Aerodynamic Downforce: Cornering Speed and Top Speed

Maximum cornering speed on a radius with and without downforce from tyre friction, and the top speed where power equals aerodynamic drag and rolling resistance.

Method: Point-mass cornering and power balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Vehicle mass	1,200.0	kg
Tyre friction coefficient	1.2000	
Corner radius	100.00	m
Air density	1.2000	kg/m³
Downforce area C_L·A	1.8000	m²
Drag area C_D·A	0.90000	m²
Engine power	300.00	kW
Driveline efficiency	90.000	%
Rolling resistance coefficient	0.012000	

Calculated results

Parameter	Value	Unit
Cornering speed without downforce	123.50	km/h
Cornering speed with downforce	130.76	km/h
Downforce at that speed	1,424.8	N
Top speed	279.59	km/h

Notes for this case

• Cornering: mv²/R = μ(mg + ½ρC_LAv²) gives v = √[μmg/(m/R − μ½ρC_LA)]. Top speed: ηP = (½ρC_DAv² + C_rr(mg + ½ρC_LAv²))v. Downforce helps most in fast corners, while its drag lowers top speed; tyre μ falls somewhat with load, which this ignores.

Formula and method

$$v_c = \sqrt{\frac{\mu m g}{m/R - \mu \frac{1}{2}\rho C_L A}}, \quad \eta P = \left[\frac{1}{2}\rho C_D A v^2 + C_{rr}\left(mg + \frac{1}{2}\rho C_L A v^2\right)\right] v$$

Variables

m	Vehicle mass	kg
μ	Tyre friction coefficient	-
R	Corner radius	m
ρ	Air density	kg/m³
$C_L A$	Downforce area C_L·A	m²
$C_D A$	Drag area C_D·A	m²
P	Engine power	W
η	Driveline efficiency	-
C_{rr}	Rolling resistance coefficient	-
v_0	Cornering speed without downforce	m/s

v_c	Cornering speed with downforce	m/s
F_L	Downforce at that speed	N
v_{max}	Top speed	m/s

Method and standards

Aero balance.

Assumptions and limits

- Point mass; constant μ; flat road.

References

Point-mass cornering and power balance

Report details

Report reference	FCC-SRN2-C4GV (the same inputs always give the same reference)
Generated	23 November 2026, 18:00 UTC
Calculator	Aerodynamic Downforce: Cornering Speed and Top Speed
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/downforce-cornering-top-speed

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.