Abstract Submitted
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The corrugation instability of a piston-driven shock wave[1] JASON BATES, U.S. Naval Research Laboratory — We investigate the dynamics of a shock wave that is driven into an inviscid fluid by the steady motion of a two-dimensional planar piston with small corrugations on its surface. This problem was first considered by Freeman [Proc. Royal Soc. A. **228**, 341 (1955)], who showed that piston-driven shocks are unconditionally stable when the medium through which they propagate is an ideal gas. Here, we generalize his work to account for a fluid with an arbitrary equation of state. We find that shocks are stable when $-1 < h < h_c$, where h is the D'yakov parameter and h_c is a critical value less than unity. For values of h within this range, linear perturbations imparted to the front at time $t = 0$ attenuate asymptotically as $t^{-3/2}$ or $t^{-1/2}$. Outside of this range, they grow — at first quadratically and later linearly — with time. Such instabilities are associated with non-equilibrium fluid states and imply a non-unique solution to the hydrodynamic equations. These results may have important implications for driven shocks in laser-fusion and astrophysical environments. As a benchmark of this analysis, we compare our solution with one derived independently by Zaidel' [J. Appl. Math. Mech. **24**, 316 (1960)] for stable h-values and find excellent agreement.

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