Compression Test

Objective:

The compression test is used to:

- Observe the stress - strain behavior of some metals under compression load.
- Determine the strength and other properties of various materials.

Introduction:

In theory the compression test is just the opposite the tensile test. However, there are special limitations on the compression test:

1- Appling a truly axial load is difficult.
2- There is always a tendency for bending stresses to be set up.
3- Friction between the heads of the testing machine or bearing plates and the end surfaces of the sample.

Theory:

For a compression test, the stress – strain diagrams have different shapes from those of for tension. Ductile metals such as steel, aluminum, and copper have proportional limits in compression very close to those in tension; and therefore the initial regions of their compression stress – stain diagrams are very similar to the tension diagrams. However, when yielding begins, the behavior is quite different. In a tension test, the specimen is stretched, necking may occur, and fracture ultimately takes place. When a small specimen of ductile material is compressed, it begins to bulge outward on the sides and become barrel shaped. With increasing load, the specimen is flattened out, thus offering increased resistance to further shortening (which means the stress-strain curve goes upward). These characteristics are illustrated in Fig. 1, which shows a compression stress-strain diagram for copper.

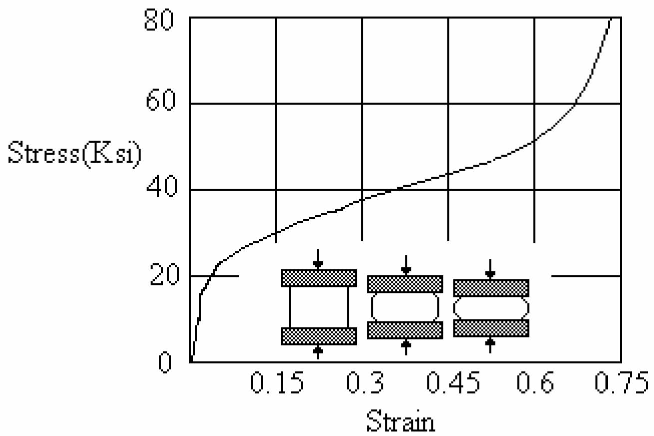


Figure 1

Brittle materials in compression typically have an initial linear region followed by a region in which the shortening increases at a higher rate than does the load. Thus, the compression stress-strain diagram has a shape that is similar to the shape of the tensile diagram. However, brittle materials usually reach much higher ultimate stresses in compression than in tension. Also, unlike ductile materials in compression, brittle materials actually fracture or break at the maximum load.

Apparatus:

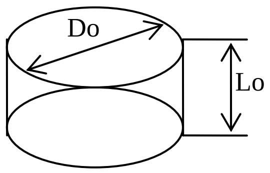
Same apparatus of tension test, but the clamps of the tension test were replaced by the compression jig parts.

Precautions:

1- Machined surfaces should be finished to 1.6μm or better.
2- Test specimens ends should be flat and parallel within .0005 in/in.
3- Test specimens should be loaded concentrically.

Procedure:

1- Measure Do and Lo at three locations along the circumference, or any other dimensions of the used specimen.



2- Lubricate bearing surfaces using suitable lubricant.
3- Start the machine, and apply a compressive force to the ends of the specimen until failure occurs.
4- The results are taken as a load deflection curve.

Results & Analysis:

1. From the load – deflection curve construct the stress – strain curve.
2. From the stress – strain curve determine the following properties for tested material:
    - a- Proportional limit.
    - b- Yield point.
    - c- Yield stress for an offset of .2%.
    - d- Ultimate and fracture stress.
3. Percentage elongation and reduction in area at fracture.
4. Modulus of Elasticity.
5. Modulus of Resilience.
6. Modulus of Toughness.
7. Shear Modulus of elasticity (G)
8. Bulk Modulus of elasticity (K).
9. Compare between engineering and true stress measures and comment on the difficulty in obtaining a uniform measure in tension and compression with the engineering stress - strain.
10. Comment in the calculated values of E, G, and ν as compared to known values in tension.
11. In compression test a greater load is necessary to cause yielding than that required in tension test for the same sample. State the reason.