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Driveline Formulas

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List of 20 Driveline Formulas

Driveline

1) Aerodynamic Resistance

Open Calculator

fx $F_{ar} = 0.5 \cdot \rho \cdot A \cdot V_c^2 \cdot C_D$

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

2) Angular Acceleration of Driven Shaft

Open Calculator

fx

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

ex

$$14.75256\text{rad/s}^2 = -(62\text{rad/s})^2 \cdot \cos(5^\circ) \cdot \sin(5^\circ)^2 \cdot \frac{\sin(2 \cdot 15^\circ)}{\left(1 - \cos(15^\circ)^2 \cdot \sin(5^\circ)^2\right)^2}$$

3) Axial Force of Multiplate Clutch using Uniform Wear Theory

Open Calculator

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

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

4) Drawbar Pull

Open Calculator

$$Dp = \frac{T_g \cdot R_{Gear} \cdot 1000}{r} - F_r$$

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

5) Effective Gear Ratio

Open Calculator

$$Gr_{eff} = \frac{D_{old}}{D_{new}} \cdot i_g$$

$$2.743182 = \frac{0.710\text{m}}{0.660\text{m}} \cdot 2.55$$

6) Engine Torque

Open Calculator

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

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

7) Final Drive Ratio

Open Calculator

$$F = Gr_{rear} \cdot Or$$

$$2.6 = 4 \cdot 0.65$$

8) Gear Step

Open Calculator

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

$$1.34593 = \frac{4.63}{3.44}$$

9) Percentage Gradeability of Vehicle

Open Calculator

$$G = \frac{10200 \cdot T_g \cdot R_{Gear}}{r \cdot GVW} - Rr$$

$$5.016667 = \frac{10200 \cdot 115\text{N*mm} \cdot 10}{0.4\text{m} \cdot 4500\text{kg}} - 1.5$$

10) Power Required to Propel Vehicle

Open Calculator

$$P_v = \frac{R_{Total} \cdot V_s}{\eta_t}$$

$$12046.99\text{W} = \frac{495\text{N} \cdot 20.2\text{m/s}}{0.83}$$

11) Total Resistance on Vehicle

Open Calculator

$$R_{Total} = F_{ar} + F_r + F_g$$

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

12) Velocity Ratio of Hooke's Joint

Open Calculator

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

ex $$0.99809 = \frac{\cos(5^\circ)}{1 - (\cos(60^\circ))^2 \cdot (\sin(5^\circ))^2}$$

13) Weight on Front Axle

Open Calculator

fx $$W_f = W - W_r$$

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

14) Weight on Rear Axle

Open Calculator

fx $$W_r = \frac{W \cdot CGf}{b}$$

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

Driveline Angular Velocity

15) Angular Velocity of Driven Shaft

Open Calculator

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

ex $$62.38063\text{rad/s} = \left(\frac{\cos(5^\circ)}{1 - (\cos(60^\circ))^2 \cdot (\sin(5^\circ))^2}\right) \cdot 62.5\text{rad/s}$$

16) Angular Velocity of Driving Shaft

Open Calculator

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

ex $$62.11864\text{rad/s} = \frac{62\text{rad/s}}{\frac{\cos(5^\circ)}{1-(\cos(60^\circ))^2\cdot(\sin(5^\circ))^2}}$$

17) Angular Velocity of Driving Shaft given Angular Acceleration of Driven Shaft

Open Calculator

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

ex $$61.99461\text{rad/s} = \sqrt{\frac{14.75\text{rad/s}^2 \cdot \left(1-\cos(15^\circ)^2\cdot\sin(5^\circ)^2\right)^2}{\cos(5^\circ)\cdot\sin(5^\circ)^2\cdot\sin(2\cdot 15^\circ)}}$$

Driveline Torque

18) Torque available at Driving Axle

Open Calculator

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

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

19) Torque Transmitted by n Friction Surfaces

Open Calculator

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

$$848230\text{N*mm} = \frac{6 \cdot 0.3 \cdot 9424.778\text{N} \cdot 0.1\text{m}}{2}$$

20) Torque Transmitted by n Friction Surfaces using Uniform Wear Theory

Open Calculator

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

$$848230\text{N*mm} = 0.5 \cdot 6 \cdot 0.3 \cdot 9424.778\text{N} \cdot 0.1\text{m}$$

Variables Used

- **A** Frontal Area of Vehicle *(Square Meter)*
- **b** Wheelbase of Vehicle *(Meter)*
- **C_D** Coefficient of Drag Exerted by Flow
- **CGf** CG Distance from Front Axle *(Meter)*
- **D_i** Inner Diameter of Friction Disc *(Meter)*
- **D_m** Mean Diameter of Friction Disc *(Meter)*
- **D_{new}** New Tire Diameter *(Meter)*
- **D_o** Outer Diameter of Friction Disc *(Meter)*
- **D_{old}** Old Tire Diameter *(Meter)*
- **Dp** Drawbar Pull *(Newton)*
- **F** Final Drive Ratio
- **F_a** Total Axial Load *(Newton)*
- **F_{ar}** Aerodynamic Resistance of Vehicle *(Newton)*
- **F_g** Gradient Resistance *(Newton)*
- **F_r** Rolling Resistance at Wheel *(Newton)*
- **G** Gradeability of Vehicle
- **Gr_{eff}** Effective Gear Ratio
- **Gr_{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

- **Or** 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_{Gear} Overall Gear Reduction
- R_{ta} Gear Reduction through Auxiliary Transmission
- R_{Total} Total Resistance on Vehicle *(Newton)*
- **Rr** Percentage Rolling Resistance
- **T** Engine Torque *(Newton Millimeter)*
- T_a Torque available at Driving Axle *(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)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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
- Measurement: **Angular Acceleration** in Radian per Square Second (rad/s²)
  Angular Acceleration Unit Conversion

Check other formula lists

- **Driveline Formulas**
- **Suspension Geometry Formulas**
- **Vehicle Collision Formulas**

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