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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@aafs.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.aafs.org/academy-standards-board.

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

Table of Contents *(to be finalized prior to publication)*

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*, 1st Ed. 2020[a].

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

3 Terms and Definitions

For purposes of this document, the following definitions apply.

3.1
ammunition
Unfired ~~cartridges~~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

3.3
azimuth angle
See **3.18 horizontal angle**

~~3.2~~3.4
ballistics
The science of projectiles in motion. Usually divided into three parts:

~~3.2.1~~3.4.1
interior ballistics
~~Study~~Studies the projectile's initial acceleration and movement inside the firearm.

[a] Available from: https://www.aafs.org/academy-standards-board

~~3.2.2~~3.4.2
exterior ballistics
Studies the projectile's movement between the muzzle and the target~~.~~(s).

~~3.2.3~~3.4.3
terminal ballistics
Studies the effect of a projectile's impact ~~at the~~with a target.
AFTE Glossary

~~3.3~~3.5
bullet
A projectile, typically non-spherical, designed specifically to be fired from a firearm~~.~~ with a rifled barrel.

~~3.4~~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]

~~3.5~~3.7
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.

3.8
~~**cartridge case/casing**~~
cartridge
Single unit of ammunition consisting of the case, primer, and propellant with one or more projectiles. Also applies to a shot shell.

~~3.6~~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

~~**3.7**~~
~~**ejection pattern**~~
~~The charting of where a particular firearm ejects fired cartridge cases or shotshells.~~
~~*AFTE Glossary*~~

~~3.8~~3.10
defect
A generic term for any surface damage.

3.11
deflection
A change in the nominal path of a projectile due to an impact

3.93.12
directionality
The property of a trajectory or projectile impact that describes which way a projectile was ~~traveling~~moving.

3.103.13
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, ~~petal slap,~~and pellet patterning~~,~~ or buffer patterning.

3.14
ejection pattern
The distribution of fired cartridge cases or shotshells relative to the location of a firearm from which they were fired.

3.15
elevation angle
See **3.35 vertical angle.**

3.113.16
firearm
Any ~~weapon~~device designed to expel a projectile with the energy generated by combustion.

3.123.17
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.

3.133.18
horizontal angle
The angle in a horizontal plane typically between the path of a bullet and a ~~surface~~object that was struck, also known as azimuth angle.

3.143.19
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 ~~incident angle. The lead-in mark is useful in establishing the direction of fire and travel of the projectile.~~
~~*AFTE Glossary*~~angle of incidence.

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

3.153.20
non-penetrating impact
Projectile ~~impact~~damage where the projectile strikes but does not penetrate a target.

3.21
pellet ~~patterning~~pattern
The distribution of ~~shot pellets~~projectile impacts from multiple projectiles fired from a ~~firearm that may~~shot cartridge or shotshell.

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

~~3.16~~3.22
penetrating impact
Projectile ~~impact~~damage where the projectile entered and did not exit a target.

~~3.17~~3.23
perforating impact
Projectile ~~impact~~damage where the projectile entered and exited a target.

3.24
pinch point
~~In painted metal surfaces, a~~A small area of surviving ~~paint that was pinched between~~original surface within an angled projectile impact that is located at the initial contact point ~~of a low incident angle bullet and the painted metal surface.~~.

NOTE The pinch ~~point establishes~~is useful in establishing the ~~entry~~entrance side of ~~an~~ the projectile impact ~~or ricochet mark and thereby the bullet's direction of travel.~~
~~*AFTE Glossary*~~.

~~3.18~~3.25
primer gunshot residue
pGSR
A subcategory of gunshot residue considering only chemicals generated from the priming mixture~~, typically~~. Typically composed of very small particles containing lead, barium, and antimony, and detected using scanning electron microscopy.

~~3.19~~3.26
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.

~~3.20~~3.27
projectile fragment
Any portion of a projectile that retains characteristics permitting it to be identified as having been part of a projectile.

~~3.21~~3.28
projectile impact, *noun*
Damage determined to have been caused by a projectile.

~~3.22~~3.29
range
The distance from a ~~firearm~~firearm's muzzle to the initial projectile impact.

~~3.23~~3.30
ricochet
~~The continued flight~~
A surface deflection of a ~~rebounded~~ projectile ~~and/~~without penetration or ~~major projectile fragments after~~ perforation of a ~~low angle impact with a surface or object.~~
~~*AFTE Glossary*~~target

~~3.24~~3.31
scene reconstruction
The ~~utilization of information gathered from the investigative~~ process to ~~develop or eliminate possible explanations for how an incident occurred.~~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

~~3.25~~3.32
shooting reconstruction
A scene reconstruction focused on the discharge of a firearm(s).

~~3.26~~3.33
target, *noun*
Any object struck by a projectile, regardless of whether it was struck intentionally.

~~3.27~~3.34
trajectory
The arched path that a projectile follows in flight, typically modeled as a straight line for short-range paths.

~~3.28~~3.35
vertical angle
The angle in a vertical plane typically between the path of a bullet and level, also known as elevation angle.

~~3.29~~3.36
wound ballistics
A subset of terminal ballistics that considers projectile impacts to tissue and tissue simulants.

4 Procedures

4.1 General

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.

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.

4.2 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, inspect firearms to assess their loaded or unloaded condition. 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.

4.2.1.2 Location of each fired cartridge case shall be documented.

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

4.2.1.4 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.

4.2.1.5 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).

4.2.1.6 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.

4.2.1.7 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.

4.3 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. ~~A single path with~~ When multiple ~~projectile~~ 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

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 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.

~~NOTE For the Photographs of instrumentation used to represent the trajectory, see 4.4.3 a) 6).~~

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:

— ~~construction~~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, the projectile impact shall be documented due to potential alteration or obliteration of projectile impact characteristics;

2) if a projectile impact is suspect, 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

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.

4.4 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 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 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-~~base~~edge protractor;

   4) horizontal angles can be measured using a zero-~~base~~edge protractor;

   5) all angle measurements shall be recorded in the scene investigator's case notes and/or documented photographically;

   6) when photographing, photographs shall be taken to accurately reflect the horizontal or vertical angle.

b) Three-dimensional survey data of the trajectories.

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

d) Impact angles for single projectile impacts can be calculated using trigonometry when the length and width for the projectile impact are measured.

4.5 Projectile Recovery

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

a) Efforts shall be made to 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 a projectile or projectile fragment can be associated with a projectile impact and/or trajectory, this shall be documented in the notes.

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

e) ~~If a projectile~~ Projectiles that cannot be found or physically recovered~~, the reasons~~ shall be documented.

f) If ~~the~~a projectile impact ~~on a target~~ 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~~, which records pertinent observations and measurements~~.

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 ~~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

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 in the standard.

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