Firearms Section

Distance Determination and Gunshot Residue Examination Methods

1. Scope

To test for the presence of gunshot residue and determine the distance the muzzle of a firearm was from the impact point. The examiner can make opinions on such distances when the firearm is not available if sufficient information is available from the shooting incident.

2. Safety

2.1 The appropriate PPE will be worn when performing these examinations and may include: a lab coat, gloves, protective eyeglasses, and a dust mask or respirator if needed.

2.2 Use chemicals in a well-ventilated area or in a fume hood.

2.3 The chemicals are irritants and can burn skin, avoid contact when possible.

2.4 If ingested seek medical attention.

2.5 If chemical contact your eyes, wash thoroughly and then seek medical attention if needed.

3. Examination of the evidence

3.1 Notes reflecting examinations can be made by way of description, diagrams, photographs or a combination.

3.2 The physical evidence will be examined visually and/or microscopically.

3.3 Autopsy reports or discussions with the medical examiner may be useful to fully understand the incident. It is possible the firearms examiner may be asked to provide information on firing distances based on their knowledge of different types of firearms, barrel lengths, chokes or ammunition.

3.4 Tests may be conducted at the request of the medical examiner to assist in their distance determinations. Collaboration is required when the examiner is asked to assist with gunshot residue on skin.

3.5 Evidence may be chemically processed for the presence or lack of gunshot residues.

3.6 Test patterns will be created using the same firearm and ammunition combinations, or as similar as possible. A variety of test possibilities may be conducted to provide useful distance information when needed. Tests conducted are case dependent.

3.7 Distance tests in the firearms range can be done using the combined uncertainty calculation from 6 inches out to 360 inches. Contact/near contact shots are not measured.

3.7 Tests will be chemically processed in the same manner as the evidence and then compared with the evidence. Chemical tests may not be needed when distance is determined using the spread of the pattern as done in shotgun cases.

4. Sequence of Processing

4.1 **Modified Griess**

Test for burned powder residue which produces nitrites. After this procedure, let the item dry for 5 minutes before proceeding to the next test.

4.2 **Dithiooxamide (DTO)**

Test for copper or nickel (this test is at the discretion of the examiner and/or case dependent). It can be done using filter paper, a swab, spray, or dropper. When spraying these solutions, let the item dry 5 minutes before proceeding to the next test.

4.3 **Sodium Rhodizonate**

This test is for the presence of lead, when using the Modified Sodium Rhodizonate formula the chromophoric reaction may take over 5 minutes.

5. Reagent Preparation for the standard GSR Test

5.1 The following reagent preparation is for the standard procedure; however, the sodium rhodizonate test will be modified when DTO is sprayed on the physical evidence in place of swabbing the areas around a hole.

5.2 **MODIFIED GRIESS TEST**

5.2.1 **NITRITE SENSITIVE PHOTOGRAPHIC PAPER**

5.2.1.1 Prepare a solution of 7.7grains (.5g) of sulfanilic acid in 100 ml of distilled, de-ionized or MilliQ water.

5.2.1.2 Prepare a solution of 4.3 grains (.28g) of alpha-naphthol in 100ml of methanol.

5.2.1.3 Combine the equal volumes of the above solutions.

5.2.1.4 Pour the combined solutions into a non-reactive photo processing tray and briefly dip pre-cut sheets of the desensitized photographic paper into the tray. Filter paper may also be used in place of photo paper.

5.2.1.5 Set the sheets aside to dry.

5.2.1.6 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's

initials, date prepared and expiration date. It will be entered into the reagent log.

5.2.2 **NITRITE TEST SWABS**

5.2.2.1 Prepare a solution of 9.3 grains (0.6g) of sodium nitrite in 100ml of distilled, de-ionized, or MilliQ water.

5.2.2.2 Soak the cotton tipped ends of a package of six-inch swabs in the solution. Typically, this will prepare over 100 swabs.

5.2.2.3 Set the swabs aside to dry and store in a sealed container. The swabs can be stored indefinitely if they are kept dry and uncontaminated.

5.2.3 **ACETIC ACID SOLUTION**

5.2.3.1 Combine 150ml of glacial acetic acid with 850ml of distilled, de-Ionized or MilliQ water.

5.2.3.2 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. The reagent will be recorded in the reagent log.

5.3 **DITHIOOXIMIDE TEST SOLUTIONS**

5.3.1 **.2% DTO SOLUTIONS**

5.3.1.1 Dissolve .2g of DTO in100ml of 100% ethanol.

5.3.1.2 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. It will be recorded in the reagent log.

5.3.2 **50% AMMONIUM HYDROXIDE**

5.3.2.1 Dilute concentrated ammonium hydroxide with an equal volume of distilled water.

5.3.2.2 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. It will be recorded in the reagent log.

5.4 SODIUM RHODIZONATE TEST SOLUTIONS

5.4.1 SODIUM RHODIZONATE SOLUTION

5.4.1.1 Place a small amount of Sodium Rhodizonate in a small beaker and add enough distilled, de-ionized or MilliQ water to turn the solution to a medium brown color.

5.4.1.2 This reagent does not need to be recorded the reagent log as it is good for 1-day use only and then discarded.

5.4.2 BUFFER SOLUTION

5.4.2.1 Dissolve 29.3grains (1.9g) of sodium bitartrate and 23.1grains (1.5 g) of tartaric acid per 100ml of distilled, de-ionized or MilliQ water. This usually requires the application of heat and agitation to dissolve in a reasonable time. A combination hot plate (heat and magnetic stirrer) should be used.

5.4.2.2 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. It will be recorded in the reagent log.

5.4.3 HYDROCHLORIC ACID SOLUTION

5.4.3.1 Combine 5ml of concentrated acid with 95ml of distilled, de-ionized or MilliQ water.

5.4.3.2 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. It will be recorded in the reagent log.

5.5 MODIFIED SODIUM RHODIZONATE TEST

This modification is for the use of DTO as a spray and not a swab. The following formula change makes them compatible. This formula change is useful on lead free ammunition and cases involving solid copper bullets. The buffer solution is changed and the use of the third solution of HCL is not needed.

5.5.1 Sequence of Processing

5.5.1.1 Conduct the modified griess test as normally done.

5.5.1.2 Modified DTO-spray the ammonium hydroxide and wait 1 minute. Then spray the DTO solution, the presence of copper will produce an Army green/OD green color. It may take up to 5 minutes for the reaction. Yellow color change can be attributed to lead, not copper. Allow item to air dry 5 minutes before proceeding to the next step. On dark items, this procedure can be done using the lift method.

5.5.1.3 Modified Sodium Rhodizonate, process the lift or the item directly depending on the steps taken. Apply Sodium Rhodizonate to the item and let it sit one minute. Then apply the KCL buffer solution (Modified formula below.) Reaction can take up to 5 minutes and the presence of lead will provide a purple reaction.

5.6.1 **POTASSIUM CHLORIDE BUFFER SOLUTION**

5.6.1.1 Prepare a 0.2M potassium chloride (KCL) solution by dissolving 0.75g KCL in 50ml of distilled, de-ionized, MilliQ water.

5.6.1.2 Prepare a 0.2M hydrochloric acid (HCL) solution by diluting 5ml of concentrated HCL (12M stock) in 295ml of distilled, de-ionized or MilliQ water.

5.6.1.3 Combine 25ml of 0.2M KCL with 67ml of 0.2M HCL to make a buffer with pH of 1.0.

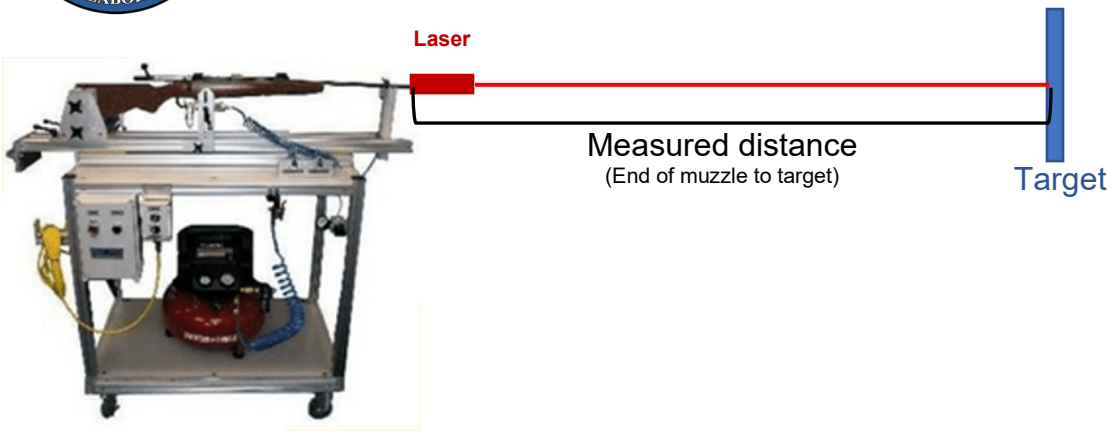
5.6.1.4 Any remaining solution can be stored up to a year. The solution will be labeled with the appropriate reagent number, consisting of the preparer's initials, date prepared and expiration date. It will be recorded in the reagent log.

6. **Measurement Procedure for Tests:**

6.1 The firearm will be mounted securely on a cart that is locked in place.

6.2 An intermediate check standard will be utilized prior to using the laser for that day to ensure it is still withing calibrated specs. This will be documented in the case notes.

6.3 The laser will be placed at the end of the barrel, while turned on and set to measure distance from the base of the laser to the target.



6.4 The laser will be stored in the laboratory when not in use.

7. **Reporting Distance Determinations**

7.1 Distance are reported by providing an approximate range at which the muzzle of a firearm was to the target using spread, residues or lack of residues present on the evidence examined.

7.2 The approximate range reported includes the pattern that is slightly smaller out to a slightly larger pattern than what is observed on the evidence. When there is an absence of reside, the range will include the furthest distance which transfer was last observed.

7.3 The combined measurement uncertainty for the process will be included in the report and will read, "**The combined uncertainty for these measurements is accurate within +/- .###" with a statistical confidence level of 95% (k=2).**"

7.4 The combined uncertainty documentation is retained in Paradigm and updated when any of the factors used in the calculation changes.

7.5 Contact shots where no measurement is taken does not have a measurement uncertainty.