



In-factory test facilities can be a major benefit to manufacturers.

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The importance of testing

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The world of footwear manufacturing never stands still, with shoe makers and sourcing companies always looking to improve competitiveness and gain market share. As result, testing continues to play an important role in footwear supply chains throughout the world.

Regardless of the type of footwear involved, it is essential to have procedures in place to provide confidence that products have been made in accordance with the correct specifications, quality levels and satisfy legal safety and fit for purpose legislation. Being able to assess the performance of footwear and components—preferably at the earliest practical stage—is highly desirable for a number of reasons.

The most important thing to remember is that 'quality' is all about

meeting customer expectations. Keeping customers satisfied is essential and their requirements will play a large part in the procedures the manufacturer puts in place. This is still largely in the form of a quality control or assurance process, which often involves some type of testing.

In the footwear industry, traditionally, testing forms part of a manufacturer's quality assurance programme or is a key element of quality control processes from initial product verification through to confirmation of production quality. It is used to verify the quality of materials, control critical processes during manufacture and validate the performance of the finished product. Sourcing companies and retailers frequently have a testing regime in place, not only to be sure the product supplied is as expected, but also often forming part of a legal 'due diligence' defence process.

Although there are many independent laboratories offering testing services, there is often greater convenience in having in-factory test facilities. The establishment of properly controlled and accredited laboratories can be a major benefit to manufacturers. By developing a greater knowledge and understanding of a product's characteristics, manufacturers are often not only able to bring improved quality products to market earlier but also work more closely with their customers to develop even better products or move into other footwear market sectors.

SETTING STANDARDS FOR 96 YEARS

SATRA has been at the forefront of test method development since its inception in 1919 and many of its methods are enshrined in national and

international standards. These methods provide a useful way to evaluate footwear and components, including materials or sub-assemblies taken from footwear. Having developed to over 250 footwear and textile related test methods they cover all aspects of shoemaking.

While SATRA itself still conducts a considerable amount of routine, often safety critical, testing in both its UK and China-based laboratories, it is more usual for manufacturers to carry out basic testing with organisations that are close to them in-country. With a catalogue of over 300 types of footwear test equipment, it is more likely to supply these laboratories, with many of the manufacturer's customers wanting tests carried out to SATRA standards or relevant international, European or US standards. In some cases brands and retailers may have their own test specifications that must be followed.

Despite trends towards relocating some manufacturing closer to major markets, the vast majority of shoemaking remains in Asia. Good supply chain management is therefore still critical and can be a fraught and complex process. Ensuring product quality is just one important issue among a number of potential pitfalls and difficulties. Although we have latterly seen a number of companies revert to procuring or making shoes closer to market, the vast majority are still sourced from regions many thousands of miles away making it more difficult to implement designs, conduct research and development, directly supervise production and report back or correct faulty products.

Many companies have their own personnel in the factories or have agents to keep an eye on things (often working in conjunction with the manufacturer's own in-house laboratory) or employ specialist independent quality control organisations to carry out third party checks of products. Smaller organisations, however, may not have this infrastructure and in many cases are likely to put a greater emphasis on finished product testing. At this stage, any problems found are more difficult to put right and may involve whole batches of product being rejected or recalled. There will always be a need for independent third party testing and many retailers and brands insist on this.

WHOLE SHOE EVALUATION

Traditional footwear tests can tell a great deal about the properties of the specimen such as resistance to abrasion, strength, hardness, flexibility, density and, of course, the presence of restricted chemicals. They do not, however, enable the evaluation of the footwear as a whole. This is an area that SATRA has been working on over recent years, developing standard laboratory whole shoe tests and equipment that can simulate what happens in wear by removing the subjective aspect of using humans as part of the test method. These whole shoe tests have applications in both research and product development as well as to ensure the integrity of production units.

WATER RESISTANCE

A good example is the SATRA TM 230 test method for evaluating water resistance of footwear which provides an alternative to the traditional 'trough test' in which a wearer repeatedly walks along a water filled trough to determine the resistance to water ingress. By utilising a mechanical flexing operation the equipment used subjects footwear to a flexing motion similar to that which

occurs during normal walking. The machine provides a more consistent, less labour intensive test and has become the organisation's preferred method of assessing whole footwear dynamic water resistance.

OVERALL DURABILITY

Another area of human subjectivity where it has implemented an automated solution is whole shoe durability testing, traditionally undertaken via a 'wear trial'. Over the years, the organisation has conducted hundreds of wear trials for shoes in an attempt to evaluate the durability of the footwear in realistic circumstances, where the footwear is undergoing the same stresses as if worn by the consumer. Wear trials, however, are usually a long drawn out processes (particularly if the footwear does not fail prematurely) and require significant planning and logistical implementation to be successful.

With demands for ever shorter time periods from initial design to retail availability, the length of a human wear trial is, more often than not, impractical and expensive. The trial itself can often take up to several months of the subject's time not to mention the



The STM 528 Pedatron accurately simulates real life wear patterns in a shoe.

probability of human error that has to be taken into consideration when undergoing this type of exercise.

Until recently, the human wear trial was the only obvious route for manufacturers who wished to assess whole life performance of their products. SATRA recognised the need for an alternative that removed the human subjectivity and time from wear trials while retaining the accuracy. Its 'Artificial Ageing Protocol' simulates a wear trial under controlled laboratory conditions by subjecting an item of footwear to a cycle of testing that can produce initial results in days rather than months.

This Simulated Wear Assessment Test (SWAT) subjects finished footwear to comparable levels of moisture, heat, pressure, flexing and abrasion as would be experienced in actual wear. The advantage SWAT has over a traditional wear trial is the accuracy and consistency of results and speed of completion.

By shortening the trial time and removing the need to involve a lot of people, it not only increases the scientific validity and accuracy of the test but substantially decreases the time it takes to provide results. The tests mimic the wear that shoes would encounter in real-life situations. The routine followed can be applied to a variety of shoes and also modified to suit more specific applications.

Typically, controlled doses of moisture and heat are introduced into the footwear to simulate foot perspiration. The footwear is then subjected to the stresses and strains typically associated with walking, realistically simulating the forces, flexing and sole abrasion equivalent of a number of months or years walking. Depending on the application, a variety of treatments and environmental conditions may also be applied (before or during the test) to further simulate real life scenarios. This gives us an insight into any design problems or manufacturing deficiencies which correlate well with those that would occur in actual use of footwear.

MIMICKING THE HUMAN GAIT

At the core of the ageing protocol is the Pedatron, the result of a research project to develop a walking machine which flexes the shoes by mimicking



The STM 567 Endofoot measures moisture management and thermal efficiency in a shoe.

the walking action of the human gait very closely. Underfoot pressure mapping instrumentation was used to characterise human subjects' walking styles which were analysed using computer software to produce a 'SATRA walk' gait. This information was converted into digital signals to control the Pedatron electronics and create a consistent walking pattern, which has been verified by comparing typical wear patterns from both the Pedatron and human subjects.

The biomechanical action that the Pedatron is able to produce is an accurate simulation of actual wear patterns. Not only are the same forces going through the heel and toe when comparisons are made to human gait but the wear pattern seen inside and outside of the shoe correlate very well with those produced in human trials. These include visible toe imprints and indenting and wear at the heel position being seen on the insole of the shoe.

Each walking cycle can be interspersed with periods of hot moisture introduction. The compound effect of all this simulated sweat combined with the heavy walking and any other conditioning treatment considered applicable is what accelerates the ageing of the footwear. After each unit, the footwear is carefully examined and any wear or damage noted.

IMPROVING COMFORT

Shoe comfort is heavily influenced by thermal insulation and moisture disposal properties and these two important characteristics have been the subject of considerable research resulting in the Endofoot machine which allows both moisture management and thermal efficiency to be determined. As a whole shoe test, the combined effect of sole, upper and lining is taken into account as well as seams and different types of hosiery.

At the heart of the machine is a moulded foot form incorporating a distribution system of small bore capillaries and electrical heating elements allowing heated water to be introduced through surface pores of the foot form to simulate sweat. Feedback control enables a uniform temperature to be maintained. Reference hose is fitted to the foot form, then the subject footwear itself. A controlled volume of airflow is introduced over the footwear at a constant temperature and humidity and the test yields a measure of the energy needed to maintain the foot form temperature. From this the thermal performance and sweat management capability can be derived.

Many materials characteristics have been proven through tests conducted under standard laboratory conditions, usually either 23°C / 50%RH or 20°C /

65%RH. While this aids consistency between laboratories and can provide considerable information about product performance, they are conditions that are far more likely to be encountered in temperate regions of the world than elsewhere. As a result, there is a wealth of information about how footwear materials perform in standard laboratory conditions, but little comparable data on property levels in 'real life', non-standard conditions.

VARYING ENVIRONMENTAL CONDITIONS

Breathability of footwear materials and moisture management of footwear are particular aspects of comfort that are heavily influenced by the conditions in which they are to be used. It has long been recognised that many of the properties of the materials and components used in footwear are to a greater or lesser extent affected by their temperature and moisture content. Sensitivity to the ambient conditions means that an item tested in a laboratory

atmosphere where the temperature and relative humidity are low is likely to give a different result from an identical one tested in another laboratory atmosphere, where the temperature and relative humidity are high.

So, more recently, SATRA has also been concentrating on whole shoe evaluation under a variety of environmental conditions in which footwear is intended to be worn. Tests have been developed that allow both materials and whole footwear to be assessed for breathability and moisture management performance levels in the types of environment in which they are intended to be used, especially harsh environments — hot, cold, dry and humid.

This is a complex area. Performance and comfort depend not only on the external environmental conditions, but also the activity level of the wearer. Results predicted from tests conducted under standard laboratory conditions often prove to be of limited use in more extreme environments as characteristics and rankings of upper

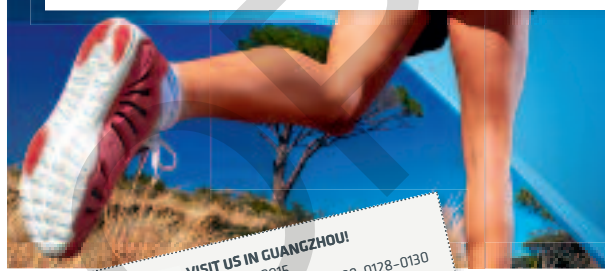
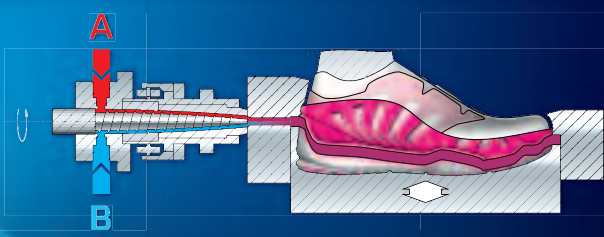
and lining materials in different climates can change dramatically. When selecting materials for footwear that will be marketed and worn in environments that are far removed from standard laboratory conditions, it should be an essential part of the selection process to have these materials tested in applicable climate conditions.

In difficult financial times, it is always tempting to reduce the level of product checking carried out as a cost saving exercise. However, this can be a false economy unless other measures of ensuring quality are in place. Testing is still one of the easiest ways to demonstrate compliance and forms a vital role throughout the footwear industry supply chain, whether for evaluating materials and prototypes, confirming production or ensuring that sourced products meet specifications. Testing as part of research and development opens up another world of knowledge enabling manufacturers to keep at the forefront of innovation. 



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