Plate Clutch Torque (Uniform Wear and Uniform Pressure)

Torque capacity of a single or multi-plate friction clutch from the axial force, friction and friction radii, by the uniform wear and uniform pressure theories.

Method: Shigley's Mechanical Engineering Design (Budynas and Nisbett); ch. 16 (disc clutches, uniform wear and uniform pressure)

Input parameters

Unit system: SI

Parameter	Value	Unit
Axial clamping force	4.0000	kN
Coefficient of friction	0.30000	
Outer radius of the friction face	125.00	mm
Inner radius	75.000	mm
Number of friction surfaces	2.0000	
Speed (for the power)	1,500.0	rpm

Calculated results

Parameter	Value	Unit
Torque, uniform wear (worn clutch)	240.00	N·m
Torque, uniform pressure (new clutch)	245.00	N·m
Highest pressure (uniform wear, at the inner radius)	169.77	kPa
Power at the speed (uniform wear)	37.699	kW

Notes for this case

- Design on uniform wear: it gives the lower (safe) torque once the lining has bedded in.

Formula and method

$$T_w = n\,\mu F\frac{r_o + r_i}{2}, \quad T_p = n\,\mu F\frac{2}{3}\frac{r_o^3 - r_i^3}{r_o^2 - r_i^2}, \quad p_{max} = \frac{F}{2\pi r_i(r_o - r_i)}$$

Variables

F	Axial clamping force	N
μ	Coefficient of friction	-
r_o	Outer radius of the friction face	m
r_i	Inner radius	m
n	Number of friction surfaces	-
N	Speed (for the power)	1/s
T_w	Torque, uniform wear (worn clutch)	N·m
T_p	Torque, uniform pressure (new clutch)	N·m
p_{max}	Highest pressure (uniform wear, at the inner radius)	Pa
P	Power at the speed (uniform wear)	W

Method and standards

Integration of friction over the annulus.

Assumptions and limits

- Flat annular faces. With an inner radius of 0 the uniform-wear peak pressure is unbounded and is not shown.

References

- Shigley's Mechanical Engineering Design (Budynas and Nisbett)
- ch. 16 (disc clutches, uniform wear and uniform pressure)

Report details

Report reference	FCC-QA5P-X7PD (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/plate-clutch-torque

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Reopens the calculator with the inputs of this report.