



INTRODUCTION OF R32 AIR CONDITIONING SYSTEM

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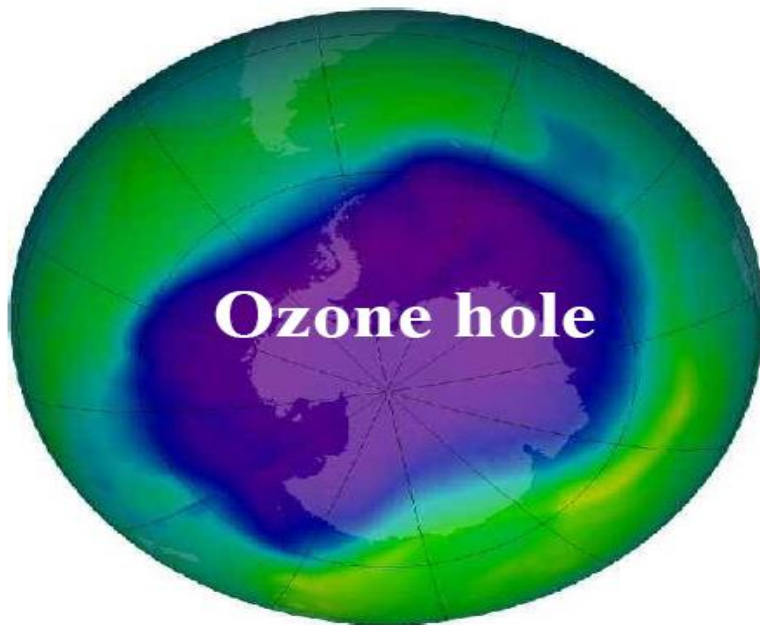
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I Refrigerant issues

I Refrigerant issues

I-1 Refrigerant and Environment issues

Ozone depletion



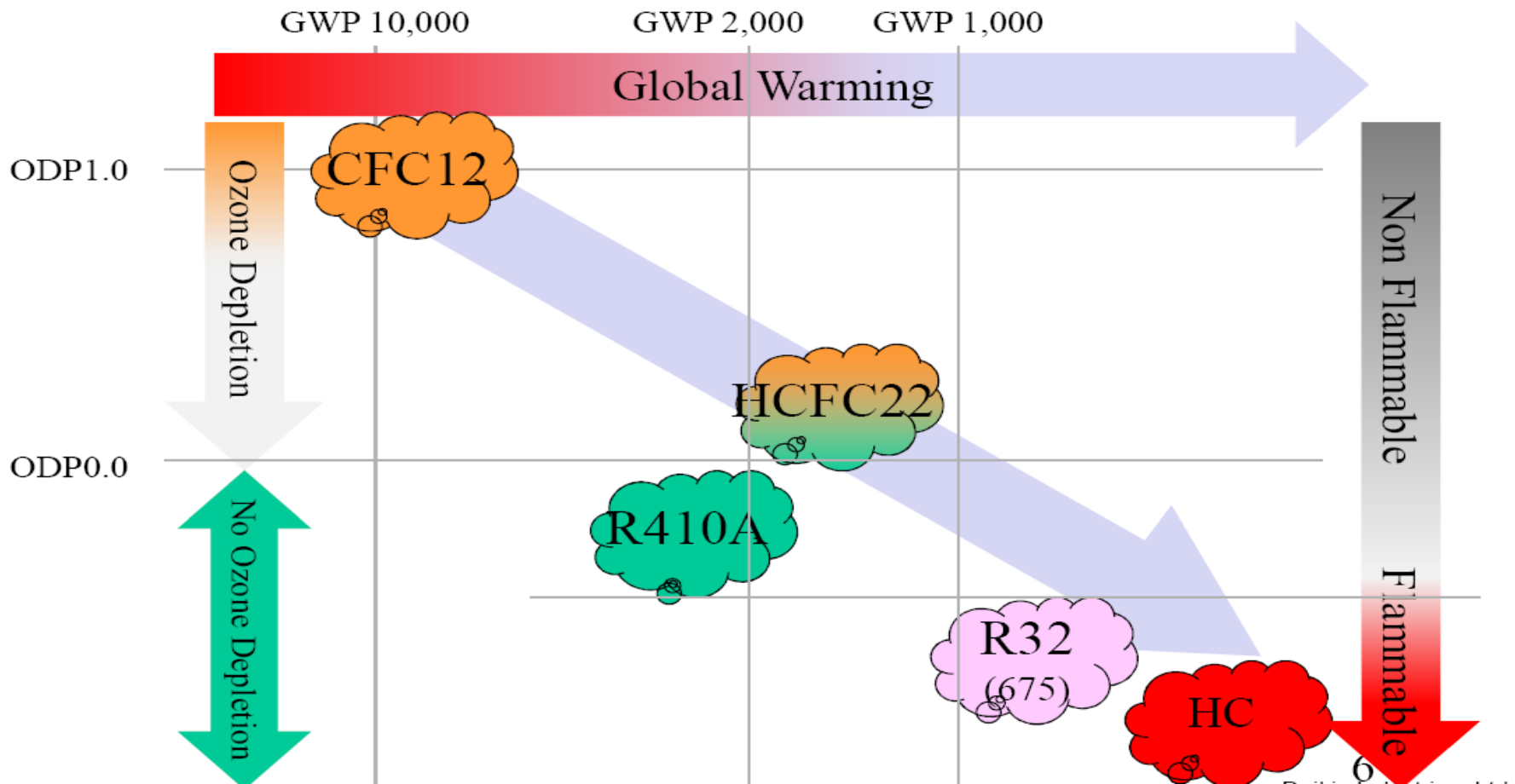
ODS : Ozone Depletion Substance
ODP : Ozone Depletion Potential

Global Warming



GHG : Green House Gas
GWP : Global Warming Potential

Improvement of Refrigerant Environment



Refrigerant R32



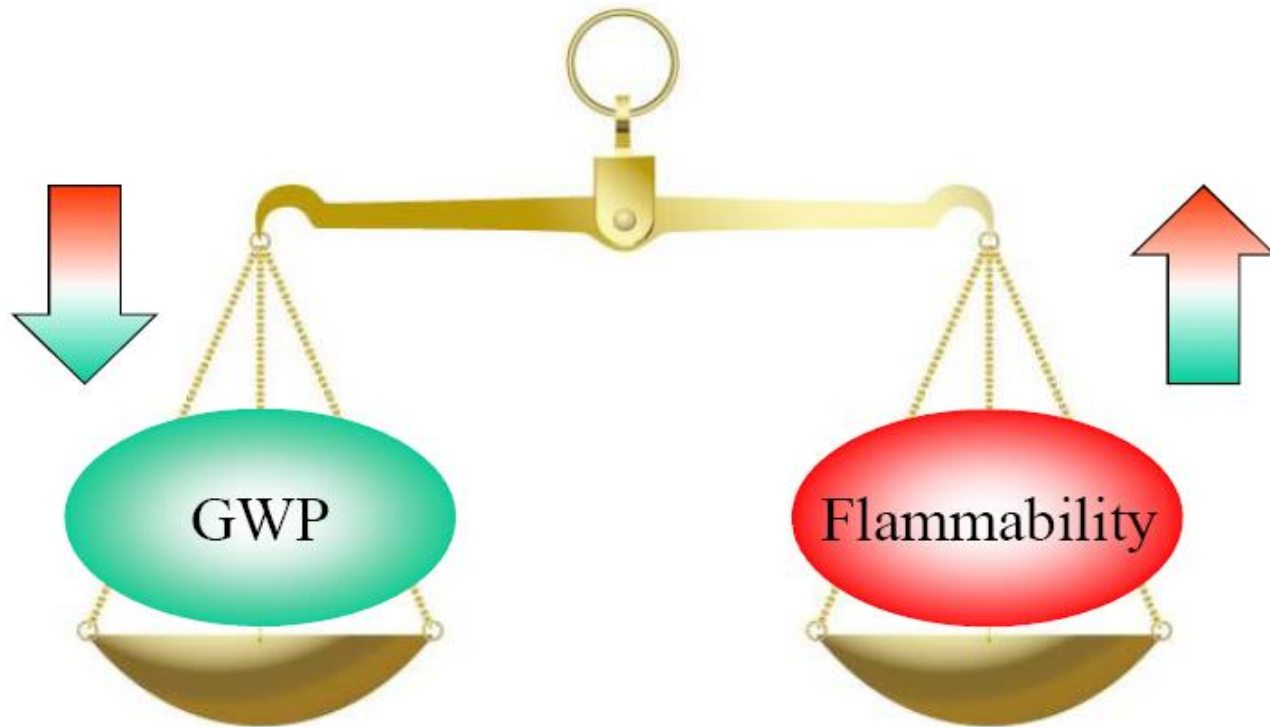
I-2 Lower GWP refrigerant

Refrigerants		Properties					
		P _{cond} (MPa)	Vol. Cool. Capacity (vs R22)	Theoretical COP (vs R22)	ODP	GWP (IPCC4th)	
R22	Single	1.73	100	100	0.05	1810	
HFC	R407C	Zeotrope	1.86	102	99	0	1770
	R410A	Azeotrope	2.72	141	92	0	2090
	R32	Single	2.80	160	97	0	675
	R1234yf	Single	1.16	57	90	0	4
	HFO-Mix	Zeotrope	?	?	?	0	?
Non-HFC	R717(NH ₃)	Single	1.78	116	106	0	0
	R290 (Propane)	Single	1.53	83	98	0	<3
	R744 (CO ₂)	Single	10	243	41	0	1

Candidates for the next generation refrigerant

I-4 Flammability and refrigerant

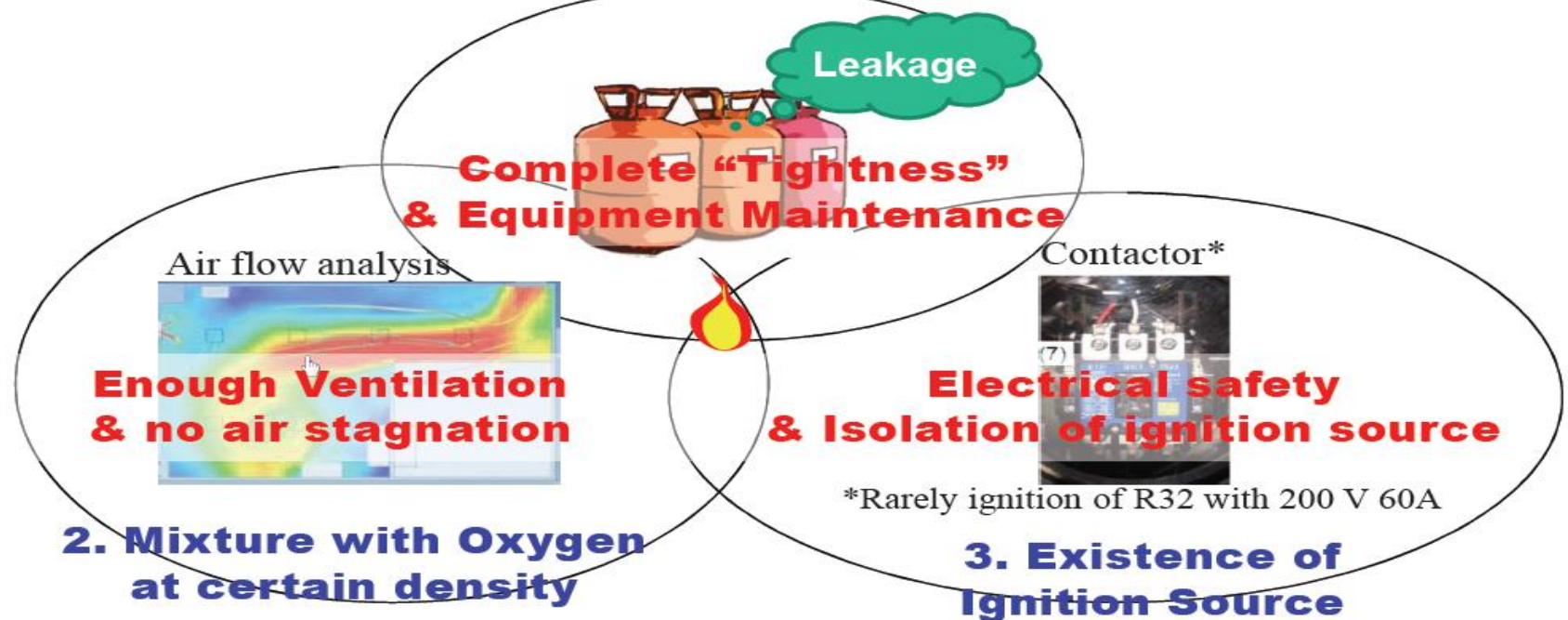
Tradeoff relation between Global warming and Flammability



Conditions for Ignition

Coestablishment of following Three conditions is mandatory for ignition

1. Existence of Flammable material



Ignition Test

4 Flammability of R32

- R32 may burn slightly when the gas concentration and ignition energy are met. But it poses no risk under the normal usage conditions for air-conditioning equipment and work environment. But, it is important to keep away from ignition source so as to prevent generating R32 combustion concentration conditions.

- Change of flame when R32 leaks:

Before R32 leakage

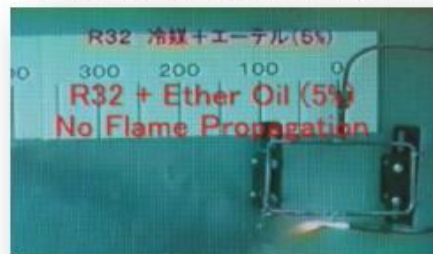


R32 leaking
(within combustion concentration range)

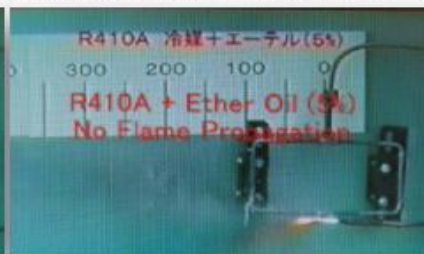


When leakage occurs, an area of concentration forms immediately below the leaking part and up to a certain height above the floor in the vicinity of the leak. The picture shows the change in the flames (flame propagation).

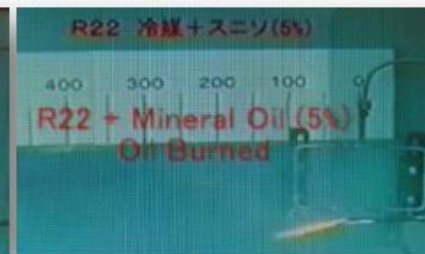
- Change of welding flame based on difference in refrigerant & oil:



R32 + Ether



R410A + Ether



R22 + Mineral Oil

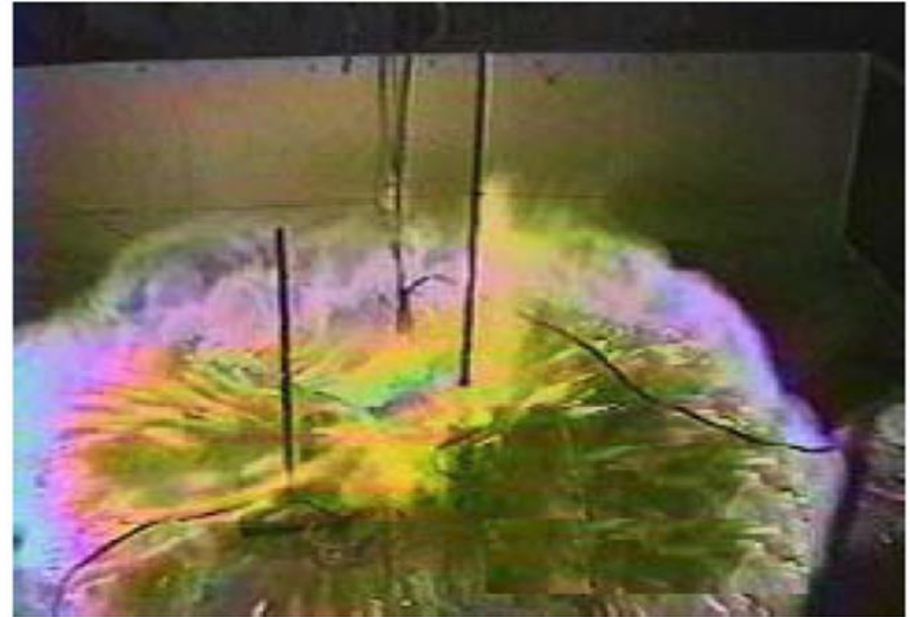
(Ignition test using a welder to the gas-leaking portion of a pipe)



In the event of R32 emission during welding, because the R32 emission flow speed is fast and the R32 burning speed is slow, there is no flame spreading when a burner is moved closer. Mineral oil (Suniso) burns easily; spread of flames is affected by refrigerant oil.

Ignition Test

Burning speed test:



	Burning speed (Unit: cm/s)
R32	6.7
Propane	46.4

Ignition test

Ignition Test



R290(propane)
30g in 1m cubic box

Exploded by electric spark



R32
320g in 1m cubic box

Ignited by open flame



R1234yf
180g in 1m cubic box

Ignited by open flame

Class 3
Higher flammable

Class 2L
Slightly flammable

Ignition Test

Flow through pipe 50g per minute.



Ignition Test



Refrigerant Flammability Classification based on ISO817

- Class 1 - no flame propagation
- Class 2 - LFL > 0.10 kg/m³ and HC < 19 MJ/kg
- Class 3 - LFL < 0.10 kg/m³ or HC > 19 MJ/kg
- **Class 2L – Class 2 with BV < 10cm/sec**

LFL: Low Flammable Limit
How easily or hardly ignited ?

HC : Heat of combustion
How large heat generated after ignited ?

BV : Burning velocity
How mild or severe the combustion is ?

II R32 and Air Conditioning

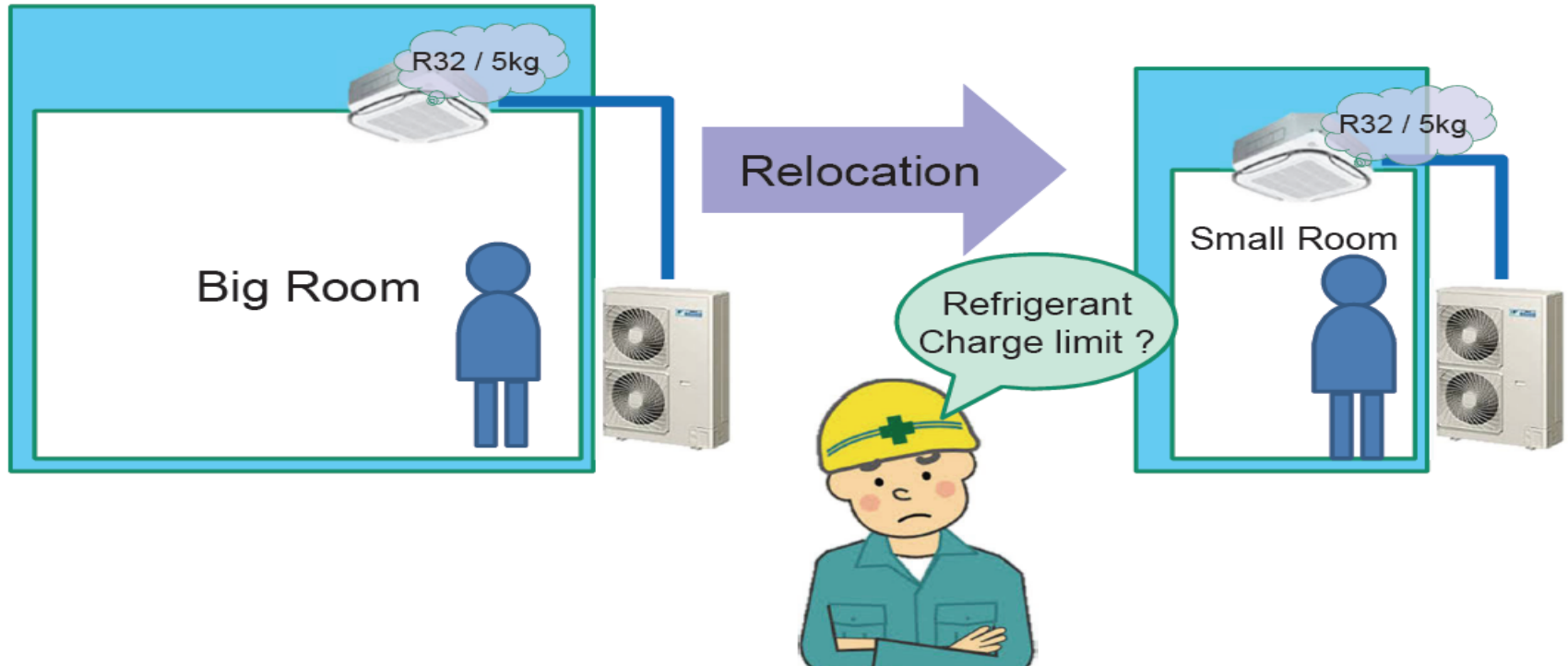
II-1 International Standards for Product design

The Main premise of factory safety
ISO & IEC followed perfectly for product design

Field	US	Europe	International	Contents
Refrigerant Classification	ASHRAE 34 UL 2182	-NA- (based on ISO)	ISO817	Calling in A2L
Usage Restriction for Safety	ASHRAE 15	EN378	ISO5149-2014	General safety standard
	UL 207 UL 250 UL 471 UL 474 UL 484 UL 984 UL 1995 UL 60335-2-40	EN60335-2-40	IEC60335-2-40 Ed.5.0:2013	Product Safety Standard

Case of Relocation

Check Refrigerant Charge Limit Again !



Major Changes for R32 from R22

	Flammability	Pressure	Discharge Temp.	Refrigeration Oil
R32 Residential Air-conditioner	Safety Standard Refrigerant Charge Service manual	Pressure Design Design Pressure R32: 4.29MPa R410A :4.15MPa	Control Control of Suction States +10 to +20 degC	Contaminants Control Synthetic Oil
R410A Residential Air-conditioner	Slightly Flammable Class 2L	1.6 times	Medium Temp.	Solubility
R22 Residential Air-conditioner	Non-Flammable Class 1	Medium Pressure 2.9MPa	Medium Temp.	Mineral Oil Suniso

Key Considerations for Safety - Gas handling

1.5 Handling of R32 refrigerant

- ❑ R32 (and other CFCs) is heavier than air, and therefore it's inclined to be settle near floor surface.
 - If the gas fills up the room or the bottom part of a room, it may also cause oxygen deficiency in people.
 - In the case of R32, it may reach it's combustion concentration.
 - Keep the room well-ventilated for a healthy work environment.
 - If a refrigerant leak is confirmed in a room or an inadequately ventilated location, do not use flame until the area has been ventilated appropriately and the work environment has been improved.

- ❑ In the case of brazing, ensure appropriate ventilation to prevent oxygen deficiency and R32 combustion. Check that there are no dangerous or combustible items nearby, and ensure a fire extinguisher is close at hand.

- ❑ If the gas comes into contact with open flame or metal (or other material) heated to over 300 to 400°C, it will cause thermal decomposition, possibly producing toxic gas. Do not allow the gas to come into contact with such objects. (Toxic gas generation is the same with R410A, R22, etc., and not limited to R32.)

- ❑ If installing air-conditioning equipment in the same room as gas-burning equipment or an electric heater, keep at least 2 m away from R32 and switch off the gas-burning equipment/electric heater in the event of a refrigerant leak from the indoor unit.

Key Considerations for Safety - Gas handling

3.2 Handling of refrigerant cylinder

- ❑ Laws and Regulations:
 - As liquefied gas, R32 is covered in the High Pressure Gas Safety Act. Therefore, refer to the High Pressure Gas Safety Act before use. The High Pressure Gas Safety Act sets forth standards that must be followed to prevent disasters that may be caused by high-pressure gases.

- ❑ Handling of Vessels:
 - R32, being a high-pressure gas, is supplied in a pressure vessel. The vessel itself is highly safe, but handling it without proper care may damage the vessel, which may result in unexpected accidents. Take due care to protect pressure vessels from dropping, being knocked down, impacts, and rolling.

- ❑ Storage:
 - R32 is, according to the General High Pressure Gas Safety Regulation, not a flammable gas. Likewise other high-pressure gases, R32 should be preserved and stored in accordance with the standards established by laws and regulations. (Cool, dark place that is well-ventilated, with a temperature of 40°C or lower; Implementation of fall-prevention devices, etc.)

Key Considerations for Safety - Gas handling

◇ When storing cylinders

- Valves must be closed tightly
- Cylinders must be stored in a cool (below 40°C) space, in a dry space to prevent corrosion and in well ventilated space.
- Cylinders must be kept away from direct sunlight or fire.
- Measures must be taken to protect the valve against external impacts or damage.



◇ When handling cylinders

- Use of cylinders under high temperature or near strong sparks* and flames is forbidden. *High power around 20KW or more.
- The cylinders must be handled with care, avoiding external impacts.
- When attaching or detaching cylinders to or from the equipment, sufficient care must be taken to avoid leakage.



◇ When handling the refrigerant

- The space of refrigerant handling must be in low temperature and sparks and flames free.
- Workers must be equipped with appropriate protective equipment to avoid contact with eyes or skin, or inhaling.
- The refrigerant must not be released into the air.
- The area for the production equipment must have a structure with ventilation to prevent refrigerant stagnation.



R32 Flammability Countermeasures



Video Shared

**Thank you very much for your
attention**

Q & A