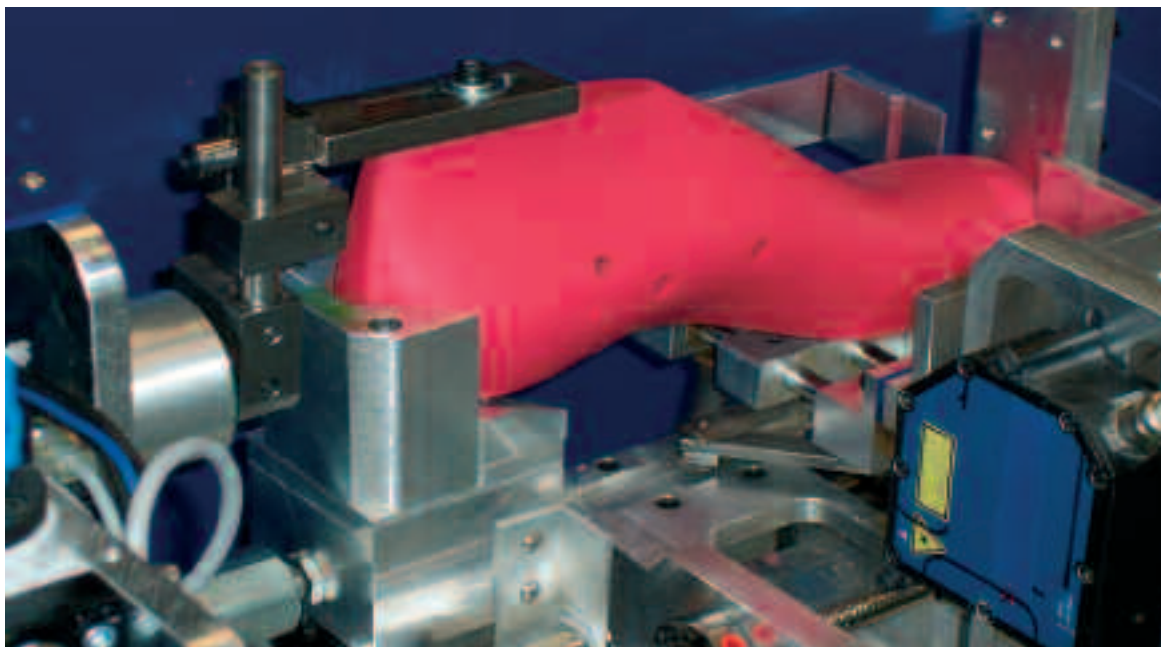




Changing dimensions

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One of the most important tools in shoe production is the last. It forms the shape of the inner shoe, so its dimensional accuracy is a decisive factor in the final fit of the shoe. Its size has to be recorded in order to assess its quality and, although there are no compulsory last standards which have to be complied with, specific last control measurements are applied in shoe production so that dimensional accuracy can be checked.

During its production life, a last may be used for several thousand cycles during which thermal and mechanical strains will change its geometry. These include:

- Impacts during lasting of the upper
- Tensile forces and pressure during last slipping
- Pressure during injection moulding when closing the moulds
- Heating while the injected material cures
- Accidental handling damage

It is very enlightening to see just how fast the form of a last can change and signs of wear and tear begin to show. The question then becomes: At what point does a last need to be replaced in order to guarantee the quality of the shoe?

MEASURING DIMENSIONAL CHANGE

A laser scanner, developed by PFI, can be used in order to examine the impact of wear and tear, and to measure geometric changes. It is simple to use and allows lasts to be checked during the course of shoe production (*Title photo*). Five key dimensions are taken (*Figure 1*):

- Stick length
- Toe spring
- Insole length
- Back cone height
- Ball girth

TESTING THE SYSTEM

About 100 lasts, both new and used, were measured manually and with a scanner.

Used lasts were compared to their specifications and also with the original model. The results were then checked both visually and quantitatively.

A major point to note is that the ball girth of a used last was generally found to be below the value of the original specification. One reason for this is the wear and tear of the feather-edge, which is externally visible. The next diagram

Figure 1: Five dimensions measured by the device

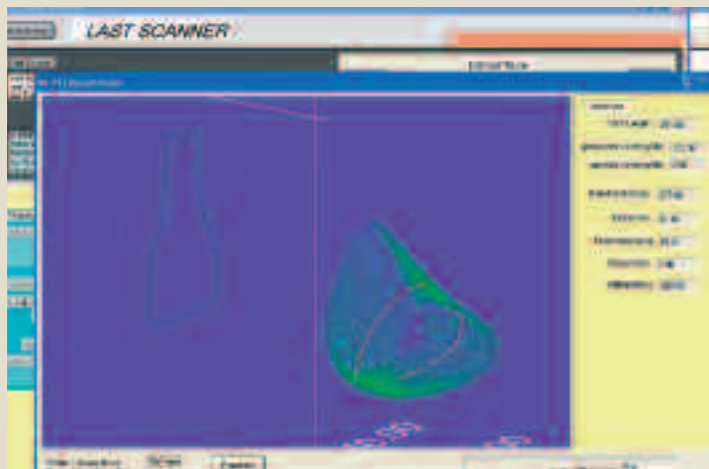
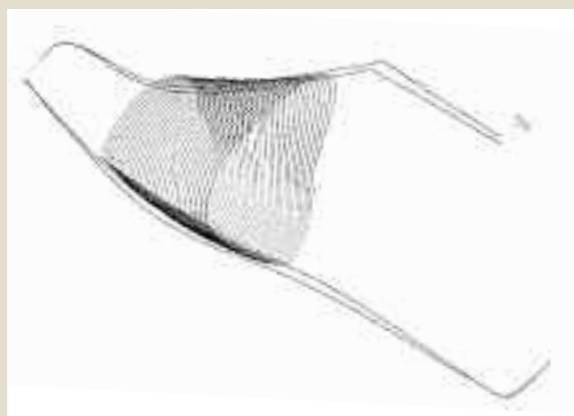


Figure 2: Typical feather-edge wear on a last (blue is new last, red is used last)



Figure 3: Insole lines and arch lines of the two scans



(Figure 2) shows a section of two ball girth lines (22.5° at 62%) through the last. Measurements of a used last and a new one of the same model and size showed that the ball girth had been reduced by nearly 2 mm.

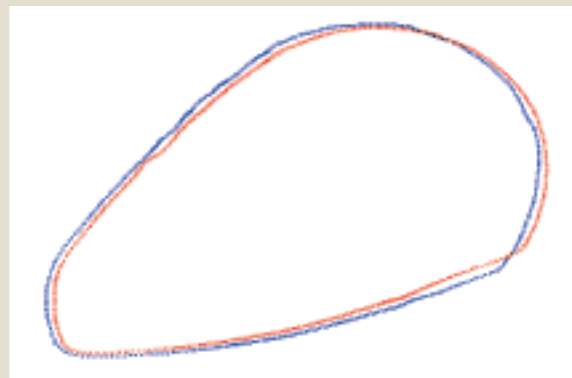
The value of the toe spring after usage is, in most cases, above specification due to wear and tear of the edges. Other values

were also often beyond the original specifications, but in order to be able to state whether the difference is a direct result of usage, a test was carried out to follow the lifecycle of a new last.

First, the original characteristics and contour of an unused last were scanned. A simulation was then used to create the conditions the last would be subjected to in production. As a plastic last consists of semi-crystalline polyethylene, it is naturally thermoplastic and as most of its work is at high temperatures such as in sole attaching and heat-setting it was heated to nearly 100°C. It was then subjected to mechanical strain by compressing and decompressing it several times for one hour. No change was directly visible but, when the last was fixed and centred from heel to toe in the device and scanned, the change in shape became obvious when the data was compared (Figure 3).

The point groupings had overlapped while the heel points stayed fixed and certain other characteristics had changed significantly. According to the measurements, the production toe spring had been raised by 6.5 mm and the insole length by 2.5 mm. The insole length and instep curve had bent downwards, and the ball girth lines had also changed, while the girth value remained almost the same (Figure 4). The blue points illustrate the original ball girth and the red ones the changed girth, showing that the last had become flatter in the forepart.

Figure 4: Complete ball girth points of the two scans

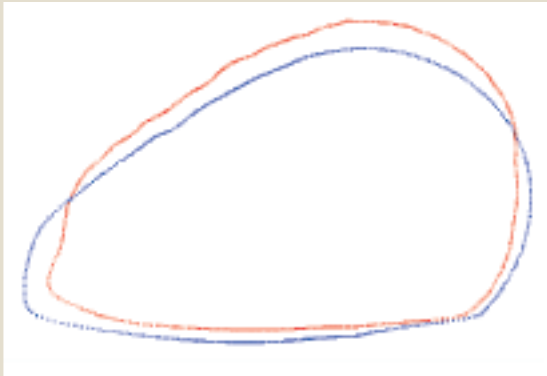


A test was also carried out to simulate side pressure influences as well as pressure from below, the idea being that the last stretches and becomes smaller. The result was clear in that the ball girth had been reduced by 9 mm and the stick length had increased by 2 mm. The difference in ball girth can be seen in Figure 5, where the red line shows the pressure points on both sides. The last had in fact become rounder, thus explaining the reduction in the ball girth.

Although not directly visible, the characteristics of a last can change significantly, so constant monitoring is obviously necessary during its lifecycle. The advantage of laser scanning is that trained staff can measure a last fully in a matter of minutes. The experiment also demonstrated that recording five dimensions is not sufficient in assessing the wear and tear of a last.

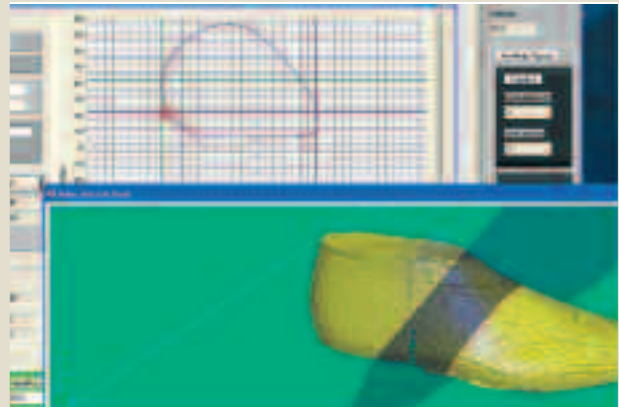
The horizontal and vertical extensions of the ball girth also

Figure 5: Comparison of ball girths after pressure from both sides



have to be considered and the aim now is to measure the changes taking place in a number of lasts under actual factory conditions and record the resulting data. Parallel to this, data on the surface of the lasts will also be checked in order to examine additional characteristics that can indicate wear and tear quantitatively. These values can be received through surface building which can be carried out using software specifically

Figure 6: Examination of a last



developed for the measuring device (*Figure 6*).

The measuring software will then be adapted in order to automatically receive and compare the dimensions during testing of the last. The lifecycle of a last can then be clearly defined by fixing limits, based on the degree of reduced dimensional accuracy, at which the deformation becomes unacceptable to the factory. 🌐

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