

Lab #3: Mechanical Properties of Metals

Objective:

The objective of this laboratory session is to identify an unknown specimen based upon its mechanical properties as measured in the tension test. The unknown metal will be either mild steel, high strength steel or aluminum.

Relevant ASTM Standards:

ASTM E8 - Test Methods for Tension Testing of Metallic Materials

Reading:

Accompanying review notes: Mechanics Properties of Materials and/or EAS 209 textbook.

Laboratory Procedure:

Specimen and Apparatus

Each group will test ONE specimen. The coupon will be either mild steel, high strength steel or aluminum. You will not be told which material you are testing.

The apparatus will include a Tinius Olsen tension test machine and a data acquisition system.

Tension Test:

The tension test is the most common stress-strain test and can be used to determine the mechanical properties of metals. Testing should be carried out in accordance with ASTM E 8 , *Standard Test Methods for Tension Testing of Metallic Materials*.

The standard specimen has a diameter of 12.8 mm (0.505 in). The length of the reduced-section is 4 times the diameter, namely 51.2 mm (2.25 in). Measurements of the elongation of the sample are made over the gage length which is 50.8 mm (2 in). A standard specimen is shown in Figure 1. Rectangular specimens can also be tested.

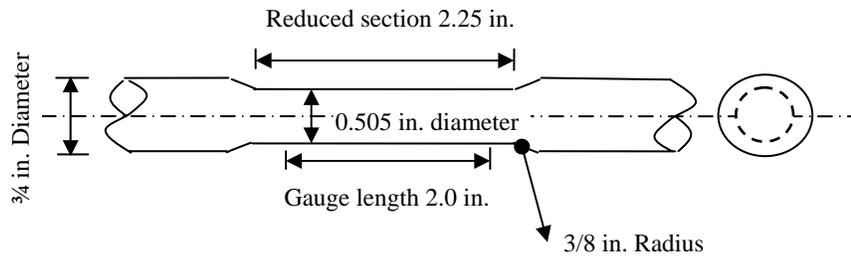


Figure 1: Standard specimen dimensions

For our tests the ends of the specimen are threaded. The specimen is mounted into the testing machine, as shown in the Figure 2, and loaded to failure along its axis. During testing deformation is confined to the narrowed central region.

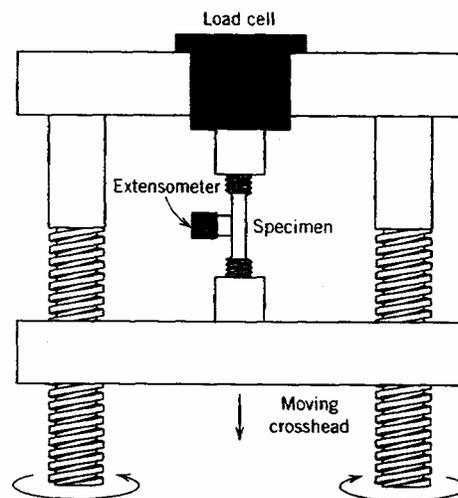


Figure 2: Specimen mounted in testing machine

The applied load is measured by a load cell and the deformation is measured by an extensometer. The data are collected by a data acquisition system. A plot of load versus deformation can be viewed on the computer screen while the test is running. The load-deformation data will be posted on UBLearn after the test for you to download.

Data from tension tests can be used to:

- Plot load versus deformation
- Plot stress versus strain (use engineering stress/strain here NOT true stress/strain)
- Determine the mechanical properties of the material

Student Responsibilities

The TA and the laboratory technician will perform the test. Students are to 'actively' observe. See how quickly you can determine correctly which metal you are testing. Since each group will test only one coupon, check UBLearns to see what time your group is scheduled to test. Groups are to meet in 112 Ketter Hall. Please review the notes on mechanical properties of materials and research the mechanical properties of the three metals before coming to lab.

Health and Safety Reminders

1. All students must wear safety shoes (don't forget to bring them in).
2. All students must wear a hard hat. Hard hats are available, but bring yours from home if you prefer.

Assignment #3 (individual assignment)

Write a full laboratory report (maximum 3 pages). See Chapter 2 of your lab manual for guidance on writing the methods section for an experiment where you follow a standard test protocol.

Each student must plot the stress-strain curve (use engineering stress and engineering strain) for their specimen and determine the following:

1. Modulus of elasticity
2. Proportional limit
3. Yield strength
4. Tensile strength
5. Ductility
6. Toughness
7. Resilience
8. Type and character of each fracture

Use the mechanical properties of the material to determine which material was tested.