Crash Deceleration from Crush Depth

Average deceleration, pulse duration, force and absorbed energy of a vehicle or occupant stopped from a given speed over a crush or stopping distance.

Method: Constant-deceleration crash pulse

Input parameters

Unit system: SI

Parameter	Value	Unit
Impact speed (change of velocity)	56.000	km/h
Crush or stopping distance	600.00	mm
Mass	1,500.0	kg

Calculated results

Parameter	Value	Unit
Average deceleration	20.562	g
Pulse duration	77.143	ms
Average force	302.47	kN
Kinetic energy absorbed	181.48	kJ

Notes for this case

• For a constant deceleration from speed v to rest over distance C, ā = v²/2C and the pulse lasts t = 2C/v. Real crash pulses peak at about 1.5–2 times the average; a half-sine pulse with the same Δv and duration peaks at π/2 times the average. Doubling the crush distance halves the deceleration, which is why crumple zones, airbags and seat-belt stretch save lives.

Formula and method

$$\bar{a} = \frac{v^2}{2C}, \quad t = \frac{2C}{v}, \quad E = \frac{1}{2}mv^2$$

Variables

v	Impact speed (change of velocity)	m/s
C	Crush or stopping distance	m
m	Mass	kg
$\bar{a}$	Average deceleration	m/s²
t	Pulse duration	s
$\bar{F}$	Average force	N
E	Kinetic energy absorbed	J

Method and standards

Crash pulse.

Assumptions and limits

- Constant deceleration; no rebound.

References

Constant-deceleration crash pulse

Report details

Report reference	FCC-QP0K-9VE7 (the same inputs always give the same reference)
Generated	23 November 2026, 18:00 UTC
Calculator	Crash Deceleration from Crush Depth
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/crash-deceleration-from-crush

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.