

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS L 1096 : 2010

(JTETC/JSA)

**Testing methods for woven and
knitted fabrics**

ICS 59.080.30

Reference number : JIS L 1096 : 2010 (E)

PROTECTED BY COPYRIGHT

Date of Establishment: 1979-03-01

Date of Revision: 2010-06-21

Date of Public Notice in Official Gazette: 2010-06-21

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Consumer Life Products

JIS L 1096:2010, First English edition published in 2012-10

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

PROTECTED FY COPYRIGHT

Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	2
3 Terms and definitions	4
4 Test items	4
5 Test conditions	6
5.1 Testing site	6
5.2 Absolute dry mass	6
5.3 Official moisture regain	6
5.4 Temperature and humidity	6
6 Sampling and preparation of samples and test specimens	6
7 Rounding-off method of numerical values	6
8 Testing methods	6
8.1 Weave	6
8.2 Dimensions	7
8.3 Mass per unit area	8
8.4 Thickness	9
8.5 Bulkiness	10
8.6 Density	10
8.7 Crimp percentage of yarn	11
8.8 Knitted loop length and cover factor	12
8.9 Composition of yarn	13
8.10 Moisture regain and moisture content	16
8.11 Apparent specific gravity and pore volume ratio	16
8.12 Skew	17
8.13 Scum and neppy fabric	19
8.14 Breaking strength and elongation percentage	19
8.15 Elastic recovery percentage of elongation on fixed elongation	23
8.16 Stretchability of stretch fabrics and knitted fabrics	25
8.17 Tearing strength	36
8.18 Bursting strength	41
8.19 Abrasion resistance and change in colour due to abrasion	43
8.20 Compressibility ratio and compressive elasticity modulus	54
8.21 Bending resistance	55
8.22 Bending repulsion	61
8.23 Slippage resistance	65

8.24	Wrinkles after laundering	72
8.25	Dryness	76
8.26	Air permeability	77
8.27	Warmth retaining property	79
8.28	Light resistance	80
8.29	Weather resistance	81
8.30	Sizing ratio	81
8.31	Resin qualification and resin content	81
8.32	Oil and fat content	81
8.33	Elute by solvent	81
8.34	Scouring loss	81
8.35	Degumming loss	82
8.36	Free formaldehyde content	82
8.37	pH of extract	82
8.38	Barium activity number	83
8.39	Dimensional change	83
9	Test report	93
Annex A (normative)	Textiles—Woven fabrics—Construction—Methods of analysis—Methods for the presentation of a weave diagram and plans for drafting, denting and lifting	97
Annex B (normative)	Textiles—Fabrics—Determination of width and length	104
Annex BA (informative)	Arrangement for conditioning, relaxing and measurement	108
Annex C (normative)	Textiles—Woven fabrics—Determination of mass per unit length and mass per unit area	109
Annex D (normative)	Textiles—Fabrics—Construction—Method of analysis—Determination of mass of warp and weft per unit area of fabrics	115
Annex E (normative)	Textiles—Determination of thickness of textiles and textile products	119
Annex EA (normative)	Test area position and alternatives for presser-foot area and applied pressure	122
Annex EB (informative)	Bibliography	123
Annex F (normative)	Textiles—Woven fabrics—Construction—Methods of analysis—Determination of number of threads per unit length	124
Annex FA (normative)	Method using taper and parallel-form densimeter	129
Annex G (normative)	Textiles—Woven fabrics—Construction—Methods of analysis—Determination of crimp of yarn in fabric	132

Annex GA (normative)	Straightening tensions	136
Annex H (normative)	Textiles—Woven fabrics—Construction—Methods of analysis—Determination of linear density of yarn removed from fabric	137
Annex I (normative)	Textiles—Woven fabrics—Construction—Methods of analysis—Determination of twist in yarn removed from fabric	142
Annex J (normative)	Textiles—Tensile properties of fabrics—Determination of maximum force and elongation—Strip method	146
Annex J1 (informative)	Suggested procedure for sampling	155
Annex J2 (informative)	Locations of test specimens cut from a laboratory sample	156
Annex J3 (informative)	Bibliography	157
Annex K (normative)	Textiles—Tensile properties of fabrics—Determination of maximum force—grab method	158
Annex KA (informative)	Suggested procedure for sampling	164
Annex KB (informative)	Locations of test specimens cut from a laboratory sample	165
Annex KC (informative)	Arrangements of jaws for grab test	166
Annex KD (informative)	Bibliography	167
Annex L (normative)	Textiles—Tear properties of fabrics—Determination of tear force using ballistic pendulum method (Elmendorf)	168
Annex LA (informative)	Adjustment and verification of apparatus	174
Annex LB (informative)	Suggested procedure for sampling	175
Annex LC (informative)	Example of pattern for cutting out test specimens from the laboratory sample	176
Annex LD (informative)	Bibliography	177
Annex M (normative)	Textiles—Bursting properties of fabrics—Determination of bursting strength and bursting distension (hydraulic method)	178
Annex MA (informative)	Selection of testing areas	183
Annex N (normative)	Textiles—Test method for assessing the smoothness appearance of fabrics after cleansing	184
Annex NA (informative)	Precision and accuracy	189

Annex O (normative)	Textiles—Determination of the permeability of fabrics to air	190
Annex OA (normative)	Advice on checking the calibration and conducting the test	194
Annex OB (normative)	Suggested sampling procedure	195
Annex P (normative)	Textiles—Determination of pH of aqueous extract	196
Annex PA (informative)	Preparation of standard buffer solutions	200
Annex JA (informative)	Comparison table between JIS and corresponding International Standards	201

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Textile Evaluation Technology Council (JTETC)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS L 1096:1999** and **JIS L 1018:1999** have been revised and withdrawn, respectively, and are replaced with this Standard.

This **JIS** document is protected by the Copyright Law.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Testing methods for woven and knitted fabrics

Introduction

This Japanese Industrial Standard has been prepared based on the third edition of **ISO 3071** published in 2005, the first edition of **ISO 3801** published in 1977, the second edition of **ISO 5084** published in 1996, the first editions of **ISO 7211-1**, **ISO 7211-2**, **ISO 7211-3**, **ISO 7211-4**, **ISO 7211-5**, and **ISO 7211-6** published in 1984, the third edition of **ISO 7768** published in 2009, the first edition of **ISO 9237** published in 1995, the first editions of **ISO 13934-1** and **ISO 13934-2** published in 1999, the first editions of **ISO 13936-1** and **ISO 13936-2** published in 2004, the first edition of **ISO 13936-3** published in 2005, the first edition of **ISO 13937-1** published in 2000, the first edition of **ISO 13938-1** published in 1999, and the first edition of **ISO 22198** published in 2006 with some modifications of the technical contents to reflect the actual situation in Japan.

The **ISO** methods are described in Annex A to Annex P of this Standard which have been prepared without modifying the technical contents of the corresponding International Standards. Other methods are prepared with some modifications of the corresponding International Standards. A list of modifications with explanations is given in Annex JA.

1 Scope

This Standard specifies testing methods for assessing general characteristics of general woven fabric textiles (hereafter referred to as “woven fabrics”) and weft and warp knitted fabric textiles composed of continuous knitted loops (hereafter referred to as “knitted fabrics”). In the case where testing methods for colour fastness and physical property on which separate Japanese Industrial Standards exist and in the case of carpets, polyurethane fabrics, flocked fabrics and laminated fabrics for clothes, relevant testing methods specified separately shall apply.

NOTE 1 “Weft knits” involve “flat knits” and “circular knits”.

NOTE 2 The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows:

ISO 3071:2005 *Textiles—Determination of pH of aqueous extract*

ISO 3801:1977 *Textiles—Woven fabrics—Determination of mass per unit length and mass per unit area*

ISO 5084:1996 *Textiles—Determination of thickness of textiles and textile products*

ISO 7211-1:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 1: Methods for the presentation of a weave diagram and plans for drafting, denting and lifting*

ISO 7211-2:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 2: Determination of number of threads per unit length*

ISO 7211-3:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 3: Determination of crimp of yarn in fabric*

ISO 7211-4:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 4: Determination of twist in yarn removed from fabric*

ISO 7211-5:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 5: Determination of linear density of yarn removed from fabric*

ISO 7211-6:1984 *Textiles—Woven fabrics—Construction—Methods of analysis—Part 6: Determination of the mass of warp and weft per unit area of fabric*

ISO 7768:2009 *Textiles—Test method for assessing the smoothness appearance of fabrics after cleansing*

ISO 9237:1995 *Textiles—Determination of the permeability of fabrics to air*

ISO 13934-1:1999 *Textiles—Tensile properties of fabrics—Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 13934-2:1999 *Textiles—Tensile properties of fabrics—Part 2: Determination of maximum force using the grab method*

ISO 13936-1:2004 *Textiles—Determination of the slippage resistance of yarns at a seam in woven fabrics—Part 1: Fixed seam opening method*

ISO 13936-2:2004 *Textiles—Determination of the slippage resistance of yarns at a seam in woven fabrics—Part 2: Fixed load method*

ISO 13936-3:2005 *Textiles—Determination of the slippage resistance of yarns at a seam in woven fabrics—Part 3: Needle clamp method*

ISO 13937-1:2000 *Textiles—Tear properties of fabrics—Part 1: Determination of tear force using ballistic pendulum method (Elmendorf)*

ISO 13938-1:1999 *Textiles—Bursting properties of fabrics—Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 22198:2006 *Textiles—Fabrics—Determination of width and length* (Overall evaluation: MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

- JIS B 0601 *Geometrical Product Specifications (GPS)—Surface texture: Profile method—Terms, definitions and surface texture parameters*
- JIS B 7512 *Steel tape measures*
- JIS B 7516 *Metal rules*
- JIS B 7522 *Textile tape measures*
- JIS B 7751 *Light-exposure and light-and-water-exposure apparatus (Enclosed carbon-arc type)*
- JIS B 7754 *Light-exposure and light-and-water-exposure apparatus (xenon-arc lamp type)*
- JIS C 7601 *Fluorescent lamps for general lighting service*
- JIS K 1408 *Sodium silicate*
- JIS K 2201 *Gasoline for industrial purpose*
- JIS K 3302 *Laundry bar soaps*
- JIS K 3303 *Laundry powdered soaps*
- JIS K 3371 *Synthetic detergents for home laundering*
- JIS K 8625 *Sodium carbonate*
- JIS L 0101 *Tex system to designate linear density of fibres, yarn intermediates, yarns and other textile materials*
- JIS L 0105 *General principles of physical testing methods for textiles*
- JIS L 0200 *Method of representation for knitting stitch*
- JIS L 0208 *Glossary of terms used in textile industry—Testing*
- JIS L 0211 *Glossary of terms used in textile industry—Knitting section*
- JIS L 0217 *Care labelling of textile goods*
- JIS L 0801 *General principles of testing methods for colour fastness*
- JIS L 0803 *Standard adjacent fabrics for staining of colour fastness test*
- JIS L 0804 *Grey scale for assessing change in colour*
- JIS L 0805 *Grey scale for assessing staining*
- JIS L 0842 *Test methods for colour fastness to enclosed carbon arc lamp light*
- JIS L 0843 *Test methods for colour fastness to xenon arc lamp light*
- JIS L 0844 *Test methods for colour fastness to washing and laundering*
- JIS L 0860 *Test methods for colour fastness to dry cleaning*
- JIS L 0891 *Test methods for fastness to artificial accelerated weathering with xenon arc lamp light or sunshine carbon arc lamp light*
- JIS L 1013 *Testing methods for man-made filament yarns*
- JIS L 1041 *Test methods for resin finished textiles*

- JIS L 1057 *Testing methods for dimensional change by ironing of woven and knitted fabrics*
- JIS L 1062 *Testing methods for distortion and slippage of yarn in woven fabrics*
- JIS L 1092 *Testing methods for water resistance of textiles*
- JIS L 1095 *Testing methods for spun yarn*
- JIS L 2101 *Cotton sewing thread*
- JIS L 2511 *Polyester sewing thread*
- JIS R 6251 *Abrasive cloths*
- JIS R 6253 *Waterproof abrasive papers*
- JIS Z 8401 *Guide to the rounding of numbers*
- JIS Z 8703 *Standard atmospheric conditions for testing*
- JIS Z 8805 *Glass electrodes for measurement of pH*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS L 0105**, **JIS L 0208** and **JIS L 0211**, and the following definitions apply.

3.1 initial tension

application of load to the extent that the thread or the test specimen does not elongate and its unnatural wrinkle does not appear

NOTE : It is specifically determined in each clause.

3.2 apparent fineness

perspective fineness of the yarn removed from woven fabric or knitted fabric (same as the linear density)

4 Test items

The test items shall be as follows.

The number in parentheses indicates the subclause of this Standard.

- a) Weave (**8.1**)
- b) Dimensions (**8.2**)
 - 1) Width (**8.2.1**)
 - 2) Length (**8.2.2**)
- c) Mass per unit area (**8.3**)
- d) Thickness (**8.4**)
- e) Bulkiness (**8.5**)
- f) Density (**8.6**)
- g) Crimp percentage of yarn (**8.7**)

- h) Knitted loop length and cover factor **(8.8)**
- i) Composition of yarn **(8.9)**
- j) Moisture regain and moisture content **(8.10)**
- k) Apparent specific gravity and pore volume ratio **(8.11)**
- l) Skew **(8.12)**
- m) Scum and neppy fabric **(8.13)**
- n) Breaking strength and elongation percentage **(8.14)**
- o) Elastic recovery percentage of elongation on fixed elongation **(8.15)**
- p) Stretchability of stretch fabrics and knitted fabrics **(8.16)**
- q) Tearing strength **(8.17)**
- r) Bursting strength **(8.18)**
- s) Abrasion resistance and change in colour due to abrasion **(8.19)**
- t) Compressibility ratio and compressive elasticity modulus **(8.20)**
- u) Bending resistance **(8.21)**
- v) Bending repulsion **(8.22)**
- w) Slippage resistance **(8.23)**
- x) Wrinkles after laundering **(8.24)**
- y) Dryness **(8.25)**
- z) Air permeability **(8.26)**
- aa) Warmth retaining property **(8.27)**
- ab) Light resistance **(8.28)**
- ac) Weather resistance **(8.29)**
- ad) Sizing ratio **(8.30)**
- ae) Resin qualification and resin content **(8.31)**
- af) Oil and fat content **(8.32)**
- ag) Elute by solvent **(8.33)**
- ah) Scouring loss **(8.34)**
- ai) Degumming loss **(8.35)**
- aj) Free formaldehyde content **(8.36)**
- ak) pH of extract **(8.37)**
- al) Barium activity number **(8.38)**
- am) Dimensional change **(8.39)**

5 Test conditions

5.1 Testing site

The testing site is as specified in **5.1** of **JIS L 0105**.

5.2 Absolute dry mass

The absolute dry mass is as specified in **5.3.2** of **JIS L 0105**.

5.3 Official moisture regain

The official moisture regain is as specified in **4.1** of **JIS L 0105**.

5.4 Temperature and humidity

The temperature and humidity are as specified in **5.2** of **JIS L 0105**.

6 Sampling and preparation of samples and test specimens

The sampling and preparation of samples and test specimens shall be as specified in clause **6** of **JIS L 0105** with the exception of the test on the weave.

The number of test specimens specified in each item may be increased or decreased as agreed between the interested parties. However, in such a case, that effect shall be appended to the test report.

7 Rounding-off method of numerical values

The test results are rounded off according to rule B (counting fractions of 5 or over as unit and cutting away the rest) of **JIS Z 8401** so as to obtain the specified numerical numbers. The number of digits to be rounded is according to the specification of each test item.

8 Testing methods

8.1 Weave

The weave is according to the weave of woven fabrics and the weave of knitted fabrics.

8.1.1 Weave of woven fabrics

The weave of woven fabrics is tested according to Method A (**JIS** method) or Method B (**ISO** method) as follows.

- a) **Method A (JIS method)** After the test specimen of appropriate size is taken from the sample, the state of combination of warps and wefts is indicated by the weave diagram, letters or symbols as shown in figure 1 by ravelling the warps and wefts or observing the woven fabric magnified by a magnifier. As the weave diagram, the warps in vertical rows and the wefts in horizontal rows are drawn, and the warp floats are marked on the design paper. When the marking of weft floats gives a more accurate view, it may be used.

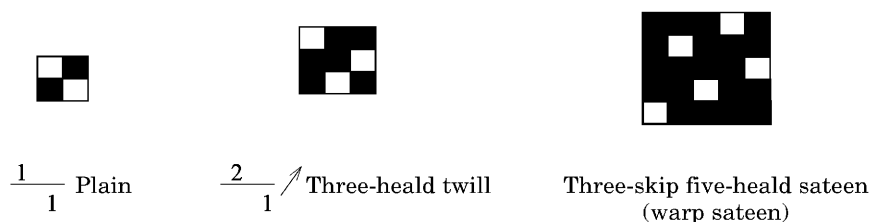


Figure 1 Example of three foundation weaves for expressing weave of woven fabrics

- b) **Method B (ISO method)** The methods for the presentation of weave diagram, and plans for drafting, denting and lifting shall be as specified in Annex A.

8.1.2 Weave of knitted fabrics

For the weave of knitted fabrics, the test specimen of appropriate size is taken from the sample, the weave diagram is drawn by unravelling the knitting yarns from the test specimen or by using magnifier. The weave diagram is indicated by the combination state of knitting yarns with diagrams, letters or symbols specified in **JIS L 0200**.

8.2 Dimensions

The dimensions are according to the width and the length.

8.2.1 Width

The width of woven fabrics or knitted fabrics is determined by Method A (**JIS** method) or Method B (**ISO** method) as follows.

a) **Method A (JIS method)**

- 1) **Procedure** The woven fabric or knitted fabric is placed on a flat table with its unnatural wrinkles and tension removed, and the distance (cm) from selvage edge to selvage edge perpendicular to the edges at three different positions is measured individually using a metal rule specified in **JIS B 7516**, steel tape measure specified in **JIS B 7512** or other scale at least equivalent in precision thereto. "Distance from selvedge edge to selvedge edge" is determined as follows according to the type of material.
 - 1.1) In the case of a fabric in tubular form, the tube is flatten and the distance from edge to edge is measured by keeping it flat, then it is doubled to obtain the overall width.
 - 1.2) In the case of a fabric in non-tubular form, incomplete portions are removed from both ends.
 - 1.3) In the case of cutting one selvage or both selvages, that effect shall be appended to the test report.
 - 2) **Calculation and test results** The average value of three measurements is calculated and rounded off to one decimal place.
- b) **Method B (ISO method)** The determination of width of fabrics conditioned in the relaxed state free from tension shall be as specified in Annex B.

8.2.2 Length

The length of woven fabrics or knitted fabrics is determined by Method A (**JIS** method) or Method B (**ISO** method) as follows.

- a) **Method A (JIS method)** The woven fabric or knitted fabric is placed on a flat table with its unnatural wrinkles and tension removed, and the overall length (m) is measured to two decimal places using a textile tape measure specified in **JIS B 7522** or other textile tape measure at least equivalent in precision thereto. In the case of using a wrap reel, a standard measure is used.

Incomplete portions shall be removed from both ends.

- b) **Method B (ISO method)** The determination of length of fabrics conditioned in the relaxed state free from tension shall be as specified in Annex B.

8.3 Mass per unit area

The mass per unit area is according to the corrected mass, mass per unit area under standard condition or mass of warps and wefts per unit area of the woven fabric.

8.3.1 Corrected mass

The corrected mass is obtained in such a way that two test specimens measuring approximately 200 mm × 200 mm are taken from the sample prepared as specified in clause 6, the absolute dry mass (g) of each test specimen is weighed and the mass per square metre (g/m²) is obtained by the following formula. The average value of these measurements is calculated and rounded off to one decimal place.

$$C_m = W' \times \left(1 + \frac{R}{100}\right) \times \frac{1}{A}$$

where, C_m : corrected mass (g/m²)
 W' : absolute dry mass (g)
 R : official moisture regain (%)
 A : area of test specimen (m²)

8.3.2 Mass per unit area under standard condition

The mass per unit area of the woven fabric under standard condition is determined by Method A (**JIS** method) or Method B (**ISO** method) as follows.

- a) **Method A (JIS method)** The mass per unit area under standard condition is determined in such a way that two test specimens measuring approximately 200 mm × 200 mm are taken from the sample prepared as specified in clause 6, the mass (g) of each test specimen is weighed and the mass per square metre (g/m²) is obtained by the following formula. The average value of these measurements is calculated and rounded off to one decimal place.

$$S_m = \frac{W}{A}$$

where, S_m : mass per unit area under standard condition (g/m²)
 W : mass of test specimen under standard condition (g)
 A : area of test specimen (m²)

NOTE 1 “METUKE” is the mass per square metre under the standard condition.

NOTE 2 “METUKE” may be obtained according to **a)** as well as obtained so that the total mass of a piece is weighed, the value is calculated by the following formula and rounded off to one decimal place, and converted to the mass per square metre (g/m²).

NOTE 3 For wool fabrics and jute fabrics, the mass may be expressed in “METUKE” or in the mass (in kg rounded off to one decimal place) per a roll of fabric.

$$M = \frac{W}{L \times S}$$

where, M : METUKE (mass per square metre) (g/m²)

W : mass of one roll of fabric (g)

L : length (m)

S : width (m)

NOTE 4 For silk fabrics, the mass is expressed in the silk METUKE. The silk METUKE may be expressed as the value obtained by taking a degummed mass as 3.75 g corresponding to the length of 22.86 m and the width of 3.81 cm as a unit of 1, and calculated to one decimal place by the following formula.

$$M_s = \frac{W}{L \times S} \times \frac{22.86 \times 3.81}{3.75} = \frac{W}{L \times S} \times 23.2$$

where, M_s : METUKE

W : degummed mass of one roll of fabric (g)

L : length (m)

S : width (cm)

b) **Method B (ISO method)** The determination method of the mass per unit length or per unit area of woven fabric shall be as specified in Annex C.

8.3.3 Mass of warps and wefts per unit area of woven fabrics

The mass of warps and wefts per unit area of woven fabric shall be as specified in Annex D.

8.4 Thickness

The thickness of woven fabric or knitted fabric is according to Method A (**JIS** method) or Method B (**ISO** method) as follows.

a) **Method A (JIS method)** The thickness (mm) of the sample prepared as specified in clause 6 at five different positions after a definite time under a specific pressure using a thickness gauge is measured, and the average value of five measurements is calculated and rounded off to two decimal places. If tested under other conditions than those specified, that effect shall be appended to the test report. Further, the definite time and definite pressure are as follows.

1) **Definite time** Period required for the thickness settled to constant under the pressure, usually 10 s

- 2) **Definite pressure** 23.5 kPa for general woven fabrics, 0.7 kPa for raised woven fabrics, 0.7 kPa for general knitted fabrics and 0.3 kPa for raised knitted fabrics
- b) **Method B (ISO method)** The determination of thickness shall be as specified in Annex E.

8.5 Bulkiness

The bulkiness shall be mainly applied to the knitted fabrics, and the value is obtained by the following formula from 8.3.2 and 8.4 and rounded off to two decimal places.

$$B_u = \frac{t}{S_m} \times 1\,000$$

where, B_u : bulkiness (cm³/g)
 S_m : mass per unit area under standard condition (g/m²)
 t : thickness (mm)

8.6 Density

The density is according to the density of woven fabrics and density of knitted fabrics (“DOMOKU”).

8.6.1 Density of woven fabrics

The density of woven fabric is according to Method A (**JIS method**) or Method B (**ISO method**) as follows.

- a) **Method A (JIS method)** The sample prepared as specified in clause 6 is placed on a flat table with its unnatural wrinkles and tension removed, the number of warps and wefts in an appropriate interval (50 mm, 30 mm, 25.4 mm, etc.) are counted at five different positions, and the average value of respective counts per unit length is calculated and rounded to one decimal place. As needed, the test specimen of appropriate size is taken from the sample prepared as specified in clause 6 perpendicular to warp direction and weft direction, warps and wefts are unravelled, the number of respective yarns is counted, and the count per unit length may be obtained. In the case of wool fabrics; however, the density is usually obtained so that four test specimens measuring 25 mm × 25 mm are taken perpendicular to warp direction and weft direction, warps and wefts are unravelled, the number of respective yarns is counted to obtain total number from four test specimens, and the number of warps and wefts per 100 mm is obtained.
- b) **Method B (ISO method)** The determination method of the density of woven fabrics (number of threads per unit length) shall be as specified in Annex F.

8.6.2 Density of knitted fabrics

The sample prepared as specified in clause 6 is placed on a flat table with its unnatural wrinkles and tension removed, the number of wales and courses in an appropriate interval (50 mm, 30 mm, 25.4 mm, etc.) are counted at five different positions, and the average value of respective counts per unit length is calculated and rounded to one decimal place.

NOTE 1 “DOMOKU” is the sum of the number of wales and the number of courses per 1.27 cm obtained from the determined density.

NOTE 2 “HIKIME” is the number of wales and the number of courses in an appropriate interval when a knitted fabric is elongated with a proper machine. In this case, the grip width and the load used shall be appended to the test report.

8.7 Crimp percentage of yarn

The crimp percentage of yarn of woven fabric is according to Method A, Method B or Method C (ISO method) as follows.

a) Method A

- 1) **Procedure** In Method A, test specimens in strip-shape whose length is approximately 350 mm are taken from the sample prepared as specified in clause 6 at two positions in warp direction and weft direction, respectively. An interval of 250 mm is marked, and five yarns from each test specimen are ravelled taking care not to untwist nor stretch them. Then, using a tensile testing machine for single yarn with autographic recorder and making its clamping distance 250 mm, the initial load-elongation curve shall be prepared as shown in figure 2.
- 2) **Determination and calculation** A tangential line is drawn on the curved point B on the initial load-elongation curve, and the point C where the tangential line intersects with the x axis is obtained. The crimp percentage is calculated by the following formula, and the average value of 10 measurements for respective warps and wefts is rounded off to one decimal place.

$$Cw = \frac{AC}{250} \times 100$$

where, Cw : crimp percentage (%)

AC : crimp length (mm)

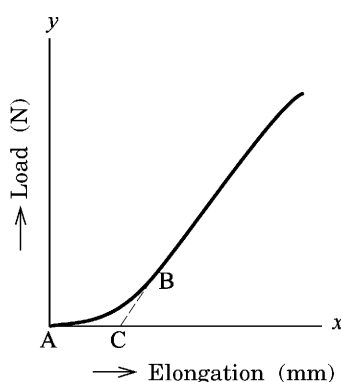


Figure 2 Load-elongation curve

b) Method B

- 1) **Procedure** In Method B, an interval of 200 mm is marked at three positions on the sample prepared as specified in clause 6 in warp direction and weft direction, warps and wefts between the marks are ravelled from the sample, and

the length (mm) thereof when straightened under the initial tension is measured. However, the initial tension specified in **6.1** of **JIS L 1095** is used for spun yarns and the initial tension specified in **5.1** of **JIS L 1013** is used for filament yarns. If other load than those is used, the load used for measurement shall be appended to the test report.

- 2) **Determination and calculation** The crimp percentage (%) is obtained by the following formula. The number of yarns at one place shall be five each for warps and wefts. The average values of three positions for respective warps and wefts are calculated, and rounded off to one decimal place.

$$Cw = \frac{L - 200}{200} \times 100$$

where, Cw : crimp percentage (%)

L : length when straightened (mm)

- c) **Method C (ISO method)** The crimp percentage of the yarn shall be as specified in Annex G.

8.8 Knitted loop length and cover factor

The knitted loop length and the cover factor are as follows.

- a) **Knitted loop length** Five yarns of an appropriate interval are ravelled from the sample prepared as specified in clause **6**, the length under an initial tension is measured, and the knitted loop length (mm) is obtained by the following formula. The average value thereof is obtained and rounded off to two decimal places. However, the initial tension specified in **6.1** of **JIS L 1095** is used for spun yarns and the initial tension specified in **5.1** of **JIS L 1013** is used for filament yarns.

If other load than those is used, the load used for measurement shall be appended to the test report.

$$Sl = \frac{L}{n}$$

where, Sl : knitted loop length (mm)

L : length of yarn ravelled (mm)

n : number of loops ravelled

- b) **Cover factor** The cover factor is calculated by the following formula from the knitted loop length and the fineness of yarn (tex), and rounded off to one decimal place. Also, the cover factor of yarn count in the constant length system can be obtained by this formula.

$$Fl = \frac{\sqrt{NT}}{Sl}$$

where, Fl : cover factor

Sl : knitted loop length (mm)

NT : fineness of yarn (tex)

NOTE : The cover factor of yarn count in the constant weight system can be obtained by the following formula.

$$F_w = \frac{1}{Sl\sqrt{N}}$$

where, F_w : cover factor of yarn count in constant weight system

Sl : knitted loop length (mm)

N : yarn count in constant weight system

8.9 Composition of yarn

The composition of yarn is according to “fineness¹⁾ and marking” and “twist number, percentage of twist shrinkage and marking of twist”.

Note ¹⁾ The Measurement Units Ordinance specifies that “tex, denier or kg/m” shall be used as the unit of fineness (a synonym of the linear density).

8.9.1 Fineness and marking

The fineness and marking are according to the apparent fineness of yarn and “marking of fineness and marking of blending ratio”.

8.9.1.1 Apparent fineness of yarn (tex system)

The apparent fineness of yarn is according to the apparent fineness of yarn in woven fabrics and the apparent fineness in knitted fabrics.

a) **Apparent fineness of yarn in woven fabrics** The apparent fineness of yarn in woven fabrics is according to Method A (**JIS** method) or Method B (**ISO** method) as follows.

1) **Method A (JIS method)**

1.1) **Procedure and determination** The sample prepared as specified in clause 6 is put between two metallic templates (measuring 200 mm × 200 mm), the portion outside the template is trimmed, and three test specimens measuring 200 mm × 200 mm are prepared. The warps and wefts of 25 pieces are unravelled respectively from one test specimen, and the mass thereof (mg) is weighed. As appropriate, desizing, etc. is carried out. The desizing method is as specified in 8.30.

1.2) **Calculation** The apparent fineness is obtained by the following formula. The average values of three measurements for respective warps and wefts are calculated, and rounded off to one decimal place.

$$T = \frac{0.2 \times W}{1 + \frac{P}{100}}$$

where, T : apparent fineness of yarn (tex)

W : mass of 25 yarns of sample (mg)

P : crimp percentage (%)

NOTE : Apparent yarn count and apparent denier in woven fabrics

The apparent yarn count and the apparent denier may be measured according to the same method as the apparent fineness of yarn (tex system) and obtained by the following formulae.

$$C_c = \frac{2\,952.7}{W} \times \left(1 + \frac{P}{100}\right)$$

$$M_c = \frac{5\,000}{W} \times \left(1 + \frac{P}{100}\right)$$

$$F_c = \frac{8\,267.7}{W} \times \left(1 + \frac{P}{100}\right)$$

$$J_c = 0.005\,8 \times W \times \left(1 + \frac{P}{100}\right)$$

$$D = \frac{1.8 \times W}{1 + \frac{P}{100}}$$

where, C_c : cotton count
 M_c : metric count
 F_c : flax count
 J_c : jute count
 D : denier
 W : mass of 25 yarns of sample (mg)
 P : crimp percentage (%)

- 2) **Method B (ISO method)** The determination of apparent fineness of yarns unravelled from a fabric shall be as specified in Annex H.
- b) **Apparent fineness of yarn in knitted fabrics (tex system)** The apparent fineness of yarn in knitted fabrics is as follows.
 - 1) **Procedure** For the apparent fineness of yarn in knitted fabrics, five yarns are unravelled from the sample prepared as specified in clause 6, the initial tension is applied to each yarn and the length (mm) is measured in addition to the mass thereof (mg).
 - 1.1) **Initial tension of yarn** The initial tension specified in 6.1 of **JIS L 1095** is used for spun yarns and the initial tension specified in 5.1 of **JIS L 1013** is used for filament yarns. If other load than those is used, the load used for measurement shall be appended to the test report.
 - 1.2) The length of the yarn to be sampled is normally 1 m or longer in total length.

NOTE : If unable to unravel yarns from the warp knitted fabrics, etc, the apparent fineness may be obtained by measuring the diameter using a microscope, etc. In such a case, that effect shall be appended to the test report.

- 2) **Calculation** The apparent fineness is obtained from the measured values by the following formula, and the average value of five measurements are calculated and rounded off to one decimal place.

$$T = \frac{W}{L} \times 1\,000$$

where, T : apparent fineness of yarn (tex)
 W : mass of sample (mg)
 L : length of yarn (mm)

NOTE : The apparent yarn count and the apparent denier of knitted fabrics are determined by the same method as in the apparent fineness of yarn (tex system), which are calculated from the mass (mg) per metre by the following formulae and rounded off to one decimal place.

$$C_c = \frac{590.5}{W'}$$

$$M_c = \frac{1\,000}{W'}$$

$$F_c = \frac{1\,653.5}{W'}$$

$$J_c = \frac{W'}{34.45}$$

$$D = W' \times 9$$

where, C_c : cotton count
 M_c : metric count
 F_c : flax count
 J_c : jute count
 D : denier
 W' : mass of 1 m of sample (mg)

8.9.1.2 Marking of fineness (tex system) and blending ratio

The marking of fineness (tex system) of woven fabrics and knitted fabrics, and blending ratio are as follows.

- a) **Marking of fineness (tex system)** The marking of fineness (tex system) is as specified in clause 7 of **JIS L 0101**.

NOTE : Normally, the fineness is marked with tex; however the case where the marking of yarn count is required shall be as specified in 4.2 of **JIS L 1095**. The case where the marking of fineness with denier is as follows.

120 deniers 120 D

- b) **Marking of blending ratio** The marking of blending ratio is as specified in **4.3** of **JIS L 1095**.

8.9.2 Marking of twist number, percentage of twist shrinkage and twist

The twist number, percentage of twist shrinkage and twist of woven fabrics and knitted fabrics are as follows. Method B (ISO method) for the twist number, however, is applicable only to the woven fabrics.

- a) **Twist number** The twist number is as follows.
- 1) **Method A (JIS method)** The twist number of yarns in woven fabrics is as specified in **9.15** of **JIS L 1095** for yarns ravelled from the sample prepared as specified in clause **6**.
 - 2) **Method B (ISO method)** The determination of the twist in yarn taken from the fabric is as specified in Annex I.
- b) **Percentage of twist shrinkage** The percentage of twist shrinkage is as specified in **9.16** of **JIS L 1095**.
- c) **Marking of twist** The marking of twist is as specified in **4.4** of **JIS L 1095**.

8.10 Moisture regain and moisture content

The moisture regain and the moisture content are as follows.

- a) **Moisture regain** The moisture regain is obtained so that two test specimens measuring approximately 200 mm × 200 mm are taken from the sample prepared as specified in clause **6**, the mass (g) before drying and the absolute dry mass (g) are weighed respectively, the moisture regains (%) are obtained by the following formula and the average thereof is calculated and rounded off to one decimal place.

$$M_r = \frac{W_1 - W_2}{W_2} \times 100$$

where, M_r : moisture regain (%)
 W_1 : mass before drying (g)
 W_2 : absolute dry mass (g)

- b) **Moisture content** The moisture content (%) is calculated by the following formula according to the same method as that of the moisture regain, and rounded off to one decimal place.

$$m_c = \frac{W_1 - W_2}{W_1} \times 100$$

where, m_c : moisture content (%)
 W_1 : mass before drying (g)
 W_2 : absolute dry mass (g)

8.11 Apparent specific gravity and pore volume ratio

The apparent specific gravity and the pore volume ratio of woven fabrics and knitted fabrics are as follows.

- a) **Apparent specific gravity** The apparent specific gravity is calculated by the following formula as specified in **8.3.2** and **8.4**, and rounded off to two decimal places.

$$A_g = \frac{S_m}{1\,000 \times t}$$

where, A_g : apparent specific gravity

S_m : mass per square metre under standard condition (g/m²)

t : thickness (mm)

- b) **Pore volume ratio** The pore volume ratio is calculated by the following formula from the apparent specific gravity obtained in **a)** and the specific gravity of the fibre, and rounded off to one decimal place.

$$P_v = \frac{S - A_g}{S} \times 100$$

where, P_v : pore volume ratio (%)

S : specific gravity of fibre

A_g : apparent specific gravity

The specific gravity of each fibre is given in table 1 for reference. For the fibre the specific gravity of which is given with a range, the specific gravity thereof shall be measured in advance as specified in **8.17** of **JIS L 1013**. In the case of blending, the specific gravity thereof shall be calculated after obtaining the average specific gravity of composing fibres by carrying out the calculation in proportion to the blending ratio.

Table 1 Specific gravity of fibre (informative)

Type of fibre	Specific gravity	Type of fibre	Specific gravity
Cotton	1.58	Vinylidene	1.70
Hemp (flax and ramie)	1.50	Polyvinylchloride	1.39
Silk	1.33	Polyester (PET)	1.38
Wool	1.32	Acryl	1.17
Rayon	1.50	Acryl fibre	1.23 to 1.28
Polynosic	1.50	Polyethylene	0.94 to 0.96
Cupra	1.50	Polypropylene	0.91
Acetate	1.32	Polyurethane	1.00 to 1.30
Triacetate	1.30	Benzoate	1.34
Promix	1.22	Polyclar	1.32
Vinylon	1.26 to 1.30	Alamid	1.37 to 1.45
Nylon	1.14		

8.12 Skew

The skew in the direction of weft or course and in the direction of warp or wale is as follows.

a) **Skew in direction of weft or course**

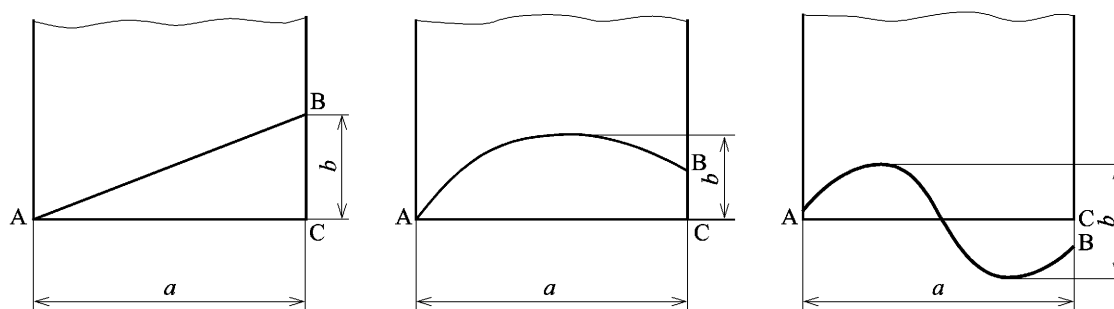
- 1) **Measurement** A weft line or a course line AB is drawn along the weft or course line of thread of the woven fabrics and knitted fabrics from one selvage end A to another selvage end B of the sample prepared as specified in clause 6 at three different positions as shown in figure 3. Then, a line is drawn from A perpendicular to the selvage, the point at which this line intersects the opposite selvage is defined as C, the length a (cm) of the line AC (width) is obtained, and the maximum distance b (cm) of AC shown in figure 3 is measured.
- 2) **Calculation** The percentage of skew (%) in the direction of weft or course is obtained by the following formula, and the average of three different measurements is obtained and rounded off to one decimal place.

$$D_b = \frac{b}{a} \times 100$$

where, D_b : skew in direction of weft or course (%)

a : width (mm)

b : maximum distance (mm)



a) Example of bias filling b) Example of bowing c) Example of S-shape

Figure 3 Type and measuring point of skew in direction of weft or course

b) **Skew in direction of warp or wale (bias filling)**

- 1) **Measurement** Two lines DE and FG perpendicular to the edge line of the woven fabrics and knitted fabrics are drawn with the interval of 1 m on the sample prepared as specified in clause 6 at three different positions as shown in figure 4, the point A at approximately centre of line DE is marked, the intersection of the skew line in the direction of warp or wale from A with another line (FG) is made as the point C. Then, the vertical line is drawn from A to another line (FG) to make the intersection with another line (FG) the point B, and the distances between B and C at three different positions are measured respectively.
- 2) **Calculation** The percentage of skew (%) in the direction of warp or wale is obtained by the following formula, and the average value thereof is obtained and rounded off to one decimal place.

$$W_b = \frac{c}{1000} \times 100$$

where, W_b : skew (%) in warp or wale direction
 c : skew (bias filling) distance (mm)

Unit: m

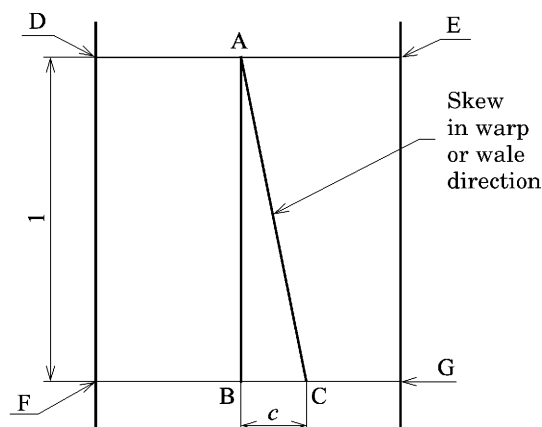


Figure 4 Skew in warp or wale direction (bias filling)

8.13 Scum and neppy fabric

For the scum and neppy fabric, three test specimens measuring approximately 200 mm × 200 mm are taken from the sample prepared as specified in clause 6, the number of scum and neppy fabrics attached to both surfaces is counted within the area of 100 mm × 100 mm using an appropriate apparatus, and the average of three measurements is obtained and rounded off to the integer.

8.14 Breaking strength and elongation percentage

The breaking strength and the elongation percentage are according to **JIS** method or **ISO** method.

8.14.1 JIS method

The **JIS** method consists of Method A (strip method), Method B (grab method), Method C (strip method in wet condition) or Method D (grab method in wet condition).

a) **Method A (strip method)** Method A (strip method) is the test method for the breaking strength and the elongation percentage under the standard condition.

1) **Preparation of sample** The preparation of the sample of Method A is according to the ravelled strip method and the cut strip method. The number of samples is three for woven fabrics or five for knitted fabrics.

1.1) The ravelled strip method is applied to the woven fabrics. Three test specimens are taken from the sample prepared as specified in clause 6 under any of the condition shown in table 2, and made to be of a specific width by removing approximately equal number of yarns from both sides of the width.

In the case of heavy fabrics, for yarns on both sides of the test specimen capable of detaching from the fabric during the test, the test specimen is prepared so that it is cut with four or more yarns remained on both sides out of 30 mm width of the specimen at the position 50 mm apart from both ends of clamping jaws as shown in figure 5.

- 1.2) The cut strip method is applied to the knitted fabrics and special woven fabrics to which ravelled strip method cannot be applied. The test specimens are cut from the sample prepared as specified in clause 6 into the width as specified in table 2 along the direction of weft or course, and the direction of warp or wale.

Table 2 Preparation of test specimen for strip method

Type of fabrics			Size of test specimen when cut out	Width of test specimen mm	Number of test specimens
			Width mm × length mm		
Woven fabrics	Ordinary woven fabrics		Approx. 55 × Approx. 300	50	3
			Approx. 30 × Approx. 200	25	
	Heavy fabrics	Density of 60/5 cm or more	Approx. 40 × Approx. 300	30	
		Density of under 60/5 cm	Approx. 50 × Approx. 300		
Knitted fabrics			50 × Approx. 300	50	5
			25 × Approx. 200	25	

Unit: mm

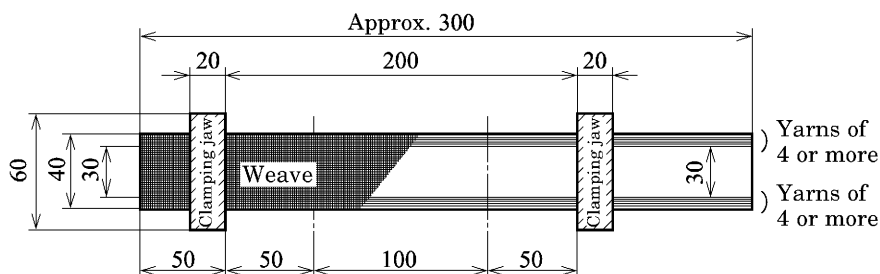


Figure 5 Preparation of test specimen

- 2) **Operation** The test specimen is clamped by the tensile tester having an appropriate performance under the initial tension, the test is carried out under any of the condition shown in table 3 to measure the strength (N) at the time of breakage and the elongation percentage (%) except the test specimen cut within 10 mm from the clamping jaw or cut abnormally. If the test specimen is broken under the load other than the maximum load, the maximum load (N) and the elongation (%) at that time shall be made as the measurement values.

In addition, the initial tension used is usually the weight corresponding to the test specimen of 10 m for woven fabrics and 29 mN for knitted fabrics; however, if other load than above is used, it shall be appended to the test report.

Table 3 Test conditions of strip method

	Type of tensile tester	Type of fabric	Width of specimen mm	Clamping distance mm	Tensile speed mm/min
Woven fabrics	Constant rate of traverse	Ordinary fabrics	50	200 ^{a)}	150 ± 10 or 300 ± 20
		Ordinary fabrics	25	100	
		Heavy fabrics	30	200	200 ± 10
	Constant rate of specimen extension	Ordinary fabric	50	200	Elongation speed of clamping distance of approx. 50 % or 100 % per minute
		Ordinary fabric	25	100	
		Heavy fabrics	30	200	
Knitted fabrics	Constant rate of traverse	—	50	200	150 ± 10 or 300 ± 20
			25	100	
	Constant rate of specimen extension	—	50	200	Elongation speed of clamping distance of approx. 50 % or 100 % per minute
			25	100	
Note ^{a)} For wool fabrics, it should be 150 mm.					

3) **Calculation** The test results are calculated as follows. The test conditions shall be appended to the test report.

3.1) For woven fabrics, the average value of three measurements in the direction of warp and weft is calculated respectively, and rounded off to three significant figures.

3.2) For knitted fabrics, the average value of five measurements in the direction of wale and course is calculated respectively, and rounded off to one decimal place.

b) **Method B (grab method)** Method B (grab method) is the test method for the breaking strength and the elongation percentage under the standard condition.

1) **Preparation of test specimen** Test specimens measuring 100 mm in width and approximately 150 mm in length are taken as follows from the sample prepared as specified in clause 6.

1.1) **For woven fabrics** Three test specimens are taken in warp direction and weft direction respectively, and test specimens in warp direction are taken so that the length direction becomes parallel to warps and test specimens in weft direction are taken so that the length direction becomes parallel to wefts.

1.2) **For knitted fabrics** Five test specimens are taken in wale direction and course direction respectively, and test specimens in wale direction are taken so that the length direction becomes parallel to wales and test specimens in course direction are taken so that the length direction becomes parallel to courses.

2) **Operation** Using the tensile tester having an appropriate performance, the test specimen is clamped under the initial tension as shown in figure 6 with a

clamping distance of 76 mm and the clamping areas of 25 mm × 25 mm on the surface side and of 51 mm × 25 mm or larger on the back side at both upper and lower jaws. The test is carried out under the condition shown in table 4, the strength (N) at the time of breakage and the elongation percentage (%) are obtained except the test specimen cut within 10 mm from the clamping jaw or cut abnormally.

In addition, the initial tension used is usually the weight corresponding to the test specimen of 10 m for woven fabrics and 29 mN for knitted fabrics; however, if other load than above is used, it shall be appended to the test report.

Unit: mm

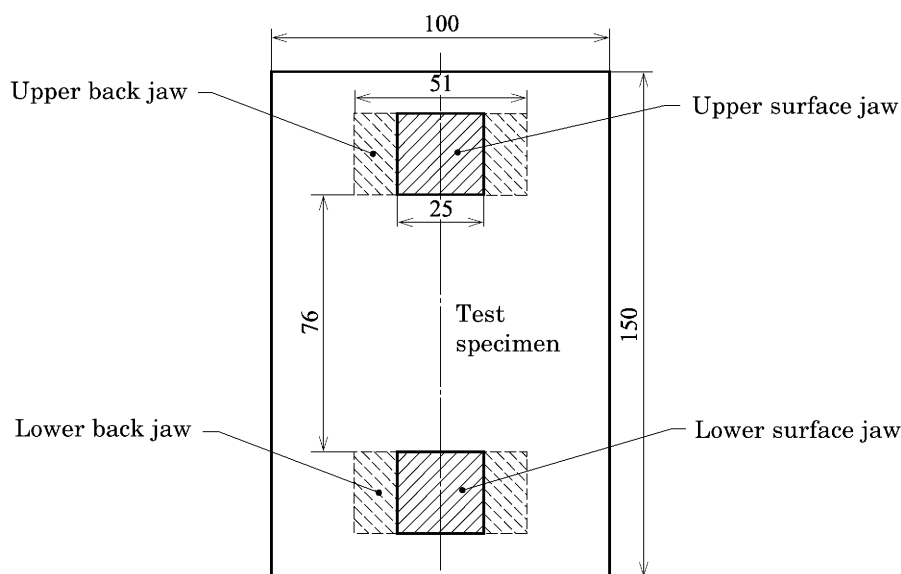


Figure 6 Preparation of test specimen

Table 4 Test conditions of grab method

	Size of test specimen Width mm × length mm	Type of tensile tester	Width of test specimen mm	Clamping distance cm	Tensile speed mm/min	Number of test specimens
Woven fabrics	100 × approx. 150	Constant rate of traverse	100	76	300 ± 20	3
		Constant rate of specimen extension				
Knitted fabrics	100 × approx. 150	Constant rate of traverse	100	76	150 ± 10 or 300 ± 20	5
		Constant rate of specimen extension			50 ± 10, 100 ± 10 or 300 ± 20	

- 3) **Calculation** The test results are calculated as follows. The test conditions shall be appended to the test report.

- 3.1) For woven fabrics, the average values of three measurements in warp direction and weft direction are calculated respectively, and rounded off to three significant figures.
 - 3.2) For knitted fabrics, the average values of five measurements in wale direction and course direction are calculated respectively, and rounded off to one decimal place.
- c) **Method C (strip method in wet condition)** Method C (strip method in wet condition) is the test method for the breaking strength and the elongation percentage under the wet condition mainly applied to woven fabrics.
- 1) **Procedure** For the test in wet condition, the test specimen sampled according to Method A in **a)** is put in a container prepared separately and left as it is until it sunk in water ($20\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$) under its own weight or immersed in water for 1 h or longer. When required to moisten the fabric completely which is difficult to be moistened, the non-ionic surfactant agent specified in **JIS L 0860** of 0.1 % solution or under may be used. In this case, it is washed sufficiently with water before the test. The test specimen shall be tested in the same way as Method A in **a)** within 1 min after taking it out from the water.
 - 2) **Calculation** The breaking strength (N) and the elongation percentage (%) are obtained in the same way as Method A in **a)**.
- d) **Method D (grab method in wet condition)** Method D (grab method in wet condition) is the test method for the breaking strength and the elongation percentage under the wet condition mainly applied to woven fabrics.
- 1) **Procedure** For the test in wet condition, the test specimen sampled according to Method B in **b)** is put in a container prepared separately and left as it is until it sunk in water ($20\text{ }^{\circ}\text{C}\pm 2\text{ }^{\circ}\text{C}$) under its own weight or immersed in water for 1 h or longer. When required to moisten the fabric completely which is difficult to be moistened, the non-ionic surfactant agent specified in **JIS L 0860** of 0.1 % solution or under may be used. In this case, it is washed sufficiently with water before the test. The test specimen shall be tested in the same way as Method B in **b)** within 1 min after taking it out from the water.
 - 2) **Calculation** The breaking strength (N) and the elongation percentage (%) are obtained in the same way as Method B in **b)**.

8.14.2 ISO method

The **ISO** method is according to Method E (strip method) and Method F (grab method) as follows.

- a) **Method E (strip method)** Method E (strip method) for the breaking strength and the elongation percentage is as specified in Annex J.
- b) **Method F (grab method)** Method F (grab method) for the breaking strength and the elongation percentage is as specified in Annex K.

8.15 Elastic recovery percentage of elongation on fixed elongation

The elastic recovery percentage of elongation on fixed elongation is according to Method A (elastic recovery percentage of elongation on fixed rate elongation) and Method B (elastic recovery percentage of elongation on fixed length elongation).

8.15.1 Method A (elastic recovery percentage of elongation on fixed rate elongation)

Method A is mainly applied to woven fabrics according to the one-time method and the repetitive method.

a) **Elastic recovery percentage of elongation on fixed rate elongation** Method A is mainly applied to woven fabrics.

- 1) **Preparation of test specimen** Three test specimens are taken from the sample prepared as specified in clause 6 in warp direction and weft direction respectively in the same way as Method A (strip method) of 8.14.1 a) or Method B (grab method) of 8.14.1 b).
- 2) **Operation** With applying the initial tension, the test specimen is stretched to the fixed rate elongation (103 % or 105 % of the original length) at a tensile speed of 10 % of the clamping distance (200 mm) per minute using the extension tensile tester of constant rate elongation with autographic recording device, and this condition is kept for 1 min. Then, the load is removed at the same speed, this condition is kept for 3 min, and the test specimen is stretched again to the fixed elongation at the same speed. The residual elongation is determined from the load-elongation curve recorded (figure 7).
- 2.1) The initial tension used is usually the load corresponding to the test specimen of 10 m for woven fabrics; however, if other load than above is used, it shall be appended to the test report.
- 2.2) The load range of the recording chart should be such that the load at the fixed rate elongation becomes at least 50 % of the full scale. The speed of the recording chart is determined so that the fixed elongation corresponds to at least 50 mm on the recording chart.

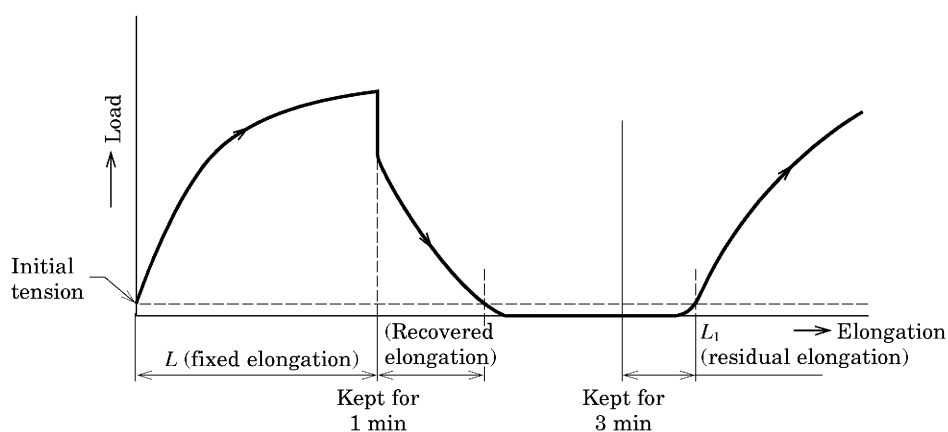


Figure 7 Load-elongation curve

- 3) **Calculation** The elastic recovery percentage of elongation is obtained by the following formula. The average values of three measurements in warp direction and weft direction are calculated respectively, and rounded off to the integer. The test conditions shall be appended to the test report.

$$E_e = \frac{L - L_1}{L} \times 100$$

where, E_e : elastic recovery percentage of elongation (%)

L : fixed rate elongation (mm)

L_1 : residual elongation (mm)

- b) **Repetitive elastic recovery percentage of elongation on fixed rate elongation** The repetitive elastic recovery percentage of elongation on fixed rate elongation is obtained by the same formula as in Method A after repeating five times or ten times the same operation under the same condition as in Method A, and the average values of three measurements in warp direction and weft direction respectively are obtained. In this case, the number of times of repetition shall be appended to the test report.

8.15.2 Method B (elastic recovery percentage of elongation on fixed length elongation)

Method B is mainly applied to woven fabrics.

- a) **Preparation of test specimen** Five test specimens are taken in the same way as Method A (strip method) of 8.14.1 a) or Method B (grab method) of 8.14.1 b).
- b) **Operation** The test specimen is stretched to 10 mm (5 % of the original length) using the tensile tester, and the load is removed immediately after this condition is kept for 1 min. After left as it is for another 3 min, the initial tension is applied and the residual elongation is measured.

The initial tension used is usually the load corresponding to the test specimen of 10 m for woven fabrics; however, if other load than above is used, it shall be appended to the test report.

- c) **Calculation** The elastic recovery percentage of elongation is obtained by the following formula. The average values of five measurements in warp direction and weft direction are calculated respectively and rounded off to the integer.

$$E_e = \frac{10 - L_1}{10} \times 100$$

where, E_e : elastic recovery percentage of elongation (%)

L_1 : residual elongation (mm)

8.16 Stretchability of stretch fabrics and knitted fabrics

The stretchability is according to the elongation percentage, elastic recovery percentage of elongation (elongation recovery rate), residual strain percentage, load for stretching and percentage of stress relaxation. The stretch fabrics are the fabrics using stretchable yarns (such as chemical fibre stretchability texturized yarn, polyurethane yarn), or those given particularly the stretchability by other methods.

8.16.1 Elongation percentage

The elongation percentage is determined according to Method A (constant rate elongation method), Method B (constant load method for woven fabrics) or Method C

(repetitive constant load method) that is mainly applied to woven fabrics, in addition to Method D (constant load method for knitted fabrics) that is mainly applied to knitted fabrics.

a) **Method A (constant rate elongation method)** Method A is mainly applied to woven fabrics as follows.

- 1) **Preparation of test specimen** Three test specimens measuring approximately 60 mm × approximately 300 mm or approximately 60 mm × approximately 600 mm are taken in warp direction and weft direction respectively from the sample prepared as specified in clause 6, then approximately same number of yarns are taken from both sides of width to make the width 50 mm.
- 2) **Operation** Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen is mounted so that the clamping distance becomes 200 mm or 500 mm under the initial tension of the load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen, and the load-elongation curve is drawn at a tensile speed of 100 % of the clamping distance per minute.
- 3) **Calculation** The elongation percentage (%) at the loading of 14.7 N is obtained, the average value of three measurements is calculated and rounded off to the one decimal place. As appropriate, the load other than 14.7 N may be used. In such a case, that effect shall be appended to the test report.

b) **Method B (constant load method for woven fabrics)** Method B is mainly applied to woven fabrics as follows.

- 1) **Procedure** On the test specimen same as that of Method A (constant rate elongation method) in a), one end thereof is fixed with the upper clamp using the tensile tester or an apparatus having equivalent performance, the initial tension of load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen is usually applied to another end. Then, the interval of 200 mm or 500 mm is marked and the load of 14.7 N is gently applied. After kept for 1 min, the length (mm) between the marks is measured. As appropriate, the load and/or period other than that of 14.7 N and/or 1 min may be used, respectively. In such a case, that effect shall be appended to the test report.
- 2) **Calculation** The elongation percentage (%) is calculated by the following formula, and the average value of three measurements is calculated and rounded off to one decimal place.

$$E_p = \frac{L_1 - L_0}{L_0} \times 100$$

where, E_p : elongation percentage (%)

L_0 : original length between marks (200 mm or 500 mm)

L_1 : length between marks after subjected to load of 14.7 N for 1 min (mm)

c) **Method C (repetitive constant load method)** Method C is mainly applied to woven fabrics as follows.

- 1) **Procedure** On the test specimen same as that of Method A (constant load method for woven fabrics) in **a**), the initial tension of load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen is usually applied in the same way as Method B in **b**), and the interval of 200 mm or 500 mm is marked. Returned to the unloaded condition, the load of 14.7 N is applied, and the procedure is repeated four times at a cycle of 5 s until returned to the unloaded condition. After the application of loads of five times, the test specimen is kept still for 30 s, and the length (mm) between marks is measured. As appropriate, the load other than 14.7 N may be used. In such a case, that effect shall be appended to the test report.
- 2) **Calculation** The elongation percentage (%) is calculated by the following formula, and the average value of three measurements is calculated and rounded off to one decimal place.

$$E_p = \frac{L_1 - L_0}{L_0} \times 100$$

where, E_p : elongation percentage (%)

L_0 : original length between marks (200 mm or 500 mm)

L_1 : length between marks after subjected to loads of five times and kept still for 30 s (mm)

- d) **Method D (constant load method for knitted fabrics)** Method D is mainly applied to knitted fabrics as follows.

- 1) **Procedure** Five test specimens are taken in wale direction and course direction respectively from the sample prepared as specified in clause 6, one end thereof is fixed with the upper clamp using the tensile tester or an apparatus having appropriate performance under the condition shown in table 5, and the initial tension of 29 mN is applied to another end. Then, the interval of 76 mm for the grab method and 200 mm or 100 mm for the cut strip method is marked, kept still for 1 min while applying the fixed load²⁾ gently, and the length (mm) between marks is measured.

Note ²⁾ The fixed load appropriate to type, wale direction and course direction, for example, 0.98 N, 2.94 N per 10 mm in width is used.

Table 5 Test conditions

Method	Size of test specimen Width mm × length mm	Width of test specimen mm	Clamping distance mm	Initial tension mN	Tensile speed mm/min
Grab method	100 × approx. 150	100	76	29	50 ± 10, 100 ± 10 or 300 ± 20
Cut strip method	50 × approx. 300	50	200		Elongation rate of approx. 50 % or 100 % of clamping distance per minute

- 2) **Calculation** The elongation percentage (%) is calculated by the following formula, and the average value of five measurements is calculated and rounded off to one decimal place. The test conditions shall be appended to the test report.

$$E_p = \frac{L_1 - L}{L} \times 100$$

where, E_p : elongation percentage under constant load (%)

L_0 : original length between marks (mm)

L_1 : length between marks under constant load and kept still for 1 min (mm)

8.16.2 Elastic recovery percentage of elongation (elongation recovery rate) and residual strain percentage

The elastic recovery percentage of elongation (elongation recovery rate) and the residual strain percentage are determined according to Method A (repetitive constant rate constant elongation method), Method B-1 (constant load method), Method B-2 (constant elongation method after elongation percentage measurement) or Method C (constant elongation method after repetitive measurement of elongation percentage) that is mainly applied to woven fabrics, in addition to Method D (repetitive constant elongation method) or Method E (repetitive constant load method) that is mainly applied to knitted fabrics.

- a) **Method A (repetitive constant rate constant elongation method)** Method A is mainly applied to woven fabrics as follows.

- 1) **Procedure** Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen same as that of Method A (constant rate elongation method) of **8.16.1 a)** is mounted so that the clamping distance becomes 200 mm or 500 mm under the initial tension of the load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen. Then, it is stretched at a tensile speed of 100 % of the clamping distance per minute until reaching 80 % of the elongation obtained by Method A of **8.16.1 a)**, kept still for 1 min, returned to the original position at the same speed and kept still for 3 min. The procedure is repeated 10 times, then the test specimen is stretched again with the same speed to draw the load–elongation curve as shown in figure 8. As appropriate, other elongation and/or repetitive times may be used. In such a case, the test conditions shall be appended to the test report.

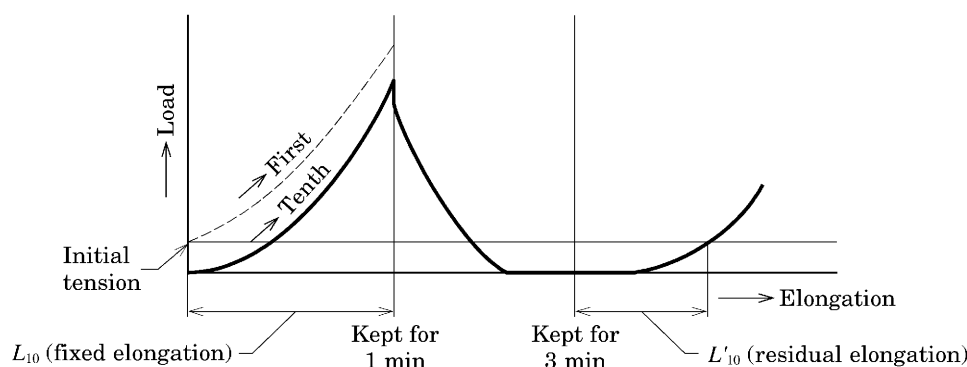


Figure 8 Load-elongation curve

- 2) **Measurement and calculation** From this curve, the elastic recovery percentage of elongation (elongation recovery rate) (%) and the residual strain percentage (%) are obtained by the following formula, and the average values of three measurements are calculated respectively and rounded off to one decimal place.

$$E_r = \frac{L_{10} - L'_{10}}{L_{10}} \times 100$$

$$R_s = \frac{L'_{10}}{L_0} \times 100$$

where, E_r : elastic recovery percentage of elongation (elongation recovery rate) (%)

R_s : residual strain percentage (%)

L_{10} : elongation of 80 % of elongation obtained by Method A of 8.16.1 a) (mm)

L'_{10} : residual strain after applying load for 10 times (mm)

L_0 : original distance between clamps (200 mm or 500 mm)

- b) **Method B-1 (constant load method)** Method B-1 is mainly applied to woven fabrics as follows.

- 1) **Procedure** On the test specimen same as that of Method A (constant rate elongation method) of 8.16.1 a), one end thereof is fixed with the upper clamp using the tensile tester or an apparatus having equivalent performance, the initial tension of the load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen is usually applied to another end, then the position of 200 mm or 500 mm from the lower end of the clamp is marked on the test specimen. Then, the load of 14.7 N is gently applied and kept still for 1 h to measure the length (mm) to the mark. The load is removed and the initial tension is applied after 30 s or after 1 h to measure the length to the mark (see figure 9). As appropriate, other load than 14.7 N and/or period (1 h) may be used. In such a case, the test conditions shall be appended to the test report.

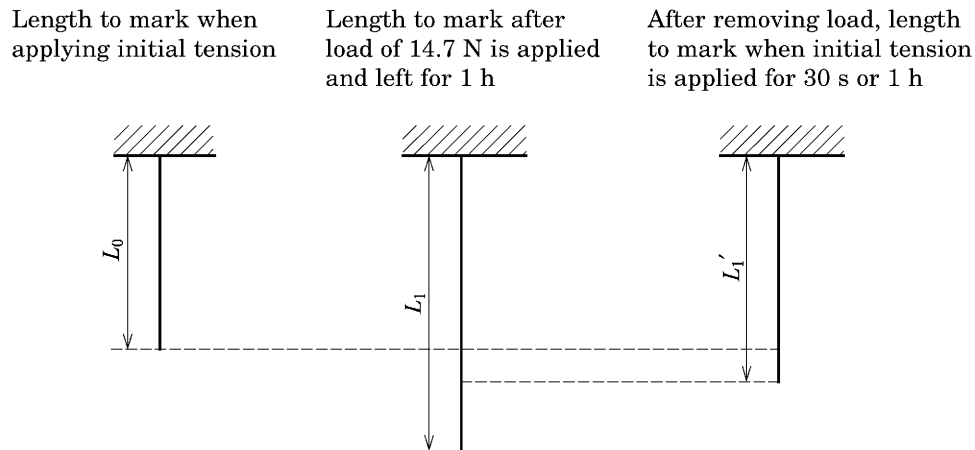


Figure 9 Pattern diagram of constant load method

- 2) **Measurement and calculation** The elastic recovery percentage of elongation (elongation recovery rate) and the residual strain percentage are obtained by the following formula, and the average values of three measurements are calculated respectively for those after 30 s or after 1 h and rounded off to one decimal place. The period that the test specimen has been kept still after removing the load shall be appended to the test report.

$$E_r = \frac{L_1 - L'_1}{L_1 - L_0} \times 100$$

$$R_s = \frac{L'_1 - L_0}{L_0} \times 100$$

where, E_r : elastic recovery percentage of elongation (elongation recovery rate) (%)

R_s : residual strain percentage (%)

L_0 : length to mark when initial tension is applied (200 mm or 500 mm)

L_1 : length to mark after applying load of 14.7 N for 1 h (mm)

L'_1 : after removing load, length to mark when initial tension is applied after 30 s or after 1 h (mm)

- c) **Method B-2 (constant elongation method after elongation percentage measurement)** Method B-2 is mainly applied to woven fabrics as follows.

- 1) **Procedure** On the test specimen same as that of Method A (constant rate elongation method) of 8.16.1 a) in the same way as Method B-1 of 8.16.2 b), the initial tension of the load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen is usually applied to another end, and the interval of 200 mm or 500 mm is marked on the test specimen. Then, it is stretched until reaching 80 % of the elongation obtained by Method B of 8.16.1 b) and kept still for 1 h, and the load is removed, then the initial tension is applied after 30 s or after 1 h to measure the length between marks (mm).

The period that the test specimen is left after the load is removed shall be appended to the test report. As appropriate, other elongation and/or period (1 h) may be used. In such a case, the test conditions shall be appended to the test report.

- 2) **Calculation** The elastic recovery percentage of elongation (elongation recovery rate) (%) and the residual strain percentage (%) are obtained by the following formula, and the average values of three measurements are calculated respectively for those after 30 s or after 1 h and rounded off to one decimal place.

$$E_r = \frac{L_1 - L'_1}{L_1 - L_0} \times 100$$

$$R_s = \frac{L'_1 - L_0}{L_0} \times 100$$

where, E_r : elastic recovery percentage of elongation (elongation recovery rate) (%)

R_s : residual strain percentage (%)

L_0 : length between marks when initial tension is applied (200 mm or 500 mm)

L_1 : length between marks when stretched to 80 % of elongation obtained by Method B of **8.16.1 b**) (mm)

L'_1 : after removing load, length to mark when initial tension is applied after 30 s or after 1 h (mm)

- d) **Method C (constant elongation method after repetitive measurement of elongation percentage)** Method C is mainly applied to woven fabrics as follows.

- 1) **Procedure** On the test specimen same as that of Method A (constant rate elongation method) of **8.16.1 a**) in the same way as Method B-1 of **8.16.2 b**), the initial tension of the load (N) (a value to the nearest integer) corresponding to the gravitational force by 1 metre in length and width of the test specimen is usually applied to another end, and the interval of 200 mm or 500 mm is marked on the test specimen. Then, it is stretched until reaching 80 % of the elongation obtained by Method C of **8.16.1 c**), kept still for 1 h and the load is removed, and the initial tension is applied after 30 s or after 1 h to measure the length between marks (mm). The period that the test specimen has been kept after the load is removed shall be appended to the test report. As appropriate, other elongation and/or period (1 h) may be used. In such a case, the test conditions shall be appended to the test report.
- 2) **Calculation** The elastic recovery percentage of elongation (elongation recovery rate) (%) and the residual strain percentage (%) are obtained by the following formula, and the average values of three measurements are calculated respectively for those after 30 s or after 1 h and rounded off to one decimal place.

$$E_r = \frac{L_1 - L'_1}{L_1 - L_0} \times 100$$

$$R_s = \frac{L'_1 - L_0}{L_0} \times 100$$

where, E_r : elastic recovery percentage of elongation (elongation recovery rate) (%)

R_s : residual strain percentage (%)

L_0 : length between marks when initial tension is applied (200 mm or 500 mm)

L_1 : length between marks when stretched to 80 % of elongation obtained by Method C of 8.16.1 c)

L'_1 : after removing load, length to mark when initial tension is applied after 30 s or after 1 h (mm)

e) **Method D (repetitive constant elongation method)** Method D is mainly applied to knitted fabrics as follows.

- 1) **Procedure** Five test specimens are taken in wale direction and course direction respectively from the sample prepared as specified in clause 6. Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen under the condition shown in table 5 is stretched to the fixed elongation and kept still for 1 min. Then, it is returned to the original position at the same speed and kept still for 3 min. The procedure is repeated, and the load-elongation curve as shown in figure 10 is drawn.

In the case of wet test, the test specimen moistened fully with water (20 °C ± 2 °C) shall be used.

- 1.1) The fixed elongation appropriate to type, wale direction and course direction, for example, 10 %, 30 %, 50 % is used.
- 1.2) The repetitive times is, for example, one, five, ten, etc. which is used according to type, wale direction and course direction, appropriately.

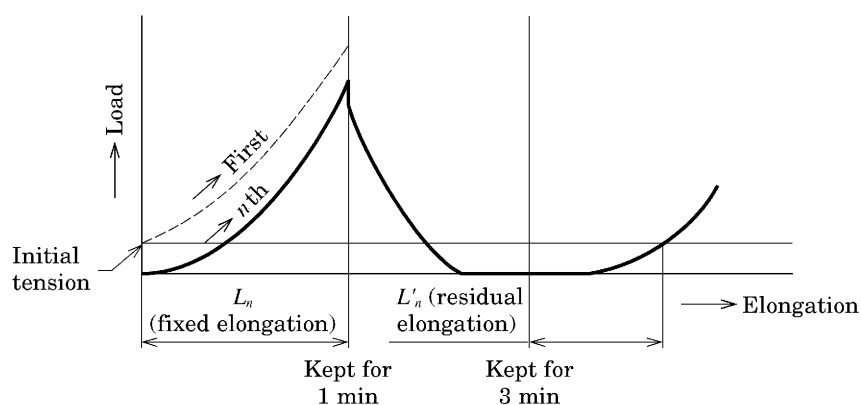


Figure 10 Load-elongation curve

- 2) **Measurement and calculation** The residual elongation is determined from this curve, the elastic recovery percentage of elongation (elongation recovery rate) (%) is obtained by the following formula, and the average value of the measurements in wale direction and course direction is obtained respectively and round off to one decimal place. The test conditions shall be appended to the test report.

$$E_e = \frac{L_n - L_n'}{L_n} \times 100$$

where, E_e : elastic recovery percentage of elongation at constant elongation (elongation recovery rate) (%)

L_n : fixed elongation (mm)

L_n' : residual elongation (mm)

- f) **Method E (repetitive constant load method)** Method E is mainly applied to knitted fabrics as follows.

- 1) **Procedure** Five test specimens are taken in wale direction and course direction respectively from the sample prepared as specified in clause 6. Using the tensile tester or an apparatus having appropriate performance, the test specimen is kept still with a fixed load applied for 1 min under the condition shown in table 5. Immediately, the load is removed and the test specimen is kept still for another 3 min. After repeating this procedure, the length (mm) between marks is measured under the initial tension.
- 1.1) The fixed load is, for example, 0.98 N, 2.94 N per 1 cm which is used according to type, wale direction and course direction, appropriately.
- 1.2) The repetitive times is, for example, one, five, ten, etc. which is used according to type, wale direction and course direction, appropriately.
- 2) **Calculation** The elastic recovery percentage of elongation at constant load (elongation recovery rate) (%) is obtained by the following formula, and the average values of the measurements in wale direction and course direction are obtained respectively and round off to one decimal place. The test conditions shall be appended to the test report.

$$E_e = \frac{L_0 - L_1}{L_0 - L} \times 100$$

where, E_e : elastic recovery percentage of elongation at constant load (elongation recovery percentage) (%)

L : original length between marks (mm)

L_0 : length between marks to which fixed load is applied and kept still for 1 min (mm)

L_1 : after removing load, length between marks when initial tension is applied after approximately 3 min (mm)

8.16.3 Load for stretching

The load for stretching is determined according to Method A (load for stretching at constant elongation of woven fabrics) or Method B (load for stretching at constant elongation of knitted fabrics).

a) **Method A (load for stretching at constant elongation of woven fabrics)**

Method A is applied to woven fabric as follows.

- 1) **Procedure** Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen same as that of Method A (constant rate elongation method) of **8.16.1 a)** is generally mounted so that the clamping distance becomes 200 mm or 500 mm under the initial tension of the load [a value to the nearest integer (N)] corresponding to the gravitational force by 1 metre in length and width of the test specimen. The test specimen is stretched until reaching 80 % of the elongation obtained by Method A of **8.16.1 a)** with a tensile speed of 100 % of the clamping distance per minute. The load (N) at that time is obtained from the load-elongation curve. As appropriate, other elongation may be used.
- 2) **Calculation** The average value of three measurements is calculated and round off to one decimal place. The test conditions shall be appended to the test report.

b) **Method B (load for stretching at constant elongation of knitted fabrics)**

Method B is applied to knitted fabric as follows.

- 1) **Procedure** Five test specimens are taken in wale direction and course direction respectively from the sample prepared as specified in clause 6. Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen is stretched to the fixed elongation and kept still for 1 min under the condition shown in table 5. The load at this time is determined from the load-elongation curve.

The fixed elongation is, for example, 10 %, 30 %, 50 % which is used according to type, wale direction and course direction, appropriately.
- 2) **Calculation** The average value of five measurements is calculated and round off to one decimal place. The test conditions shall be appended to the test report.

8.16.4 Percentage of stress relaxation

The percentage of stress relaxation is mainly applied to woven fabrics and determined according to Method A (one time load method) or Method B (repetitive load method) as follows.

a) **Method A (one time load method)**

- 1) **Procedure** Using the extension tensile tester of constant rate elongation with autographic recording device, the test specimen same as that of Method A (constant rate elongation method) of **8.16.1 a)** is generally mounted so that the clamping distance becomes 200 mm or 500 mm under the initial tension of the load [a value to the nearest integer (N)] corresponding to the gravitational force by 1 metre in length and width of the test specimen. The test specimen is

stretched until reaching 80 % of the elongation obtained by Method A of **8.16.1 a)** with the tensile speed of 100 % of the clamping distance per minute and kept still for 10 min, and the load-elongation curve as shown in figure 11 is drawn. As appropriate, other elongation may be used. In such a case, the elongation shall be appended to the test report.

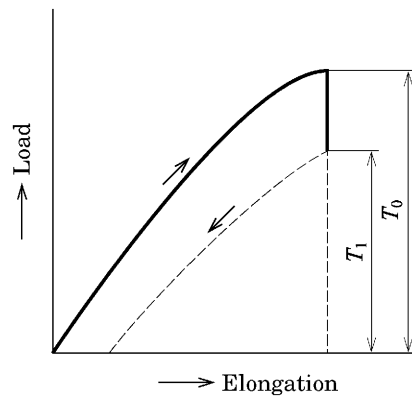


Figure 11 Load-elongation curve

- 2) **Calculation** The percentage of stress relaxation (%) is obtained by the following formula, and the average value of three measurements is calculated and rounded off to one decimal place.

$$S_r = \frac{T_0 - T_1}{T_0} \times 100$$

where, S_r : percentage of stress relaxation (%)

T_0 : load when test specimen is stretched to 80 % of elongation obtained by Method A of **8.16.1 a)** (N)

T_1 : load after kept still for 10 min (N)

b) **Method B (repetitive load method)**

- 1) **Procedure** The test specimen same as that of Method A (constant rate elongation method) of **8.16.1 a)** is stretched until reaching 80 % of the elongation obtained by Method A of **8.16.1 a)** and kept still for 1 min, then returned to the original position and kept still for 3 min. This procedure is repeated and, at the tenth cycle, the test specimen is stretched reaching 80 % of the elongation, then kept still for 3 min, and the load-elongation curve as shown in figure 12 is drawn. As appropriate, other elongation and/or repetitive times may be used. In such a case, the test conditions shall be appended to the test report.

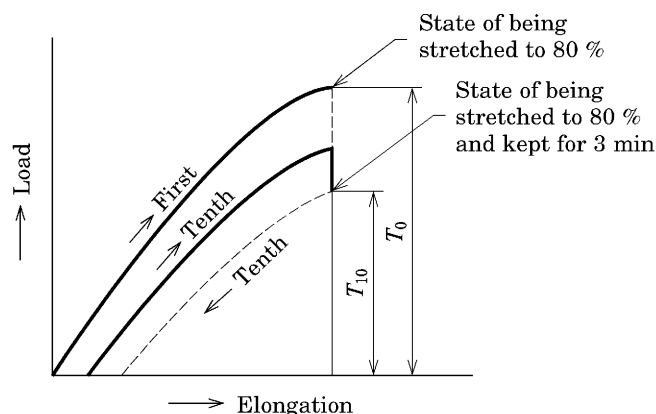


Figure 12 Load-elongation curve

- 2) **Calculation** The percentage of stress relaxation is obtained by the following formula, and the average value of three measurements is calculated and rounded off to one decimal place.

$$S_r = \frac{T_0 - T_{10}}{T_0} \times 100$$

where, S_r : percentage of stress relaxation (%)

T_0 : load when stretched to 80 % of elongation obtained by Method A of **8.16.1 a)** (N)

T_{10} : load after kept for 3 min with 10 times repetitive elongation (N)

8.17 Tearing strength

The tearing strength is determined according to Method A (single-tongue method), Method B (double-tongue method), Method C (trapezoid method), Method D (pendulum method) or Method E (ISO pendulum method).

8.17.1 Method A (single-tongue method)

Method A is according to Method A-1 (single-tongue method) or Method A-2 (single-tongue method).

- a) **Method A-1** Method A-1 is applied to woven fabrics and knitted fabrics as follows.

- 1) **Procedure** Test specimens measuring approximately 50 mm × approximately 250 mm or approximately 100 mm × approximately 250 mm, three for woven fabrics in warp direction and weft direction respectively and five for knitted fabrics in wale direction and course direction respectively, are taken from the sample prepared as specified in clause 6.
- 1.1) A cut of 100 mm is given to the middle of the short side at right angle to the side, and using a tensile tester having clamps of 50 mm or more in width, each tongue of the test specimen is held between clamps perpendicularly with a clamping distance of 100 mm on the test specimen as shown in figure 13.

- 1.2) For wale direction of knitted fabrics, the test specimen is held with its needle loop side down as shown in figure 13.
- 1.3) At the tensile speed of 100 mm/min or 150 mm/min, the maximum loads [tearing strength (N)] when tearing in warp direction or weft direction, or wale direction or course direction respectively are measured.

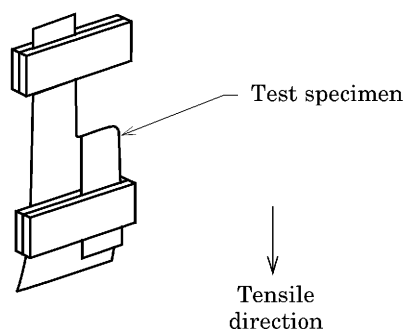


Figure 13 Pattern diagram of mounting of test specimen to clamps

- 2) **Calculation** The average value of the warp tearing strength or the tearing strength in wale direction, and the weft tearing strength or the tearing strength in course direction are calculated respectively, and rounded off to one decimal place.

In this case, the weft tearing strength is the case of cut in weft yarns, and the warp tearing strength is the case of cut in warp yarns. The tearing strength in wale (course) direction is the case where the test specimen is torn in wale (course) direction. The test conditions shall be appended to the test report. If the test specimen is torn abnormally, it shall be appended to the test report.

b) **Method A-2** Method A-2 is mainly applied to wool fabrics as follows.

- 1) **Procedure** Five test specimens measuring approximately 75 mm × 200 mm are taken from the sample prepared as specified in clause 6 in warp direction and weft direction respectively. A cut of 80 mm is given to the middle of the short side at right angle to the side, and using the tensile tester with autographic recording device having clamps of 75 mm or more in width, each tongue of the test specimen is held between clamps perpendicularly with a clamping distance of 75 mm as shown in figure 13. The tensile speed of 50 mm/min is used, and the measurement from the point of tearing 5 mm from the first local maximum point is continued for 60 s.
- 2) **Calculation** The weft tearing strength and the warp tearing strength are indicated by one of the following. In this case, the weft tearing strength is the case of cut in weft yarns, and the warp tearing strength is the case of cut in warp yarns.
- 2.1) **Average value of five local maximum point values** From the position except 5 mm from the first local maximum point, the local maximum points in each of five divisions divided by the equal interval of 12.5 mm are obtained, and the average value of five local maximum points is calculated.

- 2.2) **Average value by means of integrator** The tearing strength is obtained by the following formula.

$$T_s = \frac{X \times W}{K}$$

where, T_s : tearing strength (N)
 X : reading of integrator
 W : load in full scale (N)
 K : constant given by reading of integrator after 60 s from when runout of recorder pen becomes full scale when input of integrator is definite

- 2.3) **Median peak load** The number of local maximum points lying in the range from the position except 5 mm from the first local maximum point to the area where the cross head has travelled 50 mm, are counted and marked. A transparent scale is moved up and down on the recording paper in parallel to the abscissa (time) until the peaks are divided into the equal number in the upper and lower half. The position of the ordinate (load) is taken as the median peak load.

8.17.2 Method B (double-tongue method)

Method B is mainly applied to woven fabrics as follows.

- a) **Procedure** Three test specimens measuring approximately 150 mm × 180 mm are taken from the sample prepared as specified in clause 6 in warp direction and weft direction respectively. A cut of 100 mm is given to the positions which divide the short side into three equal lengths at right angle to the side as shown in figure 14, using the tensile tester having the clamps of 150 mm or more in width, the central tongue of the test specimen is held between one set of clamps. The outside tongue is held between other set of clamps perpendicularly to the side with the clamping distance of 100 mm. With a tensile speed of 150 mm/min or 200 mm/min, the test specimen is torn in warp direction and weft direction leaving a 25 mm in length, the maximum loads [tearing strength (N)] indicated at those times are measured.

Unit: mm

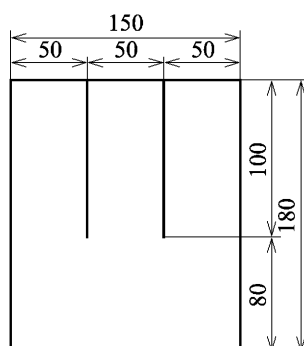


Figure 14 Preparation of test specimen

- b) **Calculation** The average values of the weft tearing strength (N) and the warp tearing strength (N) are calculated respectively, and rounded off to one decimal place. The test conditions shall be appended to the test report. In this case, the weft tearing strength is the case of cut in weft yarns, and the warp tearing strength is the case of cut in warp yarns. If the test specimen is torn abnormally, it shall be appended to the test report.

8.17.3 Method C (trapezoid method)

Method C is mainly applied to woven fabrics as follows.

- a) **Procedure** Three test specimens measuring 75 mm × approximately 150 mm are taken from the sample prepared as specified in clause 6 in warp direction and weft direction respectively. A mark of trapezoidal shape is given to each test specimen as shown in figure 15, and a cut of 10 mm is given to the middle of the short side marked at right angle to the side. Using the tensile tester with the clamps of 75 mm or more in width, the test specimen is held by clamps along the mark of isosceles trapezoid (dotted line of figure 15) taking a clamping distance of 25 mm on the test specimen. With a tensile speed of 150 mm/min or 200 mm/min, the maximum loads [tearing strength (N)] indicated when the test specimen is torn in warp direction and weft direction are measured.

Unit: mm

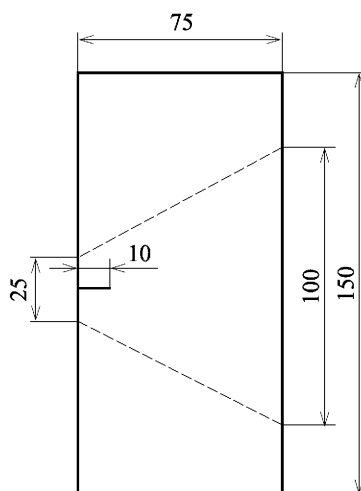


Figure 15 Preparation of test specimen

- b) **Calculation** The average values of the weft tearing strength (N) and the warp tearing strength (N) are calculated respectively, and rounded off to one decimal place. In this case, the weft tearing strength is the case of cut in weft yarns, and the warp tearing strength is the case of cut in warp yarns. The test conditions shall be appended to the test report. If the test specimen is torn abnormally, it shall be appended to the test report.

8.17.4 Method D (pendulum method)

Method D is mainly applied to woven fabrics and knitted fabrics as follows.

- a) **Procedure** Five test specimens measuring 63 mm × approximately 100 mm are taken from the sample prepared as specified in clause 6 in warp direction and weft direction, or in wale direction and course direction respectively. Using Elemendorf type tearing strength tester as shown in figure 16, the sample is held by clamps (For wale direction of knitted fabrics, the test specimen is held with its needle loop side down.). A cut of 20 mm is given to the middle of both clamps at right angle, the remaining 43 mm is torn in warp direction and weft direction, or in wale direction and course direction, and the load strength (tearing strength) (N) is measured. If the test specimen is torn abnormally³⁾, it shall be appended to the test report. Examples of statements to be added are shown in table 6.

Note ³⁾ The guideline of abnormal in the test specimen torn in the cut direction means is such that the torn direction deviates 8 mm or more from the extended line of the cut on its opposite side.

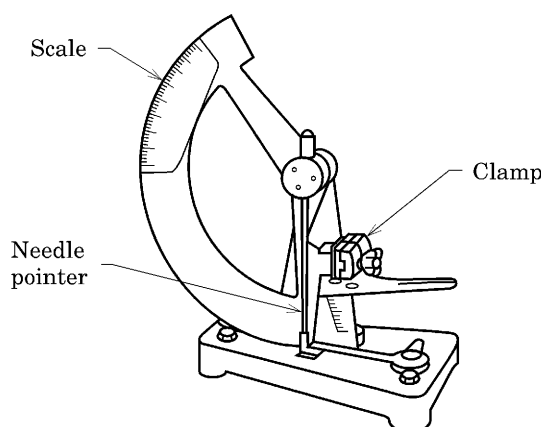


Figure 16 Example of Elemendorf type tearing tester

- b) **Calculation** The average value of the warp tearing strength or the tearing strength in wale direction, and the weft tearing strength or the tearing strength in course direction are calculated respectively, rounded off to three significant figures.

In this case, the weft tearing strength is the case of cut in weft yarns, and the warp tearing strength is the case of cut in warp yarns. The tearing strength in wale (course) direction is the case where the test specimen is torn in wale (course) direction.

Table 6 Examples of statements appended to test report (informative)

	Example of abnormal state	Example of statement to be added
1	Manner of cutting where test specimen is torn perpendicular to cut line	Cut perpendicularly to tearing direction (○○ N min.)
2	Manner of cutting where test specimen is torn oblique to cut line	Cut obliquely to tearing direction (○○ N min.)
3	Manner of cutting where test specimen is not cut completely to the end but few centimetres of it remain at clamp	Cut residue exists (○○ N min.)
4	Case when yarn of test cloth is slipped out	Cannot cut in specified width because slip out occurred (○○ N min.)
NOTE : Basically the minimum load shall be filled into ○○ N (the measured value is entered in ○○).		

8.17.5 Method E (ISO pendulum method)

Method E (ISO pendulum method) for tearing strength shall be as specified in Annex L.

8.18 Bursting strength

The bursting strength is determined according to Method A (Müllen type method), Method B (constant rate extension method) or Method C (ISO method).

8.18.1 Method A (Müllen type method)

Method A (Müllen type method) is mainly applied to knitted fabrics as follows.

a) **Apparatus** The Müllen low-pressure tester shall be as follows.

- 1) **Clamping device** The clamping device consists of upper clamping plate and lower clamping plate, and is capable of clamping the test specimen securely between two flat circular surfaces parallel to each other. The flat circular surface is concentrically-grooved or spirally-grooved with 60° V-shape grooves whose pitches are approximately 1 mm. The shapes and dimensions of the upper clamping plate (clamp ring) and lower clamping plate (rubber diaphragm) are in figure 17 and figure 18.

In addition, the diameter of upper clamping plate is usually 30.5 mm ± 0.3 mm, the surface roughness of clamping face is R_z 1.6 as specified in **JIS B 0601** and the centre misalignment of both upper and lower plates shall be ± 0.25 mm. Furthermore, the apparatus should be able to keep clamping pressure constant.

- 2) **Fluid pressure adding device** The increasing rate of fluid to pressurize shall be 98 ml/min ± 4 ml/min.
- 3) **Rubber diaphragm** The rubber diaphragm made of pure rubber material of 0.84 mm to 0.89 mm in thickness containing no mineral fillers is used, and the pressure when it swells to the height taller than the clamp surface by 9.5 mm is 34.3 kPa to 44.1 kPa. This swelling pressure is measured before testing, and if it is out of the prescribed range, the diaphragm shall be changed by another new one. If air exists under the diaphragm, the measurements fluctuate, and it shall be removed before the test or at the time of exchange of diaphragm.

Unit: mm

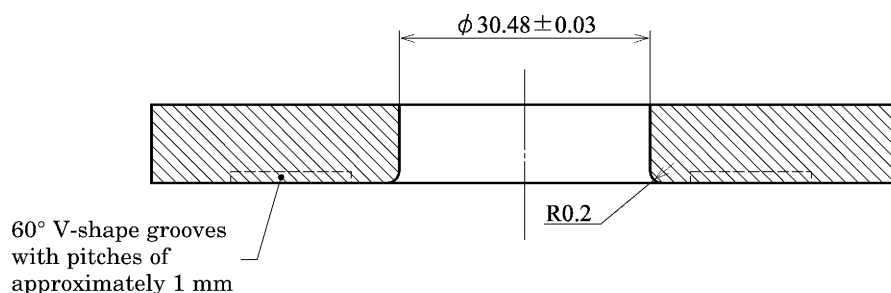
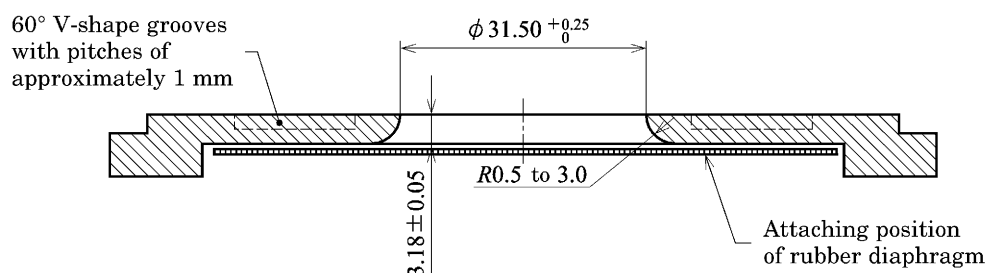


Figure 17 Shape/dimension of upper clamping plate



NOTE : The lower portion of the inner circle of the rubber diaphragm should be rounded with R of 0.5 mm to 3.0 mm to prevent it from cut when pressurized.

Figure 18 Shape/dimension of lower clamping plate

- b) **Procedure** Five test specimens measuring approximately 150 mm × 150 mm are taken from the sample prepared as specified in clause 6. Using Müllen low-pressure tester or the Müllen burst type tester having equivalent precision, the test specimen is clamped with its surface upward under a uniform tension so as not to produce any wrinkle and slack, and the strength (kPa) of the rubber diaphragm which bursts the test specimen and the strength (kPa) of the rubber diaphragm itself only at the time of breaking are measured when pressurized.
- c) **Calculation** The bursting strength (kPa) is obtained by the following formula, and the average value thereof is calculated and rounded off to three significant figures.

$$B_s = A - B$$

where, B_s : bursting strength (kPa)

A : strength when rubber diaphragm bursts test specimen (kPa)

B : strength of rubber diaphragm at breakage (kPa)

NOTE : For the validation of tester, the adjustment is carried out with reference aluminium. Materials of reference aluminium should be that of alloy number 1N30 specified in **JIS H 4160** or that of alloy number 1N90 specified in **JIS H 4170** of which burst strength is confirmable.

8.18.2 Method B (constant rate extension method)

Method B is mainly applied to woven fabrics and knitted fabrics as follows.

- a) **Procedure** Five test specimens measuring approximately 80 mm in diameter are taken from the sample prepared as specified in clause 6. Using the constant rate extension type bursting tester as shown in figure 19, the test specimen is attached with its back surface upward by the clamp of 44 mm in internal diameter after applying a uniform tension so as not to produce any wrinkle and slack. Then, using a plunger rod of 12.5 mm in radius of curvature on the tip and 25 mm in diameter, the strength (N) of the plunger rod to burst the specimen at a loading speed of 100 mm/min is measured.
- b) **Calculation** The average value of five measurements is calculated and rounded off to one decimal place.

Unit: mm

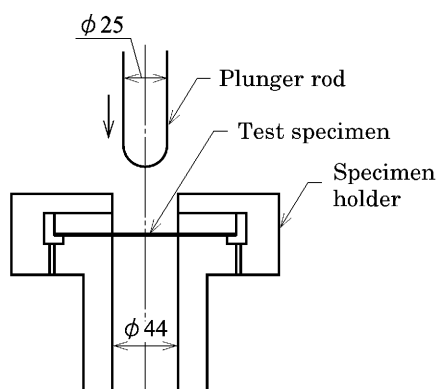


Figure 19 Constant rate extension type burst tester

8.18.3 Method C (ISO method)

The hydraulic method for determination of bursting strength and bursting distension shall be as specified in Annex M.

8.19 Abrasion resistance and change in colour due to abrasion

The abrasion resistance is determined according to Method A (universal type method), Method B (Scott type method), Method C (Taber type method), Method D (accelerator type method), Method E (Martindale method) or Method F (uniform type method).

8.19.1 Method A (universal type method)

Method A is according to Method A-1 (flat method), Method A-2 (bending method) or Method A-3 (fold method).

- a) **Method A-1 (flat method)** Method A-1 is applied to the evaluation on the flat abrasion of elbow, knee, armpit, buttocks, etc. mainly for clothes of woven fabrics or knitted fabrics as follows.
 - 1) **Procedure** Five test specimens measuring approximately 120 mm in diameter are taken from the sample prepared as specified in clause 6. The test specimen is mounted on the rubber diaphragm as shown in figure 20, and rubbed with an