



CREDIT: MICAM

Avoiding heel failures

Solid and securely attached heels are of vital importance on ladies dress shoes and, the higher the heel, the more difficult this becomes due to the small size of both the top-piece and the seat of the heel. The former creates balance problems for the wearer, while the latter makes the heel more difficult to attach securely. Furthermore, failure of the attachment in wear can lead to serious injury and potential legal action for damages. This might seem to be stating the obvious, but people new to the industry may not be fully aware of what can be done to prevent this from happening.

The foremost thing to understand about heel attaching is that it does not just hold the heel on but also affects the structural integrity of the entire backpart of the shoe. It must also be able to withstand unexpected blows from such hazards as kerbs and metal gratings as well as the normal mechanical rigours of walking. Several key aspects can ensure good

heel attachment. These involve the choice of materials, design and construction of the backpart and quality of the attaching process itself.

HEELS

The first thing is to ensure the nail-holding properties of the heel plastic are adequate, especially if the design of the heel restricts the length of nail that can be inserted into it. The market is dominated by PS (polystyrene) which is adequate for most applications. HIPS (high impact polystyrene) is stronger and suitable for most of the more extreme heels or to provide an extra margin of safety on normal heels. It is produced by adding either BR (butadiene rubber) or SBS (styrene-butadiene-styrene rubber) to the moulding compound. Strongest of all is ABS (acrylonitrile-butadiene-styrene) which can be used on most extreme heels.

PP (polypropylene) would also be a suitable material for the production of heels, especially the high-performance

metallocene catalysed grades, but for one major problem. It is very difficult to achieve an adequate bond with either paint when spray finished or adhesive when covering. Other



Extreme heels should be made from ABS with an additional central reinforcing pin.

materials, such as nylon and polyacrylates, have also been evaluated but have not found any significant usage.

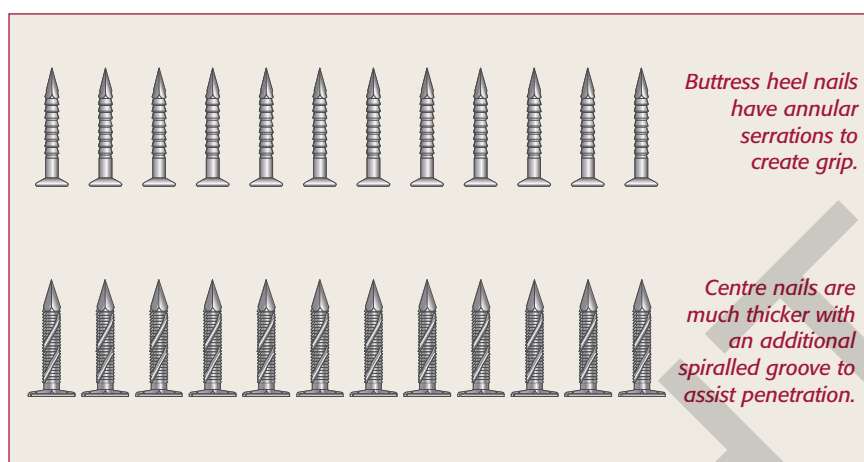
While this short article is principally concerned with the essentials of good heel attaching, it is worth pointing out that in the case of extremely high/slim heels the heel itself can fail unless adequately reinforced. While this is primarily the heel makers concern, a serious failure in wear and any subsequent litigation can also cause adverse publicity for the shoe brand itself.

Heels of this type need to incorporate a steel reinforcing pin. This usually consists of a rolled steel tube running virtually the full height of the heel, from the top piece to just short of the heel seat surface. The bottom of the tube is flush with the tip to which the top piece is attached. Even though a good heel supplier will take quality and performance very seriously, it is nevertheless prudent to have the heel independently tested in the case of a new supplier.

INSOLES

The insole is the foundation of a ladies dress shoe and its performance is as important to secure heel attaching as the plastic used in the heel itself. It must be rigid enough to support the foot on a high heeled shoe and, at the same time, strong enough to hold the heads of the nails securely to prevent them being pulled through under load. The solution is to use an insole that combines a 2mm flexible cellulose board laminated to a high quality 2.0 or 2.5mm shank board reinforcement at the waist and heel with a strong fluted steel shank held between the two and secured by rivets at each end. For the most extreme heels, a second 0.8 or 1.0mm layer of shankboard can be bonded simultaneously to the top surface of the cellulose board. It is a simple case of the greater the thickness combination, the greater the final strength and rigidity.

Shank boards are hard and strong fibre boards which can withstand the tremendous loads which occur in the waist and heel areas of high-heeled shoes. Made from a mixture of recycled paper and vegetable resins, they are designed to provide longitudinal stiffness and torsional



stability to withstand the twisting forces that occur during walking as well as mechanical strength to prevent heel attaching nails from pulling through the insole.

HEEL NAILS

Despite all the other developments that have taken place in footwear technology, attaching a heel still relies on driving a number of nails into the top of the heel simultaneously at high speed. This is despite constant problems in ensuring they are inserted without bending or deviating from their intended line and damaging the insole by pushing the nail heads too far into the insole. Alternative methods have been tried including adhesive systems and precision engineering components but proved to be either inadequate or too expensive.

Driving a pattern of nails through the insole and into the heel from inside the shoe after the last has been removed does in fact offer a very secure attachment provided the type of nail is carefully matched to the material used to produce the heel. For plastic heels, the buttress nail where a series of annular serrations allows it to penetrate easily but then become all but immovable is the one to use. Length depends on a combination of factors including thickness of insole and upper, heel height and shape as, with a sharply tapered heel, there can be a risk of the nails penetrating the external surface. Head size should be sufficient to provide a good grip on the surface of the insole and the nails not driven in too far.

The choice of nail pattern is important; a minimum of five nails is the norm for ladies heels and their spacing usually something of a





Shanks for centre nail heel attachment.

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Tensile testers provide simple and effective quality control.

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compromise. It should be as wide as possible at the insole/heel interface in order to maximise the consolidation of the backpart. In the heel itself, the spacing needs to be narrow enough to prevent nails emerging through the sides of the heel. Their position with respect to the shank and heel breast is also a critical factor in achieving a strong backpart which will not deform under load. The shank must be positioned to give maximum strength at the heel breast where the stresses are highest.

CENTRE NAILING

Where a heel is particularly narrow, conventional inside attaching cannot always be used as the nailing pattern would be too tight. The alternative is centre nailing, where a single large diameter nail is driven into the centre of the heel. The increased diameter of these nails offers nearly the same gripping surface area as five standard nails, while the large head offers secure anchorage to the insole. They again have annular serrations but can also include a spiral to assist penetration of tougher plastics such as ABS.

Centre nailing while effective, does

however create a problem as far as shanks are concerned. If the insole is the foundation of a shoe, the shank is its backbone. It reinforces the waist area, provides overall stability and is a key part of the overall structure. To achieve this fully, the rear of the shank should ideally be 10-20mm in from the back of the insole. In the case of centre nailing, the shank needs a large hole in it through which the nail can pass. This reduces the length of the fluting and, unless a wider shank with extra flutes either side of the hole is used, creates a potential weakness.

MONITORING

Even if the design and construction of the shoe backpart is correct in every way, quality must be maintained in manufacturing. Some faults are obvious, such as nails missing or over-driven into the insole. Others are less so, such as the quality of the serrations on the nails, a change in quality of the heel plastic or a problem with positioning of the nails in respect of the shank. The operation needs to be constantly monitored, both visually and by periodic testing of shoes taken from the production line.

Attachment strength can easily be assessed with a heel pull-off test using one of the simple tensile testers that can be obtained from testing houses such as Satra. This can be used both to confirm that materials, design and construction are satisfactory and as an in-factory test to monitor quality. The principle of the test is quite straightforward. The forepart of the shoe and the heel are gripped in the jaws and simply pulled apart. The force needed to do this is a measure of the strength of the heel attachment. This simple approach is ideal for everyday quality control.

A heel pull-off test can also reveal much more about the suitability and construction of the shoe backpart, and how the strengths of the various components interrelate. By observing the way in which the backpart deforms during the test, Satra is able to identify any potential weaknesses and advise manufacturers on ways to overcome them. It therefore also constitutes a useful tool in product development and maintaining overall quality of the final product. Poor heel attaching can prove to be an expensive error and it is a foolish manufacturer who tries to cut corners. 🔍