

FL 120

Stress and strain analysis on a membrane



Description

- deflection and strain of a membrane under compressive load
- membrane with strain gauge application
- determine radial and tangential stress profiles from measured strains

In experimental stress and strain analysis, strain gauges are used to determine stresses and strains in components and structures. The maximum stresses and strains are key variables in terms of its structure, and ultimately dictate the dimensions of a component. Strain gauges provide the means required to evaluate mechanical stress and strains.

The FL 120 experimental unit can be used to measure the deflection and strain of a disk under different compressive loads. For this purpose, a thin disk, also called a membrane or diaphragm, is clamped into place and subjected to pressure. A cylinder with a hand-operated piston generates pressure in a maintenance-free hydraulic system. This pressure is indicated on a manometer.

Strains on the surface of the membrane are recorded by strain gauges. The layout of the strain gauges at optimally selected points provides a comprehensive view of the stresses and strains over the entire disk. The maximum stresses and strains are calculated by applying the law of elasticity.

The strain gauge measurements are recorded and displayed by means of the FL 152 measuring amplifier. The measured values can be imported into the application software for visualisation to evaluate the experiment.

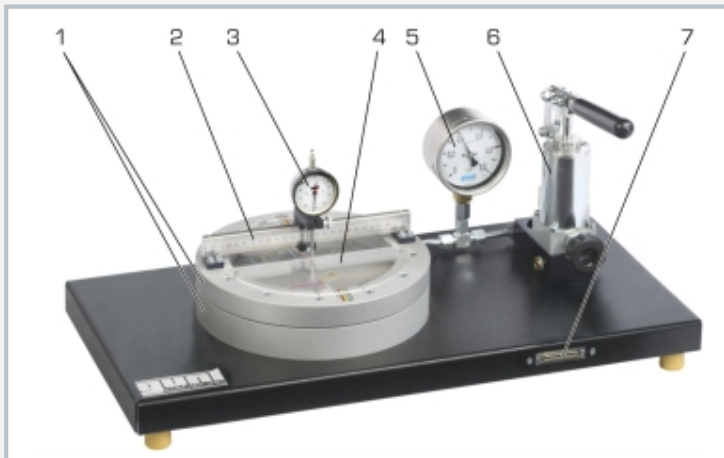
At the same time, the deflection of the membrane is measured by a dial gauge. The dial gauge can be moved along a cross-member, enabling measurements to be taken at any radius.

Learning objectives/experiments

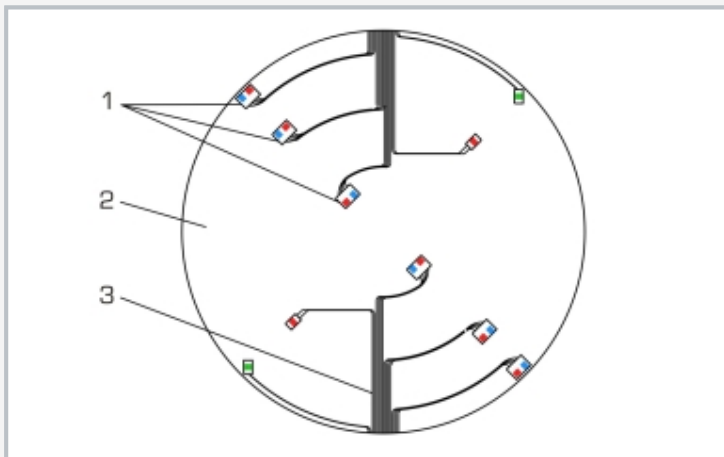
- measure radial and tangential strain using strain gauges
- measure deflection using a dial gauge
- calculate the stresses from the measured strains: radial stress, tangential stress
- determine direction of principal stress
- application of Mohr's strain circle to determine the principal strains
- fundamental principle: using strain gauge technology to measure strains

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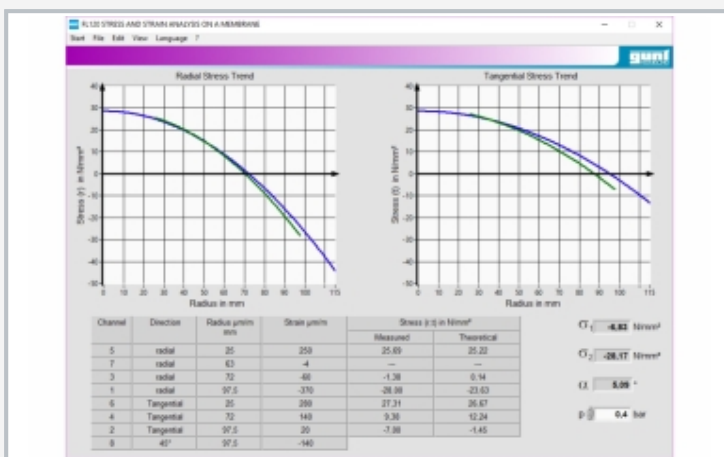
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1 clamp for disk, 2 member with scale, 3 dial gauge, 4 disk, 5 manometer, 6 hydraulic pump, 7 port for FL 152 measuring amplifier



Strain gauge layout on the disk: 1 strain gauge measuring points, 2 disk, 3 wiring; red: strains in the radial direction, blue: strains in the tangential direction, green: shear



Application software in FL 152 for stress analysis: representation of the stress curve

Specification

- [1] investigate the deflection and strain of a thin disk under compressive load
- [2] strain gauges measure in the radial and tangential direction
- [3] strain gauge configured as half-bridge
- [4] possible to measure the deflection at any radius
- [5] measure the deflection via adjustable dial gauge, scale indicates position along the radius
- [6] hermetically sealed hydraulic system, maintenance-free, for generating the compressive load
- [7] hydraulic system with hydraulic pump and manometer
- [8] FL 152 measuring amplifier required
- [9] software for analysing measured values in FL 152

Technical data

Aluminium disk

- outer diameter: \varnothing 230mm
- diameter used in the experiment: \varnothing 200mm
- thickness: 3mm

Strain gauge application

- 8 strain gauges: half-bridges, 350 Ohm
- gauge factor: $2,00 \pm 1\%$
- power supply: 10V

Dial gauge

- 0...20mm
- graduation: 0,01mm

Manometer

- 0...1bar
- accuracy: class 1,0

System pressure

- max. 0,6bar

LxWxH: 700x350x350mm

Weight: approx. 25kg

Scope of delivery

- 1 experimental unit
- 1 set of instructional material

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Required accessories

FL 152 Multi-channel measuring amplifier

Optional accessories

WP 300.09 Laboratory trolley