Technical Procedure for Unfired Cartridge/Shotshell Examination

1.0 Purpose – To outline the procedures for examination and comparison of unfired cartridge and shotshell evidence.

2.0 Scope – This procedure applies to cases submitted to the Firearms Section that contain unfired cartridges or shotshells.

3.0 Definitions

- **Caliber (Ammunition)** – A numerical term, without the decimal point, included in a cartridge name to indicate the nominal bullet diameter.
- **Cannelure** – A circumferential groove generally of a knurled or plain appearance on a bullet or cartridge case that is typically used for crimping, lubrication, and identification.
- **Cartridge** – A single unit of ammunition consisting of the case, primer, and propellant with one or more projectile(s).
- **Centerfire** – Any cartridge that has its primer central to the axis in the head of the case.
- **Chambering detail** – Individual microscopic marks placed upon a cartridge case by the chamber wall as a result of inserting a cartridge into the chamber of a firearm.
- **Class characteristics** – Measurable features of a specimen which indicate a restricted group source. They result from design factors, and are therefore determined prior to manufacture.
- **Comparison microscope** – Essentially two microscopes connected to an optical bridge which allows the viewer to observe two objects simultaneously with the same degree of magnification.
- **Ejection port** – An opening in the receiver or slide to allow ejection.
- **Ejector** – A portion of a firearm's mechanism which ejects or expels cartridges or cartridge cases from a firearm.
- **Extractor** – A portion of a firearm's mechanism which withdraws a cartridge or cartridge case from the chamber of a firearm.
- **Gauge** – A term used in the identification of a shotgun bore. The number of round lead balls of bore diameter that equal one pound. Thus, 12 gauge is the diameter of a round lead ball weighing 1/12 pound.
- **Headstamp** – Numerals, letters and symbols (or a combination thereof) stamped into the head of a cartridge case or shotshell to identify the manufacturer, caliber, gauge, or give additional information.
- **Individual characteristics** – Marks produced by the random imperfections or irregularities of tool surfaces. These random imperfections or irregularities are produced incidental to manufacture and/or caused by use, corrosion, or damage. They are unique to that tool and distinguish it from all other tools.
- **Objective** – The lens or lenses in an optical instrument which form the image of an object.
- **Oblique lighting** – A method of illumination where the light source is placed at an angle, generally to produce shadows or enhance edges.
- **Primer** – The ignition component of a cartridge.
- **Rimfire** – A flange-headed cartridge containing the priming mixture inside the rim cavity.
- **Shell latch** – The part of a shotgun that holds live shotshells in the magazine tube.
- **Shotshell** – A cartridge containing projectile(s) designed to be fired in a shotgun. The cartridge body may be metal, plastic, or paper.
- **Stereomicroscope** – An optical instrument which provides three dimensional viewing of an object through paired objectives and eyepieces. Some models share a common main objective.
- **Subclass characteristics –** Features that may be produced during manufacture that are consistent among items fabricated by the same tool in the same approximate state of wear. These features are not determined prior to manufacture and are more restrictive than class characteristics.

- **Sufficient agreement** – Agreement is sufficient when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool.

4.0 Equipment, Materials, and Reagents

- Comparison microscope
- Stereomicroscope
- Caliper
- Balance
- Ammunition Reference Collection
- Engraver
- Bullet puller
- Cotton-tipped swabs
- Cleaning solutions such as Terg-A-Zyme, Hibiclens, ethanol, acetone and cartridge case cleaner (5 % v/v dilution of Birchwood Casey Concentrate in water)
- Magnet
- Personal protective equipment
- Soft bristle brush

5.0 Procedure

5.1 Unfired cartridges and shotshells shall not be microscopically examined for cycling detail when such items are found with the firearm.

5.2 If a group of unfired cartridges or shotshells is requested to be microscopically compared to either a firearm or other ammunition component(s), the examination shall end when one (1) unfired item is identified as having been cycled through the firearm or the same firearm as the other ammunition component(s).

5.3 A result statement shall be reported for unfired cartridges or shotshells even those included in the item description of a submitted firearm.

5.4 Unfired Cartridge/Shotshell Examination

5.4.1 Item Preparation

5.4.1.1 Prior to examination, ensure that any additional service requests (e.g., Forensic Biology, Trace, Latent, etc.) that shall be completed before analysis by the Firearms Section have been completed. This can be verified by examining one, or a combination, of the following:

5.4.1.1.1 The status of other case records in Forensic Advantage (FA).

5.4.1.1.2 The chain of custody.

5.4.1.1.3 Markings from other Forensic Scientists on the evidence packaging.

5.4.1.2 Wear appropriate personal protective equipment, such as gloves, lab coat, and/or safety glasses, if the item may be contaminated with a biohazardous material (blood or other potentially infectious material).

5.4.1.3 Visually inspect the item for possible trace evidence such as hair, fibers, wood, etc. Note the location on the item where the trace material was found. Carefully remove the material and place in a container suitable for return to the submitting agency or submission to the appropriate Laboratory Section for further examination.

5.4.1.3.1 If the trace material is not to be retained, indicate as such in the case notes.

5.4.1.4 Unfired cartridges or shotshells contaminated with blood, body matter or other biological material shall be evaluated for the need to preserve biological material. Upon evaluation and preservation, if required, the unfired cartridge or shotshells may be cleaned with a soft bristle brush and a disinfectant such as Terg-A-Zyme, Hibiclens, and/or ethanol.

5.4.1.5 Unfired cartridges or shotshells may generally be cleaned with a cotton-tipped swab saturated with ethanol, acetone, and/or cartridge case cleaner.

5.4.1.6 Mark all evidence cartridges and shotshells for identification.

5.4.1.6.1 Do not mark on the head or rim or mark on possible extractor or chambering marks. Find an area devoid of markings.

5.4.1.6.2 If cartridges and shotshells are examined for manufacturing information and not used for further testing, the evidence container may be properly marked in lieu of marking the items themselves.

5.4.2 Physical Characteristics Examination

5.4.2.1 Recording in FA

5.4.2.1.1 Unfired cartridges/shotshells that are to be microscopically compared for cycling detail shall be recorded on a Cartridge Case Worksheet or Shotshell Worksheet, respectively. Cartridges/shotshells of similar class characteristics may be grouped together on the same worksheet.

5.4.2.1.2 Cartridges/shotshells without a specific request for microscopic comparison shall be recorded on a Firearm Worksheet or on the Not Examined Worksheet as follows:

5.4.2.1.2.1 If some or all of the unfired cartridges/shotshells will be used as test fires, they shall be included on the Firearm worksheet for the firearm in which they will be fired.

5.4.2.1.2.2 If the unfired cartridges/shotshells were submitted with a firearm and are a caliber that can be fired by the firearm,

either intentionally or otherwise, they shall be included on the Firearm worksheet for the firearm with which they were submitted or on the Not Examined worksheet.

5.4.2.1.2.3 If unfired cartridges/shotshells are submitted independently from a firearm or were submitted with a firearm, but are a caliber that cannot be fired by the firearm either intentionally or otherwise, they shall be listed on the Not Examined Worksheet.

5.4.2.1.3 Each worksheet entry shall contain the item number assigned to the item by the Forensic Scientist.

5.4.2.2 Features of unfired cartridges/shotshells that shall be noted, if applicable, include:

5.4.2.2.1 Design characteristics of unfired cartridges or shotshells:

- Manufacturer
- Caliber/Gauge
- Hull markings (load information)

5.4.2.2.2 Class characteristics of the firearm that cycled the cartridge or shotshell:

- Presence of a firing pin strike
- Extractor mark(s) and position
- Ejector mark(s) and position
- Chambering detail type
- Resizing marks or any other indications of reloading

5.4.2.3 Features of unfired cartridges/shotshells that may be noted, if applicable, include:

5.4.2.3.1 Design characteristics of unfired cartridge or shotshells:

- Headstamp
- Ignition system (centerfire or rimfire)
- Composition of the case, primer, and/or hull
- Cannelure type and location
- Primer sealant presence and color
- Shape, description, and/or weight of the cartridge bullet

5.4.2.3.2 Class characteristics of the firearms that cycled the cartridge or shotshell:

- Magazine lip marks
- Shell latch marks
- Ejection port markings

5.4.2.4 If an unfired cartridge/shotshell will be microscopically compared to either another evidence item or to a submitted firearm, the item must first be evaluated to identify characteristics suitable for comparison.

5.4.2.4.1 The result of this evaluation will be recorded in the case notes.

5.5 Class Characteristics Comparison

5.5.1 Should a microscopic comparison be requested, the evidence unfired cartridges or shotshells will first be evaluated for agreement of class characteristics to each other or to a submitted firearm. The Forensic Scientist may ascertain at this point if the class characteristics agree by noting whether or not the type, shape, and location of extractor marks, ejector marks, etc. are similar.

5.6 Individual Characteristics Comparison

5.6.1 The following is an illustration of an approved method of performing a comparison microscope examination of test and/or evidence unfired cartridges or shotshells. Forensic Scientists may develop their own routine for this type of examination; however, they shall incorporate the general underlined points mentioned below.

5.6.1.1 Select the correct objective (magnification) setting and ensure that the objectives are locked in place. Low magnification (10X - 15X) is typically used to examine the cartridge or shotshell looking for areas with the most obvious individual characteristics. Higher magnification (20X or greater) is typically used to verify the correspondence of finer striations.

5.6.1.2 The illumination (lights) used shall be properly adjusted. Oblique lighting is usually preferred.

5.6.1.3 If a firearm was submitted for comparison, compare the test cartridges/shotshells cycled through this firearm to each other to determine which microscopic characteristics are reproducing.

5.6.1.3.1 Cycling detail

5.5.1.5.1.1 The Forensic Scientist may examine extractor, ejector, chambering, feed marks and any other marks that may be present on the test cartridges/shotshells.

5.5.1.5.1.2 Position the test cartridges/shotshells on the stages in the position that most clearly highlights the area(s) of concern.

5.5.1.5.2 If the test cartridges/shotshells cannot be matched to each other (there is not sufficient agreement), more tests cartridges/shotshells may be cycled and inter-compared. If the test cartridges/shotshells still cannot be matched, the Forensic Scientist may reach the conclusion that the firearm in question does not reproduce its individual characteristics

very well or that the firearm does not produce sufficient individual marks to reach a positive conclusion.

5.5.1.6 Compare evidence unfired cartridge(s)/shotshell(s) to either another evidence unfired cartridge/shotshell or a test cartridge/shotshell.

5.5.1.6.1 In the case of comparison to a test cartridge/shotshell, attempt to locate the area on the evidence cartridge/shotshell that corresponds to the previously examined area of the test cartridge/shotshell.

5.5.1.6.2 When comparing evidence cartridges/shotshells to each other or to evidence fired cartridge cases/shotshells, an area with obvious individual characteristics may be noted on one cartridge/ shotshell. The other item may then be examined in an attempt to locate the corresponding area.

5.5.1.7 These examinations shall be made with the cartridges/shotshells in phase. This means that cartridges/shotshells that are being examined shall be oriented similarly using a common point of reference such as drag marks, extractor marks, ejector marks, etc.

5.5.1.8 The entire unknown shall be considered. The Forensic Scientist shall examine and compare all detail of a similar type present on the unfired cartridge/shotshell. For example, when comparing chambering detail, the Forensic Scientist shall examine the entire case wall for all chambering detail present.

5.5.1.9 Evaluate for subclass characteristics.

5.5.1.9.1 Subclass characteristics can be used for alignment and phasing of evidence and/or test cartridge(s)/shotshell(s).

5.5.1.9.2 The method and outcome of evaluation shall be noted in the Comparison Exams worksheet.

5.5.1.10 The Forensic Scientist may halt the examination if he/she finds sufficient agreement to match in one area of detail. For example, if the Forensic Scientist finds sufficient agreement to match based on extractor mark detail, the Forensic Scientist need not examine and compare chambering detail. If, however, the Forensic Scientist does not find sufficient agreement in a particular area, the Forensic Scientist shall continue looking at other areas until he/she determines that there is sufficient agreement to match or until there are no more areas of detail to examine.

5.5.1.11 If the cartridges/shotshells may be matched to each other, the cartridges/shotshells shall be indexed with an indelible marker to indicate the position in which the agreement is most clearly viewed.

5.5.1.11.1 The Forensic Scientist may refer to previously indexed areas when describing the orientation, such as an extractor index mark.

5.5.1.11.2 Specific areas of chambering detail agreement shall be indexed on the case walls immediately adjacent to the agreement.

5.5.1.12 If an identification is not initially made, the Forensic Scientist may consider the following possible reasons for the lack of sufficient agreement:

5.5.1.12.1 The evidence cartridge/shotshell and test cartridges/shotshells were cycled through different firearms.

5.5.1.12.2 The firearm was damaged between cycling the evidence cartridge/shotshell and the test cartridge/shotshell.

5.5.1.12.3 The test ammunition available is significantly different from the evidence causing a difference in the way the cartridge/shotshell was marked.

5.5.1.12.4 Extreme fouling is/was present in the firearm, either prior to cycling the evidence cartridge/shotshell or occurring since the evidence cartridge/shotshell was cycled.

5.5.1.12.5 Damage occurred to the evidence cartridge/shotshell causing distortion, deformation or the elimination of microscopic detail.

5.5.1.12.6 The evidence cartridge/shotshell was cycled through a firearm of an incorrect caliber.

5.5.1.12.7 Other reasons may exist and may be considered and tested if appropriate at the discretion of the Forensic Scientist based on his/her training and experience.

5.6 Range of Conclusions

5.6.1 The suggested report wording listed below may be modified at the Forensic Scientist's discretion to reflect more accurately his/her conclusions. Any such modifications to report wording shall be reviewed and approved with the technical review.

5.6.2 Identification

5.6.2.1 There is agreement of all discernible class characteristics and sufficient agreement of individual characteristics to constitute a match.

- "Item 12 was cycled through the Item 5 pistol."
- "Items 4 through 6 were cycled through the same firearm."

5.6.3 Inconclusive

5.6.3.1 There is agreement of all discernible class characteristics and some agreement of individual characteristics, but insufficient for an identification; or

There is agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility; or

There is agreement of all discernible class characteristics and possible agreement of individual characteristics, but the potential for subclass carryover could not be eliminated; or

There is agreement of all discernible class characteristics and some disagreement of individual characteristics, but insufficient for elimination.

- "There is agreement of all discernible class characteristics between the Item 3 shotshell and test shotshells cycled through the Item 1 shotgun; however, the comparison of individual characteristics was inconclusive. Therefore, the Item 3 shotshell could not be identified or eliminated as having been cycled through the Item 1 shotgun."

- "There is agreement of all discernible class characteristics and possible individual characteristics between cycling marks found on Items 4 and 7. However, the potential for subclass carryover could not be eliminated. Therefore, Items 4 and 7 were either cycled through the same firearm, or through different firearms manufactured with the same tool in the same approximate state of wear."

- "There is agreement of all discernible class characteristics between Item 10 and Item 12; however, the comparison of individual characteristics was inconclusive. Therefore, Item 10 and Item 12 could not be identified or eliminated as having been cycled through the same firearm."

5.6.4 Elimination

5.6.4.1 The Firearms Section does not eliminate based on cycling detail, as a cartridge or shotshell can be cycled through a firearm with no tool marks resulting. However, there may be significant disagreement of discernible class characteristics and/or individual characteristics.

- "There is disagreement of discernible cycling class and/or individual characteristics between the Item 7 cartridge and test cartridges cycled through the Item 2 pistol. However, due to the possibility of a cartridge being cycled through multiple firearms without cycling marks being produced, the Item 7 cartridge could not be eliminated as having been cycled through the Item 2 pistol."

5.6.5 Not Microscopically Compared

5.6.5.1 Cartridges or shotshells were removed from the chamber, action, or magazine of a firearm.

- "Item 8 was examined for manufacturer information and was not microscopically compared."

5.6.5.2 No request for microscopic comparison was made.

- "The Item 9 cartridges were examined for manufacturer information and were not microscopically compared."

5.6.5.3 Some of the unfired cartridges/shotshells were used for test firing while the remaining were not microscopically compared.

- "Three (3) of the Item 6 cartridges were used for test firing purposes and are being returned as such. The remaining Item 6 cartridges were not microscopically compared."

5.6.5.4 The evidence in question is not suitable for comparison purposes (e.g. no marks of value, limited quantity of detail of unknown origin).

- "Item 5 is unsuitable for comparison purposes."

5.6.5.5 Unfired cartridges/shotshells are different calibers than each other or a submitted firearm.

- "Items of different calibers were not microscopically compared to one another as no indications of having been fired by a firearm of improper caliber were observed."

5.6.6 Forensic Scientists shall include in their notes all conclusions reached from the microscopic comparison of evidence cartridges, shotshells and/or test ammunition components. Forensic Scientists shall also explain their reasons for reaching these conclusions. The reasons shall be clear and succinct and shall be able to be understood by any other competent forensic firearms scientist. The Forensic Scientist shall include the position and type of index marks used and which of the test cartridges or shotshells (if an evidence firearm was submitted) was used or if more than one test was used to reach the conclusions.

5.7 Standards and Controls – N/A

5.8 Calibration – For caliper calibration information, see the Firearms Section Technical Procedure for Instrument Calibration and Maintenance.

5.9 Maintenance – For comparison microscope, stereomicroscope, and caliper maintenance information, see the Firearms Section Technical Procedure for Instrument Calibration and Maintenance.

5.10 Sampling – N/A

5.11 Calculations – N/A

5.12 Uncertainty of Measurement – N/A

6.0 Limitations – N/A

7.0 Safety – Examinations performed in the Firearms Section are inherently dangerous. These procedures involve hazardous chemicals, firearms, and potential biohazards. All hazardous procedures shall be performed in compliance with the State Crime Laboratory Safety Manual. If the examination involves a biohazard, the Forensic Scientist shall use proper personal protective equipment, such as eye protection, a lab coat, and/or gloves.

8.0 References

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9.0 Records

- FA Worksheets: Main, Cartridge Case, Shotshell, and Disposition/Result

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
06/25/2021	9	**Header** and throughout– corrected to reflect organizational change. Changed "live" to "unfired" and "fired in" to "fired by" where appropriate. Removed through all reference to item designation or K numbers Changed throughout – "unit" to "section" **3.0** – added term and definition subclass characteristic Added new **5.3**. Removed old **5.3.1.6.2** **5.4.1.4** –changed "shall" to "may" **5.4.2.1.2** – changed "Disposition page" to "Not Examined worksheet" **5.4.2.1.2.2** – changed "listed in the Comments block on the Disposition page" to "on the Not Examined worksheet" **5.4.2.1.2.3** – changed "in the Comments block on the Disposition page" to "on the Not Examined worksheet" **5.4.2.1.3** – removed "and Comments block" **5.4.2.2** – added "/shotshells". **5.4.2.2.1** and **5.4.2.2.2** – updated Added new **5.4.2.3, 5.4.2.3.1,** and **5.4.2.3.2** Added new **5.4.2.3** and subsection. Added new **5.5** and subsection. **5.6** – renamed section from "Comparison Microscope Protocol" to "Individual Characteristics Comparison". **5.6.1.3** – added "before comparing to evidence unfired cartridges/ shotshells". **5.5.1.6** – changed "unknown" to "evidence" and removed old **5.4.1.4.**1 and **5.4.1.4.1.1** subsections. **5.5.1.6.2** – added "or to evidence fired cartridge cases/shotshells" to first sentence and changed "cartridge /shotshell" to "item" in last sentence. Added new **5.5.1.9, 5.5.1.9.1, 5.5.1.9.2** **5.6** – added quotation marks around suggested report wording examples and changed "firearm" to specific firearm types throughout when referencing a submitted firearm. **5.6.1.3** – removed reference to test fires being compared first **5.6.3** – include sub-class result example Removed old **5.6.4.1** and bullet points. Added new **5.6.4.1** and bullet point. Added new **5.6.5.1**, **5.6.5.2**, **5.6.5.3**, and **5.6.5.5**. Moved unsuitable result section to new **5.6.5.4**