

Insocks come in diverse materials and designs.

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Insocks and comfort

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Insocks are extremely versatile components made from many different materials. They can have a wide range of attributes and offer a variety of benefits to the wearer, including enhanced comfort and helping control odour. The underfoot environment is however very demanding, so quality and durability are essential for customer satisfaction. But first, we should perhaps define what is meant by the term insock. Many consumers use the terms 'insole' and 'insock' synonymously. Insole is a term applied to the rigid or semi-rigid backbone of a shoe which is not removable. Insocks generally lie on the surface of the insole and may or may not be removable. Moulded insocks are often also called footbeds.

Insocks are produced in a wide variety of constructions. They can be thin sheet socking material covering whole or part of the insole, full-length

sheet foam insocks with a top-covering material or moulded polymeric components. Replacement insocks or footbeds are nevertheless commonly marketed as insoles to replace worn-out components or customise the footwear to a customer's particular preference. This may be to improve cushioning, add odour control or change the fitting properties. Footwear fit and underfoot comfort are generally the two most important factors for both short- and long-term comfort. Insocks play a key role in influencing customer choice and in maintaining comfort levels throughout the day as well as after long periods of wear.

MODIFYING FIT

Fit is undoubtedly the most important factor controlling foot comfort. An insock takes up volume inside the shoe, thus reducing the space available to the foot. It is therefore essential that the last

is designed with an appropriate allowance to accommodate the thickness of the insock to be inserted during shoemaking. This is a fundamental design consideration and can be compromised if the insock specification is changed at a later stage.

Conversely, changing the insock specification can be used as an easy and economical means of correcting fitting problems. At SATRA, we frequently see prototype shoes sent in for fitting trials which have overly deep and generous foreparts, causing excessive creasing of the vamp and discomfort when the foot is flexed. While ideally the last and/or the upper patterns should be modified, an increase in insock substance by a few millimetres can often resolve these problems.

Indeed, some footwear brands supply several different insocks with new shoes to allow purchasers to customise

the fitting properties to their individual liking. Some children's shoes are sold with a selection of insocks, enabling parents to adjust for different size or shape of left and right feet, and providing additional growth allowance when a thinner insock is used.

CUSHIONING AND SHOCK ABSORPTION

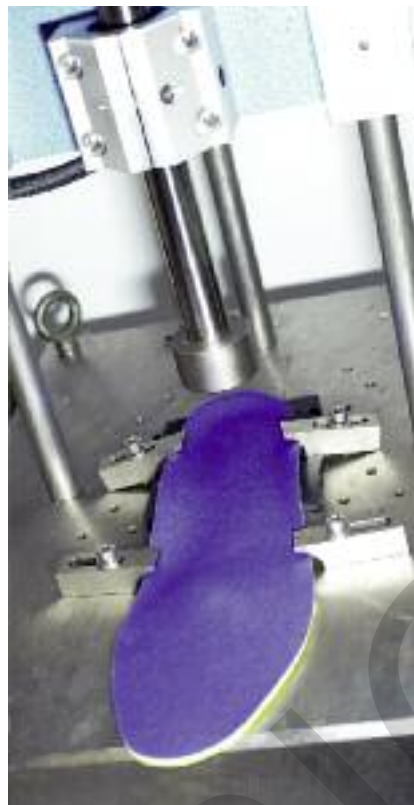
Cushioning is the ability of the insock to distribute pressure more evenly over the sole of the foot while standing, walking or running. Cushioning insocks can help to minimise high pressure points underfoot, reducing discomfort, soreness and development of blisters and areas of hard skin. However, selecting the correct insock for a specific shoe is not simply finding one with the most cushioning as too much can introduce a sense of instability. The goal should be to achieve the optimum level of cushioning and hence comfort required by the customer for the particular type of footwear involved.

Shock absorption is the reduction of impact forces which occur at heel strike in walking and running. These repeated impact forces send shock waves through the ankle, knee and hip joints and can cause long-term joint damage. Insocks alone cannot provide the higher levels of shock absorption required due to their limited thickness as, for example, in high-performance sports shoes. To achieve the highest levels of shock absorption, all the underfoot materials (insock, insole, midsole and sole) in the seat region must be able to contribute. Many sports shoes therefore incorporate much thicker cellular midsoles which provide the greater proportion of the shock absorption properties.

Nevertheless, in dress shoes and other formal footwear that have low inherent shock absorption in the bottom construction, such as those with leather soles, a high performance insock or footbed can significantly improve shock absorption and hence comfort.

COSSETING AND FRICTION

The term 'cosseting' encompasses several factors, including softness (compressible under low pressure), friction (slipperiness or grip), thermal impression (feeling warm or cold), texture and roughness. Each of these factors influences the customer's tactile perception of the inside of the shoe and



Testing shock absorption.

can help to sell shoes by adding a cosy feeling at the point of sale. During subsequent wear, however, the wearer generally soon loses awareness of cossetting factors unless something specific occurs such as excessive pilling (bobbles) due to abrasion which creates feelings of roughness.

Surface friction is an element in cossetting, but its importance increases if the friction level is inappropriate for a given shoe. Surface friction can in fact be a source of major discomfort and foot injury. Studies at SATRA have indicated that the optimum level varies according to the particular characteristics of the shoe as for example in the case of fit. In very generous, loose-fitting footwear, low friction can detract from comfort and give a sense of insecurity. The foot may slide inside the shoe and rub against the upper which is likely to lead to blisters and skin damage, particularly around the toes.

During wear, the level of friction should not change significantly, so that comfort levels remain close to the optimum. A significant increase or decrease in friction as the insock becomes damp—such as with sweat— or as abrasion causes it to become either rough or smooth, will

compromise comfort. Therefore, it is particularly important to compare dry and damp friction levels as they can significantly change some materials.

SWEAT MANAGEMENT

The plantar (underside) surface of the foot does not sweat as much as the dorsal (upper) surface. Nevertheless, the insock may still accumulate significant quantities of moisture. If the top cover material is non-absorbent, the moisture will sit on the surface. From there, it can be readily re-absorbed back through the hose into the skin, so that the latter becomes macerated (softened), increasing the risk of skin injuries such as abrasions and blisters.

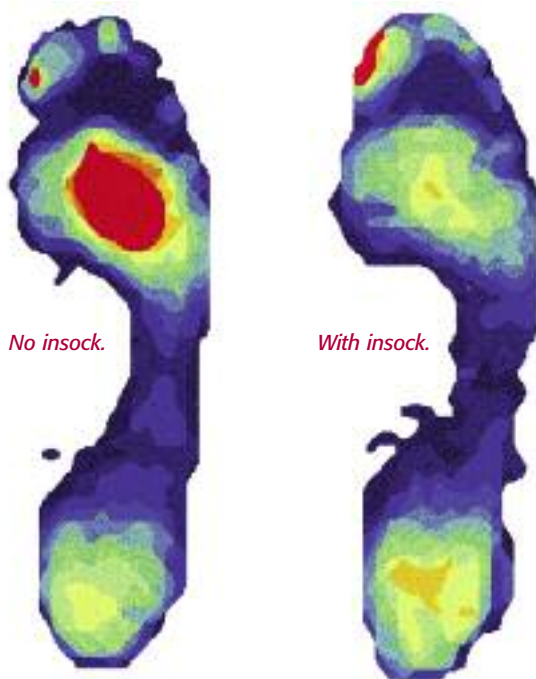
The best insock is a highly absorbent one that will also desorb moisture quickly, allowing it to dry out overnight when the shoe is not being worn. However, high absorbency may work for a few hours' wear only. Over longer wear periods or under very heavy exertion and high sweat rates, there is a danger of saturation. In this case, the moisture must be expelled by permeation through the upper or by ventilation (air circulation). A highly wicking insock top cover material can move moisture away from under the forepart of the foot in closed upper-style footwear and toward the linings and upper or to the back of the shoe where it may be expelled by the pumping action of walking or running.

Holes, perforations or open-foam cell structures can also be beneficial if they lead to an external outlet, so providing a continuous circulation of air to the outside of the shoe. Holes that lead only downward onto the insole board or midsole simply trap moisture inside the shoe. Alternatively, well-designed underfoot air-pumping systems can be effective in improving ventilation.

Sweat management includes keeping the foot cool so that sweat rates will be lower. Foam insocks are not ideal for this as they entrap air—still the best insulating material available. Of course, sweat management is not always the problem and, sometimes, the need is for thermal insulation to keep the feet warm. Air-entrapping insocks can play an important role in this instance.

QUALITY AND DURABILITY

Of equal importance to the fit and comfort aspects are quality and



Cushioning insocks reduce peak pressure values (red areas).

durability. Will the product maintain performance throughout its expected life? Will comfort performance be retained or a discomfort problem perhaps develop? Firstly, it is important to appreciate the range of materials used. Most insocks will comprise at least two layers, a surface or top covering which contacts the foot or wearer's hose and a backing on the underside, lying against the insole or midsole.

Many materials are in fact used for covers, including leather (such as pigskin), woven cotton/polyester blend fabrics, PVC- and PU-coated fabrics and nonwovens. In some instances, materials such as PVC and PU foam, cork, coconut fibre and felts are used as insocks without any top covering and are therefore in direct contact with the foot or hose.

The quality of the covering material is particularly important, because it comes into contact with the foot or hose and is also visible. The wearer can see if it becomes damp or wet in wear, if any print or label rubs off, if the colour bleeds or fades or if the surface starts pilling or delaminating. Therefore, from a durability and aesthetic viewpoint, physical properties such as abrasion resistance and colour fastness become critical.

ABRASION RESISTANCE AND COLOUR FASTNESS

Poor abrasion resistance of top coverings is unsightly and a potential cause of discomfort if they become rough or uneven. While premature abrasion during wear does not always give rise to returns, it does not leave a good impression of product quality. Most problems occur in damp conditions and it is surprising just how damp insocks can become from sweat, even in open sandals. Indeed, there is more likely to be complaints about abrasion occurring in sandals, since any wear is more noticeable, especially at the toe end of open-toed styles. Metallic finishes on leathers and coated fabrics seem to be a particular problem as the

metallic finish can come off quite readily, revealing a contrasting colour underneath.

Colour bleed and/or colour transfer to adjacent materials may be the result of the physical rubbing action of the foot against the insock or extraction by leaching out of the colour by foot perspiration or water. Not surprisingly, the worst offenders are suedes, nubucks and natural textiles which are often deeply dyed in colours such as navy blue, red and dark green. Finished leathers and man-made textiles are generally better but should still be tested.

The most common form of backing material for insocks is a polymeric foam, incorporated to provide the wearer with cushioning and shock absorption properties. In addition to foam, various solid polyurethane materials are on the market as well as a range of gels. The main characteristic of both these compared with traditional foams is that they have very pronounced viscoelastic properties causing them to behave differently under compression and shearing. In particular, viscoelastic materials compress and recover their thickness after compression more slowly. Backing materials have their own durability requirements, including compression set resistance and adhesion bonding strength. Their properties may also influence the durability and wear properties of the covering material itself.

OTHER KEY PHYSICAL PROPERTIES

Keeping the cover well bonded to the backing material is critical to continued good performance of the insock as peeling off of the top cover will cause significant discomfort to the wearer. The adhesion of the insock itself to the insole (or midsole) is also important for its security in the shoe. A poorly secured one could slide towards the toe, again giving discomfort problems. Moulded footbeds, however, although generally loose fitted, are less likely to suffer such problems as they are stiffer and perhaps even semi-rigid.

Repeated wetting and drying by whatever cause—ingress of rain water, heavy sweating or washing—can lead to shrinkage of the insock, deterioration of bond strength and possible breakdown of foam materials. A simple washing test quickly reveals potential shrinkage or curling problems.

A new insock is intended to give a certain level of comfort and it is desirable that this same level of performance is maintained over the life of the product. This means that it requires good compression set resistance so that it retains



Measuring thickness change as a result of compression set.

its fitting, shock absorption, cushioning, shear absorption and thermal insulation properties. Each of these properties will be diminished if the structure or substance of the backing material collapses and the thickness is reduced with wear. In foam materials with a closed cell structure, individual cells may burst under pressure, causing the structure to collapse. In open cell foams, the strength comes from the walls of the cells, which may weaken under the repeated fatigue loading of many walking steps.

ODOUR CONTROL

As well as comfort and durability, there is one final property which can either cause a problem or reduce it; odour production or control. Shoe odour is predominantly the result of microbial activity as they feed off dead skin cells, residual perspiration and other natural materials such as cotton in the shoe and insock. The warm and moist in-shoe environment provides ideal breeding conditions for microorganisms such as fungi, yeasts

and bacteria. The cellular materials used as insock backing materials may act as a reservoir for these organisms and their food, thereby exacerbating the problem. Manufacturers have turned this into a marketing opportunity and now many insocks claim to actively reduce the problem of foot odours.

There are two main approaches to preventing or controlling odour. One is the use of antimicrobial agents (biocides) to prevent or limit microorganisms from growing and producing the odour. The other is to absorb and neutralise the odour produced by using odour-absorbing materials such as activated charcoal. A combination of both approaches is likely to be most effective.

Any biocides or other chemicals incorporated into insocks must comply with any national or international restrictions on their use, for example, in Europe both the Biocidal Products Regulation and the REACH Directive will apply. The REACH Directive will also cover all other chemicals such as dyestuffs and polymer additives.

SAFETY FOOTWEAR

In addition to the properties of insocks for everyday footwear already discussed, it is also worth noting that there are specific quality testing and performance requirements for insocks used in some safety footwear. Certainly all safety footwear sold in Europe must have insocks tested for water absorption and desorption, and for abrasion resistance. Leather insocks also have to be tested for pH and possible chromium VI content. Other, optional, insock tests relate to properties such as electrical resistance and thermal insulation.

While developing and promoting comfortable performance insocks and footbeds is a key marketing strategy for many brands, the basics should not be overlooked. All insocks, whether high or low priced, should be fit-for-purpose, durable and not harmful to either the wearer or to the environment. Development of a new insock product is not complete until the required comfort performance aspects have been incorporated and quality and durability fully assessed. 🔴

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