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FORENSIC CHARACTERISATION OF THE MECHANISM OF FORMATION OF TRACES ON BULLETS FIRED FROM CRAFT-MADE FIREARMS AND STANDARD TYPES OF FIREARMS

Abstract. ***Purpose.*** The purpose of the article is a forensic characterisation of the mechanism of formation of traces on bullets fired from craft-made firearms and standard types of firearms. ***Results.*** The article describes the mechanism of formation of traces on bullets fired from different samples of craft-made firearms. The article also specifies a number of circumstances that characterise craft-made firearms and form a trace pattern on bullets. The article describes the regularities revealed in the mechanism of trace formation on bullets at different ratios of bullet diameters and barrel channel. When firing craft-made smooth-bore firearms with different values of caliber excess, it is noted that: – with the increase of the clearence between the surfaces of the bullet and the barrel channel, the size, location and shape of the trace reflection changes (from complete deformation of the leading part of the bullets to a semi-oval). On such traces, it is possible to determine the approximate value of caliber excess, enabling to establish the design features of firearms that have not been submitted for examination; – traces on the bullet, reflected by a shot from firearms with a large caliber, can be distinguished from the traces reflected by the use of firearms with a misaligned chamber, drum chamber or equipped with a device for silent shooting (silencer). It is revealed that the occurrence of translationally oscillatory and translationally circular movements of the bullet can be explained by the following reasons: – uneven fastening (segmental crimping, coring, etc.) of the bullet in the cartridge case; – use of craft-made cartridges, in which the top in the head part of the bullet is located eccentric to its longitudinal axis; – mismatch of the bullet and cartridge case axes; – uneven pressure of powder gases on the bullet, due to: a) misalignment of the bullet inlet and the barrel channel; b) defects in the barrel channel, formed during the manufacture or operation of the firearm, and manifested in a partial reduction or increase in its diameter. ***Conclusions.*** When removing the elements of the dissector with violation of the integrity of the barrel channel, shells are formed that change the transverse roundness and fragmentarily increase the transverse area of the barrel channel. When the bullet crosses such a shell, the uniformity of pressure on the bottom part changes, because of which the direction of movement changes, and it begins to make translational and oscillatory movements. With self-made crimping, even and symmetrical depressed traces remain. With a tight fit of the bullet, the metal may be displaced around the cartridge case bore.

Key words: craft-made firearm, caliber of the firearm, barrel channel, rifling fields, muzzle of the barrel, bullet, chamber, trace.

1. Introduction

By the presence or absence of specific traces on the bullets, it is possible to establish not only the fact of the use of craft-made firearms, but also to determine its type (completely improvised, modified or adapted).

The analysis of the materials of expert practice, as well as the results of the experiments, allow to include among the constant conditions of the shot, which are essential for establishing the fact of the use of craft-made firearms, in addition to the design flaws in the parts and components of the firearm, formed in the manufacture of such firearms, also the mismatch of the diameters of the bullet and the barrel channel.

2. Traces on bullets from craft-made firearms

Traces on bullets fired from craft-made firearms primarily depend on the relief of the barrel channel. If a standard barrel from a factory-made firearm is used in the design and standard cartridges for the barrel are fired, the mechanism of formation of traces on the bullet will be the same as when firing from a standard firearm for which this barrel was originally intended. If there are irregularities and burrs in the muzzle of the barrel caused by rough machining or sawing of the barrel, traces of deformation are formed on the bullet.

Traces on the bullets fired from a craft-made revolver, unlike pistols, remain from the barrel channel, chamber channels of the drum, as well as from the rotating cartridge block and other parts of the firearm. The bullet may have traces formed on impact from a craft-made stump, as well as from the surface of the drum chamber in which the cartridge was located at the time of the shot. These traces are displayed as separate traces, which helps the expert not only to determine the design of the craft-made revolver, but also to identify it. For example, sometimes when fired from modified gas revolvers, the length of the bullet is reduced, but its caliber diameter is increased, while retaining traces suitable for identifying the modified drum (Photo 1).

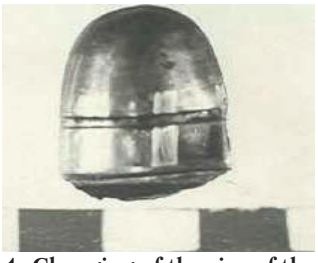

Photo 1. Changing of the size of the bullet (reducing of the length and increasing of diameter), fired from a modified gas revolver "Strazh"

The absence of traces of rifling on the bullet can be explained by the fact that the rifling in the firearm was made without observing the basic requirements for the manufacture of barrels. The length of the barrel, the pitch of the rifling and their depth were chosen by the manufacturer arbitrarily, somewhat smaller than necessary for such firearms. As a result, when firing a standard cartridge with a jacketless bullet, the latter overcomes the barrel channel, not having time to perceive the effect of the rifling. When firing from such a barrel with a cartridge that has a smaller powder charge, clear traces of rifling are displayed on the surface of the bullet (Ustinov, 1968, p. 69–72).

Most criminologists include differences in the diameters of the bullet and the barrel channel to the group of constant conditions that characterise craft-made firearms and form a trace pattern on the bullet. For example, a bullet fired from a firearm with a smaller caliber than it, crashing under strong pressure into the barrel channel, stretches, taking its diameter along the rifling, so its surface shows traces not only on the fields, but also the entire bottom surface of the riflings, with traces located not only on the leading part, but also on the lower parts of the head and tail of the bullet. In such cases, even with a worn barrel channel, traces of rifling fields are clearly visible. By such traces, it is possible to easily establish the group affiliation of the firearm used.

When firing a firearm with a larger diameter (caliber) of the barrel channel than the bullet, the movement of the bullet through the barrel channel will be unstable. This factor affects the dynamics of forward motion, so the bullet begins to make additional movements, which changes the trace pattern on its surface. Signs of the degree of influence of the discrepancy in diameters (calibers) on the formation of the trace pattern are necessary, first of all, for experts conducting forensic ballistics research. However, firstly, the data published so far are not summerised and differ significantly in the minimum clearance at which a change in the trace pattern occurs (E.N. Tikhonov – 0,01 mm) (Tihonov, 1974, p. 71), (E.I. Stashenko – 0,1 mm) (Stashenko, 1973, p. 57); (V.V. Sharunov – 0,28 mm) (Sharunov, 1981, p. 95), (V.V. Filippov – 1,0 mm) (Filippov, 1967, p. 19), and, secondly, the authors studied the mechanism of trace formation on the bullet when using only standard rifled firearms. Therefore, due to simpler technologies, the bulk of craft-made firearms are made with a smooth barrel

channel. However, the forensic literature provides no information about the parameters of the clearence at which the trace pattern on a bullet fired from such firearms changes.

We conducted an experiment in which different types of smooth-bore firearms were used with the caliber of the barrel channel exceeding from 0.1 to 1.0 mm. To obtain more detailed information about the mechanism of trace formation on the bullet, smooth-bore firearms with different barrel lengths were used, firing 5.45x39 (AKM) and 9x18 (PM) cartridges. The surface of the barrel channel was processed by machine equipment using a single technology. The purpose of the experimental study is to identify regularities in the mechanism of trace formation on the bullet at different diameters of the bullet and the barrel channel.

3. Bullet movement when the caliber of the barrel channel is exceeded

Direct examination of the surface of the bullets under a microscope MBS-10, as well as the study of traces on the photo scans found that, despite the differences in the size of the clearence, all the bullets to some extent had contact with the surface of the barrel channel, enabling to detect an important identification feature of firearms, which characterises the relative position of individual elements in traces belonging to a group of common features.

When the caliber of the barrel channel exceeds +0.1 mm, the bullet moves in a translational and oscillatory motion, without full contact with the surface of the barrel channel. In such a movement, the longitudinal axis of the bullet does not coincide with the axis of the barrel channel, and on the diagonally opposite surfaces of the driven part, parallel to the axis, well-defined traces-tracks are formed. Traces on bullets of different designs differ in size and location. The differences are caused by the fact that a 9 mm bullet's area of contact with the surface of the barrel channel along its circumference is larger than that of a 5.45 mm bullet. In addition, the 5.45 mm bullet is longer, it has a bevel in the tail part, which also affects the differences in the length of the traces (Photo 2).

With this excess of caliber, the traces on the bullets are more distinct in the area located closer to the tail part (80% – 5.45 mm, 65% – 9 mm), which is due to a deeper riflingting of the shell metal. Such traces consist of two parts that form a kind of rings. One ring is located at the junction of the head and leading parts, the other is at the junction of the leading and tail (bottom) parts of the bullet.

Photo 2. Traces on the surfaces of bullets fired from a smooth-bore craft-made firearm, in which the caliber of the barrel channel is 0.1 mm larger (left – bullet from a 5.45x39 mm cartridge, on the right – 9x18 mm)

When the caliber of the barrel channel is increased (+0.5 mm), the size, location and degree of traces' expressiveness change (Photo 3). This is manifested in their slight displacement (in 80% of the fired bullets the traces shifted to the tail of the bullet, while the length of the traces decreased). The boundary of the trace, located in the head part of 5.45 mm bullets, became wavier.

Photo 3. Traces on the surfaces of bullets fired from a smooth-bore craft-made firearm, with the caliber of the barrel channel exceeding +0.5 mm (on the left, bullet from a 5.45x39 cartridge, on the right, from a 9x18 cartridge)

With a further increase in caliber (up to + 1.0) of the firearm, the shape and size of the traces also change proportionally. These traces have the shape of a half oval, in which the rounded part is directed towards the top of the bullet. There is a slight shift in the direction of the traces relative to the bullet axis, which is not typical for smooth-bore firearms (Photo 4).

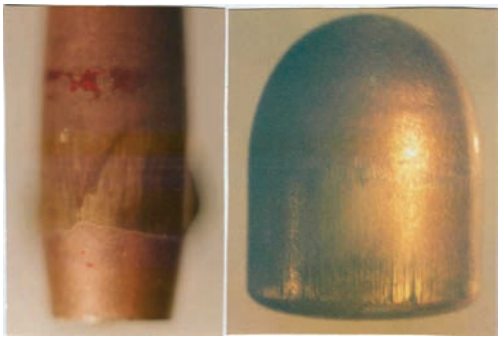

Photo 4. Traces on the surfaces of bullets fired from a smooth-bore craft-made firearm, exceeding the caliber of the barrel channel + 1.0 mm (on the left, bullet from a 5.45x39 cartridge, on the right, 9x18)

The change of direction can be explained by the fact that at a certain excess of the clearence, the bullet, in addition to the translational and oscillatory movement, can make a translational-circular movement. With this movement of the bullet, its contact with the surface of the barrel channel occurs at two points located on opposite sides of the bullet (Fig. 1). A distinctive feature of the translational-circular motion of the bullet from the translational-rotational motion, which is observed when using rifled firearms, is that the circular motion does not occur around the axis of the bullet.

Such traces in shape may resemble the traces formed when the cartridge chamber (drum chamber) and the barrel channel are mismatched (Photo 5).

You can distinguish them according to:

1) the place of reflection (in this case, closer to the tail part, and in case of misalignment of the chamber or the drum store, at the boundary of the slave and the main part of the bullet);

2) the shape (in case of inconsistency, the traces have double roundness);

3) the degree of expressiveness (with the normal arrangement of the axes, the depth of metal riflingting is less).

Photo 5. Traces on the surfaces of bullets that were reflected when fired from a craft-made firearm, in which the chamber (photo on the left) and the drum chamber (photo on the right) are misaligned

The traces on the bullets formed with a larger diameter of the barrel channel differ from the traces left by firing from a firearm equipped with a device for silent shooting (silencer). The latter have the peculiarities of reflecting a trace-defect (shearing of the shell) on the surface of the bullet: firstly, this trace has a characteristic concavity, and, secondly, it always has significant dimensions (Photo 6) (Latyshov, Maksimenkov, 1999, pp. 82–90).

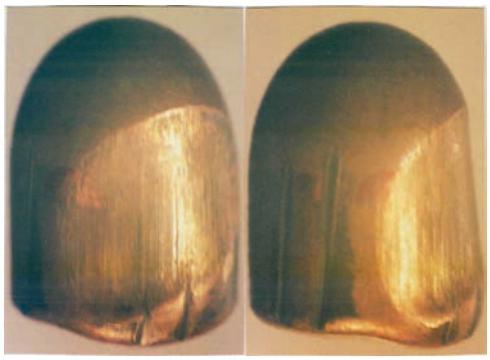

Photo 6. Traces on the surfaces of bullets reflected when fired from a firearm equipped with a device for silent shooting (silencer)

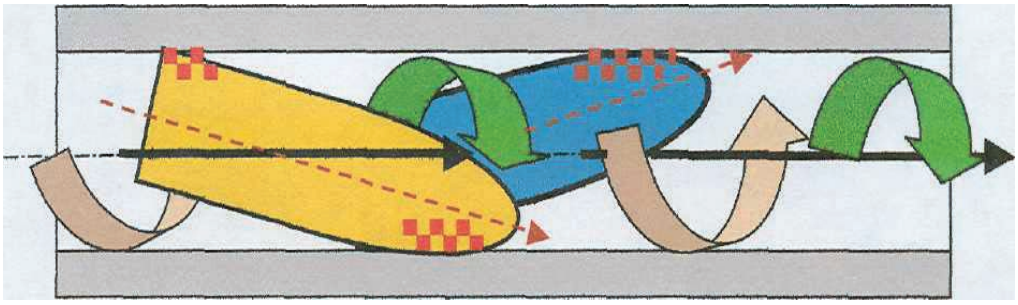

Figure 1. The mechanism of formation of traces at translational-circular movements of the bullet along the channel of the barrel of larger diameter

Bilateral deformation (within the driven and bottom (9 mm) or driven and tail parts of the bullets (5.45 mm), in which the cross-section of the bullet takes an oval (ellipsoidal) shape, was displayed in cases of use of firearms with a barrel length of more than 120 mm. The bullets fired from the guns with shorter barrel lengths mostly had only one-sided deformation. The differences in deformation are explained by the different barrel lengths, so the number of oscillatory movements does not correspond to them.

4. Traces of firing a craft-made smooth-bore firearm

Assessing the results of the experimental firing of craft-made smooth-bore firearms with different caliber excess, we note that:

1) with the increase of the clearence between the surfaces of the bullet and the barrel channel, the size, location and shape of the trace reflection changes (from complete deformation of the leading part of the bullets to a semi-oval). On such traces, it is possible to determine the approximate value of caliber excess, enabling to establish the design features of firearms that have not been submitted for examination;

2) traces on the bullet, reflected by a shot from firearms with a large caliber, can be distinguished from the traces reflected by the use of firearms with a misaligned chamber, drum chamber or equipped with a device for silent shooting (silencer).

The occurrence of occurrence of translational and oscillatory and translationally circular movements of the bullet can be explained by the following reasons:

1) uneven fastening (segmental crimping, coring, etc.) of the bullet in the cartridge case;

2) use of craft-made cartridges, in which the top in the head part of the bullet is located eccentric to its longitudinal axis;

3) mismatch of bullet and cartridge case axes;

4) uneven pressure of powder gases on the bullet, due to: a) misalignment of the bullet inlet and the barrel channel; b) defects in the barrel channel, formed during the manufacture or operation of the firearm, and manifested in a partial reduction or increase in its diameter.

Partial (fragmentary) reduction of the diameter of the barrel channel in the craft-made manufacture of firearms can be due to:

1) incomplete removal (drilling or knocking out) of the splitter in gas barrel firearms or the locking screw during the processing of firearms for underwater hunting (Demin, 1974, p. 41);

2) placing craft-made plugs in the gas exhaust hole in automatic firearms or in the hole drilled in training firearms (Gusarov, 1973, pp. 27–29);

3) rough processing of the barrel channel, resulting in arched rollers and grooves on its surface.

Under these factors, the residual elements from the splitter or plug remaining in the bore go inside the barrel channel, protruding beyond its surface. When the bullet passes through such a section, well-defined dynamic traces-tracks are formed along its entire length, which contribute to the correct determination of the design of the removed splitter.

In the places where the residual elements go beyond the surface of the barrel channel, the greatest metallisation occurs, which also affects the formation of microrelief in the traces. This is confirmed by the H.A. Samsonov's data (Samsonov, 1960, p. 43), which demonstrate that the microrelief of the traces is significantly modified during the metallisation of the barrel channel.

When removing the elements of the dissector with violation of the integrity of the barrel channel, shells are formed that change the transverse roundness and fragmentarily increase the transverse area of the barrel channel. When the bullet crosses such a shell, the uniformity of pressure on the bottom part changes, resulting in a change in the direction of movement, and it begins to make progressive oscillatory movements. Shells in the barrel channel leave traces on the bullet in the form of separate tracks. E.I. Stashenko explains the formation of these traces by the fact that when the bullet passes the area with protruding irregularities, "... swelling of the metal on the edges of the shells from the action of powder gases penetrating into the cracks of the surface layer" (Stashenko, 1973, p. 64), separate groups of tracks are formed (Photo 7).

Photo 7. A bullet fired from a craft-made firearm that has defects on the surface of the barrel channel (shell)

5. Conclusions

In addition, the signs indicating the use of craft-made firearms are as follows:

1) The absence of traces of fields and rifling on the bullet from a factory-made cartridge intended for rifled firearms (Photo 8);

2)

3) Photo 8. Two bullets to 9x18 cartridge fired from a standard firearm (PM) – on the left and from a craft-made smooth-bore pistol – on the right.

1) Non-standard number, as well as steepness and width of the riflings (Photo 9 "a", "b", "c", "d", "e");

2) Change in the character (degree) of roundness (ovality) or the presence of angularity of the cross section of the bullet.

The listed signs, depending on the form of manifestation, indicate:

1) craft-made production of riflings in the barrel channel;

2)

3) Photo 9. Six bullets (9x18 cartridges) fired from a firearm (from left to right, top to bottom): a firearm with four right-hand rifling (RH ПМ); a craft-made firearm with five left-hand rifling; a craft-made firearm with five right-hand rifling; a craft-made firearm with six right-hand rifling; a craft-made firearm with seven right-hand rifling.

1) larger caliber of the barrel channel than the bullet;

2) shortening of the standard barrel near the muzzle (Rusakov, 1981, p. 52);

3) incompleteness of factory production of the part – ствола the barrel (Latyshov, 1997, p. 131).

1) Elongation of the bullet by reducing its diameter, resulting from firing a firearm of a smaller calibre than the bullet (Ladin, 1965, pp. 196–199). In such cases, the traces of the rifling of the barrel channel are clearly visible, without changing the angle of their inclination;

2) Signs of craft-made changes in the shape of the bullet, manifested by shortening its length, or reducing its diameter;

3) Signs of craft-made fastening of the bullet in the cartridge case (non-standard shape, size, number and location of fastening marks). Craft-made crimping leaves even and symmetrical depressed traces. If the bullet fits tightly, the metal may be displaced around the cartridge case bore.

4) Traces of "sticking" on the head of the bullets, reflected from defects in the processing of the chamber and barrel inflow in the form of groups of arched scratches.

The article presents materials enabling forensic experts to correctly evaluate the traces formed on the fired bullets, while considering the influence of various factors on the patterns of trace formation and successfully solve the issues posed to them in the study of craft-made firearms.

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КРИМІНАЛІСТИЧНА ХАРАКТЕРИСТИКА МЕХАНІЗМУ УТВОРЕННЯ СЛІДІВ НА КУЛЯХ, ВИСТРІЛЯНИХ ІЗ САМОРОБНОЇ ВОГНЕПАЛЬНОЇ ЗБРОЇ ТА СТАНДАРТНИХ ВИДІВ ВОГНЕПАЛЬНОЇ ЗБРОЇ

Анотація. ***Мета.*** Метою статті є здійснення криміналістичної характеристики механізму утворення слідів на кулях, вистріляних із саморобної вогнепальної зброї та стандартних видів вогнепальної зброї. ***Результати.*** У статті викладено характеристику механізму утворення слідів на кулях, стріляних в різних зразках саморобної вогнепальної зброї. Також в статті детально розглядаються ціла низка обставин, які характеризують саморобну вогнепальну зброю і формують слідову картину на кулях. В статті описані виявлені закономірності в механізмі слідоутворення на кулях при різних співвідношеннях діаметрів куль та каналу ствола. При відстрілі саморобної гладкоствольної зброї з різною величиною перевищення калібру, відзначено, що: – зі збільшенням зазору між поверхнями кулі і каналу ствола змінюється розмір, розташування і форма відображення сліду (від повної деформації провідної частини куль до напівовалу). На таких слідах можна визначити приблизну величину перевищення калібру, що допоможе встановити конструктивні ознаки зброї, що не надійшла на дослідження; – сліди на кулі, що відобразилися при пострілі зі зброї з великим калібром, можна відрізнити від слідів, що відобразилися при застосуванні зброї з неспіввісним патронником, камори барабана або укомплектованого приладом для безшумової стрільби (глушником). З'ясовано, що виникнення поступально-коливальних і поступально-кругових рухів кулі може бути пояснено такими причинами: – нерівномірним кріпленням (сегментне обтиснення, керніння і т.п.) кулі в гільзі; – використанням саморобних патронів, у яких вершина в головній частині кулі розташована ексцентрично її повздовжньої вісі; – невідповідністю вісей кулі та гільзи; – нерівномірністю тиску порохових газів на кулю, внаслідок: а) несувісності кульового входу і каналу ствола;

б) наявних в каналі ствола дефектів, що утворилися при виготовленні або експлуатації зброї, і що виявилися в частковому зменшенні або збільшенні його діаметра. ***Висновки.*** При видаленні елементів розсікача з порушенням цілісності каналу ствола, утворюються раковини, що змінюють поперечну округлість і фрагментарно збільшують поперечну площу каналу ствола. При перетині кулею такої раковини, рівномірність тиску на донну частину змінюється, внаслідок чого змінюється напрямок руху, і вона починає здійснювати поступально-коливальні рухи. При саморобному обтиску залишаються парні і симетричні вдавлені сліди. При щільній посадці кулі можливий зсув металу навколо дульца гільзи.

Ключові слова: саморобна вогнепальна зброя, калібр зброї, канал ствола, поля нарізів, дульна частина ствола, куля, патронник, слід.

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