WOOL GRADES

Guide B-409

Cooperative Extension Service
College of Agriculture and Home Economics

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This publication is scheduled to be updated and reissued 2/07.

INTRODUCTION

The potential range of end products that wool may be used for is dictated by many qualities, including fineness, clean wool yield, length, color, and uniformity. Consequently, these qualities determine the value of the raw product. Fineness, or grade, is of primary importance in determining market value of raw wool. Finer (smaller diameter) wools usually are associated with more expensive, lighter weight fabrics, while coarser-fibered wools (larger diameter) usually are used in bulkier sweaters, blankets, and carpets.

FINENESS

Wool fineness refers only to the diameter of the individual wool fibers. When wool is graded (fineness determined), the entire fleece is given a grade that represents the average fineness and is placed into grade lines with fleeces of similar fiber diameter. Grading should not be confused with wool classing; sorting fleeces into various lines according to fineness, length, strength, yield, color, and style.

Three systems of wool grading are used in the United States: American Blood Grade System, Spinning Count System, and Micron System. All three systems are used interchangeably, but the latter is the system used internationally and preferred by wool buyers and manufacturers (table 1).

The American Blood Grade System was developed in the early 1800s and originally represented the amount of fine-wool Merino genetics (Spanish origin) present in the native coarse-wool sheep. The wool grade was simply defined as a percentage of Merino genetics. The first cross was expressed as 1/2 blood; the same applied for 3/8 blood and 1/4 blood. The American Blood Grade System no longer refers to breeding background but represents a broad description of fiber diameter. Grades of wool described by the American Blood Grade System are Fine, 1/2 Blood, 3/8 Blood, 1/4 Blood, Low 1/4 Blood, Common, and Braid (fig. 1).

The Spinning Count System is a more technical classification of wool fineness than the American Blood Grade System and identifies wool within a narrower range of fiber diameter (table 1). For example, wool that grades 80s, 70s, or 64s in the Spinning Count System would fall within the broader Fine category in the American Blood Grade System. The "spinning count" is based on the number of "hanks" of yarn that can be spun from one pound of clean wool. Finer wools have more individual fibers per unit of weight. Consequently, more hanks of yarn can be spun from fine wool than coarse wool. A hank is equal to 560 yards. One pound of clean, Fine, 80s spinning count wool spun to its maximum would result in 80 hanks of yarn, or 44,800 yards (80 hanks x 560 yards). One pound of clean, Low 1/4 Blood, 46s spinning count wool would yield only 25,760 yards (46 hanks x 560 yards).

Table 1. Specifications for wool grades.

American Blood Grade	Spinning Count	Range for Average Fiber Diameter (μm)	Maximum Standard Deviation
Fine	Finer than 80s	under 17.70	3.59
	80s	17.70-19.14	4.09
	70s	19.15-20.59	4.59
	64s	20.60-22.04	5.19
1/2 Blood	62s	22.05-23.49	5.89
	60s	23.50-24.94	6.49
3/8 Blood	58s	24.95-26.39	7.09
	56s	26.40-27.84	7.59
1/4 Blood	54s	27.85-29.29	8.19
	50s	29.30-30.99	8.69
Low 1/4 Blood	48s	31.00-32.69	9.09
	46s	32.70-34.39	9.59
Common	44s	34.40-36.19	10.09
	40s	36.20-38.09	10.69
Braid	36s	38.10-40.20	11.19
	Coarser than 36s	more than 40.20	

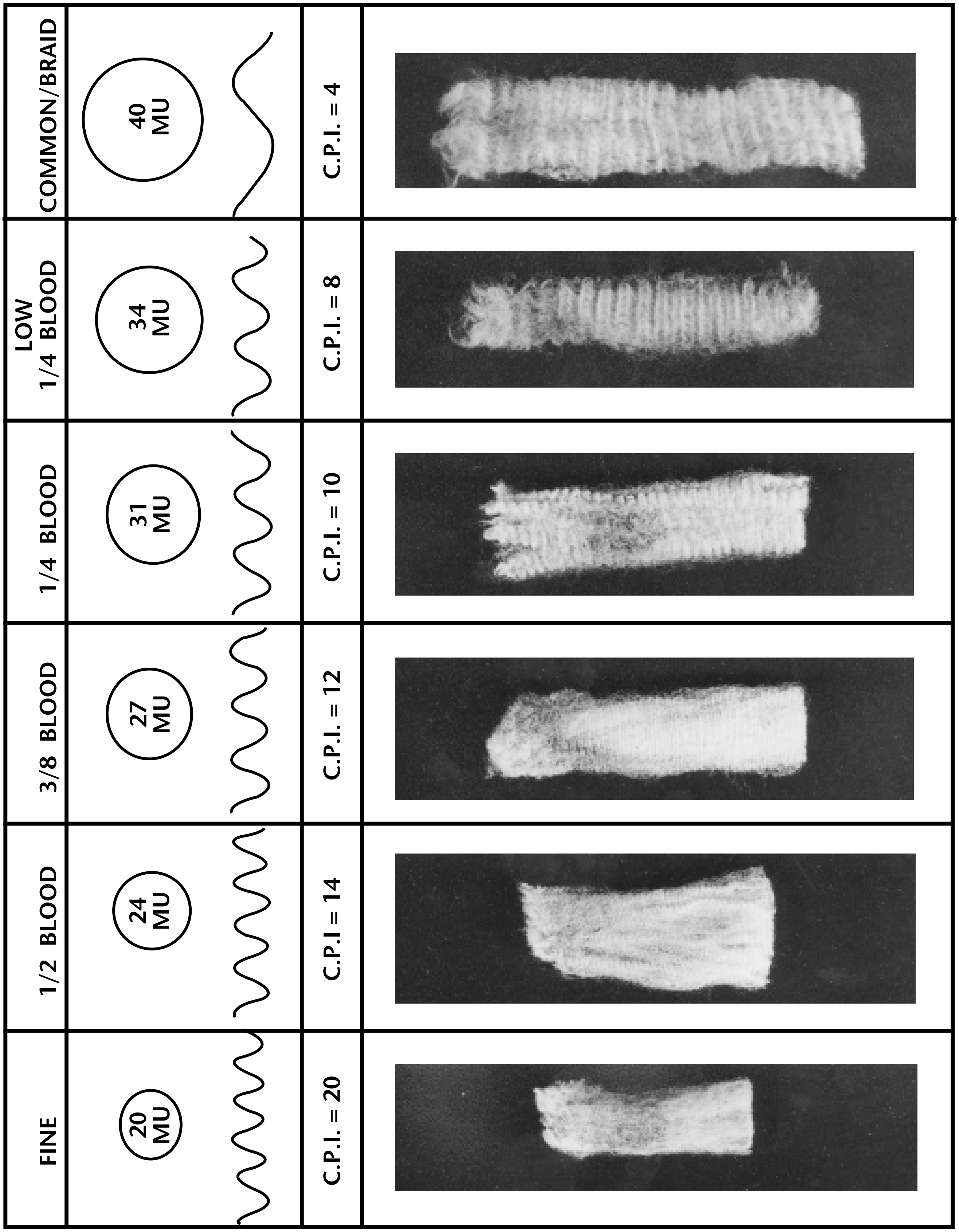


Figure 1. Grades of wool described by the American Blood Grade System (C.P.I = Crimps per inch; MU = micron units).

The Micron System is a much more precise and descriptive method of measuring average fiber diameter. Individual fiber diameters are measured in microns (1/25,400 of an inch). Traditionally, the standard method of measuring these fibers is by a microprojection technique in which short longitudinal sections of the fibers are projected onto a screen at 500-fold magnification. As the wool gets coarser, it becomes necessary to measure significantly more fibers to ensure a high degree of accuracy. Wool that grades in the 62s spinning count requires about 3,000 fiber measurements, while 50s spinning count wool requires taking more than 6,000 fiber measurements to ensure acceptable accuracy. A competent technician could measure only about 600 fibers per hour. Technological advancements have greatly improved the efficiency and accuracy of fiber diameter measurement.

Electro-optical and image analysis machines are much faster and have the capability of measuring 2,000 fibers, calculating an average, standard deviation and a coefficient of variation, and printing this information with a histogram in less than 3 minutes (figs. 2 and 3).

The Optical Fiber Diameter Analyzer 100 (OFDA100) analyses 2 mm snippets of the original scoured sample. These fibers are spread automatically onto a glass slide and loaded into the OFDA. The OFDA can measure 4,000 fibers in about 30 seconds. The latest OFDA machine, OFDA2000, is a portable unit that can analyze grease wool and diameter profile along the staple. The OFDA2000 allows a rancher to analyze about 800 samples in 8 hours, while never leaving the shearing pen.

The Sirolan-Laserscan uses a scoured, 20 g subsample for fiber diameter measurement. The sample is carded using a Shirley Analyzer to remove vegetable matter and blend the fibers in an open web. The web is divided into four sections and placed into a minicore set above the Laserscan. The snippets fall into the Laserscan and are mixed automatically into a solution within the instrument. The Laserscan measures 1,000 fibers from each of the four sections for a total of 4,000 fibers (figs. 2 and 3).

The range of average diameters for the major sheep breeds is listed in table 2. These are commonly accepted ranges. However, it is possible to find individuals within each breed that produce wool measuring outside of these ranges.

Table 2. Common ranges of fiber diameter, grease fleece weight, and clean wool yield for various sheep breeds.*

Breed	Range of Average Fiber Diameter (μm)	Range of Grease Fleece Weight (lb)	Range of Clean Wool Yield (%)
Border Leicester	38-30	8-12	60-70
Cheviot	33-27	5-8	50-65
Columbia	30-23	9-14	45-60
Cormo	22-19	10-14	60-70
Corriedale	31-24	9-14	45-60
Debouillet	23-18	9-14	45-55
Delaine-Merino	22-17	9-14	40-50
Dorset	32-26	5-8	50-65
Finnsheep	31-24	4-8	50-70
Hampshire	33-25	6-10	50-60
Lincoln	41-34	10-14	55-70
Merino (superfine)	<18	6-9	60-70
Merino (fine)	19-20	6-11	60-70
Merino (medium)	21-22	9-13	65-75
Merino (strong)	23-26	11-15	65-75
Montadale	30-25	7-11	50-60
Oxford	34-28	7-10	50-60
Rambouillet	23-19	9-14	45-60
Romney	39-32	8-12	55-70
Shropshire	33-25	6-10	50-60
Southdown	29-24	5-8	40-55
Suffolk	33-26	4-8	50-60
Targhee	25-21	9-14	45-60
Texel	33-28	7-10	60-70

*Primary source: Sheep Production Handbook. 1996. American Sheep Industry Association Inc. Production, Education, and Research Council.

Table 3. Uniformity of wools as expressed by a coefficient of variation.

Coefficient of Variation	Standard of Uniformity
Less than 21%	Excellent
21% to 27%	Average
Over 27%	Poor

SIROLAN LASERSCAN
MICRON TEST REPORT

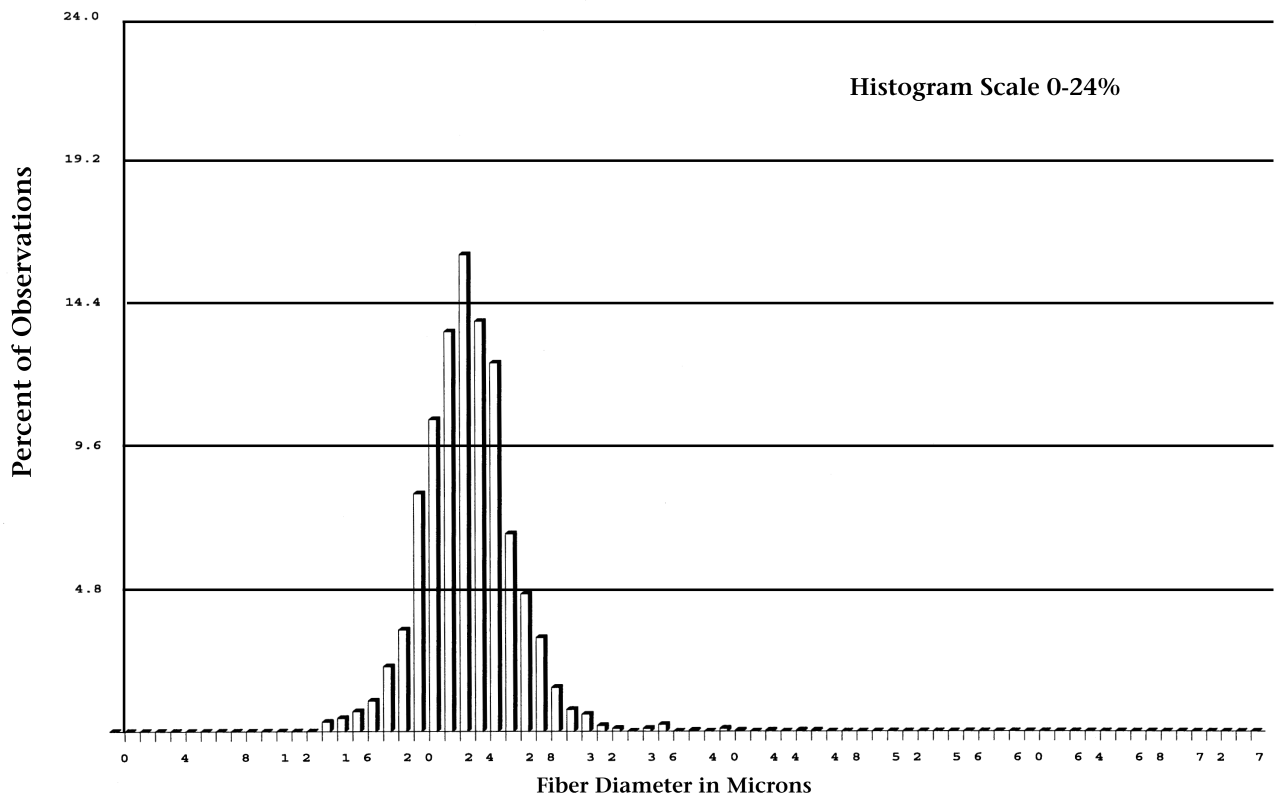
NEW MEXICO STATE UNIVERSITY/CLAY P. MATHIS, Ph.D. 07/24/00
P.O. BOX 30003, MSC 3AE
LAS CRUCES NM 88003-8003 Test No: 87111

ANIMAL & SAMPLE DESCRIPTION:

ID No: 33		Name:	33
Breed:			XXXXX
Sex:			RAM
Age:			YRLG
Sample Location: SIDE		Sample Date:	05/02/00

LABORATORY DATA

Average Fiber Diameter:	23.3 Microns
Standard Deviation:	3.1 Microns
Coefficient of Variation:	13.3 Percent
Fibers Greater Than 30 Microns	1.7 Percent



THIS TEST PERFORMED ACCORDING TO I.W.T.O. METHOD 12

Figure 2. Side sample measurements of Ram 33 with excellent uniformity.

SIROLAN LASERSCAN
MICRON TEST REPORT

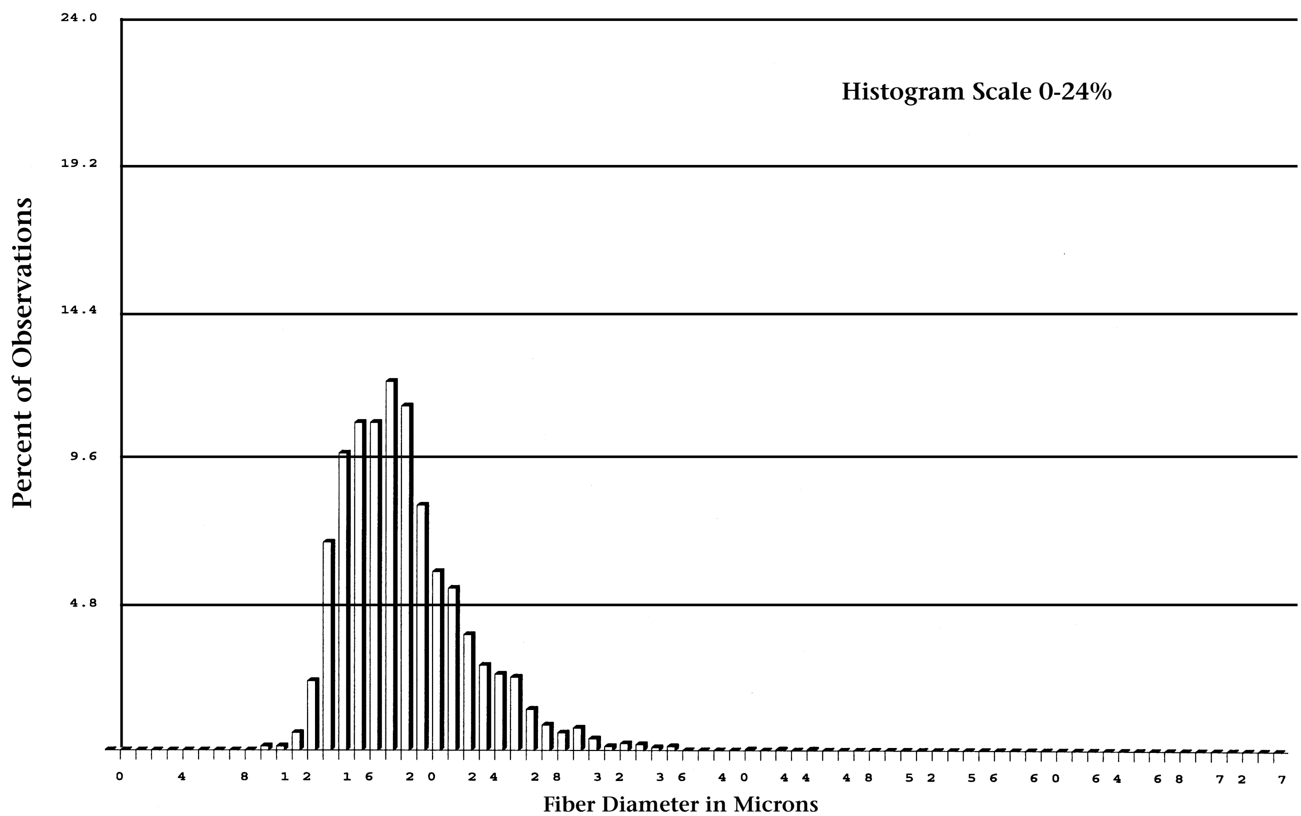
NEW MEXICO STATE UNIVERSITY/CLAY P. MATHIS, Ph.D. 07/24/00
P.O. BOX 30003, MSC 3AE
LAS CRUCES NM 88003-8003 Test No: 87144

ANIMAL & SAMPLE DESCRIPTION:

ID No: 50		Name:	50
Breed:			XXXXX
Sex:			RAM
Age:			YRLG
Sample Location: BRITCH		Sample Date:	05/02/00

LABORATORY DATA

Average Fiber Diameter:	18.9 Microns
Standard Deviation:	4.1 Microns
Coefficient of Variation:	21.7 Percent
Fibers Greater Than 30 Microns	1.6 Percent



THIS TEST PERFORMED ACCORDING TO I.W.T.O. METHOD 12

Figure 3. Britch sample measurements of Ram 50 with average uniformity.

DISTRIBUTION OF FIBER DIAMETER

Individual fibers vary in diameter within any fleece. The britch typically is coarser than the rest of the fleece, even in fine-wool breeds selected for uniformity. In crossbreds and sheep of coarser wool breeds, it is common to find fibers representing 4-5 spinning counts within the same fleece. Because of the variation within individual fleeces, it may be economical to sort wool into uniform lots prior to selling. Sorting reduces variation and consequently optimizes marketing potential.

It is to the manufacturers' advantage to know how much grade variation grade exists in any given lot of wool before determining its fair market value. The amount of grade variation is expressed as either the "standard deviation" or "coefficient of variation." Most micron test reports include this information (figs. 2 and 3). The standard deviation measures the distribution or variation of fiber diameters about an average. Two-thirds of the fibers' diameters are within one standard deviation of the average fiber diameter (fig. 4, normal distribution with SD marked). Highly variable wool will have a larger standard deviation.

The American Society for Testing Materials has established variability limits for wool fineness (fig. 1). If a wool sample is more variable, or has a higher standard deviation than the one allowed for that grade, the grade is then lowered one spinning count.

The "coefficient of variation" is another useful measurement of fiber diameter variability. The coefficient of variation is the fraction or percentage that the standard deviation is of the average. This statistic is most useful in comparing the variation of unrelated groups, such as coarse wool variation versus fine wool variation. A standard of uniformity based on coefficient of variation has been developed for wool (table 3).

CONCLUSION

Grade of fiber diameter and diameter variation are of primary importance in determining wool value. As the textile industry continues to modernize its carding, combing, spinning, and weaving equipment with high-speed, state-of-the-art technology, grade and uniformity of the raw product become even more important. A higher percentage of wool will be purchased based on objective measurements. Consequently, producers must become more knowledgeable about the use of objective measurements. Obtaining side and britch sample micron tests on replacements, particularly rams, will be more important as the industry demands higher quality, more uniform wool.

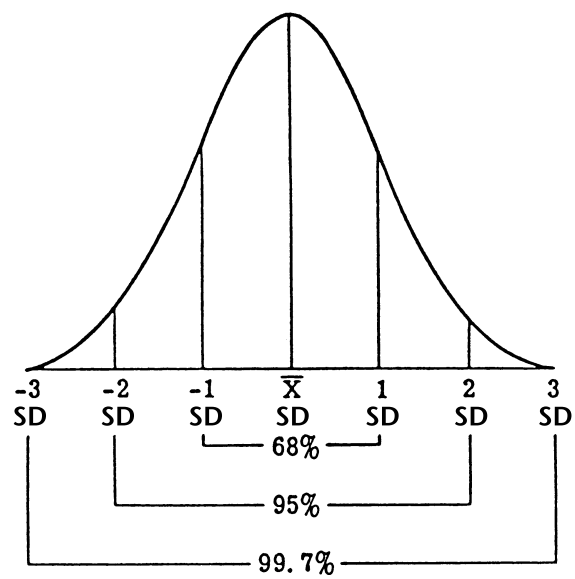


Figure 4. Normal distribution showing how the mean (x) and standard deviation (SD) may be used to describe the expected variability of fiber diameter.

Revised February 2002 **Las Cruces, NM**
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