

Table 6.1 Recommended Roughness Values for Commercial Ducts

Material	Condition	ϵ		Uncertainty, %
		ft	mm	
Steel	Sheet metal, new	0.00016	0.05	±60
	Stainless, new	0.000007	0.002	±50
	Commercial, new	0.00015	0.046	±30
	Riveted	0.01	3.0	±70
	Rusted	0.007	2.0	±50
Iron	Cast, new	0.00085	0.26	±50
	Wrought, new	0.00015	0.046	±20
	Galvanized, new	0.0005	0.15	±40
	Asphalted cast	0.0004	0.12	±50
Brass	Drawn, new	0.000007	0.002	±50
Plastic	Drawn tubing	0.000005	0.0015	±60
Glass	—	Smooth	Smooth	
Concrete	Smoothed	0.00013	0.04	±60
	Rough	0.007	2.0	±50
Rubber	Smoothed	0.000033	0.01	±60
Wood	Stave	0.0016	0.5	±40

Table 6.5 Resistance Coefficients
 $K = h_m/[V^2/(2g)]$ for Open Valves, Elbows, and Tees

	Nominal diameter, in									
	$\frac{1}{2}$	Screwed				Flanged				
		1	2	4	1	2	4	8	20	
Valves (fully open):										
Globe	14	8.2	6.9	5.7	13	8.5	6.0	5.8	5.5	
Gate	0.30	0.24	0.16	0.11	0.80	0.35	0.16	0.07	0.03	
Swing check	5.1	2.9	2.1	2.0	2.0	2.0	2.0	2.0	2.0	
Angle	9.0	4.7	2.0	1.0	4.5	2.4	2.0	2.0	2.0	
Elbows:										
45° regular	0.39	0.32	0.30	0.29						
45° long radius					0.21	0.20	0.19	0.16	0.14	
90° regular	2.0	1.5	0.95	0.64	0.50	0.39	0.30	0.26	0.21	
90° long radius	1.0	0.72	0.41	0.23	0.40	0.30	0.19	0.15	0.10	
180° regular	2.0	1.5	0.95	0.64	0.41	0.35	0.30	0.25	0.20	
180° long radius					0.40	0.30	0.21	0.15	0.10	
Tees:										
Line flow	0.90	0.90	0.90	0.90	0.24	0.19	0.14	0.10	0.07	
Branch flow	2.4	1.8	1.4	1.1	1.0	0.80	0.64	0.58	0.41	

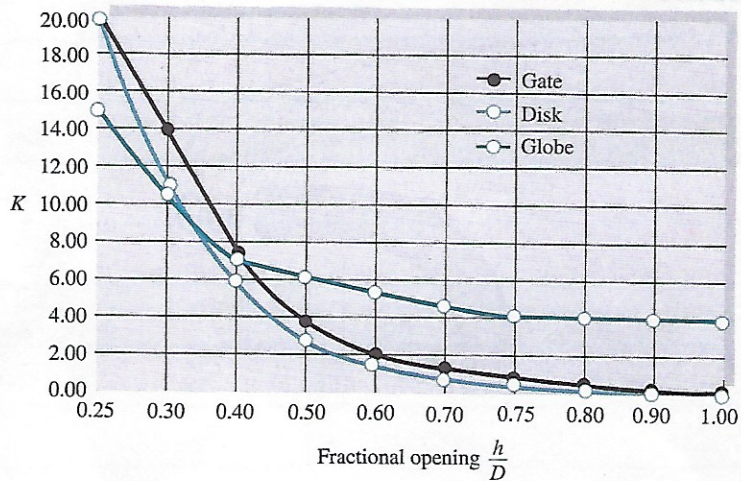


Fig. 6.18b Average loss coefficients for partially open valves (see sketches in Fig. 6.17).

Fig. 6.21 Entrance and exit loss coefficients: (a) reentrant inlets; (b) rounded and beveled inlets. Exit losses are $K \approx 1.0$ for all shapes of exit (reentrant, sharp, beveled, or rounded).

Source: From ASHRAE Handbook-2012 Fundamentals, ASHRAE, Atlanta, GA, 2012.

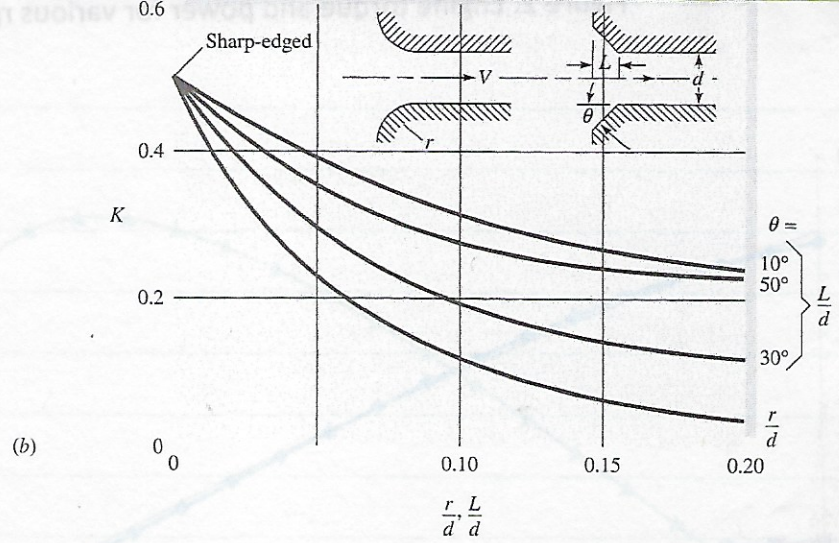


Fig. 6.22 Sudden expansion and contraction losses. Note that the loss is based on velocity head in the small pipe.

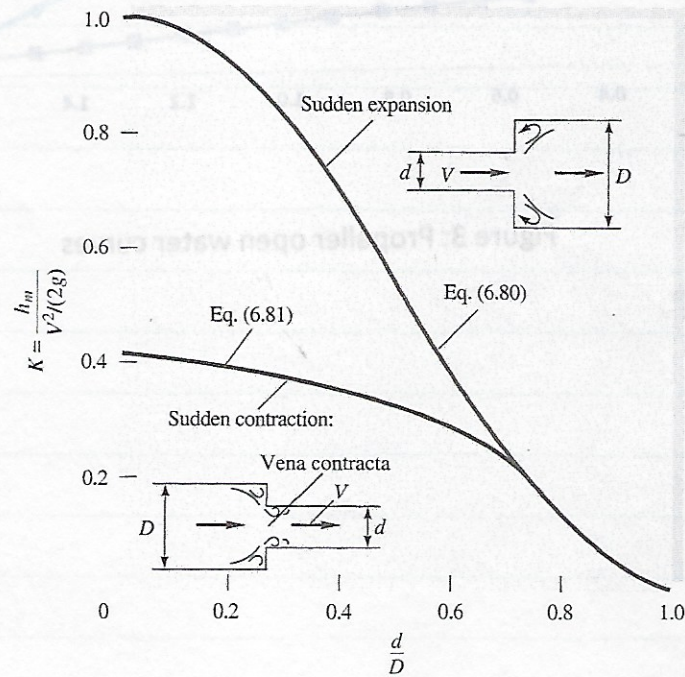


Fig. 6.23 Flow losses in a gradual conical expansion region, as calculated from Gibson's suggestion [15, 50], Eq. (6.79), for a smooth wall.

