Clutch Slip Time, Energy and Temperature at Launch

Slip time and heat generated in a friction clutch when starting a vehicle from rest at constant engine speed and clutch torque, with the plate temperature rise.

Method: Clutch engagement energy balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Vehicle mass	1,500.0	kg
Rolling radius	310.00	mm
Overall ratio (first gear × final drive)	13.000	
Engine speed during slip	1,500.0	rpm
Clutch torque while slipping	150.00	N·m
Rolling resistance coefficient	0.012000	
Road grade (rise/run)	0	%
Pressure plate and disc mass heated	6.0000	kg
Specific heat of plate	0.46000	kJ/(kg·K)
Share of heat into that mass	50.000	%

Calculated results

Parameter	Value	Unit
Load torque at the clutch	4.2093	N·m
Vehicle inertia at the clutch	0.85296	kg·m²
Slip time	0.91901	s
Heat generated in slip	10.827	kJ
Plate temperature rise	1.9614	K

Notes for this case

- Constant engine speed and clutch torque: J dω/dt = T_c − T_L until the clutch locks; slip heat = ½T_cω_et_s. Hill starts and towing multiply it; repeated launches without cooling add up.

Formula and method

$$t_s = \frac{J\omega_e}{T_c - T_L}, \quad E_s = \frac{1}{2} T_c \omega_e t_s, \quad J = \frac{mr^2}{i^2}$$

Variables

m	Vehicle mass	kg
r	Rolling radius	m
i	Overall ratio (first gear × final drive)	-
n_e	Engine speed during slip	1/s
T_c	Clutch torque while slipping	N·m
f_r	Rolling resistance coefficient	-
G	Road grade (rise/run)	-
m_p	Pressure plate and disc mass heated	kg
c	Specific heat of plate	J/(kg·K)

χ	Share of heat into that mass	-
T_L	Load torque at the clutch	N·m
J	Vehicle inertia at the clutch	kg·m²
t_s	Slip time	s
E_s	Heat generated in slip	J
ΔT	Plate temperature rise	K

Method and standards

Slip energy.

Assumptions and limits

- Constant engine speed and clutch torque; rotating masses ignored.

References

Clutch engagement energy balance

Report details

Report reference	FCC-MQZM-M537 (the same inputs always give the same reference)
Generated	23 November 2026, 18:19 UTC
Calculator	Clutch Slip Time, Energy and Temperature at Launch
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/clutch-slip-energy-launch

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.