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Fronts in high-temperature laminar jets MARIO SANCHEZ-SANZ, ANTONIO SANCHEZ, Universidad Carlos III de Madrid, AMABLE LINAN, Universidad Politecnica de Madrid — This paper addresses the slender laminar flow resulting from the discharge of a low-Mach-number hot gas jet of radius a and moderately large Reynolds number R_j into a cold atmosphere of the same gas. We give the boundary-layer solution for plane and round jets with very small values of the ambient-to-jet temperature ratio ε accounting for the temperature dependence of the viscosity and conductivity typical of real gases. It is seen that the leading-order description of the jet in the limit $\varepsilon \to 0$ exhibits a front-like structure, including a neatly defined separating boundary at which heat conduction and viscous shear stresses vanish in the first approximation. Separate analyses are given for the jet discharging into a stagnant atmosphere, when the jet boundary is a conductive front, and for the jet discharging into a coflowing stream, when the jet boundary appears as a contact surface. We provide in particular the numerical description of the jet development region corresponding to axial distances of order $R_j a$ for buoyant and non-buoyant jets, as well as the self-similar solutions that emerge both in the near field and in the far field. In all cases considered, the comparisons with the numerical integrations of the boundary-layer problem for moderately small values of ε indicate that these front descriptions give excellent predictions for the temperature and velocity fields in the near-axis region.

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