International Journal of Computational Research and Development (IJCRD)
Impact Factor: 5.015, ISSN (Online): 2456 - 3137
(www.dvpublication.com) Volume 3, Issue 2, 2018

DETERMINATION OF RANGE OF FIRING BY GSR - A REVIEW

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Cite This Article: Komal Yadav, Prashant Agarwal & NB Bardhan, "Determination of Range of Firing by GSR - A Review", International Journal of Computational Research and Development, Volume 3, Issue 2, Page Number 22-25, 2018.

Abstract:

A variety of country made firearms are manufactured in different parts of India. These firearms are designed to fire shotgun, pistol, and revolver as well as rifle cartridges, which are easily available. But there is great difference in manufacturing of standard firearms and country-made firearms. Country-made firearms are made up of locally available materials with no proper or standard measurement. This causes a great hindrance in the estimation of range of firing from GSR distribution pattern made on the target surface. The main aim of this study is to show that range of firing can be determined by observing the dispersion pattern of Gunshot Residue on the target in case of country made firearms. The present study includes firing of 7.65mm and .315"/8mm ammunition from country made pistols at three different ranges of 4", 8" and 12". In India, more than 75% of the cases, 7.65mm and .315"/8mm are used for commit the crime.

Key Words: Country-Made Firearms, Range of Firing & GSR Distribution Pattern

Review of Literature:

Maiara O. Salles, Juliana Naozuka and Mauro Bertotti given that analyses of electrochemical lead in gunshot residue (GSRs) were carried out using an acidic solution with a bare gold microelectrode in the presence of chloride ions. The analysis was done with the GSRs from four different guns i.e. (0.38 in. revolver, 12 caliber pump-action shotgun, 0.38 repeating rifle, and a 0.22 caliber semi-automatic rifle) and six different types of ammunition (Clean Range®, normal, semi-jacketed, especial 24g®, 3T®, CBC®, and Eley®) were examined. T-test performed by students indicated that there was no significant difference between them at the confidence level of 95% and the results obtained with the proposed methodology were compared with those from an atomic absorption spectrometry analysis. This methodology was done for, the detection limit of 1.7 nmol L-1 (3σ/slope), a linear range between 10 and 100 nmol L-1, and a relative standard deviation of 2.5% from 10 measurements were obtained.

Zuzanna Brozek-Mucha given that the study of sizes of gunshot residue and its chemical contents originating from 9*18 mm PM ammunition, depositing in the vicinity of the shooting person was performed by means of two instruments that are energy dispersive X-Ray spectrometry and scanning electron microscopy. The collection of residue samples were from the targets placed at various distances in the range 0-100 cm as well as from hands and clothing of the shooting person. The targets were covered by fragments of white cotton fabric or black bovine leather. Micro traces of cotton targets were collected from circles of 5 and 10 cm in radius. Examination in the form of numbers of particles results in proportions of their chemical classes and dimensions revealed a dependence on the distance from the gun muzzle, both in the direction of shooting ad in the opposite one, i.e. on the shooting person. Depending on the kind of the target substrate the describing parameters of gunshot residue also differs. The type of result acquired gives an information to understand the general rules of the dispersion of the gunshot residue in the surrounding of the shooting gun. Thus, it may be used for the reconstruction of shooting incidences, as well as especially for establishing the mutual positions of the shooter and other participants of the incident.

A. Duarte, L.M. Silva, C.T. de Souza and E.M. Stori et.al given that In the present work when a gun is fired we embarked on the evaluation of the Sb/Pb, Ba/Pb and Sb/Ba elemental ratios found in relatively large particles (of the order of 50-150µm across) ejected in the forward direction. Gunshot residue (GSR) is referred commonly for these particles. The intention of this work is to compare the elemental ratios of the GSR with those found in the primer of pristine cartridges in order to check for possible correlations. Respectively the ammunition and elemental concentration of gunshot residues were investigated through PIXE (Particle-Induced X-ray Emission) and micro-PIXE techniques. The ammunition composed of a .38 SPL caliber (ogival lead type) charges in a Taurus revolver. For the measurements of PIXE pristine cartridges were taken apart. The Forensic Institute at Porto Alegre is the restricted area were shooting sessions were carried out. Residues ejected at forward direction were collected on a micro porous tape. The experiments of PIXE were carried out employing 2.0 MeV proton beams with a beam spot size of 1 mm2. The samples were irradiated with 2.2 MeV proton beams of 2*2 µm2 for the micro-PIXE experiments. The evaluations of results were found for the ration of Sb/Pb, Ba/Pb, Ba/Pb and Sb/Ba do not correlate with those stemming from the analysis of the primer.

Jorge E. Souza Sarkis, Osvaldo N. Neto, Sonia Viebig and Steven F. Durrant given that Single round-barrel caliber 0.38 revolver is the most popular handgun in Brazil. Pistols have become increasingly popular and currently represent about 20% of police seizures and in recent years, it has owing to the modernization of police arms and their availability on the legal and illicit markets. Earlier the paper was presented the novel collection method for gunshot residues (GSR) using sector field-high resolution-inductively coupled plasma-mass spectrometry (SF-HR-ICP-MS). The present paper will be discussing the capability of this methodology to identify antimony (Sb), barium (Ba) and lead (Pb) on the volunteer hands after shot tests with 9 mm and 0.40 in. caliber pistols. The type of munitions were tested are: 9 mm Taurus and clean range. A powerful tool in forensic science constitutes the use of technique with high sensitivity, such as SF-HR-ICP-MA, permits the identification of low concentrations (less than 1µg/L) of metals in firearm residue. Sampling procedure is also discuss as an important role, also it constitutes the collection from a different body part than the gun hand of the suspects. The analytical data obtained on comparison allows the clear discrimination between samples from the hands of shooters and non-shooters.

Andrea Martiny, Andrea P.C. Campos, Marcia S. Sader et al. given that The development of heavy metal-free environmental ammunition primers is with the exposition to the heavy metal metal-rich airborne due to fire practicing force all over the world. The characterization of the gunshot residue elements present in the Brazilian lead-free ammunition produced by Companhia Brasileira de Cartuchos (CBC) and commercialized by Mag Tech in the U.S. and Europe under the name Clean Rnage ® centerfire cartridges. The analysis was done on both first and second generations of Clean Range® in calibers 9 mm Luger, .40 S&W, .380 AUTO and .38 SPL were analyzed and compared to regular Brazilian CBC ammunition by scanning electron microscopy/energy dispersive spectroscopy. The composition and morphology differences of GSR particles from the two generations of Clean Range® were observed. Strontium being the only unique element detected as the first generation ammunition (found in Europe) presented spherical particles. The irregular particles composed mostly by potassium, aluminum, silicon and calcium are the second generation (found in the U.S.A). By the identification of GSR derived from CBC second generation we can conclude that identification of lead-free ammunition in suspect's hands may be impossible without the addition of a distinct metallic taggant in the primer composition by the manufacturer.

Zuzanna Brozek-Mucha given that The collected gunshot residue from targets were examined to various features in a function of shooting distance as well as from hands and the forearm, from front and back parts of the upper clothing of the shooting person were performed with SEM-EDX. The Walter P-99 pistol and Luger 9 mm ammunition of GSR samples were obtained of Polish production. The design of experiments were in such a way that the substrates for collecting GSR reminded the ones usually obtained for examinations within criminal cases. Following are the parameters describing the results of the performed examinations of GSR particles: the number of GSR, proportions of their chemical classed as well as their sizes revealed a dependence on the shooting distance both, in the direction of shooting and backwards, i.e. on the shooting person. Examination of the distribution of particles in the vicinity of the shooting gun may be utilized in the elucidation of the general rules of the dispersion of the GSR as well as in the reconstruction of a real shooting case.

Silke Latzel, Dieter Neimke, Rudiger Schumacher et al. given that For the detection of gunshot residue (GSR) of modern lead-free ammunition the XRF's multiple element detection capability is especially useful technique. To determine the shooting distance in an analogous way to the chemographic imprint an elemental mapping from milli-X-ray fluorescence analysis (m-XRF) can be used. The shooting range estimation becomes more reliable as it is possible to take the mappings of all relevant elements into account. For displaying the data a numerical tool is presented that helps to differentiate between shooting distances. Some problems arise from the nature of the samples, i.e. a small amount of GSR deposited on a highly scattering background. There are some examples of major problems in spectra interpretation that are stated. Verification is needed at some points by an experienced user and spectra interpretation cannot be fully automated.

M. Chohra, B. Beladel, L. Baba Ahmed et al. given that The work is done to determine appropriate techniques for the revelation of mineral gun shoot residues. The indicial traces are used as material proofs for helping and guiding the judicial investigations that are picked up from the crime scene. There are two (02) techniques were employed for mineral gun shoot residues, as an achievement to this namely are; Neutron Activation Analysis, and scanning electron microscopy/EDX. After several shoots the samples of metallic powder residue were realized by different kind of weapons with local and foreign ammunitions. In order to improve forensic investigations this, study was undertaken to develop chemical ballistic specialty, and to derive benefit to Technical and Scientific Police of Algeria to be used for judicial investigation.

The methods SEM/EDX method turns out that is more adequate to this type of investigation, despite the high sensitivity of the NAA. NAA remains the complementary methods as stated earlier.

Agostinho Santos, et al. given that the study aims to estimate the firing distance that was conducted using a 7.65 mm ×17 mm Browning (.32ACP) pistol as experimental setup. The test shots, were made briefly against a target of cotton tissue (35 cm × 35 cm), and the amounts of antimony (Sb), barium (Ba), and lead (Pb) deposited in quadrangular pieces (1 cm × 1 cm) of the target cut from four radial positions at increasing

distances from the bullet entrances hole ("samples") were determined by inductively coupled plasma-mass spectrometry (ICP-MS). In mathematical model the data obtained were used for estimating the firing distance. A simple linear correlation between FD (the firing distance) and in c (where c is the content of Sb, Ba, or Pb in the samples, expressed in µg/g of target tissue) was the bet model.

The samples collected at radial distances within 2.0-3.0 cm from the bullet entrance hole were best results among them. It was possible to accurately (±6 cm) estimate the firing distance in the interval [20-90] cm from the target by using this approach.

Matthew E. Christopher et.al given by A standard technique that can provide important forensic evidence is imaging and analyzing gunshot residue (GSR) particles using the scanning electron microscope equipped with an energy dispersive X-ray spectrometer (SEM/EDS) but the discrimination powder of this technique is limited due to low sensivity to trace elements and difficulties in obtaining quantitative results from small particles. A non-destructive quantitative analysis and a faster method using a scanning proton microbeam and Particle Induced X-ray Emission (µ-PIXE), together with Elastic Backscattering Spectrometry (EBS) is used of the elemental composition of single GSR particles. The GSR particles were all Pb, Ba, and Sb in this particular study. The precision of the following method is assessed. The multivariate analysis is the grouping behavior of different that makes of ammunition. With a confidence >99%, the protocol correctly groups the cartridges studied here, irrespective of the firearm or population of particles selected.

Materials and Methods:

Two types of .315"/8mm and 7.65mm calibre of standard and country made pistol were used for shooting test. The ammunition of KF(khadki factory), pune were used for test firing. Ten KF (khadki factory, pune) ammunition, .315"/8mm and 7.65mm cartridges were used for firing from each firing distance.

The targets were made up of sheet of chart paper and cotton cloth having size of 45cm X 45cm (app.), fitted on cardboard sheet by cello tape having size of 40cm X 40cm (app.). The cardboard was fixed to recovery box; recovery box was 120 cm above the ground. The firearm was fixed in the stand, in front of target and their position adjusted at different distances according to the firing range. Test firing were conducted in the firing room of CFSL/CBI/New Delhi from three different distances i.e. at 4", 8', 12" on the target from each of 7.65mm and .315"/8mm country made and standard firearms. Thereafter GSR pattern on the chart paper and cotton cloth targets were collected carefully. A Ca non EOS 1200D (Made in japan) digitalcamera was used for photographing the images. After that dispersion pattern of GSR was calculated by visual method by taking the outer radius of the circle (outer radius of the circle was taken from the centre of the circle to the outer dispersion line) and then inner radius of the circle (inner radius was taken from the centre of the circle to the inner dispersion line) and put the formula of area of circle ($A = \pi r^2$). By using this formula, we can find out the dispersion pattern area of the Gun Shot Residue.

Conclusion and Results:

This study will help the forensic expert in dispose of the caes where range of fire is to ascertain in case of country made firearms. After calulating the dispersion pattern area, we can give an estimate idea about the range of firing, calibre of the weapon and whether standard or country made made firearms were used in the crime.

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