A. Purpose

The dithiooxamide (DTO) test, also known as rubeanic acid, is a chemically specific chromophoric test for the presence of cuprous material. This test may be used by an examiner to determine if a hole in a garment or on an item of evidence may have been caused by the passage of a copper-jacketed projectile.

B. Responsibility

Analysts assigned to the Firearms Section or analysts competent in distance determination.

C. Safety

| **Listings** | | | | |
|---|---|---|---|---|
| **Chemical** | **Health Hazard** | **Flammability Hazard** | **Reactivity Hazard** | **Specific Hazard** |
| Dithiooxamide | 2 | 0 | 0 | |
| Ethanol | 2 | 3 | 0 | |
| Ammonium hydroxide | 3 | 0 | 0 | |
| | | | | |

The analyst shall use PPE such as gloves and lab coat when preparing and using these chemicals.

D. Procedure

DTO Reagent Preparation

1. Combine 0.2 grams (3.09 grains) of dithiooxamide with 100mL 100% ethanol to produce a 0.2 w/v solution of DTO.
2. Place solution in a glass bottle to prevent the evaporation of the ethanol.
3. Discard solution after one year or earlier if solution becomes cloudy.

Preparation of 50% Ammonium Hydroxide solution

1. Combine 10mL of ammonia with 10mL of distilled $H_2O$ to produce a 50% ammonium hydroxide solution.

The reagents are labeled with a minimum, preparer's name, name of reagent, date of preparation.

DTO Control Test

1. A positive and negative control should be run on a corner of the evidence item if practical. If the items can be processed in an area away from the questioned damage, rub a copper jacketed projectile forming the (+) symbol and run a nickel

jacketed projectile forming the (-) symbol. If the item of evidence is not suitable to run a control directly on it, then on a piece of filter paper, rub a copper jacketed projectile on one area of the paper and a nickel jacketed projectile on another area. Use the unmarked area of the filter paper as the location of the negative control.

2. Spray filter paper or control test area with the 50% ammonium hydroxide solution and let sit for one minute.

3. Spray filter paper or control test area with the 0.2% DTO solution and wait approximately 5 minutes.

   A green color should develop in the area that was rubbed with the copper control projectile. Green can range from a mossy, forest green to a grey-green color. A green color is an indication that the chemicals are working correctly and the positive copper control passed. A pink or blue color should develop in the area rubbed with the nickel positive control. Areas not changing color on the filter paper are used to indicate a negative control.

   Results of the controls are documented on the worksheet.



DTO Evidence Examination

1. Saturate the item of evidence or test shot with 50% ammonium hydroxide. Allow to sit for one minute.

2. Saturate the item with the 0.2% DTO solution. Wait approximately five minutes and then document any color changes. A green color will indicate a positive reaction for the presence of copper. A pink or blue color will indicate a positive reaction for the presence of nickel. The appearance of a brown color may be due to the presence of cobalt. The appearance of a yellow color may be due to the presence of lead. The interpretation of lead should be made with the Sodium Rhodizonate Test.

Dark Colored Clothing Testing Method:

The visualization of the positive green reaction may be difficult on dark items. To visualize this reaction, it is recommended that a lift of the area be made for this testing.

1. Moisten a piece of filter paper with 50% ammonium hydroxide. Press this filter paper against the area to be tested for approximately two minutes.

2. Saturate the filter paper with the 0.2% DTO solution. Wait approximately five minutes and then document any color changes. A green color will indicate a positive reaction for the presence of copper. A pink or blue color will indicate a

positive reaction for the presence of nickel. The appearance of a brown color may be due to the presence of cobalt. The appearance of a yellow color may be due to the presence of lead. The interpretation of lead should be made with the Sodium Rhodizonate Test.

E. Other Considerations

The dithiooxamide test is not routinely performed and would only be conducted if requested or needed based on the examiner's observations or type of ballistic evidence associated with the case.

Environmental factors may produce false positive results; the examiner will consider the resulting patterns when interpreting the products of the reactions.

F. References

Anon., (1970). "Gunshot Residues and Shot Pattern Test", F.B.I. Law Enforcement Bulletin, Vol. 39, No. 9, p. 7.

Dillon, John, H., "A Protocol for Gunshot Residue Examinations in Muzzle-To-Target Distance Determinations", AFTE Journal, 1990. Vol. 22, No. 3, p. 32.

Lekstrom, Julie and Koors, Robert, "Copper and Nickel Detection on Gunshot Targets by Dithiooxamide Test", FBI – Gunpowder and Gunshot Residue Manual, p. 67.

Schous, Clara, "A Sequence of Chemically Specific Chromophoric Tests for Nitrite Compounds, Copper and Lead in Gunshot Residues", FBI – Gunpowder and Gunshot Residue Manual, p. 77.