

Fanning Friction Factor for Turbulent Flow through Circular Pipes

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Some commonly used equations for calculating the Fanning friction factor f for turbulent flow in rough pipes are listed below.

Colebrook Equation

$$\frac{1}{\sqrt{f}} = -4.0 \log_{10} \left[\frac{\varepsilon/D}{3.7} + \frac{1.26}{\text{Re}\sqrt{f}} \right]$$

Zigrang-Sylvester Equation

$$\frac{1}{\sqrt{f}} = -4.0 \log_{10} \left[\frac{\varepsilon/D}{3.7} - \frac{5.02}{\text{Re}} \log_{10} \left(\frac{\varepsilon/D}{3.7} + \frac{13}{\text{Re}} \right) \right]$$

In these equations, Re is the Reynolds number and (ε/D) is the relative roughness. The textbook by Welty et al. lists the Haaland Equation as an alternative to the Colebrook Equation for explicit calculation of the friction factor when the Reynolds number and the relative roughness are specified. It is given below.

Haaland Equation

$$\frac{1}{\sqrt{f}} = -3.6 \log_{10} \left[\frac{6.9}{\text{Re}} + \left(\frac{\varepsilon/D}{3.7} \right)^{10/9} \right]$$

The Zigrang-Sylvester Equation, which also permits explicit calculation of the friction factor when the Reynolds number and the relative roughness are specified, performs somewhat better than the Haaland Equation in approximating the Colebrook result over a wide range of values of both the Reynolds number and the relative roughness. Therefore it is recommended for your use when such explicit calculation is desired.