

JIS

JAPANESE INDUSTRIAL STANDARD

Testing Methods for Spun Yarn

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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Testing Methods for Spun Yarn

J I S
L 1095-1990

1. Scope

This Japanese Industrial Standard specifies the general testing methods for spun yarn.

Remark: The units and numerical values given in { } in this Standard are based on the traditional units and are currently the criteria in force.

2. Definitions

For the purposes of this Standard, the following definitions apply:

- (1) standard condition of test room or apparatus The condition of the temperature and humidity in a test room or in an apparatus with tolerances at $20 \pm 2^{\circ}\text{C}$ and $65 \pm 2\%$ specified in JIS Z 8703.
- (2) standard condition of sample A condition in which the sample is allowed to stand in a test room or an apparatus of a standard condition to a moisture equilibrium.
- (3) moisture equilibrium A condition in which a sample, which has lowered its moisture regain not more than official regain by preliminarily drying (at a temperature $40 \pm 5^{\circ}\text{C}$), is allowed to stand in a test room or an apparatus of a standard condition to a constant mass.
Remark: For fiber of 0 % in official regain, preliminarily drying may be omitted.
- (4) absolute dry condition of sample The condition in which the sample is allowed to stand in a hot-air drier kept at a temperature of $105 \pm 2^{\circ}\text{C}$ to a constant mass.
Remark: For the fiber of 0 % in official regain, the standard condition shall be taken as the absolute dry condition.
- (5) absolute dry mass The mass of a sample in the absolute dry condition.
- (6) constant mass The condition in which the difference in mass of a sample measured at least 1 h apart under moisture equilibrium and at least 15 min apart under absolute dry condition has come within 0.1 % of the latter measurement.
- (7) official regain The officially fixed value of moisture regain, that is, the ratio, expressed in percentage, of the difference between the mass of a sample in an optional condition and its absolute dry mass to the absolute mass.
- (8) corrected mass The absolute dry mass plus the mass corresponding to official regain.
- (9) yarn number count or fineness The unit for expressing the thickness of yarn. The yarn number counts or fineness used in this Standard are as follows:
 - (a) cotton count The length of yarn per 453.59 g of corrected mass expressed in hank number (1 hank = 768.1 m).
 - (b) metric count The length of yarn for each gram of corrected mass expressed in number of meters.
 - (c) flax count The length of yarn for each 453.59 g of corrected mass expressed in number of tying hanks (1 tying hank = 274.32 m).
 - (d) jute count The corrected mass of yarn for each 29029 m in length expressed in number of kilograms.
 - (e) tex The corrected mass of yarn for each 1 km in length expressed in number of grams.

Applicable Standards, Corresponding International Standards and Reference Standards:
 See pages 39 and 40.

- (10) nominal count The yarn number count to be used in trading.
- (11) apparent count The yarn number count of a yarn in an arbitrary condition.
- (12) yarn number based on corrected mass The yarn number count of a yarn in the condition of moisture corresponding to official regain.
- (13) initial tension The tension of a magnitude that straightens the yarn without extending.

3. Marking of Yarn Number Count, Blending Ratio and Twist

3.1 Marking of Yarn Number Count The yarn number count shall be expressed as follows:

(1) In the Case of Using Cotton Count, Flax Count and Jute Count

20 yarn number count single yarn	20^s
20 yarn number count 2-ply yarn	$20/2^s$
20 yarn number count 5-ply 3-twist yarn	$20/5/3^s$
Twist yarn of 20 yarn number count single yarn and 30 yarn number count 2-ply yarn	$\frac{20}{30/2}/2^s$ or $20 \times 30/2^s$
20 yarn number count 2-double yarn	$20//2^s$

(2) In the Case of Using Metric Count

20 yarn number count single yarn	$1/20$
20 yarn number count 2-ply yarn	$2/20$
20 yarn number count 5-ply 3-twist yarn	$3/5/20$
Twist yarn of 20 yarn number count single yarn and 30 yarn number count 2-ply yarn	$2/\frac{1/20}{2/30}$ or $1/20 \times 2/30$
20 yarn number count 2-double yarn	$2//20$

(3) In the Case of Using Tex

20 tex single yarn	20 tex
20 tex 2-ply yarn	$20 \text{ tex} \times 2$
20 tex 2-double yarn	$20 \text{ tex} // 2$

3.2 Marking of Blending Ratio The blending ratio shall be expressed as follows alongside yarn number count.

Yarn number count

(blended fiber name, blended ratio, blended fiber name, blended ratio)

or yarn number count $\left(\begin{array}{l} \text{blended fiber name, blended ratio} \\ \text{blended fiber name, blended ratio} \end{array} \right)$

Example: $20^s (A 70 \cdot B 30)$ or $20^s \left(\begin{array}{l} A 70 \\ B 30 \end{array} \right)$

$$2 \left/ \begin{array}{l} 1/20 (A 70 \cdot B 30) \\ 2/30 (C 50 \cdot D 50) \end{array} \right. \quad \text{or} \quad 2 \left/ \begin{array}{l} 1/20 \left(\begin{array}{l} A 70 \\ B 30 \end{array} \right) \\ 2/30 \left(\begin{array}{l} C 50 \\ D 50 \end{array} \right) \end{array} \right.$$

$$30 \text{ tex} \times 2 (A 65 \cdot B 35) \text{ or } 30 \text{ tex} \times 2 \left(\begin{array}{l} A 65 \\ B 35 \end{array} \right)$$

Note that each of A, B, C and D in parentheses indicates the name of fiber and the numerals indicate the blending ratio.

3.3 Marking of Twist The marking of twist shall be as follow.

- (1) The twist direction shall be expressed by S and Z as shown in Fig. 1.

Single yarn S twist S

Z twist Z

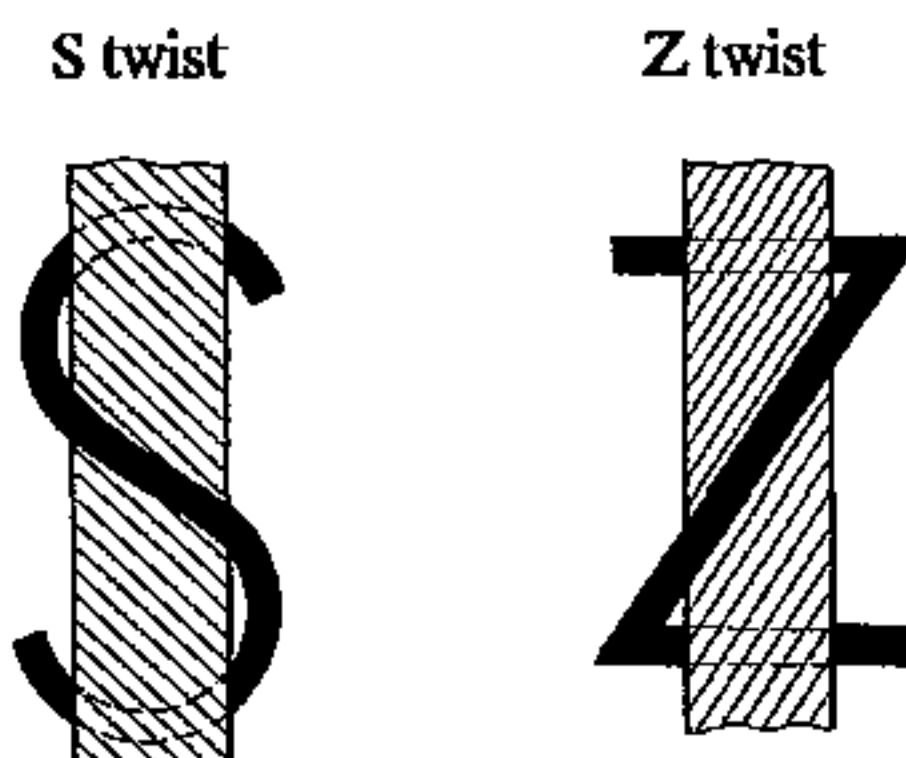
Twist yarn (a) In the case of using cotton count, flax count and jute count
first twist direction/final twist directionExample: In the case of S twist made by combining two or more
Z twists of single yarn Z/SIn the case where two or more Z twists of single yarn
are joined to be S twist, and further two or more
S twists are are joined to be Z twist..... Z/S/Z

- (b) In the case of using metric count

final twist direction/first twist direction

Example: In the case of S twist made by joining two or more
Z twists of single yarn S/ZIn the case where two or more S twists of single yarn
are joined to be Z twist and further two or more
Z twists are joined to be S twist S/Z/S

Fig. 1. Twist Direction



- (2) The number of twists shall be expressed by numerical value for a constant unit length with the unit appended.

Example: 15/2.54 cm, 50/10 cm, 450/m

- (3) In the case where the number of twists and the twist direction are juxtaposed, they shall be expressed as follows:

- (a) In the case of using cotton count, flax count and jute count

Single yarn: twist direction number of twists

Example: Single yarn of Z twist of 18 in number of twists Z 18/2.54 cm

Twist yarn: first twist direction, number of first twists/final twist
direction, number of final twistsExample: S twist yarn of which the number of final twists is made
12 by doubling two or more single yarns of Z 18 Z 18/S 12/2.54 cmZ twist yarn of which the number of final twists is made
6 by doubling two or more single yarns of Z 18, further
giving them first twist of S 12 and lastly doubling two or
more of them Z 18/S 12/Z 6/2.54 cm

(b) In the case of using metric count

Single yarn: twist direction number of twists

Example: Single yarn of Z twist of 480 in number of twists Z 480/m

Twist yarn: final twist direction, final number of twists/first twist
direction, number of first twists.

Example: S twist yarn of which number of final twists made 480 by
doubling two or more single yarns of Z 500 S 480/Z 500/m

Z twist yarn of which the number of final twists is made
250 by doubling two or more single yarns of Z 500, further
giving them first twist of S 480 and lastly doubling two or
more of them. Z 250/S 480/Z 500/m

4. Test Items

Test items shall be as follows:

- (1) Yarn length
- (2) Moisture regain
- (3) Corrected mass
- (4) Yarn number count
- (5) Single yarn tensile strength and elongation percentage
- (6) Lea tensile strength and elongation percentage
- (7) Knot strength
- (8) Loop strength
- (9) Impact strength
- (10) Wear strength
- (11) Coefficient of friction
- (12) Extension elastic modulus
- (13) Initial tension resistance
- (14) Bulkiness
- (15) Number of twists
- (16) Twist shrinkage percentage
- (17) Snarl index
- (18) Uneven color gloss, stain and color gloss
- (19) Appearance
- (20) Yarn evenness
- (21) Slub
- (22) Fluff
- (23) Shrinkage percentage
- (24) Hot water shrinkage percentage
- (25) Blending ratio
- (26) Blending evenness
- (27) Paste content
- (28) Fats-and-oils content

- (29) Washing loss
- (30) Solvent extract
- (31) Color fastness
- (32) Barium active number

Remark: The test items (25) and (31) shall be referred to the relevant Standards.

5. Preparation of Sample

The sample to be used for the test influenced by temperature and humidity shall be allowed to stand in a test room or an apparatus under the standard condition to reach the standard condition. However, the sample to be used for a wet time test shall be excepted.

6. Test Conditions

6.1 Test Place The test place shall be a test room kept in a standard condition. When a test room can not be maintained at a standard condition, the test may be carried out in a place as near to the standard condition as possible with a note stating the temperature and humidity at the time of test. This requirement does not apply to the case where a test not influenced by temperature and humidity is to be carried out.

6.2 Absolute Dry Mass In the case of seeking absolute dry mass, the infrared dryer, pressure reduction dryer, etc. may be used in addition to hot-air dryer.

Further, in the case of yarn containing fiber sensitive to temperature, a temperature lower than 105°C shall be used with a note, appended to the test report.

6.3 Official Regain The official regain in the case of yarn consisting of same fibers shall be as specified in Table 1, and in the case of blended yarn, it shall be calculated using the official regain of each fiber given in Table 1 from the following formula:

- (1) In the case of calculating from absolute dry blending ratio:

$$R = \frac{AR_1 + BR_2 + \dots + NR_n}{100}$$

where, R : calculated official regain of blended yarn (%)

$A, B, \dots, N$: absolute dry mixing rate of each fiber (%)

$R_1, R_2, \dots, R_n$: official regain of each fiber (%)

- (2) In the case of calculating from corrected mass blending ratio:

$$R = \frac{\frac{aR_1}{1 + \frac{R_1}{100}} + \frac{bR_2}{1 + \frac{R_2}{100}} + \dots + \frac{nR_n}{1 + \frac{R_n}{100}}}{\frac{a}{1 + \frac{R_1}{100}} + \frac{b}{1 + \frac{R_2}{100}} + \dots + \frac{n}{1 + \frac{R_n}{100}}}$$

where, R : calculated official regain of blended yarn (%)

$a, b, \dots, n$: corrected mass blending ratio of each fiber (%)

$R_1, R_2, \dots, R_n$: official regain of each fiber (%)

Remark: When the formula of (2) is developed, it becomes as follows:

$$\frac{100}{100 + R} = \frac{a}{100 + R_1} + \frac{b}{100 + R_2} + \dots + \frac{n}{100 + R_n}$$

or

$$R = \left(\frac{1}{\frac{a}{100 + R_1} + \frac{b}{100 + R_2} + \dots + \frac{n}{100 + R_n}} - 1 \right) \times 100$$

Table 1. Official Regain of Each Fiber

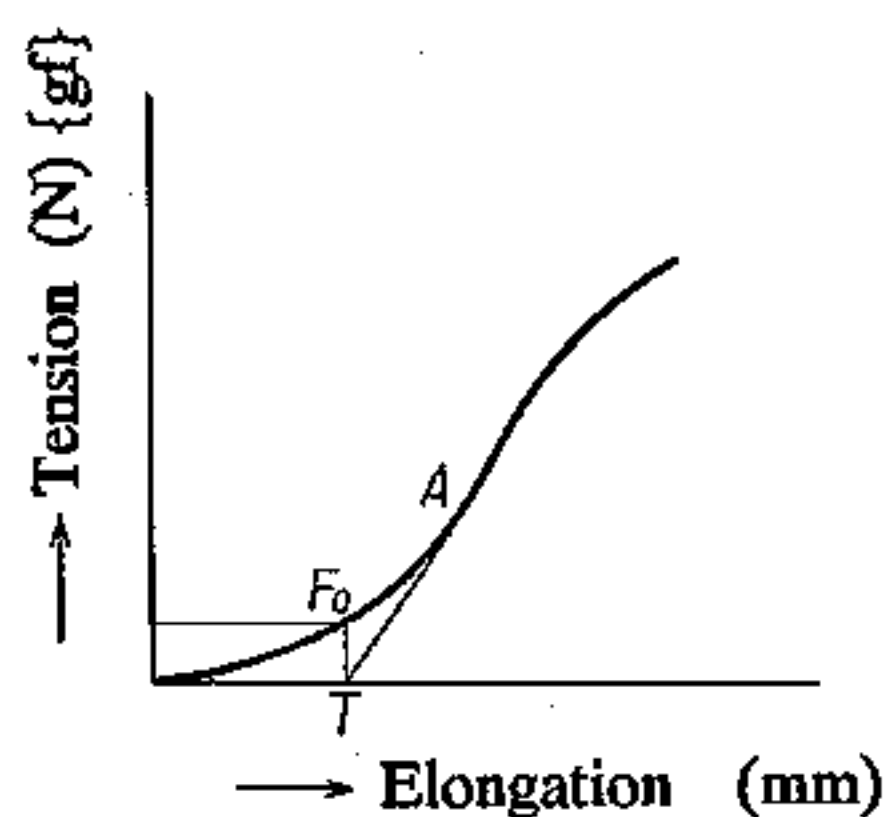
Kind of fiber	Official regain (%)
Cotton	8.5
Wool	15.0 ⁽¹⁾
Silk	12.0 ⁽²⁾
Flax and ramie	12.0
Jute	13.75
Rayon	11.0
Polynosic	11.0
Cuprammonium rayon	11.0
Acetate	6.5
Triacetate	3.5
Promix	5.0
Nylon	4.5
Vinylon	5.0
Vinylidene	0
Polyvinyl chloride	0
Polyester	0.4
Acrylic and acrylic series	2.0
Polyethylene	0
Polypropylene	0
Polyurethane	1.0
Polychlal	3.0
Benzoate	0.4
Glass fiber	0
Aramid	7.0

Notes ⁽¹⁾ It indicates moisture regain at standard condition, and excepting special case, this is used.

⁽²⁾ It indicates the case of drawing silk.

6.4 Initial Tension For initial tension, use the tension corresponding to gravity exerted on yarn length 250 m⁽³⁾. However, in the case where this tension is not suitable, draw the initial tension-elongation curve as shown in Fig. 2, draw a vertical line from the point *T* where the tangent at the point *A* (the maximum point of tangential line angle) indicating the maximum variation of tension relative to the elongation variation near the origin intersects the elongation axis, and use the tension corresponding to the point *F*₀ intersecting the tension-elongation curve with a note to that effect.

Fig. 2. Tension-Elongation Curve



Note ⁽³⁾ For the bulk spun yarn, use the tension corresponding to the gravity extended on the yarn 125 m in length.

Remark: This applies to tests for yarn length, number of twists, tensile strength and elongation percentage, extension elastic modulus, shrinkage percentage, etc.

Informative reference: As the initial tension for spun yarn of individual yarn number count systems, the following numerical values shall, as a rule, be used.

Informative Reference Table 1. Cotton Count

Yarn number count	Initial tension (N {gf})	Yarn number count	Initial tension (N {gf})
8	0.181 {18.5}	40	0.034 {3.5}
10	0.147 {15.0}	42	0.034 {3.5}
14	0.103 {10.5}	50	0.029 {3.0}
16	0.093 { 9.5}	60	0.025 {2.5}
20	0.074 { 7.5}	64	0.023 {2.3}
24	0.059 { 6.0}	80	0.020 {2.0}
30	0.049 { 5.0}	84	0.018 {1.8}
32	0.044 { 4.5}	100	0.015 {1.5}
36	0.039 { 4.0}	120	0.012 {1.2}

Informative Reference Table 2. Metric Count

Yarn number count	Initial tension (N {gf})	Yarn number count	Initial tension (N {gf})
1/17	0.147 {15.0}	1/ 48	0.054 {5.5}
1/20	0.123 {12.5}	1/ 52	0.049 {5.0}
1/24	0.103 {10.5}	1/ 68	0.034 {3.5}
1/32	0.078 { 8.0}	1/102	0.025 {2.5}
1/34	0.074 { 7.5}	1/135	0.020 {2.0}
1/40	0.059 { 6.0}	1/170	0.015 {1.5}

Informative Reference Table 3. Metric Count (In the case of wool yarn)

Yarn number count	Initial tension (N {gf})	Yarn number count	Initial tension (N {gf})
1/60 or over	0.015 {1.5}	1/20 or over to and excl. 1/30	0.049 { 5.0}
1/50 or over to and excl. 1/60	0.020 {2.0}	1/10 or over to and excl. 1/20	0.098 {10.0}
1/40 or over to and excl. 1/50	0.025 {2.5}	1/ 5 or over to and excl. 1/10	0.196 {20.0}
1/30 or over to and excl. 1/40	0.030 {3.0}	Under 1/5	0.294 {30.0}

Informative Reference Table 4. Tex

Tex	Initial tension (N {gf})	Tex	Initial tension (N {gf})
5	0.012 {1.2}	20	0.049 { 5.0}
6	0.015 {1.5}	25	0.064 { 6.5}
7	0.018 {1.8}	30	0.074 { 7.5}
8	0.020 {2.0}	37	0.093 { 9.5}
10	0.025 {2.5}	42	0.103 {10.5}
12	0.029 {3.0}	50	0.123 {12.5}
14	0.034 {3.5}	59	0.147 {15.0}
16	0.040 {4.0}	74	0.181 {18.5}

6.5 Temperature and Humidity For measurement of temperature and humidity, obtain temperature using the Meteorological Agency type psychrometer or Assmann psychrometer specified in JIS Z 8806, and obtain the relative humidity according to the humidity table based on Sprung's formula.

7. Test Methods

7.1 Yarn Length Measure the yarn length under the initial tension using a repeating machine of a known frame periphery⁽⁴⁾ or an electronic yarn length measuring apparatus having an equivalent performance.

Note ⁽⁴⁾ The frame periphery shall, as a rule, be either 1.372 m or 1 m.

7.2 Moisture Regain Take a sample⁽⁵⁾ not less than 20 g, weigh its mass and absolute dry mass, and calculate the moisture regain (%) from the following formula (to one place of decimal):

$$M_p (\%) = \frac{W_1 - W_2}{W_2} \times 100$$

where, M_p : moisture regain (%)

W_1 : mass of sample at taking (g)

W_2 : absolute dry mass of sample (g)

Note ⁽⁵⁾ In the case of wool yarn, take three samples, each about 100 g.

Remark: In the case of cop, cheese or cone, remove the outer layer part at taking the sample.

7.3 Corrected Mass Measure the absolute dry mass by the method of 7.2 and calculate the corrected mass (g) from the following formula (to one place of decimal):

$$W (g) = W_1 \times \left(1 + \frac{R}{100}\right)$$

where, W : corrected mass (g)

W_1 : absolute dry mass of sample (g)

R : official regain of sample (%)

7.4 Yarn Number Count

7.4.1 Corrected Yarn Number Count With respect to the sample⁽⁶⁾ of 7.2, calculate the corrected yarn number count from the following formulas (to one place of decimal) using yarn length (m) and absolute dry mass (g):

$$S_1 = \frac{453.59 \times L \times n}{W \times \left(1 + \frac{R}{100}\right) \times 768.1}$$

$$S_2 = \frac{L \times n}{W \times \left(1 + \frac{R}{100}\right)}$$

$$\text{tex} = \frac{1\,000 \times W \times \left(1 + \frac{R}{100}\right)}{L \times n}$$

$$S_3 = \frac{453.59 \times L \times n}{W \times \left(1 + \frac{R}{100}\right) \times 274.32}$$

$$S_4 = \frac{29.029 \times W \times \left(1 + \frac{R}{100}\right)}{L \times n}$$

where,
 S_1 : cotton count
 S_2 : metric count
 S_3 : flax count
 S_4 : jute count
tex : tex
 L : yarn length (m)
 W : absolute dry mass of sample (g)
 R : official regain of sample (%)
 n : number of twists

Note (6) With respect to worsted weaving yarn and worsted knitting yarn, single yarn shall be 100 m, two-ply yarn 50 m, hand knitting yarn and woolen yarn 25 m, and the number of samples shall be 25.

Remark: The percentage of deviation of yarn number count shall be calculated from the calculation formula of Informative Reference 1.1 using the marked yarn number count and corrected yarn number count obtained according to 7.4.1.

7.4.2 Apparent Yarn Number Count Calculate the apparent yarn number count from the following formulae (to one place of decimal) using the yarn length (m) and mass (g) of sample.

$$S_1 = \frac{453.59 \times L \times n}{W \times 768.1}$$

$$S_2 = \frac{L \times n}{W}$$

$$\text{tex} = \frac{1\,000 \times W}{L \times n}$$

$$S_3 = \frac{453.59 \times L \times n}{W \times 274.32}$$

$$S_4 = \frac{29.029 \times W}{L \times n}$$

where,
 S_1 : cotton count
 S_2 : metric count
 S_3 : flax count
 S_4 : jute count
tex : tex
 L : yarn length (m)
 W : mass of sample (g)
 n : number of twists

7.4.3 Yarn Number Count Percentage of Variation With respect to the sample prepared in 5., make a small skein of definite yarn length⁽⁷⁾ under the initial tension using a repeating machine of a known frame periphery⁽⁴⁾, measure the masses (g), and calculate the yarn number count percentage of variation (%) from the calculation formula of Informative Reference 1.2 (to one place of decimal).

Note ⁽⁷⁾ The definite yarn length shall, generally, be as follows:

In the case of single yarn of cotton count	109.728 m (1 lea)
In the case of cotton count of two-ply yarn or single yarn of thick count	54.864 m (0.5 lea)
In the case of metric count, tex of single yarn	100 m
In the case of metric count, tex of two-ply yarn or single yarn of thick count	50 m

Remark: In the case of a shortage in amount of sample, make use of a torsion balance or the like.

7.5 Single Yarn Tensile Strength and Elongation Percentage⁽⁸⁾

7.5.1 Standard Time Apply initial tension to the sample prepared according to 5., carry out the test under any of the conditions of Table 2, and measure the tension (N {gf}) and elongation (cm) at breaking

Carry out the test 60 times⁽⁹⁾, express the tensile strength by the average value of tensions at breaking (to an integer place), and express the elongation percentage by the average value of ratio (%) of elongation at breaking relative to the grip distance (to one place of decimal).

To the test result report, append the test conditions.

Table 2. Test Conditions

Type of test machine	Distance between grips	Tensile speed
Constant rate of traverse	50 or 25 cm	30 ± 2 cm/min
Constant rate of load	50 or 25 cm	—
Constant rate of specimen extension	50, 25 or 20 cm	Extension rate of 100 % or about 50 % of distance between grips per 1 min

Notes ⁽⁸⁾ This means the tensile strength and elongation percentage of a single yarn.

⁽⁹⁾ The number of tests shall be 50 times for wool yarn and 40 times for jute yarn.

- Remarks
1. As required, carry out the test by adjusting the speed so that the time required before breaking becomes 20 ± 3 s.
 2. In the case where the tension at breaking is not the maximum tension, measure the maximum tension and the elongation at that time.
 3. In case the yarn breaks at the gripping part in the test, discard the measured value.
 4. In the case of obtaining percentage of variation, marked count conversion strength, strength factor, breaking length and strength utilizing rate, calculate from the calculation formulas of Informative References 1.2 and 1.4 to 1.7.

7.5.2 Wet Time Put the sample of 7.5.1 into a separately provided container, immerse in water (20 ± 2°C) for not less than 10 min to wet sufficiently, and thereafter obtain the tensile strength and elongation percentage by the method similar to 7.5.1.

7.6 Lea Tensile Strength and Elongation Percentage

7.6.1 Standard Time Prepare 40 leas by taking up each 80 turns⁽¹⁰⁾ under the initial tension on a wrap reel 1.372 m in frame periphery⁽¹⁰⁾ from the sample prepared in 5. Tie the beginning and the end of each lea in a simple knot to make a parallel condition. Then, using a lea tensile testing machine carry out the test under the condition of 30 cm per 1 min in tensile speed, and measure the tension (N {kgf}) and elongation percentage (%) at breaking.

Carry out the test 40 times, express the tensile strength by the average value of tension at breaking (to one place of decimal), and express the elongation percentage by the average value of ratio (%) of elongation at breaking relative to the distance between grips (to one place of decimal).

To the test results, append the type and capacity of the testing machine, the distance between grips, the tensile speed or the breaking time.

Note ⁽¹⁰⁾ In the case where frame periphery and the number of windings are different from the specification, they shall be noted in the test report.

Remark: In the case where the tension at breaking is not the maximum tension, the maximum tension and the elongation at that time shall be measured.

7.6.2 Wet Time Put the sample of 7.6.1 into a separately provided container, immerse in water ($20 \pm 2^\circ\text{C}$) for not less than 10 min to wet sufficiently, and thereafter obtain the tensile strength (N {kgf}) and elongation percentage (%) by the method similar to 7.6.1.

Remark: In the case of woolen yarn, the following method shall be followed.

Using a repeating machine 1 m in frame periphery and taking the number of rotations 100 to 120 per minute as reference, prepare 25 small 25 m skeins. Tie the yarn ends at the beginning and end of winding in a simple knot without bundling. Loosen the skeins adequately to make them parallel before mounting them on the test machine. Set the distance between grips at 50 cm, and the tensile speed at 30 cm per 1 min for the skein tensile test machine. Carry out the test on 25 small skeins and obtain the average value (to one place of decimal).

The breaking tension indicated by the skein tensile test machine should preferably not coincide with the extreme ends of the graduation range.

7.7 Knot Strength

7.7.1 Standard Time In the middle between the grips of the sample prepared in 5., provide a type of the knots shown in Fig. 3 under the conditions similar to 7.5.1 and measure the tension at breaking (N {gf}).

Carry out the test 60 times, and express the knot strength by the average value of measured values at breaking in the knot parts (to integer place).

To the test results append the type and capacity of test machine, distance between grips, tensile speed or breaking time, type of knots, and ratio of breakage number in knot part.