

Alabama A&M University
Mechanical Engineering Department
ME 313L – Experimental Mechanics Lab
Spring 2016 – Test #1

Student's name _____

1. The following are the Brinell hardness values obtained for magnesium alloy samples:

76.3 73.5 74.9 71.8 74.3 74.7 75.1 74.5 78.4 73.2

Determine the following (show your calculations):

(5 points)

- a. The sample mean =
- b. The sample Variance =
- c. The sample standard deviation =
- d. The COV =

2. From the torsion test graph, determine the following (write the equations used and show your solution on the graph): (5 points)

a. The Max. Shear Stress =

b. Shear Stress at Proportional Limit =

c. Modulus of Rigidity =

d. If the shaft diameter is 10 mm, what is the maximum torque?

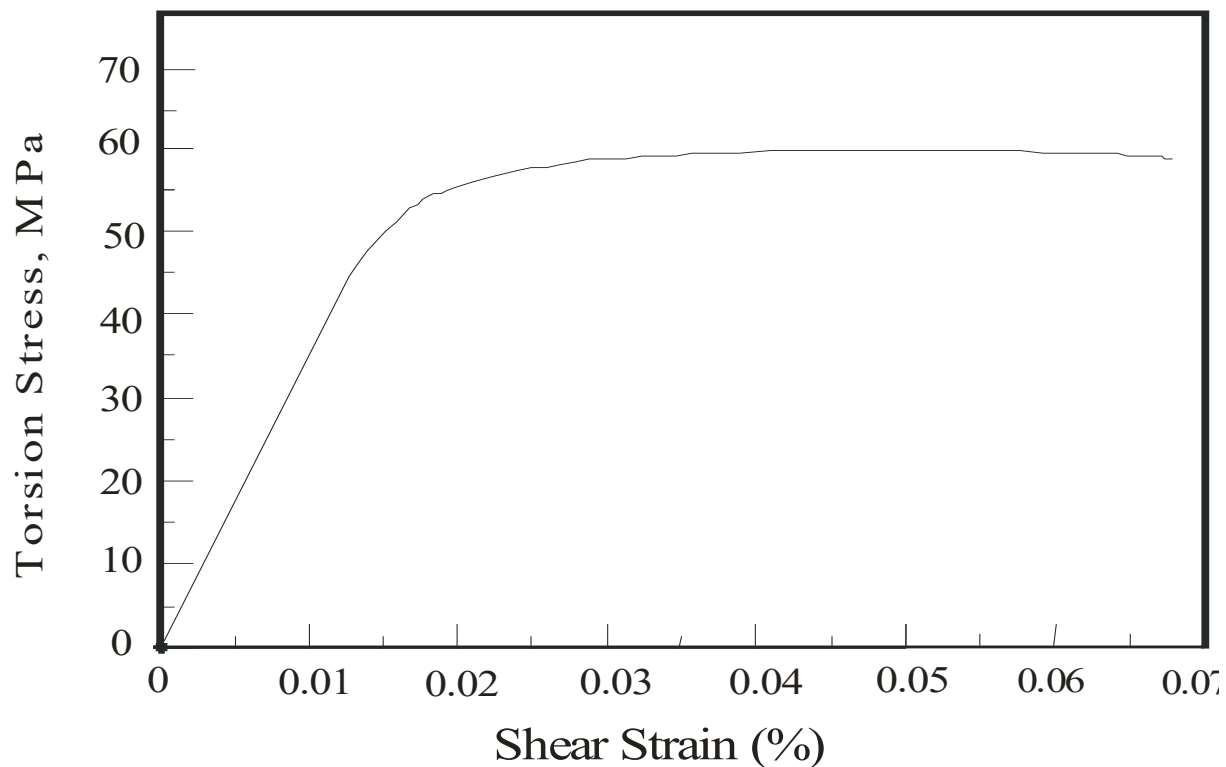
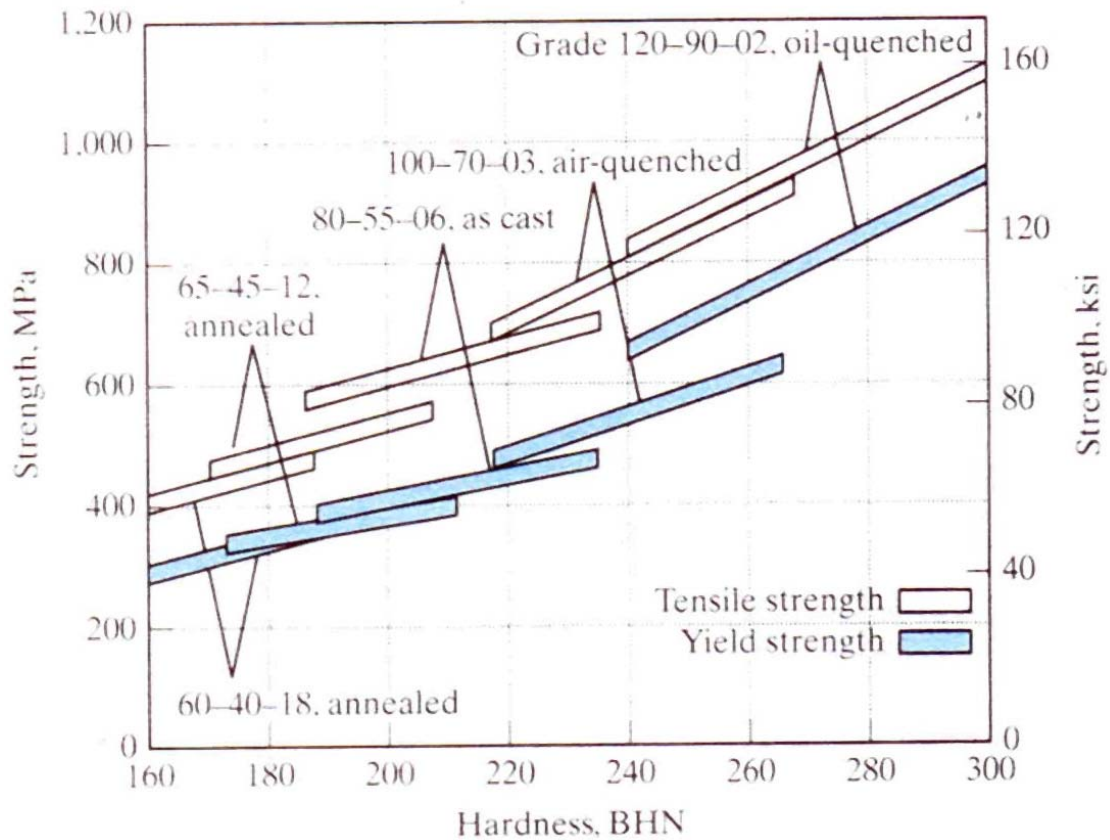


Fig. 2. Torsion stress and shear strain diagram

3. A Brinell hardness measurement is made on a ductile iron (100-70-03, air-quenched) using a 10-mm-diameter sphere of tungsten carbide. A load of 3,000 kg produces a 3.833-mm-diameter impression in the iron surface.
- Calculate the BHN of this alloy. (The correct units for the Brinell equation are kilograms for load and millimeters for diameters.)
 - Predict the tensile and yield strengths (5 Points)



4. In a fatigue test using Aluminum Alloy (tensile strength 395 MPa, and yield strength 220 MPa), two tests are performed with the following results:

| Parameter | Test # 1 | Test # 2 |
|--------------------|---------------|---------------|
| Test Load: | 72 N | 60 N |
| Cycle Rate: | 60 Hz | 60 Hz |
| Starting Time: | 3:20:42 pm | 3:21:32 pm |
| Stop Time: | 3:23:45 pm | 3:30:41 pm |
| Cycles to Failure: | 10,000 Cycles | 30,000 Cycles |

The specimens used in both tests have the following dimensions:

Min. Diameter: 4 mm

L (distance between load and smallest section): 32 mm

Required:

a.) Determine the failure stress

b.) Locate the results in the S-N Graph and include the following data.

(5 Points)

| | Point #1 | Point #2 | Point #3 | Point #4 | Point# 5 |
|--------------|----------|----------|----------|----------|----------|
| Stress, MPa | 384 | 304.5 | 275.3 | 255.5 | 234.4 |
| Cycles Count | 7,022 | 30,068 | 39,490 | 113,091 | 140,404 |

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1. From the tension test graph, determine the following (write the equations used and show your solution on the graph): (5 points)

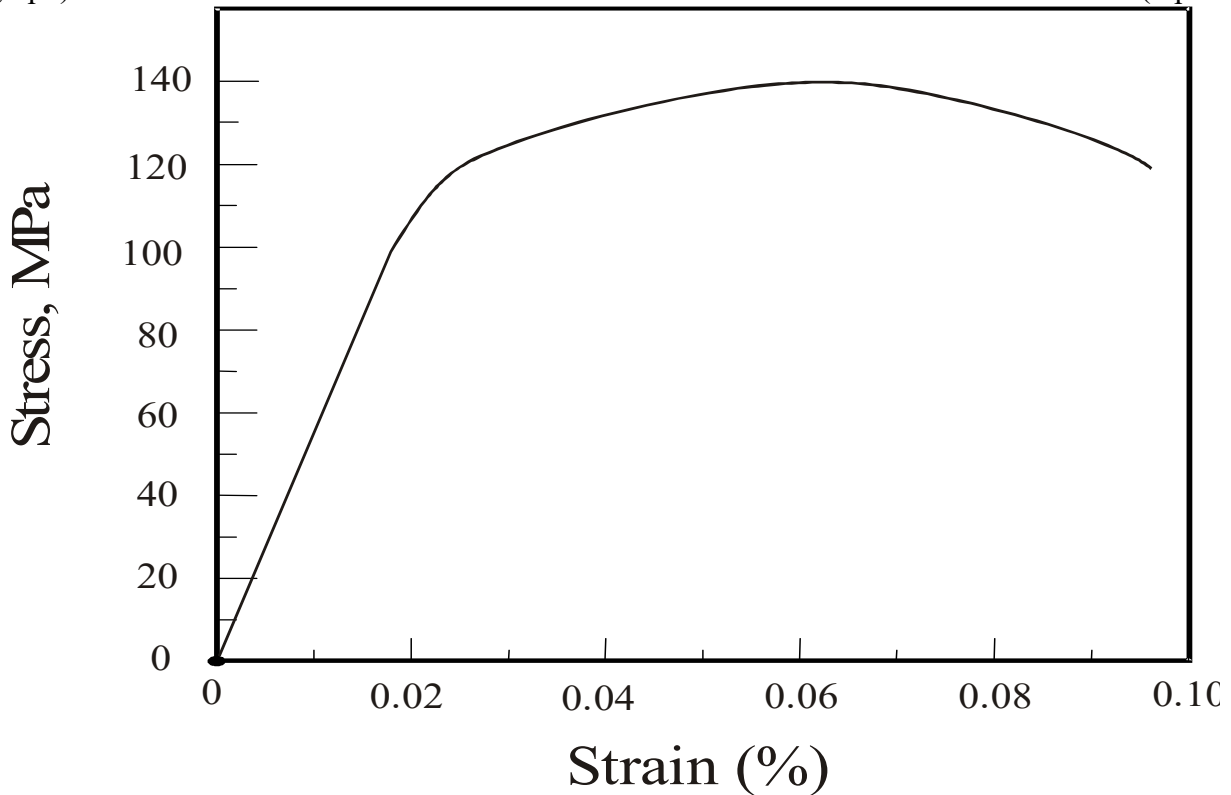
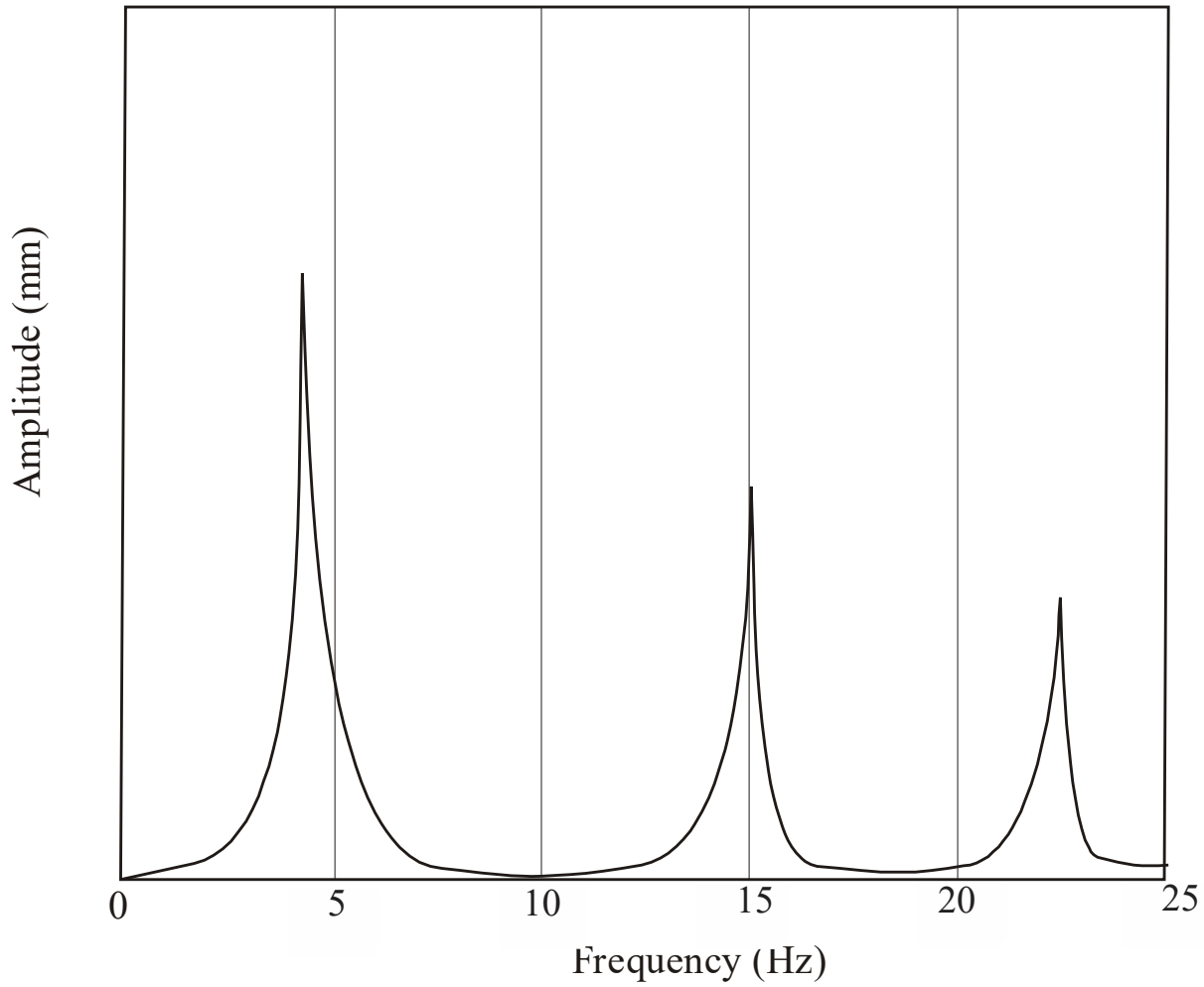


Fig. 1. The stress - strain diagram

- a. The Ultimate Tensile Strength =
- b. Yield Strength (using 0.2% offset method) =
- c. Modulus of Elasticity (Stiffness) =
- d. Modulus of Resilience =

2. A) What are the two types of modal testing?

B) The figure shows a free-free end bar modal testing. Determine the first three fundamental frequencies, and draw the associated mode shapes. (5 points)



3. An Ultrasound Test was run under the following conditions:

Power: 40 V

Frequency: 5000 kHz

Cycles: 2

Sampling Rate: 50 MHz

Gain: 30 dB

Determine: a) the speed of sound in this material if the sample thickness was 12 mm and the results as shown in Figure 1.

b) the thickness of the material in Figure 2, if same material was used.

(5 points)

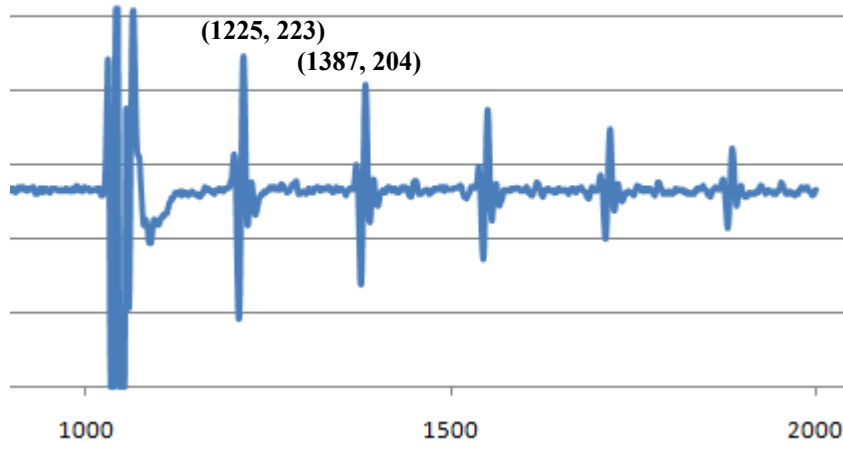


Figure 1. Ultrasonic results for 12 mm thickness

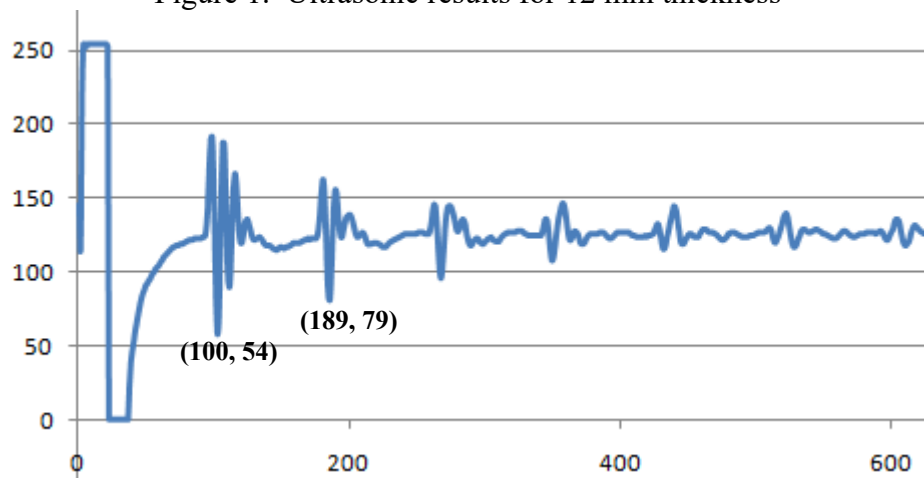


Figure 2. Ultrasonic results for unknown thickness

4. In a fatigue test using Aluminum Alloy (tensile strength 395 MPa, and yield strength 220 MPa), two tests are performed with the following results:

| Parameter | Test # 1 | Test # 2 |
|--------------------|---------------|---------------|
| Test Load: | 72 N | 60 N |
| Cycle Rate: | 60 Hz | 60 Hz |
| Starting Time: | 3:20:42 pm | 3:21:32 pm |
| Stop Time: | 3:23:45 pm | 3:30:41 pm |
| Cycles to Failure: | 10,000 Cycles | 30,000 Cycles |

The specimens used in both tests have the following dimensions:

Min. Diameter: 4 mm

L (distance between load and smallest section): 32 mm

Required:

a.) Determine the failure stresses of the two tests.

b.) Locate the results in the S-N Graph and include the following data.

(5 Points)

| | Point #1 | Point #2 | Point #3 | Point #4 | Point# 5 |
|--------------|----------|----------|----------|----------|----------|
| Stress, MPa | 384 | 304.5 | 275.3 | 255.5 | 234.4 |
| Cycles Count | 7,022 | 30,068 | 39,490 | 113,091 | 140,404 |