

JIS

JAPANESE INDUSTRIAL STANDARD

Testing Methods for Knitted Fabrics

JIS L 1018—1990

Translated and Published

by

Japanese Standards Association

Printed in Japan

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

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Testing Methods for Knitted Fabrics

L 1018-1990

1. Scope

This Japanese Industrial Standard specifies the testing methods for evaluating general characteristics of knitted fabrics⁽¹⁾.

Note ⁽¹⁾ The knitted fabrics, hereinafter referred to as the "fabrics" are of warp knits and weft knits.

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 purpose of this Standard, following definitions apply.

- (1) standard condition of testing room or apparatus The temperature, humidity and tolerances of testing room or apparatus are in conditions of $20 \pm 2^\circ\text{C}$, and $65 \pm 2\%$ RH specified in JIS Z 8703.
- (2) standard condition of sample A condition of sample where the sample has reached moisture equilibrium by being left in a testing room under standard condition.
- (3) moisture equilibrium A condition of sample when the sample has reached the constant mass or constant length by being left in a testing room under standard condition after the sample is preliminarily dried (at a temperature of $40 \pm 5^\circ\text{C}$) and then its moisture is lessened to under the official moisture regain.

Remark: Relating to fibres of 0 % in official moisture regain the preliminary drying may not be performed.

- (4) absolute dry condition of sample A condition of sample where the sample has reached a constant mass by being left in a dryer at a temperature of $105 \pm 2^\circ\text{C}$.

Remark: Relating to fibres of 0 % in official moisture regain the standard condition shall be taken as absolute dry condition.

- (5) absolute dry mass A mass of a sample when it is made the absolute dry condition
- (6) constant mass When the mass of a sample is measured at an interval of 1 h or longer in a moisture equilibrium, and at an interval of 15 min or longer in an absolute dry mass state, the state in which the difference between the two mass values successively weighed comes to within 0.1 % of the latter mass value.
- (7) constant length When the length between gauge marks of the samples (200 mm) is measured at an interval of 1 h or longer, the state in which the difference between the two length values successively measured comes to within 0.5 % of the latter length value.
- (8) official moisture regain The officially defined moisture percentage
- (9) corrected mass The absolute dry mass added with the mass corresponding to official moisture regain.
- (10) yarn number counts and fineness Units for expressing the thickness of yarn. The yarn number counts and fineness used in this Standard are as follows:
 - (a) cotton count The yarn number count expressing the yarn length per 453.59 g in corrected mass by number of hanks (1 hank = 768.1 m).
 - (b) metric count The yarn number count expressing the yarn length per 1 g in corrected mass by number of meters.
 - (c) flax count The yarn number count expressing the yarn length per 453.59 g corrected mass by number of tie-bands (1 tie band = 274.32 m).

Applicable Standards, Corresponding International Standards and Reference Standard:

See page 52, 53 and 54.

- (d) jute count The yarn number count expressing the corrected mass of yarn per 29.029 km in length by number of grams.
- (e) denier (D) The corrected mass of yarn per 9 km in length expressed by number of grams.
- (f) tex The corrected mass of yarn per 1 km in length expressed by number of grams.
- (11) initial load The load of such degree that the test piece is not elongated and unnatural wrinklins disappear.
- (12) course direction The direction parallel to the course.
- (13) wale direction The direction parallel to the wale.

3. Sampling and Preparation of Sample

Make the sample a size sufficient to take test specimens, generally take from a part apart, by 100 cm or more from the end of fabric or a part apart by 10 cm or more from ear end for the fabric having ear and make it standard condition. However, when it is impossible to make such, take from the part representative to the fabric and make the standard condition.

Further, in the case where the sample is a product, take at random from surface fabric and make standard condition.

Further, except where the test influencing on no temperature nor humidity is carried out.

4. Test Conditions

4.1 Test Place Let the test place be a test room under the standard condition. In case where it is impossible to keep the test room at standard condition, carry out at a place as near the standard condition as possible, and append the temperature and humidity at the time of testing to the test results. However, except where the test influencing on no temperature nor humidity is carried out.

4.2 Absolute Dry Mass In the case of obtaining the absolute dry mass, other than hot wind dryer, infrared dryer, pressure reducing dryer, etc. may be used. In this case, the used dryer shall be appended to the test results.

Further in the case of fabrics used of fibers to receive influence of temperature, use at a temperature lower than 105°C, and append the temperature.

4.3 Official Moisture Regain In the case of fabrics constituted by the same fibers, the official moisture regain shall be as shown in Table 1, and in the case of mixed fabrics, it shall be obtained by using the official moisture regain of each fiber of Table 1 according to the following formula.

- (1) In the case of having obtained from mixing ratio based on bone dry mass.

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

where

- R : calculating official moisture regain of mixing fabric (%)
- $A, B, \dots, N$: mixing ratio based on bone dry mass of each fiber (%)
- $R_1, R_2, \dots, R_n$: official moisture regain of each fiber (%)

(2) In the case of having obtained from mixture ratio based on corrected mass.

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

where

R : calculating official moisture regain of mixing fabric (%)

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

$R_1, R_2, \dots, R_n$: official moisture 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 Moisture Regain of Each Fiber

Classification of fiber	Official moisture regain (%)	Classification of fiber	Official moisture regain (%)
Cotton	8.5	Vynlon	5.0
Wool	15.0 ⁽²⁾	Vinylidene	0
Silk	12.0 ⁽³⁾	Polyvinyl chloride	0
Flax and ramie	12.0	Polyester	0.4
Jute	13.75	Acryl and acrylic series	2.0
Rayon	11.0	Polyethylene	0
Polynosic	11.0	Polypropylene	0
Cupra	11.0	Polyurethane	1.0
Acetate	6.5	Polychlal	3.0
Triacetate	3.5	Benzoate	0.4
Promix	5.0	Glass fiber	0
Nylon	4.5	Aramid	7.0

Notes ⁽²⁾ It indicates the moisture percentage in the standard condition and it is used except special cases.

⁽³⁾ It indicates the case of yarn dyed silk.

4.4 Temperature and Humidity For measurement of temperature and humidity, obtain the temperature by using psychrometer of the Meteorological Agency type or of Assman's aspiration dry-and-wet bulb specified in JIS Z 8806, and then obtain the relative humidity by humidity table according to Sprung's formula.

5. Test Items

Test items shall be as follows:

- (1) Texture
- (2) Width
- (3) Length
- (4) Mass per unit area
- (5) Thickness
- (6) Moisture regain
- (7) Construction of using yarn
- (8) Density
- (9) Apparent specific gravity and pore volume
- (10) Stitch length and cover factor
- (11) Stitch bow
- (12) Foreign matters and nep
- (13) Tensile strength and elongation percentage
- (14) Elongation force and elongation percentage
- (15) Elongation elastic modulus
- (16) Tearing strength
- (17) Bursting strength
- (18) Abrasion resistance
- (19) Compressibility and compressive elastic modulus
- (20) Bulkiness
- (21) Bending rebound characteristics
- (22) Bending resistance
- (23) Crease resistance
- (24) Seam strength
- (25) Pilling
- (26) Bagging
- (27) Snag
- (28) Pile retention property
- (29) Pleating property
- (30) Shrinkage percentage
- (31) Wrinkle after washing
- (32) Permissible temperature to ironing
- (33) Shrinkage percentage by ironing
- (34) Air permeability

- (35) Thermal insulating property
- (36) Drying property
- (37) Water absorbing property
- (38) Light resistance
- (39) Weather resistance
- (40) Moth proofing property
- (41) Water repellency
- (42) Moisture permeability
- (43) Combustion quality
- (44) Electric charging property
- (45) Mixture ratio
- (46) Liberated formaldehyde
- (47) Qualitative property of resin and quantity of resin
- (48) Fat-and-oil content
- (49) Solvent extract content
- (50) Washing loss
- (51) PH of extract solution
- (52) Dyestuff group
- (53) Fluorescent brightening agent group
- (54) Colour fastness
- (55) Colour fastness to abrasion
- (56) Migration of dyestuff and the like

Remark: Relating to test items of (24) to (29), (41) to (47), (52) to (54), and (56), Standards specified separately are applied.

6. Testing Methods

6.1 Texture Take a test piece of suitable size from the sample prepared according to 3. and prepare the texture diagram by unfastening knitted yarns from test piece or by using fabric decomposition mirror to judge. As to the texture of fabrics, express the condition of combination of knit yarns by the figure, letters, or symbols specified in JIS L 0200.

6.2 Width Place a fabric on a flat table, remove the unnatural creases and tension, measure the whole width (cm) at five or more different places with a scale, and express the width by the average value (until the first decimal place).

Remarks 1. For cylindrical fabrics, fold them to attain the flat condition as it is, measure the width and double the width thus obtained to take it as the whole width.

2. For non-cylindrical fabrics, the incomplete parts at both ends shall be excluded.

6.3 Length Place a fabric on a flat table, remove the unnatural creases and tension and measure the whole length (m) (until two places of decimals).

Remarks 1. The incomplete parts at both ends shall be excluded.

2. In the case where the measurement is made by a checking device, take the placed scale as reference.

6.4 Mass per Unit Area

6.4.1 Corrected Mass Take three test pieces of 25 cm × 25 cm from the sample prepared according to 3., weigh the absolute dry mass (g) of each test piece, obtain the corrected mass, and express the average value by the mass per 1 m² (g/m²) (until the first place of decimal).

$$\text{Corrected mass (g/m}^2\text{)} = W' \times \left(1 + \frac{R}{100}\right) \times \frac{1}{A}$$

where W' : absolute dry mass (g)
 R : official moisture regain (%)
 A : area of test piece (m²)

6.4.2 Mass per Unit Area under Standard Condition Take three test pieces of 25 cm × 25 cm from the sample prepared according to 3., measure each mass (g) under the standard condition and express the average value by mass per 1 m² (g/m²) (until the first place of decimal).

Remark: METSUKU Take three test pieces of 25 cm × 25 cm from the sample prepared according to 3., weigh each mass (g) under the standard condition, obtain the average value and multiply it by 16 to express as the mass per 1 m² (g/m²) (until the first place of decimal).

Further, weigh the whole mass of fabric (kg), obtain METSUKU according to the following formula, and then it can be expressed by the mass per 1 m² or the mass per 1 m (until one place of decimal).

$$\text{METSUKU (g/m}^2\text{)} = \frac{1\,000\,W}{L \times S}$$

$$\text{METSUKU (g/m)} = \frac{1\,000\,W}{L}$$

where W : mass of fabric (kg)
 L : length (m)
 S : width (m)

6.5 Thickness Relating to five different places of sample prepared according to 3., measure the thickness (mm) under the initial load⁽⁵⁾ in the definite time⁽⁴⁾ by using a thickness measuring device, and express by the average value (until two places of decimals). In case where the test has been carried out under conditions other than those specified, append the testing conditions.

Notes ⁽⁴⁾ This means the time until the thickness under the applied pressure in stabilized. Usually it is preferable to be 10 s.

⁽⁵⁾ This shall be 0.7 kPa {7 gf/cm²} for ordinary fabrics and, 0.3 kPa {3 gf/cm²} for fabrics having wool.

6.6 Moisture Regain Take three test pieces of 10 cm × 10 cm from the sample prepared according to 3., weigh the mass (g) before drying and absolute dry mass (g) of each, obtain the moisture regain (%) according to the following formula, and express by the average value (until one place of decimal).

$$\text{Moisture regain (\%)} = \frac{W - W'}{W'} \times 100$$

where W : mass before drying (g)
 W' : absolute dry mass (g)

Reference Moisture regain (%) = $\frac{W - W'}{W} \times 100$

where W : mass before drying (g)

W' : absolute dry mass (g)

6.7 Constitution of Used Yarns

6.7.1 Yarn Number Count, Fineness and Marking

- (1) Apparent Count and Apparent Fineness of Yarns Unfasten five yarns from the sample prepared according to 3., apply initial load⁽⁶⁾ to each yarn, measure the length (mm)⁽⁷⁾ and mass (mg), obtain the apparent count or apparent fineness from the mass (mg) per 1 m according to the following formula and express by the average value of five times (until one place of decimal).

$$\text{Cotton count} = \frac{590.5}{W}$$

$$\text{Metric count} = \frac{1000}{W}$$

$$\text{Flax count} = \frac{1653.5}{W}$$

$$\text{Jute count} = \frac{W}{34.45}$$

$$\text{Denier} = 9 W$$

$$\text{Tex} = W$$

where W : mass of sample 1 m (mg)

Notes ⁽⁶⁾ In the case of spun yarn, the gravity to be applied to mass corresponding to 250 m in yarn length (mN {gf}).

In the case of filament yarn, $\frac{49}{150}$ mN $\{\frac{1}{30}$ gf} per 0.11 tex {1 D} of marking fineness

In the case of filament bulkiness worked yarn, $\frac{49}{50}$ mN $\{\frac{1}{10}$ gf} per 0.11 tex {1 D} of marking fineness

⁽⁷⁾ The length of yarn to be taken shall be, as a rule, 1 m or longer in extended length.

Remark: In case where the yarn can not be unfastened such as in warp fabrics and the like, the apparent count or fineness may be obtained by measuring the diameter of yarn by using microscope or the like.

(2) Marking of Yarn Number Count, Fineness and Blending Ratio

- (a) Marking of Yarn Number Count The marking of yarn number count shall be in accordance with 3.1 of JIS L 1095.
- (b) Marking of Fineness The marking of fineness shall be in accordance with 3.1 of JIS L 1013.
- (c) Marking of Blending Ratio The marking of blending ratio shall be in accordance with 3.2 of JIS L 1095.

6.7.2 Twist Number, Percentage of Twist Shrinkage and Marking of Twist

- (1) Twist Number Relating to the yarn of unfastened sample prepared according to 3., the twist number shall be in accordance with 7.15 of JIS L 1095.
- (2) Percentage of Twist Shrinkage The percentage of twist shrinkage shall be in accordance with 7.16 of JIS L 1095.
- (3) Marking of Twist The marking of twist shall be in accordance with 3.3 of JIS L 1095.

6.8 Density Place a sample prepared according to 3. on a flat table, remove unnatural creases and tension, count the number of wales and courses existing within a suitable⁽⁸⁾ range relating to different five places, and obtain each average value of wales and courses per unit length (until one place of decimal).

Note ⁽⁸⁾ It means 5 cm, 3 cm, 2.54 cm, etc.

- Remarks
1. Obtain the number of wales and number of courses per 1.27 cm from the measured density, and define the sum of both as DOMOKU.
 2. The number of wales and the number of courses existing in a suitable range when the fabric is stretched by a suitable device are called HIKIME. However, the used clamping distance and the load shall be appended to the test results.

6.9 Apparent Specific Gravity and Pore Volume

6.9.1 Apparent Specific Gravity Obtain the apparent specific gravity from 6.4.2 and 6.5 according to the following formula (until two places of decimals).

$$\text{Apparent specific gravity} = \frac{W}{1000 \times t}$$

where W : mass per 1 m² under the standard condition (g/m²)
 t : thickness (mm)

6.9.2 Pore Volume Obtain the pore volume from the apparent specific gravity and specific of fibre obtained in 6.9.1 according to the following formula (until one place of decimal).

$$\text{Pore volume (\%)} = \frac{S - S'}{S} \times 100$$

where S : specific gravity of fiber
 S' : apparent specific gravity

Reference: The specific gravity of fiber shall be in accordance with JIS L 1030.

6.10 Stitch Length and Cover Factor Unfasten five yarns in a suitable range from the sample prepared according to 3., apply the initial load, measure the length, obtain the stitch length (cm) according to the following formula and express by the average value (until two places of decimals).

$$\text{Stitch length (cm)} = \frac{L}{N}$$

where L : length of unfastened yarn (cm)
 N : number of stitches unfastened

Further, obtain the cover factor from the stitch length and yarn number count according to the following formula (until two places of decimals).

In the case of constant weight type yarn number count, cover factor = $\frac{1}{L\sqrt{N}}$

In the case of constant length type yarn number count, cover factor = $\frac{\sqrt{ND}}{L}$

where L : stitch length (cm)
 N : constant weight type yarn number count
 ND : constant length type yarn number count

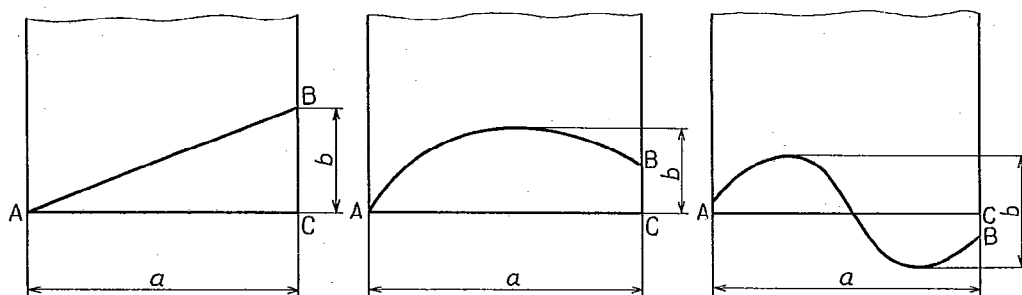
6.11 Stitch Bow

6.11.1 Course Bow Relating to five different places of sample prepared according to 3., as shown in Fig. 1 draw a course line AB from one end A of fabric along the course until the other end B. Next, draw a line at right angles with the line of end of fabric from A, take the intersecting point with the other end as C obtain the length a (cm) of line AC (width), measure the maximum oblique transfer distance b (cm) between AC shown in Fig. 1, obtain the course bow (%) according to the following formula, and relating to different five places, express the course bow by the average value (until one place of decimal).

$$\text{Course bow (\%)} = \frac{b}{a} \times 100$$

where a : width (cm)
 b : maximum oblique transfer distance (cm)

Fig. 1. Course Bow

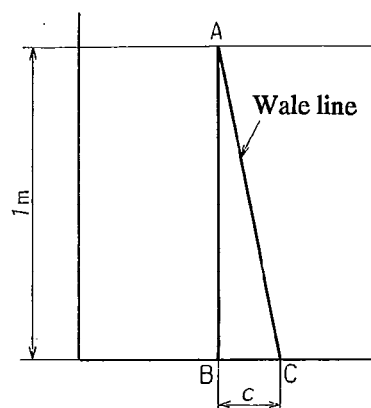


6.11.2 Wale Bow Relating to five different places from the sample prepared according to 3., draw two lines at interval of 1 m at right angles with the end line of fabric as shown in Fig. 2, mark point A at approximately middle part of fabric on the line of one side, and take the intersecting point of wale line from A and the other line as C. Then, draw a vertical line from A, take the intersecting point with the other line as B, measure the distance between B and C relating to different five places, obtain the wale bow (%) according to the following formula and express the course bow by the average value (until one place of decimal).

$$\text{Wale bow (\%)} = \frac{c}{100} \times 100$$

where c : bow distance (cm)

Fig. 2. Wale Bend



6.12 **Foreign Matter and Nep** Take three test pieces of 20 cm × 20 cm from the sample prepared according to 3., count the number of foreign matters and neps adhering on the surface and back within the area of 10 cm × 10 cm by using a suitable apparatus, and express by average value of three times (until the integer place).

6.13 **Tensile Strength and Elongation Percentage** Take five test pieces respectively in wale direction and course direction from the sample prepared according to 3., carry out the test according to the conditions of Table 2 by using a tensile testing machine having a suitable performance, measure the strength at rupture (N {kgf}) and elongation percentage (%), and express them by the average value (until one place of decimal). However, the test conditions shall be appended in the test results.

Remark: In the case of using of grab method, fix the test piece as shown in Fig. 3.

Fig. 3. Fixing Method of Test Piece

Unit: cm

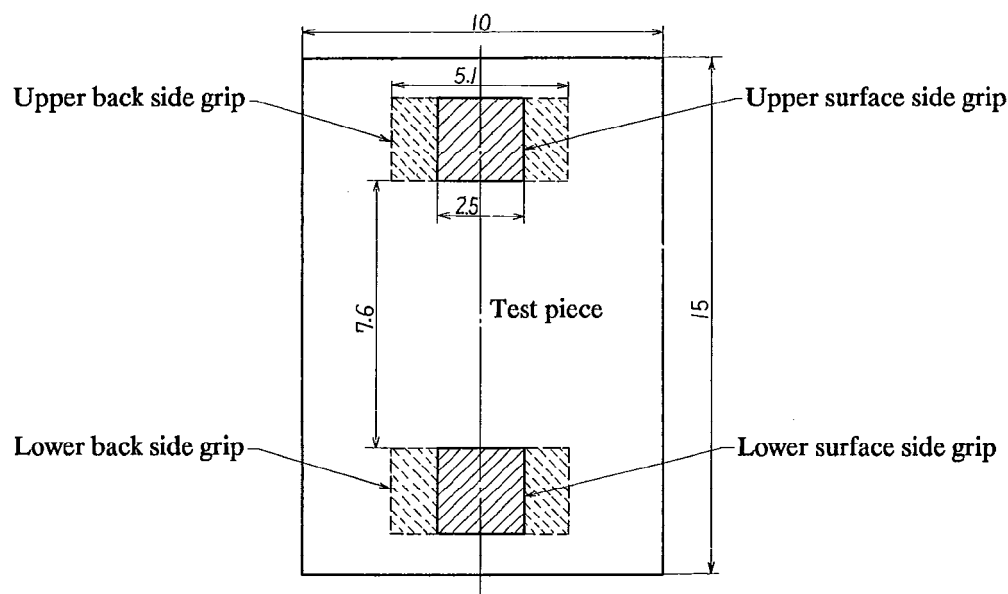


Table 2. Test Conditions

Method	Size of taken test piece (width × length cm)	Type of testing machine	Test width (cm)	Grip interval (cm)	Initial load	Tensile rate
Grab method	10 × 15	Constant rate of traverse type	10	7.6	29 mN {3 gf}	15 ± 1 or 30 ± 2 (cm/min)
		Constant rate of extension type				5 ± 1, 10 ± 1 or 30 ± 2 (cm/min)
Cut strip method	5 × 30	Constant rate of traverse type	5	20		15 ± 1 or 30 ± 2 (cm/min)
	2.5 × 20		2.5	10		
	5 × 30	Constant rate of extension type	5	20		Elongation of approximately 100 % or 50 % of distance between grips
	2.5 × 20		2.5	10		

6.14 Elongation Force and Elongation Percentage

6.14.1 **Elongation Force at Specific Elongation Time** Take five test pieces respectively in wale direction and course direction from the sample prepared according to 3., elongate to a definite elongation⁽⁹⁾ under the conditions of Table 3 by using a tensile testing machine of constant rate extension type attached with self-recording device, measure the elongation force (N {kgf}) from the load-elongation curve when having left for 1 min, and express the elongation force by the average value (until one place of decimal). However, the test conditions shall be appended to the test results.

Note ⁽⁹⁾ The definite elongation suitable respectively for type, wale direction, course direction is used, and for example there are 10 %, 30 %, 50 %, etc.

Table 3. Test Conditions

Method	Size of taken test piece (width × length cm)	Test width (cm)	Distance between grips (cm)	Initial load	Tensile rate
Grab method	10 × 15	10	7.6	29 mN {3 gf}	5 ± 1, 10 ± 1 or 30 ± 2 (cm/min)
Cut strip method	5 × 30 2.5 × 20	5 2.5	20 10		Elongation of approximately 100 % or 50 % of distance between grips

6.14.2 **Elongation Percentage at Definite Loading** Take five test pieces respectively in wale direction and course direction from the sample prepared according to 3., fix one end of test piece by upper part clamp under the conditions of Table 3 by using a tensile testing machine or apparatus having suitable performance, then apply the initial load to the other end, attach the mark at interval of 7.6 cm in grab method, at interval of 20 cm or 10 cm in cut-strip method, gently apply a definite load⁽¹⁰⁾, measure the length (cm) between the marks after leaving as it is for 1 min, obtain the elongation percentage (%) according to the following formula and express by the average value (until one place of decimal). However, the test conditions shall be appended to the test results.

$$\text{Elongation percentage at definite loading (\%)} = \frac{L_1 - L}{L} \times 100$$

where

L : length between the original marks (cm)

L_1 : length between marks after leaving for 1 min as it is with applying a definite load (cm)

Note ⁽¹⁰⁾ The definite load suitable respectively for type, wale direction, course direction is used, and for example there are 0.98 N {100 gf}, 2.94 N {300 gf}, etc. per 1 cm in width.

6.15 Elongation Elastic Modulus

6.15.1 Method A (Definite Elongation Method) Take five test pieces respectively in wale direction and in course direction from the sample prepared according to 3., elongate to a definite elongation⁽⁹⁾ under the conditions of Table 3 by using a tensile testing machine of constant rate of extension type attached with self-recording device, leave as it is for 1 min, then return to the original position at the same rate and leave as it is for 3 min. After repeating this operation⁽¹¹⁾, draw the load-elongation curve as shown in Fig. 4, measure the residual elongation (%) from this curve, obtain the elongation elastic modulus at a definite elongation time (%), express by the respective average values of wale direction and course direction, and append the test conditions to the test results (until one place of decimal).

$$\text{Elongation elastic modulus at a definite elongation (\%)} = \frac{L - L_1}{L} \times 100$$

where

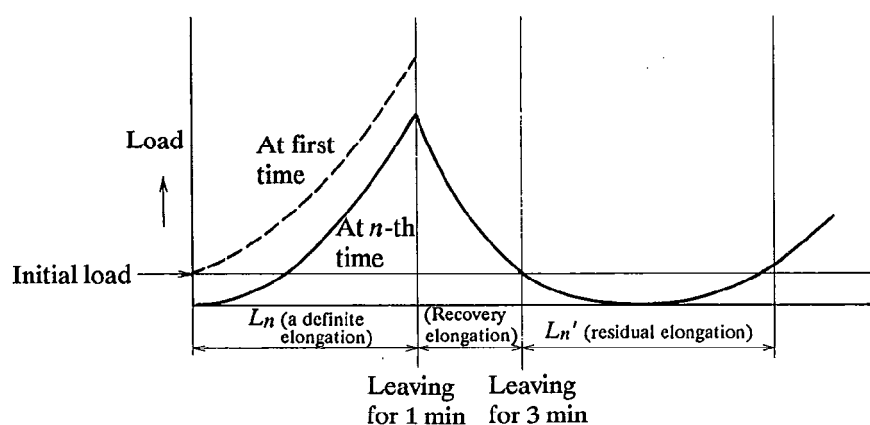
L : a definite elongation (mm)

L_1 : a residual elongation (mm)

Note ⁽¹¹⁾ As to repeating number of times, the number of times suitable respectively for type of goods, wale direction, course direction, such as once, 5 times, or 10 times, etc. is to be used.

Remark: In the case of wet test, a test piece wetted sufficiently by ordinary-temperature water shall be used.

Fig. 4. Load-Elongation Curve



6.15.2 Method B (Definite Load Method) Take five test pieces respectively in wale direction and course direction from the sample prepared according to 3., apply a definite load⁽¹⁰⁾ under the conditions of Table 3 by using a tensile testing machine or apparatus having suitable performance, after leaving as it is for 1 min, immediately remove the load and further leave as it is for 3 min. After repeating⁽¹¹⁾ this operation, again measure the length (cm) between the marks under the initial load, obtain the elongation elastic modulus at a definite load (%), and express by average values of five times respectively in wale direction and course direction (until one place of decimal). However, append the test conditions to the test results.

$$\text{Elongation elastic modulus at a definite load (\%)} = \frac{L_0 - L_1}{L_0 - L} \times 100$$

where

L : length between the original marks (cm)

L_0 : length between the marks after applying a definite load and leaving for 1 min (cm)

L_1 : length between the marks when applied with initial load after leaving for approximately 3 min after removing the load (cm)

6.16 Tearing Strength

6.16.1 Method A (Pendulum Method) Take five test pieces of 6.3 cm × 10 cm respectively in wale direction and course direction from the sample prepared according to 3., in the case of wale direction, grip so as the needle loop to become down by using an Elmendorf type tearing tester, give a cut of 2 cm at right angles at the middle between the both grips of test piece, measure the loading strength (N {kgf}) indicated when the remaining 4.3 cm is torn, and express by respective average values in wale direction and course direction (until one place of decimal).

Further, in case where the torn condition is abnormal, append the fact to the test results.

6.16.2 Method B (Single Tongue Method) Take five test pieces of 5 cm × 25 cm respectively in wale direction and course direction from the sample prepared according to 3., give a cut of 10 cm at right angles with the side at the middle of short side, thereafter by using a tensile tester having clamps of 5 cm or more in width in the case of wale direction, make the needle loop of test piece down, make the distance between clamps 10 cm, and hold each tongue with upper and lower clamps. Make the tensile rate 10 cm/min or 15 cm/min, measure the maximum value (mN {gf}) indicated when tearing, and express the tearing strengths (N {kgf}) in wale direction and course direction by the respective average value (until one place of decimal). However, append the test conditions to the test results.

Remark: The tearing strength in wale direction (course direction) means the strength when the test piece is torn in wale direction (course direction).

6.17 Bursting Strength

6.17.1 Method A (Müllen Type Method) Take five test pieces of approximately 15 cm × 15 cm from the sample prepared according to 3., by using a Müllen type bursting tester grip the test piece with its surface upward by the clamp by applying so uniform tensile force that creases and loosening are not generated, measure the breaking strength (kPa {kgf/cm²}) of test piece by rubber film by applying a pressure and the strength of rubber film (kPa {kgf/cm²}) when the clamp is removed, obtain the bursting strength (kPa {kgf/cm²}) according to the following formula and express by the average value (until one place of decimal).

Further, make the diameter of clamp, as a rule, 3.05 ± 0.03 cm and the increasing rate of oil for applying pressure 98 ± 4 ml/min.

$$\text{Bursting strength (kPa \{kgf/cm}^2\}) = A - B$$

where

A : strength when the rubber film breaks the test piece (kPa {kgf/cm²})

B : strength of rubber film when the clamp is removed (kPa {kgf/cm²})

Remarks 1. The rubber film of tester shall be of pure rubber material containing no filler of mineral substance of 0.84 to 0.89 mm in thickness.

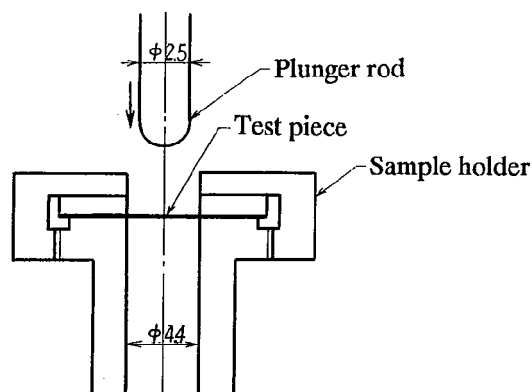
2. For verification of tester, the correction shall be carried out by using standard aluminium.

The quality of standard aluminium shall be that specified in JIS H 4170, of 0.1 mm in thickness, 2.71 in specific gravity, 99.96 % in purity, and 13.55 g (100 mm × 500 mm) in mass. Its bursting strength shall be 1.089 kPa {11.11 kgf/cm²}.

6.17.2 Method B (Constant Rate of Extension Type Method) Take five test pieces of approximately 8 cm in diameter from the sample prepared according to 3., by using a constant rate of extension type bursting machine as shown in Fig. 5, with making the back surface upward, apply so uniform tensile force that wrinkling and loosening are not generated, and then attach to the clamp of 4.4 cm in internal diameter. Then, by using a plunger rod of 1.25 cm in radius of curvature of its top end, and 2.5 cm in diameter measure the bursting strength (N {kgf}) of test piece by the plunger rod at a pressurizing rate of 10 cm per 1 min, and express by the average value of five times (until one place of decimal).

Fig. 5. Constant Rate of Extension Type Bursting Tester

Unit: cm



6.18 Abrasion Resistance

6.18.1 Method A (Uniform Type Method) Take five test pieces of approximately 7 cm in diameter from the sample prepared according to 3., by using a uniform type abrasion tester as shown in Fig. 6, attach to a sample holder of 2.5 cm in diameter of abrasion surface and apply the uniform tensile force to the test piece by tensile load of 11.1 N {1.13 kgf} or 22.3 N {2.27 kgf}. Use a spring steel blade for abrasor, by the pressing load of 22.3 N {2.27 kgf} or 44.5 N {4.54 kgf} abrade the test piece in many directions, measure the number of times⁽¹²⁾ when the test piece is broken, and express the average value (until an integer). However, append the test conditions to the test results.

Remarks 1. When using abrasive paper for abrasor, use the abrasive paper specified in JIS R 6253, and append its number.

Further, let the pressing load be 44.5 N {4.54 kgf}. When it is not in accordance with this, append the conditions to the test results.

2. As to wet abrasion resistance, immerse the test piece preliminarily in water at ordinary temperature, after wetting sufficiently carry out the test, and at each 1000 time abrasion with the test piece attached to the sample holder as it is drop water to the test piece by means of a spoon.