

Testing upper leather

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A detailed search of test methods reveals an enormous range of tests applicable to finished leather and as many again relevant to constituents and part-processed goods. Tests like resistance to compression and percentage weight loss on soaking are used relatively rarely. Others are specific to only one end use, such as the grain crack index specifically relevant to sole leathers. By contrast, tear strength and light-fastness are appropriate to many end uses and so are carried out frequently. The situation is complicated, as there can be several methods available for assessing the same basic property.

Strength testing

Strength is probably the most commonly assessed property and this can be measured by using either tear or tensile strength. Tear strength is often preferred for upper leather as it automatically takes account of the thickness of the test sample. Comparison of tear strength against thickness can be a useful guide to quality.

In the Baumann test, two hooks are inserted into a slot in the test specimen and pulled apart, causing the leather to tear from

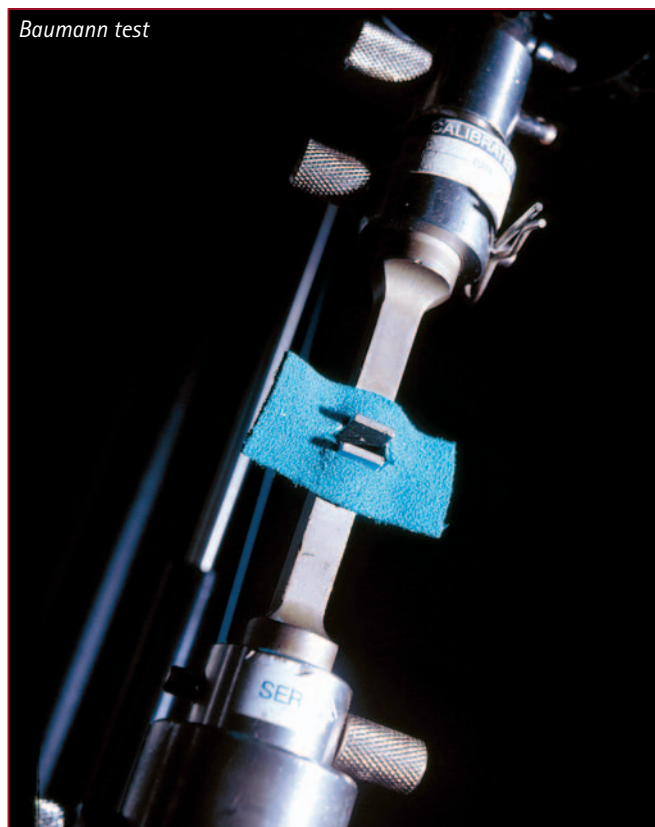
the two ends of the slot. SATRA quotes the maximum load produced during tearing, while some laboratories may divide it by two. A tensile test enables the modulus of the leather (its stretchiness) to be determined as well as its ultimate strength. This can be useful in determining the softness and comfort of the final product as well as the risk of complete failure of the leather.

SATRA's Star-burst test, on the other hand, measures both tear and deformation properties of a single test-piece, which is both quicker and cheaper. An eight-spoke cut is made in a circular sample and placed in a ring clamp. A steel ball is forced into the flesh surface at a constant rate of movement and distension until the sample ruptures across its full width. Maximum force, and distension at maximum force, are both recorded. The test is omni-directional, allowing the leather to tear in the weakest direction, so requiring fewer samples compared with conventional uniaxial tear tests.

Grain crack resistance

The lastometer test predicts the risk of grain crack at lasting. A disc of leather is clamped round its periphery and a small metal ball (much smaller than in the Star-burst test) is pressed up into the flesh side until cracking of the grain occurs. The resulting load and distension gives a measure of the resistance to grain cracking.

Baumann test



Star-burst test



*Bally Penetrometer test*

Water resistance

Some leathers are required to resist penetration by water and, with grain leathers, this can only be enhanced during tanning. There are several methods of assessment. Upper leather is normally put through the Maeser test, a demanding dynamic method where it is flexed while in contact with water. Leathers for less demanding applications may be assessed using the Bally Penetrometer. Both measure the time or number of flexing cycles the leather will withstand before water penetration, although the Bally test will often also measure water uptake.

Water vapour permeability (WVP)

One of the principal reasons why leather is perceived as being comfortable to wear is its 'breathability'. For example, it can transmit water vapour and so prevent a build-up of perspiration next to the skin. Unfinished leather has high permeability, but this progressively falls as heavier coats of finish are applied—unless they are designed to be permeable. However, many leather finishes 'break up' to some degree when flexed during normal wear and this can significantly improve permeability.

Standard permeability tests often involve measuring the weight gain of a desiccant within a closed container sealed with the leather under test. A common method is the Nice-Mitton test which can classify leathers from very high to low permeability. This is preferable to introducing a pass/fail requirement as different end uses and constructions will not always require high levels.

Much of the comfort attributed to permeability is in fact due to leather's inherent high absorptive capacity. It is therefore preferable to assess the true comfort potential of a leather through a combined permeability and absorption test. Ensuring high permeability in a grain must again be achieved during the production processes, as there is little that can be achieved once it is finished.

Colour-fastness

This can relate to both a leather's tendency to change colour and to the transfer of colour to any material in contact with it. Surface colour-fastness of an unfinished leather is highly dependent on the dyeing and is influenced by both the type of dye and the quantity required to achieve the shade. Leather collagen has a limited number of sites to which dye can be chemically fixed and generally the deeper the shade the greater the tendency to shed colour.

Water and perspiration fastness is assessed by placing wetted fabrics of different fibre composition in contact with the leather and recording the amount of colour transferred to the fabrics. In addition, colour change of the leather itself may also be assessed. Any recommended performance guidelines that cover this property must strike a careful balance between what can be realistically achieved by the tanner and what is acceptable to the consumer.

Light-fastness

Leathers can fade or otherwise change colour on exposure to light. Light-fastness is determined in the laboratory by exposure to light from a xenon arc (a good reproduction of the spectrum of natural daylight) at a high intensity which accelerates any changes and brings the test down to a reasonable time scale. Light-fastness is again dependent on the dye and quantity present. Some do have a lower light-fastness associated with a lower concentration and pastel shades may show a greater tendency to fade.

The difference between a deep and a pastel shade can be as much as two to three steps on the Blue Wool Standard assessment scale (each step on the scale doubling the light-fastness) and extra care should therefore be taken in selecting pale shades. Once a pigmented finish has been applied to the leather the original dyeing is protected from light and the ➤

*Exposure to xenon arc*

Vamp flex test



light-fastness of the finish becomes the important factor.

Pigments have an inherently superior light-fastness compared to dyes, so finishing would be expected to improve light-fastness. However, this can be impaired if a dye with a low light-fastness is incorporated into the finish as part of colour matching or to provide aesthetic effects.

Flex resistance

Most finished leathers undergo flexing in use and repeated flexing can damage the finish. This normally involves cracking or crazing, but delamination (blistering, flaking and peeling) can also occur. There are two basic test methods. The SATRA vamp flex test is normally recommended for footwear leathers as this accurately reproduces the flexing strains to which uppers are subjected in wear. The Bally flexometer is more severe in certain aspects but may still be effective in assessing the likelihood of finish failure.

Wet and dry rub fastness

In use, leathers are often subjected to a continuous mild abrasion in the form of rubbing. The circular rub test reproduces this and determines both the colour change of the leather finish and also transfer to the rubbing pad under the test conditions. An alternative rub fastness test known as the Veslic test uses a to-and-fro mode of rubbing.

The fastness of a finish is determined by selection of the appropriate binder and by the amount of pigment. It is not good practice to leave too much of the final wet rub fastness to the top coat. Better overall results are obtained if some of this performance is built into the pigmented base coats.

Dry rub fastness is related to how thermoplastic the finish is and soft resins cannot be expected to have as good a rub fastness as harder resins. Beware, however, of making the finish too hard or it will detract from the flex resistance. Much of the traditional skill associated with leather finishing is striking a balance between softness for flex resistance and hardness for rub fastness.

Finish adhesion

A finish that detaches from leather is a serious cause for concern. The load required to remove a finish can be determined by bonding the surface to a rigid substrate and measuring the load needed to separate it from the leather. However, this measure can be misleading for lightly-finished grain leathers. Rub fastness and flex tests are usually all that are required to fully assess finish durability and adhesion for these materials. For heavier and stronger finish films a direct assessment of adhesion strength is needed.

Poor finish adhesion cannot be corrected, expensive removal and refinishing being the only option. However, future batches may be improved once the cause is identified. This may require improvements in the absorbency and

wettability of the leather grain surface, the viscosity and dilution of the finish and the formulation and choice of finish constituents. Any change made to improve finish adhesion must again be tested to ensure it has not had an adverse effect on other properties like flexing and rub fastness.

Other tests

There are many others that will need to be carried out depending on leather type and end use. For example, shape retention tests to measure the effectiveness of heat setting, adhesion properties for stuck-on production, and the Zwick lastability test to check for cracking at stitch holes on patent leathers.

Most specifications today will stipulate maximum levels of a variety of restricted chemicals, some of which, such as azo-dyes, are enshrined in environmental legislation. Hence there is also an increasing range of chemical and analytical tests which will need to be routinely carried out.

Points to watch

Because leather is a natural material, there are a number of factors to take into account when measuring its performance properties. In particular, care must be taken with the number of samples and from where on the skin they are taken. Results from one batch of hides cannot necessarily be applied to other batches of ostensibly the same material. Tanners have quality systems restricting variability to tight limits but some variation in final product performance is inevitable.

The level of moisture contained in a leather can have a significant effect on its physical properties. For example, if the moisture content is increased, it is likely that its grain crack resistance will also increase. Pre-conditioning samples is therefore important for most physical tests. Standard conditions are 48 hours at 20°C and 65% relative humidity (rh) but leathers tested against EN ISO 20344/20345 have to be conditioned at 23°C and 50% rh. Accepting test results on leather samples without pre-conditioning, other than that for ongoing in-factory quality testing is at best unwise. 