Interference (Press) Fit Pressure and Holding Torque

Contact pressure of an interference fit between a hub and a hollow or solid shaft by the Lamé equations, with the hoop stresses, press force and torque capacity.

Method: Shigley's Mechanical Engineering Design (Budynas and Nisbett); ch. 2–3 (press and shrink fits, Lamé thick cylinders)

Input parameters

Unit system: SI

Parameter	Value	Unit
Diametral interference	40.000	µm
Nominal fit diameter	50.000	mm
Hub outside diameter	100.00	mm
Shaft bore (0 for solid)	0	mm
Modulus (hub and shaft)	207.00	GPa
Poisson's ratio	0.30000	
Length of the fit	60.000	mm
Coefficient of friction	0.12000	

Calculated results

Parameter	Value	Unit
Contact pressure	62.100	MPa
Hoop stress at the hub bore	103.50	MPa
Hoop stress at the shaft surface	-62.100	MPa
Torque the fit can carry π f p d² l / 2	1,755.8	N·m
Axial press-in force π f p d l	70.233	kN

Notes for this case

- Same material for hub and shaft; the shaft hoop stress is compressive.

Formula and method

$$p = \frac{\delta}{d\left[\frac{1}{E}\left(\frac{d_o^2+d^2}{d_o^2-d^2}+\nu\right)+\frac{1}{E}\left(\frac{d^2+d_i^2}{d^2-d_i^2}-\nu\right)\right]}$$

$$T = \frac{\pi f p d^2 l}{2}$$

Variables

δ	Diametral interference	m
d	Nominal fit diameter	m
d_o	Hub outside diameter	m
d_i	Shaft bore (0 for solid)	m
E	Modulus (hub and shaft)	Pa
ν	Poisson's ratio	-
l	Length of the fit	m
f	Coefficient of friction	-

p	Contact pressure	Pa
$\sigma_{t,o}$	Hoop stress at the hub bore	Pa
$\sigma_{t,i}$	Hoop stress at the shaft surface	Pa
T	Torque the fit can carry π f p d² l / 2	N·m
F_a	Axial press-in force π f p d l	N

Method and standards

Lamé thick-cylinder solution at the common surface.

Assumptions and limits

- Same material, elastic, long hub.
- No yield check of the hub bore (combined hoop and radial stress), no allowance for surface smoothing (loss of interference on pressing), and hub and shaft of different materials are not supported.

References

- Shigley's Mechanical Engineering Design (Budynas and Nisbett)
- ch. 2–3 (press and shrink fits, Lamé thick cylinders)

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/machine-design/interference-fit-pressure

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Reopens the calculator with the inputs of this report.