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Requirements and Recommendations for a Firearm and Toolmark Examiner Training Program

*Firearms & Toolmarks Subcommittee
Physics/Pattern Interpretation Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science*





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Draft OSAC Proposed Standard

OSAC 2021-N-0012

Requirements and Recommendations for a Firearm and Toolmark Examiner Training Program

Prepared by
Firearms & Toolmarks Subcommittee
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Disclaimer:

Disclaimer: This OSAC Proposed Standard was written by the Firearms & Toolmarks Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science following a process that includes an open comment period. This Proposed Standard will be submitted to a standards developing organization and is subject to change.

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56 Keywords: *Firearm and Toolmark Examination, Firearm and Toolmark Examiner, Training*

57

58 This document is intended to provide requirements and recommendations for firearm and
59 toolmark examiner training programs.

60

61

62 **Foreword**

63

64 The following standard identifies the training requirements to become a qualified firearm and
65 toolmark examiner.

66

67 This standard was proposed by the Firearms and Toolmarks Subcommittee of the Organization of
68 Scientific Area Committees (OSAC).

69



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100 **1 Scope**

101
102 This standard covers minimum requirements and recommendations for firearm and toolmark
103 examiner training programs. The requirements listed in this standard include the essential skills
104 and knowledge needed to perform successfully in the discipline. The additional recommended
105 elements are considered by the subcommittee to be highly beneficial and worthy of inclusion
106 should the necessary resources be available. Requirements and recommendations include training
107 topics, documentation, casework exercises, and methods for testing competency. This document
108 will also provide guidance regarding which training elements may be removed in cases where a
109 trainee is being qualified in only one category of testing. This standard does not preclude agencies
110 from adding additional mission-specific requirements.

111
112 **2 Normative References**

113
114 none

115
116 **3 Terms and Definitions**

117
118 **3.1 Firearm and Toolmark Examination**

119 A discipline of forensic science that includes the classification and comparison of microscopic
120 toolmarks created by firearms or other tools. It may also include the examination of firearms and
121 non-firearm tools, serial number restoration, and muzzle-to-object distance determinations.

122
123 **3.2 Firearm Examination**

124 A specialized type of firearm and toolmark examination that includes the classification and
125 comparison of microscopic toolmarks created by firearms on ammunition components. It may also
126 include the examination of firearms, serial number restoration, and muzzle-to-object distance
127 determinations.

128
129 **3.3 Firearm and Toolmark Examiner**

130 A person who has completed training in the firearm and (non-firearm) toolmark categories of
131 testing and is currently authorized to perform work in these categories of testing at a particular
132 forensic science service provider.

133
134 **3.4 Firearm Examiner**

135 A person who has completed training in the discipline of firearm examinations and is currently
136 authorized to perform work in this category of testing at a particular forensic science service
137 provider.

138
139 **3.5 Forensic Science Services Provider (FSSP)**

140 A forensic science agency or forensic science practitioner providing forensic science services.

141
142 **3.6 Known Match**

143 Toolmarks known to have been made by the same tool.

144
145 **3.7 Known Non-Match**

146 Toolmarks known to have been made by different tools or different working surfaces of the same
147 tool.

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3.8 Toolmark Examiner

A person who has completed training in the discipline of (non-firearm) toolmark examinations and is currently authorized to perform work in this category of testing at a particular forensic science service provider.

3.9 Toolmark Examination

A specialized type of firearm and toolmark examination that includes the classification and comparison of microscopic toolmarks created by non-firearm tools. It may also include the examination of non-firearm tools.

3.10 Trainee

A person who is undergoing, but has not yet completed, training in the disciplines of firearm and/or toolmark examination.

3.11 Trainer

A person who is responsible for delivering or monitoring training, or verifying the successful completion of training elements. This person may be a currently qualified or formerly qualified examiner with appropriate expertise who has been authorized by the forensic science service provider to perform training-related duties.

4 Requirements

4.1 Administrative

4.1.1 Documentation

A document describing all training requirements and trainee expectations shall be issued to the trainee at the beginning of the training period. This document shall contain information regarding the training topics that will be covered, the expected timeline of their completion, and the various types of tests that the trainee must successfully complete. The completion of all required elements of training shall be documented and retained.

4.1.2 Required Elements

All trainees shall complete sections 4.1 (all), 4.2.1, 4.2.3, 4.2.4, 4.2.8, 4.2.13 - 4.2.17
Trainees being trained in firearms, but not toolmarks, shall also complete sections 4.2.2, 4.2.5, 4.2.6, 4.2.7, 4.2.9, 4.2.10

Trainees being trained in toolmarks, but not firearms, shall also complete sections 4.2.11 and 4.2.12.

Trainees being trained in both firearms and toolmarks shall also complete sections 4.2.2, 4.2.5, 4.2.6, 4.2.7, 4.2.9, 4.2.10, 4.2.11 and 4.2.12.

The requirements for total known match and known non-match comparisons shall not be reduced based upon categories of training.

Trainees being trained in fracture match comparisons (5.4), serial number restoration (5.3), or distance determinations (5.1, 5.2) shall also complete the corresponding requirements for those categories.

197 **4.1.3 Training Topics Not Present**

198
199 The absence of a particular knowledge area or skill in the training topics listed below is not
200 necessarily intended as an objection to its inclusion in a training plan. FSSPs should add any
201 training topics that are relevant and beneficial.
202

203 **4.1.4 Training Methods**

204
205 For most topics, this document does not describe or endorse particular learning methods. It is the
206 responsibility of each FSSP to determine the most effective methods for training. A successful
207 training program includes reading, lecture, group discussions, real or mock examinations under the
208 guidance of a qualified examiner, and a substantial amount of “hands-on” self-study of
209 firearms/tools, toolmarks, and comparison techniques. The order of the topics listed in this
210 document is not intended to be the recommended order of training. Many of the topics are
211 interrelated and do not necessarily need to be taught separately.
212

213 **4.1.5 Testing**

214
215 Competency in the various training topics may be assessed using a combination of: written tests,
216 oral examinations, intercomparison tests, and mock casework.
217

218 Competency testing shall be performed with realistic casework elements including case notes,
219 comparison examinations, and written reports.
220

221 Training shall include mock courtroom exercise(s).
222

223 **4.1.6 Supervised Casework**

224
225 Trainees shall have their initial casework reviewed or supervised. This process shall occur in the
226 latter stages of training, or immediately upon completion of training. FSSBs shall clearly define both
227 the process and the extent to which it will occur, such as a particular number of cases or a certain
228 number of months.
229

230 **4.1.7 Evaluation of Training Program**

231
232 The forensic science service provider shall establish a formal mechanism for trainees to provide
233 feedback on the effectiveness of the training program. This information shall be used by the FSSP to
234 evaluate, update and improve the training program on a periodic basis.
235

236 **4.1.8 Continuing Education**

237
238 After completion of training, examiners shall engage in continuing education, such as attending
239 conferences, participating in research, or visiting manufacturing facilities. FSSPs shall dedicate the
240 necessary resources to ensure compliance and define minimum continuing education requirements
241 for qualified examiners.
242

243 **4.2 Training Topics**

244 **4.2.1 General Manufacturing and Machining**

246
247 Understanding general manufacturing and machining processes, especially as they pertain to the
248 production of firearms and tools, is of fundamental importance. This understanding will allow the
249 trainee to assess the significance of the toolmarks encountered during initial examinations, during
250 comparison examinations, and when rendering source conclusions.

251
252 The following subject areas shall be included in a training program:

- 253
254 Gross Forming Techniques
- 255 Forging
 - 256 Hand
 - 257 Drop
 - 258 Press
 - 259 Casting
 - 260 Sand
 - 261 Investment/Lost Wax
 - 262 Fine Forming Techniques
 - 263 Turning
 - 264 Milling
 - 265 Drilling
 - 266 Boring
 - 267 Reaming
 - 268 Broaching
 - 269 Sawing
 - 270 Electrical discharge machining
 - 271 Electrochemical machining
 - 272 Metal injection molding
 - 273 Finishing Techniques
 - 274 Grinding/Sanding
 - 275 Etching
 - 276 Media blasting
 - 277 Tumbling media
 - 278 Finishes
 - 279 Bluing
 - 280 Browning
 - 281 Oxide (Parkerizing, etc.)
 - 282 Plating
 - 283 Coatings/Paint
 - 284 Key Machining Concepts for Toolmark Identification
 - 285 Chip formation
 - 286 Plastic deformation
 - 287 Tool wear
 - 288 Built Up edge

289
290 The following subject areas should be included in a training program:

- 291
292 Tours of machine shops or manufacturers, supplemental to any other firearm, ammunition
293 or tool manufacturer tours, to ensure sufficient exposure to manufacturing/machining
294 methods listed above

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General concepts and practices of Additive Manufacturing (3-D printing)

4.2.2 Firearms Manufacturing

In addition to general manufacturing techniques, an understanding of the specific manufacturing and machining processes that pertain to the production of firearms and firearm parts will assist the trainee in understanding both the design concepts and the function of firearms. Additionally, an understanding of the common machining methods used for barrels, breech faces, and other surfaces that contact ammunition components will allow the trainee to understand the sources and nature of toolmarks present on fired and unfired ammunition components.

The following subject areas shall be included in a training program:

Barrels

Blanks

- Deep hole drilling
- Reaming
- Extrusion (Hi-Point)

Rifling

- Button
- ECM (Electrochemical Machining)
- EDM (Electrical Discharge Machining)
- Gang Broach
- Hammer Forged
- Single Point/Hook/Scrape Rifling

Finishing

- Straightening
- Chambering
- Throating
- Crowning
- Contouring
- Honing/Lapping/Polishing

Common machining techniques that are used to produce the following parts:

Breech faces

- Chambers
- Hammers/Firing pins/Strikers
- Firing pin aperture
- Extractors
- Ejectors
- Feed ramps / forcing cones
- Magazines
- Ejection port

Common alterations and associated toolmarks

- Sawed off barrel
- Muzzle attachments
- Front sight alteration

344
345 The following subject areas should be included in a training program:

346
347 Additive Manufacturing (3-D printing)

348
349 Tours

350 Firearm Manufacturers

351 Barrel Manufacturers

352

353 **4.2.3 History of Firearm and Toolmark Examinations**

354

355 An understanding of the legal context of firearm and toolmark examinations requires knowledge of
356 the evolution of firearm and toolmark practice and testimony in courts of law, as well as applicable
357 laws prohibiting the use of certain firearms and accessories.

358

359 The following subject areas shall be included in a training program:

360

361 Evolution of use in court

362 Evolution of examination and comparison techniques

363 Photomicrographs

364 Comparison microscope

365

366 Literature Review

367 Relevant peer reviewed journal articles and textbooks

368

369 **4.2.4 Theory and Validity of Firearm and Toolmark Examinations**

370

371 The successful application of examination techniques and any subsequent communication
372 regarding the results of examinations requires a complete understanding of the scientific
373 foundation of firearm and toolmark examinations. Theory, nomenclature, research, and statistical
374 methods are all crucial to successful completion of training.

375

376 The following subject areas shall be included in a training program:

377

378 AFTE Theory of Identification

379 Class characteristics

380 Subclass characteristics

381 Individual characteristics

382 Types of Toolmarks

383 Impressed Toolmarks

384 Striated Toolmarks

385 Concept of Known Match and Known Non-Match comparisons

386 Research

387 Validity Testing

388 Early studies

389 Black, White, and Grey box studies

390 Error Rates

391 Expressions of Confidence

392 Criticisms of Current Methods

- 393 Basic concepts of QCMS
394
395 The following subject areas should be included in a training program:
396
397 Statistics, including Likelihood Ratios
398 Toolmark topography instruments and correlation algorithms
399
400 **4.2.5 Ammunition**
401
402 Successful examinations of both fired and unfired ammunition components require knowledge of
403 industry terminology, the evolution of ammunition designs, and manufacturing methods associated
404 with ammunition.
405
406 The following subject areas shall be included in a training program:
407 Ammunition manufacturing
408 Blanking
409 Cupping
410 Drawing
411 Swaging
412 Headstamps
413 Case/primer materials
414 Assembly
415 Crimping
416 Reloading
417
418 Terminology associated with both historic and modern ammunition
419 Caliber naming conventions
420 Cartridge case design
421
422 Terminology associated with shotshell ammunition
423 Components
424 Gauge
425 Pellet sizes
426
427 Caliber determination of bullets
428 Instrumentation used
429
430 Caliber determination of cartridges/cartridge cases
431 Headstamps
432 Case dimensions
433 Caliber families
434 Mismatching and Interchangeability of ammunition and firearm caliber
435 Wildcat cartridges
436
437 Evolution of ammunition
438 Propellants, black powder to modern smokeless powder
439 Rimmed and centerfire
440 Types of primers
441 Bullet shapes, designs

- 442 Current common brands and types of ammunition
443
444 The following subject areas should be included in a training program:
445
446 Tours of ammunition factories
447 Manufacturing toolmark examinations and comparisons (e.g. bunter marks, mold marks), including
448 interpretation limitations
449
450 **4.2.6 Firearm Design and Terminology**
451
452 The successful examination of firearms requires comprehensive knowledge of terminology,
453 evolution of design concepts, firearm parts, and the cycle of operation of firearms.
454
455 The following subject areas shall be included in a training program:
456
457 Evolution of Firearms
458 Ignition Systems
459 Safeties
460 Firearms Terminology
461 Pistol
462 Revolver
463 Rifle
464 Shotgun
465 Parts and nomenclature associated with types of firearms
466 Assembly and disassembly of firearms, supplemented with owner's manuals, books and
467 videos
468 Cycle of fire
469 Action types
470 Bolt action
471 Lever action
472 Pump action
473 Revolver
474 Semi-Automatic/Automatic Actions
475 Blowback
476 Recoil
477 Gas operated
478 Modes of Fire
479 Single Action
480 Double Action
481 Burst/Fully Automatic
482 Post manufacture alterations and accessories
483 Full Auto conversions
484 Incomplete firearms ("80%" firearms, receiver blanks, home-built)
485 Drop-in barrels
486 Bump stocks
487 Trigger modifications
488
489
490

491 **4.2.7 Examination of Firearms**

492

493 In addition to design and terminology, examiners must know the common examination techniques
494 that are required for a full analysis and documentation of a firearm's design and functional
495 characteristics. This must be coupled with safe handling and firing practices and knowledge of the
496 source of important toolmarks within each firearm and any associated accessories.

497

498 The following subject areas shall be included in a training plan:

499

500 Safe handling and firing of firearms

501 Function Exams

502 Firearm safety/recall list

503 Test firing and selection of appropriate ammunition

504 Safety tests

505 Trigger Pull

506 Barrel and overall length measurements

507 Impact test

508 Casting of firearm parts/alternate tools for creating test marks

509

510 Firearms Laws

511 NFA (National Firearms Act)

512 GCA (Gun Control Act)

513 Relevant State/Local Specific Laws

514

515 Firearm components that potentially create toolmarks:

516

517 Lands and grooves

518 Breech / bolt face

519 Firing pin

520 Ejector

521 Ejection port

522 Extractor

523 Chamber

524 Feed ramp

525 Magazine

526

527 Evaluation of potential for subclass characteristics in each of the categories above.

528

529 **4.2.8 Microscope Use and Familiarization**

530

531 Microscopes are the primary tools with which firearm and toolmark examiners conduct
532 examinations of fired ammunition components and toolmarked surfaces.

533

534 The following subject areas shall be included in a training program:

535

536 Design and use of a stereoscope

537 Design and use of a comparison microscope

538 Light sources and lighting techniques

539 Photographic techniques

540 Comparison techniques

541

542 The following subject areas should be included in a training program:

543

544 Focus variation microscopy

545 Interferometric microscopy

546 Confocal microscopy

547 Photometric microscopy

548 Virtual comparison microscopy

549

550 **4.2.9 Bullet Examinations**

551

552 Bullets, when fired through the barrel of a firearm, acquire surface features from the internal
553 surfaces of the barrel. Accurate examinations of these characteristics are essential. Additional
554 knowledge of rifling characteristics and bullet design may also allow the examiner to eliminate
555 certain classes of firearms from any association with the fired bullet.

556

557 The following subject areas shall be included in a training program:

558

559 Caliber determination

560 Design features

561 Direction of twist

562 Land and groove impression measurement techniques

563 General Rifling Characteristics (GRC) database

564 Recognition of potential subclass characteristics in both barrels of firearms and areas on bullets

565 Evaluation and comparison of test fired bullets and selection of appropriate ammunition

566 Evaluation and comparison of questioned bullets

567 Range of conclusions for bullet comparisons

568 Documentation of exam results and comparisons

569

570 **4.2.10 Cartridge/Cartridge Case/Shotshell Examinations**

571

572 Cartridge cases and shotshells, when fired in a firearm, acquire characteristics from the working
573 surfaces of that firearm. Accurate examinations of these characteristics are essential. Additional
574 knowledge of cartridge/shotshell design allows the examiner to eliminate certain classes of
575 firearms from any association with the ammunition component.

576

577 The following subject areas shall be included in a training program:

578

579 Recognition of marks on cartridges/cartridge cases/shotshells

580 Firing pin impression

581 Breech face marks

582 Aperture impression/shear

583 Extractor

584 Ejector

585 Firing pin drag

586 Chamber marks

587 Magazine lip marks

588 Loaded chamber indicator impressions

- 589 Shell stop marks
- 590 Anvil Marks
- 591 Caliber/gauge determination
- 592 Design features
- 593 Recognition of potential subclass marks on fired cartridge cases/shotshells
- 594 Recognition of manufacturing marks
- 595 Evaluation and comparison of test fired cartridge cases/shotshells and selection of appropriate
- 596 ammunition
- 597 Evaluation and comparison of cartridge cases/shotshells
- 598 Range of conclusions for cartridge/cartridge case/shotshell comparisons
- 599 Documentation of exam results and comparisons

600

601 **4.2.11 Tool Manufacturing**

602

603 Building upon manufacturing and machining knowledge, examiners must be familiar with the
604 variety of methods used to create tools. Of specific importance are the techniques applied to tool
605 working surfaces that may come into contact with evidentiary items. This understanding will assist
606 the trainee in assigning significance to the toolmarks encountered during examinations, and will
607 therefore assist with source conclusions.

608

609 The following subject areas shall be included in a training program:

610

611 Definition of tool, both common and in the context of toolmark examination

612 Common types of hand tools and their associated parts.

613

614 Common manufacturing methods for hand tools

615 Screwdrivers

616 Bolt Cutters

617 Knives

618 Chisels

619 Hammers

620 Diagonal Pliers

621 Tongue and Groove Pliers

622 Shears/snips

623

624 The following subject areas should be included in a training program:

625

626 Tours of tool manufacturers

627

628 **4.2.12 Toolmark Examinations**

629

630 Knowledge of common tool actions and the wide variety of ways that tools can leave toolmarks is
631 essential to the toolmark examiner. Additionally, examiners must be able to reliably classify
632 toolmarks, evaluate areas of possible subclass influence, and compare toolmarks for the purpose of
633 rendering source conclusions.

634

635 The following subject areas shall be included in a training program:

636

637

- 638 Categories of tool actions:
- 639 Shearing action
- 640 Pinching action
- 641 Scraping action
- 642 Slicing action
- 643 Gripping action
- 644 Prying action
- 645 Crimping action
- 646 Class characteristic evaluation of toolmarks
- 647 Creating test marks in different substrates
- 648 Casting methods
- 649 Recognition of potential subclass characteristics
- 650 Evaluation and comparison of toolmarks
- 651 Range of conclusions for toolmark comparisons
- 652 Documentation of exam results and comparisons

653

654 **4.2.13 Casework Documentation**

655

656 Casework documentation must satisfy various stakeholders, to include the examiner, technical and
657 administrative reviewers, FSSP quality guidelines, investigators, and any interested parties at trial.

658

659 The following subject areas shall be included in a training program:

660

- 661 Types of information that must be recorded
- 662 Types of information that may be recorded
- 663 Acceptable forms of documentation
- 664 Quality system requirements for casework documentation

665

666 **4.2.14 Casework Exercises**

667

668 Casework exercises should be sufficient to impart to the trainee a full knowledge of a FSSP's
669 casework process.

670

671 The following subject areas shall be included in a training program:

672

- 673 Evidence assignment and chain of custody
- 674 Proper evidence handling procedures
- 675 Simulated casework
- 676 Supervised casework
- 677 Verification and review

678

679 **4.2.15 Known Non-Match (KNM)/Known Match (KM) Exercises**

680

681 Comparisons of KMs and KNMs are a core component of training for firearm and toolmark
682 examiners. KM and KNM comparisons develop a trainee's ability to recognize levels of
683 correspondence that are consistent with toolmarks known to have been created by the same tool,
684 and levels of correspondence that are consistent with toolmarks known to have been created by
685 different tools.

686

687 For the purposes of this document, a single KM or KNM comparison examination consists of a
688 complete comparison examination of two items (bullets, cartridge cases, etc.), not a comparison of
689 only two land impressions or two firing pin impressions.

690
691 Samples for use in KM and KNM exercises are typically produced by trainers or trainees who are
692 direct witnesses to their creation, thereby establishing ground truth.

693
694 The source of the toolmarks used to meet this requirement should reflect the categories of testing
695 included in training. For example, if the training program is exclusively firearms examinations, most
696 of these exercises should be conducted with bullets, cartridge cases, and shotshells. However, some
697 exposure to sources of toolmarks outside of the trainee’s expected categories of testing may also be
698 beneficial. This requirement may be met through the cumulative completion of various training
699 exercises and supplemented as necessary to meet the minimum number. Regardless, training
700 records shall clearly document the quantity of each type of comparison completed for this
701 requirement.

702
703 The following studies shall be conducted and documented, regardless of which categories of testing
704 the trainee will be qualified in. The numbers listed are a combined total, it is not necessary to
705 repeat the exercise for non-firearm toolmarks:

706
707 200 Known Non-Match comparisons, including both impressed and striated toolmarks.

708
709 200 Known Match comparisons, including both impressed and striated toolmarks.¹

710
711 Some of the KNM comparisons shall include samples created by consecutively manufactured
712 tools/firearms.

713
714 In order to familiarize trainees with QCMS, the FSSP should consider documenting runs of
715 consecutive matching striae for a portion or all of the above exercises.

716
717 **4.2.16 Communication, Legal Issues, Court**

718
719 These topics address the intersection of science and the law, and the necessity of effective
720 communication with various stakeholders in the legal system.

721
722 The following topics shall be addressed in examiner training:

- 723
724 Courtroom procedures
725 Court admissibility
726 Role of expert testimony
727 Public speaking
728 Communicating within the judicial system
729 Courtroom etiquette

¹ The number 200 was chosen after a survey of five training manuals currently in use by federal and state/local FSSBs. Please note that the provision of a minimum number is intended to prevent insufficient exposure to KM/KNMs, and should not be construed as the “perfect” number of studies to be qualified as a toolmark examiner. The five agencies surveyed were the Bureau of Alcohol, Tobacco, Firearms and Explosives, the Federal Bureau of Investigation, the Illinois State Police, the Indiana State Police, and the Los Angeles Police Department.

730 Court rulings, including the range of conclusions permitted

731 Discovery requirements

732 Moot court exercises

733

734 **4.2.17 Ethics, Bias, Human Factors**

735

736 Knowledge of common forms of bias is an essential part of any attempt to limit the influence of bias
737 within a forensic science discipline. Likewise, a sound institutional knowledge of ethical issues
738 related to forensic science helps build and maintain the integrity of the persons and institutions
739 performing forensic analyses.

740

741 The following topics shall be addressed in examiner training:

742

743 Contextual information

744 Confirmation bias

745 Task relevant information

746 Neutrality in forensic science

747 Codes of ethics

748

749 **4.2.18 Forensic Science Service Provider Operations**

750

751 In the absence of other institutional or forensic science service provider-wide training
752 requirements for examiners in all disciplines, the following topics shall be included in examiner
753 training:

754

755 Authority structure within the FSSP

756 Quality system

757 Accreditation matters

758 Laboratory safety

759 Safe handling of evidence / universal precautions

760 Evidence tracking / LIMs systems

761

762 **5 Optional Topics**

763

764 **5.1 Distance Determination via Gunshot Residues**

765

766 In this section, “distance determination” refers to any determinations that can be made regarding
767 the distance from the muzzle of the firearm to an impact surface based upon the examination of
768 gunshot residues on clothing or other impact sites.

769

770 The following subject areas shall be included in a training program:

771

772 Factors regarding the deposition of residue from the use of a firearm

773 Ammunition type

774 Firearm type

775 Revolvers

776 Pistols

777 Rifles

778 Shotguns

- 779 Substrate type
- 780 Visual inspection
 - 781 Hole
 - 782 Ripping/tearing
 - 783 Singeing/burning/melting
 - 784 Presence of powder/particulate or vaporous lead
- 785 Chemistry and examination techniques for
 - 786 Nitrites
 - 787 Lead
 - 788 Copper
- 789 Application of techniques for nitrites and lead
 - 790 Test known distance patterns using appropriate techniques
 - 791 Test unknown distance patterns using appropriate techniques
- 792 Comparison of known and unknown patterns, documentation, interpretation and conclusions,
793 including limitations
- 794
- 795 **5.2 Distance Determination via Shot Patterns**
- 796
- 797 In this section, “distance determination” refers to any determinations that can be made regarding
798 the distance from the muzzle of the firearm to the impact surface based upon the examination of
799 impact patterns on a victim’s clothing or other impact sites.
- 800
- 801 The following subject areas shall be included in a training program:
- 802
- 803 Factors regarding shot patterns from the use of a firearm
 - 804 Ammunition types
 - 805 Pellet sizes
 - 806 Shotshell wadding
 - 807 Buffer Material
 - 808 Firearm type
 - 809 Shotgun choke systems
 - 810 Measuring shot patterns
 - 811 Correcting for non-orthogonal patterns
 - 812 Creating and measuring shot patterns at known distances
 - 813 Comparison of known and unknown patterns, interpretation and conclusions, including
814 limitations
- 815
- 816 **5.3 Serial Number / Obliterated Character Restoration**
- 817
- 818 The recovery of an obliterated serial number on a firearm or characters present on other evidence
819 types can be a valuable piece of intelligence for investigators. This section is designed to impart
820 knowledge about common destruction processes and both knowledge of and experience using the
821 many recovery methods available to examiners.
- 822
- 823 The following subject areas shall be included in a training program:
- 824
- 825 Serial number application processes
- 826 Types of destruction methods

- 827 Grinding
- 828 Over stamping
- 829 Peening
- 830 Gouging
- 831 Heating
- 832 Welding
- 833 Scratching
- 834 Drilling
- 835 Terminology regarding serial number recovery processes
- 836 Chemical methods
- 837 Polishing methods
- 838 Sanding methods
- 839 Electro-chemical methods
- 840 Magnetic Particle inspection
- 841 Barcode decryption
- 842 Lighting techniques
- 843
- 844 Use of different recovery processes
- 845 Application of recovery methods to ferrous firearms
- 846 Application of recovery methods to non-ferrous firearms
- 847 Application of recovery methods by barcode decryption
- 848 Documentation of recovery of serial numbers
- 849 Photography
- 850 Note taking
- 851 Reporting Conclusions
- 852 Alternative sources of serial number recovery
- 853 Secondary serial numbers
- 854 Secondary/hidden manufacturer codes

855

856 **5.4 Fracture Examinations**

857

858 The analysis of fractured objects and surfaces to determine if they were once part of the same
859 object is performed by firearm and toolmark examiners in some FSSBs. The list of training topics
860 below is designed only to be used in combination with either firearm examiner or toolmark
861 examiner training, and does not provide sufficient training and skill if it is completed without
862 firearm or toolmark training. Additionally, since this document pertains to firearm and toolmark
863 training, the listed training requirements are for that purpose only; this document imposes no
864 requirements or recommendations on persons training in fracture examinations within other
865 disciplines.

866

867 The following topics shall be addressed in examiner training:

868

869 Failure modes of brittle materials

870 Plastic deformation

871 Elastic deformation

872 Class characteristics

873 Physical fit

874 Reverse lighting techniques, microscopic comparison

875 Casting or coatings for translucent/translucent materials



*Requirements and Recommendations for a
Firearm and Toolmark Examiner Training Program*

- 876 Range of conclusions
- 877
- 878 Known Match and Known Non-Match studies shall be performed utilizing a variety of substrate
- 879 materials and object geometries that are typical of casework.
- 880

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