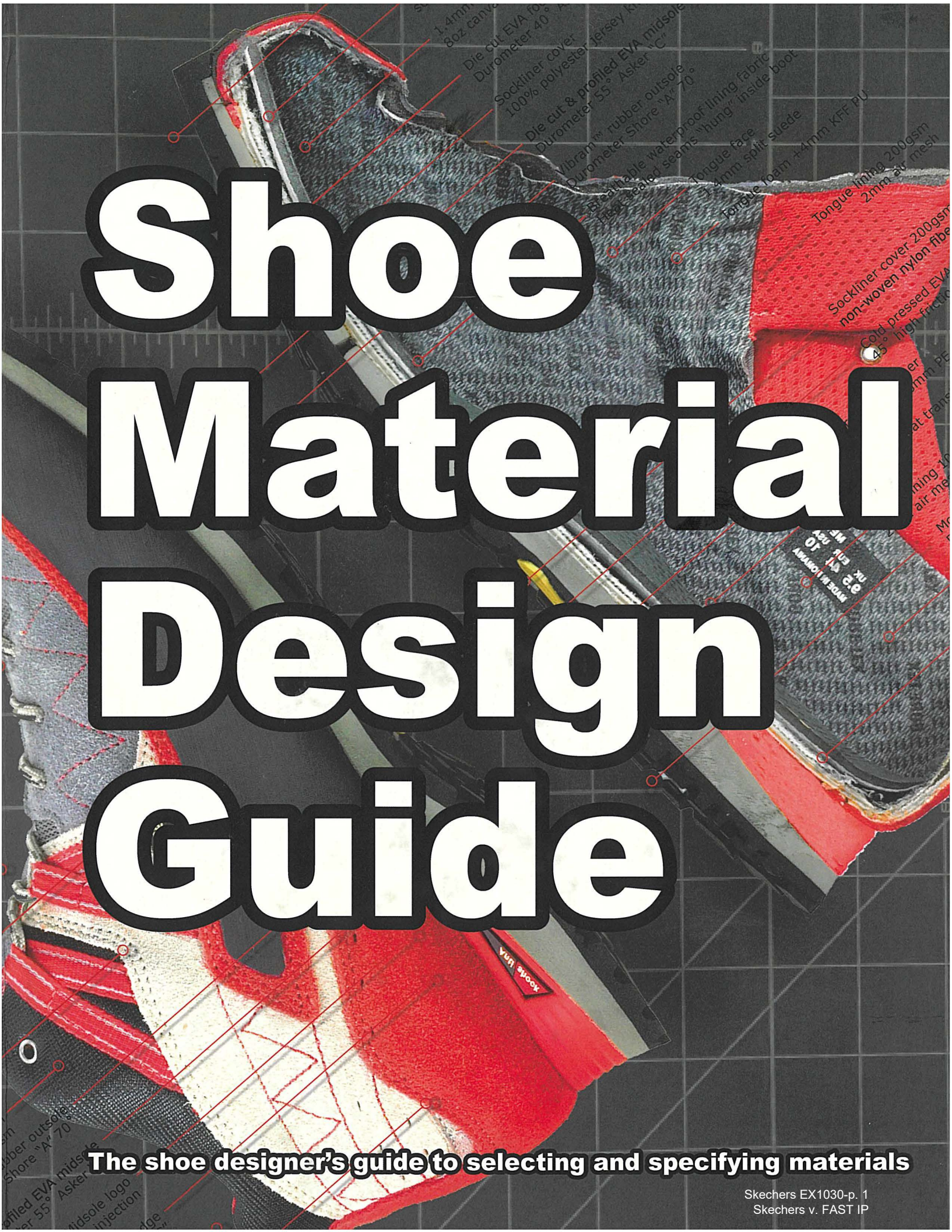


Shoe Material Design Guide

The shoe designer's guide to selecting and specifying materials

Skechers EX1030-p. 1
Skechers v. FAST IP

Today's shoe designer has an infinite number of available options when choosing materials for new footwear designs. Learning how to select and specify footwear materials accurately is a critical skill you will need to become a successful, professional shoe designer. The wrong choices can make a footwear mess, and the right choices can create a modern masterpiece!

You must take great care to pick materials appropriate for the demands of footwear marketing, performance, and manufacturing. The right material choices will make your shoe designs comfortable, compelling, and long-lasting.





Available now:
How Shoes are Made
How to Start Your Own Shoe Company
Shoe Material Design Guide
Cómo se hacen los zapatosz
Cómo empezar tu propia empresa de calzado
Guía para el diseño de materiales de calzado
鞋子是怎样制成的

Coming 2021:
How to Design Sneakers
Patronaje de calzado y diseño de hormas

Coming 2022:
How to Design Women's Shoes

WWW.SNEAKERFACTORY.NET
Shoe Material Design Guide

Written and Edited by
Wade and Andrea Motawi
USA Copyright © Wade Motawi 2017
ISBN-13: 978-1-7358833-1-1

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations in critical reviews and other noncommercial use permitted by copyright law.

ask_a_shoe_dog@sneakerfactory.net

Any trademarks, service marks, trade names, trade dress, product names and logos that may appear in this book are the property of their respective owners. SneakerFactory.net makes no claims to any trademarks, service marks, trade names, trade dress, product names and logos that may appear in this book.

Dear Readers,

This book was written to educate, inform, and inspire the next generation of shoe designers, shoe developers, shoemakers, and footwear entrepreneurs! Our goal is to help prepare people for fulfilling careers in the world of shoes!

Enjoy!

Special thanks to:

Andrea, Alex & Erik, Karim, Halla, Mom & Dad, Dave, Alfredo, Jason, David, Lizzie, Johnson, Steve, Lenny, Bernie, Simon, Ben, Chad, The Mint Project.

Thanks to all my working friends in the USA, China, Hong Kong, Korea, Taiwan and Europe.

Shoe Material Design Guide

WADE MOTAWI

Skechers EX1030-p. 4
Skechers v. FAST IP

SHOE MATERIAL DESIGN GUIDE

CHAPTER 1 : LEATHER FOR FOOTWEAR.....3
How leather is made and how to use leather in your shoe designs.

CHAPTER 2 : TEXTILES FOR SHOES 17
Fabric options for footwear.

CHAPTER 3 : SYNTHETICS FOR SHOES.....27
Man-made materials for the modern shoe.

CHAPTER 4 : SHOE STITCHING THREAD 35
Thread and stitching hold it all together.

CHAPTER 5 : FOOTWEAR REINFORCEMENTS.....37
How to create, support, and fix the shape of shoes.

CHAPTER 6 : SHOELACES.....43
Options for shoe closure systems.

CHAPTER 7 : SHOE GLUE.....45
The use and application of adhesives in shoes.

CHAPTER 8 : HARDWARE FOR SHOES.....49
Metal and plastic parts for shoes.

CHAPTER 9 : LOGO APPLICATIONS FOR SHOES 53
Techniques for branding shoes.

CHAPTER 10 : FOAM FOR SHOES 57
How to specify foam.

CHAPTER 11 : MIDSOLE CUSHIONING SYSTEMS.....63
A review of 14 different midsole types.

CHAPTER 12 : OUTSOLES FOR FOOTWEAR.....69
A study of eight different outsole constructions.

CHAPTER 13 : WATERPROOF CONSTRUCTIONS.....79
An overview of waterproof construction techniques.

CHAPTER 14 : FOOTBEDS.....81
Picking the right footbed, ten options to study.

SHOE MATERIAL DESIGN GUIDE

CHAPTER 15 : WEBBING FOR SHOES.....89
Options and uses of webbing.

CHAPTER 16 : PLASTIC PARTS 91
A quick study of plastic molding for shoe parts.

CHAPTER 17 : PACKING BOXES.....95
How to design and specify packing materials for shoes.

CHAPTER 18 : SHOE MATERIAL SPECIFICATIONS.....99
How to create a footwear specification.

CHAPTER 19 : SHOE MATERIAL TESTING 105
Testing requirements for shoe and shoe materials.

CHAPTER 20 : LOCAL MARKET SHOE MATERIALS 109
Using locally available stock materials.

CHAPTER 21 : MATERIAL VENDOR RELATIONS.....111
How to get the most from your material vendors.

CHAPTER 22 : MATERIAL COSTING AND CONSUMPTION.....113
How to calculate the cost of shoe components.

CHAPTER 23 : SHOE MATERIAL SUPPLY CHAIN.....117
The challenges of sourcing footwear materials.

CHAPTER 24 : EXOTIC AND ILLEGAL MATERIALS 119
How to know if rare materials are safe and legal to use.

CHAPTER 25 : BUILDING A SHOE MATERIAL LIBRARY.....121
Tips and techniques for collecting material swatch books.

CHAPTER 26 : SUSTAINABLE SHOE PRODUCTION.....123
How to reduce the environmental impact of your shoes.

CHAPTER 27 : SHOE DISSECTION.....127
Cross section views of popular shoe styles.

CHAPTER 28 : SHOE MATERIAL VENDOR LIST.....191
Where to find top quality shoe materials.



HOW TO USE THIS BOOK

How to select the right materials for your shoes

This book was written to help shoe designers, product managers, footwear developers, and students select the right materials for their footwear projects. After reading this book, you will have a better understanding of the material types available and the many options for each material type.

You will learn how to qualify your material choices; making sure they meet the performance requirements for your shoe. Once you have selected your materials, you will need to communicate your material choices to the factory.

Section 1: Material options for the shoe designer

The first section of the book details the many materials available to the shoe designer. Each chapter will focus on a specific material type or component. You will study the manufacturing processes and available options for each material. Once you have an understanding of your material choices, we will review how to use each material type to maximize its effect in your shoe designs.

Section 2: How to qualify and specify shoe materials

The second section of the book details exactly how to qualify and specify materials. We explain how to test materials, how to manage vendor relations, and how to build your material library. You will also learn about the challenges of sourcing, ordering, and managing the shoe material supply chain.

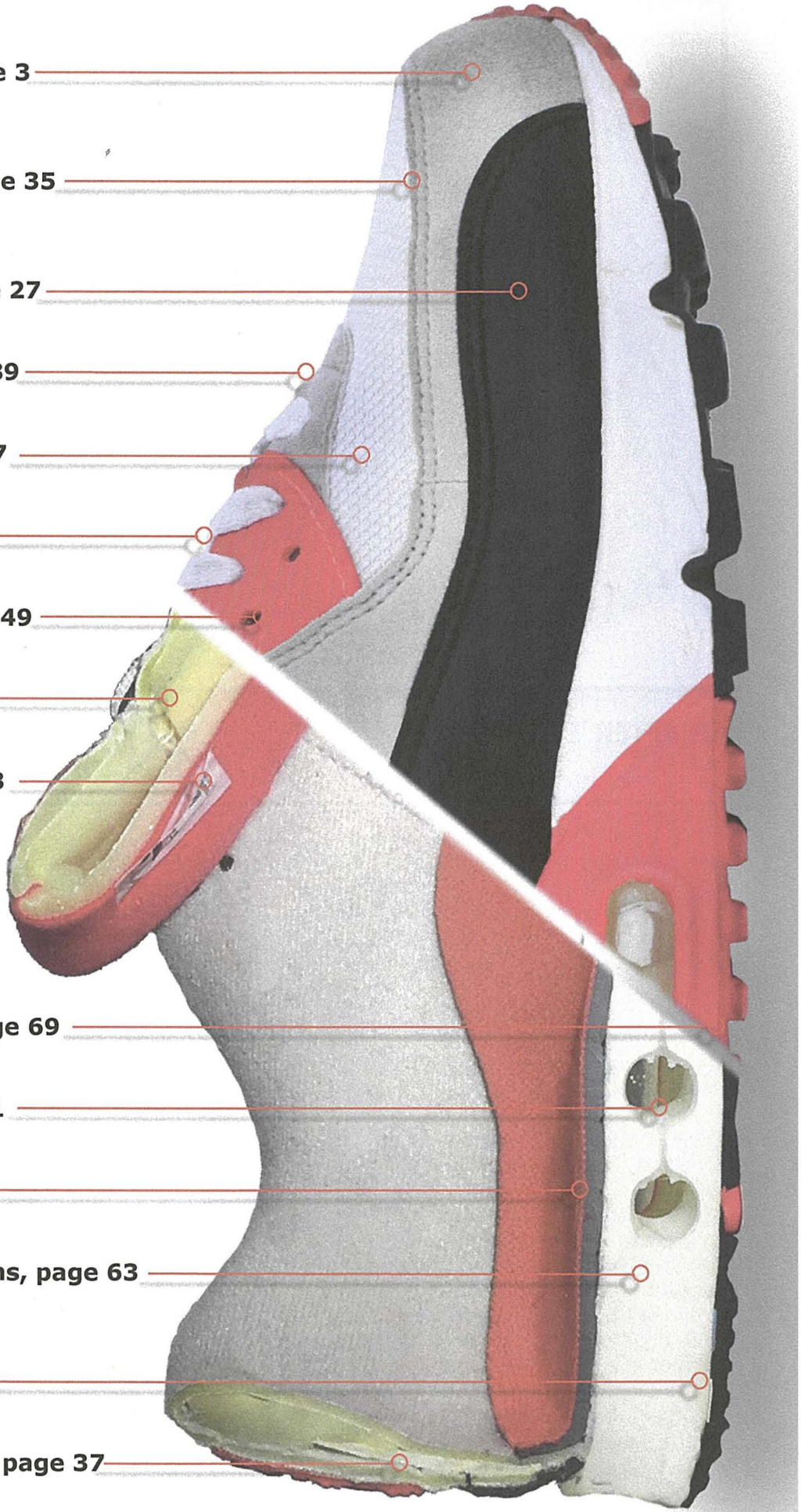
Section 3: How materials are used in shoe production

For this section, we have cut a sampling of shoes in half to identify what materials are used and where they are used to make many popular styles of modern and classic shoes. Use this section as a reference for common materials used to create many footwear styles.

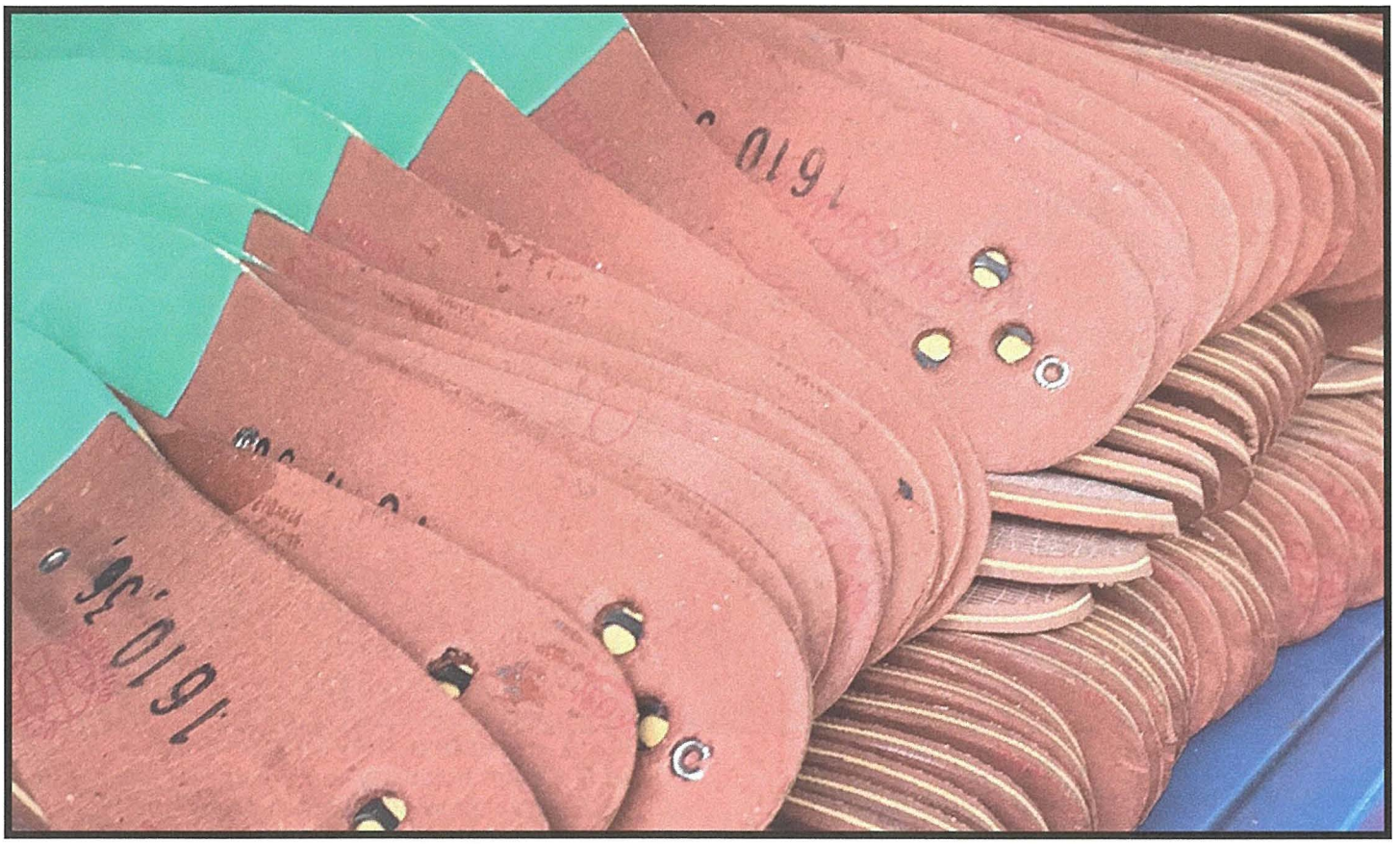
Section 4: Who makes the best shoe materials?

To help you find the best material suppliers, we list the top vendors for major material categories.

Skechers EX1030-p. 7
Skechers v. FAST IP



Skechers EX1030-p. 8
Skechers v. FAST IP



CHAPTER 5

FOOTWEAR REINFORCEMENTS

Reinforcements are quite often the hidden heroes inside of footwear that make a shoe design truly functional and practical. The internal reinforcements you select will allow your shoe to hold its shape, protect the foot, provide support, and stay together. The reinforcements are a significant factor in determining your shoes' performance, comfort, durability, and suitability for its designated task. The reinforcements inside hiking boots or work boots are radically different from what you will need inside a running shoe or casual footwear.

Reinforcement functions

Shaping the shoe
Upper support
Outsole stiffness
Material backing
Tear resistance
Safety requirements

Shaping the shoe

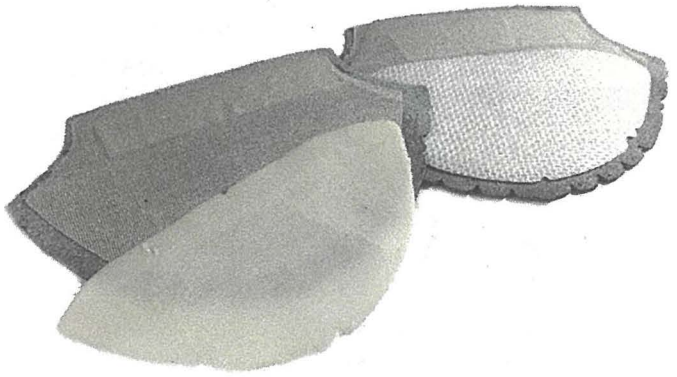
The overall shape of a shoe is determined by the last and pattern. If the upper is constructed with un-backed fabric, then it's a sock, not a shoe. Almost every shoe will have some type of shaping reinforcement to hold the shape once the last is removed. Leather will take the shape of the last, but over time, without a supporting layer, can stretch and distort. Leather is often reinforced with a fusible backing layer.

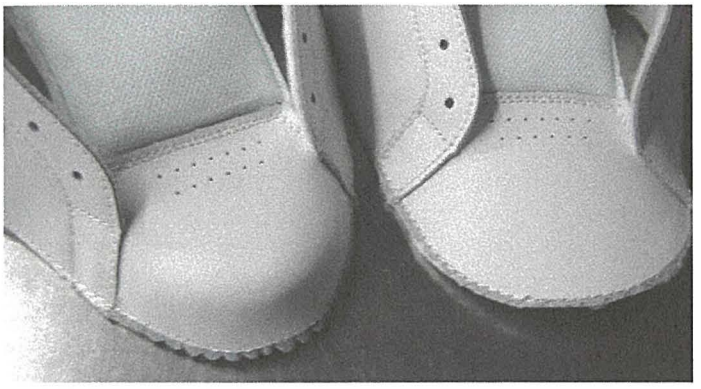
Hot melt glue is often applied between the upper layer and inner lining of a shoe. During the lasting operations and when the shoe is heated on the assembly line, the hot melt takes shape and is then set in a cooling tunnel. Hot melt glue is firm but flexible and can help a shoe "stand up" in appearance. This shoe shaping reinforcement can be overdone. Inexpensive shoes are often overly stiff. While the uppers may look crisp and wrinkle-free, they may also feel like cardboard on your feet.

Skechers EX1030-p. 9
Skechers v. FAST IP

Toe counters

The toe counter or toe puff may be made of a non-woven polyester fabric saturated with a heat moldable plastic. The material is die cut from flat sheets to fit the shoe pattern. When the shoe upper is processed during stitching, but before the strobel bottom is sewn on, the toe counter is heat formed. The front of the shoe is placed in a heater for a few minutes. Next, the upper is clamped into a cooling fixture with a shaped metal form to set the shape.





Here a worker uses a mechanical lasting machine to toe last a women's fashion shoe. The toe counter is softened in the heat tunnel and the final shape is fixed during the lasting operation.



Upper support

To make a shoe with solid ankle support, it must have a heel counter. The heel counter can be hidden inside the shoe or attached to the outside of the upper, but will always be firmly attached to the outsole. The heel counter may be made using the same shaping process as the toe puff, but with a much thicker material.

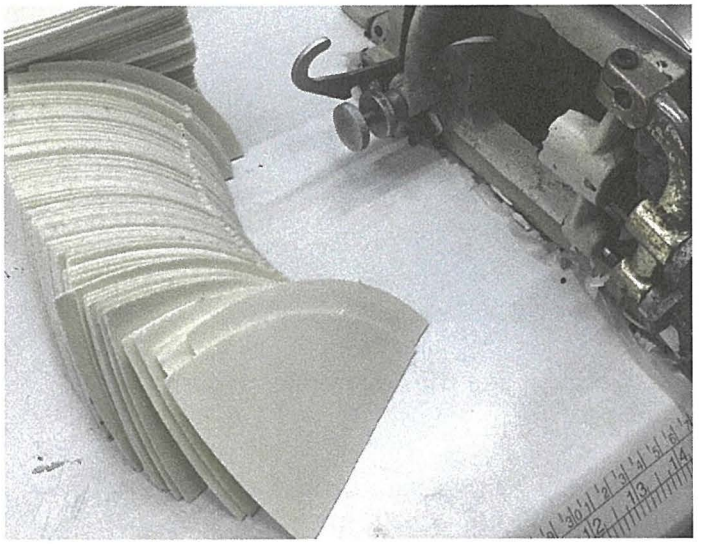
Heel counters can be made from thick leather, rubber, non-woven chemical sheet, injection molded plastic, or heat moldable plastic sheet. Each material has its special properties.

Leather

Leather heel counters are found in hand-crafted leather shoes and western boots. A firm piece of leather is carefully skived to make the edges thin. The leather is saturated with a mild adhesive or water, then formed to the last. The leather counter can be very stiff depending on the thickness and temper of the leather.

Chemical sheet

Known in the shoe trades as chemi-sheet, this material is made of non-woven polyester fibers saturated with plastic resin. The material comes in sheets ranging from .5mm to 2.0mm in thickness. The counter is die-cut into shape, then dipped into or brushed with a solvent. The solvent softens the resin binder material allowing the flat sheet to conform to the upper. Chemi-sheet is only found in relatively inexpensive shoes as the material tends to crack and is not as easy to shape as other thermo-plastic materials.



Skechers EX1030-p. 10
Skechers v. FAST IP



Heat-molded plastic sheet

Molded counters are very popular and can be found in almost all modern mass-produced shoes.

The counter material comes in sheets ranging from .2mm to 2.5mm in thickness. The material is die-cut and bonded into the upper with hot melt glue or fusible coating. Before the shoe is closed and lasted, the unfinished upper is placed into a heater that softens the counter material.

Once the counter is soft and pliable, it is moved to a pressing machine fitted with the heel section of the shoe's last. The press squeezes the upper onto the chilled last heel, setting the shape of the counter. The materials made by Texon™ and TecnoGi™ will contain heat moldable Surlyn plastic.

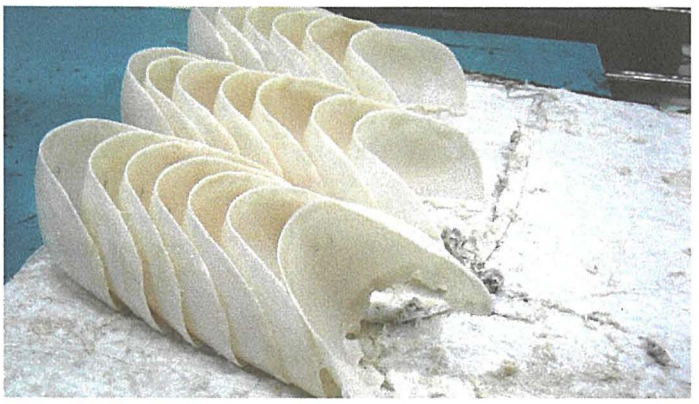


Here you can see the frost collecting on the cooling form.

Injection molded heel counters

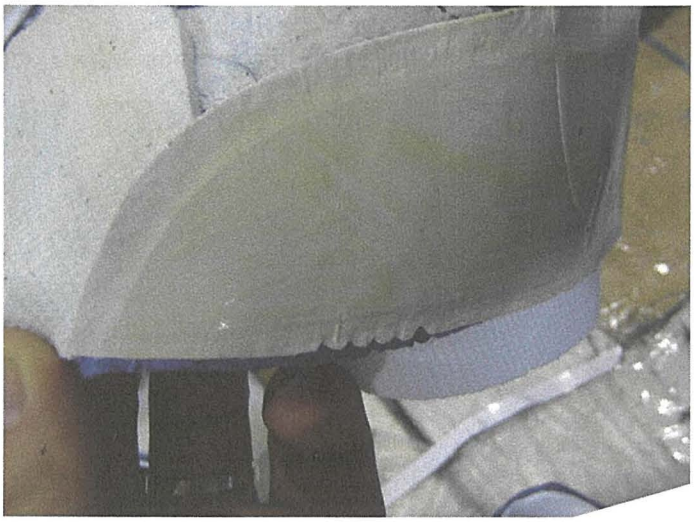
For some high production volume shoes, the factory may use a 3D injected plastic counter. The fit can be exact, and the processing inside the stitching room can be faster. The injection molded counters can be made from Surlyn, PVC, or nylon plastics.

The 3D shape can be very precise and the material thickness adjusted to make both firm and flexible counters. You can also see injection molded heel stabilizers attached to the outside of a shoe. Close fitting soccer shoes with thinner uppers are likely to have ridged injection molded heel counters.



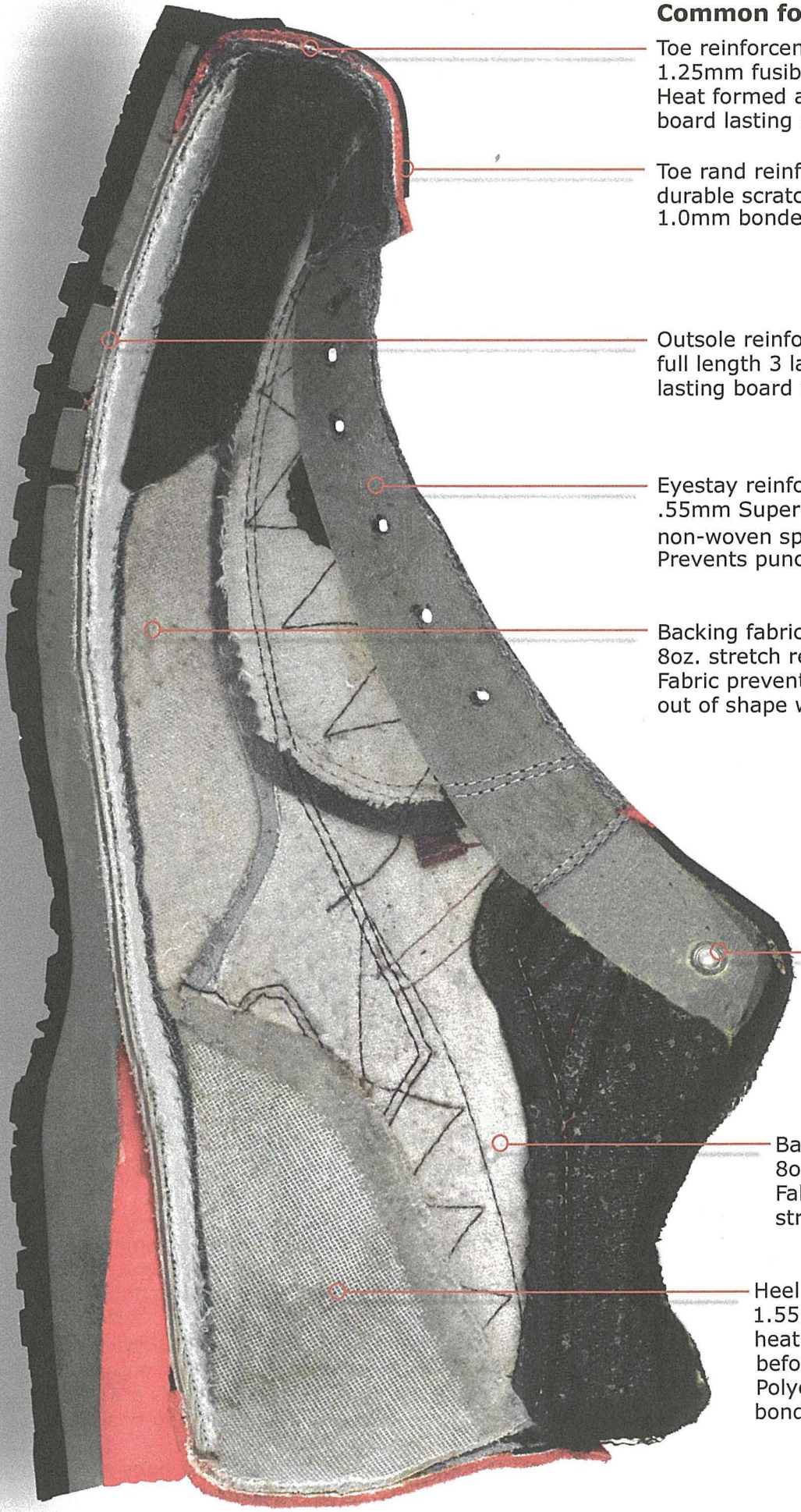
Vulcanized rubber

Rubber heel counters are found in vulcanized shoes. The same rubber compound used to make the sole foxing parts is re-purposed to make heel counters. Cut scraps for the sole making processes are remixed and rolled into sheets for die-cutting. The rubber edges are skived before they are cemented into the upper. The flat rubber counter takes the shape of the last when the entire shoe is vulcanized.



Skechers EX1030-p. 11
Skechers v. FAST IP

Common footwear reinforcements



Toe reinforcement: extra firm
1.25mm fusible Surlyn plastic.
Heat formed after stitching, just before board lasting operations.

Toe rand reinforcement:
durable scratch rubber sheet. Die cut.
1.0mm bonded to the leather toe tip.

Outsole reinforcement:
full length 3 layer sole stiffener
lasting board with 1.5mm PE plastic insert

Eyestay reinforcement:
.55mm Super-Tuff
non-woven spun-bonded polyester fabric.
Prevents punched eyelets from tearing.

Backing fabric:
8oz. stretch resistant canvas.
Fabric prevents leather from stretching out of shape when wet.

Eyestay reinforcement:
.55mm Super-Tuff
non-woven spun-bonded polyester fabric
holds the rivet back in place.

Backing fabric:
8oz. stretch resistant canvas.
Fabric prevents leather from stretching out of shape.

Heel counter: extra firm
1.55mm fusible Surlyn plastic,
heat formed after stitching, just before board lasting operations.
Polyester mesh backing to improve bonding. Edges skived.

CHAPTER 6

SHOELACES

Shoelaces have two very simple functions. First, to hold the shoe onto your foot and second, to provide some style! The earliest leather shoes dated from 3500 B.C.E. have leather laces. 5000 years later, the function is the same, but the style has come a long way.

For the shoelace to do its job correctly, it should resist stretching and stay tied. Once these basic functions have been satisfied, more specific attributes can be studied for different shoe types. The "correct" shoelace depends on the function of your shoe. The same lace that works for a fine leather office shoe will not be suitable for hunting boots or ballerina slippers.

The aglet

The end cap on the shoelace is called the "aglet". The aglet is made of plastic tape wrapped tightly around the lace, or a metal cap crimped over the end. The plastic aglet tape may have a printed logo, while the metal aglet may have a logo stamped onto its surface. Yes, aglet is a funny sounding word! The origin is French, aiguillette, meaning 'small needle.'

The lace

The lace is simply a string. There are many material options depending upon the functional requirements of the shoe. The waxed cotton lace of an office dress shoe does not need to be high strength, 2mm diameter is okay. The lace on a hockey skate is cut resistant, wide to displace lacing pressure, and has high tensile strength so the players can pull the laces tight. The hockey skate lace may be 12mm wide. Laces with a textured surface and compressible core will stay tied better than smooth firm laces.

Style

The shoelace is also an element of style! Skateboarders often replace the standard black lace with a brightly colored lace. The boat shoe has leather laces due to tradition rather than functionality.

Shoelace constructions:

Braided, waxed, jacquard weave, reflective, oval, round, flat.

Shoelace materials:

Polyester, nylon, cotton, leather, Kevlar, elastic rubber with knit cover, stainless steel wire.

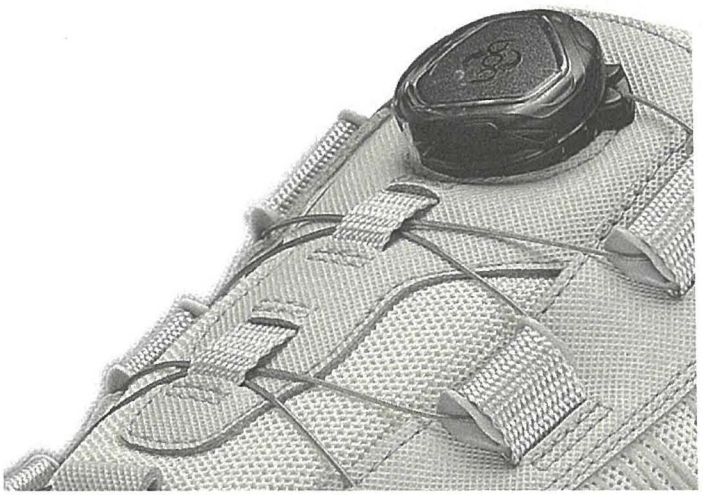




Other lacing systems

Aside from conventional woven or knit laces, there are many other ways to secure a shoe to your foot.

Steel cable lacing systems can be found on cycling shoes, snow boots, golf and running shoes. The cable reel and fittings will add US$2.00 to $10.00 to the factory price of your shoe and provide a unique function.

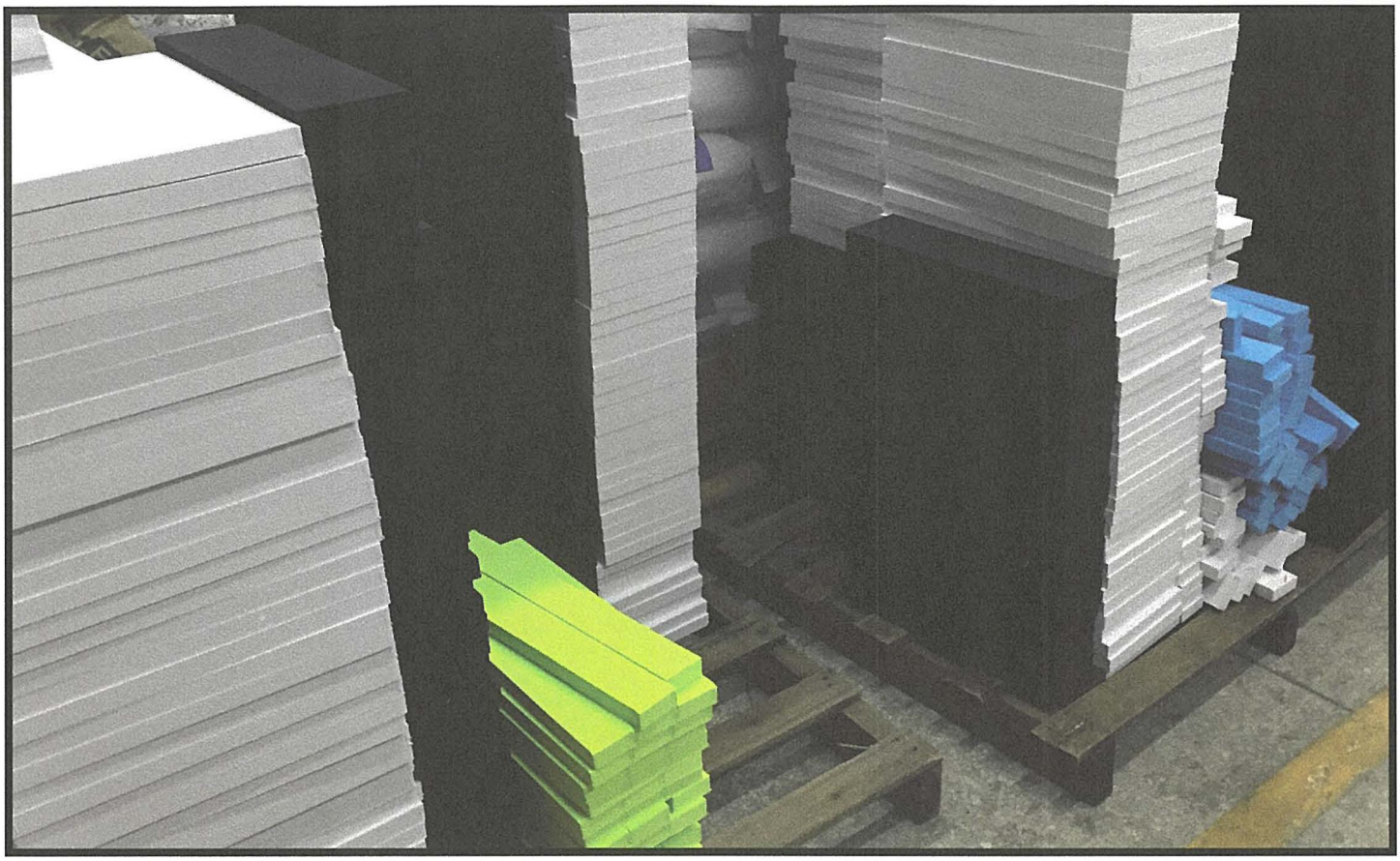


Of course, some shoes may not have any laces at all. The adjusting function may be velcro straps or elastic goring. The shoe brand Royal Elastics™ is based entirely on shoes without laces.



How long should a shoelace be?

There are charts available on-line that suggest the lace length based on how many lace holes are in the shoe. A basic measurement also works: starting with the shoe upper still on the last, the lace should run through every position then add 6 inches (15cm).



CHAPTER 10

FOAM FOR SHOES

There are many types of foam used to make shoes. In this chapter, we are going to review the types of foam found inside the uppers and outsoles of shoes. The modern sports shoe will have several types of foam inside. Foam can provide comfort, structure, cushioning and can help define the styling of your shoe's design.

Footwear designers and developers have many different types of foam available to choose from depending on the fashion or performance requirements of the shoes they are making.

What is foam?

Foam can be any plastic or rubber compound with air bubbles or cells inside. The stretchability and hardness of the materials making up the foam, combined with the size of the cells, determines the character of foam. Compounds used to make structure foams can be soft or hard, heavy or light. The compound is critical to the feeling of the foam. Does the foam have a bouncy feeling or an energy absorbing slow feeling?

Foam can be classified into two types, "open cell" or "closed cell" foam. These two types of foam have very different attributes and have many different functions inside a shoe.

Skechers EX1030-p. 15
Skechers v. FAST IP

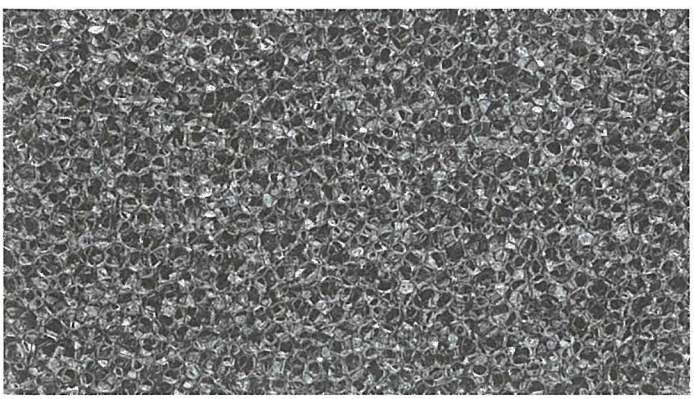
Open cell foam

Open cell foam is exactly what it sounds like, the plastic compounds that make up the foam cells are open. Air and water are free to enter and exit the foam just like a dish-washing sponge. Open cell foam is water absorbing with hydrophilic properties and can be used to wick sweat away from the foot. It is usually soft and used in the shoe's upper components such and tongues and linings.

Open cell foam is most commonly made of polyurethane plastic. This open cell PU foam is available in different densities and in almost every thickness and color. It is used in the tongues and collars of shoes. Thin sheets of PU foam are used to back fabric in most shoe uppers. The PU foam allows the stitches to sink in and gives fabric, like mesh, some extra support while reducing wrinkle. Reticulated foam is the most open style of foam.



This type is often used for ventilation features. Reticulated foam is almost skeletal looking. Air and water flow freely through the foam. Memory foam is a variation of open cell polyurethane foam with additional chemicals that increase its viscosity and density.



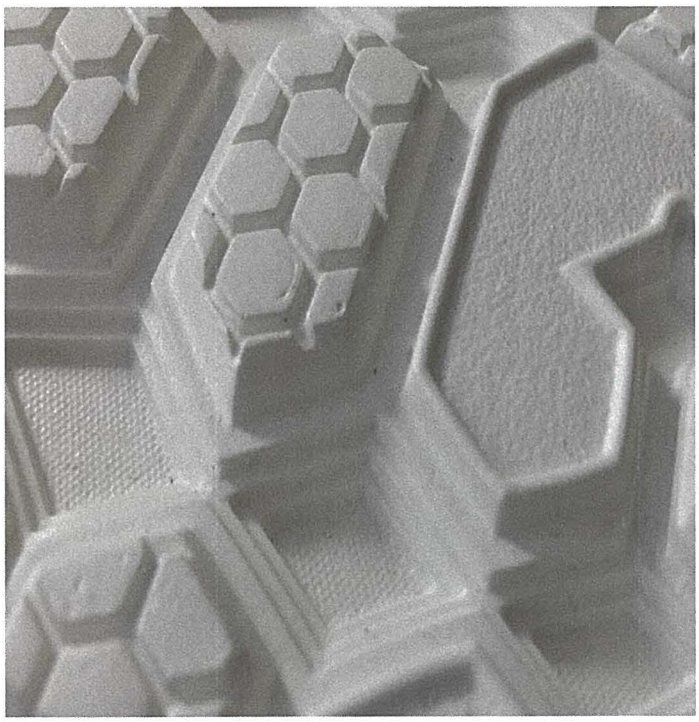
Closed cell foam

In closed cell foam, the individual air cells are closed or sealed and do not allow the foam's internal gas to escape. Closed cell foams are waterproof and can have hydrophobic properties.

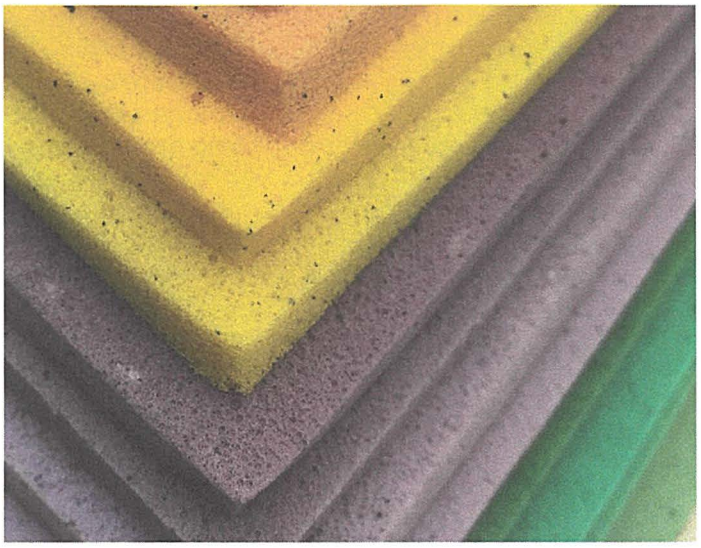
Thin EVA layers can be used to create waterproof or water resistant shoes. Closed cell foams are made from many different plastic compounds and are available in all densities, from pillow soft to nearly wooden hard.

Closed cell foam is ordinarily denser than open cell foam, but it is also available is some very soft and rubber-like formulations. Midsoles of shoes are all made from this type of foam. The most common closed cell foams include EVA (ethyl vinyl acetate), PE (Polyethylene), SBR (Styrene butadiene rubber), PU (Polyurethane), Latex, and Neoprene. Each has their individual properties.

For example, EVA foam is used for backing mesh materials. A 2mm sheet of EVA will make the fabric waterproof. Neoprene and SBR are used when elastic properties are required. Latex is common for collar linings. PE foam is very light and molds well but is not very durable.



Skechers EX1030-p. 16
Skechers v. FAST IP



When working with foam, it is important to know what foam is appropriate for the shoe upper and what is appropriate for cushioning the shoe outsole. When specifying foam, it is critical to understand the performance attributes.

Density
Durometer
Compression set
Impact resistance
Energy return
Conformability
Moldability
Breathability
Hydrophilic vs hydrophobic

Foam density

Density is a measurement of how heavy the foam is when compared to its volume. Open cell PU foam has a low density and can be very soft. Neoprene foam has a higher density making it heavy, but it is also soft. PE foams can be very hard, but still relatively lightweight. The rigidity of the plastic material making up the foam, combined with the size of the cells, determines the density. Density is measured in pounds per square foot. A 2 lb. density foam is very light, while an 8 lb. density foam is a heavy structural foam.

Durometer

Durometer is a measurement of how firm or soft the foam is. Durometer measures the foam's resistance to surface penetration. Lower numbers indicate softer, more flexible materials, while higher numbers indicate harder materials. For EVA foam, a durometer reading of density of 25° Asker C" is okay for the upper padding but way too soft for the midsole. The stretchability and hardness of the plastic material making up the foam, combined with the size of the cells, determines the durometer of the foam.

Compression set

Compression set resistance is the foam's ability to bounce back after it is compressed. Foams with poor compression set will be crushed flat after just a few days. Foams that resist compression set can be used to make cushioning for a running shoe that will last for hundreds of miles. Softer foams can be used in the shoe upper but not underfoot.

Impact resistance

Impact resistance is the ability of foam to absorb and disperse energy. Good impact resistance protects the foot from bruising or even fractures when jumping or falling.

Energy return

Energy return is a critical attribute for the midsole cushioning of any shoe. A foam material with high-energy return rebounds quickly and can have a spring-like, lively feeling. Foam with low or slow energy return will make a very comfortable upper, but if placed under the foot can result in a shoe that feels slow, dead, tiring, and is sapping energy from every step.

Conformability

It is critical to the comfort of an upper that the foam conforms to the foot. Sheet foam that does not conform or molded foam that does not fit the contours of the foot will not be comfortable.

Moldability

Depending on the compound and process used to make the foam, it may be molded into ergonomic shapes of a shoe or not. Where and how a foam is used depends on its moldability.

Breathability

Breathability of a specific foam can be an asset or a liability depending on the functional requirements of a shoe. Breathable can mean cool in hot weather, but it can also make a shoe cold and sodden in wet weather.

Hydrophilic vs Hydrophobic

Hydrophilic open cell foams can absorb water or sweat to create a cooling function, while hydrophobic closed cell foams resist water absorption. Hydrophobic foam is great for a river shoe, allowing it to dry fast and stay lightweight even when wet.

Skechers EX1030-p. 17
Skechers v. FAST IP

Selecting the right foam

With the nine different performance factors in mind, the designer can select the correct foam for each functional application. Here is a listing of foams commonly found in shoes.

EVA (ethyl vinyl acetate)

EVA is the most common midsole material for sports shoes. It is lightweight, durable, easy to form, and resists compression set. EVA can be hot pressed, cold pressed, die cut, injected, and machined to make midsoles. Available in a wide range of densities and formulations, EVA can be pillow soft and flexible, or rock hard and stiff. EVA can be made in almost any color. It can be found in all different styles of shoes. EVA is also used to make footbeds, padded strobel socks, and is often laminated as a fabric backing. EVA is not breathable, but it can be perforated

Closed cell PU (Polyurethane)

Closed cell PU is also a common foam for shoes. PU foam is "blown" into molds. The liquid compound expands and forms air cells to fill molds. It is used to make durable midsoles for hiking boots. It can also be made into entire sole units which include the tread and midsole all in one. PU foam is used to directly attach midsoles to uppers. PU is expanded from a liquid allowing it to fill complex shapes. Many women's high heel outsoles are made from high-density PU. Very soft PU is used for footbeds due to its resistance to compression set. The classic Nike Foamposite™ is made of PU foam.

Open Cell PU (Polyurethane)

Open cell PU foam is found in the uppers of almost every sports shoe. Because the foam is open cell, it is breathable, be careful so it does not absorb the glue. Thin layers of PU are laminated to fabric to provide backing substance. PU foam is also used to make tongue foam and collar foam. Often called KFF foam. Due to its softness, open cell PU foam cannot be used underfoot.

PE (Polyethylene)

Expanded into sheets, PE foam is easily die cut and laminated. Parts are then pressed into shape for internal pads and tongues. Due to its weakness in compression set, PE foam is not used underfoot. PE foam is closed cell and waterproof.

SBR foam (Styrene butadiene rubber)

SBR is very soft foam often laminated between two layers of fabric. It is closed cell and is used to make parts waterproof. SBR foam is often used as a lightweight replacement for neoprene rubber, but it is not as stretchable.

PVC (PolyVinyl chloride) sponge foam

PVC sponge foam is a closed cell that is available in many formulations. Rigid PVC sponge foam is used to reinforce surfboards, while soft PVC sponge foam is used to make life jackets and other sporting goods. PVC sponge is a relatively heavy foam but responds well to compression molding. Not used for underfoot cushioning, PVC foam is used as a moldable backing material for synthetic leathers and is used in logo treatments.

Latex rubber foam

Latex foam is easily formed into complex shapes in open top molds. Latex is used for upper padding but not as a midsole material. High-density latex foam sheets can be used to make die cut footbeds. The latex footbed provides excellent comfort for in-store effect but is not a durable foam for running for other athletic shoes. Molded anatomic features inside snowboard and ski boots are often made from latex foam. Latex is also used for bonding cork granules into midsole components.

Memory foam

Memory foam consists mainly of polyurethane as well as additional chemicals increasing its viscosity and density. It is often referred to as "viscoelastic" polyurethane foam or low-resilience polyurethane foam. Higher density memory foam softens in reaction to body heat, allowing it to mold in a few minutes. Memory foam may lose its viscoelastic properties in cold weather and may shatter if exposed to subzero temperatures.

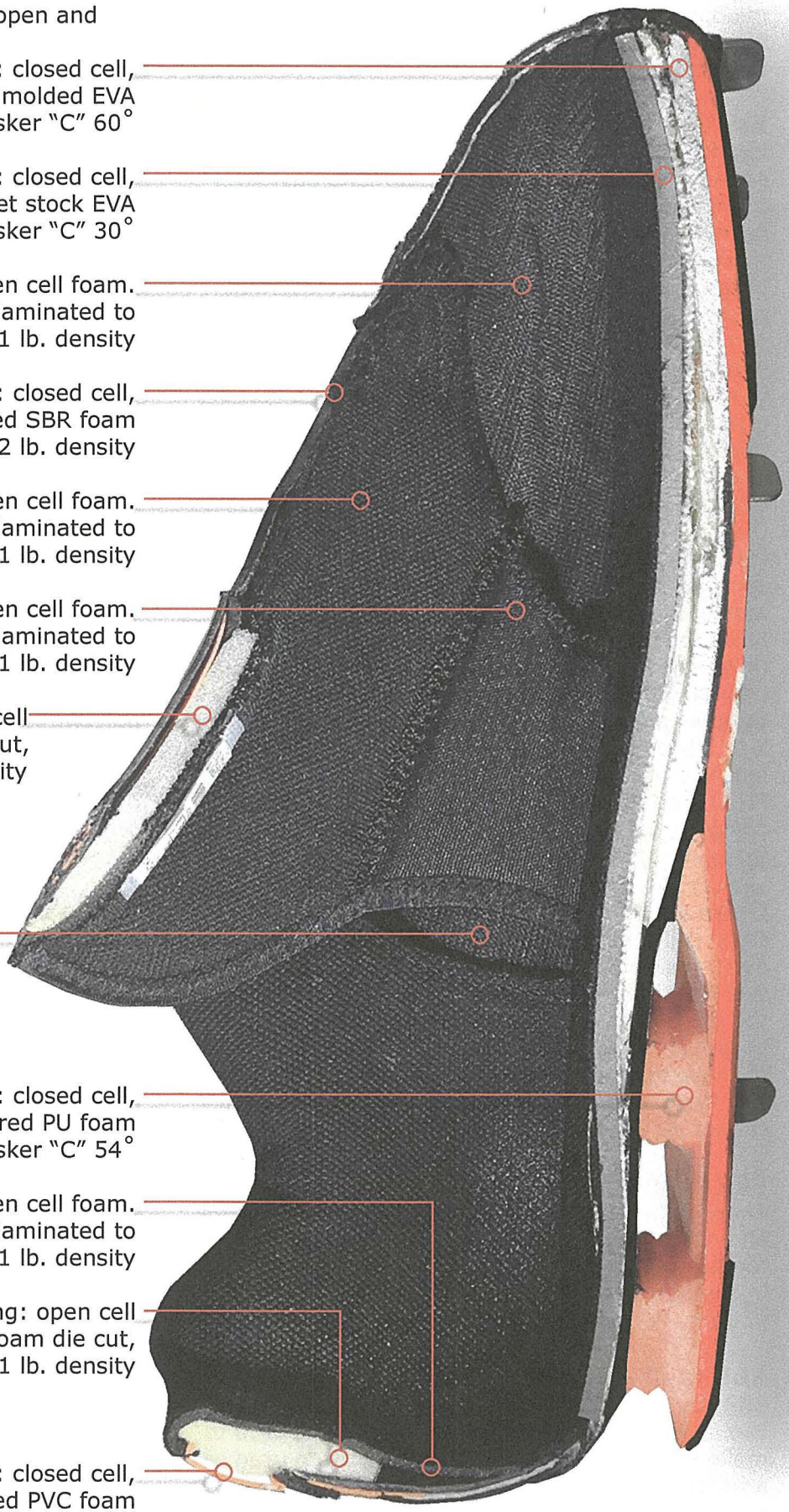
Neoprene rubber

Neoprene or polychloroprene is closed cell expanded synthetic rubber produced by polymerization of chloroprene. Neoprene is made in large blocks or buns and then skived down into the required thickness. Thickness can range from 1mm to 12mm. Neoprene maintains flexibility over a wide temperature range and is used as an insulating layer. It is the most common material used in wetsuit booties and is often used to make elastic collars in shoes. Neoprene is waterproof, but not breathable, and is relatively heavy and expensive.

Skechers EX1030-p. 18
Skechers v. FAST IP

Foam inside a modern athletic shoe

This baseball cleat has 12 different foam components using 8 different types of open and closed cell foam.



Midsole foam: closed cell, hot pressed compression molded EVA Durometer Asker "C" 60°

Footbed foam: closed cell, die cut 5mm sheet stock EVA Durometer Asker "C" 30°

Vamp lining: open cell foam. Padding: 4mm PU KFF foam flame laminated to fabric, 1 lb. density

Tongue face foam: closed cell, 2mm perforated SBR foam 2 lb. density

Tongue lining: open cell foam. Padding: 4mm PU KFF foam flame laminated to fabric, 1 lb. density

Tongue gusset: open cell foam. Padding: 4mm PU KFF foam flame laminated to fabric, 1 lb. density

Tongue foam padding: open cell 6mm PU KFF foam die cut, 1 lb. density

Upper foam padding: open cell 4mm PU KFF foam laminated, 1 lb. density

Midsole shock structure: closed cell, poured PU foam Durometer Asker "C" 54°

Collar lining: open cell foam. Padding: 4mm PU KFF foam flame laminated to fabric, 1 lb. density

Tongue foam padding: open cell 6mm PU KFF foam die cut, 1 lb. density

Logo backing foam: closed cell, 2mm embossed PVC foam Durometer Asker "C" 25°