

LW N°03: Torsion Test

A torsion test, also known as a torque test, is an experimental method used to determine the behavior and strength of materials subjected to torsional or twisting loads.

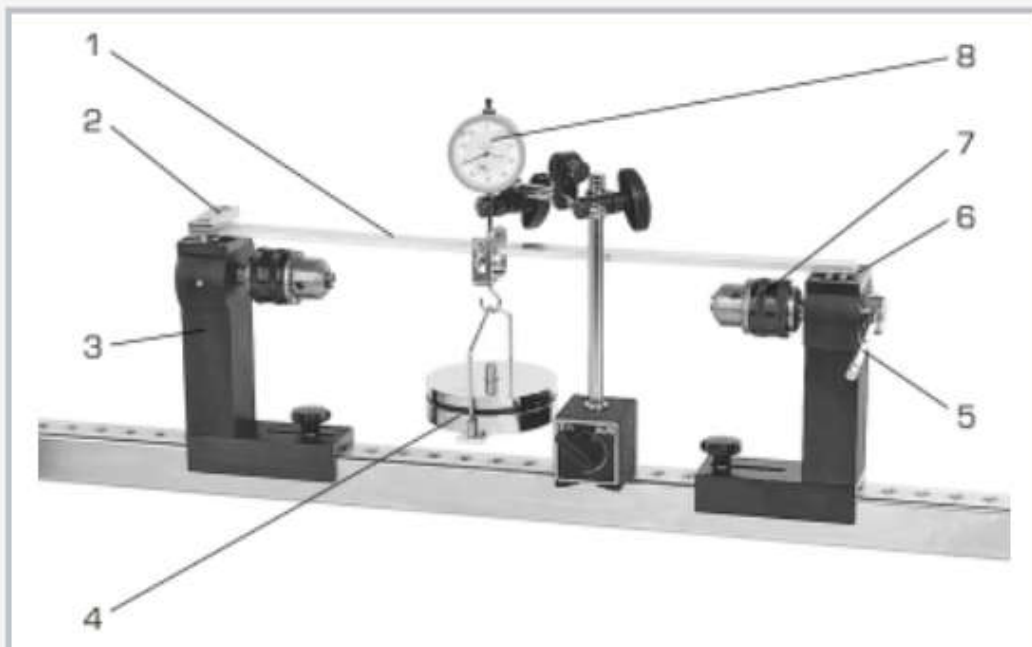
1. Objectives

- ✓ Experimental determination of the relationship between the torque (Mt) and the torsion angle (Θ) of a bar with a circular cross-section ;
- ✓ Experimental determination of the value of the rigidity modulus (Shear modulus G).

2. Laboratory Equipment Description

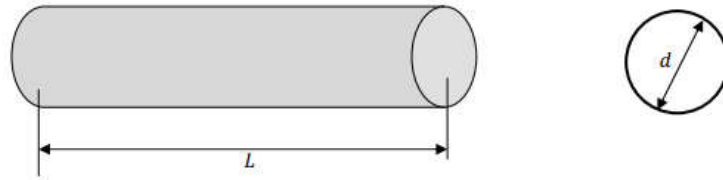
The WP 100, consisting of a frame, two movable supports containing mandrels the torsion bars and supports for the bars during the bending test, a dial gauge with support and, finally, a device on a support, the torsional moment and a set of weights to generate the bending or torsional moments (as shown in the following figure).

WP 100 Deformation of bars under bending or torsion



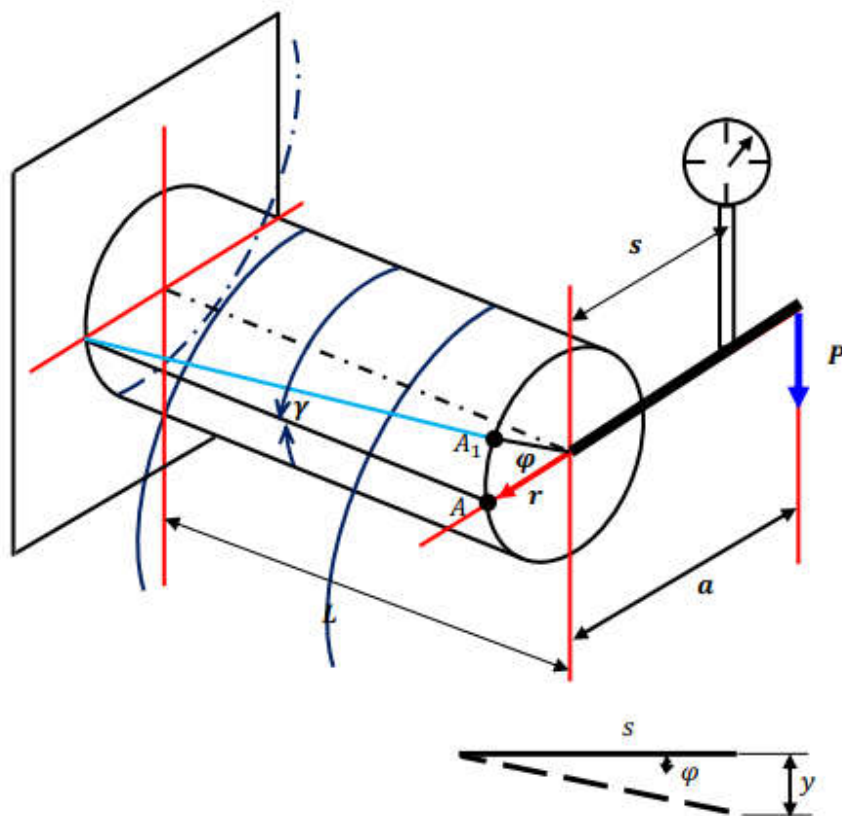
1 beam, 2 clamp fixing for bending test, 3 support block, 4 weight, 5 device to generate the twisting moment in the torsion test, 6 support for bending test, 7 clamping chuck for torsion test, 8 dial gauge

The specimens used for the torsion test as shown in the bellow figure, are cylindrical with a solid cross-section, diameter and length L . Three types of material are used: steel, aluminium and copper.



3. Governing Equations

Torsion on the round bar (see the bellow figure): P applied force, a lever arm, r radius, γ shear angle, Θ angle of twist



Torque: $M_t = P \cdot a$

Twist angle (rad): $\Theta = M_t y / G I_p$

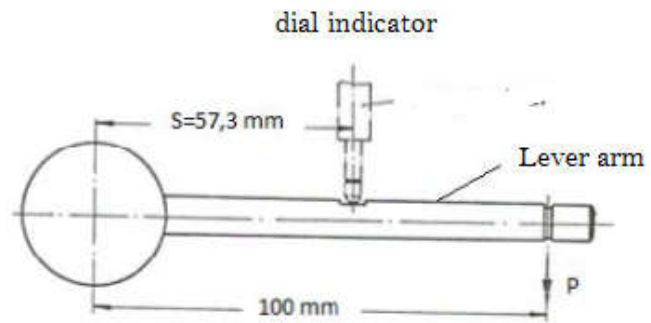
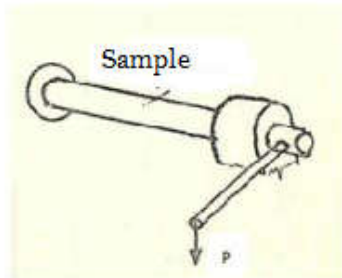
Polar moment of inertia: $I_p = \pi d^4 / 32$

Shear stress: $\tau = M_t y / I_p$ with $(0 \leq y \leq r)$

Shear angle: $\gamma = \Theta \cdot r / L$

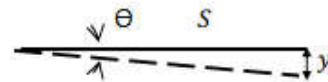
$\tau = G \cdot \gamma$

Lever arm:



For small angles Θ , the arc y can be replaced, with good accuracy, by direct reading on a dial indicator.

$$\Theta = \frac{y}{S} = \frac{y}{57,3};$$



Unit Θ is (rad).

References

Guerira B.2017. Polycopie de résistance des matériaux pour dixième année tronç commun, Université de Biskra

Website: <https://www.gunt.de>