Version 1.0
jproth@mit.edu

Viscoelastic Flows in Abrupt Contraction-Expansions

III. Test Geometry

Figure 1 shows a schematic diagram of the abrupt axisymmetric contraction-expansion used in all of our experiments. The apparatus is modular and has been designed to permit us to study different contraction ratios and lip curvatures. The origin is defined to be at the centerline of the *inlet* to the throat as shown on Figure 1. The radius of curvature of the lip is denoted R_c. Table 1 lists the physical values of all the length scales shown in Figure 1. In general we report our results in terms of dimensionless lengths scaled with the small tube radius, R_2. The contraction ratio is denoted $\beta = R_1 / R_2$. Table 2 lists the experimental configurations for which pressure drop measurements, Laser Doppler Velocimetry (LDV) measurements, Digital Particle Image Velocimetry (DPIV) and vortex growth dynamics (*ie*. measurements of R_v, Z_v and L_v) measurements have been performed. For a copy

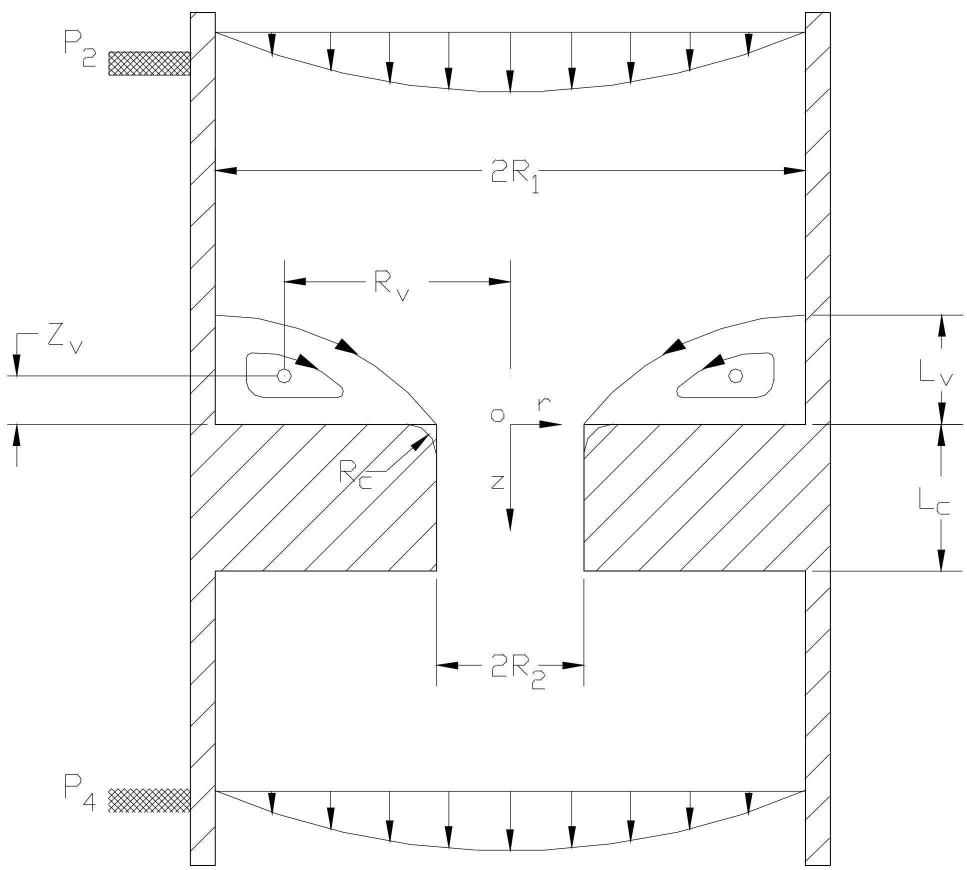

Figure 1: Schematic diagram of the axisymmetric contraction-expansion geometry and definition of relevant length scales

of any or all of these data sets please contact Jonathan Rothstein by email at jproth@mit.edu.

	Parameter	**Length [cm]**	**Dimensionless Length**
2:1:2 Contraction-Expansion	L_c	0.3175	$L_c / R_2 = 0.5$
	R_1	1.2700	$R_1 / R_2 = 2.0$
	R_2	0.6350	
4:1:4 Contraction-Expansion	L_c	0.3175	$L_c / R_2 = 1.0$
	R_1	1.2700	$R_1 / R_2 = 4.0$
	R_2	0.3175	
8:1:8 Contraction-Expansion	L_c	0.3175	$L_c / R_2 = 2.0$
	R_1	1.2700	$R_1 / R_2 = 8.0$
	R_2	0.1588	

Table 1: Physical values of contraction-expansion lengths for abrupt contractions.

Radius of Curvature for the Re-entrant Corner	**2:1:2**	**4:1:4**	**8:1:8**
$R_c / R_2 < 0.025$ **('Sharp')**	✓	✓	✓
$R_c / R_2 = 0.50$ **(Upstream Only)**		✓	
$R_c / R_2 = 0.10$ **(Upstream and Downstream)**		✓	
$R_c / R_2 < 0.18$ **(Upstream and Downstream)**			✓

Table 2: Lip curvatures for which measurements have been taken.

Although we nominally report the contraction-expansion as "sharp", for any real experimental apparatus there is a finite radius of curvature. This can have a significant impact on the measured pressure drop at fixed flow rates. Although this is difficult to quantify exactly the radius of curvature of these experiments is no larger than 4×10^{-3} cm. We have also investigated the role of the re-entrant lip curvature directly by systematically smoothing the corner. We have focused on the 4:1:4 contraction-expansion and have data for the ratios shown in Table 2. We also have some limited data for 8:1:8 contraction-expansion.