Vehicle Acceleration Time and Distance

Time and distance to accelerate between two speeds from wheel power, mass with rotating inertia, rolling and air resistance and the traction limit.

Method: Integration of the longitudinal equation δm dv/dt = F_t − F_r (Gillespie, Fundamentals of Vehicle Dynamics (SAE, 1992), ch. 2)

Input parameters

Unit system: SI

Parameter	Value	Unit
Power at the wheels Engine power × drivetrain efficiency (about 0.85–0.92); not the engine's rated power.	80.000	kW
Vehicle mass	1,500.0	kg
Rotating mass factor	1.0800	
Rolling resistance coefficient	0.012000	
Drag area	0.70000	m²
Air density	1.2000	kg/m³
Adhesion × driven-axle weight share	0.50000	
Start speed	0	km/h
End speed	100.00	km/h

Calculated results

Parameter	Value	Unit
Acceleration time	9.8094	s
Distance covered	166.06	m
Speed where power replaces traction as the limit	39.157	km/h

Notes for this case

• Constant wheel power above v*, traction-limited (constant force) below it; gear shifts are not modelled. Rotating-mass factor about 1.05–1.15 in high gears, more in first gear.

Formula and method

$$t = \int_{v_1}^{v_2} \frac{\delta m \, dv}{\min(\mu\phi m g, P/v) - m g C_{rr} - \frac{1}{2}\rho C_d A v^2}$$

Variables

P	Power at the wheels	W
m	Vehicle mass	kg
δ	Rotating mass factor	-
C_{rr}	Rolling resistance coefficient	-
$C_d A$	Drag area	m²
ρ	Air density	kg/m³
$\mu\phi$	Adhesion × driven-axle weight share	-
v_1	Start speed	m/s
v_2	End speed	m/s
t	Acceleration time	s
s	Distance covered	m

v^*	Speed where power replaces traction as the limit	m/s

Method and standards

Equation of motion.

Assumptions and limits

- P is the power delivered at the wheels: multiply the engine power by the drivetrain efficiency (about 0.85–0.92) before entering it. Entering the engine's rated power gives times that are too short.
- Constant power above v*; no shift time.

References

- Integration of the longitudinal equation δm dv/dt = F_t − F_r (Gillespie, Fundamentals of Vehicle Dynamics (SAE, 1992), ch. 2)

Report details

Report reference	FCC-4ZCE-773M (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Vehicle Acceleration Time and Distance
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/vehicle-acceleration-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.