

# Put Your Best Foot Forward

Evonik supplies VESTAMID®, an important high-performance plastic, for running shoes



Who remembers James Fixx these days? At the end of the 1970s, the man was a celebrity, a star, because he started a mass movement. His book, *The Complete Book of Running*, made the United States into a nation of joggers, and it made him a rich man. His exercise bible stayed at the top of the New York Times bestseller list for months. The wave spilled over into other countries and no later than November 1978, when *Der Spiegel* magazine devoted its cover story to the trendy new sport, did Germany discover the pull of running as well. People—infected with a desire to run—ran in fields, woods and meadows, on paths along rivers, on sidewalks, and if there weren't any, in the street.

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On October 13, 1974, the first Berlin Marathon was run. There were 286 runners from four countries registered; 244 made it to the finish line. At that point, there was nothing to indicate that this was going to become the rage; people strolling in Berlin's Grunewald forest used to make derogatory comments about the out-of-breath athletes running by. Thirty-three years later, the Berlin Marathon has long moved from the periphery into the city center, and, with 40,215 registered runners and 100,000 spectators on the sidelines, it has become the largest Germany city marathon. And it has a lot of competition. Nowadays, there are few German cities that don't attempt to entice runners with a city marathon, not to mention international races.



"Let me check out your shoes!": Molding compounds based on polyamide 12 meet the high standards runners have for their shoes.

Stefan is 50 years old and a marathoner. His best time: 2:56:32. Ambitious hobby runners achieve times like this only with regular, consistent training. Stefan runs during his lunch break several times a week, on weekends he goes for at least one 20-kilometer run. His weekly totals are between 50 and 80 kilometers, and they are even higher when he is training for a marathon. When training at this intensity, running shoes have to take a lot of punishment, sometimes going on hard asphalt, sometimes trails through the woods, sometimes paths along river banks.

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Runners literally go over hill and dale, and after a heavy rain, through mud and muck. For training runs, Stefan prefers a sturdier model, but for races he chooses the lightest shoe possible. "Because when it comes to racing," he explains, "every gram counts."

Stability and low weight: Michael Beyer knows the requirements of the running shoe market very well indeed. "Athletic shoes," notes the director of market development at Evonik Industries AG's High Performance Polymers Business Line, "need to meet a wide variety of requirements." And to fulfill these requirements the special-chemistry, experts from Marl, a city located at the northern edge of the Ruhr Valley of Germany, have developed some specialized products. Marc Knebel, Lifestyle key account manager for High Performance Polymers, and himself a runner, explains, "Complex chemical structures need to be transformed into tangible applications. We've accomplished this successfully by working closely with well-known sporting goods manufacturers during the development of athletic footwear using molding compounds based on polyamide 12 and polyamide 12 elastomers from Evonik. Polyamides play a large role in the design of athletic footwear. The focus is essentially on semi-crystalline materials from the top-third of the polymer pyramid, so these high standards can be met. Compared with other polyamides, molding compounds based on polyamide 12 are characterized by high dimensional stability, constancy of properties in fluctuating environmental conditions, and low water absorption."



Both lightweight and tough, and not just a fair weather shoe; it can handle all types of weather: the perfect running shoe.

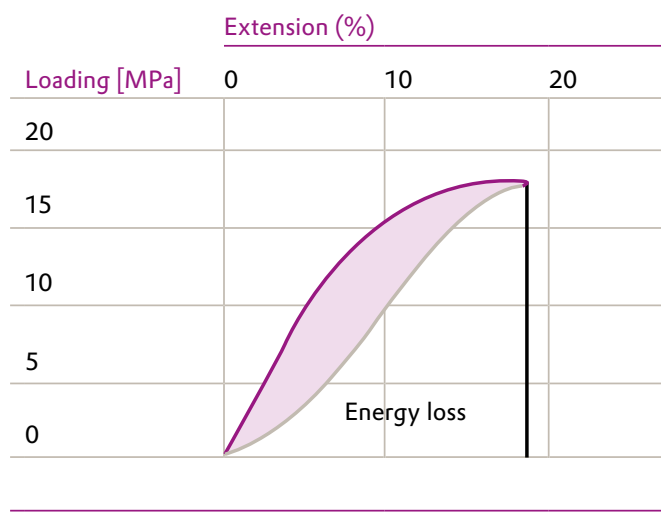
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Athletes demand a lot from footwear. Great performances have a lot to do with wearing the right footwear; it's not for nothing that each sport has its own shoe. At least for top-tier athletics, every athlete wears custom shoes tailored to his or her special requirements. Partial customizing takes place in the form of different versions that are used for different weather and surface conditions.

Even when hobby runners don't splurge on custom shoes, their standards for this important piece of "athletic equipment" are high. The shoe needs to fit (manufacturers refer to this as "correct fit"), it needs to be comfortable, and it should support a tendency to run naturally. That is, the shoe should restrict the natural sequences of movements during running as little as possible.

So what is required of athletic shoes, and what can the polyamides from Evonik offer? Beyer responds, "Athletic shoes need to be tough, which means the polymers need to meet very tough mechanical requirements, both static and dynamic ones. And the polyamides also need to be able to stand up to the effects of the weather. The shoes need to give a feeling of effortlessness—giving sprinters wings, long-jumpers a tailwind, and long-distance runners legs that float. Because the polyamide 12 molding compounds have a density of just under one, the weight savings for a 100-meter sprinter would be one kilogram. In addition, the shoes need to be able to handle environmental influences. Top athletes need to perform at their best both at extremely low temperatures of down to -40°C and in extreme heat, so temperature fluctuations also need to be taken into account." Marc Knebel continues, "Add to this the fact that the shoes have to be transported in containers where temperatures can go up to 80°C. In addition to temperature, contact with rain, snow and dirt also play a role, and polymers need to withstand them as well. And, lastly, athletic footwear needs to meet design requirements, be they colorful or, as is the current trend, transparent, and the different degrees of hardness are important as well."

## Hysteresis Curve



— Extension curve  
— Unloading curve

The sole material absorbs energy when it is deformed, some of which is returned to the runner as an impulse via a spring effect. With VESTAMID® the difference between the absorbed and returned energy is very small compared to other materials.

The most lucrative part of the business is in mass-market running shoes and that is where, says Beyer, "our VESTAMID® has been incorporated into many shoes. The magic word is cushioning." Cushioning is supposed to keep the feet as comfortable as possible on hard surfaces without neglecting athletics, and while supporting the work of the muscles and joints. Beyer notes, "The sole system is what provides the cushioning, which, depending on the design, is usually divided into a topsole, mid-sole, and an outsole. Different combinations of materials are used for different types of stresses. A variety of VESTAMID® grades are utilized, mostly as mid-soles or outsoles, providing optimal cushioning.

The market is always changing, and new trends pop up all the time. The shoes the 244 marathon pioneers wore running through Berlin's Grunewald in 1974 are now fit only for a sports museum. Training versus race shoes, cushioning, cutting-edge transparency and design, new requirements emerge every season practically—which means new challenges for manufacturers and their suppliers.

And Fixx, the man who got us all running? He died of a heart attack while out on a run at only age 52. But his notion of running as an ideal sport—because it was simple, healthy, and inexpensive—continues to fascinate millions of people around the globe.



### Not just for running shoes

Other sports can also take advantage of high-performance plastics from Evonik:

- Cycling shoes, the soles of which need to be particularly stiff to impart the surface pressure from the foot to the pedals and thus into the bottom bracket. At the same time the soles need to be extremely impact resistant to prevent them from cracking.
- Mountain bike shoes need to have the same properties as shoes for bicycle racers, but wearers also need to be able to wear them normally walking down a street or on natural terrain.
- Keirin shoes, a special type of cycling shoe. The sport places extreme stress on the soles, but they also need to be lightweight.
- Prostheses for participants in the Paralympics, to provide athletes with disabilities with the best conditions possible.
- Fencing shoes that need to be very heat resistant and need to have excellent friction and abrasion properties.