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Rubber threads — Methods of test

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National foreword

This British Standard is the UK implementation of ISO 2321:2017. It supersedes BS 5421-1:1976 which is withdrawn.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

This fourth edition cancels and replaces the third edition (ISO 2321:2006), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clause 3 has been added to list all the terms and definitions;

— the distance between cutting blades in Figure 1 has been added;

— the tensile testing of type A rings in Figure 2 has been added and all the figure numbers have been updated;

— a new test, namely tension set, has been added in Clause 13;

— the clause numbers in Table 1 and Table 2 have been updated;

— the unit of density has been changed from megagram per cubic metre (Mg/m^3) to gram per cubic centimetre (g/cm^3).

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Rubber threads — Methods of test

1 Scope

This document specifies methods of test for determining general physical and mechanical properties of rubber threads, as well as specific mechanical properties of such threads in contact with fabrics. 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 document are not entirely suitable for threads made from certain synthetic rubbers (e.g. urethane rubber). These tests are intended for natural or synthetic polyisoprene rubbers.

Comparisons can 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, the previous history is important, and what is known of this and of any relaxation treatments used is intended to be reported.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-A03, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining*

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 648, *Laboratory glassware — Single-volume pipettes*

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
metric yield
unstretched length, in metres, of 1 000 g of the thread

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3.2
density
<of thread> mass per unit volume of a test piece of thread measured at a standard laboratory temperature

Note 1 to entry: It is expressed in grams per cubic centimetre.

Note 2 to entry: The standard laboratory temperatures are given in ISO 23529.

3.3
tensile strength
stress at which the thread breaks when it is stretched under specified conditions, based on the initial cross-sectional area

Note 1 to entry: The value is expressed in megapascals (1MPa = 1N/mm^2).

3.4
modulus at 300 % and 500 %
stress calculated with respect to the original cross-sectional area, at 300 % and 500 % elongation

Note 1 to entry: It is measured in megapascals (1MPa = 1N/mm^2).

3.5
elongation at break
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

EXAMPLE A test piece, 30 mm in length which increases in length to 210 mm at break, is said to give an elongation of 600 % at break.

3.6
Schwartz value
average of the stresses calculated with respect to the original cross-sectional area at a specified elongation measured on extension and retraction of a previously massaged (mechanically conditioned) thread

Note 1 to entry: It is expressed in megapascals (1MPa = 1N/mm^2).

Note 2 to entry: It is denoted by the abbreviated term, SV_n^c, where c is the massaging elongation (the elongation to which the test piece is stretched during mechanical conditioning) and n the elongation at which the readings are taken. Both c and n are expressed as percentages of the initial length as multiples of 100 and, unless otherwise specified, are chosen so that $c = n + 100$.

Note 3 to entry: The preferred values of n are 300 % and 500 %, depending on the type of thread under test.

3.7
Schwartz hysteresis ratio
ratio of the loads at a specified elongation measured on extension and retraction, after massaging (mechanical conditioning)

Note 1 to entry: It is denoted by the abbreviated term, SHR_n^c, where c is the massaging elongation (the elongation to which the test piece is stretched during mechanical conditioning) and n the elongation at which readings are taken. Both c and n are expressed as percentages of the initial length as multiples of 100 and, unless otherwise specified, are chosen so that $c = n + 100$.

Note 2 to entry: The preferred values of n are 300 % and 500 %, depending on the type of thread under test.

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3.8
elongation under specified load
percentage elongation of a rubber thread when stressed by the application of a specified load per unit area

Note 1 to entry: It is determined by applying a load to an unmassaged thread (i.e. a thread which has not been mechanically conditioned) and so is liable to be affected by the age and previous history (including storage history and any conditioning) of the thread.

Note 2 to entry: It is normally determined at two levels of applied force: 15,5 kPa (= 15,5 mN/mm^2) and 27,4 kPa (= 27,4 mN/mm^2).

3.9
stress retention
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

3.10
tension set
elongation remaining in a test piece in the relaxed condition after it has been subjected to a constant elongation at a specified time, expressed as a percentage of the elongation

3.11
discoloration
change in the original shade of a product, resulting from outside influences

3.12
colour staining
undesired pick-up of colour by a fabric

a) when immersed in water, dry-cleaning solvent or a similar liquid medium, which contains dyestuffs or colouring material not intended for colouring the fabric;

b) by direct contact with other dyed material from which colour is transferred by bleeding or sublimation

4 Conditioning of samples or test pieces

The samples or test pieces shall be kept in a relaxed state in one of the standard atmospheres described in ISO 23529, 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 of their compounds during conditioning or testing.

5 Count

5.1 Sectional count

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

The sectional count corresponds to the tex count for a nominal density of 1 g/cm^3. The use of the sectional count is recommended.

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5.2 Conventional count (size number)

5.2.1 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, in millimetres, of the thread.

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

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, whose diameter is equal to 0,254 mm: In the case of a square thread, the number 40 is the conventional count of a thread whose sides are equal to 0,635 mm.

5.2.2 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).

EXAMPLE A round thread of count 50 is indicated by 50/56.

5.2.3 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.

EXAMPLE 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 by 3/32/36.

5.3 Apparatus

See Figure 1.

The apparatus for cutting the test pieces consists of a rectangular vertical frame at the upper and lower ends of which are mounted two metallic plates whose inside edges are parallel and sharp. Two cutting devices (the fixed blade of which consists of the inside edge of the metal 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 metal plates shall be 100 mm ± 1 mm.

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