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Standard Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics[1]

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ε[1] NOTE—Terms were added editorially in September 2016.

1. Scope

1.1 This terminology is the compilation of all definitions developed by Subcommittee D13.19 on Tire Cords and Fabrics.

1.2 The terminology, mostly definitions, is unique to the tire cord fabric industry. Meanings of the same terms used outside the tire cord fabric industry can be found in other compilations or in dictionaries of general usage.

1.3 In addition to being a specialized dictionary, this terminology is also a tool for managing the Subcommittee's terminology. This includes finding, eliminating, and preventing redundancies, that is, where two or more terms relating to the same concept are defined in different words.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles
D885 Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manufactured Organic-Base Fibers
D1871 Test Method for Adhesion Between Tire Bead Wire and Rubber
D2229 Test Method for Adhesion Between Steel Tire Cords and Rubber
D2692 Test Method for Air Wicking of Tire Fabrics, Tire Cord Fabrics, Tire Cord, and Yarns
D2969 Test Methods for Steel Tire Cords
D2970/D2970M Test Methods for Testing Tire Cords, Tire Cord Fabrics, and Industrial Yarns Made From Glass Filaments
D4393 Test Method for Strap Peel Adhesion of Reinforcing Cords or Fabrics to Rubber Compounds
D4776 Test Method for Adhesion of Tire Cords and Other Reinforcing Cords to Rubber Compounds by H-Test Procedure
D4974 Test Method for Hot Air Thermal Shrinkage of Yarn and Cord Using a Thermal Shrinkage Oven
D4975 Test Methods for Single-Filament Tire Bead Wire Made from Steel
D5591 Test Method for Thermal Shrinkage Force of Yarn and Cord With a Thermal Shrinkage Force Tester
D6320 Test Methods for Single Filament Hose Reinforcing Wire Made from Steel
D6477 Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics
D6611 Test Method for Wet and Dry Yarn-on-Yarn Abrasion Resistance

3. Terminology

abrasion, *n*—the wearing away of any part of a material by rubbing against another surface. **D6611**

adhesion, *n—in tire fabrics,* the force required to separate a textile material from rubber or other elastomer by a definite prescribed method. **D1871, D2229, D4393, D4776**

adhesion, *n*—the property denoting the ability of a material to resist delamination or separation into two or more layers. **D6477**

adhesive treated tire cord, *n*—a tire cord whose adhesion to rubber or other elastomer has been improved by the application of a dip followed by rapid drying and (normally) additional heat treatment. **D5591**

air wicking, *n— in tires,* the passage of air longitudinally along or through yarns in a fabric that has been encased and cured in rubber or other elastomer, that is, air permeability in the plane of the fabric. **D2692**

apex angle, *n*—the angle formed between the incoming and outgoing yarn at the top (and bottom) of the inter-wrapped yarn area in the static condition.

DISCUSSION—*In yarn abrasion testing*, the state of a yarn, which has been soaked for a prescribed period of time in water before testing and then immersed in water during the abrasion test. **D6611**

[1] This terminology is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.19 on Industrial Fibers and Metallic Reinforcements.

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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.

applied tension, *n*—*In yarn abrasion testing*, the static tension exerted on the weighted end of the yarn by the applied weight.

DISCUSSION—Tension in the yarn varies along its length during each cycle because of friction and dynamic effects. The tension at any point in the interwrapped yarn region and at any time may differ substantially from the applied tension but is a function of that applied tension. **D6611**

breaking force, *n*—the maximum force applied to a material carried to rupture.

DISCUSSION—Materials that are brittle usually rupture at the maximum force. Materials that are ductile are usually capable of withstanding the maximum force without rupturing. For many years, it has been the usual practice in the tire industry and related industries to use the term *breaking strength* to characterize yarn and cord of a specified size and type without consideration of their unit size. Numerically, *breaking strength* is equal to breaking force for the same specimen. The average of the breaking forces observed on two or more specimens of a specific sample is referred to as the sample breaking strength, which is the property used in engineering calculations for a specific textile material. *Tensile strength* and *breaking tenacity*are derived or calculated values for materials that include consideration of the unit size of the materials. These terms can be used to compare intrinsic strengths of yarns and cords of different sizes or different materials. The term *tensile strength*, in MPA (psi), is not synonymous hit either *breaking force* or *breaking strength*, in N (lbf), or breaking tenacity, in mN/tex (gf/den). **D885, D2970/D2970M, D4975, D6320**

breaking strength, *n*—the ability or capacity of a specific material to withstand the ultimate tensile load or force required for rupture. (See also **tensile strength**).

DISCUSSION— Breaking strength is particularly significant as the characteristic of a sample as distinct from a specimen, and is usually expressed as newtons (N) or pounds-force (lbf). See discussion for **breaking force**. **D885**

breaking tenacity, *n*—the tenacity at the breaking force.

DISCUSSION—See discussion for *breaking force*. **D885, D2970/D2970M**

catenary length, *n*—the difference between the length of the shortest and the longest component in a plied yarn or cables cord after twisting. **D2970/D2970M**

chafer fabric, *n*—woven fabric, usually coated with unvulcanized rubber, which is laid around the bead of a tire before vulcanization.

DISCUSSION—Chafer fabric is used to reinforce the outer layer of rubber on the tire bead to provide an abrasion resistant surface in contact with the wheel rim. In the case of tubeless tires, the chafer fabric is usually made wickproof to prevent air leaking from the inflated tire. **D2692, D4393**

cord, *n*—a twisted or formed structure composed of one or more single or plied filaments, strands, or yarns of organic polymer or inorganic materials.

DISCUSSION—Cord, as used in these test methods, is used for the manufacture of pneumatic tires or other industrial fabrics. The direction of twist used to combine the single or plied yarn elements into a cord construction is in the direction opposite to that used in the yarns. Frequently, tire and other reinforcing cords consist of a single yarn strand having little or no twist. These cords as well as single monofilaments, are used synonymously with twisted and plied cords in this test method. **D885, D4776, D5591**

cord twist, *n*—the amount of twist in a cord made from two or more single or plied yarns.

DISCUSSION—Cord twist is based on the initial length of a cord specimen. Cord twist is expressed as the number of turns divided by the length of the untwisted cord. **D885, D2970/D2970M**

core, *n*—a filament or strand that serves as an extended axis about which other elements can be wound. **D2969**

curing, *n*—see the preferred term **vulcanization**. **D1871, D4393, D4776**

cycles to failure, CTF, *n*—*in yarn abrasion testing*, the number of cycles applied to the yarn before it fails due to abrasion.

DISCUSSION—Failure is considered to occur when the yarn is completely separated. **D6611**

dip, *n*—a chemical composition that is applied to a textile cord or fabric to improve its adhesion to rubber or other elastomer. **D885, D2970/D2970M**

dip pick-up, *n*—the amount of dip or dip components present in a textile cord or fabric after processing, expressed as a percentage of the mass of the oven-dried dip-free material. **D885, D2970/D2970M**

direction of lay, *n*—the helical disposition of the components of a strand or cord.

DISCUSSION—The strand or cord has an "S" or left hand lay if, when held vertically, the spirals around the central axis of the strand or cord conform in the direction of slope to the central portion of the letter "S"; and "Z", or righthand lay, if the spirals conform in direction of slope to the central portion of the letter "Z". **D2969**

direction of twist, *n*—see **direction of lay**. **D2969**

dry, *adj*—the state of a yarn which has not been exposed to excessive moisture. **D6611**

elongation, *n*—the ratio of the extension of a material to the length of the material prior to stretching.

DISCUSSION—Elongation may be measured at any specified force or at rupture. **D885, D6320**

fabric , *n*—*in textiles,* a planar structure consisting of yarns or fibers.

DISCUSSION—In tire cord, fabrics are produced with tire cord warp yarns interlaced with widely spaced filling yarns. **D885, D2970/D2970M**

fabric dip, *n*—for *tire fabrics,* a chemical composition which is applied to a textile cord or fabric to improve its adhesion to rubber compounds. **D4393**

filament, *n*—*in steel cord,* the individual element in a steel strand or cord source. **D6477**

flare, *n*—the spreading of the filament ends or the strand ends at the cut end of a steel tire cord, expressed as the unraveled length. **D2969**

greige cord, *n*— *in tire cords,* a cord that has not been adhesive treated, heat treated, or otherwise treated before use (see *cord*). **D4974, D5591**

greige tire cord, *n*—a tire cord that has not been dip treated or heat treated before use (see *tire cord*). D5591

growth, *n*—the increase one or more dimensions of an object or a material.

DISCUSSION—The increase in length of a specimen caused by the application of a continuing load or force under specified conditions. D885

high elongation, *adj—in steel tire cord*, a cord with an average elongation at break greater than 3.0 %. D2969

high-modulus aramid, *n—for the purpose of these test methods*, those aramid yarns with an initial modulus of at least 400 gf/den (35 N/tex). D6477

holland cloth, *n*—a completely filled woven fabric having a smooth gloss finish on both sides used as a separating medium for sheeted rubber compounds. D1871, D4393

hose reinforcing wire, *n*—a single filament of steel wire with a metallic coating (usually brass) used in the reinforcement of a rubber or other elastomer hose. D1871, D6320

H-test adhesion, *n*—the force to extract either end of a textile cord structure that is embedded in a rubber compound under specified conditions. D4776

industrial yarn, *n*—a yarn composed of continuous filaments, usually of high breaking tenacity, produced with or without twist, and intended for applications in which functional properties are of primary importance; for example, in reinforcing material in elastomeric products (tires, hose, belting), in protective coverings, and in cordage and webbing, and so forth. D885, D2970/D2970M, D4776

initial modulus, *n*—the slope of the initial straight portion of a stress-strain (or force elongation) curve.

DISCUSSION—Modulus is the ratio of the change in tenacity, expressed in millinewtons per tex (mN/tex) or grams-force per denier (gf/den) to the change in strain, expressed as a fraction of the original length. In the case of a tenacity elongation curve, the following equation is used to calculated the initial modulus:*initail modulus* = (*tencaity*/*percent elongation*) × 100 D885, , D2970/D2970M

length of lay, *n*—the axial distance required to make one complete revolution of any element of a strand or cord. D2969

mill grain, *n—in rubber*, grain which is imparted to rubber sheeting while being mixed or conditioned in a rubber mill and which is parallel to the direction the rubber moves in the mill. D1871

moisture equilibrium for testing, *n—for industrial yarns and tire cords*, the condition reached when, after free exposure to a test atmosphere which is in motion, two successive weighings not less than 4 h apart, show not more than 0.1 % progressive change in mass of the specimen or sample. D885

percent elongation, *n*—the increase in length of a specimen expressed as a percentage of the original length. D4975

pneumatic tire, *n*—a hollow tire that becomes load-bearing upon inflation with air, or other gas, to a pressure above atmospheric. D885, D5591

reinforcing cord, *n*—a cord made from industrial yarns and used to provide added support to other materials, such as tires, hose, belting, protective coverings, webbings, and so forth. D4776

residual torsion, *n*—revolutions made by a specified length of cord when one end is held in a fixed position and the other allowed to turn freely. D2969

retraction, *n—in yarns and cords*, the reduction in length when previous restraint is removed and relaxation is allowed, thus causing a directionally proportional increase in linear density. D5591

rope, *n*—a compact and flexible, generally torsionally balanced continuous structure, greater than 4-mm (3⁄32-in.) diameter, capable of applying or transmitting tension between two points. D6611

rubber, *n*—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, methylethyl ketone, and ethanol-toluene azeotrope. D1871, D4393, D4776

rubber compound, *n—as used in the manufacture of rubber articles*, an intimate mixture of elastomer(s) with all the materials necessary for the finished article. D1871, D2229, D4393, D4776

rubberize, *v*—to impregnate or coat with rubber compound, or both. D4393

single twist, *n*—the amount of twist in each individual single yarn element in a tire cord structure based on the length of the element after twist has been removed from the cord. D885

standard atmosphere for testing textiles, *n*—laboratory conditions for testing fibers, yarns, and fabrics in which air and relative humidity are maintained at specific levels with established tolerances.

DISCUSSION—Air is maintained at a relative humidity of 55 ± 2% and at a temperature of 24 ± 1°C (75 ± 2°F) for this test method. D885, D2970/D2970M, D4974, D5591

steel cord, *n*—a formed structure made of two or more steel filaments when used as an end product or a combination of strands or filaments and strands. D2229, D2969, D4393

steel cord wrap, *n*—a steel filament wound helically around a steel cord. D2969

steel filament, *n*—the individual element in a steel strand or cord. D2969, , D4393

steel strand, *n*—a group of steel filaments combined to form a unit product to be processed further.

DISCUSSION—A strand may be considered a cord if it is the finished product for tire reinforcement or it may be an element in a more complex structure. D2969

stitch, *v—in making rubberized articles*, to press uncured rubber compound into or around yarns or cords to form a composite of the materials and to remove entrapped air.

DISCUSSION—Normally the yarns or cords in the article are parallel. The stitching tool is normally a rolling disk mounted on an axle for manipulation by hand or by machine. The outer edge of the disk is unsharpened but narrower than the intended space between parallel cords. Application of moderate force on this tool accomplishes high local pressure on the surface to which it is applied. **D4393**

straightness, *n— in steel cord,* the property of a cord characterized by a lack of deviation from its central axis over short lengths of cord. **D2969**

tabby , *n—a plain weave fabric.*In the context of tire cord fabric, it refers to sections of closely spaced weft yarns in a special section of fabric woven to provide as sample.

tabby sample, *n*—the section of tire cord fabric between two tabbies that have been woven separately with a distance of 0.5 to 1.0 m (18 to 36 in.) between them.

DISCUSSION—A tabby usually is woven 150 to 200 mm (6 to 8 in) in length using cotton filling yarn in the range from 750 to 2000 tex (675 to 1800 denier) and 30 to 50 picks/dm (8 to 12 picks.in). **D885, D2970/D2970M**

tack, *n*—for *rubber or rubber compounds,* a property that causes two layers of these materials when pressed together to adhere at the area of contact. **D4393**

test panel, *n*—for *in air wicking tests,* the composite structure of a rubber compound and fabric which is used to test the fabric for air wicking. **D2692**

thermal shrinkage, *n—of textile yarn and cords,* contraction in length caused by heat. **D4974**

thermal shrinkage force, *n*—that force induced when a restrained material is restricted from shrinking upon exposure to heat. **D5591**

thermal shrinkage force tester, *n*—an apparatus that measures the force achieved when a yarn or similar specimen, held at a constant (fixed) length, is subjected to a temperature above that at which the specimen was mounted in the apparatus. **D5591**

tire, *n*—a load-bearing ground-contacting circumferential attachment to a vehicle wheel. **D885, D5591**

tire bead, *n*—the part of a tire that comes in contact with the rim and is shaped to secure the tire to the rim. **D1871, D4975**

tire bead wire, *n*—a monofilament of steel wire with a metallic coating, usually bronze, used in the forming of a tire bead. **D1871, D4975**

tire cord, *n*—a twisted or formed structure composed of one or more single or plied filaments, strands, or yarns of organic polymer or inorganic material.

DISCUSSION—The direction of twist used to combine the single or plied yarn elements into a cord structure is in a direction opposite to that used in the yarn. Frequently, tire and other reinforcing cords consist of a single yarn strand having little or no twist. These cords are used synonymously with twisted and plied cords in this test method. **D2692, D2970/D2970M, D4393, D4974**

tire cord fabric, *n*—a fabric consisting of tire cord warp with widely spaced (usually 40 to 200 picks/m (1 to 5 picks/in.)) single yarn filling. **D885, D2692, D2970/D2970M, D4393**

tire fabric, *n*—a textile fabric, other than tire cord fabric, which is used as a reinforcement in tires. **D2692**

torsion resistance, *n—in tire bead wire*, the number of turns of twist in a short length of wire that causes rupture. **D4975, D6320**

vulcanization, *n*—an irreversible process, usually accomplished through the application of heat, during which a rubber compound, through a change in its chemical structure (for example, cross linking) becomes less plastic and more resistant to swelling by organic liquids while elastic properties are conferred, improved, or extended over a greater range of temperatures.

DISCUSSION—Although *vulcanization* is preferred to *curing*, the terms *cured* and *uncured* are widely used as synonyms for *vulcanized* and *unvulcanized*. **D1871, D2692, D4393, D4776**

weftless fabric, *n—as used in tire building*, a sheet of parallel cords surrounded by uncured rubber compound.

DISCUSSION—Fabric stability, sufficient to ensure that fabric can be moved and handled, is imparted by the unvulcanized rubber rather than by textile yarns (wefts or picks) as in woven tire cord fabric. **D4393**

wet, *adj*—the state of a yarn which has been exposed to excessive moisture. **D6611**

wickproof, *adj— in tire fabric, tire cord fabric, tire cord, or yarn,* a term used to describe a fabric or yarn that shows no air wicking by this prescribed test. **D2692**

wildness, *n*—obsolete term, previously used to describe a number of steel tire cord properties including flare, straightness, and residual torsion. **D2969**

work-to-break, *n*—the total energy required to rupture a specimen to the breaking force during a tensile test.

DISCUSSION—Work-to-break is proportional to the area under the stress-strain curve from the origin to the breaking force. **D885**

yield strength, *n*—the stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain.

DISCUSSION—It is customary in this instance to express the deviation in terms of strain and to determine yield strength by the offset method where a strain of 0.2% is specified. **D4975, D6320**