Firearms/Toolmarks Unit (FTU) Validation Summary of Total Nitrite Visualization for Muzzle-to-Target Distance Determination

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1   SCOPE

The scope of this validation is to determine if the method for Total Nitrite Visualization (TNV) can be utilized to perform muzzle-to-garment distance determination.

2   TERMS

- Total Nitrite Visualization
- Modified Griess
- Adhesive film (e.g., ESDA film)

3   VALIDATION PLAN

3.1   Phase I – Start Date: July 1, 2019

The Firearms/Toolmarks Unit (FTU) will create gunshot residue (GSR) test patterns to determine if the TNV method is suitable for muzzle-to-target GSR distance determination for nitrite residues.

1. Utilize previously conducted validation studies performed by New York Police Department (NYPD) and reported in the Journal of Forensic Science, to evaluate the TNV method.
2. Test Samples
    a. GSR test patterns will be created at six-inch intervals (starting with contact)
        i. Twill jean will be used as the substrate for producing known distance patterns.
    b. The FTU will use, 9mm LUGER cartridges Remington (Lot number: Z20XAA200, 115 Grain, Full Metal Jacket (FMJ)), Federal (Lot number: S23P266S43267, 147 Grain, FMJ Flat Point), and Winchester (Lot number: 30FH02, 124 Grain, FMJ) ammunition.
3. Materials
    a. Modified Griess paper
    b. Laminated contact paper
    c. ESDA fixing film sheets
    d. Heat press
    e. 2% Potassium Hydroxide
4. Testing
    a. One set of known intervals test samples will be processed using TNV and MGT.
    b. Known interval test samples will be compared side-by-side to evaluate the performance.

3.2   Phase I – Completion Date: August 16, 2019

3.3   Presentation of Validation Results

Presentation of Validation Results at the Association of Firearm and Tool Mark Examiners Eastern Regional Meeting hosted by FBI Laboratory, Firearms/Toolmarks Unit Meeting date: November 7, 2019

3.4   Phase II – Start Date: April 14, 2022

The Firearms/Toolmarks Unit will create GSR test patterns to evaluate the impact of the TNV method on the Sodium Rhodizonate (SoRho) test for lead residues.

1. Test samples
   a. GSR test patterns will be created on twill jean at the following intervals: 3, 9, 15, and 21 inches.
   b. A pistol and revolver will be used to generate the test patterns.
2. Materials
   a. Adhesive/ESDA film
   b. 2% Potassium Hydroxide (KOH) in Ethanol
   c. 2.8 pH Buffer Solution
   d. 5% Hydrochloric Acid Solution
   e. Sodium Rhodizonate Solution
3. Testing
   a. One set of test patterns will be processed using TNV followed by SoRho testing.
   b. Another set of test patterns will be directly processed using SoRho testing.
   c. Test patterns will be compared side-by-side to evaluate the impact of the TNV method on the Sodium Rhodizonate test for lead residues.

3.5   Phase II – Completion Date: May 3, 2022

4 RESULTS OF VALIDATION FOR TOTAL NITRITE VISUALIZATION

Visual Results for TNV Validation

Pattern	MGT		TNV		
	Remington	Federal	Remington	Federal	Winchester
Contact	1.5"	2.0"	CND	1.5"	CND
6"	3.0"	3.0"	3.0"	4.0"	4.0"
12"	4.0"	4.0"	6.0"	6.0"	5.0"
18"	5.0"	6.0"	6.5"	7.0"	6.5
24"	6.0"	6.0"	7.0"	7.5"	7.0
30"	No pattern	6.5"	No pattern	6.0	7.5
36"	No Pattern	7.0"	No Pattern	No pattern	No pattern
42"	No pattern	No pattern	No pattern	No pattern	No pattern
48"	No pattern	No pattern	No Pattern	No pattern	No pattern
54"	No pattern	No pattern	No Pattern	No pattern	No pattern

Rxn Performance	MGT		TNV		
	Remington	Federal	Remington	Federal	Winchester
Contact	3	2	1	2	1
6"	2	3	2	3	3
12"	2	2	2	3	3
18"	1	1	3	3	3
24"	1	1	2	3	3
30"	1	1	2	2	2
36"	1	1	2	2	2
42"	0	1	1	1	1
48"	0	1	1	1	1
54"	0	1	1	1	0
Score	11	14	17	21	19

0: no reaction, 1: limited spot reaction, 2: spot reaction, 3: heavy spot reaction

	Winchester Contact Paper	Winchester ESDA	Winchester Contact Paper	Winchester ESDA
Contact	CND	CND	1	1
6"	5.0"	4.0"	3	3
12"	6.0"	5.0"	3	3
18"	6.5"	6.5"	3	3
24"	7.0"	7.0"	2	3
30"	7.5"	7.5"	2	2
36"	No pattern	No pattern	1	2
42"	No pattern	No pattern	1	1
48"	No pattern	No pattern	1	1
54"	No pattern	No pattern	1	0

5 LIMITATIONS

When using TNV for distance determination, the following is a list of limitations:

- Potential reduction of Sodium Rhodizonate performance for lead residues. Particulate lead, if present, would be captured in the ESDA film lift – Phase II evaluation.
- The limitations applicable for MGT would still apply (e.g., heavy bleeding)

6 RELIABILITY

Following existing chemical examinations integrated with total nitrite visualization methodology, the validation plan demonstrated the TNV method is reliable for the visualization of nitrite residues.

7 CONTROLS

Critical aspects of the procedure that must be controlled and monitored:

- Temperature and time for general purpose oven and heat press as defined in the FTD-206-10 Distance Determination procedure.

- Chemical reagents and test media as defined in the FTD-206-10 Distance Determination procedure and FTD-050 Chemical Reagent Log.

8 ACCURACY

This level of performance is achieved or exceeded (Rxn Performance table), due to the alkaline hydrolysis step which increases the sensitivity of modified griess test and detects the burned and unburned residues by converting the unburned nitrates into nitrites.

9 COMPETENCY TESTING

The Technical Leader, Physical Scientist/Forensic Examiner (PSFE), and Physical Scientist/Non-Examiner (PSNE) are recognized as having passed the competency testing for using TNV processing. The following individuals that participated in the validation of TNV are recognized as being competent and qualified to use the TNV method:

- TL/PSFE   Erich D. Smith
- PSFE   Theodore J. Chavez
- PSNE   Sydney Rednour

10 RECORDS

Records regarding the validation of the TNV methodology will be retained in the Firearms/Toolmarks Unit.

11   REVISION HISTORY

Revision	Issued	Changes
01	08/01/2022	Original validation summary issued
02	09/18/2023	Format was updated throughout and version history was added to footer. Section 1 – renamed section Sections 7, 8, and 11 – added sections Section 12 – added printed names

12   APPROVALS

SME Approval:_____   Date: _____

Redacted

UC Approval: _____   Date: _____

Redacted

TL Approval: _____   Date: _____

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