

# Freezing Point Temperature Measurements of Lower GWP Alternative Mixtures for Ultra-Low Temperature Refrigeration

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The refrigeration industry needs to find alternatives with lower global warming potential (GWP) to the working fluids commonly used in ultra-low temperature (ULT) equipment, i.e., R23 and R508B, characterized by GWP of 14800 and 13400, respectively. In fact, due to environmental regulations and agreements, their availability could decrease in the following years. In this regard, the following mixtures registered in the ASHRAE Standard 34-2022 were specifically proposed for ULT refrigeration: R469A (GWP = 1357), R472A (GWP = 353), and R473A (GWP = 1830). Although an accurate knowledge of their freezing point temperature is essential to define the lowest working temperature, limited experimental solid-liquid equilibrium (SLE) data for the registered mixtures are currently available in the literature.

To compensate for this lack of information, this study presents the SLE measurements of R469A, R472A, and R473A. The measurements were carried out through two experimental setups based on the cooling curve method, already used to measure the triple point temperature and SLE properties of refrigerants and their mixtures, respectively [1,2]. The experimental data were also compared to the predictions obtained by models for the SLE calculation.

## References

1. Tomassetti, S., Di Nicola, G., & Kondou, C. (2022). Triple point measurements for new low-global-warming-potential refrigerants: Hydro-fluoro-olefins, hydro-chloro-fluoro-olefins, and trifluoriodomethane. *International Journal of Refrigeration*, 133, 172-180.
2. Tomassetti, S., Di Nicola, G., Miyoshi, K., Busby, S. R., & Kondou, C. (2022). Solid-liquid equilibria of binary systems containing low global warming potential refrigerants. *International Journal of Refrigeration*, 144, 254-263.