

STRAIGHT PIPES UNDER INTERNAL PRESSURE EFFECT OF BORE ECCENTRICITY ON MAXIMUM STRESS

1. NOTATION

D	outside diameter of pipe	m	in
d	bore of pipe	m	in
f_e	maximum circumferential stress in pipe with eccentric bore	N/m ²	lbf/in ²
f_0	maximum circumferential stress in pipe with concentric bore,	N/m ²	lbf/in ²
	$p \left\{ \frac{D^2 + d^2}{D^2 - d^2} \right\}$		
p	uniform internal pressure	N/m ²	lbf/in ²
t_{min}	minimum thickness of pipe wall	m	in
t_{nom}	nominal thickness of pipe wall, $(D - d) / 2$	m	in

Both British and SI units are quoted but any coherent system of units may be used.

2. NOTES

The ratio f_e/f_0 is plotted against d/D for various values of t_{min}/t_{nom} . The curves are applicable to long straight unrestrained pipes of elastic material, and they are valid for $(t_{nom} - t_{min})/d$ up to 0.25.

Provided that $(t_{nom} - t_{min})/d$ is not greater than 0.25 the maximum stress developed under internal pressure is the circumferential stress in the inner fibre at the thinnest section of the wall.

Approximate values of f_e are given by the equations

$$f_e \approx p \left\{ \frac{D^2 + (D - 2t_{min})^2}{D^2 - (D - 2t_{min})^2} \right\} \quad (2.1)$$

$$\text{and} \quad f_e \approx p \left\{ \frac{(d + 2t_{min})^2 + d^2}{(d + 2t_{min})^2 - d^2} \right\}. \quad (2.2)$$

Equation (2.1) is accurate to within 5 per cent provided that either $(t_{nom} - t_{min})/d < 0.025$ or that $t_{min}/t_{nom} > 0.933$. A better result will be obtained from Equation (2.2) which is accurate to within 5 per cent provided that either $(t_{nom} - t_{min})/d < 0.2$ or that $t_{min}/t_{nom} > 0.6$.

Issued November 1968

Further data on the effect of geometrical inaccuracies on the maximum stresses in cylindrical pipes under internal pressure may be located by reference to the Engineering Sciences Data Index.

3. DERIVATION

1. JEFFREY, G.B. Plane stress and plane strain in bipolar co-ordinates. *Phil. Trans R. Soc., Series A*, Vol. 221, pp. 265-293, 1920.