Tools and equipment for flammable refrigerants

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TRAINING - WEBINAR AREA U-3ARC
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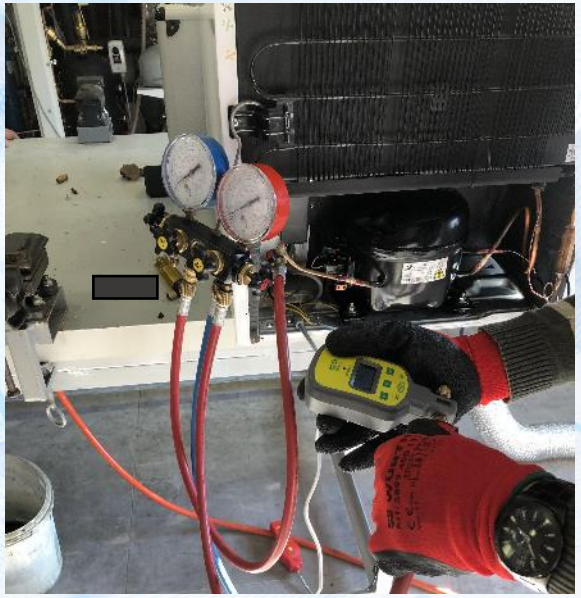
GOOD PRACTICES FOR FLAMMABLE REFRIGERANTS
(EXCERPT FROM THE COURSE)

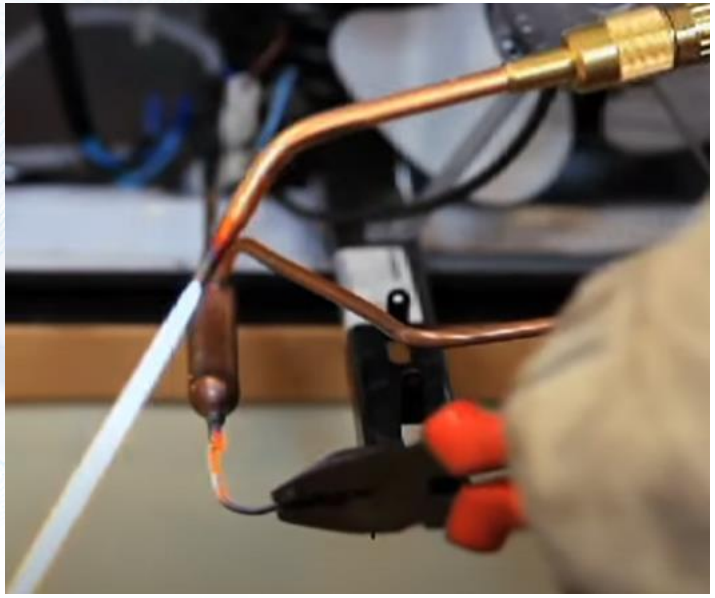
DISCLAIMER: FOLLOW A FULL COURSE IN CLASSROOM WITH PRACTICAL EXAMPLES BEFORE HANDLING FLAMMABLE REFRIGERANTS

Real Alternatives Consortium *(www.realalternatives.org)*

Good practices with flammable refrigerants

REAL Alternatives *training assumes technicians already have knowledge of RACHP systems which use HFCs and focuses on the differences between alternative refrigerants and HFCs with particular attention to the safety aspects*





Example: REAL Alternatives Flammables Course

With contribution of the LIFE programme of the European Union
Official Training Provider

Comprehensive Training Equipment Specifications (list)

- Personal protective equipment
- Electrically safe dry powder or CO_2 fire extinguisher
- Hydrocarbon gas leak monitor
- Extension lead so electrical equipment can be switched on / off outside the 3m safe area;
- A flammable refrigerant training and test system
- Suitable recovery machine and suitable recovery cylinder
- Flammable refrigerant cylinders with suitable cylinder adaptors
- Scales for weighing cylinders
- A2L ready vacuum pump if an A2L system is to be used
- Fixed leak detection and Ex rated ventilation
- Suitable flammable refrigerant leak detector.

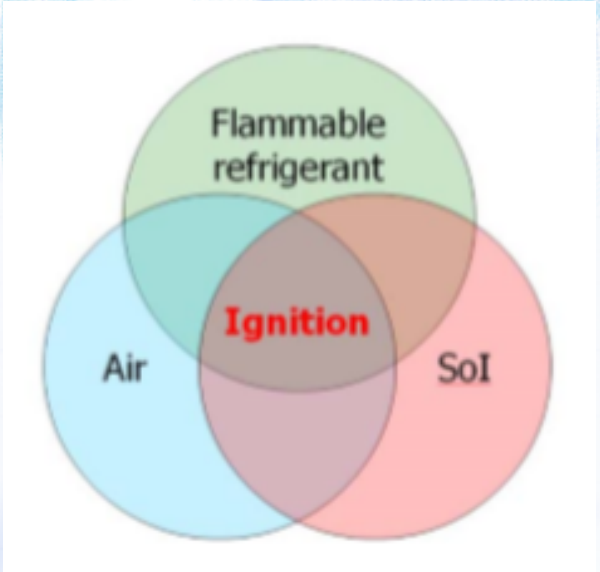
*The resources listed are **in addition to** standard tools and equipment such as gauge manifold set, pressure testing equipment, brazing equipment and hand tools that the training centre should already have.*

→Antistatic Wristband

Conditions for combustion

Three conditions are required for combustion – fuel, oxygen and a source of ignition.

For all flammable refrigerants combustion will occur if the refrigerant concentration in air is between the lower and upper flammability levels and if there is a source of ignition.



Safety

Fans

Ventilation can negate the need for changes to electrical devices or enclosures either:

- Condenser fans can be run constantly (increase the power consumption of the system), or:
- A supplementary fan can be switched on when condenser fan is off;

Careful consideration should be given to fouled condensers or failed fan motors which would significantly reduce available airflow, especially if they are the primary protection method for sources of ignition.

Service Procedure Differences

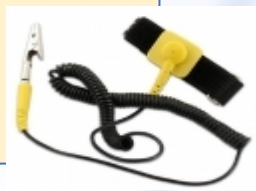
Need to carry out or refer to a risk assessment and taking into account control measures prior to carrying out any work.

- The properties of the alternative refrigerants, and in particular their hazards, affect how systems are serviced and maintained

Remember
If you are unsure of anything:
Do Not Proceed.
Stop work and ask the question!

Refrig.	Work area	Equipment	Leak testing	Charging	Recovery / disposal
R744	Very well ventilated	Suitable for the very high pressure	Method must be sensitive to R744	Initial charge should be gas to prevent dry ice formation	Venting is the usual practice
R717	Very well ventilated and free from sources of ignition	Suitable for use with R717 and free from sources of ignition	Method must be safe and sensitive to R717		Recovered
R32		Suitable for the high pressure and free from sources of ignition	Method must be safe and sensitive to R32		Recovered
R1234ze		Free from sources of ignition	Method must be safe and sensitive to R1234ze		Recovered
R600a R290			Method must be safe and sensitive to HCs	Charge weight is less so accuracy important	Small amounts* can be vented, otherwise HC is recovered
R1270					

Suitable gloves and safety glasses should be worn when working with any refrigerant, and when carrying out hot works (brazing / welding). Antistatic wrist strap should also be worn



*Small amounts are usually considered to be less than 150g.

Safety

Repairing in the field represents the moment of higher risk.

Risk assessment

Activity	R1270 recovery
Location	XX supermarket
Assessed by	XX
Assessment date	XX

Likelihood (L)

1	Unlikely
2	Likely
3	Almost certain

Severity (S)

1	Minor injury
2	Serious injury
3	Catastrophic injury or fatality

Evaluation matrix

Severity	3	Medium	High	High
	2	Low	Medium	High
	1	Low	Low	Medium
		1	2	3
		Likelihood		

Risk level (R)

Low	
Medium	
High	

Persons at risk	Hazards identified	Control measures	Risks after controls		
			L	S	R
Refrigeration technician Shop staff	Combustion	Work is carried out outside trading hours. Barriers are erected around the work area to keep shop staff away. The work area is well ventilated. There are no sources of ignition within 3 m of the HC cabinet and service equipment. A recovery machine suitable for use with HC refrigerant is used, and is switched outside the 3 m work area. A fire extinguisher is located within the work area. An HC detector is used to warn of an HC leak into the work area. The technician has received training and been assessed in safe handling of HC refrigerants.	1	2	2
Refrigeration technician	Overfilled recovery	Cylinders are clearly marked with the HC safe fill weight. Scales are used to weigh the cylinder during	1	2	2

Preventive actions

Repairing

- The area must:

✓ be very well ventilated;

✓ have a forced ventilation using a suitable fan assembly, if necessary (ATEX approved)

- Personal Protections Equipment worn properly (as for HFC)
- It is recommended that service technicians use personal monitors / detectors when working invasively on the systems
- The detector should be placed at low level adjacent to the system while working. In some cases more than one detector may be necessary.
- Have no source of ignition within 3 m from potential explosive atmosphere *(a typical safe area when working on flammable refrigerant systems with small refrigerant charge)*
- Have a fire extinguisher to hand with a capacity of at least 2 kg.

Monitor working area

- When carrying out invasive work, or if a leak is suspected, check and monitor the work area using a suitable detector.
- It is important that the detector cannot be zeroed out to background flammable refrigerant levels and alarms at 20% of the lower flammability level. The photo shows suitable detectors for HCs.

Most electronic leak detectors used for HFCs are not safe and sensitive for use with flammable refrigerants, so electronic detectors specifically for flammable gases (or leak detection spray) must be used

Fire extinguisher in the area

- You should also have a fire extinguisher to hand.
- This should either be a dry power type with a capacity of at least 2 kg, or an equivalent sized CO2 type.

This type of extinguishers are also mandatory requirement for transport of flammable refrigerants (ADR)

Dry powder

CO2

Equipment: vacuum pump

- Some standard tools and equipment can be used safely with flammable refrigerants, including gauge manifold sets,
- Most standard vacuum pumps can be safely used because usually the only potential source of ignition is the on / off switch (keep it closed and plug the vacuum pump 3 m away)
- In addition, the flammable refrigerant discharged by the pump is usually safely dispersed and does not result in a flammable zone, providing the pump is located in a well-ventilated area.

Vacuum pump with ATEX motor

Equipment: recovery machine

- Standard recovery machines cannot be safely used to recover flammable refrigerants and therefore must not be used.
- Unlike vacuum pumps there are several sources of ignition (e.g. on / off switches, relays, pressure switches). In addition, a leak would result in a flammable zone around the machine.
- These hazards cannot be avoided; therefore the correct recovery machine Ex rated must be used.

Recovery machine for use with HCs, R32 and R1234ze

Leak testing

Flammable refrigerant systems must be leak tested using a method that is safe and sensitive:

✓Leak detection spray

✓A suitable electronic flammable gas detector

Most electronic leak detectors used for HFC and HCFC leak detection are not safe and sensitive for use with flammable refrigerants, so electronic detectors specifically for flammable gases (or leak detection spray) must be used

Suitable Electronic leak detector

If you cannot find leaks using these methods you should recover the remaining charge and leak tightness test the system, using nitrogen or nitrogen with a trace of helium or hydrogen.

Refrigerant recovery

- Flammable refrigerant must be recovered using a suitable recovery machine (a standard recovery machine for halocarbon type refrigerants must not be used).
- Evacuate the recovery cylinder to remove air before filling it with flammable refrigerant.
- Do not mix flammable refrigerants with other types of refrigerant in a recovery cylinder.
- When recovering hydrocarbon refrigerants, do not fill the recovery cylinders with more than 45% of the HFC safe fill weight.
- Label the recovery cylinder to show it contains a flammable substance.

Videos in E-Learning

Hydrocarbons

General
Charging
Evacuation
Recovery
Replacing components

REAL Alternatives 4 Life - Hydrocarbons - Replace...

REAL Alternatives 4 Life - Hydrocarbons - charging H...

REAL Alternatives 4 Life - Hydrocarbons - general...

REAL Alternatives 4 Life - Hydrocarbons - evacuation...

Mechanical connections: lokring

For Production

Single ring

joints 00/50

Stopper

For Service

joints 00/50

Stopper

Un-brazing

Preferable procedure: do not un-braze the connections: cut the tube with cutter

To safely un-braze joints:

- Continuously monitor the area with a flammable refrigerant detector.
- Ensure there is good natural or forced ventilation.
- Recover the flammable refrigerant from the system (see recovery procedure), making sure you are recovering all the refrigerant from the entire system. (*)
- Run the recovery machine for long enough so the system is under vacuum and as much of the refrigerant is removed from the system as possible (*)
- Fill the system with oxygen free dry nitrogen to a pressure of 0.1 bar g (*)
- Connect a vent line to the system, open to atmosphere (*)
- Un-braze the connections (switch-on the torch only if the area is well ventilated on monitored with the refrigerant detector).

(*) Ensure **all** the refrigerant has been removed prior to unbrazing by connecting to both the high and low sides of the system.

Brazing

To safely braze joints:

- Continuously monitor the area with a flammable refrigerant detector.
- Ensure there is good natural or forced ventilation.
- When re-brazing connections, ensure at least one access point on the system open to atmosphere and purge with dry nitrogen.

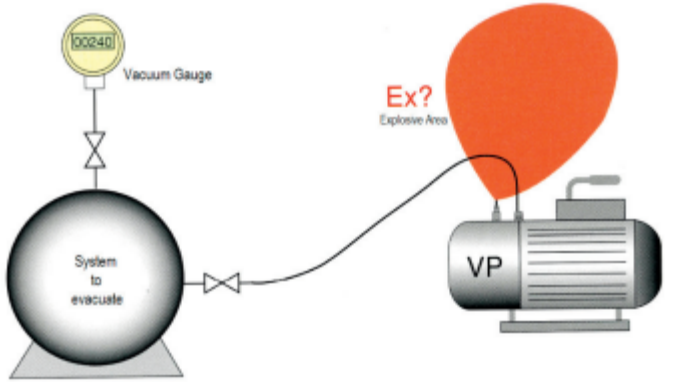
Evacuation

The vacuum pump must be checked to ensure the on / off switch is the only source of ignition. If this is the case the vacuum pump can be safely used with flammable refrigerant if the on / off switch is not used:

✓Move and block the switch to the on position and plug the pump into a socket outside the 3 m zone and control it from this socket.

✓Locate the vacuum pump in a well-ventilated area.

Credits: AREA association guideline on Equipment for Flammable Refrigerants



Charging

- Ensure there is good natural or forced ventilation.
- For HCs – use refrigerant grade HC (odorless), do not use lpg/fuel gas.
- If charging lines are not evacuated purge them carefully (by opening then closing the cylinder valve before purging).
- Do not over charge the system (for example, the HC charge weight is approximately 45% the charge weight for an equivalent HFC system).
- Accurately weigh in the charge when charging critically charged systems. The tolerance is typically ±5%. Do not adjust refrigerant charges, always use the manufacturer's indicated charge.

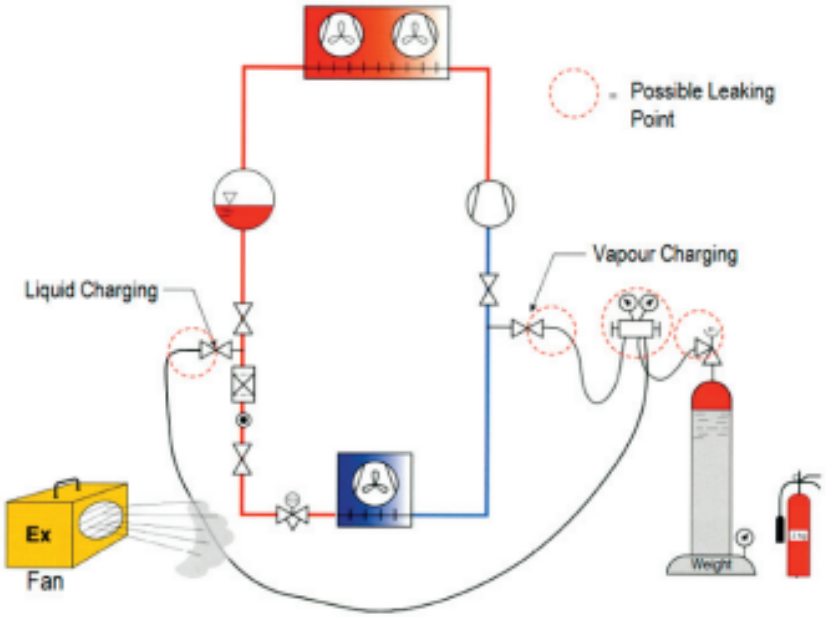


Figure 2 - Possible sources for leakage and safety equipment used when filling flammable refrigerant

Credits: AREA association guideline on Equipment for Flammable Refrigerants

Component replacement

- Replace electrical devices and compressors with **like for like** components.
- Ensure sealed electrical boxes are correctly resealed before putting the system back into operation.
- Do not modify components or relocate components.

Equipment using HC refrigerants

Massively used in the near future

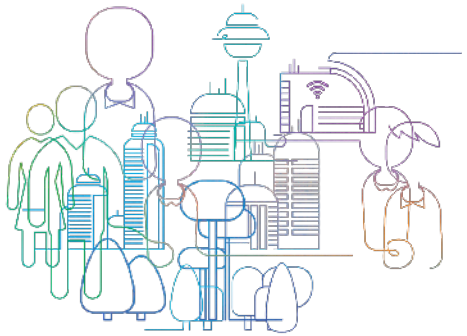
- Split
- Chillers

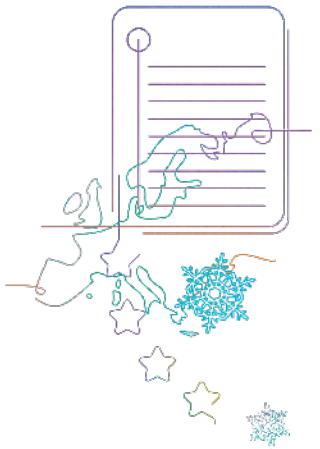
Already a standard

- Plug in Refrigeration Units
- Domestic refrigeration

In EU, mandatory training and certification for handling refrigerants

Thank you for your attention





Cooling for a better life

AREAVISION2025

Stronger together

Thank you

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