Spline Shaft Torque Capacity (Bearing Pressure)

Torque a straight-sided or involute spline can transmit for an allowable flank pressure, with load sharing, and the shaft shear stress at that torque.

Method: Bearing-pressure design of splines

Input parameters

Unit system: SI

Parameter	Value	Unit
Number of splines	6.0000	
Major diameter	32.000	mm
Minor diameter	28.000	mm
Engaged length	40.000	mm
Allowable flank (bearing) pressure	40.000	MPa
Load sharing factor	75.000	%

Calculated results

Parameter	Value	Unit
Flank (bearing) height	2.0000	mm
Mean radius	15.000	mm
Torque capacity	216.00	N·m
Shaft shear stress at the minor diameter	50.113	MPa

Notes for this case

• Each spline flank carries pressure over its working height h = (D − d)/2 and engaged length L at a mean radius (D + d)/4, so T = φzhLp_a·r_m. Manufacturing errors mean not every spline bears equally; φ ≈ 0.75 is often used (lower for long or misaligned splines). Allowable pressure depends on fit and duty: tens of MPa for sliding splines under load, more for fixed, hardened ones. The shaft at the minor diameter must also carry the torque in shear.

Formula and method

$$T = \phi\, z\, h\, L\, p_a\, r_m, \quad h = \frac{D-d}{2}, \quad r_m = \frac{D+d}{4}$$

Variables

z	Number of splines	-
D	Major diameter	m
d	Minor diameter	m
L	Engaged length	m
p_a	Allowable flank (bearing) pressure	Pa
ϕ	Load sharing factor	-
h	Flank (bearing) height	m
r_m	Mean radius	m
T	Torque capacity	N·m
τ	Shaft shear stress at the minor diameter	Pa

Method and standards

Spline capacity.

Assumptions and limits

- Uniform pressure on the flanks; static torque.

References

Bearing-pressure design of splines

Report details

Report reference	FCC-7BE9-HY4Y (the same inputs always give the same reference)
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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/spline-shaft-torque-capacity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.