

School of Engineering
Stress Analysis Laboratory

Thin Cylinder Experiment

INTRODUCTION

The experiment is designed to provide measured values of strains in the thin cylinder when subjected to internal pressure and torsional loading. The stresses derived from these strains may then be compared with calculated values.

APPARATUS

Aluminium alloy* cylinder: 3.175 mm thick, 95.25 mm internal diameter, 406.4 mm long. The ends are welded, one being fixed to the frame, the other supported but free to rotate.

Internal pressurization is achieved by a hand pump and measured by a Bourdon gauge.

Twisting is achieved by pressurizing two hydraulic actuators which rotate the arm attached to the free end of the cylinder. The actuators have a piston diameter of 38.1 mm and an overall lever arm of 203.4 mm.

***Material Properties:**

Elastic modulus	74.88 GN/m ²
Poisson's ratio	0.32

STRAIN GAUGES (nominal resistance 120 ohms, gauge factor 2.11).

<u>Description</u>	<u>Orientation</u>
Linear	0 ⁰ (longitudinal)
Linear	90 ⁰ (circumferential)
Rosette A	-15 ⁰
Rosette B	30 ⁰
Rosette C	75 ⁰

PROCEDURE

- 1) Increase the pressure with the torsion line out of circuit in suitable increments up to 1.382 MN/m² measuring strains at each increment.
- 2) Repeat (1) with the torsion line in circuit and the cylinder line out of circuit. You will need to calibrate the torsion load cells to determine torque from pressure.
- 3) Repeat (1) with both internal pressure and torsion lines in circuit.

ANALYSIS

- 1) Determine longitudinal and circumferential strains from the rosette readings, and compare these with the strains measured directly by the longitudinal and circumferential gauges.
- 2) Compare the experimental and calculated principal stresses (magnitude and direction) for all three load cases.

DISCUSSION

- 1) Comment generally on the apparatus and the accuracy of measurement.
- 2) How important are the assumed values of the elastic constants in the comparison between experimental and calculated stresses ?
- 3) Are the thin cylinder assumptions justified ?
- 4) What might be the effect on the results if the cylinder material were in the "as drawn" condition ?