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Design of Pressure Vessels Formulas

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List of 52 Design of Pressure Vessels Formulas

Design of Pressure Vessels

Bernie's and Clavarino's Equation

1) Inner Diameter of Pressurized Cylinder from Bernie's Equation

$$fx \quad d_i = \frac{2 \cdot t_w}{\left(\left(\frac{\sigma_t + ((1 - \nu) \cdot P_i)}{\sigma_t - ((1 + \nu) \cdot P_i)} \right)^{0.5} \right) - 1}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2_img.jpg\)](#)

$$ex \quad 755.2067\text{mm} = \frac{2 \cdot 30\text{mm}}{\left(\left(\frac{75\text{N/mm}^2 + ((1 - 0.3) \cdot 10.2\text{MPa})}{75\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\text{MPa})} \right)^{0.5} \right) - 1}$$

2) Inner Diameter of Pressurized Cylinder from Clavarino's Equation

$$fx \quad d_i = \frac{2 \cdot t_w}{\left(\left(\frac{\sigma_t + ((1 - 2\nu) \cdot P_i)}{\sigma_t - ((1 + \nu) \cdot P_i)} \right)^{0.5} \right) - 1}$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa_img.jpg\)](#)

$$ex \quad 1066.826\text{mm} = \frac{2 \cdot 30\text{mm}}{\left(\left(\frac{75\text{N/mm}^2 + ((1 - 2 \cdot 0.3) \cdot 10.2\text{MPa})}{75\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\text{MPa})} \right)^{0.5} \right) - 1}$$

3) Thickness of Pressurized Cylinder from Bernie's Equation

$$fx \quad t_w = \left(\frac{d_i}{2} \right) \cdot \left(\left(\left(\frac{\sigma_t + ((1 - \nu) \cdot P_i)}{\sigma_t - ((1 + \nu) \cdot P_i)} \right)^{0.5} \right) - 1 \right)$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d_img.jpg\)](#)


$$ex \quad 18.47176\text{mm} = \left(\frac{465\text{mm}}{2} \right) \cdot \left(\left(\left(\frac{75\text{N/mm}^2 + ((1 - 0.3) \cdot 10.2\text{MPa})}{75\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\text{MPa})} \right)^{0.5} \right) - 1 \right)$$



4) Thickness of Pressurized Cylinder from Clavarino's Equation [Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb_img.jpg\)](#)


$$fx \quad t_w = \left(\frac{d_i}{2} \right) \cdot \left(\left(\left(\frac{\sigma_t + ((1 - (2 \cdot \nu) \cdot P_i))}{\sigma_t - ((1 + \nu) \cdot P_i)} \right)^{0.5} \right) - 1 \right)$$

$$ex \quad 13.07617\text{mm} = \left(\frac{465\text{mm}}{2} \right) \cdot \left(\left(\left(\frac{75\text{N/mm}^2 + ((1 - (2 \cdot 0.3) \cdot 10.2\text{MPa}))}{75\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\text{MPa})} \right)^{0.5} \right) - 1 \right)$$

Bolt of Pressurized Cylinder 5) Change in External Load due to Pressure Inside Cylinder given k_b and k_c [Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)


$$fx \quad \Delta P_i = P_{\text{ext}} \cdot \left(\frac{k_b}{k_c + k_b} \right)$$

$$ex \quad 5193.662\text{N} = 25000\text{N} \cdot \left(\frac{1180\text{kN/mm}}{4500\text{kN/mm} + 1180\text{kN/mm}} \right)$$

6) Change in External Load on Bolt due to Pressure Inside Cylinder [Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$fx \quad \Delta P_i = P_b - P_1$$

$$ex \quad 4500\text{N} = 24500\text{N} - 20000\text{N}$$

7) Decrease in Outer Diameter of Cylinder given Total deformation in Pressure Vessel [Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$fx \quad \delta_c = \delta - \delta_j$$


$$ex \quad 0.8\text{mm} = 1.20\text{mm} - 0.4\text{mm}$$

8) External Load on Bolt due to Internal Pressure given k_b and k_c [Open Calculator !\[\]\(aff7c69c44a5e015f18c35867ef3f5c3_img.jpg\)](#)

$$fx \quad P_{\text{ext}} = \Delta P_i \cdot \left(\frac{k_c + k_b}{k_b} \right)$$

$$ex \quad 24308.47\text{N} = 5050\text{N} \cdot \left(\frac{4500\text{kN/mm} + 1180\text{kN/mm}}{1180\text{kN/mm}} \right)$$



9) Initial Preload due to Bolt tightening 

$$fx \quad P_1 = P_b - \Delta P_i$$

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


$$ex \quad 19450N = 24500N - 5050N$$

10) Initial Preload due to Bolt tightening given kb and kc 

$$fx \quad P_1 = P_{\max} \cdot \left(\frac{k_b}{k_c + k_b} \right)$$

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


$$ex \quad 5235.211N = 25200N \cdot \left(\frac{1180kN/mm}{4500kN/mm + 1180kN/mm} \right)$$

11) Internal Diameter of Pressurized Cylinder 

$$fx \quad d_i = 2 \cdot \frac{t_w}{\left(\left(\frac{\sigma_t + P_i}{\sigma_t - P_i} \right)^{\frac{1}{2}} \right) - 1}$$

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


$$ex \quad 409.1269mm = 2 \cdot \frac{30mm}{\left(\left(\frac{75N/mm^2 + 10.2MPa}{75N/mm^2 - 10.2MPa} \right)^{\frac{1}{2}} \right) - 1}$$

12) Maximum Load inside Pressurized Cylinder when Joint is on verge of opening 

$$fx \quad P_{\max} = P_1 \cdot \left(\frac{k_c + k_b}{k_b} \right)$$

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

$$ex \quad 96271.19N = 20000N \cdot \left(\frac{4500kN/mm + 1180kN/mm}{1180kN/mm} \right)$$

13) Resultant Load on Bolt given Pre load 

$$fx \quad P_b = P_1 + \Delta P_i$$

[Open Calculator !\[\]\(40770d9ed6ed4f1222ebf89a1396e8b2_img.jpg\)](#)


$$ex \quad 25050N = 20000N + 5050N$$



14) Thickness of Pressurized Cylinder [Open Calculator !\[\]\(bd1a142de767a21e5362c595f844a4ff_img.jpg\)](#)

$$fx \quad t_w = \left(\frac{d_i}{2} \right) \cdot \left(\left(\left(\frac{\sigma_t + P_i}{\sigma_t - P_i} \right)^{\frac{1}{2}} \right) - 1 \right)$$

$$ex \quad 34.097\text{mm} = \left(\frac{465\text{mm}}{2} \right) \cdot \left(\left(\left(\frac{75\text{N/mm}^2 + 10.2\text{MPa}}{75\text{N/mm}^2 - 10.2\text{MPa}} \right)^{\frac{1}{2}} \right) - 1 \right)$$

Gasket Joint 15) Approximate Stiffness of Cylinder Cover, Cylinder Flange and Gasket [Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$fx \quad K = (2 \cdot \pi \cdot (d^2)) \cdot \left(\frac{E}{t} \right)$$

$$ex \quad 5089.38\text{kN/mm} = (2 \cdot \pi \cdot ((15\text{mm})^2)) \cdot \left(\frac{90000\text{N/mm}^2}{25\text{mm}} \right)$$

16) Combined Stiffness of Cylinder Cover, Cylinder Flange and Gasket [Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$fx \quad k_c = \frac{1}{\left(\frac{1}{k_1} \right) + \left(\frac{1}{k_2} \right) + \left(\frac{1}{k_g} \right)}$$

$$ex \quad 4721.105\text{kN/mm} = \frac{1}{\left(\frac{1}{10050\text{kN/mm}} \right) + \left(\frac{1}{11100\text{kN/mm}} \right) + \left(\frac{1}{45000\text{kN/mm}} \right)}$$

17) Increase in Inner Diameter of Jacket given Total deformation of Pressure Vessel [Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$fx \quad \delta_j = \delta - \delta_c$$


$$ex \quad 0.4\text{mm} = 1.20\text{mm} - 0.80\text{mm}$$



18) Nominal Diameter of Gasket Joint [Open Calculator](#) 


$$\text{fx } d = \sqrt{K \cdot \frac{t}{2 \cdot \pi \cdot E}}$$

$$\text{ex } 15.00091\text{mm} = \sqrt{5090\text{kN/mm} \cdot \frac{25\text{mm}}{2 \cdot \pi \cdot 90000\text{N/mm}^2}}$$

19) Nominal Diameter of Gasket Joint Bolt given Stiffness, total thickness and Young's Modulus [Open Calculator](#) 

$$\text{fx } d = \sqrt{k_b \cdot 4 \cdot \frac{l}{\pi \cdot E}}$$

$$\text{ex } 30.30094\text{mm} = \sqrt{1180\text{kN/mm} \cdot 4 \cdot \frac{55\text{mm}}{\pi \cdot 90000\text{N/mm}^2}}$$

20) Stiffness of Bolt of Gasket Joint given Nominal Diameter, Total Thickness, and Young's Modulus [Open Calculator](#) 

$$\text{fx } k_b = \left(\pi \cdot \frac{d^2}{4} \right) \cdot \left(\frac{E}{l} \right)$$

$$\text{ex } 289.1693\text{kN/mm} = \left(\pi \cdot \frac{(15\text{mm})^2}{4} \right) \cdot \left(\frac{90000\text{N/mm}^2}{55\text{mm}} \right)$$

21) Stiffness of Cylinder Cover of Gasket Joint [Open Calculator](#) 

$$\text{fx } k_1 = \frac{1}{\left(\frac{1}{k_c} \right) - \left(\left(\frac{1}{k_2} \right) + \left(\frac{1}{k_g} \right) \right)}$$

$$\text{ex } 9098.361\text{kN/mm} = \frac{1}{\left(\frac{1}{4500\text{kN/mm}} \right) - \left(\left(\frac{1}{11100\text{kN/mm}} \right) + \left(\frac{1}{45000\text{kN/mm}} \right) \right)}$$



22) Stiffness of Cylinder Flange of Gasket Joint 

$$\text{fx } k_2 = \frac{1}{\left(\frac{1}{k_c}\right) - \left(\left(\frac{1}{k_1}\right) + \left(\frac{1}{k_g}\right)\right)}$$

Open Calculator 


$$\text{ex } 9950.495\text{kN/mm} = \frac{1}{\left(\frac{1}{4500\text{kN/mm}}\right) - \left(\left(\frac{1}{10050\text{kN/mm}}\right) + \left(\frac{1}{45000\text{kN/mm}}\right)\right)}$$

23) Stiffness of Gasket of Gasket Joint 

$$\text{fx } k_g = \frac{1}{\left(\frac{1}{k_c}\right) - \left(\left(\frac{1}{k_1}\right) + \left(\frac{1}{k_2}\right)\right)}$$

Open Calculator 


$$\text{ex } 30646.98\text{kN/mm} = \frac{1}{\left(\frac{1}{4500\text{kN/mm}}\right) - \left(\left(\frac{1}{10050\text{kN/mm}}\right) + \left(\frac{1}{11100\text{kN/mm}}\right)\right)}$$

24) Thickness of Member under Compression for Gasket Joint 

$$\text{fx } t = \left(\pi \cdot \frac{d^2}{4}\right) \cdot \left(\frac{E}{K}\right)$$

Open Calculator 

$$\text{ex } 3.124619\text{mm} = \left(\pi \cdot \frac{(15\text{mm})^2}{4}\right) \cdot \left(\frac{90000\text{N/mm}^2}{5090\text{kN/mm}}\right)$$

25) Total Deformation of Pressure Vessel given Increase in Inner Diameter of Jacket 

$$\text{fx } \delta = \delta_j + \delta_c$$

Open Calculator 

$$\text{ex } 1.2\text{mm} = 0.4\text{mm} + 0.80\text{mm}$$


26) Total Thickness of Gasket Joint given Stiffness, Nominal Diameter and Young's Modulus 

$$\text{fx } l = \left(\pi \cdot \frac{d^2}{4}\right) \cdot \left(\frac{E}{k_b}\right)$$

Open Calculator 

$$\text{ex } 13.47823\text{mm} = \left(\pi \cdot \frac{(15\text{mm})^2}{4}\right) \cdot \left(\frac{90000\text{N/mm}^2}{1180\text{kN/mm}}\right)$$



27) Young's Modulus of Gasket Joint 

$$fx \quad E = 4 \cdot K \cdot \frac{t}{\pi \cdot (d^2)}$$

Open Calculator 

$$ex \quad 720087.7N/mm^2 = 4 \cdot 5090kN/mm \cdot \frac{25mm}{\pi \cdot ((15mm)^2)}$$

28) Young's Modulus of Gasket Joint given Stiffness, Total Thickness and Nominal Diameter 

$$fx \quad E = k_b \cdot \frac{l}{\pi \cdot \frac{d^2}{4}}$$

Open Calculator 

$$ex \quad 367258.9N/mm^2 = 1180kN/mm \cdot \frac{55mm}{\pi \cdot \frac{(15mm)^2}{4}}$$

Thick Cylinder Vessel 29) External Pressure acting on Thick Cylinder given Radial Stress 

$$fx \quad P_o = \frac{\sigma_r}{\left(\frac{d_o^2}{(d_o^2) - (d_i^2)}\right) \cdot \left(\left(\frac{d_i^2}{4 \cdot (r^2)}\right) + 1\right)}$$

Open Calculator 

$$ex \quad 11.77034MPa = \frac{80N/mm^2}{\left(\frac{(550mm)^2}{((550mm)^2) - ((465mm)^2)}\right) \cdot \left(\left(\frac{(465mm)^2}{4 \cdot ((240mm)^2)}\right) + 1\right)}$$


30) External Pressure acting on Thick Cylinder given Tangential Stress 

$$fx \quad P_o = \frac{\sigma_{tang}}{\left(\frac{d_o^2}{(d_o^2) - (d_i^2)}\right) \cdot \left(\left(\frac{d_i^2}{4 \cdot (r^2)}\right) + 1\right)}$$

Open Calculator 

$$ex \quad 7.062204MPa = \frac{48N/mm^2}{\left(\frac{(550mm)^2}{((550mm)^2) - ((465mm)^2)}\right) \cdot \left(\left(\frac{(465mm)^2}{4 \cdot ((240mm)^2)}\right) + 1\right)}$$



31) Internal Pressure in Thick Cylinder given Longitudinal Stress [Open Calculator](#) 

$$fx \quad P_i = \sigma_l \cdot \frac{(d_o^2) - (d_i^2)}{d_i^2}$$

$$ex \quad 27.13239MPa = 68N/mm^2 \cdot \frac{((550mm)^2) - ((465mm)^2)}{(465mm)^2}$$

32) Internal Pressure in Thick Cylinder given Radial Stress [Open Calculator](#) 

$$fx \quad P_i = \frac{\sigma_r}{\left(\frac{d_i^2}{(d_o^2) - (d_i^2)}\right) \cdot \left(\left(\frac{d_o^2}{4 \cdot (r^2)}\right) + 1\right)}$$

$$ex \quad 13.80085MPa = \frac{80N/mm^2}{\left(\frac{(465mm)^2}{((550mm)^2) - ((465mm)^2)}\right) \cdot \left(\left(\frac{(550mm)^2}{4 \cdot ((240mm)^2)}\right) + 1\right)}$$

33) Internal Pressure in Thick Cylinder given Tangential Stress [Open Calculator](#) 

$$fx \quad P_i = \frac{\sigma_{tang}}{\left(\frac{d_i^2}{(d_o^2) - (d_i^2)}\right) \cdot \left(\left(\frac{d_o^2}{4 \cdot (r^2)}\right) + 1\right)}$$


$$ex \quad 8.280509MPa = \frac{48N/mm^2}{\left(\frac{(465mm)^2}{((550mm)^2) - ((465mm)^2)}\right) \cdot \left(\left(\frac{(550mm)^2}{4 \cdot ((240mm)^2)}\right) + 1\right)}$$

34) Longitudinal Stress in Thick Cylinder subjected to Internal Pressure [Open Calculator](#) 

$$fx \quad \sigma_l = \left(P_i \cdot \frac{d_i^2}{(d_o^2) - (d_i^2)}\right)$$



$$ex \quad 25.56355N/mm^2 = \left(10.2MPa \cdot \frac{(465mm)^2}{((550mm)^2) - ((465mm)^2)}\right)$$



35) Radial Stress in Thick Cylinder subjected to External Pressure Open Calculator 

$$\text{fx } \sigma_r = \left(P_o \cdot \frac{d_o^2}{(d_o^2) - (d_i^2)} \right) \cdot \left(1 - \left(\frac{d_i^2}{4 \cdot (r^2)} \right) \right)$$

$$\text{ex } 1.725723\text{N/mm}^2 = \left(8\text{MPa} \cdot \frac{(550\text{mm})^2}{((550\text{mm})^2) - ((465\text{mm})^2)} \right) \cdot \left(1 - \left(\frac{(465\text{mm})^2}{4 \cdot ((240\text{mm})^2)} \right) \right)$$

36) Radial Stress in Thick Cylinder subjected to Internal Pressure Open Calculator 


$$\text{fx } \sigma_r = \left(P_i \cdot \frac{d_i^2}{(d_o^2) - (d_i^2)} \right) \cdot \left(\left(\frac{d_o^2}{4 \cdot (r^2)} \right) - 1 \right)$$

$$\text{ex } 7.999704\text{N/mm}^2 = \left(10.2\text{MPa} \cdot \frac{(465\text{mm})^2}{((550\text{mm})^2) - ((465\text{mm})^2)} \right) \cdot \left(\left(\frac{(550\text{mm})^2}{4 \cdot ((240\text{mm})^2)} \right) - 1 \right)$$

37) Tangential Stress in Thick Cylinder subjected to External Pressure Open Calculator 

$$\text{fx } \sigma_{\text{tang}} = \left(P_o \cdot \frac{d_o^2}{(d_o^2) - (d_i^2)} \right) \cdot \left(\left(\frac{d_i^2}{4 \cdot (r^2)} \right) + 1 \right)$$

$$\text{ex } 54.37396\text{N/mm}^2 = \left(8\text{MPa} \cdot \frac{(550\text{mm})^2}{((550\text{mm})^2) - ((465\text{mm})^2)} \right) \cdot \left(\left(\frac{(465\text{mm})^2}{4 \cdot ((240\text{mm})^2)} \right) + 1 \right)$$

38) Tangential Stress in Thick Cylinder subjected to Internal Pressure Open Calculator 

$$\text{fx } \sigma_{\text{tang}} = \left(P_i \cdot \frac{d_i^2}{(d_o^2) - (d_i^2)} \right) \cdot \left(\left(\frac{d_o^2}{4 \cdot (r^2)} \right) + 1 \right)$$

$$\text{ex } 59.1268\text{N/mm}^2 = \left(10.2\text{MPa} \cdot \frac{(465\text{mm})^2}{((550\text{mm})^2) - ((465\text{mm})^2)} \right) \cdot \left(\left(\frac{(550\text{mm})^2}{4 \cdot ((240\text{mm})^2)} \right) + 1 \right)$$



Thin Cylinder Vessel

39) Cylinder Wall Thickness of Thin Cylinder given Longitudinal Stress

$$\text{fx } t_w = P_i \cdot \frac{d_i}{4 \cdot \sigma_l}$$

[Open Calculator !\[\]\(a03a7eb2f4046e1d3c76772003e549ea_img.jpg\)](#)

$$\text{ex } 17.4375\text{mm} = 10.2\text{MPa} \cdot \frac{465\text{mm}}{4 \cdot 68\text{N/mm}^2}$$

40) Cylinder Wall Thickness of Thin Cylinder given Tangential Stress

$$\text{fx } t_w = P_i \cdot \frac{d_i}{2 \cdot \sigma_{\text{tang}}}$$

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

$$\text{ex } 49.40625\text{mm} = 10.2\text{MPa} \cdot \frac{465\text{mm}}{2 \cdot 48\text{N/mm}^2}$$

41) Inner Diameter of Thin Cylinder given Longitudinal Stress

$$\text{fx } d_i = 4 \cdot t_w \cdot \frac{\sigma_l}{P_i}$$

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

$$\text{ex } 800\text{mm} = 4 \cdot 30\text{mm} \cdot \frac{68\text{N/mm}^2}{10.2\text{MPa}}$$

42) Inner Diameter of Thin Cylinder given Tangential Stress

$$\text{fx } d_i = 2 \cdot t_w \cdot \frac{\sigma_{\text{tang}}}{P_i}$$

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

$$\text{ex } 282.3529\text{mm} = 2 \cdot 30\text{mm} \cdot \frac{48\text{N/mm}^2}{10.2\text{MPa}}$$

43) Inner Diameter of Thin Spherical Shell given Permissible Tensile Stress

$$\text{fx } d_i = 4 \cdot t_w \cdot \frac{\sigma_t}{P_i}$$

[Open Calculator !\[\]\(c15650232aa6660c9deb34f3b82dcb72_img.jpg\)](#)

$$\text{ex } 882.3529\text{mm} = 4 \cdot 30\text{mm} \cdot \frac{75\text{N/mm}^2}{10.2\text{MPa}}$$



44) Inner Diameter of Thin Spherical Shell given Volume [Open Calculator !\[\]\(dfbd6b3763a6d1d9afaa974f64e2e4b5_img.jpg\)](#)

$$\text{fx } d_i = \left(6 \cdot \frac{V}{\pi} \right)^{\frac{1}{3}}$$

$$\text{ex } 781.5926\text{mm} = \left(6 \cdot \frac{0.25\text{m}^3}{\pi} \right)^{\frac{1}{3}}$$

45) Internal Pressure in Thin Cylinder given Longitudinal Stress [Open Calculator !\[\]\(ec9132f1d27c8919987d92907322654d_img.jpg\)](#)


$$\text{fx } P_i = 4 \cdot t_w \cdot \frac{\sigma_l}{d_i}$$

$$\text{ex } 17.54839\text{MPa} = 4 \cdot 30\text{mm} \cdot \frac{68\text{N/mm}^2}{465\text{mm}}$$

46) Internal Pressure in Thin Cylinder given Tangential Stress [Open Calculator !\[\]\(758ebdf4629c903da74c2e079717ae32_img.jpg\)](#)

$$\text{fx } P_i = 2 \cdot t_w \cdot \frac{\sigma_{\text{tang}}}{d_i}$$

$$\text{ex } 6.193548\text{MPa} = 2 \cdot 30\text{mm} \cdot \frac{48\text{N/mm}^2}{465\text{mm}}$$

47) Internal Pressure in Thin Spherical Shell given Permissible Tensile Stress [Open Calculator !\[\]\(248b91fcdac4810ffd15cf33fb6aec6f_img.jpg\)](#)

$$\text{fx } P_i = 4 \cdot t_w \cdot \frac{\sigma_t}{d_i}$$

$$\text{ex } 19.35484\text{MPa} = 4 \cdot 30\text{mm} \cdot \frac{75\text{N/mm}^2}{465\text{mm}}$$

48) Longitudinal Stress in Thin Cylinder given Internal Pressure [Open Calculator !\[\]\(d3e32d099174a7c248ec1f564ee4f69c_img.jpg\)](#)

$$\text{fx } \sigma_l = P_i \cdot \frac{d_i}{4 \cdot t_w}$$

$$\text{ex } 39.525\text{N/mm}^2 = 10.2\text{MPa} \cdot \frac{465\text{mm}}{4 \cdot 30\text{mm}}$$



49) Permissible Tensile Stress in Thin Spherical Shell [Open Calculator](#) 


$$fx \quad \sigma_t = P_i \cdot \frac{d_i}{4 \cdot t_w}$$

$$ex \quad 39.525 \text{N/mm}^2 = 10.2 \text{MPa} \cdot \frac{465 \text{mm}}{4 \cdot 30 \text{mm}}$$

50) Tangential Stress in Thin Cylinder given Internal Pressure [Open Calculator](#) 


$$fx \quad \sigma_{\text{tang}} = P_i \cdot \frac{d_i}{2 \cdot t_w}$$

$$ex \quad 79.05 \text{N/mm}^2 = 10.2 \text{MPa} \cdot \frac{465 \text{mm}}{2 \cdot 30 \text{mm}}$$

51) Thickness of Thin Spherical Shell given Permissible tensile stress [Open Calculator](#) 

$$fx \quad t_w = P_i \cdot \frac{d_i}{4 \cdot \sigma_t}$$

$$ex \quad 15.81 \text{mm} = 10.2 \text{MPa} \cdot \frac{465 \text{mm}}{4 \cdot 75 \text{N/mm}^2}$$

52) Volume of Thin Spherical Shell given Inner Diameter [Open Calculator](#) 

$$fx \quad V = \pi \cdot \frac{d_i^3}{6}$$

$$ex \quad 0.052645 \text{m}^3 = \pi \cdot \frac{(465 \text{mm})^3}{6}$$



Variables Used







- **d** Nominal Bolt Diameter on Cylinder (Millimeter)
- **d_i** Inner Diameter of Pressurized Cylinder (Millimeter)
- **d_o** Outer Diameter of Pressurized Cylinder (Millimeter)
- **E** Modulus of Elasticity for Gasket Joint (Newton per Square Millimeter)
- **K** Approximate Stiffness of Gasketed Joint (Kilonewton per Millimeter)
- **k₁** Stiffness of Pressurized Cylinder Cover (Kilonewton per Millimeter)
- **k₂** Stiffness of Pressurized Cylinder Flange (Kilonewton per Millimeter)
- **k_b** Stiffness of Pressurized Cylinder Bolt (Kilonewton per Millimeter)
- **k_c** Combined Stiffness for Gasket Joint (Kilonewton per Millimeter)
- **k_g** Stiffness of Gasket (Kilonewton per Millimeter)
- **l** Total Thickness of parts held together by Bolt (Millimeter)
- **P_b** Resultant Load on Pressurized Cylinder Bolt (Newton)
- **P_{ext}** External Load on Pressurized Cylinder Bolt (Newton)
- **P_i** Internal Pressure on Cylinder (Megapascal)
- **P_i** Initial Preload Due to Bolt Tightening (Newton)
- **P_{max}** Maximum Force Inside Pressurized Cylinder (Newton)
- **P_o** External Pressure on Cylinder (Megapascal)
- **r** Radius of pressurized cylinder (Millimeter)
- **t** Thickness of Member under Compression (Millimeter)
- **t_w** Thickness of Pressurized Cylinder Wall (Millimeter)
- **V** Volume of Thin Spherical Shell (Cubic Meter)
- **δ** Total Deformation of Pressure Vessel (Millimeter)
- **δ_c** Decrease in Outer Diameter of Cylinder (Millimeter)
- **δ_j** Increase in Inner Diameter of Jacket (Millimeter)
- **ΔP_i** Increase in Bolt Load of Cylinder (Newton)
- **σ_l** Longitudinal Stress in Pressurized Cylinder (Newton per Square Millimeter)
- **σ_r** Radial Stress in Pressurized Cylinder (Newton per Square Millimeter)
- **σ_t** Permissible Tensile Stress in Pressurized Cylinder (Newton per Square Millimeter)
- **σ_{tang}** Tangential Stress in Pressurized Cylinder (Newton per Square Millimeter)



- **v** Poisson's Ratio of Pressurized Cylinder



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:** **Volume** in Cubic Meter (m³)
Volume Unit Conversion 
- **Measurement:** **Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Stiffness Constant** in Kilonewton per Millimeter (kN/mm)
Stiffness Constant Unit Conversion 
- **Measurement:** **Stress** in Newton per Square Millimeter (N/mm²)
Stress Unit Conversion 



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