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Thermodynamic Properties of Real Moist Air

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The calculation of the thermodynamic properties for moist air as a real gas mixture using the virial equation of state is presented. The investigations include the Hyland and Wexler model (1983) and consider the Nelson and Sauer model (2001). All of the latest NIST standards for the properties of dry air and virial coefficients and formulations of the International Association for the Properties of Water and Steam (IAPWS) for the properties of ice, for sublimation pressure, and for Henry's constant have been incorporated. The range of validity of the proposed model is in pressure from 0.01 kPa to 10 MPa, in temperature from 143.15 to 623.15 K, and in humidity ratio from 0 to 10 kg(water)/kg(dry air). This model deviates only slightly from the Hyland-Wexler and Nelson-Sauer models at ambient pressure, the differences increase with increasing pressure and temperature. The developed algorithms have been implemented in a property library for practical use. In addition to thermodynamic properties and derivatives, backward functions on various sets of independent variables and transport properties can be calculated. The property library can be used for calculating air-conditioning processes, compressed air storage processes and other thermal processes having the working fluid moist air.