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Viscoplastic boundary layers DUNCAN HEWITT, University of Cambridge, NEIL BALMFORTH, University of British Columbia, RICHARD CRASTER, Imperial College London — Viscoplastic fluids are characterized by a yield stress, below which they do not deform. If the yield stress is large, viscoplastic flows can can develop narrow boundary layers that provide surfaces of failure between rigid or almost rigid regions, or between such regions and rigid boundaries. Oldroyd (1947) presented a theoretical discussion of these viscoplastic boundary layers, but they have been largely ignored since then, in part because of the complexity of the nonlinear boundary-layer equations. We revisit Oldroyds analysis, and consider various examples of flow, including a jet-like intrusion, flow past a thin plate, and flow down channels with topography. By comparison with detailed numerical solutions, we verify Oldroyds original theory, and also reveal its shortcomings. Where these exist, we present an alternative theory more akin to classical lubrication solutions. We also relate these viscoplastic flow solutions to slipline constructions in classical plasticity theory.

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