

Hydrocarbon refrigerant air conditioning systems

This series of articles written by Jane Gartshore, director at Cool Concerns, explores the increasing use of hydrocarbon refrigerants in both air conditioning and refrigeration.



The use of hydrocarbon (HC) refrigerants has significantly increased over the last two years, primarily because of their low environmental impact and good performance. In particular one retailer has opted to use HCs in all refrigeration and air conditioning equipment, leading to the need for split AC systems suitable for use with either propane or propene.

Historically very few split systems have been installed on HCs, and there was a lack of suitable equipment in the UK. Phoenix Retail Services worked in partnership with Cool Concerns to develop suitable systems. Phoenix is a dynamic company which provides retail solutions to large end users. They have in-house design expertise – one key factor in the successful development of the HC systems. The other key factor was the partnership with Cool Concerns – a company which has extensive experience in the application of HCs in a variety of equipment. Together the partnership developed a range of split AC systems which perfectly meet the needs of end users for a safe and reliable system with a low environmental impact.

The design process

The Phoenix hydrocarbon split AC systems (model HPUH) are based on R407C units. These were selected in preference to R410A systems because

the capacity of R407C is similar to both R290 (propane) and R1270 (propene). The capacity of R410A systems would significantly reduce on either HC, thus requiring redesign.

R1270 was the HC refrigerant selected as its capacity and energy efficiency are slightly better than R290.

A key stage in the design process is ensuring the systems are safe in the event of a refrigerant leak. Simulated leak testing was carried out to determine whether electrical devices needed to be moved or changed. This involved leaking HC at a rate derived from the relevant section of EN60335-2-40 from any part of the system where leakage could occur (e.g. pipe work points). The concentration of HC refrigerant at sources of ignition on the system, such as electrical switches, was then measured. If the concentration never exceeds 50% of the lower flammability level (LFL) the source of ignition is not a hazard. Where the concentration is greater than 50% LFL the electrical device must be removed or replaced with a suitable device.

The test work identified that the electrical box in its original position (internally) was in a potentially flammable zone in the event of a leak. The box was moved to an area outside this zone – allowing open type (sparking) electrical devices to continue to be used.

Application issues

EN378:2008 specifies the charge limit in systems used for comfort cooling and heating – the limit depends on the floor area, height of the indoor unit and the refrigerant's LFL. It is a very onerous limit as shown in the example, right.

This has a major impact on the application of HCs in split AC systems. The charge limit is per system, so for most room sizes more than one split system is used.

EN378:2008 specifies an absolute maximum HC charge of 1.5 kg in public areas such as supermarkets for refrigeration systems. It was decided that this limit should also be applied to air conditioning systems (EN378 omits an absolute maximum charge for air conditioning, probably in error). So the individual charge size will never be more than 1.5 kg, but will be less if the "charge limit" calculation outlined above gives a lower maximum.

To date more than 150 Phoenix R1270 split AC systems have been installed for both public and non-public areas of supermarkets for one retailer alone. Equipment supplied to sub-contractors is installed by engineers who have been on the approved HC handling course which covers the specific issues and risks associated with flammable A3 refrigerants. There are over 5,500 engineers who have completed this training, ensuring service engineers qualified to support HC equipment are widely available across the UK.

Further developments

Phoenix is now working on extending the range of HC cassette, wall mounted and ducted AC units. They are also developing HC air source heat pump / water chillers, designed to overcome the charge size restriction associated with direct expansion HC systems. These will, for example, be used in areas of high load coupled with long pipe runs and / or small room sizes.

The roll out of hydrocarbon refrigerant AC continues to be a success, mainly due to the end users' drive to use HCs and the relative simplicity in applying them. This has been aided by the increasing range of HC equipment now more readily available.



Hydrocarbon air conditioning unit from Phoenix