

**NORTHEASTERN UNIVERSITY  
MET 311, STRESS ANALYSIS**

**TENSILE TESTING OF MATERIALS**

**OBJECTIVES:**

The objectives of this experiment are 1) to study, observe, and experiment with tensile testing of various common materials 2) to develop skills in performing commercially accepted tensile tests on various materials and 3) to interpret data and prepare a technical report.

**BACKGROUND INFORMATION:**

The tensile test is one of the most common tests used to determine the following mechanical properties of materials:

- Proportional limit
- Yield point
- Yield strength
- Ultimate tensile strength
- Breaking strength
- Ductility
- Modulus of elasticity

The *proportional limit* is the maximum stress a material can withstand without permanent deformation. This can be determined graphically from the stress / strain curve. On the curve it is the point at which the curve departs from the straight line in the elastic region.

The *yield point* is the stress at which an increase in strain occurs without corresponding increase in stress on the specimen. The yield point can be determined by the use of an extensometer (strain gage). On the other hand, the *yield strength* is the load at which a specified limited permanent deformation occurs. The yield strength can be determined by the offset method.

*Ultimate tensile strength* of a material is the maximum load it can withstand in tension divided by the original cross-sectional area of the specimen.

*Breaking strength* is the load required to break that material divided by the original cross-sectional area of the specimen.

*Ductility* refers to the ability of a material to deform plastically without fracturing. Ductility is determined in terms of the percentages of elongation and the reduction of area of the specimen.

The *modulus of elasticity* is a measure of the stiffness and is expressed as the ratio of unit stress to unit strain of a material under load. In the tensile test, the modulus of elasticity (Young's Modulus) is estimated within the elastic region.

### **PROCEDURE:**

1. Measure and record on your data sheet the type of sample, original diameter,  $d_o$ , and condition of the specimen.
2. Using the appropriate center punch, place the gage length marks,  $l_o$ , at approximately the center of the specimen.
3. Mount the specimen in the grips.
4. Balance the machine as instructed.
5. Start applying the load using the displacement control at a rate of 0.1 inch per minute.
6. Observe carefully and continue loading until the specimen breaks.
7. Measure and record the final gage length,  $l_f$ , and diameter  $d_f$  of the broken specimen. Study and record the type of fracture.
8. Repeat the above procedures for all specimens.

### **RESULTS:**

1. Create a graph of load (lbs.) and tensile extension (in) for all samples. Make tensile extension your x-axis.
2. Create a graph of the sample stress  $\sigma$  (psi) based on the initial area and the sample strain  $\epsilon$  (dimensionless) for all samples. Make the sample strain your x-axis.
4. Calculate the yield strength, proportional limit and ultimate tensile strength for all specimens. Mark and label these points on your graphs. Create a table to summarize these results.
7. Summarize all these results in a neat table.
8. Questions to consider for discussion:
  - What is the difference between load and stress?
  - What is the difference between stress and strain?