Important Design of Pressure Vessels Formulas PDF

Formulas
Examples
with Units

List of 52
Important Design of Pressure Vessels Formulas

1) Bernie's and Clavarino's Equation Formulas

1.1) Inner Diameter of Pressurized Cylinder from Bernie's Equation Formula

Evaluate Formula

Formula

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

Example with Units

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

1.2) Inner Diameter of Pressurized Cylinder from Clavarino's Equation Formula

Evaluate Formula

Formula

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

Example with Units

$$1066.8264\,\text{mm} = \frac{2 \cdot 30\,\text{mm}}{\left(\left(\frac{75\,\text{N/mm}^2 + \left(\left(1 - (2 \cdot 0.3) \cdot 10.2\,\text{MPa} \right) \right)}{75\,\text{N/mm}^2 - \left(\left(1 + 0.3 \right) \cdot 10.2\,\text{MPa} \right)} \right)^{0.5} \right) - 1}$$

1.3) Thickness of Pressurized Cylinder from Bernie's Equation Formula

Evaluate Formula

Formula

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

Example with Units

$$18.4718\,\text{mm} = \left(\frac{465\,\text{mm}}{2}\right) \cdot \left(\left(\left(\frac{75\,\text{N/mm}^2 + ((1 - (0.3)) \cdot 10.2\,\text{MPa})}{75\,\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\,\text{MPa})}\right)^{0.5}\right) - 1\right)$$

1.4) Thickness of Pressurized Cylinder from Clavarino's Equation Formula

Evaluate Formula

Formula

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

Example with Units

$$13.0762\,\text{mm} = \left(\frac{465\,\text{mm}}{2}\right) \cdot \left(\left(\left(\frac{75\,\text{N/mm}^2 + ((1 - (2 \cdot 0.3)) \cdot 10.2\,\text{MPa})}{75\,\text{N/mm}^2 - ((1 + 0.3) \cdot 10.2\,\text{MPa})}\right)^{0.5}\right) - 1\right)$$

2) Bolt of Pressurized Cylinder Formulas

2.1) Change in External Load due to Pressure Inside Cylinder given kb and kc Formula

Evaluate Formula

Formula

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

Example with Units

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

2.2) Change in External Load on Bolt due to Pressure Inside Cylinder Formula

Evaluate Formula

Formula

$$\Delta P_i = P_b - P_l$$

Example with Units

$$4500\,\text{N} = 24500\,\text{N} - 20000\,\text{N}$$

2.3) Decrease in Outer Diameter of Cylinder given Total deformation in Pressure Vessel Formula

Evaluate Formula

Formula

$$\delta_c = \delta - \delta_j$$

Example with Units

$$0.8\,\text{mm} = 1.20\,\text{mm} - 0.4\,\text{mm}$$

2.4) External Load on Bolt due to Internal Pressure given kb and kc Formula

Evaluate Formula

Formula

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

Example with Units

$$24308.4746\,\mathrm{N} = 5050\,\mathrm{N} \cdot \left(\frac{4500\,\mathrm{kN/mm} + 1180\,\mathrm{kN/mm}}{1180\,\mathrm{kN/mm}} \right)$$

2.5) Initial Preload due to Bolt tightening Formula

Evaluate Formula

Formula

$$P_l = P_b - \Delta P_i$$

Example with Units

$$19450\,\mathrm{N} = 24500\,\mathrm{N} - 5050\,\mathrm{N}$$

2.6) Initial Preload due to Bolt tightening given kb and kc Formula

Evaluate Formula

Formula

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

Example with Units

$$5235.2113\,\mathrm{N} = 25200\,\mathrm{N} \cdot \left(\frac{1180\,\mathrm{kN/mm}}{4500\,\mathrm{kN/mm} + 1180\,\mathrm{kN/mm}} \right)$$

2.7) Internal Diameter of Pressurized Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$96271.1864\,\mathrm{N} = 20000\,\mathrm{N} \cdot \left(\frac{4500\,\mathrm{kN/mm} + 1180\,\mathrm{kN/mm}}{1180\,\mathrm{kN/mm}} \right)$$

2.9) Resultant Load on Bolt given Pre load Formula

Evaluate Formula

Formula

$$P_b = P_l + \Delta P_i$$

Example with Units

$$25050\,\mathrm{N} = 20000\,\mathrm{N} + 5050\,\mathrm{N}$$

2.10) Thickness of Pressurized Cylinder Formula

Evaluate Formula

Formula

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

Example with Units

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

3) Gasket Joint Formulas

3.1) Approximate Stiffness of Cylinder Cover, Cylinder Flange and Gasket Formula

Evaluate Formula

Formula

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

Example with Units

$$5089.3801\,\text{kN/mm} = \left(2 \cdot 3.1416 \cdot \left(15\,\text{mm}^2\right)\right) \cdot \left(\frac{90000\,\text{N/mm}^2}{25\,\text{mm}}\right)$$

3.2) Combined Stiffness of Cylinder Cover, Cylinder Flange and Gasket Formula

Evaluate Formula

Formula

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

Example with Units

$$4721.1054\,\text{kN/mm} = \frac{1}{\left(\frac{1}{10050\,\text{kN/mm}}\right) + \left(\frac{1}{11100\,\text{kN/mm}}\right) + \left(\frac{1}{45000\,\text{kN/mm}}\right)}$$

3.3) Increase in Inner Diameter of Jacket given Total deformation of Pressure Vessel Formula

Evaluate Formula

Formula

$$\delta_j = \delta - \delta_c$$

Example with Units

$$0.4\,\text{mm} = 1.20\,\text{mm} - 0.80\,\text{mm}$$

3.4) Nominal Diameter of Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$15.0009\,\text{mm} = \sqrt{5090\,\text{kN/mm} \cdot \frac{25\,\text{mm}}{2 \cdot 3.1416 \cdot 90000\,\text{N/mm}^2}}$$

3.5) Nominal Diameter of Gasket Joint Bolt given Stiffness, total thickness and Young's Modulus Formula

Evaluate Formula

Formula

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

Example with Units

$$30.3009\,\text{mm} = \sqrt{1180\,\text{kN/mm} \cdot 4 \cdot \frac{55\,\text{mm}}{3.1416 \cdot 90000\,\text{N/mm}^2}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$289.1693\,\text{kN/mm} = \left(3.1416 \cdot \frac{15\,\text{mm}^2}{4}\right) \cdot \left(\frac{90000\,\text{N/mm}^2}{55\,\text{mm}}\right)$$

3.7) Stiffness of Cylinder Cover of Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$9098.3607\,\text{kN/mm} = \frac{1}{\left(\frac{1}{4500\,\text{kN/mm}}\right) - \left(\left(\frac{1}{11100\,\text{kN/mm}}\right) + \left(\frac{1}{45000\,\text{kN/mm}}\right)\right)}$$

3.8) Stiffness of Cylinder Flange of Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

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

3.9) Stiffness of Gasket of Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$30646.978\,\text{kN/mm} = \frac{1}{\left(\frac{1}{4500\,\text{kN/mm}}\right) - \left(\left(\frac{1}{10050\,\text{kN/mm}}\right) + \left(\frac{1}{11100\,\text{kN/mm}}\right)\right)}$$

3.10) Thickness of Member under Compression for Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$3.1246\,\text{mm} = \left(3.1416 \cdot \frac{15\,\text{mm}^2}{4}\right) \cdot \left(\frac{90000\,\text{N/mm}^2}{5090\,\text{kN/mm}}\right)$$

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

Evaluate Formula

Formula

$$\delta = \delta_j + \delta_c$$

Example with Units

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

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

Evaluate Formula

Formula

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

Example with Units

$$13.4782\,\text{mm} = \left(3.1416 \cdot \frac{15\,\text{mm}^2}{4}\right) \cdot \left(\frac{90000\,\text{N/mm}^2}{1180\,\text{kN/mm}}\right)$$

3.13) Young's Modulus of Gasket Joint Formula

Evaluate Formula

Formula

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

Example with Units

$$720087.6981\,\text{N/mm}^2 = 4 \cdot 5090\,\text{kN/mm} \cdot \frac{25\,\text{mm}}{3.1416 \cdot \left(15\,\text{mm}^2\right)}$$

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

Evaluate Formula

Formula

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

Example with Units

$$367258.8731\,\text{N/mm}^2 = 1180\,\text{kN/mm} \cdot \frac{55\,\text{mm}}{3.1416 \cdot \frac{15\,\text{mm}^2}{4}}$$

4) Thick Cylinder Vessel Formulas

4.1) External Pressure acting on Thick Cylinder given Radial Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$11.7703\,\text{MPa} = \frac{80\,\text{N/mm}^2}{\left(\frac{550\,\text{mm}^2}{(550\,\text{mm}^2) - (465\,\text{mm}^2)}\right) \cdot \left(\left(\frac{465\,\text{mm}^2}{4 \cdot (240\,\text{mm}^2)}\right) + 1\right)}$$

4.2) External Pressure acting on Thick Cylinder given Tangential Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$7.0622\,\text{MPa} = \frac{48\,\text{N/mm}^2}{\left(\frac{550\,\text{mm}^2}{(550\,\text{mm}^2) - (465\,\text{mm}^2)}\right) \cdot \left(\left(\frac{465\,\text{mm}^2}{4 \cdot (240\,\text{mm}^2)}\right) + 1\right)}$$

4.3) Internal Pressure in Thick Cylinder given Longitudinal Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$27.1324\,\text{MPa} = 68\,\text{N/mm}^2 \cdot \frac{(550\,\text{mm}^2) - (465\,\text{mm}^2)}{465\,\text{mm}^2}$$

4.4) Internal Pressure in Thick Cylinder given Radial Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$13.8008\,\text{MPa} = \frac{80\,\text{N/mm}^2}{\left(\frac{465\,\text{mm}^2}{(550\,\text{mm}^2) - (465\,\text{mm}^2)}\right) \cdot \left(\left(\frac{550\,\text{mm}^2}{4 \cdot (240\,\text{mm}^2)}\right) + 1\right)}$$

4.5) Internal Pressure in Thick Cylinder given Tangential Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$8.2805\,\text{MPa} = \frac{48\,\text{N/mm}^2}{\left(\frac{465\,\text{mm}^2}{\left(550\,\text{mm}^2\right) - \left(465\,\text{mm}^2\right)}\right) \cdot \left(\left(\frac{550\,\text{mm}^2}{4 \cdot \left(240\,\text{mm}^2\right)}\right) + 1\right)}$$

4.6) Longitudinal Stress in Thick Cylinder subjected to Internal Pressure Formula

Evaluate Formula

Formula

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

Example with Units

$$25.5635\,\text{N/mm}^2 = \left(10.2\,\text{MPa} \cdot \frac{465\,\text{mm}^2}{\left(550\,\text{mm}^2\right) - \left(465\,\text{mm}^2\right)}\right)$$

4.7) Radial Stress in Thick Cylinder subjected to External Pressure Formula

Evaluate Formula

Formula

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

Example with Units

$$1.7257\,\text{N/mm}^2 = \left(8\,\text{MPa} \cdot \frac{550\,\text{mm}^2}{\left(550\,\text{mm}^2\right) - \left(465\,\text{mm}^2\right)}\right) \cdot \left(1 - \left(\frac{465\,\text{mm}^2}{4 \cdot \left(240\,\text{mm}^2\right)}\right)\right)$$

4.8) Radial Stress in Thick Cylinder subjected to Internal Pressure Formula

Evaluate Formula

Formula

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

Example with Units

$$7.9997\,\mathrm{N/mm^2} = \left(10.2\,\mathrm{MPa} \cdot \frac{465\,\mathrm{mm}^{\,2}}{\left(550\,\mathrm{mm}^{\,2}\right) - \left(465\,\mathrm{mm}^{\,2}\right)} \right) \cdot \left(\left(\frac{550\,\mathrm{mm}^{\,2}}{4 \cdot \left(240\,\mathrm{mm}^{\,2}\right)} \right) - 1 \right)$$

4.9) Tangential Stress in Thick Cylinder subjected to External Pressure Formula

Evaluate Formula

Formula

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

Example with Units

$$54.374\,\mathrm{N/mm^2} = \left(8\,\mathrm{MPa} \cdot \frac{550\,\mathrm{mm}^{\,2}}{\left(550\,\mathrm{mm}^{\,2}\right) - \left(465\,\mathrm{mm}^{\,2}\right)} \right) \cdot \left(\left(\frac{465\,\mathrm{mm}^{\,2}}{4 \cdot \left(240\,\mathrm{mm}^{\,2}\right)} \right) + 1 \right)$$

4.10) Tangential Stress in Thick Cylinder subjected to Internal Pressure Formula

Evaluate Formula

Formula

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

Example with Units

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

5) Thin Cylinder Vessel Formulas

5.1) Cylinder Wall Thickness of Thin Cylinder given Longitudinal Stress Formula

Evaluate Formula

Formula

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

Example with Units

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

5.2) Cylinder Wall Thickness of Thin Cylinder given Tangential Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$49.4062\,\text{mm} = 10.2\,\text{MPa} \cdot \frac{465\,\text{mm}}{2 \cdot 48\,\text{N/mm}^2}$$

5.3) Inner Diameter of Thin Cylinder given Longitudinal Stress Formula

Evaluate Formula

Formula

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

Example with Units

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

5.4) Inner Diameter of Thin Cylinder given Tangential Stress Formula

Evaluate Formula

Formula

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

Example with Units

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

5.5) Inner Diameter of Thin Spherical Shell given Permissible Tensile Stress Formula

Evaluate Formula

Formula

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

Example with Units

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

5.6) Inner Diameter of Thin Spherical Shell given Volume Formula

Evaluate Formula

Formula

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

Example with Units

$$781.5926\,\text{mm} = \left(6 \cdot \frac{0.25\,\text{m}^3}{3.1416}\right)^{\frac{1}{3}}$$

5.7) Internal Pressure in Thin Cylinder given Longitudinal Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$17.5484\,\text{MPa} = 4 \cdot 30\,\text{mm} \cdot \frac{68\,\text{N/mm}^2}{465\,\text{mm}}$$

5.8) Internal Pressure in Thin Cylinder given Tangential Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$6.1935\,\text{MPa} = 2 \cdot 30\,\text{mm} \cdot \frac{48\,\text{N/mm}^2}{465\,\text{mm}}$$

5.9) Internal Pressure in Thin Spherical Shell given Permissible Tensile Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$19.3548\,\text{MPa} = 4 \cdot 30\,\text{mm} \cdot \frac{75\,\text{N/mm}^2}{465\,\text{mm}}$$

5.10) Longitudinal Stress in Thin Cylinder given Internal Pressure Formula

Evaluate Formula

Formula

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

Example with Units

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

5.11) Permissible Tensile Stress in Thin Spherical Shell Formula

Evaluate Formula

Formula

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

Example with Units

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

5.12) Tangential Stress in Thin Cylinder given Internal Pressure Formula

Evaluate Formula

Formula

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

Example with Units

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

5.13) Thickness of Thin Spherical Shell given Permissible tensile stress Formula

Evaluate Formula

Formula

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

Example with Units

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

5.14) Volume of Thin Spherical Shell given Inner Diameter Formula

Evaluate Formula

Formula

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

Example with Units

$$0.0526\,\text{m}^3 = 3.1416 \cdot \frac{(465\,\text{mm})^3}{6}$$

Variables used in list of Design of Pressure Vessels Formulas above

- **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)*
- k_1 Stiffness of Pressurized Cylinder Cover *(Kilonewton per Millimeter)*
- k_2 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_l 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)*

Constants, Functions, Measurements used in list of Design of Pressure Vessels Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- 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: **Volume** in Cubic Meter (m^3) *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/mm^2) *Stress Unit Conversion*

- **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)*
- **ν** Poisson's Ratio of Pressurized Cylinder

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