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Manufacturing Processes for Athletic Shoe Outsoles and Their Significance in the Examination of Footwear Impression Evidence

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ABSTRACT: The most common methods of manufacturing athletic shoe outsoles are given and how each method can influence the examination of footwear impression evidence. Several processes for manufacturing athletic shoe outsoles are described. Significant factors of each process that are relevant to the examination of footwear impressions are explained. Some manufacturing processes result in distinguishing random characteristics which can assist in the identification of a shoe sole, even when new. These characteristics, together with the traditionally observed wear patterns and random cuts on the shoe outsoles, enable the examiner a stronger basis for expert opinion.

KEYWORDS: criminalistics, footwear, impressions, outsoles, class characteristics, manufacturing characteristics, individual characteristics, cut outsoles, molded outsoles, compression molding, injection molding, calendered, stippled, last

Traditionally, footwear impression comparisons have concerned themselves with four areas of examination: (1) the physical size and shape of the outsole, (2) the outsole design, (3) wear characteristics, and (4) random individual identifying characteristics such as cuts and tears on the outsole which have occurred randomly during the use of the footwear. It has been the third and fourth areas, the wear characteristics and the random individual characteristics, that have been used to distinguish and possibly "identify" a specific item of footwear as having made a particular footwear impression as opposed to other footwear having similar class characteristics. The results of footwear examinations in which wear characteristics and random individual characteristics were lacking or absent, and which associated the known shoe and questioned impression only by means of physical size and design, were thought of as being essentially nonconclusive and of little value. This is because almost all laymen, and unfortunately, many footwear examiners, regard all "newly manufactured shoes" of the same size and design as being indistinguishable from each other, and therefore, regard any manufacturing characteristics which those new shoes have as "class characteristics." This is not correct in the majority of instances.

A recent look at the manufacturing techniques currently in use in the production of shoes

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has shown that manufacturing techniques and characteristics should also be considered during a footwear examination as a fifth area of examination.

Although some of the manufacturing characteristics found in the outsoles of some footwear are true "class characteristics" (that is, shared by all other footwear from that manufacturer in that size and design), the outsoles of most footwear reflect at least one, and often numerous random characteristics, which occur during the various steps of the manufacturing processes. In some processes, the "randomness" of a particular manufacturing step may be limited; that is, it can and will reoccur but only in a percentage of the time. In other processes, the "randomness" can be so great that the shoes can be identified as unique before ever being worn.

It is the intent of this paper to identify the most common manufacturing processes of the outsoles of athletic footwear and to point out some of those characteristics that are significant in trying to individualize an item of footwear.

Methods of Manufacturing Athletic Shoe Outsoles

There are currently four basic methods of manufacturing athletic shoe outsoles. The first two of these methods utilize cutting processes in which the outsoles are cut from outsole material. They are called (1) die cutting and (2) outsole cutting. The second two methods use two different molding processes, both in which the outsoles are formed in a mold. They are called (3) compression molding and (4) injection molding. In addition, there are variations and combinations of each of these methods (Fig. 1).

Before an explanation of the die cut and outsole cut processes, the sources of the outsole material used for these cutting processes need to be discussed. The outsole material can be milled on location in a calendering process or the outsole material can be purchased from a rubber company in premolded sheets, already containing the design of the outsole.

Calendered Outsole Material

Many of the larger footwear manufacturers mill some of their own outsole material just before cutting the outsoles. In this operation, a synthetic rubber compound is mixed, then heated, and fed through a calendering machine having a series of smooth rollers which roll the material into a uniform thickness. The final roller contains the engraved outsole design which is transferred into the rubber (Fig. 2). (The engraving roller is interchangeable, so many different designs can be made on one machine simply by changing that roller.) A continuous sheet of calendered outsole material exits the machine on a conveyer belt. This material is unvulcanized and is very soft and pliable. Workable slabs, in lengths of around 1 m (4 ft), are cut from the continuous sheet of this newly milled outsole material. The slabs are stacked and then carried to the die cutting or outsole cutting processes, as will be later discussed. Many variables occur during this operation, which contribute toward making the outsole material, and therefore the outsoles, more individual.

Some of these variables are:

1. Variations and impurities in the mixed rubber before calendering.

2. Flaws or damage to the calendering roller (containing the outsole design) that have occurred during the life of the roller and are reproduced in the calendered outsole. Because of the random manner that outsoles are cut, this flaw, although repeated with each turn of the calendered roller, would show up in different positions on the outsoles.

3. Variations caused by adjustments made to the calendering machine.

4. Shrinkage or stretching and damage because of the handling of the slabs of unvulcanized outsole material before cutting.

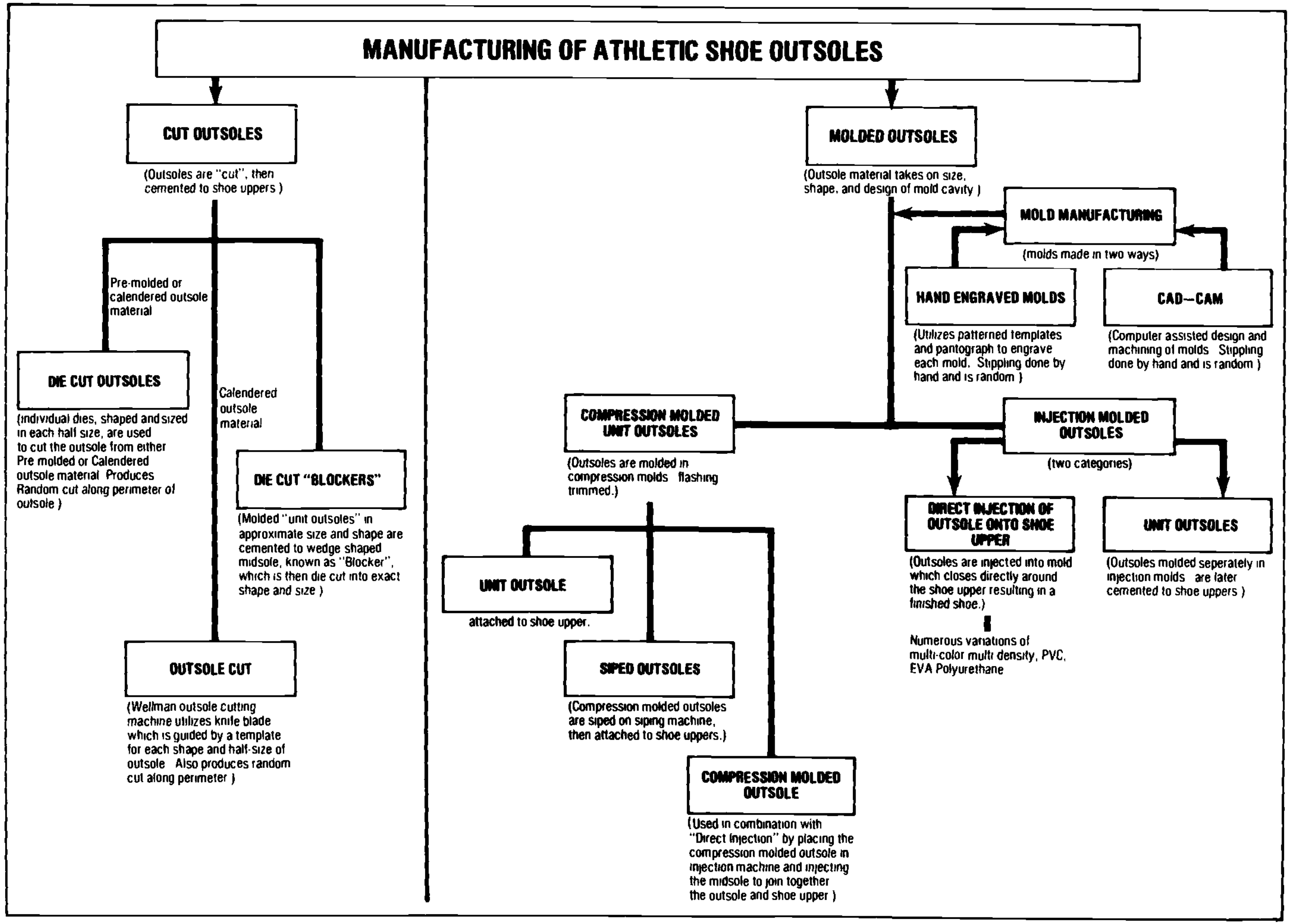

FIG. 1—*Manufacturing of athletic shoe outsoles.*

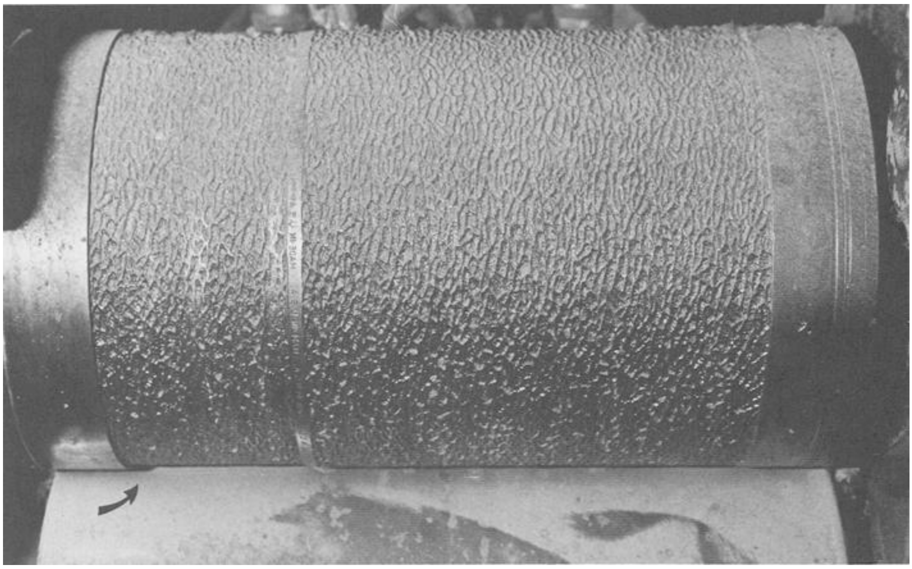

FIG. 2—*The design roller on the calendering machine transfers its design into the soft, unvulcanized rubber as it passes through the machine. The design roller can be changed, allowing many different outsole designs to be milled on this machine.*

5. Possibility of random characteristics as a result of the handling by persons during the sole cutting operation and during the assembly of the outsole to the shoe upper. Both are done before vulcanization, when the material is still soft.
6. Variations caused by the vulcanization process itself.

Premolded Sheets Of Outsole Material

Footwear manufacturers, who do not make and mill their own calendered outsole material, can purchase from numerous companies sheets of premolded outsole material from which individual outsoles can then be cut. These "premolded" sheets of outsole material come in a large variety of designs and different materials such as synthetic rubbers, ethyl vinyl acetate (EVA), and expanded EVA. They are compression molded and therefore take on the same characteristics of each mold, sheet after sheet, and will acquire very few, if any, additional defects before being worn.

Die Cut Outsoles

Die cutting employs the use of steel dies, each of which has been formed in the size and shape of a shoe outsole and which contains a sharpened edge. A separate left and right die exists for each half size. The die is positioned on a sheet of calendered or premolded outsole material. Using a clicker machine, which stamps the die through the outsole material, the operator cuts out each shoe outsole in a "cookie cutter" fashion and then repositions the die in preparation for cutting the next outsole (Fig. 3). The operator is concerned with getting the most cuts from each sheet of outsole material and also in cutting the outsoles out as quickly as necessary to meet production quotas. The operator is not concerned with and makes no effort to attempt to duplicate the positioning of the die over the design of the

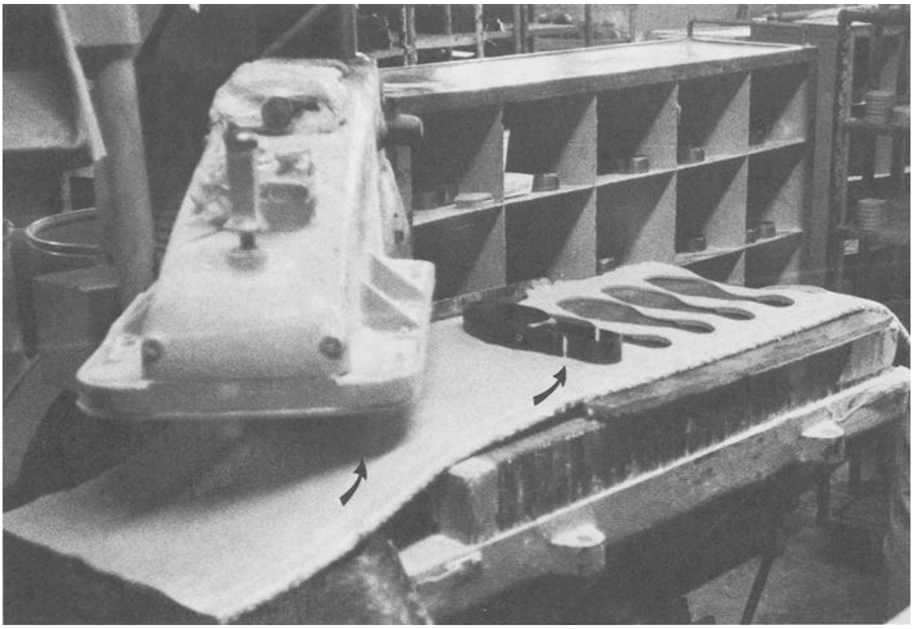

FIG. 3—*A steel die is positioned on calendered outsole material. The "Clicker" machine will be positioned over the die and will stamp the die through outsole.*

outsole. In certain instances, he may try to align the die in a certain way when a particular design must cross the bottom of a shoe in a preferred direction; however, a great deal of variation will still occur in successive cuttings.

The method and procedure used in die cutting outsoles results in a series of shoe outsoles that have been cut with the edge or perimeter of the die in a slightly different position almost every time. The specific part of the design where it meets the edge of the outsole around the entire perimeter will vary considerably from one outsole to the next. Although the "exact" position of the die cut will eventually be duplicated (simply through chance and because there is a reasonable limit in the number of different possible positions that the die could be in depending on the particular design being cut), any outsole cut in this fashion can be distinguished from the vast majority of other outsoles cut from the same outsole material with the same die. How distinguishable it is depends on the repetitive nature of the design on the outsole material, how many times the pattern repeats on any particular sheet of outsole material, and whether the design is a directional one—one in which the die must be lined up in a certain direction. This can be elaborated on further as illustrated in the example below:

Example 1: From a sheet of premolded material consisting of a textured or stippled design, a die could be turned in any direction and still cut out an acceptable piece of outsole material (Fig. 4). The operator can and will use every position of the die to get the most cuts from the sheet of outsole material. Because of arrangement of the design on premolded textured outsole material, the die would have to cut through another sheet of premolded outsole material, which came from the same mold, in the precise exact position to get a duplicate outsole.

Example 2: Some outsole material, by the very nature of its design, must be positioned on the shoe bottom in a certain direction. Examples are outsole material with a thicker heel

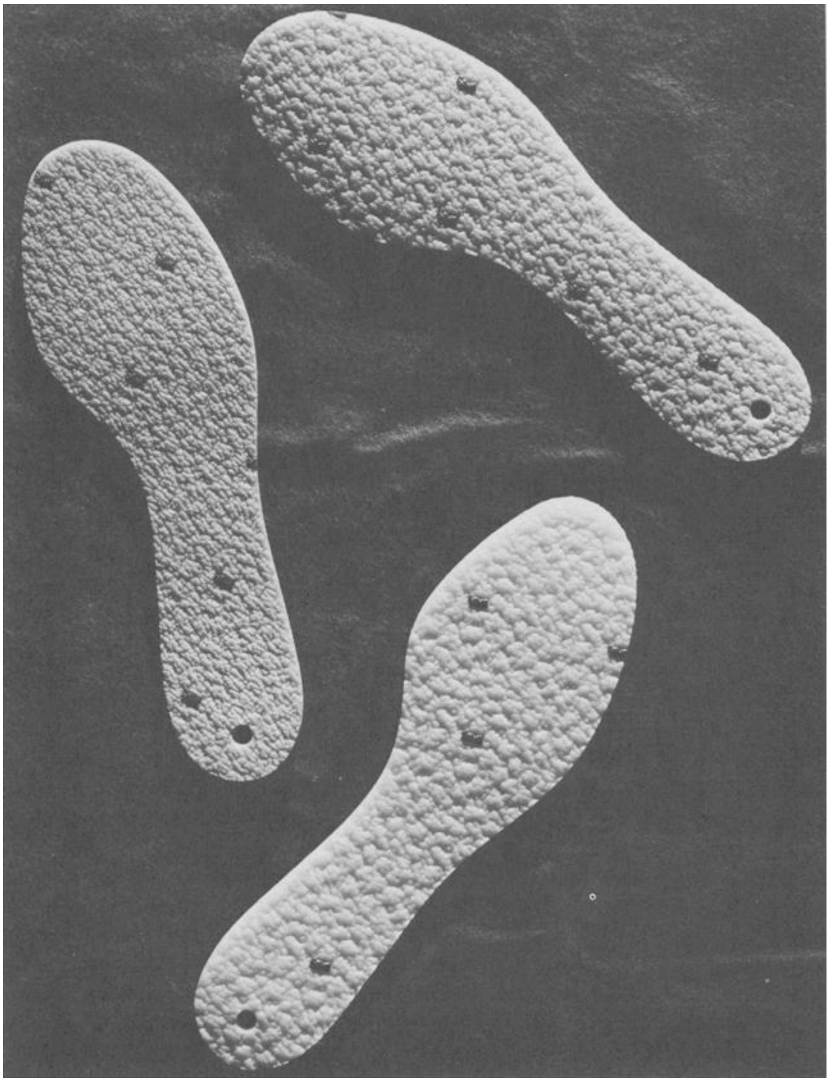

FIG. 4—*Three outsoles that have been cut with the same die from a premolded sheet having a stippled design. The die can be positioned in any position and produce an acceptable outsole.*

area, with a name or logo on the outsole material, or, in the case of designs like a herringbone design, for functional reasons, must run across the shoe in a certain direction. Although the restrictions in some way limit the number of possible positions in which the die can be placed, there are still an enormous number of distinguishable outsoles which can be cut with each die (Fig. 5).

Example 3: The above discussion and examples concern themselves with one die of the same shape and size. Any time a different shape or different size of die is used, the precise cut will have to change. What this means is that there is no way in which a cut outsole of one shape or size can be a duplication of any other cut outsole of a different shape or size (Fig. 6).

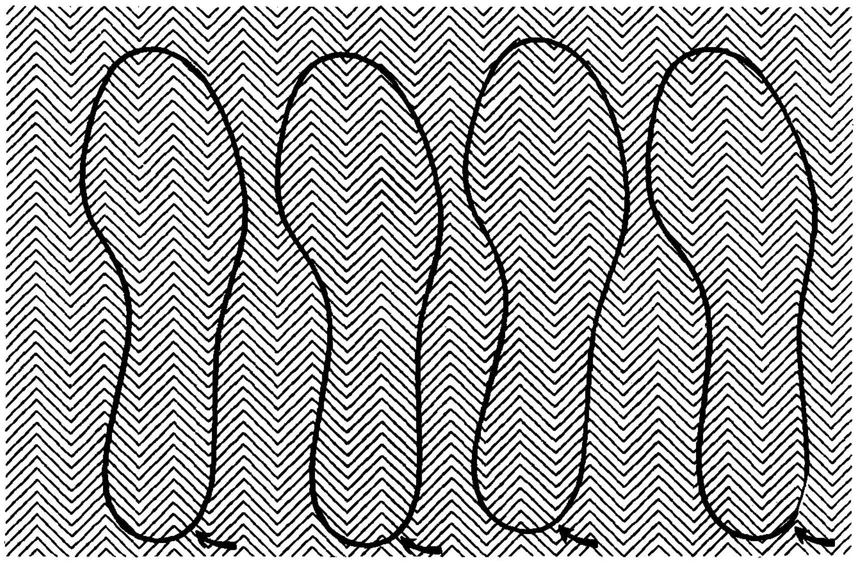

FIG. 5—*One die making four successive cuts, even though aligned in the same direction, results in easily distinguishable outsoles. Note the different configurations in the herringbone design at the arrows and around the remaining perimeter of the outsoles.*

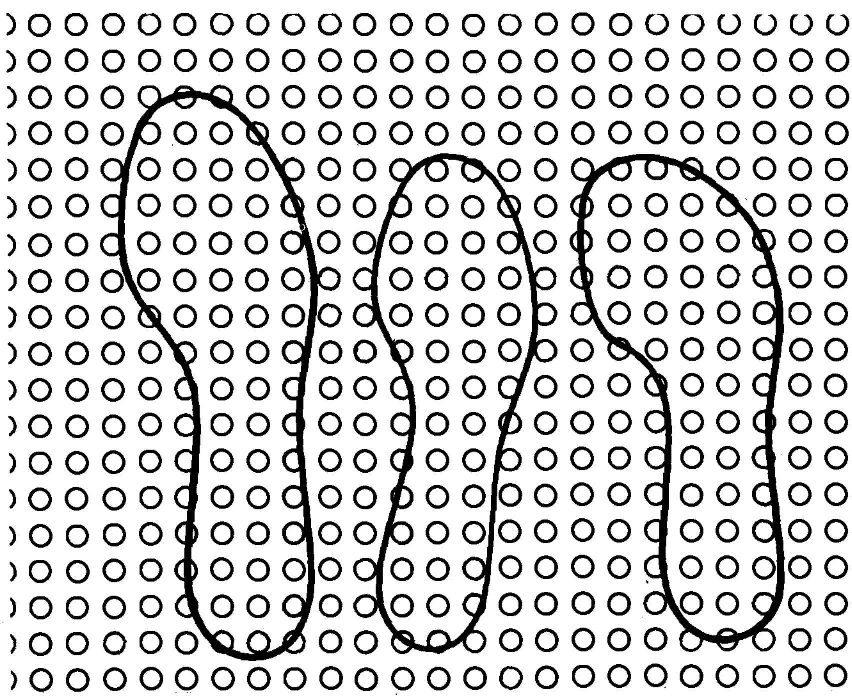

FIG. 6—*A different size or shape of the die will result in a different outsole cut.*

Die Cut Blockers

For certain types of shoes such as the "wedge soled" jogging-type shoes, a premolded outsole of approximate shape and size is glued to the midsole unit (Fig. 7). This unit is referred to as a "blocker." The blocker is then die cut into the final size and shape. The edge of the unit may also then be buffed and ground to create a beveled or wedge look. Since the outsoles initially could come from the same mold and only a small portion is trimmed away with the die, there is far less room for variations from one die cutting of a blocker to the next, in contrast to the regular die cut sheet goods as described in the preceding section. In most cases, depending on the design, there is still enough room for sufficient variations to distinguish the die cut blocker outsole from the majority of other blockers cut with the same die.

Outsole Cutting Machine

A second method of cutting outsoles is achieved on the Wellman outsole cutting machine (Fig. 8). This machine utilizes a knife blade, which is guided by a template, to cut each outsole from calendered outsole sheets. As is the case with dies and die cutting, the outsole cutting process uses a different template for each half size and shape. The outsole materials are fed beneath the cutting knife, which very rapidly travels around the template. An experienced operator can rapidly guide a slab of calendered outsole material through the machine and easily cut out ten outsoles in a couple of seconds. Because the knife blade is set at an angle, this type of cutting results in an outsole with a beveled edge. Depending on whether the outsole material is cut with the design facing up or down, and whether or not a foxing strip may be used to cover that edge, the beveled edge may or may not still be evident in the finished shoe.

The results of the method and procedure utilized on the outsole cutting machine are almost the same as those of the die cutting method, with the perimeter of the cut varying from

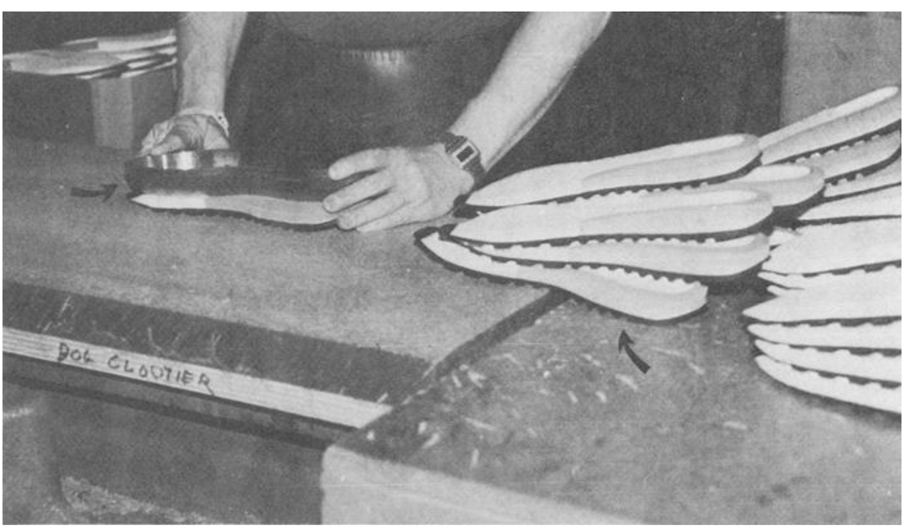

FIG. 7—*Premolded outsoles have been glued to a white midsole to form a blocker. The blocker is then die cut into the proper shape and size. Its edge may then be ground down to give it a beveled or wedge shape.*

FIG. 8—*A "slab" of calendered outsole material is manually fed beneath the cutting head of the Wellman Outsole Cutting machine.*

one outsole to the next (Fig. 9). Since only the soft "calendered" outsole material (and not premolded outsole material) is used with this process, other points should be made. First, in the outsole cutting machine operation, the machine operator usually lines up the slab of outsole material to some degree with a reference point, so that most of the variation within each size will be laterally (along the direction the slab is fed through the machine). Second, note that since the slabs of calendered outsole material are randomly cut from a continuous feed of outsole material from the calendering operation, the beginning point that the outsole cutting machine begins on each slab is random. Third, as previously stated, the soft, pliable nature of calendered outsole material, which has not be vulcanized, is subject to stretching or shrinking and is also very prone to picking up slight random defects during the handling and assembly of the shoe, up to and in the vulcanizing process.

Molded Outsoles

Molded outsoles are manufactured with two different molding processes—compression molding and injection molding. Both result in an outsole that has taken on the shape, size, and detailed design of the specific mold cavity in which it was formed. One or more molds exist for each half size and for both the left and right outsoles. Before discussing the separate

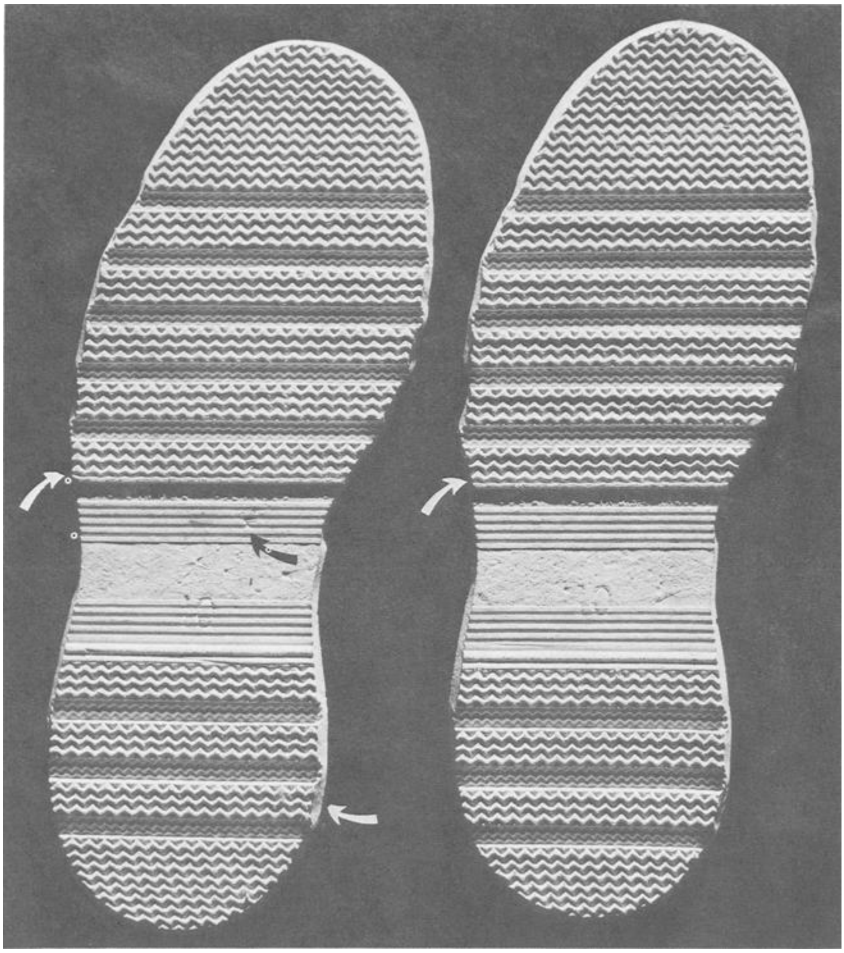

FIG. 9—*Two Wellman cut outsoles. Note the variations in the cut, the beveled edge, the random damage to the outsole, and the variation in the position of the Size 10.*

molding processes, some things need to be stated about the manufacturing of the molds themselves.

Mold Manufacturing

Both compression molds and injection molds are made in one of two ways. The first and traditional way involves hand engraving and uses a hand operated pantograph. The pantograph transfers the design from precut templates to the engraving arm of the pantograph which routs the design into a block of metal (Fig. 10). Many variables are encountered throughout this type of operation which cause successive molds of the same size and design to have distinguishable differences in the "gross design" of the mold (Fig. 11). (In this paper the term gross design, for shoe outsoles or molds, is meant to refer to the portions of the design that are routed into the mold and their exact positioning with regard to the perimeter

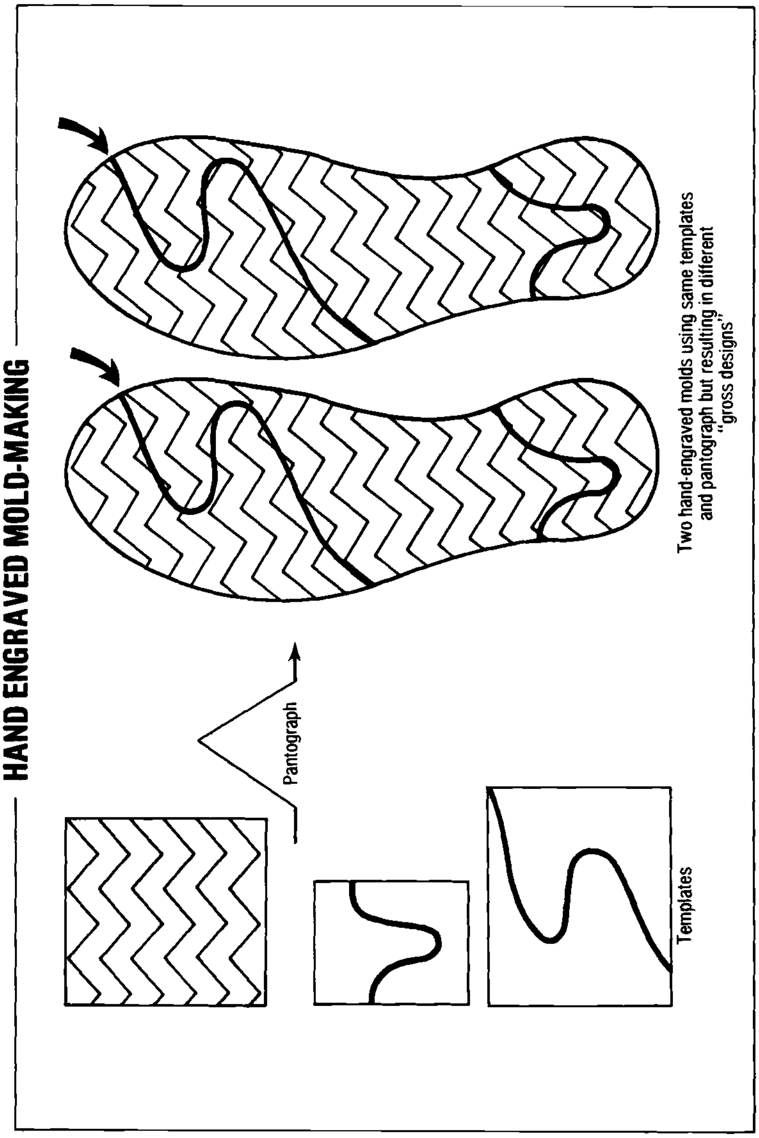

FIG. 10—*Hand engraved mold making.*

FIG. 11—*Respective portions of outsoles from two different molds, same size and design, made by the same mold manufacturer at the same time. Note the variations in the gross design. Also note the hand stippling on the border* (white arrow).

of the design. It does not include the stippled or textured portions.) The same template can be used to rout out molds of different sizes of the same design, or different templates can be used to rout out identically sized molds of the same design, or multiple templates of different designs can be used to create a mold which may have two or more individual designs. These various possibilities, combined with the fact that each of these templates are readjusted or positioned each time a mold is made, contribute to an unlikeliness that two molds which are made this way will be exactly the same (even though they are being made in the same size and design).

The second way of making molds is by using a Computer Assisted Design-Computer Assisted Manufacture (CAD-CAM) process wherein a design is generated and stored in a computer, with the computer then directing a machine to rout automatically the design into a block of metal. In this system, two successive molds may have identical gross designs, but variations can still occur.

Stippled Or Textured Areas Of The Mold Surface

In the above two explanations of how a mold can be made, the term gross design did not include any textured or stippled portions of the design. Portions of some outsole designs require that the molds be stippled or textured. Regardless of whether a mold is hand engraved or is made with a CAD-CAM operation, the stippled areas are added to the molds by hand with the use of a small steel punch. This is accomplished by a skilled craftsman who artfully hand stamps the design into the selected areas of the mold. The surface of the punch is small and is therefore repositioned with each strike of the hammer. Variations in the force with which the punch is struck as well as the exact relationship of the positioning of successive strikes of the punch to each other, result in a random and unique pattern of hand stippling on each mold. The significance of this is that it enables specific items of footwear, in which the hand stippling is still present, to leave footwear impressions which can, through comparisons, be found to not only correspond in size and gross design, but to have come from the same mold. This can be determined without ever seeing the mold, simply through the knowledge that this stippling is a random design and is unique to only one mold.

Very fine texturing on mold surfaces is done in a "sandblasting" manner. This type of textured surface, as opposed to a stippled surface, is also random, but normally does not leave as detailed an impression and also wears off of the outsole more rapidly.

Compression Molded Outsoles

Compression molds are usually two-piece molds, some of which are hinged together. A premixed and weighed "biscuit" of rubber is placed between the two halves of the mold

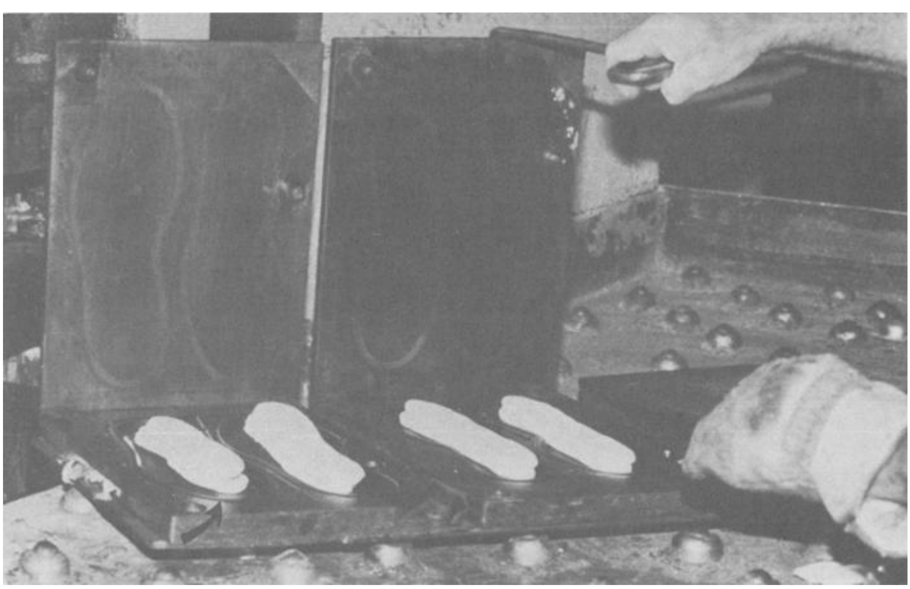

FIG. 12—*A preweighed "biscuit" of rubber in a compression mold before molding.*

(Fig. 12). The mold is closed by hand and placed under extreme heat and pressure for approximately 20 min. This melts the rubber and allows it to conform to the size and shape of the mold. Excess rubber escapes out of the side of the mold and is referred to as "flash" (Fig. 13). The flash is later trimmed off. The resulting molded outsole is an accurate replica of the mold and each will contain the specific class characteristics of that mold. (This method is similar to making waffles, where the batter is placed on the bottom waffle iron, the top half of the waffle iron is closed, and the excess batter leaks out of the sides.) Compression molded outsoles can also be made with two colors using a three- or four-piece compression mold.

In almost all instances, especially in the most popular size range, a manufacturer will usually have more than one mold for each size in a particular design. The precise gross design in these molds, even though they may have been made by the same mold manufacturer, will vary from mold to mold. As an example, in one particular design of shoe currently being sold, the manufacturer has over 30 different mold sets (left and right together) for Size 9. They have been made by several mold makers over a span of 40 years. All of those molds were observed to have distinctive variations in the gross design and can easily be distinguished from each other.

A good example of the compression molding process and one way in which the outsole is attached to the rest of the shoe can be seen in the Converse Chuck Taylor All Star (CCTAS) basketball shoe. The CCTAS outsoles are compression molded. With the exception of the very large sizes, there are many molds for each size of outsole. The gross design of each mold is distinguishable from each of the others in each respective size. As the outsoles are taken from the molds, the left outsoles and the right outsoles become separated. No apparent effort is made to keep the left and right outsoles that originated from a particular mold together. Therefore, as an example, if there are 15 different mold pairs in 1 size, each with distinguishable gross designs, and the left and right outsoles were separated during the as-

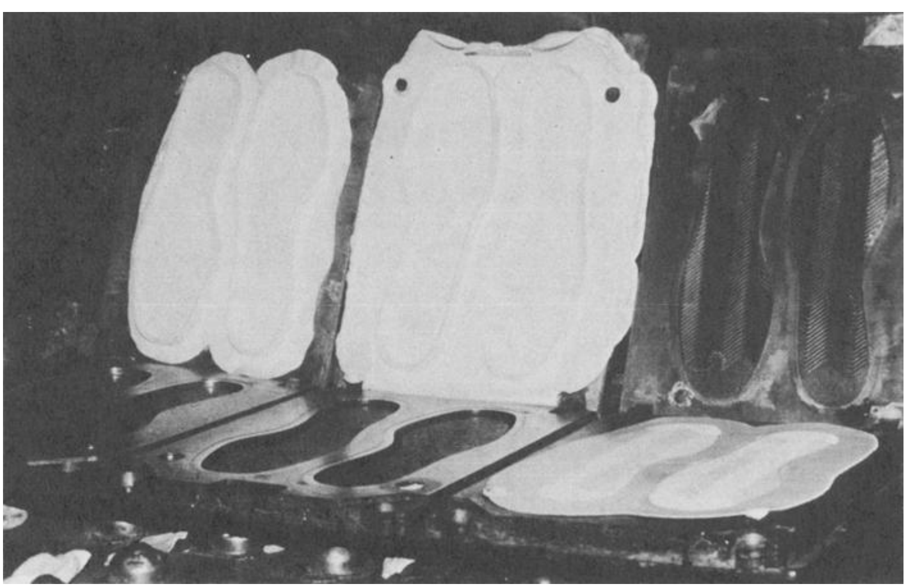

FIG. 13—*After compression molding, the rubber "biscuit" has melted and conformed to the size and shape of the mold. The excess rubber is referred to as flash.*

sembly process, the chances of the same left and right outsoles being paired together for sale would be 1 chance in 225 (1/15 × 1/15 = 1/225).

In addition to the molded outsole, other manufacturing characteristics are significant regarding the CCTAS. In the assembly of the outsole to the upper portion of the shoe, the assembled upper is placed on a device known as a last, which approximates the size and shape of a foot. A foxing strip with a red stripe is handwrapped around the bottom of the

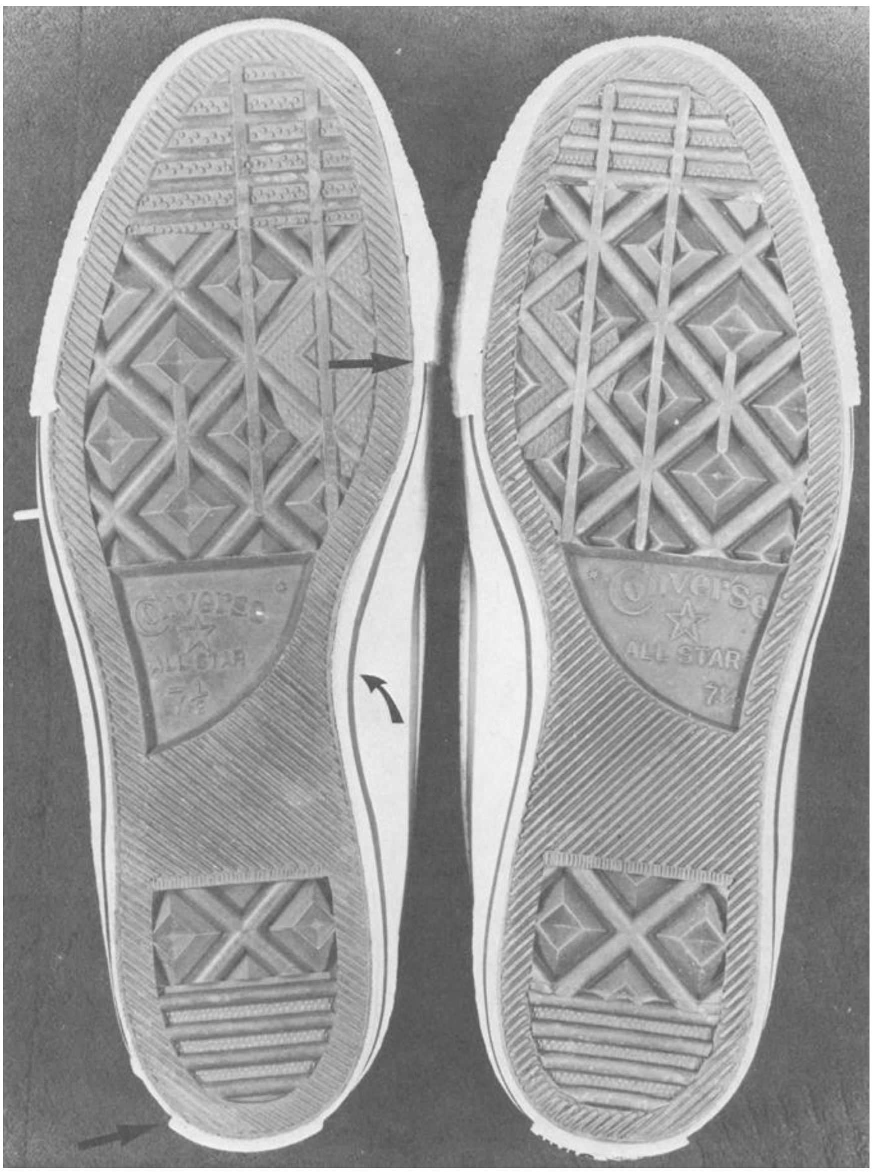

FIG. 14—*A purchased pair of CCTAS shoes. Note the handwrapped foxing strips, the toe cap, and the heel cap or label. Also note the variations between the molded outsoles.*

lasted upper. The outsole is then attached. After this step, a second foxing strip, having a blue stripe, is handwrapped around the shoe, and extends to the bottom of the outsole, covering the entire edge of the outsole (Fig. 14). Both of these strips of rubber are of unvulcanized material and are wrapped around the shoe slightly different each time. The exact position in which the foxing strip begins and ends must only be within the area that the subsequent toe cap will cover. At the point that the second foxing strip overlaps itself, a small triangular space will occur (Fig. 15). The exact point of this overlap as well as the exact size and shape of the triangle will vary a great deal from shoe to shoe. Next, the toe cap is added. The toe cap material, also of unvulcanized rubber, is also placed around the toe area of the shoe with no particular attention being placed on its exact positioning. Thus, the beginning and ending positions of the toe cap also vary a great deal from shoe to shoe. Like the toe cap, a heel cap or label is added to the heel area of the shoe. Its positioning is also done by hand and will also vary. All of these characteristics can be reflected in impressions made by the shoe. The assembled shoe now goes into an autoclave where it is vulcanized and the various strips of rubber and outsole are bonded together.

The randomness of the assembly of the Converse Chuck Taylor All Star (CCTAS) shoes is extremely significant in an examination. There is no precise way in which one could accurately predict the mathematical likelihood of a specific left or right CCTAS being exactly like another left or right CCTAS including the molded outsole, the foxing strip overlap, and the toe and heel cap characteristics. Nor is there any precise way to predict mathematically an even more unlikely chance of a pair of CCTAS shoes being alike in all respects to another pair; however, this knowledge will strengthen a footwear examination significantly, and is another excellent illustration of why manufacturing information is important.

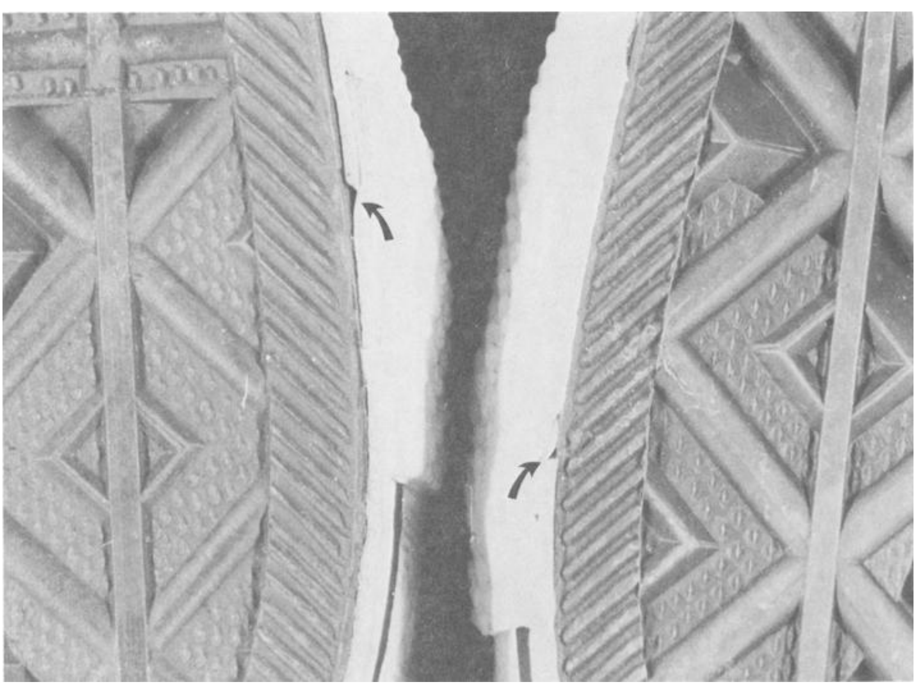

FIG. 15—*Triangular spaces left at the point where the second foxing strip overlaps itself. The exact point of the overlap as well as the size and shape of the triangular space varies considerably.*

Injection Molding

There are two categories of injection molding. One involves the injection of single, individual outsoles referred to as "*unit outsoles*." These are made with the injection molding process; however, the outsoles still must be cemented, stitched, or otherwise attached to the upper portion of the shoe. The second category involves "*direct injection*" *molded outsoles*, which are outsoles that are injected directly around the shoe upper, resulting in a completed shoe.

Injection molding is very versatile. Many injection mold machines have molds with two or three separate compartments and injection stations enabling the injection of one-, two-, or three-colored outsoles as well as one, two, or three different types of midsole and outsole materials. For example, a three-color injection mold process could enable an outsole with two colors and a midsole with a third color. Additionally, the particular material used in the outsole can be selected for function (long wear, long life qualities, or excellent traction on a specific surface), while the injected midsole material may be a low density material used to reduce the weight of the shoe or to increase the flexibility of the shoe.

Injection molds and molding machines are more complicated but much cleaner than the hot and dirty compression molding operation. The mixing and injection, and then the solidification of these materials in the mold cavity involves chemical reactions, but little heat or pressure. Because the time required to inject an outsole takes much less than needed to make a compression molded outsole, there are often only one or two molds found in each size of each design. The process itself involves in simple terms the injection of the outsole substance into a closed mold. Trapped air and any excess materials are bled through the seams and

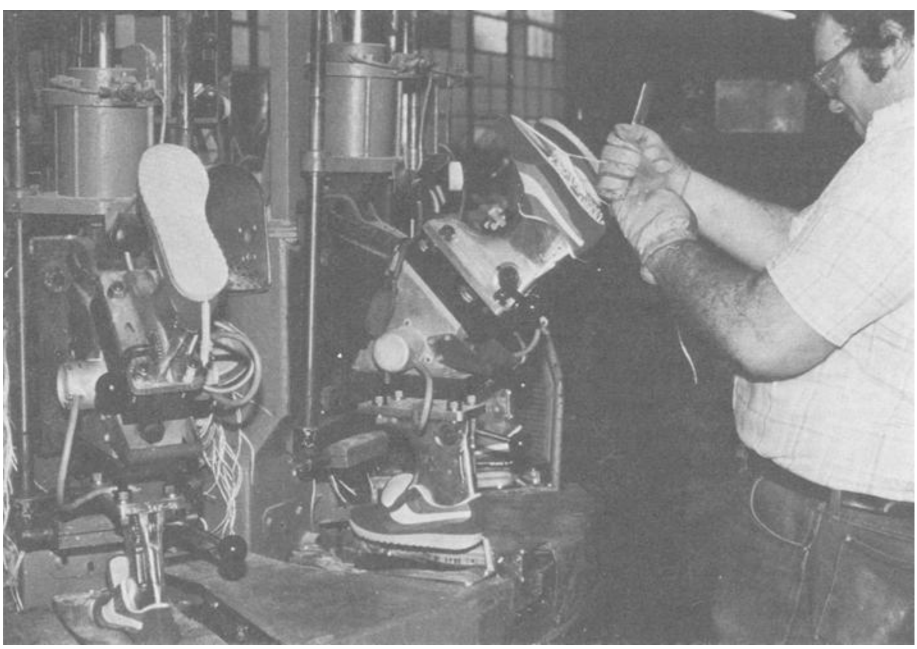

FIG. 16—*Direct injection molding machine: the shoe upper is tied over the metal last which rotates down into the mold cavity. The mold closes around the shoe upper and outsole is injected resulting in a completed shoe.*

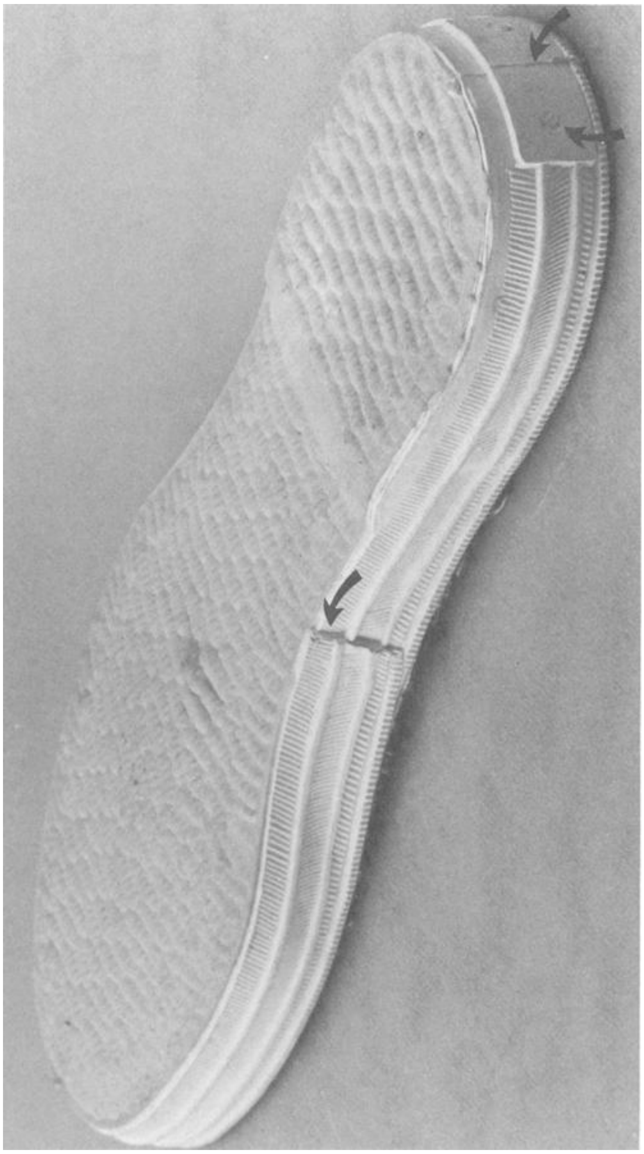

FIG. 17—*Direct injection molded outsole. Note seam where mold halves joined, injection ports, simulated die cut style outsole, and simulated handwrapped foxing strip.*

special ports in the mold. Some flash is formed in areas where there are seams between the mold parts, and in areas where different stages of injection meet. Thermoplastic rubber (TPR), polyvinyl chloride (PVC), ethyl vinyl chloride (EVC), and polyurethane are the most commonly used outsole substances.

Injection Molded Unit Outsoles

Injection molded "unit outsoles" are difficult to distinguish visually from compression molded outsoles based on observation of the outsole after the shoe has been assembled. (Of course, if the manufacturer can be identified and contacted, the exact process can be determined.) However, from an examination standpoint, the determination that it is a molded outsole (whether compression or unit injection) as opposed to a cut outsole or direct injection outsole, can be made. Additionally, characteristics associated with the way in which that unit outsole is attached to the shoe upper, such as the handwrapping method like that used on the CCTAS shoes, can be given appropriate considerations during the examination.

Direct Injection Outsoles

Footwear made with the direct injection of the outsole onto the upper are easier to recognize. The mechanics of this process require a mold that can open and close around the upper

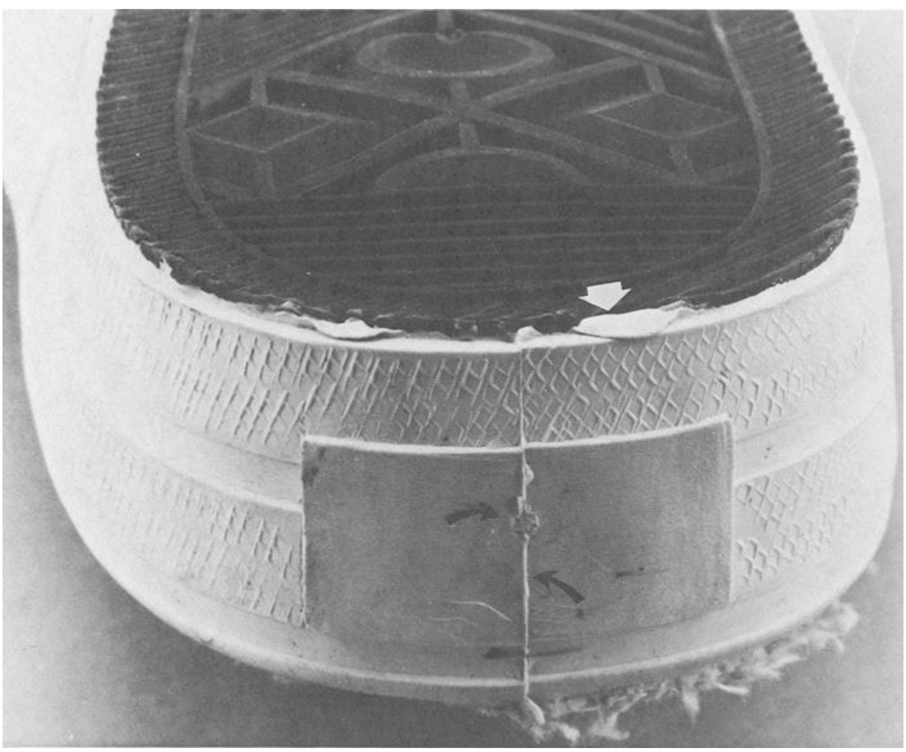

FIG. 18—*Direct injection molded outsole. Note location of injection port, and the seam where the mold halves joined. Also note the simulation of CCTAS design and simulation of handwrapped foxing strip. See the flash between the two stages of molding* (white arrow).

portion of the shoe (Fig. 16). The points where the mold halves come together, usually in the toe and heel areas, leave a visible seam. In addition, with some injection machines, there is a mark left on the toe or heel area, where the injection device injected the midsole through a small port in the mold. Presence of the seams or injection port marks or both in the toe or heel midsole is characteristic of the direct injection process only and is therefore proof to the examiner of the manufacturing method used (Figs. 17 and 18). With the number of manufacturing variations available in the injection molding of outsoles, it stands to reason that the significance each variation may have on footwear examinations may also vary. The recognition that an item of footwear is injection molded is, in itself helpful, since many injection molded outsoles have been designed for aesthetic reasons to simulate shoes made in the die cut, outsole cut, and handwrapped ways. Examples of this are illustrated in Figs. 17 and 18

FIG. 19—*Polyurethane direct injected outsole. Note how the air bubbles favor the valleys of the design.*

which show two outsoles. One is an injection molded simulation of a die cut process, the second is a simulation of a handwrapped basketball shoe similar to the previously mentioned Converse Chuck Taylor All Star shoe. Failure to recognize these as injection molded outsoles could result in erroneous conclusions.

Polyurethane Direct Injection Molded Outsoles

Although the majority of injection molded outsoles manufactured are made using PVC and EVA, the use of polyurethane for the outsole is becoming more common because of its

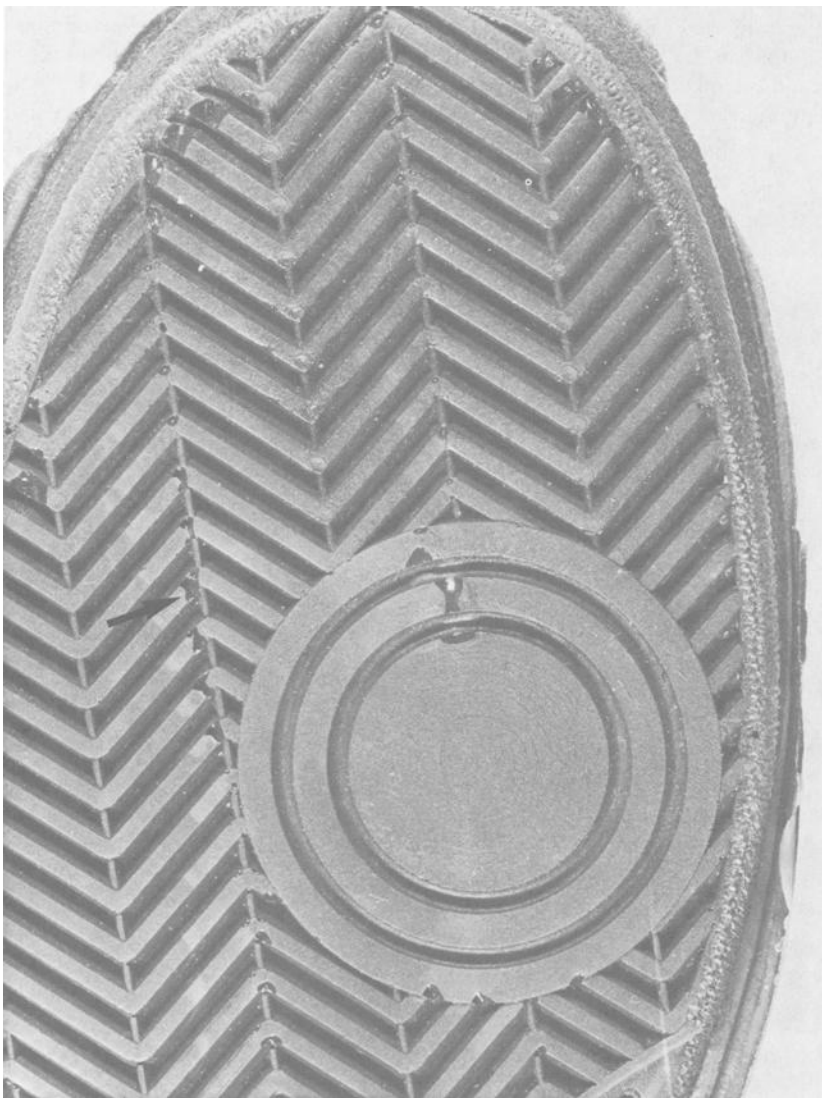

FIG. 20—*Polyurethane direct injected outsole. On this outsole, the air bubbles favor the peaks of the design.*

superior wear qualities. Polyurethane solings are formed by a process called "reaction molding" in which two materials are metered into a mixing chamber and then injected into the mold cavity while they are reacting to form a polyurethane. Because this reaction is a very quick one, the mixed polyurethane must be rapidly "blown" into the mold cavity. As this is done, turbulence is created as the polyurethane rapidly passes over the high and low spots of the design in the mold. Air is trapped in the turbulent, but rapidly solidifying mixture, resulting in the permanent fixture of air bubbles in the outsole. These are readily visible and have a glossy surface. They occur in a variety of sizes and can occur anywhere across the surface of the outsole. They also occur within the outsole, so as the outsole is worn down, new air bubbles will appear (Figs. 19 through 21).

The random occurrence of these bubbles results in outsoles that are unique and therefore identifiable at the time they are made. However, depending on the direction that the polyurethane is injected from, the air bubbles tend to favor certain portions of certain designs. For example, in the herringbone and circular designs, the bubbles favor the peaks of the circles and herringbone pattern in some makes of shoes, while in other makes (which means different injection machines) the bubbles would favor the valleys of a herringbone pattern.

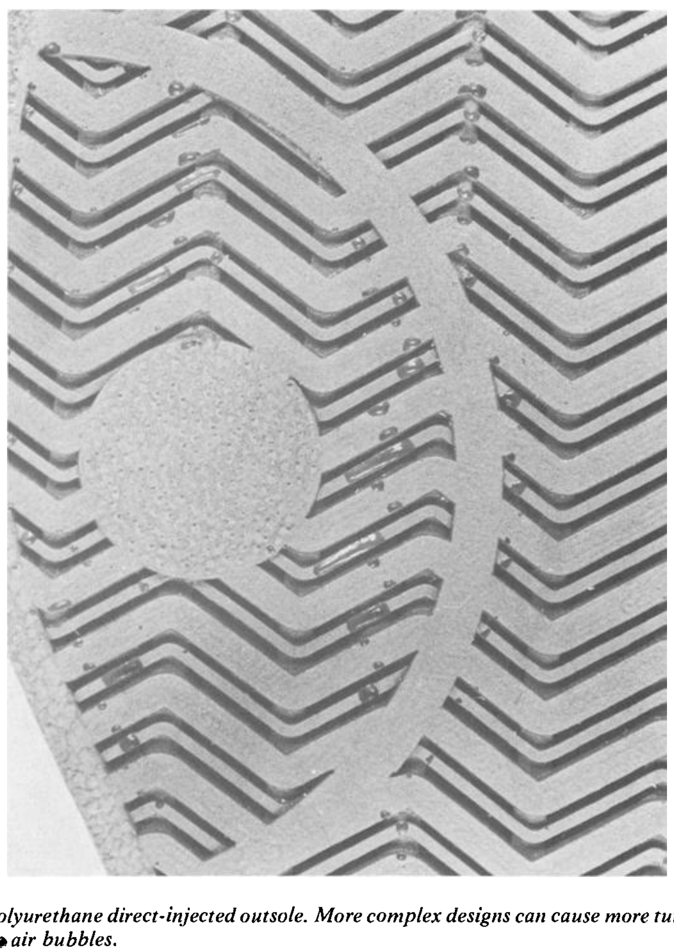

FIG. 21—*Polyurethane direct-injected outsole. More complex designs can cause more turbulence and therefore more air bubbles.*

This is due to the fact that outsole material can be injected from the toe, heel, or bottom of the mold depending on the particular brand of machine (see Figs. 19 and 20).

Nevertheless, inspection of many successive outsoles from the same mold show there is still a wide diversity in the sizes, shapes, number, and location of air bubbles to easily make each outsole unique. With regard to partial footwear impressions associated with a limited area of the outsole surface, such as represented by the rectangle in Fig. 19, a close enough duplication of the air bubble pattern is possible; therefore, caution should be used when examining partial impressions.

Combinations or Variations of the Basic Four Manufacturing Processes

Occasionally, a manufacturing process is varied slightly to meet specific needs. Two examples of this are set forth below.

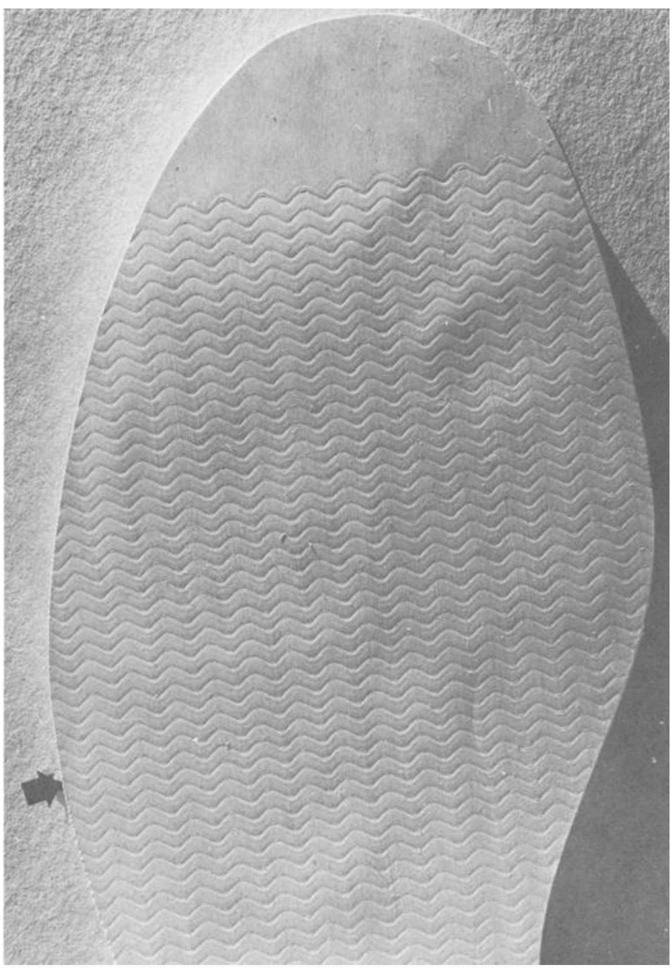

FIG. 22—*Close-up of a portion of a siped outsole. Each row of sipes is individually cut.*

Compression Molded Rubber Outsoles With Injection Molded EVA Midsoles

Some direct injection mold machines are not very compatible with certain rubber materials, yet rubber has excellent traction on tile and wood surfaces as found on gym floors. To build a shoe that has a compression molded outsole of rubber, but also has a microcellular midsole of expanded EVA, to result in a lighter shoe, a compression molded outsole of rubber is made and trimmed and placed into the mold cavity of a direct injection machine. The midsole of expanded EVA is then injected, joining the rubber outsole with the EVA midsole and the upper of the shoe.

Siped Outsoles

Blank outsoles that are absent of any design are first compression molded. The flash is trimmed from the outsoles which are then placed on a siping machine. This machines holds a thin wavy blade which, one row at a time, hacks out a sipe across the outsole (Fig. 22). Because of the variations involved in routinely changing the blade and therefore the position of the blade, variations in the relative placement of the blank outsoles on the machine, and variations in the depth of the sipe cut, the chances of two siped outsoles turning out exactly alike is lessened greatly. Sipes cut in this manner are very closed, and they open only when the outsole is flexed. They should not be confused with larger sipes which are molded into the outsole.

Summary

Four basic methods of manufacturing athletic shoe outsoles have been discussed along with some general information concerning the sources of outsole material and the manufacturing of outsole molds. Some of the significant points of these methods and materials have been discussed to provide examples of why outsole manufacturing methods and materials need to be given consideration during footwear impression examination. Although the specifics of how athletic shoes are made and assembled vary slightly among manufacturers, the basic methods will be the same and should be recognized and understood by an examiner of footwear impression evidence. Characteristics which can be recognized on footwear being examined as the type that occur infrequently or randomly during the manufacturing process will enable the examiner a stronger basis for expert opinion.

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