Tyre Contact Patch Area, Length and Deflection

Contact patch area of a pneumatic tyre from load, inflation pressure and carcass stiffness, the patch length for a tread width and the radial deflection.

Method: Membrane approximation of the tyre footprint

Input parameters

Unit system: SI

Parameter	Value	Unit
Wheel load	4.5000	kN
Inflation pressure (gauge)	230.00	kPa
Carcass stiffness contribution	30.000	kPa
Tread contact width	170.00	mm
Unloaded tyre radius	320.00	mm

Calculated results

Parameter	Value	Unit
Contact patch area	173.08	cm²
Patch length	101.81	mm
Radial deflection	4.0749	mm
Patch aspect ratio	0.59888	
Loaded radius	315.93	mm

Notes for this case

• A ≈ F_z/(p_i + p_c): inflation pressure carries most of the load and the carcass the rest (p_c of a few tens of kPa for car tyres, more for run-flats). Patch length l = A/w_t for a rectangular patch; deflection from the chord geometry δ = r − √(r² − l²/4). Real patches are rounded and pressure peaks near the edges.

Formula and method

$$A = \frac{F_z}{p_i + p_c}, \quad l = \frac{A}{w_t}, \quad \delta = r_0 - \sqrt{r_0^2 - \frac{l^2}{4}}$$

Variables

F_z	Wheel load	N
p_i	Inflation pressure (gauge)	Pa
p_c	Carcass stiffness contribution	Pa
w_t	Tread contact width	m
r_0	Unloaded tyre radius	m
A	Contact patch area	m²
l	Patch length	m
δ	Radial deflection	m
l/w_t	Patch aspect ratio	-
r_l	Loaded radius	m

Method and standards

Contact patch.

Assumptions and limits

- Rectangular patch; uniform contact pressure.

References

Membrane approximation of the tyre footprint

Report details

Report reference	FCC-BT3J-RXKG (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-contact-patch

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.