A. Purpose

The Modified Griess Technique is a test that can be used independently to detect the presence of nitrites or in conjunction with other tests to determine muzzle-to-target distances. Its use should be limited to specific areas suspected of having, or observed to have, gunshot residues. The Modified Griess test utilizes a color chemistry reaction to help distinguish obscure or faint gunpowder patterns on an object. This test detects nitrites, a product of the burning of gunpowder. Nitrite residues are exposed to an acetic acid solution and heat to form nitrous acid. The nitrous acid combines with sulfanilic acid in the test medium to form a diazonium compound of sulfanilic acid. The diazonium compound couples with the alpha-naphthol (also in the test medium) to form a bright orange water-soluble azo (nitrogen-bearing) dye. It should be noted that if multiple chemical examinations are going to be performed on an item, they must follow a specific order.[1]

First - Modified Griess
Second - Dithiooxamide (if needed or requested) [2]
Third - Sodium Rhodizonate

B. Responsibility

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

C. Safety

Listings				
Chemical	**Health Hazard**	**Flammability Hazard**	**Reactivity Hazard**	**Specific Hazard**
Sulfanilic Acid	2	0	0	
Alpha-naphthol	3	1	0	
Methanol	2	3	0	
Sodium Nitrite	2	0	1	OXIDIZER
Glacial Acetic Acid	3	2	0	

Analysts shall use PPE such as gloves, eye protection and lab coats when preparing and using these chemicals.

C. Procedure for Modified Griess Reagent Preparation

Nitrite Test Swabs (controls)

1. Dissolve 0.6 grams (9.26 grains) of sodium nitrite in 100 mL of distilled H_2O.

2. Soak approximately 50 cotton tipped swabs in this solution.

3. Allow to air dry. Store swabs in a sealed container.

4. Swabs may be retained at room temperature and used for 1 year.

Preparation of Photographic Paper[3]

1. Dissolve 0.5 grams (7.72 grains) of sulfanilic acid in 100 mL of distilled H_2O.

2. Dissolve 0.28 grams (4.32 grains) of alpha-naphthol in 100 mL of methanol.

3. Combine the equal volumes of both solutions and stir well. Pour the combined solutions into a non-reactive tray.

4. Slowly dip each page of photo paper into the solution until completely submerged.

5. Remove the paper from the solution and allow to air dry.

6. If there is any remaining solution, it may be retained in a sealed container at room temperature. The shelf life of this solution is two months from the date of preparation.

Preparation of 15% Acetic Acid Solution

1. Combine 150mL of glacial acetic acid with 850mL of distilled H_2O.

2. Store liquid in a sealable container and label appropriately. The shelf life of this reagent is one year from the date prepared.

D. Testing Procedure for Modified Griess Test

1. Prior to beginning examination, a control test must be performed on the treated paper.

   a. Place a small amount of the 15% acetic acid solution into a beaker.

b. Saturate a nitrite test swab in this solution and then dab the four corners of the paper.

c. An orange color should appear, indicating that the treated paper is reacting correctly when nitrites are present. If no color change occurs, the control has failed and the examiner should troubleshoot reasons for failure.

2. Place the evidence or the known distance test shot cloth (questioned side down) on the coated side of the paper. With a lead pencil, index the location of bullet holes, seams, buttons, rips, pockets or other demarcations to use as reference.

3. Soak a piece of nitrite-free cheesecloth in the 15% acetic acid solution and wring out any excess liquid. Place the cheesecloth on the questioned item or known distance test fires creating a "sandwich".

4. Using a hot iron set on the "cotton" setting, press the total surface area of the cheesecloth "sandwich."

5. Discard the cheesecloth and separate the questioned item or test shot from the photographic paper. An orange coloration on the photo paper indicates a positive chemical reaction specific to the presence of a nitrite residue.

   An orange color change may indicate the presence of visible nitrite source (burned or partially burned gunpowder, observed as pinpoint reactions) or the presence of nitrite deposits that cannot be visually observed.

6. Photographically document all results.

7. The photo paper should be allowed to air dry and then marked appropriately with Lab case number, submission number and/or test fire information and the examiner's initials. Place each photo paper separately in a sheet protector and then place in a manila envelope and seal.

8. Sub-itemize these photo papers in LIMS and retain in a cool dry location.

9. Allow the evidentiary items and test materials to dry completely prior to proceeding to the next type of testing.

D. Other Considerations

It should be noted that there are environmental factors that may also produce a color reaction that may not be related to a firearms discharge. The pattern of the color array would differ from a nitrite deposit around a bullet hole. The environmental source may also produce a background haze on the paper.

E. 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.

Owens, Margart & George, William, "Gunshot Residue Examinations: Modification in the Application of the Sequence of Chemical Tests", AFTE Journal, 1991. Vol. 23, No. 4.

F. Footnotes

[1] Modifications to the sequence may be made on areas of clothing in which there is no bullet damage/hole that requires testing. (Owens)

[2] The dithiooxamide test is not routinely performed and would only be added to this testing sequence if requested or needed based on the examiner's observations.

[3] Filter paper may be used as a replacement to glossy photo paper and treated in the same manner.