Forensic Value of Sidewall Marks on Cartridge Cases Discharged from Homemade Weapons

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ABSTRACT

On cartridge cases discharged from homemade and converted firearms, conventional and non-conventional marks can be observed. Some of these marks, such as firing pin impression, extractor and ejector are well-known. However, the origin and forensic value of other marks are unknown due to the specific character of these firearms. Many of these marks can be found on the sidewall of cartridge cases; the description and development of these marks will be given below. This paper studies the processes and elements which cause the formation of the marks. The potential to use these marks for class characterization and individual identification is also discussed.

Introduction

In the course of forensic examination of discharged cartridge cases, different areas must be examined. Most informative and, thus more commonly used, are the marks left by the firing pin, breach face, ejector and extractor. Examination of these marks may allow the examiner to determine the type and model of firearm, or when a firearm is available, come to a conclusion regarding identifications or eliminations. For the determination of the firearms type and for the identification, the marks that can be found on the sidewall of the cartridge case are used less often than the marks of the firing pin, breech face or ejector on center fire ammunition. Marks produced by the firearm's chamber, and other components such as the ejection port, locking lugs, loading ramp, and magazine, may be present on the cartridge case sidewall. The examination of these marks can improve the level of confidence in determining the weapon type, as well as the results of comparison. Marks observed on the sidewalls, and produced by factory-made weapons have been described in professional literature and are well established **[1–5]**. Homemade and converted firearms produce a broad variety of marks on the sidewall area, many of which are never found in factory-made firearms, which make them open for discussion. One of the reasons for the appearance of such marks is that in the manufacturing of the chamber in homemade and converted weapons, unlike in factory-made weapons, often non-specialized equipment is used. Additionally, the finishing of the inner surface of the chamber, such as grinding, is usually not performed on homemade weapons. This may cause the appearance of traces from cutting tools in the chamber. These traces are transferred to the surface of cartridge during the firing.

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The increase in the number of different homemade weapons and the authors' experience in the examination of these marks encouraged us to analyze and classify them, and present the results to the community of firearms examiners. The authors studied a considerable number of different homemade and converted firearms.

Figure 1: A primitive homemade firearm.

Classification of marks on the cartridge case sidewall

The first type of homemade firearms, which leave very clear marks on the sidewall of cartridge cases, are primitively constructed from pipes, fittings, and springs or rubber bands **(Figure 1)**. One of their properties is the construction of a chamber that does not support the cartridge. In some circumstances, the front part of the cartridge can actually protrude from the "muzzle". Shooting such homemade weapons will usually cause the cartridge case wall to rupture **(Figure 2)**. In many of these cases, as a result of its strong deformation, the ruptured cartridge case or shot shell case gets stuck in the part used as the chamber. The extraction of

such cartridge cases or shotshell cases can cause additional deformation and even fragmenting of the cartridge case. The ruptured shape of the fired case can be used by examiners to decide if the weapon is a primitive homemade weapon. However, it may not add any information during the comparison process, except in cases where there are noticeable defects in the part used as a chamber, which imprint marks on the fired cases.

Figure 2: Ruptured cartridge case discharged from a primitive homemade firearm.

The second group is formed by the marks of a chamber which does not properly fit the dimensions of the cartridge (fire forming marks). Similar marks are well known in cases in which the wrong caliber ammunition was used, for example shooting 9x17mm (380 Auto) from 9x19mm (9mm Luger) **[6]** or 5.56x45mm from 7.62x39mm **[7]** and other combinations **[8, 9]**. In these situations, the cartridge and the chamber are different sizes. As a result, the cartridge may not be fully supported by the chamber, which during the shot causes the expansion of the cartridge case to the size of the chamber. This expansion can be used to indicate that the calibers of the cartridge and the chamber differ. In cases of homemade weapons, the differences between the chamber and the cartridge may not be in just the diameter, but also in the construction. The chambers in homemade weapons do not always have cylindrical or conical forms; sometimes it can be curved or the geometry can be different from the geometry of the cartridge. These shapes can be easily seen **(Figures 3, 4)** and this difference can be used to reach conclusions about the homemade origin of the chamber, even if the breech face and the firing pin marks look similar to factory-made firearms.

The third group includes marks that are common for submachine guns with an open bolt mechanism. These marks are the swellings in the cartridge case sidewall **(Figure 5)**. This type of deformation has been commonly found in homemade

Figure 3: Cartridge cases in caliber 5.56x45 mm discharged from a homemade firearm (left) and from an original, correct caliber (right) chamber.

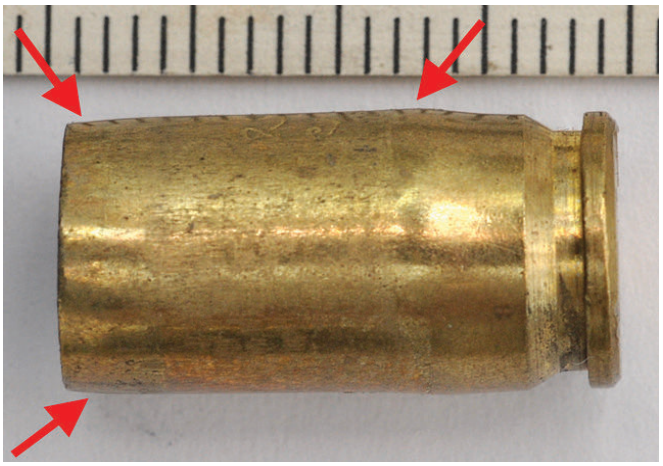

Figure 4: The deformation on a 9mm Luger cartridge case discharged from a homemade firearm.

Figure 5: Swelling on a cartridge case discharged from a homemade submachine gun.

submachine guns. The cartridge case swelling can be caused by early opening of the chamber due to a non-balanced proportion of the spring strength and the bolt's mass. It may also occur when the cartridge is not fully inserted into the chamber (early ignition) because of the chamber's construction, its roughness or fragments of previously discharged bullets broken by the homemade barrel **[10]**. Since this cartridge swelling is made by internal pressure of gases on the unsupported sidewalls of the cartridge case, it does not receive any marks which can be used for identification. These marks can be used only as a sign of an open bolt mechanism, implying a high possibility of a homemade origin of the weapon.

In most homemade assault rifles and converted Airsoft rifles **(Figure 6)** examined in the laboratory, factory-made rifled barrels were inserted. These were original M-16 barrels or Galil assault rifle barrels adapted for use in homemade/converted firearms. Laboratory experience shows that in some instances a rifled barrel lacking a chamber was used. In these cases, for firing 5.56x45mm caliber ammunition, a homemade chamber was welded to the barrel. The place of attachment of the barrel to the chamber had seam defects such as steps, non-welded areas, etc. These seams and defects can produce radically different marks and deformations on the neck and mouth of the cartridge case **(Figure 7)**. For an examiner, these marks can be a good indicator of the type of chamber-barrel construction. These modifications provide many opportunities for finding individual characteristics for use in comparisons. In the course of examination of homemade M-16s and converted Airsoft rifles, it is important to investigate the condition of the barrel and its construction before test firing. This allows examiners to discover defects, which during test

Figure 6: A converted Airsoft rifle.

Figure 7: Marks on the cartridge case mouth imprinted from the connection between the homemade chamber and the rifled barrel.

Figure 8: A barrel destroyed during shooting - the rifled barrel disconnected from the homemade chamber.

firing could cause damage to the evidence and even injury to the shooter. It is important to remember that the seam is a weak point in the construction and sometimes can cause its catastrophic failure **(Figure 8)**. Any doubt as to the integrity of these conversions should prompt the examiner to test fire these weapons remotely and from a position of safety.

One of the most noticeable marks, which can be observed in the sidewall of a cartridge case discharged from a specific type of homemade submachine gun, is perforation or penetration at the mouth of the cartridge case **(Figure 9)**. This defect becomes a special class characteristic for this certain type of homemade submachine gun. In this group, the barrel is secured to the body of a homemade submachine gun with a set screw **(Figure 10)**. In some submachine guns, the screw hole in the barrel continues and penetrates the "barrel" at the chamber area. Sometimes the screw hole is positioned at the front part of the chamber. On firing, the powder gases can actually press the cartridge case wall into the screw hole causing a perforation. In some instances, a fragment of the cartridge case is cut out. This mark indicates a crude technique of barrel/chamber mating of the homemade submachine gun. Theoretically, it can also be used for a point of comparison. However, laboratory experience shows that the quality of individual marks made by perforation or penetration in the screw hole is often poor and cannot be used for identification.

In factory-made firearms, the chamber is usually well-machined and polished, so other than possible ejection port marks, no additional special marks can be observed on cartridge cases. In some manufactured firearms, the chamber has special elements in its internal surface. The most common of them is fluting. This design feature is usually used in weapons made by Heckler and Koch Company, such as the MP-5 submachine, the P7 semiautomatic pistol and the G3 assault rifle. The fluting in these weapons is used to reduce friction and facilitate the extraction of a discharged cartridge case **[11, 12]**. This addition consists of a number of parallel groves in the chamber which proceed from the chamber throat and leave marks on cartridge cases **(Figure 11)**.

Another type of fluting is used in the chamber of a modified Makarov pistol (the PMM, or Pistolet Makarova Modernizirovannyy). The original Makarov pistol was designed for 9x18 mm (9mm Makarov) ammunition with a muzzle energy of about 300J (221ft*lbs). The PMM variants utilize a more powerful cartridge with the same size and form but an increased muzzle energy of 505J (373ft*lbs), similar to a "+P" designation for the 9x18mm. The simple blow back mechanism used in Makarov pistols was not suitable for such powerful ammunition as had been designed for the PMM, so it requires an increase of mass of the slide and the recoil spring

Figure 9: Perforation in the front part of cartridge cases made by a barrel screwhole of a homemade submachine gun.

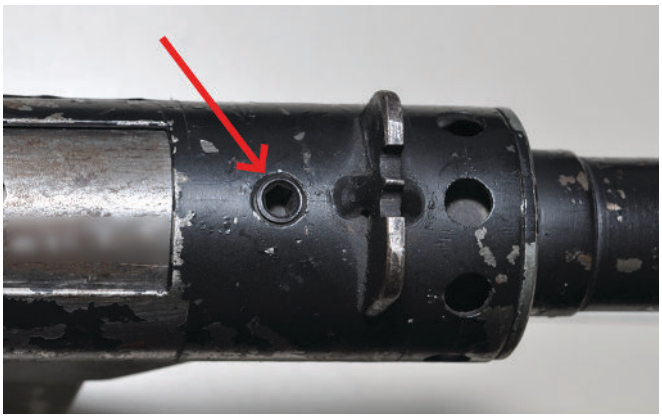

Figure 10: Barrel retaining screw in a homemade submachine gun.

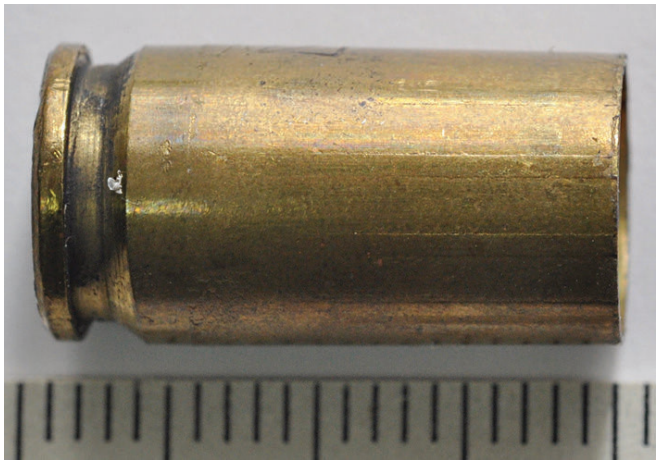

Figure 11: Fluting on the cartridge case discharged from an H&K MP-5.

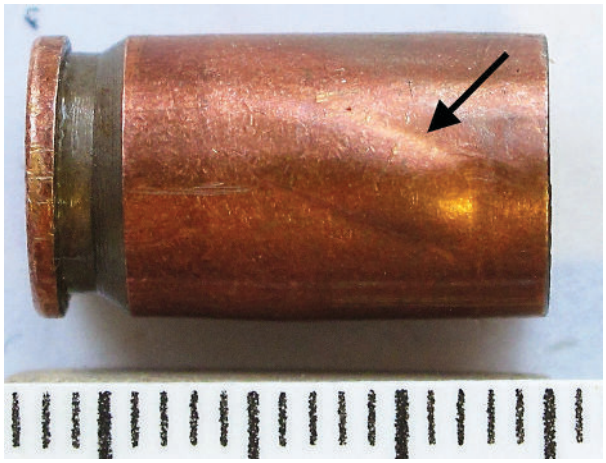

Figure 12: A cartridge discharged from a Modified Makarov pistol.

tension to slow down the opening of the slide. These changes could have significantly increased the weight and the size of the weapon. One of the known ways to avoid this issue and to make the extraction process slower is to use retarding annular and helical grooves, which was done in several American experimental pistols **[12]**. In the PMM as a retarding fluting, three spiral grooves were made in the chamber. During the discharge, the cartridge case expands into these grooves, and higher energy is required for the extraction. This makes the slide move slower. Thus, the chamber opening occurs only after a bullet leaves the barrel and gas pressure is reduced. The grooves from the fluting leave strong marks on the sidewalls of the cartridge cases **(Figure 12)**.

During routine case work, the author's laboratory received homemade submachine guns **(Figure 13)** with a strange chamber construction. In the chambers, twenty spiral left-twist grooves were noted. **(Figure 14)**. A cast of the chamber

Figure 13: Homemade submachine guns.

revealed sequential spiral grooves, a freebore and the beginnings of homemade rifling **(Figure 15)**. The purpose of these spiral grooves is not clear. The depth of the grooves and their location in the chamber are similar to those used in Heckler and Koch firearms **(Figure 11)**, but the spiral shape resembles the grooves in Modified Makarov pistols **(Figure 12)**. This "fluting" leaves easily recognizable marks on the cartridge case's sidewall **(Figure 16)**. These spiral fluting marks could be class characteristics; individualization of these marks could not be determined in four cases received in this laboratory.

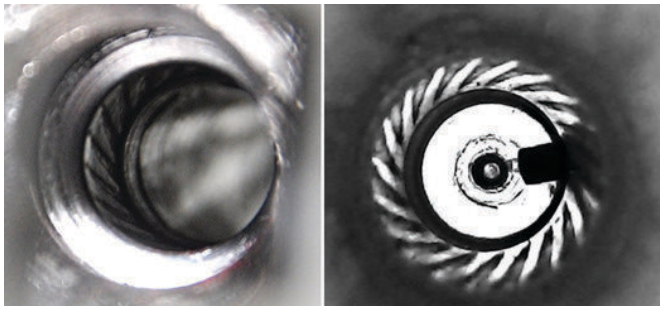

Figure 14: Grooves in the chamber of a homemade sub machine gun. The view from the breech side (left) and through the bore (right).

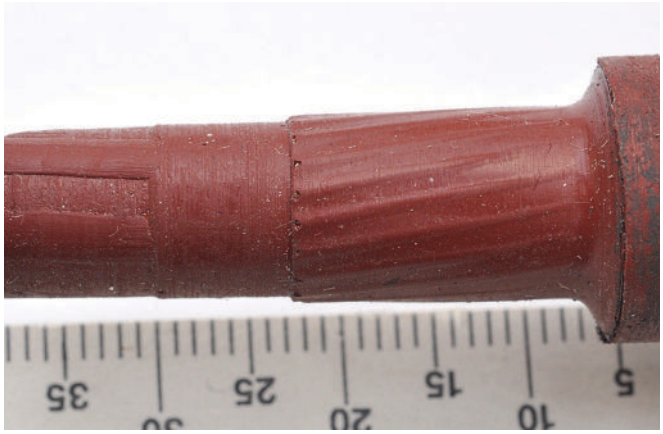

Figure 15: Cast of the chamber with the grooves, freebore and homemade rifling.

Figure 16: Marks of spiral grooves in the chamber of a homemade submachine gun.

Summary

Homemade firearms leave a variety of different marks on cartridge cases, some of them are standard; however some of them contain additional areas providing both class and individual marks. This article describes and discusses marks which can be found on the sidewall of cartridge cases. The discussed marks can have various sources, such as the difference between the size of a cartridge and a homemade chamber, the way of connecting homemade chambers with rifled barrels, or barrels to weapon bodies, as well as different flutings, etc. On the basis of these marks, the weapon from which the cartridge case was discharged can be identified as homemade. Some of the marks, such as chamber treating marks or marks of the connection of the chamber and the barrel, can also contain individual characteristics. However, other areas such as swelling, point only to the type of the mechanism, and cannot be used for comparison. The information about the reproducibility and the quality of these marks, their origin, as well as the possibility to use them for class and individual identification, can be helpful for the examination of evidence.

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