FBI Laboratory
Firearms/Toolmarks Unit
The Dithiooxamide Test for Copper Residues

1 Scope

The Dithiooxamide Test (DTO) is designed for detecting depositions of vaporous and particulate copper around a suspected bullet hole. Such depositions may be on evidence items such as clothing, furniture, bedding, and wallboard.

2 Equipment/Materials/Reagents

Electronic balance (minimum weighing range must exceed 0g - 50 grams, but not exceed 0 - 3000 grams; the linearity specification must not exceed 0.1 gram); Microspatula; Filter paper; Aerosol spray equipment; Blotters/brown wrapping paper; Glass stirring rod; Disposable PVC gloves; Hot plate/magnetic stirrer; Polyethylene bottles; Laboratory coat; Glass beaker (500 mL); Exhaust hood; Ammonium Hydroxide (reagent grade or better);Concentrated ammonium chloride (reagent grade or better); Dithiooxamide (reagent grade or better), Potassium Chloride (reagent grade or better), Hydrochloric acid (reagent grade or better).

3 Standards and Controls

Standards are not applicable. A copper jacketed bullet is used as a positive control for the DTO Test. If a chemical reagent must be prepared before an examination, the following information must be recorded on the FTU Chemistry Log (Appendix C): chemical produced, preparer, date (lot number), parent chemical, FBI Laboratory serial number and the performance check. The chemical lot number for reagents used during examinations will be recorded in the examination notes.

4 Calibration

Not applicable.

5 Sampling

Not applicable.

6 Procedures

6.1 Preparation of Reagents and Test Media

6.1.1 Storage of prepared chemicals and test media should be such that contamination is not possible. Storage containers should be kept sealed until the contents are needed. Fractions or multiples of the weights and volumes indicated may be used as appropriate to the amount of work to be done. For disposal of the chemicals used for this procedure, refer to the Guideline for Hazardous Waste Management in the Firearms-Toolmarks Unit (FTU), copies of which are maintained in the FTU Chemistry Room.

6.1.2 Reagents for the Dithiooxamide Test (DTO)

6.1.2.1 Add 500mL of ammonium hydroxide to 500mL of distilled water (dH_20) – 50% Ammonium Hydroxide solution. Properly label storage and applicator containers.

6.1.2.2 Add 0.2 grams of dithiooxamide (DTO) to 100mL of ethanol (C_2OH) – DTO solution. Properly label storage and applicator containers.

6.1.3 Reagents for the Modified Sodium Rhodizonate Test for Use with DTO

6.1.3.1 Dissolve a small amount of sodium rhodizonate in distilled water to prepare a saturated solution. Make enough for immediate use, 150mL should be sufficient. Do not store solution.

6.1.3.2 Add 0.75g of potassium chloride (KCl) in 50mL of distilled water (dH_2O) – 0.2M KCl.

6.1.3.3 Add 5mL of concentrated hydrochloric acid (HCl) to 295mL of distilled water (dH_2O) – 0.2M HCl.

6.1.3.4 Combine the 25mL of 0.2M KCl with 67mL of 0.2M HCl to make a potassium chloride buffer with pH 1.0. Properly label storage and applicator containers

6.2 Preparation of Controls

6.2.1 Positive Control

A copper jacketed bullet from the FTU ammunition room will be wiped across a piece of test material and the material then processed for the expected green color (ranging from forest green to army green/gray) reaction. The results will be recorded in the examiner's notes.

6.2.2 Negative Control

Observing the absence of any color development on the non-wiped portions of the test material is sufficient for a negative control. The results will be recorded in the examiner's notes.

6.3 Direct Application to Light-Colored Items of Evidence

6.3.1 Saturate the questioned item using a spray bottle with the prepared solution of ammonium hydroxide. Allow the item to sit for a minimum of one minute.

6.3.2 Saturate the questioned item using a spray bottle with the prepared solution of DTO. Note the color change immediately after applying. The presence of a yellow color may be attributed to lead and should not be misinterpreted as copper at this step.

6.3.3 Allow to air dry for five minutes before proceeding to additional chemical testing.

6.4 The Method for Dark-Colored Items that Would Mask the Green Coloration of a Positive Test Result

6.4.1 Place a piece of filter paper over the appropriate area of the questioned item.

6.4.2 Index the filter paper relative to the garment or other item to indicate the location of such things as suspected bullet holes, seams, buttons, button holes, pockets, rips, and tears. Indexing in pencil is preferable since ink may bleed during the application of reagents.

6.4.3 Uniformly dampen the filter paper on the questioned item by spraying with a 50% solution of ammonium hydroxide.

6.4.4 Press the saturated filer paper against the surface of the item for approximately two minutes.

6.4.5 Remove the filter paper which was in direct contact with the evidence item, and process it using the steps in 6.3.2 above. Note any positive (green) indications.

6.4.6 Prompt note-taking is essential in that sometimes the color change can be unpredictable and can rapidly fade. When dry, filter paper should be properly marked in ink for future identification and returned to the contributor as secondary evidence.

6.5 The Dithiooxamide Test for use with Modified Griess and Sodium Rhodizonate Test

6.5.1 Perform the Modified Griess Test, see Firearms/Toolmarks Unit (FTU) *The Modified Griess Test for Nitrite Residues* procedure.

6.5.2 Perform the Dithiooxamide Test as outlined in Sections 6.1 through 6.4.6.

6.5.3 Perform the Modified Sodium Rhodizonate Test as outlined below.

6.5.3.1 Saturate the questioned item using a spray bottle with the prepared solution of sodium rhodizonate. Allow the item to sit for one minute. The item should turn a yellowish orange color.

6.5.3.2 Saturate the item with the KCl buffer at pH 1.0 using a spray bottle. Allow the item to sit for a minimum of five minutes. A purple reaction indicates the presence of lead. Note the color change.

6.5.3.3 If a strong yellowish orange color from the sodium rhodizonate persists, apply more KCl buffer at pH 1.0 until it fades.

7 Calculations

Not applicable.

8 Uncertainty of Measurement

Not applicable.

9 Limitations

The Dithooxamide Test yields results for the presence of copper regardless of whether these are related to the discharge of a firearm or the passage of a bullet.

10 Safety

Since many of the procedures involve the spraying of reagents in an aerosol form. All spraying should be done in an exhaust hood that has an air flow velocity of 60 - 120 feet/minute. Protective latex or vinyl gloves will be worn at all times.

11 References

Lekstrom, A. J. and Koons, R.D., "Copper and Nickel Detection on Gunshot Targets by Dithiooxamide Test," J. Forensic Science, 1986; 4:1283-1291.

Schous, C. E., "A Sequence of Chemically Specific Chromophoric Tests for Nitrite Compounds, Copper, and Lead in Gunshot Residues," AFTE Journal,

FBI Laboratory Quality Assurance Manual

FBI Laboratory Operations Manual

FBI Laboratory Safety Manual

FBI Laboratory, FTU Quality Assurance Manual

Rev. #	Issue Date	History
0	07/10/06	Original issue for ASCLD/LAB-*International* accreditation.
1	02/19/07	Updated section 3 including the use of the FTU Chemistry Log (Appendix C).
2	12/15/09	Removed "modified" from Sections 1 and 9. Added reagents to Section 2. Revised Sections 4, 5, 7 and 8 for consistency. Added new Section 6.1.2 as a heading and renumbered subsections. Added section 6.1.3 including subsections. In Sections 6.1.2.1 added labeling of reagent bottles. Updated language in Section 6.3.1. Removed "that" from second sentence in Section 6.4.5. Revised Section 6.4.6 to reflect secondary evidence policy and removed language that allowed negative results to be discarded. Added section 6.5.
3	07/14/10	Redacted FTU Technical Procedures manual in section 6.1.1 and changed heading in section 6.5.
4	02/08/12	Updated title and page numbering error.

Approval

Redacted - Signatures on File