Flange Coupling Bolt Shear from Torque

Shear stress in the bolts of a rigid flange coupling from the torque, number of bolts and pitch circle, with the bolt diameter needed and the shaft torque capacity.

Method: Rigid flange coupling; fitted bolts in shear (textbook machine design)

Input parameters

Unit system: SI

Parameter	Value	Unit
Torque transmitted	2,000.0	N·m
Number of bolts	6.0000	
Bolt pitch circle diameter	160.00	mm
Bolt diameter (shank in shear)	12.000	mm
Allowable shear stress of the bolts	60.000	MPa

Calculated results

Parameter	Value	Unit
Force on each bolt	4.1667	kN
Shear stress in the bolts	36.841	MPa
Bolt diameter needed	9.4032	mm
Torque the bolts carry at the allowable stress	3,257.2	N·m

Notes for this case

- Fitted bolts in shear, load shared equally. With clearance bolts the torque passes by friction from the bolt preload instead.

Formula and method

$$F_b = \frac{2T}{nD_b}, \quad \tau = \frac{F_b}{\pi d^2/4}, \quad T_{max} = n\,\frac{\pi d^2}{4}\,\tau_a\,\frac{D_b}{2}$$

Variables

T	Torque transmitted	N·m
n	Number of bolts	-
D_b	Bolt pitch circle diameter	m
d	Bolt diameter (shank in shear)	m
τ_a	Allowable shear stress of the bolts	Pa
F_b	Force on each bolt	N
τ	Shear stress in the bolts	Pa
d_{min}	Bolt diameter needed	m
T_{max}	Torque the bolts carry at the allowable stress	N·m

Method and standards

Torque shared equally by the bolts.

Assumptions and limits

- Equal sharing. A shear stress above the allowable is flagged.
- Bearing (crushing) of the bolts on the flange and the flange and hub strength are not checked.

References

- Rigid flange coupling
- fitted bolts in shear (textbook machine design)

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/flange-coupling-bolts

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Reopens the calculator with the inputs of this report.