Power Screw Torque (Acme or Trapezoidal) with Collar Friction

Torque to raise and lower a load with an Acme or trapezoidal power screw including thread angle and collar friction, with efficiency and self-locking check.

Method: Shigley's Mechanical Engineering Design (Budynas and Nisbett); ch. 8 (power screws, raise and lower torque with thread angle; collar torque F f_c d_c / 2)

Input parameters

Unit system: SI

Parameter	Value	Unit
Axial load	6.4000	kN
Lead	8.0000	mm
Mean thread diameter	28.000	mm
Half thread angle (14.5° Acme, 15° trapezoidal, 0 square)	14.500	°
Thread friction	0.080000	
Mean collar diameter	40.000	mm
Collar friction	0.080000	

Calculated results

Parameter	Value	Unit
Torque to raise (thread)	15.670	N·m
Torque to lower (thread)	-0.73935	N·m
Collar torque	10.240	N·m
Total torque to raise	25.910	N·m
Overall efficiency F l /(2π T)	31.450	%

Notes for this case

- Not self-locking: the load drives the screw down.
- The lowering torque shown is for the thread only; with collar friction the total torque to lower is T_L + T_c = 9.5 N·m. Self-locking is judged on the thread alone (collar friction adds holding torque).

Formula and method

$$T_R = \frac{F d_m}{2}\frac{l + \pi f d_m \sec\alpha}{\pi d_m - f l \sec\alpha}, \quad T_L = \frac{F d_m}{2}\frac{\pi f d_m \sec\alpha - l}{\pi d_m + f l \sec\alpha}, \quad T_c = \frac{F f_c d_c}{2}$$

Variables

F	Axial load	N
l	Lead	m
d_m	Mean thread diameter	m
α	Half thread angle (14.5° Acme, 15° trapezoidal, 0 square)	rad
f	Thread friction	-
d_c	Mean collar diameter	m
f_c	Collar friction	-
T_R	Torque to raise (thread)	N·m
T_L	Torque to lower (thread)	N·m
T_c	Collar torque	N·m

T	Total torque to raise	N·m
e	Overall efficiency F l /(2π T)	-

Method and standards

Force analysis of a thread with flank angle.

Assumptions and limits

- Uniform friction.
- The lowering torque is for the thread only; the total to lower is T_L + T_c (given in a note). Self-locking is judged on the thread alone, which is conservative.

References

- Shigley's Mechanical Engineering Design (Budynas and Nisbett)
- ch. 8 (power screws, raise and lower torque with thread angle; collar torque F f_c d_c / 2)

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/power-screw-torque

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Reopens the calculator with the inputs of this report.