

Running shoes are at the forefront of footwear technology and are particularly effective in cushioning shock to the body. In addition to subjective opinion and objective laboratory shoe testing, opinions differ as to how and why various shoe-cushioning systems work. In striving to outdo competitors, the leading brands all try to have a different approach. Is there anything here for producers of other types of footwear?

Underfoot cushioning systems

Mel Cheskin

The most common approach is to use a material or substance that disperses shock. This material is added to the shoe's midsole which is itself a primary shock absorber. Most running shoe midsoles are made of EVA with occasionally some additional rubber or polyurethane for greater durability. EVA is a useful material in that it is available in different durometer readings to make it either easier or harder to compress.

EVA can also be blended with rubber to create a midsole with a better energy return. Asics, Brooks, New Balance and Saucony have all done this with various formulations. Mizuno has a new polymer called AP which has performed so much better than EVA that it now relies solely on an AP midsole for all cushioning needs.

Asics uses its SpEVA blended material for the complete insole in Strobel construction shoes. This is very soft underfoot and creates an excellent 'try on feel' for the customer. Different durometer readings are used in different shoes and there would seem to be no reason why this idea could not be tried in a wide range of non-athletic footwear. The initial soft 'try on feel' would be a strong selling point for comfort shoes.

Mechanical cushioning is also used and systems including cantilevers, wave plates, mechanical springs and other esoteric concepts are very much in vogue. Many of these are as much marketing ploys as performance enhancers and are really either too bulky or too gimmicky for the general run of footwear, even when there is a thick sole.

Factory shoe inserts are usually basic in order to keep costs down and because a wide range of sophisticated after-sales inserts is available. Component suppliers such as Rogers and Jones & Vining offer complex cellular foam materials in either flat or moulded shapes for almost any type of application and are well known to everyone. They provide a far simpler and more flexible means of adding cushioning for manufacturers lacking the vast volumes of the sports shoe brands.



Adidas showing rear Foamless Heel Cushion - EVA Forepart technology

What the sports shoe brands are doing

Adidas' 'One' shoe uses a sophisticated computer-operated mechanical system (see review in July/August 2004 issue of *World Footwear*). Clever but not practical for any other footwear as it stands.

Asics also uses gel and this is quite good provided there is enough sole thickness. It feels like a soft visco-elastomer next to the foot and attenuates shock quite well. Suitably sized encapsulated gel packs provide cushioning under the calcaneus and metatarsal areas. SpEVA Strobel insoles add further cushioning.

Avia employs both mechanical and material systems. The very functional cantilever system in the new Ecto-Cantilever shoe is one of the better mechanical forms of cushioning and might be useable in hiking boots. The company adds its own shock absorbing midsole material called Dura-Ryd under the forefoot and heel strike areas and the total package is said to be quite effective.

Brooks has Hydroflow. This comprises a controlled viscous filled bag with channels to allow the fluid to be dispersed on impact and provide shock attenuation. The heel pack not only absorbs impact forces but also has a positive effect on stability. Brooks also employs flex lines in the heel strike area to create a 'crash' zone for further absorption. This type of system could well be good for hiking boots.

Fila is another to combine mechanical and material forms of cushioning. It has a flow system that cradles the foot which can provide either cushioning and moderate pronation control or more severe motion control depending on the shoe model. The cradle is designed with cut outs to allow it to 'give' and thus

FOOTWEAR TECHNOLOGY

absorb impact. Clever, but again unlikely to be suitable for other footwear.

Mizuno has some good technologies. Its VS1 cushioning material is more of a dampening substance and deforms better to the foot than many other materials. It is used in both the heel strike area and under the forefoot. Its new advanced polymer midsole material is lighter, more cushioned and responds better than EVA. Effective overall cushioning without gimmicks.

New *Balance* is not best known as an innovator and relies on material cushioning. The furthest it goes is to combine two materials in a midsole/wedge using a soft spongy material called Abzorb. In the forepart, a more advanced silicon based material is used which seems to be good for dispersing force. It also uses a blended midsole material, much like the SpEVA referred to earlier, so there is obviously much here which could be adapted for use elsewhere.

Nike's success over the years has been mostly due to its Air system that has been progressively developed since the original Tailwind was introduced in 1978. The patent expired in the late 90s, so Nike has come up with Shox, a combined mechanical and material pillar system. The pillars are basically foam-filled plastic columns that are sandwiched between polypropylene plates. It is once again as much a marketing strategy as a performance enhancer.

Pearl Izumi is a new company that has combined its mechanical Syncroframe with a material cushioning called Skydex. Syncroframe acts as a guidance system for the foot and is designed to cradle it and absorb impact. It is literally a plastic frame integrated into the rear and forepart of the midsole. The additional Sydex is very similar to all the other materials being used. Suitably adapted, the cradle concept could offer some useful support in other types of footwear where the foot comes under stress.

Puma has come up with some major innovations in its time and is pursuing a unique new foamless technology called duoCELL. This is a mechanical and material form of all-in-one cushioning that may have a lot of promise. Small pentagon shaped absorbent plastic pods, hollow in the middle but with rigid sidewalls and top, form the cell structure. DuoCELL uses a base cell with a stack of smaller cells on top. The result works almost like a piston creating good shock absorption at heel strike as the smaller cells absorb into the larger base cell. The cell structure replaces the normal midsole material at the back of the shoe, making it a completely foamless system.

Reebok's DMX foam encapsulated cell material was its primary claim to fame. It still uses it for walking shoes along with DMX Walk, a completely different air-chamber system. This exchanges pressurised air from rear to forefoot on landing and

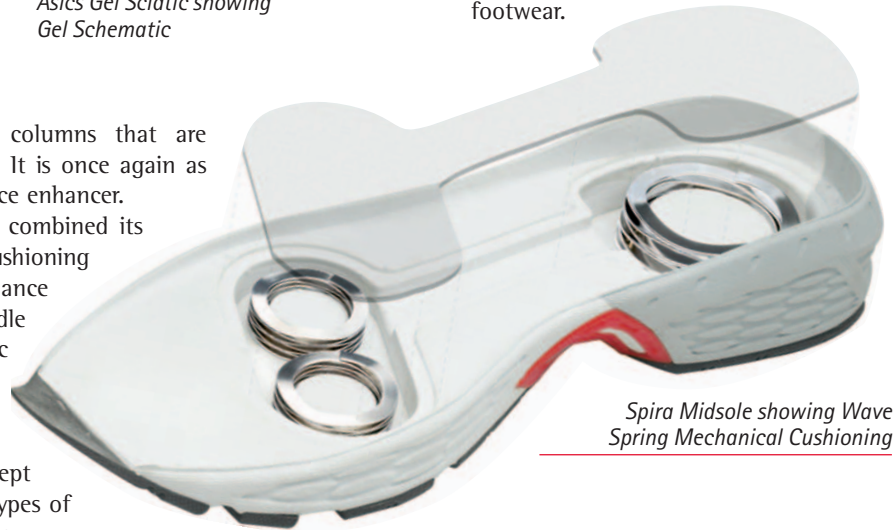


Asics Gel Sciatic showing Gel Schematic

visa versa on toe off. Not a new concept and Clarks has used something similar for several years.

Saucony has a very unusual system called GRID whereby a small cartridge is integrated into the midsole directly under the heel. It has an outer frame with strands criss-crossing from one side to the other. It works like a miniature tennis racquet placed under the heel to catch it, much as it would a tennis ball at impact. Although not for extreme running conditions, it has generally proved very successful and could well be applied to other footwear.

Swiss Masai's concept is to change total body posture (see article on *Natural footwear* in the July/August 2005 issue of *World Footwear*). Its shoes do have a somewhat different feel and so take some getting used to when first worn. Although the shoe is technically on a neutral plane, a soft wedge is incorporated at the back of the heel that compresses on landing, so this is definitely applicable to general activity footwear.



Spira Midsole showing Wave Spring Mechanical Cushioning

Conclusion

Over the years many other shock absorbent and energy rebound systems have been tried. Many of the more extreme and gimmicky ideas did not stand the test of time and the one consistent performer has been the use of material cushioning. This is also far easier to apply to other types of footwear as there are so many permutations that can be employed. Continual advances in polymer engineering also mean that there would appear to be no immediate limit on the improvements that can still be made.

What is also clear is that the industry in general can learn much from the extreme sports shoes that are continually coming on to the market. In much the same way that many of the developments in Formula One racing cars eventually trickle down in some form or other to the everyday cars we all drive, so the same principal can be applied to footwear. 🏃