

## FORENSIC BALLISTIC IN CRIMINAL JUSTICE SYSTEM

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### ABSTRACT

Criminals with guns frequently use firearms to perform numerous major crimes that end in fatalities or dangerous injuries. However, recent reports of terrorists and other criminal elements using sophisticated weapons that were clandestinely smuggled across our country's international borders and used indiscriminately raise serious concerns for the law and order apparatus. Due to the employment of firearms by terrorists, naxals, interstate criminals, serial killers, and repeated criminals throughout the nation, crimes involving firearms are on the rise. Criminals frequently use the same weapon to conduct several crimes over an extended period of time in various jurisdictions. A forensic science lab is a technical organization with a dedicated focus on advancing criminal justice. By addressing or helping to address the crucial questions of whether a crime has been committed, how and when it was committed, who committed it, and just as essential could not have committed it, it provides this help.

**Keywords:** *Forensic Ballistic, Criminal, Justice.*

### I. INTRODUCTION

Forensic ballistics is the examination of weapons, cartridges and bullets.<sup>2</sup> Ballistic weapons which are used for crimes of violence can be categories into main types; smooth bore and rifled firearms. Between the two types there are various types of ballistic weapons, but suffice it to say here that a smooth bore firearm is the ordinary type of shotgun or shot-pistol, and the bullet used is the shot which consists of small lead balls or pellets.<sup>3</sup>

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<sup>2</sup> M.C. Sarkar, S.C. Sarkar, et. al., Sarkar's Law of Evidence 877 (Wadhwa and Company Law Publishers, Nagpur 1999).

<sup>3</sup> V. Mitter, Law of Identification 95 (Law Publishers, Allahabad, 1961).

shotgun or shot-pistol, and the bullet used is the shot which consists of small lead balls or pellets. The physical evidence related to ballistic weapons normally deals with the fired cartridges, empties, firearms etc. The nature of the examination in ballistic weapon cases is normally to find out whether the fired cartridge are fired from a particular firearm, nature and the type of the firearm, the direction of the firing, the distance of the firing, the range of firing of the firearm the time elapsed since the time of firing etc.<sup>4</sup> A genuine investigator has several challenges, the most common of which are:

- Identifying the crime's location.
- Go to the area & collect tangible evidence from the scene of the offense.
- Identification of the weapon used in the incident.
- Finding information from inputs.
- Providing one or more missing links in an investigative process.

The investigator's research can be limited to small ballistic weapons such as guns, rifles, pistols, semiautomatic pistols, and magazines weapons. The lock, stock, barrels, and accessories are the components of all of these guns. A pistol or revolver has a short barrel and a curved stock, requiring the handgun to be carried in the hand when shot.<sup>5</sup> Every ballistic weapon discovered at the scene of a crime should not be taken immediately. Before they can be retrieved, it must be determined if they have gone through the hands of anybody. If some ballistic weapons are discovered that have not been touched by anyone, the investigator may discover valuable fingerprint of the perpetrator on them. The investigator should make a note of the firearm's serial number, manufacture, and model, and properly package it for expert inspection.

The bullets, or cartridges, used in contemporary ballistic weapons have three components incorporated inside them. Cartridges, propellant, and primer are the components. The cartridge is the projectile that will exit the barrels after firing. It is constructed of several metals such as brass, steel, and aluminum, as well as rubber and mood. For maximum efficiency and durability, most rounds contain lead as well as other metals.

The police investigator with a team consisting of firearms, medico-legal and a fingerprint expert along with a photographer should visit the scene of crime. The first and foremost

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<sup>4</sup>Rukmani Krishnamurthy, Forensic Science in Crime Investigation 327(Selective & Scientific Books, New Delhi, 2011).

<sup>5</sup> Ronald Martin Howe, M.C., Criminal Investigation A Practical Textbook for Magistrates, Police Officers and Lawyers 164 (Sweet & Maxwell Limited, London, 1949).

duty should be to attend on the victim and arrange for necessary medical aid and recording of dying declaration.

## II. MECHANISM OF FIREARMS

Two key elements comprise the ballistic weapon: (1) the barrels & (2) the automated system that contains the chamber, tightening pin, extractor, and ejection device & activate. There are two kinds of barrels: (1) smooth bore and (2) smooth grooves.

All barrels are made of boiled solid steel parts. The solid steel pieces are subjected to the drilling process from one end to the other with a uniform diameter. The inner side of the barrel will later bore with a reamer to produce a smooth surface. One of the scientific significance of barrel is that due to the drilling process, the inner surface of the barrel gets various scratches and scars which supplies the individually to that barrel. These scratches and scars give distinct marks on the bullets that fired through that barrel, which are considered in forensic firearms as individual characteristics. On the other hand, rifles contain various grooves and lands artificially created for firing accuracy, rotation of bullets, firing to a long distance etc. Barrel grooves are of two types: (1) grooves twist towards that left hand side and (2) grooves twist towards the right hand side.<sup>6</sup>

The improvised weapons are also recognized as country-made weapons, home-made weapons, pipe weapons, zip weapons etc. these weapons are made by ordinary blacksmiths to no particulars specifications, nor any standard raw material is used. These firearms have short span of life and most of them are extremely dangerous.<sup>7</sup>

Iron tubing of different size, sanitary pipes, bicycle frames are used for manufacture of barrels, metal strips for action body and frame, wood pieces for butts, metallic wires, nut-bolts and cheap quality of nails, and at times, jute or cotton threads are used for assembly. The entire manufacturing process is done in indigenous work-shops of a blacksmith with the assistance of ordinary instruments. The barrels are made from cheap quality iron tubing which is never tested for the desired strength. There is no special fabrication of chamber, nor there do any chamber cone. The chamber and other parts of the barrel are in one continuation. There is hardly any polishing or lapping of the bore.<sup>8</sup>

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<sup>6</sup> Rinker R.A., Understanding Firearm Ballistics 128 (Mulberry House Publishing, Clarksville, 2004).

<sup>7</sup>*Id.* at 273.

<sup>8</sup>*Ibid.*

### III. EVIDENCE COLLECTION

Before packaging the ballistic weapon, its serial number, make, model, calibre, etc. should always be recorded. The empty cartridge are often found at the crime scene, there position should be noted. Since, they may contain chamber, firing pin, and ejector marks, hence should be collected carefully. The ballistic weapon may contain live cartridge in the chamber or in the magazine. In such a situation, they should be recovered with taking extra care by an expert ballistic weapon handler only. Cartridge may be found embedded in a wall, tree, and trunk. Doors, windows, etc. the material around the place of lodgement of the cartridge should first be removed to lose the cartridge and then it may be taken out carefully, so that extra scratch marks will not develop on its surface.<sup>9</sup>

The crime firearm is sent to Forensic Science Laboratory to determine, if it is prone to accidental fired prior to its dispatch to Forensic Science Laboratory as shown by analysis of barrel washings, etc. it is also required for test firing of cartridge and bullet cases to ascertain if the crime ammunition was fired from the suspect firearm. Restoration of erased serial number, manufacture's identification marks, bore/caliber and proof marks may be necessary.

The package/dispatching firearms/ammunitions are:

- (i) wrap weapon with tissue paper and package in plastic bag,
- (ii) wrap live cartridges, cartridge shells, bullets and distorted projectiles and fragments in clean cotton by lifting with plastic tweezers and package small bags separately,
- (iii) Never mark on firearm or ammunition. Label the container instead,
- (iv) bullets or projectiles recovered from dead body should be allowed to air dry before packaging,
- (v) if a firearm is to be shipped to the lab, unload it before packing. If an auto loading pistol is involved, remove the clip and cartridge from the chamber (if the firearm was loaded). If the firearm is a revolver, remove all bullets from the cylinder, both fired and unfired. However, notes should be made of the exact position of each bullets and the chamber from which it was removed. This information should be furnished to the lab,

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<sup>9</sup> B.P. Maithi, Physical Evidence in Criminal Investigation & Trials 299 (Selective & Scientific Books, New Delhi, 2012).

(vi) to prepare ballistic weapons for shipment, place the firearm on it's on the bottom of a strong corrugated cardboard box. Lace the firearm in a larger carton, or place a lid on the one used and wrap securely with heavy paper. Seal, label, and submit to the lab. Be sure to include a copy of the request for examination within the package. Rifles and shotguns may be dismantled in order that they may be dismantled in order that they may be more conveniently shipped.<sup>10</sup>

The study in Forensic firearms involves identifying the firearms that have been recovered or used. The law of originality is the cornerstone of identity. When a firearm is found, it might be necessary to determine if the firearms are properly produced or are created illegally. The sequential number, manufacture & model, kind & firearms bore/caliber must also be recognized as part of the laboratory examination. Sometimes the criminal removes the serial number to avoid identifying or to be requested by the legitimate firearms owner. It is the responsibility of the laboratory to address all such queries. The concept of identification is laid forth in the legislation itself in such circumstances.<sup>11</sup>

#### IV. METHODS OF EXAMINATION OF BALLISTIC WEAPONS

A number of approaches are used to gather gunshot remnants. The following are significant methods:

- **DRY METHOD**

Gunshot Residues from hands are collected using molten wax with a sufficient melting point. It is carefully rubbed over the hands until it is thick enough. It is permitted to set. If the wax has hardened, it is scrubbed off. It collects the residues of Gunshot particles from the hand.<sup>12</sup> On location with gunshot remnants a solution of cellulose is administered. It is taken off when it has dried. The cast collects the remains of the gunshot. On the spot with the powder markings, the solution is sprayed. The created film is enhanced by nylon strands. The reinforced film that collects the powder remains is pulled off and desiccated. It picks up the Gunshot Residues particles. The tape is held within the vial before and after usage in a vial with an adhesive surface. The tape is attached to the stub to be examined.

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<sup>10</sup> John J. Horgan, Criminal Investigation 31 (McGraw-Hill Book Company, New York, 1974).

<sup>11</sup> Kaushalendra Kumar, Forensic Ballistics in Criminal Justice 216 (Eastern Book Company, Lucknow, 1987).

<sup>12</sup> B.R. Sharma, Forensic Science in Criminal Investigation and Trials 481 (Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2014).

- **WET METHODS**

Diluted acetic acid moistens a filter paper. It is pushed against the place suspected of carrying traces of firearms. The filter paper collects them. A cotton cloth or cotton swab is wetted with diluted hydrochloric acid (10 per cent) and with nitric acid (5 per cent) and this piece of cloth is swabbed on the spot containing firearm residues. It collects the residue of firearms. The swabs are taken individually from various areas of the hand.

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- **DERMAL NITRATE TEST**

The dermal nitrates test was used often to identify the gunman before 1950. The test is straightforward. The nitrates are collected on a paraffin wax cast, as previously reported. Diphenylamine dissolves the remains of the cast in strong sulfuric acid. The development of blue dots shows nitrates. In turn, the existence of the gunshot remnants is suggestive. The technique is no longer utilized as several common materials had a positive reply to the aforementioned tests.

- **PARAFFIN TEST**

The method of detecting gunpowder residues in the hands of a suspect in a case of shooting is known as paraffin test and depends upon the fact that when a poorly constructed weapon is fired, the burnt/unburnt gunpowder residue escape through the rear and get deposited on the firing hand. If the hand is examined before it is washed, the products of combustion of propellant will be detected therein.

- **GREISS TEST**

Presence of nitrite particles on firearm shot residues is detected by a colour test known as 'Greiss Test', involving the sequence as follows: (i) solution of 10% sodium hydroxide is used for spraying of the surface containing the firearm shot residue, (ii) dipping of Whatman filter paper in solution of Griess reagent comprising of 5% sulphuric acid in which is dissolved 3% sulphanilamide, 0.3% N-(1- naphthyl) ethylene diamide, dihydrochloride,<sup>14</sup> and (iii) pressing of light iron over the moistened filter paper, placed over the pattern of firearm shot residue.

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<sup>13</sup>B.R. Sharma, Firearms in Criminal Investigation & Trials 237 (Universal Law Publishing Co. Pvt. Ltd., New Delhi, 2012).

<sup>14</sup>Anoop Modak (eds.), Firearms Investigation 178 (Universal Law Publishing, an imprint of LexisNexis, Gurgaon, 2016).

- **HARRISON AND GILROY'S TEST**

Availability of main, barium & antimony, can be determined by a spot test known as 'Harrison & Gilroy's Test', used for identification of a bullet hole or a shooter, which entails collection of firearm shot residues embedded with metallic constituents, on moistened cotton cloth with dilute hydrochloric acid.

## **V. AUTOMATED FIREARM IDENTIFICATION**

In the area of ballistic weapon identification, a number of automated comparison systems like landmark identification system, non-contact laser surface analysis, and laser profilometry are being developed at the international level. It is reported that in some countries, whenever firearm, bullets, or cartridge cases are discovered in a crime, an inter-comparison is made with the other crime cases to explore linkage, if any. This appears to be promising technique to keep a track of unsolved crime cases involving firearms.<sup>15</sup>

The Central Forensic Science Laboratory, Chandigarh is working on the development of automated ballistic weapons identification system and establishment of firearm and ammunition database for forensic investigation. The lab should extend its efforts to set up a national database for use by the entire forensic science lab and other law enforcement agencies in the India. The database therefore helps connect previously unlinked offenses perpetrated in various jurisdictions with the similar ballistic weapons.<sup>16</sup>

## **VI. NATIONAL INTEGRATED BALLISTIC INFORMATION NETWORK (NIBIN)**

NIBIN system is a sort of fingerprint bureau for the 'thumbprint' of ballistic weapons. The identifying data from all the licensed factory-made ballistic weapons, if generated and stored in the computers of the NIBIN before they are sold, they are sold, can be used to identify the offending ballistic weapons abused in a crime. The fired bullet, cartridges left at the scene can identify the ballistic weapon from the corresponding recorded data kept in the National Integrated Ballistic Information Network. The NIBIN system has many importance: (i) Comparison takes less time, (ii) Comparison and verification can be done

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<sup>15</sup> B.B. Nanda & Dr. R.K. Tewari, *Forensic Science of India* 212 (Select Publishers, New Delhi, 2001).

<sup>16</sup> S.S. Baisoya, *National Ballistics Imaging Database Management and its Applications in Indian Perspective* The Indian Police Journal (2005) Sept. 12, 2022, 10.00 AM), <http://www.bprd.nic.in/WriteReadData>.

at any designated match point place where the facilities for the work are installed, and (iii) the hurdle presented by the deformation of bullets is taken care of by the NIBIN system.

## VII. EXPERT EVIDENCE UNDER INDIAN EVIDENCE ACT, 1872

An expert testifies in court on his credentials, expertise, and practice in a relevant subject as well as real firearms examination. As a result, the credentials and experience are as follows. Brought to the court's attention for the perseverance of determining whether the individual presenting evidence is an expert under Section 45 of the Indian Evidence Act<sup>17</sup> or not. S. 45 of the Indian Evidence Act states that only individuals who are highly competent in the art or science in that they are stating their thoughts are permitted to offer expert evidence. The purpose of recording the expert's credentials is to demonstrate that the expert is uniquely equipped to voice an opinion on the issue at hand due to education, training, or experience.

An intelligible and convincing inference constituting the examination report essentially comprises of data, charts, sketch/illustrations and photographs. Adducing of such report in court as evidence can be made in person by the expert accompanied and supported by the data, or by way of written report in compliance with Sec. 293 of the CrPC, 1973. Personal appearance of such expert for the purpose of elaboration or justification of the inference can be secured by the Court, wherever necessary. A prosecution counsel renders assistance to the expert in the course of presentation of evidence in a Court, which is subjected to critical appraisal by the counsel for defense. A final assessment of the evidentiary value of the expert evidence is arrived at by a conscientious Judge, on observation of performance of the expert.<sup>18</sup>

Ultimate evaluation of evidence of the expert and its utility is, undertaken by the Court. Courts are sometimes hostile towards the expert evidence produced, on the belief that the expert accepts the roles of the Court, and are reluctant to accept the same by terming it as weak evidence. Instances are available of either acceptance of '*ipse dixit*' of the expert or ignoring the evidence, on the feeling that the expert report is beyond the understanding of the court. Towards appreciation of evidence, the Courts must ensure: (i) Presence of relevancy, intelligence and proper demonstration of expert evidence, which conforms to the special standards, (iii) Discharge of duties by the expert, as well as by the defence and

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<sup>17</sup> Section 45 of the Indian Evidence Act, 1872.

<sup>18</sup> Section 293 of the Criminal Procedure Code, 1973.

prosecution counsels, (iv) Prevention of intervention by an imposter, in respect of the evidence, (v) Non-use of technical terms/verbosity or jargon by the expert to conceal the demerits in the report, or for misleading the Court on issues which are not relevant, (vi) That answers to relevant questions are not skipped by the expert, (vii) Clarification of ambiguity in areas, created either by the prosecution or the defence or by both.

In *State v. Mohd. Afzal And Ors.*,<sup>19</sup> (Popularly known as Parliament Attack Case) “On 13<sup>th</sup> December, 2001, five terrorists infiltrated Parliament House in a vehicle labelled with the Home Ministry & Parliament. While both the Rajya Sabha & the Lok Sabha had been adjourned forty minutes before the attack, many members of parliament & government officials, including Home Minister L.K. Advani & Minister of State for Defence Harin Pathak, were believed to be still in the building at the time of the attack.” The shooters drove a vehicle with a fake identity sticker, effortlessly breaching the protection setup around the legislative complex. The terrorists were firearms with AK-47 rifles, assault rifles, grenade launchers, pistols, & grenades, electronic detonators, spare ammunition, and explosives in the form of improvised explosive devices, such as tiffin bombs, as well as a sophisticated bomb in a container in the boot of the car made of a large amount of ammonium nitrate.

The Forensic Science Laboratory in Chandigarh testified about the explosives in improvised explosive devices, and the vehicle bomb seized from the scene of the crime on December 13<sup>th</sup>, 2001. According to forensic report, “Ammonium Nitrate, Aluminum/Silver powder, & Sulphur” were discovered in the explosives. Evidence indicates that the chemical samples (taken from the hideaways) included Aluminum Nitrate, Sulphur, & Silver powder. Afzal was found guilty according to forensic evidence. The punishment was set to be carried out on October 20<sup>th</sup>, 2006; however Afzal was granted a stay of execution & is still on death row. On February 9<sup>th</sup>, 2013, at 8:00 a.m., he was hung at Delhi's Tihar Jail.

In the case of *Shahzad Ahmed v. State*<sup>20</sup> (Popularly known as Batla House encounter case), On September 19<sup>th</sup>, 2008, the encounter occurred at flat no. L-18, Batla House in the Jamia Nagar neighbourhood of New Delhi, six days after serial bomb explosions rocked the city, killing 26 people and wounding 133 more. The police had arrived at the Batla House after

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<sup>19</sup>State v. Mohd. Afzal And Ors. (2003) DLT 385, 2003 (71) DRJ 178, 2003 (3) JCC 1669 (India).

<sup>20</sup> Shahzad Ahmed v. State (2013) CRL.A. 1196 (India).

receiving information that several suspected militants engaged in the explosions were holed up inside. From the scene, the police squad discovered two .30 bore pistols & one AK series rifle with two filled magazines holding 30 live rounds. “The forensic ballistic examination also proved that empty cartridges were fired from weapons in the possession of the terrorist duo. The Court holds Shahzad guilty of murdering inspector M.C. Sharma & assaulting other police officers.”

In *The State v. Sushil Sharma*<sup>21</sup> (popularly known as the Tandoor Murder Case), “Shushil Sharma killed his wife, Naina Sahni, at home by shooting three bullets into her corpse. He murdered his wife because he suspected she was having an affair with her classmate & fellow congress worker. Sharma drove his wife's body to the Bagiya restaurant after murdering her, where he and restaurant manager Keshav Kumar attempted to burn her in a tandoor. Sharma's firearm & bloodstained clothing were collected by police and sent to the Lodhi Road Forensic Laboratory.” During the post-mortem investigation of that poor woman's burned corpse, bullets were discovered imbedded in the head and neck region and the ballistic expert determined that those rounds were fired from the .32 Arminius revolvers that the appellant admittedly owned at the time. On July 4<sup>th</sup>, 1995, five fired cartridge cases of .32 calibre & one bullet of .32 calibre, as well as some blood-stained articles were recovered from a flat & those cartridge cases & bullet were also found to have been fired from the licensed firearm by a ballistic expert. Sushil Sharma's .32 revolvers and the blood on other objects were determined to be of the AB Group, which was Naina Sahni's blood group. Mr. Shushil Sharma was found guilty with the help of forensic evidence.

## VIII. CONCLUSION

Ballistics Division's task entails identifying and comparing weapons, ammunition, and parts thereof. Examining target materials is also part of the job. Standard small arms and ammunition of varied make and caliber are on display, as well as homemade/improvised weapons and ammunition, bullets, pellets, wads, propellant, cartridge casings, and the appliances used in the manufacturing of firearm ammunition. This category examines conventional and country-made guns, deadly weapons such as revolvers, pistols, assault rifles, carbines, & ammunition. This division is also responsible for the inspection of guns in possession under the Arms Act. This section also examines gunshot remnants from fired bullets, cartridges, shot holes on clothes/skin/window glasses, & so on, as well as the

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<sup>21</sup> *The State v. Sushil Sharma* (1996) CriLJ 3944 (India).

distance of shooting in cases of murder/assault. A comparison microscope is used to compare the striations on fired ammunitions & firing pin impressions on fired cartridge cases from the crime scene with test-fired bullets & test fire magazine cases. In this sector, scanning electron microscopy is utilized in forensic ballistic applications such as gunshot residue analysis, weapon identification (bullets and empty cartridges), and case markings comparisons. A ballistics specialist is familiar with the many marks that weapons make on bullets when they are shot, such as the rifling marks on a barrel and other striations on the projectile.

In India, the causes of death due to accidental firing are very common because of the easy availability of improvised firearms/homemade weapons. It has often come across in the news about deaths due to accidental firing in wedding ceremonies and other similar functions. Moreover, lack of proper knowledge of handling weapons is also a common reason for accidental cases related to firearms. The Arms Amendment Act, 2019, which was approved on December 14<sup>th</sup>, 2019, included celebratory gunfire, stating that anybody who uses weapons for celebratory shooting will face a 2-year jail sentence and a fine of up to Rs 1 lakh.

## **IX. SUGGESTIONS**

- Forensic Science Laboratories should organize seminars/conferences and workshops regarding the examination of ballistic weapons and the importance of forensic ballistic research to the criminal justice system.
- Indian Forensic examination ballistic weapons division should review and study forensic ballistic weapons examination procedures in England, Canada, the United States America, and Interpol's forensic ballistic labs. These countries are having advanced technology of forensic examination ballistic weapons.
- Proper channel and procedure must be followed while handling and collecting evidence for correctly report, review, evaluation, investigation procedure, firearms and submits evidence in forensic science laboratories.
- Illegal weapons/country made firearms are a big problem all over the world. The forensic ballistic divisions should developed and discover new inventions and new tools/techniques/technology for the examination of country-made weapons/ homemade firearms.