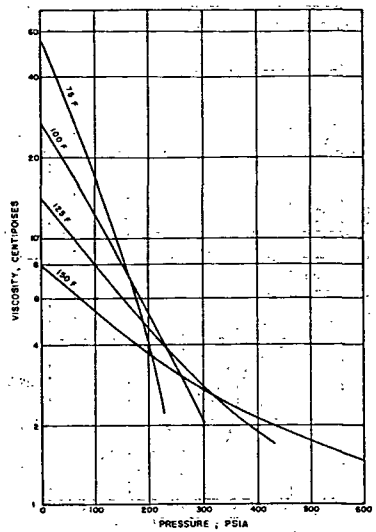


Fig. 19 .... Viscosity of Mixture of 150 SUV Paraffin Base Oil and Refrigerant 13B1[14]

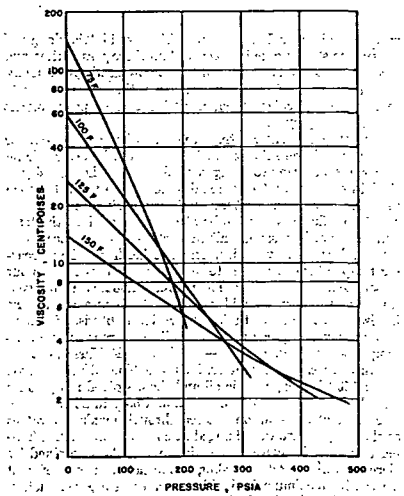


Fig. 20 .... Viscosity of Mixture of 300 SUV Naphthene Base Oil and Refrigerant 13B1[14]

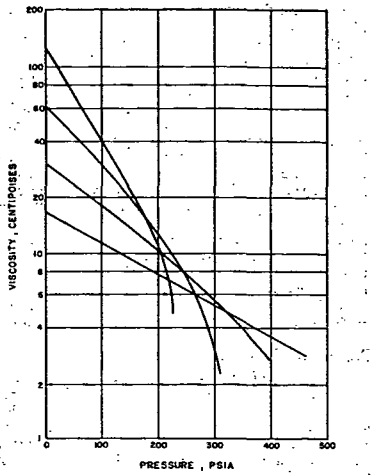


Fig. 21 .... Viscosity of Mixture of 300 SUV Paraffin Base Oil and Refrigerant 13B1[14]

ate point where much of the refrigerant has escaped from the oil. In the case of the highly miscible oil-Refrigerant 12 solutions, the maximum viscosity is quite low, and oil return problems have seldom occurred with this refrigerant. On the other hand, such problems have occurred with Refrigerant 22 in some low temperature installations, and it is possible to picture a possible example from the data in Fig. 39. If an evaporator on a Refrigerant 22 system is operating at about − 40 F, which corresponds to 1 psig suction pressure, any oil-Refrigerant 22 solution that separates should be quite low in viscosity at that temperature. However, when this solution moves into a region where the temperature is − 20 F, possibly in the suction line, its viscosity would be expected to increase many times, perhaps to such an extent as to interfere with gas flow.

Fluidity of Oil at Low Temperatures

As implied in the preceding paragraph, any oil intended for low temperature service, whether in refrigeration equipment or in other types of machinery, should be able to flow at the lowest temperature likely to be encountered. This requirement is usually met by specifying a suitably low pour point. The *pour point* of an oil is defined as the lowest temperature at which it is still fluid, and can be poured, when tested according to the standard method prescribed in ASTM D-97. Nominal pour points of typical refrigeration oils are listed in Table 1.

The loss of fluidity by cooling to the pour point temperature may manifest itself in two different ways. With some oils a gradual increase in viscosity occurs; the flow becomes more and more sluggish as the temperature is lowered and, finally, becomes so slow that no perceptible motion is seen within the time (5 sec) specified in the test procedure. This type of behavior is most frequently seen in testing naphthene base oils.

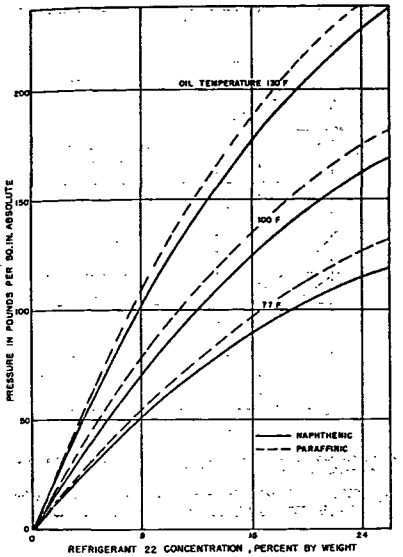


Fig. 22 .. Solubility of Refrigerant 22 in 150 SUV Oils[15]

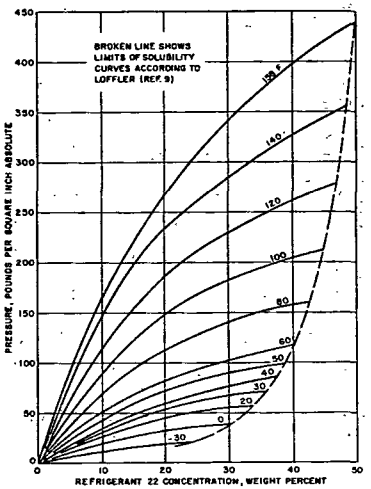
Paraffin base oils, on the other hand, are apt to crystallize at the pour point temperature to form a rigid network of wax crystals which occupy the entire volume of the sample. This network prevents flow but may still retain unfrozen liquid in its interstices. The wax crystals have relatively high freezing points in comparison with other hydrocarbon types; hence, when equivalent viscosity grades are tested, pour points of paraffin base oils are generally higher than pour points of naphthene base oils.

Oils intended for refrigeration use, whether paraffin or naphthene base, are normally refined and dewaxed to obtain low pour points. Although not recommended for refrigeration oils, for some applications pour points can be lowered by adding chemicals known as *pour point depressors.* These chemicals do not actually prevent wax separation but merely change the crystal structures from needle-like shapes which trap the unfrozen oil to ball-like shapes which will pour with the oil.[23]

Liquids other than mineral oils, such as polybutyl silicates[24] and alkyl benzenes[25] which do not contain waxy constituents, have also been suggested for lubricating systems in which wax separation (or oil-rich phase separation) may be a problem.

Standard pour tests are performed on oils alone, in room air. But in a refrigerant system, oil is always mixed with refrigerant which, if soluble, greatly increases the fluidity even at low temperatures. For this reason, the significance of the standard pour tests when used to qualify refrigeration oils has been questioned.

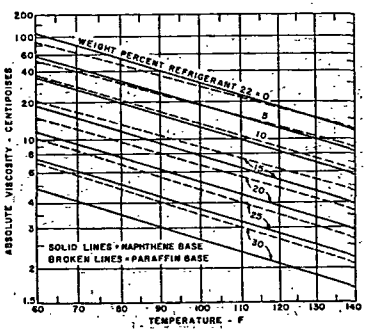
Standard pour test values are significant in the selection of



Combined data from References 9, 13, and 15. Includes naphthene and paraffin base oils in viscosity grades from 150 SUV to 300 SUV.

Fig. 23 .... Solubility of Refrigerant 22 in Refrigeration Oils

oils for ammonia and carbon dioxide systems, or for any other system in which refrigerant and oil are almost totally immiscible. In such a system, any oil which gets into the low side is essentially refrigerant-free, and hence the pour point of the oil itself—in other words, the standard pour point—will de-



Converted from Reference 15.

Fig. 24 .... Viscosity-Temperature Chart for Solutions of Refrigerant 22 in 150 SUV Naphthene and Paraffin Base Oils