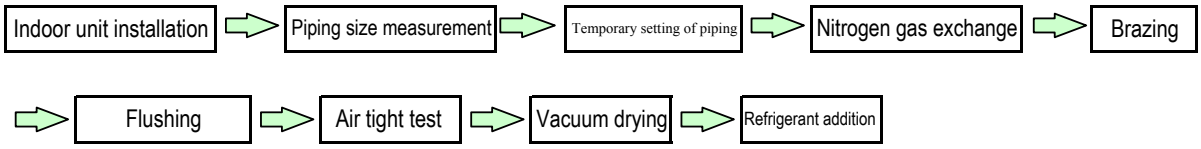
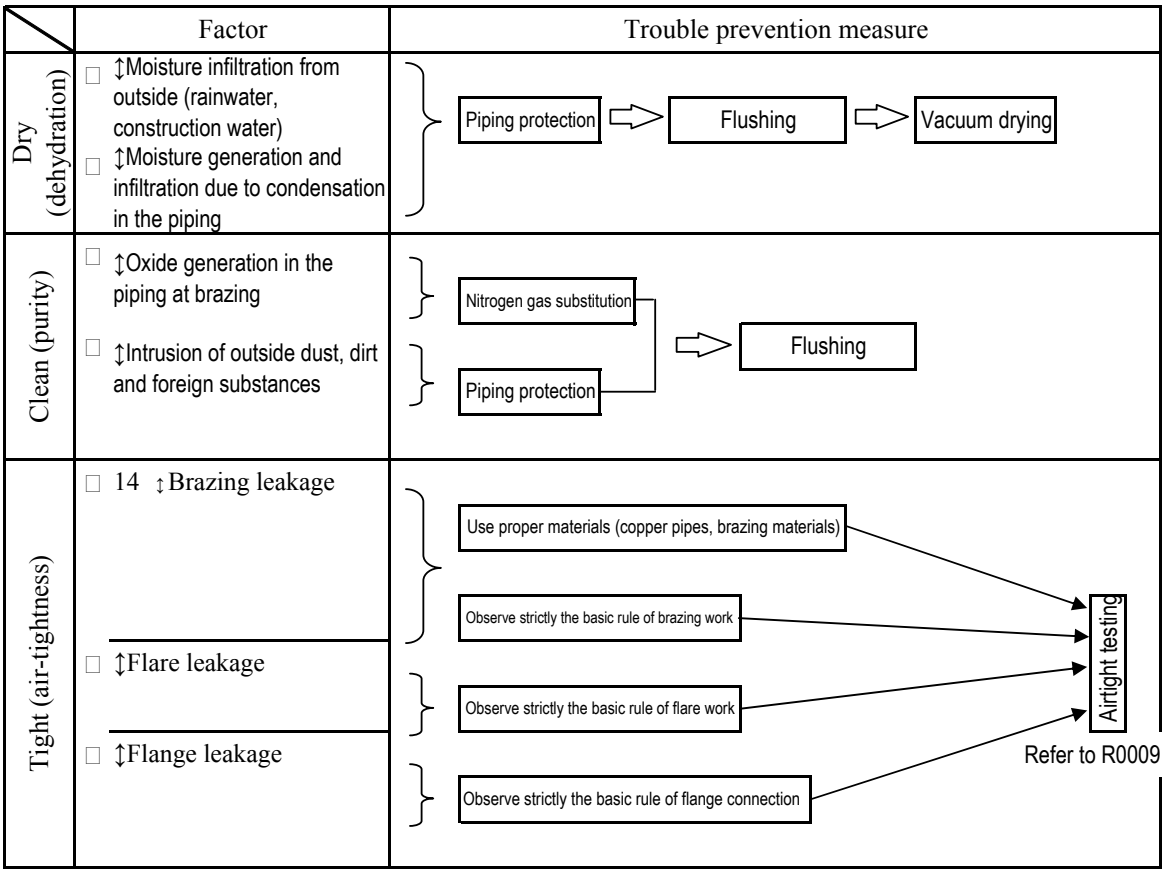
Work sequence

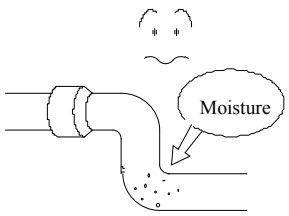
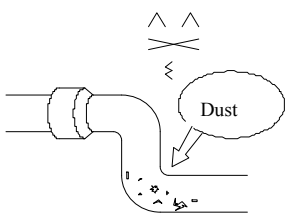
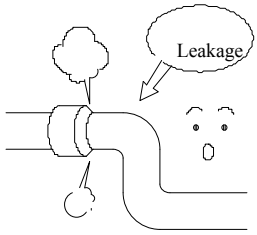


1) Three principles for refrigerant piping

Observe strictly "Three principles for refrigerant piping"



Three principles for refrigerant piping

Dry (dehydration)	Clean (purity)	Tight (air-tightness)
There isn't moisture inside pipe	There isn't garbage inside pipe	There isn't refrigerant leakage
		

2) Nitrogen gas exchange method, (at brazing)

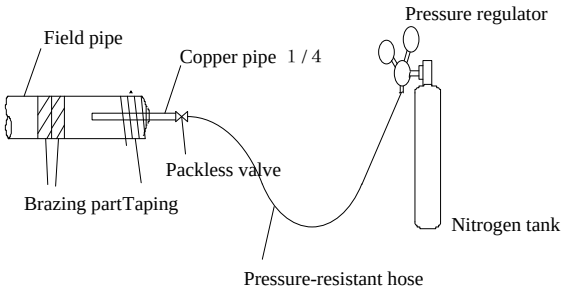
Much of oxide layer is generated on the inner side of the piping if it is brazed without passing nitrogen gas through the piping.

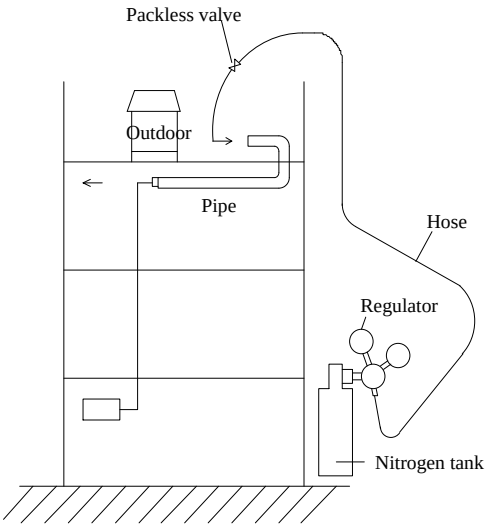
The oxide layer existing in the system may have adverse effects on valves, compressors, etc in the refrigerant system to hinder normal operation.

In order to prevent this, perform brazing while passing nitrogen gas through the piping.

This is called “nitrogen gas exchange”. (exchange between air and nitrogen gas)

This is a basic method for brazing works.





Cautions:

① Use nitrogen gas only.

② Be sure to use a pressure reducing valve.

3) Care of refrigerant pipes

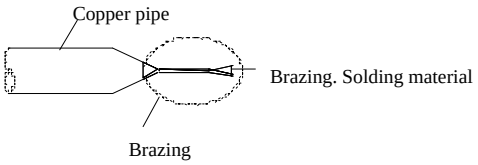
Care is the most important work to prevent moisture, dust, dirt from intruding into the piping. In the past, serious accidents occurred due to moisture intrusion. Pay largest attention to this work to prevent accidents.

All pipe ends should be cared. "Pinch method" is the most reliable one. "Taping method" can be selected as a simple one depending on work areas and periods.

Location	Term of work	Protection method
Outside	⩾ 3 months	Pinch method
	< 3 months	Pinch method or Taping method
Inside	Irrespective of work periods	Pinch method or Taping method

① Pinch method

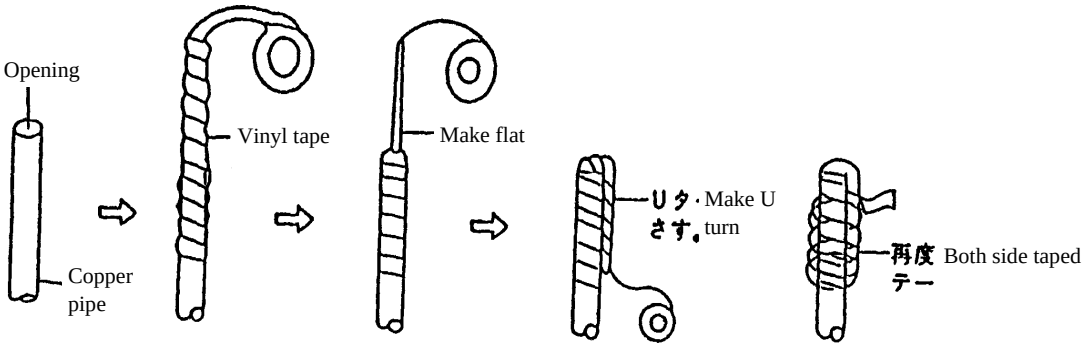
Close the end of copper pipes and braze the gap.



② Taping method

A method to cover the end of copper pipes with vinyl tapes

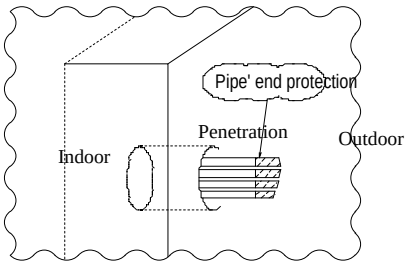
<Taping method>

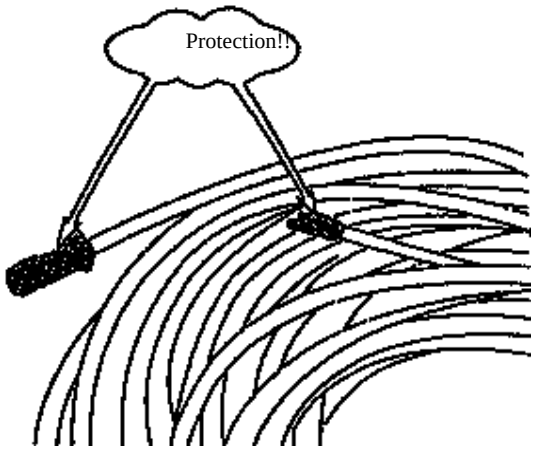


Special care should be taken in the following cases!

- A copper pipe is passed through a cut-through area. (Dusts are likely to intrude)
- A copper pipe end is projected outdoor. (Rainwater may intrude)

(Need special care for outdoor standpipes)





4) Flushing

"Flushing" is to remove foreign substances in piping using gas pressure.

Three major effects

1 Removal of oxide layer generated due to deficient exchange of nitrogen gas on brazing.

2 Removal of foreign substances, moisture, etc in piping due to deficient care.

3 Connection check of indoor/outdoor piping system (including liquid gas)

Procedure (example)

① Set an entrance valve on the nitride gas cylinder.

Don't use gases other than nitride gas.

③ Fit a blind plug to the indoor unit (B) other than unit (A).

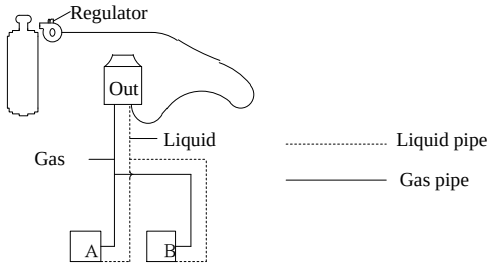
④ Open the main valve of the nitride gas cylinder. Set the reducing valve to 5Kg/cm^2.

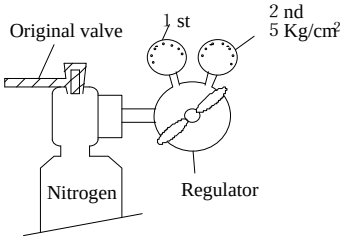
⑤ Confirm that nitride gas comes from the liquid pipe of Unit A

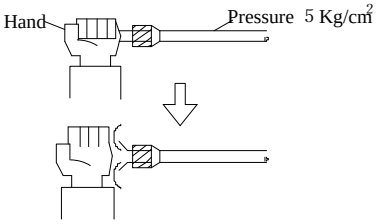
⑥ Flushing

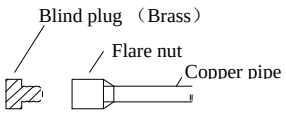
- Block off the pipe with a palm. →
- If the pressure becomes high enough that it can't be blocked by a palm, remove the palm from the pipe suddenly. (first flushing) →
- Block off the pipe with a palm again. →

(perform the second flushing)









(When flushing, put a waste cloth at the end of the pipe in order to check the foreign substances and the amount. If moisture is detected even in a small amount, remove the moisture in the pipe completely)

Procedure: (1) Flush the pipe with nitride gas. (until no moisture comes out)

(2) Perform vacuum drying completely. (see p.37)

⑦ Close the main valve of the nitride gas cylinder.

⑧ Repeat the procedure shown above for unit B.

⑨ After completing the procedure for liquid pipes, perform the procedure for gas pipes.

5) Selecting refrigerant pipe materials

a Refrigerant pipe

- Be sure to use pipes complying with JIS. (size, materials, wall thickness, etc)

Specification: phosphorous deoxidized seamless copper pipe (refer to C1220T, JISH3300)

- Use long pipes or coil (thermal insulation material coated copper pipes) in order to reduce the number of brazed section as possible.
- Use thermal insulation material coated copper pipes for easy processing.

b) Brazed joint, special branch

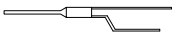
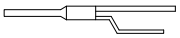
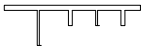
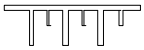
① For common use, (L-bend joint, socket joint, T-joint, etc)

- Be sure to use pipes complying with JIS. (size, materials, wall thickness, etc)

② Special branch

- Use genuine parts of Daikin Industries, Ltd. specified by series (types).

EXII (Example)

	REFNET joint	REFNET header			
		For Outdoor unitRSXY5,6GA（5,6HP）		For Indoor unitRSXY8,10GA（8,10HP）	
		4 branches	8 branches	6 branches	8 branches
Liquid Heat-proof coating					
Gas Heat-proof coating					

c) Brazing material

After this, “copper to copper” junction will be explained because other types of junction are not performed for building multi.

- Be sure to use “hard brazing materials”.

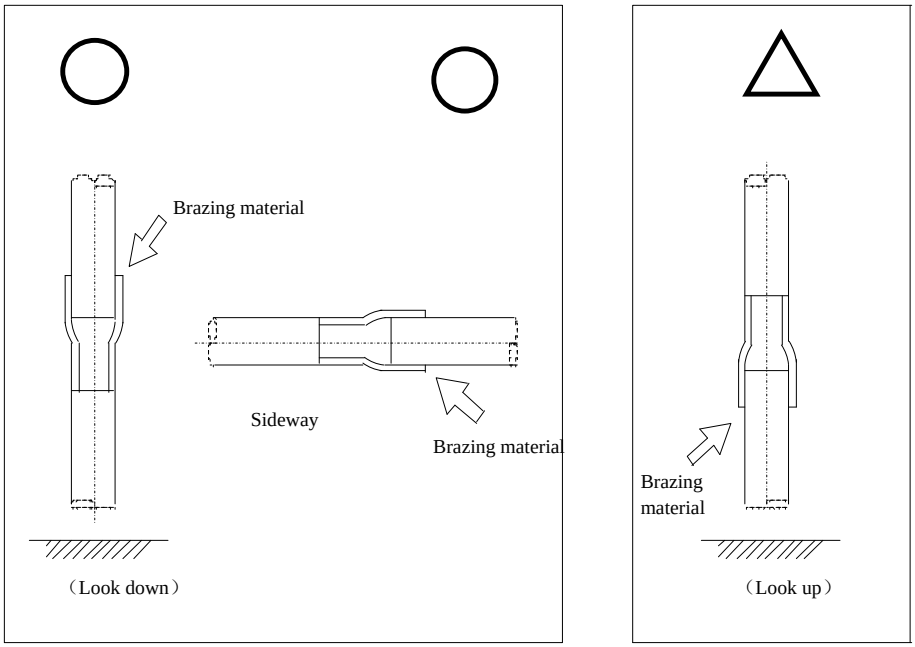
classification	Brazing material JIS	Brazing temp.（℃）	Shearing force（kg/mm）^{2}	Jointing interval（mm）	Brazing method	Reference exp. (Brand name）	Flux （Reference exp.）	Remark
Hard solder	BCuP-2（Phosphor copper solder）	735 ~ 840	about 25	0.05 ~ 0.2	Gas	NEiS #2BD	Unnecessary	
	BAg-2（Silver solder）	700 ~ 845	about 20	0.05 ~ 0.2	Gas	NEiS #107	NEiS #103	

⇨ Normally use this.

6) Brazing work

a) Perform brazing work in downward or horizontal direction. Evade upward direction as possible.

(for preventing leakage)



b) Be sure to use specified liquid pipes and gas pipes. Take care of fitting direction and angle. (to prevent oil return and drift)---case examples (see p.53)

c) Basically, perform brazing in nitride gas exchange method.

Cautions

① Try to guard against fires. (Caring brazed areas and around, preparing a fire extinguisher, water)

② Take care of burns.

③ Confirm that the gap between a pipe and a joint is proper. (to prevent leakage)

④ Refer to the table shown below for the support interval of horizontal pipes (copper pipes).

- As a rule, supporting interval for horizontal pipes (copper pipe) should be based on the table below.

Copper pipe support interval (from HASS 107-1977)

Dia	≤ 20	25 ~ 40	50
Max interval (m)	1.0	1.5	2.0

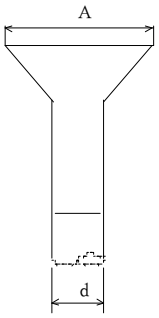
- Evade fixing copper pipes directly with metal bracket, etc.

7) Flare junction

a) Be sure to anneal pipes once before performing flare processing of hardened pipes.

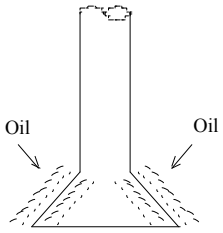
b) Be sure to use a pipe cutter to cut pipes. (Use a cutter with larger size for larger pipe diameter. A hack-saw may be used to cut pipes which are larger than the cutter size. Take care that cuttings should not intrude into the pipe).

c) Set flare tools in order to make specified flare size.



Dia.	Pipe outside dia. (d)	Pipe expansion (A)
3/8 H	9.53	12.2～12.8
1/2 H	12.7	15.6～16.2
5/8 H	15.88	18.8～19.4
3/4 H	19.05	23.1～23.7

d) Apply freezing machine oil to outside and inside surface of the flare. (It prevents the twist of pipes by improving lubricity of flare nuts)



Cautions

① Remove weld flashes securely.

② Be sure to use two wrenches to tighten.

③ Be sure to insert a flare nut before processing a flare.

④ Tighten nuts with proper torque.

Flare nut tightening torque standard		
Size	Clamp torque	
	Kgf □cm	N □cm
1/4（6.4φ）	144～176	1420～1720
3/8（9.5φ）	333～407	3270～3990
1/2（12.7φ）	504～616	4950～6030
5/8（15.9φ）	630～770	6180～7540
3/4（19.1φ）	990～1210	9270～11860

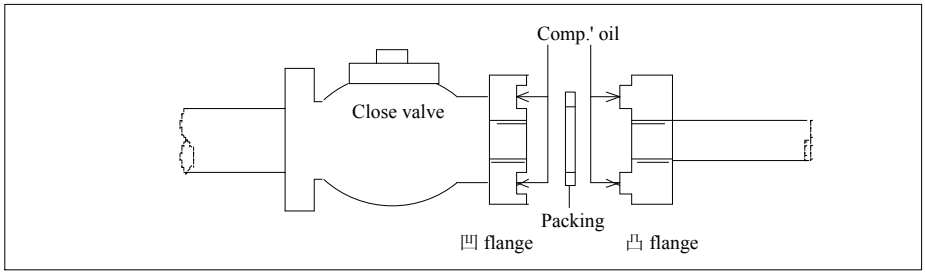
⑤ Confirm that there is no flaw on the flare surface.

8) Flange junction

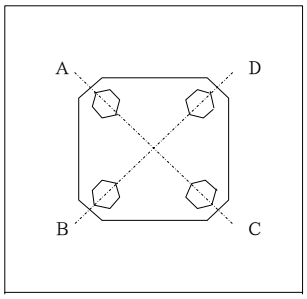
a) The seat surface of a flange should be clean and have no flaw, etc.

(If stains exist, clean them with waste cloth, etc. Then, confirm there is no flaw.)

b) Insert a gasket in the seat surface of the flange after applying freezing machine oil.



c) Tighten bolts in a diagonal line in sequence in order to evade impartial tightening.



<Example>

Progress A → C → B → D

Repeat the order shown on the left side. Finally, four bolts should be tightened with even

Cautions

① Use clean freezing machine oil. (no stain or moisture)

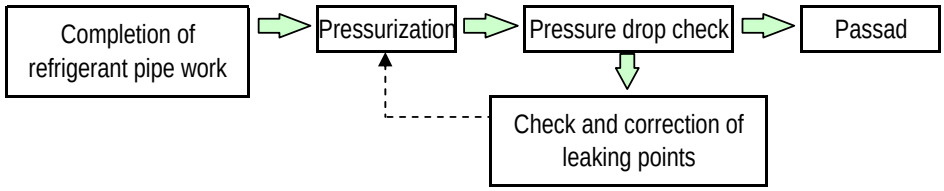
② Tighten flange bolts with proper torque.

Screw and bolt tightening torque (standard)

I S O hexagonal bo

Classify / Size	5.8 (5 T)		10.9 (10 T)	
	Kgf□cm ±15%	N□m ±15%	Kgf□cm ±15%	N□m ±15%
M8	125	1230	302	2960
M10	257	2520	620	6080
M12	436	4280	1050	10300
M16	1030	10100	2480	24300
M20	2050	20100	4950	48500

Work sequence



Test method (protracted pressurizing test)

Be sure to perform test in the following work method and sequence.

a) Pressurize both liquid and gas pipes step by step by refrigerant system. (Be sure to use nitride gas)

- Step 1 3.0kg/cm²pressurized ⩾ 3 minutes
- Step 2 15.0kg/cm²pressurized ⩾ 3 minutes

} Large leakage can be found.

- Step 3 28.0kg/cm²pressurized about 24 hours ※

} Even minute leakage can be found.

※ In the case of pressurization to 28.0Kg/cm^2, if the time period is short, minute leakage can't be found. So, it is recommended that pipes should be pressurized and left to stand 24 hours for step 3.

Caution!! Never pressurize more than 28.0Kg/cm^2.

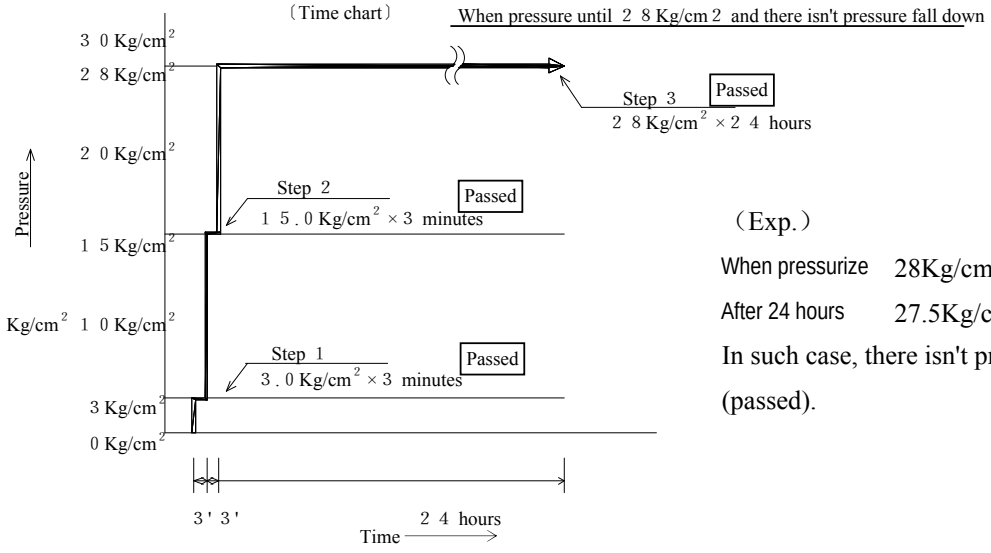
b) Check pressure fall.

If the pressure does not fall, the pipe will be accepted.

If there is a difference between ambient temperatures at pressurizing step and pressure fall check step, there is pressure fluctuation of about 0.1Kg/cm^2 per 1℃. So, perform compensation for this case.

⇨ Refer to next page

Compensated value: (temperature at pressurizing step- temperature at pressure fall check step)×0.1



(Exp.)

When pressurize 28Kg/cm^2 25℃

After 24 hours 27.5Kg/cm^2 20℃

In such case, there isn't pressure fall down (passed).

2) Leaking point check

Check 1 (In the case that pressure fell in the step 1 to 3 in the previous page)

- Audio check Listen noise of large leakage.
- Manipulation check Check large leakage by putting hands on the junction.
- Soap water check ※(Snoop) If there is a leakage, bubbles are generated.

※ Snoop: spray type agent which can be used instead of soap. It prevents rust formation. (manufactured by Osaka Pulp Fitting, Inc)

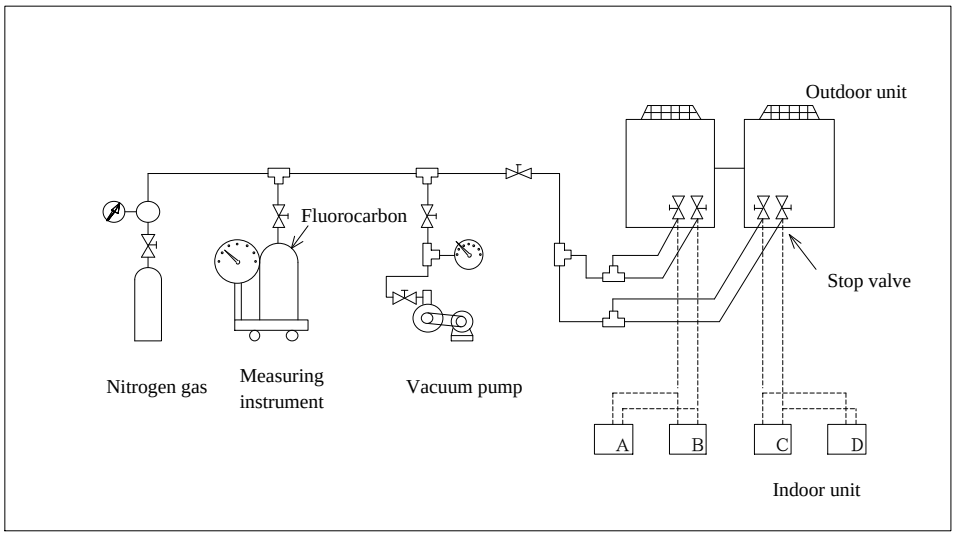
Check 2 (In the case of seeking minute leakage, or leaking points are unknown in spite that the pressure fell in pressurized protracted test method)

① Inject nitride gas to 3.0Kg/cm^2.

② Pressurize chlorofluorocarbon gas (R22) in gas state to 5.0Kg/cm^2. (nitride gas and chlorofluorocarbon gas are mixed)

③ Check leaking points with a halide torch type detector, a propane type detector, an electric detector, etc.

④ If leaking points are not found, check them by pressurizing to 28.0Kg/cm^2 with nitride gas. (Never pressurize more than 28.0Kg/cm^2.)



Cautions

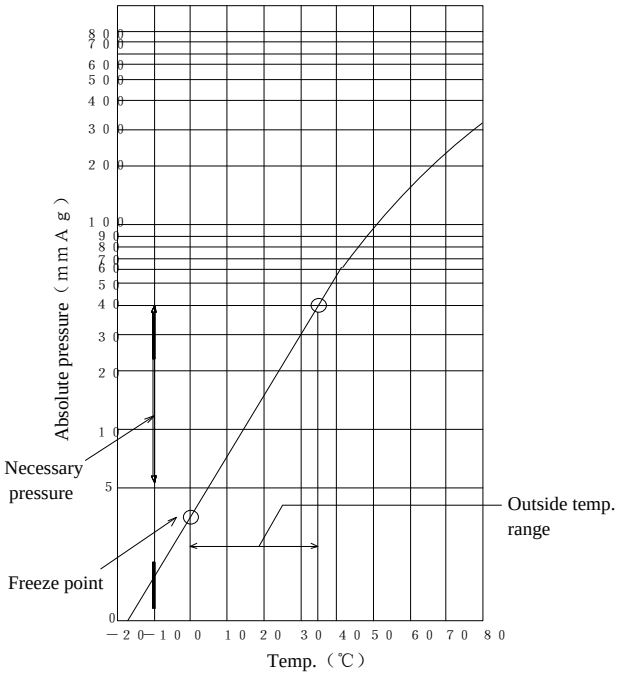
① If the pipe is long, perform an air-tight test by block.

Examlpe
1）Indoor unit side.
2）Indoor unit side + vertical pipe.
3）Indoor unit side + vertical pipe + outdoor unit side.

1) What is “Vacuum drying”?

It is “to dry inside of piping by converting the moisture (liquid) in piping to steam (gas) and discharging it outside.”

The boiling point (evaporating temperature) of water is 100℃ in 1 atm (760mmHg). The boiling point falls rapidly when approaching air pressure in piping to vacuum state with a vacuum pump. If the boiling point fell to the ambient temperature, the water will evaporate.



(Example) In the case of ambient temperature 7.2℃, vacuum drying is impossible unless the pressure is reduced to -8mmHg or less. So, “selection and maintenance of a vacuum pump” is important for vacuum drying.

2) Selecting a vacuum pump

Consider the following two points in selecting a vacuum pump.

① Select a vacuum pump with fine ultimate pressure.

(It is desirable to reach 5mmHg or less)

② Air volume displacement should be relatively large.

（About 40 L /min or above）

Be sure to confirm that the pump reaches 5mmHg or less with a vacuum gauge before vacuum drying work.

Water boiling point（℃）	Pressure	
	mmHg	Pa
40	55	7333
30	36	4800
26.7	25	3333
24.4	23	3066
22.2	20	2666
20.6	18	2400
17.8	15	2000
15.0	13	1733
11.7	10	1333
7.2	8	1067
0	5	667

It is also important to check the ultimate pressure of an oil rotary type pump by exchanging oil every one or two month.

(Reference) Ultimate pressure by types of vacuum pump

Type	Pressure Exhaust volume	Purpose	
		For vacuum dry	For air with draw
Oil rotary type （Need oil）	0.02mmHg 100 L/min	OK	OK
Oilless rotary type （No need oil）	10mmHg 50 L/min	NO	OK
	0.02mmHg 40 L/min	OK	OK

3) Procedure of vacuum drying

There are two patterns of vacuum drying. Adopt either one depending on field conditions.

Normal vacuum drying …… Common method

〔Work sequence〕

① Vacuum drying (first time) --- Connect a manifold gauge to a service port of liquid pipes and gas pipes.

Operate a vacuum pump for two hours or more.

(The pressure should be 5mmHg or less)

If 5mmHg or less can't be obtained after two hours of vacuuming, there may be moisture or leaking points in the system. Vacuum it further for one hour or more.

If 5mmHg or less can't be obtained after three hours of vacuuming, check leaking points.

② Protracted vacuum test

Leave it for one hour or more under -755mmHg or less. Confirm that the value indicated by the vacuum gauge does not increase. (If the value increases, there is moisture or leaking points in the system)

③ Additional filling of refrigerant

Fill required amount of refrigerant from the liquid side service port with a charging cylinder.

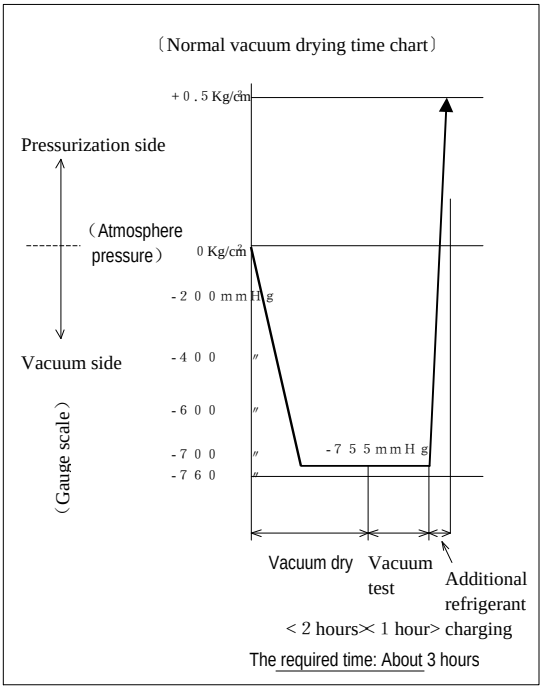
④ Shut-off valve full open

Full open the shut-off valve on liquid and gas side.

Note: Vacuumize from both liquid pipes and gas pipes.

(Because piping is blocked on the way due to the functional parts in the indoor unit)

〔Normal vacuum drying time chart〕



Special vacuum drying

This vacuum drying is performed only when there may be moisture intruded into the piping.

For example:

- Moisture was detected when flushing refrigerant piping.
- There may be condensation in piping because of a construction work in rainy season.
- There may be condensation in piping because of long term construction work.
- Rainwater may intrude into the piping during construction.

In this method, a vacuum break process with nitride gas is added on the way of the normal vacuum drying process shown above.

〔Work sequence〕

① Vacuum drying (first time) --- two hours

② Vacuum break (first time) --- nitride gas is pressurized to 0.5Kg/cm^2.

(The effect of vacuum drying is enhanced because nitride gas is dried nitrogen. However, if there is much water, it can't be eliminated by this method. So, take care that water should not intrude or be generated in the construction of refrigerant pipes)

③ Vacuum drying (second time) --- Operate a vacuum pump for one hour or more.

(evaluation: the ultimate pressure should be 5mmHg or less. When 5 mmHg or less is not obtained in spite of two hour evacuation, repeat from ② vacuum break to ③ vacuum drying).

④ Vacuum protracted test, --- one hour

⑤ Refrigerant additional filling

⑥ Shut-off valve full open

※ Be sure to use nitride gas for vacuum break. (The use of oxygen gas may cause an explosion)

〔Special vacuum dry time chart〕