

ME 215 ENGINEERING MATERIALS I

TORSION TEST

Procedure of the test:

1. Measure the gauge length and diameter of the specimen.
2. Place the specimen into torsion test machine.
3. Set the torque-meter and angular twist scales to zero. Remain the water level horizontal.
4. Record the torque versus angle of twist at required intervals.

Note: The materials should be prepared in compliance with the standards, the surface of the specimen should be clear/free from scratches and notches, the loading over the specimen have to be pure torsional, and any condition which may cause tension/compression or bending must be eliminated.

In your test reports:

1. Prepare a cover page includes student name and group number.
2. Write a short theory about shear properties of a material as an introduction.
3. Plot the graphs;
 - a. Torque vs. angle of twist. [Nm vs degree]
 - b. Shear stress(τ) vs. shear strain(γ) [MPa vs mm/mm]. " $\tau=Tr/J$, $\gamma=r\theta/L$ "
 - There should be 4 graphs in all, 2 for each specimen.
4. Determine yield torque (T_y) based on %0.2 offset of gauge length from Torque (Nm) vs. angle of twist (degree) graph for each specimen. "offset=0.002xL₀"
5. Calculate;

- a. Yield strength in torsion (S_{sy} [MPa=N/mm²]).

$$S_{sy} = \frac{T_y r}{J} \quad \text{where, } J \text{ is the polar moment of inertia of the specimen.}$$

" $J=\pi d^4/32$ (for circular cross section)"

- b. Stiffness (Modulus of rigidity [MPa=N/mm²])

$$G = \frac{T_e L_0}{\theta_e J} \quad \text{where, } T_e \text{ is any torque in elastic zone and } L_0 \text{ is the gauge length.}$$

- c. Modulus of resilience in shear (u_s [MPa=N/mm²])

$$u_s = \frac{T_y \theta_y}{2AL_0} \quad \text{or} \quad u_s = \frac{S_{sy}^2}{4G}$$

- d. Plastic Shear Strength (Modulus of Rupture [MPa=N/mm²])

$$S_{su} = \frac{T_{max} r}{J}$$

- e. Toughness ([MPa=N/mm²])

$$T_0 = \frac{T_{max} \theta_f}{A.L_0} \quad \text{where, } \theta_f \text{ is angle of twist at fracture and } A \text{ is the cross sectional area.}$$

Note: In the calculations, θ values will be taken as radian, 1 degree= $\pi/180=0.0174$ rad, and calculations will be made for each specimen.

6. Add a conclusion at the end of your report and discuss your results in this section.

Note: Do not forget to put this sheet into your test reports.

