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Leather — Tests for colour fastness — Change in colour with accelerated ageing

Cuir — Essais de solidité des teintures — Changement de couleur avec vieillissement accéléré

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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.

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.

ISO 17228 was prepared by the Fastness Tests Commission of the International Union of Leather Technologists and Chemists Societies (IUF Commission, IULTCS). It is based on IUF 412 published in *J. Soc. Leather Tech. Chem.*, **86**, pp. 325-331, 2002, and declared an official method of the IULTCS in May 2003.

IULTCS, originally formed in 1897, is a world-wide organization of professional leather societies to further the advancement of leather science and technology. IULTCS has three Commissions, which are responsible for establishing international methods for the sampling and testing of leather. ISO recognizes IULTCS as an international standardizing body for the preparation of test methods for leather.

Leather — Tests for colour fastness — Change in colour with accelerated ageing

1 Scope

Over time, the surface colour of leather and the leather itself change due to ageing and to the action of the surroundings on the leather. The purpose of the various ageing procedures described in this International Standard is to obtain an indication of the changes that could occur when leather is exposed to a certain environment for a prolonged time. The test conditions to be used depend on the type of leather and its intended use.

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 105-A01, *Textiles — Tests for colour fastness — Part A01: General principles of testing*

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 105-A04, *Textiles — Tests for colour fastness — Part A04: Method for the instrumental assessment of the degree of staining of adjacent fabrics*

ISO 105-A05, *Textiles — Tests for colour fastness — Part A05: Instrumental assessment of change in colour for determination of grey scale rating*

ISO 2418, *Leather — Chemical, physical and mechanical and fastness tests — Sampling location*

ISO 2419, *Leather — Physical and mechanical tests — Sample preparation and conditioning*

3 Principle

A test specimen of leather is exposed to at least one of the three following conditions:

— heat (Clause 6);

— heat and humidity (Clause 7);

— cycles of different temperature and humidity (Clause 8).

One or more of these procedures may take place simultaneously. The change in colour of the specimen is assessed with the standard grey scale and, if applicable, any changes in the finish or appearance are noted.

These procedures can be used to prepare the leather specimen for other physical or fastness tests after accelerated ageing.

NOTE Accelerated-ageing tests are for guidance only and they may not necessarily be representative of long-term use at ambient temperatures.

The general colour fastness testing principles shall be in accordance with those described in ISO 105-A01, taking into account that the substrate is leather.

4 Apparatus and materials

Normal laboratory apparatus and the following:

4.1 Oven, fitted with a central rack, capable of maintaining a temperature within ± 2 °C of the defined temperature. The oven should have a vent, preferably with a circulating fan, and an inside made of inert materials.

4.2 Climate chamber, fitted with a central rack, capable of maintaining a temperature within ± 2 °C of the defined temperature and a relative humidity within ± 5 % of the defined relative humidity.

4.3 Suitable system for holding the specimen and preventing contact with the oven or climate chamber sides.

4.4 Grey scale for assessing change in colour, complying with ISO 105-A02, or an **instrumental system for assessing change in colour**, complying with ISO 105-A05.

4.5 Grey scale for assessing staining, complying with ISO 105-A03, or an **instrumental system for assessing staining**, complying with ISO 105-A04.

5 Test specimens

5.1 Prior to cutting out specimens, condition the piece of leather in accordance with ISO 2419.

5.2 Cut out two representative test specimens measuring not less than 100 mm × 100 mm.

If the piece of leather available for testing is a whole hide or skin, then the specimens shall be taken in accordance with standard procedures given in ISO 2418.

NOTE If other properties, such as dimensional change, are to be measured, then larger test specimens, for example 300 mm × 300 mm, may be used.

6 Ageing by heat alone

6.1 Principle

The purpose of this procedure is to simulate prolonged ageing by the application of heat. Two different types of change can be involved:

a) the change in colour of the substances in the leather;

b) the evaporation of volatile substances or the migration of substances, leading to a change in the colour and/or other properties of the leather or finish.

As both the exposure time and the temperature can be varied, this procedure can be used for a variety of purposes, including preparing specimens for other tests.

6.2 Procedure

6.2.1 Pre-heat the oven (4.1) to the desired temperature (see 6.2.3).

6.2.2 Place one test specimen (the reference specimen) in a place where it is protected from light and kept under standard conditions (see ISO 2419).

6.2.3 Hang the other test specimen with a clip from, or place it on, the holder (4.3) in the middle of the oven such that the air has free access to both sides.

Unless specified otherwise, age the specimen under one of the sets of conditions indicated in Table 1.

Table 1 — Ageing by heat

Method	Conditions for ageing by heat	Recommended use
6A	24 h ± 1 h at 60 °C ± 2 °C	General-purpose ageing conditions
6B	24 h ± 1 h at 100 °C ± 2 °C	Specifically for yellowing of individual products in undyed leather
6C	72 h ± 2 h at 60 °C ± 2 °C	Extended general-purpose ageing
6D	72 h ± 2 h at 100 °C ± 2 °C	Ageing of automotive leather
6E	168 h ± 2 h at 90 °C ± 2 °C	Extended ageing of automotive leather
6F	168 h ± 2 h at 50 °C ± 2 °C	Extended ageing at moderate temperature
6G	168 h ± 2 h at 70 °C ± 2 °C	Extended ageing at elevated temperature

The sets of conditions given in Table 1 have been selected to provide a range of conditions for different applications. If other conditions are used, then they shall be clearly noted in the test report.

6.2.4 After the period of time has elapsed, remove the test specimen from the oven. Allow the specimen to cool. Then recondition both the test and the reference specimen under standard conditions for 24 h.

6.2.5 Either visually assess the colour difference between the aged specimen and the reference specimen using the appropriate grey scale in accordance with ISO 105-A02 (4.4) or ISO 105-A03 (4.5) or alternatively, assess the grey scale colour difference instrumentally in accordance with ISO 105-A05 or ISO 105-A04.

NOTE In the case of undyed leather, the change in colour is often referred to as yellowing. See Annex A for further details.

6.2.6 Note any change in appearance, hue or flexibility and any shrinkage of the aged specimen in comparison with the reference specimen.

7 Ageing by heat and elevated humidity

7.1 Principle

This procedure is similar to the application of heat, but the moisture present acts as a mild hydrolysing agent, thus simulating prolonged ageing at ambient conditions with some degree of humidity. At high humidities, some substances can migrate to the surface.

As different levels of humidity can be used, and the time and temperature can be varied, this procedure can be used for a variety of purposes, including preparing specimens for other tests.

7.2 Procedure

7.2.1 Bring the climate chamber (4.2) to the desired temperature and humidity (see 7.2.3).

7.2.2 Place one test specimen (the reference specimen) in a place where it is protected from light and kept under standard conditions (see ISO 2419).

7.2.3 Hang the other test specimen with a clip from, or place it on, the holder (4.3) in the middle of the climate chamber such that the air has free access to both sides.

Unless specified otherwise, age the specimen under one of the sets of conditions indicated in Table 2.

Table 2 — Ageing by heat and elevated humidity

Method	Conditions for ageing by heat and elevated relative humidity (r.h.)	Recommended use
7A	24 h ± 1 h at 50 °C ± 2 °C and 90 % r.h. ± 5 % r.h.	General-purpose ageing conditions
7B	96 h ± 2 h at 50 °C ± 2 °C and 90 % r.h. ± 5 % r.h.	Extended general-purpose ageing
7C	12 h ± 1 h at 70 °C ± 2 °C and 90 % r.h. ± 5 % r.h.	Migration test for finished leather
7D	48 h ± 1 h at 55 °C ± 2 °C and 80 % r.h. ± 5 % r.h.	Climate test for automotive leather
7E	168 h ± 2 h at 38 °C ± 2 °C and 95 % r.h. ± 5 % r.h.	Extended climate test for automotive leather

The sets of conditions given in Table 2 have been selected to provide a range of conditions for different applications. If other conditions are used, then they shall be clearly noted in the test report.

7.2.4 After the period of time has elapsed, remove the test specimen from the climate chamber. Allow the specimen to cool. Then recondition both the test and the reference specimen under standard conditions for 24 h.

7.2.5 Assess the colour difference between the aged specimen and the reference specimen as described in 6.2.5 above.

7.2.6 Note any change in appearance, hue or flexibility and any shrinkage of the aged specimen in comparison with the reference specimen.

8 Cyclic variation in heat and elevated humidity

8.1 Principle

This procedure is similar to those in Clauses 6 and 7, but the temperature and humidity are varied cyclically to simulate the changes which could be experienced during a typical day. This procedure is especially used for automotive leather.

As different levels of humidity can be used, and the time and temperature can be varied, the procedure can be used for a variety of other purposes, including preparing specimens for other tests.

8.2 Procedure

8.2.1 Bring the climate chamber (4.2) to the desired temperature and humidity (see 8.2.3).

8.2.2 Place one test specimen (the reference specimen) in a place where it is protected from light and kept under standard conditions (see ISO 2419).

8.2.3 Hang the other test specimen with a clip from, or place it on, the holder (4.3) in the middle of the climate chamber such that the air has free access to both sides.

Unless specified otherwise, age the specimen for the given number of cycles under one of the sets of conditions indicated in Table 3.

Table 3 — Ageing under cyclic temperature/humidity conditions

Method	Conditions for cycling at various temperatures and relative humidities (r.h.)	Recommended use
8A	1 cycle consists of: 24 h ± 1 h at 38 °C ± 2 °C and 95 % r.h. ± 5 % r.h.; 24 h ± 1 h at 100 °C ± 2 °C. Run 3 cycles under these conditions.	General-purpose climate test for automotive leather
8B	1 cycle consists of: 4,0 h ± 0,2 h at 70 °C ± 2 °C and 20 % r.h. ± 5 % r.h.; 16 h ± 1 h at 38 °C ± 2 °C and 95 % r.h. ± 5 % r.h.; 4,0 h ± 0,2 h at −30 °C ± 2 °C. Run 10 cycles under these conditions.	Extended climate test for automotive leather (including temperatures below freezing)
8C	1 cycle consists of: 4,0 h ± 0,2 h at 40 °C ± 2 °C and 90 % r.h. ± 5 % r.h.; 2,0 h ± 0,2 h heating to 120 °C (above 90 °C, switch humidity control off); 4,0 h ± 0,2 h at 120 °C ± 2 °C; 2,0 h ± 0,2 h cooling to 40 °C and 90 % r.h. ± 5 % r.h., (below 90 °C, switch humidity control back on). Run 20 cycles under these conditions.	Simulation of warm, humid climate for automotive leather

The sets of conditions given in Table 3 have been selected to provide a range of conditions for different applications. If other conditions are used, then they shall be clearly noted in the test report.

8.2.4 After the period of time has elapsed, remove the test specimen from the climate chamber. Allow the specimen to cool. Then recondition both the test and the reference specimen under standard conditions for 24 h in accordance with ISO 2419.

8.2.5 Assess the colour difference between the aged specimen and the reference specimen as described in 6.2.5 above.

8.2.6 Note any change in appearance, hue or flexibility and any shrinkage of the aged specimen in comparison with the reference specimen.

9 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) a description of the type of leather tested;

c) the ageing method selected and the ageing conditions used, i.e. type of ageing, time, temperature, humidity and number of cycles (if relevant);

d) the numerical rating obtained for the change in colour of the aged specimen, stating whether visual or instrumental assessment was used;

e) any change in appearance, hue or flexibility and any shrinkage of the aged specimen;

f) details of any deviations from the procedure specified;

g) the dates between which the ageing was carried out.

Annex A
(informative)

Comments on specific aspects of the colour-measurement procedure

A.1 Instrumental colour measurement

The actual colour change of the aged specimen compared with the reference specimen can be measured instrumentally. It is recommended that the colour change be measured at four different positions on the specimen and that the result be given as the average of these measurements.

Details on measuring surface colour and colour differences are given in ISO 105-J01 and ISO 105-J03.

A.2 Evaluation of yellowing

One typical use of ageing procedures is the evaluation of the propensity of chemical agents used in the tanning, retanning and fat-liquoring processes to change the colour of the leather substrate, normally referred to as yellowing. This is carried out using treated, undyed leather specimens. The degree of yellowing of undyed leather is commonly assessed by measuring it instrumentally using a reflectance spectrophotometer.

A number of yellowing formulae are given in the literature. Two examples of ways commonly used in the leather industry to assess the degree of yellowing are as follows:

EXAMPLE 1 Using the CIELab system.

The change in yellowness is determined from the Δb^* colour difference value using D65 illumination (including spectral reflection) and the 10° standard observer. ISO 105-J01 and ISO 105-J03 give details of the measurement of surface colour and colour differences.

EXAMPLE 2 Using DIN 6167.

The so-called yellowing factor G is calculated using D65 illumination (including spectral reflection) and the 10° standard observer:

$$G = \frac{1{,}301 \times X - 1{,}149 \times Z}{Y} \times 100$$

where X, Y and Z are the standard tristimulus values.

In both cases, the degree of yellowing of the reference specimen is subtracted from that of the aged specimen.

Bibliography

[1] ISO 105-J01, *Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour*

[2] ISO 105-J03, *Textiles — Tests for colour fastness — Part J03: Calculation of colour differences*

[3] DIN 6167, *Description of yellowness of near-white or near-colourless materials*

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