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Design of Pressure Vessel Subjected to Internal Pressure Formulas

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List of 17 Design of Pressure Vessel Subjected to Internal Pressure Formulas

Design of Pressure Vessel Subjected to Internal Pressure

1) Bolt Circle Diameter

Open Calculator

fx $$B = G_o + (2 \cdot d_b) + 12$$

ex $$4.112\text{m} = 1.1\text{m} + (2 \cdot 1.5\text{m}) + 12$$

2) Circumferential Stress (Hoop Stress) in Cylinderical Shell

Open Calculator

fx $$\sigma_c = \frac{P_{Internal} \cdot D}{2} \cdot t_c$$

ex $$1625.7\text{Pa} = \frac{270.95\text{Pa} \cdot 5\text{m}}{2} \cdot 2.4\text{m}$$

3) Coefficient Value for Thickness of Flange

Open Calculator

fx $$k = \left(\frac{1}{(0.3) + \frac{1.5 \cdot W_m \cdot h_G}{H_{gasket} \cdot G}} \right)$$

ex $$0.456107 = \left(\frac{1}{(0.3) + \frac{1.5 \cdot 1000\text{N} \cdot 1.82\text{m}}{3136\text{N} \cdot 0.46\text{m}}} \right)$$

4) Diameter of Gasket at Load Reaction

Open Calculator

fx $$G = G_o - 2 \cdot b$$

ex $$0.46\text{m} = 1.1\text{m} - 2 \cdot 0.32\text{m}$$

5) Effective Thickness of Conical Head

Open Calculator

fx $$t_e = t_{ch} \cdot (\cos(A))$$

ex $$1.575966\text{m} = 3\text{m} \cdot (\cos(45\text{rad}))$$

6) Gasket Factor

Open Calculator

fx $$m = \frac{W - A_2 \cdot P_{test}}{A_1 \cdot P_{test}}$$

ex $$2.380989 = \frac{97\text{N} - 13\text{m}^2 \cdot 0.39\text{Pa}}{99\text{m}^2 \cdot 0.39\text{Pa}}$$

7) Hoop Strain

Open Calculator

fx $$E = \frac{l_2 - l_0}{l_0}$$

ex $$0.428571 = \frac{10\text{m} - 7\text{m}}{7\text{m}}$$

8) Hydrostatic End Force using Design Pressure

Open Calculator

fx $$H = \left(\frac{\pi}{4}\right) \cdot \left(h_G^2\right) \cdot P_i$$

ex $$2.5E\hat{}7N = \left(\frac{\pi}{4}\right) \cdot \left((1.82m)^2\right) \cdot 9.8MPa$$

9) Internal Pressure of Cylindrical Vessel given Hoop Stress

Open Calculator

fx $$P_{HoopStress} = \frac{2 \cdot \sigma_c \cdot t_c}{D}$$

ex $$1560.672Pa = \frac{2 \cdot 1625.7Pa \cdot 2.4m}{5m}$$

10) Internal Presure of Vessel given Longitudinal Stress

Open Calculator

fx $$P_{LS} = \frac{4 \cdot \sigma_l \cdot t_c}{D}$$

ex $$51776.64Pa = \frac{4 \cdot 26967Pa \cdot 2.4m}{5m}$$

11) Longitudinal Stress (Axial Stress) in Cylindrical Shell

Open Calculator

fx $$\sigma_{CylindricalShell} = \frac{P_{LS} \cdot D}{4} \cdot t_c$$

ex $$155329.9Pa = \frac{51776.64Pa \cdot 5m}{4} \cdot 2.4m$$

12) Maximum Bolt Spacing

Open Calculator

$$b_{s(max)} = 2 \cdot d_b + \left(6 \cdot \frac{t_f}{m} + 0.5\right)$$

$$303.5\text{m} = 2 \cdot 1.5\text{m} + \left(6 \cdot \frac{100\text{m}}{2} + 0.5\right)$$

13) Minimum Bolt Spacing

Open Calculator

$$b_{s(min)} = 2.5 \cdot d_b$$

$$3.75\text{m} = 2.5 \cdot 1.5\text{m}$$

14) Outside Diameter of Flange using Bolt Diameter

Open Calculator

$$D_{fo} = B + 2 \cdot d_b + 12$$

$$7.112\text{m} = 4.1\text{m} + 2 \cdot 1.5\text{m} + 12$$

15) Radial Distance from Gasket Load Reaction to Bolt Circle

Open Calculator

$$h_G = \frac{B - G}{2}$$

$$1.82\text{m} = \frac{4.1\text{m} - 0.46\text{m}}{2}$$

16) Wall Thickness of Cylindrical Shell Given Hoop Stress

Open Calculator

fx $$tc_{hoopstress} = \frac{2 \cdot P_{HoopStress} \cdot D}{\sigma_c}$$

ex $$9.6\text{m} = \frac{2 \cdot 1560.672\text{Pa} \cdot 5\text{m}}{1625.7\text{Pa}}$$

17) Wall Thickness of Pressure Vessel given Longitudinal Stress

Open Calculator

fx $$tc_{longitudinalstress} = \frac{P_{Internal} \cdot D}{4 \cdot \sigma_l}$$

ex $$0.012559\text{Pa} = \frac{270.95\text{Pa} \cdot 5\text{m}}{4 \cdot 26967\text{Pa}}$$

Variables Used

- **A** Apex Angle *(Radian)*
- **A_1** Gasket Area *(Square Meter)*
- **A_2** Inside Area of Gasket *(Square Meter)*
- **b** Effective Gasket Seating Width *(Meter)*
- **B** Bolt Circle Diameter *(Meter)*
- **$b_{s(max)}$** Maximum Bolt Spacing *(Meter)*
- **$b_{s(min)}$** Minimum Bolt Spacing *(Meter)*
- **D** Mean Diameter of Shell *(Meter)*
- **d_b** Nominal Bolt Diameter *(Meter)*
- **D_{fo}** Outside Flange Diameter *(Meter)*
- **E** Hoop Strain
- **G** Diameter of Gasket at Load Reaction *(Meter)*
- **G_o** Outside Diameter of Gasket *(Meter)*
- **H** Hydrostatic End Force *(Newton)*
- **h_G** Radial Distance *(Meter)*
- **H_{gasket}** Hydrostatic End Force in Gasket Seal *(Newton)*
- **k** Coefficient Value for Thickness of Flange
- **l_0** Initial Length *(Meter)*
- **l_2** Final Length *(Meter)*
- **m** Gasket Factor
- **$P_{HoopStress}$** Internal Pressure given Hoop Stress *(Pascal)*
- **P_i** Internal Pressure *(Megapascal)*

- $P_{Internal}$ Internal Pressure for Vessel *(Pascal)*
- P_{LS} Internal Pressure given Longitudinal Stress *(Pascal)*
- P_{test} Test Pressure *(Pascal)*
- t_c Thickness of Cylindrical Shell *(Meter)*
- t_{ch} Thickness of Conical Head *(Meter)*
- t_e Effective Thickness *(Meter)*
- t_f Thickness of Flange *(Meter)*
- $tc_{hoopstress}$ Thickness of Shell for Hoop Stress *(Meter)*
- $tc_{longitudinalstress}$ Thickness of Shell for Longitudinal Stress *(Pascal)*
- W Total Fastener Force *(Newton)*
- W_m Maximum Bolt Loads *(Newton)*
- σ_c Circumferential Stress *(Pascal)*
- $\sigma_{CylindricalShell}$ Longitudinal Stress for Cylindrical Shell *(Pascal)*
- σ_l Longitudinal Stress *(Pascal)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

Check other formula lists

- **Design of Pressure Vessel Subjected to Internal Pressure Formulas**
- **Vessel Heads Formulas**

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