



Standard Terminology Relating to Athletic Shoes and Biomechanics¹

This standard is issued under the fixed designation F 869; 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.

1. Scope

1.1 This terminology defines biomechanical and shoe-related terms for use in the development of standard test methods and specifications for athletic footwear.

1.2 The terms defined in this terminology are appropriate for use by the athletic footwear manufacturers and by biomechanicists in matters concerning athletic shoe technology, test methods, and specifications.

2. Terminology

2.1 Definitions:

abduction—the movement of a body part from the longitudinal (midline) of the body or in reference to fingers and toes, movement away from the midline of hand or foot.

abrasion tester—a machine for determining the quantity of material lost by friction wear under specified conditions.

accelerated aging—the deterioration of a material faster than normal by subjecting the material to conditions specified by the test method being followed.

accelerated life test—method designed to approximate, in a short time, the deteriorating effect of normal, long-term service conditions. (D 1566, D-11)

aging—(1) the effect on materials of exposure to an environment for an interval of time. (2) the process of exposing materials to an environment for an interval of time. (D 883, D-20)

anteroposterior—extending from the front to the rear.

anthropometry—the science of the measurement of the human body and its parts.

arch-footwear—the bottom curve of a shoe last from heel to ball.

arch support—a device of leather, metal, or other material shaped to the contour of the longitudinal arch of the foot and inserted or built in a shoe.

backpart molding—a preparatory shaping operation to heel seat prior to lasting, usually performed on the thermoplastic

counters where backpart components are heated on a metal heel form and molded into the backpart heel shape combining counter, upper and lining before the actual lasting operation is performed on the backpart of the shoe.

ball measurement—the line running completely around the foot or last coplanar to the joints of large and small toes.

bench test—a modified service test in which the service conditions are approximated, but the equipment is laboratory equipment and not necessarily identical with that in which the product will be employed.

bottoms—the underface of the shoe sole which extends from the toe to the heel breast. The heel is not a part of the bottom.

california process—this process requires the accurate drafting of patterns, cutting, and stitching of the upper, sock lining, and platform cover. The upper and sock lining are stitched together. The platform cover is stitched to the other two parts in a separate operation. The last is then inserted into the upper. After the last is inserted, the platform is accurately pressed into place.

cast—an impression or mold taken from a person or thing.

cellular plastic—a plastic containing numerous cells, intentionally introduced, interconnecting or not, distributed throughout the mass. (D 883, D-20)

cement construction—a process in which the outsole is attached to the upper by cementing instead of sewing or by other methods. Also known as the compo process, after Compo Industries, Inc., which introduced this method commercially into the U.S. about 1930; also known as cement process and as cemented process.

cinematography—an instrumentation system for filming, measuring, and analyzing movements of the athlete, usually including a computerized digitizer for data analysis.

circumduction—the movement of a body part about an axis so as to describe a cone or the conical movement of a body part about an axis.

combination last (or shoe)—designed to provide a proper fit for the individual with thinner than normal instep or heel. Length and width will be of standard measurements, but narrower fitting qualities will prevail through instep, waist, and heel.

composition—materials composed of granulated fillers, such as cork, leather, fibers, minerals, in a resinous matrix, usually

¹ These definitions are under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and are the direct responsibility of Subcommittee F08.54 on Footwear.

Current edition approved Jan. 10, 2001. Published February 2001. Originally published as F 869 – 84. Last previous edition F 869 – 00.

- an elastomer. Compressed and molded into sheet materials, compositions are used for insoles, heel bases, etc.
- compound**—a mixture of a polymer with other ingredients such as fillers, stabilizers, catalysts, processing aids, lubricants, modifiers, pigments, or curing agents. (F 412, F-17)
- compression deflection**—the amount of deformation of material when being compressed.
- compression mold**—a mold which is open when the material is introduced and which shapes the material by heat and by the pressure of closing.
- counter**—a piece of stiffening material inserted between the lining and the outside of a shoe upper at the back of the shoe. The purpose of the counter is to strengthen the back part and to prevent it from sagging and losing its shape. There are two types of counter: flat and molded.
- counter pocket**—a piece of lining material attached to inside quarters of unlined shoes to conceal counter.
- crepe rubber**—originally unvulcanized natural rubber with light color and knobby surface for soles and heels. Most crepe rubber for shoes is now of synthetic elastomers.
- durometer**—an instrument for measuring hardness, that is, the resistance to the penetration (without puncturing) of the indenter into the surface of rubber or other shoe material.
- durometer hardness**—an arbitrary numerical value which measures the resistance to indentation of the blunt indenter point of the durometer. The value may be taken immediately or after a very short specified time.
- dutchman**—a thin wedge of leather or fiberboard inserted between the insole and outsole of a shoe, or between the lifts of a built-up heel, to throw the foot inward or outward and to correct foot posture.
- dynamography**—the instrumentation method for recording forces.
- elastomer**—a macromolecular material that at room temperature returns rapidly to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of the stress. (D 883, D-20)
- electrogoniometry**—an instrumentation system for recording angular displacement at a joint continuously during movement.
- elongation**—extension produced by a tensile stress. (D 1566, D 11)
- energy absorption**—the dissipation or transfer of energy due to motion into heat energy.
- epicondyles**—the bony prominence above the condyles where the ligaments attach.
- ethylene-vinyl acetate (EVA)**—copolymers from these two monomers form a class of plastic materials.
- eversion**—a turning outward, eversion of the foot; turning the sole away from the mid-line of the body.
- extension**—movement by which the angle at the joint is increased in the sagittal plane; the opposite of flexion.
- fitting stool**—a low stool, generally having a forward projection, the top of which recedes at an approximate angle of 30° and is utilized for the fitting of shoes.
- flexion**—the condition of decreasing the angle between two body segments; opposite of extension.
- flex life**—the number of cycles required to produce a specified state of failure in a specimen that is flexed in a prescribed method. (D 1566, D-11)
- flex life test**—a laboratory method used to determine the life of a product when subjected to dynamic bending stresses.
- foxing**—a shoe component that reinforces or covers the shoe at a point of particular wear or stress, such as the heel area of the joint between sole and upper.
- girth**—distance around; circumference.
- (a) *joint*—around *metatarso*—phalangeal joint,
 (b) *waist*—smallest girth behind joint,
 (c) *instep*—smallest girth passing over prominence on middle cuneiform,
 (d) *long heel*—seat to instep to give “pass line” in riding boot,
 (e) *short heel*—seat to lowest crease in front of ankle,
 (f) *ankle*—around and above ankle bones,
 (g) calf, thigh as necessary. (manual of shoemaking: c. & k. clark ltd. 1976, p. 44)
- gmax**—the maximum value of acceleration experienced during impact expressed in units of g’s.
- ground reaction forces**—the forces, both shearing and normal, acting on the foot during contact with the ground.
- indentation**—1) the extent of deformation by the indenter point of any one of a number of standard hardness testing instruments; 2) a recess in any surface of a rubber article.
- inferior**—lower, also toward the foot.
- inseam**—the hidden seam of a welted shoe holding together the welt, upper, lining, and insole.
- insole**—a sole of leather or other material cut to the size and shape of the bottom of the last. In some shoe constructions, the insole surface forms the inside of the bottom of the shoe; in others it is covered with a sock lining of thin material which conceals stitching, nails, etc. (Also known as inner-sole).
- instep**—top part of the arch of a foot over the metatarsal bones from back of the toes to the ankle, also the corresponding part of a shoe last.
- inversion**—the act of turning inward, turning the sole of the foot toward the midline of the body.
- last, n**—a piece of wood, metal, or synthetic material roughly following the shape of the foot and acting as a form on which a shoe is made.
- v—to shape a fitted upper to the last using the stretch of the leather (or other material) and then fix it temporarily or permanently to the insole.
- lateral**—away from the midline. (Opposite: medial)
- medial**—toward the inside or center. (Opposite: lateral)
- midsole**—a sole of leather or other material placed between the outsole and the insole.
- motion control**—the restriction of extraneous motion of the foot by the shoe.
- nap**—the wooly or fuzzy surface finish of some fabrics and some leathers such as suede and antelope, reversed calf and side leather.
- neoprene**—an elastomer, polychloroprene, formed by adding hydrogen chloride to monovinylacetylene.

- orthopedic devices**—any device of leather, metal or other material included in the construction of a shoe or inserted in a shoe to prevent or correct foot defects and deformities.
- orthotic**—an accessory inserted in a shoe to prevent or correct foot defects and deformities.
- outsole**—the bottom sole thickness. The surface of which is exposed to wear.
- pattern**—metal, fiberboard, wood or paper forms from the outlines of which are cut the various pieces of the shoe.
- permanent set**—the amount by which an elastic material fails to return to its original form after deformation.
- plantar**—pertaining to the sole of the foot.
- plasticity**—a property of a material that allows it to be deformed continuously and permanently without rupture upon the application of a force that exceeds the yield value of the material. (D 907, D-14)
- polyethylene**—a polymer prepared by the polymerization of ethylene as the sole monomer. (D 883, D-20)
- poly(vinyl chloride) (pvc)**—a polymer prepared by the polymerization of vinyl chloride as the sole monomer. (D 883, D-20)
- proximal**—nearest to the body, or center, or some other point considered as the center of a system.
- pulling over**—operation in which upper of a shoe is pulled over the last.
- rearfoot stability**—the stability of the heel seat. (See **stability**)
- rotation**—movement about an axis; such as a body segment about a joint, also used to denote movement about the longitudinal axis of the bone (medial or lateral rotation).
- roughing**—the exposure and erection of the fibers of the material on the lasted over margin of the upper and the corresponding edges of the outsole in order to provide a more grippable surface to be cemented for the purpose of sole attaching.
- rubber**—a material that is capable of recovering from large deformations quickly and forcibly, and can be, or already is, modified to a state in which it is essentially insoluble (but can swell) in boiling solvent, such as benzene, methyl ethyl ketone, and ethanoltoluene azeotrope. (D 1566, D-11)
- sagittal**—pertaining to the anteroposterior median plane of the body (sagittal plane), the median vertical plane of the body dividing it into right and left halves that is the major plane for walking and running.
- sample for test**—a specified number of sample units taken from a lot for the purpose of testing the lot for all physical and chemical properties for which requirements are specified.
- sample size**—the number of units of product in the sample.
- sample unit (for test purposes)**—the total quantity of material necessary to obtain one test result for each of the properties and characteristics specified in the material specification or procurement document.
- service test**—a test in which the product is used under actual service conditions.
- shank**—that part of the sole of the shoe between the heel and the ball or tread; also, the steel, plastic, or wood piece inserted in the arch of a shoe for reinforcement; also, the leg segment between the thigh and the foot.
- shock**—the short duration high force initial part of an impact.
- shock absorption**—the reduction of peak force by increasing the time over which the force is applied. The reduction of ground reaction forces is of primary importance in athletic footwear. (*Syn.* shock attenuation)
- shock attenuation*—see **shock absorption**.
- slipsole**—a half-sole extending from the toe of the shoe to the shank on the bottom surface.
- sock lining**—a piece of material placed over the entire insole on the inside of a shoe to protect the foot from stitches on the inside in certain types of constructions.
- sole**—the bottom of the foot or shoe.
- stretch**—1) an increase or elongation in dimension; 2) mechanically enforcing an elongation of belting during the vulcanization to render it less extensible in service.
- superior**—higher, denoting the upper of two parts, also means towards the head.
- support (foot)**—the degree to which the shoe upper provides sufficient containment of the motions of the foot.
- thermoplastic**—capable of being repeatedly softened by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion.
- DISCUSSION*—thermoplastics applies to those materials whose change upon heating is substantially physical. (D 833, D-20)
- throat**—the central part of a shoe vamp opening where it is seamed to the front of the quarter.
- traction**—the coefficient of friction generated between the outsole and typical jogging or running surface.
- traction test**—method of evaluating the traction characteristics of footwear.
- transverse**—crosswise; at right angles to the longitudinal axis of the body.
- upper**—all of the upper parts of a shoe stitched together and ready for lasting and bottoming. It includes both the outside and lining of the shoe.
- vamp**—the lower part of a shoe upper which is attached to the sole or welting.
- waist**—the smallest part of the foot between the instep and the ball, also the corresponding part of a shoe last.
- weather aging**—placing materials in known environmental conditions to evaluate changes.
- welt beating**—operation of lightly beating the welt into a smooth position around the edge of a shoe.
- width**—the width measurement is a straight line running across the bottom of the last at the ball or the widest part of the foot.



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