Economic (Optimum) Pipe Diameter for Liquids and Gases

Economic (optimum) pipe diameter for turbulent flow from carbon steel and stainless steel cost equations, with the resulting velocity and Reynolds number.

Input parameters

Unit system: SI

Parameter	Value	Unit
Mass flow	6.9444	kg/s
Fluid density	820.00	kg/m³
Fluid viscosity (for the flow check)	2.0000	mPa·s
Method	Carbon steel cost equation	

Calculated results

Parameter	Value	Unit
Optimum inside diameter	68.364	mm
Volume flow	30.488	m³/h
Velocity at the optimum diameter	2.3072	m/s
Reynolds number	64,669	

Notes for this case

- Choose the nearest standard pipe size. The equations reflect typical installed pipe and power costs and are valid for turbulent flow; do not use them for steam or two-phase lines.

Formula and method

$$d_{opt} = 293\,G^{0.53}\rho^{-0.37}\ \text{mm (carbon steel)},\quad d_{opt} = 260\,G^{0.52}\rho^{-0.37}\ \text{mm (stainless)}$$

$$D_{opt} = 0.363\,Q^{0.45}\rho^{0.13}\ \text{m (alternative form, } Q \text{ in m}\geq/\text{s)}$$

Variables

G	Mass flow	kg/s
ρ	Fluid density	kg/m³
μ	Fluid viscosity (for the flow check)	Pa·s
method	Method	-
d_{opt}	Optimum inside diameter	m
Q	Volume flow	m³/s
u	Velocity at the optimum diameter	m/s
Re	Reynolds number	-

Method and standards

Empirical optimum-diameter equations balancing pipe cost against pumping cost.

Assumptions and limits

- Turbulent flow; typical cost ratios built into the constants.

Report details

Report reference	FCC-71DX-C066 (the same inputs always give the same reference)
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Calculator	Economic (Optimum) Pipe Diameter for Liquids and Gases
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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/piping/economic-pipe-diameter

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.