

Chapter 2: Nonwoven Terminology

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Glossary

ABRASION RESISTANCE: The ability of a fiber or fabric to withstand surface wear and rubbing.

ABSORPTION: The process by which a gas or liquid is taken up within a material.

ADDITIVES: Chemicals added or incorporated in materials to give them different functional or esthetic properties, such as flame retardancy and softness.

ADSORPTION: The process by which a gas or liquid is taken up by the surface of a material.

AFTERTREATMENT (FINISHING): Processes usually carried out after a web has been formed and bonded. Examples are embossing, creping, softening, printing, and dyeing.

AGGLOMERATION: A cluster of particles or fibers.

AIR PERMEABILITY: The porosity or the ease with which air passes through a fabric.

ANTISTAT: An additive that reduces the accumulation or assists the dissipation of electrical charges that arise during the processing of fibers, fabrics, and films, and during the use of products. Also can be a coating on monofilaments used in manufacture of forming fabrics, to dissipate static in dry forming applications.

BASIS WEIGHT: The weight of a unit area of fabric. Examples are ounces per square yard and grams per square meter.

BATTING: A soft, bulky assembly of fibers, usually carded. A carded web is sometimes called a batt.

BEATER: The machine that does most of the fiber separation and cleaning, in the processes of picking and opening, that occur before the fiber is made into a web.

BONDING: The process of combining fibers in webs into sheets by means of self adherence, solvent-based adhesives, thermally softened plastics, or by mechanical entanglement. Bonding is a critical step in the production of nonwovens, and the choice of the method and the material used is at least as important to ultimate functional properties as the basic fibers in the web.

BONDING WITH:

(1) **BINDER FIBERS:** Specially engineered low melting point fibers are blended with other fibers in a web, so that a uniformly bonded structure can be generated at low temperature by fusion of the binder fiber with adjacent fibers.

(2) **POINT BONDING:** The process of binding thermoplastic fibers into a nonwoven fabric by applying heat and pressure so that a discrete pattern of fiber bonds is formed. Also called spot bonding.

(3) **PRINT BONDING:** A process of binding fibers into a nonwoven fabric by applying an adhesive in a discrete pattern.

(4) **SATURATION BONDING:** A process of binding fibers into a nonwoven fabric by soaking the web with an adhesive.

(5) **SPRAY BONDING:** A process of binding fibers into a nonwoven fabric involving the spray application of a fabric binder.

(6) **STITCH BONDING:** A bonding technique for nonwovens in which the fibers are connected by stitches sewn or knitted through the web. Also known as quilting.

BRITTLINESS: The opposite of toughness; the inability to absorb work without rupture, fracture, or breaking.

CALENDER: A machine used in finishing to impart a variety of surface effects to fabrics. A calender essentially consists of two or more heavy rollers, sometimes heated, through which the fabric passes under heavy pressure.

CARD: A machine designed to separate fibers and remove impurities, align and deliver them to be laid down as a web or to be further separated and fed to an air-laid process. The fibers in the web are aligned with each other predominantly in the same direction. The machine consists of a series of rolls or a drum that are covered with many projecting wires or metal teeth. These wire-clothed rolls and drums are called cards.

CARDING: A process for making fibrous webs in which the fibers are aligned essentially parallel to each other in the direction that the machine produces the web (see Machine Direction).

CELLULOSIC FIBERS: Made from plants that produce fibrous products based on polymers of the cellulose molecule. Cotton plants produce separate cellulose fibers. Wood pulp is made by mechanically and chemically separating wood fibers. Rayon is made by dissolving pulp in a solution and extruding the solution through spinnerets into a chemical bath that regenerates the fibers. Other cellulosic fibers are flax, jute, and ramie.

CHEMICAL FINISHING: Processes that apply additives to change the esthetic and functional properties of a material. Examples are the application of antioxidants, flame retardants, wetting agents, and stain and water repellents.

CHIPS: Feed stock in the form of pellets or granules. Examples are polymers used in fiber production and wood pulp used in rayon production.

COATING: Application of liquid material to one or both surfaces of a fabric, followed by drying or curing.

COMPOSITE: A structure made by laminating a nonwoven fabric with other nonwovens or with other materials. Also by impregnating a nonwoven fabric with resins.

CONTINUOUS FILAMENT: A fiber in unending length, usually made by extruding a plastic or polymer solution through a hole in a die called a spinneret.

COTTON FIBER: A unicellular, natural fiber composed of almost pure cellulose. As taken from plants, the fiber is found in lengths of 3/8 to 2 inches. For marketing, the fibers are graded and classed for length, strength, and color.

COVERSTOCK: A lightweight nonwoven material used to contain and conceal an underlying core material. Examples are the facing materials that cover the absorbent cores of diapers, sanitary napkins, and adult incontinence products.

CREPE: A quality in a fabric imparted by wrinkling or embossing to give crimped surface and greater fabric bulk.

CRIMP: The waviness of a fiber. Crimp amplitude is the height of the wave with reference to straight uncrimped fiber.

CROSS DIRECTION: The width dimension, within the plane of the fabric, that is perpendicular to the direction in which the fabric is being produced by the machine.

CURING: A process by which resins, binders or plastics are set into or onto fabrics, usually by heating, to cause them to stay in place. The setting may occur by removing solvent or by crosslinking so as to make them insoluble.

DENIER: The measure of a weight per unit length of a fiber. Denier is numerically equal to the weight in grams of 9000 meters of the material. Low numbers indicate fine fiber

sizes and high numbers indicate coarse fiber sizes. The tex system is used in countries outside the United States. A tex is numerically equal to the weight in grams of one kilometer of fiber. It can be calculated by dividing the denier by nine.

DISPERSION: A distribution of small particles in a medium as in a colloidal suspension of a substance. It also describes the uniform suspension of fibers in water for wet forming.

DRAPE: The ability of a fabric to fold on itself and to conform to the shape of the article it covers.

DRAWING: A process of stretching a filament after it has been formed so as to reduce its diameter. At the same time, the molecules of the filament are oriented, thereby making it stronger. The ratio of the final length to the initial length is called the draw ratio.

DRY FORMING (DRY LAYING): A process for making a nonwoven web from dry fiber. These terms usually refer to formation of carded webs, whereas air laying refers to the formation of random webs.

DURABILITY: A relative term for the resistance of a material to loss of physical properties or appearance as a result of wear or dynamic operation.

ELASTICITY: The ability of a strained material to recover its original size and shape immediately after removal of the stress that causes deformation.

EMBOSSING: A process whereby a pattern is pressed into a film or fabric, usually by passing the material between rolls with little clearance, and where one or both rolls has a raised design. At least one of the rolls is usually heated.

ESTHETICS: Properties of fabrics perceived by touch, sight, smell, and sound. Examples are hand, drape, texture, rustle, color, and odor.

EXTRUSION: A process by which a heated polymer is forced through an orifice to form a molten stream that is cooled to form a fiber. Examples are polypropylene and polyester. A solution of the polymer can also be forced through the orifice into a solvent that causes the fiber to solidify. Examples are rayon and Kevlar.

FABRIC: A sheet structure made from fibers, filaments or yarns.

FIBER: The basic threadlike structure from which yarns and textiles are made. It is different from a particle by having a length at least 100 times its width.

FIBER DISTRIBUTION: The orientation (random or parallel) of fibers and the uniformity of their arrangement in a web.

FIBRID: A fiber having a lower melting point than the matrix fibers which can ultimately be melted to act as a local binder/enforcement system.

FIBRILLATE: To break up a plastic sheet into a fibrous sheet. Also to break fibers into smaller fibers.

FILLER: A nonfibrous additive used in a fiber to increase weight, replace more expensive polymer, change luster, and opacity.

FILTER FABRIC: A cloth used to separate particles from their suspension in air or liquids.

FINISH: Substance added to fibers and textiles, in a post-treatment, to change their properties. Examples are lubricants and flame retardants.

FLEXIBILITY: (1) The ability to be flexed or bowed repeatedly without rupturing. (2) A term relating to the hand of fabric, referring to ease of bending and ranging from pliable (high) to stiff (low).

FORMED FABRIC: Another term for nonwoven fabric.

GEOTEXTILE: A permeable fabric used in civil engineering construction projects such as paving, dams, embankments, and drains for the purposes of stabilization, sedimentation control, erosion control, support, and drainage.

HAND: The tactile qualities of a fabric, e.g., softness, firmness, elasticity, fineness, resilience, and other qualities perceived by touch.

HEAT RESISTANCE: The ability to resist degradation at high temperatures.

HEAT SETTING: Process by which fibers, yarns, or fabrics are heated to a final crimp or molecular configuration so as to minimize changes in shape during use.

HIGHLOFT: General term for low-density, thick, or bulky fabrics as compared to flat, paper-like fabrics.

HYDRAULIC ENTANGLEMENT: See Spunlaced Fabric.

HYDROPHILIC: Having an affinity for being wetted by water or for absorbing water.

HYDROPHOBIC: Lacking the affinity for being wetted by water or for absorbing water.

INDUSTRIAL FABRICS: Textiles for non-apparel and non-decorative uses. Examples are wipes, cable wrappings and geotextiles.

INTERFACING (INTERLINING): A fabric used in garments, to provide weight and stiffness.

LAMINATE: A layered material containing two or more sheets bonded together with an adhesive, foam, or thermoplastic resin.

MACHINE DIRECTION: The long direction within the plane of the fabric, that is in the direction in which the fabric is being produced by the machine.

MAN-MADE FIBER: A class name for various genera of fibers (including filaments) produced from fiber-forming substances which may be: (1) polymers synthesized from chemical compounds, e.g., acrylic, nylon, polyester, polyethylene, polyurethane, and polyvinyl fibers; (2) modified or transformed natural polymers, e.g., alginic and cellulose-based fibers such as acetates and rayons; and (3) minerals, e.g., glasses. The term man-made usually refers to all chemically produced fibers to distinguish them from the truly natural fibers such as cotton, wool, silk, flax, etc.

MELTBLOWN FABRIC: Nonwoven fabric made by the conversion of molten polymer to a web. The molten plastic is blown with hot, high-velocity air through extruder die lips. The filaments exiting from the extruder are attenuated during their formation until they break. The fibers break into short lengths rather than being continuous, as those formed from the spinneret used in spunbonding. The short fibers, thereby created, are spread with cool quench air onto a moving belt called a forming fabric, or onto a drum, where they bond to each other on cooling to form a white, opaque, fine-fibered web.

MIL: One-thousandth of an inch. Commonly used to measure the diameter of fibers and the thickness of films.

MODULUS: The amount of force it takes to stretch a material a unit distance. It is a measure of elasticity. An extensible material or fiber has a low modulus. Stiff materials have a high modulus.

MORPHOLOGY: Study of the fine, microscopic structure of a fiber or other material, e.g., its crystalline and amorphous nature.

NATURAL FIBERS: Fibers made directly from animals, vegetables, or minerals. Examples are silk, wool, cotton, flax, jute, ramie, and asbestos.

NEEDLE PUNCHING: Mechanically binding a web to form a fabric by puncturing the web with an array of barbed needles that carry tufts of the web's own fibers in a vertical direction through the web.

NIP: The line of close contact between two cylinders between which a fabric or web passes.

NONWOVEN: A manufactured sheet, web, or batt of directionally or randomly oriented fibers, made by bonding or entangling fibers through mechanical, thermal, or chemical means. They exclude paper and products which are woven, knitted, tufted, or felted by wet milling. The fibers may be of natural or man-made origin.

NONWOVEN FABRIC: A fabric made directly from fibers or filaments or from a web of fibers, without the yarn preparation needed for weaving or knitting.

NYLON FIBER: A manufactured fiber in which the fiber-forming substance is any long chain synthetic polyamide having recurring amide groups (-NH-CO-) as an integral part of the polymer chain (FTC definition). The two principal nylons are nylon 66, which is polyhexamethylenediamine adipamide, and nylon 6, which is polycaprolactam.

This material is melted and extruded through a spinneret while in the molten state to form filaments which solidify quickly as they reach the cooler air. The filaments are then drawn or stretched, to orient the long molecules from a random arrangement to an orderly one in the direction of the fiber axis. This drawing process gives elasticity and strength to the filaments.

Although the properties of the nylons vary in some respects, they all exhibit excellent strength, flexibility, toughness, elasticity, abrasion resistance, washability, ease of drying, and resistance to attack by insects and microorganisms.

OLEFIN FIBER: A manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of ethylene, propylene, or other olefin units. Olefin fibers combine light weight with high strength and abrasion resistance. (Also see Polyethylene Fiber and Polypropylene Fiber.)

ORIENTATION: The lining up or parallelism of molecular chains in fibers and films.

PERMEABILITY: The ability to be penetrated by liquids or gases.

PILLING: The tendency of fibers to come loose from a fabric surface and form balled or matted particles of fiber.

PLASTIC: A polymer with its additives. Also, the ability to be deformed and molded.

POLYESTER FIBER: A manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of dihydric alcohol and terephthalic acid (FTC definition). The polymer is produced by the reaction of ethylene glycol and terephthalic acid or its derivatives.

Fiber forms produced are filament, staple, and tow. The process of production resembles that of nylon. Polymerization is accomplished at a high temperature, using a vacuum. The glycol and ester reaction forms a polymer chain, releasing methanol. As with nylon, the filaments are spun in a melt-spinning process, then stretched several times their original length, which orients the long chain molecules and give the fiber strength.

Polyester fibers have high strength and are resistant to shrinking and stretching. Fabrics are quick-drying and tend to have wrinkle resistance and crease retention, wet and dry.

POLYETHYLENE FIBER: A man-made fiber made of polyethylene, usually in monofilament form, although work has been done on continuous filament yarns and staple. Ethylene is polymerized at high pressures, and the resulting polymer is melt-spun and cold drawn. It may also be dry-spun from xylene solution. Polyethylene fibers have a low specific gravity, extremely low moisture regain, the same tensile strength wet and dry, and are resistant to attack by mildew and insects.

POLYMER: A high molecular chain-like structure from which man-made fibers are derived; produced by linking together molecular units called monomers.

POLYPROPYLENE FIBER: An olefin fiber made from polymers or copolymers of propylene. Polypropylene fiber is produced by melt spinning the molten polymer, followed by stretching to orient the fiber molecules.

PULP: The end product of cooking wood chips, cotton, or some source of cellulose, with water and appropriate chemicals. Used in the manufacture of cellulosic fibers, paper, and other cellulose-based products.

RAYON FIBER: A manufactured fiber composed of regenerated cellulose, as well as manufactured fibers composed of regenerated cellulose in which substituents have replaced not more than 15% of the hydrogens of the hydroxyl groups. Rayon fibers include yarns and fibers made by the viscose process, the cuprammonium process and the now obsolete nitro-cellulose and saponified acetate processes. Generally, in the manufacture of rayon, cellulose derived from wood pulp, cotton linters, or other vegetable matter is dissolved into a viscose spinning solution. The solution is extruded into an acid-salt coagulating bath and drawn into continuous filaments. Groups of these filaments may be made in the form of yarns or cut into staple.

Rayon yarns are made in a wide range of types in regard to size, physical characteristics, strength, elongation, luster, handle, suppleness, etc. They may be white or solution dyed. Strength is regulated by the process itself and the structure of the yarn.

REPELLENCY: The ability to resist wetting and staining by materials and soils.

RESILIENCY: Ability of a fiber or fabric to spring back when crushed or wrinkled.

RESIN: A solid or semisolid polymeric material (see Polymer).

ROLL GOODS: Fabric rolled up on a core after it has been produced. It is described in terms of weight and width of the roll and the length of the material on the roll.

SCRIM: A very open fabric, such as a netting, used as a support or a backing, in a laminate or impregnated in a composite.

SHORT FIBER: Staple fiber less than 0.75 inches long. Typically used in wet-laid processes, to make fabrics, or as fillers in the absorbent cores of disposable diapers.

SLURRY: A watery or solvent suspension; e.g., titanium dioxide mixed with water for addition to polymers.

SPIN-DRAWING: Combined spinning and drawing in one operation in melt-spun fibers.

SPINNERETTE: A metal disc containing numerous minute holes used in yarn extrusion. The spinning solution or melted polymer is forced through the holes to form the yarn filaments.

SPINNING: The process or processes used in the production of single yarns or of fabrics generated directly from molten polymer.

SPUNBONDED FABRIC: Nonwoven fabric made by the conversion of molten polymer to a web. Continuous filaments are extruded through a spinneret, a device with tiny holes like a shower nozzle. The filaments are blown about and spread on a moving belt, called a forming fabric or wire. The hot filaments are still sufficiently molten to adhere and thereby bond to themselves at their crossover points.

The desired orientation of the fibers in the web are achieved by rotating the spinneret, by electrical charges, by controlled air streams, and by the speed of the belt. The web can be additionally bonded by passing through compaction rolls and/or hot-roll calendaring.

SPUNLACED FABRIC: A nonwoven fabric produced by entangling fibers in a preformed web, generally carded, using high-pressure, columnar waterjets. As the jets penetrate the web and deflect from a wire or plastic screen or other permeable backing, some of the fluid splashes back into the web with considerable force. Fiber segments are carried by the turbulent fluid and become entangled on a semi-micro scale. In addition to bonding the web, spunlaced, or hydraulic entanglement, can also be used to impart

a pattern to the web. The fabric formed has little or no additional binder added.

STAPLE FIBERS: Natural fibers or cut lengths from filaments. The staple length of natural fibers varies from less than 1 inch as with some cotton fibers to several feet for some hard fibers. Man-made staple fibers (occasionally less than 1 inch).

STIFFNESS: The ability of a fabric to resist bending. It is related to fiber modulus or elasticity.

STRAIN: Elongation, deformation, or change in dimensions of a body as the result of applied stress, expressed either as relative unit changes or as percentage changes.

STRAND: A single fiber, filament, or monofilament.

STRESS: An external force applied to one end of a body whose other end is immovably fixed.

STRETCH: The ability of a fabric to grow in length when pulled.

SUBSTRATE: Fabric to which coatings or other fabrics are applied.

SUPERABSORBENT: A material that can absorb many times the amount of liquid ordinarily absorbed by cellulosic materials such as wood pulp, cotton, and rayon.

SYNTHETIC FIBER: A man-made fiber, usually from a molten polymer or from a polymer in solution.

TEAR STRENGTH: The force required to begin or to continue a tear in a fabric under specified conditions.

TENACITY: A measure of the strength of a fiber. The tensile stress when expressed as force per unit linear density of the unstrained specimen (e.g., grams-force per denier or newtons per tex).

TENSILE STRENGTH: (1) In general, the strength shown by a specimen subjected to tension as distinct from torsion, compression, or sheer. (2) Specifically, the maximum tensile stress expressed in force per unit cross-sectional area of the unstrained specimen, e.g., kilograms per square millimeter, pounds per square inch.

TENSILE TEST: A method of measuring the resistance of a yarn or fabric to a force tending to stretch the specimen in one direction.

TEXTURE: A term describing the surface effect of a fabric such as dull, lustrous, wooly, stiff, soft, fine, coarse, open, or closely woven; the structural quality of a fabric.

THERMOPLASTIC: Polymeric materials that have a melting temperature and can flow or be formed into desired shapes on application of heat at or below the melting point.

THERMOSET: Polymeric materials that become intractably hardened by exposure to heat and/or catalyst action.

TOUGHNESS: Ability to absorb work. Commonly measured as the area under the stress/strain curve. The opposite of brittleness.

WEB: (1) The wide film of fibers that is delivered from the card. (2) A similar product of other web-forming equipment, such as that formed by air or water deposition and used to make nonwoven fabrics. (3) A term loosely used for lightweight nonwoven fabrics.

WET FORMING (WET LAYING): Forming a web by filtering an aqueous suspension of fibers onto a screen belt or onto a perforated drum. To distinguish wet-laid nonwovens from wet-laid papers, a material would be regarded as a nonwoven if:

(1) More than 50% by mass of its fibrous content is made up of fibers (excluding chemically digested vegetable fibers) with a length to diameter ratio greater than 300; or if

(2) More than 30% by mass of its fibrous content is made up of fibers (excluding chemically digested vegetable fibers) with a length to diameter ratio greater than 300, and its density is less than 0.40 g/cm³.

WICKING: Transport of liquid within an absorbent fabric, vertically into the fabric web and horizontally within the plane of the fabric.

Conversion factor table

To convert	Multiply by this factor	To obtain
Inches	25.4001	Millimeters
Inches	2.54001	Centimeters
Inches	0.0254	Meters
Feet	0.3048	Meters
Yards	0.914402	Meters
Millimeters	0.03937	Inches
Centimeters	0.3937	Inches
Meters	39.37	Inches
Meters	3.281	Feet
Meters	1.0936	Yards

Metric and decimal equivalents

1 inch = 25.4 mm, 1 mm = 0.03937 inch

(fractions of an inch)

Inch	Decimals	Millimeter
1/64	0.016	0.4
1/32	0.031	0.8
1/16	0.063	1.6

Length and area

1 statute mile = 1760 yards
5280 feet
1.609 kilometers

1 yard (yd) = 3 feet
0.914 meters

1 foot (ft) = 12 inches
30.48 centimeters

1 inch (in.) = 25.40 millimeters

100 ft per min = 0.508 meters per second

1 square yard = 9 sq feet
0.836 sq meters

1 square foot = 144 sq inches
0.0929 sq meters

1 square inch = 6.45 sq centimeters

1 kilometer (km) = 1000 meters
0.621 statute miles

1 meter = 100 centimeters (cm)
1000 millimeters
1.094 yards
3.281 feet
39.37 inches

1 millimeter (mm) = 1000 microns

1 meter per second = 196.9 ft per min

1 sq meter (m²) = 10,000 sq centimeters
1.196 sq yards
10.76 sq feet

1 sq centimeter = 100 sq millimeters
0.1550 sq inches

Weights

1 USA long ton = 2240 pounds
1016 kilograms

1 USA short ton = 2000 pounds
907 kilograms

1 pound (lb) = 16 ounces
7000 grains
0.454 kilograms

1 ounce (oz) = 0.0625 pounds
28.35 grams

1 grain (gr) = 64.8 milligrams
0.0023 ounces

1 pound per foot = 1.488 kg per meter

1 metric ton = 1000 kilograms
0.984 USA long tons
1.102 USA short tons
2205 pounds

1 kilogram = 1000 grams
2.205 pounds

1 gram (g) = 1000 milligrams
0.03527 ounces
15.43 grains

1 kg per meter = 0.672 pounds per ft

1 cubic meter (m³) = 1000 liters
1308 cubic yards
35.31 cubic feet

1 liter = 1000 cubic cm (cm³)
0.2200 Imperial gallon
0.2642 USA gallon
61.0 cubic inches

Volume

1 cubic yard = 27 cubic feet
0.765 cubic meters

1 cubic foot = 1.728 cubic inches
28.32 liters

1 cubic inch = 16.39 cubic cm

1 Imperial gallon = 277.4 cubic inches
4.55 liters

1 USA gallon = 0.833 Imperial gallon
3.785 liters
231 cubic inches

1 USA barrel (petroleum) = 42 USA gallons
35 Imperial gallons

1 cu ft per min = 1.699 m³ per hour