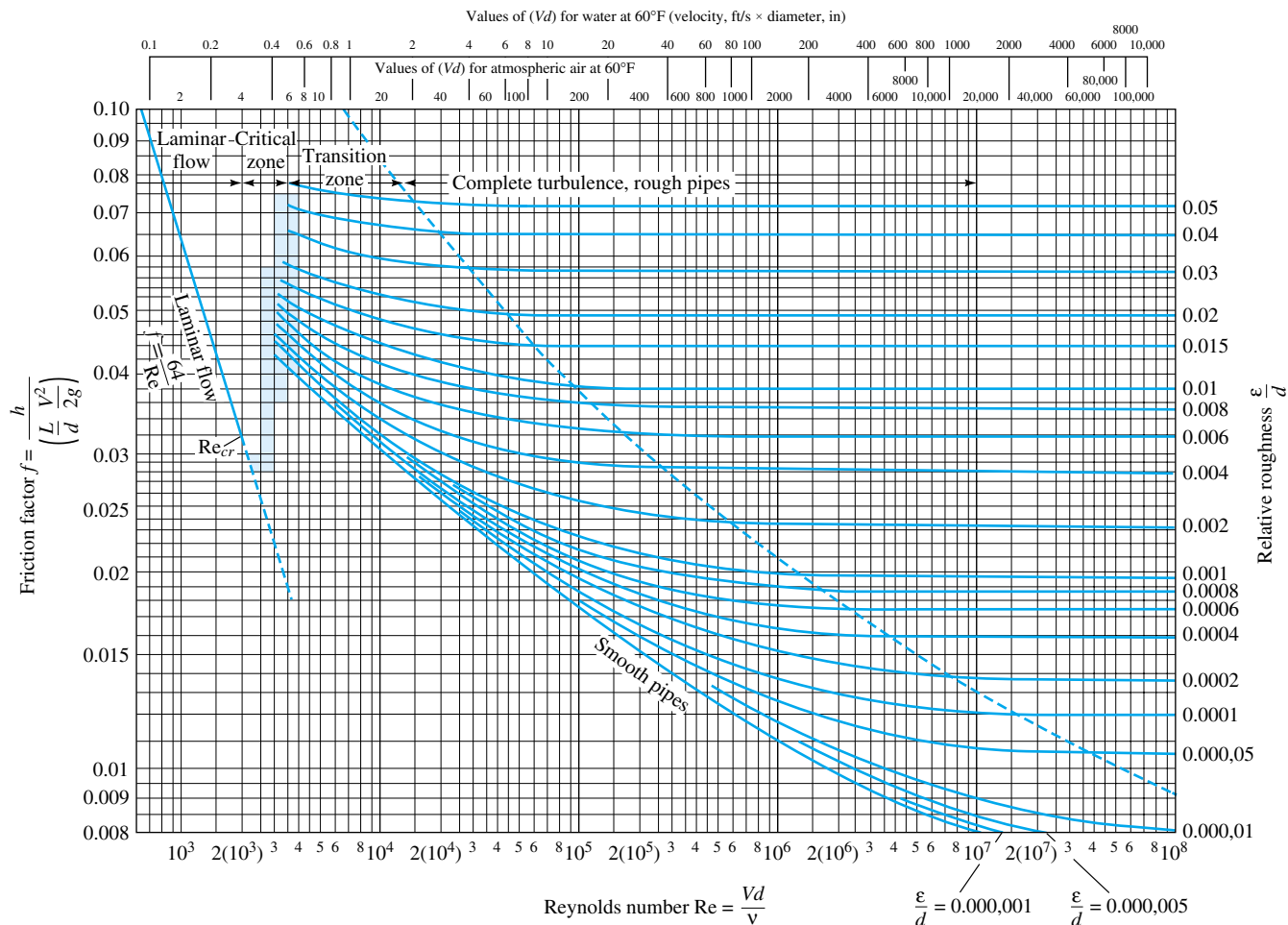


FIGURE 6-4 Moody diagram.



**Fig. 6.13** The Moody chart for pipe friction with smooth and rough walls. This chart is identical to Eq. (6.64) for turbulent flow. (From Ref. 8, by permission of the ASME.)

**Table 6.1** Recommended Roughness Values for Commercial Ducts

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