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Methods of test for

Elastomeric threads

Part 1. Rubber threads

[ISO title: Rubber threads – Methods of test]

Méthodes d'essai des fils élastomériques
Partie 1. Fils élastiques

Prüfverfahren für Elastomerdrähte
Teil 1. Gummidrähte

Gr 6

British Standards Institution

Contents

Foreword

This British Standard has been prepared under the authority of the Rubber Industry Standards Committee. It is identical with ISO 2321 'Rubber threads—Methods of test' (including Addendum 1, which constitutes clause 13 of ISO 2321).

This British Standard supersedes BS 903 'Methods of testing vulcanized rubber', Parts H1 to H11 'Methods of testing rubber threads'; that publication is therefore withdrawn.

Work is in progress to produce a Part 2 to this standard covering methods of test for polyurethane thread.

For the purposes of this British Standard the text of ISO 2321 given in this publication should be modified as follows.

Terminology. The words 'British Standard' should replace 'International Standard' wherever they appear.

The decimal point should replace the decimal comma wherever it appears.

Cross-references. The references to other International Standards should be replaced by references to British Standards as follows.

Reference to ISO publication	Appropriate British Standard
ISO/R 37–1968 'Determination of tensile stress-strain properties of vulcanized rubbers'	BS 903 'Methods of testing vulcanized rubber' Part A2 : 1971 'Determination of tensile stress-strain properties'
ISO/R 188–1971 'Vulcanized rubbers—Accelerated ageing or heat resistance tests'	BS 903 : Part A19 : 1975 'Heat resistance and accelerated air ageing tests'
ISO/R 471–1966 'Standard atmospheres for the conditioning and testing of rubber test pieces'	No equivalent

Additional information. It is customary in the UK to condition and test rubber threads at 20 ± 2 °C and 65 ± 5 % r.h. (one of the standard atmospheres (see clause **3** of this standard) described in ISO/R 471) this being the preferred usage in the textile industry.

British Standard Methods of test for

Elastomeric threads

Part 1. Rubber thread

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of test for determining certain physical and mechanical properties of rubber threads. Owing to the comparatively small cross-section and the unusual conditions of service of this material, certain special methods have been developed.

Some of the tests included in this International Standard may not be entirely suitable for thread made from certain synthetic rubbers, for example urethane rubber, these tests being intended for natural or synthetic polyisoprene rubbers.

It is pointed out that comparisons may only be made on new rubber threads or on those with identical processing histories. In the interpretation of results from threads which have been subjected to spooling, fabrication or any other process, it must be borne in mind that the previous history is important, and what is known of this and of any relaxation treatments used shall be stated in the test report.

2 REFERENCES

ISO/R 37, *Determination of tensile stress-strain properties of vulcanized rubbers.*

ISO/R 188, *Vulcanized rubbers – Accelerated ageing or heat resistance tests.*

ISO/R 471, *Standard atmospheres for the conditioning and testing of rubber test pieces.*

3 CONDITIONING OF SAMPLES OR TEST PIECES

The samples or test pieces shall be kept in a relaxed state in the dark in one of the standard atmospheres described in ISO/R 471, for not less than 16 h before testing. The tests shall be carried out under similar atmospheric conditions. The test piece selected shall be clean, dry and free from any visual defects.

Samples or test pieces shall not be allowed to come into contact with copper or manganese or their compounds during conditioning or testing.

4 COUNT

4.1 Sectional count

The sectional count of a rubber thread is given by the value of its cross-sectional area, expressed in square millimetres, multiplied by 1 000.

NOTE – The sectional count corresponds to the tex count for a nominal density of 1 Mg/m^3 (= 1 g/cm^3). The use of the sectional count is recommended.

4.2 Conventional count (size number)

4.2.1 The conventional count of a rubber thread is the number of threads which, when placed side by side, measure 25,4 mm.

The conventional count of a round thread is calculated by dividing 25,4 by the diameter of the thread in millimetres.

The conventional count of a square thread is calculated by dividing 25,4 by the length of one of the sides of the thread expressed in millimetres.

The conventional count of a rectangular thread is generally quoted as the count of a square thread of equivalent cross-sectional area.

Thus, in the case of a round thread, the number 100 is the conventional count of a thread having its diameter equal to 0,254 mm; in the case of a square thread, the number 40 is the conventional count of a thread having its sides equal to 0,635 mm.

4.2.2 It is customary to quote the conventional count of a round thread, followed by the whole even number which is nearest to the actual conventional count of the square thread of equivalent cross-sectional area (count of round thread × 1,13 = actual count of square thread); for example a round thread of count 50 is indicated as 50/56.

4.2.3 The conventional count of a multi-filament round thread is expressed by stating successively the number of components, the count of the single round thread which would have the same total cross-sectional area as the component threads, and the count of the corresponding square thread.

Thus, the conventional count of a multi-filament round thread made up of three components equal in total cross-sectional area to a round thread of count 32 is indicated as 3/32/36.

4.3 Procedure

4.3.1 *Cutting of test pieces*

Take five straight thread samples and cut them to a length of approximately 1 050 mm.

NOTE – Kinked or curved thread will introduce errors.

If these threads are taken from bobbins or from any other type of presentation in which the thread is under tension, heat treat them for 30 min in a thermostatically controlled oven at a temperature of 70 ± 2 °C. After this heat treatment, condition the thread as specified in clause 3. For threads taken from forms of presentation where no tension is applied to the thread, condition as specified in clause 3.

Two types of apparatus may be used for cutting to size. With the first (Method A), the cut is made with the thread placed in a groove of a horizontal base. With the second (Method B), the thread is suspended and maintained in a vertical position by its own weight.

Method A (see figure 1)

The apparatus consists of a horizontal, flat, metallic base, rectangular in shape and having one or more longitudinal grooves. A clamp is fixed at a position a few centimetres from the end of the groove. A cutting device is fitted to each end of the groove such that the distance between the cutting devices is 1 000 ± 1 mm. The grooves shall have an equilateral triangular section with a base not less than 2 mm.

Lay each conditioned thread in a groove of the apparatus, carefully avoiding stretching. Clamp it and cut to length by means of the cutting devices.

Method B (see figure 2)

The apparatus consists of a rectangular vertical frame at the upper and lower ends of which are mounted two metallic plates having the inside edges parallel and sharp. Two cutting devices (the fixed blade of which consists of the inside edge of the metallic plate) and two external clamps are provided. The clamps shall be of a spring-loaded type and the distance between the internal edges of the metallic plates shall be 1 000 ± 1 mm.

Suspend each conditioned thread from the upper clamp. When it has settled in the vertical position without stretch, fix it by means of the lower clamp. Cut the thread to length with the two cutting devices, using the lower one first.

4.3.2 *Weighing of test pieces*

Free the cut threads from any loose dusting powder by shaking or brushing them gently, and weigh to an accuracy of ± 1 %.

4.4 Expression of results

4.4.1 Calculate the sectional count S, using the following formula :

$$S = 1\,000 \frac{m}{\rho}$$

where

ρ is the density of the thread, in megagrams per cubic metre, determined as specified in clause 6;

m is the mass, in grams, of 1 000 mm of thread.

4.4.2 Calculate the conventional count of rubber thread, C, using the following formulae :

– for round thread : $C = 22{,}51 \sqrt{\frac{\rho}{m}}$

– for square thread : $C = 25{,}40 \sqrt{\frac{\rho}{m}}$

where

ρ is the density of the thread, in megagrams per cubic metre, determined as specified in clause 6;

m is the mass, in grams, of 1 000 mm of thread.

4.4.3 Express the count of the thread as the median of the values for the five test pieces as indicated in 4.2.3. The maximum and minimum values obtained shall also be stated.

5 METRIC YIELD

5.1 Definition

metric yield : The unstretched length, in metres, of 1 000 g of the thread.

5.2 Procedure

Determine the mass of each of five test pieces as specified in 4.3.2.

5.3 Expression of results

5.3.1 Calculate the metric yield of rubber thread, in metres per kilogram, using the following formula :

$$\text{Metric yield} = \frac{1\,000}{m}$$

where m is the mass, in grams, of 1 000 mm of thread.

5.3.2 Express the metric yield of the thread as the median of the values for the five test pieces.

6 DENSITY

6.1 Definition

density : The mass per unit volume of a test piece of thread measured at a standard laboratory temperature and expressed in megagrams per cubic metre.

The standard laboratory temperatures are given in ISO/R 471.

6.2 Principle

Test pieces are placed in a suitable mixture of liquids, the density of which is adjusted until the test pieces neither float nor sink; this density is determined.

6.3 Immersion liquids

6.3.1 Most of the rubber threads on the market have a density in the range of 0,90 to 1,11 Mg/m³. It is necessary, therefore, to have a series of liquids having densities within this range. Mixtures of ethanol (0,79 Mg/m³) and ethylene glycol (1,11 Mg/m³) are suitable.

For threads of greater density, a suitable inorganic salt solution may be used. A solution of sodium chloride is suitable.

6.3.2 Before the mixtures are used, they shall be homogeneous and free from air bubbles. They shall be kept in closed containers so as to avoid evaporation. They shall be used at a temperature of 20 ± 2 °C.

6.4 Apparatus

6.4.1 Glass cylinder, capacity about 1 000 cm³.

6.4.2 Hydrometer or **hydrostatic balance** or **other apparatus** allowing measurement of the density of liquids to an accuracy of at least 0,005 Mg/m³.

6.5 Procedure

6.5.1 Take four test pieces approximately 10 mm long from the sample. Dip each test piece in ethanol and then rub between the fingers to remove dusting powder and any air bubbles from the surface.

6.5.2 Thoroughly homogenize a suitable liquid mixture (6.3.1), taking care not to introduce any air bubbles. Place one of the test pieces in the liquid. Adjust the density of the liquid by additions of the appropriate components, mixing thoroughly after each addition. Continue this adjustment until the test piece neither sinks nor floats.

6.5.3 Test the other three test pieces in the mixture; two of the three test pieces must reach equilibrium in a period of 3 to 10 min.

6.5.4 Determine the density of the liquid mixture to the nearest 0,005 Mg/m³.

7 TENSILE STRENGTH

7.1 Definition

tensile strength : The stress at which the thread breaks when it is stretched under specified conditions.

The value is expressed in megapascals, based on the initial cross-sectional area.

7.2 Apparatus

The essential requirements are a dynamometer (accuracy ± 2 %) and suitable clamps to avoid damage to the test piece.

The apparatus described in 7.2.1 or 7.2.2 may be used.

7.2.1 Rotating drum clamps

A suitable apparatus is shown in figure 3 and consists of :

a) **Spring dynamometer;**

b) **Free-running idler pulley,** connected directly to the free end of the spring and free to move in the direction corresponding to the axis of the spring;

c) **Two driven winding drums** having slots or other devices for engaging the ends of the test pieces.

The drums and pulleys shall have similar diameters within the range of 25 to 30 mm. The winding drums shall be motor-driven at a uniform surface speed of 50 to 60 mm/s rotating in the direction shown and the thread path between them shall be between 250 and 400 mm.

All drums and pulleys shall have a smooth surface.

7.2.2 Rigid clamps

The apparatus described in ISO/R 37 is used with clamps consisting of :

a) **Flat rigid face** approximately 25 mm square for one jaw of each clamp;

b) **Rigid convex face** 5 ± 3 mm in radius and 25 mm wide for the other jaw of each clamp.

Rubber tubing of approximately 1,6 mm bore and a wall thickness of 0,8 mm and a threader or other device for inserting the rubber thread in the tubing are also required.

7.3 Procedure

7.3.1 *Rotating drum method*

Prepare five test pieces each consisting of a suitable number of threads to give a convenient force at break. In turn, position each test piece over the idler pulley and fix the ends to the two winding drums.

Set the apparatus in motion.

When the test piece breaks, read and record the value of the load at break.

7.3.2 *Rigid clamp method*

Prepare five test pieces approximately 125 mm in length. Place the clamps described in 7.2.2 in the testing machine with the axes of the convex surfaces horizontal and their centres 50 mm apart. Cut two pieces of rubber tubing at least 10 mm long and pass the ends of the test piece through the tubing so that at least 25 mm of thread extends beyond the tubing at each end. Secure one piece of tubing and one end of thread in the upper clamp. Straighten the test piece and adjust the tubing on the other end to eliminate slack in the test piece and secure them in the lower clamp.

Select a force scale for the dynamometer so that an accuracy of ± 2 % is attained.

Start the machine and observe or record the force and elongation at break. If the test piece breaks within 3 mm of either clamp, discard the result and test another test piece.

7.4 Expression of results

7.4.1 Calculate the tensile strength of each test piece, in megapascals, from the following formula :

$$\text{Tensile strength} = \frac{P}{AN}$$

where

P is the force at break, in meganewtons;

A is the initial cross-sectional area of the test piece, in square metres;

N is the number of ends of thread attached to the dynamometer.

7.4.2 Express the tensile strength of the thread as the median of the values for the five test pieces. The maximum and minimum values shall also be quoted. The test report shall indicate the type of apparatus and procedure used.

8 ELONGATION AT BREAK

8.1 Definition

elongation at break : The increase in length of the thread at break when it is stretched under the specified conditions, expressed as the percentage increase of the original length.

For example, a test piece 30 mm in length which increases in length to 210 mm at break is said to have an elongation at break of 600 %.

8.2 Test pieces

8.2.1 The test pieces shall be of a length suitable for the apparatus being used.

8.2.2 Each test piece shall have a reference length of not less than 30 mm clearly marked with ink.

8.3 Apparatus

As described in 7.2.1, without the dynamometer but with the addition of a graduated scale, parallel and close to the test piece; or as described in 7.2.2.

8.4 Procedure

8.4.1 *Rotating drum method*

Prepare five test pieces. In turn, fix the ends of each test piece to the two winding drums of the apparatus and set these in motion.

Follow the progressive separation of the two reference marks on the graduated scale (two observers are required).

When the test piece breaks, read the positions reached by the two marks on the scale. Record the length at break reached by the reference length.

8.4.2 *Rigid clamp method*

If the apparatus in 7.2.2 is used, follow the procedure in 7.3.2 with the initial length at 50 mm.

8.5 Expression of results

8.5.1 Calculate the percentage elongation at break of the test piece from the following formula :

$$\text{Elongation at break} = \frac{L_1 - L_0}{L_0} \times 100$$

where

L_0 is the initial reference length of the test piece, in millimetres;

L_1 is the length at break of the reference length of the test piece, in millimetres.

8.5.2 Express the elongation at break of the thread as the median of the values for the five test pieces. The maximum and minimum values shall also be quoted. The test report shall indicate the type of apparatus and procedure used.

9 STRESS AT PRE-DETERMINED ELONGATION

9.1 Definitions

9.1.1 stress during first predetermined extension : The stress, measured in megapascals, calculated on the original cross-sectional area, at a specified elongation on an unmassaged thread.

NOTE – In common practice, this is also called "Green modulus".

9.1.2 massaging (mechanical conditioning) : Subjection of the sample, conditioned as specified in clause 3, before any readings are taken, to a number of cycles of elongation to, and retraction from, an elongation greater than that at which the readings will be made, in order to eliminate the effects of storage on the physical properties of the thread, and to reproduce as far as possible the conditions of use.

9.1.3 Schwartz value : The average of the stresses, in megapascals, calculated on the original cross-sectional area at a specified elongation measured on extension and retraction of a massaged thread. It is denoted by the symbol SV_n^c, where c is the massaging elongation and n that at which readings are taken, both expressed as percentages of the initial length. c and n must be multiples of 100 and, unless otherwise specified, are chosen so that :

$$c = n + 100$$

Preferred values of n are 300 % and 500 % according to the type of thread under test.

9.1.4 Schwartz hysteresis ratio : The ratio of the loads at a specified elongation measured on retraction and extension, after massaging. It is denoted by the symbol SHR_n^c, where c is the massaging elongation and n the elongation at which readings are taken, both expressed as percentages of the initial length. c and n must be multiples of 100 and, unless otherwise specified, are chosen so that :

$$c = n + 100$$

Preferred values of n are 300 % and 500 % according to the type of thread under test.

9.2 Determination of stress during first predetermined extension, of Schwartz value and of Schwartz hysteresis ratio

9.2.1 *Apparatus*

The following apparatus or that described in 7.2.2 may be used. The essential requirements of the apparatus are that it must be capable of extending and retracting the test piece at a controlled rate of 100 ± 30 mm/s to and from any specified elongation, and of indicating the load at any point of the cycle.

A suitable form of apparatus is shown diagrammatically in figure 4.

It consists of an endless chain (1) passing round two sprockets (2) and (3), the lower sprocket (3) being driven by a reversible motor fitted with a solenoid-operated brake (this is necessary in order to obtain quick reversal without over-run).

The loop of the thread is stretched between two hooks (4) and (5), the former being attached to the chain, and the latter to the hook of a spring dynamometer (6) from which a scale (7) is also suspended. Means may be provided for recording the load indicated by the spring dynamometer at any stage of the cycle, possibly by means of a spark discharge puncturing a paper chart.

9.2.2 *Procedure*

Prepare three test pieces each consisting of a loop or a multiple loop of thread of 100 ± 1 mm circumference, the number of turns being selected to suit the count of the thread and the capacity of the apparatus.

Distribute the thread evenly between the several turns by rotating the loop around the fingers before placing it over the hooks (4) and (5).

Make six cycles of elongation and retraction without interruption to an elongation of c %. Take readings at n % elongation on the first cycle (extension) and on the sixth cycle (extension and retraction); minimal pauses to take readings are permissible.

NOTE — If the apparatus in 7.2.2 is used, follow the procedure in 7.3.2 but make six cycles of extension and retraction without interruption to an elongation of c % and take readings at n % on the first cycle (extension) and on the sixth cycle (extension and retraction).

9.2.3 *Expression of results*

Calculate the stress during first predetermined extension, in megapascals, from the following formula :

Stress during first predetermined extension (Green modulus)

$$GM_n = \frac{P_1}{2AN}$$

Calculate the Schwartz value, in megapascals, and Schwartz hysteresis ratio, as a percentage, from the following formulae :

Schwartz value $$SV_n^c = \frac{P_2 + P_3}{4AN}$$

Schwartz hysteresis ratio $$SHR_n^c = \frac{P_3}{P_2} \times 100$$

where

P_1 is the load, in meganewtons, at n % elongation on extension (1st cycle);

P_2 is the load, in meganewtons, at n % elongation on extension (6th cycle);

P_3 is the load, in meganewtons, at n % elongation on retraction (6th cycle);

A is the original cross-sectional area of the test piece, in square metres;

N is the number of complete loops tested.

Express the stress during first predetermined extension, the Schwartz value and Schwartz hysteresis ratio of the thread as the median of the values obtained for the three test pieces. The test report shall indicate the type of apparatus and procedure used.

10 ELONGATION UNDER A SPECIFIED LOAD

10.1 Definition

elongation under a specified load : The percentage elongation of a rubber thread when stressed by the application of a specified load per unit area.

It is determined by applying a load to an unmassaged thread and so is liable to be affected by the age, storage, condition and previous history of the thread.

It is normally determined at two levels of applied force, i.e. 15,5 kPa (158 gf/mm²) and 27,4 kPa (280 gf/mm²).

10.2 Test pieces

One or more pieces of thread, according to count, shall be used as a test piece.

10.3 Apparatus

10.3.1 The essential requirements are that the apparatus permits a test piece to be stretched at a constant speed until it just supports a pre-determined load, and that it incorporates a graduated scale for reading the elongation.

10.3.2 A suitable apparatus is shown in figure 5 and consists of :

a) **Graduated scale** for reading the elongation of the test piece;

b) **Two clamps** for gripping the ends of the test piece, the length between the clamps in the initial state being 150 ± 2 mm, together with a **means** of mechanically moving the upper clamp in a vertical direction to extend the test piece at a constant speed of 30 ± 10 mm/s;

c) **Pan**, attached to the lower clamp, to which the necessary weights may be added to make up the load appropriate to the count of the thread being tested;

d) **Electric switch**, situated immediately beneath the pan; when the weight of the pan is exceeded by the force exerted by the stretched thread, the pan will be lifted and the switch will stop the motor and apply the brake.

NOTE — If, for this test, an apparatus differing from that described but complying with 7.2.2 is used, the test report shall contain a reference to the type of apparatus and procedure used.

10.4 Procedure

Prepare three test pieces. In turn, fix the ends of each test piece in the clamps and add the required weights to the pan. Start the motor and when it is automatically stopped by the switch, measure the elongation of the test piece on the scale.

10.5 Expression of results

10.5.1 Calculate the percentage elongation of the test piece under the specified load from the following formula :

$$\text{Elongation at specified load} = \frac{L_1 - L_0}{L_0} \times 100$$

where

L_0 is the original length of the test piece, in millimetres;

L_1 is the total length of the extended test piece, in millimetres.

10.5.2 Express the elongation under specified load as the median of the values for the three test pieces.

11 STRESS RETENTION

11.1 Definition

stress retention : The residual load, expressed as a percentage of the original load on the thread, after the test piece has been maintained at a constant elongation (usually 100 %) for a specified time.

11.2 Test pieces

Test pieces shall be composed of loops of the type described in 9.2.2.

11.3 Apparatus

Figure 6 shows a simple apparatus for carrying out this test. One end of the test piece shall be passed round one peg, the other end being attached to the other peg by means of a wire clip. A spring dynamometer shall be attached to the other end of the wire clip and the load required just to lift the clip off the peg measured. The distance between the two pegs shall be such that the thread is subjected to the specified elongation ± 2 %.

11.4 Procedure

11.4.1 Prepare three test pieces. Pass the end of each test piece round the bottom peg and attach the other end to the wire clip as shown in figure 6. Then pass the inner loop of the wire clip over the top peg, thus subjecting the test piece to the specified elongation with an accuracy of ± 2 % (usually 100 ± 2 %). Maintain this extension during the test.

11.4.2 When a measurement of stress is to be made, attach the spring dynamometer to the outer loop of the wire clip and raise the dynamometer until the wire clip is just clear of its supporting peg. At this point, read the dynamometer, which just counter-balances the force exerted on the rubber thread.

11.4.3 Take the initial reading 30 ± 1 min after the initial extension of the thread on the apparatus and further readings after 14 days and at intermediate intervals if required.

11.5 Expression of results

11.5.1 Calculate the stress retention of the test piece, as a percentage, from the following formula :

$$\text{Stress retention} = \frac{P_2}{P_1} \times 100$$

where

P_1 is the original load;

P_2 is the residual load.

11.5.2 Express the stress retention of the thread as the median of the values obtained for the three test pieces.

NOTE — This test may be carried out at ambient or elevated temperatures and the conditions and duration of the test shall be stated in the test report.

11.6 Test report

If the test elongation differs from 100 %, this must be recorded.

12 ACCELERATED AGEING TEST ON RUBBER THREADS IN A RELAXED STATE

12.1 General

12.1.1 Accelerated ageing tests on rubber threads in a relaxed state are made in order to determine the change in physical properties of a rubber thread subjected to hot air treatment at atmospheric pressure at a controlled temperature and for a specified time.

12.1.2 These accelerated ageing tests have only a comparative value, and may not be taken as an exact indication of the storage life of rubber threads, as the test conditions cannot reproduce all the various aspects of storage.

12.2 Principle

12.2.1 The ageing properties of a rubber thread are normally evaluated by the following measurements :

- tensile strength
- elongation at break
- Schwartz value

12.2.2 These properties on unaged test pieces are determined in accordance with clauses 7, 8 and 9.

The same properties are determined on other test pieces after a treatment in hot air at 70 ± 1 °C for 14 days, and compared with the properties of unaged test pieces.

12.2.3 Other parameters may also be similarly compared.

12.3 Test pieces

12.3.1 A set of test pieces for each of the above properties shall be prepared and identified, as described in clauses 7, 8 and 9.

12.4 Apparatus

12.4.1 The apparatus for ageing treatment shall be in accordance with either clause 2 or clause 3 of ISO/R 188; the apparatus in clause 2 is to be preferred, as it has the advantage of maintaining in separate cells the test pieces taken from different samples during the heat ageing.

12.5 Procedure

12.5.1 The set of test pieces shall be put in the oven, previously regulated at 70 °C, and left in a relaxed state for 14 days. At the end of the treatment period, the set of test pieces shall be removed from the oven, and left for 16 h in the conditions described in clause 3.

12.5.2 The properties listed in 12.2.1 shall then be determined on the aged samples.

12.6 Expression of results

12.6.1 The results of this test shall be stated indicating :

a) the median of the values obtained for each property before ageing;

b) the median of the values obtained for each property after ageing;

c) the percentage variations of each parameter due to the ageing treatment, calculated as follows :

$$\frac{b-a}{a} \times 100$$

where

a is the value on the unaged sample;

b is the value on the aged sample.

13 RIBBONS : DEGREE OF ADHESION BETWEEN THREADS

13.1 General

This method is intended for determining the degree of adhesion between the threads composing a rubber ribbon in order to predict the behaviour of the ribbon in practical use.

13.2 Principle

At one end of the ribbon, all the threads are separated for a short distance and placed into two groups of alternate threads. The minimum force required to separate the threads in these two groups for a further specified distance under a specified rate of extension is determined.

In order to express the result independently of the thread count, the degree of adhesion is usually expressed as the length of ribbon tested whose weight is equivalent to the measured force required to separate the threads.

13.3 Apparatus

13.3.1 Tensile testing machine, with a constant rate of traverse of 5,0 ± 0,3 mm/s and with flat clamps so that the individual threads can be aligned in parallel; a capacity range from 0 to 5 N is generally satisfactory. The use of a stress-strain recording paper is suggested.

13.3.2 Simpler apparatus may also be used, consisting of a **support** (hook or clamp) on which one of the two groups of threads may be hung, together with a **pan** which can be attached to the other set of threads and on which **weights** may be placed.

13.4 Test pieces

Each test piece shall be composed of a piece of an entire ribbon, approximately 500 mm long. (See note, sub-clause 13.6.)

13.5 Procedure

13.5.1 Separate all the threads at one end of the test piece for about 50 mm.

13.5.1.1 When using the apparatus described in 13.3.1, group together all the even-positioned and all the odd-positioned threads in two separate groups by placing alternate individual threads on masking tape in order, one after the other. Maintain the alignment of the individual threads.

Set the jaw separation on the testing machine at 75 mm.

Mount one set of threads in the upper jaw and the other set in the lower jaw, taking care to ensure parallel alignment of the threads. The free end of the ribbon shall be supported horizontally throughout the test.

Set the apparatus in motion, and record the average force required to separate the threads over a test length of 100 mm.

13.5.1.2 When using the apparatus described in 13.3.2, group together all the even-positioned and all the odd-positioned threads and knot the free ends. One of the two groups shall be hung from the support, leaving the other free for the attachment of the pan.

Apply force by adding weights of known mass to the pan until a slow but continuous separation for at least 50 mm of the ribbon is obtained.

13.5.2 During the test, note whether the separation takes place in a sufficiently uniform manner on all the front of the ribbon; any irregularities indicate different degrees of adhesion for different threads.

13.6 Expression of results

Express the degree of adhesion of the threads as the length of ribbon, in metres, whose weight is equivalent to the average separation force determined.

NOTE — In the case in which fractions of the entire ribbon, for example ten threads, are submitted to the test, the value of the degree of adhesion obtained will have to be multiplied by a correction factor which takes into account the different ratio in the two cases between the number of threads and the lines of adhesion, so that it may be compared with the value of the degree of adhesion for the entire ribbon. This ratio is expressed by the formula

$$\frac{(N-1)n}{(n-1)N}$$

where

N is the number of threads in the entire ribbon;

$N-1$ is the number of lines of adhesion in the entire ribbon;

n is the number of threads in the fraction of ribbon tested;

$n-1$ is the number of lines of adhesion in the fraction of ribbon tested;.

13.7 Test report

The test report shall state :

a) the identification of the ribbon tested;

b) the degree of adhesion, in metres;

c) whether the separation took place uniformly or not.

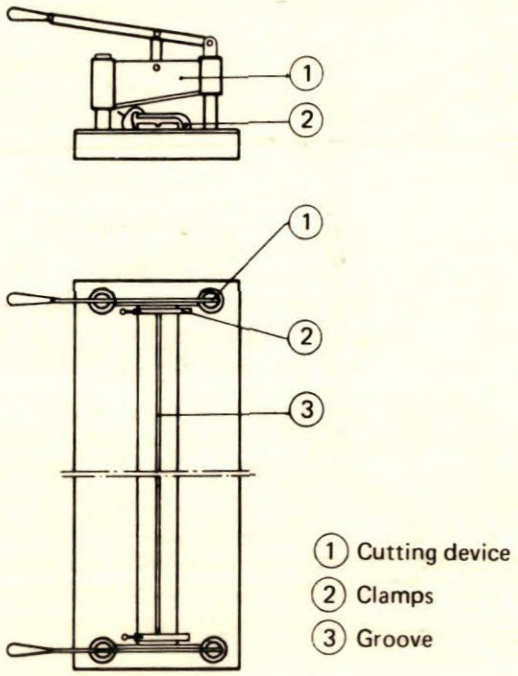


FIGURE 1 – **Apparatus for cutting test pieces** (Method A)

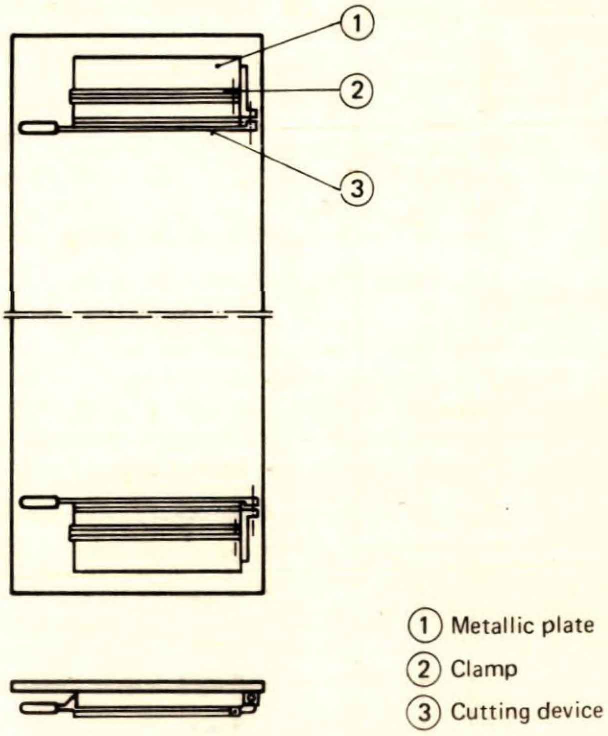


FIGURE 2 – **Apparatus for cutting test pieces** (Method B)

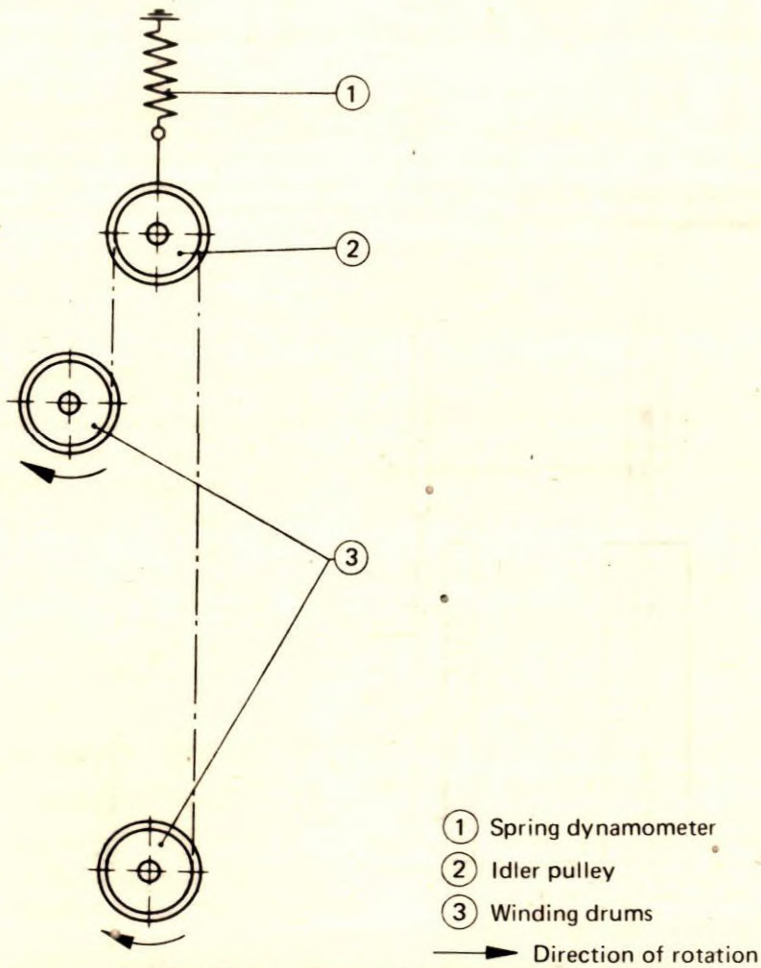
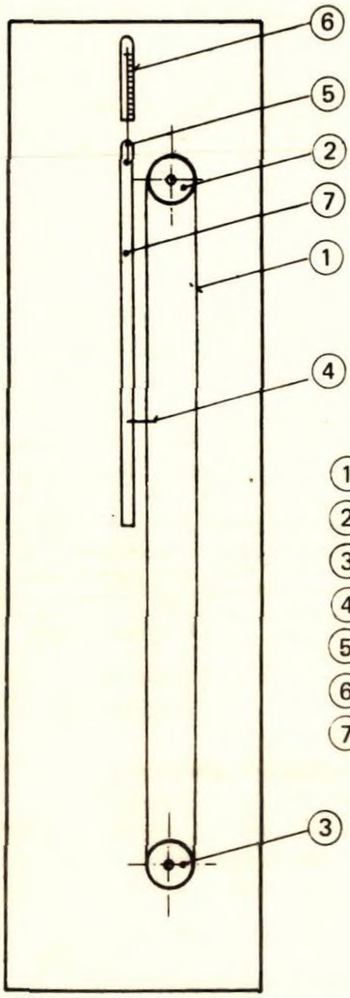
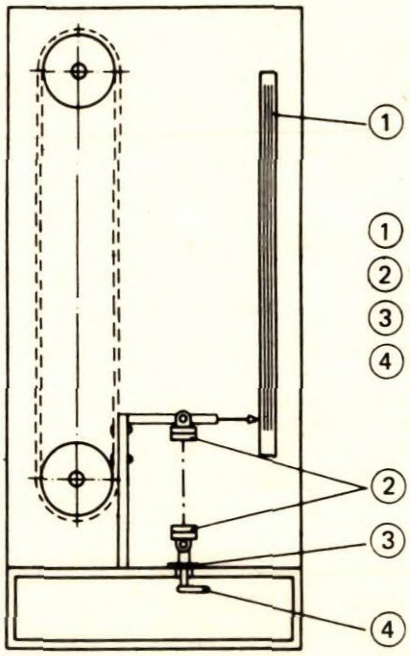


FIGURE 3 – **Apparatus for determination of tensile strength**



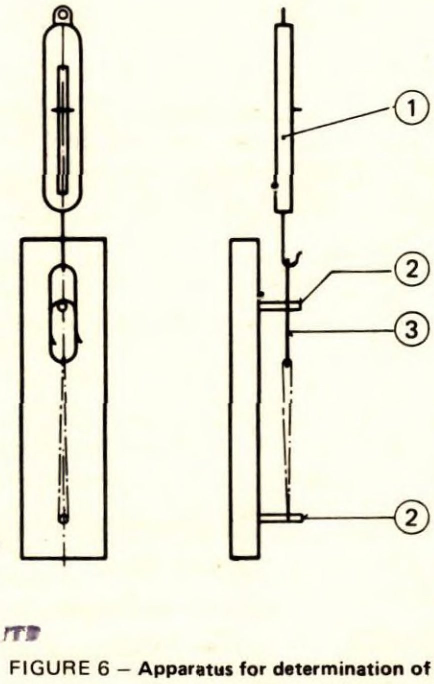
1. Endless chain
2. Sprocket
3. Driven sprocket
4. Hook
5. Hook
6. Spring dynamometer
7. Scale

FIGURE 4 – **Apparatus for determination of stress at pre-determined elongation**



1. Graduated scale
2. Clamps
3. Pan for weights
4. Electric switch

FIGURE 5 – **Apparatus for determination of elongation under a specified load**



1. Spring dynamometer
2. Pegs
3. Wire clip

FIGURE 6 – **Apparatus for determination of stress retention**

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Contract requirements
Attention is drawn to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

Revision of British Standards
British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. **It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.**

The following BSI references relate to the work on this standard:
Committee reference RUC/9 Draft for comment 75/71804 DC

Cooperating organizations

The Rubber Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

British Association of Synthetic Rubber Manufacturers
British Rubber Manufacturers' Association Limited
Department of Industry
*Malaysian Rubber Producers' Research Association
Ministry of Defence
Rubber & Plastics Research Association of Great Britain
Rubber Growers' Association
Society of Motor Manufacturers & Traders Limited
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The scientific organization marked with an asterisk in the above list, together with the following, was directly represented on the committee entrusted with the preparation of this British Standard.

Hosiery and Allied Trades Research Association
Narrow Fabrics Federation
Individual experts

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