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Study and New Criteria for the Assessment of Upholstery Leathers with a Pigment Finish in Relation to the Characteristics Recommended in the PN-EN 13336 Standard

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Abstract
The fundamental physical, mechanical and chemical properties given in the PN-EN 13336:2013 standard ("Leathers – Upholstery leather characteristics – Guide for selection of leather for furniture") were examined for 27 selected upholstery leathers with a pigment finishing. Colour resistance to rubbing with dry, wet felt, and felt socked with artificial perspiration solution, adhesion of the finish, flex resistance, tear strength, colour fastness to a water spot, and the pH of water extracts were determined. Moreover, some features of these upholstery leathers which are not listed in the standard were also tested, namely the tensile strength, maximal elongation, distension and strength at a crack of the grain or finish and at the bursting of the full thickness of the leather tested as well as the content of chromium(VI). It was found that the majority of the leathers tested fulfilled the recommended values of characteristics given in the PN-EN 13336:2013 standard. Some deviations from these values were random and did not depend on the colour of the finish. Leathers with a two-colour covering (so-called "antique" finish) did not show worse properties than those with a one-colour finish. On the basis of the results obtained, a wider range of the fundamental tests and other values of parameters generally higher than those recommended in the standard are proposed for the quality assessment of upholstery leathers with a pigment finish.

Key words: *upholstery leathers, pigment finish, recommended assessment parameters.*

Introduction

Textile products and natural and artificial leathers are used as materials in upholstery products [1]. The diversity of these materials is large [2-8]. Customers expect that leather and textile products will gain new features in regard to the area of usage by means of new technologies and chemical products [9-13].

Upholstery leathers used for the covering a variety of furniture, including leisure sets, often do not meet the expectations of users, because they undergo various types of damage after a relatively short time of use (often after a few months). Furniture with leather upholstery are a frequent subject of complaints and disputes between the user and seller or furniture manufacturer, because the high price of upholstered furniture prompts users to report even small defects in upholstery leathers.

The Institute of Leather Industry, as a competent institution to issue opinions in the field of leather quality, performs laboratory tests of upholstery leather that is the subject of complaints and prepares expert opinions for the needs of the producers and users of furniture, courts and other institutions. A significant number of complaints about furniture products with leather upholstery induced the Institute of Leather Industry to deal with the issue of the quality of leather intended for furniture coverings. It was noted that the defectiveness of upholstery leathers is revealed during the use of the furniture within the period of the warranty, even when the values of parameters determined for these meet the requirements recommended in PN-EN 13336: 2013-03 [14].

The organoleptic assessment of leather furniture covers performed by specialists in the field of tannery and leather quality most often did not indicate that the defects of upholstery leathers, reported as a part of the complaint, resulted from improper use or inappropriate care. In our opinion, the too low values of indicators proposed for furniture leathers in the standard [14] allow to use leathers with worse properties as furniture covers, which after a short time of their use favours the formation of damage and consequently leads to a significant increase in the number of complaints. The most common object of complaint is the low quality of furniture leathers with a pigment finish, both with a one colour and two colour finish (so-called "antique" leathers), where the finishing surface undergoes peeling and/or wiping.

In order to meet the expectations of users and manufacturers of furniture with leather upholstery, as well as their sellers, it was planned to check selected properties of upholstery leathers with a pigment finish and to determine values of the new parameters, especially those that have a significant impact on the quality of leather upholstery.

This article presents the results of tests performed on upholstery leathers with a pigment finish. The purpose of this work was to extend the scope of properties examined in relation to those recommended in the standard [14] for pigmented upholstery leathers and also to propose new values of some characteristics so that the leather used in the production of furniture upholstery will be characterised by greater durability and resistance to various external factors during the use of the furniture.

For many years, the Institute has been working on the properties of leather and textile materials and has indicated possibilities of managing industrial waste [15-26].

Experimental

Material

Samples of pigmented upholstery leathers coming from various tanneries, both domestic and foreign, that are used for furniture and car covers were selected

for these studies. The leathers examined were finished according to a given company's technology, in different colours, i.e. using a one-colour finish and shaded finish with a two-colour effect. The characteristics and symbols of the upholstery leather samples with a pigment finish selected for testing are given in ***Table 1***.

Test methods

Studies on selected properties of the upholstery leathers (***Table 1***) were made in accordance with the methods included in current functional standards with the status of Polish, European and international standards [27-35]. Due to the small size of some leather samples chosen for testing, the values of several planned parameters were determined based on the test results of only a slightly smaller selection of leather samples than that listed in ***Table 1***.

Calculations

Calculation of the values of individual parameters was carried out in accordance with the formulas given in the functional standards [27-35], according to which a particular property of the leather was examined. On the basis of the test results obtained, the geometric mean ($\overline{g}$) was calculated according to the following ***Equation (1)***:

$$\overline{g} = \sqrt[n]{a_1 \cdot a_2 \cdot \ldots \cdot a_n}, \qquad (1)$$

wherein:

$a_1, a_2, \ldots, a_n$ – determined, individual values of the parameter tested, n – number of values determined (measurements).

Geometric means ($\overline{g}$), which were calculated from the experimental results obtained during the testing of particular properties of the pigmented upholstery leathers, can be a reference point for proposing new values of the recommended parameters.

Results and discussion

Determining the parameters recommended in the PN-EN 13336:2013 standard [14]

Colour fastness to to-and-fro rubbing [27]

Results of the colour fastness to rubbing with dry and wet felt as well as with felt soaked in artificial perspiration solution are shown graphically in ***Figures 1-3***.

To assess colour fastness to the rubbing of the leather samples tested, both chang-

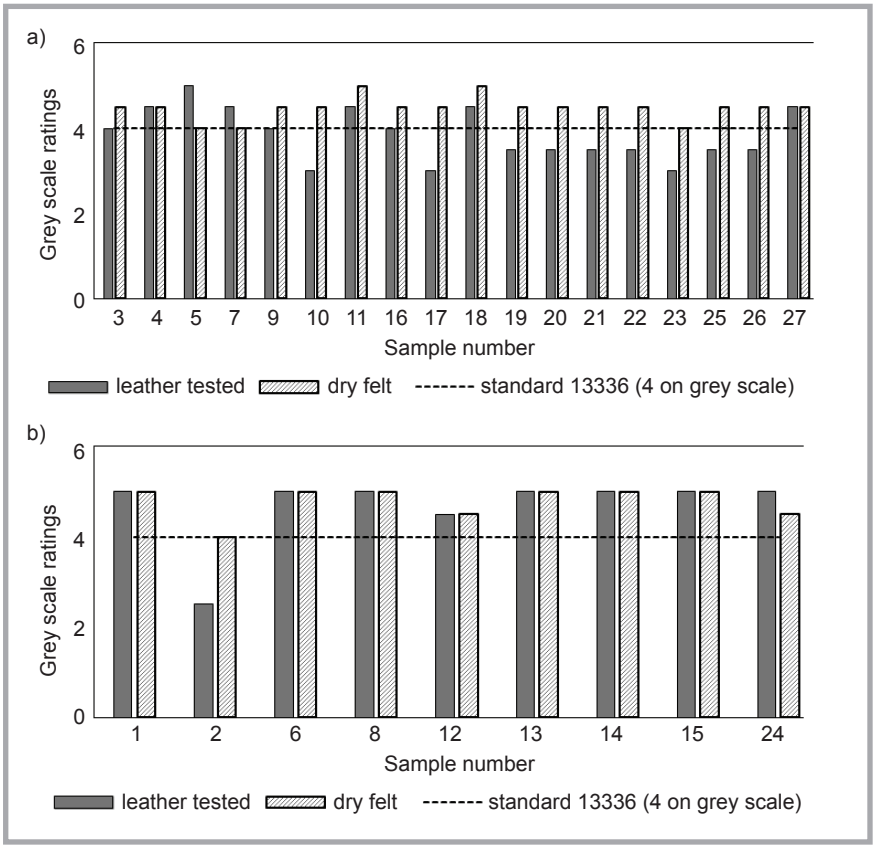

Figure 1. *Colour fastness to to-and-fro rubbing using dry felt (white or black) determined for the following upholstery leathers: a) with one-colour finishing and b) with shaded finishing. Changes in colour on the leather surface and staining of the felt were assessed in degrees of the grey scale after 500 cycles.*

Table 1. *Characteristics of leather samples used in the research.*

Sample number	Average thickness, mm	Description of pigment finishing
1	1.20	medium brown colour, shaded
2	0.84	medium brown colour, shaded
3	1.02	medium brown colour
4	1.08	dark brown colour
5	1.21	ecru colour
6	0.92	dark brown colour, shaded
7	0.98	black coluor
8	1.44	reddish brown colour, shaded
9	1.04	honey colour
10	1.15	black colour
11	1.05	beige colour
12	1.12	medium brown colour, shaded
13	1.29	dark brown colour, shaded
14	1.03	light brown colour, shaded
15	1.19	medium brown colour, shaded
16	1.40	light beige colour
17	1.13	chocolate brown colour
18	1.16	dark beige colour
19	0.87	dark brown colour
20	1.22	black colour
21	1.03	black colour
22	0.78	black colour
23	0.87	black colour
24	0.92	brown colour, shaded
25	1.02	black colour
26	0.88	black colour
27	1.15	white colour

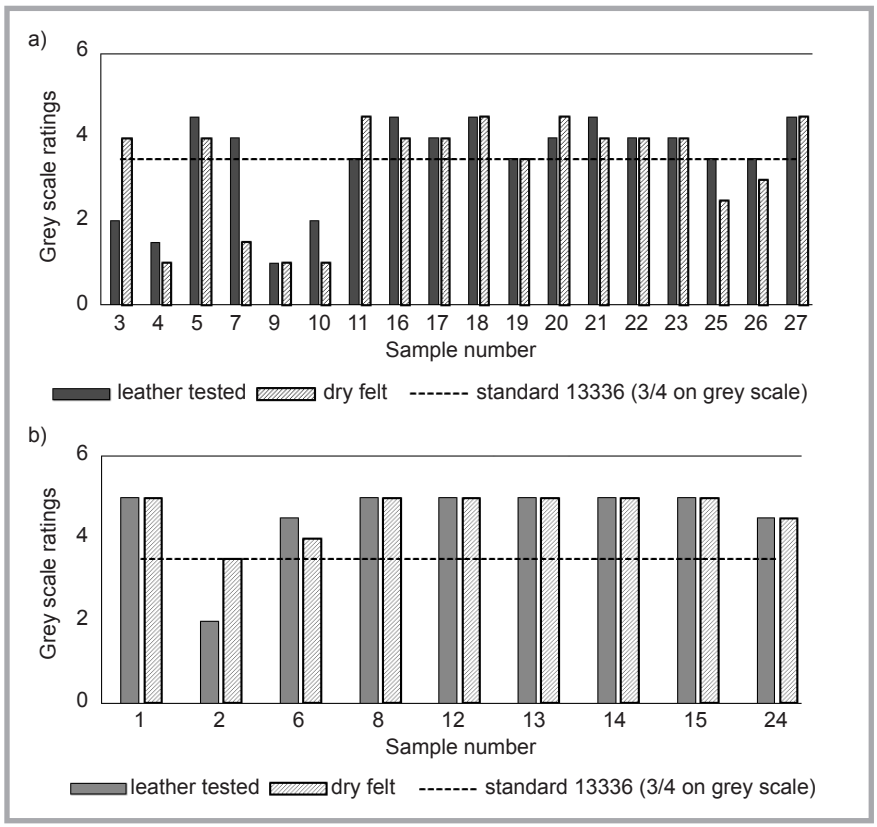

Figure 2. *Colour fastness to to-and-fro rubbing using wet felt (white or black) determined for the leather samples tested: a) with one-colour finishing, b) with shaded finishing. Changes in colour on the leather finish and staining of rubbing agents were assessed in degrees of the grey scale after 250 cycles.*

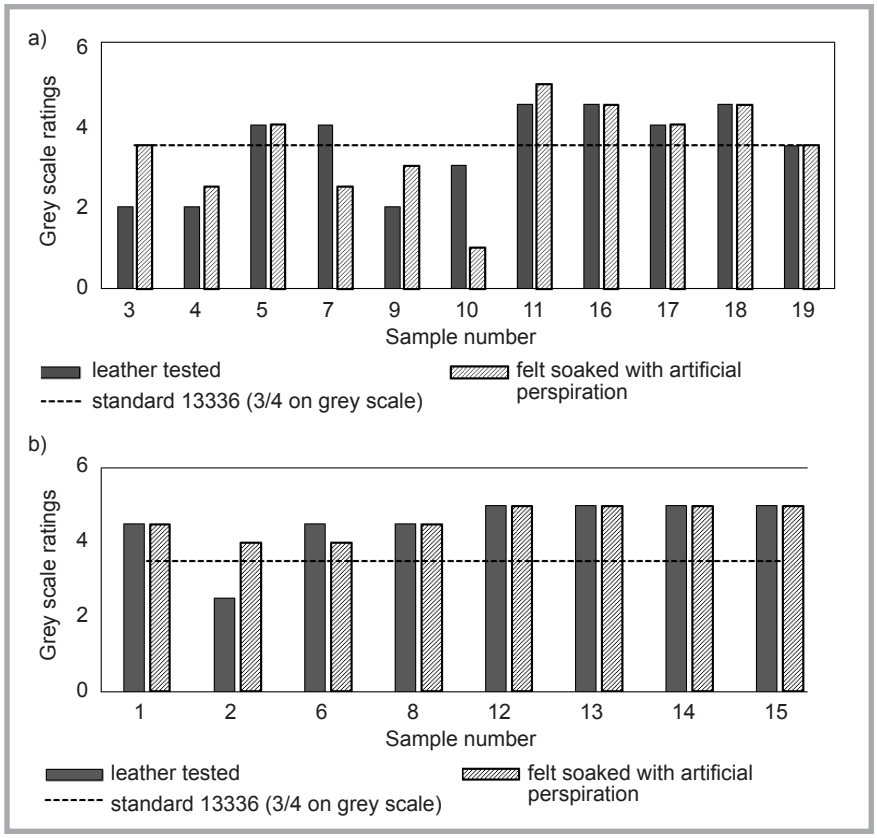

Figure 3. *Color fastness to to-and-fro rubbing using felt wetted with artificial perspiration determined for the leather samples tested: a) with one-colour finishing, b) with shaded finishing. Changes in colour on the leather surface and staining of the felt were assessed in degrees of the grey scale after 80 cycles.*

es in the finishing of the leather and corresponding soiling of the rubbing agent, expressed in ratings of the grey scale, were taken into account. Applying this rule, it can be seen in ***Figure 1.b*** that six leather samples with a two-colour finishing (No. 1, 6, 8, 13, 14 & 15) are characterised by high fastness of colour to dry rubbing, because after 500 cycles of rubbing, both changes in colour on the leather finishing and the soiling of the rubbing agent were assessed as 5 degrees on the grey scale. This result means that no colour change or damage were observed on the leather surface or on the rubbing agent after the test. In contrast, no leather sample with a one-colour finish (***Figure 1.a***) was rated extremely highly. Moreover, all the results in ***Figure 1*** indicate that 17 leather samples fulfilled the requirements recommended in the standard [14], i.e. changes observed after the test both on the leather surface and on the rubbing agent correspond to a minimum of 4 degrees on the gray scale. On the other hand, only 1 leather sample with a two-colour finish and 9 leather samples with a one-colour finish were assessed lower than the parameter recommended in the standard [14], i.e. below 4° on the grey scale, which means that these 10 leather samples have a colour fastness to dry rubbing which is too low.

In summary, changes in colour observed on the surface of 17 (about 63%) leathers tested and soiling of the rubbing agent corresponded to a minimum of 4° on the grey scale, while only 10 of all samples tested (about 37%) were rated below 4° on the grey scale, i.e. they had a worse colour fastness to dry rubbing than that recommended in the standard [14]. The geometrical means calculated from all the results presented in ***Figure 1*** both for changes visible on the leather surfaces and for soiling of the dry felt are equal to 4° and 4/5° on the grey scale, respectively.

On the basis of results of the colour fastness to wet rubbing, shown in ***Figure 2***, it can be concluded that 19 (including 11 leathers with a one-colour finish and 8 leathers with a two-colour finish) of all 27 upholstery leathers examined meet the requirements of the standard [14], i.e. the colour change of the leather finishing and soiling of the rubbing agent corresponded to a contrast of no less than between 3° and 4° on the grey scale after 250 cycles of wet rubbing. Three of the leath-

ers with a one-colour finish tested (***Figure 2.a***) showed very low colour fastness to wet rubbing, because the changes on the surface of the leathers and rubbing agent that occurred after this test corresponded to 1° and 2° on the grey scale.

In summary, the colour fastness to wet rubbing of 19 leathers tested (about 70%) were assessed at a minimum of between 3° and 4° on the grey scale. The geometrical means calculated from all the results, presented in ***Figure 2***, are equal to between 3° and 4° on the grey scale both for the colour changes observed on the finish of the leathers and for the soiling of the wet felt.

The requirements specified in the standard [14] for colour fastness to rubbing with sweat solution for upholstery leather with a pigmented finish indicate that a change in colour on the leather surface and soiling of the rubbing agent after 80 cycles of rubs should correspond to a contrast minimum of between 3° and 4° on the grey scale. The results presented in ***Figure 3*** show that these demands were fulfilled by 13 (about 68%) leather samples tested. Moreover, 12 samples had a high fastness of colour to rubbing under these conditions, because the changes observed after the tests corresponded to a minimum of 4° on the grey scale. Meanwhile, one leather sample with a two-colour finish (No. 2) and five leather samples with a one-colour finish (numbers 3, 4, 7, 9 and 10) (***Figure 3***) are characterised by the lowest colour fastness to rubbing with felt soaked in artificial perspiration solution and did not meet the requirements specified in the standard [14]. The geometrical means calculated from all the results received under these conditions (***Figure 3***) are equal to 3/4° on the grey scale both for the changes in colour on the leather surface and for the soiling of felt wetted with artificial perspiration solution.

Adhesion of the finishing [28]

Values of the adhesion of leather finishing were determined for the 22 upholstery leather samples according to the method described in the standard [28]. The results obtained are shown in ***Figure 4***.

The results presented in ***Figure 4*** indicate that the strengths of adhesion of the finish to the leather determined for all samples tested fulfill the value of the parameter (2 N/10 mm) recommended in the standard [14]. Moreover, values of the adhesion strength determined significantly exceed 2 N/10 mm, irrespective of the kind of leather finish (two-colour or one-colour). On the other hand, the geometric mean calculated from all the results in ***Figure 4***, in accordance with ***Equation (1)***, is equal to 8.7 N/10 mm, which is also much higher (over 4 times) than the recommended parameter value [14]. Therefore, it can be assumed that the parameter proposed in the standard [14] is too low and that the value of the geometric mean should be taken into account to plan a new criterion concerning the adhesion of the finish of upholstery leather to the pigmented coating.

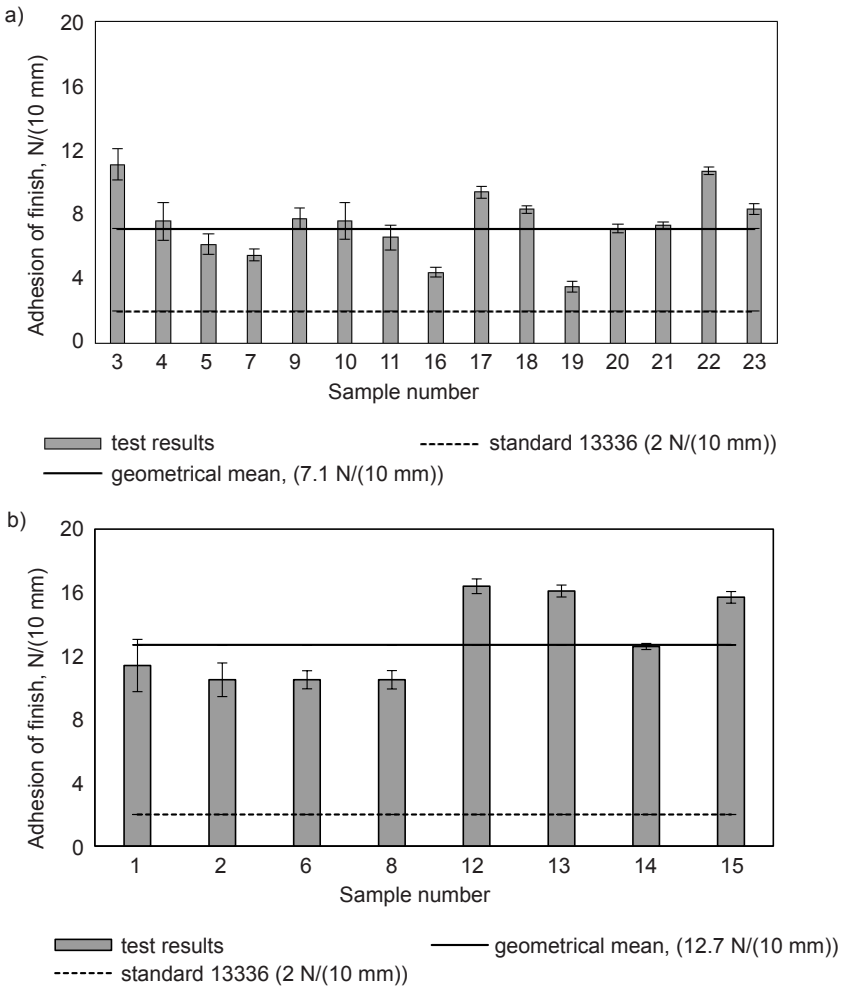

Figure 4. *Adhesion of finish determined for upholstery leathers tested: A – with one-colour finishing, B – with shaded finishing.*

Finishing resistance to flexing at temperature 23 ± 2 °C [29]

A test of the resistance to flexing of upholstery leather finishing was conducted for the 26 leathers mentioned in ***Table 1***. Sample for the test were cut from the same leather in two opposite directions (along (↑) and across (⊥) the dorsal line). As a final result for both directions examined, the maximal number of flexing cycles was accepted at which a weaker sample was still not destroyed, irrespective of the direction of its cutting. Final results considering both directions tested are presented in graphical form in ***Figure 5***. The number of flexing cycles shown in this Figure denotes the maximal number of cycles at which there still was no visible damage on the finishing of the sample tested.

On the basis of observations during the test and on the results obtained, it was found that greater resistance to flexing were shown by leather samples cut across than along the dorsal line.

Analysing the results determined jointly for all leather samples and both directions tested (***Figure 5***), it can be seen that one leather sample with a two-col-

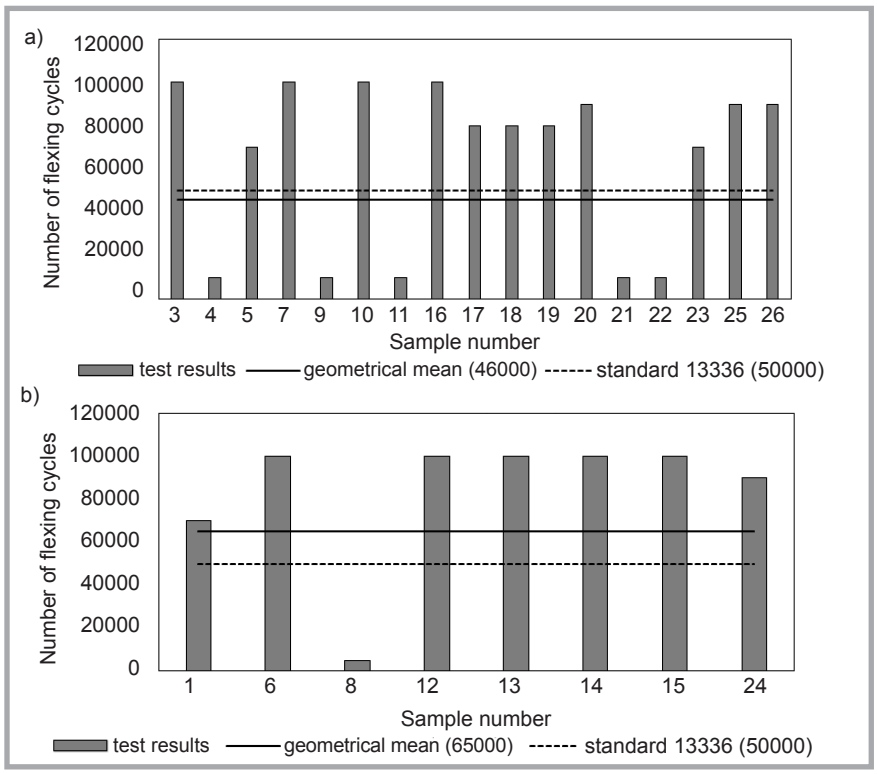

Figure 5. *Resistance of the pigmented finishing to flexing determined for the leathers tested: A – with one-colour finishing, B – with shaded finishing (number of cycles given together for samples cut along ↑ and across (⊥) the dorsal line).*

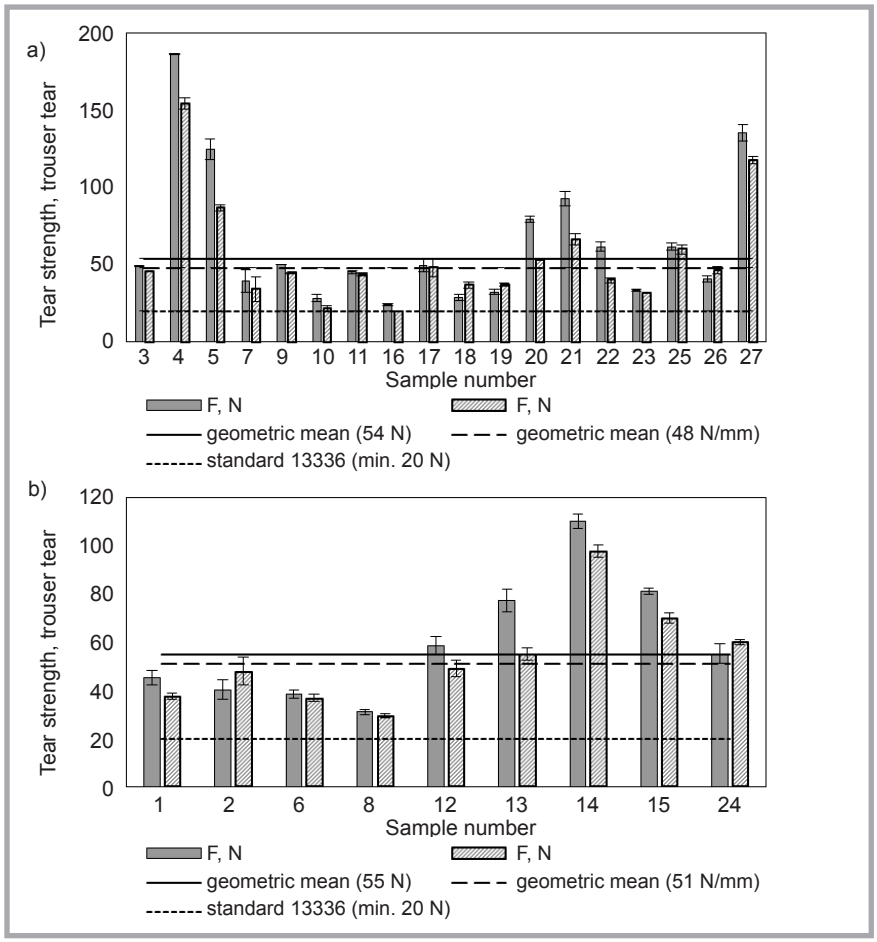

Figure 6. *Average values of tear strength (calculated for two directions) expressed in, N for leather samples of different thickness and for the same samples considering their thickness, in, N/mm.*

our finish (No. 8) and five samples with a one-colour finish (numbers 4, 9, 11, 21 & 22) withstood any damage for only 10,000 flexing cycles, i.e. significantly fewer than recommended in the standard (50,000 cycles) [14]. On the other hand, nine of all 26 upholstery leathers with pigmented finishing examined (four samples with a one-colour finish and five samples with a shaded finish) were characterised by high resistance to flexing, because after 100,000 cycles no damage was observed on the finishing surface of these leathers. In addition, the results illustrated in ***Figure 5*** show that 19 (about 73%) of all upholstery leathers tested withstood 70,000 flexing cycles without any damage to the finish. The geometrical mean calculated from all the results presented in ***Figure 5*** is equal to 51,000 flexing cycles. Therefore, this number of cycles can be the basis for proposing a new value of the flexing resistance parameter for upholstery leathers with a pigment covering.

pH value of an aqueous extract from the leather [30]

pH values were determined for aqueous extracts obtained from the randomly selected leather samples described in ***Table 1***. The test was carried out in accordance with the method given in the standard [30]. The experimental results indicated that all leathers examined met the pH value recommended in the standard [14], which should not be lower than 3.2. The geometrical mean calculated from the results obtained, according to the ***Equatoin (1)***, is equal to 4.4, which could be taken into account when a new criterion for the aqueous extract pH from upholstery leathers with a pigmented finishing will be set.

Resistance to one-sided tearing [31]

Resistance to one-sided tearing (tear strength) was determined for all leather samples described in ***Table 1***. According to the standard [31], tearing strength values are given in Newton's (N), and the thickness of the leather examined is not taken into account in the calculations. On the other hand, it is generally known that the thickness of the leather is a parameter that has a strong influence on its tear strength, and in our opinion it should be taken into account in the calculations. As a consequence, the new parameter value proposed for the assessment of upholstery leather should be expressed in N/mm. Average values of the tear

strength calculated from the results obtained for samples cut out in two opposite directions (↑ ⊥) are demonstrated graphically in ***Figure 6***. Due to the fact that the upholstery leathers tested (***Table 1***) differed from one another in thickness, which varied from 0.76 mm to 1.51 mm, results of the tear strength, shown in ***Figure 6***, were expressed both in accordance with the standard [31] in N and considering the leather thickness in N/mm.

Analysing the average values of the tear strength of the leathers tested (***Figure 6***), it can be stated that all 27 samples tested met the requirement of the standard [14], i.e. the value of the tear strength should be a minimum of 20 N. ***Figure 6*** shows that sometimes the tear strength determined many times (4-9 times) exceeded the values recommended in the standard [14] (e.g. tear strength for samples 4, 5, 14 and 27,). Moreover, it can be noticed (***Figure 6***) that the thickness of the leathers tested is an important parameter which affects leather resistance to tearing. In most cases, the consideration of thickness in the calculations caused a decrease in the value of the tear force in relation to the value expressed in N. However, for several samples (2, 18, 19, 24 and 26), the tear strength expressed in N/mm is higher than that given only in N. Hence, it can be concluded that the value of the tear strength calculated per unit of thickness is more suitable for the comparison and objective assessment of the resistance to tearing of leathers of varying thickness. The geometrical means calculated for all the results shown in ***Figure 6*** are equal to 54 N or 49 N/mm and are about 2-times higher than the parameter given in the standard [14], irrespective of the unit used. Thus, it can be concluded that the calculated geometrical mean expressed in N/mm should be considered to establish a new criterion for the assessment of upholstery leathers with pigment finishing in terms of their resistance to tearing.

Colour fastness to a spot of water according to the standard [32]

The colour fastness to a spot of water was checked for upholstery leathers randomly chosen from those in ***Table 1***. Changes in the leather finishing under the influence of a spot of water were assessed in degrees of the grey scale after 30 minutes and after 16 hours from applying the drop on the finishing of the leather. Observations made after 30 min-

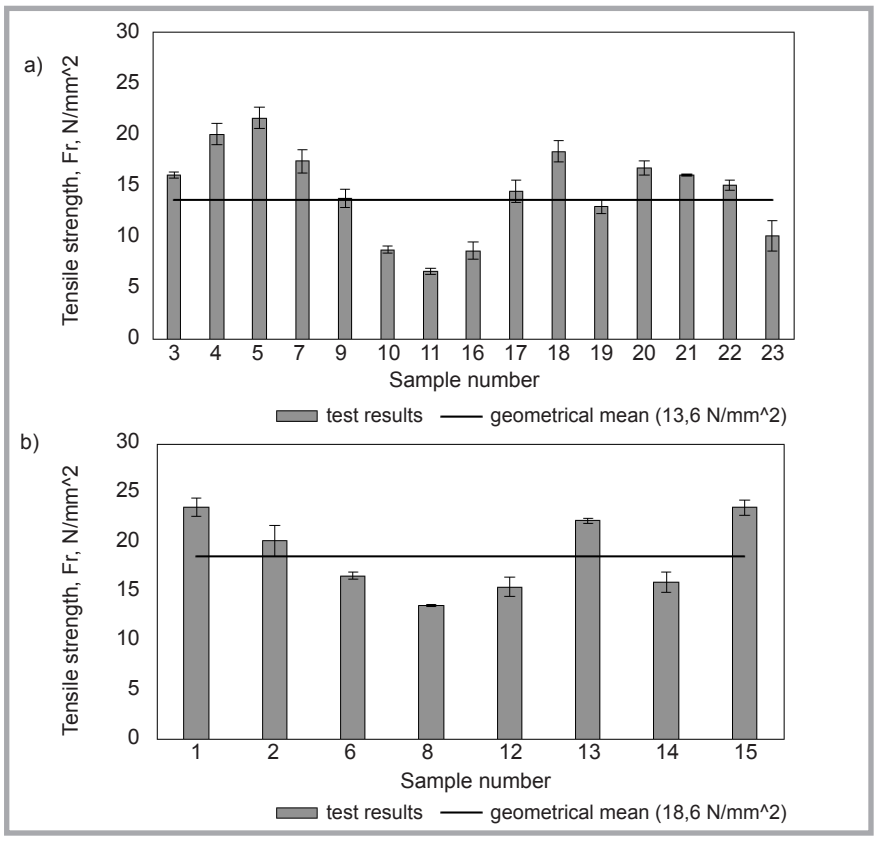

Figure 7. *Average tensile strength of examined upholstery leathers calculated from values determined in two opposite directions (along and across the dorsal line) and geometric means calculated for leathers with different kinds of finish.*

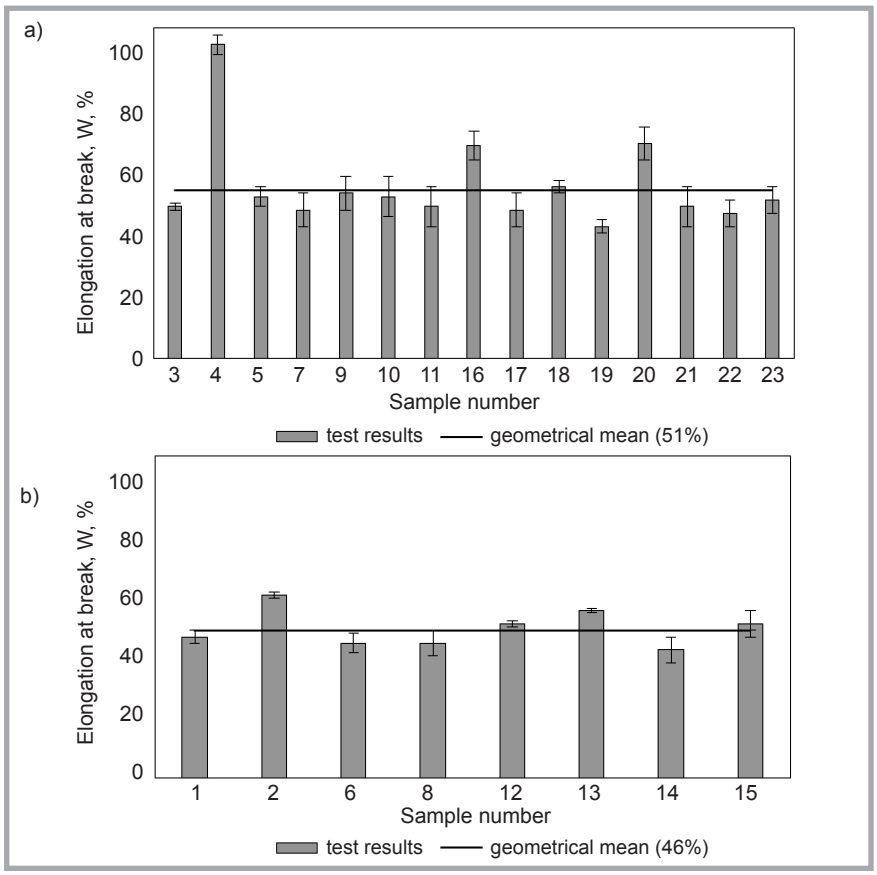

Figure 8. *Average maximum elongation (at break) of tested upholstery leathers calculated from results determined in two opposite directions (along and across the dorsal line) and the geometric means calculated for leathers with different kinds of finish.*

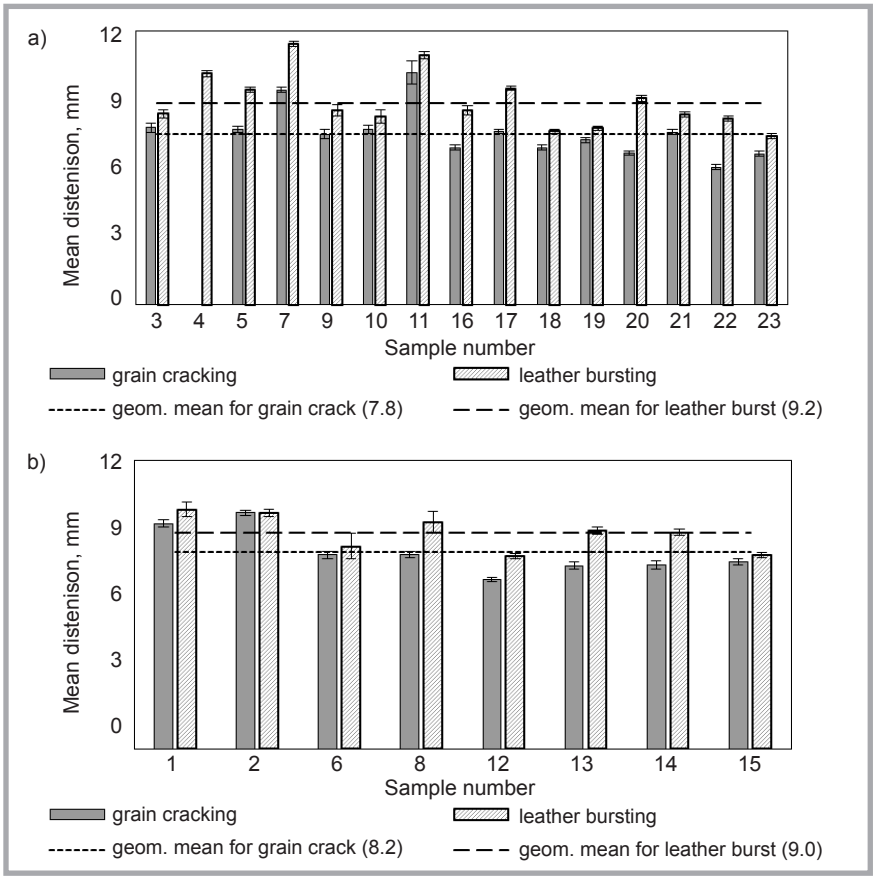

Figure 9. *Distensions determined at cracking of the grain and at bursting of the leather for samples with different finishes (one-colour and two-colour).*

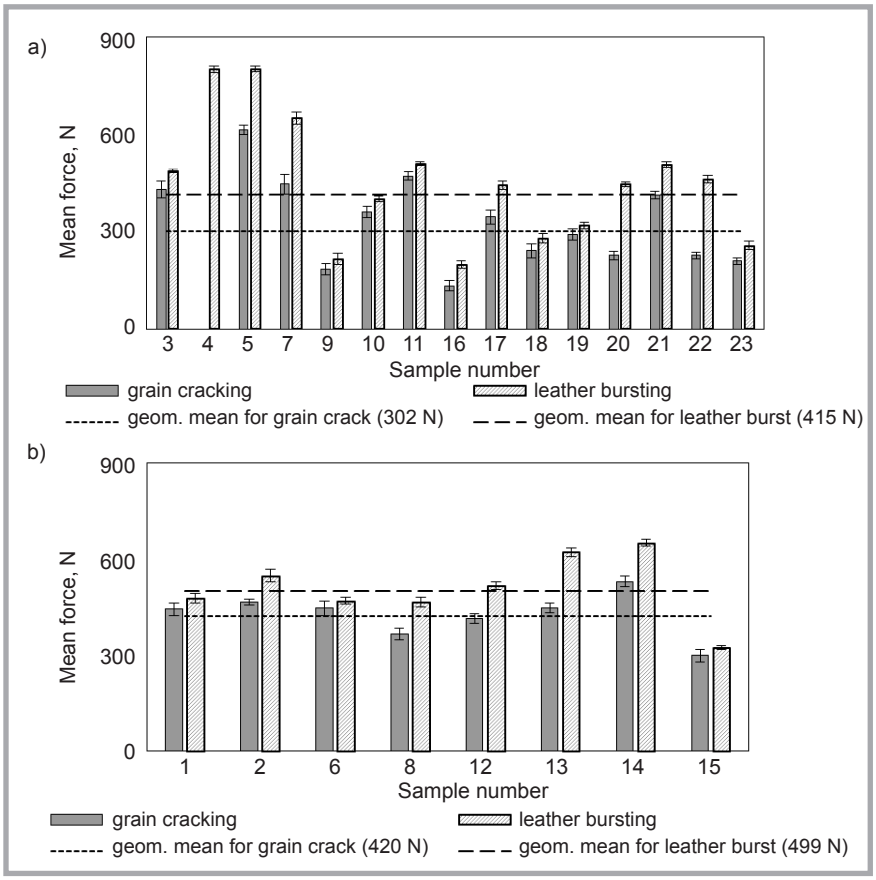

Figure 10. *Forces determined at cracking of the grain and at bursting of the leather for samples with different finishes (one-colour and two-colour).*

utes from applying the drop of water proved that a very slight loss of gloss was visible only on the surface of the three samples tested (numbers 3, 6 and 10). However, after 16 hours from applying the drop of water, it was found that no change in colour or other physical variations were observed, e.g. swelling or wrinkling of the coating, on the surface of any of the leathers tested. Therefore, the lack of any changes on the surface of the samples examined after 16 hours from applying the drop of water corresponds to 5° on the grey scale. Hence, it can be concluded that all upholstery leathers tested met and significantly exceeded the parameter recommended in the standard [14], according to which the change in colour on the leather finishing after 16 hours should correspond to a minimum of 3° on the grey scale, and permanent leather swelling should not be observed. Therefore, to establish new criteria for the assessment of upholstery leathers with a pigment coating, the water drop resistance factor (a minimum of 3°) can be improved to a minimum of 4° on the grey scale.

Determination of parameters not included in the standard [14]

Tensile strength (Fr) and maximum elongation (W) according to the standard [33]

The tensile strength and maximum elongation were determined for the 23 leather samples selected for these studies (***Table 1***). Both parameters were tested using the method given in the standard [33], according to which the tensile strength is given in N/mm^2, i.e. the thickness and width of the leather sample tested are taken into account in the calculation of this parameter. The maximum elongation (at break) of the leather sample is expressed as a percentage. Tensile strength and maximum elongation results determined for the two opposite directions tested (↑ ⊥) are shown in ***Figures 7*** and ***8***, respectively. Geometric means calculated from averages of the tensile strength (***Figure 7***) and maximum elongation (***Figure 8***) determined for all the leather samples (with one-colour and two-colour finish) in both directions tested (↑ ⊥) are equal to 14.9 N/mm^2 and 49.5%, respectively. Moreover, analysis of the results in ***Figures 7*** and ***8*** indicates that 15 (about 65%) from all the leather samples tested have a tensile strength greater than 15 N/mm^2, and values of the maximum elongation (at break) for 17 (74%) leath-

er samples (with one-colour and two-colour finish) are within the range 40-50%. Therefore, it can be assumed that both values of geometric means calculated (tensile strength and maximum elongation) may be included in the new criteria established for the quality assessment of upholstery leathers with pigment finishing.

Determination of the force and distension at cracking of the leather grain and at bursting of the leather by the ball burst method [34]

The bursting height and corresponding strength value both when the leather grain is cracked and when the leather has been pierced, were determined for the 23 selected leather samples described in ***Table 1***. The results obtained are illustrated in ***Figures 9*** and ***10***.

On the basis of the values of height determined (***Figure 9***) and the force (***Figure 10***) obtained both at the cracking of the grain and at the bursting through of all the leather samples (with one-colour and two-colour finish), the geometric mean values were calculated, which are presented in ***Table 2***. The values of geometric means determined (force and distension) can be the basis for determining new parameters for the quality assessment of upholstery leathers with pigmented finishing.

Determination of chromium(VI) content according to [35]

Bearing in mind the safety of using upholstery leathers (contact of the user's body with the surface of the leather), determination of the chromium(VI) content was carried out for 11 randomly selected samples of upholstery leathers. It is known that compounds of Cr(VI) were determined to exert a carcinogenic action on humans [36-37]. Chromium(VI) was found in one leather sample – number 9, the content of which was equal to 4.5 mg/kg of dry matter, thus exceeding a value of 3 mg/kg, which is treated as the minimum limit for the determination of chromium(VI) according to the method described in the PN-EN ISO 17075-1:2017-05 standard [35]. Taking into account the carcinogenic effect of chromium(VI) compounds, the value of the parameter determining its permissible content in upholstery leathers should be considered to establish new criteria for their quality assessment.

Table 2. *Geometric means of force and distension determined at cracking of the leather grain and at piercing of the leather calculated from all experimental results obtained, presented in* ***Figure 9*** *and* ***Figure 10****.*

Parameter		Geometric means
Force, N	at cracking of grain	340
Distension, mm		7.9
Force, N	at bursting of leather	443
Distension, mm		9.0

Table 3. *New values of parameters proposed on the basis of the experimental results and those recommended in the PN-EN 13336:2013 standard [14] for assessment of the quality of upholstery leather with pigment finishing (one-colour and two-colour).*

Kind of test	Unit	Parameter		Method of testing
		Recommended in PN-EN 13336:2013 [14]	Proposed on basis of tests	
Color fastness to rubbing:	degree of grey scale	*Change in colour on leather finishing and soiling on felt:*		PN-EN ISO 11640:2013-05
• with dry felt after 500 cycles		≥ 4°	≥ 4°	
• with wet felt after 250 cycles		≥ 3/4°	≥ 4°	
• with felt soaked with artificial perspiration solution after 80 cycles		≥ 3/4°	≥ 4°	
Adhesion of finish	N/(10 mm)	≥ 2	≥ 8	PN-EN ISO 11644:2010
Tear strength (trouser strength)	N	≥ 20	–	PN-EN ISO 3377-1:2012
	N/mm	–	≥ 50	
Resistance to flexing at temperature 23 ± 2 °C	cycle number	50 000 lack of any damage (including cracks)	50 000 lack of any damage (including cracks)	PN-EN ISO 5402-1:2017-04
pH value	–	≥ 3,2	≥ 3,2	PN-EN ISO 4045:2009
Difference figure for pH < 4,0	–	< 0,7	< 0,7	
Colour fastness to a spot of water after 16 hours	degree of grey scale	≥ 3° no permanent swelling	≥ 4° no physical changes on leather surface	PN-EN ISO 15700:2001

Table 4. *Values of additional parameters established on the basis of experimental results proposed for the quality assessment of upholstery leathers with one-colour and two-colour pigment finishing.*

Kind of test	Unit	Parameter	Method of test
Tensile strength	N/mm^2	≥ 15	PN-EN ISO 3376:2012
Maximum elongation	%	40 ÷ 50	
Bursting of grain/leather surface:			PN-EN ISO 3379:2015-11
– Distension at • cracking of leather grain	mm	≥ 7,8	
• Bursting of leather		≥ 9,0	
– force at • cracking of leather grain	N	≥ 340	
• Bursting of leather		≥ 440	
Chromium(VI) content	mg/kg	undetectable (< 3 mg/kg)	PN-EN ISO 17075-1:2017-05

New criteria for the assessment of upholstery leather established on the basis of the experimental results

New criteria for the assessment of the quality of upholstery leathers with one-colour and two-colour pigmented coating are proposed on the basis of the analysis of the experimental results as well as the values of geometric means determined for particular parameters. New values established for previously used parameters (given in the standard [14]), as well as new, additional parameters for assessment of the quality of these leathers are provided in ***Table 3*** and ***Table 4***, respectively.

Comparison of the data in ***Table 3*** shows that the values of parameters determined on the basis of the experimental results are, in most cases, higher than those of the same parameters recommended in

the PN-EN 13336:2013 standard [14]. In other words, the properties and, consequently, the quality of the majority of the upholstery leathers with a pigment covering examined is much better than would result from the values of the parameters recommended in the standard [14].

The insertion of additional parameters (given in ***Table 4***) to the criteria for assessment of the quality of upholstery leathers with different pigmented finishes (one-colour and two-colour) may protect them against excessive stretching (formation of folds) during use, and also protect human health against the harmful effects of chromium(VI) compounds during the use of furniture with leather upholstery. In addition, the introduction of a bursting resistance parameter may prevent the leathers from damage during the assembly of furniture.

Conclusions

Different samples of upholstery leather with pigment finishing (one-colour and two-colour) were tested in terms of the physico-mechanical parameters recommended in the PN-EN 13336:2013 standard. The following properties were determined: colour resistance to rubbing with dry felt, wet felt and with felt soaked in artificial perspiration solution, adhesion of the finish, resistance to flexing, tear strength (trouser strength), finish resistance to a spot of water, as well as the pH value of aqueous extracts obtained from the leathers.

It was found that the majority of the upholstery leathers with a pigment covering tested meet the criteria given in the PN-EN 13336:2013 standard. Two-colour leathers – shaded (antiqued) exhibit slightly better properties than those with a one-colour finishing. Deviations from the values of parameters recommended in the PN-EN 13336:2013 standard were accidental, i.e. depending rather on the characteristics of the leather from which the sample was taken, and not on the type of pigment finishing (two-colour, one-colour) or thickness of the leather.

Moreover, additional physico-mechanical parameters not included in the PN-EN 13336:2013 standard were tested, such as the tensile strength and maximum elongation, as well as the bursting height and strength both when the grain is cracked and when the leather is punctured. Due to the possibility of the direct contact of furniture leathers with the human body, the content of carcinogenic Cr(VI) was also determined.

On the basis of the analysis of the results obtained and geometric means determined, new and improved values of parameters are proposed in relation to those recommended in the PN-EN 13336:2013 standard. Moreover, the introduction of new parameters such as stretching properties and the content of harmful chromium(VI) compounds into criteria for the quality assessment of upholstery leather with pigment finishing is also suggested.

If upholstery leathers with pigment finishing meet the improved requirements, then they will achieve higher quality and better use durability, which in the end may lead to a reduction in the number of complaints. In addition, the introduction of additional parameters such as the tensile strength and chromium(VI) content into the assessment criteria may prevent upholstery leathers from excessively stretching (formation of folds) during usage, and also protect human health against the harmful effects of chromium compounds(VI).

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