

## Dew-Point/Bubble-Point Measurements for HFC/HFO Refrigerant Mixtures

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In the field of refrigeration and air conditioning, the development and adoption of low-global warming potential (GWP) refrigerants, which do not contribute to global warming, is advancing. Particularly in the air conditioning sector, mixed refrigerants are being adopted in most applications to meet the challenging trade-offs between thermal efficiency and refrigeration capacity, and/or low-GWP and safety. The vapor-liquid equilibrium properties of these mixed refrigerants are especially critical in the development of alternative refrigerants and the equipment utilizing them. The performance of the equipment is significantly influenced by the temperature difference between the dew-point and boiling point. However, the measurement of the vapor-liquid equilibrium properties of mixed refrigerants has been challenging due to the need for elaborate equipment such as circulation methods and gas chromatography, posing issues of time and cost. In this research, a synthetic-method-based vapor-liquid equilibrium measuring device, which is compact and allows for rapid temperature control, has been developed. The results of measurements conducted on existing alternative refrigerants and the evaluation of the device's integrity are reported.