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RS-45 (R434A) & LUBRICANTS

CFCs (chlorofluorocarbons) and HCFCs (hydrochlorofluorocarbons) are generally miscible with the traditional lubricants 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 alkylbenzene 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 than 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. It is worth remembering that ammonia, a refrigerant which has been used extensively from the beginning of large scale industrial refrigeration in the mid 19th century, is not miscible with mineral oil. 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. The selection of hydrocarbons appropriate for the HFC components is key to oil return while maintaining non flammability of the blend under all conditions of fractionation as defined by ASHRAE.

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 offers 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 POE lubricants may be appropriate. 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). Using mineral and alkylbenzene lubricants with RS-45 provides the following advantages:

(1) Cost:

- a. Lower lubricant costs: POE lubricants cost some 4 or 5 times more than mineral (MO) and alkyl benzene (AB) oils.
- b. Assembly lines for units using MO and AB require no changes while converting lines for POE requires investment in extra equipment to minimise water ingress, re-training operators and ongoing, extra quality control to maintain the new system.

(2) Lower discharge temperature: The lower discharge temperature of RS-45 compared to R22 reduces the problems of MO decomposition. The life of equipment is extended and potential warranty claims are reduced for systems operating at high ambient conditions.

(3) Lower refrigerant solubility:

- a. Improved working viscosity at start-up: the lower solubility of RS-45 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 R410A & R407C in POE decreases the viscosity of the lubricant, and thus hydrodynamic lubrication, reducing 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 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.

(4) Lower moisture pick-up:

- a. Mineral & alkylbenzene oils absorb little moisture, in marked comparison to POE lubricants which are well-known to be hygroscopic. Moisture absorption of the lubricant during manufacturing is a major concern, and the ability to continue using mineral oil reduces this risk significantly.
- b. Even more than in manufacture the continued use of MO and AB lubricants is especially advantageous during servicing, where water ingress is necessarily beyond the control of OEMs who thus have more problems in judging warranty liability claims. Commercial systems, which are periodically opened for inspection and service, are particularly vulnerable:
 - i. Moisture adsorbed by POE lubricants rapidly saturates driers leaving water in the oil capable of icing up of expansion devices.
 - ii. Even worse, water reacts chemically with POEs generating corrosive organic acids which can damage the equipment. Furthermore corrosion products can block pipe work, especially capillaries.

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