Tyre Longitudinal Slip Ratio and Force

Longitudinal slip ratio of a driven or braked wheel from wheel speed, rolling radius and vehicle speed, with the force in the linear slip range.

Method: Longitudinal slip definitions

Input parameters

Unit system: SI

Parameter	Value	Unit
Wheel speed	820.00	rpm
Rolling radius	310.00	mm
Vehicle speed	90.000	km/h
Longitudinal slip stiffness (per unit slip)	120.00	kN

Calculated results

Parameter	Value	Unit
Wheel peripheral speed	95.831	km/h
Slip ratio (+ driving, − braking)	6.0848	%
Longitudinal force (linear range)	7.3018	kN

Notes for this case

• Driving slip (ωr − v)/ωr, braking slip (ωr − v)/v; F = C_s·s holds only up to about ±5–10 % slip, beyond which the force peaks and then falls (ABS and traction control work around the peak).

Formula and method

$$s = \frac{\omega r - v}{\max(\omega r,\, v)}, \quad F_x = C_s s$$

Variables

n_w	Wheel speed	1/s
r	Rolling radius	m
v	Vehicle speed	m/s
C_s	Longitudinal slip stiffness (per unit slip)	N
v_w	Wheel peripheral speed	m/s
s	Slip ratio (+ driving, − braking)	-
F_x	Longitudinal force (linear range)	N

Method and standards

Slip ratio.

Assumptions and limits

- Straight-line motion; linear tyre range.

References

Longitudinal slip definitions

Report details

Report reference	FCC-0XQ7-1DJ8 (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/tyres-wheels/tyre-slip-ratio-force

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.