R32 as a refrigerant - low GWP, low flammable proposal for AC

R32 is a refrigerant which is proposed to be used in some air conditioning equipment which currently uses R410A so this bulletin is an introduction to this refrigerant. It is mildly flammable and has similar performance and operating conditions to R410A. It has a lower global warming potential (GWP) than the commonly used HFCs.

Characteristics

R32 is difluoromethane (methylene fluoride) and it is an HFC type refrigerant. R32 has been used for many years as a component of both R407C and R410A. It is flammable on its own, but not when mixed with the other components of these blends.

Table 1 below summarises its main characteristics in comparison with HFCs R410A and R407C, and hydrocarbon R290 (propane). The information is from EN378-1:2008+A2:2012, Refrigerating systems and heat pumps – Safety and environmental requirements, Part 1 – Basic requirements, definitions, classification and selection criteria. See Table 2 for an explanation of A1, A2 and A3.

Flammability

Refrigerants are classified according to their flammability and toxicity. "A" classification indicates low toxicity ("B" is high toxicity). The numbers 1, 2 or 3 following the A or B indicate the degree of flammability. The safety groups A1, A2 and A3 are explained in the tables below.

Working safely with R32

You should take the same care when handling R32 as you do for the hydrocarbon refrigerants. The following points summarise the safe handling guidance:

- Work in a well-ventilated area;
- Eliminate sources of ignition within 3 m of the system and associated service equipment;

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Table 1 - Refrigerant characteristics

	Boiling point	Safety group	Lower flammability level kg/m^3	Practical limit kg/m^3	Ignition temp	GWP
R32	-51^{O}C	A2	0.307	0.061	648^{O}C	550
R410A	-52^{O}C	A1	-	0.44	-	1980
R407C	-44^{O}C to -37^{O}C	A1	-	0.31	704^{O}C	1650
R290	-42^{O}C	A3	0.038	0.008	470^{O}C	3

Table 2 - Refrigerant flammability classification

Safety classification	Lower Flammability level, % in air by volume	Heat of combustion, J/kg	Flame propagation
A1	No flame propagation when tested at 60^{O}C and 101.3 kPa		
A2, lower flammability	> 3.5	< 19,000	Exhibit flame propagation when tested at 60^{O}C and 101.3 kPa
A3, higher flammability	≤ 3.5	≥ 19,000	Exhibit flame propagation when tested at 60^{O}C and 101.3 kPa

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- Use a suitable detector to warn of a build-up of flammable refrigerant in the air;
- Have a fire extinguisher available;
- Ensure your recovery machine is safe to use with flammable refrigerant;
- Use leak detection spray or a safe, sensitive electronic leak detector;
- If you need to un-braze connections ensure you have recovered the system onto a vacuum and filled with a charge of dry nitrogen to a slight positive pressure before un-brazing;
- When evacuating the system ensure the vacuum pump is in a well-ventilated area (or outside) and control it by a switch outside the 3m area.

You should refer to the detailed information provided by the suppliers or training providers.

Charge size limitations (as specified in the current EN378-1:2008)

The amount of flammable refrigerant which can be used in systems is restricted and depends on a number of factors:

- Location of equipment, e.g. below or above ground level;
- Occupancy of area being cooled, e.g. unrestricted access by the public or authorised access only;
- Type of system, e.g. direct expansion or secondary / refrigeration or air conditioning.

The limits are different for comfort cooling / heating and non comfort cooling / heating applications.
R32 is proposed for use in split air conditioning systems, so the most common charge size restriction is that applying to comfort cooling / heating applications. The maximum charge is based on the LFL of the refrigerant, the floor area and the height of the indoor unit:

$$M = 2.5 \times LFL^{1.25} \times h \times \sqrt{A}$$

M = max charge, kg
LFL = lower flammability limit, kg/m^3
h = height of unit, m, (0.6 for floor mounted, 1.0 for window, 1.8 for wall, 2.2 for ceiling)
A = floor area, m^2

Example of charge size limitation calculation

A split AC system with a ceiling mounted indoor unit in a room 9 m long by 5.5 m wide using
R32:

$$M = 2.5 \times 0.307^{1.25} \times 2.2 \times \sqrt{(9 \times 5.5)} = 8.84 \text{ kg}$$

In this application the maximum charge size for R290 (propane) would be 0.65 kg because of its greater LFL. For this reason R32 can be more widely applied.

For non comfort cooling and heating applications the maximum charge is calculated using the practical limit, and there are also absolute maximum charge sizes – these are detailed in EN378.

A2L Low Flammable Refrigerant in Refrigeration Safety Standards

Recent announcements from the European Commission about the proposed amendments to the F-Gas Regulations coincided with news from the International Standards Organisation that the two key standards, ISO5149 and ISO817, had failed the final draft vote and therefore would not be issued in the immediate future. These standards, the international equivalents of EN378, would have been the first appearance in standards that are applicable in Europe of the much discussed "2L sub-class" of flammability which is intended to make the adoption of HFO refrigerants easier and more universal.

The Institute's Technical Committee reviewed this delay at their meeting in January 2013 in response to the suggestion that these new refrigerants could not be used until either EN378 or ISO5149 was revised. The Committee concluded that, in fact, this was not the case - it is perfectly possibly to use any of the refrigerants that will be classed as "2L" by applying the requirements of the existing standard, which was published in 2008. Some refrigerants in this flammability class, such as R-32 and R-717, have been in the Standards for years already. Others, such as R-1234yf, have been added in interim amendments. In all cases they can be treated as class 2 refrigerants, for which the rules are clearly defined. The introduction of the L sub-class to class 2 will not totally transform these rules, but will increase the charge limits in some applications and will simplify the requirements in other cases. So even though ISO5149 and ISO817 have gone back for further review the new fluids can be deployed by following the requirements of the current published standards.

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