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Belt Drive Formulas

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List of 20 Belt Drive Formulas

Belt Drive

1) Angle Made by Belt with Vertical Axis for Cross Belt Drive

$$\text{fx } \alpha = \frac{r_2 + r_1}{x}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 0.523732\text{rad} = \frac{6\text{m} + 10\text{m}}{30.55\text{m}}$$

2) Angle Made by Belt with Vertical Axis for Open Belt Drive

$$\text{fx } \alpha = \frac{r_1 - r_2}{x}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 0.130933\text{rad} = \frac{10\text{m} - 6\text{m}}{30.55\text{m}}$$

3) Angle of Contact for Cross Belt Drive

$$\text{fx } \theta_c = 180 \cdot \frac{\pi}{180} + 2 \cdot \alpha$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 4.187593\text{rad} = 180 \cdot \frac{\pi}{180} + 2 \cdot 0.523\text{rad}$$



4) Angle of Contact for Open Belt Drive

$$fx \quad \theta_c = 180 \cdot \frac{\pi}{180} - 2 \cdot \alpha$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 2.095593\text{rad} = 180 \cdot \frac{\pi}{180} - 2 \cdot 0.523\text{rad}$$

5) Centrifugal Tension in Belt

$$fx \quad T_c = m \cdot v$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 72.45689\text{N} = 21\text{kg} \cdot 3.450328\text{m/s}$$

6) Cross Belt Drive Length

$$fx \quad L_b = \pi \cdot (r_2 + r_1) + 2 \cdot x + \frac{(r_2 + r_1)^2}{x}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 119.7452\text{m} = \pi \cdot (6\text{m} + 10\text{m}) + 2 \cdot 30.55\text{m} + \frac{(6\text{m} + 10\text{m})^2}{30.55\text{m}}$$


7) Frictional Force in V Belt Drive

$$fx \quad F_f = \mu_b \cdot R \cdot \cos ec \left(\frac{\beta}{2} \right)$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 17.50424\text{N} = 0.3 \cdot 15\text{N} \cdot \cos ec \left(\frac{0.52\text{rad}}{2} \right)$$



8) Initial Tension in Belt 

$$fx \quad T_o = \frac{T_1 + T_2 + 2 \cdot T_c}{2}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 266.5N = \frac{22N + 11N + 2 \cdot 250N}{2}$$

9) Length of Belt that Passes over Driver 

$$fx \quad L_o = \pi \cdot d_1 \cdot N_d$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 0.201062m = \pi \cdot 0.12m \cdot 32rev/min$$

10) Length of Belt that Passes over Follower 

$$fx \quad L_f = \pi \cdot N_f \cdot d_2$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 0.088488m = \pi \cdot 26rev/min \cdot 0.065m$$

11) Length of Open Belt Drive 

$$fx \quad L'_b = \pi \cdot (r_2 + r_1) + 2 \cdot x + \frac{(r_1 - r_2)^2}{x}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 111.8892m = \pi \cdot (6m + 10m) + 2 \cdot 30.55m + \frac{(10m - 6m)^2}{30.55m}$$

12) Maximum Tension for Transmission of Maximum Power by Belt 

$$fx \quad P_m = 3 \cdot T_c$$

[Open Calculator !\[\]\(40770d9ed6ed4f1222ebf89a1396e8b2_img.jpg\)](#)

$$ex \quad 750N = 3 \cdot 250N$$



13) Maximum Tension of Belt

$$fx \quad P_m = \sigma \cdot b \cdot t$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 750.036N = 8.929N/mm^2 \cdot 0.028m \cdot 0.003m$$

14) Normal Reaction between Belt and Sides of Groove

$$fx \quad R_n = \frac{R}{2 \cdot \sin\left(\frac{\beta}{2}\right)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 29.17374N = \frac{15N}{2 \cdot \sin\left(\frac{0.52rad}{2}\right)}$$

15) Power Transmitted by Belt

$$fx \quad P = (T_1 - T_2) \cdot v$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 0.037954kW = (22N - 11N) \cdot 3.450328m/s$$


16) Relation between Pitch and Pitch Circle Diameter of Chain Drive

$$fx \quad d_p = P_c \cdot \cos ec\left(\frac{180 \cdot \frac{\pi}{180}}{t_s}\right)$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$ex \quad 0.478339m = 0.05m \cdot \cos ec\left(\frac{180 \cdot \frac{\pi}{180}}{30}\right)$$




17) Torque Exerted on Driven Pulley 

$$\text{fx } \tau = (T_1 - T_2) \cdot \frac{d_f}{2}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$\text{ex } 0.077\text{N}\cdot\text{m} = (22\text{N} - 11\text{N}) \cdot \frac{0.014\text{m}}{2}$$

18) Torque Exerted on Driving Pulley 

$$\text{fx } \tau = (T_1 - T_2) \cdot \frac{d_d}{2}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)


$$\text{ex } 0.077\text{N}\cdot\text{m} = (22\text{N} - 11\text{N}) \cdot \frac{0.0140\text{m}}{2}$$

19) Total Percentage Slip in Belt 

$$\text{fx } s = s_1 + s_2$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)

$$\text{ex } 0.7 = 0.5 + 0.2$$

20) Velocity for Transmission of Maximum Power by Belt 

$$\text{fx } v = \sqrt{\frac{P_m}{3 \cdot m}}$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

$$\text{ex } 3.450328\text{m/s} = \sqrt{\frac{750\text{N}}{3 \cdot 21\text{kg}}}$$



Variables Used







- **b** Belt Width (Meter)
- **d₁** Diameter of Driver Pulley (Meter)
- **d₂** Diameter of Follower Pulley (Meter)
- **d_d** Diameter of Driver (Meter)
- **d_f** Diameter of Follower (Meter)
- **d_p** Pitch Circle Diameter of Gear (Meter)
- **F_f** Force of Friction (Newton)
- **L_b** Length Measurement Belt Drive (Meter)
- **L'_b** Total Length of Belt (Meter)
- **L_f** Length of Belt Over Follower (Meter)
- **L_o** Length of Belt Over Driver (Meter)
- **m** Mass of Belt Per Unit Length (Kilogram)
- **N_d** Speed of Driver (Revolution per Minute)
- **N_f** Speed of Follower (Revolution per Minute)
- **P** Power Transmitted (Kilowatt)
- **P_c** Pitch of Chain Drive (Meter)
- **P_m** Maximum Tension of Belt (Newton)
- **R** Total Reaction in Plane of Groove (Newton)
- **r₁** Radius of Larger Pulley (Meter)
- **r₂** Radius of Smaller Pulley (Meter)
- **R_n** Normal Reaction Between Belt And Sides of Groove (Newton)






- **S** Total Percentage of Slip
- **S₁** Slip Between Driver And Belt
- **S₂** Slip Between Belt And Follower
- **t** Belt Thickness (*Meter*)
- **T₁** Tension in Tight Side of Belt (*Newton*)
- **T₂** Tension in Slack Side of Belt (*Newton*)
- **T_c** Centrifugal Tension of Belt (*Newton*)
- **T_o** Initial Tension of Belt (*Newton*)
- **t_s** Number of Teeth on Sprocket
- **v** Velocity of Belt (*Meter per Second*)
- **x** Distance Between Centers of Two Pulleys (*Meter*)
- **α** Angle Made By Belt With Vertical Axis (*Radian*)
- **β** Angle of Groove (*Radian*)
- **θ_c** Angle of Contact (*Radian*)
- **μ_b** Coefficient of Friction b/w Belt & Sides of Groove
- **σ** Maximum Safe Stress (*Newton per Square Millimeter*)
- **T** Torque Exerted on Pulley (*Newton Meter*)



Constants, Functions, Measurements used


- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **cosec**, cosec(Angle)
The cosecant function is a trigonometric function that is the reciprocal of the sine function.
- **Function:** **sec**, sec(Angle)
Secant is a trigonometric function that is defined ratio of the hypotenuse to the shorter side adjacent to an acute angle (in a right-angled triangle); the reciprocal of a cosine.
- **Function:** **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.
- **Function:** **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:** **Pressure** in Newton per Square Millimeter (N/mm²)
Pressure Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Power** in Kilowatt (kW)
Power Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 



- **Measurement: Angle** in Radian (rad)
Angle Unit Conversion 
- **Measurement: Frequency** in Revolution per Minute (rev/min)
Frequency Unit Conversion 
- **Measurement: Torque** in Newton Meter (N*m)
Torque Unit Conversion 



Check other formula lists

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- [Velocity Ratio Formulas](#) 

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