# OSAC 2021-N-0019
# Standard Practice for the Documentation and Processing of Shooting Scenes

Crime Scene Investigation & Reconstruction Subcommittee
Scene Investigation Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science

## OSAC Proposed Standard

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Prepared by
Crime Scene Investigation & Reconstruction Subcommittee
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| 2.0 | November 1, 2022 | -- | Added to the OSAC Registry and publicly announced. |
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**Foreword**

This standard is meant for scene investigators who are responsible for the documentation of a shooting scene and for shooting reconstructionists performing the on-scene documentation. It is recognized that some shooting scenes are processed and documented by scene investigators who will not be performing the final reconstructive analysis. However, their work is critical to any subsequent reconstructive efforts. This standard provides guidance for shooting scene preservation and minimum documentation requirements for projectile impacts and trajectories. This standard cannot replace knowledge, skills, or abilities acquired through appropriate education, training, empirical testing, and experience and should be used in conjunction with sound professional judgment.

All hyperlinks and web addresses shown in this document are current as the publication date of this standard.

**Keywords:** *crime scene investigation, crime scene reconstruction, shooting reconstruction, projectile impact, trajectory analysis*

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**Standard Practice for Documentation and Processing of Shooting Scenes**

## 1 Scope

This document provides minimum standards and recommendations for the documentation and processing of shooting scenes that may be subject to shooting reconstruction. This document covers generally accepted professional principles and operations, shooting scene documentation, and shooting scene preservation. This document does not provide complete protocols for conducting a full shooting reconstruction.

## 2 Normative References

ASTM E620-18, *Standard Practice for Reporting Opinions of Scientific or Technical Experts*.

OSAC proposed standard: "*Guiding Principles for Scene Investigation and Reconstruction.*"

ANSI/ASB Best Practice Recommendation 068*, Safe Handling of Firearms and Ammunition*, 2020. 1s. Ed.

## 3 Terms and Definitions

For purposes of this document, the following definitions and acronyms apply.

**3.1**

**ammunition**

Unfired cartridges designed to be discharged in a firearm.

**3.2**

**ballistics**

The science and study of projectiles in motion, which is usually divided into three parts: interior ballistics, exterior ballistics, and terminal ballistics.

**3.3**

**bullet**

A projectile designed specifically to be fired from a firearm.

**3.4**

**caliber**

The nominal diameter of a projectile or the nominal inner diameter of a barrel, or a term also used to designate the specific cartridge(s) for which a firearm is chambered.

**3.5**

**cartridge case / casing**

The fired or unfired component of metallic ammunition, the purpose of which is to hold the primer, propellant, and projectile.

**3.6**

**cartridge case ejection patterning**

The use of the spatial relationship between a firearm and ejected cartridge cases/cartridges in order to approximate gun location in a scene at the time of ejection.

**3.7**

**defect**

A generic term for any surface damage.

**3.8**

**directionality**

The property of a trajectory that describes which way a projectile was traveling.

**3.9**

**distance determination**

The process of determining how far away the muzzle of a firearm was from a target at the time a shot was fired, based on one or more methods such as gunshot residue, petal slap, pellet patterning, or buffer patterning.

**3.10**

**exterior ballistics**

The branch of ballistics that deals with a projectile's flight in air. Also known as external ballistics.

**3.11**

**firearm**

Any weapon designed to expel a projectile with the energy generated by combustion.

**3.12**

**gunshot residue**

**GSR**

The total of all residues resulting from the discharge of a firearm, typically constituted of nitrites and lead, as well as unburned and partially burned gunpowder particles, primer residues, carbonaceous material plus metallic residues from projectiles, fouling, and any lubricant associated with the projectiles.

**3.13**

**horizontal angle**

The angle in a horizontal plane typically between the path of a bullet and an object that was struck, also known as azimuth angle.

**3.14**

**interior ballistics**

The study of a projectile's initial acceleration and performance in the weapon and the related processes. Also known as internal ballistics.

**3.15**

**non-penetrating impact**

Projectile damage where the projectile strikes but does not penetrate a target.

**3.16**

**pellet patterning**

The distribution of shot fired from a firearm that may be used to estimate the muzzle-to-target distance.

**3.17**

**penetrating impact**

Projectile damage where the projectile entered and did not exit a target.

**3.18**

**perforating impact**

Projectile damage where the projectile entered and exited a target.

**3.19**

**primer residue**

A subcategory of gunshot residue considering only chemicals generated from the priming mixture. Typically composed of very small particles containing lead, barium, and antimony, and detected using scanning electron microscopy.

**3.20**

**projectile**

An object propelled with an initial velocity then acted upon by gravity, air drag, and other outside forces.

**3.21**

**projectile fragment**

Any portion of a projectile that retains characteristics permitting it to be identified as having been part of a projectile.

**3.22**

**projectile impact**, *noun*

Surface damage determined to have been caused by a projectile.

**3.23**

**range**

The distance from a firearm to the initial projectile impact.

**3.24**

**scene reconstruction**

The utilization of information gathered from the investigative process to develop or eliminate possible explanations for how an incident occurred.

**3.25**

**shooting reconstruction**

A scene reconstruction focused on the discharge of a firearm(s).

**3.26**

**target**, *noun*

Any object struck by a projectile, regardless of whether it was struck intentionally.

**3.27**

**terminal ballistics**

The branch of ballistics that deals with the projectile's impact with a target.

**3.28**

**trajectory**

The arched path that a projectile follows in flight, typically modeled as a straight line for short-range paths.

**3.29**

**trajectory analysis**

The determination of a projectile's flight path.

**3.30**

**vertical angle**

The angle in a vertical plane typically between the path of a bullet and level, also known as elevation angle.

**3.31**

**wound ballistics**

A subset of terminal ballistics that considers projectile impacts to tissue and tissue simulants.

## 4 Procedures

This standard establishes the minimum requirements to document a shooting scene for reconstruction. As established in the Guiding Principles for Scene Investigation and Reconstruction, the specific circumstances at a scene may require deviation from established standards. Deviations from this standard shall be based on specific articulable circumstances and shall be documented.

### 4.1 Shooting Scene Preservation

This section applies specifically to shooting incidents and should be blended with other scene processing procedures, as necessary.

**4.1.1** The location of firearm evidence in a scene can have critical implications to a shooting reconstruction, for example: impact sites, fired cartridge cases, firearms, and/or other ammunition components. Proper location documentation of these specific type(s) of evidence shall be conducted.

a) Each fired cartridge case shall be individually labeled, headstamps described or photographed, and its location documented. If cartridge cases of the same type are commingled, they may be documented and collected together.
b) Firearm conditions shall be documented to include safety position, cylinder position for revolvers, loaded status, damage, evidence of malfunction, and trace evidence.
c) Firearm information shall be documented to include the make, model, caliber, and serial number, if present.

**4.1.2** Alterations to the scene that occur after an incident (e.g., first responder involvement, animal activity, weather, time) can greatly affect shooting scene reconstruction, and any known or suspected alterations shall be documented.

**4.1.3** In the course of shooting scene processing, it may be necessary for the investigator to move objects within the scene in the interest of the investigation (e.g., search, body movement). This is permissible, but actions shall be taken first to record the object's location to allow the object to be properly replaced for analysis, if necessary.

### 4.2 Projectile Impact Documentation

All projectile impacts shall be documented to include photography, labeling, projectile impact characteristics, and 3-dimensional location.

#### 4.2.1 Photography

Projectile impacts shall be photographically documented to record their location, scene context, and physical characteristics.

a) In addition to standard scene photography, photography of projectile impacts shall include sufficient overall and mid-range images to establish the relationship of projectile impacts with each other and other objects in the scene and close-up images taken with the sensor plane parallel to the impact.

b) Photographs shall be taken with and without a scale/label.

#### 4.2.2 Labeling

Projectile impacts shall be given a unique identifier and that shall be recorded in photographs, notes, and sketches/diagrams.

#### 4.2.3 Projectile Impact Characteristics

Projectile impacts shall be examined and their characteristics documented. These should include, but are not limited to:

a) Physical Characteristics

i) size (width, length)

ii) as non-penetrating, penetrating, or perforating

iii) target material

iv) specific features or characteristics of the impact that are used to further evaluate the projectile impact (e.g., depth)

v) any other observable forensic evidence present (e.g., trace evidence)

b) Chemical Characteristics

i) if a projectile impact is suspect, the use of chemical testing techniques for traces of bullet metals should be employed

ii) copper and lead tests (e.g., dithiooxamide (DTO) & sodium rhodizonate tests, respectively) are commonly used field tests

**4.2.4** 3-Dimensional Location

The 3-dimensional location of each projectile impact shall be measured using a coordinate system that is clearly defined and recorded in the notes or data collected.

**4.3** Trajectory Measurement

In order to measure a trajectory, the following parameters, when practicable, shall include:

**4.3.1** Directionality

A trajectory is often represented by a line traveling in only one direction. When possible, the direction of travel shall be documented.

**4.3.2** Impact Site(s)

a) each trajectory shall be associated with at least one reliable projectile impact
b) if more than one projectile impact is associated with a single, defined trajectory (e.g., primary, secondary, etc.), all the projectile impacts that can be tracked along that trajectory and their sequence shall be documented

**4.3.3** Path

The projectile's path can be described with either of the following:

a) Horizontal Angle and Vertical Angle
    i) angles are commonly reported to a degree (not tenths or hundredths of a degree)
    ii) for both horizontal and vertical measurements, zero (0) must be defined and documented
    iii) the horizontal angle is typically measured in the horizontal plane established relative to the object that was struck
    iv) the vertical angle is typically measured from level relative to gravity

b) Three-Dimensional Representations
    i) photographs of visual representations of the trajectories from which horizontal and vertical angles can be measured
    ii) three-dimensional survey data of the trajectories
    iii) horizontal and vertical angles can be calculated if appropriate three-dimensional locations along a trajectory are documented

**4.4** Projectile Recovery

After all other on-scene documentation and analysis are complete, every reasonable effort shall be made to locate and recover projectiles or projectile fragments from impacted objects.

a) All reasonable efforts shall be made to minimize damage to projectiles or projectile fragments during this process.
b) When a projectile or projectile fragment can be associated with a projectile impact and/or trajectory, this shall be documented in the notes.
c) The section of a target containing an embedded projectile may be collected for a more comprehensive attempt for recovery in a controlled environment.
d) If a projectile cannot be found or physically recovered, the reasons shall be documented.
e) An accounting of the relative numbers of projectile impacts, projectiles, and cartridge cases shall be completed when feasible.

## 5 Examples of Additional Relevant Evidence Types and Examinations

**5.1** Scene investigators shall be aware of other types of forensic evidence that can yield reconstructive value to later shooting reconstructions. Appropriate development, documentation, and collection techniques shall be applied for all evidence discovered at shooting scenes.

**5.2** Additional relevant evidence types can include, but are not limited to:

a) Firearms Identification. The identification of ammunition components as having been fired from a particular firearm can allow that firearm to be associated with a specific trajectory and/or location in the scene.
b) Gunshot Residue (GSR) Distance Determination. GSR patterns can be used to determine a muzzle-to-target range at the time a shot was fired, which can further help to place a firearm in the scene.
c) Pellet Patterning. Pellet patterns can be used to determine a muzzle-to-target range at the time a shot was fired, which can further help to place a firearm in the scene.
d) Primer Residue Analysis. Primer residues deposited on objects near a discharged firearm, most notably the shooter, can be used to associate an individual as having been in the vicinity of a firearm discharge.
e) Cartridge Case Ejection Patterns. A cartridge case pattern analysis can be used to position a firearm within a scene.
f) Exterior Ballistics. Analysis of the long-range reconstruction of a bullet's path through the atmosphere.
g) Terminal and Wound Ballistics. Analysis which can include bullet deformation, penetration depth, and wound profiles.
h) Trace Evidence. Trace evidence can indicate the type of projectile or the presence of an intervening target. Intervening targets can have a destabilizing effect on the bullet's trajectory and shall be considered when drawing conclusions from an evaluation of the ballistic evidence.

i) Bloodstain Pattern Analysis. A bloodstain pattern analysis is a type of scene reconstruction that can be helpful in locating individuals in the scene and associating them with movements or firearms events.
j) Audio and Video Recordings. Audio and video recordings of a shooting can be used to establish specific timelines, relative chronologies, and the positions and movements of individuals in the scene.
k) Fingerprint Examination. Latent prints processing can reveal an association to individuals who have handled some part of the evidence or scene in a shooting reconstruction.
l) DNA Analysis. DNA analysis can reveal an association to individuals who have handled some part of the evidence or scene in a shooting reconstruction.

## 6 Recording and Reporting Observations

**6.1** Notes shall be taken contemporaneously with the examination, which records pertinent observations and measurements. Notes shall:

a) provide the basis for conclusions and opinions

b) be in a common format (e.g., written, typed, diagrammed, photographed, scanned, audio recorded, video recorded)

c) be retained such that a peer or reviewer can thoroughly understand what was done

d) contain relevant observations regarding factors that may affect uncertainty or confidence in a measurement or conclusion

**6.2** When a report is prepared, guidance on report preparation may be found in ASTM Practice E620-18.

## 7 Commonly Used Equipment

a) cameras/imaging equipment
b) trajectory rods/probes, centering cones
c) lasers
d) strings
e) zero-edge or standard protractors
f) inclinometers
g) plumb bobs
h) 3D scanners
i) total stations
j) laser measurement tools
k) micrometers
l) calculators
m) levels
n) tripods
o) compass

p) tape measures/scales
q) chemical reagents
r) carpenter's square

**Annex A**
(informative)

**Bibliography**

This is not meant to be an all-inclusive list, as the group recognizes other publications on this subject may exist. At the time this document was drafted, these were some of the publications available for reference. Additionally, any mention of a particular software tool or vendor as part of this bibliography is purely incidental, and any inclusion does not imply endorsement by the authors of this document.

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