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Textiles — Unevenness of textile strands — Capacitance method

Textiles — Irrégularité des fils textiles — Méthode capacitive

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 16549 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

This International Standard cancels and replaces ISO 2649 which is now obsolete.

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 2649:1974. 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, IWTO-18-00, published in 2000.

ISO 16549 has mostly new wording but includes some elements of ISO 2649 and of IWTO-18-00 – with thanks to IWTO.

Textiles — Unevenness of textile strands — Capacitance method

1 Scope

This International Standard 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 require an optical sensor (see A.4).

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

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

2 Normative references

The following referenced documents are indispensable for the application 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.

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

NOTE 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 The coefficient-of-variation unevenness is expressed in percent, for example $CV_\mathrm{u} =$ 18,3 %.

NOTE 2 See also 4.5 and 4.6.

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

NOTE 1 The mean-deviation unevenness is expressed in percent, for example, $U_\mathrm{u} =$ 14,6 %.

NOTE 2 See also 4.5 and 4.6.

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 The unevenness value decreases as L_b is increased.

NOTE 2 In the capacitance method, L_b is normally the capacitor length but it can be increased electronically.

NOTE 3 L_b is sometimes referred to in the literature as B.

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

NOTE 1 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 L_w is sometimes referred to in the literature as W.

3.7
total measured length
sum of all measured lengths L_w

3.8
nep
tightly tangled knot-like mass of unorganized fibres

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

3.10
spectrogram
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 CV_u or 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 Several studies have been conducted over the years, see Reference [3] 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.

4.4 The value of unevenness has meaning only if both L_b and L_w 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 yarn on the package.

4.5 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.

4.6 If mass is distributed near to "normal", then the ratio of $CV_\mathrm{u}/U_\mathrm{u}$ is approximately 1,25. This conversion factor must 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.

4.7 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.

4.8 Unevenness testers usually contain a spectrogram, 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.

4.9 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.

4.10 Unevenness is a fundamental feature of yarn construction. It influences the efficiency of processing as well as fabric appearance. Lower unevenness generally results in a better-looking fabric but the relation is not simple and interpretation requires special care.

5 Apparatus

5.1 Different types of apparatus are in use for measuring strands made of staple fibres and filament yarns.

5.2 The apparatus consists of the following elements:

a) measuring device, featuring

— several measuring condensers, usually grouped into one unit, for strands of varying linear density,

— yarn guiding and pretensioning devices,

— an adjustable-speed motor to advance the strand;