Screw Jack: Effort, Torque and Efficiency

Effort at the handle, torque and efficiency of a screw jack with square threads from the load, pitch, mean diameter, friction and handle length, with self-locking.

Method: Square-thread screw on an inclined plane (textbook; Shigley's Mechanical Engineering Design (Budynas and Nisbett), ch. 8)

Input parameters

Unit system: SI

Parameter	Value	Unit
Load lifted	50.000	kN
Lead of the thread (pitch × starts)	8.0000	mm
Mean thread diameter	46.000	mm
Coefficient of friction of the thread	0.12000	
Handle length (radius of the effort)	0.50000	m

Calculated results

Parameter	Value	Unit
Helix angle tan α = p/(π d_m)	3.1686	°
Torque to raise	203.01	N·m
Effort at the handle	0.40602	kN
Efficiency tan α / tan(α + φ)	31.359	%
Torque to lower (negative = runs down by itself)	73.847	N·m

Notes for this case

- Self-locking: the load does not lower by itself (friction angle above the helix angle).

Formula and method

$$\tan\alpha = \frac{p}{\pi d_m}, \quad T = W\frac{d_m}{2}\tan(\alpha+\phi), \quad \eta = \frac{\tan\alpha}{\tan(\alpha+\phi)}, \quad \tan\phi = \mu$$

Variables

W	Load lifted	N
p	Lead of the thread (pitch × starts)	m
d_m	Mean thread diameter	m
μ	Coefficient of friction of the thread	-
R	Handle length (radius of the effort)	m
α	Helix angle tan α = p/(π d_m)	rad
T	Torque to raise	N·m
P_e	Effort at the handle	N
η	Efficiency tan α / tan(α + φ)	-
T_L	Torque to lower (negative = runs down by itself)	N·m

Method and standards

Unwrapped thread as an inclined plane.

Assumptions and limits

- Square thread, no collar friction.

References

- Square-thread screw on an inclined plane (textbook; Shigley's Mechanical Engineering Design (Budynas and Nisbett), ch. 8)

Report details

Report reference	FCC-AP6G-WVP9 (the same inputs always give the same reference)
Generated	17 November 2026, 19:44 UTC
Calculator	Screw Jack: Effort, Torque and Efficiency
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/screw-jack-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.