

Many official test methods used within the leather industry are different to the official test methods used within the footwear sector for testing the same leather. This situation can all too easily lead to confusion and misunderstanding. It also involves added expense through the doubling of test procedures. At a time when both tanners and footwear manufacturers are under greater pressures than ever before, this makes little sense. The sooner a practical rather than theoretical approach is applied to test procedures, the better it will be for all concerned.

Conflicting test methods

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The European Committee for Standardisation (CEN) is responsible for the generation of harmonised standards for member states within the European Union. Since its establishment, many national standards like BS, DIN, NF and UNI have been harmonised to EN Standards, but the variety of standards in the European Union has increased in the past ten years.

Unfortunately, there are different Technical Committees (TCs) which work on the same or similar materials, test methods or topics. This can result in different test methods for the same property of similar materials or even the same material when used differently. This confusing situation can be clearly demonstrated for upper leather used for the manufacture of footwear and where different technical committees of the European Commission can be valid. For example:

- The work of TC 289 and the associated standards is co-ordinated with the ISO and IULTCS (International Union of Leather Technologists and Chemists Societies) Committees and most standards are based on well-known test methods for leather.
- In the standards concerning TC 309, the focus of the tests is the shoe and the test methods have their origin in test methods for leather, textile or other materials.

In some of these standards, different methods for leather and textiles are described, while in others, one test method is valid for all the materials. Important properties and test methods generated by the relevant TC are given in *Figure 1*.

To demonstrate the different possibilities, two physical properties were analysed at PFI in regard to the difference of the test methods concerning the main properties of leather quality for producer and processor. These two tests also illustrate the fact that there are great differences in the test methods, examination and analysis of the results for the Tensile Test, but only small ones for the Tearing Test.

Tensile properties

For tensile strength and elongation the following two tests were compared:

EN ISO 3376: Leather – Physical and mechanical test
Determination of tensile strength and percentage extension.

EN 13522: Footwear – Test method for uppers
Breaking strength and elongation.

Sample conditioning of both test methods was the same at 23°C and 50% relative humidity.

A small but significant difference between the two tests is the dimension of the test pieces themselves. In the EN ISO 3376 test, it is done with a bar-bell shaped test piece with an effective length (l_1) of 50 mm and an effective width (b) of 10 mm (*Figure 2*). In the EN 13522 test, a rectangle of 160 x 25 mm is used. (*Figure 3*) shows a direct comparison between the test pieces.

Test parameters

According to EN ISO 3376, both thickness and width of the sample have to be measured. For both tests a dynamometer of the same quality has to be used and the speed of the test is 100 mm/min for both standards. For EN ISO 3376 the distance between the clamps is 50 mm while for EN 13522 it is 100 mm.

Figure 1: Current physical properties & test methods

	Leather	Footwear	Footwear by Protection
Physical Property	TC 289	TC 309	TC 161
Tensile Strength and Elongation	EN ISO 3376	EN 13522	-
Tearing Resistance	EN ISO 3377-1		
	EN ISO 3377-2	EN 13571	EN ISO 20344
Flexing behaviour (Flexometer)	EN ISO 5402	EN 13512	-
Water vapour permeability/absorption	EN ISO 14268		
	EN ISO 17229	EN 13515	EN ISO 20344
Water resistance (Penetrometer)	EN ISO 5403	EN 13518	EN ISO 20344
Colour Fastness to rubbing	EN ISO 11640	EN 13516	-

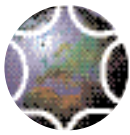


Figure 2: Test piece for tensile strength EN ISO 3376

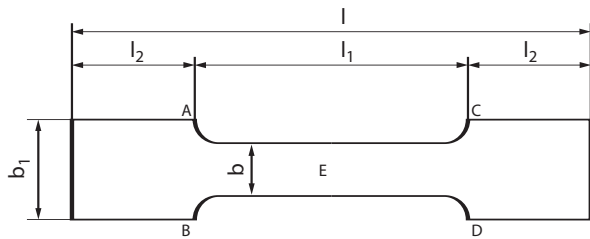


Figure 3: Difference between the two test pieces

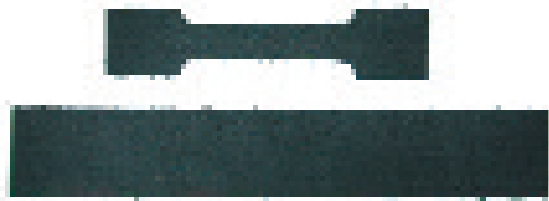


Figure 4: Results of the tensile tests of the leather sample

Test parameter	Unit	EN ISO 3376	EN 13522
		Along	Across
Maximum force	N	559.12	444.25
Tensile strength	N/mm ²	22.67	18.36
Tensile strength	N/mm ²	20.52	24.21*
Tensile resistance	N/mm	56.00*	44.43*
Tensile resistance	N/mm	50.22*	55.75
Elongation at break	%	35.0	51.2
Elongation at break	%	43.1	45.9

** No results in the standard—only for comparison

Results for EN ISO 3376 are the tensile strength ($\frac{\text{Force}}{\text{width} \times \text{thickness}}$) in N/mm² and the elongation at break as a percentage.

Results for EN 13522 are tensile resistance ($\frac{\text{Force}}{\text{width}}$) in N/mm and the elongation at break as a percentage.

The results of the elongation of break will be different between the two methods due to the completely different shaped test pieces. This means that if there is a quality requirement for a leather for use as a shoe material based on TC 309 test method EN 13522, there is no comparison to the results of the tannery if it uses EN ISO 3376 founded on TC 289 (and IULTCS).

To clarify these differences, both test methods were checked on one leather sample from a full grain cow leather. The tests were performed with five test pieces in each direction and the results are shown in Figure 4.

For elongation at break, the difference between the two test methods is up to 8%, or nearly 20% of the result. The difference between the along and across results are higher in the EN ISO 3376 test than in EN 13522. For the average of both directions the difference is about 5%. Comparison of tensile strengths shows differences of nearly 20% and for tensile resistance nearly 10%.

Tearing properties

For tearing properties the following two tests were compared.

Figure 5: Test pieces for tearing tests

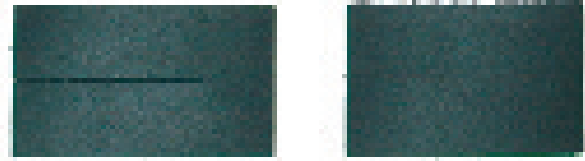


Figure 6: Test results of the tear tests of the leather sample

Test parameter	Unit	EN ISO 3377-1	EN 13571
		Along	Across
Initial tear force	N		
Maximum tear force	N		
Average tear force	N	114.29	120.26
Average tear force	N	117.28	114.91

EN ISO 3377-1: Leather – Physical and mechanical test Determination of tear load – Part 1: single edge tear

EN 13571: Footwear – Test methods for upper, linings and insoles Tear strength

Conditions of both test methods are the same but the dimensions of the test pieces are again different.

For EN 3377-1 the test piece is a rectangle of 70 x 40 mm with a cut of 50 mm, and for EN 13571 the test piece for leather materials is a rectangle of minimum 55 mm x 25 mm with a cut of 30 ± 2 mm. As larger test pieces are possible, the comparison was made with rectangles of 70 x 40 mm with different cut length (Figure 5). Clamping of the test pieces is identical and the test speed of 100 mm/min is the same.

For EN ISO 3377-1, thickness and average tearing force must be recorded. For the average tearing force, the diagram is divided into four parts. Only the two middle parts are valid for the analysis, and here, the two highest and the two lowest peaks are recorded for each part and the average of these eight values is taken as the average tear force.

For EN 13571, the initial tear force, maximum tear force and average tear force (generated by a line through the diagram) must be recorded.

Using the selected leather sample, both tests were performed with five test pieces in each direction, with the results shown in Figure 6.

In these tests, the average tear forces are quite similar in both, with the difference in both directions less than 5% and the in the average of both directions less than 3%.

Summary

Comparison of the tests for leather in regard to tensile properties, and where there are great differences in the test method, examination and analysis of the results, generates results which are not comparable.

Comparison of the tests for leather in regard to tearing properties where there are only small differences in the method and examination generates comparable values.

The producer and trader of the leather will often have quality parameters and requirements based on TC 289 or IULTCS. If the footwear manufacturer follows the requirements or quality control values based on TC 309 (which he will most likely do), there are different bases for business relations—especially where there are big differences in the test methods used.