Air Conditioners Seminar

R410A

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Content

- **Introduction**

- **Inside to New Refrigerant**
  - World Trends and EU Actions in Refrigerant Regulations
  - New Refrigerant Requirements
  - Physical Comparison of R22, and R410A

- **Installation and Servicing**
  - R410A Characteristics and Precautions
  - Installation Flow and Precautions
  - Refrigerant Piping Installation
  - Evacuation
  - Additional Refrigerant Charging
  - Installation and Servicing Tools

- **Questions & Answers**

Introduction

Introduction

What is New Refrigerant Air Conditioners?

- They are environmentally friendly air conditioners that use the new HFC refrigerant, which does not deplete the ozone layer.
- Naturally, they provide the same high performance and safety as previous air conditioners.
- Regulations to restrict the use of conventional refrigerants (HCFCs) are already beginning to take effect in some parts of Europe, and all air conditioners will eventually use new refrigerants.
- Panasonic has devoted years of research and development to this new refrigerant in an effort to preserve the environment. This has allowed us to introduce the new refrigerant models even before the new EU regulation finally prohibits the conventional refrigerants.

Inside to New Refrigerant

Inside to New Refrigerant

New Refrigerant Requirements

1 Minimal environmental impact
- Zero ozone-depleting potential (ODP)
- Low global warming potential (GWP)

2 High levels of safety
- Low toxicity (PAFT evaluation)
- Nonflammable or flame-retardant (UL evaluation)

3 Acceptable properties and performance
- Properties similar to R22
- Application properties (thermal stability, material compatibility)
- Equipment performance (refrigeration)
- Serviceability (charging, servicing, maintenance, reclaiming)

4 Economy

The following refrigerants satisfy these four requirements:

R410A

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Inside to New Refrigerant

Physical Comparison of R22, and R410A

	R22	R410A
Composition	**Single-component**	**2-component**
Mixing ratio	**-**	**R32 : R125 = 50 : 50**
Azeotropy	**Azeotropic**	**Pseudo-azeotropic**
Boiling point (°C)	**-40.8**	**-51.4**
Vaporizing pressure at 25°C (MPa)	**0.94**	**1.56**
Saturated vapor density (kg/m^3)	**44.4**	**64.0**
ODP*1 (Ozone Depletion Potential)	**0.055**	**0**
GWP*2 (Global Warming Potential)	**1700**	**1730**
Pressure	**1 times**	**1.6 times**
Refrigerant oil	**Mineral oil**	**Synthetic oil**
Flammability	**Nonflammable**	**Nonflammable**
Toxicity	**Harmless**	**Harmless**

*1: Ozone Depletion Potential: based on CFC-11 ($CFCl_3$)
*2: Global Warming Potential: based on CO_2

Installation and Servicing

Installation and Servicing

R410A Characteristics and Precautions

Pressure characteristics

The gas pressure of R410A is about 1.6 times as high as that of R22.

Chemical characteristics

R410A is a chemically stable, non-flammable refrigerant with low toxicity.

* However, just like R22, the specific gravity of R410A gas is heavier than that of air. Because of this, it can cause an oxygen deficiency if it leaks into a closed room since it collects in the lower part of the room. It may also generate toxic gas when it is directly exposed to a flame.

Compositional change (pseudo-azeotropic characteristics)

Since R410A is a pseudo-azeotropic mixture, it can be handled in almost the same manner as R22. However, when charging, there is a slight change in composition between the gas and liquid phases.

Key Points

- Use special R410A materials and tools.
- Although the gas pressure is higher, you will find no safety-related problems as long as you use materials and tools with high-pressure specifications.

- Use in a well ventilated environment where it will not collect.
- Use refrigerant recovering equipment when collecting the refrigerant.

- Always begin charging from the liquid side.
  Never charge the refrigerant from the gas side.
  (It is recommended that you use a cylinder equipped with a siphon tube.)

Installation and Servicing

R410A Characteristics and Precautions

Refrigeration oil

R22 refrigeration oil cannot be used with R410A. To ensure proper compatibility between the R410A refrigerant and the lubricating oil, use a synthetic refrigeration oil.

- Never put R410A into an R22 AC.
- To prevent the mixing of refrigeration oils, do not use any piping that was previously used for an R22 model in an R410A model.
- Manifold gauge and charging hoses that have been used for R22 cannot be used for R410A.

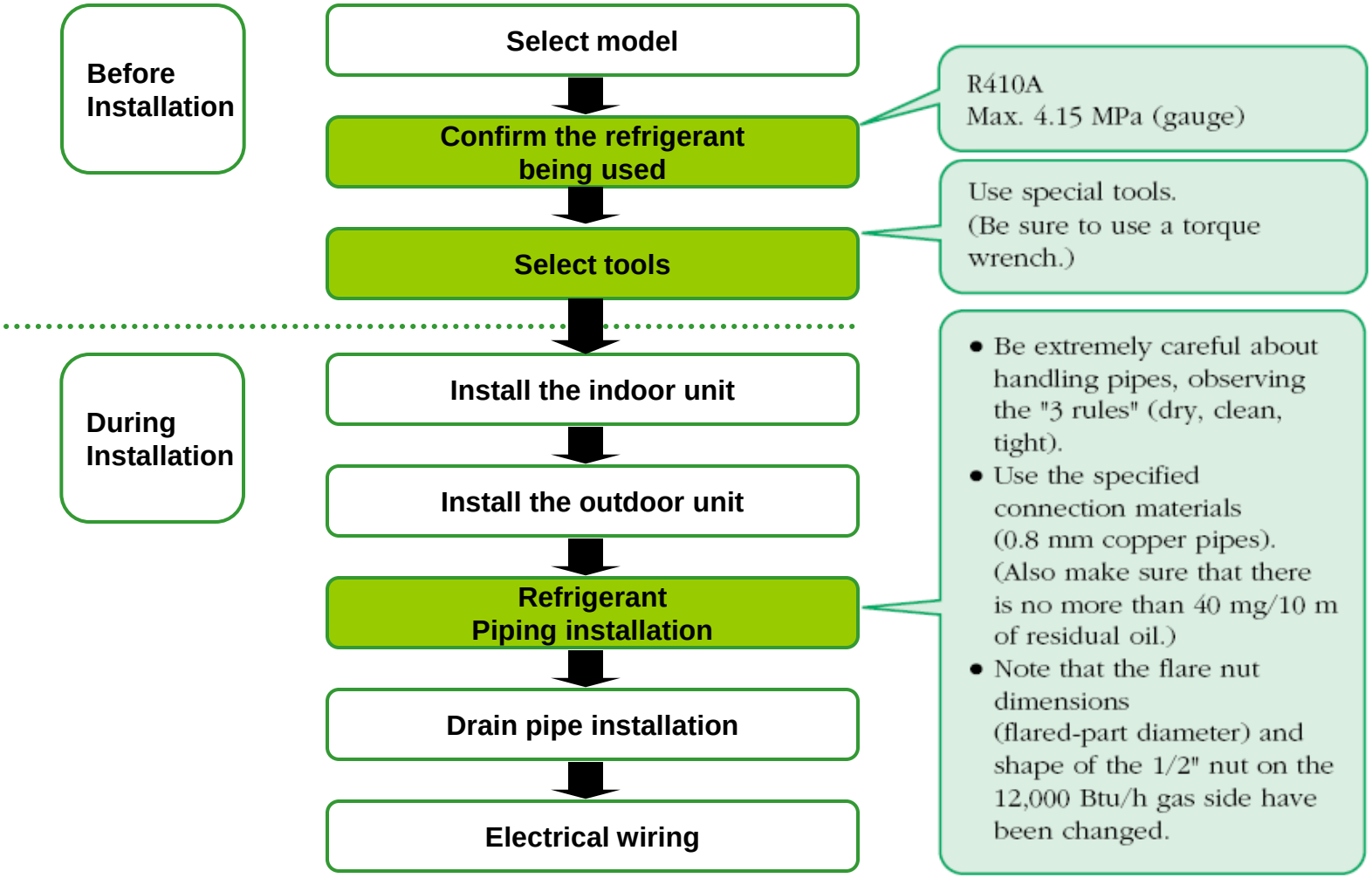
Control

Impurities in the refrigerant system can cause a number of serious problems. Careful control is required to prevent this.

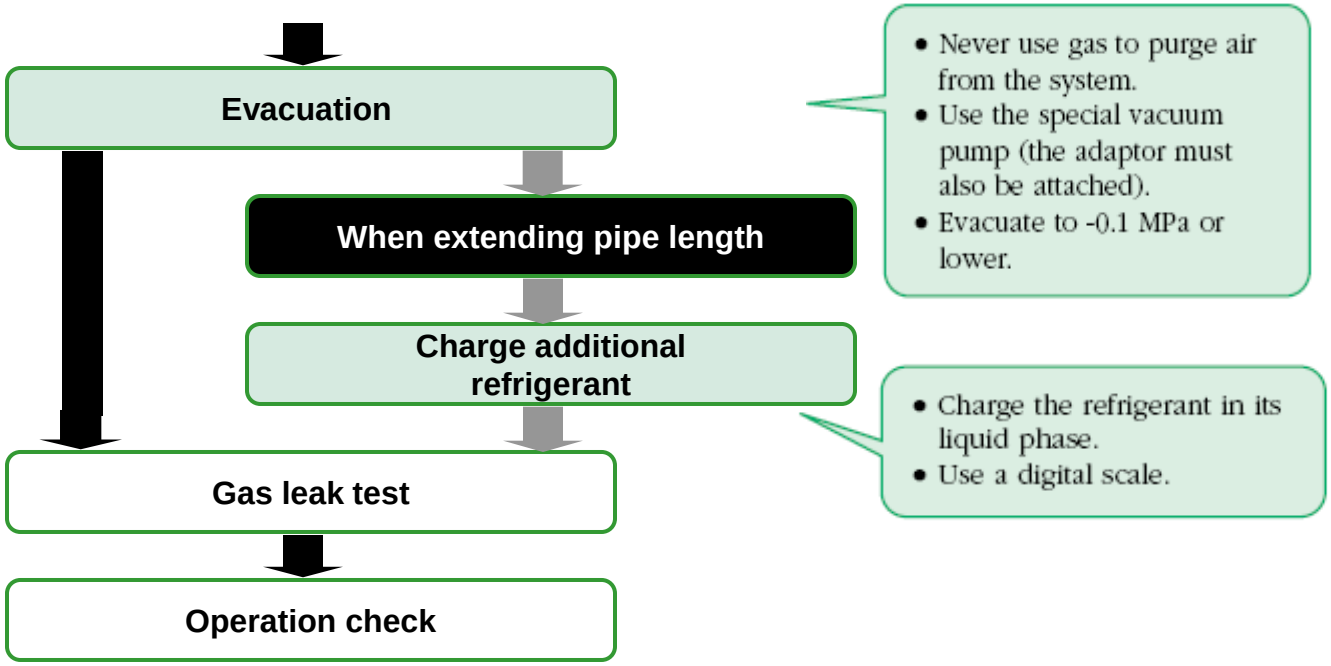
- Take even greater care to prevent the entrance of impurities (oil, moisture, etc.) into the piping than you do with R22 ACs.
- When storing pipes, seal the openings by pinching or taping them securely.

Installation and Servicing

Installation Flow and Precautions



Installation Flow and Precautions



Installation and Servicing

Refrigerant Piping Installation

Installation Precautions:

- Check the Refrigerant Marking
- Copper Pipes Selection
- Storing and Managing Piping Materials
- Processing and Connecting Piping Materials

Installation and Servicing

- Check the Refrigerant Marking

Check the Refrigerant System

Refrigerant Marking
at name tag

R410A

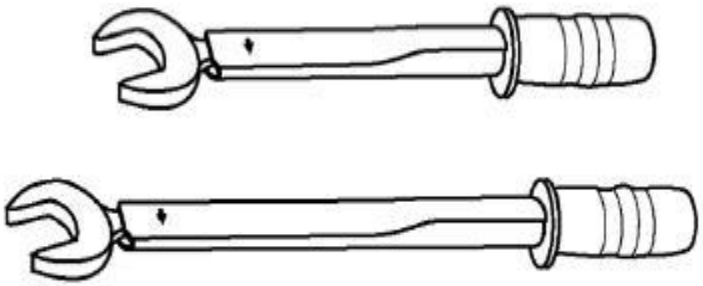
The refrigerant name is indicated in an easy-to-see location on the outdoor unit. Be sure to check this marking before starting to work.

Charging other refrigerant to the system is strictly PROHIBITED.

Installation and Servicing

Tightening Flare Nut

- Advise to use torque wrenches. It will tighten to a specified torque.
- The tightening torque for R410A is the same as R22.
- But flare nut size is bigger for 1/2” and 5/8”



Flare Nut	1/4”	3/8”	1/2”	5/8”
R22	17mm (18Nm)	22mm (42Nm)	24mm (55Nm)	27mm
R410A	17mm (18Nm)	22mm (42Nm)	26mm (55Nm)	29mm

If torque too weak, it will gas leak.

If torque too strong, flare will crack

Installation and Servicing

Use R410A Type of Pressure Gauge & Charging Hose

- Because of gas pressure for R410A system is approximately 1.6 times of R22 system, the scale of R22 pressure gauge is not enough for measurement and the charging hose also cannot withstand the R410A pressure.

R22 High Side Gauge

max 140psi

R410A High Side Gauge

Max 580psi

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Installation and Servicing

Use R410A Type of Charging Hose

- To avoid wrong refrigerant charging, the service port for R410A system is bigger diameter compare with R22 system.
- Requirement for maximum withstand pressure for R410A charging hose is higher than conventional hose.

R22 Port size smaller

R410A Port size bigger

	R22	R410A
Service Port Size	7/16”	1/2”
Charging Hose - pressure resistance (max)	17.2Mpa	27.4Mpa

Installation and Servicing

- Distinguishing Refrigerant Cylinders

Normally

R22 Refrigerant Cylinder is green color

And

R410A Refrigerant Cylinder is pink color

R22

R410A

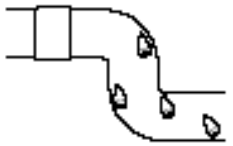
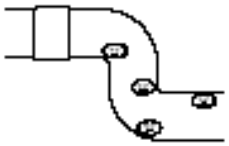
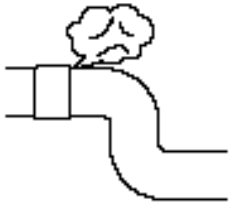
Charging other refrigerant to the system is strictly PROHIBITED.

Installation and Servicing

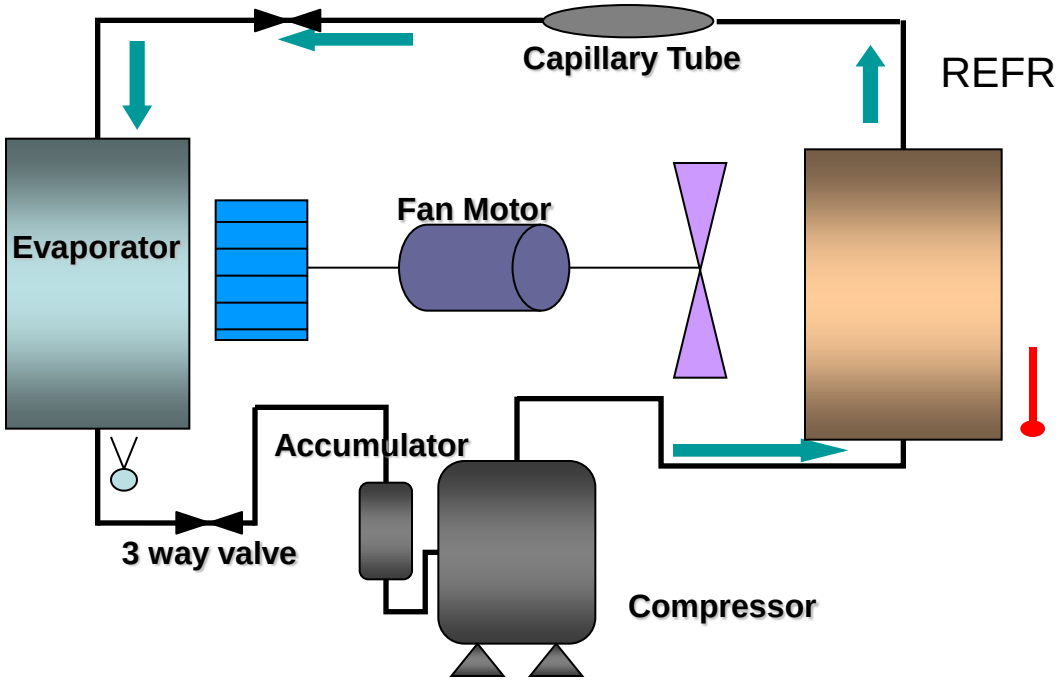
- Processing and Connecting Piping Materials

"3 Rules" for Refrigerant Piping Work

Impurities in the refrigerant system can cause a number of serious problems.
Follow these 3 rules carefully to ensure safe and trouble-free installation and operation.

	1. Dry	2. Clean	3. Tight
	No moisture inside.	No dust or dirt inside.	No refrigerant leaks.
Item			
Cause	• Moisture enters from rain or other external sources. • Moisture is generated by condensation inside the pipe.	• An oxide film forms when brazing. • Dust, dirt, oil or other foreign matter enters from the outside.	• Insufficient care when brazing. • Insufficient control of flare processing or tightening torque. • Insufficient flange tightening.
Resulting problems	• Clogged expansion valve or capillary tubes. • Doesn't cool or heat. • Refrigerating machine oil deteriorates. • Compressor malfunctions.	• Clogged expansion valve or capillary tubes. • Doesn't cool or heat. • Refrigerating machine oil deteriorates. • Compressor malfunctions.	• Gas runs out. • Doesn't cool or heat. • Outlet gas temperature rises. • Refrigerating machine oil deteriorates. • Compressor malfunctions.

Installation practice



Facts.

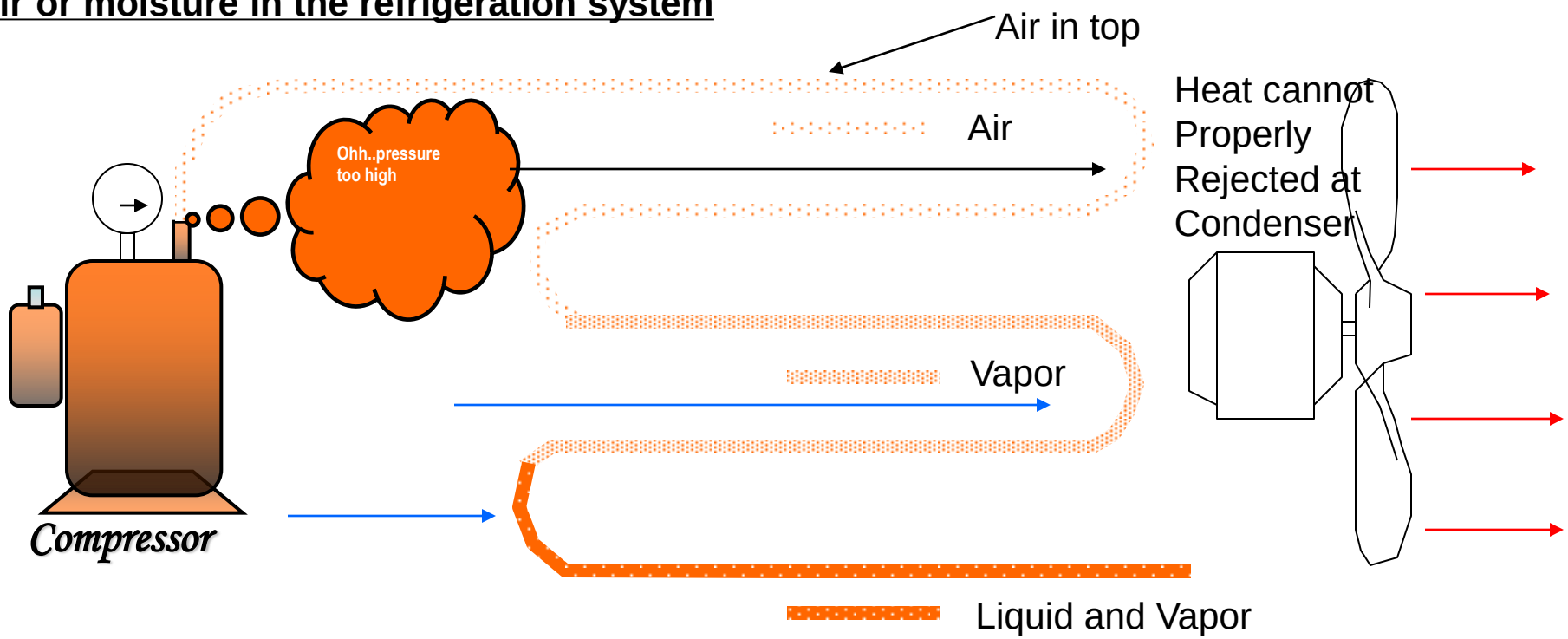
A refrigeration system is designed to operates with oil and refrigerant flowing.

Anything else is considered foreign to the system and must be removed.

This includes moisture, noncondensible gases such as air, oxides from brazing without nitrogen purge, pipe plugs, dust, and sand,

Common problem for Refrigeration system and the effect

Air or moisture in the refrigeration system



Causes.

- No proper air purging
- No vacuuming for longer piping
- Vacuum level not good
- Installation pipe not being seal during installation

Effect.

- Air contain Oxygen, Nitrogen, Hydrogen, and water vapor, all of which are detrimental to the system.
- Nitrogen cannot be condensed in the Condenser will cause a rise in Compressor pressure.
- Other gases also cause chemical reaction that produce acid in the system. Some of chemical combination create mild form of hydrochloric acid then motor will burnt out, copper will be deposited and etc.

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Compressor malfunction due to moisture

Upper shell rusty

Mechanical parts Rusty

Accum. baffle Rusty & deform

Comp. oil with rusty water

Lower shell oil with water

Coil Stator Rusty.

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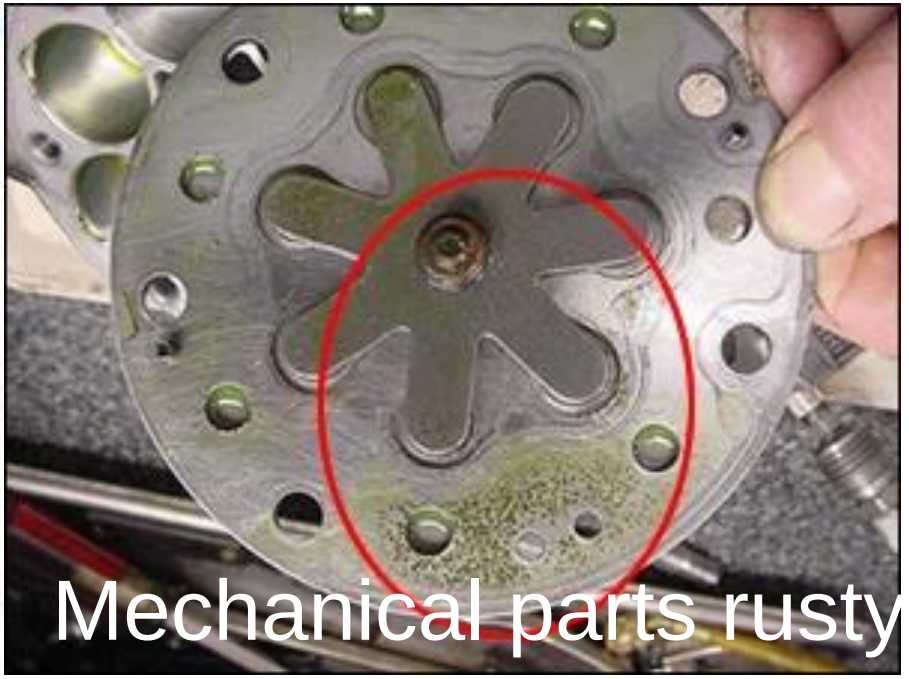
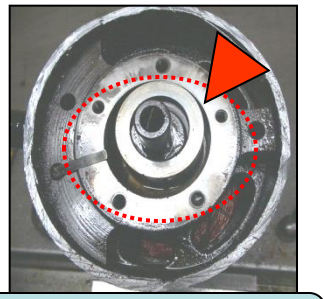
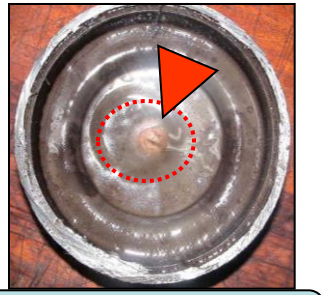
Compressor malfunction due to moisture



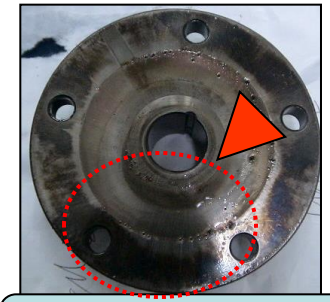
Compressor malfunction due to moisture



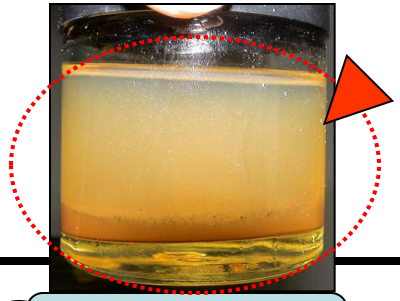
1 Rotor under overload condition



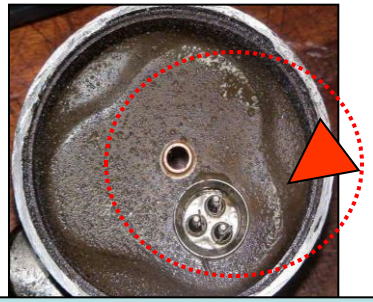
2 Lower shell oil with water



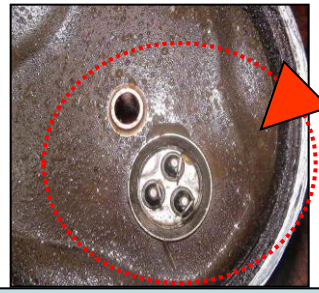
3 Coil Stator Rusty.



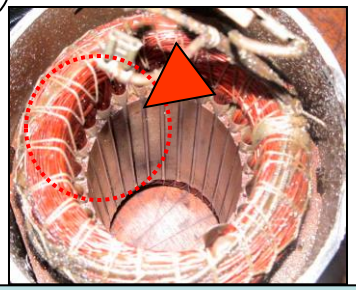
4 Comp. oil with rusty water



5 Upper shell water bubble mark and rusty

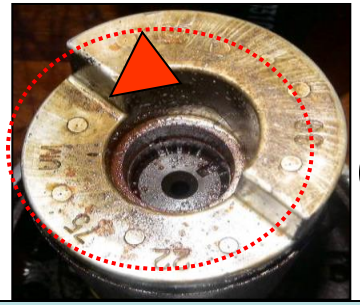


6 Upper shell water bubble mark and rusty



7 Coil Stator Rusty.

8 Rotor oxidization



9 Water bubble mark and rusty

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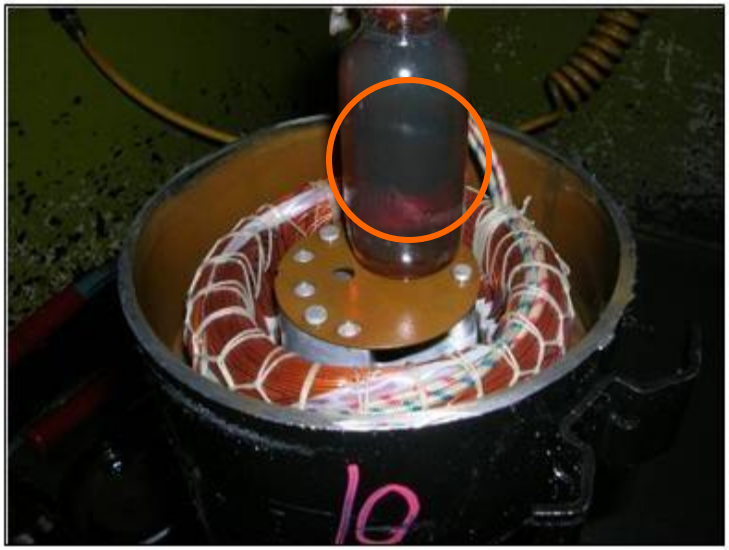
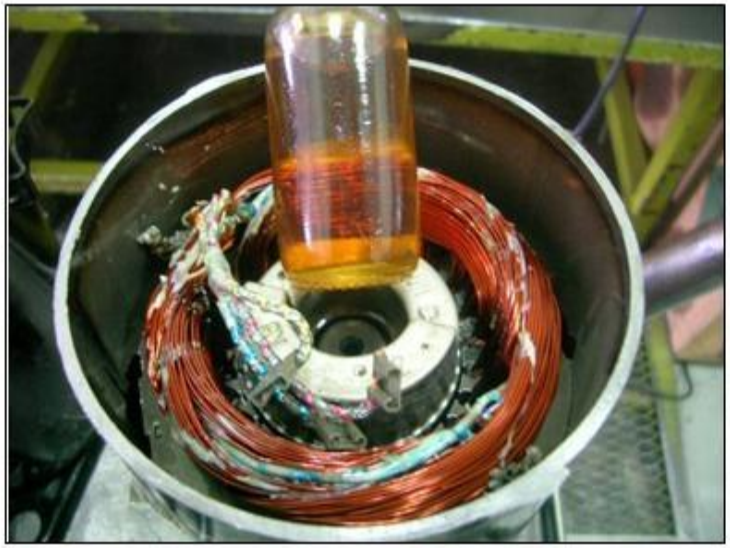
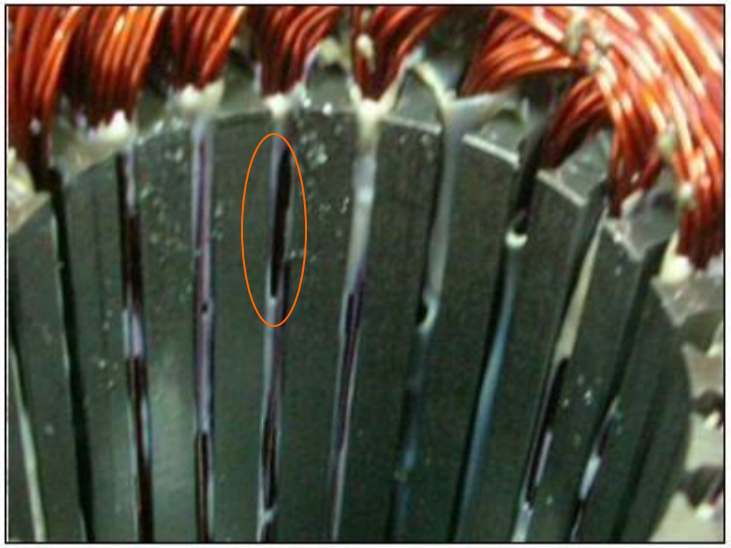
Compressor malfunction due Compressor overload running



Oil colour change Motor burnt and mecha part cooper plating





Motor burnt and slot wedges melted

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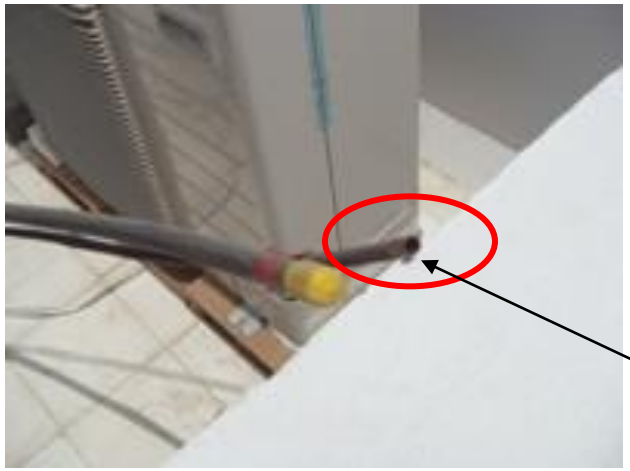
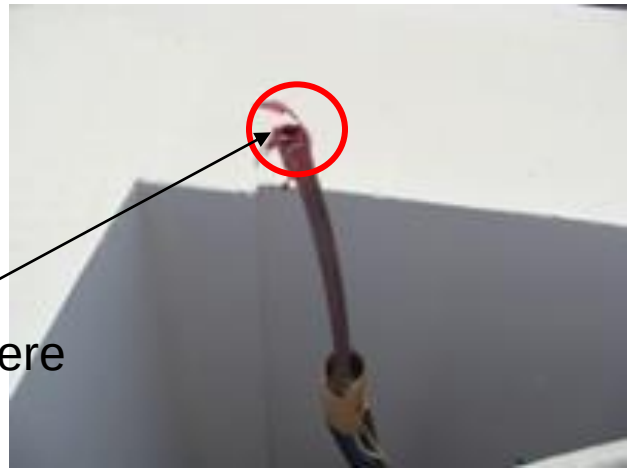
Dry, Clean and tight pipe

Wrong practice of installation

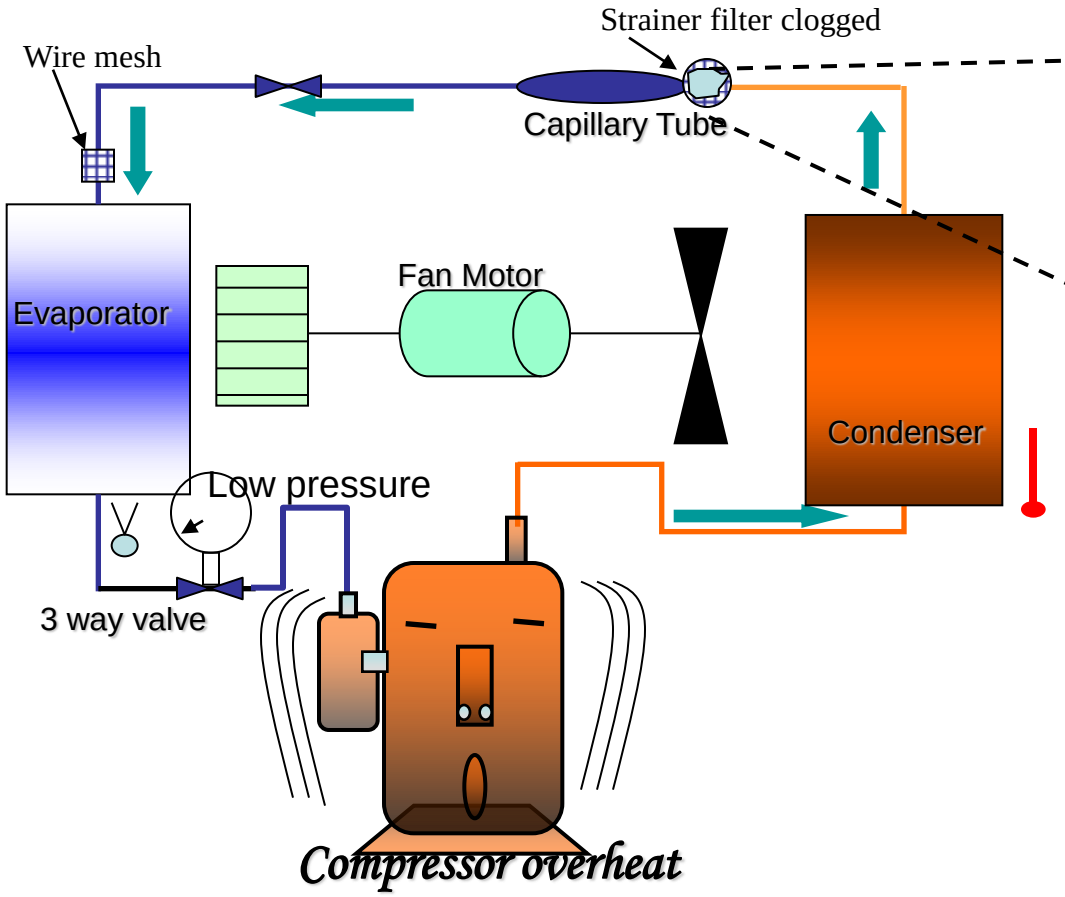




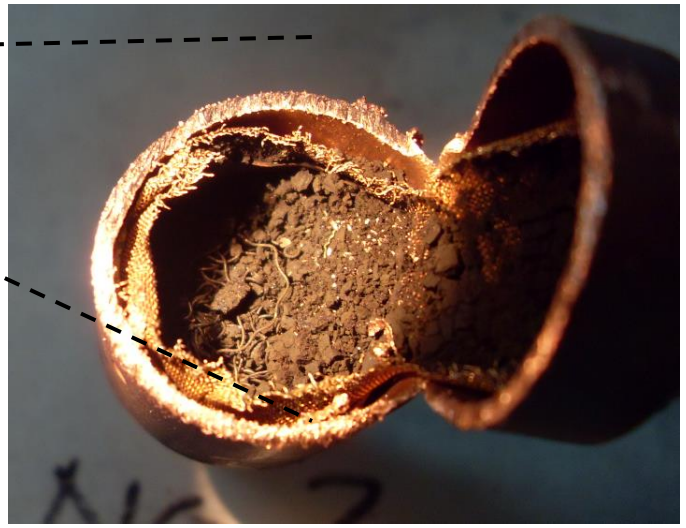
Copper tubes were left opened

Common problem for Refrigeration system and the effect

Refrigeration System clogged



Dust or very fine sand



Strainer filter or wire mesh clogged

Cause of system clogged.

1-Foreign material (dust ,sand, chip) enter installation pipe during installation

2-oxide from brazing without nitrogen purge.

Effect on the system.

Refrigeration cycle becomes clogged, there is a danger of the pressure dropping, and the temperature inside the compressor rise abnormally.

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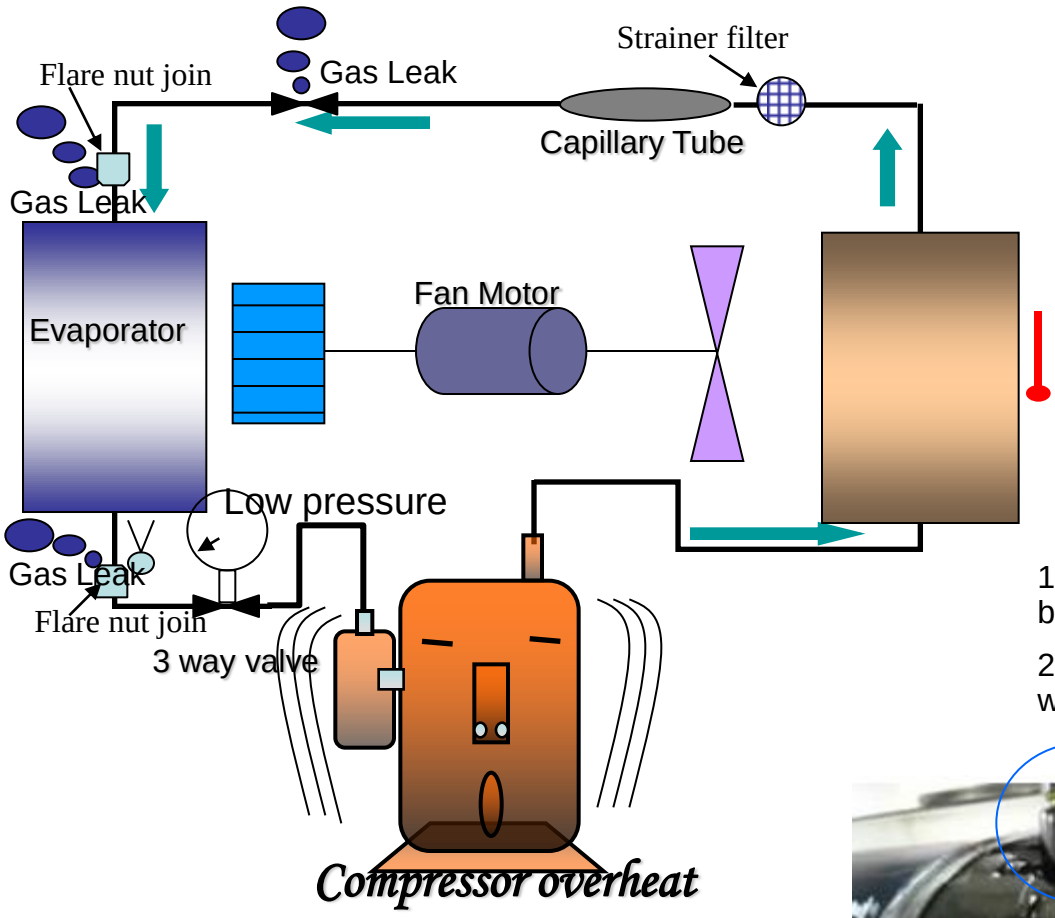
Common problem for Refrigeration system and the effect

Less gas/Gas leak in the Refrigeration System



Cause of gas leak.

1-Flare nut tightening not following spec

2-Insufficient care while brazing.

Effect on the system

1-Compressor over heat and compressor's winding become shorted

2- Compressor's oil also might be sludge. Heavy wearing of shaft. Shaft too tight or locked.

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Compressor malfunction due gas leak or less refrigerant

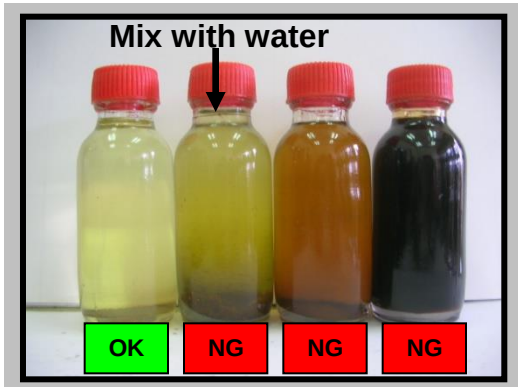
Oil sludge & stench smell at motor and mechanical area

Service Information

Compressor Oil color confirmation

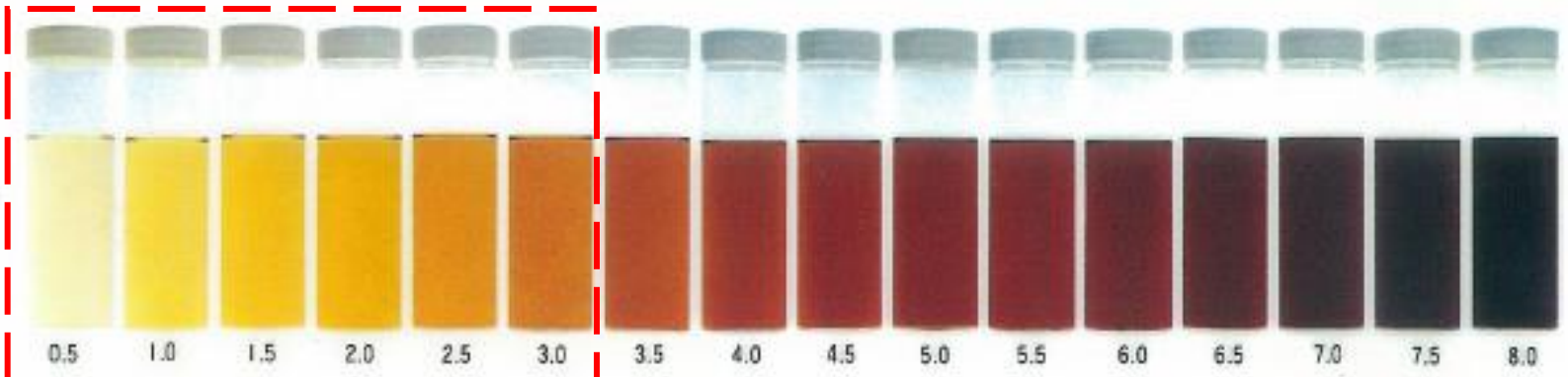
Collect oil from compressor

Check oil color condition

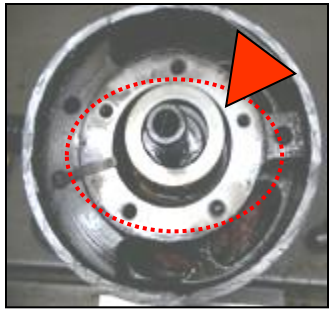
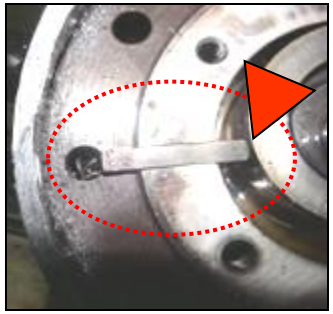
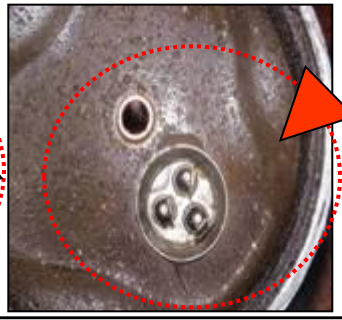
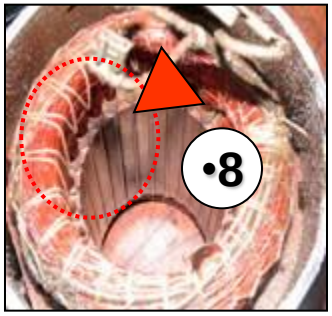
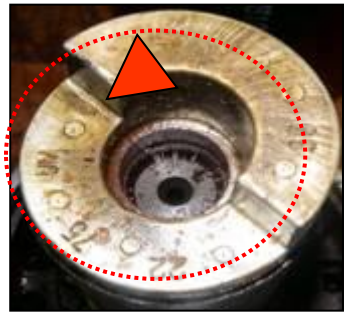


Judgment oil color

Specification oil color ≤ 3.0 ASTM



Impact for improper installation work – Compressor Issues

				
Rotor under overload condition	Vane spring broken / vane stuck	Found lower shell oil with water	Coil stator rusty	Comp. oil with rusty water
				
Upper shell water bubble mark and rusty	Upper shell water bubble mark and rusty	Coil stator rusty	Water bubble mark and rusty	Rotor oxidization

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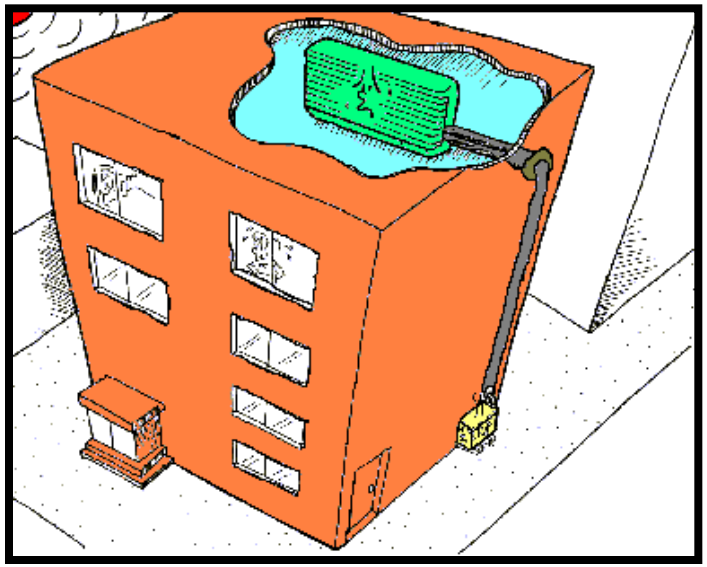
Common problem for Refrigeration system and the effect

Long installation pipe(more than spec)



Cause long piping/wrong pipe lenght.

1-Overlook on installation pipe length and height.

Ex: YC-18MKF . Spec : max. pipe 15 meters length, Height 10 meters.

Actual : 20 meter length , height 15 meters

Effect on the system.

1-Compressor over heat and compressor's winding become shorted.

2. Compressor's oil also might be sludge.

3-Heavy wearing of shaft. Shaft too tight or locked due to less oil in the compressor.

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Dry, Clean and tight pipe

Removing air and moisture within refrigeration cycle is more important.

Evacuation Process:

- What is Evacuation Process?
- Why Evacuation is Necessary?
- Evacuation Procedures

Dry, Clean and tight pipe

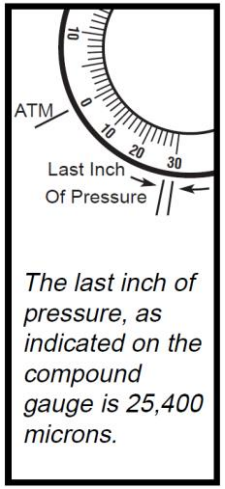
- What is Evacuation Process?

Evacuation refers to the method of reducing the pressure inside the pipe to a vacuum in order to evaporate (gasify) any moisture (liquid) in the pipe. At normal atmosphere (760mmHg), the boiling point of water is 100°C, but when the atmosphere inside the pipe is brought close to a vacuum by a vacuum pump, the boiling point drops. When this boiling point falls below the ambient temperature, the water evaporates.

Vacuum Gauge

READINGS AFTER 5-20 MINUTES

Under 500 Microns	Evacuation Complete
Slow Rise To 1500 Microns	Moisture
Rapid Rise To ATM	Leak



The last inch of pressure, as indicated on the compound gauge is 25,400 microns.


Vacuum Pump

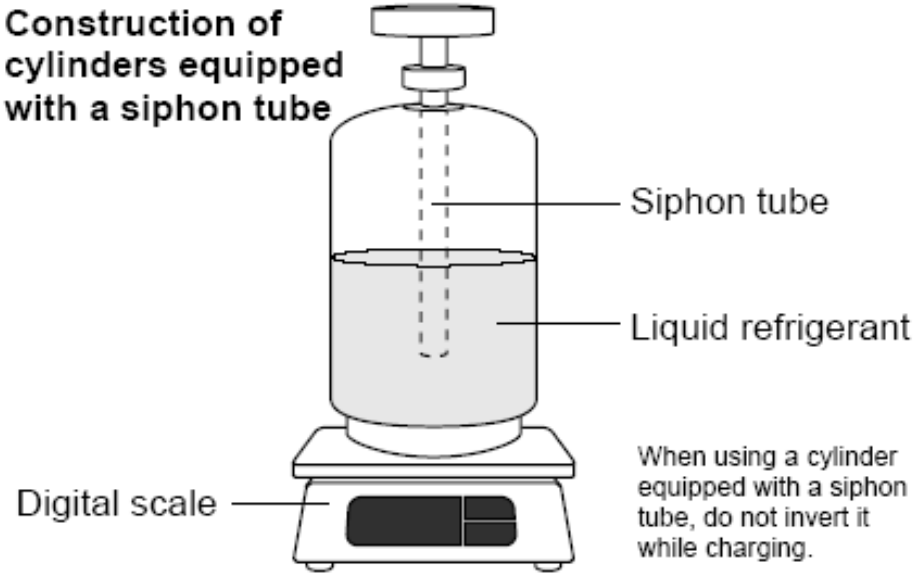
Installation and Servicing

- Distinguishing Refrigerant Cylinders

The colors of the new refrigerant cylinders are different to indicate the refrigerant type.

SIPHON TUBE DEPEND ON THE MAKER
IF DO NOT HAVE PLEASE INVERT THE TANK TO ALLOW LIQUID PHASE FLOW INSIDE THE REFRIGERANT

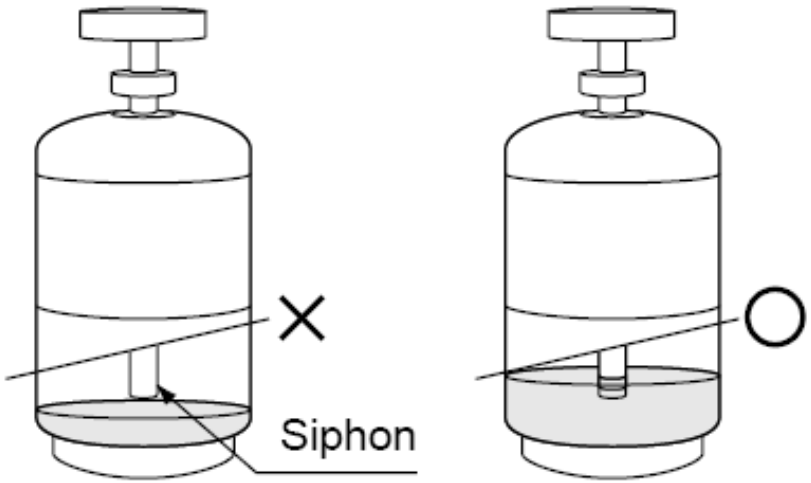
R410A (PINK)



Installation and Servicing

- Checking the Charging Amount

Because it is not possible to use all of the refrigerant from the charging cylinder when charging with the liquid phase, you should always leave about 10% of the original charging amount. To do this, use a scale to record the original charging amount in advance, and make a note of the amount.



Cylinder equipped with a siphon tube

Caution:

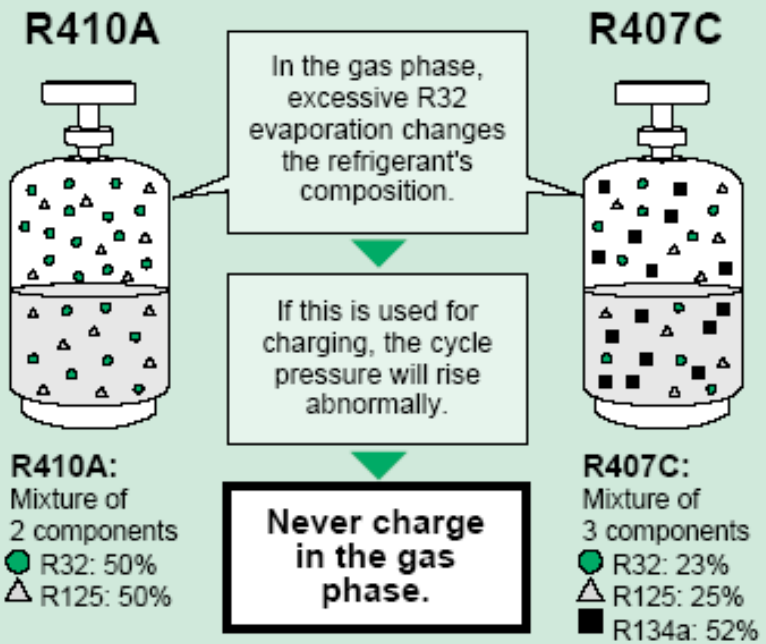
- When using a cylinder equipped with a siphon tube, do not invert the cylinder while charging.
- If the liquid level drops below the end of the siphon tube when charging, the remaining charging will be done with the refrigerant in the gas phase. Make sure that this does not happen.

Installation and Servicing

- Charging Precautions

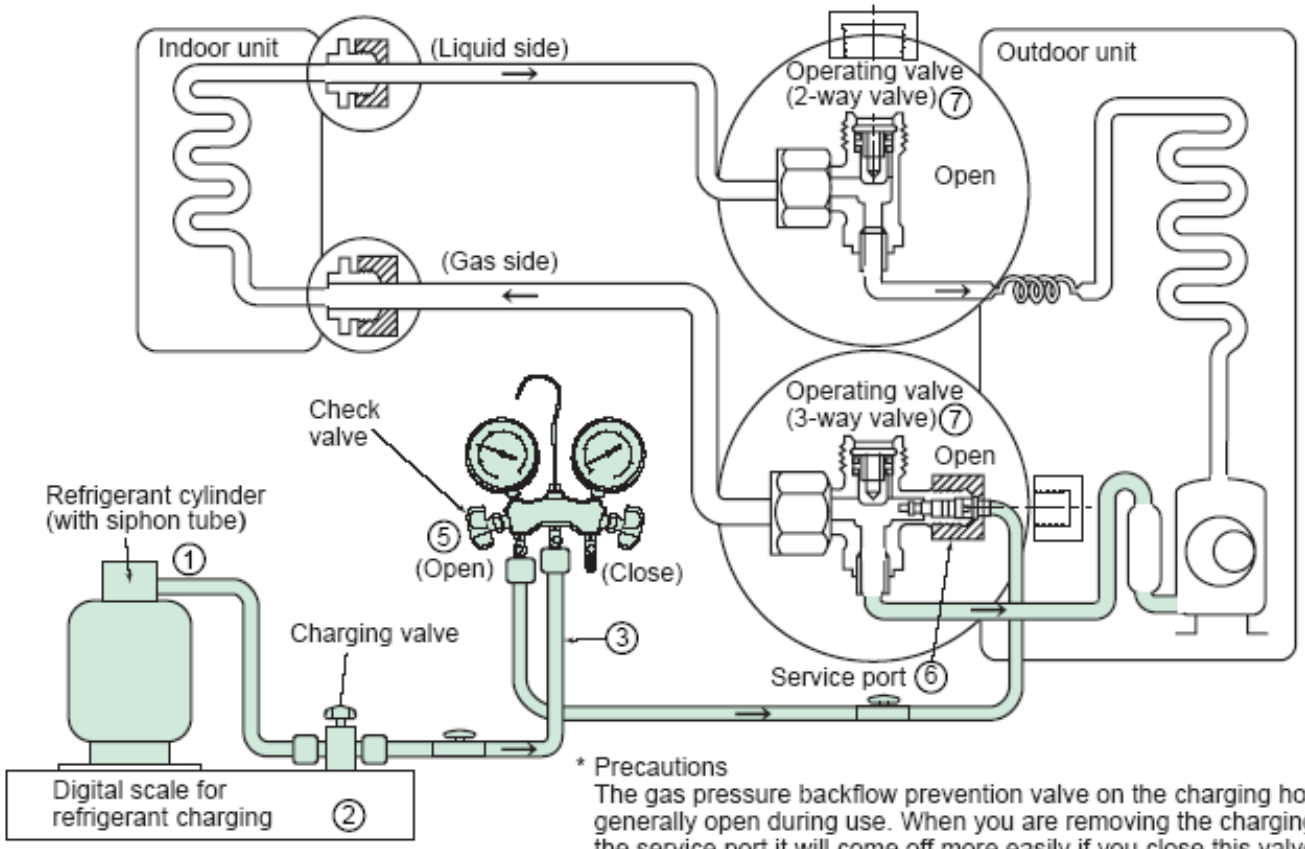
The conventional HCFC refrigerant could be charged in either liquid or gas phase, but because the new refrigerant is a pseudo-azeotropic mixture, it must be in the liquid phase for additional charging.

- **Make sure that the refrigerant is charged in the liquid phase. Never charge with the refrigerant in the gas phase.**
  If the refrigerant is charged in the gas phase, the easily vaporized component will be excessively charged and compositional changes will take place, leading to insufficient capacity or other problems.
- **Use a cylinder equipped with a siphon tube.**
  This will enable charging in the correct condition. Do not use a charging cylinder, because it will cause changes in the refrigerant composition.



Installation and Servicing

- Refrigerant Charging Procedure



* Precautions
The gas pressure backflow prevention valve on the charging hose is generally open during use. When you are removing the charging hose from the service port,it will come off more easily if you close this valve.

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Caution During Servicing / Repairing

Beware of "Diesel Explosion" phenomenon

What is diesel explosion?	Air penetrated into refrigeration cycle are being compressed by the compressor [causing high pressure and high temp]. Heated air and misty refrigerant oil form carbon. Oil soaked with carbon will be oxidised. Oxidation generates heat. When the temp reached the flash ignition point, the carbon will be ignited inducing ignation to the air and oil mist. This phenomenon might destruct the compressor.
	
An outdoor unit was severely damaged	The ignition point start from the compressor

Do not allow air to enter through the suction side of the compressor after servicing or repairing.

1. When carry out pump-down, make sure the valves have been properly and tightly closed. Before removing the pipings, make sure the compressor has been **stopped**. This is to prevent outside air being sucked into the compressor.
2. After complete refrigeration circuit repairing (i.e replacing the compressor), carry out air-tight pressure test first, followed by full vacuuming. Make sure there is no leaking.

Questions & Answers

Questions & Answers

1 Refrigerants

No.	Question	Answer
1	**Why use HFC?**	• HFC stands for hydrofluorocarbon. • HFC does not contain chlorine, and it is both non-flammable and non-toxic. It will not deplete the ozone layer if it is accidentally released into the atmosphere. • Data show that HFC's energy efficiency is almost equal to that of the currently used HCFC. • HFC is already in use in the United States, Japan and Europe, and its application has been successful.
2	**What kind of refrigerant is R410A?**	• R410A is a mixture of 50% R32 and 50% R125, which are both harmless to the ozone layer. • R410A's Ozone Depletion Potential (ODP) is zero (as compared to an ODP of 0.055 for R22). • The Global Warming Potential (GWP) is 1730, which is almost the same as that of R22 (1700). • The pressure of R410A is about 1.6 times as high as that of R22. R410A is a high-pressure refrigerant.
3	**What are the advantages of R410A?**	• Ozone Depletion Potential (ODP) = 0. It does not damage the ozone layer. (ODP for R22 = 0.055.) • The refrigerant performance of R410A is about the same as that of R22 under normal air conditioning operation. In high-capacity operation and under low outside temperatures, R410A offers slightly better performance than R22.

Questions & Answers

4	**What are the drawbacks of R410A?**	• R410A's high pressure – about 1.6 times as high as that of R22.
5	**Does high pressure have any effect on the safety of the air conditioner?**	• There are no safety-related problems as long as you use materials and tools with high-pressure specifications. • We have improved the pressure capacity of refrigerant cycle parts and piping to ensure the same level of safety as conventional R22 air conditioners.
6	**Is the refrigerant harmful?**	• No, the Programme for Alternative Fluorocarbon Toxicity Testing (PAFT) confirmed that both R32 and R125 are non-toxic (the same as R22).
7	**Why was R134a not used?**	• The refrigerating capacity of R134a, which is used in refrigerators, is 40% lower than that of R22. • When compared to R22 at the same capacity level, the performance of R134a is substantially lower. Therefore, we consider R134a unsuitable for use in air conditioners.

Questions & Answers

2 Ozone Layer Protection

No.	Question	Answer
1	What environmental protection efforts are being taken for the R22 products that were previously sold?	• To protect the ozone layer, it is necessary to collect the refrigerant (for reuse or decomposition) when repairing or disposing of R22 air conditioners.
2	What measures will be taken to prevent the release of refrigerant during air conditioner installation?	• For R22, we have been instructing installers to use the vacuuming process. This helps to reduce the discharge of refrigerants into the atmosphere. We will continue to reinforce the use of the vacuuming process to minimise refrigerant release.
3	What is the industry trend?	• As for alternative refrigerants, R410A is used mainly in small air conditioners, R410A and R407C in medium-size air conditioners, and R407C in large units, although the policy regarding refrigerants varies slightly from maker to maker. • Switching to alternative refrigerants also varies according to each company's policy.

Questions & Answers

3 CFC / HCFC Regulations

No.	Question	Answer
1	**Why are CFCs and HCFCs regulated?**	• CFCs and HCFCs that are released into the atmosphere decompose when they reach the stratosphere due to the strong ultraviolet (UV) rays in outer space. This chemical reaction causes the chlorine in the molecules to act as a catalyst and deplete the ozone layer. • Holes caused by the depletion of the ozone layer allow harmful UV rays to pass through the ozone layer and reach the earth's surface. • To protect the earth's environment, the use of ozone-depleting CFCs must be regulated.
2	**Is HCFC refrigerant regulated by international regulations?**	• Montreal Protocol: Regulate total quantity in 1996, then a 65% reduction in 2004, a 35% reduction in 2010, and a total ban in 2020.

4 Global Warming Prevention

No.	Question	Answer
1	**What is the effect of R410A on global warming?**	• R410A has a Global Warming Potential (GWP) of 1730, which is about the same as that of R22 (1700). By preventing the release of refrigerant by collecting it from air conditioners, we believe we can minimise the direct effect of R410A on global warming.

Questions & Answers

5 Products

No.	Question	Answer
1	**Does the ACD plan to switch the refrigerant in all of its air conditioner models?**	• As the top air conditioner manufacturer, we plan to lead the widespread use of alternative refrigerants and promote global environmental conservation.
2	**What were the key points in technical development?**	• We needed to select and develop the most suitable refrigerating machine oil for new refrigerant. Because there is no chlorine in the new refrigerant, its lubricating effect is slightly reduced. In order to ensure the optimum capacity and reliability of new refrigerant air conditioners, we had to develop a new refrigerating machine oil that would compensate for this lubricating effect. • We also re-examined all refrigerant cycle parts, such as compressors and heat exchangers, to improve their performance.

Questions & Answers

6 Installation and Servicing of New-Refrigerant (R410A) ACs

No.	Question	Answer
1	What kind of support system will you offer for servicing?	• We will provide a service manual and hold technical seminars, to make sure that all installers and service people understand the differences between the previous and new-refrigerant models. This level of support should ensure that they are capable of conducting safe installation and servicing to maintain the high quality and reliability of the products.
2	What about installation work?	• Although the high-pressure R410A refrigerant requires high-pressure connection piping, charging hoses and tools, the installation method is basically the same. • To prevent the mistaken use of tools designed for R22 and to ensure safe installation, we will produce manuals and hold seminars.
3	What precautions are required for installation?	• As with R22, you must prevent moisture and air from mixing with the refrigerant.
4	Can piping for R22 models be used?	• It could be, but we strongly recommend the use of R410A refrigerant piping. • Because of its high pressure, R410A requires high-pressure piping with a thickness of 0.8 mm or greater. • Piping that was previously used in an R22 model must not be used in an R410A model.
5	What would happen if R22 were charged into an R410A air conditioner?	• That is not likely to happen because we have made the diameter of the service port for refrigerant charging a different size so that R22 charging hoses will not fit. This will prevent charging with the wrong refrigerant.

Questions & Answers

6	**Does the decomposition of R410A caused by flames produce harmful substances?**	• Since there is no chlorine in the refrigerant molecules, the decomposition of R410A does not produce phosgene, which is generated when HCFC decomposes. However, a substance that is equally toxic is produced when R410A is exposed to a flame. • Therefore, if the refrigerant leaks near a burning device, it is necessary to ventilate the room. This is the same as for R22 leakage.
7	**How can refrigerant leakage be detected?**	• A soapy water solution or an HFC leak detector can be used. However, the leak test that uses a torch to detect flame reaction cannot be used since the refrigerant molecules do not contain chlorine.
8	**Can R22 products be repaired in the future?**	• Yes, we will ensure that users of R22 air conditioners are not inconvenienced by a refrigerant supply shortage. • R22 refrigerant will be available for servicing. The Montreal Protocol specifies that the supply of R22 refrigerant will continue until the year 2020. • Because R410A is a high-pressure refrigerant, it cannot be used in R22 air conditioners due to safety factors.
9	**R410A is a 2-component mixture. Are the components separated inside the cylinder? Does the cylinder have to be mixed by shaking before charging?**	• The two gases are not separated. There is no need to shake the cylinder before charging. • The refrigerant must be charged in its ***liquid phase***. *<Reason, reference information>* • *The new refrigerant is a pseudo-azeotropic mixture and exhibits little compositional change in its liquid, liquid and gas, and gas phases.*

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