

ASB Standard 124, First Edition
2025

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

DRAFT



ASB
ACADEMY
STANDARDS BOARD

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

ASB Approved Xxxxx 2025

ANSI Approved Xxxxx 2025



410 North 21st Street
Colorado Springs, CO 80904

This document may be downloaded from: www.aafs.org/academy-standards-board

This document is provided by the AAFS Standards Board (ASB). Users are permitted to print and download the document and extracts from the document for personal use, however the following actions are prohibited under copyright:

- *modifying this document or its related graphics in any way;*
- *using any illustrations or any graphics separately from any accompanying text; and,*
- *failing to include an acknowledgment alongside the copied material noting the AAFS Standards Board as the copyright holder and publisher.*

Users may not reproduce, duplicate, copy, sell, resell, or exploit for any commercial purposes this document or any portion of it. Users may create a hyperlink to www.aafs.org/academy-standards-board to allow persons to download their individual free copy of this document. The hyperlink must not portray AAFS, the AAFS Standards Board, this document, our agents, associates and affiliates in an offensive manner, or be misleading or false. ASB trademarks may not be used as part of a link without written permission from ASB.

The AAFS Standards Board retains the sole right to submit this document to any other forum for any purpose.

Certain commercial entities, equipment or materials may be identified in this document to describe a procedure or concept adequately. Such identification is not intended to imply recommendations or endorsement by the AAFS or the AAFS Standards Board, nor is it intended to imply that the entities, materials, or equipment are necessarily the best available for the purpose.

Proper citation of ASB documents includes the designation, title, edition, and year of publication.

*This document is copyrighted © by the AAFS Standards Board, LLC. 2025 All rights are reserved.
410 North 21st Street, Colorado Springs, CO 80904, www.aafs.org/academy-standards-board.*

Foreword

This document has been developed with the objective of improving the quality and consistency of firearm and toolmark examination training practices.

This document contains an outline of training topics which serve as minimum requirements for firearm and toolmark examiner training programs. The requirements listed in this standard include the essential skills and knowledge needed to perform successfully in the discipline.

The additional recommended topics are considered by the subcommittee to be highly beneficial and worthy of inclusion if the necessary resources are available. These recommended topics will be explicitly identified as such.

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 Firearms and Toolmarks Consensus Body of the AAFS Standards Board. The draft of this standard was developed by the Firearms and Toolmarks 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: *TBD*

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

1. Scope.....

2 Normative References.....

3 Terms and Definitions.....

4 Requirements.....

Annex A (informative) Bibliography.....

DRAFT

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

1 Scope

This standard covers the minimum requirements and recommendations for firearm and toolmark examiner training programs. The requirements include the essential skills and knowledge needed to perform successfully in the discipline. Requirements and recommendations include training topics, documentation, casework exercises, and methods for testing competency of the examiner. This document also provides guidance regarding which training elements may be removed in cases where a trainee is being qualified in only one category of testing. This standard does not preclude agencies from adding additional mission-specific requirements.

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. Annex A, Bibliography, contains informative references.

Association of Firearm and Tool Mark Examiners (AFTE) Training Manual.^a

ANSI/ASB Best Practice Recommendation 068, *Safe Handling of Firearms and Ammunition.*^b

ANSI/ASB Standard 105, *Minimum Education Requirements for Firearm and Toolmark Examiner Trainees.*^b

3 Terms and Definitions

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

3.1 competency test

Evaluation of the knowledge, skills, and abilities (KSAs) in the standard practices necessary to conduct examinations in a discipline or category of testing prior to performing independent casework.

3.2 firearm and toolmark examination

Discipline of forensic science charged with conducting comparison examinations of tools and toolmarks and reporting the conclusion.

NOTE When the tool is a firearm, the discipline also seeks to answer relevant questions about the firearms or ammunition components involved in an incident.

^a Available from: <https://afte.org/resources/afte-training-manual>

^b Available from: <https://www.aafs.org/academy-standards-board>

33 **3.3**

34 **firearm examination**

35 Subdiscipline of firearm and toolmark examination that includes, but is not limited to, the
36 classification and comparison of microscopic toolmarks created by firearms on ammunition
37 components.

38 NOTE It may also include the examination of firearms, serial number restoration, and muzzle-to-target
39 distance determinations.

40 **3.4**

41 **firearm and toolmark examiner trainee**

42 A person who is entering or undergoing, but has not yet completed, training in the discipline of
43 firearm and toolmark examination.

44 **3.5**

45 **Forensic Science Service Provider**

46 **FSSP**

47 Forensic science agency or forensic science practitioner providing forensic science services.

48 **3.6**

49 **known same source**

50 **KSS**

51 Toolmarks or specimens known to have been made by the same tool.

52 **3.7**

53 **known different source**

54 **KDS**

55 Toolmarks or specimens known to have been made by different tools or different working surfaces
56 of the same tool.

57 **3.8**

58 **qualified firearm examiner**

59 Individual who has completed training in the discipline of firearm examinations and is currently
60 authorized to perform work in this category of testing by a particular forensic science service
61 provider.

62 **3.9**

63 **qualified toolmark examiner**

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

67 **3.10 task-relevant information^c**

68 Information that is necessary for drawing conclusions:

- 69 — about the propositions in question;
70 — from the physical evidence that has been designated for examination;

^c Available from: <https://www.justice.gov/ncfs/file/818196/download>

71 — through the correct application of an accepted analytic method by a competent analyst

72 **3.11**

73 **toolmark examination**

74 Subdiscipline of firearm and toolmark examination that includes the classification and comparison
75 of microscopic toolmarks created by non-firearm tools.

76 NOTE The examination of non-firearm tools may also be included.

77 **4 Requirements**

78 **4.1 Administrative**

79 **4.1.1 Documentation**

80 Training requirements and trainee expectations shall be documented at the beginning of the
81 training period. The documentation shall contain information regarding the training topics to be
82 covered, the expected timeline of their completion, and the various training modules that the
83 trainee shall successfully complete. The completion of all required elements of training shall be
84 documented. Retention of the records shall be determined by the FSSP policies. Trainees should
85 retain a copy of their training records.

86 **4.1.2 Training Materials**

87 The FSSP shall determine the required and recommended training materials for the topics that are
88 provided in the document. The recommended source for the references is the Association of
89 Firearm and Tool Mark Examiners (AFTE) Training Manual. The AFTE Training Manual is
90 periodically updated and provides the best source material for the various training topics.

91 **4.1.3 Required Elements**

92 **4.1.3.1** Trainees being trained in firearms, but not toolmarks, shall complete sections 4.1, 4.2.1
93 through 4.2.13, and 4.2.16 through 4.2.21.

94 **4.1.3.2** Trainees being trained in toolmarks, but not firearms, shall complete sections 4.1, 4.2.1,
95 4.2.3, 4.2.4, 4.2.7, and 4.2.14 through 4.2.21.

96 **4.1.3.3** Trainees being trained in both firearms and toolmarks shall complete sections 4.1 and 4.2.

97 **4.1.3.4** The requirements in Section 4.2.18 for total KSS and KDS comparisons shall not be
98 reduced based upon categories of training.

99 **4.1.3.5** Trainees being trained in distance determinations (5.1, 5.2), serial number restorations
100 (5.3), and fracture examinations (5.4) shall also complete the corresponding requirements for those
101 categories.

102 **4.1.4 Additional Training Topics**

103 Additional areas of training should be included in the training program based on the needs of the
104 FSSP. FSSPs should add any training topics that are relevant and beneficial.

105 **4.1.5 Selection of Trainers**

106 **4.1.5.1** The FSSP shall have a policy that identifies personnel responsible for the selection of
 107 trainers, overseeing the performance of the trainers and trainees, developing curriculum, and
 108 approval of the training program and the qualification of examiners.

109 **4.1.5.2** FSSP should select trainer(s) who are willing to perform in this role and who have the
 110 subject matter expertise to carry out the training. This may require coordination with technical
 111 authorities in each training topic to ensure that the qualifications are met.

112 **4.1.5.3** The FSSP shall document the qualifications of selected trainers. Trainer qualifications may
 113 include, but are not limited to, good oral and written communication skills, expertise in the subject
 114 matter, and receipt of basic instructional skills training. Trainers should be available for the
 115 duration of the training to ensure stability for the trainee.

116 **4.1.6 Training Methods**

117 The FSSP shall determine the most effective approach for training each individual in the required
 118 modules. A successful training module may include readings, lectures, demonstrations, discussions,
 119 examinations under the guidance of a qualified examiner, and practical exercises incorporating
 120 firearms, tools, toolmarks, and comparison techniques. The order of the topics listed in this
 121 document is not intended to be the recommended order of training. Many of the topics are
 122 interrelated and do not necessarily need to be taught separately.

123 **4.1.7 Testing**

124 **4.1.7.1** Assessment tools for the various training topics may include, but are not limited to:
 125 written tests, oral examinations, mock casework, practical exercises/examinations (comparisons),
 126 presentations, and mock trials.

127 **4.1.7.2** Answers to the written tests, questions in oral examinations, intercomparison tests, mock
 128 casework, and practical examinations shall be known by the FSSP prior to the tests being
 129 administered. Standards for successful completion of these tests shall be clearly defined by the
 130 FSSP and provided to the trainee prior to the test being administered.

131 **4.1.7.3** Presentations and mock trials shall be evaluated according to the FSSP policies and the
 132 evaluations shared with the trainee upon conclusion.

133 **4.1.7.4** A competency test shall be successfully completed in each sub-discipline prior to
 134 assuming casework in that specific sub-discipline. Competency testing shall include a range of
 135 elements of varying difficulty that would reasonably be expected to be encountered in normal
 136 casework and shall include case notes, comparison examinations, and written reports.

137 **4.1.7.5** Successful completion based on previously defined standards of all assigned topics in the
 138 training program shall be required. It is the responsibility of each FSSP to provide the assessment of
 139 the trainee and also the pass/fail determination for the test methods they so choose.

140 **4.1.7.6** If the trainee does not successfully complete a test, the FSSP shall provide training
 141 directed toward the observed deficiencies, followed by retesting. The FSSP shall have a policy that
 142 outlines additional steps that would be necessary in cases of persistent failure to successfully
 143 complete training requirements.

144 4.1.8 Mentored Casework

145 Prior to performing independent casework, the new examiner shall participate in a period of
146 supervised casework. Mentorship shall include actual or simulated casework and should focus on
147 the depth and breadth of cases routinely encountered by the laboratory as determined by the FSSP.
148 The new examiner's trainer, or other qualified examiner may observe and assist the new examiner
149 as needed and shall perform a documented review of all casework, or simulated casework,
150 completed during mentorship, including a microscopic review of all comparison conclusions. The
151 FSSP shall determine the duration of mentored casework and the criteria for successful completion.

152 4.1.9 Evaluation of Training Program

153 The FSSP shall establish a formal mechanism for trainees to provide feedback on the effectiveness
154 of the training program. This information shall be used by the FSSP to evaluate, update, and
155 improve the training program on a periodic basis.

156 4.1.10 Continuing Education

157 The FSSP shall have a documented program to ensure technical qualifications are maintained
158 through participation in continuing education. Over a five-year period, examiners shall complete a
159 minimum of 100 hours of discipline-specific continuing education, which could include but is not
160 limited to attending conferences, participating in research, visiting manufacturing facilities,
161 reviewing literature, attending workshops, and publishing peer reviewed research projects. The
162 FSSP shall determine what qualifies as discipline-specific continuing education and how to
163 document compliance. Documentation shall include, at a minimum, the topics or titles, where
164 feasible, of workshops and other kinds of presentations attended to satisfy continuing education
165 requirements. Discipline-specific continuing education obtained to fulfill other requirements or
166 certifications may be applied to the fulfillment of this document.

167 4.2 Training Topics**168 4.2.1 General Manufacturing and Machining**

169 **4.2.1.1** Understanding general manufacturing and machining processes, especially as they
170 pertain to the production of firearms and tools, is of fundamental importance. This understanding
171 allows the trainee to assess the significance of the toolmarks encountered during initial
172 examinations, during comparison examinations, and when rendering source conclusions.

173 **4.2.1.2** The instruction regarding the following manufacturing and machining techniques shall be
174 included in a training program.

175 a) Forging:

176 1) hand,

177 2) drop,

178 3) press,

179 4) hammer.

- 180 b) Casting:
- 181 1) sand,
- 182 2) investment/lost wax.
- 183 c) Extrusion.
- 184 d) Fine forming techniques:
- 185 1) turning,
- 186 2) milling.
- 187 e) Drilling.
- 188 f) Boring.
- 189 g) Reaming.
- 190 h) Broaching.
- 191 i) Sawing
- 192 j) Electrical Discharge Machining (EDM).
- 193 k) Electrochemical Machining (ECM).
- 194 l) Metal injection molding (MIM).
- 195 m) Finishing techniques:
- 196 1) grinding/sanding,
- 197 2) etching,
- 198 3) media blasting,
- 199 4) tumbling media.
- 200 n) Finishes:
- 201 1) bluing,
- 202 2) browning,
- 203 3) oxide (parkerizing, etc.),
- 204 4) plating,
- 205 5) coatings/paint.

206 o) Key machining concepts for toolmark identification:

207 1) chip formation,

208 2) plastic deformation,

209 3) plowing,

210 4) side flow,

211 5) tool wear,

212 6) built-up edge.

213 **4.2.1.3** The following additional recommended topics should be included in a training program.

214 a) Tours of machine shops or manufacturers, supplemental to any other firearm, ammunition or
215 tool manufacturer tours, to ensure exposure to manufacturing/machining methods listed in
216 4.2.1.

217 b) General concepts and practices of additive manufacturing (e.g., 3-D printing).

218 **4.2.2 Firearms Manufacturing**

219 **4.2.2.1** In addition to general manufacturing techniques, an understanding of the specific
220 manufacturing and machining processes that pertain to the production of firearms and firearm
221 parts assists a trainee in understanding both the design concepts and the function of firearms.
222 Additionally, an understanding of the common machining methods used for barrels, breech faces,
223 and other surfaces that contact ammunition components allows a trainee to understand the sources
224 and nature of toolmarks present on fired and unfired ammunition components.

225 **4.2.2.2** The following subject areas shall be included in a training program.

226 a) Barrels:

227 1) blanks:

228 i) deep hole drilling,

229 ii) reaming,

230 2) rifling:

231 i) button,

232 ii) broach (single, double, gang, etc.),

233 iii) ECM,

234 iv) EDM,

- 235 v) hammer forged,
- 236 vi) single point/hook/scrape;

237 3) finishing:

- 238 i) straightening,
- 239 ii) chambering,
- 240 iii) throating,
- 241 iv) crowning,
- 242 v) contouring,
- 243 vi) honing/lapping/polishing.

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

- 245 1) breech faces,
- 246 2) chambers,
- 247 3) hammers/firing pins/strikers,
- 248 4) firing pin aperture,
- 249 5) extractors,
- 250 6) ejectors,
- 251 7) feed ramps/forcing cones,
- 252 8) magazines,
- 253 9) ejection port.

254 c) Common alterations and associated toolmarks:

- 255 1) shortened barrel,
- 256 2) muzzle attachments,
- 257 3) front sight alteration,
- 258 4) purposeful damage to internal gun parts.

259 **4.2.2.3** Additionally, firearm and/or barrel manufacturer tours are recommended and should be
260 included in a training program.

261 **4.2.3 Legal History of Firearm and Toolmark Examinations**

262 **4.2.3.1** Knowledge of the evolution of firearm and toolmark practice and testimony in courts of
263 law, as well as applicable laws regarding the use of certain firearms and accessories, assists the
264 trainee with understanding the legal context of firearm and toolmark examinations. Recommended
265 articles and references can be located in the AFTE Training Manual.

266 **4.2.3.2** The training program shall include an overview of the legal history of firearm and
267 toolmark examination.

268 **4.2.4 Theory and Validity of Firearm and Toolmark Examinations**

269 **4.2.4.1** A complete understanding of the scientific foundation of firearm and toolmark
270 examinations (theory, nomenclature, research, statistical methods, limitations, etc.) allows for the
271 successful application of examination techniques and subsequent communication regarding the
272 results of examination. Recommended articles and references for the subject areas in this section
273 can be located in the AFTE Training Manual and other scientific publications that discuss the
274 foundations of Firearm & Toolmark science.

275 **4.2.4.2** The following subject areas shall be included in a training program.

- 276 a) History of the Firearm & Toolmark Examination discipline
- 277 b) AFTE Theory of Identification:
- 278 c) Class characteristics.
- 279 d) Subclass characteristics.
- 280 e) Individual characteristics.
- 281 f) Types of toolmarks:
- 282 1) impressed toolmarks.
- 283 2) striated toolmarks.
- 284 g) Concept of Known Same Source Toolmark (KSST) and Known Different Source Toolmark
285 (KDST) comparisons:
- 286 1) research;
- 287 2) validity testing:
- 288 i) early studies,
- 289 ii) consecutively manufactured parts studies,
- 290 iii) black, white, and gray box studies,
- 291 iv) closed set vs open set studies,

- 292 v) accuracy,
- 293 vi) reproducibility and repeatability,
- 294 vii) error rates,
- 295 viii) participant and sample selection (including attrition rates),
- 296 ix) the “Hawthorne” effect.
- 297 h) Expressions of confidence.
- 298 i) Criticisms of current methods.
- 299 j) Basic concepts of Quantitative Consecutive Matching Stria (QCMS).
- 300 **4.2.4.3** The following additional recommended topics should be included in a training program.
- 301 — Statistics.
- 302 — Toolmark topography instruments and correlation algorithms.
- 303 **4.2.5 Ammunition**
- 304 **4.2.5.1** Knowledge of industry terminology, the evolution of ammunition designs, and
- 305 manufacturing methods associated with ammunition provides a foundation for successful
- 306 examinations of both fired and unfired ammunition components. Recommended articles and
- 307 references for the subject areas in this section can be located in the AFTE Training Manual.
- 308 **4.2.5.2** The following subject areas shall be included in a training program.
- 309 a) Ammunition manufacturing:
- 310 1) blanking,
- 311 2) cupping,
- 312 3) drawing,
- 313 4) swaging,
- 314 5) annealing,
- 315 6) cold heading,
- 316 7) punching/headstamps,
- 317 8) case/primer materials,
- 318 9) loading/assembly,

- 319 10) crimping,
320 11) reloading,
321 12) bunter marks,
322 13) mold marks.
- 323 b) Terminology associated with both historic and modern ammunition:
- 324 1) caliber naming conventions,
325 2) cartridge case design,
326 3) terminology associated with shotshell ammunition,
327 i) components,
328 ii) gauge,
329 iii) pellet sizes,
330 iv) slug designs.
- 331 c) Caliber determination of bullets including instrumentation.
- 332 d) Caliber determination of cartridges/cartridge cases:
- 333 1) headstamps,
334 2) case dimensions,
335 3) caliber families,
336 4) mismatching of ammunition and firearm,
337 5) acceptable interchangeability of ammunition^d,
338 6) wildcat cartridges.
- 339 e) Evolution of ammunition:
- 340 1) propellants, black powder to modern smokeless powder,
341 2) rimfire and centerfire,
342 3) types of primers,

^d <https://saami.org/wp-content/uploads/2024/11/SAAMI-Generally-Accepted-Firearms-and-Ammunition-Interchangeability-10-8-2021.pdf>

- 343 4) bullet/projectile shapes and designs,
- 344 5) current common brands and types of ammunition.

345 **4.2.5.3** Additionally, ammunition manufacturer tours are recommended and should be included
346 in a training program.

347 **4.2.6 Firearm Design and Terminology**

348 **4.2.6.1** Comprehensive knowledge of terminology, evolution of design concepts, firearm parts,
349 and the cycle of operation of firearms provides the foundation for the successful examination of
350 firearms. Recommended articles and references for the subject areas in this section can be located
351 in the AFTE Training Manual.

352 **4.2.6.2** The following subject areas shall be included in a training program.

- 353 a) Evolution and history of firearm designs.
- 354 b) Firearms terminology:
 - 355 1) pistol,
 - 356 2) revolver,
 - 357 3) rifle,
 - 358 4) shotgun.
- 359 c) Parts and nomenclature associated with types of firearms:
 - 360 1) assembly and disassembly of firearms, supplemented with owner's manuals, books and
361 videos.
- 362 d) Safeties:
 - 363 1) active/manual safeties,
 - 364 2) passive safeties.
- 365 e) Rifling designs.
- 366 f) Cycle of fire:
 - 367 1) action types:
 - 368 i) break action,
 - 369 ii) bolt action,
 - 370 iii) lever action,

- 371 iv) pump action,
- 372 2) revolver;
- 373 3) falling block/rolling block/trap door;
- 374 4) blowback/delayed blowback;
- 375 5) recoil;
- 376 6) gas operated;
- 377 7) modes of fire:
 - 378 i) single action,
 - 379 ii) double action,
 - 380 iii) hybrid action,
 - 381 iv) striker vs hammer fired,
 - 382 v) semi-automatic,
 - 383 vi) burst/fully automatic;
- 384 8) post manufacture alterations and accessories;
- 385 9) full auto conversions;
- 386 10) incomplete firearms (“80%” firearms, receiver blanks);
- 387 11) privately manufactured firearms (home-built, zip guns);
- 388 12) drop-in barrels;
- 389 13) bump stocks;
- 390 14) trigger modifications;
- 391 15) new and emergent firearm technologies.

392 **4.2.7 Evidence Handling**

393 **4.2.7.1** Firearms, tools and other firearm and toolmark related evidence items recovered during
394 an investigation may contain trace evidence transferred from the crime scene, latent prints, or DNA,
395 whether in the form of blood or as transfer DNA.

396 **4.2.7.2** The following subject areas shall be included in a training plan.

- 397 a) Evaluation of evidence.

- 398 b) Order of evidence processing.
- 399 c) Potential for other discipline evidence being present.
- 400 d) Documentation and preservation (when possible) of other discipline evidence.
- 401 e) Collection of other discipline evidence, as required by the FSSP.

402 **4.2.8 Examination of Firearms**

403 **4.2.8.1** Knowledge of the common examination techniques provide a foundation for a full analysis
404 and documentation of a firearm's design and functional characteristics. Recommended articles and
405 references for the subject areas in this section can be located in the AFTE Training Manual.

406 **4.2.8.2** The following subject areas shall be included in a training plan.

- 407 a) Safe handling and firing of firearms (i.e., ANSI/ASB Best Practice Recommendation 068, *Safe*
408 *Handling of Firearms and Ammunition*, 2020. 1st Ed.):
- 409 b) Function examinations:
 - 410 1) searching the firearm recall list,
 - 411 2) testing of firearm safety mechanisms,
 - 412 3) testing the operability/functionality of firearms, including designs listed in 4.2.6,
 - 413 4) inspection of firearms for malfunctions or alterations causing unexpected firing,
 - 414 5) selection and test firing of appropriate ammunition.
- 415 c) Firearms laws:
 - 416 1) NFA (National Firearms Act),
 - 417 2) GCA (Gun Control Act),
 - 418 3) Firearm Owner's Protection Act,
 - 419 4) relevant state/local specific laws.
- 420 d) Firearm components that potentially create toolmarks:
 - 421 1) lands and grooves,
 - 422 2) breech/bolt face,
 - 423 3) firing pin,
 - 424 4) ejector,

- 425 5) ejection port,
- 426 6) extractor,
- 427 7) chamber,
- 428 8) feed ramp,
- 429 9) barrel extension,
- 430 10) magazine.

431 e) Evaluation of potential for subclass characteristics in each of the categories above.

432 f) Casting of firearm parts/alternate tools for creating test marks.

433 **4.2.8.3** The following additional recommended topics should be included in a training program.

434 — Trigger pull measurement.

435 — Barrel and overall length measurement.

436 — Impact testing.

437 — Sound suppressors (silencers).

438 **4.2.9 Function testing and collection of test-fired samples**

439 Submitted firearms are typically test fired during examination. Training programs shall include
440 instruction in proper use of equipment for safe test firing of live ammunition and collection of
441 known bullet and cartridge case samples.

442 **4.2.10 Microscope Use and Familiarization**

443 **4.2.10.1** Microscopes are the primary tools with which firearm and toolmark examiners conduct
444 examinations of fired ammunition components and toolmarked surfaces. Recommended articles
445 and references for the subject areas in this section can be located in the AFTE Training Manual.

446 **4.2.10.2** The following subject areas shall be included in a training program.

447 a) Design and use of a stereoscope.

448 b) Design and use of a comparison microscope.

449 c) Light sources and lighting techniques.

450 d) Photographic techniques.

451 e) Comparison techniques.

452 **4.2.10.3** The following additional recommended topics should be included in a training program.

453 — Use of three-dimensional measurement instruments (e.g., focus variation, photometric stereo,
454 and confocal microscopy).

455 — Virtual comparison techniques.

456 **4.2.11 Bullet Examinations**

457 **4.2.11.1** Bullets, when fired through the barrel of a firearm, acquire surface features from the
458 internal surfaces of the barrel. Recommended articles and references for the subject areas in this
459 section can be located in the AFTE Training Manual.

460 **4.2.11.2** The following subject areas shall be included in a training program.

461 a) Caliber determination.

462 b) Design features.

463 c) Direction of twist of rifling on fired bullets.

464 d) Land and groove impression measurement techniques.

465 e) General rifling characteristics (GRC) database.

466 f) Recognition of potential subclass characteristics in firearm rifling and on fired bullets.

467 g) Selection of appropriate ammunition for known sample collection.

468 h) Evaluation and comparison of test fired bullets.

469 i) Evaluation and comparison of questioned bullets.

470 j) Range of conclusions for bullet comparisons.

471 k) Documentation of examination results and comparisons.

472 **4.2.12 Cartridge/Cartridge Case/Shotshells (Fired/Unfired) Examinations**

473 **4.2.12.1** Cartridge cases and shotshells, when cycled and/or fired in a firearm, acquire
474 characteristics from the working surfaces of that firearm. Recommended articles and references for
475 the subject areas in this section can be located in the AFTE Training Manual.

476 **4.2.12.2** The following subject areas shall be included in a training program.

477 a) Recognition of marks on cartridges/cartridge cases/shotshells(fired/unfired):

478 1) firing pin impression,

479 2) breech face marks,

480 3) aperture impression/shear,

- 481 4) extractor,
482 5) ejector,
483 6) ejection port marks,
484 7) firing pin drag,
485 8) chamber marks,
486 9) barrel extension marks,
487 10) magazine lip marks,
488 11) loaded chamber indicator impressions,
489 12) shell stop marks,
490 13) anvil marks.
- 491 b) Caliber/gauge determination.
492 c) Design features characteristic of a brand.
493 d) Recognition of potential subclass marks on cycled cartridges and fired cartridge
494 cases/shotshells.
495 e) Recognition of manufacturing marks and potential limitations for their use in comparison (e.g.,
496 bunter/ mold marks).
497 f) Reloading tool/die marks.
498 g) Selection of appropriate ammunition for known sample collection.
499 h) Evaluation and comparison of cycled cartridges and test fired cartridge cases/shotshells.
500 i) Evaluation and comparison of questioned cartridges/cartridge cases/shotshells (fired/unfired).
501 j) Range of conclusions for cartridge/cartridge case/shotshell (fired/unfired) comparisons.
502 k) Documentation of examination results and comparisons.

503 **4.2.13 Shotshell Component Examinations**

504 **4.2.13.1** Shotshell components, when fired through the barrel of a shotgun, may acquire surface
505 features from the internal surfaces of the barrel. Additionally, shotshell components may be
506 examined for gauge determination, possible manufacture, shot size, and/or composition.
507 Recommended articles and references for the subject areas in this section can be located in the
508 AFTE Training Manual.

509 **4.2.13.2** The following subject areas shall be included in a training program.

- 510 a) Gauge determination.
- 511 b) Design features characteristic of a brand.
- 512 c) Shot size and composition determination.
- 513 d) Slug examination.
- 514 e) Wad/Shotcup examination.

515 **4.2.14 Tool Manufacturing**

516 **4.2.14.1** Knowledge of manufacturing and machining processes, specifically the techniques
517 applied to tool working surfaces that may come into contact with evidentiary items, provides a
518 foundation for understanding the significance of toolmarks encountered during examinations and
519 the resulting source conclusions. Recommended articles and references for the subject areas in this
520 section can be located in the AFTE Training Manual.

521 **4.2.14.2** The following subject areas shall be included in a training program.

- 522 a) The definition of tool, both common and in the context of toolmark examination.
- 523 b) Common manufacturing methods for hand tools:
 - 524 1) broaching,
 - 525 2) abrasive machining (e.g., grinding, abrasive blasting, reaming),
 - 526 3) milling,
 - 527 4) filing,
 - 528 5) turning,
 - 529 6) forging/stamping,
 - 530 7) electrical machining (e.g., EDM, ECM, EDWC),
 - 531 8) laser machining,
 - 532 9) metal injection molding/sintering,
 - 533 10) drilling,
 - 534 11) sawing,
 - 535 12) casting.
- 536 c) Common types of hand tools, how they are used, and their associated parts:
 - 537 1) screwdrivers,

- 538 2) bolt cutters,
- 539 3) knives,
- 540 4) chisels,
- 541 5) axes,
- 542 6) saws,
- 543 7) hammers,
- 544 8) diagonal cutters,
- 545 9) tongue and groove pliers,
- 546 10) prying tools,
- 547 11) shears/snips.

548 **4.2.14.3** Additionally, tours of tool manufacturers are recommended and should be included in a
549 training program.

550 **4.2.15 Toolmark Examinations**

551 **4.2.15.1** Knowledge of common tool actions and the wide variety of ways that tools can leave
552 toolmarks provides a foundation for toolmark examination. Recommended articles and references
553 for the subject areas in this section can be located in the AFTE Training Manual.

554 **4.2.15.2** The following subject areas shall be included in a training program.

555 a) Categories of tool actions:

- 556 1) shearing,
- 557 2) pinching,
- 558 3) scraping,
- 559 4) slicing,
- 560 5) gripping,
- 561 6) prying,
- 562 7) crimping,
- 563 8) compression,
- 564 9) chopping,

- 565 10) sawing.
- 566 b) Class characteristic evaluation of toolmarks.
- 567 c) Creating test marks in different substrates.
- 568 d) Casting methods.
- 569 e) Recognition of potential subclass characteristics.
- 570 f) Evaluation and comparison of toolmarks.
- 571 g) Range of conclusions for toolmark comparisons.
- 572 h) Documentation of examination results and comparisons.

573 **4.2.16 Casework Documentation**

574 **4.2.16.1** The purpose of documentation generated during the analysis of evidence is to support
575 the conclusions in such a way that, in the absence of the primary examiner, another qualified
576 examiner could understand, evaluate, and interpret the work performed and the conclusions
577 reached.

578 **4.2.16.2** The following subject areas shall be included in a training program.

- 579 a) Specific case information required by the FSSP.
- 580 b) Additional case specific information.
- 581 c) Acceptable forms of documentation.
- 582 d) FSSP technical record requirements.

583 **4.2.17 Casework Training Exercises**

584 **4.2.17.1** Performing casework exercises provides the trainee with a foundational understanding
585 of the FSSP's case management and quality processes.

586 **4.2.17.2** The following subject areas shall be included in a training program.

- 587 a) Evidence assignment and chain of custody.
- 588 b) Proper evidence handling procedures.
- 589 c) Simulated casework.
- 590 d) Verification and review.

591 **4.2.18 Known Same Source/Known Different Source Exercises**

592 **4.2.18.1** Comparisons of KSSTs and KDSTs are a core component of training for firearm and
 593 toolmark examiners. KSST and KDST comparisons develop a trainee's ability to recognize levels of
 594 correspondence that are consistent with toolmarks known to have been created by the same tool or
 595 same surface of the tool, and levels of correspondence that are consistent with toolmarks known to
 596 have been created by different tools or different areas of the same tool.

597 **4.2.18.2** For the purposes of this document, a single KSST or KDST comparison exercise consists
 598 of the complete comparison examination of two items (i.e., bullets, cartridge cases, etc.). Samples
 599 for use in KSST and KDST exercises are typically produced by trainers or trainees who are direct
 600 witnesses to their creation, thereby establishing ground truth.

601 **4.2.18.3** The source of the toolmarks used to meet this requirement should reflect the categories
 602 of testing included in training. For example, if the training program is exclusively firearms
 603 examinations, most of these exercises should be conducted with bullets, cartridge cases, and
 604 shotshells. However, some exposure to sources of toolmarks outside of the trainee's expected
 605 categories of testing may also be beneficial. This requirement may be met through the cumulative
 606 completion of various training exercises and supplemented as necessary to meet the minimum
 607 number.

608 **4.2.18.4** The following studies shall be conducted and documented, regardless of which
 609 categories of testing the trainee will be qualified in. Training records shall clearly document the
 610 quantity of each type of comparison completed for this requirement. The numbers listed are a
 611 combined total, it is not necessary to repeat the exercise for non-firearm toolmarks. Some of the
 612 KDST comparisons shall include samples that show the potential effects of subclass characteristics,
 613 which could include consecutively manufactured tools/firearms.

614 — 200 Known Same Source Toolmark comparisons, including both impressed and striated
 615 toolmarks.

616 — 200 Known Different Source Toolmark comparisons, including both impressed and striated
 617 toolmarks^e.

618 **4.2.18.5** The completion of the minimum number of KSST/KDST comparisons does not
 619 automatically convey qualification of a firearm/toolmark examiner. The FSSP shall determine final
 620 competency based on testing as described in 4.1.7.

621 **4.2.18.6** In order to familiarize trainees with QCMS, the FSSP should consider documenting runs
 622 of consecutive matching striae for a portion or all of the above exercises.

623 **4.2.19 Communication, Legal Issues, Court**

624 **4.2.19.1** These topics address the intersection of science and the law, and the necessity of
 625 effective communication with various stakeholders in the legal system. The development of training
 626 topics covering court and other legal issues should include input from local attorneys or other legal
 627 experts. Articles and references for the subject areas in this section can be located in the AFTE

^e The number 200 was chosen after a survey of five training manuals currently in use by federal and state/local FSSPs. 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.

628 Training Manual, in the SWGGUN ARK located on the AFTE website^f, and other scientific
629 publications that discuss legal issues in Firearm & Toolmark science.

630 **4.2.19.2** The following topics shall be addressed in examiner training.

631 a) Courtroom procedures (local, state, federal).

632 b) Contemporary admissibility issues.

633 c) Role of expert testimony.

634 d) Public speaking.

635 e) Communicating within the judicial system.

636 f) Courtroom etiquette.

637 g) Discovery and exculpatory evidence issues.

638 NOTE This topic should include discussions of *Brady v Maryland*, 373 U.S. 83 (1963) and *United States*
639 *v. Giglio*, 405 U.S. 150 (1972)

640 h) Moot court exercises.

641 **4.2.20 Ethics, Bias, Human Factors**

642 **4.2.20.1** Knowledge of common forms of bias may limit the influence of bias within a forensic
643 science discipline. Likewise, a sound institutional knowledge of ethical issues related to forensic
644 science helps build and maintain the integrity of the persons and institutions performing forensic
645 analyses.

646 **4.2.20.2** The following topics shall be addressed in examiner training.

647 a) Confirmation, cognitive, explicit, and implicit bias.

648 b) Identifying and avoiding task-irrelevant information.

649 c) Identifying task-relevant information.

650 d) Neutrality in forensic science.

651 e) Codes of ethics.

652 **4.2.21 Forensic Science Service Provider Operations**

653 In the absence of other institutional or FSSP-wide training requirements for examiners in all
654 disciplines, the following topics shall be included in examiner training.

^f <https://afte.org/resources/swggun-ark>

- 655 a) Authority structure within the FSSP.
- 656 b) FSSP quality system.
- 657 c) Accreditation matters.
- 658 d) Laboratory safety.
- 659 e) Safe handling of evidence/universal precautions.
- 660 f) Evidence tracking/laboratory information managements systems (LIMS).

661 **5 Optional Topics**

662 **5.1 General**

663 The training requirements in this section are only applicable when authorization in these sub-
664 disciplines is required by the FSSP.

665 **5.2 Distance Determination via Gunshot Residues**

666 **5.2.1** In this section, “distance determination” refers to any determinations that can be made
667 regarding the distance from the muzzle of the firearm to an impact surface based upon the
668 examination of gunshot residues present on impact surface(s). Recommended articles and
669 references for the subject areas in this section can be located in the AFTE Training Manual.

670 **5.2.2** The following subject areas shall be included in a training program.

- 671 a) Factors regarding the deposition of residue from the use of a firearm:
 - 672 1) ammunition type;
 - 673 2) firearm type:
 - 674 i) revolvers,
 - 675 ii) pistols,
 - 676 iii) rifles,
 - 677 iv) shotguns;
 - 678 3) substrate type:
 - 679 i) fabric,
 - 680 ii) skin,
 - 681 iii) porous surface,
 - 682 iv) non-porous surface;

- 683 4) visual inspection:
- 684 i) hole,
- 685 ii) ripping/tearing,
- 686 iii) singeing/burning/melting,
- 687 iv) presence of powder/particulate or vaporous lead,
- 688 v) chemistry and examination techniques for,
- 689 (1) nitrates,
- 690 (2) nitrites,
- 691 (3) lead,
- 692 (4) copper.
- 693 b) Application of appropriate techniques for nitrites and lead:
- 694 1) test known distance patterns;
- 695 2) test evidence patterns.
- 696 c) Comparison of known and unknown patterns, documentation, interpretation, and conclusions,
- 697 including limitations.
- 698 d) Measurement uncertainty.

699 **5.3 Distance Determination via Shot Patterns**

700 **5.3.1** In this section, “distance determination” refers to any determinations that can be made
701 regarding the distance from the muzzle of the firearm to an impact surface based upon the
702 examination of damage patterns caused by shotshell components. Recommended articles and
703 references for the subject areas in this section can be located in the AFTE Training Manual.

704 **5.3.2** The following subject areas shall be included in a training program.

- 705 a) Factors regarding shot patterns from the use of a firearm:
- 706 1) ammunition types,
- 707 2) pellet sizes,
- 708 3) shotshell wadding,
- 709 4) buffer material,
- 710 5) firearm type,

- 711 6) shotgun choke systems,
- 712 7) measuring shot patterns,
- 713 8) non-orthogonal patterns,
- 714 9) creating and measuring shot patterns at known distances,
- 715 10) comparison of known and unknown patterns, interpretation and conclusions, including
- 716 limitations.
- 717 b) Measurement uncertainty.

718 **5.4 Serial Number/Obliterated Character Restoration**

719 **5.4.1** The recovery of an obliterated serial number on a firearm or characters present on other
720 evidence types can be a valuable piece of intelligence for investigators. This section is designed to
721 impart knowledge about common destruction processes and both knowledge of and experience
722 using the many recovery methods available to examiners. Recommended articles and references for
723 the subject areas in this section can be located in the AFTE Training Manual.

724 **5.4.2** The following subject areas shall be included in a training program.

- 725 a) Serial number application processes.
- 726 b) Reviewing references for serial numbers:
 - 727 1) Serial Number Structure Guide
 - 728 2) Firearm Reference Collection
- 729 c) Types of destruction methods:
 - 730 1) grinding,
 - 731 2) over stamping,
 - 732 3) peening,
 - 733 4) gouging,
 - 734 5) heating,
 - 735 6) welding,
 - 736 7) scratching,
 - 737 8) drilling.
- 738 d) Terminology regarding serial number recovery processes:

- 739 1) chemical methods,
- 740 2) polishing methods,
- 741 3) sanding methods,
- 742 4) electro-chemical methods,
- 743 5) magnetic particle inspection,
- 744 6) barcode decryption,
- 745 7) lighting techniques.
- 746 e) Use of different recovery processes:
 - 747 1) application of recovery methods to ferrous surfaces,
 - 748 2) application of recovery methods to non-ferrous surfaces,
 - 749 3) application of recovery methods by barcode decryption,
 - 750 4) application of recovery methods for non-metal surfaces.
- 751 f) Documentation of recovery of serial numbers.
- 752 g) Photography.
- 753 h) Casting prior to recovery if toolmarks are present.
- 754 i) Note taking.
- 755 j) Reporting conclusions.
- 756 k) Alternative sources of serial number recovery:
 - 757 1) secondary serial numbers,
 - 758 2) secondary/hidden manufacturer codes.

759 **5.5 Fracture Examinations**

760 **5.5.1** The analysis of fractured objects and surfaces to determine if they were once part of the
761 same object is performed by firearm and toolmark examiners in some FSSPs. The list of training
762 topics in this section is designed only to be used in combination with either firearm examiner or
763 toolmark examiner training and does not provide sufficient training and skill if it is completed

764 without firearm or toolmark training. Recommended articles and references for the subject areas in
765 this section can be located in the AFTE Training Manual.

766 **5.5.2** The following topics shall be addressed in examiner training.

767 a) Failure modes of brittle materials.

768 b) Plastic deformation.

769 c) Elastic deformation.

770 d) Class characteristics.

771 e) Physical fit:

772 1) Manufacturer toolmarks.

773 2) Pre-existing ancillary features.

774 f) Reverse lighting techniques, microscopic comparison.

775 g) Casting or coatings for translucent/transparent materials.

776 h) Range of conclusions.

777 i) Photography.

778 j) Documentation/note taking.

779 **5.5.3** KSS and KDS studies shall be performed utilizing a variety of substrate materials and object
780 geometries that are typical of casework.

781

782
783

Annex A (informative)

784

Bibliography

785 The following bibliography is not intended to be an all-inclusive list, review, or endorsement of
786 literature on this topic. The goal of the bibliography is to provide examples of publications
787 addressed in the standard.

- 788 1] ASTM Standard E2917-19a, *Standard Practice for Forensic Science Practitioner Training*
789 *Continuing Education, and Professional Development Programs*, 2019^g.
- 790 2] Association of Firearm & Tool Mark Examiners, *Glossary*. E-book, edited by the Standardization
791 and Training Committee^h.
- 792 3] National Commission on Forensic Science, “Views of the Commission Ensuring That Forensic
793 Analysis Is Based Upon Task-Relevant Information.” White Paperⁱ.

^g Available from: <https://www.astm.org/e2917-19a.html>

^h Available from: https://afte.org/uploads/documents/AFTE_Glossary_Version_6.091922_FINAL_COPYRIGHT.pdf

ⁱ Available from: <https://www.justice.gov/ncfs/file/818196/download>



ASB
ACADEMY
STANDARDS BOARD

Academy Standards Board
410 North 21st Street
Colorado Springs, CO 80904

www.aafs.org/academy-standards-board