Important Design of Keys Formulas PDF

Formulas
Examples
with Units

List of 32
Important Design of Keys Formulas

1) Design of Kennedy Key Formulas

1.1) Compressive Stress in Kennedy Key Formula

Evaluate Formula

Formula

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

Example with Units

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

1.2) Diameter of Shaft given Compressive Stress in Kennedy Key Formula

Evaluate Formula

Formula

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

Example with Units

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

1.3) Diameter of Shaft given Shear Stress in Kennedy Key Formula

Evaluate Formula

Formula

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

Example with Units

$$45.0704\,\text{mm} = \frac{712763.6\,\text{N*mm}}{\sqrt{2} \cdot 63.9\,\text{N/mm}^2 \cdot 5\,\text{mm} \cdot 35\,\text{mm}}$$

1.4) Length of Kennedy Key given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$35.0078\,\text{mm} = \sqrt{2} \cdot \frac{712763.6\,\text{N*mm}}{44.98998\,\text{mm} \cdot 5\,\text{mm} \cdot 128\,\text{N/mm}^2}$$

1.5) Length of Kennedy Key given Shear Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$35.0626\,\text{mm} = \frac{712763.6\,\text{N*mm}}{\sqrt{2} \cdot 44.98998\,\text{mm} \cdot 5\,\text{mm} \cdot 63.9\,\text{N/mm}^2}$$

1.6) Shear Stress in Kennedy Key Formula

Evaluate Formula

Formula

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

Example with Units

$$64.0143\,\mathrm{N/mm^2} = \frac{712763.6\,\mathrm{N{*}mm}}{\sqrt{2} \cdot 44.98998\,\mathrm{mm} \cdot 5\,\mathrm{mm} \cdot 35\,\mathrm{mm}}$$

1.7) Torque Transmitted by Kennedy Key given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$712604.9267\,\mathrm{N{*}mm} = 128\,\mathrm{N/mm^2} \cdot 44.98998\,\mathrm{mm} \cdot 5\,\mathrm{mm} \cdot \frac{35\,\mathrm{mm}}{\sqrt{2}}$$

1.8) Torque Transmitted by Kennedy Key given Shear Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$711491.4815\,\mathrm{N{*}mm} = 63.9\,\mathrm{N/mm^2} \cdot \sqrt{2} \cdot 44.98998\,\mathrm{mm} \cdot 5\,\mathrm{mm} \cdot 35\,\mathrm{mm}$$

1.9) Width of Key given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$5.0011\,\mathrm{mm} = \sqrt{2} \cdot \frac{712763.6\,\mathrm{N{*}mm}}{44.98998\,\mathrm{mm} \cdot 128\,\mathrm{N/mm^2} \cdot 35\,\mathrm{mm}}$$

2) Design of Splines Formulas

2.1) Major Diameter of Spline given Mean Radius Formula

Evaluate Formula

Formula

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

Example with Units

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

2.2) Mean Radius of Splines Formula

Evaluate Formula

Formula

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

Example with Units

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

2.3) Mean Radius of Splines given Torque Transmitting Capacity Formula

Evaluate Formula

Formula

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

Example with Units

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

2.4) Minor Diameter of Spline given Mean Radius Formula

Evaluate Formula

Formula

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

Example with Units

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

2.5) Permissible Pressure on Splines given Torque Transmitting Capacity Formula

Evaluate Formula

Formula

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

Example with Units

$$5.1397\,\text{N/mm}^2 = \frac{224500\,\text{N*mm}}{1560\,\text{mm}^2 \cdot 28\,\text{mm}}$$

2.6) Torque Transmitting Capacity of Splines Formula

Evaluate Formula

Formula

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

Example with Units

$$224499.9994\,\text{N*mm} = 5.139652\,\text{N/mm}^2 \cdot 1560\,\text{mm}^2 \cdot 28\,\text{mm}$$

2.7) Torque Transmitting Capacity of Splines given Diameter of Splines Formula

Evaluate Formula

Formula

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

Example with Units

$$224499.9994\,\text{N*mm} = \frac{5.139652\,\text{N/mm}^2 \cdot 65\,\text{mm} \cdot 6 \cdot \left(60\,\text{mm}^2 - 52\,\text{mm}^2\right)}{8}$$

2.8) Total Area of Splines Formula

Evaluate Formula

Formula

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

Example with Units

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

2.9) Total Area of Splines given Torque Transmitting Capacity Formula

Evaluate Formula

Formula

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

Example with Units

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

3) Design of Square and Flat Keys Formulas

3.1) Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

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

3.2) Compressive Stress in Square Key due to Transmitted Torque Formula

Evaluate Formula

Formula

$$\sigma_c = 2 \cdot \tau$$

Example with Units

$$127.8\,\mathrm{N/mm^2} = 2 \cdot 63.9\,\mathrm{N/mm^2}$$

3.3) Force on Key Formula

Evaluate Formula

Formula

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

Example with Units

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

3.4) Height of Key given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$4.4554\,\mathrm{mm} = 4 \cdot \frac{224500\,\mathrm{N{*}mm}}{44.98998\,\mathrm{mm} \cdot 35\,\mathrm{mm} \cdot 128\,\mathrm{N/mm^2}}$$

3.5) Length of Key given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$34.6528\,\mathrm{mm} = 4 \cdot \frac{224500\,\mathrm{N{*}mm}}{44.98998\,\mathrm{mm} \cdot 128\,\mathrm{N/mm^2} \cdot 4.5\,\mathrm{mm}}$$

3.6) Length of Key given Shear Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$31.2363\,\mathrm{mm} = \frac{9980\,\mathrm{N}}{5\,\mathrm{mm} \cdot 63.9\,\mathrm{N/mm^2}}$$

3.7) Shaft Diameter given Compressive Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$44.5437\,\mathrm{mm} = 4 \cdot \frac{224500\,\mathrm{N{*}mm}}{128\,\mathrm{N/mm^2} \cdot 35\,\mathrm{mm} \cdot 4.5\,\mathrm{mm}}$$

3.8) Shaft Diameter given Force on Key Formula

Evaluate Formula

Formula

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

Example with Units

$$44.99\,\mathrm{mm} = 2 \cdot \frac{224500\,\mathrm{N{*}mm}}{9980\,\mathrm{N}}$$

3.9) Shear Stress in given Force on Key Formula

Evaluate Formula

Formula

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

Example with Units

$$57.0286\,\text{N/mm}^2 = \frac{9980\,\text{N}}{5\,\text{mm} \cdot 35\,\text{mm}}$$

3.10) Shear Stress in Key given Torque Transmitted Formula

Evaluate Formula

Formula

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

Example with Units

$$57.0286\,\text{N/mm}^2 = 2 \cdot \frac{224500\,\text{N*mm}}{5\,\text{mm} \cdot 35\,\text{mm} \cdot 44.98998\,\text{mm}}$$

3.11) Shear Stress on Flat Key Formula

Evaluate Formula

Formula

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

Example with Units

$$57.0286\,\text{N/mm}^2 = \frac{2 \cdot 224499.99458\,\text{N*mm}}{5\,\text{mm} \cdot 44.98998\,\text{mm} \cdot 35\,\text{mm}}$$

3.12) Torque Transmitted by Keyed Shaft given Force on Keys Formula

Evaluate Formula

Formula

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

Example with Units

$$224500.0002\,\text{N*mm} = 9980\,\text{N} \cdot \frac{44.98998\,\text{mm}}{2}$$

3.13) Torque Transmitted by Keyed Shaft given Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

$$226749.4992\,\text{N*mm} = 128\,\text{N/mm}^2 \cdot 44.98998\,\text{mm} \cdot 35\,\text{mm} \cdot \frac{4.5\,\text{mm}}{4}$$

3.14) Width of Key given Shear Stress in Key Formula

Evaluate Formula

Formula

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

Example with Units

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

Variables used in list of Design of Keys Formulas above

- **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)*
- **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)*
- **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)*
- **$\tau_{flat\ key}$** Shear Stress *(Newton per Square Millimeter)*

Constants, Functions, Measurements used in list of Design of Keys Formulas above

- Functions: **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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