Brake Temperature Build-up over Repeated Stops

Brake disc temperature after a series of repeated stops with Newtonian cooling between them, and the limiting temperature for endless cycling, for fade checks.

Method: Repeated-stop brake temperature (Newtonian cooling)

Input parameters

Unit system: SI

Parameter	Value	Unit
Vehicle mass	1,600.0	kg
Speed at brake application	100.00	km/h
Front axle share of braking	70.000	%
Discs on the front axle	2.0000	
Disc mass	8.0000	kg
Disc specific heat	0.50000	kJ/(kg·K)
Mean cooling coefficient	60.000	W/(m²·K)
Disc cooling area	0.15000	m²
Time between stops	60.000	s
Number of stops	10.000	
Ambient temperature	25.000	°C

Calculated results

Parameter	Value	Unit
Temperature rise per stop	54.012	K
Disc temperature just after the last stop	341.83	°C
Limiting temperature after many stops	452.71	°C
Cooling time constant	7.4074	min

Notes for this case

• Each stop adds ΔT = share of ½mv²/(m_dc); between stops the disc cools as e^(−t/τ), τ = m_dc/(hA). The temperatures form a geometric series. Cooling coefficients rise with speed and vented discs; use a measured τ when available.

Formula and method

$$\Delta T_1 = \frac{\phi \, \frac{1}{2} m v^2}{n_d m_d c}, \quad T_n = T_a + \Delta T_1 \frac{1 - e^{-n t_c/\tau}}{1 - e^{-t_c/\tau}}, \quad \tau = \frac{m_d c}{h A_d}$$

Variables

m	Vehicle mass	kg
v	Speed at brake application	m/s
ϕ	Front axle share of braking	-
n_d	Discs on the front axle	-
m_d	Disc mass	kg
c	Disc specific heat	J/(kg·K)
h	Mean cooling coefficient	W/(m²·K)
A_d	Disc cooling area	m²
t_c	Time between stops	s

n	Number of stops	-
T_a	Ambient temperature	K
ΔT_1	Temperature rise per stop	K
T_n	Disc temperature just after the last stop	K
T_∞	Limiting temperature after many stops	K
τ	Cooling time constant	s

Method and standards

Repeated-stop heating.

Assumptions and limits

- Lumped disc temperature; constant cooling coefficient.

References

Repeated-stop brake temperature (Newtonian cooling)

Report details

Report reference	FCC-XE58-JKXC (the same inputs always give the same reference)
Generated	23 November 2026, 18:00 UTC
Calculator	Brake Temperature Build-up over Repeated Stops
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/vehicle-dynamics/brake-temperature-repeated-stops

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.