Viscous losses in pipes

The most basic data set that is needed by the fluids engineer is knowledge of the loss coefficients for a straight, cylindrical pipe. In this instance, the loss coefficient will clearly be proportional to the length of the pipe and therefore we need to define a loss coefficient per unit length or K/L where L is the pipe length. But in order to keep the quantity dimensionless we need to multiply this by a length and the obvious choice is the pipe diameter, d. The resulting loss coefficient is called the **friction factor**, f, which is therefore defined by

$$f = \frac{Kd}{L} = \frac{2gd\Delta H}{U^2L} \qquad \text{(Bfc1)}$$

where U is the volume averaged fluid velocity equal to the volume flow rate divided by the internal cross-sectional area of the pipe. The friction factor is a function of the Reynolds number of the flow in the pipe, $Re = Ud/\nu$ where ν is the kinematic viscosity of the fluid. In addition, f depends on the nature of the flow in the pipe, whether it is laminar or turbulent; we shall discuss this at length on a different page. The friction factor also depends on the roughness of the interior surface of the pipe and this will also be addressed in a separate page. All of this information is contained in a chart known as a **Moody diagram** whose content will be addressed on other pages. For the present we simply include the classic Moody diagram as Figure 1 in which the friction factor, f, is plotted against the pipe Reynolds number, Re.

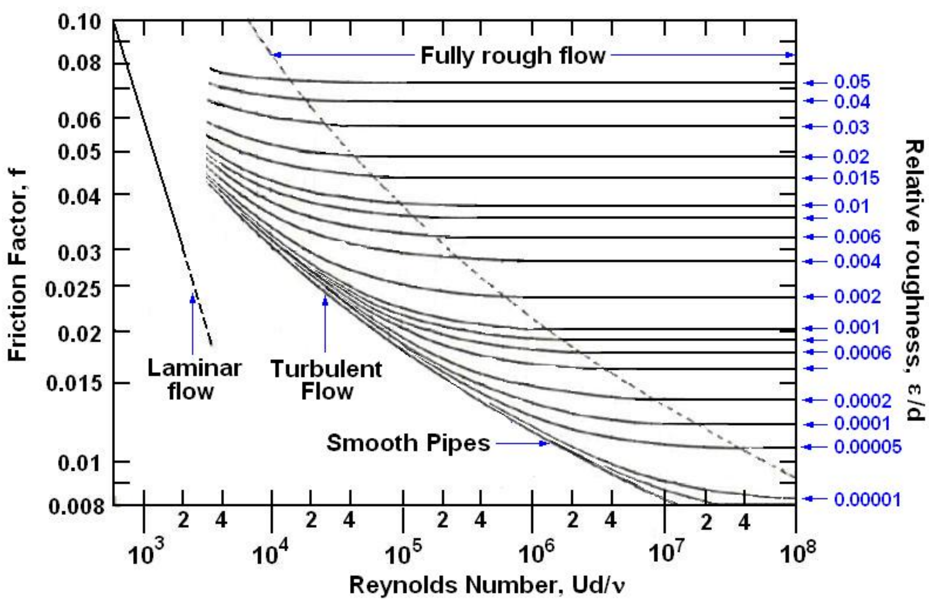

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Figure 1: Moody diagram for the pipe friction factor as a function of the pipe Reynolds number.