Friction Devices Formulas

List of 27 Friction Devices Formulas

Friction Devices

Pivot Bearing

1) Frictional Torque on Conical Pivot Bearing by Uniform Pressure

Open Calculator

fx $$T = \frac{\mu_{friction} \cdot W_t \cdot D_{shaft} \cdot h_{Slant}}{3}$$

ex $$2.4\text{N*m} = \frac{0.4 \cdot 24\text{N} \cdot 0.5\text{m} \cdot 1.5\text{m}}{3}$$

2) Frictional Torque on Conical Pivot Bearing by Uniform Wear

Open Calculator

fx $$T = \frac{\mu_{friction} \cdot W_t \cdot D_{shaft} \cdot \cos ec\frac{\alpha}{2}}{2}$$

ex $$2.379418\text{N*m} = \frac{0.4 \cdot 24\text{N} \cdot 0.5\text{m} \cdot \cos ec\frac{0.5286\text{rad}}{2}}{2}$$

3) Frictional Torque on Flat Pivot Bearing by Uniform Pressure

Open Calculator

fx $$T = \frac{2}{3} \cdot \mu_{friction} \cdot W_t \cdot R$$

ex $$21.12\text{N*m} = \frac{2}{3} \cdot 0.4 \cdot 24\text{N} \cdot 3.3\text{m}$$

4) Frictional Torque on Truncated Conical Pivot Bearing by Uniform Pressure

Open Calculator

fx $$T = \frac{2}{3} \cdot \mu_{friction} \cdot W_t \cdot \frac{r_1^3 - r_2^3}{r_1^2 - r_2^2}$$

ex $$67.65714\text{N*m} = \frac{2}{3} \cdot 0.4 \cdot 24\text{N} \cdot \frac{(8\text{m})^3 - (6\text{m})^3}{(8\text{m})^2 - (6\text{m})^2}$$

5) Mean Radius of Collar

Open Calculator

fx $$R_{collar} = \frac{R_1 + R_2}{2}$$

ex $$0.04\text{m} = \frac{0.050\text{m} + 0.03\text{m}}{2}$$

6) Pressure over Bearing Area of Flat Pivot Bearing

Open Calculator

fx $$p_i = \frac{W_t}{\pi \cdot R^2}$$

ex $$0.701509\text{Pa} = \frac{24\text{N}}{\pi \cdot (3.3\text{m})^2}$$

7) Torque Required to Overcome Friction at Collar

Open Calculator

fx $$T = \mu_{collar} \cdot W_{load} \cdot R_{collar}$$

ex $$0.1696\text{N*m} = 0.16 \cdot 53\text{N} \cdot 0.02\text{m}$$

8) Total Frictional Torque on Conical Pivot Bearing Considering Uniform Pressure

Open Calculator

fx $$T = \mu_{friction} \cdot W_t \cdot D_{shaft} \cdot \cos ec \frac{\alpha}{3}$$

ex $$3.172558\text{N*m} = 0.4 \cdot 24\text{N} \cdot 0.5\text{m} \cdot \cos ec \frac{0.5286\text{rad}}{3}$$

9) Total Frictional Torque on Conical Pivot Bearing Considering Uniform Wear when Slant Height of Cone

Open Calculator

fx $$T = \frac{\mu_{friction} \cdot W_t \cdot h_{Slant}}{2}$$

ex $$7.2\text{N*m} = \frac{0.4 \cdot 24\text{N} \cdot 1.5\text{m}}{2}$$

10) Total Frictional Torque on Flat Pivot Bearing Considering Uniform Wear

Open Calculator

fx $$T = \frac{\mu_{friction} \cdot W_t \cdot R}{2}$$

ex $$15.84\text{N*m} = \frac{0.4 \cdot 24\text{N} \cdot 3.3\text{m}}{2}$$

11) Total Frictional Torque on Truncated Conical Pivot Bearing Considering Uniform Wear

Open Calculator

fx $$T = \mu_{friction} \cdot W_t \cdot \frac{r_1 + r_2}{2}$$

ex $$67.2N^*m = 0.4 \cdot 24N \cdot \frac{8m + 6m}{2}$$

12) Total Vertical Load Transmitted to Conical Pivot Bearing for Uniform Pressure

Open Calculator

fx $$W_t = \pi \cdot \left(\frac{D_{shaft}}{2}\right)^2 \cdot p_i$$

ex $$1.963495N = \pi \cdot \left(\frac{0.5m}{2}\right)^2 \cdot 10Pa$$

Screw and Nut

13) Force at Circumference of Screw given Helix Angle and Coefficient of Friction

Open Calculator

fx $$F = W \cdot \left(\frac{\sin(\psi) + \mu_{friction} \cdot \cos(\psi)}{\cos(\psi) - \mu_{friction} \cdot \sin(\psi)}\right)$$

ex $$63.89666N = 60kg \cdot \left(\frac{\sin(25°) + 0.4 \cdot \cos(25°)}{\cos(25°) - 0.4 \cdot \sin(25°)}\right)$$

14) Force at Circumference of Screw given Helix Angle and Limiting Angle

Open Calculator

fx $$F = W_{load} \cdot \tan(\psi + \Phi)$$

ex $$40.66833N = 53N \cdot \tan(25° + 12.5°)$$

15) Helix Angle

Open Calculator

fx $$\psi = a\tan\left(\frac{L}{C}\right)$$

ex $$0.054805° = a\tan\left(\frac{0.011m}{11.5m}\right)$$

16) Helix Angle for Multi-Threaded Screw

Open Calculator

fx $$\psi = a\tan\left(\frac{n \cdot P_{screw}}{\pi \cdot d}\right)$$

ex $$89.865° = a\tan\left(\frac{16 \cdot 5m}{\pi \cdot 0.06m}\right)$$

17) Helix Angle for Single Threaded Screw

Open Calculator

fx $$\psi = a\tan\left(\frac{P_{screw}}{\pi \cdot d}\right)$$

ex $$87.84102° = a\tan\left(\frac{5m}{\pi \cdot 0.06m}\right)$$

18) Lead of Screw

Open Calculator

fx $$L = P_{screw} \cdot n$$

ex $$80\text{m} = 5\text{m} \cdot 16$$

19) Torque Required to Overcome Friction between Screw and Nut

Open Calculator

fx $$T = W_{load} \cdot \tan(\psi + \Phi) \cdot \frac{d}{2}$$

ex $$1.22005\text{N*m} = 53\text{N} \cdot \tan(25° + 12.5°) \cdot \frac{0.06\text{m}}{2}$$

20) Torque Required to Overcome Friction between Screw and Nut during Lowering Load

Open Calculator

fx $$T = W_{load} \cdot \tan(\Phi - \psi) \cdot \frac{d}{2}$$

ex $$-0.352495\text{N*m} = 53\text{N} \cdot \tan(12.5° - 25°) \cdot \frac{0.06\text{m}}{2}$$

21) Torque Required to Overcome Friction between Screw and Nut while Lowering Load

Open Calculator

fx $$T = W_{load} \cdot \tan(\Phi - \psi) \cdot \frac{d}{2}$$

ex $$-0.352495\text{N*m} = 53\text{N} \cdot \tan(12.5° - 25°) \cdot \frac{0.06\text{m}}{2}$$

Screw Jack

22) Efficiency of Screw Jack when Screw Friction as well as Collar Friction Considered

Open Calculator

fx $$\eta = \frac{W \cdot \tan(\psi) \cdot d}{W_{load} \cdot \tan(\psi + \Phi) \cdot d + \mu_{collar} \cdot W_{load} \cdot R_{collar}}$$

ex $$0.356329 = \frac{60kg \cdot \tan(25°) \cdot 0.06m}{53N \cdot \tan(25° + 30°) \cdot 0.06m + 0.16 \cdot 53N \cdot 0.02m}$$

23) Efficiency of Screw Jack when only Screw Friction is Considered

Open Calculator

fx $$\eta = \frac{\tan(\psi)}{\tan(\psi + \Phi)}$$

ex $$0.326512 = \frac{\tan(25°)}{\tan(25° + 30°)}$$

24) Force Required to Lower Load by Screw Jack given Weight of Load

Open Calculator

fx $$F = W_{load} \cdot \frac{\mu_{friction} \cdot \cos(\psi) - \sin(\psi)}{\cos(\psi) + \mu_{friction} \cdot \sin(\psi)}$$

ex $$12.88063N = 53N \cdot \frac{0.8 \cdot \cos(25°) - \sin(25°)}{\cos(25°) + 0.8 \cdot \sin(25°)}$$

25) Force Required to Lower Load by Screw Jack given weight of load and Limiting angle

Open Calculator

fx $$F = W_{load} \cdot \tan(\Phi - \psi)$$

ex $$4.636899\text{N} = 53\text{N} \cdot \tan(30° - 25°)$$

26) Ideal Effort to Raise Load by Screw Jack

Open Calculator

fx $$P_o = W_{load} \cdot \tan(\psi)$$

ex $$24.71431\text{N} = 53\text{N} \cdot \tan(25°)$$

27) Maximum Efficiency of Screw Jack

Open Calculator

fx $$\eta = \frac{1 - \sin(\Phi)}{1 + \sin(\Phi)}$$

ex $$0.333333 = \frac{1 - \sin(30°)}{1 + \sin(30°)}$$

Variables Used

- **C** Circumference of Screw *(Meter)*
- **d** Mean Diameter of Screw *(Meter)*
- D_{shaft} Shaft Diameter *(Meter)*
- **F** Force Required *(Newton)*
- h_{Slant} Slant Height *(Meter)*
- **L** Lead of Screw *(Meter)*
- **n** Number of Threads
- p_i Pressure Intensity *(Pascal)*
- P_o Ideal Effort *(Newton)*
- P_{screw} Pitch *(Meter)*
- **R** Radius of Bearing Surface *(Meter)*
- r_1 Outer Radius of Bearing Surface *(Meter)*
- R_1 Outer Radius of Collar *(Meter)*
- r_2 Inner Radius of Bearing Surface *(Meter)*
- R_2 Inner Radius of Collar *(Meter)*
- R_{collar} Mean Radius of Collar *(Meter)*
- **T** Total Torque *(Newton Meter)*
- **W** Weight *(Kilogram)*
- W_{load} Load *(Newton)*
- W_t Load Transmitted Over Bearing Surface *(Newton)*
- α Semi Angle of Cone *(Radian)*
- η Efficiency

- μ_{collar} Coefficient of Friction for Collar
- $\mu_{friction}$ Coefficient of Friction
- $\mu_{friction}$ Coefficient of Friction
- Φ Limiting Angle of Friction *(Degree)*
- Φ Limiting Angle of Friction *(Degree)*
- ψ Helix Angle *(Degree)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **atan**, atan(Number)
  Inverse trigonometric tangent function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **cosec**, cosec(Angle)
  Trigonometric cosecant function
- Function: **sec**, sec(Angle)
  Trigonometric secant function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **tan**, tan(Angle)
  Trigonometric tangent function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Radian (rad), Degree (°)
  Angle Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion

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