Disc for Meta	Screwdriver Bit Set
Extension Cord	Hole Saw Set
Drill	Self Tapping Screws
Phillips Screwdriver	Flat Head Screwdriver
Side Cutters	Pliers
Automotive Staple Remover	

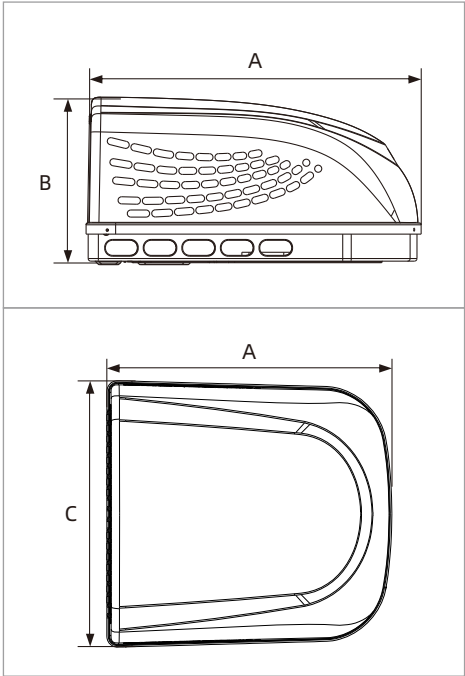
2.6 Dimensions



NOTICE

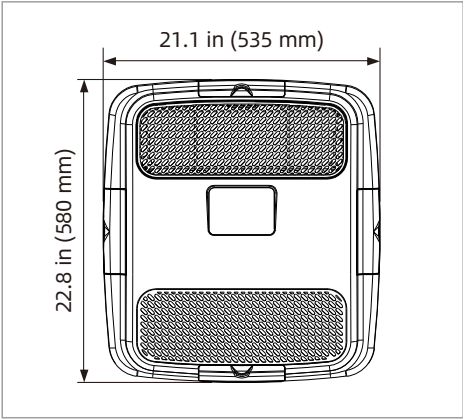
The images used in this document are for reference purposes only. Measurements may vary  $\pm 0.38$  in. (10 mm).

Rooftop Air Conditioner

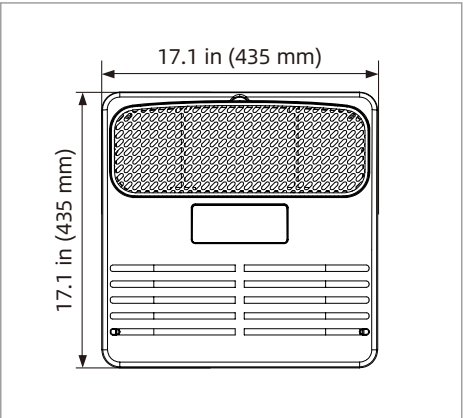


A	B	C
29.5 in (750 mm)	14.2 in (360 mm)	27.6 in (700 mm)

Air Distribution Box - Type A



Air Distribution Box - Type B



NOTICE

The ADB images in the manual are for reference only, and ADBs with different configurations may vary. Here they are just used for the convenience of description and as a reference guide.

## 2.7 Main Parameters

MODEL		FA110-H	FA135	FA150	FA150-H
Product Series	/	InstaCool 110P II	InstaCool 135 II	InstaCool 150 II	InstaCool 150P II
Nominal capacity	BTU/hr	11,000	13,500	15,000	15,000
Power Supply	VAC/Hz	115/60			
Control Voltage	VDC	12			
Motor Compressor RLA/LRA	A	13.5/54			
Fan Motor FLA/HP	A/HP	3.2/0.11			
PTC Electric Heater	A	13.5	/	/	13.5
Maximum allowable pressure High/Low side	Mpa	6.3/2.8			
Air volume (high speed)	ft <sup>3</sup> /h	28251			
Minimum circuit ampacity (MCA)	A	21			
Maximum rating of overcurrent protective device (MOP)	A	30			
Refrigerant charged R32	oz	11.3	11.3	16.2	16.2
Operating Temperature Range	/	Cooling: Indoor 63~90 °F (17~32 °C ) Outdoor 63~109 °F (17~43 °C ) Heating: Indoor 28~81 °F (-2~27 °C )			
Minimum Wire Size	/	12AWG copper wire, length not exceeding 8m.			



### WARNING

Please use the connecting wires complying with the national regulations.  
During sizing of the generator, the total power usage of RV must be considered.



### NOTICE

Tip: the generator will lose power due to high altitude and lack of maintenance.  
Circuit protection: please use Time Delay Fuse or Circuit Breaker.

# 3 Installation

## 3.1 Choosing Proper Location for Unit

This unit is specifically designed for installation on the roof of an RV air conditioner. When determining your cooling requirements, the following should be considered:

- Size of RV air conditioner;
- Window area (increases heat gain);
- Amount of insulation in walls and roof;
- Geographical location where the RV air conditioner will be used;
- Personal comfort level required.

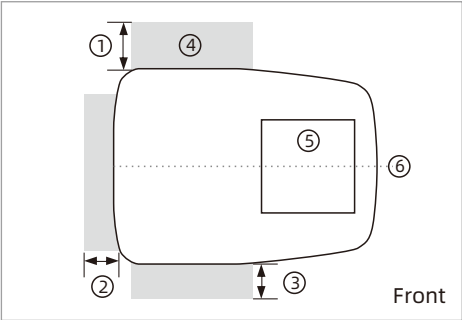
### Normal locations

The unit is designed to fit over an existing roof vent opening.

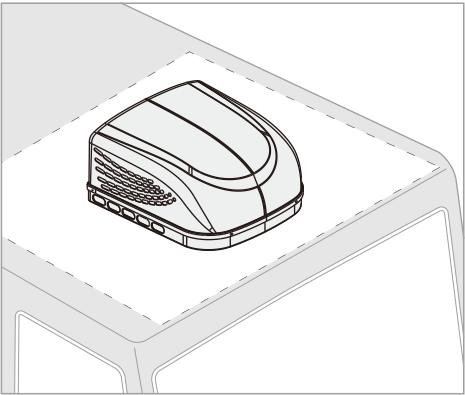
### Other locations

When no roof vent is available or another location is desired, the following is recommended:

1. For one unit installation: The unit should be mounted slightly forward of center (front to back) and centered from side to side.
2. For two unit installations: Install one unit 1/3 and one unit 2/3's from front of RV air conditioner and centered from side to side. It is preferred that the unit be installed on a relatively flat and level roof section measured with the RV air conditioner parked on a level surface. The maximum inclination angle is 8°.
3. Products equipped with an auxiliary heater (PTC) must be installed to ensure a minimum distance of 13 inches between flammable materials and the machine.

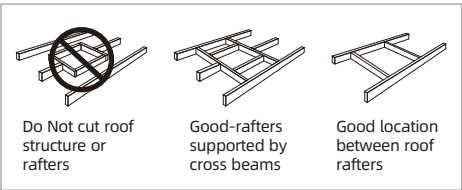


- |  |                       |
|--|-----------------------|
| ① 12 in. (305 mm)                                | ⑤ Roof opening        |
| ② 4 in. (102 mm)                                 | ⑥ Center line of unit |
| ③ 4 in. (102 mm)                                 |                       |
| ④ Keep these air flow areas free of obstructions |                       |



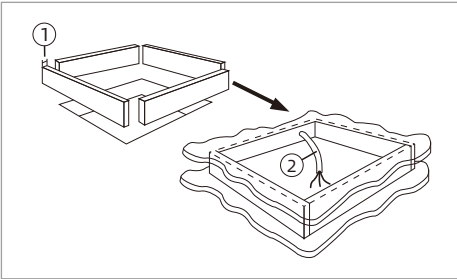
4. Maintain structural integrity. Otherwise damage to product and/or RV air conditioner could occur.

The roof must be designed to support 130 pounds when RV air conditioner is in motion. Normally a 200 lb. static load design will meet this requirement.





5. Check inside the RV air conditioner for air distribution box (hereinafter referred to as "ADB") obstructions (i.e. door openings, room dividers, curtains, ceiling fixtures, etc.).



- ① 3/4" Min.      ② 15" Min at front of opening

Frame opening so it won't collapse when bolting down unit.

Leave access for power supply wiring.

### 3.2 Roof Preparation



#### **WARNING**

#### **FIRE OR ELECTRICAL SHOCK HAZARD.**

Make sure there are no obstacles (wires, pipes, etc.) inside RV air conditioner's [roof/floor/walls]. Shut OFF gas supply, disconnect 120 VAC power from RV air conditioner, and disconnect positive (+) 12 VDC terminal from supply battery BEFORE drilling or cutting into RV air conditioner.

Failure to obey these warnings could result in death or serious injury.

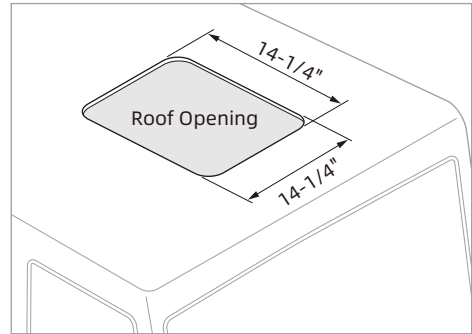
#### **Opening Requirements**

Before preparing the ceiling opening, read all of the following instructions before beginning the installation.

### 3.2.1 Creating a New Roof Opening

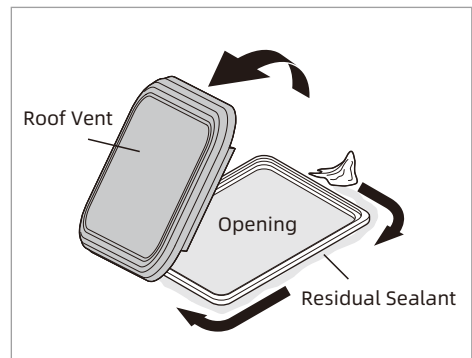
If an existing roof vent opening will NOT be used a roof opening MUST be cut through the roof and ceiling of the RV air conditioner.

This opening MUST be located between the roof reinforcing members. See "2.2 Roof Requirements"



### 3.2.2 Using an Existing Roof Opening

1. Unscrew and remove the roof vent.
2. Remove all caulking compound around opening.
3. Seal all screw holes and seams where the roof gasket will be located. Use a good grade of all weather sealant.



If the opening is less than 14-1/8" x 14-1/8", it must be enlarged. See "2.2 Roof Requirements".

1. Carefully mark and cut the required roof opening. See "2.2 Roof Requirements" .
2. Maintain structural integrity. Otherwise damage to product and/or RV Air conditioner could occur.



#### **CAUTION**

**NEVER** create a low spot on RV Air conditioner roof. Otherwise, water will pool and could cause a leak.

Using the roof opening as a guide, cut the matching hole in the ceiling.

The opening created must be framed to provide adequate support and prevent air from being drawn from the roof cavity. Framing stock 3/4" or more in thickness must be used. Remember to provide an entrance hole for power supplies at the front of the opening.

### **3.3 Wiring Requirements**

Route a copper, with ground, 120 Vac supply wire from the time delay fuse or circuit breaker box to the roof opening. Use a listed/certified non metallic - sheathed single strand cable.

If vent fan was removed, the existing wire may be used provided it is of proper type, size, location, and correctly fused.

1. This supply wire must be located in the front portion of the roof opening.
2. The power **MUST** be on an appropriately sized separate time delay fuse or circuit breaker. See "2.1"
3. Make sure that at least 15" of supply wire extends into the roof opening. This ensures an easy connection at the junction box.
4. Protect the wire where it passes into the opening with approved method.

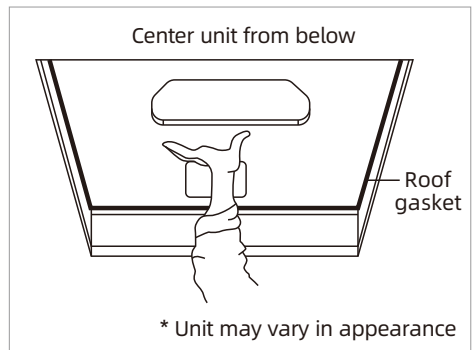
### **3.4 Placing Unit on Roof**

1. Remove the unit from the carton and discard carton.
2. **LIFTING HAZARD.** Use proper lifting technique and control when lifting product. Failure to obey this caution could result in injury. Place unit on the roof.
3. Do **NOT** slide unit. Otherwise, damage to gasket (on bottom of unit) may occur and could cause a leak. Lift and place the unit over the prepared opening using the gasket on the unit as a guide.
4. Place the ADB kit inside the RV air conditioner. This box contains mounting hardware for the unit and will be used inside the RV air conditioner.

This completes the outside work. Minor adjustments can be done from inside the RV air conditioner if required.

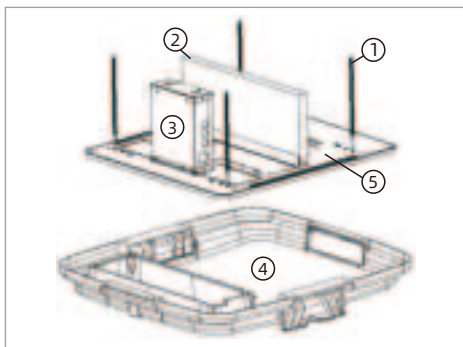
### **3.5 Installation Preparation**

Check gasket alignment of the unit over the roof opening and adjust if necessary. Unit may be moved from below by slightly lifting.



### 3.6 Install Air Distribution Box

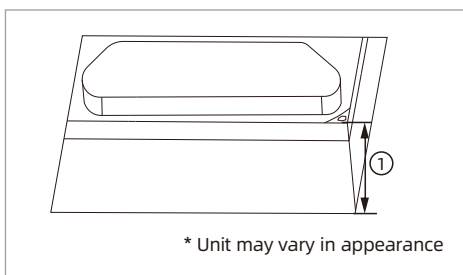
#### Installing Type A Air Distribution Box



- ① Mounting Bolt \*4    ④ Air Distribution Box  
 ② Duct Divide        ⑤ Ceiling Template  
 ③ Control Box

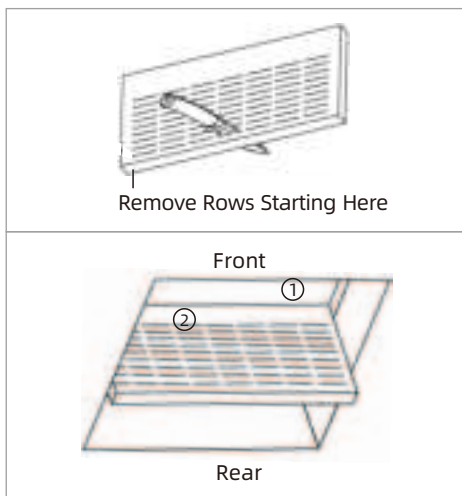
1. Install the wall control panel and route the cable into the interlayer of the air conditioner mounting port.

2. Measure the ceiling to AC bottom thickness.



- ① Measure ceiling thickness

3. Based on the measured thickness from the ceiling to the bottom of the air conditioner minus the excess height on the ceiling template. Carefully install the duct divider in the roof opening.



- ① Base pan    ② Duct divider

4. Fix the electric control box on the top template and align it with the return air end of the host. Fix the top template on the ceiling with the fixing screws.

5. Wiring: First, connect all the terminal connectors.

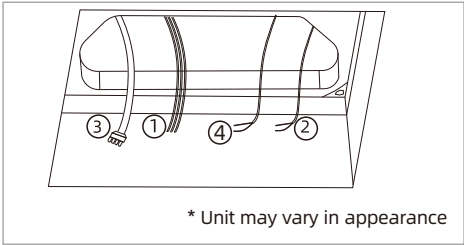
Then:

**STEP 1:** Connect the controller's power supply wires (red and black) to 12V DC Power Supply. Use 12 Volts DC. You may connect to the RV Battery. Please pay attention to the positive and neutral lines. Red Color = Hot, Black color = Neutral.

**STEP 2:** Connect the Main Power Supply to the AC3 Wires: Black= Hot, White= Neutral, and Green = Ground.

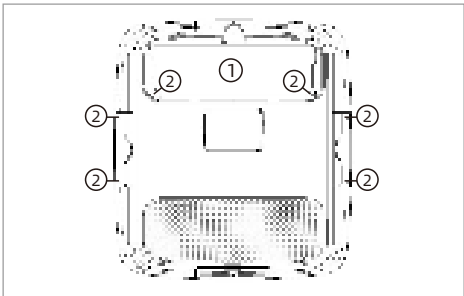
**STEP 3:** If applicable, locate the furnace wires from the ceiling controller, which are two separate blue wires tagged with "FURNACE". Connect them with the 12V+ wire from the furnace, and the return wire to the furnace.

**NOTE:** Polarity does not matter, connection can be freely made to either wire. Do not connect the two blue "FURNACE" wires together.



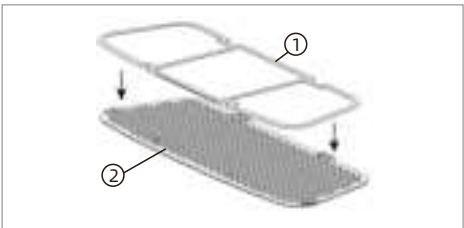
- ① Power Supply for the Whole Machine.  
3 wires: Hot, Neutral and Ground.
- ② Controller Power Supply.  
2 Wires: Red and Black Colors.
- ③ Wired controller 4 wires
- ④ Furnace connection wires.  
two separate blue wires .

6. Install ADB panel. Cover the top template with ADB, align the air inlet with the host air return port, and fix the screws in sequence.

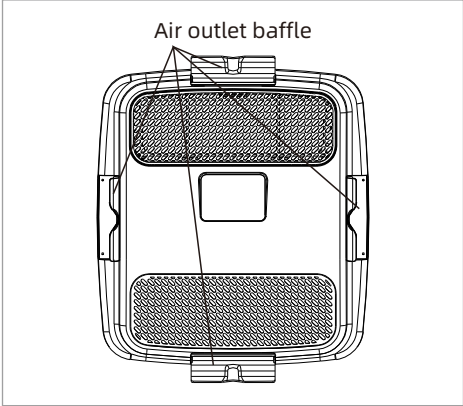


- ① Air inlet
- ② Screw \*6

7. Place filter in return air vent grille. It may already be installed on some units.



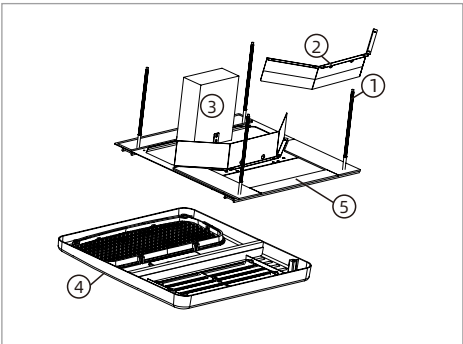
- ① Filter
- ② Return air vent grille



### CAUTION

Please open the air outlet when the air conditioner is running, and the air volume can be adjusted by adjusting the angle of the air outlet baffle.

## Installing Type B Air Distribution Box



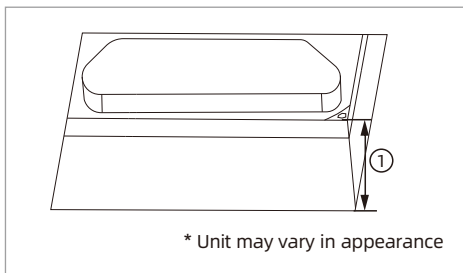
- ① Mounting Bolt \*4
- ② Duct Divide
- ③ Control Box
- ④ ADB
- ⑤ Ceiling Template

1. Install the wall control panel and route the cable into the interlayer of the air conditioner mounting port.

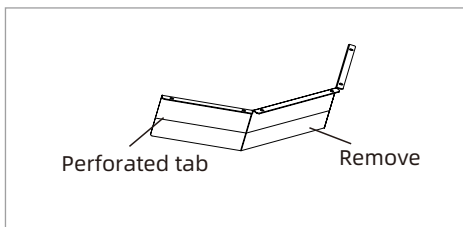
## 2. Installation Of Duct Divider Plate.

### A. Measure the ceiling to AC bottom thickness.

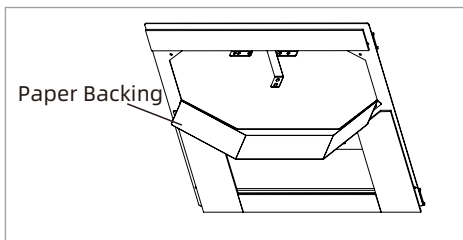
- If distance is 2-1/2" - 4-1/4", remove perforated tab from divider plate.
- If distance is 4-1/4" - 6.0", remove no tabs.



- ① The ceiling to AC bottom thickness.

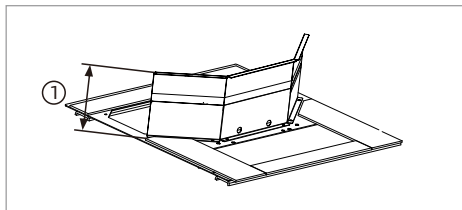


### B. Remove the backing paper from the double-sided tape on the ceiling template.



### C. Install the duct divide plates correctly on the ceiling template based on the measured ceiling to AC bottom thickness. incorrect installation could cause compressor to quick-cycle, and could result in supply circuit overload and reduced product performance.

The adhesive on the double-sided tape is extremely sticky. Make sure the divider plate is properly positioned before pressing into place.



- ① The ceiling to AC bottom thickness.

4. Fix the electric control box on the top template and align it with the return air end of the host. Fix the top template on the ceiling with the fixing screws.
5. Wiring: First, connect all the terminal connectors.

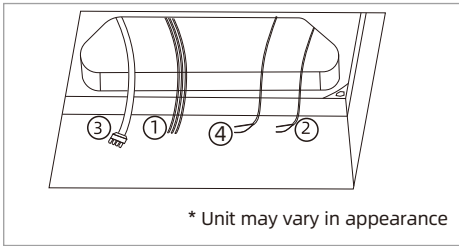
Then:

STEP 1: Connect the controller's power supply wires (red and black) to 12V DC Power Supply. Use 12 Volts DC. You may connect to the RV Battery. Please pay attention to the positive and neutral lines. Red Color = Hot, Black color = Neutral.

STEP 2: Connect the Main Power Supply to the AC3 Wires: Black= Hot, White= Neutral, and Green = Ground.

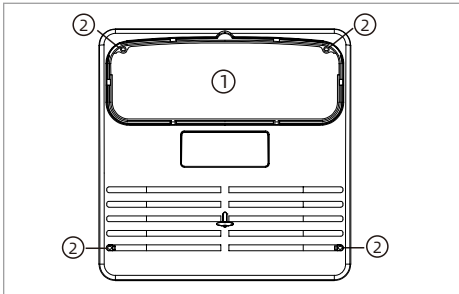
STEP 3: If applicable, locate the furnace wires from the ceiling controller, which are two separate blue wires tagged with "FURNACE". Connect them with the 12V+ wire from the furnace, and the return wire to the furnace.

NOTE: Polarity does not matter, connection can be freely made to either wire. Do not connect the two blue "FURNACE" wires together.



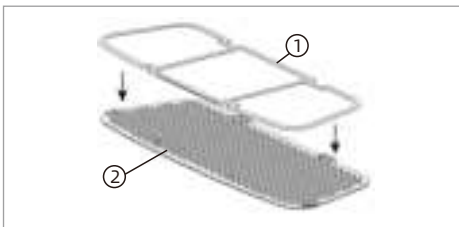
- ① Power Supply for the Whole Machine.  
3 wires: Hot, Neutral and Ground.
- ② Controller Power Supply.  
2 Wires: Red and Black Colors.
- ③ Wired controller 4 wires
- ④ Furnace connection wires.  
two separate blue wires .

6. Install ADB panel. Cover the top template with ADB, align the air inlet with the host air return port, and fix the screws in sequence.



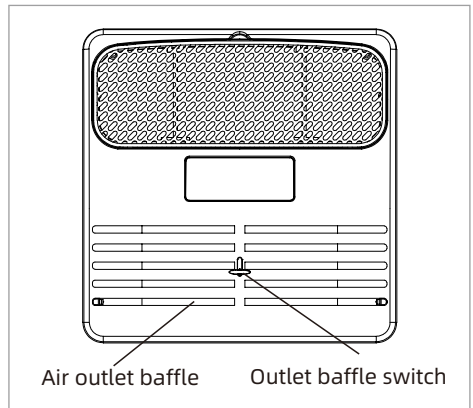
- ① Air inlet
- ② Screw \*4

7. Place filter in return air vent grille. It may already be installed on some units.



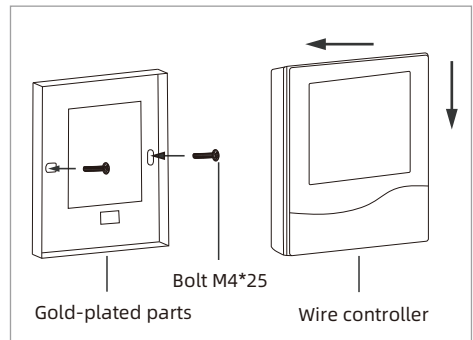
- ① Filter
- ② Return air vent grille

8. Please open the air outlet when their air conditioner is running, and the air volume can be adjusted by adjusting the size of the air outlet baffle.



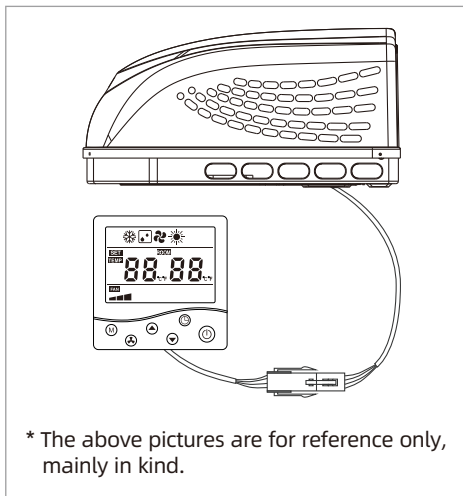
### 3.7 Wall Mounted Control Installation

- Step 1: Remove the cover of Wire controller box.
- Step 2: Secure the back cover with screws.
- Step 3: According to the drawing install two screws one by one.
- Step 4: Finally, the wire controller is buckled on the back cover and the installation is completed.



**Remarks:**

After power-off and power-on or abnormal communication returns to normal, you need to reoperate the on-off button, or after setting the timing setting, or after waiting for three minutes, you can directly operate and adjust.

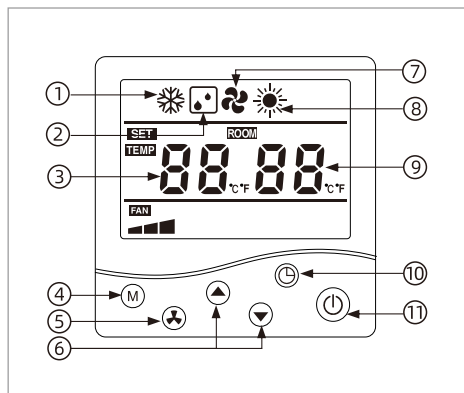
**Wire connection:**

## 4 Operation

**WARNING**

If the power cuts off suddenly during the operation of the device, please do not turn it on immediately. The device must stop running for 1 minute before turning it on; otherwise, excessive current may cause the damage of the device.

### 4.1 Operation Instructions



- ① Cooling
- ② Dehumidify
- ③ Set temp
- ④ Mode key
- ⑤ Wind speed key
- ⑥ Increase/decrease Temperature set-point
- ⑦ Fan speed
- ⑧ Heating
- ⑨ Room temp
- ⑩ °C/°F switching
- ⑪ Power ON/OFF

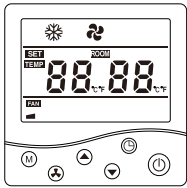
Quick reference to control buttons

- 1. Press " ⏻ " button switch on or switch off the machine.
- 2. Press " M " button select cold, heat, blow, dehumidification.
- 3. Press " ⚙ " button adjust the high or middle and low speed.
- 4. Press " ▲ " button increase set temperature point.  
Press " ▼ " button decrease set temperature point.  
Temperature range: 61 °F - 88 °F (16 °C - 31 °C).

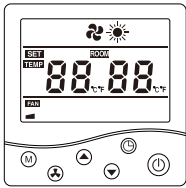
To difficult to change from °C to °F ?

Under the power-on state [ ⏻ ] press and hold to switch °C/°F

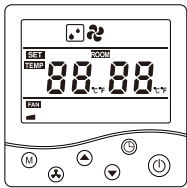
4.2 Mode Display



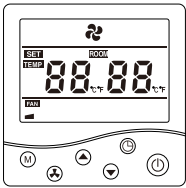
Cooling



Heating  
(only for the product with Heating function)



Dehumidity

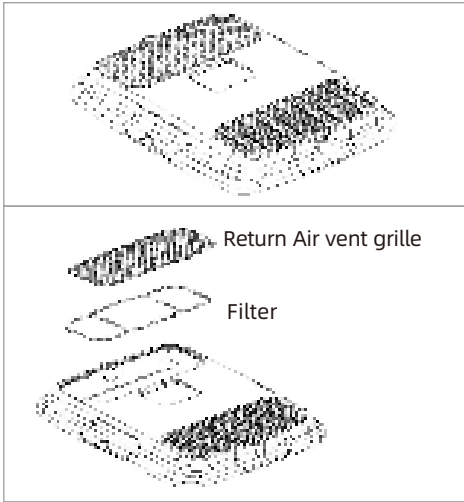



Fan

5 Maintenance

5.1 Cleaning of Air filter

Remove the filter screen behind the interior panel (press the left and right buttons of the decorative panel, and the decorative panel can be removed), clean with water, and then re install after drying.





**WARNING**  
It is forbidden to operate the air conditioner without the air filter, otherwise, the evaporator coil will be defiled and the service life of air conditioner will be affected.

5.2 Panel Surface Cleaning

Clean the outer surface of the panel with soft cloth dipped in neutral detergent. Do not use polishing or cleaning powder.

5.3 Fan Motor

The fan motor has been lubricated during production procedure and does not need special maintenance.



## 6 Troubleshooting

If the air conditioning equipment cannot work normally, please carry out inspection as follows to remove the faults:

- Check whether the fuse of air conditioning equipment or leakage circuit breaker of the RV is turned on.
- If the air conditioner is powered by a generator, please first confirm whether the generator power matches the air conditioner, whether the generator runs normally and generates electricity, and whether voltage output of the generator is stable.
- If the RV is connected to the main supply, please make sure that the specification of power line matches the operating load of this product and that there is power supply. Check whether the mains voltage meets related requirements (the operating voltage of air conditioner is 115V).
- Check whether the connecting wires of air conditioner are inserted in place and connected in good condition. If the air conditioner still cannot work normally after the above inspection, please contact the factory for further help.

Code	Cause	Solution
E1	Communication fault	1. Chek the wire between power and controller. 2. Replace PCB or Controller.
E2	Room temperature sensor fault	1. Chek the wire between power and controller. 2. Replac Controller.
E3	Controller DC 12V power supply voltage is too low	Connect the controller to the standard correct DC 12V power supply voltage.
E4	Controller DC 12V power supply voltage is too high	Connect the controller to the standard correct DC 12V power supply voltage.

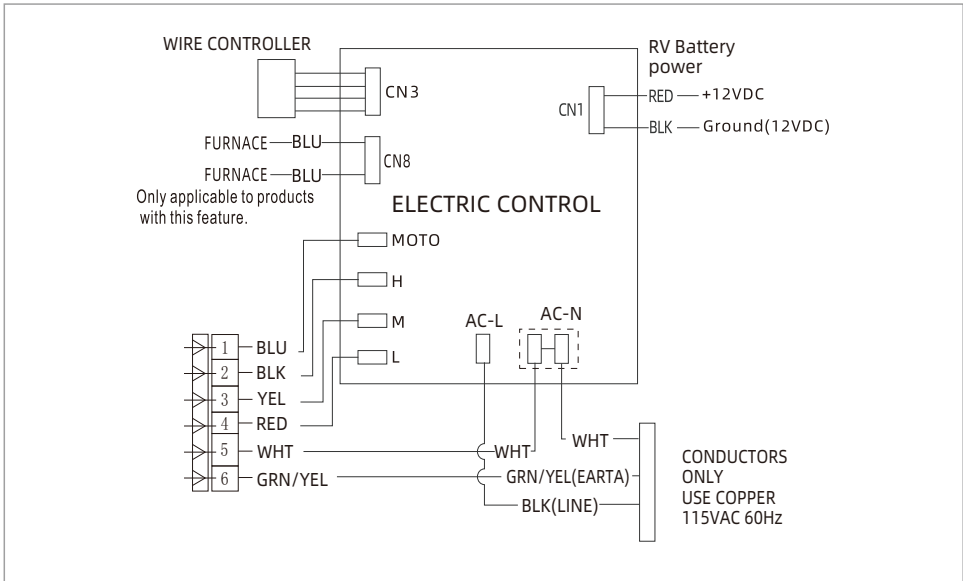
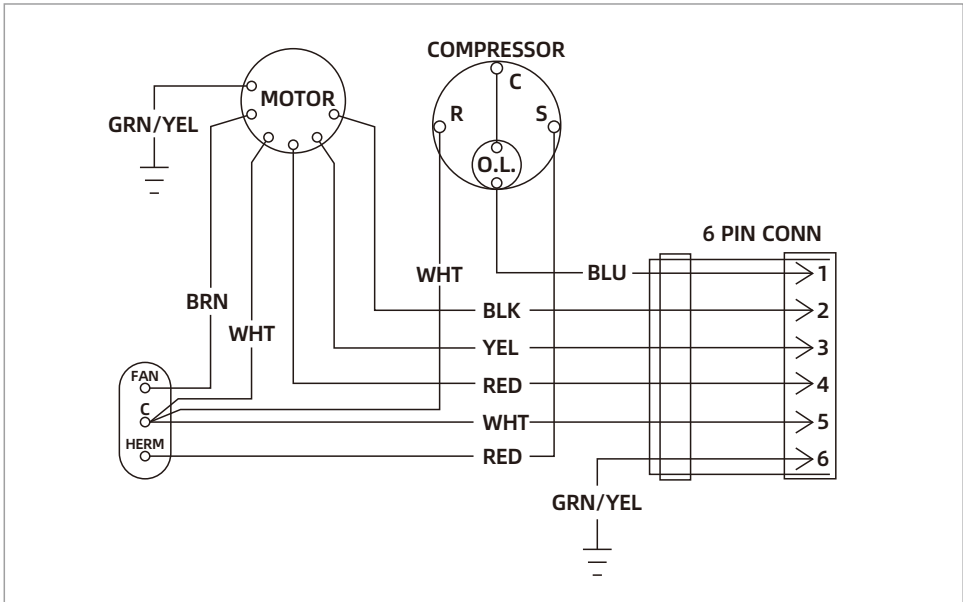


### CAUTION

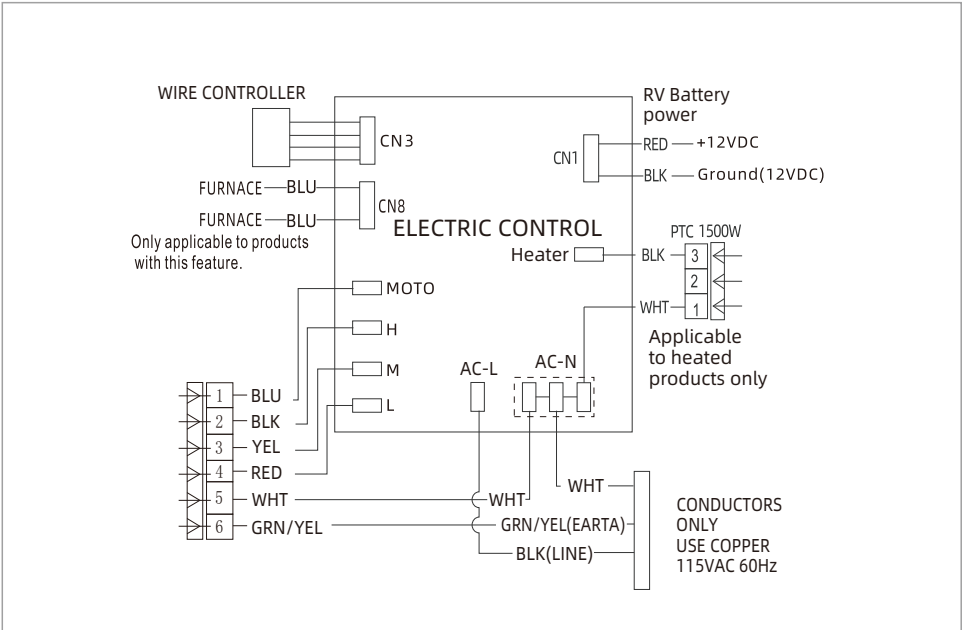
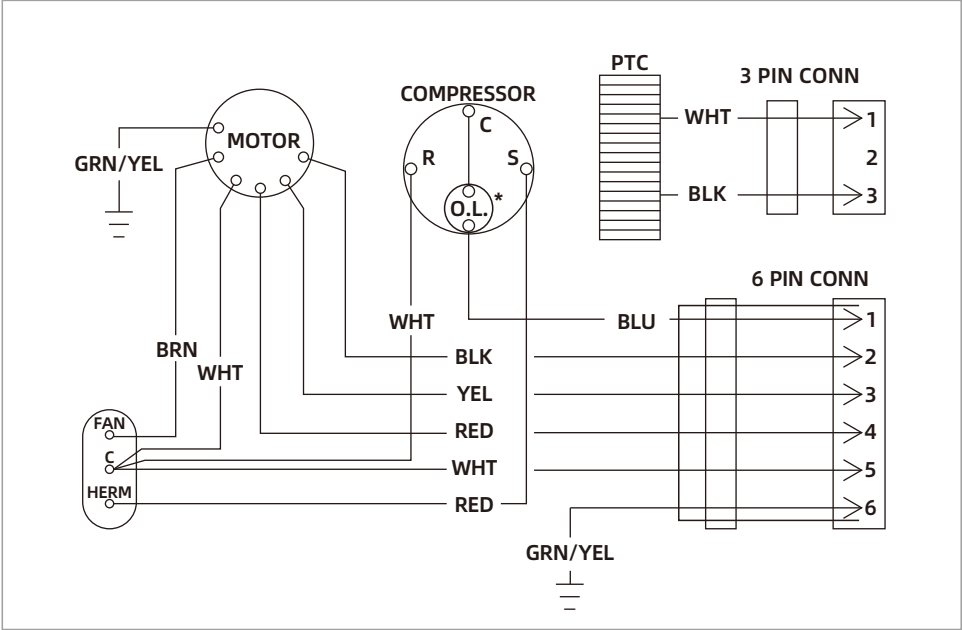
The equipment must be repaired by professional personnel.

# 7 Circuit Diagram

## 7.1 Wire Controller type



7.2 Wire control model with cooling and heating



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# **Transportation, marking and storage for units that employ flammable refrigerants**

## **1. Transport of equipment containing flammable refrigerants**

Attention is drawn to the fact that additional transportation regulations may exist with respect to equipment containing flammable gas. The maximum number of pieces of equipment or the configuration of the equipment permitted to be transported together will be determined by the applicable transport regulations.

## **2. Marking of equipment using signs**

Signs for similar appliances used in a work area are generally addressed by local regulations and give the minimum requirements for the provision of safety and/or health signs for a work location.

All required signs are to be maintained and employers should ensure that employees receive suitable and sufficient instruction and training on the meaning of appropriate safety signs and the actions that need to be taken in connection with these signs.

The effectiveness of signs should not be diminished by too many signs being placed together.

Any pictograms used should be as simple as possible and contain only essential details.

## **3. Disposal of equipment using flammable refrigerants**

See national regulations.

## **4. Storage of equipment/appliances**

The storage of the appliance should be in accordance with the applicable regulations or instructions, whichever is more stringent.

## **5. Storage of packed (unsold) equipment**

Storage package protection should be constructed in such a way that mechanical damage to the equipment inside the package will not cause a leak of the REFRIGERANT CHARGE.

The maximum number of pieces of equipment permitted to be stored together will be determined by local regulations.

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# Requirements for operation, service and installation manuals of appliances using flammable refrigerants

## 1. Warning

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.

Do not pierce or burn.

Be aware that refrigerants may not contain an odour.

## 2. General

- a warning to keep any required ventilation openings clear of obstruction;
- a notice that servicing shall be performed only as recommended by the manufacturer;
- a warning that ducts connected to an appliance shall not contain a POTENTIAL IGNITION SOURCE;

## 3. Qualification of workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons according.

Examples for such working procedures are:

- Breaking into the refrigerating circuit;
- Opening of sealed components;
- Opening of ventilated enclosures.

## 4. Information on servicing

### 4.1 General

The manual shall contain specific information for service personnel according to 4.2 to 4.10.

### 4.2 Checks to the area

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the REFRIGERATING SYSTEM, 4.3 to 4.7 shall be completed prior to conducting work on the system.

### 4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

### 4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

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#### 4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

#### 4.6 Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO<sub>2</sub> fire extinguisher adjacent to the charging area.

#### 4.7 No ignition sources

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

#### 4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

#### 4.9 Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- The actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed;
- The ventilation machinery and outlets are operating adequately and are not obstructed;
- if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- Marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

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#### 4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

- That capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- That no live electrical components and wiring are exposed while charging, recovering or purging the system;
- That there is continuity of earth bonding.

#### 5. Repairs to sealed components

5.1 During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

5.2 Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

#### 6. Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.

Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

**NOTE:** The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

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## 7. Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

## 8. Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area. Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work. NOTE Examples of leak detection fluids are

- bubble method,
- fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

## 9. Removal and evacuation

When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures shall be used. However, for FLAMMABLE REFRIGERANTS it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:

- remove refrigerant;
- purge the circuit with inert gas (optional for A2L);
- evacuate (optional for A2L);
- purge with inert gas (optional for A2L);
- open the circuit by cutting or brazing.



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The REFRIGERANT CHARGE shall be recovered into the correct recovery cylinders. For appliances containing FLAMMABLE REFRIGERANTS other than A2L REFRIGERANTS, the system shall be purged with oxygen-free nitrogen to render the appliance safe for FLAMMABLE REFRIGERANTS. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing FLAMMABLE REFRIGERANTS, other than A2L REFRIGERANTS, REFRIGERANTS purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. This operation is absolutely vital if brazing operations on the pipe-work are to take place.

Ensure that the outlet for the vacuum pump is not close to any POTENTIAL IGNITION SOURCES and that ventilation is available.

## **10. Charging procedures**

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

## **11. Decommissioning**

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

- a) Become familiar with the equipment and its operation.
- b) Isolate system electrically.
- c) Before attempting the procedure, ensure that:
  - Mechanical handling equipment is available, if required, for handling refrigerant cylinders;
  - All personal protective equipment is available and being used correctly;
  - The recovery process is supervised at all times by a competent person;
  - Recovery equipment and cylinders conform to the appropriate standards.

- 
- d) Pump down refrigerant system, if possible.
  - e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
  - f) Make sure that cylinder is situated on the scales before recovery takes place. g) Start the recovery machine and operate in accordance with instructions. h) Do not overfill cylinders (no more than 80 volume liquid charge).
  - i) Do not exceed the maximum working pressure of the cylinder, even temporarily.
  - j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
  - k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

## **12. Labelling**

Equipment shall be labeled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

## **13. Recovery**

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, FLAMMABLE REFRIGERANTS. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.



**WARNING:** Risk of electric shock can cause injury or death: disconnect all remote electric power suppliers before servicing.

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**Tel: 877-216-1818 | E-mail: [us@fogatti.com](mailto:us@fogatti.com)**

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