Zeotropic (gliding) Refrigerants

Many lower-GWP refrigerants that meet the requirements of F-Gas are zeotropic. Unlike single component refrigerants, such as R-134a or azeotropic refrigerants such as R-507, that evaporate or condense at a constant temperature at a fixed pressure, zeotropic refrigerants are blends that boil or condense over a range of temperatures. This range of temperatures is known as glide.

Although zeotropic refrigerants, such as R-407C and R-407A, have been used at commercial scale for many years in a number of application areas, there are still many engineers and technicians who are unfamiliar with handling them. This guide details a few key points to successfully use these refrigerants in the field. By following this guidance, refrigerants such as R-407A may be used in new or retrofit equipment that typically used R-22 or R-404A without substantial system modifications.

1 Charge from the liquid phase

The composition of the vapour of zeotropic refrigerant blends is different from that of the liquid. To ensure the refrigerant composition is reliable and constant, it should be transferred in the liquid state from the cylinder. Charging from the vapour phase will result in an incorrect composition in the system and the remaining cylinder contents will rapidly go out of specification. If liquid refrigerant cannot be introduced into a system, the required charge mass should be transferred as liquid to an empty intermediate vessel and then the complete content of the intermediate vessel transferred to the system as vapour.

2 Set evaporator and condenser using mid-point

The refrigerant mid-point is the average of the inlet and outlet condition, which may be approximated by the average of the dew and bubble point. If R-404A has an evaporator temperature of -30°C, the same system using R-407A would need the evaporator to be set at a mid-point temperature of -30°C. Values for mid-point temperatures and corresponding pressures can be obtained by averaging the dew and bubble data from tables of physical properties.To set the evaporator or condenser mid-point, decide the operating temperature and look-up the corresponding mid-point pressure. Use mid-point pressure to set the system operating pressure.

3 Determine subcooling and superheat

At any given pressure, the bubble point is the temperature where the liquid is fully saturated and the dew point corresponds to saturated vapour. The right level of evaporator superheat is determined from the dew temperature at the evaporator operating pressure. The correct level of liquid subcooling is determined from the bubble temperature at the condenser operating pressure. For system sizing, obtain the dew (temperature and pressure) at the desired operating mid-point conditions as above and use those dew conditions as input to the compressor sizing and selection process.

1. Bubble Point
2. Evaporator inlet
3. Mid-point
4. Dew-point
5. Superheat
6. Compressor inlet