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## Standard for the Documentation and Processing of Shooting Scenes

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## Standard for the Documentation and Processing of Shooting Scenes

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## Foreword

This standard is meant for scene investigators who are responsible for the documentation and processing 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.

The American Academy of Forensic Sciences established the Academy Standards Board (ASB) in 2015 with a vision of safeguarding Justice, Integrity, and Fairness through Consensus Based American National Standards. To that end, the ASB develops consensus based forensic standards within a framework accredited by the American National Standards Institute (ANSI), and provides training to support those standards. ASB values integrity, scientific rigor, openness, due process, collaboration, excellence, diversity and inclusion. ASB is dedicated to developing and making freely accessible the highest quality documentary forensic science consensus Standards, Guidelines, Best Practices, and Technical Reports in a wide range of forensic science disciplines as a service to forensic practitioners and the legal system.

This document was revised, prepared, and finalized as a standard by the Crime Scene Investigation Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Crime Scene Investigation and Reconstruction Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science.

Questions, comments, and suggestions for the improvement of this document can be sent to AAFS-ASB Secretariat, [asb@aaafs.org](mailto:asb@aaafs.org) or 410 N 21st Street, Colorado Springs, CO 80904.

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

ASB procedures are publicly available, free of cost, at [www.aaafs.org/academy-standards-board](http://www.aaafs.org/academy-standards-board).

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

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# Standard for the Documentation and Processing of Shooting Scenes

## 1 Scope

This document provides requirements for the documentation and processing of shooting scenes that may be subject to shooting reconstruction. This document does not provide complete protocols for conducting a full shooting reconstruction.

## 2 Normative References

The following references are indispensable for the application of the standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. See Annex A, Bibliography, for informative references.

ANSI/ASB Best Practice Recommendation 068, *Safe Handling of Firearms and Ammunition*, 1<sup>st</sup> Ed. 2020<sup>a</sup>.

ANSI/ASB Standard 159, *Standard for Scene Investigation and Reconstruction—Foundational Principles*. 1<sup>st</sup> Ed. 2023<sup>a</sup>.

## 3 Terms and Definitions

For purposes of this document, the following definitions apply.

### 3.1

#### **ammunition**

Unfired cartridge(s) designed to be discharged in a firearm.

### 3.2

#### **angle of incidence**

The angle formed between the nominal path of a projectile and the plane of the target (also referred to as angle of impact).

### 3.3

#### **azimuth angle**

See **3.18 horizontal angle**

### 3.4

#### **ballistics**

The science of projectiles in motion. Usually divided into three parts:

#### **3.4.1**

##### **interior ballistics**

Studies the projectile's initial acceleration and movement inside the firearm.

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### 3.4.2

#### **exterior ballistics**

Studies the projectile's movement between the muzzle and the target(s).

### 3.4.3

#### **terminal ballistics**

Studies the effect of a projectile's impact with a target.

[AFTE Glossary]

### 3.5

#### **bullet**

A projectile, typically non-spherical, designed specifically to be fired from a firearm with a rifled barrel.

### 3.6

#### **bullet wipe**

The discolored area caused by a physical transfer from the surface of a projectile to a target on the immediate periphery of a projectile entrance.

[AFTE Glossary [mod]]

### 3.7

#### **caliber**

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

### 3.8

#### **cartridge**

Single unit of ammunition consisting of the case, primer, and propellant with one or more projectiles. Also applies to a shot shell.

### 3.9

#### **cartridge case**

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

NOTE: The terms *casing*, *shell*, and *brass* are often used incorrectly for the term cartridge case

### 3.93.10

#### **defect**

A generic term for any surface damage.

### 3.103.11

#### **deflection**

A change in the nominal path of a projectile due to an impact

### 3.113.12

#### **directionality**

The property of a trajectory or projectile impact that describes which way a projectile was moving.

**3.123.13****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, and pellet patterning or buffer patterning.

**3.133.14****ejection pattern**

The distribution of fired cartridge cases or shotshells relative to the location of a firearm from which they were fired.

**3.143.15****elevation angle**

See **3.35 vertical angle**.

**3.153.16****firearm**

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

**3.163.17****gunshot residue****GSR**

The total of all residues resulting from the discharge of a firearm.

NOTE Examination of GSR can include chemical analysis to identify the presence of GSR or interpretation of GSR patterns to determine the location or position of a firearm at the time of discharge.

**3.173.18****horizontal angle**

The angle in a horizontal plane ~~typically~~ between the path of a bullet and ~~aan~~ object that was struck, measured at the point of impact, also known as azimuth angle.

**3.183.19****lead-in mark**

A visible, thin, elongated deposition of bullet wipe transferred to a surface as a bullet first makes contact with that surface at a shallow angle of incidence.

NOTE The lead-in mark is useful in establishing the entrance side of the projectile impact.

**3.193.20****non-penetrating impact**

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

**3.203.21****pellet pattern**

The distribution of projectile impacts from multiple projectiles fired from a shot cartridge or shotshell.

NOTE Pellet patterns can be used to estimate the muzzle-to-target distance and/or ~~impact~~ angle of incidence.

**3.213.22****penetrating impact**

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

**3.223.23****perforating impact**

Projectile damage where the projectile entered and exited a target.

**3.233.24****pinch point**

A small area of surviving original surface within an angled projectile impact that is located at the initial contact point.

NOTE The pinch is useful in establishing the entrance side of the projectile impact.

**3.243.25****primer gunshot residue****pGSR**

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.

**3.253.26****projectile**

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

NOTE A projectile can be complete, fragmented, or other ejected material.

**3.263.27****projectile fragment**

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

**3.273.28****projectile impact, *noun***

Damage determined to have been caused by a projectile.

**3.283.29****range**

The distance from a firearm's muzzle to the initial projectile impact.

**3.293.30****ricochet**

A surface deflection of a projectile without penetration or perforation of a target

**3.303.31****scene reconstruction**

The process to gain explicit knowledge of the series of events that surround a scene using deductive and inductive reasoning, physical evidence, scientific processes, and their interrelationships.

[ANSI/ASB Std 159]



**3.313.32****shooting reconstruction**

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

**3.323.33****target, noun**

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

**3.333.34****trajectory**

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

**3.343.35****vertical angle**

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

**3.353.36****wound ballistics**

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

**4 Procedures****4.1 General**

**4.1.1** The requirements and recommendations in this document apply specifically to the documentation and processing of shooting incidents and should be used in conjunction with other scene processing procedures, as necessary.

**4.1.2** ANSI/ASB Std 159, *Standard for Scene Investigation and Reconstruction—Foundational Principles*, shall be used in conjunction with this document as ANSI/ASB 159 provides the foundational principles upon which additional specific requirements, such as this document, will be based.

**4.1.3** Personnel from a variety of disciplines can, at times, perform specialized functions within the broader scope of scene investigation (e.g., medicolegal death investigation, digital forensics). When operating in such specialist capacities, these individuals are subject to distinct duties, requirements, and standards that pertain specifically to their area of expertise. Accordingly, they may have limited responsibilities outlined in this standard.

**4.1.4** This standard is not intended to override, conflict with, or otherwise interfere with the established responsibilities or protocols governing those specialized investigative disciplines. However, in situations where a specialist serves as the sole scene investigator, the applicable elements of this standard shall be implemented.

## 4.2 Shooting Scene Preservation and Firearms Evidence Documentation

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

**4.2.1.1** Prior to any examination, the examiner shall inspect firearms to assess their loaded or unloaded condition. ~~Ensure~~

~~4.2.1.14.2.1.2~~ The examiner shall ensure that the muzzle of the firearm is pointed in a safe direction at all times. A safe direction is one that minimizes risk of injury in the case of unintentional discharge, and takes into account such factors as the bullet-resistance of barriers, potential for ricochet, etc. ANSI/ASB Best Practice Recommendation 068, *Safe Handling of Firearms and Ammunition*, 1st Ed. 2020 and any departmental or agency requirements and protocols shall be used to minimize the risk of injury.

~~4.2.1.24.2.1.3~~ Location of each fired cartridge case shall be documented.

~~4.2.1.34.2.1.4~~ A unique identifier shall be assigned for each cartridge case, and recorded, along with respective headstamp information. ~~Exceptions shall be documented.~~

~~4.2.1.44.2.1.5~~ All available firearm information shall be documented, to include the make, model, caliber, and serial number; or whether the information is absent, obliterated, or altered.

~~4.2.1.54.2.1.6~~ Firearm conditions shall be documented (e.g., safety position, cylinder position for revolvers, action open/closed, loaded status, attachments, damage, evidence of malfunction, and trace and biological evidence).

~~4.2.1.64.2.1.7~~ 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.

~~4.2.1.74.2.1.8~~ In the course of shooting scene documentation and 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 non-destructive actions shall be taken first to record the object's location to allow the object to be properly replaced for analysis, if necessary.

**4.2.1.8.1** Method(s) implemented to record the removal and replacement of each item's position/location shall be clearly documented.

## 4.3 Projectile Impact Documentation

### 4.3.1 General

All projectile impacts shall be documented to include photography, labeling, measurements, and location. Surface damage that lacks the physical or chemical characteristics to describe it as a projectile impact shall be documented in the same manner as a projectile impact and may be referred to as a defect when practicable and necessary.

### 4.3.2 Labeling

Projectile impacts shall be given a unique identifier and that shall be recorded in photographs, notes, and sketches/diagrams. When multiple impacts have been associated with a single path they can be documented in a corresponding manner (e.g., A1, A2, A3).

### 4.3.3 Photography

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

**4.3.3.2** In addition to standard scene photography, photography of projectile impacts shall include 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.

**4.3.3.3** Photographs shall be taken with and without a scale/label.

### 4.3.4 Projectile Impact Characteristics

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

a) Physical Characteristics:

1) target surfaces considerations:

- material (e.g., glass, drywall, metal);
- contour (e.g., flat, convex, concave);
- angle;

2) size (width, length);

3) as non-penetrating, penetrating, or perforating;

4) specific features or characteristics of the impact that are used to further evaluate the projectile impact (e.g., pinch point, lead-in mark, bullet wipe);

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

b) Chemical Characteristics:

- 1) prior to application of chemicals, document the projectile impact ~~shall be documented~~ due to potential alteration or obliteration of projectile impact characteristics;
- 2) if a projectile impact is suspect, employ the use of chemical testing techniques for traces of bullet metals ~~should be employed~~;

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

#### 4.3.5 Location of Projectile Impacts

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

**4.3.5.2** If a projectile impact is removed, the removed area shall be collected and preserved after properly documenting its location within the context of the scene.

#### 4.4 Trajectory Documentation

##### 4.4.1 General

In order to document a trajectory, the directionality, impact sites, and angle measurements, when practicable, shall be recorded.

##### 4.4.2 Establishing Directionality and Trajectory

**4.4.2.1** When possible, the direction of travel shall be documented. Directionality can be determined by certain physical characteristics of projectile impact sites (e.g., pinch point, lead-in mark, bullet wipe). ~~When possible, the direction of travel shall be documented.~~ These physical characteristics can also be used to establish a trajectory.

**4.4.2.2** Trajectory can be determined by a single projectile impact or by corresponding projectile impacts.

**4.4.2.2.1** Single projectile impacts can provide trajectory information through measurements to calculate an angle of impact ~~angle~~ using trigonometric functions.

**4.4.2.2.2** When it can be determined that two or more projectile impacts are associated with a single projectile, trajectory can be determined by connecting the corresponding projectile impacts using tools such as rods, strings, or lasers.

**4.4.2.2.3** All the projectile impacts that can be tracked along ~~that~~ trajectory and their sequence shall be documented.

##### 4.4.3 Measurement and Calculation of Impact Angles

Projectile impact angles shall be measured using at least one of the following methods.

a) Horizontal (azimuth) angle and vertical (elevation) angle:

- 1) commonly reported to a whole degree;
- 2) zero (0) ~~shall be~~ defined and documented;
- 3) vertical angles can be measured using an inclinometer/angle finder or zero-edge protractor;

- 4) horizontal angles can be measured using a zero-edge protractor;
- 5) all angle measurements ~~shall be~~ recorded in the scene investigator's case notes and/or documented photographically;
- 6) when photographing, take photographs ~~shall be taken to~~ accurately to reflect the horizontal or vertical angle.

b) Three-dimensional survey data of the trajectories.

NOTE 1 Horizontal and vertical angles can be calculated using trigonometry ~~or resolving multiple measurements in if three-dimensional locations along a trajectory are measured using the same~~ coordinate system.

~~Impact angles~~NOTE 2 Angles of impact for single projectile impacts can be calculated using trigonometry when the length and width for the projectile impact are measured.

## 4.5 Projectile Recovery

**4.5.1** After all other on-scene documentation and analysis are complete, ~~efforts~~personnel shall ~~be made~~make the effort to locate and recover projectiles or projectile fragments from impacted objects.

**4.5.2** ~~Efforts~~During location and recovery, personnel shall ~~be made to~~;

- a) minimize damage to projectiles or projectile fragments during recovery;
- b) ~~Efforts shall be made to~~ safeguard recovered projectiles or projectile fragments for trace and DNA evidence;
- c) ~~When document in the notes when~~ a projectile or projectile fragment can be associated with a projectile impact and/or trajectory, ~~this shall be documented in the notes~~;
- d) document reasons why a projectile cannot be found or physically recovered.

NOTE The section of a target containing an embedded projectile may be collected for a more comprehensive attempt for recovery in a controlled environment.

~~d) Projectiles that cannot be found or physically recovered shall be documented.~~

~~e) If a projectile impact is removed from the scene, the removed area shall be collected and preserved.~~

## 4.6 Accounting

**4.6.1** A scene review of the relative numbers of projectile impacts, projectiles, and cartridge cases should be completed to ensure all potential ballistic evidence at the scene has been considered.

**4.6.2** Shot accounting shall include the loaded status of all firearms and magazines recovered in connection with the shooting incident, if available.

## 5 Recording and Reporting Observations

**5.1** Notes, which record pertinent observations and measurements, shall be taken contemporaneously with the examination.

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

## 6 Commonly Used Equipment

The following list includes the basic equipment typically used for shooting incident documentation and reconstruction.

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

n) Calipers

o) tripods;

p) compass;

q) tape measures/scales;

r) chemical reagents;

s) carpenter's square.

## Annex A (informative)

### Bibliography

The following bibliography is not intended to be an all-inclusive list, review, or endorsement of literature on this topic. The goal of the bibliography is to provide ~~examples of~~ publications ~~addressed incited informationally, and publications relevant to~~ the standard.

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