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Methods of test for

Elastomeric threads

Part 2. Polyurethane thread (elastane yarn)

Méthodes d'essai des fils élastomériques
Partie 2. Fil de polyuréthane (filé d'élasthanne)

Prüfverfahren für Elastomerdrähte
Teil 2. Polyurethandraht (Elasthangarn)

British Standards Institution

Gr 5

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Foreword

This British Standard has been prepared under the direction of the Rubber Standards Committee.

Polyurethane thread (elastane yarn) is manufactured elastomeric fibre, in which the fibre-forming substance is a long chain synthetic polymer which consists of at least 85 % of a segmented polyurethane (see BS 4815).

It should be noted that direct comparisons may be made only on new polyurethane threads or those of identical processing histories. In the interpretation of results concerning threads that have been subjected to spooling, fabrication, or other processes, the previous history is important, and what is known of this and any relaxation treatments used should be stated.

Attention is drawn to Part 1 of this standard which covers methods of test intended primarily for natural or synthetic polyisoprene rubber thread.

For users of this standard who may not be familiar with the International System of units (SI) as applied in these methods, the following explanations may be helpful.

(a) newton (N)
The newton (N) is the unit of force. One newton (1 N) is the force which, when applied to a body having a mass of one kilogram (1 kg), imparts to it an acceleration of one metre per second squared (1 m/s^2).

(b) tex
Tex is the unit of linear density used in the textile industry. A fibre which has a mass of M grams per 1000 metres of length is said to have a linear density of M tex. 1 tex = 10^{-6} kg/m.

(c) centinewton per tex (cN/tex)
The centinewton per tex (cN/tex) is the unit used to quantify all expressions of force per linear density (breaking load and pretension).

For further explanation, reference should be made to BS 3763 and to PD 5686.

The methods in this Part of BS 5421 have been submitted for consideration to Technical Committee ISO/TC 45 – Rubber and Rubber Products, of the International Organization for Standardization (ISO).

British Standard Methods of test for

Elastomeric threads

Part 2. Polyurethane thread (elastane yarn)

1. Scope

This Part of BS 5421 describes eight methods of test for polyurethane thread (elastane yarn):

method 1 Preparation of test specimens;
method 2 Determination of mass per unit length;
method 3 Determination of breaking load, tenacity and elongation at break;
method 4 Determination of load at predetermined elongation;
method 5 Determination of stress decay;
method 6 Determination of set;
method 7 Resistance to copper staining during laundering;
method 8 Resistance to atmospheric fume staining.

2. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3. Method 1: preparation of test specimens

The samples or test specimens shall be kept in a relaxed state in the dark in an atmosphere with a temperature of 20 ± 2 °C and a relative humidity of 65 ± 5 %, for not less than 16 h before test. The tests shall be carried out in the same atmosphere. The test specimens selected shall be clean, dry, and free from any visible defects. Samples or test specimens that are to be exposed to ageing or wet treatment shall not be allowed to come into contact with copper or manganese or with their alloys or compounds during preparation or testing.

When the yarn is taken from a package, care should be exercised to see that the thread is not elongated. It is desirable that the sample for use in method 3 (determination of breaking load, tenacity and elongation at break) should be cut from pieces of yarn on which the determination of mass per unit length (method 2) has been made.

4. Method 2: determination of mass per unit length

4.1 Introduction. This method is intended for threads in the 'as received' condition, but may be used for treated threads provided that the treatment is specified. The method does not cover finish removal procedures to determine the mass per unit length of 'finish free' threads. Owing to the complexity of the methods existing for accurate determination of thread finish, e.g. infra-red analysis, it is deemed best that information with regard to finish content should be supplied by the thread manufacturer.

The value of mass per unit length, determined by the following method, may be used in conjunction with other physical tests provided that the samples or test specimens have not been heated or subjected to other forms of handling that might change their mass per unit length.

4.2 Definition. For the purposes of this method the following definition applies.

mass per unit length. The quotient obtained by dividing the mass of the thread by its length, the preferred units of measurement being in grams per 1000 metres (tex).

4.3 Sampling. Cut a minimum of five specimens to approximately 1.5 m each in length. If these samples are taken from bobbins, or from any other form of presentation in which the thread is under tension, allow them to relax for at least 48 h under the conditions specified in clause 3. Samples taken from forms of presentation where no tension is applied to the thread shall be conditioned as specified in clause 3.

4.4 Apparatus (see figure 1). The following apparatus is required.

4.4.1 *A rectangular vertical frame.*

4.4.2 *Two metallic plates,* mounted at the upper and lower ends of the frame; the inside edges shall be parallel and sharp, and the distance between them shall be 1000 ± 1 mm.

4.4.3 *Two cutting devices,* the fixed blades of which consist of the inside edges of the metallic plate.

4.4.4 *Two external clamps,* of a spring loaded type.

4.5 Procedure. Take the specified number of samples of thread, and cut and condition them as specified in **4.3.** 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. Then cut the thread to 1000 ± 1 mm in length with the two cutting devices, using the lower one first.

4.6 Weighing of test specimens. Weigh each test specimen separately to three significant figures.

4.7 Calculation. Calculate the average mass of the test specimens. The average mass per unit length in tex is equal to the average mass of the 1000 mm lengths in mg.

4.8 Test report. The test report shall include the following information:

(a) identification of the thread;

(b) number of specimens tested;

(c) average mass per unit length (in tex);

(d) a reference to this British Standard, i.e. BS 5421 : Part 2, method 2.

5. Method 3: determination of breaking load, tenacity and elongation at break

5.1 Principle. A thread specimen is placed in the clamps of a tensile testing machine and is stretched until broken; the breaking force and elongation are then observed.

5.2 Definitions. For the purposes of this method the following definitions apply.

5.2.1 breaking load. The maximum force which a test specimen can support during a test of loading to break under defined conditions. The preferred units for breaking load are the centinewton (cN) (for yarns and fibres) and the decanewton (daN) (for cords).

5.2.2 tenacity. The breaking load, expressed as force per mass per unit length of the unstrained specimen, i.e. cN/tex.

5.2.3 elongation. The increase in length of a stretched specimen, expressed as a percentage of the original length.

5.2.4 elongation at break. The elongation corresponding to the breaking load.

5.3 Apparatus. The following apparatus is required.

5.3.1 *Tensile testing machine* of the constant rate of extension type, with an autographic recorder. The tensile testing machine shall be of the low inertia type, in accordance with BS 5214 : Part 1, having an accuracy of force measurement of grade B and an extensometer accuracy of grade D. The force capacity shall be such that the thread ruptures within 15 % to 85 % of the selected scale range. A machine with a capacity ranging from 10 cN to 2000 cN is usually adequate.

5.3.2 *Tensioning weight* to provide pretensioning of the thread at 0.003 ± 0.001 cN/tex.

5.3.3 *Clamping assembly.* Line contact clamps, one jaw having a flat steel face (nominally 25 mm × 25 mm) and the other jaw having a convex 3 mm radius steel face (nominally 25 mm × 6 mm).

5.3.4 *Rubber tubing* of 1.6 mm nominal bore, 0.8 mm wall thickness and rubber hardness less than 45 IRHD.

5.3.5 *Needle threader* or other means for passing the thread through the rubber tubing.

5.4 Sampling. A minimum of five specimens (see clause **3**) shall be tested.

5.5 Procedure. Take representative test specimens of known mass per unit length (see clause **4**) and cut each one to approximately 125 mm in length. Adjust the tensile testing machine as follows.

Gauge length : 50 ± 0.5 mm
Cross head speed : 500 mm/min
Chart speed : 500 mm/min

Locate the clamps so that the convex surfaces are in a horizontal plane. (See figure 2.)

Cut two pieces of rubber tubing each approximately 12.5 mm long. Thread the test specimen through one piece of tubing using the needle threader so that approximately 25 mm of thread extends beyond one end of the tubing. Grasp the threaded tubing with forceps and place it in the central part of the top clamp so that approximately 6 mm of tubing and 90 mm of the thread are below the contact point. Close the top clamp. Thread the free end through the second piece of tubing and place the tubing in the lower clamp directly beneath the upper tubing, with approximately 6 mm of tubing above the clamp.

Attach a tensioning weight, equivalent to 0.003 ± 0.001 cN/tex, to the thread below the lower clamp. Close the lower clamp and remove the tensioning weight.

Select the range of the tensile testing machine so that the estimated breaking force required to rupture the thread falls between 15 % and 85 % of the full scale deflection. Start the machine, observe and record the breaking force and elongation. If a specimen breaks within the rubber tubing disregard the result and test another specimen. (During the testing of multifilament thread, the first filament break should be recorded.)

5.6 Calculation

5.6.1 *Breaking load.* Read the breaking force directly from the chart.

5.6.2 *Tenacity.* Calculate the average tenacity (in cN/tex) from the following expression:

$$\text{tenacity} = \frac{\text{average breaking force (in cN)}}{\text{mass per unit length (in tex)}}$$

5.6.3 *Elongation at break.* Read the elongation at maximum force from the force elongation chart. Calculate the percent elongation on the basis of the nominal gauge length.

5.7 Test report. The test report shall include the following information:

(a) the make and model of testing machine used;

(b) the number of specimens tested;

(c) the individual values and the average values for the breaking force, tenacity and elongation at break;

(d) a reference to this British Standard, i.e. BS 5421 : Part 2, method 3.

6. Method 4: determination of load at predetermined elongation

6.1 Principle. The thread is cycled six times to an elongation greater than that at which readings will be taken and the force/elongation curve is recorded on the sixth cycle.

6.2 Definition. For the purposes of this method the following definition applies.

load at a predetermined elongation. The tensile force exerted by the thread at a specified elongation which is measured on extension (stretch resistance) and retraction (recovery power). The results are expressed in centinewtons for a given mass per unit length.

6.3 Apparatus. The following apparatus is required.

6.3.1 *Tensile testing machine* of the constant rate of extension type, with an autographic recorder. The tensile testing machine shall be of the low inertia type, in accordance with BS 5214 : Part 1, having an accuracy of force measurement of grade B and an extensometer accuracy of grade D. The force capacity shall be such that the maximum force during cycling falls within 15 % to 85 % of the selected scale range. A machine with a capacity ranging from 10 cN to 2000 cN is usually adequate.

6.3.2 *Tensioning weight* to provide pretensioning of the thread at 0.003 ± 0.001 cN/tex.

6.3.3 *Clamping assembly.* Line contact clamps, one jaw having a flat steel face (nominally 25 mm × 25 mm) and the other jaw having a convex 3 mm radius steel face (nominally 25 mm × 6 mm).

6.3.4 *Rubber tubing* of 1.6 mm nominal bore, 0.8 mm wall thickness and rubber hardness less than 45 IRHD.

6.3.5 *Needle threader* or other means for passing the thread through the rubber tubing.

6.4 Sampling. A minimum number of five specimens (see clause **3**) shall be tested.

6.5 Procedure. Take representative test specimens of known mass per unit length (see clause **4**) and cut each one to approximately 125 mm in length. Adjust the tensile testing machine as follows.

Gauge length : 50 ± 0.5 mm
Cross head speed : 500 mm/min
Chart speed : 500 mm/min

Select the force range so that the maximum force during cycling occurs between 15 % and 85 % of full scale capacity.

Adjust the machine so that the specimen is cycled between zero and a predetermined elongation.

Mount the thread specimens in the jaw clamps as specified in **5.5**.

Give each specimen six cycles of elongation and retraction without interruption, to the predetermined elongation.

6.6 Calculation. Read from the chart the force in centinewtons at selected elongations on the load and retraction curves of the sixth cycle. It is recommended that elongations should be chosen in multiples of 50 %.

6.7 Test report. The test report shall include the following information:

(a) identification of the thread;

(b) the predetermined cycling elongation;

(c) the individual values and the average value for the stretch resistance reported as the force at each selected elongation on the extension curve;

(d) the individual values and the average value for the force at the predetermined cycling elongation;

(e) the individual values and the average value for the recovery power reported as the force at each selected elongation on the recovery curve;

(f) a reference to this British Standard, i.e. BS 5421 : Part 2, method 4.

7. Method 5: determination of stress decay

7.1 Principle. The thread is extended and held at a predetermined elongation, and the force is measured initially and after a specified time.

7.2 Definition. For the purposes of this method the following definition applies.

stress decay. The decrease in tensile force that occurs when a specimen is held at a constant extension, expressed as a percentage of the original force at that extension.

7.3 Apparatus. The following apparatus is required.

7.3.1 *Tensile testing machine* of the constant rate of extension type, with an autographic recorder. The tensile testing machine shall be of the low inertia type, in accordance with BS 5214 : Part 1, having an accuracy of force measurement of grade B and an extensometer accuracy of grade D. The force capacity shall be such that the maximum force during cycling falls within 15 % to 85% of the selected scale range. A machine with a capacity ranging from 10 cN to 2000 cN is usually adequate.

7.3.2 *Tensioning weight* to provide pretensioning of the thread at 0.003 ± 0.001 cN/tex.

7.3.3 *Clamping assembly.* Line contact clamps, one jaw having a flat steel face (nominally 25 mm × 25 mm) and the other jaw having a convex 3 mm radius steel face (nominally 25 mm × 6 mm).

7.3.4 *Rubber tubing* of 1.6 mm nominal bore, 0.8 mm wall thickness and rubber hardness less than 45 IRHD.

7.3.5 *Needle threader* or other means for passing the thread through the rubber tubing.

7.4 Sampling. A minimum of five specimens (see clause **3**) shall be tested.

7.5 Procedure. Follow the procedure specified in **6.5** modified as follows.

Carry out five cycles of elongation and retraction, without interruption, to an elongation of 300 %. On the sixth cycle, hold the specimen in the extended state for 5 min with the chart still running before returning the cross head. From the graph read off the force at peak, at 30 s and at 5 min.

7.6 Calculation. Calculate the following quantities.

(a) Stress decay after 30 s,

$$\frac{F_1 - F_2}{F_1} \times 100$$

(b) Stress decay between 30 s and 300 s,

$$\frac{F_2 - F_3}{F_2} \times 100$$

where

F_1 is the maximum force

F_2 is the force after 30 s at maximum extension on the sixth cycle

F_3 is the force after 5 min of maximum extension on the sixth cycle

7.7 Test report. The test report shall include the following information:

(a) identification of the thread,

(b) the individual values and the average value for the stress decay after 30 s,

(c) the individual values and the average value for the stress decay between 30 s and 5 min;

(d) a reference to this British Standard, i.e. BS 5421 : Part 1, method 5.

8. Method 6: determination of set

8.1 Definition. For the purposes of this method the following definition applies.

set. Measure of the increase in the relaxed length of the thread resulting from stretching and relaxing under specified conditions.

8.2 Apparatus. The following apparatus is required.

8.2.1 *Tensile testing machine* of the constant rate of extension type, with an autographic recorder. The tensile testing machine shall be of the low inertia type, in accordance with BS 5214 : Part 1, having an accuracy of force measurement of grade B and an extensometer accuracy of grade D. The force capacity shall be such that the thread ruptures within 15 % to 85 % of the selected scale range. A machine with a capacity ranging from 10 cN to 2000 cN is usually adequate.

8.2.2 *Tensioning weight* to provide pretensioning of the thread at 0.003 ± 0.001 cN/tex.

8.2.3 *Clamping assembly.* Line contact clamps, one jaw having a flat steel face (nominally 25 mm × 25 mm) and the other jaw having a convex 3 mm radius steel face (nominally 25 mm × 6 mm).

8.2.4 *Rubber tubing* of 1.6 mm nominal bore, 0.8 mm wall thickness and rubber hardness less than 45 IRHD.

8.2.5 *Needle threader* or other means for passing the thread through the rubber tubing.

8.3 Sampling. A minimum of five specimens (see clause **3**) shall be tested.

8.4 Procedure. Follow the procedure specified in **6.5**, modified as follows.

On completion of the sixth cycle, wait 30 s and adjust the cross head manually until visible slack is just removed from the specimen. Record the residual elongation (E) at this point.

8.5 Calculation. Calculate the set after the sixth cycle for each specimen as follows:

$$\text{Percentage set} = \frac{E}{G} \times 100$$

where

E is the residual elongation as indicated in **8.4**

G is the gauge length.

8.6 Test report. The test report shall include the following information:

(a) identification of the thread;

(b) the individual values and the average value for the percentage set;

(c) a reference to this British Standard, i.e. BS 5421 : Part 2, method 6.

9. Method 7: Resistance to copper staining during laundering

9.1 Introduction. This method is intended to determine the amount of staining caused to adjacent textile materials and the amount of discoloration of a polyurethane thread when it is washed in water containing dissolved copper salts.

This test has only a comparative value, and may not indicate the exact performance of a thread in service because of the wide variation of copper contents of domestic water supplies.

9.2 Principle. The thread under test is placed in intimate contact with textile fabrics and heated in a wash solution containing a known concentration of dissolved copper. The amounts of staining and discoloration are determined by visual inspection of the samples after the test, using the grey scales specified in BS 2662 and BS 2663.

9.3 Reagents. The following reagents are required.

9.3.1 *Standard copper solution.* Dissolve 3.982 g of copper sulphate ($CuSO_4.5H_2O$) in copper-free distilled water, add 100 ml of 0.880 ammonium hydroxide solution and make up to 1 litre with distilled water. This solution contains 0.001 g/ml of copper which is equivalent to 0.1 %.

9.3.2 *Sodium dodecylbenzenesulphonate* or

9.3.3 *Standard soap solution.* Prepare the soap solution by dissolving 10 g of copper-free sodium hydroxide in 100 ml of copper-free distilled water and adding 500 ml of near-boiling distilled water. Stir in 70.5 g of copper-free oleic acid warmed to 70 °C. When frothing has died down and the solution is cool, transfer it to a volumetric flask and make up to 1 litre with distilled water.

9.4 Apparatus and materials. The following apparatus and materials are required.

9.4.1 *Aluminium plates,* 50 mm × 50 mm × 3 mm.

9.4.2 *Beakers* of 250 ml capacity.

9.4.3 *Thermometer* with a scale covering 0 °C to 100 °C in divisions of 0.2 °C.

9.4.4 *Volumetric flasks,* of 1000 ml capacity.

9.4.5 *Pipettes,* of 1 ml and 5 ml capacity.

9.4.6 *Grey scale* complying with the requirements of BS 2662 for assessing change in colour (see BS 2662C).

9.4.7 *Grey scale* complying with the requirements of BS 2663 for assessing staining (see BS 2663C).

9.4.8 *Textile fabric samples.* These may be either individual samples of white acetate, cotton, nylon and viscose fabrics, yarns, or multifibre fabric swatches, preferably 62 mm × 62 mm.

NOTE. The multifibre fabric swatch consists of strips of acetate, cotton, nylon, polyester, acrylic and wool, and may be obtained from Wentworth Instruments, North Green, Datchet, Slough SL3 9JH

9.5 Test pieces. The test pieces shall consists of 0.5 g to 1.0 g of uncovered polyurethane thread.

9.6 Preparation of test specimens (polyurethane thread plus other textile materials)

9.6.1 *General.* The test specimens shall consist of an intimate assembly of the polyurethane thread under test and the various fabrics or yarns. The methods specified in **9.6.2** to **9.6.4** should be used, depending on the fabric specimens available.

9.6.2 *Individual samples of textile fabric.* Take 0.5 g to 1.0 g of polyurethane thread and form it into a skein or hank approximately 75 mm in length. Place the skein on a piece of acetate fabric and place a piece of cotton fabric over the top. Roll at right angles to the skein length to form a cylinder, and tie by wrapping with cotton thread. Repeat for nylon and viscose fabrics.

9.6.3 *Individual textile yarns.* Form skeins of all the yarns and the polyurethane thread on a textile 'wrap reel'. Cut each skein and take one cut end of the polyurethane, acetate and cotton skeins and tie together with cotton thread. Plait the three components together into an intimate assembly for a distance of approximately 75 mm and tie off as for the starting end. Make a second plaited assembly for the polyurethane, nylon and viscose yarns.

9.6.4 *Multifibre fabric swatches,* Place a multifibre fabric swatch around an aluminium plate. Wrap 0.5 g to 1.0 g of polyurethane thread on top of the fabric so that it crosses each of the fibres snugly but with a minimum of tension.

9.7 Procedure

9.7.1 Prepare a fresh test solution by diluting 5 ml of the standard copper solution (see **9.3.1**) to 1 litre with distilled water.

9.7.2 Place 200 ml of the test solution in a 250 ml beaker and add either 1 g of sodium dodecylbenzenesulphonate, (see **9.3.2**) or 1 ml of standard soap solution (see **9.3.3**).

9.7.3 Raise the temperature of the test solution to 70 ± 2 °C and add the test specimens. Maintain at this temperature for 30 min with occasional stirring.

9.7.4 Remove the test specimens, rinse with cold distilled water and drain. Allow to dry in air at 23 °C on a watch glass.

9.7.5 Remove the polyurethane thread from the textile

samples and assess any staining of the textiles as specified in BS 2663 and any discoloration of the polyurethane thread as specified in BS 2662.

9.7.6 Carry out a separate test for each sample of polyurethane thread.

9.8 Test report. The test report shall include the following information:

(a) identification of the thread;

(b) the numerical rating for the staining of each fabric, using the grey scale specified in BS 2663;

(c) the numerical rating for the discoloration of the thread, using the grey scale specified in BS 2662;

(d) if no staining or discoloration is evident, report the thread as non-staining;

(e) a reference to this British Standard, i.e. BS 5421 : Part 2, method 7.

10. Method 8: resistance to atmospheric fume staining

10.1 Introduction. This method is intended to determine the resistance of polyurethane thread to discoloration when exposed to oxides of nitrogen in a test chamber. This effect is also known as gas fume fading.

The method is based on a test developed by the Society of Dyers and Colourists and simulates the conditions encountered when a thread is exposed to the combustion products of burnt fuels in the atmosphere.

10.2 Principle. A specimen of the polyurethane thread is exposed to nitrogen oxides in a closed container until a dyed textile control specimen, exposed simultaneously, has changed colour to a predetermined extent. The change in colour of the specimen is assessed by reference to the standard grey scale.

10.3 Reagents. The following reagents are required.

10.3.1 *Calcium chloride solution* containing 300 g/l of $CaC1_2$.

10.3.2 *Freshly prepared phosphoric acid solution* containing 500 g/l of phosphoric acid (ρ = 1.75 g/ml).

10.3.3 *Freshly prepared sodium nitrite solution* containing 7 g/l of $NaNO_2$.

10.3.4 *Urea solution* containing 10 g/l of $NH_2.CO.NH_2$, buffered at pH 7 by the addition of 2 g/l of sodium dihydrogen orthophosphate (NaH_2PO_4, $2H_2O$) and 1.25 g/l of *di*sodium hydrogen orthophosphate (Na_2HPO_4, $12H_2O$).

10.4 Apparatus and materials. The following apparatus and materials are required.

10.4.1 *Exposure chamber.* A suitable apparatus is shown in figure 3 and consists of a glass or plastics chamber of 3 litre to 20 litre capacity in which are placed:

(a) basins containing calcium chloride solution to maintain the relative humidity at 65 %;

(b) a basin containing a mixture of phosphoric acid and sodium nitrite for generating nitrogen oxides;

(c) a small fan for circulating the nitrogen oxides;

(d) a frame for suspending the specimens (this frame may be rotated, in which case the fan may be dispensed with).

10.4.2 *Blue test control* (see note). A dyeing of Celliton Blue FFRN (C I Disperse Blue 3) on secondary cellulose acetate satin.

10.4.3 *Standard of fading* (see note). Viscose satin dyed with vat dyes to match a faded specimen of the test control, the contrast between the standard of fading and the test control being approximately equal to grade 2 of the grey scale (see **10.4.4**) for assessing change in colour. To facilitate comparison with the test control, the standard of fading may be sealed in a transparent polyethylene bag and placed in the chamber.

10.4.4 *Grey scale* complying with the requirements of BS 2662 for assessing change in colour (see BS 2662C).

NOTE. Both the test control (see **10.4.2**) and the standard of fading (see **10.4.3**) are prepared by the American Association of Textile Chemists and Colorists and can be obtained from Wentworth Instruments, North Green, Datchet, Slough JL3 9JH.

10.5 Test specimens

10.5.1 Wind a hank of 0.5 ± 0.1 g on a textile wrap reel or similar device; after removal, fold the large diameter skein into a very much smaller one of about 100 mm circumference and lightly tie in position, using undyed cotton thread.

10.5.2 Cut a specimen 5 cm × 4 cm of the test control dyeing (see **10.4.2**).

10.6 Procedure

10.6.1 Place the thread specimen (and, if necessary, additional thread of the same type) and the test control specimen on the arms of the apparatus, so that the combined mass of the thread specimen and the test control specimen is 0.4 + 0.1 g per litre of exposure chamber capacity.

10.6.2 Place basins containing calcium chloride solution (see **10.3.1**) on the floor of the exposure chamber, the surface area of the solution being 15 ± 1.5 cm^2 per litre of chamber capacity and the volume 10 ml per litre of chamber capacity; place the exposure chamber in position. Switch on the fan or the rotating frame and allow the specimens to condition at 20 ± 2 °C for 1 h.

10.6.3 Pipette 0.3 ml of phosphoric acid solution (see **10.3.2**) per litre of chamber capacity into the upper basin, followed by 0.3 ml of sodium nitrite solution (see **10.3.3**) per litre of chamber capacity; ensure that the two solutions are thoroughly mixed; close the chamber immediately, switch on the fan or the rotating frame, and shield the chamber from bright light.

10.6.4 Observe the thread specimen and the test control specimen, and remove them from the chamber when the test control specimen has faded to the same shade as the standard of fading (see **10.4.3**).

10.6.5 Fix the test control specimen and the thread specimen by immersion in buffered urea solution (see **10.3.4**).

10.6.6 Immerse an unexposed skein of polyurethane thread in the urea solution at the same time.

10.6.7 After immersion in the urea solution for 5 min, squeeze the skein, and dry in air at a temperature not exceeding 60 °C.

10.6.8 Assess the change in colour of the specimen against the portion of the original thread that has been treated with urea by reference to the grey scale (see **10.4.4**).

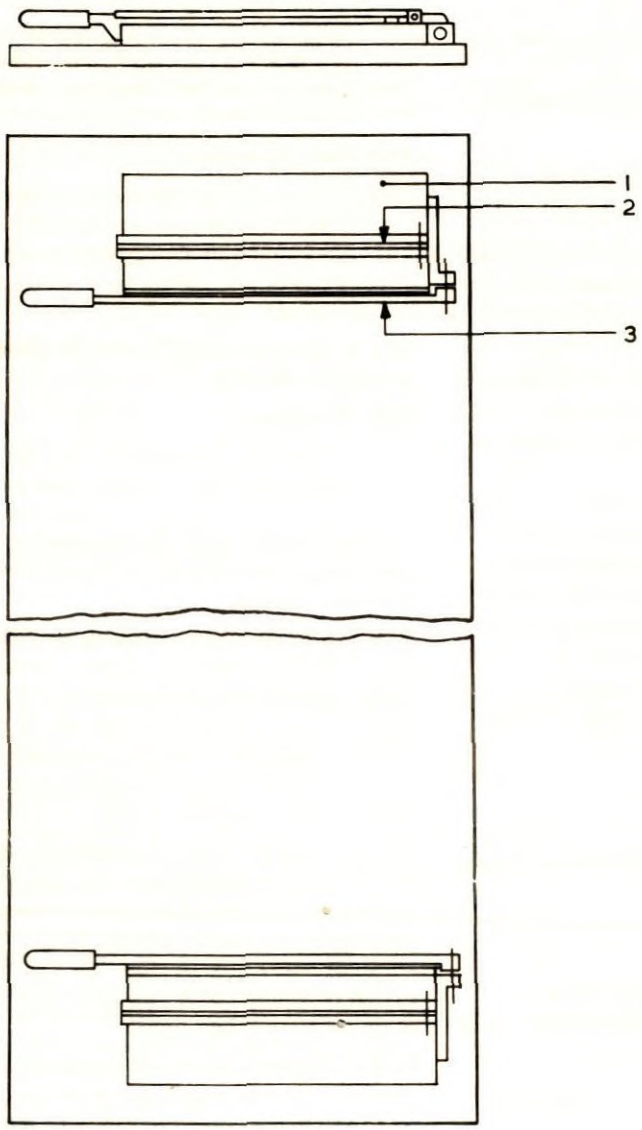
NOTE. Whilst this test should be adequate for most purposes, it may be desirable to submit specimens that are unchanged on completion of the test to a maximum of five cycles. In such cases, a thread specimen should be repeatedly exposed, omitting the treatment with urea, until the test control specimen (**10.4.2**) shows a contrast at least equal to grade 4 of the grey scale. The thread specimen should then be treated with urea, dried and assessed as specified in **10.6.8.** The report should state the number of cycles and the numerical rating.

10.7 Test report. The test report shall include the following information:

(a) identification of the thread;

(b) the numerical rating for the discoloration of the test specimen using the grey scale specified in BS 2662;

(c) a reference to this British Standard, i.e. BS 5421 : Part 2, method 8.



1. Metallic plate
2. Clamp
3. Cutting device

Figure 1. Method 2: apparatus for cutting test pieces

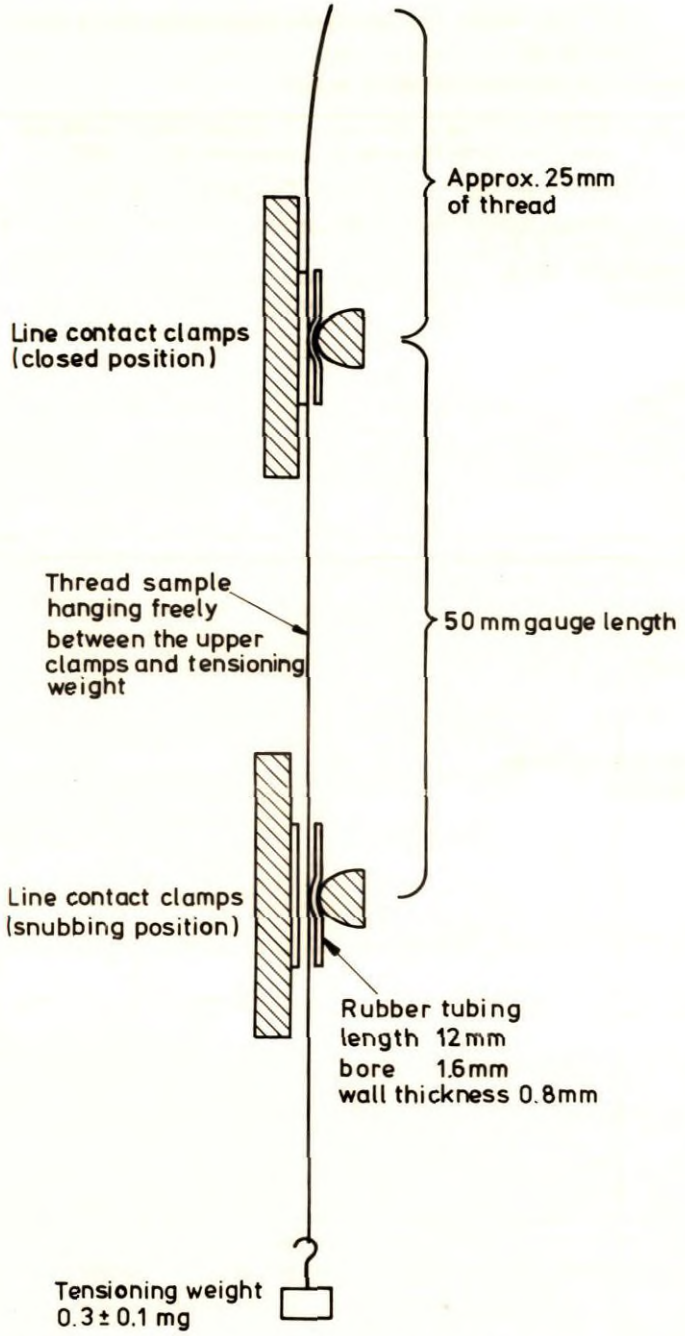


Figure 2. Method 3: recommended method of positioning, tensioning, and clamping a polyurethane thread in the tensile testing machine

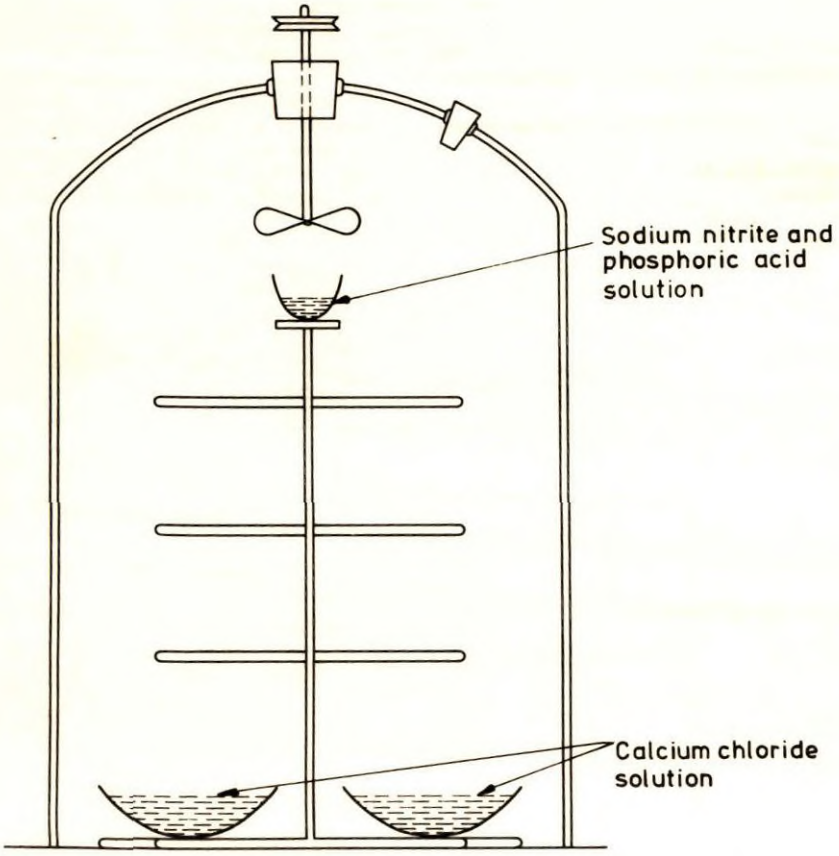


Figure 3. Method 8: suitable apparatus for determining resistance to atmospheric fume staining

Standards publications referred to

BS 2662	Grey scale for assessing change in colour
BS 2662C	Geometric grey scale for assessing the effect on the pattern in fastness testing
BS 2663	Grey scale for assessing staining
BS 2663C	Geometric grey scale for determining the degree of staining in fastness testing
BS 3763*	The International System of units (SI)
BS 4815*	Glossary of generic names for man-made fibres
BS 5214	Testing machines for rubbers and plastics Part 1 Tensile, flexural and compression machines
BS 5421*	Methods of test for elastomeric threads Part 1 Rubber threads [ISO 2321]
PD 5686*	The use of SI Units

* Referred to in the foreword only

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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/39 Draft for comment 76/50177 DC

Cooperating organizations

The Rubber Standards Committee, under whose direction 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
Department of Industry (Chemicals and Textiles)
Institution of Production Engineers
*Malaysian Rubber Producers' Research Association
Ministry of Defence
Rubber and Plastics Research Association of Great Britain
Rubber Growers' Association
Society of Motor Manufacturers and Traders Limited

The 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:

British Man-made Fibres Federation
Hosiery and Allied Trades Research Association
Narrow Fabrics Federation
Individual experts

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