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Design of Keys Formulas

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List of 32 Design of Keys Formulas

Design of Keys

Design of Kennedy Key

1) Compressive Stress in Kennedy Key

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

Open Calculator 

$$ex \quad 128.0285\text{N/mm}^2 = \sqrt{2} \cdot \frac{712763.6\text{N*mm}}{44.98998\text{mm} \cdot 5\text{mm} \cdot 35\text{mm}}$$

2) Diameter of Shaft given Compressive Stress in Kennedy Key

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

Open Calculator 

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

3) Diameter of Shaft given Shear Stress in Kennedy Key

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

Open Calculator 

$$ex \quad 45.07042\text{mm} = \frac{712763.6\text{N*mm}}{\sqrt{2} \cdot 63.9\text{N/mm}^2 \cdot 5\text{mm} \cdot 35\text{mm}}$$



4) Length of Kennedy Key given Compressive Stress in Key

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

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

$$ex \quad 35.00779\text{mm} = \sqrt{2} \cdot \frac{712763.6\text{N}^*\text{mm}}{44.98998\text{mm} \cdot 5\text{mm} \cdot 128\text{N}/\text{mm}^2}$$

5) Length of Kennedy Key given Shear Stress in Key

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

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

$$ex \quad 35.06258\text{mm} = \frac{712763.6\text{N}^*\text{mm}}{\sqrt{2} \cdot 44.98998\text{mm} \cdot 5\text{mm} \cdot 63.9\text{N}/\text{mm}^2}$$

6) Shear Stress in Kennedy Key

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

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

$$ex \quad 64.01425\text{N}/\text{mm}^2 = \frac{712763.6\text{N}^*\text{mm}}{\sqrt{2} \cdot 44.98998\text{mm} \cdot 5\text{mm} \cdot 35\text{mm}}$$



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

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

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

$$ex \quad 712604.9N*mm = 128N/mm^2 \cdot 44.98998mm \cdot 5mm \cdot \frac{35mm}{\sqrt{2}}$$

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

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

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

$$ex \quad 711491.5N*mm = 63.9N/mm^2 \cdot \sqrt{2} \cdot 44.98998mm \cdot 5mm \cdot 35mm$$

9) Width of Key given Compressive Stress in Key

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

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

$$ex \quad 5.001113mm = \sqrt{2} \cdot \frac{712763.6N*mm}{44.98998mm \cdot 128N/mm^2 \cdot 35mm}$$

Design of Splines

10) Major Diameter of Spline given Mean Radius

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

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7_img.jpg\)](#)

$$ex \quad 60mm = 4 \cdot 28mm - 52mm$$



11) Mean Radius of Splines

$$fx \quad R_m = \frac{D + d}{4}$$

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

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

12) Mean Radius of Splines given Torque Transmitting Capacity

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

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

$$ex \quad 28mm = \frac{224500N*mm}{5.139652N/mm^2 \cdot 1560mm^2}$$

13) Minor Diameter of Spline given Mean Radius

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

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

$$ex \quad 52mm = 4 \cdot 28mm - 60mm$$

14) Permissible Pressure on Splines given Torque Transmitting Capacity

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

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

$$ex \quad 5.139652N/mm^2 = \frac{224500N*mm}{1560mm^2 \cdot 28mm}$$



15) Torque Transmitting Capacity of Splines

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

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

$$ex \quad 224500N*mm = 5.139652N/mm^2 \cdot 1560mm^2 \cdot 28mm$$

16) Torque Transmitting Capacity of Splines given Diameter of Splines

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

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

ex

$$224500N*mm = \frac{5.139652N/mm^2 \cdot 65mm \cdot 6 \cdot ((60mm)^2 - (52mm)^2)}{8}$$

17) Total Area of Splines

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

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7_img.jpg\)](#)

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

18) Total Area of Splines given Torque Transmitting Capacity

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

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58_img.jpg\)](#)

$$ex \quad 1560mm^2 = \frac{224500N*mm}{5.139652N/mm^2 \cdot 28mm}$$



Design of Square and Flat Keys

19) Compressive Stress in Key

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

[Open Calculator !\[\]\(83f22ed94ec5517769dd76d702c6bfd8_img.jpg\)](#)

$$ex \quad 126.7302 \text{N/mm}^2 = 4 \cdot \frac{224500 \text{N*mm}}{44.98998 \text{mm} \cdot 35 \text{mm} \cdot 4.5 \text{mm}}$$

20) Compressive Stress in Square Key due to Transmitted Torque

$$fx \quad \sigma_c = 2 \cdot \tau$$

[Open Calculator !\[\]\(3cb60d42b10e53f9522bb0b392c1c4cd_img.jpg\)](#)

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

21) Force on Key

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

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e_img.jpg\)](#)

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

22) Height of Key given Compressive Stress in Key

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

[Open Calculator !\[\]\(683dba75afe26e28cd4de5730b776760_img.jpg\)](#)

$$ex \quad 4.455357 \text{mm} = 4 \cdot \frac{224500 \text{N*mm}}{44.98998 \text{mm} \cdot 35 \text{mm} \cdot 128 \text{N/mm}^2}$$



23) Length of Key given Compressive Stress in Key 

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

Open Calculator 

$$ex \quad 34.65278\text{mm} = 4 \cdot \frac{224500\text{N} \cdot \text{mm}}{44.98998\text{mm} \cdot 128\text{N}/\text{mm}^2 \cdot 4.5\text{mm}}$$

24) Length of Key given Shear Stress 

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

Open Calculator 


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

25) Shaft Diameter given Compressive Stress in Key 

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

Open Calculator 

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

26) Shaft Diameter given Force on Key 

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

Open Calculator 

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



27) Shear Stress in given Force on Key 

$$fx \quad \tau_{\text{flat key}} = \frac{F}{b_k \cdot l}$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0_img.jpg\)](#)

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

28) Shear Stress in Key given Torque Transmitted 

$$fx \quad \tau_{\text{flat key}} = 2 \cdot \frac{M_t}{b_k \cdot l \cdot d_s}$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1_img.jpg\)](#)

$$ex \quad 57.02857\text{N/mm}^2 = 2 \cdot \frac{224500\text{N}^*\text{mm}}{5\text{mm} \cdot 35\text{mm} \cdot 44.98998\text{mm}}$$

29) Shear Stress on Flat Key 

$$fx \quad \tau_{\text{flat key}} = \frac{2 \cdot T}{b_k \cdot d_s \cdot l}$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\)](#)

$$ex \quad 57.02857\text{N/mm}^2 = \frac{2 \cdot 224499.99458\text{N}^*\text{mm}}{5\text{mm} \cdot 44.98998\text{mm} \cdot 35\text{mm}}$$

30) Torque Transmitted by Keyed Shaft given Force on Keys 

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

[Open Calculator !\[\]\(3342c215b2a8b663596a81468d5dc314_img.jpg\)](#)

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



31) Torque Transmitted by Keyed Shaft given Stress in Key

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

[Open Calculator !\[\]\(0f848bbd71cef6b345273b16f905912a_img.jpg\)](#)

$$\text{ex } 226749.5\text{N}\cdot\text{mm} = 128\text{N}/\text{mm}^2 \cdot 44.98998\text{mm} \cdot 35\text{mm} \cdot \frac{4.5\text{mm}}{4}$$

32) Width of Key given Shear Stress in Key

$$\text{fx } b_k = \frac{F}{\tau_{\text{flat key}} \cdot l}$$

[Open Calculator !\[\]\(3211b5d1d968fc1665909b34f9f16010_img.jpg\)](#)

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









Variables Used

- **A** Total Area of Splines (Square Millimeter)
- **b_k** Width of Key (Millimeter)
- **d** Minor Diameter of Spline Key Shaft (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)
- **M_{t_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)
- **T** Torque Transmitted by Shaft (Newton Millimeter)
- **σ_c** Compressive Stress in Key (Newton per Square Millimeter)
- **τ** Shear Stress in Key (Newton per Square Millimeter)
- **τ_{flat key}** Shear Stress (Newton per Square Millimeter)









Constants, Functions, Measurements used

- **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:** **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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