# Pipe Pressure Drop (Darcy–Weisbach)

Pressure drop and head loss in a pipe or round duct by Darcy–Weisbach with the Colebrook friction factor, including fittings, with velocity and Reynolds number.

**Method:** Darcy–Weisbach equation; Colebrook (1939); ...

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Volume flow | 50.000 | m³/h |
| Pipe inside diameter | 102.30 | mm |
| Pipe length | 100.00 | m |
| Absolute roughness of the pipe wall<br>Commercial steel 0.045 mm; drawn tubing 0.0015 mm; galvanised steel 0.15 mm; cast iron 0.26 mm; concrete 0.3–3 mm (Moody 1944). | 0.045000 | mm |
| Fluid density | 998.20 | kg/m³ |
| Dynamic viscosity | 1.0020 | cP |
| Sum of fitting loss coefficients (0 = straight pipe only)<br>Add the K of each bend, valve, entry and exit; for example 90° long-radius bend 0.2–0.3, gate valve open 0.15, globe valve 6–10, exit 1. | 0 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Total pressure drop | 26.178 | kPa |
| Head loss | 2.6742 | m |
| Friction in straight pipe | 26.178 | kPa |
| Velocity | 1.6898 | m/s |
| Reynolds number | 172,207 | |
| Darcy friction factor | 0.018792 | |
| Relative roughness | 4.3988e-04 | |

## Formula and method

$$\Delta p = \left( f \frac{L}{D} + \Sigma K \right) \frac{\rho v^2}{2} \qquad v = \frac{4Q}{\pi D^2} \qquad Re = \frac{\rho v D}{\mu} \qquad h_L = \frac{\Delta p}{\rho g}$$

$$f = \frac{64}{Re} \quad (Re < 2300) \qquad \frac{1}{\sqrt{f}} = -2 \log_{10} \left( \frac{\varepsilon / D}{3.7} + \frac{2.51}{Re \sqrt{f}} \right) \quad (Re \geq 2300)$$

### Variables

| | | |
|---|---|---|
| $Q$ | volume flow | m³/s |
| $D$ | pipe inside diameter | m |
| $L$ | pipe length | m |
| $\varepsilon$ | absolute roughness of the wall | m |
| $\rho$ | fluid density | kg/m³ |
| $\mu$ | dynamic viscosity | Pa·s |
| $\Sigma K$ | sum of fitting loss coefficients | – |
| $\Delta p$ | total pressure drop | Pa |

| | | |
|---|---|---|
| $h_L$ | head loss | m |
| $\Delta p_f$ | friction in straight pipe | Pa |
| $\Delta p_K$ | loss in fittings | Pa |
| $v$ | mean velocity | m/s |
| $Re$ | Reynolds number | – |
| $f$ | Darcy friction factor | – |
| $\varepsilon/D$ | relative roughness | – |
| $g$ | standard gravity, 9.806 65 | m/s² |

### Method and standards

Darcy–Weisbach equation with the Darcy friction factor from the Colebrook–White equation (C.F. Colebrook, 1939), the basis of the Moody chart (L.F. Moody, 1944), solved by iteration to full precision; laminar flow uses the exact 64/Re. Roughness values in the help text are Moody's.

### Assumptions and limits

- Incompressible, isothermal, fully developed flow in a full circular pipe. For gases it holds while the drop is under about 10 % of the absolute pressure.
- Between Re 2 300 and 4 000 the flow is in transition; the turbulent value is shown and is conservative.
- No static head: add ρ·g·Δz for a change of elevation.
- For a rectangular duct use its equivalent diameter.

### References

- Darcy–Weisbach equation
- Colebrook (1939)
- Moody (1944)

## Report details

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|---|---|
| Report reference | FCC-T7QT-8B3K (the same inputs always give the same reference) |
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| Calculator | Pipe Pressure Drop (Darcy–Weisbach) |
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| Release checks | 4 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/mechanical/fluid-mechanics/pipe-pressure-drop

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.