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The Individuality of Toolmarks Produced by a Label Maker Used to Write Extortion Notes

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ABSTRACT: To determine if toolmarks produced by label makers can be useful in identifying taped messages produced from them, examinations were conducted on seven tapes received as evidence and three reference label makers. It was determined that Dymo® Model 1885 Handimark label makers can be linked to the labeling tapes they produce on the basis of the individual characteristics of the drive wheel impressions and cutting toolmarks, along with the class characteristics which include flaws in the character wheel. An unusual case involving an abduction, where extortion notes had been written on Dymo labeling tape, was received in the Questioned Documents Section of the Virginia Bureau of Forensic Science. The laboratory was asked to determine whether the seven tapes had been produced by one label maker. When it was observed that there were scratches running the length of the tapes which might be suitable for comparison, the case was referred to the Firearms and Toolmarks Section. The scratches did not appear to be of any value for comparison, since they were apparently artifacts of the manufacturing process and not repetitive. However, further investigation revealed more useful information.

KEYWORDS: questioned documents, toolmarks, striations

Background

Label makers are hand-held tools which are used to emboss characters of different types on plastic or metal tape which will adhere to various surfaces and materials. Most labeling tapes are constructed of two layers of plastic, a colored opaque layer beneath a thicker colorless transparent layer. In addition, a removable plastic layer protects adhesive on the back of the tape.

In general, label makers contain some common components which vary with respect to size, shape, and relative location within the different makes and models. These include a character wheel, drive wheel, drive wheel advancer, embossing trigger, embossing press, and cutter. The most visible differences, other than general construction and appearance, are the number, variety, and size of the characters which are included in the character wheel.

A typical label maker is the Dymo® Model 1885 Handimark (Fig. 1), which has 43 characters on its character wheel. The character wheel is actually 2 parallel wheels which are fastened together so that the characters on the lower wheel line up with the corresponding characters of the upper wheel. The lower wheel is constructed with raised characters, similar to

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FIG. 1—*Dymo Model 1885 Handimark label maker.*

the printing surface of a typewriter, which are mounted "daisy wheel" fashion on flexible plastic arms radiating from a central hub. The upper wheel is a solid piece of plastic with corresponding recessed characters. A space of approximately 3 mm separates the two wheels, allowing the labeling tape to pass between them. When the character to be embossed is in alignment, the embossing trigger is then squeezed, driving the plastic press against the back of the character on the lower wheel. This forces the tape into the shape of the recessed area of the upper wheel and the raised lower wheel (Fig. 2). The character becomes white from the stretching of the tape and is therefore visible against the colored background. When the embossing trigger is released, the tape automatically advances one space.

The tape is fed through the label maker by means of a plastic drive wheel (Fig. 3), which is held in place by, and pivots on, an integral axle (Fig. 4). One end of the axle is fixed, while the other end protrudes through a slot in the side of the label maker and is held up by the pressure of a spring. The protruding end is pressed down to release the tension of the drive wheel on the tape during loading or removal of unused tape. The spring causes the drive wheel to maintain firm contact with the tape as it feeds the tape through the label maker. This process leaves drive wheel tooth impressions on the tape backing. Since one side of the axle is held in place, acting as a pivot, the drive wheel does not press completely flat against the back of the tape. This causes one end of each drive wheel tooth to impress heavily into the

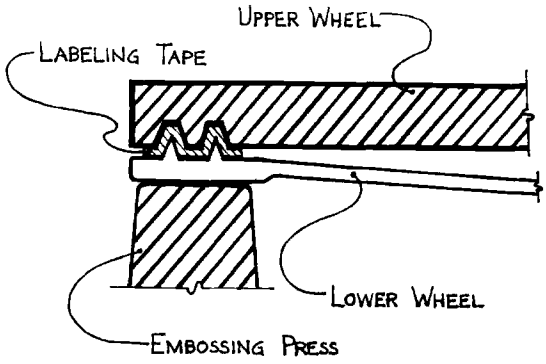

FIG. 2—*Cross section of label maker during embossing.*

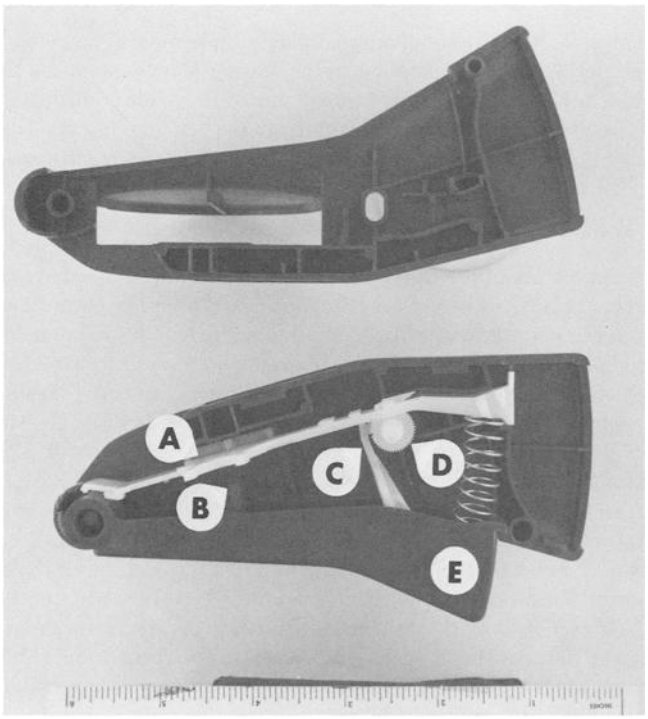

FIG. 3—*Components of Dymo Model 1885 Handimark label maker:* (a) *character wheel attachment site,* (b) *embossing press,* (c) *drive wheel advancer,* (d) *drive wheel, and* (e) *embossing trigger.*

label backing, while at the same time, the other end usually leaves no impression at all. Drive wheel impressions are left every time the embossing trigger is used, whether to emboss characters or to leave spaces.

When a label is completed, the tape can be severed by means of a built-in cutter. The cutting blades are incorporated into the upper character wheel, and cutting is accomplished with the same action as character embossing. The two blades are individually ground, simi-

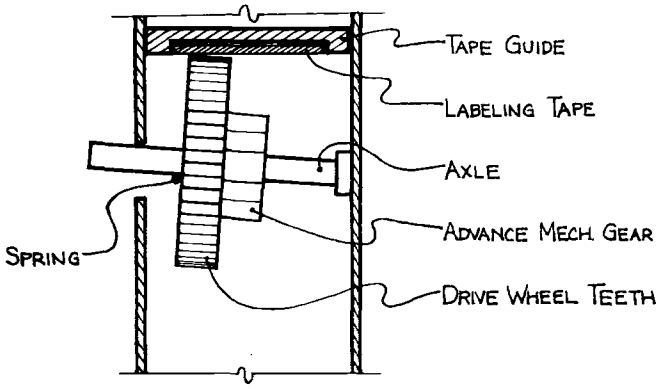

FIG. 4—*Cross section of label maker showing drive wheel.*

lar to razor blades, with a distance of approximately 2 mm separating them.[3] The surface of the lower character wheel corresponding to the cutting blades forces the labeling tape up against the blades. This surface is flat beneath one of the blades, but two grooves beneath the other prevent it from cutting completely through the backing (Fig. 5). This leaves a small tab on the end of the tape which aids in removing the plastic backing to expose the adhesive.

Examination of the Evidence

The initial examination of the submitted evidence tapes revealed small defects in the embossed characters that could be seen in the plastic backing. The letter "S," in particular, had a distinct microscopic flaw approximately 0.5 mm in length which was reproduced consistently throughout all seven tapes (Fig. 6). Many other letters and characters were found to have small defects. These provided the stimulus for further research into the area of label makers to determine which of these defects, if any, could be classified as individual characteristics and which could only be considered as class characteristics of a given make and model of label maker [*1*].

The sets of marks left by the drive wheel were examined. These marks, impressed into the plastic backing, ran continuously just below the embossed characters. Because of the unusual shape of each individual tooth mark, it was possible to determine the number of teeth on the drive wheel. This was accomplished by counting from the most unusual mark until it was repeated. This set of 46 marks was then measured to determine the circumference of the drive wheel, and from that the diameter was calculated to be 12.7 mm (1/2 in.).

On five of the tapes, the drive wheel marks were absent for approximately 47.7 mm (1 7/8 in.) following the first embossed character. It was determined that the lag was probably the result of the tapes having been manually fed through the label maker without the use of the drive wheel, before the start of embossing. The space between the first embossed character and the first drive wheel mark was concluded to be the approximate distance between the drive wheel and the embossing press inside the label maker. The tapes that were marked from the leading edge throughout their entire length were mechanically fed through the label maker by the use of the drive wheel, before embossing.

The ends of the tapes were examined for toolmarks which could have been left by the

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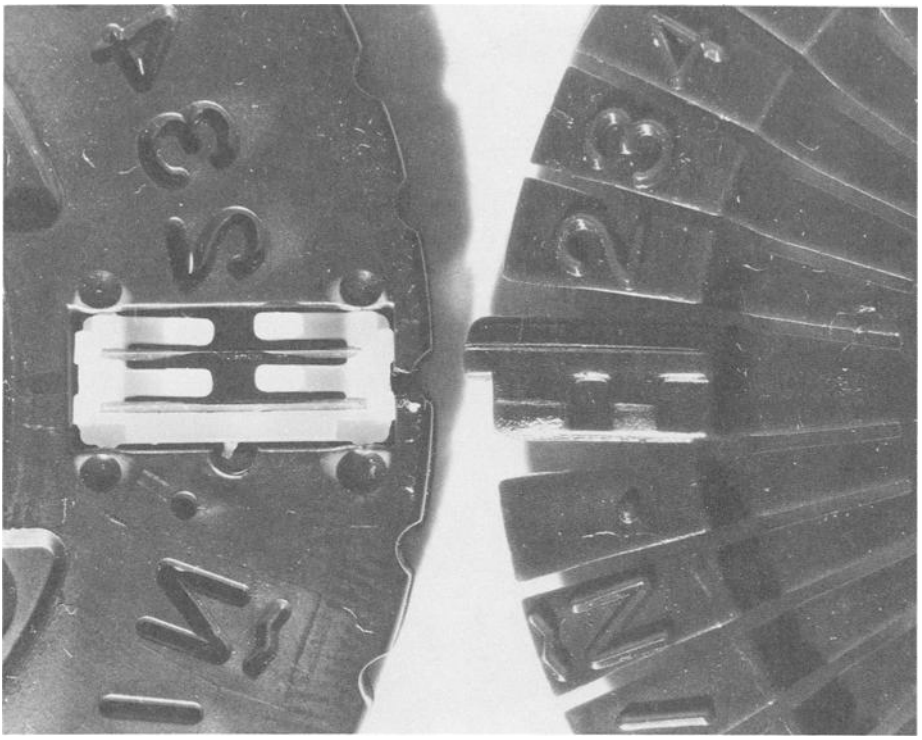

FIG. 5—*Cutting blades on character wheel.*

cutting mechanism of the label maker. Two of the tapes had been melted on the ends, possibly to eliminate any toolmarks. Three of the tapes were longer than 3.7 m (12 ft), the nominal length of Dymo tapes, which indicated that they probably had factory cuts on both ends.[3] The remaining two tapes had toolmarks on their leading ends which were considered suitable for comparison.

Comparisons of the toolmarks on the cut ends of the tape were unusually difficult because of the tape itself. When examined under a comparison microscope using oblique lighting, striation detail was obscured by the light transmitting properties of the plastic. To alleviate this problem, casts were made of the tape ends using Duplicast®, Permlastic®, and Tray Elasticon® brand casting compounds. Tray Elasticon, a more fluid material, made excellent casts after black fingerprint powder was added to change its color from light pink to dark gray. Through the use of the casts, it was possible to identify the cutting marks as having been made by the same cutting tool on two of the seven tapes (Fig. 7).

Because the police had no clue as to the type of label maker that had produced the tapes, all of the information obtained from the tapes was used to determine its characteristics. The following requirements were used to search for a comparable label maker:

1. The label maker had to use 9.5-mm (3/8-in.) wide tape.
2. The labels produced by the label maker had to read horizontally.
3. The label maker had to have uppercase letters, approximately 3.0 mm in height, with approximately 4.3 mm between the centers of adjacent characters.
4. The drive wheel had to be positioned in the label maker so that it rolled along the bottom side of the tape, below the characters.

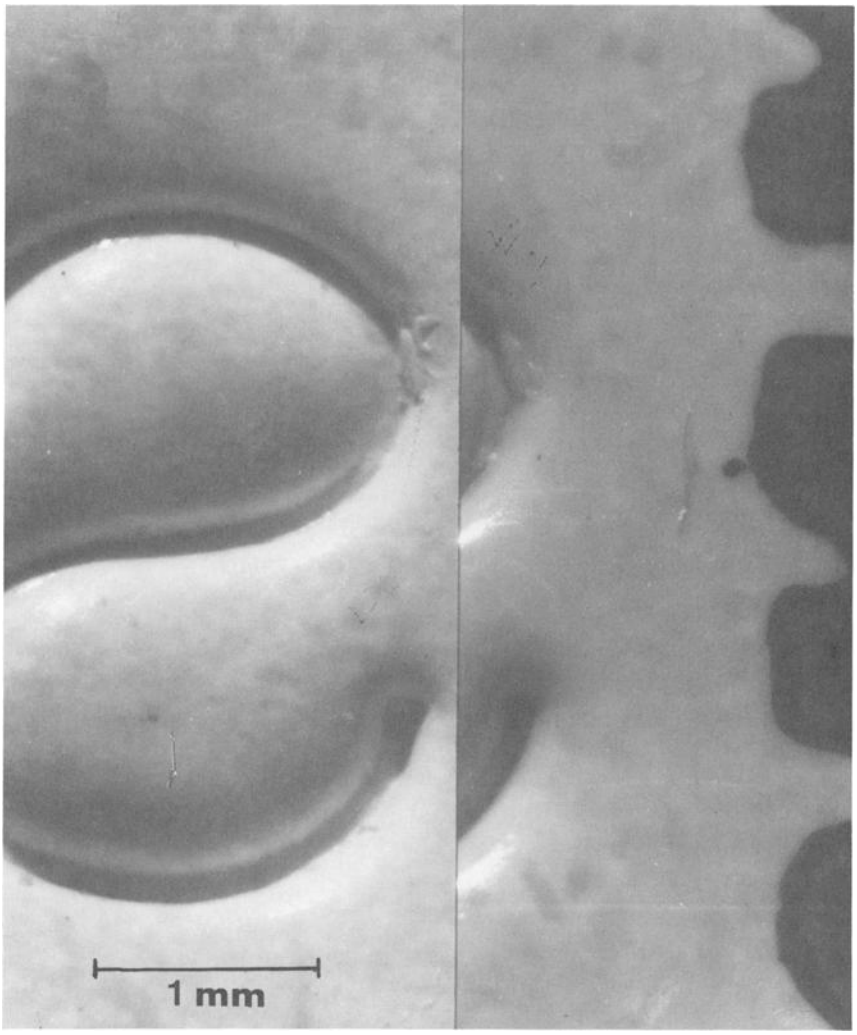

FIG. 6—*Similar defects in the letter "S." Evidence on left and test on right.*

5. The label maker had to have a drive wheel located approximately 47.7 mm (1 7/8 in.) behind the embossing press.
6. The drive wheel had to be 12.7 mm (1/2 in.) in diameter and contain 46 teeth.
7. The drive wheel had to turn at a rate equivalent to ten embossed characters per revolution.

After examining more than a dozen label makers of various makes and models, the only one located that incorporated all of the necessary class characteristics was the Dymo Model 1885 Handimark.

Materials and Methods

Three Dymo Model 1885 Handimark label makers were obtained for examination and comparison. The label makers were disassembled to measure the internal dimensions for

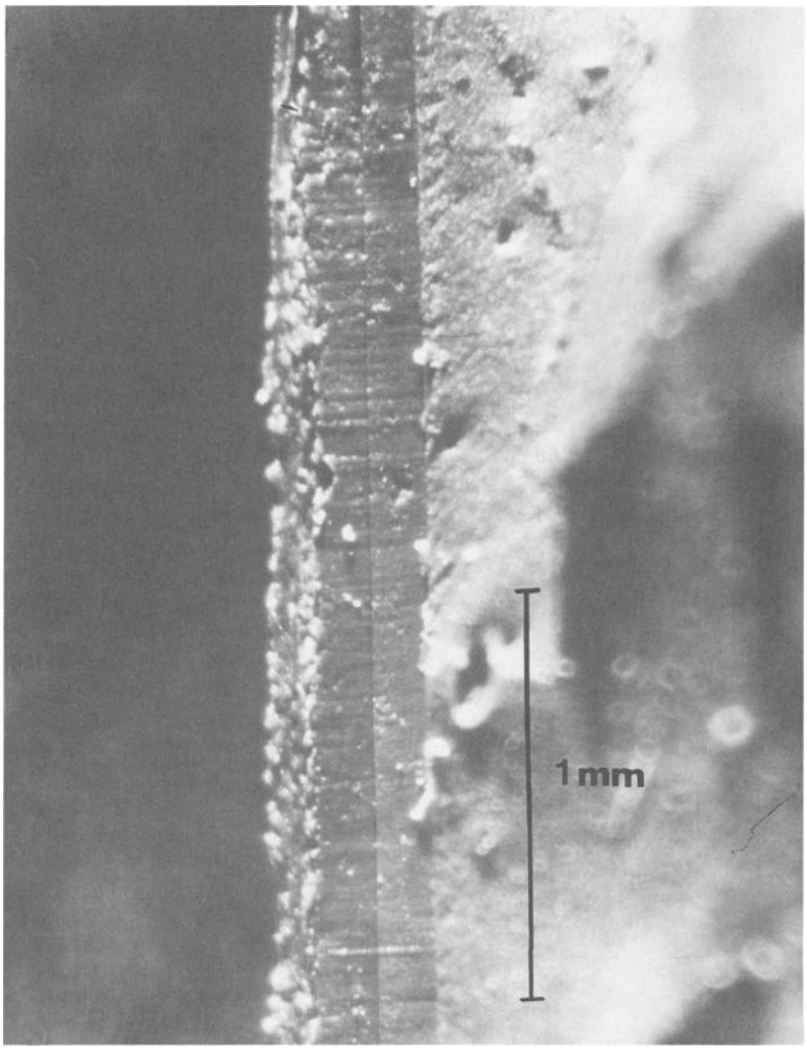

FIG. 7—*Comparison of casts of the cut ends of two evidence tapes.*

verification of the class characteristics, and also to examine the mechanics of the drive wheel, cutting, and embossing systems. Dymo and other labeling tapes were used for the embossing tests. Labels were made with the complete set of characters from each of the test label makers. The labels were compared with each other for similar characteristics in both the character wheel and the drive wheel impressions, as well as the cutting blade toolmarks. Tray Elasticon mixed with fingerprint powder was used to cast the drive wheel impressions and the cut ends of the tapes.

Results and Discussion

Drive Wheels

The marks left by the drive wheels of the three test label makers were similar to the evidence in size, shape, and relationship to the embossed characters. The marks were similar in

appearance to railroad spikes, pointed on one end and gradually widening, forming a head on the other end which differed from mark to mark.

The difference in size between the width of the drive wheel teeth, which was approximately 1.8 mm, and the length of the marks they left, which generally ranged from 1.2 to 1.5 mm, was a result of the drive wheel not pressing flat against the tape (Fig. 4).

Examination of the drive wheel revealed that the edge which impressed heavily into the labeling tape was also the place where the two halves of the mold used to cast the piece joined to form the seam. Material flowing into this seam during casting gave each tooth a unique profile.

Further examination of the drive wheels revealed two irregularly shaped bumps on the sides of the wheels, below the teeth. These bumps, which appeared microscopically similar on all three wheels, along with some machining marks which were apparently made during the manufacturing of the original drive wheel model, made possible an alignment of the wheels so that corresponding teeth on all three drive wheels could be compared (Fig. 8). Comparisons of tooth impressions were made by marking the tooth closest to one of the defects, placing the wheel back into the label maker with the marked tooth oriented at the 12 o'clock position and running the tape through until one full revolution was completed. This process left each of the forty-six tooth impressions in the exact corresponding order as the other two sets.

When the tooth impressions were examined under a comparison microscope, it became evident that there was a need to enhance the impressions in some way for photographic purposes, since the marks were difficult to see as a result of the shiny surface of the tape backing. A method which worked well was to run a permanent marking pen across the drive wheel impressions (green was found to be the most effective) in the same direction as the length of the tape, leaving a shallow layer of ink in the impressions which greatly increased the visibility of the detail. This was adequate except in cases where the impressions were obscured by the manufacturer's printing on the plastic backing. In such cases, a cotton swab soaked in methanol was used to erase the printing and then the ink was applied (Fig. 9).

When the test impressions were compared to the evidence, a method of enhancing the detail other than inking had to be used. The tooth impressions tended to be deeper in the evidence, allowing the accumulation of too much ink which obscured detail. The method that worked best was to cast the tapes with Tray Elasticon darkened with fingerprint powder (Fig. 10).

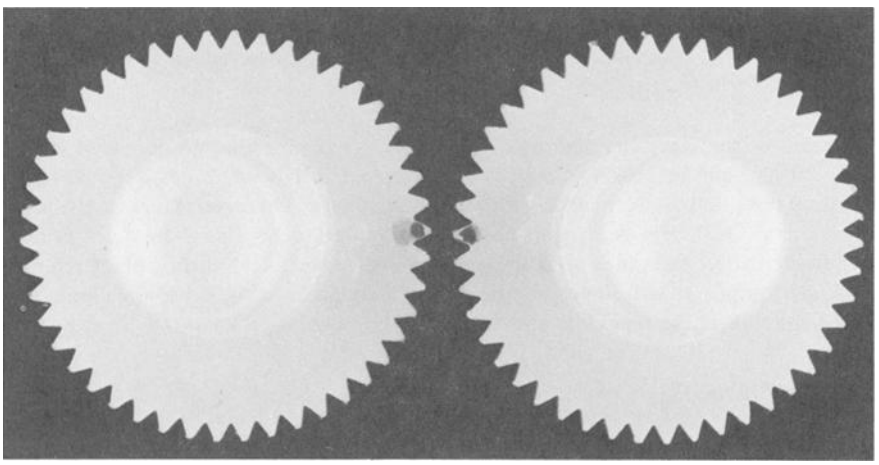

FIG. 8—*Orientation of two different drive wheels by alignment of corresponding defects.*

FIG. 9—*Comparison of drive wheel impressions on test tapes with and without manufacturer's printing and marking pen enhancement.*

Differences were found between all of the test label maker drive wheel impressions and the evidence marks. This agreed with the hypothesis that the drive wheel leaves individually identifiable marks on the tape as a result of the mold seam leakage, causing unique heads on the drive wheel teeth. Each tooth impression in a set was found to be individual and as a group could be used to identify the label maker, or drive wheel, which made the impressions.

It was found that if the backing had been removed from the tape, there could be insufficient detail on the tape itself to identify the label maker on the basis of drive wheel impressions because of the shallowness of the marks. More study would be necessary to determine if a tape backing which had been removed could be identified with the tape from which it came. The observations made to this point indicate that the sequence of characters embossed could enable an identification to be made.

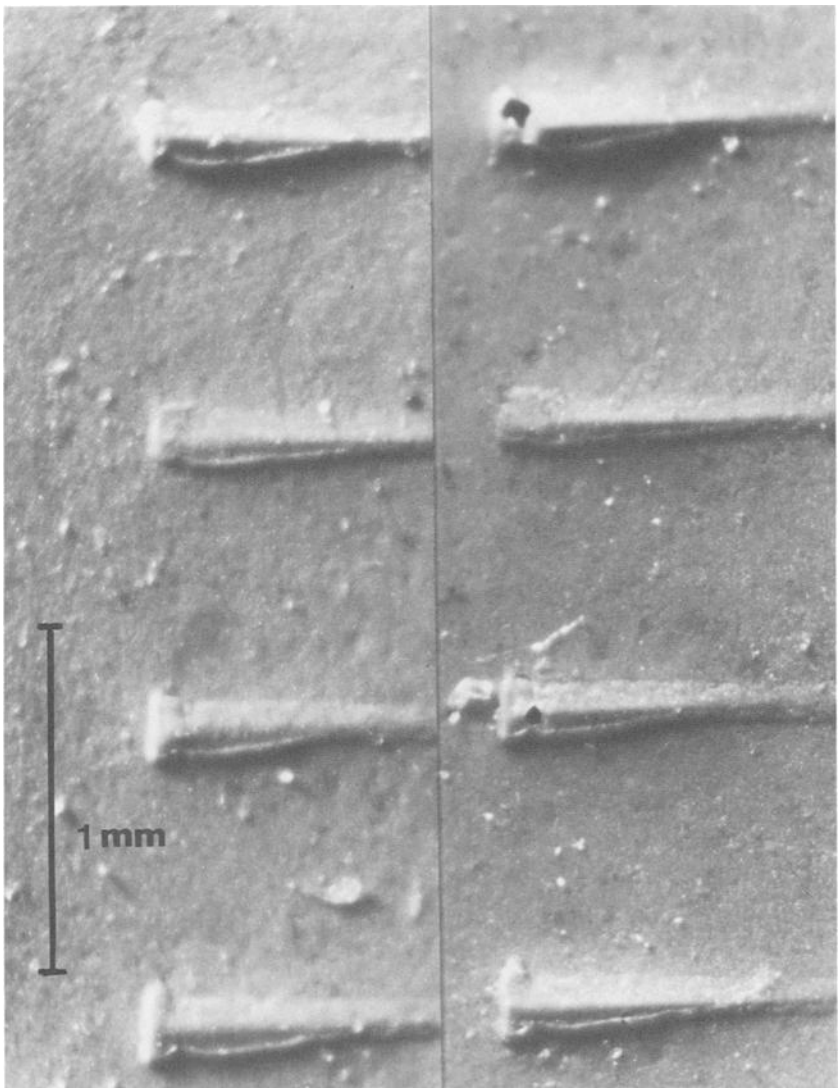

FIG. 10—*Comparison of casts of drive wheel impressions in two evidence tapes.*

Character Wheels

Similar flaws were found in identical letters of two of the three test label makers. These flaws were in the same location within the letters and were of the same general size and shape, but were microscopically different. The two character wheels that had similar flaws each had the numbers 2, 3000-89, and 917450 molded into the lower half of the wheel, whereas the wheel which did not have these flaws was numbered 4, 3000-89, and 917450. This indicated that the character wheels which had similar defects might have been produced in the same mold or in different molds using the same "parent" die. The other character wheel might have been produced in a mold with a different "parent" die.

The flaws in the embossed characters of the evidence tapes were also in the same location

within the letters, and were of the same general size and shape as the tapes from the two similar test label makers; however, there were microscopic differences between the evidence and the test tapes (Fig. 6).

Without more research and information as to the manufacturing processes involved in the production of the character wheels, the value of the character flaws as individual or class characteristics cannot be determined.

Cutting Blades

Microscopic examination of the cutting blades used in Dymo label makers revealed individual grinding marks. Therefore, the striations left on the tapes after cutting could be considered unique and enable the identification of a tape to the label maker from which it had been cut.

Conclusion

The results of this study, coupled with manufacturing information obtained from the Dymo Company, led to the following conclusions concerning Dymo Model 1885 Handimark label makers, which may be applicable to other makes and models of label makers:

1. The plastic drive wheel can leave individual identifiable marks on the plastic backing of labeling tape.
2. The toolmarks on the ends of labeling tapes left by the cutting blade can be used to identify the label maker from which they were cut.
3. Class characteristics of the marks produced by the character wheel on labeling tapes can indicate the model of the label maker used, since the character wheel is not interchangeable with any other model.[3]

References

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