Color analysis of heat yellowing and light fastness tests on leather

The SmiTool *Light and Heat* already discussed the subject of heat yellowing and light fastness tests on leather. The current SmiTool explains the differences between subjective and objective assessment of the tested leather and the way and how to report test results for heat yellowing and light fastness.

For color analysis an X-Rite spectrophotometer s being used. This equipment enables us to analyze color in an objective way. Why is this so important?

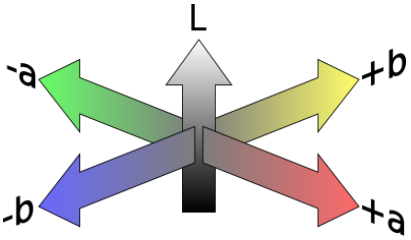
When color changes are evaluated by the human eye, all kinds of factors will affect the color perception:

- Age (older people tends to seen more yellow)
- Fatigue
- Lightning conditions (artificial/natural)
- Background and contrasting colors
- Texture of the material (suede/aniline/embossed)
- Color deficiency

With the spectrophotometer the analysis can be done in a standardized manner, anywhere and anytime. For a true evaluation of the color without respect to gloss or texture, the setting is set for D65/10 illuminant and SPIN .

Color scales

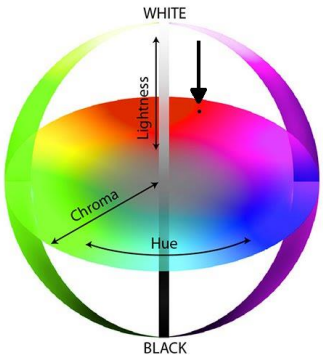
L*a*b scale



L= lightness 100 = white 0= black

Range a and b values +60 to -60

L*C*h° scale



C = Distance from grey (grey = 0)

Hue = angle from red (0°)

L*a*b* scale and L*C*h° scale are used as numerical tolerance methods for color analysis. L*C*h° is the best approach for the interpretation of color by the human eye.

However, the most widely used method for assessing test results is based on the Gray scale. The fastness grades of the Gray scale steps and the corresponding color difference and tolerances are determined by the CIE L*a*b* (CIELAB) formula.

Gray Scale for Staining

This scale is used in heat/light fastness tests for evaluating staining on undyed leather. The scale consists of pairs of nominally white and gray color chips each representing a difference in color or contrast (shade and strength) corresponding to a numerical grade for staining. Fastness grade 5 is represented on the scale by two identical white reference chips mounted side by side. Fastness grades 4.5 to 1, are represented by a reference white chip identical for grade 5 paired with similar but neutral gray chips.

Gray scale for color change

This scale is used in visual evaluation of the changes in color of dyed leather resulting from heat/ light fastness tests. The colorfastness grades of the scale steps and the corresponding total color differences and tolerances used are determined by the CIE L*a*b* (CIELAB) formula. The color change scale consists of nine pairs of grey colored chips, from grades 4.5 to 1.

Light fastness testing Blue Wool Scale

The light fastness test method of Smit and zoon is an in-house test method based on ISO 105 B02. This ISO method is intended for testing color fastness of textiles to artificial Xenon Arc fading light. The standard setting for the in-house method is 72 hours at 50°C BST.
BST is short for Black Standard Temperature and this is a tool to control the temperature inside the test chamber of the light fastness tester. Humidity is not controlled.

Blue wool references developed and produced in Europe are identified by the numerical designation 1to 8. These references are blue wool cloths dyed with the dyes listed in table 1. They range from 1 (very low color fastness) to 8 (very high fastness) so that each higher-numbered reference is approximately twice as fast as the preceding one.

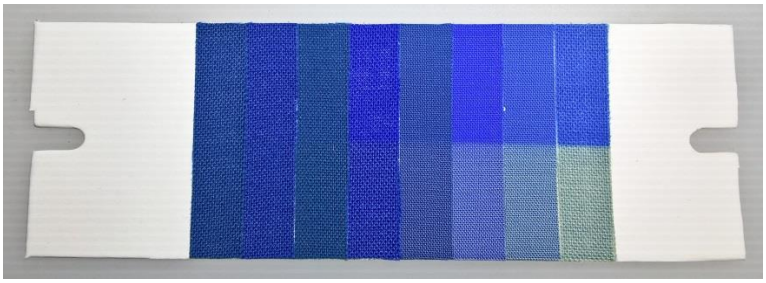


Table 1 — Dyes for blue wool references 1 to 8

Reference	Dye (Colour Index designation) [1]
1	CI Acid Blue 104
2	CI Acid Blue 109
3	CI Acid Blue 83
4	CI Acid Blue 121
5	CI Acid Blue 47
6	CI Acid Blue 23
7	CI Solubilized Vat Blue 5
8	CI Solubilized Vat Blue 8

1) The Colour Index (third edition) is published by the Society of Dyers and Colourists, P.O. Box 244, Perkin House, 82 Grattan Road, Bradford BD1 2JB, West Yorks, UK, and by the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709-2215, USA.

During the light fastness test, one half of the blue wool standard reference card is covered to prevent exposure to UV light.

The exposed leather is judged on contrast compared to the non exposed leather and then compared with a similar difference in contrast of the blue wool standards. This is a subjective analysis of the light fastness.

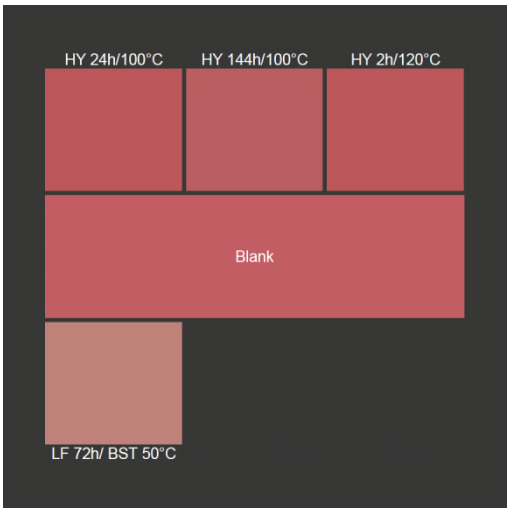
X-Rite reports

Our standard report provides tests results in Gray scale staining (undyed leather), Grey scale coloring (dyed leather) and L*a*b* scale. For light fastness testing, reporting in Blue Wool Scale rating is possible but be aware, this is a test method for textile and it is a subjective observation.

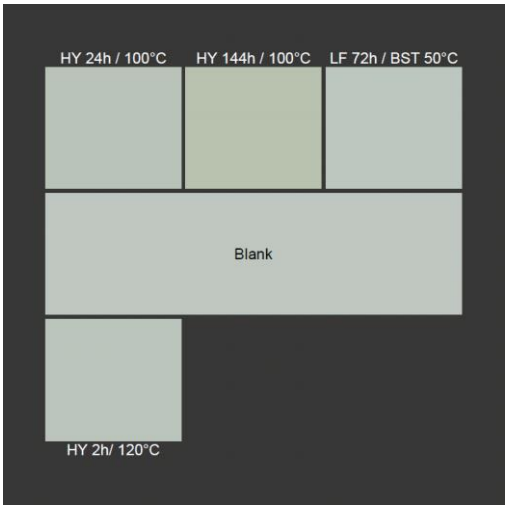
The standard is measured in L*a*b*scale and L*C*h° scale.

If a sample after a heat yellowing test becomes more yellow compared to the standard (not treated) the Delta b* value will be positive. If more blue than Delta b* value will be negative. The same goes for Delta a* value (red/green). Delta E is the overall result of Delta L, Delta a and Delta b

For light fastness testing it is best to do this on undyed leather. Pictures show the test result of the same recipe with dyed and undyed leather. GS change results of the dyed leather compared to the undyed leather show the effect of bleaching of the dye.



Trial Name	DL*	Da*	Db*	DE*	GS Stain	GS Change
HY 24h/100°C	-2.14 D	0.53 R	2.03 Y	3.00	4.5	3.5
HY 144h/100°C	-0.86 D	-3.40 G	0.29 Y	3.52	4.5	3.5
HY 2h/120°C	-2.24 D	0.60 R	1.87 Y	2.98	4.5	3.5
LF 72h/ BST 50°C	8.39 L	-17.80 G	-2.47 B	19.84	2.5	1



Trial Name	DL*	Da*	Db*	DE*	GS Stain	GS Change
HY 24h / 100°C	-2.07 D	-0.93 G	1.43 Y	2.69	4.5	3.5
HY 144h / 100°C	-2.94 D	-1.88 G	5.71 Y	6.69	4	2
LF 72h / BST 50°C	-0.18 D	-1.53 G	0.55 Y	1.64	5	4
HY 2h/ 120°C	-1.30 D	-0.42 G	0.74 Y	1.55	4.5	4