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Standard Terminology Relating to Methods of Mechanical Testing[1]

This standard is issued under the fixed designation E6; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This terminology covers the principal terms relating to methods of mechanical testing of solids. The general definitions are restricted and interpreted, when necessary, to make them particularly applicable and practicable for use in standards requiring or relating to mechanical tests. These definitions are published to encourage uniformity of terminology in product specifications.

1.2 Terms relating to fatigue and fracture testing are defined in Terminology E1823.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E8/E8M Test Methods for Tension Testing of Metallic Materials

E74 Practices for Calibration and Verification for Force-Measuring Instruments

E796 Test Method for Ductility Testing of Metallic Foil (Withdrawn 2009)[3]

E1823 Terminology Relating to Fatigue and Fracture Testing

2.2 *BIPM Standard:*[4]

JCGM 200 : International vocabulary of metrology — Basic and general concepts and associated terms (VIM).

3. Index of Cross-References and Associated Definitions

3.1 The terms listed below are associated with terminology that is fundamental or commonly used. The definition for the term of interest is related to or is given below the definition for the fundamental term cited.

Term	
angular strain	indexed under **strain**
axial strain	indexed under **strain**
bending strain	indexed under **strain**
chord modulus	see **modulus of elasticity**
direct verification	indexed under **verification**
compressive stress	indexed under **stress**
elastic constants	see **modulus of elasticity** and **Poisson's ratio**
elastic modulus	use **modulus of elasticity**
elastic true strain	indexed under **strain**
engineering strain	indexed under **strain**
engineering stress	indexed under **stress**
fracture stress	indexed under **stress**
indirect verification	indexed under **verification**
initial tangent modulus	see **modulus of elasticity**
instantaneous strain	see **initial strain**
linear (tensile or compressive) strain	indexed under **strain**
load	use **force**
malleability	see **ductility**
modulus of rigidity	see **shear modulus**
movable Brinell hardness testing machine	indexed under **Brinell hardness testing machine**
movable Rockwell hardness testing machine	indexed under **Rockwell hardness machine**
nominal stress	indexed under **stress**
normal stress	indexed under **stress**
permanent set	see **set**
physical properties	see **mechanical properties**
plastic true strain	indexed under **strain**
portable Brinell hardness testing machine	indexed under **Brinell hardness testing machine**
portable Rockwell hardness testing machine	indexed under **Rockwell hardness machine**
principal stress (normal)	indexed under **stress**

[1] This terminology is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.91 on Terminology except where designated otherwise. A subcommittee designation in parentheses following a definition indicates the subcommittee with responsibility for that definition.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from BIPM - Pavillon de Breteuil F-92312 Sèvres Cedex FRANCE. this document is available free-of-charge at https://www.bipm.org/en/publications/guides/vim.html

residual strain	indexed under **strain**
residual stress	indexed under **stress**
Rockwell hardness standardizing machine	indexed under **Rockwell hardness machine**
Rockwell hardness testing machine	see **Rockwell hardness machine**
Rockwell superficial hardness number	see also **Rockwell hardness number**
secant modulus	see **modulus of elasticity**
shear strain	indexed under **strain**
shear stress	indexed under **stress**
static fatigue strength	see **creep rupture strength**
stress-rupture strength	see **creep rupture strength**
tangent modulus	see **modulus of elasticity**
tensile stress	indexed under **stress**
torsional modulus	see **shear modulus**
torsional stress	indexed under **stress**
transverse strain	indexed under **strain**
true strain	indexed under **strain**
true stress	indexed under **stress**
Type 1 extensometer system	indexed under **extensometer**
Type 2 extensometer system	indexed under **extensometer**
Type 3 extensometer system	indexed under **extensometer**
ultimate tensile strength (UTS)	use **tensile strength**
yield point	use **upper yield strength**
yield strength	see also **upper yield strength** and **lower yield strength**

4. Terminology

4.1 *Terms and Definitions:*

absorbed energy [FL], *n*—work spent to fracture a specimen in a single pendulum swing, as measured by a compensated indicating device **(E28.07)**

accuracy, *n*—the permissible variation from the correct value. **(E28.01)**

adjusted length of the reduced section—the length of the reduced section plus an amount calculated to compensate for strain in the fillet region. **(E28.04)**

alignment, *n*—the condition of a testing machine that influences the introduction of bending moments into a specimen (or alignment transducer) during the application of tensile or compressive forces. **(E28.01)**

batch, *n—for strain gages*, a group of strain gages of the same type and lot, manufactured as a set (made at the same time and under the same conditions). **(E28.01)**

bearing area [L^2], *n*—the product of the pin diameter and specimen thickness. **(E28.04)**

bearing force [F], *n*—a compressive force on an interface. **(E28.04)**

bearing strain, *n*—the ratio of the bearing deformation of the bearing hole, in the direction of the applied force, to the pin diameter. **(E28.04)**

bearing strength [FL^{-2}], *n*—the maximum bearing stress which a material is capable of sustaining. **(E28.04)**

bearing stress [FL^{-2}], *n*—the force per unit of bearing area. **(E28.04)**

bearing yield strength [FL^{-2}], *n*—the bearing stress at which a material exhibits a specified limiting deviation from the proportionality of bearing stress to bearing strain. **(E28.04)**

bend test, *n*—a test for ductility performed by bending or folding a specimen, usually by steadily applied forces but in some instances by blows.

DISCUSSION—The bending may be interrupted to examine the bent surface for cracks.

DISCUSSION—The ductility is usually judged by whether or not the specimen cracks under the specified conditions of the test.

DISCUSSION—There are four general types of bend tests according to the manner in which the forces are applied to the specimen to make the bend. These are as follows:

1. Free Bend
2. Guided Bend
3. Semi-Guided Bend
4. Wrap-Around Bend

DISCUSSION—The specimen has a substantially uniform cross-section and a length several times as great as the largest dimension of the cross-section. **(E28.02)**

biaxial stretching, *n*—a mode of sheet metal forming in which positive strains are observed in all directions at a given location. **(E28.02)**

breaking force [F], *n*—the force at which fracture occurs.

DISCUSSION—When used in connection with tension tests of thin materials or materials of small diameter for which it is often difficult to distinguish between the breaking force and the maximum force developed, the latter is considered to be the breaking force. **(E28.04)**

Brinell hardness number, *n*—a number, which is proportional to the quotient obtained by dividing the test force by the curved surface area of the indentation which is assumed to be spherical and of the diameter of the ball. **(E28.06)**

Brinell hardness scale, *n*—a designation that identifies the specific combination of ball diameter and applied force used to perform the Brinell hardness test. **(E28.06)**

Brinell hardness standardizing machine—a Brinell hardness machine used for the standardization of Brinell hardness test blocks. The standardizing machine differs from a regular Brinell hardness testing machine by having tighter tolerances on certain parameters. **(E28.06)**

Brinell hardness test, *n*—an indentation hardness test using a verified machine to force an indenter (tungsten carbide ball with diameter *D*), under specified conditions, into the surface of the material under test.

DISCUSSION—The diameter of the resulting indentation *d* is measured after removal of the force. **(E28.06)**

Brinell hardness testing machine—a Brinell hardness machine used for general testing purposes. **(E28.06)**

movable Brinell hardness testing machine—a Brinell hardness testing machine that is designed to be moved to different locations on a moveable frame, table or similar support that is integral to the testing machine (for example, securely fixed to a rolling table), or a Brinell hardness testing machine that is designed to move into the testing position prior to a test, (for example, securely fixed to a moving support arm), and has been previously verified to ensure that such moves will not affect the hardness result.

portable Brinell hardness testing machine—a Brinell hardness testing machine that is designed to be transported, carried, set up, and operated by the users, and that measures Brinell hardness by the Brinell hardness test principle.

calibration, *n*—determination of the values of the significant parameters by comparison with values indicated by a reference instrument or by a set of reference standards. **(E28.06)**

calibration, *n*—operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.

DISCUSSION—A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

DISCUSSION—Calibration should not be confused with adjustment of a measuring system, often mistakenly called "self-calibration", nor with verification of calibration.

DISCUSSION—Often, the first step alone in the above definition is perceived as being calibration. **JCGM 200:2012** [5] **(E28.01)**

calibration factor, *n*—the factor by which a change in extensometer reading must be multiplied to obtain the equivalent strain.

DISCUSSION—For any extensometer, the calibration factor is equal to the ratio of change in length to the product of the gauge length and the change in extensometer reading. For direct-reading extensometers the calibration factor is unity. **(E28.01)**

compressive strength [FL^{-2}]**,** *n*—the maximum compressive stress that a material is capable of sustaining.

DISCUSSION—Compressive strength is calculated by dividing the maximum force during a compression test by the original cross-sectional area of the specimen.

DISCUSSION—In the case of a material which fails in compression by a shattering fracture, the compressive strength has a very definite value. In the case of materials which do not fail in compression by a shattering fracture, the value obtained for compressive strength is an arbitrary value depending upon the degree of distortion which is regarded as indicating complete failure of the material. **(E28.04)**

compressometer, *n*—a specialized extensometer used for sensing negative or compressive strain. **(E28.01)**

constraint, *n*—any restriction to the deformation of a body. **(E28.91)**

creep, *n*—the time-dependent strain that occurs after the application of a force which is thereafter maintained constant.

DISCUSSION—Creep tests are usually made at constant force and temperature. For tests on plastics, the initial strain – however defined– is included; for tests on metals, the initial strain is not included. **(E28.04)**

creep recovery, *n*—the time-dependent decrease in strain in a solid, following the removal of force.

DISCUSSION—Recovery is usually determined at constant temperature.

DISCUSSION—In tests of plastics, the initial recovery is generally included; for metals, it is not. Thermal expansion is excluded. **(E28.04)**

creep rupture strength [FL^{-2}]**,** *n*—the stress causing fracture in a creep test at a given time, in a specified constant environment.

DISCUSSION—This is sometimes referred to as the *stress-rupture strength* or, in glass technology, the *static fatigue strength*. **(E28.04)**

creep strength [FL^{-2}]**,** *n*—the stress that causes a given creep in a creep test at a given time in a specified constant environment. **(E28.04)**

deep drawing, *n*—a metal sheet forming operation in which strains on the sheet surface are positive in the direction of the punch travel and negative at 90° to that direction. **(E28.02)**

deflectometer, *n*—a specialized extensometer used for sensing of extension or motion, usually without reference to a specific gauge length. **(E28.01)**

Demeri Split Ring Test—a test that measures the springback behavior of sheet metal by comparing the diameter of a ring extracted from the wall of a flat bottom cup and the diameter of the same ring split to release residual stresses. **(E28.02)**

differential indentation depth hardness test, *n*—an indentation hardness test using a verified hardness testing machine to force a truncated diamond cone indenter, diamond spheroconical indenter or tungsten carbide ball indenter, under specified conditions, into the surface of the material under test, and to measure the difference in depth of the indentation as the force on the indenter is increased from a specified preliminary test force to a specified total test force and then returned to the preliminary test force. **(E28.06)**

differential indentation depth hardness number, *n*—a number derived from the net increase in the depth of indentation as the force on an indenter is increased from a specified preliminary test force to a specified total test force and then returned to the preliminary test force. **(E28.06)**

differential indentation depth hardness testing machine, *n*—a machine capable of performing a Differential Indentation Depth hardness test and displaying the resulting hardness number. **(E28.06)**

discontinuous yielding, *n*—in a uniaxial test, a hesitation or fluctuation of force observed at the onset of plastic deformation, due to localized yielding.

DISCUSSION—The stress-strain curve need not appear to be discontinuous. **(E28.04)**

discontinuous yielding stress, σ_i**,** *n*—the peak stress at the initiation of the first measurable serration on the curve of stress-versus-strain.

[5] This definition is reproduced here from JCGM 200:2012 International vocabulary of metrology – Basic and general concepts and associated terms (VIM) with permission from the Director of BIPM. The text has been put in ASTM International's form and style.