Engineering Calculation Report: Pressure Design of a Straight Pipe Under Internal Pressure

October 08, 2025

Description

Calculate the minimum wall thickness of a straight pipe under internal pressure according to ASME B31.3.

1 Known Variables

Symbol	Name	Value	Unit
D	Outside Diameter	0.84	in
E	Quality Factor	0.8	
P	Design Pressure	90	psi
S	Allowable Stress	20000	psi
$\overline{T}$	Nominal Wall Thickness	0.147	in
U_m	Mill Undertolerance	0.125	
W	Weld Joint Strength Reduction Factor	1	
Y	Y Coefficient	0.4	
c	Mechanical Allowances	0	in

2 Unknown Variables (To Calculate)

Symbol	Name	Unit
P_{max}	Maximum Pressure	psi
T	Wall Thickness	in
d	Inside Diameter	in
t	Pressure Design Thickness	in
t_m	Minimum Required Thickness	in

3 Equations Used

1. $T = \overline{T} \cdot (1 - U_m)$

2. $t = \frac{P \cdot D}{2 \cdot (S \cdot E \cdot W + P \cdot Y)}$

3. $P_{max} = \frac{2 \cdot (T - c) \cdot S \cdot E \cdot W}{D - 2 \cdot (T - c) \cdot Y}$

4. $d = D - 2 \cdot T$

5. $t_m = t + c$

4   Step-by-Step Solution

Step 1: Solve for T

    Equation:

$$T = \overline{T} \cdot (1 - U_m)$$

    Substitution:

$$T = 0.147 \, \text{in} \cdot (1 - 0.125)$$

    Result:

$$T = 0.128625 \, in$$

Step 2: Solve for t

    Equation:

$$t = \frac{P \cdot D}{2 \cdot (S \cdot E \cdot W + P \cdot Y)}$$

    Substitution:

$$t = \frac{90 \, \text{psi} \cdot 0.84 \, \text{in}}{2 \cdot (20000 \, \text{psi} \cdot 0.8 \cdot 1 + 90 \, \text{psi} \cdot 0.4)}$$

    Result:

$$t = 0.0023572 \, in$$

Step 3: Solve for P_{max}

    Equation:

$$P_{max} = \frac{2 \cdot (T - c) \cdot S \cdot E \cdot W}{D - 2 \cdot (T - c) \cdot Y}$$

    Substitution:

$$P_{max} = \frac{2 \cdot (0.128625 \, \text{in} - 0 \, \text{in}) \cdot 20000 \, \text{psi} \cdot 0.8 \cdot 1}{0.84 \, \text{in} - 2 \cdot (0.128625 \, \text{in} - 0 \, \text{in}) \cdot 0.4}$$

    Result:

$$P_{max} = 5584.05 \, psi$$

Step 4: Solve for d

Equation:

$$d = D - 2 \cdot T$$

Substitution:

$$d = 0.84 \, \text{in} - 2 \cdot 0.128625 \, \text{in}$$

Result:

$$d = 0.58275 \, in$$

Step 5: Solve for t_m

Equation:

$$t_m = t + c$$

Substitution:

$$t_m = 0.0023572 \, \text{in} + 0 \, \text{in}$$

Result:

$$t_m = 0.0023572 \, in$$

5 Summary of Results

Variable	Name	Final Value	Unit
P_{max}	Maximum Pressure	5584.05	psi
T	Wall Thickness	0.128625	in
d	Inside Diameter	0.58275	in
t	Pressure Design Thickness	0.0023572	in
t_m	Minimum Required Thickness	0.0023572	in

Disclaimer

IMPORTANT NOTICE:
While every effort has been made to ensure the accuracy and reliability of the calculations provided, we do not guarantee that the information is complete, up-to-date, or suitable for any specific purpose. Users must independently verify the results and assume full responsibility for any decisions or actions taken based on its output. Use of this calculator is entirely at your own risk, and we expressly disclaim any liability for errors or omissions in the information provided.

Report Details:

- **Generated Date:** October 08, 2025

- **Generated Using:** Qnty Library

- **Version:** Beta (Independent verification required for production use)

Professional Review and Approval:

Role	Name	Signature	Date
Calculated By			
Reviewed By			
Approved By			

Report generated using Qnty Library For questions or support, please refer to the Qnty documentation