

Important Driveline Formulas PDF



Formulas Examples with Units

List of 21 Important Driveline Formulas

1) Aerodynamic Resistance Formula ↻

Formula

$$F'_a = 0.5 \cdot \rho \cdot A \cdot V_c^2 \cdot C_D$$

Example with Units

$$250.0119 \text{ N} = 0.5 \cdot 1.293 \text{ kg/m}^3 \cdot 1.7 \text{ m}^2 \cdot 22 \text{ m/s}^2 \cdot 0.47$$

Evaluate Formula ↻

2) Angular Acceleration of Driven Shaft Formula ↻

Formula

$$\alpha_B = -\omega_B^2 \cdot \cos(\alpha) \cdot \sin(\alpha)^2 \cdot \frac{\sin(2 \cdot \Phi)}{(1 - \cos(\Phi)^2 \cdot \sin(\alpha)^2)^2}$$

Example with Units

$$14.7526 \text{ rad/s}^2 = -62 \text{ rad/s}^2 \cdot \cos(5^\circ) \cdot \sin(5^\circ)^2 \cdot \frac{\sin(2 \cdot 15^\circ)}{(1 - \cos(15^\circ)^2 \cdot \sin(5^\circ)^2)^2}$$

Evaluate Formula ↻

3) Angular Velocity of Driven Shaft Formula ↻

Formula

$$\omega_B = \left(\frac{\cos(\alpha)}{1 - (\cos(\theta))^2 \cdot (\sin(\alpha))^2} \right) \cdot \omega_A$$

Example with Units

$$62.3806 \text{ rad/s} = \left(\frac{\cos(5^\circ)}{1 - (\cos(60^\circ))^2 \cdot (\sin(5^\circ))^2} \right) \cdot 62.5 \text{ rad/s}$$

Evaluate Formula ↻



4) Angular Velocity of Driving Shaft Formula

Formula

Evaluate Formula 

$$\omega_A = \omega_B \cdot \frac{1 - (\cos(\theta))^2 \cdot (\sin(\alpha))^2}{\cos(\alpha)}$$

Example with Units

$$62.1186 \text{ rad/s} = 62 \text{ rad/s} \cdot \frac{1 - (\cos(60^\circ))^2 \cdot (\sin(5^\circ))^2}{\cos(5^\circ)}$$

5) Angular Velocity of Driving Shaft given Angular Acceleration of Driven Shaft Formula

Formula

Evaluate Formula 

$$\omega_B = \sqrt{\frac{\alpha_B \cdot (1 - \cos(\Phi))^2 \cdot \sin(\alpha)^2}{\cos(\alpha) \cdot \sin(\alpha)^2 \cdot \sin(2 \cdot \Phi)}}$$

Example with Units

$$61.9946 \text{ rad/s} = \sqrt{\frac{14.75 \text{ rad/s}^2 \cdot (1 - \cos(15^\circ))^2 \cdot \sin(5^\circ)^2}{\cos(5^\circ) \cdot \sin(5^\circ)^2 \cdot \sin(2 \cdot 15^\circ)}}$$

6) Axial Force of Multiplate Clutch using Uniform Wear Theory Formula

Formula

Evaluate Formula 

$$F_a = \pi \cdot p \cdot D_i \cdot (D_o - D_i) \cdot 0.5$$

Example with Units

$$9424.778 \text{ N} = 3.1416 \cdot 400000 \text{ N/m}^2 \cdot 0.150 \text{ m} \cdot (0.250 \text{ m} - 0.150 \text{ m}) \cdot 0.5$$

7) Drawbar Pull Formula

Formula

Example with Units

Evaluate Formula 

$$D_p = \frac{T_g \cdot R_g \cdot 1000}{r} - F_r$$

$$2854 \text{ N} = \frac{115 \text{ N*mm} \cdot 10 \cdot 1000}{0.4 \text{ m}} - 21 \text{ N}$$

8) Driveline Torque Formula

Formula

Example with Units

Evaluate Formula 

$$T_d = F_x \cdot R_e$$

$$157500 \text{ N*mm} = 450 \text{ N} \cdot 0.35 \text{ m}$$



9) Effective Gear Ratio Formula

Formula

$$G_{\text{eff}} = \frac{D'_o}{D_n} \cdot i_g$$

Example with Units

$$2.7432 = \frac{0.710_m}{0.660_m} \cdot 2.55$$

Evaluate Formula 

10) Engine Torque Formula

Formula

$$T = \frac{9.55 \cdot P_v}{N}$$

Example with Units

$$19100 \text{ N*mm} = \frac{9.55 \cdot 12000_w}{6000}$$

Evaluate Formula 

11) Final Drive Ratio Formula

Formula

$$F = G_{\text{rear}} \cdot O'$$

Example

$$2.6 = 4 \cdot 0.65$$

Evaluate Formula 

12) Gear Step Formula

Formula

$$\varphi = \frac{i_{n-1}}{i_n}$$

Example

$$1.3459 = \frac{4.63}{3.44}$$

Evaluate Formula 

13) Percentage Gradeability of Vehicle Formula

Formula

$$G = \frac{10200 \cdot T_g \cdot R_g}{r \cdot \text{GVW}} - R_r$$

Example with Units

$$5.0167 = \frac{10200 \cdot 115 \text{ N*mm} \cdot 10}{0.4_m \cdot 4500_{\text{kg}}} - 1.5$$

Evaluate Formula 

14) Power Required to Propel Vehicle Formula

Formula

$$P_v = \frac{R_t \cdot V_s}{\eta_t}$$

Example with Units

$$12046.988_w = \frac{495 \text{ N} \cdot 20.2_{\text{m/s}}}{0.83}$$

Evaluate Formula 

15) Torque available at Driving Axle Formula

Formula

$$T_a = T \cdot R_{ta} \cdot R_a$$

Example with Units

$$343227 \text{ N*mm} = 19100 \text{ N*mm} \cdot 3 \cdot 5.99$$

Evaluate Formula 

16) Torque Transmitted by n Friction Surfaces Formula

Formula

$$T_T = \frac{n \cdot \mu \cdot F_a \cdot D_m}{2}$$

Example with Units

$$848230.02 \text{ N*mm} = \frac{6 \cdot 0.3 \cdot 9424.778 \text{ N} \cdot 0.1_m}{2}$$

Evaluate Formula 



17) Torque Transmitted by n Friction Surfaces using Uniform Wear Theory Formula

Formula

$$T_T = 0.5 \cdot n \cdot \mu \cdot F_a \cdot D_m$$

Example with Units

$$848230.02 \text{ N*mm} = 0.5 \cdot 6 \cdot 0.3 \cdot 9424.778 \text{ N} \cdot 0.1 \text{ m}$$

Evaluate Formula 

18) Total Resistance on Vehicle Formula

Formula

$$R_t = F'_a + F_r + F_g$$

Example with Units

$$495 \text{ N} = 85 \text{ N} + 21 \text{ N} + 389 \text{ N}$$

Evaluate Formula 

19) Velocity Ratio of Hooke's Joint Formula

Formula

$$V = \frac{\cos(\alpha)}{1 - \cos(\theta)^2 \cdot \sin(\alpha)^2}$$

Example with Units

$$0.9981 = \frac{\cos(5^\circ)}{1 - \cos(60^\circ)^2 \cdot \sin(5^\circ)^2}$$

Evaluate Formula 

20) Weight on Front Axle Formula

Formula

$$W_f = W - W_r$$

Example with Units

$$5000 \text{ kg} = 10000 \text{ kg} - 5000 \text{ kg}$$

Evaluate Formula 

21) Weight on Rear Axle Formula

Formula

$$W_r = \frac{W \cdot CG_f}{b}$$

Example with Units

$$5000 \text{ kg} = \frac{10000 \text{ kg} \cdot 2.2 \text{ m}}{4.4 \text{ m}}$$

Evaluate Formula 



Variables used in list of Driveline Formulas above

- **A** Frontal Area of Vehicle (Square Meter)
- **b** Wheelbase of Vehicle (Meter)
- **C_D** Coefficient of Drag Exerted By Flow
- **CG_f** CG Distance From Front Axle (Meter)
- **D_i** Inner Diameter of Friction Disc (Meter)
- **D_m** Mean Diameter of Friction Disc (Meter)
- **D_n** New Tire Diameter (Meter)
- **D_o** Outer Diameter of Friction Disc (Meter)
- **D'_o** Old Tire Diameter (Meter)
- **D_p** Drawbar Pull (Newton)
- **F** Final Drive Ratio
- **F_a** Total Axial Load (Newton)
- **F_g** Gradient Resistance (Newton)
- **F_r** Rolling Resistance at Wheel (Newton)
- **F_x** Tractive Force (Newton)
- **F'_a** Aerodynamic Resistance of Vehicle (Newton)
- **G** Gradeability of Vehicle
- **G_{eff}** Effective Gear Ratio
- **G_{rear}** Rear Gear Ratio
- **GVW** Gross Vehicle Weight (Kilogram)
- **i_g** Gear Ratio of Transmission
- **i_n** Gear Ratio Number
- **i_{n-1}** Preceding Lower Gear Ratio Number
- **n** Number of Friction Discs
- **N** Engine Speed in Rpm
- **O'** Overdrive Ratio
- **p** Pressure of Intensity (Newton per Square Meter)
- **P_v** Power Required to Propel a Vehicle (Watt)
- **r** Rolling Radius of Loaded Driving Tire (Meter)
- **R_a** Axle Gear Reduction
- **R_e** Radius of Tire (Meter)

Constants, Functions, Measurements used in list of Driveline Formulas above

- **constant(s):** π , 3.14159265358979323846264338327950288
Archimedes' constant
- **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.
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Area** in Square Meter (m²)
Area Unit Conversion 
- **Measurement:** **Pressure** in Newton per Square Meter (N/m²)
Pressure Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Power** in Watt (W)
Power Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Angle** in Degree (°)
Angle Unit Conversion 
- **Measurement:** **Angular Velocity** in Radian per Second (rad/s)
Angular Velocity Unit Conversion 
- **Measurement:** **Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 
- **Measurement:** **Torque** in Newton Millimeter (N*mm)
Torque Unit Conversion 



- **R_g** Overall Gear Reduction
- **R_t** Total Resistance on Vehicle (*Newton*)
- **R_{ta}** Gear Reduction Through Auxiliary Transmission
- **R_r** Percentage Rolling Resistance
- **T** Engine Torque (*Newton Millimeter*)
- **T_a** Torque Available at Driving Axle (*Newton Millimeter*)
- **T_d** Driveline Torque (*Newton Millimeter*)
- **T_g** Torque Generated (*Newton Millimeter*)
- **T_T** Torque Transmitted (*Newton Millimeter*)
- **V** Velocity Ratio
- **V_c** Cruising Speed of Vehicle (*Meter per Second*)
- **V_s** Speed of Vehicle in Meter per Second (*Meter per Second*)
- **W** Total Weight Being Distributed of Vehicle (*Kilogram*)
- **W_f** Weight on Front Axle (*Kilogram*)
- **W_r** Weight on Rear Axle (*Kilogram*)
- **α** Angle Between Driving And Driven Shafts (*Degree*)
- **α_B** Angular Acceleration of Driven Shaft (*Radian per Square Second*)
- **η_t** Transmission Efficiency of Vehicle
- **θ** Angle Rotated By Driving Shaft (*Degree*)
- **μ** Coefficient of Friction Disc
- **ρ** Density of Air (*Kilogram per Cubic Meter*)
- **ϕ** Gear Step
- **Φ** Angle Rotated By Driven Shaft (*Degree*)
- **ω_A** Angular Velocity of Driving Shaft (*Radian per Second*)
- **ω_B** Angular Velocity of Driven Shaft (*Radian per Second*)

- **Measurement: Angular Acceleration** in Radian per Square Second (rad/s^2)
Angular Acceleration Unit Conversion 



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