

# WP 100

## Deformation of bars under bending or torsion



### Description

- elastic deformation of statically determinate or indeterminate beams under bending load
- elastic torsion of round bars under twisting moment
- influence of material, cross-section and clamping length on deformation

Bending and torsion are typical loads to which components are subjected. The resultant stresses and deformations can lead to failure of the component. A number of different factors play a role in this, including the material, the cross-section of the bar, the clamping length and the method of bearing support.

WP 100 investigates the influence of these factors on the deformation of a bar under bending load or twisting moment. A set of test bars has been assembled so as to permit direct comparison of measuring results. The bar under investigation is fixed to two movable support blocks and loaded down by a weight.

A dial gauge records the resulting deformation. The support blocks include clamping chucks to hold the torsion bars and supports for the bars in the bend test. The supports offer a range of clamping options, enabling statically determinate or indeterminate bearing supports to be investigated.

The twisting moment is applied by a device mounted on a support block. The point of load application to generate the bending moment is adjustable.

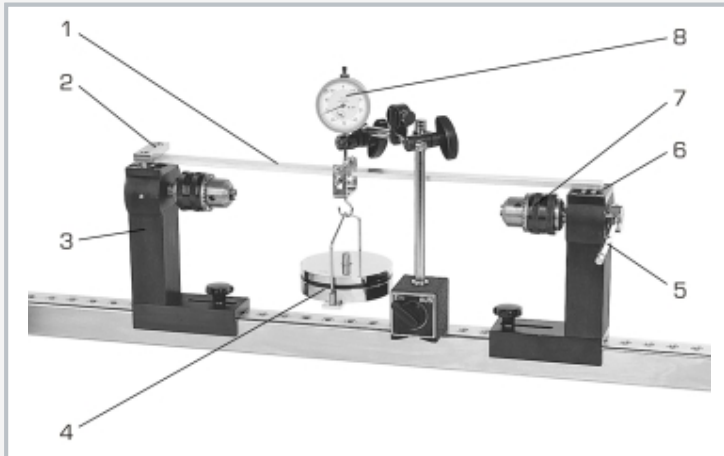
The various elements of the experiment are clearly laid-out and housed securely in a storage system. The complete experimental setup is arranged on the frame.

### Learning objectives/experiments

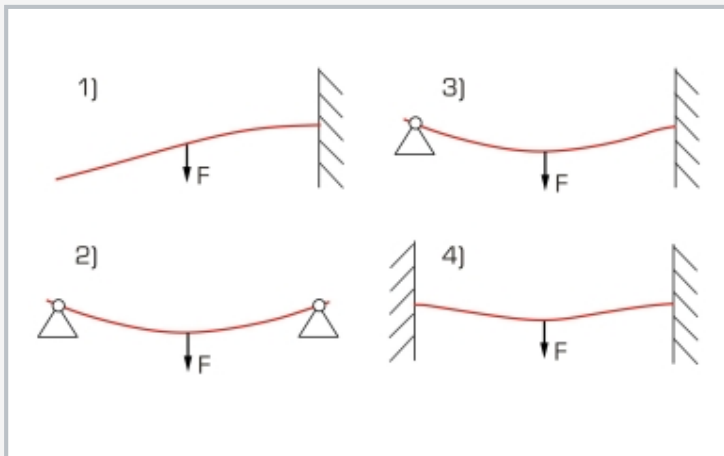
- bending tests
  - ▶ determination of the modulus of elasticity
  - ▶ statically determinate systems (beam mounted on two supports; cantilever beam)
  - ▶ statically indeterminate systems (dual-span beam)
  - ▶ deformation of a beam dependent on material, geometry (section width, height and length), type of support and length of span
  - ▶ formulation of proportional relationships for the deformation
- torsion tests
  - ▶ determination of the shear modulus of various materials
  - ▶ angle of twist dependent on clamping length, bar diameter
  - ▶ formulation of proportional relationships for the angle of twist

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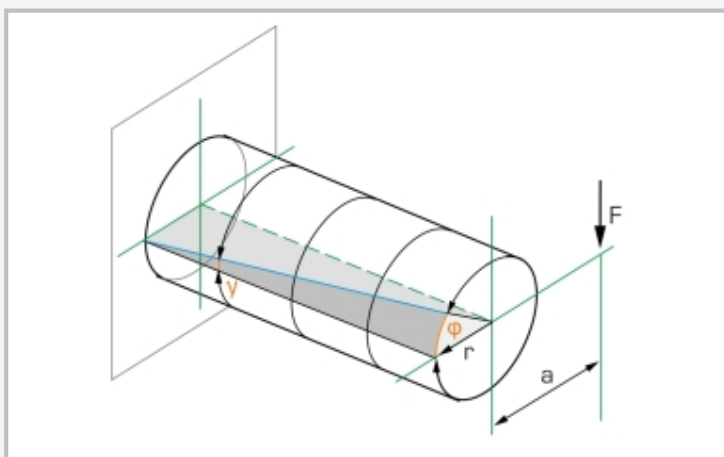
## Deformation of bars under bending or torsion



1 beam, 2 clamp fixing for bending test, 3 support block, 4 weight, 5 device to generate the twisting moment in the torsion test, 6 support for bending test, 7 clamping chuck for torsion test, 8 dial gauge



Beam deflection of a statically determinate (left) and indeterminate (right) system: 1 cantilever beam, 2 simply supported beam, 3 propped cantilever, 4 built-in beam



Torsion on round bar: F applied force, a lever arm, r radius,  $\gamma$  shear angle,  $\phi$  angle of twist

### Specification

- [1] elastic deformation of bars under bending or torsion
- [2] bending tests with statically determinate and indeterminate systems
- [3] torsion tests with a statically determinate system
- [4] supports in the bending test may be clamped or free
- [5] 2 adjustable blocks with clamping chuck for torsion tests and supports for bending tests
- [6] weights to generate the bending or twisting moment
- [7] dial gauge with bracket
- [8] storage system to house the components

### Technical data

#### 17 bars for bending tests

- material: aluminium, steel, brass, copper
- height with LxW 510x20mm:  $h=3\ldots 10\text{mm}$
- width with LxH 510x5mm:  $w=10\ldots 30\text{mm}$
- length with WxH 20x4mm:  $l=210\ldots 510\text{mm}$
- LxWxH: 20x4x510mm (Al, St, brass, Cu)
- LxWxH: 10x10x510mm (aluminium)

#### 22 torsion bars

- material: aluminium, steel, brass, copper
- length with  $\varnothing$  10mm: 50...640mm (aluminium)
- $\varnothing$ L: 10x50mm/10x340mm (aluminium, steel, copper, brass)
- diameter with L=50/340mm:  $\varnothing$  5...12mm (steel)

#### Dial gauge

- 0...10mm, graduation: 0,01mm

#### Tape measure

- graduation: 0,01m

#### Weights

- 1x 100g (hanger)
- 1x 100g, 1x 400g, 1x 500g, 1x 900g

LxWxH: 1000x250x200mm

Weight: approx. 18kg

LxWxH: 1170x480x207mm (storage system)

Weight: approx. 12kg (storage system)

### Scope of delivery

- 1 frame
- 2 support blocks
- 1 device to generate the twisting moment
- 17 bars for bending test
- 22 torsion bars
- 1 dial gauge with bracket, 1 tape measure
- 1 set of weights
- 2 hexagon socket wrenches
- 1 storage system with foam inlay
- 1 set of instructional material

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Optional accessories

WP 300.09      Laboratory trolley