

Individual and Subclass Characteristics on Bullets and Cartridge Cases Fired in Original and Converted Walther PPQ Pistols

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ABSTRACT

Several Walther PPQ pistols have recently been examined at the National Forensic Centre in Sweden. Some of these pistols show signs of having been converted to 4 mm or 6 mm Flobert (rimfire) and then converted back to their original caliber of 9 mm Luger (9x19 mm, 9 mm Parabellum). In the author's experience, marks on bullets and cartridge cases fired in Walther PPQ pistols have a limited amount of individual characteristics that can be useful for the forensic firearm examiner. The origin of these marks is discussed and whether there is a risk for subclass carryover. Drag marks on the rim of the cartridge case, marks from the chamber and marks from the firing pin aperture are however likely to be individual with limited risk of subclass carryover, whether the pistol is original or converted. Bullets fired from pistols converted back to their original caliber also have coarse marks that originate from the muzzle of the barrel which are likely to be individual, facilitating the potential for an identification or elimination.

Introduction

In 2011, Walther Arms released the model PPQ pistol, a short recoil-operated semi-automatic pistol available in caliber 9 mm Luger (9x19 mm, 9 mm Parabellum) and 40 Smith & Wesson (**Figure 1**) [1]. The new trigger system, Walther Quick Defense Trigger™, was one of the promoted features of the new pistol. Since then, more variants of the PPQ pistol have been added in different calibers, sizes, and with different features. Initially, the barrels of the PPQ pistols were conventionally rifled, but in 2015, Walther Arms started to manufacture barrels with polygonal rifling instead [2]. All the cartridge cases and bullets mentioned and examined in this article have been test fired in 9 mm Luger PPQ pistols with six right polygonal rifling.

In Sweden and in other countries in Europe, it is not easy to legally obtain a handgun. For example, one has to be an active member of a sport shooting club to get a license to possess a handgun. As a result, firearms for criminal purposes are often smuggled into Sweden. In some European countries such as Slovakia and the Czech Republic, it is legal to possess a firearm in caliber 4 mm or 6 mm Flobert caliber. Because of this, it is common to encounter firearms intended for conventional ammunition to be converted to fire the 4 mm or 6 mm Flobert cartridge, making them legal to possess. Often, the intent is to later convert them back to their original caliber [3]. This is

known throughout Europe and this type of modified firearm then converted back to its original caliber is common in the criminal context in Sweden [3, 4, 5].



Figure 1: Walther PPQ pistol.

Several of the Walther PPQ pistols that have been examined at the National Forensic Centre in Sweden show signs of having been converted to 4 mm or 6 mm Flobert, and then converted back to their original caliber of 9 mm Luger. It is not known if the conversions are done on an organized scale or by isolated pockets of the criminal community. Some of the pistols are marked "4 mm Flobert," some of them have Slovakian proof marks, and often a small portion of the muzzle end of the barrel has been cut off. When the pistol is converted to fire 4 mm or 6 mm Flobert ammunition the internal diameter of the barrel is reduced by inserting a smaller diameter barrel into

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the existing barrel. The new barrel is attached by welding it on the muzzle end of the original barrel [5]. Conversion back to original caliber is quickly done with a hammer, jaw vice, and nail. The smaller diameter barrel can be easily hammered out of the original barrel [3]. Several mm (approx. 0.1 inch) of the muzzle end is then removed, most likely because it removes welding remnants, resulting in a slightly shorter barrel. The quality of work applied to shortening the barrel varies - some barrels are cut off and crowned and some barrels are just cut off straight (Figure 2). As a result of shortening the barrel, burrs are usually created at the new muzzle.

Observations have been made of marks on cartridge cases and bullets fired in Walther PPQ pistols at the National Forensic Centre in Sweden, with pistols both in their original state and pistols converted to 4 or 6 mm Flobert, and then back to 9 mm Luger. The origin of these marks is discussed and whether there is a risk for subclass carryover. It is essential to distinguish subclass from individual characteristics on bullets and cartridge cases to avoid false positive identifications during comparisons.

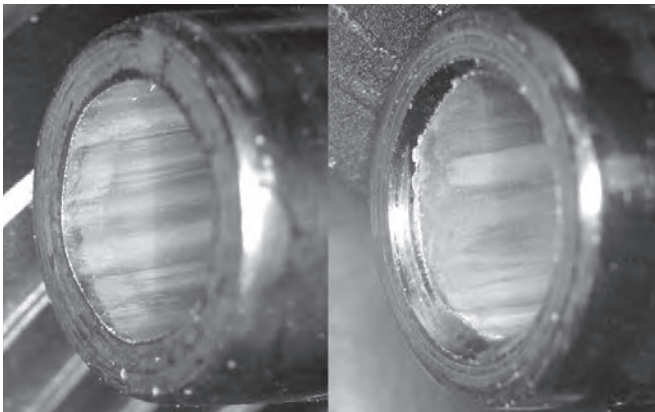


Figure 2: Muzzles of two converted Walther PPQ pistols, the one on the right has been crowned.

Definitions

In this article we discuss subclass and individual characteristics according to the definition from the AFTE glossary [6]. Individual characteristics are: "Marks produced by the random imperfections or irregularities of tool surfaces. These random imperfections or irregularities are produced incidental to manufacture and/or caused by use, corrosion, or damage. They are unique to that tool to the practical exclusion of all other tools." Subclass characteristics are: "Features that may be produced during manufacture that are consistent among items fabricated by the same tool in the same approximate state of wear. These features are not determined prior to manufacture and are more restrictive than class characteristics."

Results and discussion

Firing pin impression

The firing pin impressions on all examined cartridge cases were circular and smooth with few marks useful for comparison (Figure 3). When manufactured, the front of the firing pin in Walther PPQ pistols is stamped from a roll of sheet metal which is then turned and milled prior to induction hardening (Figure 4) [2]. There is potential for subclass characteristics on materials manufactured by milling processes. In metal cutting processes, metal chips cut from a workpiece can be dragged along between the surface and the cutting tool. This is a random process and can result in individual marks on the surface. As no individual characteristics relating to the manufacturing process could be identified in the firing pin impressions on the examined cartridge cases, the authors believe that marks from the cutting process are removed during the finishing process. Unless there are individual marks obviously imparted by damage, use, or wear, these impressions should be examined with caution.

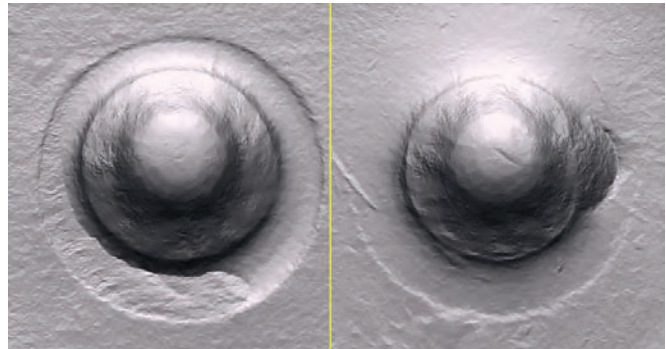


Figure 3: Firing pin impressions from two different Walther PPQ pistols; the photographs were obtained from the IBIS System.

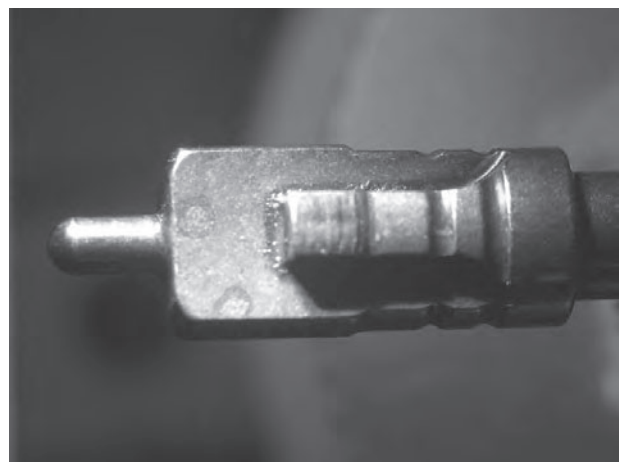


Figure 4: Firing pin from a Walther PPQ pistol.

Firing pin aperture marks

Marks from the firing pin aperture have been observed on several examined cartridge cases. The firing pin aperture on Walther PPQ pistols is drilled from the rear end of the slide, resulting in burrs from the drilling process. The firing pin aperture is drilled after milling the breech face, so as long as any finishing processes do not leave subclass characteristics that override the individual marks, there would be a limited risk of subclass carryover [2, 7].

Breech face marks

The cartridge cases examined did not display any distinct markings from the breech face. Some of the cartridge cases examined showed parallel breech face marks and as the breech face of Walther PPQ pistols are created using CNC milling processes, there is the potential for subclass carryover [2, 7, 8].

Drag marks on the cartridge case rim

In Walther PPQ pistols there is a recess cut into the inside of the slide next to the breech face, opposite to the extractor. Its purpose is to stabilize the cartridge case when it is being ejected from the pistol (**Figure 5**). The recess creates a drag mark on the rim of the cartridge case at the moment the ejector hits the cartridge case (**Figure 6, 7**). The recess is manufactured using a mill with a cylindrical milling cutter [2]. The movement of the cartridge case when it is being ejected is perpendicular to the direction of the milling cutter marks and therefore drag marks on the cartridge case rim will be individual with limited risk for subclass carryover [7, 8]. This mark may also appear on cartridges cycled through the action.

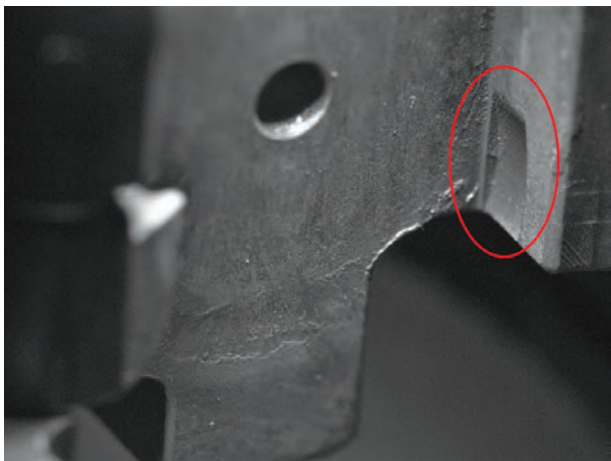


Figure 5. Recess at the side of the breech face, opposite the extractor, from a Walther PPQ pistol.

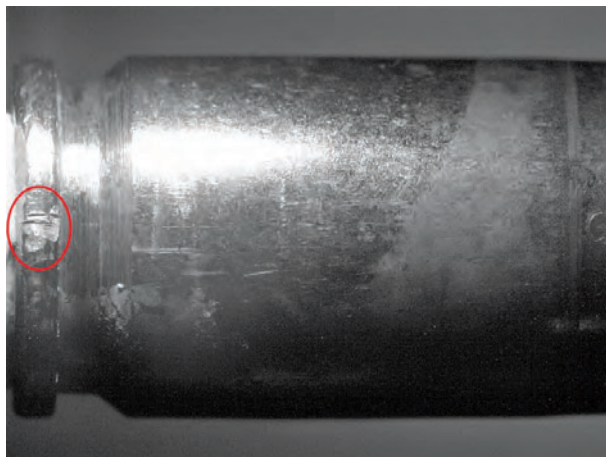


Figure 6: Drag mark at the rim of a cartridge case fired in a Walther PPQ pistol.

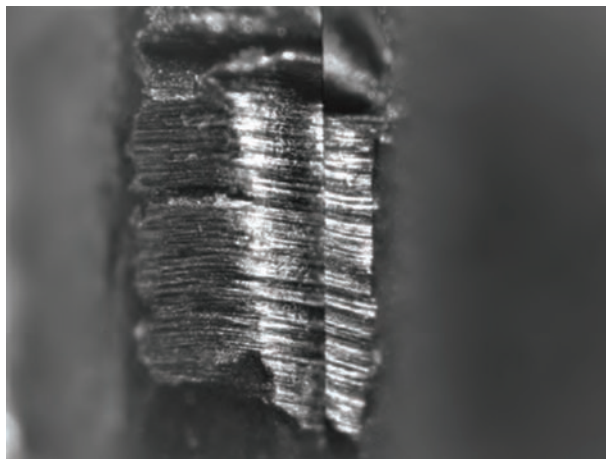


Figure 7: Agreement between drag marks from two cartridge cases fired in the same Walther PPQ pistol.

Chamber marks

Marks from the firearm chamber were observed on the walls of the examined cartridge cases, consisting of a ring around the exterior of the cartridge case about 4 mm (0.15 inch) from the case mouth (**Figure 8, 9**). When examining the front of the chamber, a constriction was observed in both converted and unaltered PPQ pistols. The constriction is from Walther's manufacturing processes and these marks originate from the edge of this constriction. The chambers in Walther barrels are made using a lathe, leaving concentric marks on the walls of the chamber [2]. When the cartridge is fired and the action cycles, the movement of the cartridge case is perpendicular to these concentric marks. These marks therefore have limited risk of subclass carryover [7, 8].

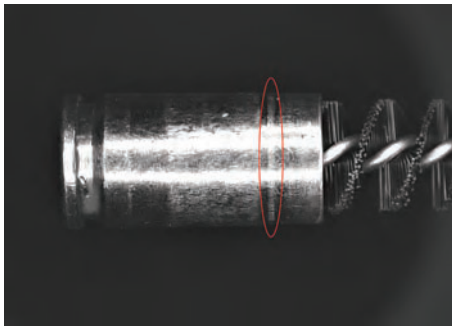


Figure 8: Chamber marks on cartridge case fired in a Walther PPQ pistol. These marks are not affected by the conversion to 4 mm or 6 mm Flobert or the conversion back to the original caliber.

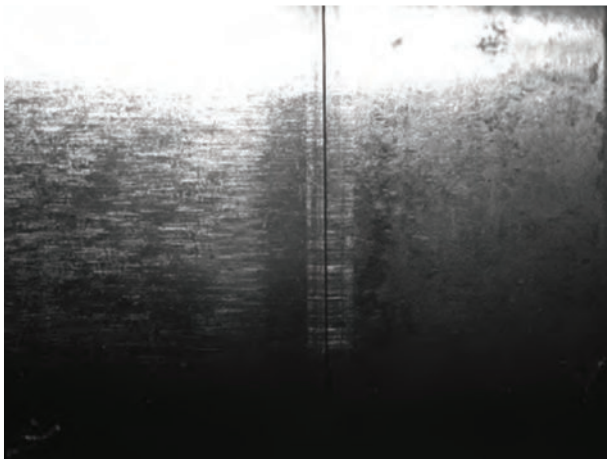


Figure 9: Agreement between chamber marks from two cartridge cases fired in the same Walther PPQ pistol.

Extractor marks

The extractor marks on examined cartridge cases had very few individual details. Walther PPQ extractors are made by metal injection molding (MIM) and the hook is finished in a secondary operation on a CNC machine [2]. When using a mold to manufacture extractors during the MIM process, extractors may possess similar features and there is potential for subclass characteristics [8]. The computerized movements of a CNC mill vary very little from each cutting pass, increasing the risk of subclass carryover. However, since the direction of the cutting edge of the tool in the CNC machine is perpendicular to the marks left on the cartridge case, the risk of subclass carryover will be low.

Ejector marks

The Walther PPQ ejector is stamped from a roll of sheet metal [2]. The edges of a stamped part will have both subclass

and individual characteristics. As the part is stamped, the initial portion of the stamped edge will have marks from the stamping tool but eventually the metal will be under enough stress that a shear zone will be created and the material will break, resulting in a surface with randomly created marks that are individual (Figure 10) [7]. Considering the orientation of the ejector in the pistol and its relation to the ejector marks on the cartridge cases, it is likely that the cut surface contacts the cartridge case, creating a risk of subclass carryover.

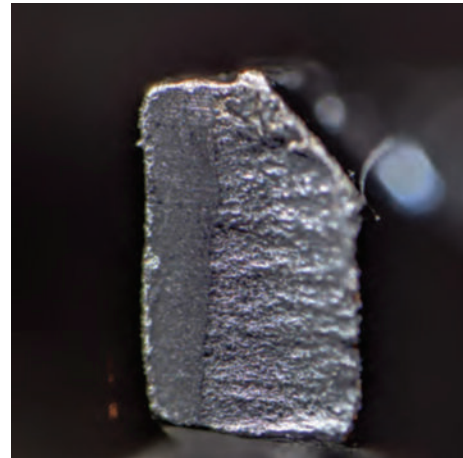


Figure 10: Ejector from a Walther PPQ pistol. The cut surface is on the left and the sheared area on the right.

Marks on bullets

Bullets from the PPQ polygonally rifled barrels examined as a part of this article have marks with very fine striations in the land impressions. On several bullets (both test fired and bullets found from crime scenes) coarse marks have also been observed (Figure 11). As previously mentioned, Walther is now producing barrels with polygonal rifling. The polygonally rifled barrels are button rifled or hammer forged and both these processes are subject to subclass carryover [8].

Several of the Walther PPQ pistols examined at the National Forensic Centre in Sweden show signs of having been converted to 4 mm or 6 mm Flobert and then back to the original caliber of 9 mm Luger. The modification of the muzzle and the burrs that are created during conversion back to the firearm's original caliber may leave coarse marks on bullets fired through them. Marks from the modification tools are added to the fine striations from the original polygonal rifling; these can sometimes completely override the fine striations. Since these coarse marks originate from metal chips breaking off, it is very likely that the marks seen on bullets are individual marks. Land impressions from converted Walther PPQ pistols that have been converted back to the original caliber can be

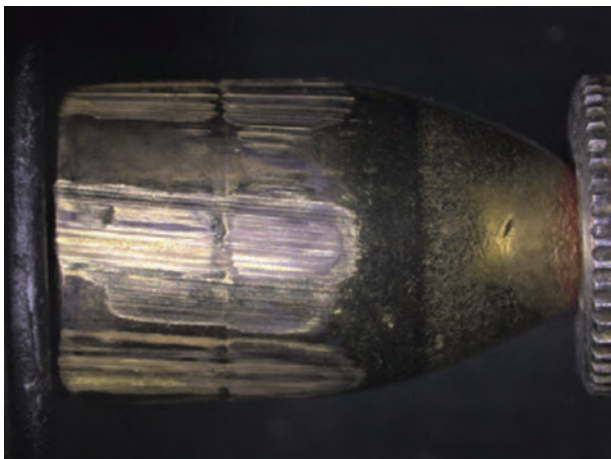


Figure 11: Bullet fired from a converted Walther PPQ pistol.

difficult to discern and bullets collected from crime scenes have occasionally been mistaken for being discharged through worn out conventionally rifled barrels.

Computerized versus manual comparisons

Because the Automated Ballistic Identification Systems (ABIS) only acquire marks on the head of the cartridge case, it is not possible to digitally compare drag marks on the rim and chamber marks. On cartridge cases fired in Walther PPQ pistols, the marks that are normally most useful for comparison are not acquired by ABIS. It is therefore essential to compare these cartridge cases manually with a comparison microscope to determine the potential for an identification or elimination. Individual marks on bullets fired through Walther PPQ pistols are, however, acquired in ABIS and they can be compared digitally.

Conclusions

Although some marks of forensic use from Walther PPQ pistols are quite smooth with limited microscopic information available, there are other areas that can help the forensic examiner. Drag marks on the rim of the cartridge case, chamber marks, and marks from the firing pin aperture are likely to be individual with little risk of subclass carryover. These marks are not affected by the conversion to 4 mm or 6 mm Flobert or the conversion back to the original caliber. There are also coarse marks on bullets caused by the modification of the muzzle of converted firearms, which are likely to be individual and can facilitate in determining an identification or elimination.

Investigated marks	Risk of subclass carryover
Firing pin impression	Moderate risk
Firing pin aperture marks	Limited risk
Breech face marks	Moderate risk
Cartridge case rim drag marks	Limited risk
Chamber marks	Limited risk
Extractor marks	Limited risk
Ejector marks	Moderate risk
Bullet marks	Limited to moderate risk

Table 1: Risk of subclass carryover in marks on cartridge cases and bullets fired in converted Walther PPQ pistols that have been modified back to their original caliber.

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