Brake Pad Wear Life from Braking Energy

Braking energy per pad per stop, the pad wear it causes from a specific wear rate, and the number of stops and distance until the usable pad is used up.

Method: Energy-based (Archard-type) friction material wear

Input parameters

Unit system: SI

Parameter	Value	Unit
Vehicle mass	1,600.0	kg
Typical speed braked from (to rest)	50.000	km/h
Stops per kilometre	0.80000	
Share of braking on this axle	70.000	%
Pads on this axle	4.0000	
Pad friction area	50.000	cm²
Usable pad thickness	9.0000	mm
Specific wear rate of the pad	0.25000	cm³/MJ

Calculated results

Parameter	Value	Unit
Energy per pad per stop	27.006	kJ
Pad volume worn per stop	0.006752	cm³
Stops to wear out	6,665.1	
Distance to wear out	8,331.4	km

Notes for this case

• Each stop from speed v turns ½mv² into heat, shared between axles by the brake balance and equally between the pads on an axle (rolling resistance and drag are ignored, which is conservative). Pad wear is close to proportional to the energy absorbed: ΔV = k_w·E, with k_w found from wear tests and rising steeply above the material's temperature limit. Usable volume is friction area times thickness down to the wear limit. Regenerative braking in hybrids and EVs takes much of this energy away.

Formula and method

$$E_p = \frac{\phi \, \frac{1}{2} m v^2}{n_p}, \quad N = \frac{A_p t_p}{k_w E_p}, \quad s = \frac{N}{n_s}$$

Variables

m	Vehicle mass	kg
v	Typical speed braked from (to rest)	m/s
n_s	Stops per kilometre	-
ϕ	Share of braking on this axle	-
n_p	Pads on this axle	-
A_p	Pad friction area	m²
t_p	Usable pad thickness	m
k_w	Specific wear rate of the pad	m³/J
E_p	Energy per pad per stop	J
ΔV	Pad volume worn per stop	m³

N	Stops to wear out	-
s	Distance to wear out	m

Method and standards

Pad life.

Assumptions and limits

- Each stop from v to rest; wear proportional to energy; equal sharing between pads.

References

Energy-based (Archard-type) friction material wear

Report details

Report reference	FCC-HEM6-V3MM (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/automotive/vehicle-dynamics/brake-pad-wear-life

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.