
DAIKIN

Good practices in servicing air conditioning system

Prepare By: Hairul Fahmi
Sharul Hakim

Contents

1. Overview of R32 Refrigerant
2. Properties of Refrigerant Oils
3. Refrigerant Cylinders
4. Service Tools for R32
5. R32 unit Installation And Service
6. Troubleshooting
7. Precautions

Overview of R32 Refrigerant

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1.1 Comparison with other refrigerant

	HFC units	HFC units	HCFC units
Refrigerant Name	**R32**	R410A	R22
Composing Substances	Single-component refrigerant	Quasi-Azeotropic Mixture (R32:R125 = 50:50 wt%)	Single-component refrigerant
Standard Design Pressure	RA : 4.17 MPa G PA : 4.0 MPa G	RA: 4.17 MPa G PA: 4.0 MPa G or 3.8 MPa G	2.75 MPa G
Refrigerant Oil	Synthetic oil (Ether)	Synthetic oil (Ether)	Mineral oil (Suniso)

* Refrigerant piping consists of copper/steel pipes, joints, and other fittings. All components must be selected and installed in conformity with the standards pertaining to the Refrigeration Safety Regulation.

Overview of R32 Refrigerant

- How can we know the unit using R32.

1- Check sticker at the unit.

2- Check marking label at the unit.

Overview of R32 Refrigerant

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1.2 Copper pipe Thickness

Copper pipe (OD)	Wall thickness of copper pipe (O-OL material) (Class 2)	Wall thickness of copper pipe (H-1/2H material) (Class 2)
6.4	0.8	0.8
9.5	0.8	0.8
12.7	0.8	0.8
15.9	1.0	1.0
19.1	1.2	1.0
22.2		1.0
25.4		1.0
31.8		1.1
38.1		1.35
44.5		1.55

*Class 2: R410A & R32

Overview of R32 Refrigerant

1.3 Properties of R32 Refrigerant

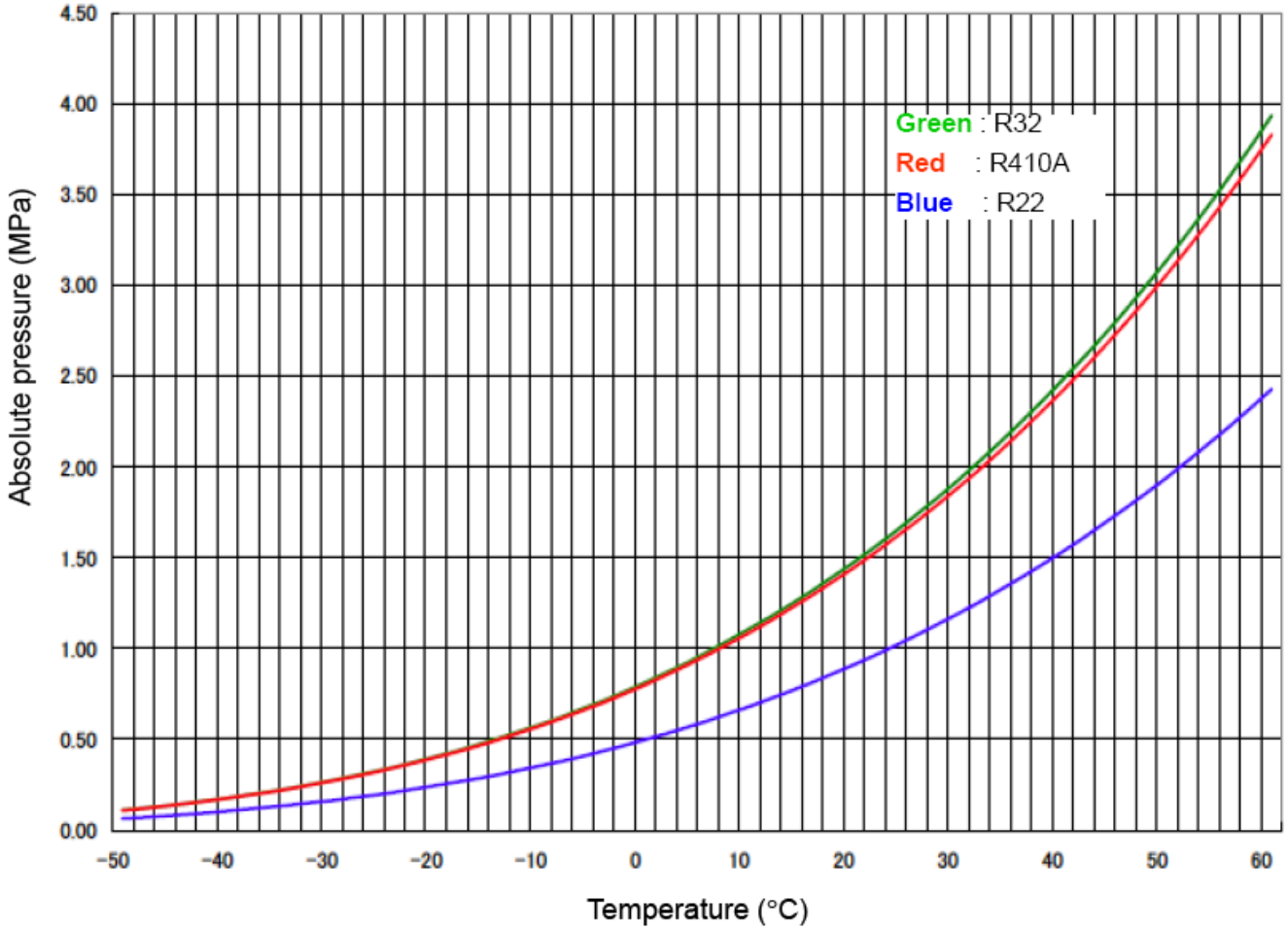
		R32	R410A	R22
Formula		CH_2F_2	CH_2F_2 /CHF_2CF_3	$CHCLF_2$
Composition (Mixture ratio: wt%)		-----	R32/R125 (50/50 wt%)	-----
Boiling temperature (ºC)		- 51.7	- 51.5	- 40.8
Pressure (physical property) *1		3.14	3.07	1.94
Capacity (physical property) *2		160 ✓	141	100
COP (physical property) *3		95 ✓	91	100
Ozone depletion potential (ODP)		0	0	0.055
Global warming potential (GWP) *4		675 ✓	2090	1810
Flammability (ASHARE)		Lower flammability (A2L)	No flammability (A1)	No flammability (A1)
Regulatory treatment in Japan (As of XXXX)	General High Pressure Gas Safety Regulation	- Non-flammable - Inert	- Non-flammable - Inert	- Non-flammable - Inert
	Refrigerant Safety Regulation	- Non-flammable - Not inert	- Non-flammable - Inert	- Non-flammable - Inert
Toxicity		No	No	No
Comparison with R410A		Same pressure; Service tools can be shared. ✓		
Comparison with R22		Pressure is approx. 1.6x; Service tools cannot be shared for pressure-resistant specifications. ✗		

***1:** Physical property value under a temperature condition of 50ºC
***2:** Temperature condition: 0/50ºC; the values are relative values based on R22 as 100
***3:** Te/Tc/SC/SH = 5/50/3/0ºC
***4:** GWP = Global warming potential; values are specified in IPCC 4th Assessment Report

Overview of R32 Refrigerant

1.3 Properties of R32 Refrigerant

<Refrigerant Properties of R32, R410A, and R22 (Pressure-Temperature Graph)>



Properties of Refrigerant oil

- R32 lacks compatibility with mineral oil (SUNISO) and reduces oil return performance. To ensure compatibility, Ether oil (a synthetic oil) has been selected as the refrigerant oil for R32 units.

- Ether oil is thus used as the refrigerant oil for both R32 and R410A units, but product names are different as indicated in the table below.

Types of Oil	Synthetic oil Ether oil	Synthetic oil Ether oil	Mineral oil
Unit (Manufacturer)	FW68DA (Idemitsu Kosan)	FVC68D FVC50K (Idemitsu Kosan)	SUNISO 4GS (Japan Sun Oil Company)
Applicable refrigerant (Daikin products)	R32	R410A	R22

Service Tool For R32

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4.1 Tools compatibility

		Changes in R22 → R32	Changes in R410A → R32
Refrigerant properties	**Pressure**	**1.6 times (Compared with R22)** **⇒ Higher pressure-resistance** in tools	**Same** **⇒ Tools for R410A can be used**
	Composition	**Both are single refrigerants** **⇒ Liquid charging and gas charging are possible**	Mixed refrigerant → **Pure refrigerant** **⇒ Liquid charging and gas charging are possible**
	Flammability	Non-flammable → **Slightly flammable**	Non-flammable → **Slightly flammable**
Refrigerant oil		Mineral oil → **Synthetic oil (Ether oil)** **⇒ Contamination control**	**Both are synthetic oil** (Ether oil) **⇒ Same level of contamination control as R410A**
Tools		**Adopted dedicated tools (can be used with R32 and R410A)**	**Can use tools for R410A**

• Service Tools For R32

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4.1 Tools compatibility

Tool	R32	R410A	R22
Gauge manifold	Sharable		
Charge hose	Sharable		
Weighing instrument	Sharable		
Pipe bender	Sharable		
Pipe cutter	Sharable		
Flaring tool	Sharable *1		
Torque wrench	Sharable *2		
Cylinder cap	Sharable		
Vacuum pump	Sharable *3		
Refrigerant recovery system			
Refrigerant recovery cylinder			
Electric gas leak detector	Sharable *4		

*1: R22 type can be used for R32 & R410A by changing the work process.
*2: Dimension of width across flats of flare nut is different between R32 & R410A and R22 (4/8" and 5/8" only. Other flare nuts can be shared.)
*3: When using an R22 type for R32 & R410A, use with a reverse flow preventive adapter.
*4: Even if a detector supports R22, if detector does not support HFC (R32, R410A), it cannot be shared.

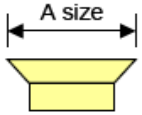
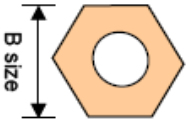
Comparison

The main reasons for the tool change (no sharing of tools) associated with the switchover from R22 to HFC (R32, R410A) are described in the following chart.

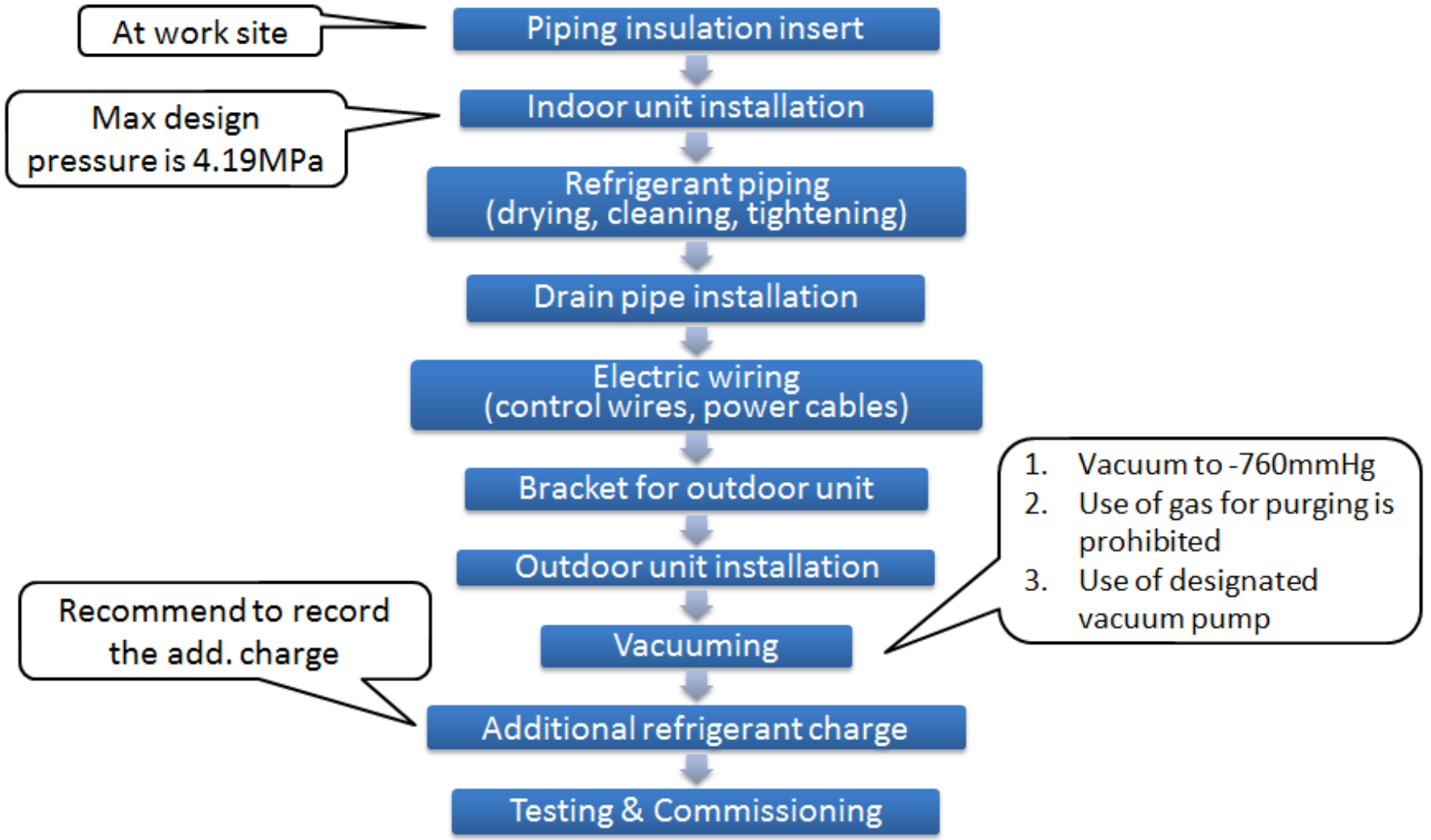
Tool	Reasons for change
Gauge manifold Charge hose	●To accommodate the higher pressure of the refrigerant (Changed the scale on the pressure gauge and increased pressure resistance) ● To prevent accidental high pressure refrigerant charging and for contamination control (preventing impurity contamination) (To accommodate the screw specification change)
Flaring tool	●To accommodate the changed dimension of width across flats for 4/8" and 5/8" flare nuts However, R22 type can also be used if appropriate modifications are made to the work process.
Torque wrench	●To accommodate the changed dimension of width across flats for 4/8" and 5/8" flare nuts
Cylinder cap	●To accommodate the screw specification change
Recovery cylinder	●To accommodate the increased refrigerant pressure For R22, recovery cylinder pressure resistance specifications FC1 to FC3 can be used. For R32 and R410A, recovery cylinder pressure resistance specification FC3 can only be used. (FC3 can be shared)

Service Tools For R32

4.1 Tools compatibility

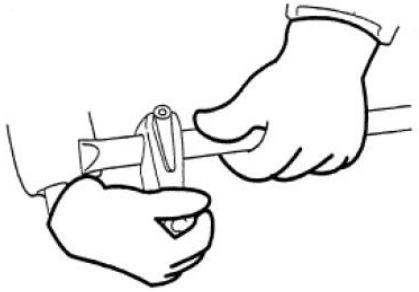
Tool	Information
Gauge manifold 	●Supports R32 (R410A) pressure - If the gauge manifold supports R410A, it can also be used with R32. - High-pressure gauge: -0.1 to 5.3 MPa Low-pressure gauge: -0.1 to 3.8 MPa ●Bore of connecting portion uses 5/16" flare screw
Charge hose 	●Supports R32 (R410A) pressure - If the charge hose supports R410A, it can also be used with R32. ●Bore of connecting portion uses 5/16" flare screw
Weighing instrument 	●Used for measuring of weight, the weighing instrument can be shared with HFCs (R32, R410A) and conventional refrigerants (R22, etc.)
Pipe bender 	●Can be shared between R32, R410A, and conventional refrigerants (R22, etc.)
Pipe cutter 	●Can be shared between R32, R410A, and conventional refrigerants (R22, etc.)
Flaring tool 	●Supports flare size (A size) for R32 (R410A) - If the flaring tool supports R410A, it can also be used for R32. - Flare size is different between R22 and R32 (R410A) 
Torque wrench 	●Supports flare nut width across flats (B size) for R32 (R410A) - If the torque wrench supports R410A, it can also be used for R32. - Width across flats is different between R22 and R32 (R410A) for 4/8" and 5/8" - No change in tightening torque value. 

Flow of Installation



Flaring

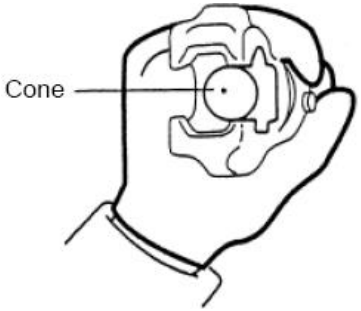
1. Cut the pipe using a pipe cutter.



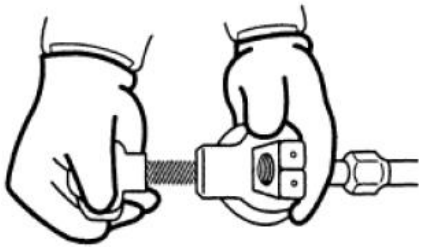
2. Remove the burrs at cutting edge using a reamer.

3. Clean the inside of the pipe.

4. Before flaring, clean the cone section of the flaring tool.

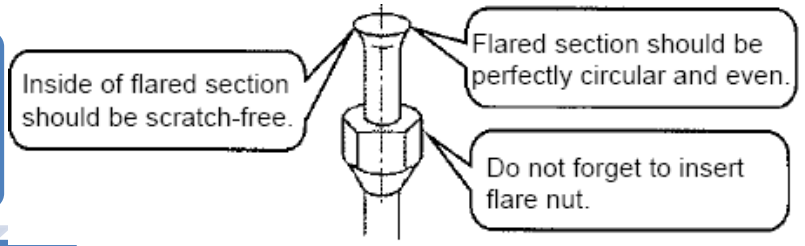


5. Flare the pipe. Rotate the flaring tool 3 - 4 turns until a clicking sound is produced.



Flaring

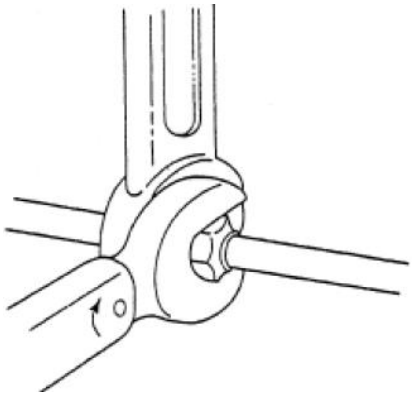
6. Check that flaring has been finished correctly.



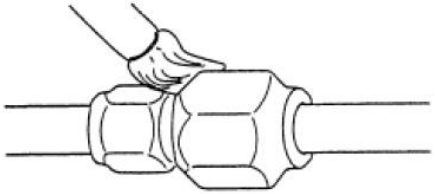
7. Apply ether oil on the inside of the flared section.

Never use mineral oil (suniso etc.)!

8. Tighten the flare nut** with torque wrench. Apply proper tightening force (refer next page).



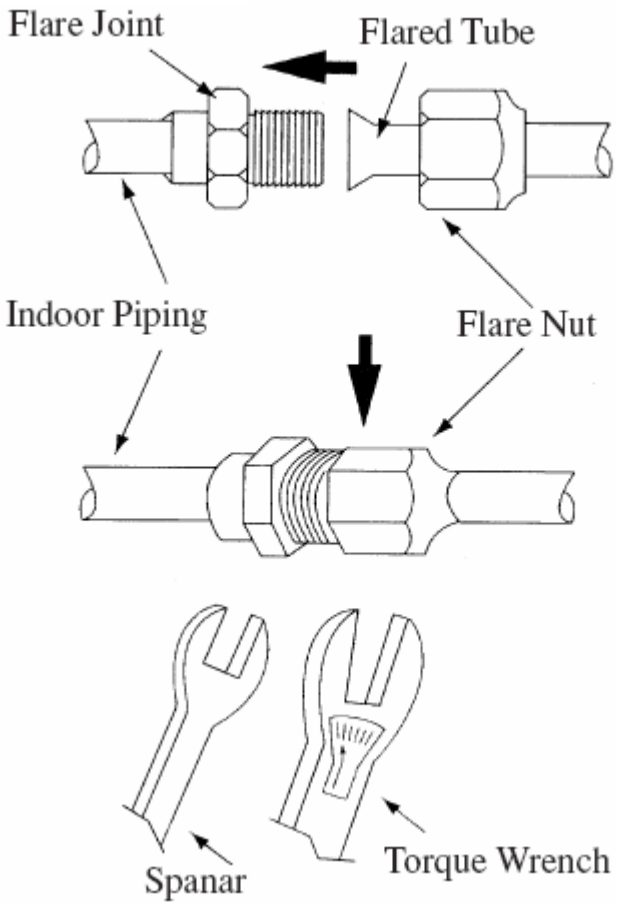
9. Check for gas leaks. Use soap water to check for leaks.



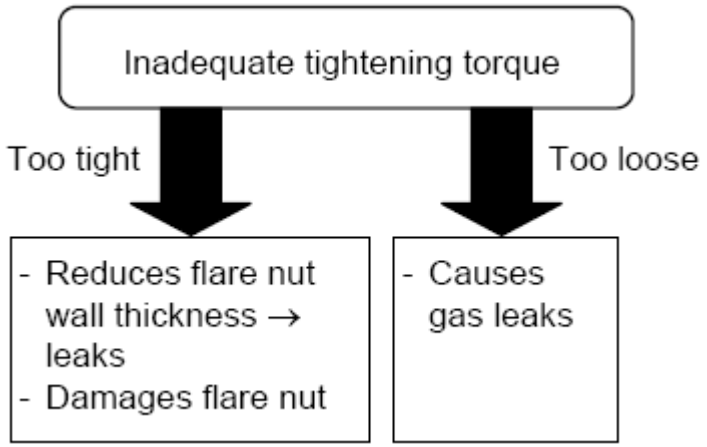
10. Wipe the nut area clean when finished.

** 1/4 and 5/8 flare nuts for R32 and R410A equipment are enlarged across the flats.
1/4: 24mm → 26mm
5/8: 27mm → 29mm

Pipe Connection



Pipe Size mm / (in)	Torque Nm / (ft - lb)
6.35 (1/4)	18 (13.3)
9.53 (3/8)	42 (31.0)
12.7 (1/2)	55 (40.6)
15.88 (5/8)	65 (48.0)
19.05 (3/4)	78 (57.6)



Torque Wrench

TITLE : PENGGUNAAN 'TORQUE WRENCH'.

OPERATING PROCEDURES.

1 – SETTING OF TORQUE.

Set the torque value using the main scale and sub scale.

1 – Loosen the lock screw. (Rotate counterclockwise)

2 – Rotate the sub scale ring to adjust the torque value.
(Main scale + sub scale = Torque value)

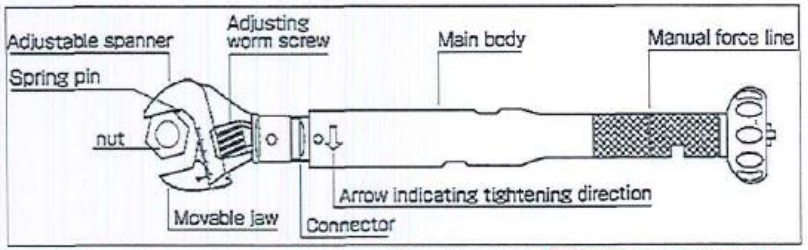
3 – Tighten the lock screw. (Rotate clockwise)

Example

For setting to 18Nm using the N45HYK

- Rotate the sub scale ring to set 15 of the main scale to the graduation base line. At this time, check that 0 of the sub scale is set at the origin
- Next, further rotate the sub scale ring to set to 3. Setting of (15 + 3 = 18Nm) is complete
- Tighten the lock screw

2 – SETTING OF DIMENSION OF OPENING.

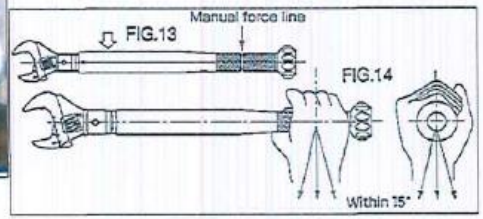


1 – Insert a nut between the measuring faces of the jaws until the spring pin contact the nut.

2 – Rotate the adjustable worm screw to touch the movable jaw onto the nut precisely tight.

3 – Slightly rotate the adjustable worm screw reversely to provide a gap for pulling out.
(You can determine the quantity of reverse rotation through a very small amount of movement of the movable jaw by rotating the worm screew while watching the graduations)

3 – APPLICATION OF FORCE.



1 – The torque value changes depending on the position where force is applied to. Hold the grip with the manual force line in the center. FIG. 13.

2 – Apply force in the direction at right angles to the torque wrench. Allowable angles shall fall within 15° horizontally and vertically. FIG. 14.

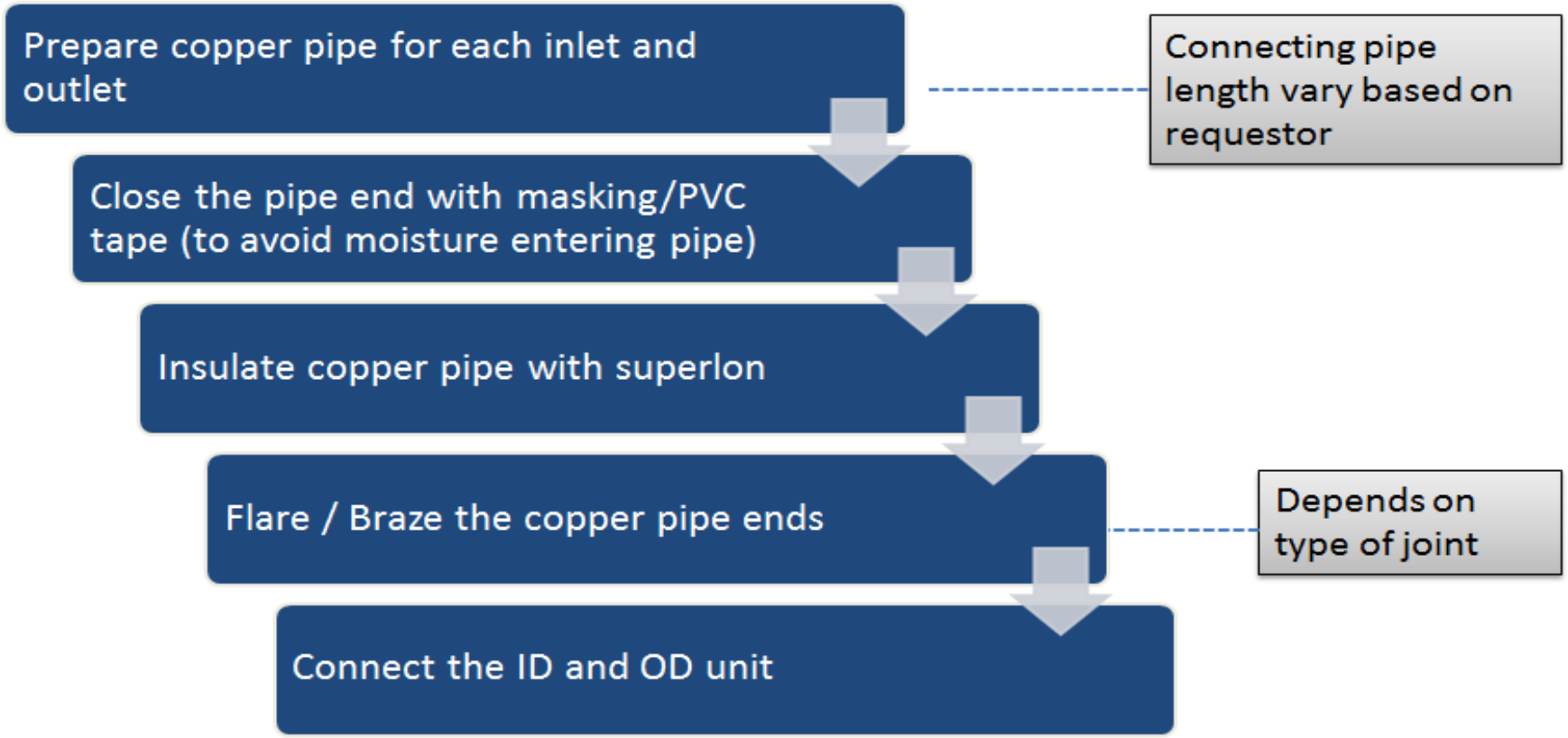
3 – Immediately after a click sound is issued, stop tightening. Further tightening will create excessive torque.

Remarks:

Test the torque wrench through break-in trial before starting its use for operation.

In the first several testing, the torque value is not stable because the toggle mechanism inside the body does not get used to operation.

Piping Connection



NOTE: Outlet pipe (gas pipe) is the larger pipe

Check leakage

Inject nitrogen gas via hand valve

R22 & R407C-> 400psig
R32 & R410A -> 500psig

Observe the trend of pressure reading 1 hour +

Use soap water to check leakage at all brazing joints and connection

Release nitrogen gas if no leakage

If pressure drop over time, there is leakage

Use soap water to detect location of the leaks

Tighten or braze any joints which are leaking

Repeat check leakage process

If no leak, release nitrogen gas until pressure reading = 0 psig

Vacumming

Vacuum drying is a method of drying the inside of a pipe by converting moisture (liquid) inside the pipe into steam (vapor) and removing it from the pipe by using a vacuum pump.

Boiling point of water (°C)	Pressure (gauge)	
	mmHg	Pa
40	-705	7333
30	-724	4800
26.7	-735	3333
24.4	-738	3066
22.2	-740	2666
20.6	-742	2400
17.8	-745	2000
15.0	-747	1733
11.7	-750	1333
7.2	-752	1066
0	-755	667

Caution: Make sure that a vacuum level of -755 mmHg or lower is attained.

Vacumming

Connect gauge manifold and vacuum pump as shown in the diagram

Fully open the valve of gauge manifold, and turn on the switch of the vacuum pump.

Check to make sure the gauge shows a pressure level of -760 mmHg, remain for 15~20mins .

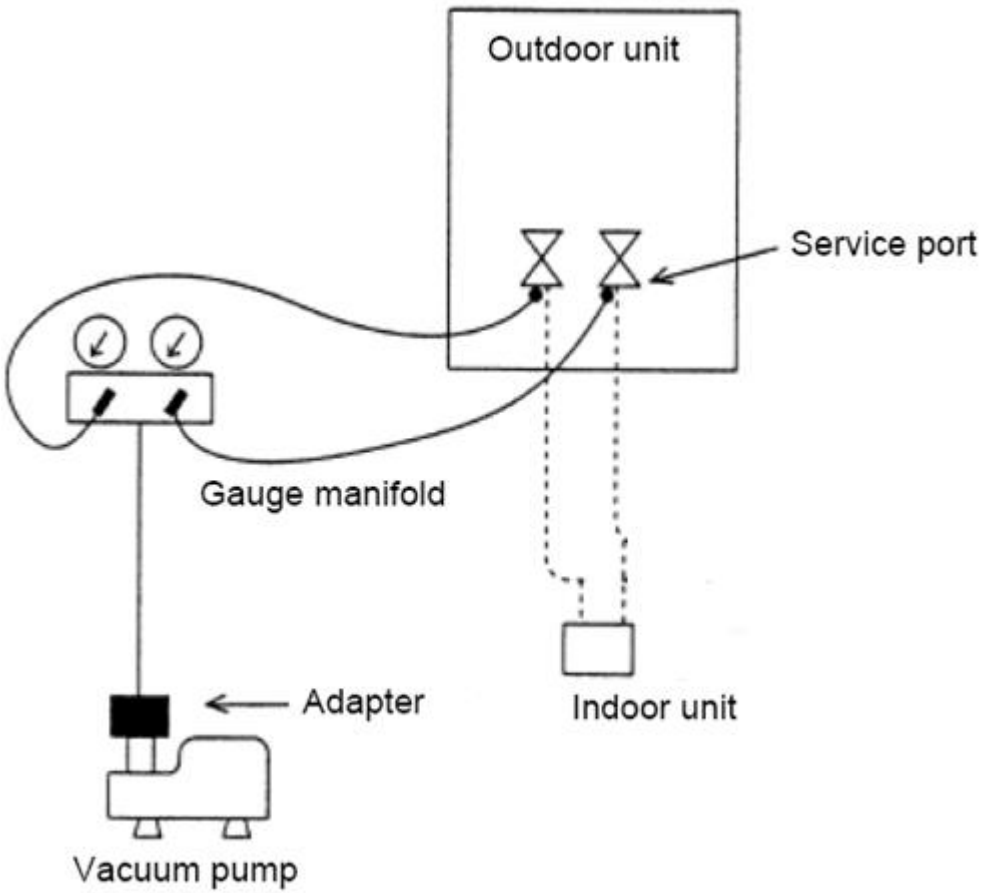
Close the valve of the gauge manifold.

Loosen the hose connected to the vacuum pump, and stop the pump.

After approximately 1 minute, check to make sure pressure indicated on the gauge does not increase.

Open the stop valves of both liquid and gas pipes of the outdoor unit.

Before vacuum drying, make sure that the power switches of the outdoor and indoor



Charging

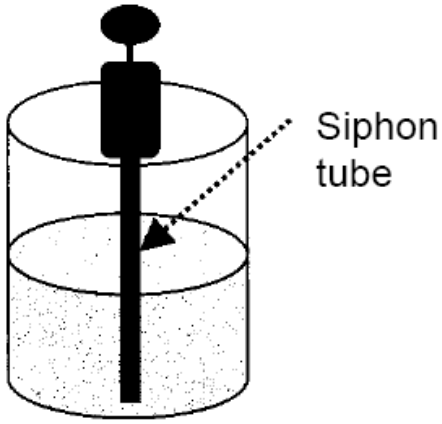
1. Screw in rubber hose of refrigerant tank to hand valve
2. Place gas cylinder (upside down) onto weighing scale
3. Open the liquid valve of the charging cylinder
4. Purge out air from the rubber hose
5. Retighten hose and re-set the weighing scale to 0 kg reading
6. Inject an initial amount of refrigerant liquid into the unit
7. Amount charged can be read from weighing scale
8. Close the hand valve and refrigerant tank liquid valve

By unscrewing a little of the hose from the hand valve

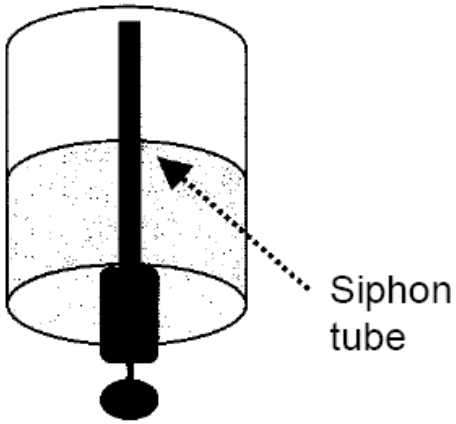
Please use the refrigerant liquid valve line during unit charging at all time.

Charging

Unlike R410A and R407C, which are mixed refrigerants, R32 is a single refrigerant; this means that no composition change occurs, and likewise R22, allows for easy liquid charge and gas charge.



Can be filled with liquid refrigerant when used in upright position



Can be filled with gas refrigerant when used in upside-down position

Cautions during vacuuming and charging

- Ensure that the outlet for the vacuum pump is not close to any ignition sources and there is ventilation available.
- Ensure that contamination of different refrigerants does not occur when using charging equipment.
- Do not overfill the refrigeration system.

Dismantling

Recovery of refrigerant before dismantle

-Remove all plastic tubing
-Remove all electrical from unit.

-Dismantle the outdoor unit panels

-Charge with nitrogen gas
-Braze and seal completely
-Close excess valve
-Uncouple the connecting pipe

Assemble back the panel

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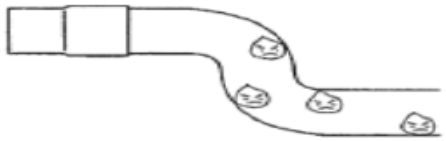
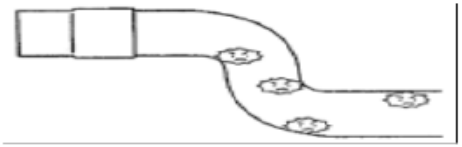
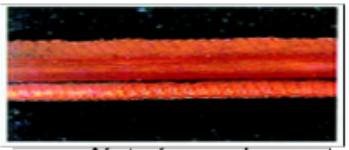
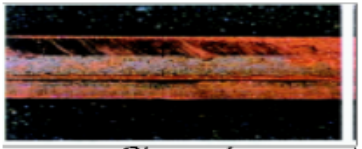
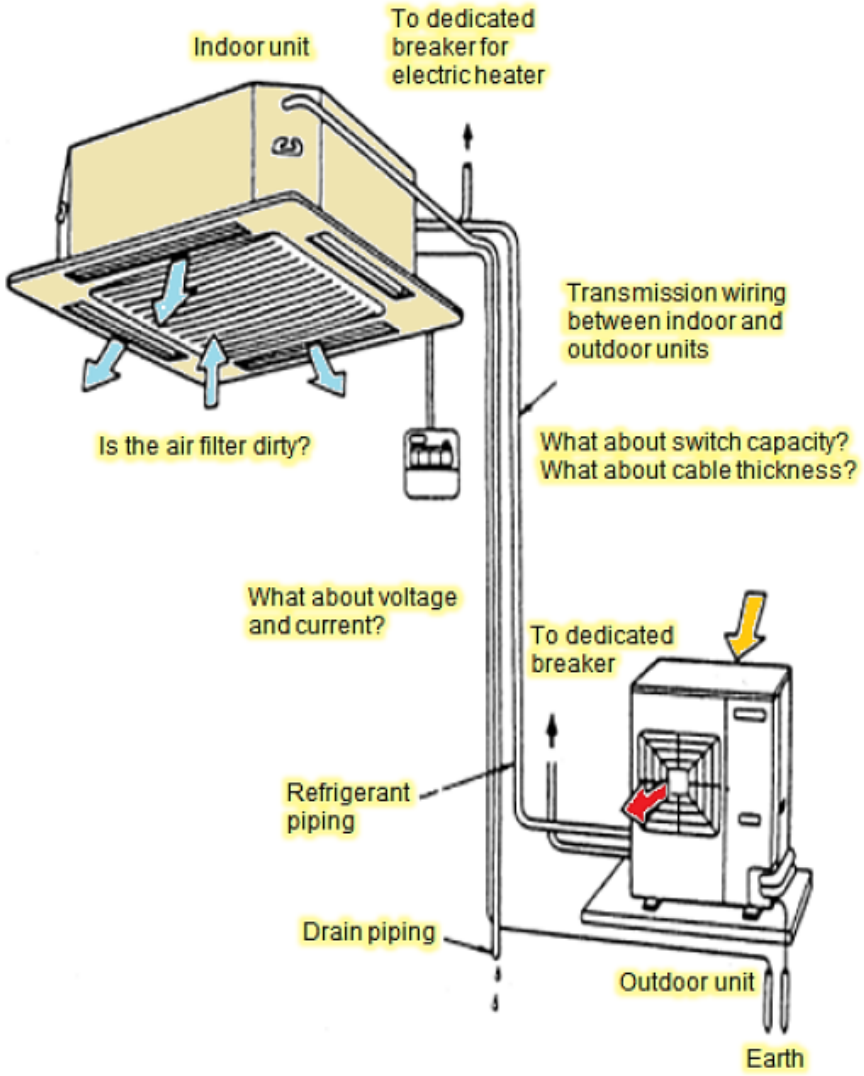
5.1 3 Basic Rules of Refrigerant Piping

	(1) Drying (no moisture) There shall be no moisture in the pipe.	(2) Cleaning (free of contamination) There shall be no dust in the pipe.	(3) Tightening (air-tightness) There shall be no refrigerant leak.
Item			
Cause	· Water entering from outside, such as rain. · Moisture due to dew condensation occurring inside the pipe.	· Oxidized film generated during brazing. · Entering of foreign items such as dust, particles and oil from outside.	· Insufficient brazing · Inadequate flaring or insufficient tightening torque. · Inadequate tightening of flange connection.
Problem	· Clogging of expansion valve, capillary tube, etc. · Insufficient cooling or heating. · Degradation of refrigerant oil. · Malfunction of compressor.	· Clogging of expansion valve, capillary tube, etc. · Insufficient cooling or heating. · Degradation of refrigerant oil. · Malfunction of compressor.	· Gas shortage · Insufficient cooling or heating. · Temperature increasing of discharge gas. · Degradation of refrigerant oil. · Malfunction of compressor.
	<For reference>  Compressor is corroded due to moisture.	 Not clogged  Clogged Capillary is clogged with dust.	
Preventive measure	Pipe preparation ↓ Flushing ↓ Vacuum drying	· Same as the items on the left. · Do not use tools or devices previously used with a different type of refrigerant.	· Follow the basic brazing procedure · Follow the basic flaring procedure. · Follow the basic flange connection procedure. · Conduct an air-tightness test (gas leak check).

Troubleshooting



<Relationship of operating state, pressure, and operating current of air-conditioning system>

When cooling

Air-Conditioner Status	Low Pressure	High Pressure	Running Current
Air Filter Fouling	Lower	Lower	Lower
Short Circuit of Indoor Unit Inlet/Outlet Air	Lower	Lower	Lower
Outdoor Unit Fin Fouling	Higher	Higher	Higher
Short Circuit of Outdoor Unit Inlet/Outlet Air	Higher	Higher	Higher
Air Mixed in Refrigerant	Higher	Higher	Higher
Water Mixed in Refrigerant	*1 Lower	Lower	Lower
Dirt Mixed in Refrigerant	*2 Lower	Lower	Lower
Lack of Refrigerant (Gas)	Lower	Lower	Lower
Unsatisfactory Compression	*3 Lower	Lower	Lower

Measured from 15-20 minutes or more after operation starts.

*1 Water in the refrigerant freezes inside the capillary tube or expansion valve, and is basically the same phenomenon as pump down.

*2 Dirt in the refrigerant clogs filters inside the piping, and is basically the same phenomenon as pump down.

*3 Pressure differential between high and low pressure becomes slight.

Precaution

7.1 What happens if the incorrect refrigerant was used?

- If an R32 units was charged with R22:
  - The chlorine content in the R22 damages the refrigerant oil.
  - Degradation of refrigerant oil reduces lubricity and can therefore cause the compressor to be damaged.

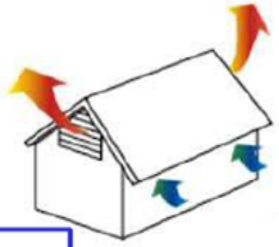
- If an R22 unit was charged with R32:
  - R32 has higher pressure than R22; therefore, in terms of pressure resistance of the machine, incorrect refrigerant charge can cause a very dangerous situation.
  - Lack of compatibility between R32 and mineral oil (SUNISO oil) reduces oil return performance, on top of R32 and the oil separating into two layers inside the compressor hindering proper oil supply to the bearing, which causes poor lubricity. This can result in the compressor burning out.

- If an R32 unit was charged with R410A or vice versus:
  - R32 units and R410A units are optimized to their respective refrigerant properties; therefore charging them with the unintended refrigerant prevents proper operation.
  - Both the R32 and R410A units use ether oil as refrigerant oil, but due to the some differences in specifications, sharing refrigerant oil can cause malfunction of the compressor.

Key Considerations for Safety - General

Regardless of the type of refrigerant, the following points must be observed inside factories at all times.

◇ Provide and keep safe and healthy work environment



- To prevent gas stagnation inside the factory, provide openings to create a well-ventilated environment.
- To Carry out local exhaust ventilation and total ventilation inside the factory.

Example) Industrial Safety and Health Act of Japan
- Keep enough openings area, equivalent to 1/20 of the factory floor area, or
- Install ventilation equipment with a capacity of over 30m^3/h/person.

- To keep temperature, humidity, luminance, noise and chemical atmosphere in the factory at certain level regulated by the authority.

◇ Carry out 5S Activity (Seiri: Sort / Seiton: Set in Order / Seiso: Shine / Seiketsu: Sanitize / Shitsuke: Sustain)

- Clearly separate necessary parts from unnecessary parts, and dispose unnecessary parts.
- Keep all parts in their specified locations, and make sure they are accessible at all times.
- Keep the working area and equipment clean at all times, maintaining a clean workplace.
- Clean, sort and tidy up parts and working area.
- Make a habit of keeping rules and carrying out work in the correct order.

Precaution

7.2 What happens if an R32 unit was charged with SUNISO oil (mineral oil)?

- Ether oil can degrade and clogging occurs due to poor lubricity in the compressor and sludge development. This cause machine failure.

Refrigerant oil degradation caused by mixing of impurities

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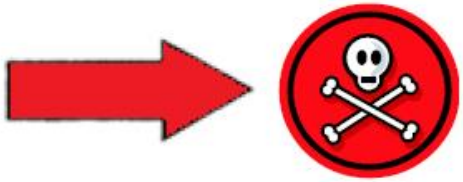
Reduced lubricity



Poor lubricity

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Compressor damage

Video Shared

THANK YOU!

QUESTION?