DAIKIN

Good Installation Practice

= Good Value

Contents

1-1 Incorrect Copper Tubes Cutting Method

An actual example of cutting copper tubes with a hack saw instead of a regular tube cutter.

Copper tube cutter

Large-sized type

Middle-sized type

Small-sized type

What is the problem?

Copper tubes were sawn off.

What problems will take place?

1) The chips will infiltrate into the tubes and damage the equipment when in operation.
2) When a tube is sawn, zigzag and uneven edge of the tube may result in gas leakage due to poor flaring.

What action should be taken?

Be sure to use a proper and suitable tube cutter for different size tubes.

1-2 Effects of Using Thin Copper Tubes

What is the problem?

These tubes have less thickness in the wall than Daikin's recommended tubes.

What problems will take place?

1) High pressure during operation can cause the tubes to deform and crack resulting in gas leakage.
2) Since the tubes are hollow and if deformation takes place, the unit will operate with insufficient capacity.

Slight noise may be noted when refrigerant passes through the deformed area.

What action should be taken?

Use correct size copper tubes. (Refer to table on the right)

An actual example of too thin wall tubes.

Even little stress can damage and deform the tube walls due to weakness.

The minimum thickness of piping is according to Japan's High-Pressure Gas Safety Law (as of January 2003)

Type of Material and Thickness

Outside diameter (mm)	VRV II R22		VRV II & III R410A	
	Material*	Thickness (mm)	Material*	Thickness (mm)
6.4 Ø	O	0.80	O	0.80
9.5 Ø	O	0.80	O	0.80
12.7 Ø	O	0.80	O	0.80
15.9 Ø	O	1.00	O	0.99
19.1 Ø	O	1.00	1/2 H	0.80
22.2 Ø	1/2 H	1.00	1/2 H	0.80
25.4 Ø	1/2 H	1.00	1/2 H	0.88
28.6 Ø	1/2 H	1.20	1/2 H	0.99
31.8 Ø	1/2 H	–	1/2 H	1.10

O : Annealed (soft) copper pipe **1/2 H** : Half hard copper pipe

Remark: The thickness and material shall be selected in accordance with local code

1-3 Poor Storage and Condition of Copper Tubes

What is the problem?

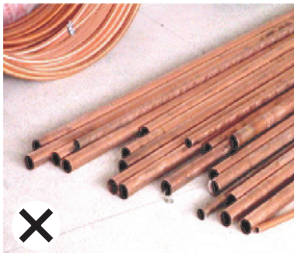
1) No seal plugs are found on the ends of tubes.
2) The tubes are directly laid on the floor.

What problems will take place?

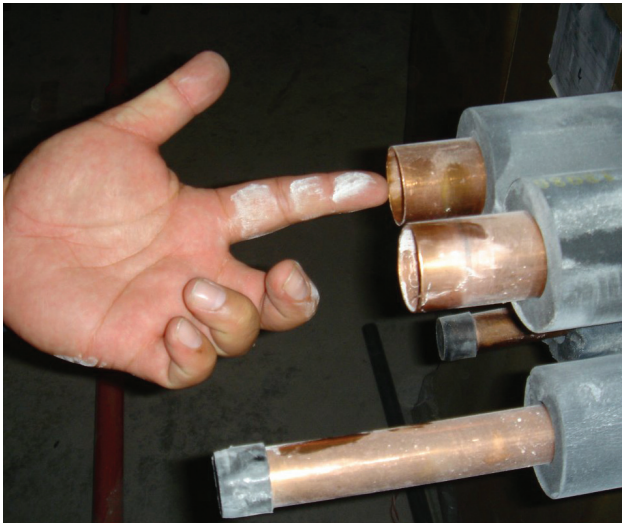
1) Moisture, dust, sand and foreign particles etc. that infiltrate into the refrigeration circuit during operation, will choke up certain components such as expansion valves, capillary tube or filters. This will result in insufficient capacity and finally a BREAKDOWN.
2) Tube is easily deformed when stepped onto. The deformed and narrow tube may invite insufficient capacity or includes some degree of noise.

What action should be taken?

Tubes are encouraged to be stored in vertical position with caps or vinyl tape securely wrapped at both ends.



Piping materials are casually kept on the floor at a construction site. No seal plugs are placed on the ends of the tubes.



1-3 Poor Storage and Condition of Copper Tubes

What is the problem?

The tubes are left without proper care after the component was removed.

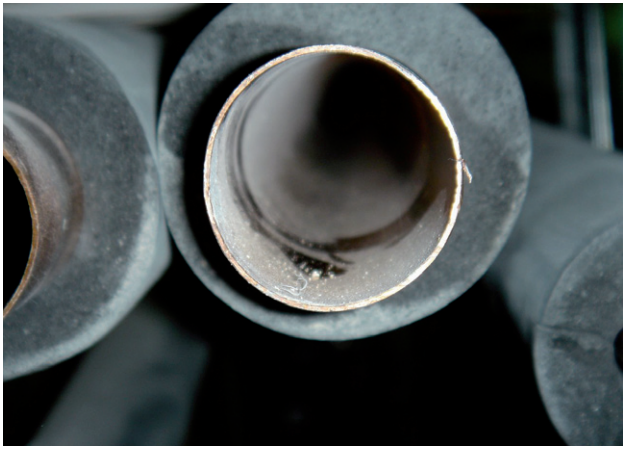
What problems will take place?

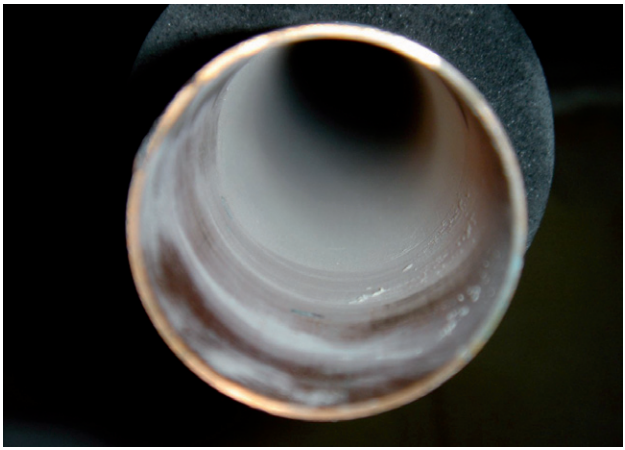
Moisture caused by rainwater or condensation, dust, rubbish and sand enter the tubes resulting in blockage in the expansion valve, capillary tube or filter which may cause compressor failure or insufficient operation.

What action should be taken?

When tubes are removed and stored even for a short time, be sure to cover both end of the tubes with blind cap. If blind caps are not available, it is recommended to wrap both ends of the tube including flare nut with vinyl tapes.

*Ensure that dust, rubbish, or moisture on the tubes or flare do not enter the tubes.

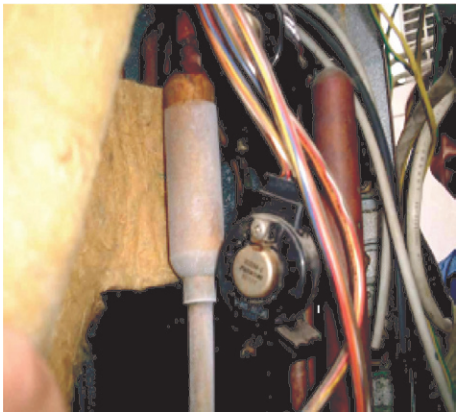




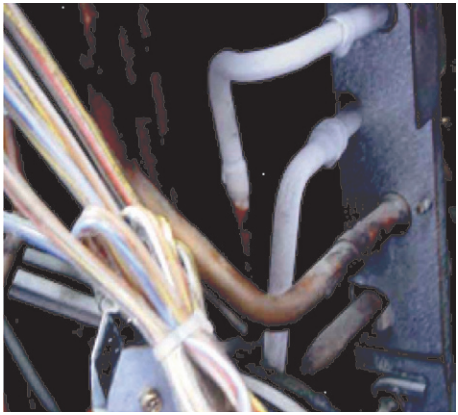
An actual example of tubes which are stored without proper care after the connected component was removed, during repair of the unit.

1-4 Trouble Cause by Impurities Inside Copper Tubes

In the outdoor unit, icing is sometimes found on the filter. This shows a typical filter choking phenomenon in which the upstream side is hot while the downstream side is frozen.



Actual example of frosting caused by filter choke



Frozen choke has occurred in the distributor on the outdoor unit heat exchanger.

What is the problem?

During piping works, moisture, dust, rubbish or sand enters the refrigeration system.

What problems will take place?

1) Choked filters by impurities will include low pressure that will reduce the capacity.
2) Extreme super heated operation could take place if such an abnormal operation continues. Subsequently, the safety switch will actuate to stop the operation.
3) This will finally result in compressor failure.

What action should be taken?

Note that moisture must be fully discharged out of the tubes.

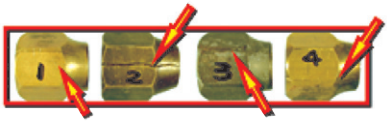
a. Perfect care for tubing
b. Remove moisture in tubes by the flashing work
c. Pay attention to the potential of moisture mixing into tubes when piping work is done on rainy day (especially in outdoor work).
d. Be sure to perform vacuum drying process before the test run.

2-1 Procedure

We would like to repeat the process of flaring, because this is very important.

Procedure	Safety Instructions	Safety Instructions Points of Work
1. Tube Cutting	Tool	Cut tube at right angle with tube cutter.
	Deformation	Cut tube again when the pipe is deformed.
	Burr	Ream the edge while keeping the face downward.
2. Flaring	Tool	Clean the dies and the cone surface. Be sure that there is no damage on the cone.
	Flare nut	Be sure that the flare nut is inserted properly.
3. Application of oil	Sealing part	Be sure that the sealing parts are clean. Be sure there is no damage on sealing surface.
	Refrigerant oil	Apply the oil to the sealing surface to ensure the tightness.
4. Connection	Required torque	Be sure to use the torque wrench. Be sure to control the torque to prevent the breakage of nut caused by overtightening.

Never tighten the nut with excessive torque!
It may create the crack on the nut in 2-3 years after installation, which cause the leakage.



Current shape; Cracks caused by stress & corrosion
(Too much tightening & corrosive substance eg. Ammonia & urea, etc)

Old shape

New shape
JIS Class1

Flare nut: "1/2
Material: C3604-O (A company)

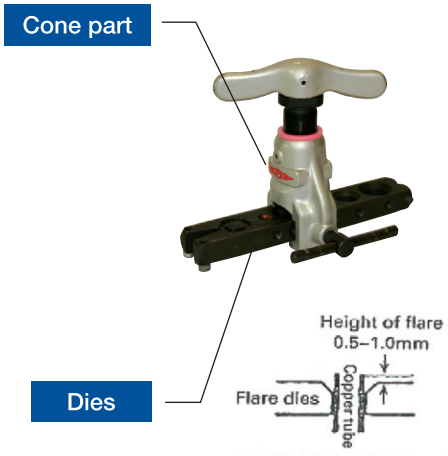
Changing of Flare Nut Shape

2-2 Flaring

1) Cleaning a flare tool
   Before using, be sure to clean the face of dies and cone.
2) Set the tube onto die at proper height.

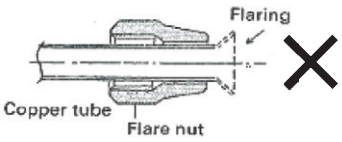
> Be sure to insert flare nut in right direction before making flare.

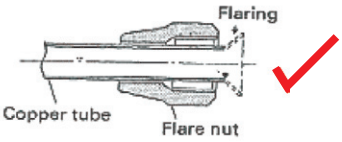
3) Set the main body onto the die, when making a flare.
4) Drive cone into tube until click sound is heard with no resistance.



Copper tube size	6.35	9.25	12.70	15.88	19.05
Height of flare	0.5mm				

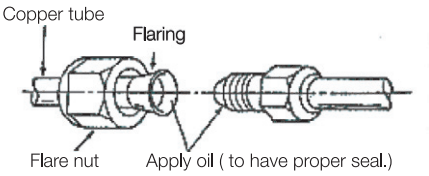
Be sure to set flare nut in proper direction before making flare as shown on the right.





Application of oil

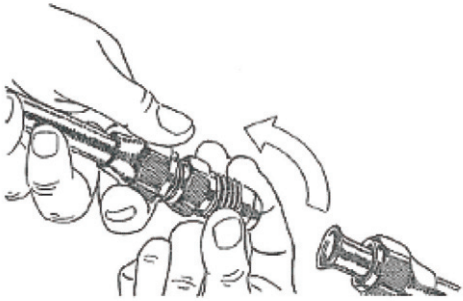
- Apply refrigerant oil on the inner of flare to prevent leakage.



Spray type refrigerant oil is available in the market for easy operation.

2-3 Connection

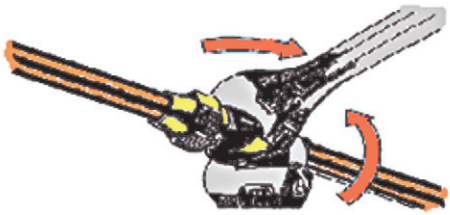
Set flare face to the joint properly and connect by fastening the flare nut.
By doing this, be sure to set the flare nut and flare joint straight, and fasten the flare nut by hand 4-5 times before locking the wrench tightly.



Join flare nut first by hand and then lock tightly by using torque wrench.

Be sure to lock the flare nut by using two wrenches.

Tube size	Required torque
6.35 mm	160± 20 kgf.cm
9.52 mm	370± 40 kgf.cm
12.70 mm	560± 60 kgf.cm
15.88 mm	700± 70 kgf.cm
19.05 mm	1100± 100 kgf.cm



You may have a leakage if the fastening torque is insufficient. If the torque is excessive, it may cause leakage due to the breakage of flare nut or insufficient thickness of the copper tube. If the torque is too little, there will be leakage from the joint parts.

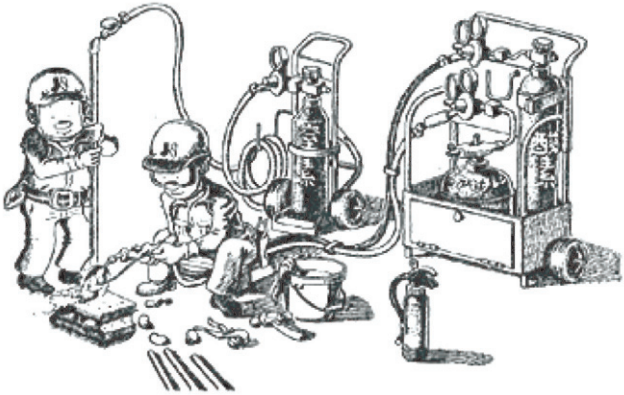
Working Procedure:

Supply low pressure Nitrogen gas at 0.2kg/cm^2 continuously during brazing of copper tube. Nitrogen is applied to prevent the oxide formation inside the copper tube during brazing.

It is very important to flow non-active gas inside the tube during the brazing. Otherwise, a lot of oxide scale will form inside tube. This oxide scale comes off from the inner surface of tube and affects the valve or the compressor, which may cause serious damage to the system.
In order to prevent this, it is important to flow the nitrogen gas into the tube to evacuate the air (oxygen) from the tube. This is called the nitrogen displacement.

Keep on flowing the nitrogen gas until the copper tube gets cold.

Nitrogen displacement device

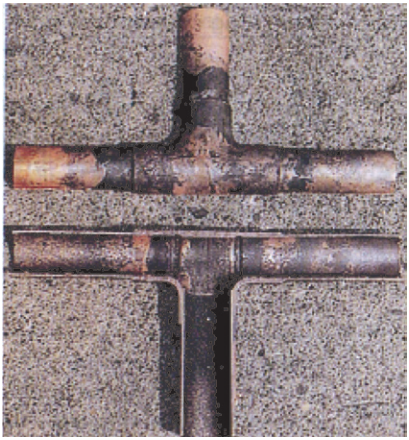


There are several ways to do this, but this device is the most effective. When you do the brazing, be sure to prepare the bucket of water or fire extinguisher to put out the fire.

3-2 Brazing Tool

Avoid using a portable torch as the temperature is not high enough. The longer the brazing time, the more carbon and copper oxide will be formed.

3-3 Nitrogen Replacement



Piping with no nitrogen displacement

Piping with nitrogen displacement

You can see the difference between the inside of the tubes at a glance, though the external appearance is similar. When nitrogen displacement is not applied during the brazing, oxidized scales are produced, which will affect the system by choking the valve or the compressor.

4-1 Refrigerant Pipe Flushing Method

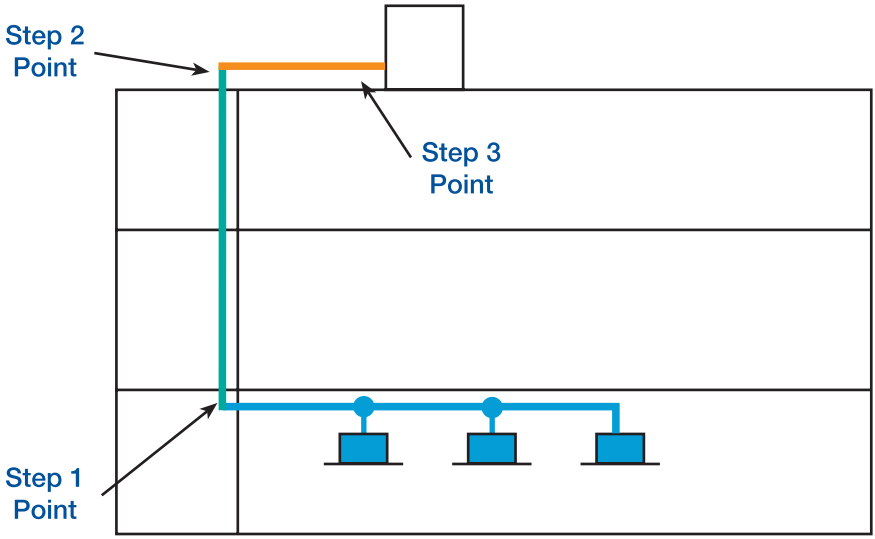
- Removes oxidized film inside copper pipes cause by insufficient charging of **N2** during brazing.
- Removes the dust, dirt or moisture from the tube, which penetrate into the tube due to improper care of copper tube.

Points to Note

Step1: Indoor horizontal pipe (before connection with FCU)

Step2: Vertical pipe only (In the Riser)

Step3: Outdoor pipe between pipe riser to outdoor unit (before connection with CU)



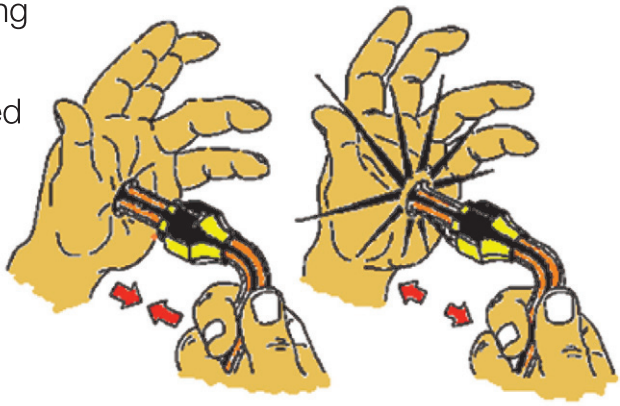
4-1 Refrigerant Pipe Flushing Method

Step by step flushing

1 Set the pressure reducing valve on the Nitrogen cylinder to approx. 5kg/cm^2 (70 psi)
2 Check the nitrogen gas flow from the liquid line of the non-connected indoor unit
3 Check the nitrogen gas flow from the gas line of the non-connected indoor unit.

Flush by closing the outlet of pipe with palm and then releasing again

Repeat the flushing until the foreign particle is removed



5-1 Problem Due to Using REFNET JOINTS Not Recommended by DAIKIN

What is the problem?

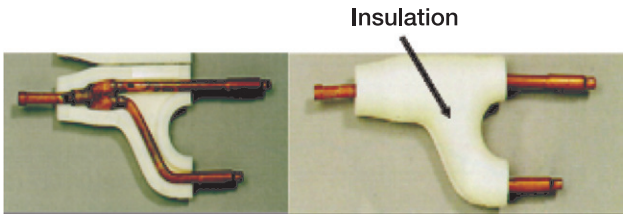
Usage of JOINTS that does not conform to DAIKIN's recommendation.

What problems will take place?

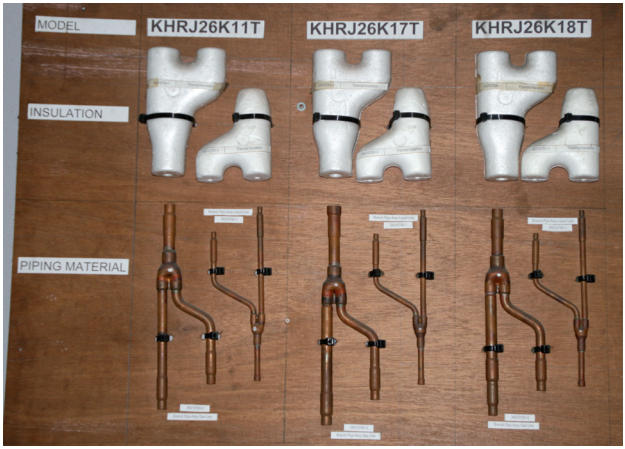
1) Inadequate capacity due to inaccurate distribution of refrigerant.
2) Air conditioner will malfunction because of oxidized film in tube chokes the expansion valve, etc.
3) Poor quality JOINT not recommended by DAIKIN may cause gas leakage at brazed part.
4) Due to lack of insulation pad for the JOINT, water condensation may occur causing problems.

What action should be taken?

Be sure to use genuine parts. (If non-genuine parts are used, the warranty will not apply).

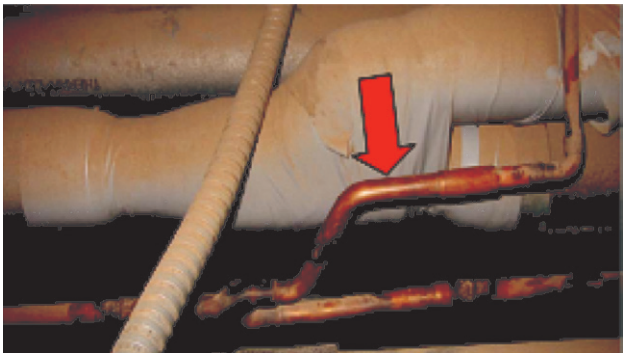


JOINTS NOT recommended by DAIKIN

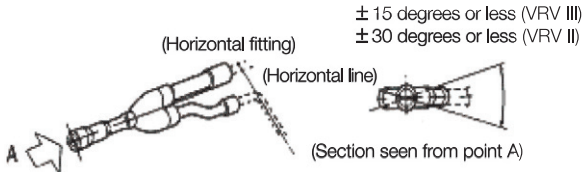


REFNET JOINTS recommended by DAIKIN

5-2 Trouble Due to REFNET JOINT Connection Fault!!



An actual example in which the Refnet Joint is not positioned correctly as shown in the picture below.



What is the problem?

Fault positioning of Refnet Joint in terms of direction. (Gravity influences to create drifting).

What problems will take place?

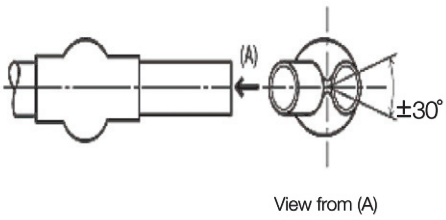
1) Excessive noise by passing refrigerant.
2) Capacity shortage will occur which is caused by refrigerant drift.

What action should be taken?

When the Refnet Joint is installed, be sure to install it in correct direction within the specified range as illustrated below.

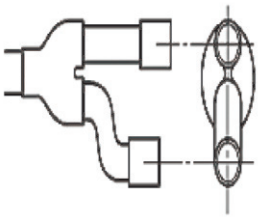
Vertical position ✓

Horizontal in level position ✓



View from (A)

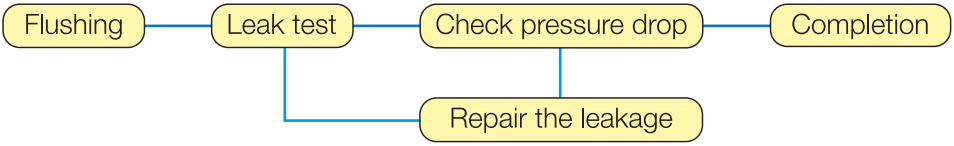
Horizontal in perpendicular position ✗



Horizontal Level Position	
VRV "II"	±30°
VRV "III"	±15°

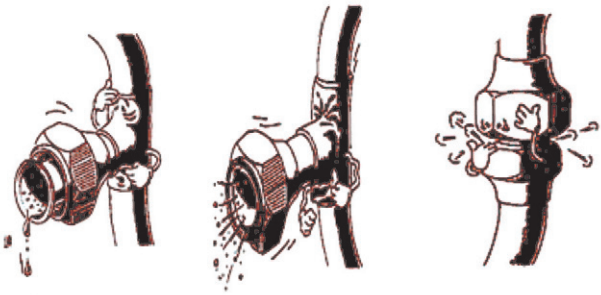
6-1 Procedure

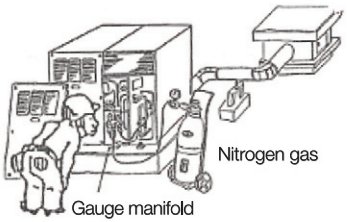
Working Procedure

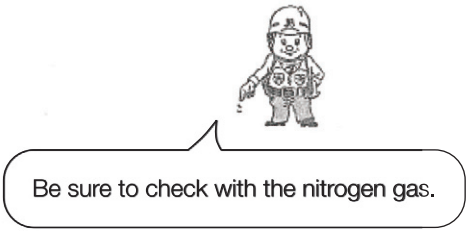


Purpose

To check that there is no leakage.







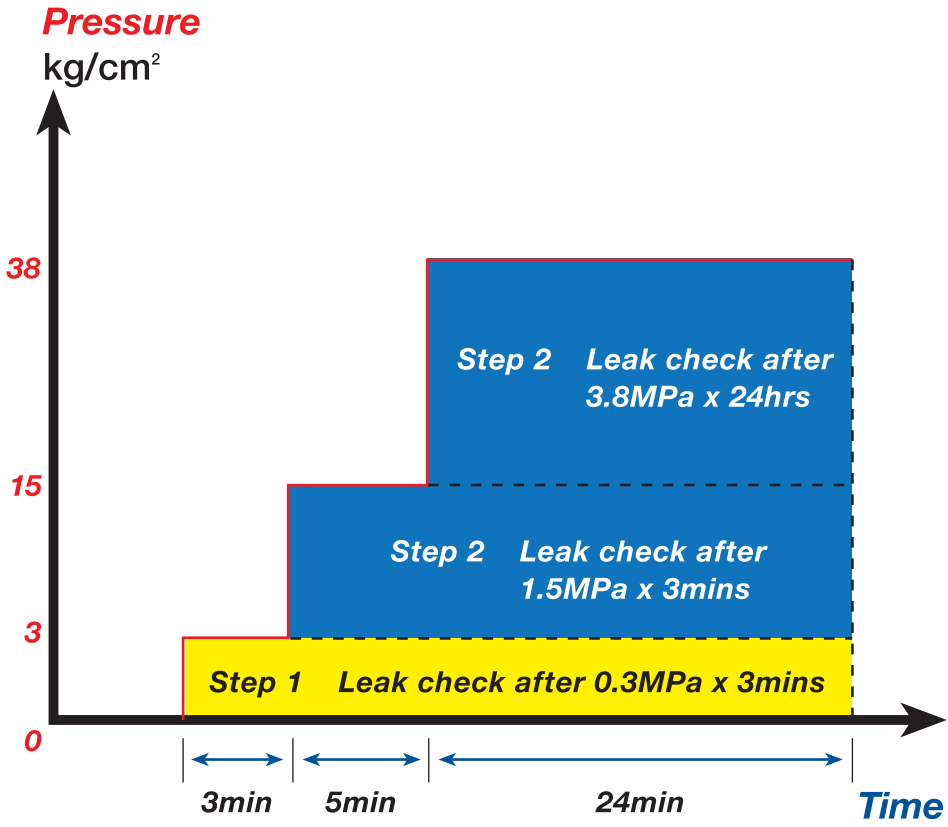
Points of work

The first step: Set the pressure of nitrogen gas at 3.0kgf/cm^2 for more than 3 minutes to check the major leakage.

The second step: Set the pressure of nitrogen gas at 15kgf/cm^2 for more than 3 minutes to check the leakage.

The third step: Set the pressure of nitrogen gas at the designated pressure (28-40kgf/cm^2) for more than 3 hours to detect minor leakage.

Working Procedure		
Refrigerant	Max Design Pressure (Kg/cm^2)	System
R22	28	VRV II
R410A	38	VRV II
R410A	40	VRV III



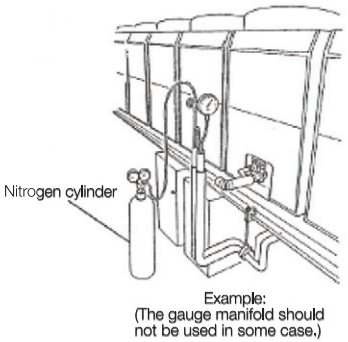
Leak test and leak detector

The leakage can be detected by several methods, such as soap solution, the electric detector, or the spray type detector. However, the halide-torch type detector is not recommended for testing nitrogen gas leakage.

Precaution for pressure variation

The pressure of nitrogen gas will vary depending on the temperature. Be sure that the pressure variation is due to the leakage or the temperature difference. (The variation of pressure is approximate 0.1kgf/cm^2 per 1˚C.)

For example: If the pressure is set at 28kgf/cm^2 at 25˚C ambient temperature when you test, it is OK even if the pressure reading is 27.5kgf/cm^2 at 20˚C when you check.

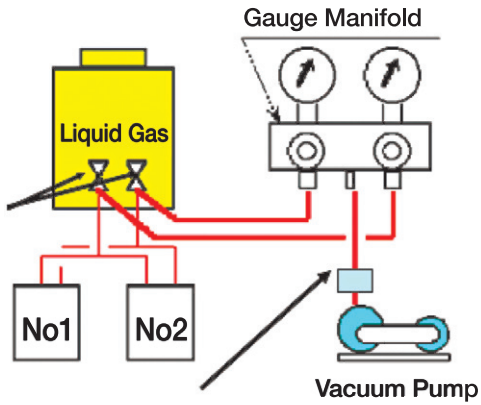


Example:
(The gauge manifold should not be used in some case.)

Be sure to check the leakage by using nitrogen gas.

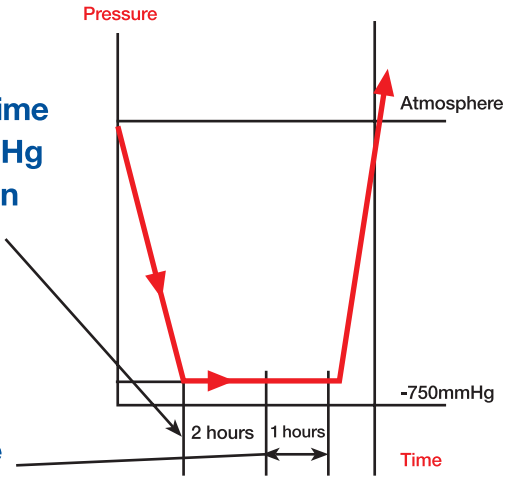
7-1 Procedure

- The vacuum pump must have a capacity of at least -755mmHg



1) Both closed

2) Put the vacuum pump adaptor with check valve units.



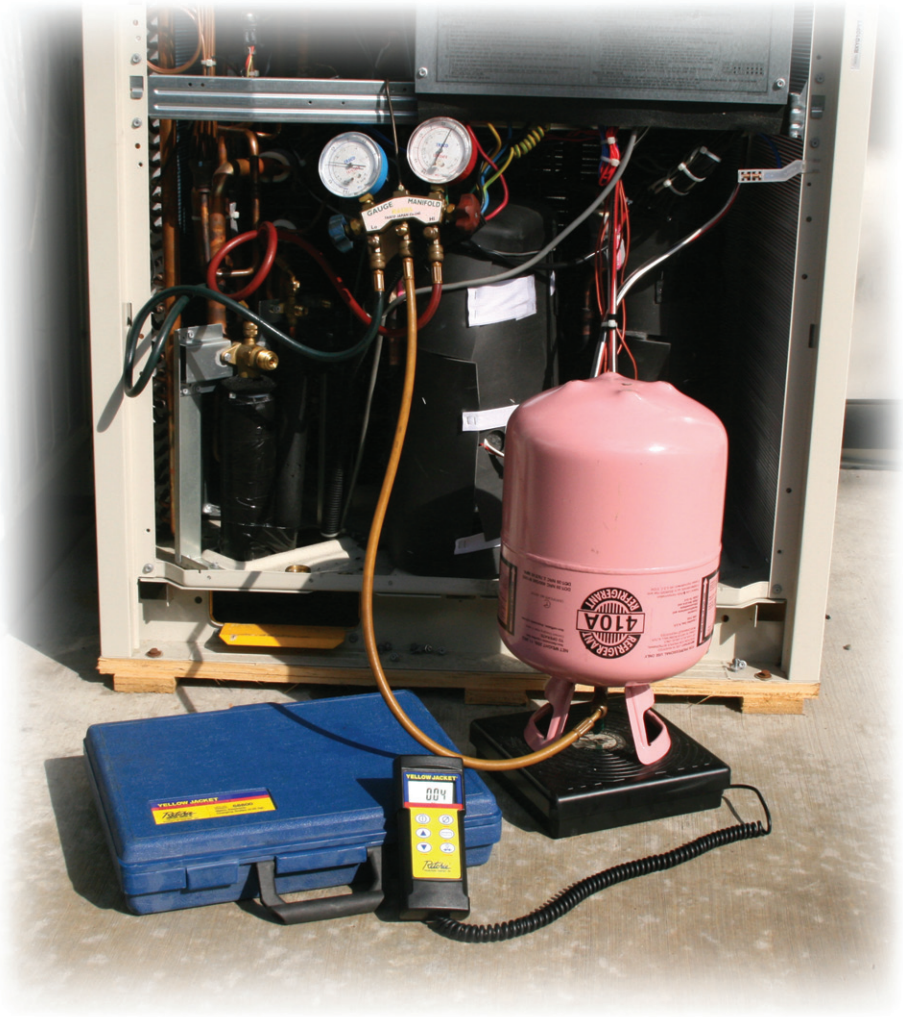
3) Vacuum pump operating time after reaching at -755mmHg for minimum 2 hrs to drain out all moisture.

4) Keep time at -755mm without vacuum pump operation to ensure there is no leak

7-2 Use of Vacuum Pump Adaptor with Check Valve

8-1 Procedure

For calculation of the correct amount of refrigerant R22 or R410A to add, please refer to respective installation manual.



Additional Charge of Refrigerant: Use digital weighting scale in Liquid state to Liquid service port only.

9-1 Incorrect Drain Pipe Size

What is the problem?

Smaller sized piping is used at the collective part.

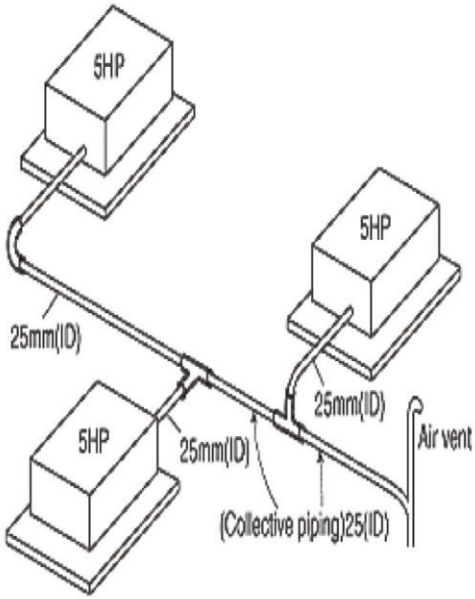
What problems will take place?

As the water flow decreases at the collective part, a protection device actuates to stop the operation.

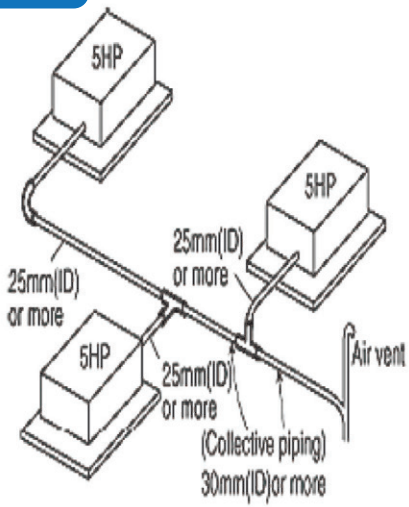
What action should be taken?

1) At least 30mm (ID) or more should be used for collective piping.
2) Check the table below and make sure the correct pipe size is selected and used.

Faulty example



Correct example



Selection of drain piping

1) Calculation for drain exhaust

Figure it out as 2[ℓ/hr] drain per 1 HP will be expected.
(Calculation example of collective drain water)
In case of 3 units x 3HP and 2 units x 3HP [(3 units x 2HP) + (2 units x 3HP)] x 2[ℓ/hr] = 24[1/hr]

2) Selection of drain piping

Select proper size to suit the drainage through the table below:

(Selection example)
When referring to the table below through the calculation result above, the collective piping must be selected PVC40 or more in accordance with 24[ℓ/hr].

3) Suitable size table of collective drain piping (relations between a diameter of horizontal line and permissible drainage capacity).

PVC piping	Inside diameter (reference values: mm)	JLS piping	Inside diameter (reference values: mm)	Permissible flow rate [L/Hr]		Note Impossible for collective piping
				Gradient 1:50	Gradient 1:100	
PVC25	19	VP20	20			(Reference data)
PVC32	27	VP25	25			
PVC40	34	VP30	31	125	88	Used for collective piping
PVC50	44	VP40	40	247	175	

Note: Large sized piping with PVC40 or more should be used for downstream line from the collective point and for the subsequent line.

10-1 Problem of Seizure on Power Supply Wiring (1)

What is the problem?

- The crimp terminal is not used.
- The screw is not securely tightened.

What problems will take place?

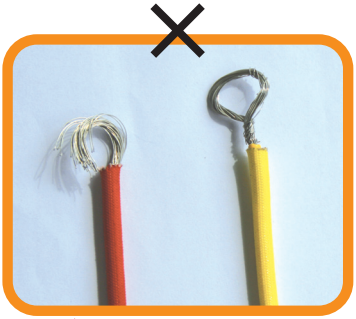
1) A safety device will actuate to stop the unit.
2) Impossible to operate because of no power supply.
3) In the worst case, the over-current keeps flowing and results in a seizure.

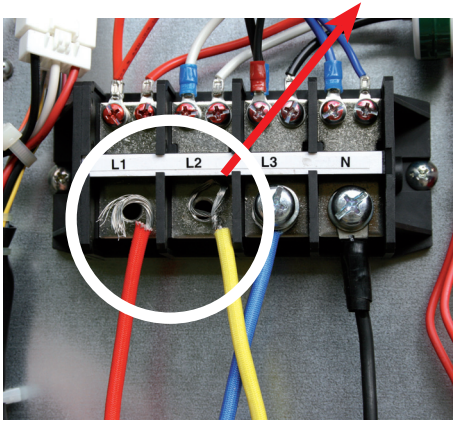
What action should be taken?

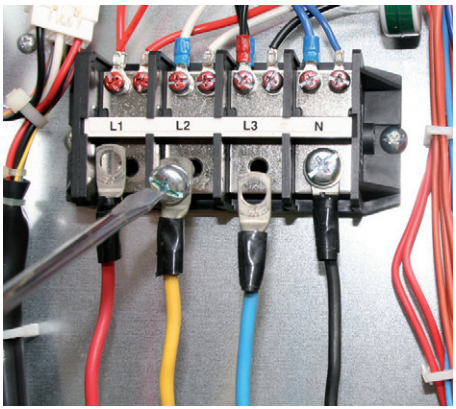
Fix the wire securely using a crimp terminal (round type).

Key points

Crimp terminal (round type)







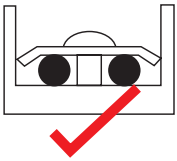
10-1 Problem of Seizure on Power Supply Wiring (2)

What is the problem?

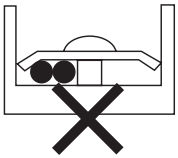
Because it was tightened over the insulation part, the screw was loosened.

- For wiring, use the designated power wire and connect firmly, then secure to prevent outside pressure being exerted on the terminal board.
- Use an appropriate screwdriver for tightening the terminal screws. A screwdriver with a small head will strip the head and make proper tightening impossible.
- Over-tightening the terminal screws may break them.

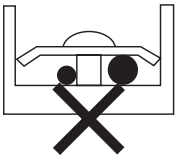
Connect same-thickness wiring to both sides.



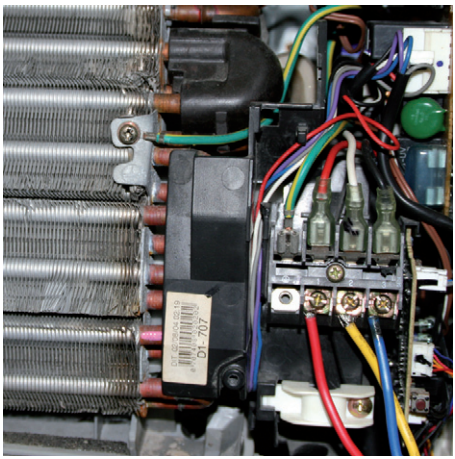
It is forbidden to connect two to one side.

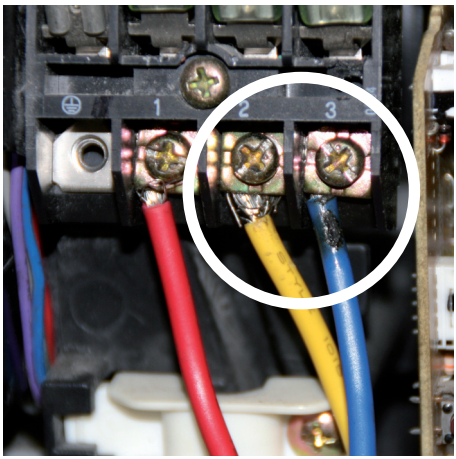


It is forbidden to connect wiring of different thicknesses.



The power supply wiring has been burnt out due to poor tightening of the wire and subsequent continuous over-current.





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