



The Voice of European Air-Conditioning, Refrigeration and Heat Pumps Contractors

# EQUIPMENT FOR REFRIGERANTS WITH LOWER (A2L) AND HIGHER (A3) FLAMMABILITY

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AREA ([www.area-eur.be](http://www.area-eur.be)) is the European organisation of air-conditioning, refrigeration and heat pumps contractors. Established in 1988, AREA voices the interests of 22 national members from 19 European countries, representing more than 13,000 companies (mainly small to medium sized enterprises), employing some 110,000 people and with an annual turnover approaching € 20 billion.

# FOREWORD

In the future we will see more alternative refrigerants to HFCs due to the EU F-gas Regulation and future international phase-down of High Global Warming Potential Substances. To lower global warming impact it is necessary to have a less stable molecule as a refrigerant, which means that the substance becomes flammable. The equipment and the tools for installation, maintenance and repair of future equipment containing flammable low GWP refrigerants need to be properly handled by competent personnel.

For the competence of the personnel, refer to the AREA Guideline: "Guidance on minimum requirements for contractors' training & certification", 2014.

This guide gives service technicians a tool to understand the equipment that should be used to service refrigeration plants containing flammable low GWP refrigerants in category A2L (lower flammability) or A3 (higher flammability). Please always refer to the manufacturer of your equipment for specific information regarding the category applicable for your tool.

## LIST OF REFRIGERANTS COVERED BY THIS DOCUMENT:

### > Lower flammability A2L-refrigerants

Low GWP – HFOs – Mixtures HFCs-HFOs (R32, R1234yf, R1234ze, R444, R445A, R454A, and R454B...

List is not complete, and please check with EN 378:2015, Annex E for details on safety classification

### > Higher flammability A3-refrigerants

HC – Hydrocarbons R290 (propane) – R1270 (propylene) – R600 (butane) - R600a (isobutane)

All these refrigerants are flammable at +20°C, with the exception of R1234ze, which is not flammable below +30°C.

# I-TRANSPORT OF FLAMMABLE REFRIGERANTS

Be aware that transport of flammable refrigerants is only allowed for a limited quantity (check ADR/ national legislation) and only if the refrigerant is transported directly from pick-up to worksite. Use preferably an open air truck, but ensure proper ventilation if the truck is enclosed.

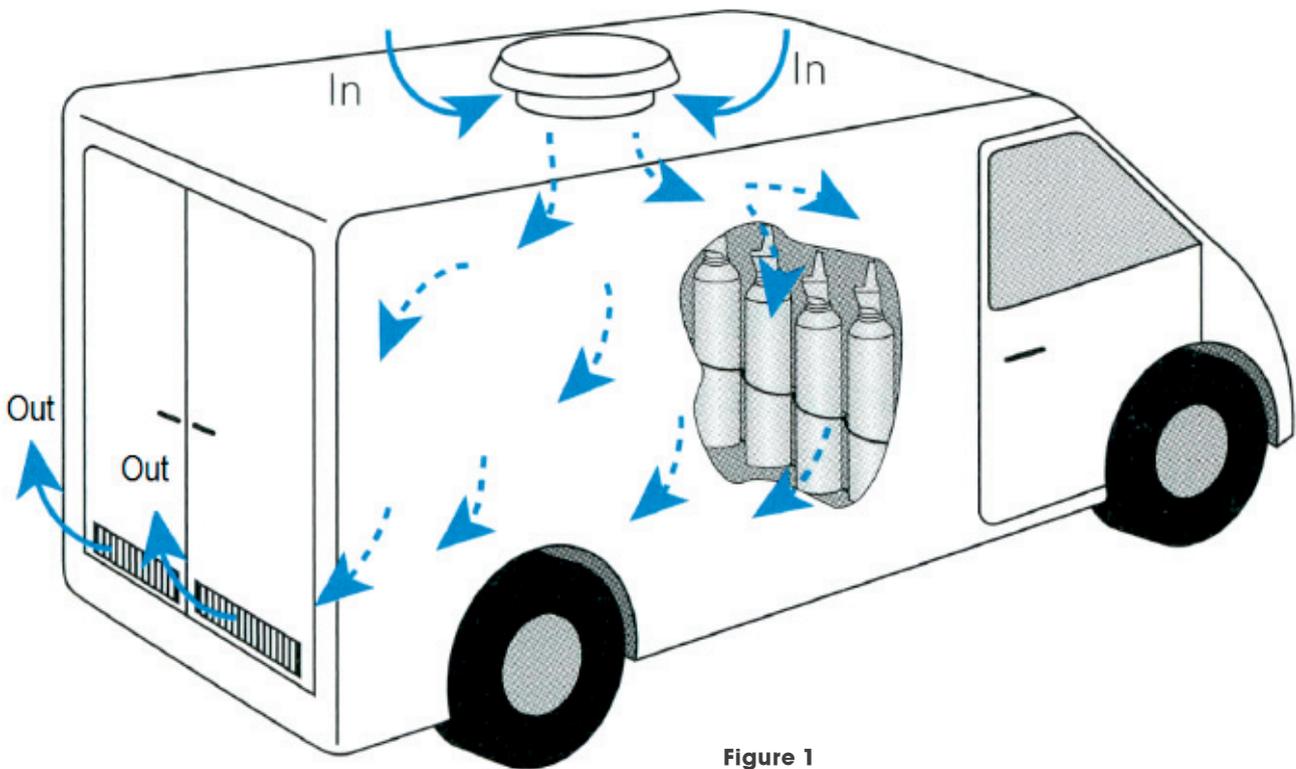


Figure 1

# II-LOWER FLAMMABILITY A2L-REFRIGERANTS

A2L are lower flammability refrigerants with a maximum burning velocity less than 10 cm/sec (ASHRAE 34 – ISO5149). Following a few but important safety precautions, such as handling by a competent refrigeration service engineer, their use is not very different from that of HFCs class A1 refrigerants. One of the main dangers is pooling (i.e. creating a temporary flammable zone when leaking refrigerant (heavier than air) gathers in small spaces). High-energy sparks in such an area could cause ignition and flame propagation.

## GENERAL

### TOOLS & EQUIPMENT

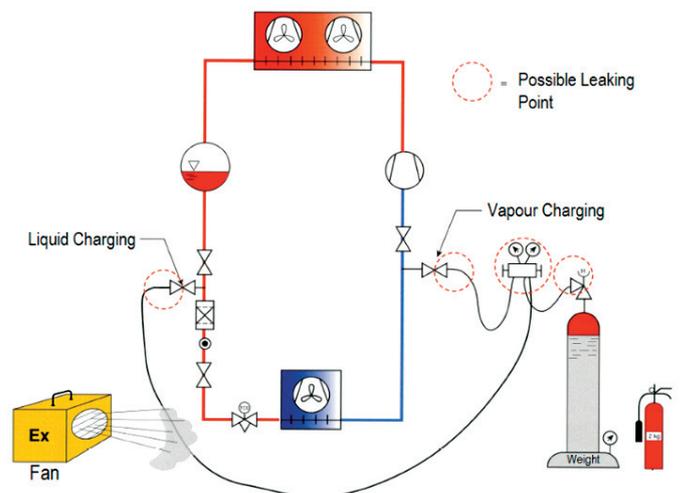
Some standard tools and equipment, including gauge manifold sets, can be used safely with flammable refrigerants

AREA recommends the use of vacuum pumps approved for use with A2L-refrigerants. Old vacuum pumps with a brushed motor should not be used because of the high-energy spark they create. Modern vacuum pumps with brushless EC motors can be used if the pump is switched on by an external power source and not by the on/off switch mounted on the pump.

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 (ATEX zone 2 = an area in which an explosive mixture is not likely to occur in normal operation and, if it does, will only exist for a short time). The section below on evacuation shows how you can avoid the hazard associated with the switch.

Standard recovery machines cannot safely 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 must be used.



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

## LEAK DETECTION

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

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

- > Leak detection spray
- > A suitable electronic flammable gas detector.

If you cannot find leaks using these methods you should recover the remaining charge and test the system for leak tightness using OFN (Oxygen-Free Nitrogen).



**Figure 3 - Electronic leak detectors suitable for flammable refrigerants**



**Figure 4 - Recovery machines for use with flammable refrigerants (respectively on the left for HCs and on the right for A2L refrigerants)**

## REFRIGERANT RECOVERY

A2L-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.

A2L synthetic refrigerants (as HFOs and R32) must be recovered as the HFC refrigerants and not vented to the atmosphere.

## EVACUATION

If a vacuum pump approved for A2L-refrigerants is not available, check that the on/off switch is the only source of ignition in the pump. If this is the case, the vacuum pump can be safely used with flammable A2L-refrigerant if the on/off switch is not used:

Move 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 or outside.

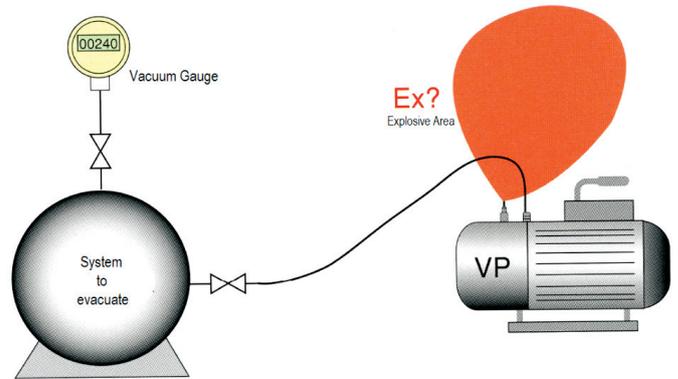


Figure 5

# REFRIGERANT R32

## SPECIFICATION OF REFRIGERANT CYLINDER

- > Red shoulder (flammable gas)
- > Left thread (an adapter piece is required to connect manifold)
- > Minimum test pressure = 48 bar
- > Fill rate for recovery bottles for R32 is 60%

## SERVICE TOOLS FOR R32

- > Tool Compatibility (if switching over from R410A)

Because R32 has approximately the same pressure as R410A, the refrigerant oil is also Polyolester (POE) oil and R32 can be accommodated with the same contamination control (preventing impurity contamination) as R410A. Tools that are used with R410A can be shared with R32 after confirmation from the tooling supplier.

| Tool  | R32   | R410A          | R22   |
|---|---|----------------|---|
| Gauge manifold  | Slightly different scale for HFC32 and R410A so check with tool supplier if manifold is shareable |                |   |
| Charge hose   | Common  |                |   |
| Scale   | Common  |                |   |
| Pipe bender   | Common  |                |   |
| Pipe cutter   | Common  |                |   |
| Flaring tool  | Common  |                | R22 type can be used by changing the work process         |
| Torque wrench   | Common  |                | Some flare nut widths are different, others can be shared |
| Cylinder thread adaptor                                   | Depends on the cylinder – some have different thread for flammable gases                          | Not applicable |   |
| Vacuum pump   | Common  |                |   |
| Recovery pump   | Check with tool supplier if shareable   |                |   |
| Electr. Leak detector<br>Torch type models CANNOT be used | Check with tool supplier if shareable   |                |   |
| Refrigerant recovery cylinder                             |   |                |   |

**Table 1 - Shared tools between commonly-used refrigerants in air conditioning systems (please always refer to the manufacturer of your equipment for specific information)**

# III-HIGHER FLAMMABILITY A3-REFRIGERANTS

A3 are refrigerants with a higher flammability risk than A2L-refrigerants. The main difference is that a relatively weak spark can ignite a flammable mixture. Static sparks typically occur from clothing, iron screwdrivers, bad electrical grounding, or a torch switch turned on. Avoiding sparks, good ventilation and no leakage are key points to avoid a dangerous situation. When working with A3-refrigerants, always use a personal leakage detector and remember that a vacuum pump, working fan, weight, recovery unit, leak detector and electrical drill must be approved for Ex-conditions, Zone 2 (ATEX).

## SAFETY PROCEDURE FOR THE WORK AREA WHERE HC SYSTEMS ARE BEING SERVICED:

- > There must be no source of ignition (compressor contactors, klixons, electrical connections) within 3m of the system
- > The area must be well ventilated
- > The area must be monitored with a hydrocarbon leak detector

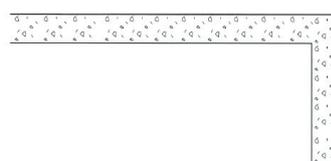
## RECOMMENDED PROCEDURE FOR RECOVERY OF HC REFRIGERANT EQUIPMENT FROM SMALL REFRIGERATION UNITS:

- > Plug in the ventilation fan 3m from the working area and position at floor level
- > Plug in the recovery unit 3m from the working area and recover the hydrocarbon refrigerant
- > When the low-pressure lamp illuminates, switch the unit to low pressure override and allow it to run for 2 minutes
- > Pressurise the system with OFN (Oxygen-Free Nitrogen) to just above atmospheric pressure
- > Using an HC sensor, check that no hydrocarbon refrigerant is in the air before lighting the brazing torch
- > Un-braze or cut the connections and complete the service operation
- > Braze back or, better still, use mechanical/compression joint tool and connectors

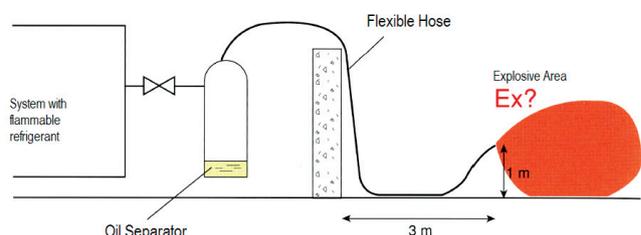
Cylinders for flammable refrigerants have left thread connections. They differ from the traditional HFC refrigerant cylinders to avoid use of the same pipework, which might confuse the technicians.

Recommendations for vacuum, recovery and leak checks for A2L-refrigerants are valid for A3-refrigerants.

For small quantities of hydrocarbons to be evacuated, normal practice recommends venting, but please always refer to your national legislation. See figure beside:



**Figure 5-2 - Example of safe venting of hydrocarbon refrigerant to outdoor location (if allowed by national legislation)**



## REFERENCES:

- > **Stig Rath** (2015) *Kuldemontøren 2*, ISBN 978-82-7345-620-5  
[www.bestsælgerklubben.no](http://www.bestsælgerklubben.no)
- > **Daikin** (2015) *Service manual for products using R32*
- > **REAL Alternatives** (2015) *E-Learning on Alternative Refrigerants* Leonardo da Vinci EU Project  
[www.realalternatives.eu](http://www.realalternatives.eu)
- > **Caresaver** (2014) *Universal Refrigerant Recovery Unit Operational Manual*

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