Thermodynamics of viscoelastic rate-type fluids and its implications for stability analysis

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We introduce a thermodynamic basis for some non-Newtonian fluids, namely we explicitly characterise energy storage and entropy production mechanisms that lead to the frequently used viscoelastic rate-type models such as the Oldroyd-B model, the Giesekus model, the Phan-Thien–Tanner model, the Johnson–Segalman model, the Bautista–Manero–Puig model and their diffusive variants. Knowing the thermodynamical basis of the models, we show how this knowledge can be used in nonlinear (finite amplitude) stability analysis of steady flows of these fluids.