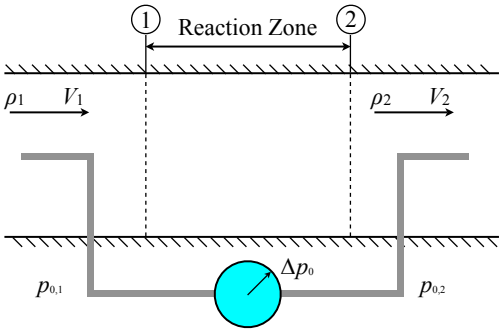
MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 5.09
This problem is from "Advanced Fluid Mechanics Problems" by A.H. Shapiro and A.A. Sonin



The sketch shows a liquid emulsion (a finely-divided mixture of two liquids) of mean density ρ_1 entering a reaction zone of a constant-area reactor with speed V_1. The components of the emulsion react chemically, and leave the reaction zone as a liquid at the density ρ_2. Pitot tubes are installed upstream of the reaction zone. (Pressure inside a pitot tube is stagnation pressure, $p_0 = p + \frac{1}{2}\rho V^2$).

It is agreed to assume that the flow is inviscid, steady and one-dimensional, that the original emulsion is incompressible, and that the liquid leaving the reaction zone is incompressible.

Calculate the value of $(p_{0,1} - p_{0,2})/(\frac{1}{2}\rho_1 V_1^2)$ in terms of the density ratio ρ_2/ρ_1.

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