Gearbox Power Loss, Efficiency and Oil Temperature Rise

Output power and losses of a gear train from the number of meshes in the power path, mesh efficiency and no-load churning loss, and the oil temperature rise.

Method: Stage efficiency and fixed losses

Input parameters

Unit system: SI

Parameter	Value	Unit
Input power	150.00	kW
Gear meshes in the power path	2.0000	
Efficiency per mesh (with bearings)	98.500	%
No-load churning and seal loss	1.5000	kW
Oil flow through the cooler	30.000	L/min
Oil density	870.00	kg/m³
Oil specific heat	2.0000	kJ/(kg·K)

Calculated results

Parameter	Value	Unit
Output power	144.03	kW
Power loss	5.9662	kW
Overall efficiency	96.022	%
Oil temperature rise through the box	6.8578	K

Notes for this case

• P_out = P_in·η_mⁿ − P₀: load-dependent mesh and bearing losses compound per stage, while churning, windage and seal losses (P₀) are roughly fixed at a speed, so part-load efficiency is poorer. All loss heat goes into the oil: ΔT = P_loss/(V̇ρc_p) through the cooler circuit.

Formula and method

$$P_{out} = P_{in}\eta_m^n - P_0, \quad \Delta T_o = \frac{P_{in} - P_{out}}{\dot{V}_o \rho_o c_{p,o}}$$

Variables

P_{in}	Input power	W
n	Gear meshes in the power path	-
η_m	Efficiency per mesh (with bearings)	-
P_0	No-load churning and seal loss	W
$\dot{V}_o$	Oil flow through the cooler	m³/s
ρ_o	Oil density	kg/m³
$c_{p,o}$	Oil specific heat	J/(kg·K)
P_{out}	Output power	W
P_{loss}	Power loss	W
η	Overall efficiency	-
ΔT_o	Oil temperature rise through the box	K

Method and standards

Gearbox losses.

Assumptions and limits

- Steady state; all losses to oil.

References

Stage efficiency and fixed losses

Report details

Report reference	FCC-CHFF-TKZ5 (the same inputs always give the same reference)
Generated	23 November 2026, 18:19 UTC
Calculator	Gearbox Power Loss, Efficiency and Oil Temperature Rise
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 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/automotive/transmission/gearbox-power-loss-heat

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.