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Design of Belt Drives Formulas

Calculators! Examples! Conversions!

List of 106 Design of Belt Drives Formulas

Design of Belt Drives

Arms of Cast Iron Pulley

1) Bending Moment on Arm of Belt Driven Pulley

Open Calculator

fx $$M_b = P \cdot R$$

ex $$44400\text{N*mm} = 300\text{N} \cdot 148\text{mm}$$

2) Bending Moment on Arm of Belt Driven Pulley given Bending Stress in Arm

Open Calculator

fx $$M_b = I \cdot \frac{\sigma_b}{a}$$

ex $$37468.89\text{N*mm} = 17350\text{mm}^4 \cdot \frac{29.5\text{N/mm}^2}{13.66\text{mm}}$$

3) Bending Moment on Arm of Belt Driven Pulley given Torque Transmitted by Pulley

Open Calculator

fx $$M_b = 2 \cdot \frac{M_t}{N_{pu}}$$

ex $$37500\text{N*mm} = 2 \cdot \frac{75000\text{N*mm}}{4}$$

4) Bending Stress in Arm of Belt Driven Pulley

Open Calculator

fx $$\sigma_b = M_b \cdot \frac{a}{I}$$

ex $$27.16254\text{N/mm}^2 = 34500\text{N*mm} \cdot \frac{13.66\text{mm}}{17350\text{mm}^4}$$

5) Bending Stress in Arm of Belt Driven Pulley given Torque Transmitted by Pulley

Open Calculator

fx $$\sigma_b = 16 \cdot \frac{M_t}{\pi \cdot N_{pu} \cdot a^3}$$

ex $$37.46444\text{N/mm}^2 = 16 \cdot \frac{75000\text{N*mm}}{\pi \cdot 4 \cdot (13.66\text{mm})^3}$$

6) Major Axis of Elliptical Cross-Section of Pulley's Arm given Moment of Inertia of Arm

Open Calculator

fx $$b_a = \left(64 \cdot \frac{I}{\pi \cdot a}\right)^{\frac{1}{3}}$$

ex $$29.57737\text{mm} = \left(64 \cdot \frac{17350\text{mm}^4}{\pi \cdot 13.66\text{mm}}\right)^{\frac{1}{3}}$$

7) Minor Axis of Elliptical Cross-Section of Arm given Moment of Inertia of Arm

Open Calculator

fx $$a = 64 \cdot \frac{I}{\pi \cdot b_a^3}$$

ex $$13.6287\text{mm} = 64 \cdot \frac{17350\text{mm}^4}{\pi \cdot (29.6\text{mm})^3}$$

8) Minor Axis of Elliptical Cross-Section of Pulley's Arm given Bending Stress in Arm

Open Calculator

fx $$a = 1.72 \cdot \left(\left(\frac{M_b}{2 \cdot \sigma_b}\right)^{\frac{1}{3}}\right)$$

ex $$14.38304\text{mm} = 1.72 \cdot \left(\left(\frac{34500\text{N*mm}}{2 \cdot 29.5\text{N/mm}^2}\right)^{\frac{1}{3}}\right)$$

9) Minor Axis of Elliptical Cross-Section of Pulley's Arm given Moment of Inertia of Arm

Open Calculator

fx $$a = \left(8 \cdot \frac{I}{\pi}\right)^{\frac{1}{4}}$$

ex $$14.49806\text{mm} = \left(8 \cdot \frac{17350\text{mm}^4}{\pi}\right)^{\frac{1}{4}}$$

10) Minor Axis of Elliptical Cross-Section of Pulley's Arm given Torque and Bending Stress

Open Calculator

fx $$a = \left(16 \cdot \frac{M_t}{\pi \cdot N_{pu} \cdot \sigma_b}\right)^{\frac{1}{3}}$$

ex $$14.79278\text{mm} = \left(16 \cdot \frac{75000\text{N*mm}}{\pi \cdot 4 \cdot 29.5\text{N/mm}^2}\right)^{\frac{1}{3}}$$

11) Moment of Inertia of Pulley's Arm

Open Calculator

fx $$I = \frac{\pi \cdot a \cdot b_a^3}{64}$$

ex $$17389.85\text{mm}^4 = \frac{\pi \cdot 13.66\text{mm} \cdot (29.6\text{mm})^3}{64}$$

12) Moment of Inertia of Pulley's Arm given Bending Stress in Arm

Open Calculator

fx $$I = M_b \cdot \frac{a}{\sigma_b}$$

ex $$15975.25\text{mm}^4 = 34500\text{N*mm} \cdot \frac{13.66\text{mm}}{29.5\text{N/mm}^2}$$

13) Moment of Inertia of Pulley's Arm given Minor Axis of Elliptical Section Arm

Open Calculator

fx $$I = \pi \cdot \frac{a^4}{8}$$

ex $$13672.96\text{mm}^4 = \pi \cdot \frac{(13.66\text{mm})^4}{8}$$

14) Number of Arms of Pulley given Bending Moment on Arm

Open Calculator

fx $$N_{pu} = 2 \cdot \frac{M_t}{M_b}$$

ex $$4.347826 = 2 \cdot \frac{75000\text{N*mm}}{34500\text{N*mm}}$$

15) Number of Arms of Pulley given Bending Stress in Arm

Open Calculator

$$N_{pu} = 16 \cdot \frac{M_t}{\pi \cdot \sigma_b \cdot a^3}$$

$$5.079925 = 16 \cdot \frac{75000\text{N*mm}}{\pi \cdot 29.5\text{N/mm²} \cdot (13.66\text{mm})^3}$$

16) Number of Arms of Pulley given Torque Transmitted by Pulley

Open Calculator

$$N_{pu} = 2 \cdot \frac{M_t}{P \cdot R}$$

$$3.378378 = 2 \cdot \frac{75000\text{N*mm}}{300\text{N} \cdot 148\text{mm}}$$

17) Radius of Rim of Pulley given Bending Moment Acting on Arm

Open Calculator

$$R = \frac{M_b}{P}$$

$$115\text{mm} = \frac{34500\text{N*mm}}{300\text{N}}$$

18) Radius of Rim of Pulley given Torque Transmitted by Pulley

Open Calculator

$$R = \frac{M_t}{P \cdot \left(\frac{N_{pu}}{2}\right)}$$

$$125\text{mm} = \frac{75000\text{N*mm}}{300\text{N} \cdot \left(\frac{4}{2}\right)}$$

19) Tangential Force at End of Each Arm of Pulley given Bending Moment on Arm

Open Calculator

$$P = \frac{M_b}{R}$$

$$233.1081\text{N} = \frac{34500\text{N*mm}}{148\text{mm}}$$

20) Tangential Force at End of Each Arm of Pulley given Torque Transmitted by Pulley

Open Calculator

fx $$P = \frac{M_t}{R \cdot \left(\frac{N_{pu}}{2}\right)}$$

ex $$253.3784\text{N} = \frac{75000\text{N*mm}}{148\text{mm} \cdot \left(\frac{4}{2}\right)}$$

21) Torque Transmitted by Pulley

Open Calculator

fx $$M_t = P \cdot R \cdot \left(\frac{N_{pu}}{2}\right)$$

ex $$88800\text{N*mm} = 300\text{N} \cdot 148\text{mm} \cdot \left(\frac{4}{2}\right)$$

22) Torque Transmitted by Pulley given Bending Moment on Arm

Open Calculator

fx $$M_t = M_b \cdot \frac{N_{pu}}{2}$$

ex $$69000\text{N*mm} = 34500\text{N*mm} \cdot \frac{4}{2}$$

23) Torque Transmitted by Pulley given Bending Stress in Arm

Open Calculator

fx $$M_t = \sigma_b \cdot \frac{\pi \cdot N_{pu} \cdot a^3}{16}$$

ex $$59056\text{N*mm} = 29.5\text{N/mm}^2 \cdot \frac{\pi \cdot 4 \cdot (13.66\text{mm})^3}{16}$$

Crossed Belt Drives

24) Belt Length for Cross Belt Drive

Open Calculator

fx $$L = 2 \cdot C + \left(\pi \cdot \frac{d + D}{2} \right) + \left(\frac{(D - d)^2}{4 \cdot C} \right)$$

ex $$4942.023\text{mm} = 2 \cdot 1600\text{mm} + \left(\pi \cdot \frac{270\text{mm} + 810\text{mm}}{2} \right) + \left(\frac{(810\text{mm} - 270\text{mm})^2}{4 \cdot 1600\text{mm}} \right)$$

25) Center Distance given Wrap Angle for Small Pulley of Cross Belt Drive

Open Calculator

fx $$C = \frac{D + d}{2 \cdot \sin\left(\frac{\alpha_a - 3.14}{2} \right)}$$

ex $$1575.408\text{mm} = \frac{810\text{mm} + 270\text{mm}}{2 \cdot \sin\left(\frac{220^\circ - 3.14}{2} \right)}$$

26) Diameter of Big Pulley given Wrap Angle for Small Pulley of Cross Belt Drive

Open Calculator

fx $$D = \left(2 \cdot \sin\left(\frac{\alpha_a - 3.14}{2} \right) \cdot C \right) - d$$

ex $$826.8587\text{mm} = \left(2 \cdot \sin\left(\frac{220^\circ - 3.14}{2} \right) \cdot 1600\text{mm} \right) - 270\text{mm}$$

27) Diameter of Small Pulley given Wrap Angle for Small Pulley of Cross Belt Drive

Open Calculator

fx $$d = \left(2 \cdot C \cdot \sin\left(\frac{\alpha_a - 3.14}{2} \right) \right) - D$$

ex $$286.8587\text{mm} = \left(2 \cdot 1600\text{mm} \cdot \sin\left(\frac{220^\circ - 3.14}{2} \right) \right) - 810\text{mm}$$

28) Wrap Angle for Small Pulley of Cross Belt Drive

Open Calculator

fx $$\alpha_a = 3.14 + \left(2 \cdot a\sin\left(\frac{D + d}{2 \cdot C}\right)\right)$$

ex $$219.358^\circ = 3.14 + \left(2 \cdot a\sin\left(\frac{810\text{mm} + 270\text{mm}}{2 \cdot 1600\text{mm}}\right)\right)$$

Introduction of Belt Drives

29) Angle of Wrap given Belt Tension in Tight Side

Open Calculator

fx $$\alpha = \frac{\ln\left(\frac{P_1 - m \cdot v_b^2}{P_2 - (m \cdot v_b^2)}\right)}{\mu}$$

ex $$160.3553^\circ = \frac{\ln\left(\frac{800\text{N} - 0.6\text{kg/m} \cdot (25.81\text{m/s})^2}{550\text{N} - \left(0.6\text{kg/m} \cdot (25.81\text{m/s})^2\right)}\right)}{0.35}$$

30) Belt Tension in Loose Side of Belt given Tension in Tight Side

Open Calculator

fx $$P_2 = \left(\frac{P_1 - (m \cdot v_b^2)}{e^{\mu \cdot \alpha}}\right) + (m \cdot v_b^2)$$

ex $$550.1426\text{N} = \left(\frac{800\text{N} - \left(0.6\text{kg/m} \cdot (25.81\text{m/s})^2\right)}{e^{0.35 \cdot 160.2^\circ}}\right) + \left(0.6\text{kg/m} \cdot (25.81\text{m/s})^2\right)$$

31) Belt tension in tight side

Open Calculator

fx $$P_1 = \left(\left(e^{\mu \cdot \alpha}\right) \cdot (P_2 - (m \cdot v_b^2))\right) + (m \cdot v_b^2)$$

ex $$799.6205\text{N} = \left(\left(e^{0.35 \cdot 160.2^\circ}\right) \cdot \left(550\text{N} - \left(0.6\text{kg/m} \cdot (25.81\text{m/s})^2\right)\right)\right) + \left(0.6\text{kg/m} \cdot (25.81\text{m/s})^2\right)$$

32) Center Distance from Small Pulley to Big Pulley given Wrap Angle of Big Pulley

Open Calculator

fx $$C = \frac{D - d}{2 \cdot \sin\left(\frac{\alpha_b - 3.14}{2}\right)}$$

ex $$1547.878\text{mm} = \frac{810\text{mm} - 270\text{mm}}{2 \cdot \sin\left(\frac{200^\circ - 3.14}{2}\right)}$$

33) Center Distance from Small Pulley to Big Pulley given Wrap Angle of Small Pulley

Open Calculator

fx $$C = \frac{D - d}{2 \cdot \sin\left(\frac{3.14 - \alpha_s}{2}\right)}$$

ex $$3126.36\text{mm} = \frac{810\text{mm} - 270\text{mm}}{2 \cdot \sin\left(\frac{3.14 - 170.0^\circ}{2}\right)}$$

34) Coefficient of Friction in between Surfaces given Belt Tension in Tight Side

Open Calculator

fx $$\mu = \frac{\ln\left(\frac{P_1 - m \cdot v_b^2}{P_2 - m \cdot v_b^2}\right)}{\alpha}$$

ex $$0.350339 = \frac{\ln\left(\frac{800\text{N} - 0.6\text{kg/m} \cdot (25.81\text{m/s})^2}{550\text{N} - 0.6\text{kg/m} \cdot (25.81\text{m/s})^2}\right)}{160.2^\circ}$$

35) Diameter of Big Pulley given Wrap Angle for Big Pulley

Open Calculator

fx $$D = d + \left(2 \cdot C \cdot \sin\left(\frac{\alpha_b - 3.14}{2}\right)\right)$$

ex $$828.1835\text{mm} = 270\text{mm} + \left(2 \cdot 1600\text{mm} \cdot \sin\left(\frac{200^\circ - 3.14}{2}\right)\right)$$

36) Diameter of Big Pulley given Wrap Angle of Small Pulley

Open Calculator

fx $$D = d + \left(2 \cdot C \cdot \sin\left(\frac{3.14 - \alpha_s}{2}\right)\right)$$

ex $$546.3597\text{mm} = 270\text{mm} + \left(2 \cdot 1600\text{mm} \cdot \sin\left(\frac{3.14 - 170.0^\circ}{2}\right)\right)$$

37) Diameter of Small Pulley given Wrap Angle of Big Pulley

Open Calculator

fx $$d = D - \left(2 \cdot C \cdot \sin\left(\frac{\alpha_b - 3.14}{2}\right)\right)$$

ex $$251.8165\text{mm} = 810\text{mm} - \left(2 \cdot 1600\text{mm} \cdot \sin\left(\frac{200^\circ - 3.14}{2}\right)\right)$$

38) Diameter of Small Pulley given Wrap Angle of Small Pulley

Open Calculator

fx $$d = D - \left(2 \cdot C \cdot \sin\left(\frac{3.14 - \alpha_s}{2}\right)\right)$$

ex $$533.6403\text{mm} = 810\text{mm} - \left(2 \cdot 1600\text{mm} \cdot \sin\left(\frac{3.14 - 170.0^\circ}{2}\right)\right)$$

39) Length of Belt

Open Calculator

fx $$L = (2 \cdot C) + \left(\pi \cdot \frac{D + d}{2}\right) + \left(\frac{(D - d)^2}{4 \cdot C}\right)$$

ex $$4942.023\text{mm} = (2 \cdot 1600\text{mm}) + \left(\pi \cdot \frac{810\text{mm} + 270\text{mm}}{2}\right) + \left(\frac{(810\text{mm} - 270\text{mm})^2}{4 \cdot 1600\text{mm}}\right)$$

40) Mass per unit length of belt

Open Calculator

fx $$m = \frac{P_1 - \left(\left(e^{\mu \cdot \alpha}\right) \cdot P_2\right)}{\left(v_b^2\right) \cdot \left(1 - \left(e^{\mu \cdot \alpha}\right)\right)}$$

ex $$0.599657\text{kg/m} = \frac{800\text{N} - \left(\left(e^{0.35 \cdot 160.2^\circ}\right) \cdot 550\text{N}\right)}{\left((25.81\text{m/s})^2\right) \cdot \left(1 - \left(e^{0.35 \cdot 160.2^\circ}\right)\right)}$$

41) Velocity of belt given tension of belt in tight side

Open Calculator

fx $$v_b = \sqrt{\frac{\left(\left(e^{\mu \cdot \alpha}\right) \cdot P_2\right) - P_1}{m \cdot \left(\left(e^{\mu \cdot \alpha}\right) - 1\right)}}$$

ex $$25.80262 \text{m/s} = \sqrt{\frac{\left(\left(e^{0.35 \cdot 160.2^\circ}\right) \cdot 550\text{N}\right) - 800\text{N}}{0.6\text{kg/m} \cdot \left(\left(e^{0.35 \cdot 160.2^\circ}\right) - 1\right)}}$$

42) Wrap Angle for Big Pulley

Open Calculator

fx $$\alpha_b = 3.14 + \left(2 \cdot \left(a \sin\left(\frac{D - d}{2 \cdot C}\right)\right)\right)$$

ex $$199.339^\circ = 3.14 + \left(2 \cdot \left(a \sin\left(\frac{810\text{mm} - 270\text{mm}}{2 \cdot 1600\text{mm}}\right)\right)\right)$$

43) Wrap Angle for Small Pulley

Open Calculator

fx $$\alpha_s = 3.14 - \left(2 \cdot \left(a \sin\left(\frac{D - d}{2 \cdot C}\right)\right)\right)$$

ex $$160.4784^\circ = 3.14 - \left(2 \cdot \left(a \sin\left(\frac{810\text{mm} - 270\text{mm}}{2 \cdot 1600\text{mm}}\right)\right)\right)$$

Maximum Power Conditions

44) Actual Power Transmitted given Power Transmitted by Flat for Design Purpose

Open Calculator

fx $$P_t = \frac{P_d}{F_a}$$

ex $$6.443478\text{kW} = \frac{7.41\text{kW}}{1.15}$$

45) Belt Tension in Loose Side of Belt given Initial Tension in Belt

Open Calculator

fx $$P_2 = 2 \cdot P_i - P_1$$

ex $$550\text{N} = 2 \cdot 675\text{N} - 800\text{N}$$

46) Belt Tension in Tight Side of Belt given Initial Tension in Belt

Open Calculator

fx $P_1 = 2 \cdot P_i - P_2$

ex $800N = 2 \cdot 675N - 550N$

47) Belt Tension in Tight Side of Belt given Tension due to Centrifugal Force

Open Calculator

fx $P_1 = 2 \cdot T_b$

ex $800N = 2 \cdot 400N$

48) Belt Velocity given Tension in Belt Due to Centrifugal Force

Open Calculator

fx $v_b = \sqrt{\frac{T_b}{m}}$

ex $25.81989m/s = \sqrt{\frac{400N}{0.6kg/m}}$

49) Initial Tension in Belt Drive

Open Calculator

fx $P_i = \frac{P_1 + P_2}{2}$

ex $675N = \frac{800N + 550N}{2}$

50) Initial Tension in Belt given Velocity of Belt for Maximum Power Transmission

Open Calculator

fx $P_i = 3 \cdot m \cdot v_o^2$

ex $674.6573N = 3 \cdot 0.6kg/m \cdot (19.36m/s)^2$

51) Load Correction Factor given Power Transmitted by Flat Belt for Design Purpose

Open Calculator

fx $F_a = \frac{P_d}{P_t}$

ex $1.148837 = \frac{7.41kW}{6.45kW}$

52) Mass of One Meter Length of Belt given Maximum Permissible Tensile Stress of Belt

Open Calculator

fx $m = \frac{P_{max}}{3 \cdot v_o^2}$

ex $1.067209\text{kg/m} = \frac{1200\text{N}}{3 \cdot (19.36\text{m/s})^2}$

53) Mass of One Meter Length of Belt given Tension in Belt Due to Centrifugal Force

Open Calculator

fx $m = \frac{T_b}{v_b^2}$

ex $0.60046\text{kg/m} = \frac{400\text{N}}{(25.81\text{m/s})^2}$

54) Mass of One Meter Length of Belt given Velocity for Maximum Power Transmission

Open Calculator

fx $m = \frac{P_i}{3} \cdot v_o^2$

ex $84332.16\text{kg/m} = \frac{675\text{N}}{3} \cdot (19.36\text{m/s})^2$

55) Maximum Belt Tension

Open Calculator

fx $P_{max} = \sigma \cdot b \cdot t$

ex $793.8\text{N} = 1.26\text{N/mm}^2 \cdot 126\text{mm} \cdot 5\text{mm}$

56) Maximum Belt Tension given Tension Due to Centrifugal Force

Open Calculator

fx $P_{max} = 3 \cdot T_b$

ex $1200\text{N} = 3 \cdot 400\text{N}$

57) Maximum Permissible Tensile Stress of Belt Material

Open Calculator

fx $\sigma = \frac{P_{max}}{b \cdot t}$

ex $1.904762\text{N/mm}^2 = \frac{1200\text{N}}{126\text{mm} \cdot 5\text{mm}}$

58) Optimum Velocity of Belt for Maximum Power Transmission

Open Calculator

fx $$v_o = \sqrt{\frac{P_i}{3 \cdot m}}$$

ex $$19.36492\text{m/s} = \sqrt{\frac{675\text{N}}{3 \cdot 0.6\text{kg/m}}}$$

59) Power Transmitted by Flat Belt for Design Purpose

Open Calculator

fx $$P_d = P_t \cdot F_a$$

ex $$7.4175\text{kW} = 6.45\text{kW} \cdot 1.15$$

60) Tension in Belt Due to Centrifugal Force

Open Calculator

fx $$T_b = m \cdot v_b^2$$

ex $$399.6937\text{N} = 0.6\text{kg/m} \cdot (25.81\text{m/s})^2$$

61) Tension in Belt Due to Centrifugal Force given Permissible Tensile Stress of Belt Material

Open Calculator

fx $$T_b = \frac{P_{max}}{3}$$

ex $$400\text{N} = \frac{1200\text{N}}{3}$$

62) Thickness of Belt given Maximum Belt Tension

Open Calculator

fx $$t = \frac{P_{max}}{\sigma \cdot b}$$

ex $$7.558579\text{mm} = \frac{1200\text{N}}{1.26\text{N/mm}^2 \cdot 126\text{mm}}$$

63) Velocity of Belt for Maximum Power Transmission given Maximum Permissible tensile Stress

Open Calculator

fx $v_o = \sqrt{\frac{P_{max}}{3 \cdot m}}$

ex $15.49193\text{m/s} = \sqrt{\frac{1200\text{N}}{3 \cdot 0.6\text{kg/m}}}$

64) Width of Belt given Maximum Belt Tension

Open Calculator

fx $b = \frac{P_{max}}{\sigma \cdot t}$

ex $190.4762\text{mm} = \frac{1200\text{N}}{1.26\text{N/mm}^2 \cdot 5\text{mm}}$

Synchronous Belt Drives

65) Datum length of synchronous belt

Open Calculator

fx $l = P_c \cdot z$

ex $1200\text{mm} = 15\text{mm} \cdot 80$

66) Distance from Belt pitch line to Pulley tip circle radius

Open Calculator

fx $a_p = \left(\frac{d'}{2}\right) - \left(\frac{d_o}{2}\right)$

ex $8\text{mm} = \left(\frac{170\text{mm}}{2}\right) - \left(\frac{154\text{mm}}{2}\right)$

67) Number of Teeth in Belt given Datum Length of Synchronous Belt

Open Calculator

fx $z = \frac{l}{P_c}$

ex $80 = \frac{1200.0\text{mm}}{15\text{mm}}$

68) Number of Teeth in larger pulley given Transmission ratio of Synchronous belt drive

Open Calculator

fx $$T_2 = T_1 \cdot i$$

ex $$60 = 20 \cdot 3$$

69) Number of Teeth in Smaller pulley given Transmission ratio of Synchronous belt drive

Open Calculator

fx $$T_1 = \frac{T_2}{i}$$

ex $$20 = \frac{60}{3}$$

70) Pitch Diameter of Larger Pulley given Transmission Ratio of Synchronous Belt Drive

Open Calculator

fx $$(d'2) = (d'1) \cdot i$$

ex $$762\text{mm} = 254\text{mm} \cdot 3$$

71) Pitch Diameter of Smaller Pulley given Transmission Ratio of Synchronous Belt Drive

Open Calculator

fx $$(d'1) = \frac{d'2}{i}$$

ex $$254\text{mm} = \frac{762\text{mm}}{3}$$

72) Pitch given Datum Length of Synchronous Belt

Open Calculator

fx $$P_c = \frac{l}{z}$$

ex $$15\text{mm} = \frac{1200.0\text{mm}}{80}$$

73) Power transmitted by synchronous belt

Open Calculator

fx $$P_t = \frac{P_s}{C_s}$$

ex $$6.446154\text{kW} = \frac{8.38\text{kW}}{1.3}$$

74) Pulley outside Diameter given Distance between Belt Pitch line and Pulley tip circle radius

Open Calculator

$$d_o = d' - (2 \cdot a_p)$$

$$154\text{mm} = 170\text{mm} - (2 \cdot 8\text{mm})$$

75) Pulley Pitch Diameter given Distance between Belt pitch line and Pulley tip circle radius

Open Calculator

$$d' = (2 \cdot a_p) + d_o$$

$$170\text{mm} = (2 \cdot 8\text{mm}) + 154\text{mm}$$

76) Service Correction Factor given Power transmitted by Synchronous Belt

Open Calculator

$$C_s = \frac{P_s}{P_t}$$

$$1.299225 = \frac{8.38\text{kW}}{6.45\text{kW}}$$

77) Speed of larger pulley given Transmission ratio of Synchronous belt drive

Open Calculator

$$n_2 = \frac{n_1}{i}$$

$$213.3333\text{rev/min} = \frac{640\text{rev/min}}{3}$$

78) Speed of smaller pulley given Transmission ratio of Synchronous belt drive

Open Calculator

$$n_1 = n_2 \cdot i$$

$$5760\text{rev/min} = 1920\text{rev/min} \cdot 3$$

79) Standard Capacity of selected Belt given Power transmitted by Synchronous Belt

Open Calculator

$$P_s = P_t \cdot C_s$$

$$8.385\text{kW} = 6.45\text{kW} \cdot 1.3$$

80) Transmission Ratio of Synchronous belt drive given no. of teeth in smaller and larger pulley

Open Calculator

fx $$i = \frac{T_2}{T_1}$$

ex $$3 = \frac{60}{20}$$

81) Transmission Ratio of Synchronous Belt drive given Pitch Diameter of Smaller and Larger Pulley

Open Calculator

fx $$i = \frac{d'2}{d'1}$$

ex $$3 = \frac{762\text{mm}}{254\text{mm}}$$

82) Transmission Ratio of Synchronous belt drive given Speed of smaller and larger pulley

Open Calculator

fx $$i = \frac{n_1}{n_2}$$

ex $$0.333333 = \frac{640\text{rev/min}}{1920\text{rev/min}}$$

V Belt Drives

Power Transmission

83) Belt Tension in Loose Side of V-Belt given Power Transmitted

Open Calculator

fx $$P_2 = P_1 - \frac{P_t}{v_b}$$

ex $$550.0969\text{N} = 800\text{N} - \frac{6.45\text{kW}}{25.81\text{m/s}}$$

84) Belt Tension in Tight Side of Belt given Power Transmitted using V-Belt

Open Calculator

fx $$P_1 = \frac{P_t}{v_b} + P_2$$

ex $$799.9031\text{N} = \frac{6.45\text{kW}}{25.81\text{m/s}} + 550\text{N}$$

85) Belt Velocity given Power Transmitted using V-Belt

Open Calculator

fx $$v_b = \frac{P_t}{P_1 - P_2}$$

ex $$25.8\text{m/s} = \frac{6.45\text{kW}}{800\text{N} - 550\text{N}}$$

86) Drive Power to be Transmitted given Number of Belts Required

Open Calculator

fx $$P_t = N \cdot \frac{(F_c r) \cdot (F_d r) \cdot P_r}{F_a r}$$

ex $$6.447301\text{kW} = 2 \cdot \frac{1.08 \cdot 0.94 \cdot 4.128\text{kW}}{1.30}$$

87) Power Rating of Single V-Belt given Number of Belts Required

Open Calculator

fx $$P_r = P_t \cdot \frac{F_a r}{(F_c r) \cdot (F_d r) \cdot N}$$

ex $$4.129728\text{kW} = 6.45\text{kW} \cdot \frac{1.30}{1.08 \cdot 0.94 \cdot 2}$$

88) Power Transmitted using V Belt

Open Calculator

fx $$P_t = (P_1 - P_2) \cdot v_b$$

ex $$6.4525\text{kW} = (800\text{N} - 550\text{N}) \cdot 25.81\text{m/s}$$

Selection of V Belts

89) Correction Factor for Industrial Service given Design Power

Open Calculator

fx $$(F_a r) = \frac{P_d}{P_t}$$

ex $$1.148837 = \frac{7.41\text{kW}}{6.45\text{kW}}$$

90) Design Power for V Belt

Open Calculator

fx $$P_d = (F_a r) \cdot P_t$$

ex $$8.385\text{kW} = 1.30 \cdot 6.45\text{kW}$$

91) Pitch diameter of big pulley of V Belt drive

Open Calculator

fx $$D = d \cdot \left(\frac{n_1}{n_2}\right)$$

ex $$90\text{mm} = 270\text{mm} \cdot \left(\frac{640\text{rev/min}}{1920\text{rev/min}}\right)$$

92) Pitch diameter of smaller pulley given pitch diameter of big pulley

Open Calculator

fx $$d = D \cdot \left(\frac{n_2}{n_1}\right)$$

ex $$2430\text{mm} = 810\text{mm} \cdot \left(\frac{1920\text{rev/min}}{640\text{rev/min}}\right)$$

93) Speed of bigger pulley given speed of smaller pulley

Open Calculator

fx $$n_2 = d \cdot \left(\frac{n_1}{D}\right)$$

ex $$213.3333\text{rev/min} = 270\text{mm} \cdot \left(\frac{640\text{rev/min}}{810\text{mm}}\right)$$

94) Speed of smaller pulley given pitch diameter of both pulleys

Open Calculator

$$n_1 = D \cdot \frac{n_2}{d}$$

$$5760\text{rev/min} = 810\text{mm} \cdot \frac{1920\text{rev/min}}{270\text{mm}}$$

95) Transmitted Power given Design Power

Open Calculator

$$P_t = \frac{P_d}{F_a r}$$

$$5.7\text{kW} = \frac{7.41\text{kW}}{1.30}$$

V Belt Characteristics and Parameters

96) Angle of Wrap of V-Belt given Belt Tension in Loose Side of Belt

Open Calculator

$$\alpha = \sin\left(\frac{\theta}{2}\right) \cdot \frac{\ln\left(\frac{P_1 - m_v \cdot v_b^2}{P_2 - m_v \cdot v_b^2}\right)}{\mu}$$

$$160.5987° = \sin\left(\frac{62°}{2}\right) \cdot \frac{\ln\left(\frac{800\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2}{550\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2}\right)}{0.35}$$

97) Belt Tension in Loose Side of V-Belt

Open Calculator

$$P_2 = \frac{P_1 - m_v \cdot v_b^2}{e^{\mu} \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)}} + m_v \cdot v_b^2$$

$$544.4056\text{N} = \frac{800\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2}{e^{0.35} \cdot \frac{160.2°}{\sin\left(\frac{62°}{2}\right)}} + 0.76\text{kg/m} \cdot (25.81\text{m/s})^2$$

98) Belt Tension in Tight Side of V-Belt

Open Calculator

fx $$P_1 = \left(e^{\mu} \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)} \right) \cdot \left(P_2 - m_v \cdot v_b^2\right) + m_v \cdot v_b^2$$

ex $$843.0982\text{N} = \left(e^{0.35} \cdot \frac{160.2°}{\sin\left(\frac{62°}{2}\right)} \right) \cdot \left(550\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2\right) + 0.76\text{kg/m} \cdot (25.81\text{m/s})^2$$

99) Belt Velocity of V-Belt given Belt Tension in Loose Side

Open Calculator

fx $$v_b = \sqrt{\frac{P_1 - \left(e^{\mu \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)}} \right) \cdot P_2}{m_v \cdot \left(1 - \left(e^{\mu \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)}} \right) \right)}}$$

ex $$25.80379\text{m/s} = \sqrt{\frac{800\text{N} - \left(e^{0.35 \cdot \frac{160.2°}{\sin\left(\frac{62°}{2}\right)}} \right) \cdot 550\text{N}}{0.76\text{kg/m} \cdot \left(1 - \left(e^{0.35 \cdot \frac{160.2°}{\sin\left(\frac{62°}{2}\right)}} \right) \right)}}$$

100) Coefficient of Friction in V-Belt given Belt Tension in Loose Side of Belt

Open Calculator

fx $$\mu = \sin\left(\frac{\theta}{2}\right) \cdot \frac{\ln\left(\frac{P_1 - m_v \cdot v_b^2}{P_2 - m_v \cdot v_b^2}\right)}{\alpha}$$

ex $$0.350871 = \sin\left(\frac{62°}{2}\right) \cdot \frac{\ln\left(\frac{800\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2}{550\text{N} - 0.76\text{kg/m} \cdot (25.81\text{m/s})^2}\right)}{160.2°}$$

101) Correcting Factor for Belt Length given Number of Belts Required

Open Calculator

fx $$(F_cr) = P_t \cdot \frac{F_ar}{N \cdot (F_dr) \cdot P_r}$$

ex $$1.080452 = 6.45\text{kW} \cdot \frac{1.30}{2 \cdot 0.94 \cdot 4.128\text{kW}}$$

102) Correction Factor for Arc of Contact given Number of Belts Required

Open Calculator

fx $$(F_dr) = P_t \cdot \frac{F_ar}{(F_cr) \cdot N \cdot P_r}$$

ex $$0.940394 = 6.45\text{kW} \cdot \frac{1.30}{1.08 \cdot 2 \cdot 4.128\text{kW}}$$

103) Correction Factor for Industrial Services given Number of Belts Required

Open Calculator

fx $$(F_ar) = N \cdot \frac{(F_cr) \cdot (F_dr) \cdot P_r}{P_t}$$

ex $$1.299456 = 2 \cdot \frac{1.08 \cdot 0.94 \cdot 4.128\text{kW}}{6.45\text{kW}}$$

104) Effective Pull in V-Belt

Open Calculator

fx $$P_e = P_1 - P_2$$

ex $$250\text{N} = 800\text{N} - 550\text{N}$$

105) Mass of One Meter Length of V-Belt given Belt Tension in Loose Side

Open Calculator

fx $$m_v = \frac{P_1 - \left(e^{\mu \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)}}\right) \cdot P_2}{v_b^2 \cdot \left(1 - \left(e^{\mu \cdot \frac{\alpha}{\sin\left(\frac{\theta}{2}\right)}}\right)\right)}$$

ex $$0.759634\text{kg/m} = \frac{800\text{N} - \left(e^{0.35 \cdot \frac{160.2^\circ}{\sin\left(\frac{62^\circ}{2}\right)}}\right) \cdot 550\text{N}}{(25.81\text{m/s})^2 \cdot \left(1 - \left(e^{0.35 \cdot \frac{160.2^\circ}{\sin\left(\frac{62^\circ}{2}\right)}}\right)\right)}$$

106) Number of V Belts Required for Given Applications

Open Calculator

fx $$N = P_t \cdot \frac{F_a r}{(F_c r) \cdot (F_d r) \cdot P_r}$$

ex $$2.000837 = 6.45\text{kW} \cdot \frac{1.30}{1.08 \cdot 0.94 \cdot 4.128\text{kW}}$$

Variables Used

- **a** Minor Axis of Pulley Arm *(Millimeter)*
- **a_p** Belt Pitch Line and Pulley Tip Circle Radius Width *(Millimeter)*
- **b** Width of Belt *(Millimeter)*
- **b_a** Major Axis of Pulley Arm *(Millimeter)*
- **C** Centre Distance between Pulleys *(Millimeter)*
- **C_s** Service Correction Factor
- **d** Diameter of Small Pulley *(Millimeter)*
- **D** Diameter of Big Pulley *(Millimeter)*
- **d_o** Pulley Outside Diameter *(Millimeter)*
- **d'** Pulley Pitch Diameter *(Millimeter)*
- **$d'1$** Pitch Diameter of Smaller Pulley *(Millimeter)*
- **$d'2$** Pitch Diameter of Larger Pulley *(Millimeter)*
- **F_a** Load Correction Factor
- **F_ar** Correction Factor for Industrial Service
- **F_cr** Correction Factor for Belt Length
- **F_dr** Correction Factor for Arc of Contact
- **i** Transmission Ratio of Belt Drive
- **I** Area Moment of Inertia of Arms *(Millimeter^4)*
- **l** Datum Length of Belt *(Millimeter)*
- **L** Belt Length *(Millimeter)*
- **m** Mass of Meter Length of Belt *(Kilogram per Meter)*
- **M_b** Bending Moment in Pulley's Arm *(Newton Millimeter)*
- **M_t** Torque Transmitted by Pulley *(Newton Millimeter)*
- **m_v** Mass of Meter Length of V Belt *(Kilogram per Meter)*
- **N** Number of Belts
- **n_1** Speed of Smaller Pulley *(Revolution per Minute)*
- **n_2** Speed of Larger Pulley *(Revolution per Minute)*
- **N_{pu}** Number of Arms in Pulley
- **P** Tangential Force at End of Each Pulley Arm *(Newton)*
- **P_1** Belt Tension on Tight Side *(Newton)*

- P_2 Belt Tension on Loose Side *(Newton)*
- P_c Circular Pitch for Synchronous Belt *(Millimeter)*
- P_d Design Power of Belt Drive *(Kilowatt)*
- P_e Effective Pull in V Belt *(Newton)*
- P_i Initial Tension in Belt *(Newton)*
- P_{max} Maximum Tension in Belt *(Newton)*
- P_r Power Rating of Single V-Belt *(Kilowatt)*
- P_s Standard Capacity of Belt *(Kilowatt)*
- P_t Power transmitted by belt *(Kilowatt)*
- R Radius of Rim of Pulley *(Millimeter)*
- t Thickness of Belt *(Millimeter)*
- T_1 Number of teeth on smaller pulley
- T_2 Number of teeth on larger pulley
- T_b Belt Tension due to Centrifugal Force *(Newton)*
- v_b Belt Velocity *(Meter per Second)*
- v_o Optimum Velocity of Belt *(Meter per Second)*
- z Number of teeth on belt
- α Wrap Angle on Pulley *(Degree)*
- α_a Wrap Angle for Cross Belt Drive *(Degree)*
- α_b Wrap Angle on Big Pulley *(Degree)*
- α_s Wrap Angle on Small Pulley *(Degree)*
- θ V belt angle *(Degree)*
- μ Coefficient of Friction for Belt Drive
- σ Tensile Stress in Belt *(Newton per Square Millimeter)*
- σ_b Bending stress in pulley's arm *(Newton per Square Millimeter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Function: **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.
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- 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 Millimeter (mm)
  Length Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm^2)
  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 Degree (°)
  Angle Unit Conversion
- Measurement: **Angular Velocity** in Revolution per Minute (rev/min)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion
- Measurement: **Second Moment of Area** in Millimeter^4 (mm^4)
  Second Moment of Area Unit Conversion
- Measurement: **Linear Mass Density** in Kilogram per Meter (kg/m)
  Linear Mass Density Unit Conversion

- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- **Power Screws Formulas**
- **Design of Belt Drives Formulas**

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