Cone Clutch Torque and Axial Force

Friction torque of a cone clutch from axial force, friction, cone angle and mean radius (uniform wear), and the axial force needed for a torque.

Method: Rattan; Theory of Machines; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Axial (engaging) force	2,000.0	N
Friction coefficient	0.25000	
Semi-cone angle	12.502	°
Outer radius	150.00	mm
Inner radius	120.00	mm
Required torque (for the force)	200.00	N·m

Calculated results

Parameter	Value	Unit
Mean radius	135.00	mm
Torque capacity (uniform wear)	311.82	N·m
Axial force for the required torque	1,282.8	N
Maximum pressure (at inner radius)	88.419	kPa

Notes for this case

• Uniform-wear theory (worn clutches); p_max is not checked against the lining's limit. Engaging under slip needs more axial force, W(sin α + μ cos α)/sin α times the value here.

Formula and method

$$T = \frac{\mu W r_m}{\sin\alpha}, \quad r_m = \frac{r_o + r_i}{2}, \quad p_{max} = \frac{W}{2\pi r_i (r_o - r_i)}$$

Variables

W	Axial (engaging) force	N
μ	Friction coefficient	-
α	Semi-cone angle	rad
r_o	Outer radius	m
r_i	Inner radius	m
T_{req}	Required torque (for the force)	N·m
r_m	Mean radius	m
T	Torque capacity (uniform wear)	N·m
W_{req}	Axial force for the required torque	N
p_{max}	Maximum pressure (at inner radius)	Pa

Method and standards

Uniform-wear clutch theory.

Assumptions and limits

- Uniform wear; rigid cone; force for steady (non-slipping) engagement.
- p_max is not compared with the lining's allowable pressure. Engaging while slipping needs W(sin α + μ cos α)/sin α.

- A semi-cone angle below about 12.5° is flagged.

References

• Rattan
• Theory of Machines
• 4th ed. (McGraw-Hill, 2014); Bhandari
• Design of Machine Elements
• 4th ed. (McGraw-Hill, 2017) (cone clutch, uniform wear)
• Budynas and Nisbett
• Shigley's Mechanical Engineering Design
• 10th ed. (McGraw-Hill, 2015)
• ch. 16

Report details

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Release checks	2 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/machine-design/cone-clutch-torque

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.