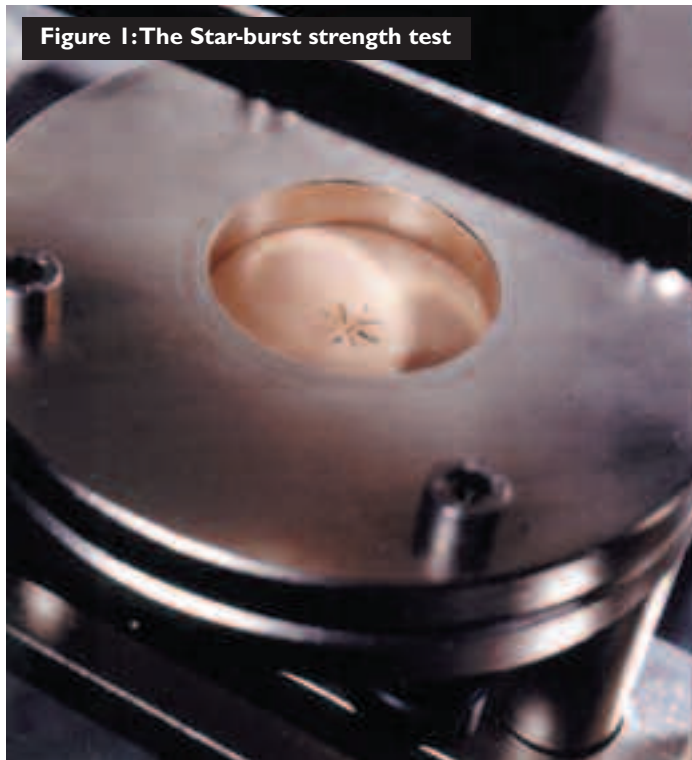


Star-burst: measurement of tear and deformation

Peter Perkins, SATRA

Figure 1: The Star-burst strength test



A new test method for shoe upper leathers has been developed that can measure the tear and deformation properties of a leather in a single test piece. Known as Star-burst, this technique offers practical benefits in terms of both speed and cost.

Knowledge of the performance properties of leather is a key factor in defining its suitability for a particular end use. With increased legislation on product liability, for example, ever greater numbers of tests are required to establish and monitor those performance properties. All add to the cost of product development.

To simplify the whole evaluation process, SATRA embarked on a research programme to develop tests that combine several properties in a single, simple test. Initially the tear and deformation properties of leather were studied. These are critical to a leather's performance in any product, but especially in shoe upper materials during manufacture and wear.

Rationalisation of performance testing

Three physical tests are commonly used to assess the tear strength and extension properties of leather:

- Baumann tear strength (test method SATRA TM162) using a double edge tear.
- Trouser-leg tear strength (SATRA TM30) using a single edge tear.
- Tensile strength and extension at break (SATRA TM43).

All these are uni-directional tests. This means samples must be cut both parallel and perpendicular to the backbone to determine the weaker direction. Even this may not provide the whole story since tearing may occur preferentially at some other orientation.

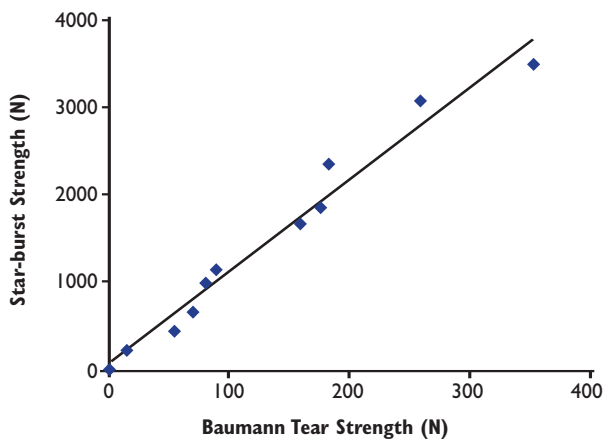
However, shoe uppers are subject to omni-directional strains and, while two-dimensional or three-dimensional strength tests exist, they do not provide the appropriate mechanism to predict tearing. The lastometer, for example, is designed to measure the propensity of the grain surface to cracking during lasting. The Mullen burst test is limited, as it is not a practical test for heavier leathers.

Previous experience had shown that biaxial strength tests in the plane of the test piece have major disadvantages and this led to the consideration of a dome deformation test. For this type of test, providing the diameter of both test piece and the dome are large in relation to leather thickness, bending stresses in the leather due to curvature of the dome can be minimised.

It was also clear that to initiate controlled tearing in a dome test, a wound or cut would need to be produced in the specimen. After trying various shapes, one cut with eight spokes resembling



Figure 2: Correlation between Star-burst strength and Baumann tear strength (weaker direction) for a range of leathers



a star bursting as it came under pressure was identified as the best option. This formed the basis for the new test method.

The Star-burst test

The new test uses a circular test specimen with a central cut produced using a specially prepared press knife. The sample is fixed in a ring clamp and a steel ball is forced into the flesh surface of the test piece at a constant rate of movement. Distension continues until the test piece ruptures across its full width. The maximum force and distension at maximum force are both recorded. The objective of a multi-directional test is thus met, with the eight spokes of the cut allowing the leather to tear in the weakest direction.

ADVANTAGES PROVIDED BY THE TEST

Star-burst can test leathers up to 3mm in thickness. A major advantage is that the load/deformation properties can be established at the same time. In this way the test can establish if the sample achieves the minimum distension required to withstand lasting strains. In addition, fewer samples need to be tested compared with conventional uniaxial tear tests.

CORRELATION WITH OTHER TEST METHODS

An extensive programme of testing was undertaken using a variety of leathers. It was found that Star-burst strength tests on a range of leathers showed excellent correlation with both Baumann and trouser tear test results as shown in *Figure 2*.

It was also confirmed that the distension in the Star-burst test gave meaningful results compared with extension at break in the tensile test.

Applications to other leathers

Although designed for testing upper and lining leathers for footwear, it is believed that the Star-burst technique may be useful in assessing the overall performance of leathers for clothing, gloving and upholstery.

The technique emphasises that a single test can provide the information previously gathered from three different forms of test. This not only produces faster results at less cost, but also requires a smaller sample of leather. This is often important when limited amounts of leather are available at the pre-production stage. ●