Journal Bearing Friction by Petroff's Equation

Friction torque, friction coefficient and power loss of a lightly loaded journal bearing by Petroff's equation, with the bearing pressure.

Method: N. Petroff (1883); Shigley's Mechanical Engineering Design (Budynas and Nisbett); ch. 12

Input parameters

Unit system: SI

Parameter	Value	Unit
Oil viscosity at the running temperature	30.000	mPa·s
Journal speed	1,500.0	rpm
Journal radius	25.000	mm
Bearing length	50.000	mm
Radial clearance	40.000	µm
Radial load	2.0000	kN

Calculated results

Parameter	Value	Unit
Friction torque 4π² µ N r³ l / c	0.57830	N·m
Friction coefficient T/(W r)	0.011566	
Power lost	90.839	W
Bearing pressure W/(2 r l)	800.00	kPa

Notes for this case

- Petroff's equation assumes a concentric journal (light load); under real loads the journal runs eccentric and friction is higher.

Formula and method

$$T = \frac{4\pi^2 \mu N r^3 l}{c}, \quad f = \frac{T}{Wr}, \quad P = 2\pi N T$$

Variables

μ	Oil viscosity at the running temperature	Pa·s
N	Journal speed	1/s
r	Journal radius	m
l	Bearing length	m
c	Radial clearance	m
W	Radial load	N
T	Friction torque 4π² µ N r³ l / c	N·m
f	Friction coefficient T/(W r)	-
P	Power lost	W
p	Bearing pressure W/(2 r l)	Pa

Method and standards

Viscous shear in a concentric film.

Assumptions and limits

- Concentric journal, full film. Valid for lightly loaded bearings only: check the Sommerfeld number S = (r/c)² µN/p; for loaded bearings use the Raimondi–Boyd charts, which give a higher friction.

References

- N. Petroff (1883); Shigley's Mechanical Engineering Design (Budynas and Nisbett)
- ch. 12

Report details

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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/journal-bearing-petroff

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Reopens the calculator with the inputs of this report.