Method for calculating the properties of pure substances using critical point theory

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Within the framework of the phenomenological theory of the critical point [1], an equation of state for pure substances in the form of the Helmholtz free energy, F, is proposed. In this case, the Helmholtz free energy structurally includes three components: the first component reflects the behavior of the substance in the regular part of the thermodynamic surface; the second is responsible for the fulfillment of the power laws of the scaling theory in the vicinity of the critical point, which tends to zero in the region of a rarefied gas and is equal to unity at the critical point; the third component is the ideal-gas component of the Helmholtz free energy. All parameters of the singular component are determined using only critical indices and generalized dependencies for the critical amplitudes of the isochoric heat capacity and the saturation line [2,3]. Thus, when determining the parameters of the singular component of the proposed equation of state, there is no need to use experimental information on the substances properties. Thus, the proposed approach can be used to develop equations of state for technically important substances whose thermodynamic properties are poorly understood near the critical point.

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