

Pressure Vessel Stress Cheat Sheet

Thin-wall stresses with torque, plus lab results

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Hoop stress (thin wall)	$\sigma_H = P r / t$	Twice the longitudinal stress
Longitudinal stress	$\sigma_L = P r / (2t)$	Closed-end cylinder
Poisson's ratio	$\nu = -\epsilon_L / \epsilon_H$ (uniaxial)	Lab compares measured and theoretical
Hooke's law, biaxial	$\epsilon_H = (\sigma_H - \nu \sigma_L) / E$	Gives E from strain data
Torsional shear	$\tau = T r / J$	Thin tube: $J \approx 2\pi r^3 t$
Modulus of rigidity	$G = E / [2(1 + \nu)]$	Isotropic materials
60° rosette	γ_{xy} from three gauge readings	Derivation shown as an image in the article

Key takeaways

- Thin walls resist little bending, so internal forces are taken as tangent to the wall.
- Test: pressurize 0→200 psi in 50 psi steps (and back) with 60° rosette gauges 1-3 and gauges 4-5; Technovate Model 9800 stress analysis system.
- Reported results: Poisson's ratio error 0.2–2.8%; torque error 1.07–17.96% (the 50 psi point is the outlier, 1.07–2.42% otherwise); modulus of rigidity error 23–29.5%, growing with pressure.
- The article's equations are images; the forms above are standard textbook equivalents.