

TENSION AND COMPRESSION TESTING

DESCRIPTION OF TECHNIQUE

The evaluation of the mechanical behavior of a sample under conditions of tension and compression can be performed to provide basic material property data that is critical for component design and service performance assessment. The requirements for tensile and compression strength values and the methods for testing these properties are specified in various standards for a wide variety of materials. Testing can be performed on machined material samples or on full-size or scale models of actual components. These tests are typically performed using a universal mechanical testing instrument.

A tensile test is a method for determining behavior of materials under axial tensile loading. The tests are conducted by fixturing the specimen into the test apparatus and then applying a force to the specimen by separating the testing machine crossheads. The crosshead speed can be varied to control the rate of strain in the test specimen. Data from the test are used to

determine tensile strength, yield strength, and modulus of elasticity. Measurement of the specimen dimensions after testing also provides reduction of area and elongation values to characterize the ductility of the material. Tensile tests can be performed on many materials, including metals, plastics, fibers, adhesives, and rubbers. Testing can be performed at subambient and elevated temperatures.

A compression test is a method for determining the behavior of materials under a compressive load. Compression tests are conducted by loading the test specimen between two plates, and then applying a force to the specimen by moving the crossheads together. During the test, the specimen is compressed, and deformation versus the applied load is recorded. The compression test is used to determine elastic limit, proportional limit, yield point, yield strength, and (for some materials) compressive strength.



ANALYTICAL INFORMATION

Compressive Strength - The compressive strength is the maximum compressive stress a material is capable of withstanding without fracture. Brittle materials fracture during testing and have a definite compressive strength value. The compressive strength of ductile materials is determined by their degree of distortion during testing.

Elastic Limit - Elastic limit is the maximum stress that a material can sustain without permanent deformation after removal of the stress.

Elongation - Elongation is the amount of permanent extension of a specimen that has been fractured in a tensile test.

Modules of Elasticity - The modulus of elasticity is the ratio of stress (below the proportional limit) to strain, i.e., the slope of the stress-strain curve. It is considered the measure of rigidity or stiffness of a metal.

Proportional Limit - The proportional limit is the greatest amount of stress a material is capable of reaching without deviating from the linear relation of the stress-strain curve, i.e. without developing plastic deformation.

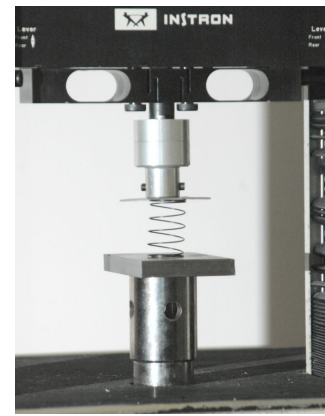
Reduction in Area- The reduction in area is the difference between the original cross-sectional area of a tensile specimen and the smallest area at the after fracture following the test.

Strain - Strain is the amount of change in the size or shape of a material due to force

Yield Point- The yield point is the stress in a material (usually less than the maximum attainable stress) at which an increase in strain occurs without an increase in stress. Only certain metals have a yield point.

Yield Strength - The yield strength is the stress at which a material exhibits a specified deviation from a linear stress-strain relationship. An offset of 0.2% is often used for metals.

Ultimate Tensile Strength - Ultimate tensile strength, or UTS, is the maximum tensile stress a material can sustain without fracture. It is calculated by dividing the maximum load applied during the tensile test by the original cross sectional area of the sample.



Compression Testing of Spring

TYPICAL APPLICATIONS

- Tensile and compression properties of raw material for comparison to product specifications
- Obtain material property data for finite-element modeling or other product design for desired mechanical behavior and service performance
- Simulation of component mechanical performance in service



Tensile Tested Specimens

SAMPLE REQUIREMENTS

Standard tensile tests on metals and plastics are conducted on specially prepared test specimens. These specimens can be machined cylindrical samples or flat plate samples (dogbone). Test samples must have a specific ratio of length to width or diameter in the test area (gage) to produce repeatable results and comply with standard test method requirements. Tubular products, fibers, and wires can be tensile tested at full size using special fixtures that promote optimal gripping and failure location.

The most common specimen used for compression testing is a right circular cylinder with flat ends. Other shapes may be used, however, they require special fixtures to avoid buckling. Special configurations for component testing or service simulations are dependent on the specific test machine to be used.