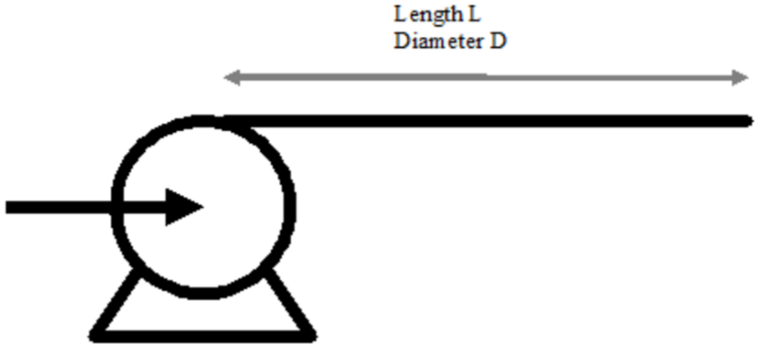
BOMBAS CENTRÍFUGAS



Viscocidad Dinámica del agua

$\mu := 1 \cdot 10^{-3}\ \mathrm{Pa\ s}$

Densidad del Agua

$\rho := 1000\ \frac{\mathrm{kg}}{\mathrm{m}^3}$

Diámetro de la Tubería

$D := 2.5\ \mathrm{in}$

Rugosidad de la Tubería

$\varepsilon := 0.005$

Longitud de Tubería

$L := 1500\ \mathrm{ft}$

Constante Gravitacional

$g_e = 9.8066\ \frac{\mathrm{m}}{\mathrm{s}^2}$

$$Q(V) := \frac{\pi \cdot D^2}{4} \cdot V$$

$$H(V) := 20\ \mathrm{ft} - 5 \cdot 10^{-3} \cdot \frac{\mathrm{ft}}{\left(\mathrm{gal\ min}^{-1}\right)^2} \cdot Q(V)^2$$

$$Rn(V) := \frac{D \cdot V \cdot \rho}{\mu}$$

Use your own numerical root procedure

NR,1 Simple and fast 1D Newton Raphson.

```
NR_1(f, a) := | [ x := a   h := NR_h · UnitsOf(a) ]
              | f(x) := | str2num(concat(num2str(f), "(", num2str(x), ")"))
              | for iter ∈ [1..NR_N]
              |    | t := eval( x - h/(f(x+h) - f(x)) · f(x) )
              |    | if |t - x| < h
              |    |    break
              |    | else
              |    |    x := t
              | t
```

$NR_N := 25$

$NR_h := 10^{-7}$

This trick is because SMath procedures can't call another SMath procedure having f(1) as argument.

$$eq_f(f_{tur}) := 1 + 2 \cdot \sqrt{f_{tur}} \cdot \log_{10}\left(\frac{\varepsilon}{3.7} + \frac{2.51}{Rn(V) \cdot \sqrt{f_{tur}}}\right)$$

Rewrite the equation for get more stable numerical values.

$$f_{tur}(V) := NR_1(eq_f, 0.1)$$

$$f_{lam}(V) := \frac{64}{Rn(V)}$$

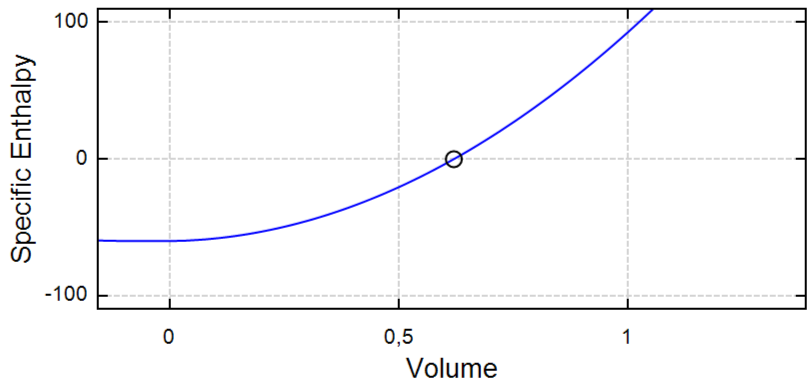
$$f_f(V) := \begin{cases} \text{if } Rn(V) > 2300 \\ \quad f_{tur}(V) \\ \text{else} \\ \quad f_{lam}(V) \end{cases}$$

$$eqV(V) := f_f(V) \cdot \frac{L}{D} \cdot \frac{V^2}{2} - g_e \cdot H(V)$$

$$Vo := NR_1\left(eqV, 1\ \frac{m}{s}\right) = 0.6209\ \frac{m}{s}$$

$$f_f(Vo) = 0.0326$$

$$Rn(Vo) = 39426.2061$$



$$\begin{cases} eqV\left(x\ \frac{m}{s}\right) \\ \text{augment}\left(Vo, eqV(Vo), \text{"o"}\right) \end{cases}$$