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IDENTIFICATION OF CREPE-SOLE SHOES

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This paper is a report on a study that was made during 1950 to determine the probability of design recurrence in crepe soles used in sport shoe manufacturing. The undertaking came as result of: (1) the discovery of a crepe sole shoe impression at a robbery scene, (2) the similarity of characteristics when compared with impressions made with a suspect's shoe after a subsequent arrest, (3) and the desire to learn whether this corrugated crepe pattern was repeated with each crepe sole manufactured.

The crepe soled canvas sport shoes worn by the suspect were size 8, and the soles indicated some wear and scuffing. The evidence right shoe impression was on a corrugated cardboard carton and did not include the entire heel.

A search through the journals and available books for data relative to making identifications in this field disclosed a brief article in the 1949 Oct.-Dec. issue of *The Police Journal,* an English publication. The author H. C. Speller discusses two English crepe sole manufacturing procedures and the solution to their problem. However, unlike the English product, our problem was to determine the extent of variations incurred during the manufacturing stage.

For finer accuracy the reproductions or comparison standards from the shoes in question were made while worn by a person of the same weight as the suspect. A comparison of individual and class characteristics in the two right shoe impressions disclosed a sufficient number of similarities to warrant an opinion that either this shoe or an exactly similar sole on another shoe made the impression in question. Since the evidence impression did not include all of the heel, the comparisons were made of the soles only. The comparisons were made with the aid of measuring instruments, photographs, translite prints, and scaled grids superimposed. Next, all size 8 crepe soled shoes on hand in four retail stores were visually examined. Variations were found in all the shoes checked. After the shoe was identified by the company's midwest sales manager, as being their product, permission was granted which enabled us to examine a large number of size 7½, 8, and 8½ crepe soled shoes in the company's Chicago warehouse. Here, measurements were made and recorded photographically when similarities were observed.

Correspondence with the manufacturer revealed additional information and was completed by the writer making a three day stay at the factory in Connecticut where more detailed data and specimens were obtained, and the manufacturing process was observed.

The rubber used in manufacturing the crepe sheeting from which the soles are cut is natural rubber known as pale crepe. The crude crepe is imported in sections measuring approximately one foot square and from six to eight inches thick. Several of these sections are placed into a large mixer and added proportionally, is sulfur, rubber accelerators, and a small amount of pigment. Although this soling formula is more or less standard, analysis of specimens taken from separately mixed compounds indicated changes which account for variations in the resiliency of the material. Since these changes do not exceed a safe working limit and do not noticeably affect the finished product, a more stringent control is not attempted.

After two or three minutes in the mixer the rubber is released into a set of rolls where the cooling and milling reduces the mass into sheets which are cut approximately two feet wide and one-half to three-quarters inches thick. Additional cooling is supplied by a long conveyor ride to an automatic cutter where the sheets are cut into five foot lengths and piled on platforms.

The crepe sheets undergo further working in a cracking machine and then again into another mill where the plasticized and mixed soling compound is reduced to a sheet, ⅜ inch thick, surplus material being cut at the sides. In the final operation the sheet is fed into a calender machine consisting of three sets of mill rolls, the first two sets progressively shaping the rubber compound into a sheet and the last two rolls, one plain, and the other engraved with the negative of the design, imparting the corrugated surface. The engraved roll is ten inches in diameter and eighteen inches wide, having ½ inch margin on either side of the engraving. The engraving roll is made by a die manufacturer using a special acid etching process to effect the unusual design. The engraving is a random design varying in depth and does not exactly repeat or duplicate from one edge of the roll to the other. Assuming that compound plasticity, temperature, and other factors are unchanged, there will be a close approximation of a repeat for each 31.4 inches of soling sheet length. Since the thickness of the sheet is not constant, some variations in height can be observed in the comparison of the cross sections removed from the calendered soling sheet. The highest points did not exceed 0.25 inch.

The engraved strip leaves the calender roll in a continuous length and is carried on an endless or revolving canvas belt. The temperature of the crepe at this stage is 160° to 180° F. The speed of the belt is adjustable and is intended to be such as to exert a slight pull and at the same time strip the sheet material from the roll. Excessive travel can exert a stretching effect on the corrugated sheet and alter the design. The continuous sheet then passes under a rotating knife, which cuts the soling material at intervals of about 46 inches. Twenty-four of the sheets measured varied from 41 to 48½ inches in length. The rotating knife blade is subject to slipping due to the cam system used so that sections measuring 10 to 14 inches in length are cut occasionally. Immediate shrinkage was observed after the shearing operation, one section measuring 47 inches shrank approximately 1.2 inches in length and the width from 17 to 16½ inches. The elapsed time was 30 minutes. Due to the lack of resiliency, stretching one of the corrugated sheets at this point produced permanent changes in the design and thickness. One 41 inch sheet was sent to the laboratory where distances between index points and characteristics were carefully compared.

The cut sheets are placed on boards, design side up and stacked on platforms, which in turn are moved to a storage area where the soling material is aged to permit drying, shrinkage, and to become relatively stable. Several of the freshly cut sheets were measured one day and re-checked the following morning. The average shrinkage was 2.6 inches lengthwise and one and one-half inches in width. After aging, the platforms containing the soling sheet are moved to the sole cutting machine, and here, no order is maintained in moving the platforms from storage so that as a result the sheet edge that came from the operator side of the calendar machine may vary. The cutting machine resembles a tailor's presser, upper arm brought down for each cut, and the die is a steel strap formed in shape of the sole having a sharpened edge on the cutting side. The length and width of the die corresponds to the sole size required. The same die is used for the right and left soles, this is accomplished by turning the sheet design over, for example design face up for the right foot and design face down for the left sole. The soles are cut from the sheet one at a time, starting from the left, the die is moved after each stamping stroke, care taken to place the die as closely to the previously cut sole as possible. The cutting is random except that the long axis of the sole is at right angles to the sheet length.

The number of soles cut from each sheet varies with the shoe size. The average number for size 8 sole was ten to a sheet. One hundred consecutively cut soles were removed, measured, and examined for similarities. They were in turn broken into eight lots, each lot containing soles with characteristics more relative to one particular group than to the others. Eliminations were made by this procedure. During this examination of individual characteristics, the writer noticed the absence of certain calender die reproductions, which were present in the suspect's shoe, in the impression in question, and completely lacking in all of the soles just checked. The manufacturer explained that a second die was purchased and placed in use since the suspect's shoe was manufactured. On request the original calender roll was installed in the mill and several sheets were processed, the size 8 die was used to cut the soles.

The cut soles are placed into binders which prevent adhering and are moved to the finishing room where operators assemble the various components. During this assembling procedure the cut crepe soles are fitted to 5/8 inch thick rubber and cork platform or midsole which is also cut in form of the crepe sole and proportional in size. Since the shoe centers vary in size, further variations are introduced as the crepe sole has to be stretched or crowded in to conform with the length and width of the midsole, this is performed by hand. Liquid latex is used as the binding agent. After the sole is attached to the midsole the thick sides are trimmed or covered with a rubber tape called foxing and here again is added another variation as the foxing is again applied by hand, the lower edge of the foxing being placed as closely to the edge of the design as possible. In the final operation the completed sole assembly is adhered to the fabric upper, and the whole shoe is vulcanized.

Changes are frequently experienced during vulcanization. Further shrinkage occurs which will alter slightly the design and spacing between major ridges. This is more pronounced along the outer edges than in the center of the sole. Perhaps more important is a variable tendency for the design to flow and lose its sharpness. This is influenced chiefly by variation in the rubber itself and by the amount of plasticizing the rubber has experienced. While this is controlled to the extent that there are not wide variations, some variation does exist.

Conclusions

During this project nearly 200 crepe soled shoes, over 100 consecutively cut soles and nearly 50 sole assemblies were examined. Measurements of varying proportions accompanied each examination, and when necessary photographs were taken. If all factors involved were constant, exact duplication and design would be possible since the design is repeated each 31.4 inches. However, no two crepe soles examined, were found to be exactly alike. The reasons for this are listed in chronological order as follows:

1. Elements causing variability in the original crude rubber.
2. Variations in plasticizing and mixing before calendering.
3. Variations caused by irregular tension in belt conveyor removing sheet.
4. Nature of the roll engraving.
5. Variable shrinkage after cutting.
6. Random handling and moving of cut sheet from storage to the cutter.
7. Random nature of the sole cutting.
8. Variations in assembling the sole with midsole.
9. Variations caused by vulcanizing.