Compressed Liquid, Superheated Vapor and Two-Phase *Pvtx* Measurements for Carbon Dioxide (R744) + Difluoromethane (R32) + 1,1,1,2-Tetrafluoroethane (R134a) Mixture

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Cascade refrigeration systems are frequently used in several refrigeration applications where single-stage or multi-stage systems are not suitable due to the very low evaporation temperatures required. CO_2 is a good solution for the low temperature cycle when the required evaporating temperature is higher than -55°C, that is higher than the triple point of carbon dioxide (216.58 K, 56.57 °C). For lower evaporating temperatures, mixtures formed by CO_2 and refrigerants with lower triple point offer an interesting solution as potential substitutes for the very high GWP refrigerant R23, commonly used at very low temperatures. However, the thermophysical properties of these mixtures are still not well studied.

In this work, compressed liquid, superheated vapor and two-phase *pvTx* measurements for ternary systems containing carbon dioxide (R744), difluoromethane (R32), and 1,1,1,2-tetrafluoroethane (R134a) are presented. Compressed liquid density measurements were performed using a vibrating tube densimeter along various isotherms from (283.15 to 353.15) K with steps of 10 K and for pressures from close to saturation up to 35 MPa. Two-phase and superheated vapor *pvTx* properties were measured with an isochoric apparatus along various isochores at temperatures from (223.15 to 303.15) K. The estimated uncertainties for the measurements is lower than 1 $kg \cdot m^{-3}$ for the liquid density and 0.005 $m^3 \cdot kg^{-1}$ for the vapor specific volume.