



THE A TO F OF 407

Amongst the myriad of refrigerants that now exist there are 6 refrigerants with the R number 407, each with a different postfix. All consist of the same three components, R32, R125 and R134a, but in different proportions and each with different properties. Peter Dinnage of Climalife reports.

It is important that these different refrigerants are not mistaken for one another. All have an Ashrae A1 classification, i.e. lowest toxicity and non-flammable. The amount of R32 in the blend is limited by the desire to remain non-flammable.

The different proportions of each component of the 407 series can be seen in Table 1 with R125 and R32 being the higher pressure components and R134a the lower pressure component. By altering the composition, different properties can be obtained.

	R407A	R407B	R407C	R407D	R407E	R407F
R32	20	10	23	15	25	30
R125	40	70	25	15	15	30
R134a	40	20	52	70	60	40
GWP	2107	2803	1774	1627	1552	1825

Table 1: Composition of the different R407 refrigerants

R407B has the lowest boiling point and was mooted as an R502 replacement, whilst R407D has the highest boiling point and found limited use as a R500 or low temperature R12 replacement. R407E has never seen the light of day in the UK. With the exception of R407B which has disappeared from the scene, all have GWPs just above or below 2000.

Up until a few years ago R407C was the only one in large scale common use, but with the trend towards lower GWP refrigerants R407A has re-emerged and R407F has also come to the fore as both are suitable alternatives to R404A.

The different versions of R407 should not be mixed for a number of reasons, although the most obvious being that it is not good refrigeration practice to mix different systems and is strongly discouraged. If they were mixed, it would be very difficult to set up a system to run properly and efficiently as the exact composition would not be known and could only be ascertained by refrigerant analysis. The only solution would be to recover and replace with a fresh charge.

R407C came to market over 20 years ago and quickly established itself in air conditioning and chiller applications as its properties were very close to that of R22 which it replaced. R407C has worked well where it has been used and will continue to do so for a few more years to come.

Navigating Glide

One of the features of the 407 refrigerants is that most possess a temperature Glide of 6-7K which has taken getting used to in some applications, but it only becomes an issue if no allowance is made for this property or the system has a flooded evaporator. Those who have a basic understanding of thermodynamics and glide have utilised blends with glide to good effect.

The basic principles apply to all blends, not just R407. It has long been recognised that you should always charge from the liquid valve to avoid fractionation with many refrigerant cylinders only allowing this option. Similarly, the condensing temperature should be the average or mid-point between the dew and bubble temperatures rather than selecting the dew point temperature. Sizing of compressors and evaporators also need to take this into account rather than using the dew point

Composition shift or fractionation can affect blends, but this is usually only an issue when the system is switched off and there is a vapour leak. When the system is working, neither liquid line or vapour line leaks lead to composition changes. Topping up a system after a leak will always return the composition closer to the original.

The Future for the 407 Range

Whilst R407A has been around as long as R407C, its use was only in a few applications. Even though it can be used as a R404A or R22 replacement, it has largely been overtaken by R407F which has a lower GWP and offers greater energy savings. Growth in the use of R407F over the next few years is likely to be significant, not just because it is a serious retrofit option to the high GWP R404A, but also because it has been shown that the payback cost of retrofitting from R404A to R407F can be a little as two years with the cost savings continuing to be realised in subsequent years. These calculations take into account the retrofit cost, refrigerant, assumed leaks and energy costs. If the price of R404A escalates over the next few years as forecast by many, then conversion of R404A systems to R407F will prove not only a cost effective change but a very wise one. With approval by major compressor brands for R407F it should be used in new equipment instead of R404A.

The three refrigerants used to make up the 407 range may also be fundamental building blocks which will be seen in the future. New, lower GWP blends such as R1234yf or R1234ze, will look to replace some of the R134a used in the blends, whilst the GWP of R32 means it will appear in future low GWP blends. There is a lot more than meets the eye when you look at the A to F of R407 refrigerants.