



REPLACEMENTS FOR R22: RS-44 (R424A) & RS-45 (R434A)

R22 is a unique refrigerant & there is no single fluid or blend which has identical properties; this includes R125, R143a, R32, R134a, R410A, R407C, R404A, R507, R422D, R417A & other refrigerants. In attempting to replace R22, it is only possible to formulate products with properties which are similar to R22 at different temperatures & pressures in varying types of equipment.

We at Refrigerant Solutions Ltd (RSL) have developed RS-45 (R434A) as a replacement for R22 which will mirror the performance (eg capacity & COP) across the range from +7⁰C to -35⁰C. But the liquid volume flow is higher than R22 with the result that it is not suitable for use in existing systems with capillary tubes (eg splits, windows, rooftops). RS-45 is suitable in units with adjustable expansion valves and is especially recommended for flooded evaporators, where it is operating satisfactorily in a number of such installations.

Because RS-45 is not recommended for use in capillary tube systems, RS-44 (R424A) has been developed precisely for this purpose. RS-44 is working well in many hundreds of units around the world in this type of application. Because RS-44 contains a significant amount of R134a in the blend, it has a theoretical capacity as calculated by modelling programs such as NIST's Cycle D, which appears to be lower than that of R22.

But such calculated results are misleading. **Real results, obtained by customers and RSL itself, clearly demonstrate that RS-44 is at least as energy efficient as R22 while simultaneously provides equivalent capacity.**

Why the difference between the cycle model and equipment? A typical capillary tube containing unit is typically small and its output capacity is controlled by a simple on/off thermostat. When retrofitted with RS-44 it will operate for longer than when operating on the original R22 charge, but the overall capacity delivered is the same averaged over reasonable period.

Furthermore, in contrast to cycle calculations, the **observed energy efficiency** of RS-44 in real equipment is at least as good, and sometimes better, than that of R22. RSL surmises that the fewer off/on cycles experienced with RS-44 contributes to this improvement. Also, the pressure difference across the compressor is smaller for RS-44 so the bearings are likely to experience lower loads and frictional losses will thus be lower.

In developing RS-44, RSL assessed a composition containing a higher ratio of R125 to R134a in an attempt to increase “instantaneous” capacity based on Cycle D calculations. When this blend was tested in a capillary unit, evaporator icing was observed and it was realised that liquid volume flow was significantly higher than for R22 and the capillary could not cope with it. RS-44 was specially designed to overcome this problem. Although RS-44 reduced the “instantaneous” capacity as calculated by Cycle D, RSL then demonstrated that the capacity was achieved by the increase in operating time, as described above.

In summary, RSL accepts that initial cycle calculations have a place in refrigerant assessment, and computer models such as Cycle D make a valuable contribution. But the results obtained must be taken in context. Indeed, Cycle D predicts that blends with higher R125/134a ratios than RS-44 will have higher volume flow rates, but implicitly assumes that a capillary tune will be sized appropriately. Of course this is not valid when retrofitting when the capillary size is already fixed. The lesson is that nothing cannot replace the hands-on experience obtained from actual testing. .

Conversion of water chillers operating on R22 to a suitable replacement will depend very much upon the type of chiller barrel or evaporator. The following is a summary of where to use RS-44 or RS-45 in chillers:

- (1) Single pass refrigerant, single pass water, counter current flow, DX, tube in tube, tube in shell or plate type.
RS-44 (R424A)
- (2) Multi pass refrigerant or water, DX, tube in shell.
RS-45 (R434A)
- (3) Flooded chillers.
RS-45 (R434A)

RS-44 is not recommended for use when evaporator temperatures are below -5°C

The main differences between RS-44 and RS-45 are that RS-45 has a higher capacity and lower temperature glide (near azeotropic). The mass flow rate of RS-45 is higher so that the expansion device on the chiller will need to accommodate a higher liquid flow rate similar to the liquid flow rate of R404A.

RS-45 is the only replacement for R22 which can match the performance in flooded systems satisfactorily. RS-45 can be used in any type of chiller if these chillers can accommodate the higher flow rate.

Both RS-44 and RS-45 have considerably lower discharge temperatures than R22, have a safety classification from ASHRAE of A1, namely low toxicity and non flammable under all conditions of flammability, and are compatible with mineral oil, alkylbenzene and POE lubricants.