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Design of Friction Clutches Formulas

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List of 48 Design of Friction Clutches Formulas

Design of Friction Clutches

1) Friction Radius of Clutch given Friction Torque

Open Calculator

fx $$R_f = \frac{M_T}{\mu \cdot P_a}$$

ex $$75\text{mm} = \frac{238500\text{N*mm}}{0.2 \cdot 15900\text{N}}$$

2) Friction Radius of Clutch given Outer and Inner Diameter

Open Calculator

fx $$R_f = \frac{d_o + d_i}{4}$$

ex $$75\text{mm} = \frac{200\text{mm} + 100\text{mm}}{4}$$

3) Inner Diameter of Clutch given Friction Radius

Open Calculator

fx $$d_i = (4 \cdot R_f) - d_o$$

ex $$100\text{mm} = (4 \cdot 75\text{mm}) - 200\text{mm}$$

4) Outer Diameter of Clutch given Friction Radius

Open Calculator

fx $$d_o = (4 \cdot R_f) - d_i$$

ex $$200\text{mm} = (4 \cdot 75\text{mm}) - 100\text{mm}$$

5) Permissible Pressure Intensity on Clutch from Constant Wear Theory given Axial Force

Open Calculator

fx $$p_a = 2 \cdot \frac{P_a}{\pi \cdot d_i \cdot (d_o - d_i)}$$

ex $$1.012225\text{N/mm}^2 = 2 \cdot \frac{15900\text{N}}{\pi \cdot 100\text{mm} \cdot (200\text{mm} - 100\text{mm})}$$

6) Permissible Pressure Intensity on Clutch from Constant Wear Theory given Friction Torque

Open Calculator

$$p_a = 8 \cdot \frac{M_T}{\pi \cdot \mu \cdot d_i \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

$$1.012225\text{N/mm}^2 = 8 \cdot \frac{238500\text{N*mm}}{\pi \cdot 0.2 \cdot 100\text{mm} \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

7) Pressure on Clutch Plate from Constant Pressure Theory given Axial Force

Open Calculator

$$P_p = 4 \cdot \frac{P_a}{\pi \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

$$0.674817\text{N/mm}^2 = 4 \cdot \frac{15900\text{N}}{\pi \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

8) Pressure on Clutch Plate from Constant Pressure Theory given Friction Torque

Open Calculator

$$P_p = 12 \cdot \frac{M_T}{\pi \cdot \mu \cdot \left(\left(d_o^3\right) - \left(d_i^3\right)\right)}$$

$$0.650716\text{N/mm}^2 = 12 \cdot \frac{238500\text{N*mm}}{\pi \cdot 0.2 \cdot \left(\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)\right)}$$

9) Rated Torque of Clutch given Torque Capacity

Open Calculator

$$M_{Trated} = \frac{Mt_r}{K_s}$$

$$27647.06\text{N*mm} = \frac{47000\text{N*mm}}{1.7}$$

10) Service Factor for Clutch

Open Calculator

fx $$K_s = \frac{Mt_r}{M_{Trated}}$$

ex $$1.700434 = \frac{47000N*mm}{27640N*mm}$$

11) Torque Capacity of Clutch

Open Calculator

fx $$Mt_r = K_s \cdot M_{Trated}$$

ex $$46988N*mm = 1.7 \cdot 27640N*mm$$

Axial Force

12) Axial Force on Clutch from Constant Pressure Theory given Fiction Torque and Diameter

Open Calculator

fx $$P_a = M_T \cdot \frac{3 \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}{\mu \cdot \left(\left(d_o^3\right) - \left(d_i^3\right)\right)}$$

ex $$15332.14N = 238500N*mm \cdot \frac{3 \cdot \left(\left((200mm)^2\right) - \left((100mm)^2\right)\right)}{0.2 \cdot \left(\left((200mm)^3\right) - \left((100mm)^3\right)\right)}$$

13) Axial Force on Clutch from Constant Pressure Theory given Pressure Intensity and Diameter

Open Calculator

fx $$P_a = \pi \cdot P_p \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{4}$$

ex $$15786.5N = \pi \cdot 0.67N/mm^2 \cdot \frac{\left((200mm)^2\right) - \left((100mm)^2\right)}{4}$$

14) Axial Force on Clutch from Constant Wear Theory given Friction Torque

Open Calculator

fx $$P_a = 4 \cdot \frac{M_T}{\mu \cdot (d_o + d_i)}$$

ex $$15900\text{N} = 4 \cdot \frac{238500\text{N*mm}}{0.2 \cdot (200\text{mm} + 100\text{mm})}$$

15) Axial Force on Clutch from Constant Wear Theory given Permissible Intensity of Pressure

Open Calculator

fx $$P_a = \pi \cdot p_a \cdot d_i \cdot \frac{d_o - d_i}{2}$$

ex $$15865.04\text{N} = \pi \cdot 1.01\text{N/mm}^2 \cdot 100\text{mm} \cdot \frac{200\text{mm} - 100\text{mm}}{2}$$

16) Axial Force on Clutch given Friction Radius

Open Calculator

fx $$P_a = \frac{M_T}{\mu \cdot R_f}$$

ex $$15900\text{N} = \frac{238500\text{N*mm}}{0.2 \cdot 75\text{mm}}$$

Coefficient of Friction

17) Coefficient of Friction for Clutch from Constant Pressure Theory given Diameters

Open Calculator

fx $$\mu = 12 \cdot \frac{M_T}{\pi \cdot P_p \cdot \left(\left(d_o^3\right) - \left(d_i^3\right)\right)}$$

ex $$0.194244 = 12 \cdot \frac{238500\text{N*mm}}{\pi \cdot 0.67\text{N/mm}^2 \cdot \left(\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)\right)}$$

18) Coefficient of Friction of Clutch from Constant Pressure Theory given Friction Torque

Open Calculator

$$\mu = M_T \cdot \frac{3 \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}{P_a \cdot \left(\left(d_o^3\right) - \left(d_i^3\right)\right)}$$

$$0.192857 = 238500\text{N*mm} \cdot \frac{3 \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}{15900\text{N} \cdot \left(\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)\right)}$$

19) Coefficient of Friction of Clutch from Constant Wear Theory

Open Calculator

$$\mu = 8 \cdot \frac{M_T}{\pi \cdot p_a \cdot d_i \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

$$0.200441 = 8 \cdot \frac{238500\text{N*mm}}{\pi \cdot 1.01\text{N/mm}^2 \cdot 100\text{mm} \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

20) Coefficient of Friction of Clutch from Constant Wear Theory given Axial Force

Open Calculator

$$\mu = 4 \cdot \frac{M_T}{P_a \cdot (d_o + d_i)}$$

$$0.2 = 4 \cdot \frac{238500\text{N*mm}}{15900\text{N} \cdot (200\text{mm} + 100\text{mm})}$$

21) Coefficient of Friction of Clutch given Friction Radius

Open Calculator

$$\mu = \frac{M_T}{P_a \cdot R_f}$$

$$0.2 = \frac{238500\text{N*mm}}{15900\text{N} \cdot 75\text{mm}}$$

Design of Centrifugal Clutches

22) Centrifugal Force on Clutch

Open Calculator

fx $F_c = \left(M \cdot \left(\omega_1^2\right) \cdot r_g\right)$

ex $1420.133\text{N} = \left(3.7\text{kg} \cdot \left((52.36\text{rad/s})^2\right) \cdot 140\text{mm}\right)$

23) Friction Force on Centrifugal Clutch

Open Calculator

fx $F_{friction} = \mu \cdot M \cdot r_g \cdot \left(\left(\omega_2^2\right) - \left(\omega_1^2\right)\right)$

ex $355.0333\text{N} = 0.2 \cdot 3.7\text{kg} \cdot 140\text{mm} \cdot \left(\left((78.54\text{rad/s})^2\right) - \left((52.36\text{rad/s})^2\right)\right)$

24) Friction Torque on Centrifugal Clutch

Open Calculator

fx $M_T = \mu \cdot M \cdot r_g \cdot r_d \cdot z_s \cdot \left(\left(\omega_2^2\right) - \left(\omega_1^2\right)\right)$

ex $234322\text{N*mm} = 0.2 \cdot 3.7\text{kg} \cdot 140\text{mm} \cdot 165\text{mm} \cdot 4 \cdot \left(\left((78.54\text{rad/s})^2\right) - \left((52.36\text{rad/s})^2\right)\right)$

25) Spring Force in Centrifugal Clutch

Open Calculator

fx $P_{spring} = M \cdot \left(\omega_1^2\right) \cdot r_g$

ex $1420.133\text{N} = 3.7\text{kg} \cdot \left((52.36\text{rad/s})^2\right) \cdot 140\text{mm}$

Design of Cone and Centrifugal Clutches

26) Axial Force on Cone Clutch from Constant Wear Theory given Permissible Pressure Intensity

Open Calculator

fx $$P_a = \pi \cdot p_a \cdot d_i \cdot \frac{d_o - d_i}{2}$$

ex $$15865.04\text{N} = \pi \cdot 1.01\text{N/mm}^2 \cdot 100\text{mm} \cdot \frac{200\text{mm} - 100\text{mm}}{2}$$

27) Axial Force on Cone Clutch from Constant Wear Theory given Pressure

Open Calculator

fx $$P_a = \pi \cdot P_p \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{4}$$

ex $$15786.5\text{N} = \pi \cdot 0.67\text{N/mm}^2 \cdot \frac{\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)}{4}$$

28) Centrifugal Force on Clutch

Open Calculator

fx $$F_c = \left(M \cdot \left(\omega_1^2\right) \cdot r_g\right)$$

ex $$1420.133\text{N} = \left(3.7\text{kg} \cdot \left((52.36\text{rad/s})^2\right) \cdot 140\text{mm}\right)$$

29) Friction Force on Centrifugal Clutch

Open Calculator

fx $$F_{friction} = \mu \cdot M \cdot r_g \cdot \left(\left(\omega_2^2\right) - \left(\omega_1^2\right)\right)$$

ex $$355.0333\text{N} = 0.2 \cdot 3.7\text{kg} \cdot 140\text{mm} \cdot \left(\left((78.54\text{rad/s})^2\right) - \left((52.36\text{rad/s})^2\right)\right)$$

30) Friction Torque on Centrifugal Clutch

Open Calculator

fx $$M_T = \mu \cdot M \cdot r_g \cdot r_d \cdot z_s \cdot \left(\left(\omega_2^2\right) - \left(\omega_1^2\right)\right)$$

ex $$234322\text{N*mm} = 0.2 \cdot 3.7\text{kg} \cdot 140\text{mm} \cdot 165\text{mm} \cdot 4 \cdot \left(\left((78.54\text{rad/s})^2\right) - \left((52.36\text{rad/s})^2\right)\right)$$

31) Friction Torque on Cone Clutch from Constant Pressure Theory

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot P_c \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{12 \cdot (\sin(\alpha))}$$

ex $$237076.2\text{N*mm} = \pi \cdot 0.2 \cdot 0.14\text{N/mm}^2 \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{12 \cdot (\sin(12.5^\circ))}$$

32) Friction Torque on Cone Clutch from Constant Pressure Theory given Axial Force

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{3 \cdot (\sin(\alpha)) \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

ex $$220282.1\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{3 \cdot (\sin(12.5^\circ)) \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

33) Friction Torque on Cone Clutch from Constant Wear Theory given Axial Force

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot \frac{d_o + d_i}{4 \cdot \sin(\alpha)}$$

ex $$212414.9\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot \frac{200\text{mm} + 100\text{mm}}{4 \cdot \sin(12.5^\circ)}$$

34) Friction Torque on Cone Clutch from Constant Wear Theory given Semi-Cone Angle

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot p_a \cdot d_i \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{8 \cdot \sin(\alpha)}$$

ex $$1.1E\hat{}6N*mm = \pi \cdot 0.2 \cdot 1.01N/mm^2 \cdot 100mm \cdot \frac{\left((200mm)^2\right) - \left((100mm)^2\right)}{8 \cdot \sin(12.5^\circ)}$$

35) Spring Force in Centrifugal Clutch

Open Calculator

fx $$P_{spring} = M \cdot \left(\omega_1^2\right) \cdot r_g$$

ex $$1420.133N = 3.7kg \cdot \left((52.36rad/s)^2\right) \cdot 140mm$$

Design of Cone Clutches

36) Axial Force on Cone Clutch from Constant Wear Theory given Permissible Pressure Intensity

Open Calculator

fx $$P_a = \pi \cdot p_a \cdot d_i \cdot \frac{d_o - d_i}{2}$$

ex $$15865.04N = \pi \cdot 1.01N/mm^2 \cdot 100mm \cdot \frac{200mm - 100mm}{2}$$

37) Axial Force on Cone Clutch from Constant Wear Theory given Pressure

Open Calculator

fx $$P_a = \pi \cdot P_p \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{4}$$

ex $$15786.5N = \pi \cdot 0.67N/mm^2 \cdot \frac{\left((200mm)^2\right) - \left((100mm)^2\right)}{4}$$

38) Friction Torque on Cone Clutch from Constant Pressure Theory

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot P_c \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{12 \cdot (\sin(\alpha))}$$

ex $$237076.2\text{N*mm} = \pi \cdot 0.2 \cdot 0.14\text{N/mm}^2 \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{12 \cdot (\sin(12.5^\circ))}$$

39) Friction Torque on Cone Clutch from Constant Pressure Theory given Axial Force

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{3 \cdot (\sin(\alpha)) \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

ex $$220282.1\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{3 \cdot (\sin(12.5^\circ)) \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

40) Friction Torque on Cone Clutch from Constant Wear Theory given Axial Force

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot \frac{d_o + d_i}{4 \cdot \sin(\alpha)}$$

ex $$212414.9\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot \frac{200\text{mm} + 100\text{mm}}{4 \cdot \sin(12.5^\circ)}$$

41) Friction Torque on Cone Clutch from Constant Wear Theory given Semi-Cone Angle

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot p_a \cdot d_i \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{8 \cdot \sin(\alpha)}$$

ex $$1.1\text{E\^{}6N*mm} = \pi \cdot 0.2 \cdot 1.01\text{N/mm}^2 \cdot 100\text{mm} \cdot \frac{\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)}{8 \cdot \sin(12.5^\circ)}$$

Design of Multiple Disk Clutches

42) Friction Torque on Multiple Disk Clutch from Constant Pressure Theory

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot z \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{3 \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

ex $$238388.9\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot 5 \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{3 \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

43) Friction Torque on Multiple Disk Clutch from Constant Wear Theory

Open Calculator

fx $$M_T = \mu \cdot P_m \cdot z \cdot \frac{d_o + d_i}{4}$$

ex $$229875\text{N*mm} = 0.2 \cdot 3065\text{N} \cdot 5 \cdot \frac{200\text{mm} + 100\text{mm}}{4}$$

Frictional Torque

44) Friction Torque on Clutch from Constant Pressure Theory given Axial Force

Open Calculator

fx $$M_T = \mu \cdot P_a \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{3 \cdot \left(\left(d_o^2\right) - \left(d_i^2\right)\right)}$$

ex $$247333.3\text{N*mm} = 0.2 \cdot 15900\text{N} \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{3 \cdot \left(\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)\right)}$$

45) Friction Torque on Clutch from Constant Pressure Theory given Pressure

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot P_p \cdot \frac{\left(d_o^3\right) - \left(d_i^3\right)}{12}$$

ex $$245567.8\text{N*mm} = \pi \cdot 0.2 \cdot 0.67\text{N/mm}^2 \cdot \frac{\left((200\text{mm})^3\right) - \left((100\text{mm})^3\right)}{12}$$

46) Friction Torque on Clutch from Constant Wear Theory given Diameters

Open Calculator

fx $$M_T = \mu \cdot P_a \cdot \frac{d_o + d_i}{4}$$

ex $$238500\text{N*mm} = 0.2 \cdot 15900\text{N} \cdot \frac{200\text{mm} + 100\text{mm}}{4}$$

47) Friction Torque on Clutch given Friction Radius

Open Calculator

fx $$M_T = \mu \cdot P_a \cdot R_f$$

ex $$238500\text{N*mm} = 0.2 \cdot 15900\text{N} \cdot 75\text{mm}$$

48) Frictional Torque on Clutch from Constant Wear Theory given Diameters

Open Calculator

fx $$M_T = \pi \cdot \mu \cdot p_a \cdot d_i \cdot \frac{\left(d_o^2\right) - \left(d_i^2\right)}{8}$$

ex $$237975.6\text{N*mm} = \pi \cdot 0.2 \cdot 1.01\text{N/mm}^2 \cdot 100\text{mm} \cdot \frac{\left((200\text{mm})^2\right) - \left((100\text{mm})^2\right)}{8}$$

Variables Used

- d_i Inner Diameter of Clutch *(Millimeter)*
- d_o Outer Diameter of Clutch *(Millimeter)*
- F_c Centrifugal Force on Clutch *(Newton)*
- $F_{friction}$ Force of Friction on Clutch *(Newton)*
- K_s Service Factor for Clutch
- M Mass of Clutch *(Kilogram)*
- M_T Friction Torque on Clutch *(Newton Millimeter)*
- M_{Trated} Rated Torque of Friction Clutch *(Newton Millimeter)*
- Mt_r Torque Capacity for Clutch *(Newton Millimeter)*
- p_a Permissible Intensity of Pressure in Clutch *(Newton per Square Millimeter)*
- P_a Axial Force for Clutch *(Newton)*
- P_c Constant Pressure between Clutch Plates *(Newton per Square Millimeter)*
- P_m Operating Force for Clutch *(Newton)*
- P_p Pressure between Clutch Plates *(Newton per Square Millimeter)*
- P_{spring} Spring Force in Centrifugal Clutch *(Newton)*
- r_d Radius of Clutch Drum *(Millimeter)*
- R_f Friction Radius of Clutch *(Millimeter)*
- r_g Radius of CG Point of Clutch *(Millimeter)*
- z Pairs of Contacting Surface of Clutch
- z_s Number of Shoes in Centrifugal Clutch
- α Semi-Cone Angle of Clutch *(Degree)*
- μ Coefficient of Friction Clutch
- ω_1 Speed at which Engagement Starts in Clutch *(Radian per Second)*
- ω_2 Running Speed of Clutch *(Radian per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm²)
  Pressure 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: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion

Check other formula lists

- Design against Fluctuating Load Formulas
- Design of Bevel Gear Formulas
- Design of Chain Drives Formulas
- Design of Cotter Joint Formulas
- Design of Coupling Formulas
- Design of Flywheel Formulas
- Design of Friction Clutches Formulas
- Design of Helical Gears Formulas
- Design of Keys Formulas
- Design of Knuckle Joint Formulas
- Design of Lever Formulas
- Design of Pressure Vessels Formulas
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