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IULTCS/IUF 412

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

*Cuir — Essais de solidité des coloris — Changement de couleur avec
vieillissement accéléré*

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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

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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO 17228 was prepared by the Fastness Tests Commission of the International Union of Leather Technologists and Chemists Societies (IUF Commission, IULTCS) in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 289, *Leather*, the secretariat of which is held by UNI, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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.

This second edition cancels and replaces the first edition (ISO 17228:2005), which has been technically revised. This new version is a general update of the procedures and in [Tables 1](#), [2](#), and [3](#) includes additional ageing options.

[Annex A](#) is informative.

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

1 Scope

This International Standard specifies various ageing procedures to obtain an indication of the changes that could occur when leather is exposed to a certain environment for a prolonged time. 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 test conditions to be used depend on the type of leather and its intended use.

This procedure can also be used to age specimens for the test of dimensional change according to ISO 17130.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

ISO 17130, *Leather — Physical and mechanical tests — Determination of dimensional change*

3 Principle

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

- heat (see [Clause 6](#));
- heat and humidity (see [Clause 7](#));
- cycles of different temperature and humidity (see [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 also be used to prepare the leather specimen for other physical or fastness tests after accelerated ageing. The assessment of dimension change is described in ISO 17130.

NOTE Accelerated ageing tests are for guidance only and they are not necessarily 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

Use 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.

4.6 Stop clock, readable to 1 s.

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 additional test specimens are used due to different kind of storage during the ageing step.

6 Ageing by heat alone

6.1 Principle

The purpose of this procedure is to simulate 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, according to 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 $\pm$ 1 h at 60 °C $\pm$ 2 °C	General-purpose ageing conditions
6B	24 h $\pm$ 1 h at 100 °C $\pm$ 2 °C	Specifically for yellowing of individual products in undyed leather
6C	72 h $\pm$ 2 h at 60 °C $\pm$ 2 °C	Extended general-purpose ageing
6D	72 h $\pm$ 2 h at 100 °C $\pm$ 2 °C	Ageing of automotive leather
6E	168 h $\pm$ 2 h at 90 °C $\pm$ 2 °C	Extended ageing of automotive leather
6F	168 h $\pm$ 2 h at 60 °C $\pm$ 2 °C	Extended ageing at moderate temperature
6G	168 h $\pm$ 2 h at 100 °C $\pm$ 2 °C	Extended ageing at elevated temperature
6H	4 h $\pm$ 0,2 h at 100 °C $\pm$ 2 °C	Short ageing of automotive leather
6J	144 h $\pm$ 2 h at 100 °C $\pm$ 2 °C	Ageing of automotive leather
6K	168 h $\pm$ 2 h at 120 °C $\pm$ 2 °C	Extended ageing of automotive leather at high 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 according to ISO 2419 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 alternatively, assess the grey scale colour difference instrumentally in accordance with ISO 105-A05, (4.4). If required, e.g. for light coloured leathers, ISO 105-A03, (4.5), or instrumentally with ISO 105-A04, (4.5), can be used to assess the grey scale colour difference.

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 If required, compare the aged specimen with the reference specimen and note any visually apparent changes in appearance, hue, or shrinkage and comment on any change in flexibility as assessed manually.

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 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 according to 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 $\pm$ 1 h at 50 °C $\pm$ 2 °C and 90 % r.h. $\pm$ 5 % r.h.	General-purpose ageing conditions
7B	96 h $\pm$ 2 h at 50 °C $\pm$ 2 °C and 90 % r.h. $\pm$ 5 % r.h.	Extended general-purpose ageing
7C	12 h $\pm$ 1 h at 70 °C $\pm$ 2 °C and 90 % r.h. $\pm$ 5 % r.h.	Migration test for finished leather
7D	48 h $\pm$ 1 h at 55 °C $\pm$ 2 °C and 80 % r.h. $\pm$ 5 % r.h.	Climate test for automotive leather
7E	168 h $\pm$ 2 h at 40 °C $\pm$ 2 °C and 95 % r.h. $\pm$ 5 % r.h.	Extended climate test for automotive leather
7F	16 h $\pm$ 1 h at 40 °C $\pm$ 2 °C and 95 % r.h. $\pm$ 5 % r.h.	General-purpose ageing conditions
7G	72 h $\pm$ 1 h at 60 °C $\pm$ 2 °C and 85 % r.h. $\pm$ 5 % r.h.	Simulate transport in closed container
7H	168 h $\pm$ 2 h at 70 °C $\pm$ 2 °C and 75 % r.h. $\pm$ 5 % r.h.	Climate test for automotive leather
7J	168 h $\pm$ 2 h at 70 °C $\pm$ 2 °C and 95 % r.h. $\pm$ 5 % r.h.	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 according to ISO 2419 for 24 h.

7.2.5 Either visually or instrumentally, assess the colour difference between the aged specimen and the reference specimen as described in 6.2.5.

7.2.6 If required, compare the aged specimen with the reference specimen and note any visually apparent changes in appearance, hue, or shrinkage and comment on any change in flexibility as assessed manually.

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 starting conditions, see [Table 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 according to 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	One cycle consists of: —24 h $\pm$ 1 h at 38 °C $\pm$ 2 °C and 95 % r.h. $\pm$ 5 % r.h.; —24 h $\pm$ 1 h at 100 °C $\pm$ 2 °C. Run three cycles under these conditions.	General-purpose climate test for automotive leather
8B	One cycle consists of: —4,0 h $\pm$ 0,2 h at 70 °C $\pm$ 2 °C and 20 % r.h. $\pm$ 5 % r.h.; —16 h $\pm$ 1 h at 38 °C $\pm$ 2 °C and 95 % r.h. $\pm$ 5 % r.h.; —4,0 h $\pm$ 0,2 h at -30 °C $\pm$ 2 °C. Run 10 cycles under these conditions.	Extended climate test for automotive leather (including temperatures below freezing)
8C	One cycle consists of: —4,0 h $\pm$ 0,2 h at 40 °C $\pm$ 2 °C and 90 % r.h. $\pm$ 5 % r.h.; —2,0 h $\pm$ 0,2 h heating to 120 °C (above 90 °C, switch humidity control off); —4,0 h $\pm$ 0,2 h at 120 °C $\pm$ 2 °C; —2,0 h $\pm$ 0,2 h cooling to 40 °C $\pm$ 2 °C and 90 % r.h. $\pm$ 5 % r.h. (switch humidity control back on only after reaching 40 °C). Run 20 cycles under these conditions.	Simulation of warm, humid climate for automotive leather

NOTE The programming of climate chamber depends on the technical construction. To avoid high humidity at high temperatures, it is necessary for many climate chambers to switch on the humidity control after high temperature periods (>100 °C) only after reaching the defined temperature of the wet period.

Table 3 (continued)

Method	Conditions for cycling at various temperatures and relative humidities (r.h.)	Recommended use
8D	One cycle consists of: —4,0 h $\pm$ 0,2 h at 10°C $\pm$ 2 °C and 92 % r.h. $\pm$ 3 % r.h.; —2,0 h $\pm$ 0,2 h at 90°C $\pm$ 2 °C and max. 20 %. rates of heating: approx. 1,5 °C/min (temperature should not exceed 50 °C at 40 % r.h. during heating and cooling) Run 10 cycles (or if required, 30 cycles) under these conditions.	Simulation of warm, humid climate for automotive leather
8E	<u>Pre-conditioning:</u> 900 min $\pm$ 10 min at 23 °C and 50 % r.h.; <u>One cycle consists of:</u> —29 min heating to 70 °C and 50 % r.h.; —31 min heating to 120 °C and < 10 % r.h.; —120 min at 120 °C; —20 min cooling to 70 °C and 50 % r.h.; —40 min cooling to 15 °C and 95 % r.h.; —120 min at 15 °C and 95 % r.h. Run nine cycles under these conditions. <u>Post-run:</u> —29 min heating to 70 °C and 50 % r.h.; —31 min heating to 120 °C and < 10 % r.h.; —180 min at 120 °C. <u>Unless given, the maximum deviations are:</u> —for time: $\pm$2 min; —for temperature: $\pm$2 °C; —for relative humidity: $\pm$5 % r.h.	Simulation of warm, humid climate for automotive leather
NOTE The programming of climate chamber depends on the technical construction. To avoid high humidity at high temperatures, it is necessary for many climate chambers to switch on the humidity control after high temperature periods (>100 °C) only after reaching the defined temperature of the wet period.		

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 in accordance with ISO 2419 for 24 h.

8.2.5 Either visually or instrumentally, assess the colour difference between the aged specimen and the reference specimen as described in [6.2.5](#).

8.2.6 If required, compare the aged specimen with the reference specimen and note any visually apparent changes in appearance, hue, or shrinkage and comment on any change in flexibility as assessed manually.

9 Test report

The test report shall include the following information:

- a) a reference to this International Standard, i.e. ISO 17228;
- 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 which grey scale was used;
- e) if required, 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.

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