Band Brake Torque and Lever Force

Braking torque of a simple band brake from the band tensions, friction and wrap angle (capstan equation), with the lever force for a given lever arrangement.

Method: Capstan equation applied to band brakes (Shigley's Mechanical Engineering Design (Budynas and Nisbett), ch. 16)

Input parameters

Unit system: SI

Parameter	Value	Unit
Braking torque needed	500.00	N·m
Drum radius	250.00	mm
Coefficient of friction	0.30000	
Angle of wrap	270.00	°
Distance from the lever pivot to the band's slack end	80.000	mm
Lever length to the hand or actuator	600.00	mm

Calculated results

Parameter	Value	Unit
Tension ratio e^{μθ}	4.1112	
Tight-side tension	2.6428	kN
Slack-side tension	0.64284	kN
Force at the lever end (simple band brake, tight end at the pivot)	0.085712	kN

Notes for this case

- Simple band brake with the tight end fixed at the pivot; reversing the drum swaps the ends and needs a much larger force.

Formula and method

$$\frac{T_1}{T_2} = e^{\mu\theta}, \quad T = (T_1 - T_2)r, \quad P = T_2 \frac{a}{l}$$

Variables

T	Braking torque needed	N·m
r	Drum radius	m
μ	Coefficient of friction	-
θ	Angle of wrap	rad
a	Distance from the lever pivot to the band's slack end	m
l	Lever length to the hand or actuator	m
T_1/T_2	Tension ratio e^{μθ}	-
T_1	Tight-side tension	N
T_2	Slack-side tension	N
P	Force at the lever end (simple band brake, tight end at the pivot)	N

Method and standards

Capstan friction and lever moments.

Assumptions and limits

- Simple band brake, one drum direction (tight end at the pivot).
- The band stress and the maximum lining pressure p_max = T₁/(b r) are not checked (the band width is not an input); check them for sizing.

References

• Capstan equation applied to band brakes (Shigley's Mechanical Engineering Design (Budynas and Nisbett), ch. 16)

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

https://calc.firecad.com/mechanical/machine-design/band-brake-torque

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.