Gunshot Residue Analysis for Law Enforcement

Webinar Series: DAY 2
“Analysis and Testimony Considerations”

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WHAT IS PRIMER GUNSHOT RESIDUE (GSR)?
What’s in a Name?

- **Gunshot Residue (GSR):** The particulate that is expelled from a firearm during the discharge.
What’s in a Name?

• Gunshot Residue:
  – Primer
    • Lead, Antimony, Barium
  – Powder or Propellant:
    • Nitrogen-based Compounds
    • Nitrocellulose, Nitroglycerine, Nitroguanadine
  – Misc. Metals from Ammo & Firearm
    • Tin, Aluminum, Copper, Zinc
How is GSR produced?

Mechanism of Action

- Trigger pulled
- Firing pin strikes primer cap setting off a gaseous reaction within the cartridge
- Particulate expelled from firearm
- Particulate lands on surrounding area
- Particulate collected
What is Primer GSR comprised of?

- Primer residue contains
  - Lead
  - Antimony
  - Barium

- These elements can combine to form 3 different particle types:
  - Characteristic of GSR (3 component particles)
  - Consistent with GSR (2 component particles)
  - Commonly associated with GSR (1 component particles)

- Typically, these elements are found in primer residue.
How Big is Primer GSR?

- Primer residue from the discharge of a firearm is unable to be seen by the unaided, naked eye.

- YOU NEED A HIGH RESOLUTION MICROSCOPE (SEM)
Primer GSR Particle

Lead (Pb), Barium (Ba), Antimony (Sb) and Tin (Sn)
SEM ANALYSIS
Primer GSR Analysis

• All samples are analyzed using a scanning electron microscope (SEM).

• Allows scientists to:
  – Determine the chemical make up of potential GSR particles
  – Visualize their shape/morphology.

Average analysis time is 4-8 hours per sample.
Historical Tests

• Paraffin or Dermal Nitrate Test
• ISID & RIFF
  – Instant Shooter Identification
  – Rapid Identification/Friend or Foe
• Atomic Absorption(AA)
  – Bulk Analysis
Scanning Electron Microscopy Kits
THE BEST

• SEM kits are the best and most effective collection technique
  – SEM is a confirmatory technique
  – Kits are cost effective
  – Fast and easy collection
  – Non-destructive
  – Reproducible
TESTIMONY
Hypothetical Situations

**IDEAL SCENARIOS**

- Static environment
- No airflow
- Functioning firearm
- Immediate, efficient collection
- No activity after discharge
- No debris on hands
- Clean test area
- Room, surface, material untouched

**POTENTIAL RESULTS**

- 100s – 1000s of GSR and GSR-related particles produced
Hypothetical Situations

REALISTIC SCENARIOS

• Rain, wind, snow, sleet
• Airflow
• Firearm is not a good producer of particles
• Collection long after incident
• Lots of activity
  – Hand washing, hand shaking, running, wiping, etc.
• Biological material
  – Blood, sweat, dirt, debris, etc.

POTENTIAL RESULTS

• 100s – 1000s of GSR and GSR-related particles (unlikely)
• Some GSR and GSR-related particles
• No GSR and GSR-related particles
WHY...
Should you collect GSR samples?

• Sample retention
• Thorough case examination
  – Testimony
  – Jury benefit
• Probative evidence
• Investigative leads
Primer GSR Population

SWG-GSR Terminology

Characteristic of GSR

- Lead-Barium-Antimony

Consistent with GSR

- Lead-Barium
- Lead-Antimony
- Barium-Antimony

Commonly Associated with GSR

- Lead
- Barium
- Antimony

* Two-component particles

* One-component particles
Results

• WHEN GSR IS PRESENT, IT MEANS:
  – Subject discharged a firearm
  – Subject was in close proximity to the discharge of a firearm
  – Subject came into contact with a surface that has GSR on it

• WHEN GSR IS NOT PRESENT:
  – Does not eliminate the possibility of a discharge
  – Inconclusive
Qualifiers

- Reasons GSR could be present
- Other sources of one and two component particles
- The meaning of inconclusive results
Testimonial Considerations

- The FBI Laboratory
  - [www.swggser.org](http://www.swggser.org)
  - Guide for Primer Gunshot Residue Analysis
  - Page 64

- Sources of Particles Similar to GSR
- Subject Occupations
- Contamination
Testimony Considerations

- How long has GSR been on there?
- What type of firearm was used?
- Who was the shooter?
THANK YOU!

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