



Colourfastness and ageing of leather to artificial light at high temperatures

Sina Finke, Clariant Produkte (Deutschland) GmbH.

(On behalf of the VGCT Leather Testing and Assessment Commission)

Leather upholstery used in the interior of automobiles is subjected to extreme external influences, including the simultaneous impact of light and heat. In view of the increasingly important role of leather for many vehicle manufacturers, the testing of heat-light resistance has been examined in detail as part of an inter-laboratory round robin test, with a particular focus on the influence of humidity, the use of various lighting apparatus and the visual assessment of the results in comparison with a colorimetric instrumental assessment.

Given the frequent occurrence of variations in the testing of leather, in particular by different laboratories, one of the tasks of the VGCT Leather Testing and Assessment Commission is to examine existing test procedures with regard to the comparability and reproducibility of results. Results of the examination of test procedures have been published at irregular intervals in the past.

This article focuses on the international standard testing procedure "Colour fastness and ageing to artificial light at high temperatures: Xenon arc fading lamp test", ISO 105-B06:1998.

Although this standard was prepared by the ISO/TC 38 Textiles Technical Committee of the International Organization for Standardization (ISO) it is also used in the testing of other materials such as leather. This standard describes the determination of the colour fastness and ageing properties of a material under the simultaneous action of heat and artificial light (D65, which corresponds to natural daylight), with special consideration being given to the light and heat conditions that occur in the interior of a vehicle.

ISO 105-B06:1998 replaces the previous DIN 75202 standards used up until 2002. VDA 75202, which contains the main features of the withdrawn DIN 75202, has existed in addition since 2001 and is still used frequently in practice.

Preliminary considerations

In advance of the round robin test, experience gained by laboratories and the factors that could influence the results were considered and can be summarised as follows:

- Modern lighting apparatus is capable of irradiating a specimen with a guaranteed predefined dose, regardless of the age of the lamp. In the early years of testing with high temperature light exposure when these guarantees could not be met, the equipment manufacturers recommended an exposure of 80 +/- 16 hours per cycle on the basis of numerous preliminary tests. However, it became apparent during the discussions that, even after the experience gained by apparatus manufacturers, this longstanding practice continues to occur. That is, even where older equipment has been replaced by modern versions. Based on the current state of the art, the duration of an exposure cycle can be determined as follows:

In accordance with ISO 105-B06:1998, Exposure Condition 3, a cycle is complete once the contrast of blue wool reference type 6 corresponds to rating 3 on the grey scale (DIN EN ISO 105-A02). This contrast should be determined colorimetrically with a spectrophotometer, and corresponds to the value of $4.3 \pm 0.4 \text{ DE}^*$ (CIELAB for D65/10°).

- Users are not always aware of the importance of changing lamps and filters on a regular basis, cleaning sensors and filters to remove the haze-like layer emitted by the leather (also known as fogging) and filling the apparatus completely with specimen-holder for a reproducible result.
- Test equipment is available with water-cooled and air-cooled lamps.
- Depending on the apparatus, irradiance is measured at 300 nm to 400 nm (broad-band measurement) or 420 nm (narrow-band measurement).
- While VDA 75202 stipulates relative humidity of $(20 \pm 10)\%$, ISO 105-B06:1998 defines a figure of $(30 \pm 5)\%$.
- The visual assessment of the specimens is influenced by factors such as the age of the tester, eye fatigue and other physiological factors. While instrument evaluation is more objective, provided specific parameters such as the size of the cut-out and measurement with or without a gloss trap are defined, some of the effects that occur following exposure of the specimen are much more easily perceived visually.

Based on these considerations, the aim of the round robin tests was to:

- Ascertain whether the use of different apparatus has an impact on the results.
- See if visual and colorimetric assessments diverge.
- Assess the extent to which humidity influences the result.
- Determine if results still vary despite comparable apparatus settings.

The investigations

The following parameters were used within the investigations:

- A total of seven laboratories participated in this testing and assessment project.



- Five automotive leathers in different shades were tested. Leather A (smooth leather) - caramel, Leather B (smooth leather) - eggshell, Leather C (smooth leather) - mushroom, Leather D (embossed leather) - light brown, Leather E (embossed leather) - light beige.
- Preliminary tests were carried out in order to ensure that the leather used was grade 2-3 and 4-5.
- Three CI Weather-Ometer (water-cooled lamps) and four Xenotest Beta LM instruments (air-cooled lamps) were used.
- Only changes in colour on the specimens were evaluated; no further tests such as rub fastness or flexometer tests following exposure were carried out.
- Specimens were assessed following the first, second and third exposure cycles. In the first procedure, the specimens were tested in accordance with VDA 75202 with 20% relative humidity in the test chamber, while in the second procedure a set of new specimens was tested according to DIN EN ISO 105-B06, Exposure Condition 3 with 30% relative humidity in the test chamber.
- A blue wool reference 6 was also exposed during each cycle for control purposes.

Advance determination made it possible to create conditions that were as similar as possible in all laboratories. These were:

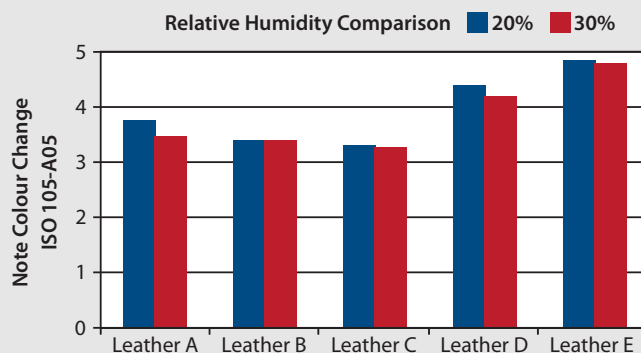
- Black standard temperature - 100°C.
- Test chamber temperature: 65°C.
- Relative humidity: 20% (Procedure A) and 30% (Procedure B).
- Irradiance: 60 W/m² (broad-band measurement) for beta LM apparatus.
- 1.2 W/m² (narrow-band measurement) for CI apparatus.
- All apparatus were operated synchronously (no turning mechanism activated).
- Leather backed with nonwoven fabric and white card.
- Filter combination Boro S / Soda Lime for CI apparatus.
- Half of each specimen was covered.
- Assessment was carried out visually as per ISO 105-A02 and colorimetrically as per ISO 105-A05 exposed specimen against covered area and exposed specimen against original.
- Documentation of the number of hours required for a change in colour of the blue wool reference in one cycle.
- Use of a new blue wool reference for each cycle.
- Assessment of the blue wool reference not before 4 hours after removal from the apparatus.
- The blue wool reference is placed on white wall tile for assessment.

Findings from the investigation

The findings can be summarised as follows:

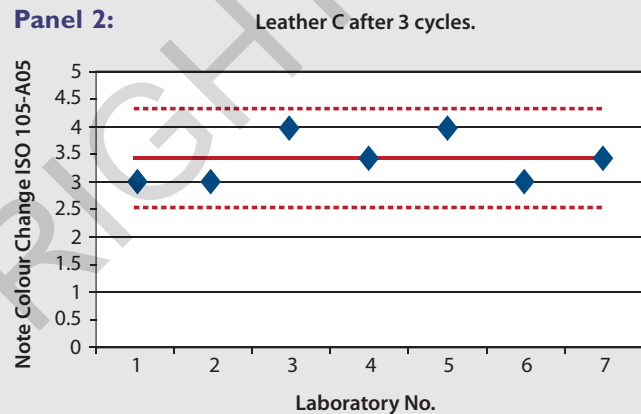
- The exposure times that result on the basis of the change in colour of the blue wool references with predefined irradiances were between 57 and 64 hours with Xenotest Beta LM instruments and approximately 70 hours with CI Weather-Ometers.
- The humidity in the test chamber was not perceived to have any influence on the change in colour of the blue wool references.
- Highly detailed examination of the results on the leather detected almost imperceptible differences between 20% and 30% relative humidity as shown in *Panel 1*, with lower humidity levels having a slightly positive effect on the result. These differences are within the normal range of variation associated with tests of this kind.

Panel 1:



Average values of the colorimetric assessment of all leather specimens as per ISO 105-A05 measured in all laboratories following three exposure cycles at both 20% and 30% relative humidity (exposed area against original).

Panel 2:



Visual assessment values as per ISO 105-A02 from the individual laboratories using the example of Leather C following three exposure cycles (exposed against original) following Procedure A.

- A very good level of consistency of results from one laboratory to another was observed as shown in *Panel 2*.
- In only a few exceptional cases were deviations of more than half a grade observed in numerous laboratories and specimens. With the majority of individual values, differences of half a grade or less were observed.
- Heat development in the covered area of the specimen might lead to changes in colour that are not detectable on the original. Leather C was, for example, significantly redder in this area.
- This observation demonstrates the importance of accurately defining the evaluation of the exposure test in the specifications. Depending on the use of leather in the vehicle, it should be defined whether evaluation should be carried out against the original or the covered area. Unless indicated in the specification, the method used must be documented in the test report. Comparison with the original is recommended here.
- No systematic differences were detected between visual and colorimetric assessment as shown in *Panel 3*.
- Depending on the leather and the degree of yellowing or ageing, visual assessment can be somewhat more or less stringent. If the changes in colour of the specimens are extremely slight, differences between colorimetric and

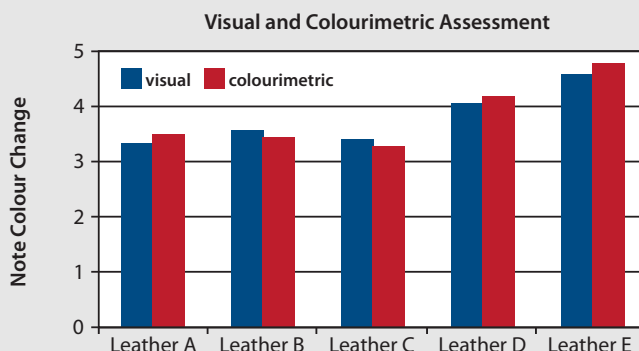


visual assessment can be observed. In colorimetric measurement a Grade 5 is often given in such cases, while slight differences that are visually detectable result by necessity in an evaluation of 4-5.

Summary and conclusion

- The testing of heat-light resistance of leather is a procedure that provides reproducible results independently of the type of apparatus used (Beta LM or CI Weather-Ometers) on the basis of the sole consideration of change in colour. This facilitates the achievement of comparable results with water-cooled and air-cooled apparatus.
- Visual and colorimetric assessments are extremely close.
- Humidity has such a slight influence on the measured result as to be negligible.
- The covered area of the specimen and the original often vary, making it extremely important to document accurately in the test report which method is used in the assessment. In order to ensure comparability, this criterion should be defined in the individual specifications. Comparison with the original is recommended because a change in colour can also occur in the covered area of the specimen as a result of exposure to heat.
- In the event of greater variation between the measurement results of various laboratories it is advisable to observe the execution of the tests more closely on site. The lifetime, age and type of the filters, cleanliness of the apparatus, complete filling of the sample carousel and location of the apparatus are possible sources of error.
- The result of this inter-laboratory round robin test shows

Panel 3:



Average values of grades from all laboratories for each leather specimen, comparison of visual (ISO 105-A02) and colorimetric (ISO 105-A05) assessment following Procedure B.

that there are only marginal differences between water-cooled and air-cooled apparatus, between 20% and 30% humidity and between visual and colorimetric assessment.

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