

# AN OPINION ON THE TRACES OF GUNSHOTS CLASSIFICATION

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## *Abstract*

A new classification proposed by the author orders the different categories of gunshots depending on the factors that caused the trace and the distance between the place of firing, and the body that was hit by the projectile. In this way, the traces created only on objects situated close to the mouth of the barrel and due to factors other than the projectile will be considered **secondary signs**, and those that remain on objects located at an arbitrary distance, but created by the action of the projectile or substances derived from its surface, will be defined as **primary traces**. It may be noted that the author considers the traces on the objects hit by the projectile regardless of distance from the mouth of fire as primary traces, while the secondary ones will be found only on close situated objects, not always hit by the projectile, so due to other factors which may not occur over a specific distance.

**Keywords:** gunshot, traces

The appearance and characteristics of the traces found on bodies touched by fire-arm shots vary with key factors and additional factors of the shot. In literature, gunshot traces are classified and described under different names depending on the causative factors.

Thus, some Romanian authors divide the **primary factors** determined by the direct action of the projectile and **additional factors** determined by the action of the powder, the composition of the staple and residue on the barrel<sup>1</sup>, others adopt a division into **main traces** listed as perforation and exit traces of bullet penetration traces, recoil traces, projectiles, tubes, caps, bearing the traces of objects created by the tracks and **secondary weapon traces** result of additional factors other than projectile<sup>2</sup>; another view shows the problem in the form of the **expertise of the main traces of the shooting**

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<sup>1</sup> C. Suci, *Criminalistica*, Edit. Didactică și Pedagogică, București, 1972, p. 347.

<sup>2</sup> L. Cârjan, *Criminalistică. Tratat*, Edit. Pinguin Book, București, 2005, p. 380.

due to the bullet and the **expertise of the secondary traces of the shooting** due to secondary factors<sup>1</sup> because, under a different presentation, the traces of the shot are classified into **marks of the projectile on the human body, tracks according to the distance of firing, tracks created by the bullet on various objects, tracks from firing at short range and traces from firing guns with pellets and case shot.**<sup>2</sup>

In the specialized foreign literature, gunshot traces are treated somewhat differently, the issues that address the problem of gunshot residues, the distance from the target<sup>3</sup> and issues of so-called terminal ballistics or lesion<sup>4</sup>, or the ways of examining of the residue remaining on various bodies<sup>5</sup>.

In this paper, in our opinion, strictly for educational reasons, we will order the different categories of gunshots depending on the factors that caused the trace and the distance between the place of firing and the body that was hit by the projectile. In this way, the traces created only on objects situated close to the mouth of the barrel and due to factors other than the projectile will be considered **secondary signs**, and those that remain on objects located at an arbitrary distance, but created by the action of the projectile or substances derived from its surface, will be defined as **primary traces**. It may be noted that we will consider the traces on the objects hit by the projectile regardless of distance from the mouth of fire as primary traces, while the secondary ones will be found only on close situated objects, not always hit by the projectile, so due to other factors which may not occur over a specific distance.

Taking into account these considerations the gunshot traces will be classified as follows:

**A. Primary traces** - mainly due to the primary factor – the bullet (or projectile), are present on the hit body regardless of the distance between the mouth of fire and target.

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<sup>1</sup> E. Stancu, *Tratat de criminalistică*, Edit. Actami, București, 2001, p. 269.

<sup>2</sup> I. Mircea, *Criminalistica*, Edit. Lumina Lex, București, 1999, pp. 172-175.

<sup>3</sup> R. Marlet, *Les Experts – Mode d'emploi*, FAVRE, Paris, 2007 p. 136

<sup>4</sup> A. Gallusser, M. Bonfanti, F. Schutz, *Expertise des armes à feu*, Presses polytechniques et universitaires romandes, Lausanne, 2002, pp. 77-86, 129-152.

<sup>5</sup> P. White, *Crime Scene to Court*, The Royal Society of Chemistry, Cambridge, 2005, pp.287-292; A. Buquet, *Manuel de criminalistique moderne*, Presses Universitaires de France, Paris, 2008, pp. 32-33.

**A1. The Inlet** characterized by the term „missing tissue” - the projectile drags the tissue from the surface inward in the direction of advance. Its circular shape is close in size to the caliber of the projectile, with size variations depending on the nature and composition of the struck body. If the projectile strikes a body after a ricochet, situation when the projectile doesn't continue its way with the tip pointing forward and spinning around its own longitudinal axis, the form of the inlet consists of a random section corresponding to the angle of the projectile, which rolls over, when it reaches the target.

**A2. The penetration channel** is generally represented by a linear path, following the trajectory of the projectile inside the struck body. We must take into consideration the fact that the shockwave corresponding to the energy of the projectile produces a temporary cavity larger than the residual cavity, inside a body characterized by a certain elasticity, traveled by the projectile. The effects of the temporary cavity on the human body manifest as destructions of the tissues and tears of blood vessels in the vicinity of the channel itself. Inside objects the penetration channel section has the form of a truncated cone with the smaller base represented by the inlet. There is the possibility that the projectile be deflected inside a body and therefore the channel will have an irregular route, or, if the projectile fragments within the body, from a certain point we may ascertain the presence of several channels which continue in different directions. If the projectile or projectile fragments no longer have enough energy they can remain inside the struck bodies, under these circumstances having closed or blind penetration channels.

**A3 The exit hole** usually has a larger diameter than the caliber of the projectile, its edge being turned outwards. This occurs due to loss of energy within the body, decrease in the speed of rotation around its axis, until a shift in the way of travel occurs, advancing takes place through rolling, leading to deformation by pushing and pulling the material over a larger area than the corresponding caliber as it leaves the body. Avulsion of the material can be found at the exit hole of a wooden plate, the fibers being detached in the way the projectile exits.

**A4 Abrasion ring** – this category of traces appears in form of deposits, more or less consistent, made around the inlet, consisting of

impurities removed from the outer surface of the bullet. The materials involved by the projectile on its surface may derive from the maintenance oil of the weapon used for barrel maintenance, from the deposition of dust and rust inside the barrel or even alien fragments collected by the projectile during its trajectory to the target. Examining the consistency of the abrasion rings, on a body touched by multiple hits coming from the same weapon, allows us to determine the order of the shots that were fired on different areas of the same body.

**A5 Metal ring** – is formed from loose metallic particles from the outer layer of the projectile due to the action of rifling and even metallic particles driven because of intense friction from the material that composes the barrel of the firearm; these semi-detached metal particles from the projectile jacket or stuck on the projectile jacket are deposited around the inlet in a harder material (bone tissue inside the human body). The abrasion and the metal rings can overlap if the bullet has, as the first contact, an object of increased hardness (a sheet of metal).

We can consider primary traces those which occur in sheets of glass pierced by the projectile. Thus we can distinguish concentric cracks around the holes which appear when a high-speed penetration takes place, accompanied by radial cracks, when the projectile has a lower speed.

**B. Secondary traces** – due to additional factors other than the projectile, are found only on the objects situated at relatively small distances from the place of firing.

**B1 Muzzle imprint** appears due to the **recoil** of the weapon. It appears as a circular bruising, corresponding to the contour of the firearm barrel. The tendency to balance the recoil of the firearm when the projectile expulsion takes place, leads to the unintentional reaction to push the gun forward causing a concussion. This category of traces appears only when the shot is made with the gun pressed against the body or from 1-2 cm away.

**B2 Breaks (laceration) of tissue and fabrics** - due to **gas pressure** resulting from the burning powder, gases that push the projectile outward. When the muzzle is spaced less than 5 cm from the body hit by the projectile, gases penetrate into the body still having a relatively cylindrical shape corresponding to the restrictive conditions of movement inside the

cylindrical shape of the gun barrel. Suddenly, the constraints of the steel cylindrical barrel disappear, the phenomenon of relaxation manifests, the pressure equalizes from tens or hundreds of atmospheres of gas pressure to normal atmosphere. Therefore, the gases exit the body violently towards the low pressure exterior, causing tearing of tissue and clothing, tears that resemble a cross or a star. The dimensions of the inlet become larger, the edges are turned outward, and, if we disregard the presence of the other categories of secondary traces, such an inlet looks like an exit hole.

**B3 Burns of the tissue and fabric** – appear due to the additional factor **high temperature (muzzle flame)** of the gas expelled. Gases resulting from a rapid combustion process of the powder have high temperatures. Oxygen in the air at end of the barrel burns contributing to the formation of the flame from the muzzle, which, at varying distances depending on the quantity and quality of the powder, burns the hair or skin (tanning of the skin) or materials situated at distances of 10-15 cm.

**B4 Tattooing** – due to additional factors **incandescent particles or in the state of semi burnt powder**. Combustion of black powder is not held with the same velocity as the entire load, so a certain amount of incandescent or semi-burned particles exist in the flow gas stream accompanying the projectile. These particles get inside the skin forming the so-called "tattoo" of the shot, circularly arranged around the entrance port of the bodies lying at distances below 30 cm from the loose end of the barrel.

**B5 Smoking sleeve** - due to additional factors **burned powder particles (cold)**. Variable amounts (depending on the quantity and quality of the powder) of burned, cold particles are propelled in the firing direction. These residues are deposited in the form of a smoking sleeve on bodies at distances up to several tens of centimeters from the firing site. The form of the sleeve is specific to the angle of the barrel towards the hit body, and its composition varies with distance, quality and quantity of powder from the flinging charge.

Residues of the firing can be seen not only on bodies affected by gunfire, but also on the hands or face of the gunman depending on the gun model used.

A special category of traces of gunshot are **traces of ricochet**, characterized by length, depth and angle (or plan) of deviation; their values

vary with the angle of incidence of the projectile with the reached surface, the type of projectile and composition of the intersected body. In these situations some categories of secondary traces of gunshot depending on the distance from the muzzle may be present, along with the trace of ricochet.

**C. Traces from firing guns with pellets or case shots** have their own characteristics due to the fact that multiple projectiles spread after leaving the gun barrel, under the form of a cone with its base directed towards the target, the so-called "scattering."

Depending on the shot scattering ray, on the surface of an object touched by the firearm shot, we can estimate the distance at which it was fired from. The circular or oval shape of the scattering surface of the pellets provides information on the angle under which the barrel is located compared to the hit object. When shooting at close range a few tens of cm, or even 1-3 m in case of choke tubes (tubes with shrunk diameter in the final part, for a tighter grouping of pellets), inlet is unique but presents irregularities on the circumference. Small holes may also appear, isolated, at distances closer to the central one. Due to the size, shape and low weight multiple projectiles have less kinetic energy, hence a lower penetration, in most cases remaining inside the object hit, at the end of a blind penetration channel.

In general, the powder used for this type of ammunition is black, after burning resulting into an increased quantity of residue which will be deposited in the form of secondary traces on objects located at larger distances, of several meters, as opposite to the colloidal powder.