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Second edition

Textiles — Unevenness of textile strands — Capacitance method

Textiles — Irrégularité des fils textiles — Méthode capacitive

PROOF/ÉPREUVE

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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).

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

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

This second edition cancels and replaces the first edition (ISO 16549:2004), which has been technically revised.

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

— correction of the description of test specimen length in 3.6 and 4.5;

— correction of the description of mass "normal" ("Gaussian") distribution in 4.7;

— correction of the description of the measuring device in 5.2 and 8.3;

— description of a method for optimum twist application on multi-filament yarns in 5.2;

— designation of twisting device speed (if twist was applied) in Clause 10.

— review of grammar and linguistic consistency of definitions in Clauses 2 and 3.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In the 1960s, the International Wool Textile Organization (IWTO) prepared an unevenness method destined for yarns and other strands made of wool. The method was adopted by ISO as ISO 2649[1]. It contains a discussion of the principles of unevenness testing and refers to the then-popular unevenness tester, the 1960s model of the Uster Evenness Tester, which was obsolete in mid-2000 when the present International Standard was written. Later, the IWTO prepared a new method[3].

This document has mostly new wording but includes some elements of ISO 2649 and of IWTO-18-00.

Textiles — Unevenness of textile strands — Capacitance method

1 Scope

This document describes a method, using capacitance measuring equipment, for determining the unevenness of linear density along the length of textile strands.

The method is applicable to tops, slivers, rovings, spun yarns and continuous filament yarns, made from either natural or man-made fibres, in the range of 4 tex (g/km) to 80 ktex (kg/km) for staple-fibre strands and 1 tex(g/km) to 600 tex (g/km) for continuous-filament yarns. It is not applicable to fancy yarns or to strands composed fully or partly of conductive materials such as metals; the latter requires an optical sensor (see A.4), and to raw silk filaments which are tested according to a specific standard.

The method describes the preparation of a variance-length curve, as well as the determination of periodicities of linear density. It also covers the counting of imperfections in the yarn, namely of neps and of thick and thin places.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

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:

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

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

3.1
unevenness
variation of linear density along the length of a continuous strand or yarn

Note 1 to entry: The term is also used occasionally for the variation of yarn diameter.

3.2
coefficient-of-variation unevenness
CV_u
value of *unevenness* (3.1) expressed as a coefficient of variation

Note 1 to entry: The coefficient-of-variation unevenness is expressed in percent, for example CV_u = 18,3 %.

Note 2 to entry: See also 4.6 and 4.7.

3.3
mean-deviation unevenness
U_u
value of *unevenness* (3.1) expressed as an average mean deviation

Note 1 to entry: The mean-deviation unevenness is expressed in percent, for example U_u = 14,6 %.

3.4
capacitor length
effective length of the capacitor in the direction of the specimen movement, usually 8 mm to 20 mm

3.5
length between
L_b
length of the test specimen for which the instrument takes an individual reading of mass

Note 1 to entry: The unevenness value decreases as L_b is increased.

Note 2 to entry: In the capacitance method, L_b is normally the *capacitor length* (3.4) but it can be increased electronically.

Note 3 to entry: L_b is sometimes referred to in the literature as *B*.

3.6
length within
L_w
length of the test specimen for which an individual value of evenness is determined, and a reading is given

Note 1 to entry: The unevenness value increases as L_w is increased. When L_w is more than 100 m or so, then a further lengthening of L_w increases CV_u (or U_u) only slightly.

Note 2 to entry: L_w is sometimes referred to in the literature as *W*.

3.7
total measured length
sum of all *lengths within*, L_w (3.6)

3.8
nep
tightly tangled knot-like mass of unorganized fibres

3.9
package
yarn wound to a shape, which can be supported (for example, bobbins, cones) or unsupported (for example, skeins, cakes), suitable for conditioning and testing

3.10
spectrogram unit
attachment to unevenness testers for the calculation and presentation of periodic variations in the strand

3.11
thick place
yarn defect with linear density substantially (at least 50 %) greater than that of the adjoining segments of the yarn and extending for at least 5 mm

3.12
thin place
yarn defect with linear density substantially (at least 50 %) smaller than that of the adjoining segments of the yarn and extending for at least 5 mm

4 Principle

4.1 A specimen is passed between two plates of a capacitor causing changes in capacitance which are proportional to the changes of mass of the specimen. The instrument evaluates these changes and reports them as coefficient-of-variation unevenness, CV_u, or mean-deviation unevenness, U_u.

4.2 The fibre dielectric constant is also a factor determining the capacitance change. As long as the dielectric constant is unchanging (non-blended strands or perfectly uniform blending), the dielectric constant has no influence on the unevenness reading, which depends solely on the variation of mass. If the dielectric constant differs for the types of fibres in a blend and if, at the same time, the blend is irregular, then the reading of unevenness is increased above its true value. The interpretation of results therefore requires caution.

4.3 Irregularities in the distribution of additives such as sizes, in moisture content and in fibre blending can increase the measured unevenness above its true value.

4.4 Several studies have been conducted over the years (see Reference [4] for example) comparing the true unevenness of a specimen, determined by cutting and weighing (see A.3.1), with the reading from an unevenness tester. Good agreement was obtained, so the readings from the tester can be taken as being the true unevenness value.

4.5 The value of unevenness has meaning only if both L_w and L_b are known and they should, in principle, always be reported, preferably as CV_u (L_b, L_w).

EXAMPLE CV_u (10 mm, 1 000 m).

In practice, these two values are usually left unstated and are assumed to be those of the most commonly used unevenness tester, namely:

— L_b: 8 mm for yarns, 12 mm for rovings, 20 mm for slivers and tops;

— L_w: total length of the test specimen.

4.6 There are two possible expressions for unevenness, CV_u and U_u. The U_u is now obsolete and its use, while permitted, is discouraged. CV_u is the preferred expression.

4.7 If mass is distributed near to “normal” (“Gaussian”), then the ratio of CV_u/U_u is approximately 1,25. This conversion factor should be used cautiously because, in case of departures from normality, the ratio can be considerably different. The conversion factor may be used to convert a table of quality levels from U_u to CV_u.

4.8 When CV_u is plotted against L_b, a “variance-length curve” is obtained which gives additional information on the material's unevenness. When the plot is made on log-log paper, then the curve is almost a straight line and its slope gives information on the relationship between short-term and long-term unevenness.

4.9 Unevenness testers usually contain a spectrogram unit, which analyses the data and provides information on periodic variations of linear density. This information is useful in finding faults in the processing. The analysis uses an algorithm based on the Fourier transformation.

4.10 Unevenness testers usually contain a counter for yarn imperfections, namely neps, and thick and thin places. The level beyond which the imperfections are counted can be adjusted.

Additional information on alternative methods can be found in Annex A.