Shaft Torque from Power and Speed (and Shaft Size)

Torque on a shaft from power and speed (T = P/ω), and the least solid shaft diameter for an allowable shear stress in pure torsion.

Method: Torsion of a solid circular shaft

Input parameters

Unit system: SI

Parameter	Value	Unit
Power transmitted	75.000	kW
Shaft speed	1,480.0	rpm
Allowable shear stress From your design code or a safety factor on the material's shear yield; keyways reduce the allowable stress.	40.000	MPa
Service (shock) factor on torque	1.5000	

Calculated results

Parameter	Value	Unit
Torque	483.92	N·m
Design torque with the service factor	725.88	N·m
Least solid shaft diameter	45.212	mm
Angular speed	154.99	rad/s

Notes for this case

- Pure torsion only: add bending from pulleys, gears or overhung loads by a combined-stress method before choosing the shaft.

Formula and method

$$\omega = 2\pi n \qquad T = \frac{P}{\omega} \qquad T_d = KT \qquad d_{min} = \sqrt[3]{\frac{16\,T_d}{\pi\,\tau_a}}$$

Variables

P	power	W
n	speed	rev/s
τ_a	allowable shear stress	Pa
K	service factor	–
T	torque	N·m
T_d	design torque	N·m
d_{min}	least solid shaft diameter	m
ω	angular speed	rad/s

Method and standards

Power–torque relation and elastic torsion of a solid circular shaft.

Assumptions and limits

- Solid round shaft; pure torsion.

References

- Torsion of a solid circular shaft

Report details

Report reference	FCC-YYCC-R55F (the same inputs always give the same reference)
Generated	17 November 2026, 19:45 UTC
Calculator	Shaft Torque from Power and Speed (and Shaft Size)
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/shaft-power-torque

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.