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# Design of Keys Formulas

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# List of 31 Design of Keys Formulas

## Design of Keys

## Design of Kennedy Key

### 1) Compressive Stress in Kennedy Key

Open Calculator

fx $$\sigma_c = \sqrt{2} \cdot \frac{Mt_k}{d_s \cdot b_k \cdot l}$$

ex $$114.035 N/mm^2 = \sqrt{2} \cdot \frac{635000 N*mm}{45mm \cdot 5mm \cdot 35mm}$$

### 2) Diameter of Shaft given Compressive Stress in Kennedy Key

Open Calculator

fx $$d_s = \sqrt{2} \cdot \frac{Mt_k}{\sigma_c \cdot b_k \cdot l}$$

ex $$40.09043mm = \sqrt{2} \cdot \frac{635000 N*mm}{128 N/mm^2 \cdot 5mm \cdot 35mm}$$

### 3) Diameter of Shaft given Shear Stress in Kennedy Key

Open Calculator

fx $$d_s = \frac{Mt_k}{\sqrt{2} \cdot \tau \cdot b_k \cdot l}$$

ex $$40.15317mm = \frac{635000 N*mm}{\sqrt{2} \cdot 63.9 N/mm^2 \cdot 5mm \cdot 35mm}$$

## 4) Length of Kennedy Key given Compressive Stress in Key

Open Calculator

fx $$l = \sqrt{2} \cdot \frac{Mt_k}{d_s \cdot b_k \cdot \sigma_c}$$

ex $$31.18144\text{mm} = \sqrt{2} \cdot \frac{635000\text{N*mm}}{45\text{mm} \cdot 5\text{mm} \cdot 128\text{N/mm}^2}$$

## 5) Length of Kennedy Key given Shear Stress in Key

Open Calculator

fx $$l = \frac{Mt_k}{\sqrt{2} \cdot d_s \cdot b_k \cdot \tau}$$

ex $$31.23024\text{mm} = \frac{635000\text{N*mm}}{\sqrt{2} \cdot 45\text{mm} \cdot 5\text{mm} \cdot 63.9\text{N/mm}^2}$$

## 6) Shear Stress in Kennedy Key

Open Calculator

fx $$\tau = \frac{Mt_k}{\sqrt{2} \cdot d_s \cdot b_k \cdot l}$$

ex $$57.0175\text{N/mm}^2 = \frac{635000\text{N*mm}}{\sqrt{2} \cdot 45\text{mm} \cdot 5\text{mm} \cdot 35\text{mm}}$$

## 7) Torque Transmitted by Kennedy Key given Compressive Stress in Key

Open Calculator

fx $$Mt_k = \sigma_c \cdot d_s \cdot b_k \cdot \frac{l}{\sqrt{2}}$$

ex $$712763.6\text{N*mm} = 128\text{N/mm}^2 \cdot 45\text{mm} \cdot 5\text{mm} \cdot \frac{35\text{mm}}{\sqrt{2}}$$

### 8) Torque Transmitted by Kennedy Key given Shear Stress in Key

Open Calculator

$$\mathrm{Mt_k} = \tau \cdot \sqrt{2} \cdot \mathrm{d_s} \cdot \mathrm{b_k} \cdot \mathrm{l}$$

$$711649.9\mathrm{N*mm} = 63.9\mathrm{N/mm^2} \cdot \sqrt{2} \cdot 45\mathrm{mm} \cdot 5\mathrm{mm} \cdot 35\mathrm{mm}$$

### 9) Width of Key given Compressive Stress in Key

Open Calculator

$$\mathrm{b_k} = \sqrt{2} \cdot \frac{\mathrm{Mt_k}}{\mathrm{d_s} \cdot \sigma_\mathrm{c} \cdot \mathrm{l}}$$

$$4.454492\mathrm{mm} = \sqrt{2} \cdot \frac{635000\mathrm{N*mm}}{45\mathrm{mm} \cdot 128\mathrm{N/mm^2} \cdot 35\mathrm{mm}}$$

## Design of Splines

### 10) Major Diameter of Spline given Mean Radius

Open Calculator

$$\mathrm{D} = 4 \cdot \mathrm{R_m} - \mathrm{d}$$

$$60\mathrm{mm} = 4 \cdot 28\mathrm{mm} - 52\mathrm{mm}$$

### 11) Mean Radius of Splines

Open Calculator

$$\mathrm{R_m} = \frac{\mathrm{D} + \mathrm{d}}{4}$$

$$28\mathrm{mm} = \frac{60\mathrm{mm} + 52\mathrm{mm}}{4}$$

## 12) Mean Radius of Splines given Torque Transmitting Capacity

Open Calculator

$$R_m = \frac{M_t}{p_m \cdot A}$$

$$28.08005\text{mm} = \frac{224500\text{N*mm}}{6.5\text{N/mm}^2 \cdot 1230\text{mm}^2}$$

## 13) Minor Diameter of Spline given Mean Radius

Open Calculator

$$d = 4 \cdot R_m - D$$

$$52\text{mm} = 4 \cdot 28\text{mm} - 60\text{mm}$$

## 14) Permissible Pressure on Splines given Torque Transmitting Capacity

Open Calculator

$$p_m = \frac{M_t}{A \cdot R_m}$$

$$6.518583\text{N/mm}^2 = \frac{224500\text{N*mm}}{1230\text{mm}^2 \cdot 28\text{mm}}$$

## 15) Torque Transmitting Capacity of Splines

Open Calculator

$$M_t = p_m \cdot A \cdot R_m$$

$$223860\text{N*mm} = 6.5\text{N/mm}^2 \cdot 1230\text{mm}^2 \cdot 28\text{mm}$$

### 16) Torque Transmitting Capacity of Splines given Diameter of Splines

Open Calculator

fx $$M_t = \left(\frac{1}{8}\right) \cdot p_m \cdot l_h \cdot n \cdot \left(\left(D^2\right) - d^2\right)$$

ex $$283920\text{N*mm} = \left(\frac{1}{8}\right) \cdot 6.5\text{N/mm}^2 \cdot 65\text{mm} \cdot 6 \cdot \left(\left((60\text{mm})^2\right) - (52\text{mm})^2\right)$$

### 17) Total Area of Splines

Open Calculator

fx $$A = 0.5 \cdot (l_h \cdot n) \cdot (D - d)$$

ex $$1560\text{mm}^2 = 0.5 \cdot (65\text{mm} \cdot 6) \cdot (60\text{mm} - 52\text{mm})$$

### 18) Total Area of Splines given Torque Transmitting Capacity

Open Calculator

fx $$A = \frac{M_t}{p_m \cdot R_m}$$

ex $$1233.516\text{mm}^2 = \frac{224500\text{N*mm}}{6.5\text{N/mm}^2 \cdot 28\text{mm}}$$

## Design of Square and Flat Keys

### 19) Compressive Stress in Key

Open Calculator

fx $$\sigma_c = 4 \cdot \frac{M_t}{d_s \cdot l \cdot h}$$

ex $$126.7019\text{N/mm}^2 = 4 \cdot \frac{224500\text{N*mm}}{45\text{mm} \cdot 35\text{mm} \cdot 4.5\text{mm}}$$

## 20) Compressive Stress in Square Key due to Transmitted Torque

Open Calculator

fx $\sigma_c = 2 \cdot \tau$

ex $127.8\text{N/mm}^2 = 2 \cdot 63.9\text{N/mm}^2$

## 21) Force on Key

Open Calculator

fx $F = 2 \cdot \frac{M_t}{d_s}$

ex $9977.778\text{N} = 2 \cdot \frac{224500\text{N*mm}}{45\text{mm}}$

## 22) Height of Key given Compressive Stress in Key

Open Calculator

fx $h = 4 \cdot \frac{M_t}{d_s \cdot l \cdot \sigma_c}$

ex $4.454365\text{mm} = 4 \cdot \frac{224500\text{N*mm}}{45\text{mm} \cdot 35\text{mm} \cdot 128\text{N/mm}^2}$

## 23) Length of Key given Compressive Stress in Key

Open Calculator

fx $l = 4 \cdot \frac{M_t}{d_s \cdot \sigma_c \cdot h}$

ex $34.64506\text{mm} = 4 \cdot \frac{224500\text{N*mm}}{45\text{mm} \cdot 128\text{N/mm}^2 \cdot 4.5\text{mm}}$

## 24) Length of Key given Shear Stress

Open Calculator

$$l = \frac{F}{b_k \cdot \tau}$$

$$31.23631\text{mm} = \frac{9980\text{N}}{5\text{mm} \cdot 63.9\text{N/mm}^2}$$

## 25) Shaft Diameter given Compressive Stress in Key

Open Calculator

$$d_s = 4 \cdot \frac{M_t}{\sigma_c \cdot l \cdot h}$$

$$44.54365\text{mm} = 4 \cdot \frac{224500\text{N*mm}}{128\text{N/mm}^2 \cdot 35\text{mm} \cdot 4.5\text{mm}}$$

## 26) Shaft Diameter given Force on Key

Open Calculator

$$d_s = 2 \cdot \frac{M_t}{F}$$

$$44.98998\text{mm} = 2 \cdot \frac{224500\text{N*mm}}{9980\text{N}}$$

## 27) Shear Stress in given Force on Key

Open Calculator

$$\tau = \frac{F}{b_k \cdot l}$$

$$57.02857\text{N/mm}^2 = \frac{9980\text{N}}{5\text{mm} \cdot 35\text{mm}}$$

## 28) Shear Stress in Key given Torque Transmitted

Open Calculator

fx $$\tau = 2 \cdot \frac{M_t}{b_k \cdot l \cdot d_s}$$

ex $$57.01587\text{N/mm}^2 = 2 \cdot \frac{224500\text{N*mm}}{5\text{mm} \cdot 35\text{mm} \cdot 45\text{mm}}$$

## 29) Torque Transmitted by Keyed Shaft given Force on Keys

Open Calculator

fx $$M_t = F \cdot \frac{d_s}{2}$$

ex $$224550\text{N*mm} = 9980\text{N} \cdot \frac{45\text{mm}}{2}$$

## 30) Torque Transmitted by Keyed Shaft given Stress in Key

Open Calculator

fx $$M_t = \sigma_c \cdot d_s \cdot l \cdot \frac{h}{4}$$

ex $$226800\text{N*mm} = 128\text{N/mm}^2 \cdot 45\text{mm} \cdot 35\text{mm} \cdot \frac{4.5\text{mm}}{4}$$

## 31) Width of Key given Shear Stress in Key

Open Calculator

fx $$b_k = \frac{F}{\tau \cdot l}$$

ex $$4.46233\text{mm} = \frac{9980\text{N}}{63.9\text{N/mm}^2 \cdot 35\text{mm}}$$

## Variables Used

- **A** Total Area of Splines *(Square Millimeter)*
- $b_k$ Width of Key *(Millimeter)*
- **d** Minor Diameter of Spline Key Shaf *(Millimeter)*
- **D** Major Diameter of Spline Key Shaft *(Millimeter)*
- $d_s$ Diameter of Shaft using Key *(Millimeter)*
- **F** Force on Key *(Newton)*
- **h** Height of Key *(Millimeter)*
- **l** Length of Key *(Millimeter)*
- $l_h$ Length of Hub on Keyed Shaft *(Millimeter)*
- $M_t$ Transmitted Torque by Keyed Shaft *(Newton Millimeter)*
- $Mt_k$ Transmitted Torque by Kennedy Key *(Newton Millimeter)*
- **n** Number of Splines
- $p_m$ Permissible Pressure on Splines *(Newton per Square Millimeter)*
- $R_m$ Mean Radius of Spline of Shaft *(Millimeter)*
- $\sigma_c$ Compressive Stress in Key *(Newton per Square Millimeter)*
- $\tau$ Shear Stress in Key *(Newton per Square Millimeter)*

# Constants, Functions, Measurements used

- Function: **sqrt**, sqrt(Number)
  *Square root function*
- Measurement: **Length** in Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm²)
  *Area Unit Conversion*
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm²)
  *Pressure Unit Conversion*
- Measurement: **Force** in Newton (N)
  *Force Unit Conversion*
- Measurement: **Torque** in Newton Millimeter (N*mm)
  *Torque Unit Conversion*
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  *Stress Unit Conversion*

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