

## **APENDIX F**

### **KSAs Linked to the AFTE Written Examination**

## **KSAs Linked to the Firearms Written Examination by the AFTE Certification Committee**

### **Knowledge Factor 1:**

20. Knowledge of various photographic techniques and their application for documenting evidence and analytical results, and for preparing courtroom exhibits.
28. Knowledge of how and when to use photographic equipment (such as camera types, lenses, film types, filters, proper camera settings, depth of field, proper illumination, and determination of film exposure times).
29. Knowledge of how and when to use various microscopy equipment; such as stereo binocular, comparison, compound (including polarizing), scanning electron microscope, video microscope.
30. Knowledge of how and when to use microscopy enhancement techniques (such as magnesium smoke).
32. Knowledge of how and when to use photomicrography equipment and its components (such as digital photography, video cameras, camera-to-microscope adapters), determination of effective magnification on printed photographs, determination of proper exposure times.
33. Knowledge of when and how to properly use measuring equipment (such as filar micrometer eyepieces, stage micrometers, dial micrometers and calipers, vernier micrometers and calipers, gauges and balances, rulers, tape measures, levels, angle finders, protractors, etc.).
37. Knowledge of how and when to use chemical laboratory equipment (such as glassware, burners, pipettes, etc.).
40. Knowledge of how and when to use ultrasonic baths and cleaners.
41. Knowledge of how and when to use various cleaning solutions.
46. Knowledge of how and when to use different probes (such as wood, fiberglass, metal, etc.) for bullet holes.
51. Knowledge of how and when to use magnifying glasses of various powers.
65. Knowledge of how and when to use chronograph equipment.
136. Knowledge of radiation hazards and how to safely use radiation equipment (such as x-ray equipment, lasers, etc.)

### **Knowledge Factor 2:**

73. Knowledge of the historical development of firearms design.
78. Knowledge of methods of imprinting serial numbers on firearms.
79. Knowledge of theory of restorative techniques of serial numbers in firearms.
85. Knowledge of propellants: physical forms and associated purposes of small arms propellants; black gun powder and Pyrodex; nitrocellulose propellants, both single and double base.
86. Knowledge of projectiles: design (ogive shape, base shape, cannelure types, forming processes); construction and composition (lead alloy compositions, jacketing materials and styles, etc.).
87. Knowledge of cartridge cases: design (i.e., rimfire, centerfire, Boxer/Berdan priming systems); compositions (copper, brass, steel, aluminum).
88. Knowledge of manufacturer information: headstamps, color coding.
89. Knowledge of the history/development of ammunition components: cartridge naming system; alternate names; interchangeability.
90. Knowledge of shotshell: design, construction and nomenclature; shot sizes and composition (hardened lead, plated steel, etc.); wad design and types of filler (buffering) materials.
91. Knowledge of primers: design, color, staking.
92. Knowledge of ammunition components.
93. Knowledge of ammunition manufacturing methods.
94. Knowledge of the types of legal vs. illegal ammunition.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

- 95. Knowledge of the principles of ammunition reloading.
- 96. Knowledge of the tools, sources, and types of components used in ammunition reloading, and when to use them.

### **Knowledge Factor 3:**

- 3. Knowledge of which tools or instruments are most appropriate for the recovery of evidence.
- 4. Knowledge of shooting-scene reconstruction techniques.
- 5. Knowledge of non-firearms/toolmark types of forensic evidence: such as trace evidence (hairs, fibers, paint, etc.), serological evidence, etc.
- 6. Knowledge of legal requirements for the preservation of evidence.
- 7. Knowledge of scientific methodologies for the preservation of evidence.
- 8. Knowledge of activities to perform to ensure the preservation of a crime scene.
- 9. Knowledge of which tools, instruments, and containers are most appropriate for the preservation of evidence.
- 10. Knowledge of the proper storage conditions for evidence collected.
- 11. Knowledge of the effects of biological agents (bacteria, molds, insects, animals, etc.) on various types of evidence and ways to prevent its effects.
- 12. Knowledge of basic Chain of Custody rules.
- 13. Knowledge of the effects that interfering factors (such as substrate, time, activity, temperature, weather, etc.) have upon various types of evidence, and ways to prevent their effects.
- 31. Knowledge of how to prepare casts and use of casting materials.
- 83. Knowledge of the types of trace materials that may be present on firearms.

### **Knowledge Factor 4:**

- 84. Knowledge of methods for determining if and how often a firearm has been fired since it was last cleaned.
- 98. Knowledge of internal ballistics: ignition, pressure, function of chamber design, chamber and cartridge dimensions, headspace considerations.
- 99. Knowledge of exterior ballistics: line of sight vs. bullet path; departure path and angle; trajectories (long and short); angle of fall; ballistic tables (flight time, drop, velocity loss with distance, wind drift, etc.); ballistic programs; bullet stability, rotational velocity, yaw, twist rates necessary to stabilize various bullet types.
- 100. Knowledge of terminal ballistics: penetration, bullet deformation and expansion and its relation to impact velocity and orientation.
- 101. Knowledge of ballistic wounds: penetration, bullet deformation and expansion; penetration mechanics in tissue and tissue simulants; temporary and permanent cavitation.
- 102. Knowledge of bullet holes/bullet impact sites and ricochet marks.
- 103. Knowledge of cartridge ejection patterns: (physics and mechanics affecting; surface effects on pattern; and the effect of intermediate objects).
- 104. Knowledge of ballistic tables, how to use them and their limitations.
- 105. Knowledge of bullet recovery methods, and the advantages and disadvantages of each.
- 120. Knowledge of firearms-generated discharge products: how deposited; primer constituents, propellant residues, bullet metal and bullet lubricants.

### **Knowledge Factor 5:**

- 97. Knowledge of proper ammunition selection.
- 130. Knowledge of the potential hazardous properties of biological hazards (such as hepatitis, AIDS, etc.).
- 131. Knowledge of the potential hazardous properties of parasites.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

132. Knowledge of the potential hazardous properties of toxic and reactive chemicals.
133. Knowledge of the potential hazardous properties of gunshot residues.
134. Knowledge of the proper methods for the handling and disposing of hazardous materials.
135. Knowledge of how to safely handle potentially dangerous items, such as defective firearms, ammunition, and explosives for laboratory examination.
138. Knowledge of the proper use of safety equipment and materials (such as protective clothing, eye and ear protective devices, and disinfectants).
139. Knowledge of safety procedures and the potential hazardous properties regarding test firing various firearms.
140. Knowledge of safety procedures associated with the use of laboratory equipment.
141. Knowledge of safety procedures associated with the use of handtools, woodworking machinery, and metalworking machinery.

### **Knowledge Factor 6:**

106. Knowledge of chemical tests used in the examination of bullet holes, bullet impact site, and ricochet marks.
107. Knowledge of how and when to perform microscopic examinations for the purpose of distance determination.
109. Knowledge of how and when to perform chemical tests (such as: sodium rhodizonate and Griess) for the purpose of distance determination.
110. Knowledge of stippling patterns/powder patterns on a surface and how they are used in distance determination.
111. Knowledge of pellet patterns and how they are used in distance determination.
112. Knowledge of which firearms, ammunition, and test pattern surfaces to use for the purpose of distance determination.
113. Knowledge of bullet hole characterization for caliber size determination (within limitations) when performing distance determination.

### **Knowledge Factor 7:**

42. Knowledge of how and when to use pulled-bullet/cartridge exemplar files.
44. Knowledge of how and when to use bore lights.
74. Knowledge of machining and finishing processes of tools, guns, barrels, breechfaces, extractors, ejectors, firing pins, and silencers (with emphasis on working surfaces and edges) and their effect on individuality.
75. Knowledge of muzzleloading firearms designs, including ignition systems and loading techniques.
76. Knowledge of breechloading firearms designs, including falling breechlocks, bolt actions, lever actions, pump actions, break open, semiautomatics (blowback, gas-operated, recoil operated, etc.), revolvers--double and single action.
77. Knowledge of firearms ignition systems: flintlock, percussion, rimfire, centerfire, caseless ammunition.
80. Knowledge of sources of information regarding identification markings and serial numbering systems in firearms (including locations of serial numbers, part/assembly numbers, proof marks on firearms and the locations of hidden numbers).
81. Knowledge of the proper operation of the different types of firearms encountered in casework.
82. Knowledge of the different materials that may be present in the bore of a firearm.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

### **Knowledge Factor 8:**

14. Knowledge of how to properly document evidence and analytical results (through notes, sketches, photography, reports, etc.).
15. Knowledge of the techniques and procedures used to properly mark evidence (when appropriate).
16. Knowledge of the proper mechanics of the English language (grammar, punctuation, spelling, and composition).
17. Knowledge of the proper methodologies for the written documentation of scientific results.
18. Knowledge of how to prepare reports for peer review.
19. Knowledge of how to prepare articles for peer review/publication.
129. Knowledge of correct word usage and pronunciation.

### **Knowledge Factor 9:**

142. Knowledge of which journals, newsletters and professional publications report information applicable to Firearm and Toolmark Examiners.
143. Knowledge of which professional organizations address Firearm and Toolmark Examiners concerns.
144. Knowledge of where to find and how to use various reference collections, tables, and databases (including ballistic tables, Drugfire and IBIS, Firearm Reference Collections, Ammunition Reference Collections, General Rifling Characteristics File for make and model determinations, etc.), and the limitations of such databases and tables.
145. Knowledge of legal requirements (e.g., *Daubert* and *Frye* cases) and the protocols for the presentation of scientific evidence.
146. Knowledge of appropriate legislation and statutory definitions as applied to the expert witness.
147. Knowledge of courtroom procedures regarding the testimony of expert witnesses.
149. Knowledge of the preparation and use of demonstrative evidence (such as displays, etc.).
150. Knowledge of training methods used to teach scientific disciplines.

### **Knowledge Factor 10:**

114. Knowledge of proper use of tools and materials for testmarks.
115. Knowledge of the toolmarks created during the reloading of ammunition.
116. Knowledge of the interactive nature of the tool/toolmark process and the transference of class, sub-class, and individual characteristics.
117. Knowledge of impressed (static) vs. striated (dynamic) toolmarks.
118. Knowledge of the best agreement possible in situations of known non-matches when comparing toolmarks.
119. Knowledge of the principles of preparing test marks and the effects of test materials in the production of testfired cartridge components and toolmarks for comparison.

### **Knowledge Factor 11:**

43. Knowledge of how and when to use borescopes.
67. Knowledge of how and when to use examination tables.
68. Knowledge of how and when to use bullet and cartridge recovery systems (water, snail, cotton waste, etc.).
69. Knowledge of how and when to use bullet pullers.
70. Knowledge of how and when to use spring trigger pull scales.
71. Knowledge of how and when to use trigger pull weights.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

### **Knowledge Factor 12:**

21. Knowledge of testing procedures commonly used to examine evidence, the expected results from each, and when to apply each.
22. Knowledge of experimental design methodologies for conducting scientific experiments and investigations.
23. Knowledge of how each scientific test affects the evidence being examined.
24. Knowledge of quality assurances and quality control procedures and how they are maintained by Firearm and Toolmark Examiners.
25. Knowledge of sequential priorities for conducting scientific tests so as not to destroy evidence or contaminate test results.
26. Knowledge of definitions of class, sub-class, and individual characteristics and the differences between them.
27. Knowledge of the sources of class, sub-class, and individual characteristics.

### **Knowledge Factor 13:**

148. Knowledge of the proper demeanor for testifying in legal proceedings.
151. Knowledge of the ethical standards maintained by the legal and law enforcement professions.
152. Knowledge of the ethical standards maintained by the scientific community (in general).
153. Knowledge of the ethical standards maintained by forensic science organizations (including the American Society of Crime Laboratory Directors and the Association of Firearms and Toolmark Examiners).

### **Knowledge Factor 14:**

38. Knowledge of how and when to use various vises, clamps, and restraining devices.
39. Knowledge of how and when to use gunsmithing tools.
52. Knowledge of how and when to use chemical reagents.
57. Knowledge of how and when to use various small handtools (such as screwdrivers, hammers, pliers, etc.).
58. Knowledge of how and when to use metal and woodworking machinery (such as drill presses, grinders, dremels, lathes, mills, etc.).
59. Knowledge of how and when to use fume hoods.
66. Knowledge of how and when to use computer systems and work-related computer programs.

### **Ability Factor 1:**

42. Ability to recognize and interpret the effects of ammunition/firearms combination on various aspects involved in reconstructing what happened at a shooting scene.
58. Ability to identify potential ballistic issues or considerations on specific cases (e.g., questionable ammunition performance, the shooter's sight picture at the moment of the shot, bullet flight time vs. changes in the position of the victim).
62. Ability to identify holes and/or defects in various objects as bullet-caused, through physical and/or chemical means (e.g., lead containing "bullet wipe," "bullet splash," copper/lead transfers in bullet graze or ricochet marks).
64. Ability to recognize situations where gunshots might be sequenced.
66. Ability to properly limit the scope of reconstruction to the hypotheses being tested.
68. Ability to recognize the limitations of a particular shooting scene reconstruction.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

### **Ability Factor 2:**

30. Ability to recognize the effect that firearms and ammunition manufacturing processes, the design of firearms, and design of firearms accessories have on markings imparted to bullets and casings and to interpret them accordingly.
31. Ability to recognize different manufacturing methods and, based upon this, to properly interpret potential for class, sub-class, and individual characteristics.
33. Ability to recognize and discriminate common rifling profiles.
34. Ability to distinguish “action” markings from those caused during firing.
37. Ability to recognize which parts of a firearm leave tool marks of forensic interest.
38. Ability to recognize when fired bullets and casings have been fired in a firearm not designed for them.
39. Ability to recognize, compare and identify various ammunition types and components.
40. Ability to recognize manufacturer-induced/placed toolmarks (sub-class characteristics) on ammunition as well as their usefulness and limitations.
46. Ability to recognize: (1) those attributes or characteristics of a particular firearm design which are reflected in the fired projectiles and fired cartridge cases; and (2) non-firearm caused toolmarks on ammunition components.
47. Ability to determine the source and uniqueness of various striated and/or static marks on bullets and cartridges.
48. Ability to recognize and properly align reproducible striae arrays sufficient for identification purposes.
49. Ability to recognize, determine the source of, and differentiate between class, sub-class, and individual characteristics on bullets, cartridges, cartridge cases, and in non-firearm related toolmarks.
50. Ability to make comparisons between evidence and reference cartridges and recovered cartridge components.
53. Ability to distinguish between the quality and quantity of matching striae in a true identity and that observed in known non-matches.
57. Ability to recognize any manufacturer-induced characteristics.

### **Ability Factor 3:**

9. Ability to design a testing protocol (based on size of sample and type of evidence) that will provide the most useful information, while avoiding procedures that are redundant or will interfere with subsequent tests.
10. Ability to evaluate examination requests, while considering the totality of the case.
11. Ability to adhere to an examination protocol for both firearms and toolmark cases.
12. Ability to use logic to analyze and identify strengths and weaknesses of different approaches.
15. Ability to determine when enhancement techniques are needed when examining evidence.
84. Ability to record scientific observations and the results of scientific tests.
86. Ability to maintain clear and comprehensive case notes.
88. Ability to read and understand information and ideas presented in writing.
89. Ability to properly document evidence items, examinations, and comparisons.
105. Ability to advocate only the propriety of the casework that was performed, and not the position of either the prosecution or the defense.
106. Ability to maintain and practice high ethical standards in the performance of one’s job duties.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

### **Ability Factor 4:**

79. Ability to evaluate the possibility/likelihood of contamination by various means (environmental, transference, dispersion due to firearms discharges in confined spaces, etc.).
80. Ability to recognize various primer mixtures available in modern rimfire and centerfire ammunition of both domestic and foreign manufacture.
82. Ability to recognize the various physical and chemical forms of propellants, their purpose in various cartridges and their value as physical evidence.

### **Ability Factor 5:**

41. Ability to identify reloaded ammunition as having been assembled by the same equipment by determining that specific reloading tool(s) came in contact with cartridge components.
43. Ability to recognize reloaded or handloaded ammunition.
44. Ability to compare ammunition components on the basis of design characteristics or features.
54. Ability to recognize commercially reloaded or handload ammunition components from their markings and characteristics.
55. Ability to identify reloaded ammunition as having been assembled by the same manufacturer and/or containing the same brand of components.
56. Ability to recognize the evidentiary value of reloaded ammunition.

### **Ability Factor 6:**

24. Ability to determine the design of the lockwork (firing system) in firearms.
25. Ability to locate and identify the type (or types) of safety system(s) incorporated in a particular firearm.
26. Ability to determine the design type, method of operation and ignition of a submitted firearm.
27. Ability to recognize when a firearm has been altered from its original design.
28. Ability to determine the metal type in which the identification numbers were located.
29. Ability to select the best restorative method(s)/solutions for raising obliterated serial numbers based on the substrate.
35. Ability to evaluate the operability of each safety system, chambering method, and lockwork, recognize and explain any defects or failures in each of these systems and the consequences of any such defect or failure.
36. Ability to compare firearm mechanisms with standards.

### **Ability Factor 7:**

1. Ability to recognize the evidence potential of an item.
2. Ability to recognize and safeguard non-firearms evidence, such as trace materials.
4. Ability to select the appropriate casting materials.
5. Ability to properly record conditions at a shooting scene or crime scene in general.
6. Ability to interpret the value, meaning, and relationship of various items of evidence at crime scenes for the purpose of reconstructing what events occurred.

## **KSAs Linked to the Firearms Written Examination (Cont.)**

### **Ability Factor 8:**

- 13. Ability to use scientific methodology, statistics, and logic in solving forensic problems.
- 17. Ability to select proper casting material and technique.
- 21. Ability to recognize discrepancies or inconsistencies in analytical findings and determine their cause and significance.
- 22. Ability to recognize utility and limitations of reference collection/database programs.
- 23. Ability to recognize the limitations of tests and interpretations.

### **Ability Factor 10:**

- 94. Ability to recognize unsafe conditions.
- 95. Ability to employ safe work practices.
- 99. Ability to interpret and present technical results and their significance in lay terms.

### **Ability Factor 12:**

- 97. Ability to recognize the need for additional expertise in certain situations and what can be expected to be gained by their participation.
- 98. Ability to remain current about, and take advantage of, new technologies.

### **Ability Factor 13:**

- 73. Ability to recognize sources of class, sub-class, and individual characteristics on any given tool.
- 74. Ability to recognize toolmarks as being class, sub-class, or individual in nature.

### **Ability Factor 14:**

- 7. Ability to establish and maintain a proper chain of custody.
- 8. Ability to maintain a complete inventory of evidence from a particular case.

## **KSAs Linked to the Gunshot Residue Written Examination by the AFTE Certification Committee**

### **Knowledge Factor 1:**

- 20. Knowledge of various photographic techniques and their application for documenting evidence and analytical results, and for preparing courtroom exhibits.
- 28. Knowledge of how and when to use photographic equipment (such as camera types, lenses, film types, filters, proper camera settings, depth of field, proper illumination, and determination of film exposure times).
- 29. Knowledge of how and when to use various microscopy equipment; such as stereo binocular, comparison, compound (including polarizing), scanning electron microscope, video microscope.
- 32. Knowledge of how and when to use photomicrography equipment and its components (such as digital photography, video cameras, camera-to-microscope adapters), determination of effective magnification on printed photographs, determination of proper exposure times.
- 33. Knowledge of when and how to properly use measuring equipment (such as filar micrometer eyepieces, stage micrometers, dial micrometers and calipers, vernier micrometers and calipers, gauges and balances, rulers, tape measures, levels, angle finders, protractors, etc.).
- 37. Knowledge of how and when to use chemical laboratory equipment (such as glassware, burners, pipettes, etc.).
- 40. Knowledge of how and when to use ultrasonic baths and cleaners.
- 41. Knowledge of how and when to use various cleaning solutions.
- 46. Knowledge of how and when to use different probes (such as wood, fiberglass, metal, etc.) for bullet holes.
- 51. Knowledge of how and when to use magnifying glasses of various powers.
- 65. Knowledge of how and when to use chronograph equipment.
- 136. Knowledge of radiation hazards and how to safely use radiation equipment (such as x-ray equipment, lasers, etc.)

### **Knowledge Factor 2:**

- 73. Knowledge of the historical development of firearms design.
- 85. Knowledge of propellants: physical forms and associated purposes of small arms propellants; black gun powder and Pyrodex; nitrocellulose propellants, both single and double base.
- 86. Knowledge of projectiles: design (ogive shape, base shape, cannelure types, forming processes); construction and composition (lead alloy compositions, jacketing materials and styles, etc.).
- 87. Knowledge of cartridge cases: design (i.e., rimfire, centerfire, Boxer/Berdan priming systems); compositions (copper, brass, steel, aluminum).
- 88. Knowledge of manufacturer information: headstamps, color coding.
- 89. Knowledge of the history/development of ammunition components: cartridge naming system; alternate names; interchangeability.
- 90. Knowledge of shotshell: design, construction and nomenclature; shot sizes and composition (hardened lead, plated steel, etc.); wad design and types of filler (buffering) materials.
- 91. Knowledge of primers: design, color, staking.
- 92. Knowledge of ammunition components.
- 93. Knowledge of ammunition manufacturing methods.
- 95. Knowledge of the principles of ammunition reloading.

## **KSAs Linked to the Gunshot Residue Written Examination (Cont.)**

### **Knowledge Factor 3:**

3. Knowledge of which tools or instruments are most appropriate for the recovery of evidence.
4. Knowledge of shooting-scene reconstruction techniques.
5. Knowledge of non-firearms/toolmark types of forensic evidence: such as trace evidence (hairs, fibers, paint, etc.), serological evidence, etc.
6. Knowledge of legal requirements for the preservation of evidence.
7. Knowledge of scientific methodologies for the preservation of evidence.
8. Knowledge of activities to perform to ensure the preservation of a crime scene.
9. Knowledge of which tools, instruments, and containers are most appropriate for the preservation of evidence.
10. Knowledge of the proper storage conditions for evidence collected.
11. Knowledge of the effects of biological agents (bacteria, molds, insects, animals, etc.) on various types of evidence and ways to prevent its effects.
12. Knowledge of basic Chain of Custody rules.
13. Knowledge of the effects that interfering factors (such as substrate, time, activity, temperature, weather, etc.) have upon various types of evidence, and ways to prevent their effects.
83. Knowledge of the types of trace materials that may be present on firearms.

### **Knowledge Factor 4:**

84. Knowledge of methods for determining if and how often a firearm has been fired since it was last cleaned.
102. Knowledge of bullet holes/bullet impact sites and ricochet marks.
105. Knowledge of bullet recovery methods, and the advantages and disadvantages of each.
120. Knowledge of firearms-generated discharge products: how deposited; primer constituents, propellant residues, bullet metal and bullet lubricants.

### **Knowledge Factor 5:**

97. Knowledge of proper ammunition selection.
130. Knowledge of the potential hazardous properties of biological hazards (such as hepatitis, AIDS, etc.).
131. Knowledge of the potential hazardous properties of parasites.
132. Knowledge of the potential hazardous properties of toxic and reactive chemicals.
133. Knowledge of the potential hazardous properties of gunshot residues.
134. Knowledge of the proper methods for the handling and disposing of hazardous materials.
135. Knowledge of how to safely handle potentially dangerous items, such as defective firearms, ammunition, and explosives for laboratory examination.
138. Knowledge of the proper use of safety equipment and materials (such as protective clothing, eye and ear protective devices, and disinfectants).
139. Knowledge of safety procedures and the potential hazardous properties regarding test firing various firearms.
140. Knowledge of safety procedures associated with the use of laboratory equipment.
141. Knowledge of safety procedures associated with the use of handtools, woodworking machinery, and metalworking machinery.

## **KSAs Linked to the Gunshot Residue Written Examination (Cont.)**

### **Knowledge Factor 6:**

106. Knowledge of chemical tests used in the examination of bullet holes, bullet impact site, and ricochet marks.
107. Knowledge of how and when to perform microscopic examinations for the purpose of distance determination.
109. Knowledge of how and when to perform chemical tests (such as: sodium rhodizonate and Griess) for the purpose of distance determination.
110. Knowledge of stippling patterns/powder patterns on a surface and how they are used in distance determination.
111. Knowledge of pellet patterns and how they are used in distance determination.
112. Knowledge of which firearms, ammunition, and test pattern surfaces to use for the purpose of distance determination.
113. Knowledge of bullet hole characterization for caliber size determination (within limitations) when performing distance determination.

### **Knowledge Factor 7:**

42. Knowledge of how and when to use pulled-bullet/cartridge exemplar files.
44. Knowledge of how and when to use bore lights.
75. Knowledge of muzzleloading firearms designs, including ignition systems and loading techniques.
76. Knowledge of breechloading firearms designs, including falling breechlocks, bolt actions, lever actions, pump actions, break open, semiautomatics (blowback, gas-operated, recoil operated, etc.), revolvers--double and single action.
77. Knowledge of firearms ignition systems: flintlock, percussion, rimfire, centerfire, caseless ammunition.
81. Knowledge of the proper operation of the different types of firearms encountered in casework.
82. Knowledge of the different materials that may be present in the bore of a firearm.

### **Knowledge Factor 8:**

14. Knowledge of how to properly document evidence and analytical results (through notes, sketches, photography, reports, etc.).
15. Knowledge of the techniques and procedures used to properly mark evidence (when appropriate).
16. Knowledge of the proper mechanics of the English language (grammar, punctuation, spelling, and composition).
17. Knowledge of the proper methodologies for the written documentation of scientific results.
18. Knowledge of how to prepare reports for peer review.
19. Knowledge of how to prepare articles for peer review/publication.
129. Knowledge of correct word usage and pronunciation.

### **Knowledge Factor 9:**

142. Knowledge of which journals, newsletters and professional publications report information applicable to Firearm and Toolmark Examiners.
143. Knowledge of which professional organizations address Firearm and Toolmark Examiners concerns.
144. Knowledge of where to find and how to use various reference collections, tables, and databases (including ballistic tables, Drugfire and IBIS, Firearm Reference Collections, Ammunition Reference Collections, General Rifling Characteristics File for make and model determinations, etc.), and the limitations of such databases and tables.

## **KSAs Linked to the Gunshot Residue Written Examination (Cont.)**

- 145. Knowledge of legal requirements (e.g., *Daubert* and *Frye* cases) and the protocols for the presentation of scientific evidence.
- 146. Knowledge of appropriate legislation and statutory definitions as applied to the expert witness.
- 147. Knowledge of courtroom procedures regarding the testimony of expert witnesses.
- 149. Knowledge of the preparation and use of demonstrative evidence (such as displays, etc.).
- 150. Knowledge of training methods used to teach scientific disciplines.

### **Knowledge Factor 11:**

- 43. Knowledge of how and when to use borescopes.
- 67. Knowledge of how and when to use examination tables.
- 68. Knowledge of how and when to use bullet and cartridge recovery systems (water, snail, cotton waste, etc.).
- 69. Knowledge of how and when to use bullet pullers.

### **Knowledge Factor 12:**

- 21. Knowledge of testing procedures commonly used to examine evidence, the expected results from each, and when to apply each.
- 22. Knowledge of experimental design methodologies for conducting scientific experiments and investigations.
- 23. Knowledge of how each scientific test affects the evidence being examined.
- 24. Knowledge of quality assurances and quality control procedures and how they are maintained by Firearm and Toolmark Examiners.
- 25. Knowledge of sequential priorities for conducting scientific tests so as not to destroy evidence or contaminate test results.

### **Knowledge Factor 13:**

- 148. Knowledge of the proper demeanor for testifying in legal proceedings.
- 151. Knowledge of the ethical standards maintained by the legal and law enforcement professions.
- 152. Knowledge of the ethical standards maintained by the scientific community (in general).
- 153. Knowledge of the ethical standards maintained by forensic science organizations (including the American Society of Crime Laboratory Directors and the Association of Firearms and Toolmark Examiners).

### **Knowledge Factor 14:**

- 38. Knowledge of how and when to use various vises, clamps, and restraining devices.
- 52. Knowledge of how and when to use chemical reagents.
- 57. Knowledge of how and when to use various small handtools (such as screwdrivers, hammers, pliers, etc.).
- 59. Knowledge of how and when to use fume hoods.
- 66. Knowledge of how and when to use computer systems and work-related computer programs.
- 42. Ability to recognize and interpret the effects of ammunition/firearms combination on various aspects involved in reconstructing what happened at a shooting scene.

## **KSAs Linked to the Gunshot Residue Written Examination (Cont.)**

### **Ability Factor 1:**

58. Ability to identify potential ballistic issues or considerations on specific cases (e.g., questionable ammunition performance, the shooter's sight picture at the moment of the shot, bullet flight time vs. changes in the position of the victim).
62. Ability to identify holes and/or defects in various objects as bullet-caused, through physical and/or chemical means (e.g., lead containing "bullet wipe," "bullet splash," copper/lead transfers in bullet graze or ricochet marks).
63. Ability to determine directionality of a bullet's course, as affected/unaffected by intervening objects, and estimate the bullet's trajectory (flight path) where possible.
64. Ability to recognize situations where gunshots might be sequenced.
66. Ability to properly limit the scope of reconstruction to the hypotheses being tested.
67. Ability to recognize bullet impact sites at shooting scenes.
68. Ability to recognize the limitations of a particular shooting scene reconstruction.

### **Ability Factor 2:**

39. Ability to recognize, compare and identify various ammunition types and components.

### **Ability Factor 3:**

9. Ability to design a testing protocol (based on size of sample and type of evidence) that will provide the most useful information, while avoiding procedures that are redundant or will interfere with subsequent tests.
10. Ability to evaluate examination requests, while considering the totality of the case.
11. Ability to adhere to an examination protocol for both firearms and toolmark cases.
12. Ability to use logic to analyze and identify strengths and weaknesses of different approaches.
15. Ability to determine when enhancement techniques are needed when examining evidence.
86. Ability to maintain clear and comprehensive case notes.
87. Ability to read and understand information and ideas presented in writing.
105. Ability to advocate only the propriety of the casework that was performed, and not the position of either the prosecution or the defense.
106. Ability to maintain and practice high ethical standards in the performance of one's job duties.

### **Ability Factor 4:**

69. Ability to compare and interpret test and evidence gunshot discharge patterns.
70. Ability to accurately record the appearance of bullet holes.
75. Ability to visualize, document and measure gunshot residue deposits on clothing and other surfaces, and to prepare representative gunshot residue test patterns with the evidence firearm and appropriate ammunition, and to estimate the muzzle to target distance from the comparison of evidence and test patterns.
76. Ability to perform relevant chemical tests for the purpose of distance determination.
77. Ability to identify the physical form and type of small arms propellant recovered from a gun, victim's clothing, etc. (e.g., flattened ball powder, perforated disc, flake powder, etc.).
78. Ability to evaluate the appropriateness of testing for primer derived gunshot residue on various substrates.

## **KSAs Linked to the Gunshot Residue Written Examination (Cont.)**

79. Ability to evaluate the possibility/likelihood of contamination by various means (environmental, transference, dispersion due to firearms discharges in confined spaces, etc.).
80. Ability to recognize various primer mixtures available in modern rimfire and centerfire ammunition of both domestic and foreign manufacture.
81. Ability to test for gunshot residues on various substrates (such as glass, cloth, painted metal, etc.).
82. Ability to recognize the various physical and chemical forms of propellants, their purpose in various cartridges and their value as physical evidence.
83. Ability to interpret results of comparative examinations of gunshot residues.

### **Ability Factor 5:**

43. Ability to recognize reloaded or handloaded ammunition.
45. Ability to compare unfired propellant samples from disassembled cartridges.

### **Ability Factor 7:**

1. Ability to recognize the evidence potential of an item.
2. Ability to recognize and safeguard non-firearms evidence, such as trace materials.
3. Ability to recognize bullet impact sites at crime scenes.
5. Ability to properly record conditions at a shooting scene or crime scene in general.
6. Ability to interpret the value, meaning, and relationship of various items of evidence at crime scenes for the purpose of reconstructing what events occurred.

### **Ability Factor 8:**

13. Ability to use scientific methodology, statistics, and logic in solving forensic problems.
14. Ability to perform routine maintenance on laboratory equipment and machines (includes calibrating instruments).
18. Ability to operate basic laboratory equipment.
19. Ability to understand and interpret technical data output from laboratory instruments
20. Ability to make detailed calculations accurately.
21. Ability to recognize discrepancies or inconsistencies in analytical findings and determine their cause and significance.
22. Ability to recognize utility and limitations of reference collection/database programs.
- I.** Ability to recognize the limitations of tests and interpretations.

### **Ability Factor 10:**

94. Ability to recognize unsafe conditions.
95. Ability to employ safe work practices.

### **Ability Factor 12:**

97. Ability to recognize the need for additional expertise in certain situations and what can be expected to be gained by their participation.
98. Ability to remain current about, and take advantage of, new technologies.

### **Ability Factor 14:**

7. Ability to establish and maintain a proper chain of custody.
8. Ability to maintain a complete inventory of evidence from a particular case.

## **KSAs Linked to the Toolmark Written Examination by the AFTE Certification Committee**

### **Knowledge Factor 1:**

20. Knowledge of various photographic techniques and their application for documenting evidence and analytical results, and for preparing courtroom exhibits.
28. Knowledge of how and when to use photographic equipment (such as camera types, lenses, film types, filters, proper camera settings, depth of field, proper illumination, and determination of film exposure times).
29. Knowledge of how and when to use various microscopy equipment; such as stereo binocular, comparison, compound (including polarizing), scanning electron microscope, video microscope.
30. Knowledge of how and when to use microscopy enhancement techniques (such as magnesium smoke).
32. Knowledge of how and when to use photomicrography equipment and its components (such as digital photography, video cameras, camera-to-microscope adapters), determination of effective magnification on printed photographs, determination of proper exposure times.
33. Knowledge of when and how to properly use measuring equipment (such as filar micrometer eyepieces, stage micrometers, dial micrometers and calipers, vernier micrometers and calipers, gauges and balances, rulers, tape measures, levels, angle finders, protractors, etc.).
37. Knowledge of how and when to use chemical laboratory equipment (such as glassware, burners, pipettes, etc.).
40. Knowledge of how and when to use ultrasonic baths and cleaners.
41. Knowledge of how and when to use various cleaning solutions.
51. Knowledge of how and when to use magnifying glasses of various powers.

### **Knowledge Factor 2:**

78. Knowledge of methods of imprinting serial numbers on firearms.
79. Knowledge of theory of restorative techniques of serial numbers in firearms.
96. Knowledge of the tools, sources, and types of components used in ammunition reloading, and when to use them.

### **Knowledge Factor 3:**

3. Knowledge of which tools or instruments are most appropriate for the recovery of evidence.
5. Knowledge of non-firearms/toolmark types of forensic evidence: such as trace evidence (hairs, fibers, paint, etc.), serological evidence, etc.
6. Knowledge of legal requirements for the preservation of evidence.
7. Knowledge of scientific methodologies for the preservation of evidence.
8. Knowledge of activities to perform to ensure the preservation of a crime scene.
9. Knowledge of which tools, instruments, and containers are most appropriate for the preservation of evidence.
10. Knowledge of the proper storage conditions for evidence collected.
11. Knowledge of the effects of biological agents (bacteria, molds, insects, animals, etc.) on various types of evidence and ways to prevent its effects.
12. Knowledge of basic Chain of Custody rules.
13. Knowledge of the effects that interfering factors (such as substrate, time, activity, temperature, weather, etc.) have upon various types of evidence, and ways to prevent their effects.
31. Knowledge of how to prepare casts and use of casting materials.

### **Knowledge Factor 4:**

102. Knowledge of bullet holes/bullet impact sites and ricochet marks.

## **KSAs Linked to the Toolmark Written Examination (Cont.)**

### **Knowledge Factor 5:**

130. Knowledge of the potential hazardous properties of biological hazards (such as hepatitis, AIDS, etc.).
131. Knowledge of the potential hazardous properties of parasites.
132. Knowledge of the potential hazardous properties of toxic and reactive chemicals.
134. Knowledge of the proper methods for the handling and disposing of hazardous materials.
135. Knowledge of how to safely handle potentially dangerous items, such as defective firearms, ammunition, and explosives for laboratory examination.
138. Knowledge of the proper use of safety equipment and materials (such as protective clothing, eye and ear protective devices, and disinfectants).
140. Knowledge of safety procedures associated with the use of laboratory equipment.
141. Knowledge of safety procedures associated with the use of handtools, woodworking machinery, and metalworking machinery.

### **Knowledge Factor 7:**

74. Knowledge of machining and finishing processes of tools, guns, barrels, breechfaces, extractors, ejectors, firing pins, and silencers (with emphasis on working surfaces and edges) and their effect on individuality.
80. Knowledge of sources of information regarding identification markings and serial numbering systems in firearms (including locations of serial numbers, part/assembly numbers, proof marks on firearms and the locations of hidden numbers).

### **Knowledge Factor 8:**

14. Knowledge of how to properly document evidence and analytical results (through notes, sketches, photography, reports, etc.).
15. Knowledge of the techniques and procedures used to properly mark evidence (when appropriate).
16. Knowledge of the proper mechanics of the English language (grammar, punctuation, spelling, and composition).
17. Knowledge of the proper methodologies for the written documentation of scientific results.
18. Knowledge of how to prepare reports for peer review.
19. Knowledge of how to prepare articles for peer review/publication.
129. Knowledge of correct word usage and pronunciation.

### **Knowledge Factor 9:**

142. Knowledge of which journals, newsletters and professional publications report information applicable to Firearm and Toolmark Examiners.
143. Knowledge of which professional organizations address Firearm and Toolmark Examiners concerns.
144. Knowledge of where to find and how to use various reference collections, tables, and databases (including ballistic tables, Drugfire and IBIS, Firearm Reference Collections, Ammunition Reference Collections, General Rifling Characteristics File for make and model determinations, etc.), and the limitations of such databases and tables.
145. Knowledge of legal requirements (e.g., *Daubert* and *Frye* cases) and the protocols for the presentation of scientific evidence.
146. Knowledge of appropriate legislation and statutory definitions as applied to the expert witness.
147. Knowledge of courtroom procedures regarding the testimony of expert witnesses.
149. Knowledge of the preparation and use of demonstrative evidence (such as displays, etc.).
150. Knowledge of training methods used to teach scientific disciplines.

## **KSAs Linked to the Toolmark Written Examination (Cont.)**

### **Knowledge Factor 10:**

- 114. Knowledge of proper use of tools and materials for testmarks.
- 115. Knowledge of the toolmarks created during the reloading of ammunition.
- 116. Knowledge of the interactive nature of the tool/toolmark process and the transference of class, sub-class, and individual characteristics.
- 117. Knowledge of impressed (static) vs. striated (dynamic) toolmarks.
- 118. Knowledge of the best agreement possible in situations of known non-matches when comparing toolmarks.
- 119. Knowledge of the principles of preparing test marks and the effects of test materials in the production of testfired cartridge components and toolmarks for comparison.

### **Knowledge Factor 11:**

- 67. Knowledge of how and when to use examination tables.
- 69. Knowledge of how and when to use bullet pullers.

### **Knowledge Factor 12:**

- 21. Knowledge of testing procedures commonly used to examine evidence, the expected results from each, and when to apply each.
- 22. Knowledge of experimental design methodologies for conducting scientific experiments and investigations.
- 23. Knowledge of how each scientific test affects the evidence being examined.
- 24. Knowledge of quality assurances and quality control procedures and how they are maintained by Firearm and Toolmark Examiners.
- 25. Knowledge of sequential priorities for conducting scientific tests so as not to destroy evidence or contaminate test results.
- 26. Knowledge of definitions of class, sub-class, and individual characteristics and the differences between them.
- 27. Knowledge of the sources of class, sub-class, and individual characteristics.

### **Knowledge Factor 13:**

- 148. Knowledge of the proper demeanor for testifying in legal proceedings.
- 151. Knowledge of the ethical standards maintained by the legal and law enforcement professions.
- 152. Knowledge of the ethical standards maintained by the scientific community (in general).
- 153. Knowledge of the ethical standards maintained by forensic science organizations (including the American Society of Crime Laboratory Directors and the Association of Firearms and Toolmark Examiners).

### **Knowledge Factor 14:**

- 38. Knowledge of how and when to use various vises, clamps, and restraining devices.
- 39. Knowledge of how and when to use gunsmithing tools.
- 52. Knowledge of how and when to use chemical reagents.
- 57. Knowledge of how and when to use various small handtools (such as screwdrivers, hammers, pliers, etc.).
- 58. Knowledge of how and when to use metal and woodworking machinery (such as drill presses, grinders, dremels, lathes, mills, etc.).
- 59. Knowledge of how and when to use fume hoods.
- 66. Knowledge of how and when to use computer systems and work-related computer programs.

## **KSAs Linked to the Toolmark Written Examination (Cont.)**

### **Ability Factor 2:**

30. Ability to recognize the effect that firearms and ammunition manufacturing processes, the design of firearms, and design of firearms accessories have on markings imparted to bullets and casings and to interpret them accordingly.
31. Ability to recognize different manufacturing methods and, based upon this, to properly interpret potential for class, sub-class, and individual characteristics.
37. Ability to recognize which parts of a firearm leave tool marks of forensic interest.
40. Ability to recognize manufacturer-induced/placed toolmarks (sub-class characteristics) on ammunition as well as their usefulness and limitations.
46. Ability to recognize: (1) those attributes or characteristics of a particular firearm design which are reflected in the fired projectiles and fired cartridge cases; and (2) non-firearm caused toolmarks on ammunition components.
57. Ability to recognize any manufacturer-induced characteristics.

### **Ability Factor 3:**

9. Ability to design a testing protocol (based on size of sample and type of evidence) that will provide the most useful information, while avoiding procedures that are redundant or will interfere with subsequent tests.
10. Ability to evaluate examination requests, while considering the totality of the case.
11. Ability to adhere to an examination protocol for both firearms and toolmark cases.
12. Ability to use logic to analyze and identify strengths and weaknesses of different approaches.
15. Ability to determine when enhancement techniques are needed when examining evidence.
88. Ability to read and understand information and ideas presented in writing.
89. Ability to properly document evidence items, examinations, and comparisons.
105. Ability to advocate only the propriety of the casework that was performed, and not the position of either the prosecution or the defense.
106. Ability to maintain and practice high ethical standards in the performance of one's job duties.

### **Ability Factor 6:**

27. Ability to recognize when a firearm has been altered from its original design.
28. Ability to determine the metal type in which the identification numbers were located.

### **Ability Factor 7:**

1. Ability to recognize the evidence potential of an item.
2. Ability to recognize and safeguard non-firearms evidence, such as trace materials.
4. Ability to select the appropriate casting materials.
5. Ability to properly record conditions at a shooting scene or crime scene in general.
6. Ability to interpret the value, meaning, and relationship of various items of evidence at crime scenes for the purpose of reconstructing what events occurred.

## **KSAs Linked to the Toolmark Written Examination (Cont.)**

### **Ability Factor 8:**

13. Ability to use scientific methodology, statistics, and logic in solving forensic problems.
14. Ability to perform routine maintenance on laboratory equipment and machines (includes calibrating instruments).
17. Ability to select proper casting material and technique.
18. Ability to operate basic laboratory equipment.
19. Ability to understand and interpret technical data output from laboratory instruments.
21. Ability to recognize discrepancies or inconsistencies in analytical findings and determine their cause and significance.
22. Ability to recognize utility and limitations of reference collection/database programs.
23. Ability to recognize the limitations of tests and interpretations.

### **Ability Factor 10:**

94. Ability to recognize unsafe conditions.
95. Ability to employ safe work practices.

### **Ability Factor 12:**

97. Ability to recognize the need for additional expertise in certain situations and what can be expected to be gained by their participation.

### **Ability Factor 13:**

71. Ability to make determinations in toolmark comparisons (both firearm and non-firearm toolmarks) regarding: identifications, exclusions, and inconclusives.
72. Ability to recognize patterns (profiles, etc.) produced by various tool working surfaces.
73. Ability to recognize sources of class, sub-class, and individual characteristics on any given tool.
74. Ability to recognize toolmarks as being class, sub-class, or individual in nature.

### **Ability Factor 14:**

7. Ability to establish and maintain a proper chain of custody.
8. Ability to maintain a complete inventory of evidence from a particular case.