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Two-Fluid Jets and Wakes

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Analytical solutions for laminar, horizontal, two-fluid jets and wakes are derived in the boundary-layer approximation, using a nonstandard similarity solution *ansatz* to account for interface deflection in the presence of gravity. Planar and axisymmetric fan jets, and classical and momentumless planar wakes, are considered. A statically stable system of lighter fluid 1 residing above heavier fluid 2, taken to be a liquid, is assumed. Velocity profiles for the jets and the classical wake depend on the parameter $\chi = \rho_1\mu_1/\rho_2\mu_2$, where ρ_i and μ_i are the respective fluid densities and viscosities. The momentumless wake profile depends on the parameter $\Omega = \rho_1\mu_2^3/\rho_2\mu_1^3$. All interfaces deflect from horizontal except the fan jet. However, while the interface for the classical planar two-fluid wake is never flat, interfaces for the planar jet and the momentumless wake become flat when $\mu_1 = \mu_2$. Velocity profiles illustrating the strongly asymmetrical jet and wake profiles that arise in air-over-water, oil-over-water, and air-over-oil flows are presented.

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