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Standard Terminology for Yarn Spinning Systems¹

This standard is issued under the fixed designation D3888; 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.

~~^{ε1}Note—This terminology was updated editorially with terms from Subcommittee D13.58 standards in September 2011.~~

1. Scope

1.1 This terminology covers terms related to ring, rotor, and air jet yarn spinning systems.

1.1.1 This standard formerly only included terminology related to open-end spinning. It has been expanded to include terms relating to ring and air jet spinning systems.

1.1.2 While the term rotor spinning is technically correct, the terms rotor and open-end are used interchangeably in the textile industry.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

~~D123 Terminology Relating to Textiles~~

~~D861 Practice for Use of the Tex System to Designate Linear Density of Fibers, Yarn Intermediates, and Yarns~~

~~D1244 Practice for Designation of Yarn Construction~~

D2255 Test Method for Grading Spun Yarns for Appearance

~~D2260 Tables of Conversion Factors and Equivalent Yarn Numbers Measured in Various Numbering Systems~~

D3888 Terminology for Yarn Spinning Systems

D3990 Terminology Relating to Fabric Defects

3. Significance and Use

3.1 Terminology D3888 was originally developed as a terminology standard for rotor spinning when it evolved as a new yarn spinning technology in the ~~1980's~~ 1980s. Ring spinning production had been the traditional spinning since the early ~~1800's~~ 1800s when hand spinning became mechanized. Rotor spinning and other spinning technologies increased yarn production rates and formed yarns by different mechanical means that generated yarns with characteristics unlike traditional ring-spun yarns. The revision of this document is intended to compile terminology for current yarn spinning systems into one standard rather than individual standards, in that all yarn formation is generated by processing raw fiber into a spun yarn by using common preparation steps, such as opening, cleaning, carding, roving formation, and sometimes combing. Terminology in this standard is grouped by the type of spinning system and in chronological order of their development and production usage. It should be noted that the higher end of yarn number ranges cited with each spinning system are possible but are rare in actual production.

4. Terminology

4.1 *Ring Spinning*—Ring spinning is the oldest spinning system in use, therefore ring-spun yarns are the basis for comparing yarns produced from other spinning systems. Production rates are low when compared to new spinning systems. The production delivery capability of ring spinning is limited by traveler velocity and the twist limits of the yarn number being made; the speed may range between 10 and 20 m/min. Ring spinning allows for the production of the widest range of yarn numbers from 200 to 2 tex (N_{ec} 3/1 to 300/1). Ring-spun yarns are produced by drafting rovings between pairs of rollers, twisting the drafted roving

¹ This terminology is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarns and Fibers. ~~Current edition approved Dec. 1, 2007. Published January 2008. Originally approved in 1980. Last previous edition approved in 2001 as D3888-95(2001). DOI: 10.1520/D3888-07E01.~~

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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.

by passing it under a traveler that rotates around a fixed ring on the frame of the spinning machine, and winding the twisted strand on a removable bobbin mounted on a rotating spindle. Ring spun yarns are characterized by a uniform fiber orientation around the yarn axis. See Fig. 1.

bobbin, *n*—a slightly tapered plastic cylinder, mounted on a spindle of a ring spinning frame on which yarn produced from drafting and twisting is wound.

DISCUSSION—Yarn from several ring frame bobbins is wound onto a cone or cheese to create a larger package from which it can be easily unwound for use in weaving, knitting, or other processes.

carding, *v*—a mechanical preparation, utilized by staple fiber spinning systems, that cleans, straightens, and aligns fibers using wire-covered rolls (or cylinders) that converts fibers into a sliver.

carded yarn, *n*—an organized, continuous strand of staple fibers produced by carding, drawing, roving formation, and spinning. (Compare with **combed yarn**.)

combing, *v*—an optional mechanical preparation process undertaken to remove additional trash particles, neps, and short fibers (typically fibers less than 12.5 mm or 0.5 in.) from carded sliver to further align the remaining fibers.

combed yarn, *n*—an organized, continuous strand of staple fibers produced by carding, roving, drawing, formation, combing, and spinning. (Compare with **carded yarn**.)

DISCUSSION—Combed yarns of the same yarn number, produced on the same spinning system are, generally, stronger, more uniform with fewer imperfections, and have greater luster than carded yarns.

compact spinning, *n*—a modified ring-spinning process that alters the geometry of the spinning twist triangle to produce a more uniform structure by binding fibers into the body of the yarn. See Fig. 2.

DISCUSSION—Yarns produced from compact ring spinning exhibit reduced hairiness (see Fig. 3) and produce higher strength than conventional ring spun yarns in the same yarn number.

drafting, *v*—the process of attenuating a web, sliver or roving of staple fiber to increase its length per unit mass.

DISCUSSION—Drafting is generally attained by passing a web, sliver or roving between pairs of rollers (or a combination of pairs of rollers with aprons), operating at differing speeds.

drafting zone, *n*—the location on a spinning, draw, and roving frame where pairs of rollers, or cylinders, rotating at differing speeds, control the number of fibers per cross-section of the yarn. —the location on a drawing, roving or spinning frame where pairs of rollers, cylinders, aprons or a combination of the same, operate at differing surface speeds.

DISCUSSION—The differing surface speeds attenuate the material being processed, and control the number of fibers per cross-section.

ring spinning machine, *n*—a machine that converts roving of staple fiber (produced from carded or combed sliver) into spun yarn by drafting, twisting, and winding onto a removable bobbin. (Syn. ring-spinning frame.) See Fig. 4.

roving, *n*—the intermediate product between sliver and spinning that is a loose assembly of fibers drawn into a single strand that has very little twist.

scratch-combed yarns, *n*—the process of combining comber and carded sliver to produce a continuous yarn strand of staple fibers.

DISCUSSION—Yarns produced from scratch combing do not have the full spectrum of attributes (length uniformity, evenness, luster) of completely combed sliver in a yarn strand.

sliver, *n*—a continuous strand of loosely assembled fibers, approximately uniform in cross-section and without twist, produced by a card, draw frame, or comber.

spindle, *n*—a slender, tapered rod, placed in a vertical position on a ring-spinning frame that rotates at a high rate speed around its axis and on which a bobbin is mounted.

traveler, *n*—a C-shaped metal piece that rides on the ring of a spinning frame and guides the twisted yarn onto a bobbin.

twist, *n*—the number of turns about the axis per unit of length in a yarn or other textile strand.

4.2 *Rotor Spinning*—Rotor, or open-end, spinning is a production spinning technology that can spin yarn at a rate of up to ten times that of ring spinning. Rotor spinning production capability, typically utilized for coarser yarn number production, is dependant on rotor dimensions and nozzle configuration; its spinning speeds may range between 150 to 250 m/min. It does not require either roving formation prior to spinning or an extra winding step after spinning. Its yarn number production range is 200 to 15 tex (N_e 3/1 to 40/1). Rotor-spun yarns are characterized by some degree of random fiber entanglements, called wraps, or wrappers, around the yarn axis. See Fig. 5.

~~**carding**, *n*—a mechanical preparation, utilized by staple fiber spinning systems, that cleans, straightens, and aligns fibers using wire-covered rolls (or cylinders) that converts fibers into a sliver. —See **carding** in 4.1.~~

collecting surface, *n*—in the rotor of an open-end spinning machine, that portion of the internal surface of the rotor, often in the form of a groove, in which the fibers are condensed for assembly into yarn.

doffing tube, *n*—a component of an open-end spinning machine which is an extension to the navel and is used to guide the

withdrawn yarn en route to the take-up rollers. (See also **navel**.)

feed unit, *n*—in an open-end spinning machine, the device which presents the fiber feed stock to the opening roller by either a feed roller and feed plate combination or interacting feed rollers. (See **opening device**.)

fiber channel, *n*—a component of an open-end spinning machine through which the fibers are conveyed by an air current from the opening device to the rotor. (Syn. fiber transport tube.) (See also **opening device**.)

DISCUSSION—Different navel designs will impact the physical properties of rotor-spun yarns.

navel, *n*—a component of an open-end spinning machine located on the axis of the rotor through which the yarn is withdrawn from the rotor and which modifies the twist of the yarn inside the rotor. (See **doffing tube**). [D13.58]D3888

open-end spinning machine, *n*—a textile machine for converting staple fiber into spun yarn by a continuous process in which the individual fibers or groups of fibers are caused to assemble at the open end of the forming yarn. (See **rotor-type open-end spinning machine**) [D13.58]D3888

open-end yarn, *n*—see **rotor-spun yarn**.

opening device, *n*—in open-end spinning, either a drafting system or an opening roller which separates the feed stock into individual fibers or very small tufts prior to their reassembly into yarn.

opening roller, *n*—a component of the opening device in open-end spinning machines, a roller covered with pins or teeth or similar device used to separate the feed stock into individual fibers or very small tufts by a continuous combing action. (Syn. combing roll.)

package, *n*—plastic, open cylinder onto which rotor and air jet yarns are wound.

rotor, *n*—in open-end spinning machines, a device resembling a centrifuge, in which fibers are assembled and in which, by virtue of its rotation, twist is inserted into the end of the yarn being formed.

DISCUSSION—The rotor separates fibers and incoming air. The air dissipates through holes in the rotor or over the rim of the rotor into the rotor housing where it is exhausted through an outlet duct.

rotor, *n*—in open-end spinning machines, a device resembling a centrifuge, in which the fibers are assembled and in which, by virtue of its rotation, real twist is inserted in the forming yarn. [D13.58]D3888

rotor groove, *n*—the collection slot inside the rotor cup on a rotor-spinning machine where fibers are assembled.

rotor-type open-end spinning machine, *n*—an open-end spinning machine wherein the assembly of individual fibers and the insertion of real twist are affected by a rotor. (See also **open-end spinning machine**.) [D13.58]D3888

rotor-spinning machine, *n*—a machine that converts sliver of staple fiber, usually carded, into a spun yarn by a process in which fibers are opened and drawn by air suction into a rotor cup rotating at a high rate of speed, where they become attached to a loose (open) end of yarn, exiting the rotor cup. (Syn. open-end spinning.) See Fig. 5.

separator, *n*—a component of some open-end spinning machines located inside the rotor that directs the incoming fibers to the slide surface.

slide surface, *n*—in the rotor of an open-end spinning machine, that part of the internal surface of the rotor on which the fibers are deposited and are caused to slide to the collecting surface.

take-up rollers, *n*—in open-end spinning machines, a pair of closely set, continuously rotating cylinders which withdraw the spun yarn from the rotor.

thin place, *n*—a yarn defect characterized by a segment that is substantially (at least 25 %) smaller in diameter than the average diameter of the yarn. (See also **thick place**.) [D13.58] D2255, D3990

trash-removal device, *n*—in open-end spinning machines, a system for removing impurities from the opened feed stock before the fibers are conveyed to the rotor.

winding system, *n*—in open-end spinning machines, a device which forms the yarn package.

wrapper fibers, *n*—in rotor-spun yarns, fiber entanglements created during yarn formation that surround the circumference of the yarn cross section in random sequence but are not part of the twist helix.

yarn package, *n*—tubes, cones, and cheeses from which yarn can be unwound easily for use in weaving, knitting, or other processes.

4.3 *Air-Jet Spinning*—Air-jet spinning, as with rotor spinning does not require either roving prior to spinning or winding after spinning. The yarn production capability of this technology can be up to double that of rotor spinning and triple that of ring spinning; its spinning speed may range between from 350 to 450 m/min. Air jet yarn numbers range from 39 to 7 tex (N_c 15/1 to 80/1). In air-jet spinning, sliver is drafted between drafting rollers, then pulled into an orifice by suction by airflow that creates a vortex. Similar to rotor-spun yarns, air-jet spun yarns also exhibit a random fiber configuration along their length but, unlike rotor-spun yarns, do not exhibit wrapper fibers around their axis. See Fig. 1. Newer air-jet spinning technologies are called vortex spinning.

air-jet spinning machine, *n*—a machine that converts slivers of staple fibers into spun yarn using drafting rollers and a vortex created by an airflow suction orifice. See Fig. 6.

carding, *n*—a mechanical preparation, utilized by staple fiber spinning systems, that cleans, straightens, and aligns fibers using wire-covered rolls (or cylinders) that converts fibers into a sliver.—See **carding** in 4.1.

delivery roller, *n*—air-jet spinning frame component that controls yarn tension from the front roll through the nozzle box.

drafting zone, *n*—the location on a spinning, draw, and roving frame where pairs of rollers, or cylinders, rotating at differing speeds, control the number of fibers per cross-section of the yarn.

N₁ air nozzle, *n*—the first nozzle that creates an air vortex through which the leading, free, surface fibers are twisted while trailing ends remain fixed under the front spinning roll.

N₂ air nozzle, *n*—the second air nozzle that creates an air vortex in the opposite direction than the N₁ air nozzle resulting in a false twisting motion.

nozzle box, *n*—an air-jet spinning frame component where parallel fibers are twisted and wrapped to create the yarn structure.

take-up package, *n*—a cone on which spun yarn is wound for downstream processing.

yarn clearer, *n*—an optical or capacitive sensor that monitors for yarn defects which can activate a break in the yarn being produced so that the undesirable defect can be removed.

waxing device, *n*—a container of wax, positioned between a delivery roll and a take-up package that coats the yarn, typically those being produced for knitting.

5. Keywords

5.1 air-jet spinning; ring spinning; rotor spinning

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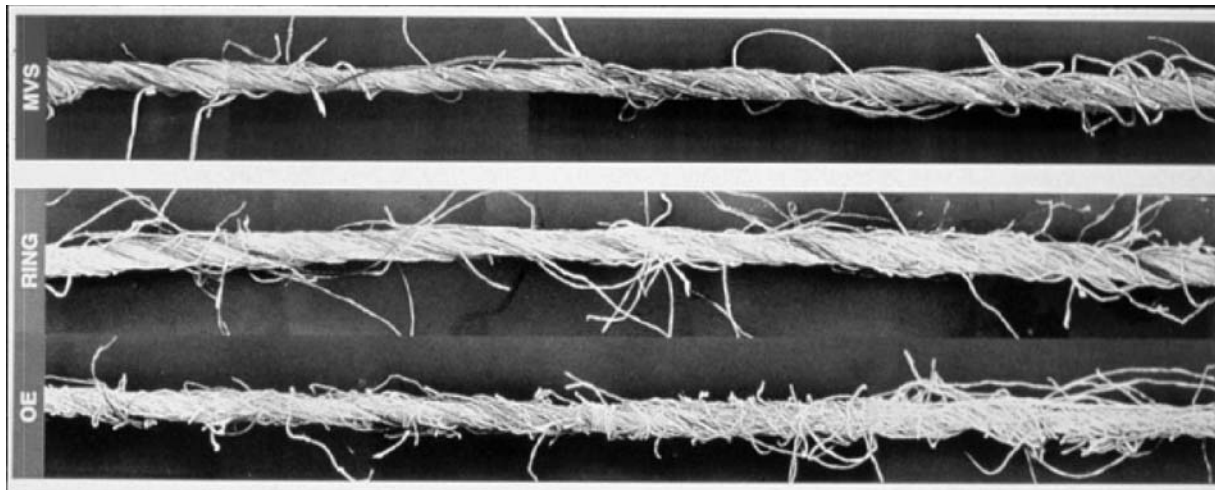


FIG. 1 Longitudinal Sections of Ring (middle view), Rotor (bottom view) and Air Jet (top view) Yarns
(Courtesy of Murata Machinery, Ltd.)