Meaning of the parameters

Density. The mass of one cubic metre of the material.

Elastic limit. Greatest stress that can be applied to a material without causing permanent deformation. For metals and other materials that have a significant straight line portion in their stress-strain diagram, elastic limit is approximately equal to proportional limit. For materials that do not exhibit a significant proportional limit, elastic limit is an arbitrary approximation (apparent elastic limit).

Hardness. Measure of a material's resistance to localized plastic deformation. Most hardness tests involve indentation, but hardness may be reported as resistance to scratching (file test), or rebound of a projectile bounced off the material (scleroscope hardness). Some common measures of indentation hardness are Brinell hardness number, Rock well hardness number, ASTM hardness number, diamond pyramid hardness number, durometer hardness, Knoop harness and Pfund hardness number. Hardness often is a good indication of tensile and wear properties of a material. A hardness conversion table can be found at www.inox.co.kr

Impact strength. Energy required to fracture a specimen subjected to shock loading, as in an impact test. Alternate terms are impact energy, impact value, impact resistance and energy absorption. It is an indication of the toughness of a material. For more details of impact testing, see www.instron.com/impact/whatisimpact.html

Plastic deformation. Deformation that remains after the load causing it is removed. It is the permanent part of the deformation beyond the elastic limit of a material. It also is called plastic strain and plastic flow.

Shear modulus of elasticity. Tangent or secant modulus of elasticity of a material subjected to shear loading. Alternate terms are modulus of rigidity and modulus of elasticity in shear. Also, shear modulus of elasticity usually is equal to torsional modulus of elasticity.

Strain. Change per unit length in a linear dimension of a part or specimen, usually expressed in %. Strain as used with most mechanical tests is based on original length of the specimen. True or natural strain is based on instantaneous length and is equal to ln l/lo where l is instantaneous length and lo is original length of the specimen. Shear strain is the change in angle between two lines originally at right angles.

Stress. Load on a specimen divided by the area through which it acts. As used with most mechanical tests, stress is based on original cross section area without taking into account changes in area due to applied load. This sometimes is called conventional or engineering stress. True stress is equal to the load divided by the instantaneous cross section area through which it acts.

Stress-strain ratio. Stress divided by strain at any load or deflection. Below the elastic limit of a material it is equal to tangent modulus of elasticity. An alternate term is secant modulus of elasticity. Stripping strength. Alternate term for peel strength.

Strain energy. Measure of energy absorption characteristics of a material under load up to fracture. It is equal to the area under the stress strain diagram, and is a measure of the toughness of a material.

Tensile strength. Ultimate strength of a material subjected to tensile loading. It is the maximum stress developed in a material in a tension test.

Toughness. Extent to which a material absorbs energy without fracture. It is usually expressed as energy absorbed in an impact test. The area under a stress-strain diagram also is a measure of toughness of a material. (ASTM D-256, plastics and ASTM E-23, metals).

Ultimate strength. Highest engineering stress developed in material before rupture. Normally, changes in area due to changing load and necking are disregarded in determining ultimate strength.

Yield strength. Indication of maximum stress that can be developed in a material without causing plastic deformation. It is the stress at which a material exhibits a specified permanent deformation and is a practical approximation of elastic limit.

Offset yield strength is determined from a stress-strain diagram. It is the stress corresponding to the intersection of the stress-strain curve and a line parallel to its straight line portion offset by a specified strain. Offset is usually specified as 0.2 %, i.e., the intersection of the offset line and the 0-stress axis is at 0.2 % strain.

Definitions

Stress = load / area

Strain = deformation / gage length = $\Delta L / L_o$

Modulus of Elasticity, E = slope of intial linear part of the stress-strain curve

Proportional Limit Stress, σ_{pl} = stress value at which the stress-strain curve goes nonlinear

Yield Point Stress, σ_y = stress value at which the stress-strain curve goes horizontal (for many steels)

0.2%-Offset Yield Stress, $\sigma_{0.2\%\,y}$ = the stress value at which a line drawn with slope E starting at 0.002 strain intersects the stress-strain curve

Ultimate Tensile Stress, σ_{ult} = largest stress on the stress-strain curve (top of the curve)

Engineering Fracture Stress = fracture load / original area

True Fracture Stress = fracture load / fracture area

Modulus of Resilience, U_r = area under the elastic portion of the stress-strain curve = $\sigma_{pl}^2 / 2E$

Modulus of Toughness, U_t = area under the entire stress-strain curve

Energy at Yield = area under the elastic portion of the load-deformation curve

Energy at Break = area under the entire load-deformation curve

Percent Elongation = $(L_f - L_o) / L_o \times 100\%$

- Percent Elongation of 2" Gage Length = ΔL_2 / 2" x 100%
- Percent Elongation of 8" Gage Length = ΔL_8 / 8" x 100%