

Important Wheel Parameters Formulas PDF



Formulas Examples with Units

List of 20 Important Wheel Parameters Formulas

1) Angle between Traction Force and Horizontal Axis Formula ↻

Formula

$$\theta = \text{asin}\left(1 - \frac{h_{\text{curb}}}{r_d}\right)$$

Example with Units

$$0.6898_{\text{rad}} = \text{asin}\left(1 - \frac{0.2_{\text{m}}}{0.55_{\text{m}}}\right)$$

Evaluate Formula ↻

2) Aspect Ratio of Tire Formula ↻

Formula

$$\text{AR} = \frac{H}{W} \cdot 100$$

Example with Units

$$54.6667 = \frac{0.123_{\text{m}}}{0.225_{\text{m}}} \cdot 100$$

Evaluate Formula ↻

3) Circumference of Wheel Formula ↻

Formula

$$C = 3.1415 \cdot d_w$$

Example with Units

$$2.1362_{\text{m}} = 3.1415 \cdot 0.680_{\text{m}}$$

Evaluate Formula ↻

4) Contact Point of Wheel and Curb Distance from Wheel Center Axis Formula ↻

Formula

$$s = \sqrt{2 \cdot r_d \cdot (h - h^2)}$$

Example with Units

$$0.3639_{\text{m}} = \sqrt{2 \cdot 0.55_{\text{m}} \cdot (0.14_{\text{m}} - 0.14_{\text{m}}^2)}$$

Evaluate Formula ↻

5) Damper angle from Vertical given wheel rate Formula ↻

Formula

$$\Phi = \text{acos}\left(\frac{K_t}{K \cdot (IR^2)}\right)$$

Example with Units

$$89.62^\circ = \text{acos}\left(\frac{100_{\text{N/m}}}{60311.79_{\text{N/m}} \cdot (0.5^2)}\right)$$

Evaluate Formula ↻



6) Height of Center of Gravity of Vehicle by method of jacking Vehicle from Rear Formula

Formula

Evaluate Formula 

$$h_{cg} = \left(R_{LF} \cdot \left(\frac{c}{b} \right) \right) + \left(R_{LR} \cdot \left(\frac{a_{cg}}{b} \right) \right) + \left(\frac{(W_F \cdot b) - (m \cdot c)}{m \cdot \tan(\theta_a)} \right)$$

Example with Units

$$1480.92_{in} = \left(11_{in} \cdot \left(\frac{30_{in}}{2.7_{m}} \right) \right) + \left(15_{in} \cdot \left(\frac{27_{in}}{2.7_{m}} \right) \right) + \left(\frac{(150_{kg} \cdot 2.7_{m}) - (55_{kg} \cdot 30_{in})}{55_{kg} \cdot \tan(10^\circ)} \right)$$

7) Installation Ratio given Wheel Rate Formula

Formula

Example with Units

Evaluate Formula 

$$IR = \sqrt{\frac{K_t}{K \cdot \cos(\Phi)}}$$

$$0.5 = \sqrt{\frac{100_{N/m}}{60311.79_{N/m} \cdot \cos(89.62^\circ)}}$$

8) Ride rate of car Formula

Formula

Example with Units

Evaluate Formula 

$$K_{RR} = \frac{K_t \cdot K_{tr}}{K_t + K_{tr}}$$

$$9.9991_{N/m} = \frac{100_{N/m} \cdot 11.11_{N/m}}{100_{N/m} + 11.11_{N/m}}$$

9) Spring angle correction factor Formula

Formula

Example with Units

Evaluate Formula 

$$\cos\theta = \cos(\theta_s)$$

$$0.866 = \cos(30.0^\circ)$$

10) Spring rate given wheel rate Formula

Formula

Example with Units

Evaluate Formula 

$$K = \frac{K_t}{(IR^2) \cdot \cos(\Phi)}$$

$$60311.789_{N/m} = \frac{100_{N/m}}{(0.5^2) \cdot \cos(89.62^\circ)}$$

11) Spring rate required for coilover given desired droop and motion ratio Formula

Formula

Evaluate Formula 

$$k = W_{cs} \cdot \frac{g}{M.R. \cdot W.T. \cdot \cos(\theta_s)}$$

Example with Units

$$160.8213_{N/m} = 1.208_{kg} \cdot \frac{9.8_{m/s^2}}{0.85 \cdot 100.0_{mm} \cdot \cos(30.0^\circ)}$$



12) Stiffness of Spring provided Wheel rate Formula ↻

Formula

$$k = \frac{K_t}{\left((M.R.)^2 \right) \cdot (\cos\theta)}$$

Example with Units

$$160.8931 \text{ N/m} = \frac{100 \text{ N/m}}{\left((0.85)^2 \right) \cdot (0.86025)}$$

Evaluate Formula ↻

13) Tire Rate given Wheel Rate and Ride Rate Formula ↻

Formula

$$K_{tr} = \frac{K_t \cdot K_{RR}}{K_t - K_{RR}}$$

Example with Units

$$11.11 \text{ N/m} = \frac{100 \text{ N/m} \cdot 9.9991 \text{ N/m}}{100 \text{ N/m} - 9.9991 \text{ N/m}}$$

Evaluate Formula ↻

14) Tire Side Wall Height Formula ↻

Formula

$$H = \frac{AR \cdot W}{100}$$

Example with Units

$$0.123 \text{ m} = \frac{54.66667 \cdot 0.225 \text{ m}}{100}$$

Evaluate Formula ↻

15) Track Width of Vehicle given Wheel rate and Roll rate Formula ↻

Formula

$$a = \sqrt{\frac{2 \cdot K_\Phi}{K_t}}$$

Example with Units

$$1.2 \text{ m} = \sqrt{\frac{2 \cdot 72 \text{ Nm/rad}}{100 \text{ N/m}}}$$

Evaluate Formula ↻

16) Wheel Diameter of Vehicle Formula ↻

Formula

$$d_w = D + 2 \cdot H$$

Example with Units

$$0.68 \text{ m} = 0.434 \text{ m} + 2 \cdot 0.123 \text{ m}$$

Evaluate Formula ↻

17) Wheel Radius of Vehicle Formula ↻

Formula

$$r_w = \frac{d_w}{2}$$

Example with Units

$$0.34 \text{ m} = \frac{0.680 \text{ m}}{2}$$

Evaluate Formula ↻

18) Wheel rate Formula ↻

Formula

$$K_t = K \cdot (IR^2) \cdot \cos(\Phi)$$

Example with Units

$$100 \text{ N/m} = 60311.79 \text{ N/m} \cdot (0.5^2) \cdot \cos(89.62^\circ)$$

Evaluate Formula ↻



19) Wheel Rate given Tire Rate and Ride Rate Formula

Formula

$$K_t = \frac{K_{tr} \cdot K_{RR}}{K_{tr} - K_{RR}}$$

Example with Units

$$100 \text{ N/m} = \frac{11.11 \text{ N/m} \cdot 9.9991 \text{ N/m}}{11.11 \text{ N/m} - 9.9991 \text{ N/m}}$$

Evaluate Formula 

20) Wheel rate in vehicle Formula

Formula

$$K_t = k \cdot \left((\text{M.R.})^2 \right) \cdot (\cos \theta)$$

Example with Units

$$100.0001 \text{ N/m} = 160.8932 \text{ N/m} \cdot \left((0.85)^2 \right) \cdot (0.86025)$$

Evaluate Formula 



Variables used in list of Wheel Parameters Formulas above

- **a** Track Width of Vehicle (Meter)
- **a_{cg}** Horizontal Distance of C.G. From Front Axle (Inch)
- **AR** Aspect Ratio of Tire
- **b** Wheelbase of Vehicle (Meter)
- **c** Horizontal Distance of C.G. From Rear Axle (Inch)
- **C** Wheel Circumference (Meter)
- **cosθ** Spring Angle Correction Factor
- **D** Rim Diameter (Meter)
- **d_w** Wheel Diameter of Vehicle (Meter)
- **g** Acceleration due to Gravity (Meter per Square Second)
- **h** Height of Curb (Meter)
- **H** Tire Side Wall Height (Meter)
- **h_{cg}** Height of Center of Gravity (C.G.) of Vehicle (Inch)
- **h_{curb}** Curb Height (Meter)
- **IR** Installation Ratio
- **k** Stiffness of Spring (Newton per Meter)
- **K** Spring Rate (Newton per Meter)
- **K_{RR}** Ride Rate of Car (Newton per Meter)
- **K_t** Wheel Rate of Vehicle (Newton per Meter)
- **K_{tr}** Tire Rate (Newton per Meter)
- **K_φ** Roll Rate/ Roll Stiffness (Newton Meter per Radian)
- **m** Mass of Vehicle (Kilogram)
- **M.R.** Motion Ratio in Suspension
- **r_d** Effective Radius of Wheel (Meter)
- **R_{LF}** Loaded Radius of Front Wheels (Inch)
- **R_{LR}** Loaded Radius of Rear Wheels (Inch)
- **r_w** Wheel Radius in Meter (Meter)
- **s** Contact Point Distance from Wheel Center Axis (Meter)
- **W** Tire Width (Meter)

Constants, Functions, Measurements used in list of Wheel Parameters Formulas above

- **Functions:** **acos**, acos(Number)
The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- **Functions:** **asin**, asin(Number)
The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.
- **Functions:** **cos**, cos(Angle)
Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- **Functions:** **sin**, sin(Angle)
Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- **Functions:** **sqrt**, sqrt(Number)
A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- **Functions:** **tan**, tan(Angle)
The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- **Measurement:** **Length** in Meter (m), Inch (in), Millimeter (mm)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Acceleration** in Meter per Square Second (m/s²)
Acceleration Unit Conversion 
- **Measurement:** **Angle** in Radian (rad), Degree (°)
Angle Unit Conversion 
- **Measurement:** **Surface Tension** in Newton per Meter (N/m)
Surface Tension Unit Conversion 
- **Measurement:** **Torsion Constant** in Newton Meter per Radian (Nm/rad)



- **W_{cs}** Corner Sprung Mass of Vehicle (Kilogram)
- **W_F** Weight of Front Wheels with Rear Elevated (Kilogram)
- **$W.T.$** Wheel Travel (Millimeter)
- **θ** Angle between Traction Force and Horizontal Axis (Radian)
- **θ_a** Angle through which Rear Axle of Vehicle Raised (Degree)
- **θ_s** Angle of Spring/Shock Absorber from Vertical (Degree)
- **Φ** Damper Angle from Vertical (Degree)

Torsion Constant Unit Conversion 



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