THE FORMATION AND PERSISTENCE OF TOOLMARKS IN THE CARTRIDGE CASE HEAD FORMING PROCESS

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While working a homicide case the question of the significance of matching manufacturing toolmarks found on cartridge cases was raised. The case involved a comparison of .25 Automatic cartridge cases found at a crime scene with a single unfired cartridge taken from the suspect's residence. Toolmarks produced during the forming of the cartridge case were found on the circumference of the primer pocket of the loaded cartridge. They matched those found on one of the crime scene casings with a large number of consecutive matching lines.

The two items were produced by the same tool, but I did not know how much weight to place on this conclusion. Specifically, I did not know how many cartridge cases might also bear similar marks.

The casings were produced by Winchester-Western. I contacted the Olin Corporation in East Alton, Illinois, where W-W ammunition is produced. Don McCollister, an Ammunition Engineer with Olin was very helpful in describing the manufacturing process, which is described below. My questions concerning the significance of the toolmarks were unanswered, however. Although the factory monitors the wear on the tools and any defects that would mar the appearance of the finished cartridges, they are not concerned with the type of marks that a firearms examiner would utilize in comparisons. This led to asking if Olin would be agreeable to supplying sample cartridge cases to do a study on the effect of bunter wear on the marks that would be of interest to firearms examiners. The Olin Corporation kindly provided the samples requested.

The .25 Automatic cartridge case starts with a cold formed brass cup. The following processes take the cup to the primed case: A series of draws, washes, anneals, and trims along with head, head turn(which trims the rim and extractor groove) and flash hole pierce/cap. The "Head" operation is the source of the toolmarks that had been compared.

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The Heading operation is that which forms the primer pocket and the headstamp. In this operation the formed brass cup is supported on the inside by a punch. A tool called a bunter is forced into the base of the case forming the primer pocket and head, including the headstamp. The bunter has a negative image of the final primer pocket and headstamp. In examining the head of a cartridge microscopically it appears that the brass flows from the area of the primer pocket out towards the rim. The bunter leaves striations on the brass due to minute irregularities on the bunter surface.

To determine the persistence of these striations(toolmarks), I arranged with Mr. McCollister to supply a sampling of "W-W 25 AUTO" cases as they came off the heading press. The following sampling scheme was used: The first ten cases produced from a new bunter and then three cases at these intervals during the life of the bunter- 100, 200, 400, 600, 800, 1000, 5000, 10,000, 20,000, 20,100, 20,200, 20,300, 20,500, 50,000, 100,000, and each 25,000 until the bunter was removed from service. Not being at all sure over what interval the marks would last, I wanted to get some at close intervals once the bunter had been producing for some time in case there was a break-in period of non-reproducibility. This is the reason for the close spacing in the 20,000 range.

The bunter used in this study is one produced by a relatively new method of machining called Electron Discharge Machining (EDM). EDM produced bunters start with a lathe turned steel cylinder with a protrusion on one end. The protrusion is what forms the primer pocket. The area around this protrusion is then electrically machined down leaving the negative impression of the headstamp. The tops of the headstamp characters still show evidence of the original lathe turning. This indicates that each bunter will produce individual marks.

Prior to the EDM process, bunters were produced from an engraved master die. In this older method known as Hobbing, several bunters could be produced from the master die. When comparing a Hobbed bunter-produced cartridge case with an EDM bunter-produced case a difference is noted. The electric etching of EDM leaves a pebbly surface on the bunter, while the Hobbing process gives a much smoother surface. The finished EDM case shows lines radiating towards the rim on the head surface between the letters. The Hobbed bunter case has a very smooth head except in the characters themselves and the primer pocket area, both which show toolmarks. On some older .25 Auto cartridges, which have been produced by Hobbing, radiating lines have been noted. Although they appear similar to toolmarks found on EDM produced cases this is probably due to wear of the tool rather than to manufacture of the bunter.

Comparisons

Each case was identified with a code indicating the production series and the number within that series. The first ten produced were labelled A-1 through A-10. At number 100 of production the three sampled cases were labelled B-1 through B-3; at 200, C-1 through C-3, etc.

Upon starting I determined that toolmarks within the headstamp characters were much easier to compare than the striations around the edge of the primer pocket. In fact, the primer pocket was almost devoid of marks, especially in early samples. The indications used in my notes and referred to in the rest of the article are: MATCH indicates sufficient consecutive individual striations matching to conclude that two toolmarks were produced by the same tool; CONSISTENT means some consecutively matching lines noted, but not quite enough to call a match.

Case A-1 could be easily matched to all other cases within the A series on almost all characters. The bunter produced matching marks from the start of production. In comparing subsequent series, the three casings within a series were always first intercompared. As a rule, characters within a series exhibited a high degree of matching characters. On occasion two headstamp characters on cases within the same series would be only consistent. The large majority of the characters, however, did match.

After intercomparing within a series, comparisons with other series were made to determine over what intervals of production the bunter would produce matching characters. I noted that the headstamps had fewer striations at the start and more as the bunter showed wear. Some characters became less distinct and tended to smear out. This was particularly evident in horizontal lines such as the dash in "W-W" and the top of the T in "AUTO".

RESULTS

In making comparisons on individual characters it was generally possible to match at least one headstamp character on two cases that were separated by 10,000 units. In one instance it was possible to match a character separated by 19,000 units, but normally only consistency could be established by a separation of 20,000.

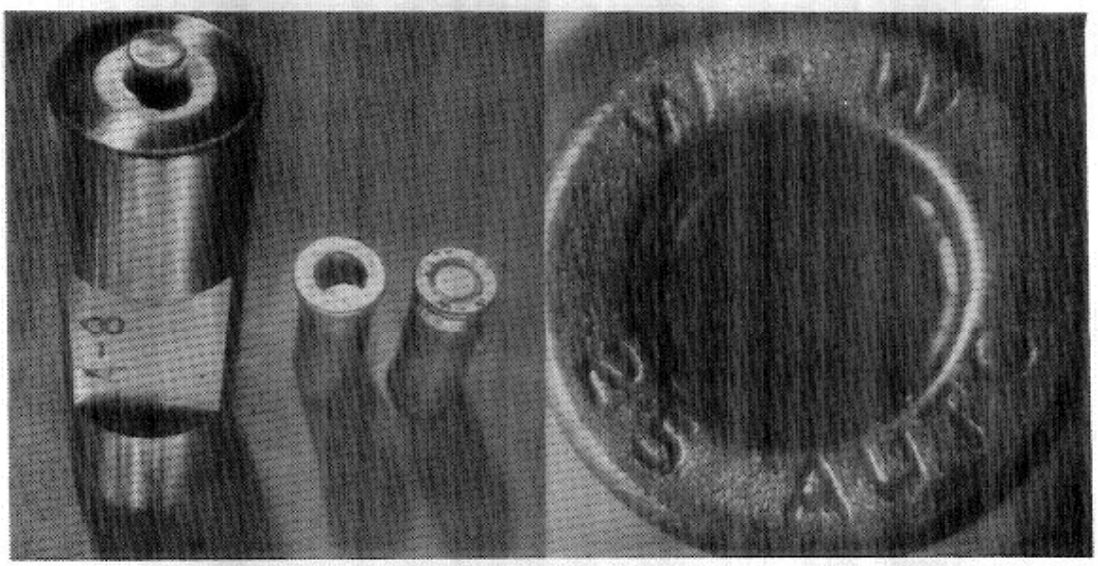
If a comparison was based on examining the entire cartridge head, which includes the headstamp characters and the space surrounding them, the separation range yielding a match was widened. This is due to comparitively gross marks that were found surrounding the headstamp characters. They persisted longer than the fine letter striations. Matches based on the gross marks were made at separations of up to 65,000.

The primer pocket striations in this experiment never did develop into an area for comparison. The junction between the vertical wall of the primer pocket and the flat of the head was very sharp. I have used striations in this area before where the junction was a mild curve. Perhaps the sharpness is a result of producing the bunter by EDM.

While this data may be useful in comparing .25 Automatic cartridges, I do not expect these numbers to be reliably used in higher calibers. In comparison to a .38 Special, for example, the .25 case has a much smaller head and I would expect the bunter to wear more rapidly with respect to toolmarks. This is an area for further research.

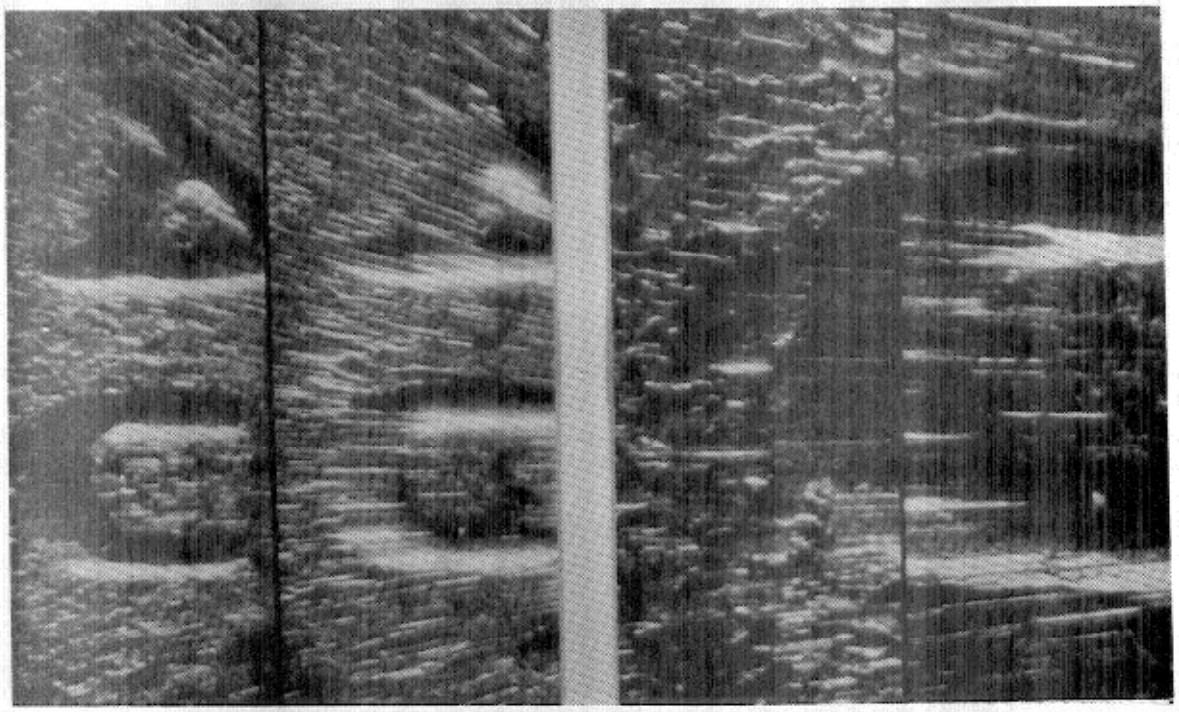
My original question concerning primer pocket striations is yet unanswered. The cartridge cases at the crime scene appear to have been produced by a Hobbed bunter. At this time Olin is utilizing EDM to produce their .25 Auto bunters. Because ammunition has a habit of turning up in a crime many years after it is produced, I feel a study of this sort utilizing a Hobbed bunter is needed. Since they are produced from master dies, and many bunters can be produced from one master, a study of the carryover of characteristics would be useful as well.

I would like to thank the Olin Corporation for making this study possible. I also want to thank Don McCollister and Mark Nienas of the Winchester-Western Division of Olin for their assistance.



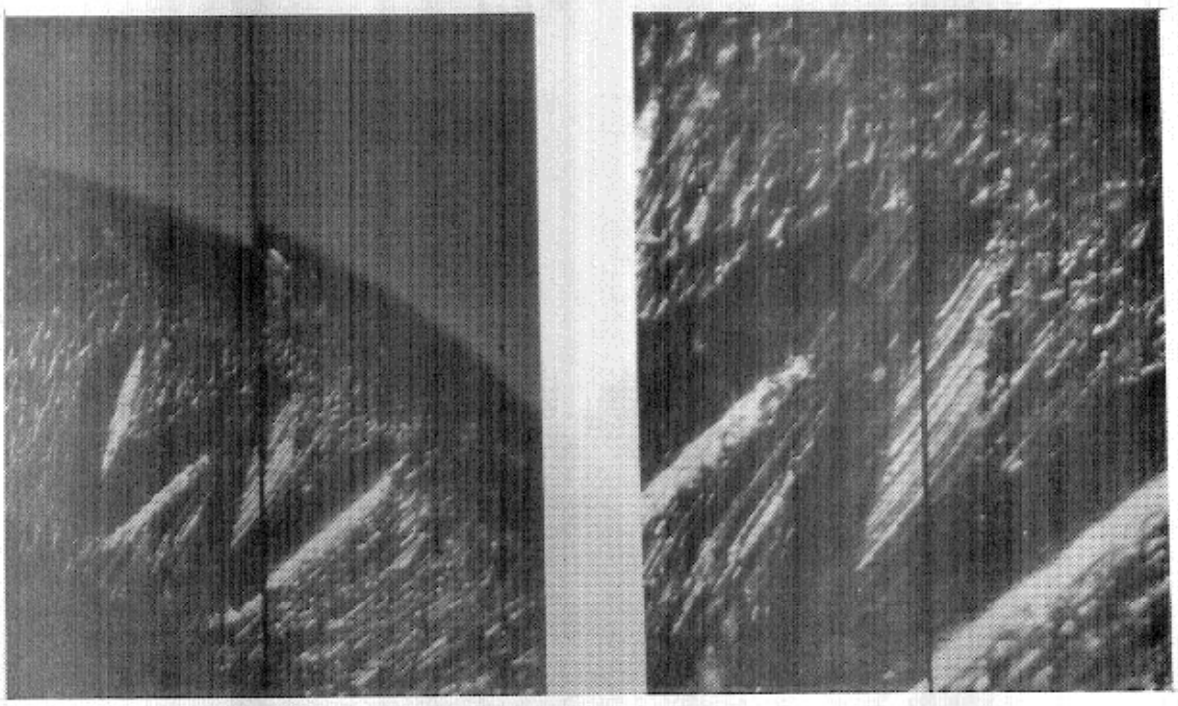
1: 25 Automatic Bunter: 25 Automatic cartridge case after bunting; finished cartridge case.

2: 25 Automatic cartridge head as it looks after bunting. This is prior to flash hole piercing, head turning (rim trimmed & extractor groove cut), and trim to length.



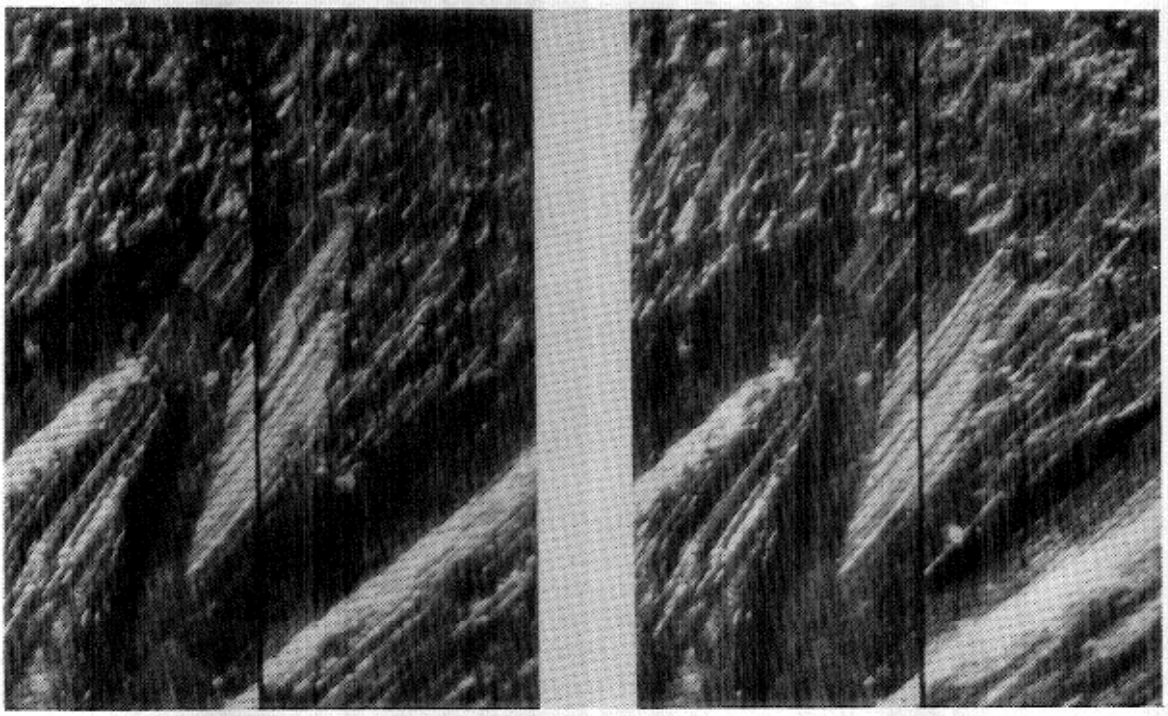
3A 3B

AU and U from AUTO in the headstamp compared. The left side is a case from a new bunter. The right side shows a case produced just prior to the removal of the bunter from service after producing over 125,000 cases. Note the increase in number and depth of striations in and around the headstamp characters due to wear of the bunter.



4A 4B

New Bunter At 1000 New Bunter At 1000



4C
New Bunter At 20,000

4D
New Bunter At 50,000

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Hide-A-Gun

This gun rig, designed for sale to law enforcement agencies, conceals a handgun under the dash of an automobile. The rig has no straps to loosen, allowing the user to have the gun in his hand in only 2 seconds.