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Important Formulas of Piston

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List of 18 Important Formulas of Piston

Important Formulas of Piston

1) Inner Diameter of Piston Pin

$$fx \quad d_i = 0.6 \cdot d_o$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$ex \quad 33.3\text{mm} = 0.6 \cdot 55.5\text{mm}$$

2) Length of Piston Pin used in Connecting Rod

$$fx \quad l_1 = 0.45 \cdot D_i$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$ex \quad 81\text{mm} = 0.45 \cdot 180\text{mm}$$

3) Length of Piston Skirt given Allowable Bearing Pressure

$$fx \quad l_s = \mu \cdot \pi \cdot D_i \cdot \frac{P_{\max}}{4 \cdot P_b}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$ex \quad 50.60791\text{mm} = 0.1 \cdot \pi \cdot 180\text{mm} \cdot \frac{1.43191084\text{N}/\text{mm}^2}{4 \cdot 0.4\text{N}/\text{mm}^2}$$

4) Maximum Bending Moment on Piston Pin

$$fx \quad M_b = F_P \cdot \frac{D_i}{8}$$

[Open Calculator !\[\]\(83bbbd261710c59db0214aa27b2edc0d_img.jpg\)](#)

$$ex \quad 3240\text{N}\cdot\text{m} = 144\text{kN} \cdot \frac{180\text{mm}}{8}$$



5) Maximum Bending Stress in Piston Pin

$$fx \quad \sigma_{\max} = 4 \cdot F_P \cdot D_i \cdot \frac{d_o}{\pi \cdot (d_o^4 - d_i^4)}$$

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

ex

$$221.3985\text{N/mm}^2 = 4 \cdot 144\text{kN} \cdot 180\text{mm} \cdot \frac{55.5\text{mm}}{\pi \cdot ((55.5\text{mm})^4 - (33.2\text{mm})^4)}$$

6) Maximum Gap between Free Ends of Ring after Assembly

$$fx \quad G = 0.004 \cdot D_i$$

[Open Calculator !\[\]\(5361750c22c4e047a52f4eac1ec2d4cc_img.jpg\)](#)

$$ex \quad 0.72\text{mm} = 0.004 \cdot 180\text{mm}$$

7) Maximum Gap between Free Ends of Ring before Assembly

$$fx \quad G = 4 \cdot b$$

[Open Calculator !\[\]\(b792654f2cef9719eabeb6c5be00811e_img.jpg\)](#)

$$ex \quad 21.36\text{mm} = 4 \cdot 5.34\text{mm}$$

8) Maximum Gas Force on Piston Head

$$fx \quad F_P = \pi \cdot D_i^2 \cdot \frac{P_{\max}}{4}$$

[Open Calculator !\[\]\(84f47badaad7772cd95667a7c387a639_img.jpg\)](#)

$$ex \quad 36.43769\text{kN} = \pi \cdot (180\text{mm})^2 \cdot \frac{1.43191084\text{N/mm}^2}{4}$$



9) Maximum Length of Piston Skirt

$$fx \quad l_s = 0.8 \cdot D_i$$

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

$$ex \quad 144\text{mm} = 0.8 \cdot 180\text{mm}$$

10) Minimum Length of Piston Skirt

$$fx \quad l_s = 0.65 \cdot D_i$$

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

$$ex \quad 117\text{mm} = 0.65 \cdot 180\text{mm}$$

11) Number of Piston Rings

$$fx \quad z = \frac{D_i}{10 \cdot h_{\min}}$$

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

$$ex \quad 3.991131 = \frac{180\text{mm}}{10 \cdot 4.51\text{mm}}$$

12) Outer Diameter of Piston Pin

$$fx \quad d_o = \pi \cdot D_i^2 \cdot \frac{P_{\max}}{4 \cdot (p_b c) \cdot l_1}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 59.26852\text{mm} = \pi \cdot (180\text{mm})^2 \cdot \frac{1.43191084\text{N}/\text{mm}^2}{4 \cdot 7.59\text{N}/\text{mm}^2 \cdot 81\text{mm}}$$



13) Permissible Bending Stress for Piston

$$fx \quad \sigma_{ph} = \frac{P_0}{f_s}$$

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

$$ex \quad 30.66667N/mm^2 = \frac{92N/mm^2}{3}$$

14) Radial Width of Piston Ring

$$fx \quad b = D_i \cdot \sqrt{3 \cdot \frac{P_w}{\sigma_{tp}}}$$

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

$$ex \quad 5.346797mm = 180mm \cdot \sqrt{3 \cdot \frac{0.025N/mm^2}{85N/mm^2}}$$

15) Radius of Piston Cup

$$fx \quad R = 0.7 \cdot D_i$$

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

$$ex \quad 126mm = 0.7 \cdot 180mm$$

16) Side Thrust on Piston

$$fx \quad F_a = \mu \cdot \pi \cdot D_i^2 \cdot \frac{P_{max}}{4}$$

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

$$ex \quad 3.643769kN = 0.1 \cdot \pi \cdot (180mm)^2 \cdot \frac{1.43191084N/mm^2}{4}$$



17) Thickness of Piston Head According to Grashoff's Formula

[Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7_img.jpg\)](#)

$$\text{fx } t_h = D_i \cdot \sqrt{3 \cdot \frac{P_{\max}}{16 \cdot \sigma_{\text{ph}}}}$$

$$\text{ex } 16.84399\text{mm} = 180\text{mm} \cdot \sqrt{3 \cdot \frac{1.43191084\text{N/mm}^2}{16 \cdot 30.66\text{N/mm}^2}}$$

18) Thickness of Piston Head given Cylinder Inner Diameter

[Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae_img.jpg\)](#)

$$\text{fx } t_h = 0.032 \cdot D_i + 1.5$$

$$\text{ex } 7.26\text{mm} = 0.032 \cdot 180\text{mm} + 1.5$$



Variables Used






- **b** Radial Width of Piston Ring (*Millimeter*)
- **d_i** Inner Diameter of Piston Pin (*Millimeter*)
- **D_i** Diameter of Cylinder Bore (*Millimeter*)
- **d_o** Outer Diameter of Piston Pin (*Millimeter*)
- **F_a** Side Thrust on Piston (*Kilonewton*)
- **F_P** Force Exerted on Piston (*Kilonewton*)
- **f_s** Factor of Safety of Engine Piston
- **G** Gap between Free Ends of Piston Ring (*Millimeter*)
- **h_{min}** Minimum Axial Thickness of Piston Ring (*Millimeter*)
- **l₁** Length of Piston Pin in Connecting Rod (*Millimeter*)
- **l_s** Length of Piston Skirt (*Millimeter*)
- **M_b** Bending Moment (*Newton Meter*)
- **P₀** Ultimate Tensile Strength of Piston (*Newton per Square Millimeter*)
- **P_b** Bearing Pressure for Piston Skirt (*Newton per Square Millimeter*)
- **p_{bC}** Bearing Pressure of CrankPin Bush (*Newton per Square Millimeter*)
- **p_{max}** Maximum Gas Pressure Inside Cylinder (*Newton per Square Millimeter*)
- **p_w** Allowable Radial Pressure on Piston Ring (*Newton per Square Millimeter*)
- **R** Radius of Piston Cup (*Millimeter*)
- **t_h** Thickness of Piston Head (*Millimeter*)
- **z** Number of Piston Rings



- μ Coefficient of Friction for Piston Skirt
- σ_{\max} Maximum Bending Stress in Piston Pin (*Newton per Square Millimeter*)
- σ_{ph} Bending Stress in Piston Head (*Newton per Square Millimeter*)
- σ_{tp} Permissible Tensile Stress for Ring (*Newton per Square Millimeter*)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **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:** **Pressure** in Newton per Square Millimeter (N/mm²)
Pressure Unit Conversion 
- **Measurement:** **Force** in Kilonewton (kN)
Force Unit Conversion 
- **Measurement:** **Torque** in Newton Meter (N*m)
Torque Unit Conversion 
- **Measurement:** **Stress** in Newton per Square Millimeter (N/mm²)
Stress Unit Conversion 



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