Equation of state taking into account the features of the critical point

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An equation of state (EOS) was developed based on the Benedek hypothesis [1] and the expression for entropy S:

$$\Delta S = X^{-(1-\alpha)/\chi}\left(\varphi_0 + \varphi_1 m^2 + \varphi_2 X^{-\Delta/\chi} + \varphi_3 X^{-\Delta/\chi} m^2\right), \quad (1)$$

$$X = A\left|\Delta\rho\right|^{-\chi/\beta}\left|x + x_1\right|^{-\chi}, \quad (2)$$

where $\Delta S = \rho_c T_c / p_c \left[S(\rho,T) - S_r(\rho,T)\right]\phi(\rho)$; ρ_c, p_c, T_c are critical parameters; $\phi(\rho)$ and $S_r(\rho,T)$ are regular function; T is the temperature; ρ is the density; α, β, χ and Δ are critical indices; $\Delta\rho = (\rho - \rho_c)/\rho_c$; $x = \tau/\left|\Delta\rho\right|^{1/\beta}$ is the scaling variable; φ_n are constant parameters; $\tau = 1 - T/T_c$.

EOS (1, 2) was tested on the example of argon with pressure to 10000 MPa and temperature to 15000 K. Good agreement with the results of [2] is observed. Thermodynamic tables have been calculated for the pressure, entropy, enthalpy, heat capacity, and speed of sound of R1243zf and R1234ze(E) in the single-phase region and on the saturation line. Comparison with the known thermodynamic tables of these substances is carried out.

[1] Rykov S V and Kudryavtseva I V 2021 *J. Phys.: Conf. Ser.* **2057** 012112

[2] Rykov S V, Rykov V A, Kudryavtseva I V, Ustyuzhanin E E and Sverdlov A V 2020 *Mathematica Montisnigri* **47** 124–136