Fuel Gas Pipe Pressure Drop (Isothermal)

Outlet pressure and pressure drop of a natural gas or fuel gas line by the isothermal compressible-flow equation with the Colebrook friction factor.

Method: Isothermal compressible flow in pipes (Darcy–Weisbach form); Colebrook–White friction factor

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas flow at normal conditions	1,000.0	Nm³/h
Molar mass of the gas About 16–18.5 kg/kmol for natural gas; from the gas analysis.	17.400	kg/kmol
Gas dynamic viscosity	1.1000e-05	Pa·s
Inlet pressure (absolute)	4.0000	bar
Gas temperature	20.000	°C
Pipe inside diameter	102.30	mm
Pipe length (with fittings as equivalent length)	500.00	m
Pipe roughness	0.046000	mm

Calculated results

Parameter	Value	Unit
Outlet pressure (absolute)	3.8911	bar
Pressure drop	10.889	kPa
Inlet velocity	9.1876	m/s
Outlet velocity	9.4447	m/s
Reynolds number	243,989	
Darcy friction factor	0.018223	

Formula and method

$$G = \frac{\dot{V}_n \rho_n}{\pi D^2/4} \qquad Re = \frac{G\,D}{\mu} \qquad f = f_{Colebrook}(Re, \varepsilon/D)$$

$$p_1^2 - p_2^2 = \frac{G^2\,R\,T}{M}\left(\frac{f\,L}{D} + 2\ln\frac{p_1}{p_2}\right) \qquad v_1 = \frac{G}{\rho_1} \qquad v_2 = \frac{G}{\rho_2}$$

Variables

$\dot{V}_n$	gas flow at normal conditions	Nm³/s
M	molar mass of the gas	kg/kmol
μ	dynamic viscosity	Pa·s
p_1	inlet pressure, absolute	Pa
T	gas temperature	K
D	pipe inside diameter	m
L	pipe length with equivalent length of fittings	m
ε	pipe roughness	m
p_2	outlet pressure, absolute	Pa
Δp	pressure drop	Pa

v_1	inlet velocity	m/s
v_2	outlet velocity	m/s
ρ_2	density at outlet conditions	kg/m³
Re	Reynolds number	–
f	Darcy friction factor	–
G	mass flux	kg/(m²·s)
$\rho_n\$, \$\rho_1$	density at normal and at inlet conditions	kg/m³
R	universal gas constant	J/(kmol·K)

Method and standards

Steady isothermal flow of an ideal gas in a constant-area pipe with the Darcy friction factor from the Colebrook–White equation (FireCAD Friction); the outlet pressure is found by bracketed root solving.

Assumptions and limits

- Isothermal ideal gas (Z = 1); horizontal pipe; flow below choking. Above about 10 bar natural gas departs from Z = 1 and a warning appears.
- The friction factor uses Colebrook in the 2300–4000 transition range (conservative).
- Normal volumes are at 0 °C and 101.325 kPa; scfm is converted to the US standard cubic foot (60 °F, 14.696 psia).
- Isothermal flow chokes when the outlet pressure falls to $G\sqrt{RT/M}$ (velocity $\sqrt{RT/M}$); if the equation has no solution above that pressure, the line is reported as choked.

References

- Isothermal compressible flow in pipes (Darcy–Weisbach form)
- Colebrook–White friction factor

Report details

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Release checks	3 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/boilers-power-plant/combustion/gas-pipe-pressure-drop

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Reopens the calculator with the inputs of this report.