Hoop and Longitudinal Stress in a Thin Cylinder (Barlow)

Hoop and longitudinal stress in a thin-walled pipe or cylinder under internal pressure, by Barlow's formula and the mean-diameter formula, with the pressure for a stress.

Method: Barlow's formula; Thin-wall cylinder theory

Input parameters

Unit system: SI

Parameter	Value	Unit
Internal pressure (above the outside pressure)	10.000	bar
Outside diameter	168.30	mm
Wall thickness	7.1100	mm
Stress to check against (0 = none)	0	MPa

Calculated results

Parameter	Value	Unit
Hoop stress, Barlow (on outside diameter)	11.835	MPa
Hoop stress on mean diameter	11.335	MPa
Longitudinal stress (closed ends)	5.6677	MPa

Notes for this case

- Not a code wall-thickness calculation: design codes add joint efficiency, corrosion allowance, mill tolerance and other factors.

Formula and method

$$\sigma_h = \frac{pD_o}{2t}$$

$$\sigma_{h,m} = \frac{p(D_o - t)}{2t}, \quad \sigma_l = \frac{p(D_o - t)}{4t}$$

$$p_S = \frac{2St}{D_o}$$

Variables

p	internal pressure above the outside	Pa
D_o	outside diameter	m
t	wall thickness	m
S	stress to check against	Pa
σ_h	hoop stress, Barlow	Pa
$\sigma_{h,m}$	hoop stress on mean diameter	Pa
σ_l	longitudinal stress	Pa
p_S	pressure giving the stress S	Pa

Method and standards

Equilibrium of half a thin ring gives the hoop stress; Barlow's form uses the outside diameter and is slightly conservative. The longitudinal stress in a closed-ended cylinder is half the hoop stress.

Assumptions and limits

- Thin wall (D/t above about 20), uniform internal pressure.
- No corrosion allowance, tolerance or weld efficiency.

References

- Barlow's formula
- Thin-wall cylinder theory

Report details

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

This calculator online

https://calc.firecad.com/mechanical/strength-of-materials/thin-cylinder-hoop-stress

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.