SCIENTIFIC WORKING GROUP for FIREARMS and TOOLMARKS

Projectile Path Reconstruction- Essential Elements

1.0 Objectives / Introduction

The objective of the following guidelines is to identify the essential elements suggested for use in establishing training and procedure manuals as applied to the determination of projectile paths from penetration or impact.

1.1 To recognize or identify techniques and procedures used in the identification, reconstruction, and documentation of projectile paths based on impact marks including penetrating, perforating, or non-penetrating points of impact.

1.2 Projectile paths, for the purpose of this document, are determined from a short segment of the entire trajectory path.

2.0 Definitions/ Terminology

Standard terminology should be used in the documentation of projectile path evidence, from sources such as the Association of Firearms and Tool Mark Examiners (AFTE) Glossary and the National Rifle Association (NRA) Fact Book.

2.1 Commonly used terms may include:

2.1.1 Ballistics: Internal, External, Terminal

2.1.2 Bullet wipe

2.1.3 Conical, Concentric, Radial and Rib glass fractures

2.1.4 Deflection

2.1.5 Incident angle, Departure angle

2.1.6 Keyhole

2.1.7 Perforation vs. Penetration

2.1.8 Ricochet, Ricochet angle

2.1.9 Trajectory

3.0 Equipment

Proper equipment should be used and checked for acceptable accuracy when appropriate.

3.1 Equipment and supplies may include:

3.1.1 String, cord or rope

3.1.2 Probes of various types and sizes

3.1.3 Laser devices

3.1.4 Distance measuring devices

3.1.5 Angle measuring devices

3.1.6 Leveling devices

3.1.7 Plumb bob and line

3.1.8 Calculator with scientific functions

3.1.9 Compass

3.1.10 Measuring tapes and scales

3.1.11 Safety equipment

4.0 Concepts

4.1 Projectile paths can be important in determining the physical origins of gunshots, location of additional physical evidence and other general crime scene reconstruction.

4.2 Over relatively short distances, projectile trajectories can be represented by a straight line not withstanding deflection or ricochet. Therefore, readily available aids such as string, probes and lasers can be used to illustrate or document the projectile path.

4.3 Points along a path may be delineated by penetrating, perforating, or non-penetrating points of impact.

4.4 A projectile path consists of both the line and direction along which a projectile travels.

4.5 At least two points of reference are generally needed to establish a path; however, a single hole may sometimes be used to estimate a path based on the associated shape, relative dimension, depth and/or trace deposits.

4.6 Direction of travel can sometimes be determined from the shape and characteristics of an impact mark, as well as from bullet material deposition.

4.7 Caution should be used when attempting to determine the projectile diameter from the hole or impact.

4.8 The angle of incidence and the angle of departure can sometimes be estimated using the physical characteristics of the impact mark, and the nature of the impacted material and/or projectile.

5.0 Procedures / Methods

5.1 Recognition of marks and holes

Care should be taken to preserve evidence associated with projectile impacts as well as to avoid damaging the projectile during collection.

5.1.1 Documentation of visible characteristics associated with marks and holes

5.1.2 Trace evidence associated with the marks, holes, or projectiles should be considered

5.1.3 Chemical tests can be used to recognize impact marks or holes as well as direction of fire, these tests may include:

5.1.3.1. Copper residue testing, e.g., dithiooxamide

5.1.3.2. Lead residue testing; e.g., sodium rhodizonate

5.1.4 Define coordinate system to establish a frame of reference

5.2 Path Determination

5.2.1. Probe method – suitable for relatively short distances

5.2.2. String method – suitable for relatively short distances

5.2.3. Laser method – effective for distances or over terrain where string or probes are not practical

5.3 Angle Determination

Angle determination includes both vertical and horizontal angles.

5.3.1 Direct measurement can be performed using a variety of tools

5.3.2 Basic mathematical formulas can be used to calculate angles where linear dimensions have been properly documented

5.4 Documentation

A variety of ways are available to document the projectile path relative to fixed locations or relative to evidence items. These may include:

5.4.1 Sketching

5.4.2 Narrative description

5.4.3 Photographic

5.4.4 Audio or video recording

5.4.5 Measurements

5.4.6 Computer Assisted Programs

5.4.7 Computer assisted programs or software

5.5 Additional Factors for Consideration

5.5.1 Proper evidence collection techniques

5.5.2 Trace evidence

5.5.3 Environment e.g., terrain, physical barriers

6.0 Training / Qualification of Personnel

6.1 Training may include the following:

6.1.1 Study of published materials and/or general procedure manuals

6.1.2 Recognition and collection of firearm and ammunition related evidence

6.1.3 Documentation techniques

6.1.4 Equipment use

6.1.5 Study under the guidance of experienced mentors/examiners

6.1.6 Evaluation of known projectile paths during controlled studies

6.1.7 Report writing and testimony preparation

6.1.8 Supervised or assisted crime scene investigation

6.1.9 Mock casework and testimony presentation

6.1.10 Formal Courses

Appendix 1 - References

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Appendix 2- Revisions

Date	Section	Changes
9/28/12		Added Appendix 1 and 2