

Testing supply chain specifications

Regardless of retail selling price, consumers have a right to expect their footwear to meet certain minimum criteria, including safety, durability and performance. MARK SOUTHAM explains how testing specifications can be used to achieve this.

There are many aspects to 'quality' in relation to footwear and related products, but good quality can be essentially defined as 'consistently meeting or exceeding customer expectations'. The 'customer' may be a manufacturer (in the case of material and component suppliers), brand owner, sourcing company, distributor, retailer or, of course, ultimately a consumer.

Working to an agreed product specification is key to delivering footwear that has the required attributes and performance. This should be a comprehensive statement of all the aspects that must be present. It will

describe and define material and construction requirements, as well as quality characteristics such as functionality, appearance and durability. The specification may also form part of the retail point of sale information advising the final customer of the properties and performance characteristics of the product.

A precise specification is needed when purchasing materials and components for use in the manufacturing process to ensure that the final product will meet the specification and be fit for purpose. Poorly specified orders or reliance on

instructions – for example, 'as previously supplied' or 'as agreed with your representative' – are likely to lead to confusion and poor control.

Ultimately, failure to meet the required performance level may require product recall from the market, so a specification is a prerequisite to not only identifying the product design criteria and performance, but also relevant safety legislation.

Testing plays an important part in confirming aspects of the specification – particularly in relation to performance and safety. Reports are often used to demonstrate compliance to the needs of customers within the supply chain.



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Figure 1: SATRA has seen a number of cases where the wearer has tripped because a sole became loose

What to specify

A testing specification can take many forms. Ideally, it should be based on the required performance of the materials or footwear, taking into account expected attributes and legislative requirements. It should demonstrate the suitability of all aspects of the product, including individual materials and components for shoemaking, as well as wear-related properties through to testing of the constructional and final product aspects.

The most meaningful test on any material or finished product is an actual performance trial. In footwear, the performance trial may be a combination of a shoemaking trial and a wear test. It is quite common for limited trials with a small number of wearers to be used to assess risk associated with new designs or particular concerns – for instance, a novel upper material where poor performance is suspected.

Comprehensive longer-term trials can be used to assess all or many aspects of the product's durability and performance. However, these can be costly and time consuming, and need to be run under well-controlled conditions in order to derive meaningful data. For this reason, traditional wear trials using human subjects are now rarely carried out. SATRA has developed a protocol whereby whole footwear can be 'aged' within the laboratory to

determine condition at end of life and all stages in between.

SATRA assesses footwear materials, components and finished products in accordance with more than 400 different test methods. These range from simple assessments of material characteristics through to complex whole shoe evaluations.

Tests are available to cover all aspects of the product. However, specifications detailing test requirements will relate to the type of footwear, required performance attributes and risks associated with the product. Many test specifications – particularly for fashion or everyday footwear – are often kept relatively simple to only cover critical points. Suppliers may opt for a focused view, often known as a 'basic' or 'critical' testing specification. Whichever approach is taken, it is essential that safety critical properties are assessed to ensure the safe performance of the footwear.

For whole footwear, testing should cover the following as a minimum:

Slip resistance: Slipping, tripping and falling remain the most likely cause of footwear-related accidents. Although these accidents will never be totally eliminated, they can be significantly reduced by using soles which have been tested to show they have good slip resistance properties. SATRA TM144:2011 – 'Friction (slip resistance) of

footwear and floorings' is our recommended test for slip resistance, and this is the accepted industry standard. Testing is generally carried out on a reference clay tile surface in wet and dry conditions, although this can often be supplemented with other floorings – such as carpet, wood and vinyl.

Sole bond strength: Sole bond and interlayer bond failures are also a major reason for complaints and accidents. We have come across a number of cases where the wearer has tripped because a sole became loose (figure 1). Tests can be conducted to ensure that bonding systems are adequate – that the upper, adhesive and sole are compatible – and regular batch testing should be carried out to make sure that bonding processes are consistent and correct. Strength of the bond at the toe (toe load) using SATRA TM404:1992 – 'Rapid sole adhesion test – for complete footwear' is a simple spot-check that can be done in the factory without the need for sophisticated laboratory equipment.

Heel attachment and heel strength (impact and fatigue resistance): Heel failure (either detachment or breaking) can cause serious accidents. SATRA is aware of several incidents of heels coming off when the wearer was on a staircase, which have led to significant personal injury claims. Testing is, therefore, essential (see figure 2).

Strap and fastening strength: Although many straps are purely decorative, most are functional and perform a number of roles – securing the shoe to the foot, optimising fit and providing stability. Thus, any type of strap failure could lead to the wearer stumbling and falling, potentially resulting in injury. Straps, including buckle attachments, elastics and touch-and-close fasteners therefore need to be tested to ensure they are fit for purpose. Sole bond and interlayer bond failures are also a major reason for complaints and accidents.

Special consideration should also be given to children's footwear. Tests need to be used which not only assess the more usual properties – including those listed above – but also anticipate other foreseeable hazards which might be likely. For instance, young children tend to suck and chew their shoes, so any attachments (including decorative trims and buckles) need to be assessed to

ensure that they cannot be easily pulled off to present a choking hazard.

It is important to understand that specifying purely critical or basic test parameters will only provide limited information regarding a product's overall performance. In our experience, it is not possible to predict all areas of concern using minimum testing. Some returns should be expected, due to properties not assessed.

Specifications for footwear incorporating specific attributes or intended for more rigorous environments – for example, sports, hiking, occupational or military applications – are likely to include more testing requirements, both to assess materials and confirm whole shoe performance. These can be comprehensive, with tests identified to cover all aspects of the product.

Some footwear styles with unusual features may require less-common tests. These may not be listed in a generic type of specification – for instance, rather than assess a narrow-strapped sandal for bond strength, strap-to-sole detachment strength is appropriate. An examination of individual styles is needed to decide on the appropriate specification for that style, as clearly not all tests will be appropriate for all styles.

There is also the risk that some styles – such as novel designs or those with innovative materials – will require tests that are not in the specification.

Restricted chemicals

The use of harmful chemicals in consumer products (including footwear) has come under scrutiny in recent years. An increasing number of nations are placing these chemicals on 'restricted' lists, which in many cases effectively prohibit their use in that country. It is, therefore, important that suppliers are aware of the listed substances and the types of goods that may contain them for the countries into which they are being supplied.

Testing in practice – materials approval

Using suitable materials and component parts is essential to the performance of the finished product. Therefore, a specification is likely to include tests to verify agreed performance standards (figure 3).



Figure 2: Assessing heel attachment strength

It is not uncommon for specifications to be flexible at the materials selection stage, and it may be possible to modify materials that initially fail to comply with the relevant performance standard – for example, by adding reinforcement to a weak material.

Good monitoring systems are needed to ensure that the outcome of this 'risk' is assessed. The performance standards should be reviewed and, where necessary, modified. Specifications (and, therefore, the test requirements) should be set appropriate to the end use, and caution needs to be exercised to avoid unnecessarily relaxing a standard.

An approved materials register – including the product or component for which the material is approved – is recommended for materials shown to comply with relevant performance standards.

Sample verification

New footwear lines should be tested against the performance standards set

by the customer. Sourcing companies, retailers and brand owners often allow the manufacturer to select the materials and components, provided these can be shown to meet the required standards (although manufacturers should be asked to supply their customer with a full list of materials and supplier details). Others retain a tight control over everything.

Once the performance of samples has been confirmed, it needs to be agreed that material substitutions are not acceptable during bulk production without prior approval of the sourcing company. This verification stage will also identify areas of weakness and ensure that they are addressed before bulk production. 'Get it right up front' is the message.

Adequate preparation in the pre-production area is key to minimising problems in bulk production and associated emergency activities – for instance, essential remedial work or supply chain problems. This will also

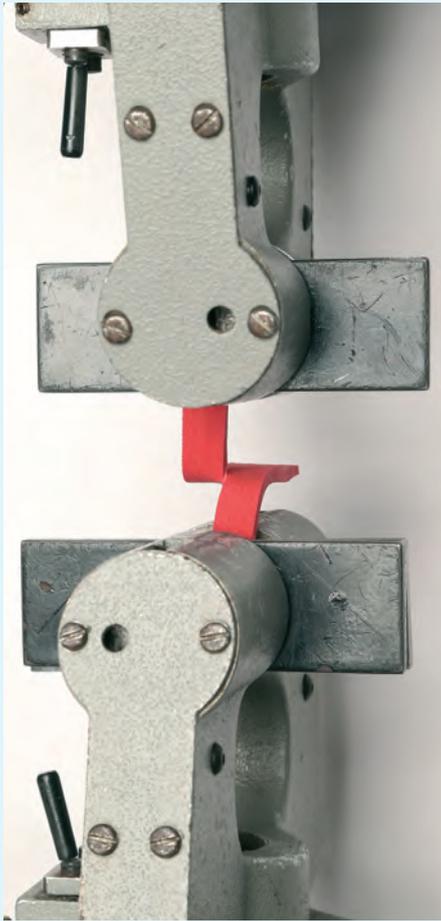


Figure 3: SATRA TM218 being used to test the tear strength of soling materials

allow the buyer to confirm or amend the original specification.

Initial bulk production verification

Once the initial bulk has been produced, it should similarly be tested against the footwear specification. Sample footwear is often made on different machines and with more care than bulk production, so it is sensible to check samples taken from the initial bulk production run to ensure that processing conditions are correct.

Additional samples should be tested wherever an unacceptable result is obtained to establish whether the first sample is representative. However, overreaction to a rogue shoe should be avoided, as the rest of the production may be perfectly acceptable.

Provided enough groundwork was done in pre-production, problems should not be experienced here. If they do appear, an investigation into the effectiveness of the pre-production process and factory controls needs to be carried out and action taken.

Ongoing production testing

It is not practical to test every incoming delivery of materials and components for all properties. A plan linked to a supplier appraisal system needs to be developed to enable the factory to focus on key properties and to monitor consistency of supply.

Ideally, all material suppliers should be able to provide reliable and meaningful test data in support of each delivery. In reality, this is seldom the case.

Having initially approved the material, it is possible to identify those properties needing to be monitored to ensure that they remain at a satisfactory level. For example, upper leather found to have physical properties far exceeding minimum requirements might only require testing for colour fastness and the occasional tear strength test to ensure conformity.

Perhaps the one test to focus on for an outsole will be abrasion resistance, as this characteristic is affected by slight variations in most other properties. The key is to be realistic and to not attempt to test everything every time – otherwise the system will become overloaded and too cumbersome to work.

Each supplier is different and will be able to supply varying amounts and qualities of ongoing test data. This needs to be taken into account in the plan and be reflected in the testing done in the factory to evaluate each supplier. Once enough experience data has been built up, it can be reviewed and the better suppliers may need to carry out less additional testing in the factory.

Complaint investigation

Information regarding complaints needs to be accurate. Where possible, returned footwear should be examined and appropriate testing carried out against the specification on other footwear from that production batch, so that preventative action can be taken to avoid reoccurrence of the problem. In extreme circumstances, withdrawal of the product from the market or a product recall may be necessary where the footwear does not meet the specification – especially for safety critical tests.

Due diligence

Product testing should not be confined to pre-production. Throughout the

manufacturing life of any product, there is every chance that changes to the materials or manufacturing methods could occur, and that these could have a significant effect on the quality of the finished product. There are various reasons that this might happen:

- inconsistency between or even within batches of one or more components
- change of supplier of one or more components
- change in production methods or expertise of production staff
- change to an alternative production line/facility.

To ensure that products continue to comply, they should be tested regularly (perhaps for limited key properties), and backed up by a periodic full test. How often to sample a product and test it is a fundamental question. The key factor is being confident that testing is completely representative of the batch. Sampling once per season, per style or per colour is commonplace for some properties, but it is unlikely to be good enough for safety-related or performance parameters such as water resistance. A daily or batch-testing regime is better. For instance, some brand owners will request test data per specified number of pairs. Sampling batches in accordance with statistical sampling procedures – for instance, ISO 2859-1 can be used as an alternative.

Dynamic testing specifications

No specification should be 'set in stone' and used blindly without consideration of its relevance to the particular product and its end use. Perhaps one of the most difficult aspects of using a specification is knowing how to interpret results. Of course, a simple pass/fail criterion is beneficial in that it is easy to understand and is not open to question or doubt as to whether a sample should be accepted or rejected.

However, footwear comes in a huge variety of styles, materials and constructions, and the end use will depend on a number of factors. These include market sector, branding and, naturally, wearer expectation.

In other words, interpretation should be based on the end use and the market for footwear that is being assessed. For instance, when assessing an upper material, it is important to consider on what type of footwear it will be used. By way of



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an example, a material should not necessarily be rejected just because it has a low tear resistance. It may perform perfectly adequately in light use – such as in an indoor slipper, or may be reinforced to improve its performance. Another example is ‘breathability’ – materials can be graded in terms of how breathable they are. A low value does not necessarily mean that the material cannot be used at all.

In some instances, a style or material may be considered by the company to be vital to the range’s success and brand profile. Therefore, the decision on whether or not to reject a sample which falls below the general specification may also be a commercial one. An expected level of returns (higher than normal) may be considered to be acceptable from a financial point of view, such as a decision which may be taken to include a particular fashion upper material or trim.

However, one area in which taking a commercial risk is not acceptable is for safety-related properties. For instance, a heel which does not meet the specification for fatigue resistance presents a potential failure in wear, which could cause an injury to the wearer. This could result in a product recall, a large claim for injury compensation, brand damage and the possibility of heavy fines for putting dangerous goods onto the market. In

the past, SATRA has been asked if such a test result would be acceptable for high fashion use where the shoe might be worn only on special occasions. The answer is ‘no’ – an accident under this type of use is just as serious as one with a shoe worn every day.

Furthermore, a testing specification should be a dynamic document which must be relevant to the current market, and reflect what is acceptable from both a commercial and practical point of view. It should take into account recent commercial and testing experiences, and the development of new materials and manufacturing methods. These factors may, for instance, mean that higher standards are required to meet increased customer expectations and guideline levels can be raised. Experience might also indicate that a recommendation lower than previously used is acceptable.

Testing specifications must, therefore, be reviewed regularly to ensure that they are relevant, realistic and cover all aspects of the product. Where changes are needed, these should be put in place and the revision distributed to all those in the supply chain that will be using it.

SATRA services

The most comprehensive testing specifications to use are SATRA guidelines, provided through a unique

service available only to our members and based on our 100 years of experience. SATRA has unrivalled knowledge of footwear materials, construction and finished products, and this provides the ideal source of information when compiling fitness for purpose specifications. Our experience will mean that product standards are realistically achievable and acceptable to both wearers and regulatory authorities.

How can we help?

SATRA’s performance guidelines and experience make us ideally placed to help members develop and review footwear testing specifications. It is important to remember that a specification should be flexible, and that interpretation may need to be applied to the results – something that SATRA routinely does in its test reports. Please email SATRA’s footwear testing team for further information about specifications and testing.



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