A

Adherence—The extent to which a coating bonds to a substrate.

Adherence Index--Measure of the Adherence of porcelain enamel and ceramic coatings to sheet metal.

Alpha Rockwell Hardness—Index of the resistance of a plastic to surface penetration by a specified indenter under specified load applied with a Rockwell Hardness tester. Higher values indicate higher indentation Hardness.

Axial Strain—The Strain in the direction that the load is applied, or on the same axis as the applied load.

Analogue board—A machine circuit board, which converts analogue signals into digital signal.

Anchor Pin—A steel pin that connects a grip or jig to an eye end

Auto Return—Auto Return, when set to on, causes the crosshead to return automatically to its Zero point at the end of the test.

B

Bend Test—Method for measuring Ductility of certain materials. There are no standardized terms for reporting bend test results for broad classes of materials; rather, terms associated with bend tests apply to specific forms or types of materials. For example, materials specifications sometimes require that a specimen be bent to a specified inside diameter (ASTM A-360, steel products). A bend test for Ductility of welds is given in ASTM E-190. Results of tests of fiberboard are reported by a description of the failure or photographs.

Bending Strength—Alternate term for Flexural Strength. It is most commonly used to describe flexure properties of cast iron and wood products.

Bond Strength—Stress (tensile load divided by area of bond) required to rupture a bond formed by an adhesive between two metal blocks.

Break Elongation—The Elongation of the specimen to the break point.

Breaking Load—Load which causes fracture in a tensile, compression, flexure or Torsion Test. In tensile tests of textiles and yarns, breaking load also is called breaking strength. In tensile tests of thin sheet materials or materials in form of small diameter wire it is difficult to distinguish between breaking load and the maximum load developed, so the latter is considered the breaking load.

Breaking Strength—Stress required rupturing the specimen.

Bulk Modulus of Elasticity—Ratio of Stress to change in volume of a material subjected to axial loading. Related to Modulus of Elasticity (E) and Poisson's Ratio (r) by the following equation: Bulk Modulus K=E/3(1-2r).

C

Cleavage Strength—Tensile load required to cause separation of a 1-in. long metal-to-metal adhesive bond under the conditions set in ASTM D-1062.

Climbing Drum Peel Test—Method for determining Peel Resistance of adhesive bond between a relatively flexible and a rigid material. (ASTM D-1781).

Coefficient of Elasticity—An alternate term for Modulus of Elasticity.

Cohesive Strength—Theoretical Stress that causes fracture in tensile test if material exhibits no plastic deformation.

Complex Modulus—Measure of dynamic mechanical properties of a material, taking into account energy dissipated as heat during deformation and Recovery. It is equal to the sum of static modulus of a material and its loss modulus. In the case of shear loading, it is called dynamic modulus.

Compressibility—Extent to which a material is compressed in test for compressibility and Recovery of gasket materials. It is usually reported with Recovery.

Compressibility and Recovery Test—Method for measuring behavior of gasket materials under short time compressive loading at room temperature. ASTM F-36 outlines a standard procedure. This test is not designed to indicate long term (creep) behavior and should not be confused with the plastometer test.

Compression—Typically a direction of force applied to a sample to decrease its height

Compression Fatigue—Ability of rubber to sustain repeated fluctuating compressive loads. (ASTM D-623)

Compression set—The extent to which rubber is permanently deformed by a prolonged compressive load (ASTM D-395). Should not be confused with low temperature compression set.

Compression test—Method for determining behavior of materials under crushing loads. Specimen is compressed, and deformation at various loads is recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram which is used to determine elastic limit, proportional limit, yield point, Yield Strength and (for some materials) compressive strength. Standard compression tests are given in ASTM C-773 (high strength ceramics), ASTM E-9 (metals), ASTM E-209 (metals at elevated temperatures) and ASTM D-695 (plastics).

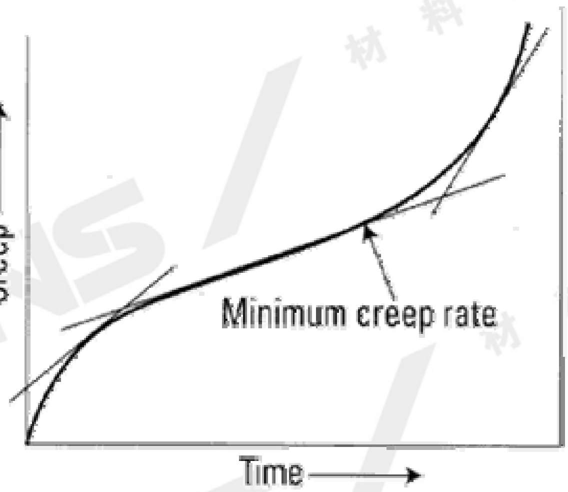
Compression-Deflection Test—Nondestructive method for determining relationship between compressive load and deflection under load for specimen

Compressive Deformation—Extent to which a material deforms under a Crushing Load.

Compressive Strength—Maximum stress a material can sustain under crush loading. Compressive strength is calculated by dividing the maximum load by the original cross-sectional area of a specimen in a compression test.

Compressive Yield Strength—Stress which causes a material to exhibit a specified deformation. Usually it is determined from the stress-strain diagram obtained in a compression test.

Creep—Deformation that occurs over a period of time when a material is subjected to constant stress at constant temperature. In metals, creep usually occurs only at elevated temperatures. Creep at room temperature is more common in plastic materials and is called cold flow or deformation under load. Data obtained in a creep test usually is presented as a plot of creep vs. time with stress and temperature constant. Slope of the curve is creep rate and end point of the curve is Time for Rupture. As indicated in the accompanying diagram, the creep of a material can be divided into three stages. First stage, or primary creep, starts at a rapid rate and slows with time. Second stage (secondary) creep has a relatively uniform rate. Third stage (tertiary) creep has an accelerating creep rate and terminates by failure of material at Time for Rupture.



Creep Limit—Alternate term for Creep Strength.

Creep Rate—Time rate of deformation of a material subject to Stress at a constant temperature. It is the slope of the creep vs. time diagram obtained in a creep test. Units usually are in/in/hr or % of elongation/hr. Minimum creep rate is the slope of the portion of the creep vs. time diagram corresponding to secondary creep.

Creep Recovery—Rate of decrease in deformation that occurs when load is removed after prolonged application in a Creep Test. Constant temperature is maintained to eliminate effects of thermal expansion, and measurements are taken from time load is zero to eliminate elastic effects.

Creep Rupture Strength—Stress required to cause fracture in a creep test within a specified time. Alternate term is Stress Rupture Strength.

Creep Strength—Maximum Stress required to cause a specified amount of creep in a specified time. Also used to describe maximum Stress that can be generated in a material at constant temperature under which creep rate decreases with time. An alternate term is creep limit.

Creep Test—Method for determining creep or stress relaxation behavior. To determine creep properties, material is subjected to prolonged constant tension or compression loading at constant temperature. Deformation is recorded at specified time intervals and a creep vs. time diagram is plotted. Slope of curve at any point is creep rate. If failure occurs, it terminates test and Time for Rupture is recorded. If specimen does not fracture within test period, creep recovery may be measured. To determine stress relaxation of material, specimen is deformed a given amount and decrease in stress over prolonged period of exposure at constant temperature is recorded. Standard creep testing procedures are detailed in ASTM E-139, ASTM D-2990 and D-2991 (plastics) and ASTM D-2294 (adhesives).

Crush Resistance—Load required to produce fracture in a glass sphere subjected to crush loading. (ASTM D-1213).

Crushing Load—Maximum compressive force applied during a compression or crushing test. For materials that do not shatter, crushing load is defined as the force required to produce a specified type of failure.

Crushing Strength—Compressive load required to cause a crack to form in a sintered metal powder bearing (ASTM B-438 and B-439). Cold crushing strength of refractory bricks and shapes is the gross compressive Stress required to cause fracture. (ASTM C-133).

Compounding—The combination of polymers with other materials either by means of mechanical (dry) blending or melt state blending

Crosshead—This is the main beam on the testing machine. It is this beam that moves either up or down producing a compressive or tensile force. A grip is attached to the crosshead and the test piece is attached to the grip. The distance that the crosshead moves through is measured from a rotating optical sensor.

Crosshead Loom—A ribbon cable that connects the moving crosshead to the machine electronics, to supply the load cell with a voltage and supply the machine with a load signal.

D

Deformation Energy—Energy required to deform a material a specified amount. It is the area under the Stress-Strain Diagram up to a specified strain.

Deformation Under Load—Measure of the ability of rigid plastics to withstand permanent deformation and the ability of nonrigid plastics to return to original shape after deformation. Standard test methods for determining both types of deformation under load are given in ASTM D-621. For rigid plastics, deformation is re-ported as % change in height of specimen after 24 hours under a specified load. For nonrigid plastics, results are reported as % change in height after 3 hours under load and Recovery in the 1-1/2 hour period following removal of the load. Recovery is % increase in height calculated on basis of original height.

Delamination Strength—Measure of the node-to-node Bond Strength of honeycomb core materials. It is equal to the tensile load applied to a honeycomb panel at fracture divided by its width times its thickness. (ASTM C-363)

Denier—The unit of linear density equal to the mass in grams per 9000 m of fiber, yarn, or other textile strand.

Dry Strength—Strength of an adhesive joint determined immediately after drying or after a period of conditioning in a specified atmosphere. (ASTM D-2475)

Ductility—Extent to which a material can sustain plastic deformation without rupture. Elongation and Reduction of Area are common indices of ductility.

Dynamic Creep—Creep that occurs under fluctuating load or temperature.

Die swell—Whenever a polymer melt emerges from a die the diameter or thickness is always larger than the diameter (or gap) of the die.At usual production throughputs,diameter or thickness ratios range from 1.20-1.40 for PVC to 1.50-2.00 for commercial grade Polyethyene’s and much more for some polymers containing a high molecular weight tail.It is an indication of the elasticity of the polymer.The more elastic polymers give larger swell.Of course,by pulling the extrudates the swell is reduced and of course extrudates can be drawn down to diameters(or thickness) much smaller than the die diameter or gap.

Diameter—Used where the cross section shape of the test piece is round.

E

EASL（Elongation at a specified load）

Eccentricity of Loading—Distance between the actual line of action of compressive or tensile loads and the line of action that would produce a uniform Stress over the cross section of the specimen.

Edge Tearing Strength—Measure of the resistance of paper to tearing when folded over a

V-notch beam and loaded in a tensile testing machine. Results are re-ported in lb or kg. (See Tear Resistance)

Elastic Hysteresis—Difference between strain energy required to generate a given Stress in a material and elastic energy at that Stress. It is the energy dissipated as heat in a material in one cycle of dynamic testing. Elastic hysteresis divided by elastic deformation energy is equal to damping capacity.

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 (the apparent elastic limit).

Elastic Limit, Apparent—Arbitrary approximation of the elastic limit of materials that do not have a significant straight line portion on a Stress/strain diagram. It is equal to the Stress at which the rate of strain is 50% greater than at zero Stress. It is the Stress at the point of tangency between the Stress-Elastic Hysteresis strain curve and the line having a slope, with respect to the Stress axis, 50% greater than the slope of the curve at the origin.

Elasticity—Ability of a material to return to its original shape when load causing deformation is removed.

Elongation—Measure of the ductility of a material determined in a Tensile Test. It is the increase in gage length (measured after rupture) divided by original gage length. Higher elongation indicates higher ductility. Elongation cannot be used to predict behavior of materials subjected to sudden or repeated loading.

Embrittlement—Reduction in ductility due to physical or chemical changes.
Endurance—Alternate term for Fatigue Limit.

Engineering Stress—Load applied to a specimen in a tension or compression test divided by the cross-sectional area of the specimen. The change in cross-sectional area that occurs with increases and decreases in applied load, is disregarded in computing engineering Stress. It is also called conventional Stress.

Extensometer—Instrument for measuring changes in linear dimensions. Also called a Strain gauge. Frequently based on Strain gauge technology.

Eye End—An adapter that fits to a load cell or machine, that enables grip or jigs to be attached

F

Fatigue—Permanent structural change that occurs in a material subjected to fluctuating Stress and strain. However, in the case of glass, fatigue is determined by long-term static testing and is analogous to Stress rupture in other materials. In general, fatigue failure can occur with Stress levels below the elastic limit.

Fatigue Life—Number of cycles of fluctuating Stress and strain of a specified nature that a material will sustain before failure occurs. Fatigue life is a function of the magnitude of the fluctuating Stress, geometry of the specimen and test conditions. An S-N diagram is a plot of the fatigue life at various levels of fluctuating Stress.

Fatigue Limit—Maximum fluctuating Stress a material can endure for an infinite number of cycles. It is usually determined from an S-N diagram and is equal to the Stress corresponding to the asymptote of the locus of points corresponding to the fatigue life of a number of fatigue test specimens. An alternate term is endurance limit.

Fatigue Notch Factor—Ratio of fatigue strength of a specimen with no stress concentration to fatigue strength of a specimen with a notch or other stress raisers. Fatigue notch factor is usually lower than the theoretical Stress Concentration Factor because of stress relief due to plastic deformation. An alternate term is strength reduction ratio.

Fatigue Ratio—Ratio of fatigue strength or fatigue limit to tensile strength. For many materials, fatigue ratio may be used to estimate fatigue properties from data obtained in tension tests.

Fatigue Strength—Magnitude of fluctuating Stress required to cause failure in a fatigue test specimen after a specified number of cycles of loading. Usually determined directly from the S-N diagram.

Fatigue Strength Reduction Factor—An alternate term for fatigue notch factor.

Fatigue Test—A method for determining the behavior of materials under fluctuating loads. A specified mean load (which may be zero) and an alternating load are applied to a specimen and the number of cycles required to produce failure (fatigue life) is recorded.
Fiber Stress—Stress through a point in a part in which Stress distribution is not uniform.

Flex Resistance—Ability of material to sustain repeated compressive loads without damage.

Flexural Modulus of Elasticity—Alternate term for Modulus in Bending.

Flexural Strength—Maximum fiber stress developed in a specimen just before it cracks or breaks in a flexure test. Flexural Yield Strength is reported instead of flexural strength for materials that do not crack in the flexure test. An alternate term is modulus of rupture.

Flexure Test—Method for measuring behavior of materials subjected to simple beam loading. Specimen is supported on two knife edges as a simple beam and load is applied at its midpoint. Maximum fiber stress and maximum strain are calculated for increments of load. Results are plotted in a stress-strain diagram, and maximum fiber stress at failure is flexural strength.

Flexural Yield Strength is reported for materials that do not crack.
Flow Stress—Stress required to cause Plastic Deformation.

Fracture Stress—True Stress generated in a material at fracture.

Fracture Test—Visual test where a specimen is fractured and examined for grain size, case depth, etc.

Fracture Toughness—Ability of a material to resist crack propagation when subjected to shock load as in an Impact Test.

Fractional melt index—A melt flow index of less than 1.0

Flexural—Typically a compressive or tensile force designed to bend a sample that is supported at either end。

G

Glass transition(Tg)—The lowest temperature,at which a polymer can be considerd softened and possibly flowable for HDPE and LDPE it is -100℃ and for PS+100℃.

Gauge Length—The gauge length during a tensile test is the length of part of the cylindrical/prismatic portion of the specimen identified by two gauge marks. Gauge Length is the original length of that portion of the test piece over which strain or change of length is determined. The gauge length is normally less than the full test piece length and is essentially user defined.

H

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, Rockwell Hardness Number, ASTM Hardness Number, Diamond Pyramid Impact Test Hardness Number, Durometer Hardness, Knoop Hardness, and Pfund Hardness. A table relating various types of hardness values of metals is given in ASTM E-140. Hardness often is a good indication of tensile and wear properties of a material.

Hooke's Law—Stress is directly proportional to Strain. Hooke's law assumes perfectly elastic behavior. It does not take into account plastic or dynamic loss properties.

High load melt flow index(Hlmfi)—Melt flow index using a higher than the usual(2.16kg)weight.For PE,it is usually 10kg.

Impact Energy—Energy required to fracture a part subjected to shock loading as in an Impact Test. Alternate terms are impact value, impact strength, impact resistance, and energy absorption.

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 the material.

Impact Test—A method for determining behavior of material subjected to shock loading in bending, tension, or torsion. The quantity usually measured is the energy absorbed in breaking the specimen in a single blow, as in the Charpy Impact Test, Izod Impact Test, and Tension Impact Test. Impact tests also are performed by subjecting specimens to multiple blows of increasing intensity, as in the drop ball impact test, and repeated blow impact test. Impact resilience and scleroscope hardness are determined in nondestructive impact tests.

K

Kink Test—Method for determining ductility of metal wire.

K-Value of PVC—A measure of the molecular weight of PVC based on measurements of viscosity of a PVC solution.It ranges usually between 35 and 80.Low K-Value imply low molecular weight (which is eassy to process but has inferior properties) and high K-Value imply high molecular weight,(which is difficult to process,but has outstanding properties)

L

LASE—Load At Specified Elongation.

Linear Density—Mass per unit length.

Load Protect—See Specimen Protect

Load-Deflection Diagram—Plot of load versus corresponding deflection.

Lead screw—Used to transfer the motor drive to the crosshead

Limit Switches—Magnetic or electrically operated switches fitted to the vertical column of a machine that disables the drive system of a machine when the crosshead movement activates them. The switches are user defined and prevent damage to test specimens, load cells and grips due to operator error。

Load Calibration—A procedure to change the characteristics of a load sensing device to return it to normal operating tolerances

Load Verification—A procedure to confirm that the load sensing device is operating within normal tolerances

Load cell—Load measuring device fitted to the crosshead, which provides an electrical representation of an applied physical force.

LVDT—A Linear Voltage Displacement Transducer is a device for measuring small amounts of movement in one plane

M

Maximum Fiber Stress—Maximum tensile or compressive stress in a homogeneous flexure or Torsion Test specimen. For a specimen loaded as a simple beam at its midpoint, maximum fiber stress occurs at mid-span and may be calculated by the formula (for rectangular specimens):

$$S = \frac{3PL}{2bd^2}$$

where S is maximum fiber stress; P, load; L, span; b, width of the beam; and d, depth of the beam. For a circular cross section member loaded in torsion, maximum fiber stress may be calculated by the following formula:

$$S = \frac{T \cdot R}{J}$$

where T is twisting moment; r, original outer radius and J, polar moment of inertia of original cross section.

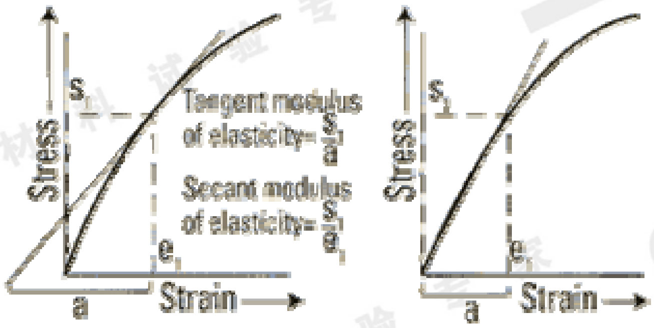
Mean Stress—Algebraic difference between maximum and minimum Stress in one cycle of fluctuating loading, as in a fatigue test. Tensile Stress is considered positive and compressive Stress negative.

Minimum Bend Radius—Minimum radius to which a sheet or wire can be bent to a specified angle without failure.

Modulus—Alternate term for Modulus of Elasticity。

Modulus in Bending—Ratio of maximum fiber stress to maximum strain, within elastic limit of Stress-Strain Diagram obtained in flexure test. Alternate term is flexural modulus of elasticity.

Modulus of Elasticity—Rate of change of strain as a function of stress. The slope of the straight line portion of a stress-strain diagram. Tangent modulus of elasticity is the slope of the stress-strain diagram at any point. Secant modulus of elasticity is stress divided by strain at any given value of stress or strain. It also is called stress-strain ratio.



Tangent and secant modulus of elasticity are equal, up to the proportional limit of a material. Depending on the type of loading represented by the stress-strain diagram, modulus of elasticity may be reported as: compressive modulus of elasticity (or modulus of elasticity in compression); flexural modulus of elasticity (or modulus of elasticity in flexure); shear modulus of elasticity (or modulus of elasticity in shear); tensile modulus of elasticity (or modulus of elasticity in tension); or torsional modulus of elasticity (or modulus of elasticity in torsion). Modulus of elasticity may be determined by dynamic testing, where it can be derived from complex modulus. Modulus used alone generally refers to tensile modulus of elasticity. Shear modulus is almost always equal to torsional modulus and both are called modulus of rigidity. Modulus of elasticity in tension and compression are approximately equal and are known as Young's Modulus. Modulus of rigidity is related to Young's Modulus by the equation:

$$E = 2G(r + 1)$$

where E is Young's Modulus (psi), G is modulus of rigidity (psi) and r is Poisson's ratio. Modulus of elasticity also is called elastic modulus and coefficient of elasticity.

Modulus of Rigidity—Rate of change of strain as a function of stress in a specimen subjected to shear or torsion loading. It is the modulus of elasticity determined in a Torsion Test. Alternate terms are modulus of elasticity in torsion and modulus of elasticity in shear. Apparent modulus of rigidity is a measure of the stiffness of plastics measured in a Torsion Test (ASTM D-1043). It is "apparent" because the specimen may be deflected past its proportional limit and the value calculated may not represent the true modulus of elasticity within the elastic limit of the material.

Modulus of Rupture—Ultimate strength determined in a flexure or torsion test. In a flexure test, modulus of rupture in bending is the maximum fiber stress at failure. In a torsion test, modulus of rupture in torsion is the maximum shear stress in the extreme fiber of a circular member at failure. Alternate terms are flexural strength and Torsional Strength.

Modulus of Strain Hardening—Alternate term for rate of Strain hardening.

Modulus of Toughness—The work done on a unit volume of material as a simple tensile force is gradually increased from zero to the value causing rupture is defined as the Modulus of Toughness. This may be calculated as the entire area under the stress-strain curve from the origin to rupture. Toughness of a material is its ability to absorb energy in the plastic range of the material.

Melt flow index(Also called Melt index or Melt flow rate) —The number of grams of polymer that can be pushed out of a capillary die of standard dimensions (Diameter:2.095mm.Length:8.0mm)under the action of standard weight (2.16kg for PE,at 190 ℃.)in 10 minutes (ASTM standard 1238).The usual melt index range is from less than 1.0(called fractional)to more than 25(up to 100 for injection moulding).For PP it is usually called melt flow rate and the standard temperature is 230℃.

Melt strength—A measure of the extensional viscosity of polymer melts.It represents the maximum tension that can be applied to the melt without rupture or tearing.Usually a capillary viscometer is used to extrude a polymer strand and the strand is pulled till rupture

Melting point—The temperature at which,the structure of a crystalline polymer is destroyed to yield a liquid.HDPE it is about 135℃,for LDPE it is about 110℃.It is not scientifically correct to talk about the melting point of an amorphous polymer like PS,because it has no crystalline structure.However,in extrusion practice it is often practical to use the glass transition temperature plus 50℃ to define an equivalent melting point of such amorphous polymers.For PS this would be 100℃+50℃=150℃(see GLASS TRANXITION).

Machine Console—A user interface panel, fitted to a Universal Testing machine that enables the operator to enter information to define a test set up and enter data via a alpha-numeric keypad.

N

Necking—Localized reduction of cross-sectional area of a specimen under tensile load. It is disregarded in calculating engineering stress but is taken into account in determining True Stress.

Nominal Stress—Stress calculated on the basis of the net cross section of a specimen without taking into account the effect of geometric discontinuities such as holes, grooves, fillets, etc.

Newtonian fluids—Fluids,which exhibit constant viscosity's independent of the shear rate.Water,glycerine,oil and other small molecule fluids are Newtonian.

O

Offset Yield Strength—Arbitrary approximation of elastic limit. It is the stress that corresponds to the point of intersection of a Stress-Strain Diagram and a line parallel to the straight line portion of the diagram. Offset refers to the distance between the origin of the Stress-Strain Diagram, and the point of intersection of the parallel line and the 0 stress axis. Offset is expressed in terms of strain (often 0.2%).

Operating Stress—Stress imposed on a part in service.

Overstressing—Application of high fluctuating loads at the beginning of a fatigue test and lower loads toward the end. It is a means for speeding up a fatigue test.

P

Peel Resistance—Torque required to separate an adhesive and adhered in the Climbing Drum Peel Test (ASTM D-1781). It is a measure of bond strength.

Peel Strength—Measure of the strength of an adhesive bond. It is the average load per unit width of bond line required to part bonded materials where the angle of separation is 180 degrees and separation rate is 6 in/min. (ASTM D-903)

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.

Plastic Strain Ratio—Plastic Strain ratio, r, is the ratio of the true width Strain to the true thickness Strain.

Plasticity—Tendency of a material to remain deformed, after reduction of the deforming stress, to a value equal to or less than its Yield Strength.

Plasticity Number—Index of the compressibility of rubber at elevated temperatures. Equal to 100 times the height of a standard specimen, after a 3 to 10 minute compression by a 5 kg load. (ASTM D-926)

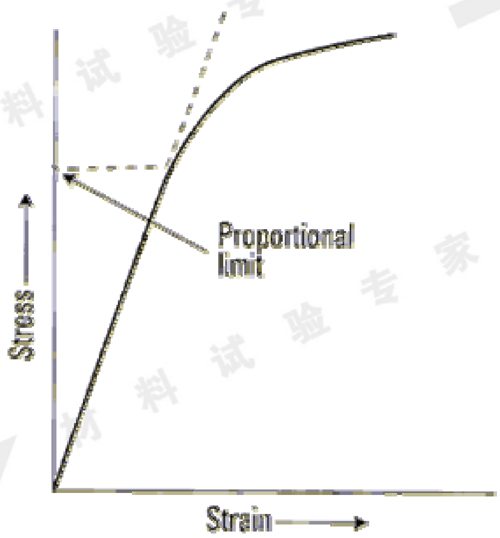
Poisson's Ratio—Ratio of lateral strain to axial strain in an axial loaded specimen. It is the constant that relates modulus of rigidity to Young's Modulus in the equation:

$$E = 2G(r + 1)$$

where E is Young's Modulus; G, modulus of rigidity; and r, Poisson's ratio. The formula is valid only within the elastic limit of a material. A method for determining Poisson's ratio is given in ASTM E-132.

Proof Stress—Stress that will cause a specified permanent deformation.

Proportional Limit—Highest stress at which stress is directly proportional to strain. It is the highest stress at which the curve in a Stress-Strain Diagram is a straight line. Proportional limit is equal to elastic limit for many metals.



Preload—Preload is a user- defined force that is applied to the test piece before any measurements begin. For example, if a pre-load of 10N is selected, then measurement will not begin until the force on the test piece has achieved 10N.By having a pre-load, problems associated with determining zero-load on the test piece are eliminated.

Preload Speed—Preload Speed is the speed at which the crosshead moves until the onset of preload。

R

Rate of Strain Hardening—Rate of change of True Stress as a function of true strain in a material undergoing plastic deformation. An alternate term is modulus of strain hardening.

Recovery—Index of a material's ability to recover from deformation in the compressibility and Recovery Test (ASTM F-36), the deformation under load test (ASTM D-621) and the plastometer test (ASTM D-926).

Recovery Test—Method for measuring compressibility and recovery of gasket and seal materials. (ASTM F-36)

Reduction of Area—Measure of the ductility of metals obtained in a Tensile Test. It is the difference between original cross sectional area of a specimen and the area of its smallest cross section after testing. It is usually ex-pressed as % decrease in original cross section. The smallest cross section can be measured at or after fracture. For metals, it usually is measured after fracture and for plastics and elastomers, it is measured at fracture.

Relative Modulus—Ratio of the modulus of a rubber at a given temperature to its modulus at 73° F.

Relaxation—Rate of reduction of stress in a material due to creep. An alternate term is Stress

Relaxation.

Residual Elongation—Measure of ductility of plastics. It is the elongation of a plastic specimen measured 1 minute after rupture in a Tensile Test.

Rupture Resistance—Indication of ability of rubber to withstand tensile loading. It is the load required to rupture a rubber specimen under conditions set out in ASTM D-530.

Rupture Strength—Nominal stress developed in a material at rupture. It is not necessarily equal to Ultimate Strength. And, since necking is not taken into account in determining rupture strength, it seldom indicates true stress at rupture.

S

Secant Modulus of Elasticity—Ratio of stress to strain at any point on curve in a Stress-Strain Diagram. It is the slope of a line from the origin to any point on a stress-strain curve.

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. A method for determining shear modulus of elasticity of structural materials by means of a twisting test is given in ASTM E-143. A method for determining shear modulus of structural adhesives is given in ASTM E-229.

Shear Strength—Maximum shear stress that can be sustained by a material before rupture. It is the Ultimate Strength of a material subjected to shear loading. It can be determined in a torsion test where it is equal to torsional strength. The shear strength of a plastic is the maximum load required to shear a specimen in such a manner that the resulting pieces are completely clear of each other.

S-N Diagram—Plot of stress (S) against the number of cycles (N) required to cause failure of similar specimens in a fatigue test. Data for each curve on an S-N diagram are obtained by determining fatigue life of a number of specimens subjected to various amounts of fluctuating stress. The stress axis can represent Stress Amplitude, maximum stress or minimum stress.

Splitting Resistance—Measure of the ability of felt to withstand tearing. It is the load required to rupture a slit felt specimen by gripping lips of the cut in jaws and pulling them apart (ASTM D-461). An alternate term is Tear Resistance.

Springback—Degree to which a material returns to its original shape after deformation. In plastics and elastomers, it is also called recovery.

Stiffness—Measure of resistance of plastics to bending. It includes both plastic and elastic behavior, so it is an apparent value of elastic modulus rather than a true value. (ASTM D-747)

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.

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 curve, and is a measure of the Toughness of a material.

Strain Hardening Exponent—Measure of increase in hardness and strength caused by plastic deformation. It is related to True Stress and true strain by the equation:
s = s0d h where s is True Stress, s0 is True Stress at unit strain, d is true strain and h is strain hardening exponent.

Strain Rate—Time rate of elongation.

Strain Relaxation—Alternate term for creep of rubber

Strength Reduction Ratio—Alternate term for fatigue notch factor.

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-sectional 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-sectional area through which it acts.

Stress Amplitude—One-half the range of fluctuating stress developed in a specimen in a fatigue test. Stress amplitude often is used to construct an S-N diagram.

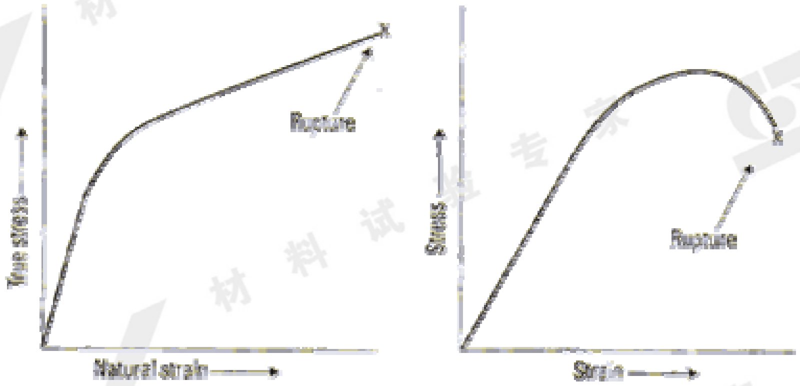
Stress Concentration Factor—Ratio of the greatest stress in the area of a notch or other stress raiser to the corresponding nominal stress. It is a theoretical indication of the effect of stress concentrators on mechanical behavior. Stress concentration factor usually is higher than the empirical fatigue notch factor or Strength Reduction Ratio, because it does not take into account stress relief due to local plastic deformation.

Stress Ratio—Ratio of minimum stress to maximum stress in one cycle of loading in a fatigue test. Tensile stresses are considered positive and compressive stresses negative.

Stress Relaxation—Decrease in stress in a material subjected to prolonged constant strain at a constant temperature. Stress relaxation behavior is determined in a creep test. Data often is presented in the form of a stress vs. time plot. Stress relaxation rate is the slope of the curve at any point.

Stress Rupture Strength—Alternate term for Creep Strength.

Stress-Strain Diagram—Graph of stress as a function of strain. It can be constructed from data obtained in any mechanical test where load is applied to a material, and continuous measurements of stress and strain are made simultaneously. It is constructed for compression, tension and torsion tests. An example is shown below.



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 the secant modulus of elasticity.

Stripping Strength—Alternate term for Peel Strength.

Software Console—Software interface between the universal testing machine and data analysis software.This console enables the machine to be driven from a computer.

Strain Gauge—An electrical device which when attached to a deforming material will exhibit a change in the ratio of it's electrical input, to it's electrical output. Typically used for minute amounts of movement.

Shear flow—The sliding of imaginary fluid slices parallel to each other,like a deck of cards.Shearing occurs whenever fluids flow through tubes and channels.The velocity is zero right at the wall surface and maximum at the center.So the fluid is being sheared as it flows through a tube or channel.

Shear rate—The velocity gradient i.e.velocity/gap measured in reciprocal seconds,s^{-1}.In screw extruder channels the shear rate can usually reach $100s^{-1}$ or more.In flow through extrusion dies it might reach $500s^{-1}$ or more while in injection moulding more than $5000s^{-1}$

Shear stress—A tangential force divided by the area (FORCE/AREA) on which it is applied.The shear stress is equal to the viscosity multiplied by the shear rate (measured in units of pressure i.e.MPa or psi).At the die lips under usual production conditions the shear stress may reach values of 0.2MPa or more.The usually accepted value for the onset of sharkskin in capillaries is 0.14MPa.With additives the critical shear stress value might be pushed up to 0.5MPa

Shear thinning—The reduction of the viscosity as the shear rate increases,which is exhibited by polymeric liquids.Shear thinning is due to molecular chain alignments in the direction of flow and disentanglements.

Shear viscosity—The ordinary viscosity that is the ratio of shear stress to the shear rate.

T

Tangent Modulus of Elasticity—The instantaneous rate of change of stress as a function of strain. It is the slope at any point on a Stress-Strain Diagram.

Tear Length—Measure of the drawability of sheet metal. Two small parallel slots are cut in the edge of the sheet to form a tab which is gripped and torn from the sheet. The variation in length of tabs torn in different directions is an indication of crystal orientation in the sheet (tabs torn in the direction of orientation are longer). The degree of orientation is an indication of difficulty to be expected in drawing the sheet to uniform shapes.

Tear Resistance—Measure of the ability of sheet or film materials to resist tearing. For paper, it is the force required to tear a single ply of paper after the tear has been started.

Tearing Strength—Tensile force required to rupture a pre-slit woven fabric specimen under the conditions outlined in ASTM D-2261 and ASTM D-2262. Edge tearing strength of paper is the force required to tear a specimen folded over a V-notch and loaded in a Tensile Test machine.

Tenacity—The tensile stress expressed as force per unit Linear Density of an unstrained specimen.

Tensile Impact Test—Method for determining energy required to fracture a specimen under shock tensile loading (ASTM D-1822). Also known as Tension Impact Test.

Tensile Modulus of Elasticity—Tangent or secant modulus of elasticity of a material subjected to tensile loading. Alternate terms are Young's Modulus and modulus of elasticity in tension. It can be measured in a tensile test or in a dynamic test where it is related to resonant frequency on a cylindrical rod by the equation:

$$E = \frac{4\pi^2 1^2 \rho f^2}{k^2 j^4}$$

where E is modulus of elasticity; 1, length of the rod; p, density; f, resonant frequency; k, radius of gyration of the rod about an axis normal to the rod axis and plane of motion (d/4 for cylindrical rods) and j, a constant dependent on the mode of vibration. Tensile modulus of elasticity is approximately equal to compressive modulus of elasticity within the proportional limit.

Tensile Strength—Ultimate strength of a material subjected to tensile loading. It is the maximum stress developed in a material in a Tensile Test.

Tension Set—Extent to which vulcanized rubber is permanently deformed after being stretched a specified amount for a short time. It is expressed as a % of the original length or distance between gage marks (ASTM D-412).

Tension Test—Method for determining behavior of materials under axial stretch loading. Data from test are used to determine elastic limit, elongation, modulus of elasticity, proportional limit, reduction in area, tensile strength, yield point, Yield Strength and other tensile properties. Tension tests at elevated temperatures provide creep data.

Tex—The unit of Linear Density equal to the mass in grams per 1000 m of fiber, yarn, or other textile strand.

Time for Rupture—Time required to rupture specimen under constant stress and temperature in a creep test.

Torsion Test—Method for determining behavior of materials subjected to twisting loads. Data from torsion test is used to construct a stress-strain diagram and to determine elastic limit, torsion modulus of elasticity, modulus of rupture in torsion, and Torsional Strength. Shear properties are often determined in a torsion test. (ASTM E-143)

Torsional Deformation—Angular displacement of specimen caused by a specified torque in torsion test. It is equal to the angular twist (radians) divided by the gage length (in.).

Torsional Modulus of Elasticity—Modulus of Elasticity of material subjected to twist loading. It is approximately equal to shear modulus and also is called modulus of rigidity.

Torsional Strain—Strain corresponding to a specified torque in the torsion test. It is equal to Torsional Deformation multiplied by the radius of the specimen.

Torsional Strength—Measure of the ability of a material to withstand a twisting load. It is the Ultimate Strength of a material subjected to torsional loading, and is the maximum torsional stress that a material sustains before rupture. Alternate terms are modulus of rupture and shear strength.

Torsional Stress—Shear stress developed in a material subjected to a specified torque in torsion test. It is calculated by the equation:

$$S = \frac{T \cdot r}{J}$$

where T is torque, r is the distance from the axis of twist to the outermost fiber of the specimen, and J is the polar moment of inertia.

Toughness—Toughness is the resistance of a material to fracture or break. It is usually measured in units of energy.

True Strain—Instantaneous percentage of change in length of specimen in mechanical test. It is equal to the natural logarithm of the ratio of length at any instant to original length.

True Stress—Applied load divided by actual area of the cross section through which load operates. It takes into account the change in cross section that occurs with changing load.

Tension—Typically a direction of force applied to a sample to increase its length.

Thickness and Width—Used where the cross sectional shape of the test piece is rectangular.

Tubular—Used where the cross sectional shape of the test piece is round, with a hole in the middle.

U

Ultimate Elongation—Alternate term for elongation of material at rupture under tensile loading.

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.

W

Wet Strength—Breaking strength of paper saturated with water. Also, the strength of an adhesive bond after immersion in water.

Weissenberg number—The product of a characteristic material time and shear rate.

Y

Yield Point—Stress at which strain increases without accompanying increase in stress. Only a few materials (notably steel) have a yield point, and generally only under tension loading.

Yield Point Elongation—In materials that exhibit a yield point, the Yield Point Elongation (YPE) is the difference between the elongation of the specimen at the start and at the finish of discontinuous yielding (the area in which an increase in strain occurs without an increase in stress).

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 for metals is usually specified as 0.2%, i.e., the intersection of the offset line and the

0-stress axis is at 0.2% strain. Offset for plastics is usually 2%.

Yield Strength Elongation—Strain corresponding to yield strength of material.

Yield Value—Stress in an adhesive joint at which a marked increase in deformation occurs without an increase in load.

Young's Modulus—Alternate term for modulus of Elasticity in tension or compression.

Z

Zero shear viscosity—The asymptotic viscosity value at zero shear rate (i.e.the maximum value).As the shear rate increases the viscosity decreases due to alignments of molecular chains in the direction of flow and molecular chain disentanglements.The zero shear viscosity is proportional to the 3.4 power of the weight average molecular weight(i.e.□0=constant* $Mw^{3.4}$for most common polymers).