Continuity

Mechanical Engineering

Mass in equals mass out, and what that does to velocity in a pipe.

Mass entering a control volume equals mass leaving it, so a narrower section means a faster flow.

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2 \cdot \text{incompressible: } A_1 V_1 = A_2 V_2$$

Area halves Incompressible flow.	**Velocity doubles**
Diameter halves Area goes as d^2.	**Velocity times four**
$Q = 0.02\ m^3/s$, $A = 0.01$ $V = Q \div A$.	**$V = 2\ m/s$**

THE COMMON MISTAKE

× Halving diameter to halve the area

✓ Area goes as diameter squared

Halving a pipe diameter quarters the area, quadruples the velocity, and raises the friction loss by roughly thirty times.

Steady flow assumed. Compressible flow keeps the density term and you cannot cancel it out.