Pipe Support Span from Stress and Sag

Largest span between supports of a horizontal pipe full of liquid, from its weight, an allowed bending stress and an allowed sag, treated as a beam.

Method: Beam theory for uniform load (simply supported and fixed-end); Allowed stress and sag set by the designer

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe outside diameter	168.30	mm
Wall thickness (less corrosion allowance if you wish)	7.1100	mm
Pipe material density	7,850.0	kg/m³
Contents density (0 for gas)	1,000.0	kg/m³
Insulation, cladding and other weight per length	100.00	N/m
Modulus of elasticity	200.00	GPa
Allowed bending stress from weight (your design value)	40.000	MPa
Allowed sag at mid-span	2.5000	mm
Treat the span as	Simply supported (wL²/8, 5wL⁴/384EI)	

Calculated results

Parameter	Value	Unit
Total weight per length	560.02	N/m
Second moment of area of the pipe	1,171.6	cm⁴
Section modulus of the pipe	139.23	cm³
Span limited by stress	8.9195	m
Span limited by sag	5.3239	m
Largest span (the smaller of the two)	5.3239	m

Notes for this case

- Straight run with uniform weight only; valves, flanges, bends and vertical runs need shorter spans. Code span tables, where your code has them, govern.

Formula and method

$$w = g\left[\rho_p \frac{\pi}{4}(D_o^2 - d_i^2) + \rho_f \frac{\pi}{4} d_i^2\right] + w_x$$

$$L_s = \sqrt{\frac{k_m Z S_b}{w}}, \quad L_d = \left(\frac{k_d E I y}{w}\right)^{1/4}, \quad L = \min(L_s, L_d)$$

$$k_m = 8,\ k_d = 384/5 \ \text{(simply supported)}; \quad k_m = 12,\ k_d = 384 \ \text{(fixed)}$$

Variables

D_o	Pipe outside diameter	m
t	Wall thickness (less corrosion allowance if you wish)	m
ρ_p	Pipe material density	kg/m³
ρ_f	Contents density (0 for gas)	kg/m³
w_x	Insulation, cladding and other weight per length	N/m

E	Modulus of elasticity	Pa
S_b	Allowed bending stress from weight (your design value)	Pa
y	Allowed sag at mid-span	m
ends	Treat the span as	-
w	Total weight per length	N/m
I	Second moment of area of the pipe	m^4
Z	Section modulus of the pipe	m^3
L_s	Span limited by stress	m
L_d	Span limited by sag	m
L	Largest span (the smaller of the two)	m
d_i	Pipe inside diameter	m
g	Standard gravity	m/s^2
k_m, k_d	Beam coefficients for moment and sag	-

Method and standards

The pipe is a uniformly loaded beam; the span is the smaller of the one that reaches the allowed bending stress and the one that reaches the allowed mid-span sag.

Assumptions and limits

- Straight horizontal run, uniform weight.
- Weight only: no wind, seismic or thermal loads.
- A real continuous pipe lies between the simply supported and fixed-end cases; simply supported is the safe side. Concentrated loads (valves, flanges) are not included.

References

- Beam theory for uniform load (simply supported and fixed-end)
- Allowed stress and sag set by the designer

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

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Reopens the calculator with the inputs of this report.