A2L Refrigerants - Key Information for Split A/C Systems

This document provides key information about A2L refrigerants in split air conditioning systems (single and multi-split systems).

A2L refrigerants are classed as lower flammability. This means that compared to A3s such as hydrocarbons the concentration in air required for combustion is greater, they are more difficult to ignite and the flame propagation is slower. Concentrations above the lower flammability level can be ignited by a flame such as a brazing torch and might be ignited by an arc or spark from an electrical switch. The table below shows the A2L refrigerants currently used in split AC systems.

Refrigerant	Type	LFL[1], kg/m^3	BP[2], ^{O}C
R32	HFC	0.307	-52.6
R454C	HFC / HFO blend	0.293	-45.6 to -37.8

Charge Size Restrictions and Other Application Considerations[3]

If the charge size of any split AC system using R32 or R454C is greater than 1.8 kg restrictions apply. A site survey must be carried out to determine:

- Floor area of the air conditioned space and of each room the pipe work passes through if there are pipe joints in that room;
- System charge and trim charge.

The maximum allowable refrigerant charge is worked out from the smallest room size (note – this might not be the air conditioned space):

$m_c = 2.5 \times LFL^{1.25} \times h_0 \times A^{0.5}$ and must not exceed $0.75 \times LFL \times h_0 \times A$

m_c is the maximum charge
h_0 is the release height from the floor of a potential refrigerant leak[4]
A is the floor area in m^2

The table below shows maximum charge sizes for a range of floor areas using R32 in a system with a ceiling mounted indoor unit. The maximum charge is per individual system.

Floor area, m^2	Max charge, kg
10	4.0
40	8.0
100	12.6
150	15.4

For systems with more than 16 kg of R32 additional risk mitigation measure are required which are not practical for split AC systems. Therefore, charge sizes greater than 16 kg are not used in split systems (but can be used in other AC systems such as VRV systems where the risk mitigation measures are more appropriate and cost effective).

Note – the maximum charge sizes and threshold charge sizes for R454C are similar to those for R32 because the LFL is similar.

[1] LFL is lower flammability level
[2] BP is the boiling point at atmospheric pressure
[3] In accordance with IEC 60335:2018 Household and similar electrical appliances – safety, part 2-40 particular requirements for electrical heat pumps, air conditioners and dehumidifiers
[4] For wall mounted indoor unit, h_0 = 1.8 m, for ceiling mounted indoor unit, h_0 = 2.2 m

You must refer to the installation manual provided by the AC system supplier for detailed information about maximum charge sizes and other application, installation and service information. A spreadsheet based charge size calculator is also available.

Service of A2L Split AC Systems

Do not retrofit systems (e.g. from R410A) to A2L refrigerants.

To work safely with A2L refrigerants the work area must be well ventilated and there should be no sources of ignition (flames and sparking electrical equipment) within 3 m of the system and work equipment. Engineers must wear suitable gloves and safety glasses.

Risk assessment – carry out a risk assessment as required by DSEAR (Dangerous Substances and Explosive Atmospheres Regulations 2002) to identify people at risk, hazards and control measures for each service activity. The hazard code which apply to A2L refrigerants are H221 (flammable gas) and H280 (contains gas under pressure; may explode if heated).

Training – ensure engineers have attended flammable refrigerant safe handling training[5]. This summary does not remove the need for training.

Leak detection – use an A2L leak detector.

Refrigerant recovery – use an A2L recovery machine and check the safe fill weight of the recovery cylinder (e.g. for R32 the fill weight is 60% of the R410A fill weight).

Before unbrazing connections – recover the refrigerant so the system in under vacuum, break the vacuum with nitrogen to a pressure of 0.5 bar g, then unbraze with connections open.

Evacuation – use an A2L vacuum pump.

Component replacement – replace electrical components (including the compressor) with a like for like replacement.

Charging – a different cylinder adaptor will probably be needed – refer to the refrigerant supplier.

Do not vent A2L refrigerants – they are F Gases.

Do not burn A2L refrigerants – this will produce hydrogen fluoride which forms highly toxic hydrofluoric acid when in contact with moisture (e.g. in your mouth / lungs).

Transport of A2L refrigerant cylinders [6]

ADR Small Load Exemptions (ADR 1.1.3.6) applies to most service vehicles carrying a mixture different refrigerants and other compressed fluids. Requirement still apply under the exemptions:

- Material Safety Data Sheets for each fluid carried should be available to the driver;
- The vehicle must be equipped with a 2kg dry powder fire extinguisher;
- The driver must be appropriately trained & aware of what actions to take in an emergency;
- Cylinders should be transported secured (ideally upright);
- The bulkhead separating the driver from the load should be airtight or the vehicle well ventilated;
- Optional – Flammable & Compressed Gas diamonds displayed on the outside of the vehicle.

[5] See www.coolconcerns.co.uk for information on flammable refrigerant training
[6] ADR 2019 applies when transporting any refrigerant in cylinders (as well as other gases, oxygen, acetylene etc)