

# FLUENT - Sudden Expansion

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## Problem Specification

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## Sudden Expansion in Laminar Pipe Flow

### Problem Statement



Consider a fluid flow through a sudden expansion in an axisymmetric pipe. The flow is laminar and axisymmetric. Due to symmetry, the computational domain covers only half of the pipe.  $BD$  is the axis of symmetry. The radius  $R_1 = 1 \text{ m}$  and  $R_2/R_1 = 2$ .

$L_1/R_1 = 20$  and  $L_2/R_2 = 50$ . The inlet velocity at  $AB$  is uniform,  $U_1 = 0.277 \text{ m/s}$ . The fluid exhausts into the ambient atmosphere which is at a pressure of 1 atm at  $CD$ . The density  $= 1 \text{ kg/m}^3$ , and the dynamic viscosity is:  $\mu = 0.01 \text{ kg/(ms)}$ .

The Reynolds number  $Re$  at  $AB = (2 R_1 U_1) / \mu = 55.4$ .

This  $Re$  value is selected to match one of the experimental cases in the paper by Hammad et al. (1999).

Use FLUENT via ANSYS Workbench to predict the flow and validate your results by comparing them with those in the following journal papers:

1. Macagno, E. and Hung, T-K. "Computational and experimental study of a captive annular eddy", **J. Fluid Mech.** vol. 28 (1967) pp. 43-64.
2. Hammad, KJ, Otugun, MV and Arik, EB "A PIV study of the laminar axisymmetric sudden expansion flow", **Experiments in Fluids** 26 (1999) pp. 266-272.

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