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RS-45 (R434A) &LUBRICANTS

CFCs (chlorofluorocarbons) and HCFCs (hydrochlorfluorocarbons) are generally miscible with the traditional lubricants and so oil return has not been a problem in systems using these unique chemicals. As is now well known, HFCs are not soluble in mineral and alkylebenzene lubricants and new synthetic oils have been developed. However, these new lubricants pick up moisture rapidly which can cause severe problems if not properly controlled. Furthermore, polyol ester and polyalkylene glycol lubricants are considerably more expensive that the traditional oils.

There is no technical requirement to have full miscibility between the refrigerant and the lubricant, but rather the key issue in any refrigeration or air-conditioning system is to ensure satisfactory oil return to the compressor. Hydrocarbons provide the critical link between the non chlorine non ozone depleting HFCs and ensuring oil return to the compressor during the normal refrigeration cycle. It is the selection of hydrocarbons appropriate for the HFC components which is critical in providing the required oil return while maintaining no flammability of the blend under all conditions of fractionation.

Refrigerant Solutions Ltd (RSL) has developed RS-45 (R434A) to replace R22 which is non ozone depleting but can be used with the traditional lubricants and offer a similar performance to R22. In systems with inherent poor oil return, often with unusually long suction lines and/or at low temperatures, the use of a POE lubricants may be appropriate in such cases. RS-45 is fully miscible in POE lubricants in the same way as other HFC blends including R404A, R507, R410A, R407C etc.

OEMs have a choice of using mineral, alkylbenzene or POE lubricants when using RS-45 (R434A). The use of mineral or alkylbenzene lubricants coveys the following advantages:

(1) Avoids use of POE:

   (a) Lower costs: POE lubricants cost some 4 or 5 times more than mineral (MO) & alkyl benzene (AB) oils.
   (b) No moisture pick up: POE lubricants are very hygroscopic which causes corrosion of the system.
   (c) Production lines using mineral oil would require no changes either in equipment or lubricant
   (d) No changes in assembly time with the compressor open to atmosphere

(2) Lower refrigerant solubility:

   (a) Improved working viscosity at start-up: the lower solubility of RS-44 in mineral oil has only a marginal effect on viscosity thus improving hydrodynamic lubrication at start-up and increasing service life. In contrast, the high solubility of R407C in POE reduces the viscosity of the lubricant Lower viscosity can affect hydrodynamic lubrication resulting in reduced service life

(b) Faster pull down time: in residential air conditioner and similar systems using HFC blends with POE during the off cycle most of the refrigerant will reside in the compressor dissolved in POE. On start up, it will take some time for the POE to warm up and expel the refrigerant into the circuit which, apart from having a delaying effect on the operation of the system, could also have a detrimental effect on the lubrication of the bearings due to the highly diluted POE. Where RS-45 is used with MO, only a few per cent of the refrigerant is dissolved in the oil resulting in uninterrupted lubrication and faster pull down.

(c) Reduced oil loss & carry-over on start up: a sharp reduction in crankcase pressure on start up can cause violent foaming of the refrigerant-saturated oil in the compressor, which results in oil entering the circuit. Although a crankcase heater can avoid this effect, using MO minimises this problem because of the lower solubility of RS-45.

(d) Lower moisture pick-up: as is widely known, POE lubricants are highly hygroscopic. While this is likely to be less of a problem in closed systems such as household refrigerators/freezers, in commercial systems which are periodically opened for inspection and during service moisture pick-up is a significant risk which can adversely affect the life of the equipment. While mineral oils absorb little moisture, the ability of POE lubricants to absorb moisture can lead to the rapid saturation of driers and the icing up of expansion devices, such as capillaries.

Moisture absorption of the lubricant during manufacturing is also a major concern, and the ability to continue using mineral oil reduces this risk dramatically

Moisture pick-up by POE lubricants results in the formation of harmful acids in the system which cause corrosion.

(3) Lower discharge temperature: reduces problems of oil decomposition and provides a wider range of applications. The life of the equipment is extended and potential warranty claims are reduced when systems operate at high ambient conditions.

(4) Avoids problems of differential solubility of blend components in POE: solubility in POE of the components of R407C &R410A differ which can have a negative effect. This can lead to having an excess of the less miscible component of the refrigerant blend circulating throughout the system.

(5) Reduced chemical reactivity: the much higher moisture levels in POE increase chemical reactivity leading to formation of materials that plug capillaries, filter driers etc and increase the propensity for icing of expansion devices. The potential for harmful chemical reactions appear to be many times greater when ester oils are present as compared to mineral oil, due to the formation of corrosive organic acids when POE lubricants absorb moisture