

ME 305 Fall 2015
Lab 2: Torsion
Grading Rubric

Introduction (10 points)

- What are the objectives of this lab?
 - Review Coulomb torsion theory and observe twisting of uniform shafts (4 points)
 - Test validity of Coulomb torsion theory
 - Test prediction of linearity (2 points)
 - Validate Coulomb torsion by measuring shear modulus and comparing it to accepted values (2 points)
- Why is this important? How is it relevant for engineer/scientists? (2 points)

Theory (15 points)

- $\phi = \frac{TL}{GJ}$ (2 points)
- $J = \frac{\pi}{32} d^4$ (2 points)
- $T = k\phi$ (2 points)
- $G = \frac{kL}{J}$ (2 points)
- $T = F \frac{d}{2} = mg \frac{d}{2}$ (1 points)
- No rotation at one end (boundary condition)/assumptions for equations (3 points)
- Uniform cross section, one material (3 points)
- All variables must be defined; equations explained

Measurements (15 points)

- *Equipment (4 points)*
 - Megazord apparatus
 - Samples – 3 materials
 - Ruler/micrometer
 - Weights
 - Level
 - DLAG
- *Procedure (11 points)*
 - Level Megazord (1 point)
 - Measure lengths and diameters of samples (1 point)
 - Load sample, fit hexagons into slots, clamp one end (2 point)
 - Add 10 g mass to end of wire (1 point)
 - Zero DLAG and record initial angle measurement (2 points)
 - Add weight in 20 g increments until total of 130 grams, record angle after each added weight (2 points)
 - Loosen clamp before removing weights and sample (1 point)
 - Repeat for remaining samples (1 point)

Results and Analysis (25 points)

- Table with all measurements of the samples and apparatus (4 points)

- Angle of twist data with error (2 points)
- Torque values (2 points)
- J values (1 point)
- Torque vs. angle of twist plot for each material (3 points each)
 - Fit line to get slope (k)
- Plot for all materials with error bars for ϕ ; could be either ϕ vs. T or T vs. ϕ (2 points)
- Table with experimental shear modulus (G) values with errors, accepted G values for each material, and difference between experimental and accepted (5 points)

Discussion and Conclusion

- *Discussion (20 points)*
 - Question 1 (6 points)
 - Question 2 (9 points – 6 points for steel and why, remaining 3 points for discussion of other 2 materials)
 - Sources of error (3 points)
 - Deformations in samples
 - Measurements of dimensions
 - Only 1 sample tested for each material
 - Friction between load wire and torque wheel
 - Calibration error due to taking off and adding weight
 - Too few data points
 - Error due to poor level
 - How can the lab be improved? (2 points)
- *Conclusion (5 points)*
 - Did the lab achieve its purpose? What was accomplished?
 - What did you learn?
 - Key results of the lab? Conclusions made based on results?
 - Why is this experiment useful?