
S&B NONTOX
Ammunition in Criminal
Casework

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Typical Gunshot Residue Analysis

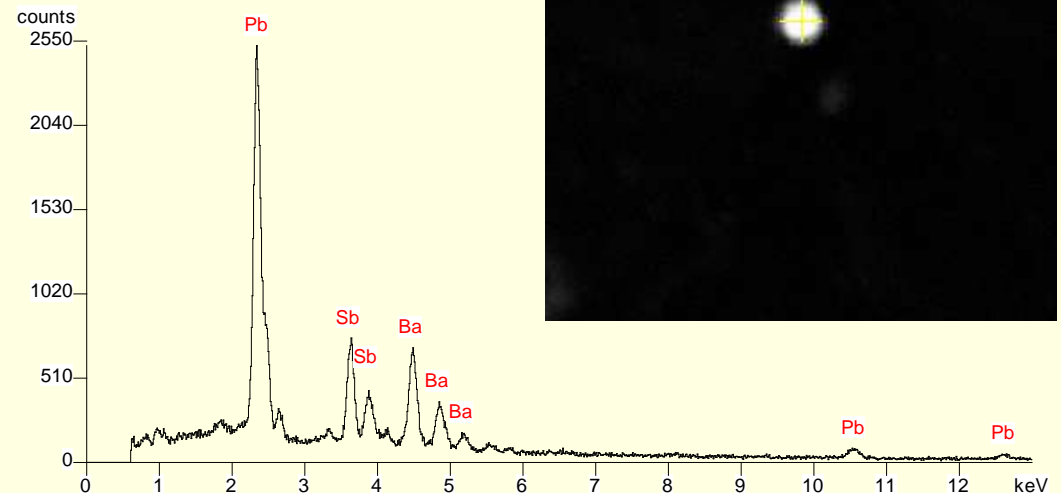
- Small Arms Percussion Primers
 - Explosive, initiator
 - Oxidizers
 - Fuel
 - Frictionators
 - Sensitizers
 - Binders

Typical Gunshot Residue Analysis

- Sinoxid “*without rust*” primer formulation
 - Lead styphnate
 - Tetrazene
 - Barium nitrate
 - Lead dioxide
 - Antimony trisulfide
 - Calcium silicide

Typical Gunshot Residue Analysis

- Bulk analysis
 - Elevated levels of the elements
 - In proper proportions
- Particle analysis
 - Elemental composition
 - Morphology



Experience with Atypical Primers

- 1996 MRP (Magtech Recreational Products)
 - Primers purchased from CBC (Companhia Brasileira de Cartuchos)
- 1987 – 1995 Various Calibers
 - Priming Mixture 5067
 - Barium nitrate 60%
 - Lead styphnate 38%
 - Tetrazene 2%

Experience with Atypical Primers

- Test results from typical case guns
 - Six different 9mm firearms test fired
 - 1 or 2 shots under ideal test fire conditions
 - All test results inconclusive
 - Lack of elements/unacceptable ratios
 - Discharged cartridge cases antimony free
 - AAS and SEM/EDX

Sellier and Bellot NONTOX

- Promoted as “green” ammunition
 - Discharge a large amount of toxic heavy metals... do not meet environmental standards.
- Sports, hunting, and practice shooting
- Pb/Ba/Sb/Hg free



U.S. Patent 6964287

- “Non-toxic and non-corrosive ignition mixture”
 - Initiator
 - Nitroesters or nitramines
 - Sensitizer
 - Tetrazene or derivatives of tetrazoles
 - Oxidizers
 - Oxides and peroxides of metals
 - Fuel
 - Amorphous boron

U.S. Patent 6964287

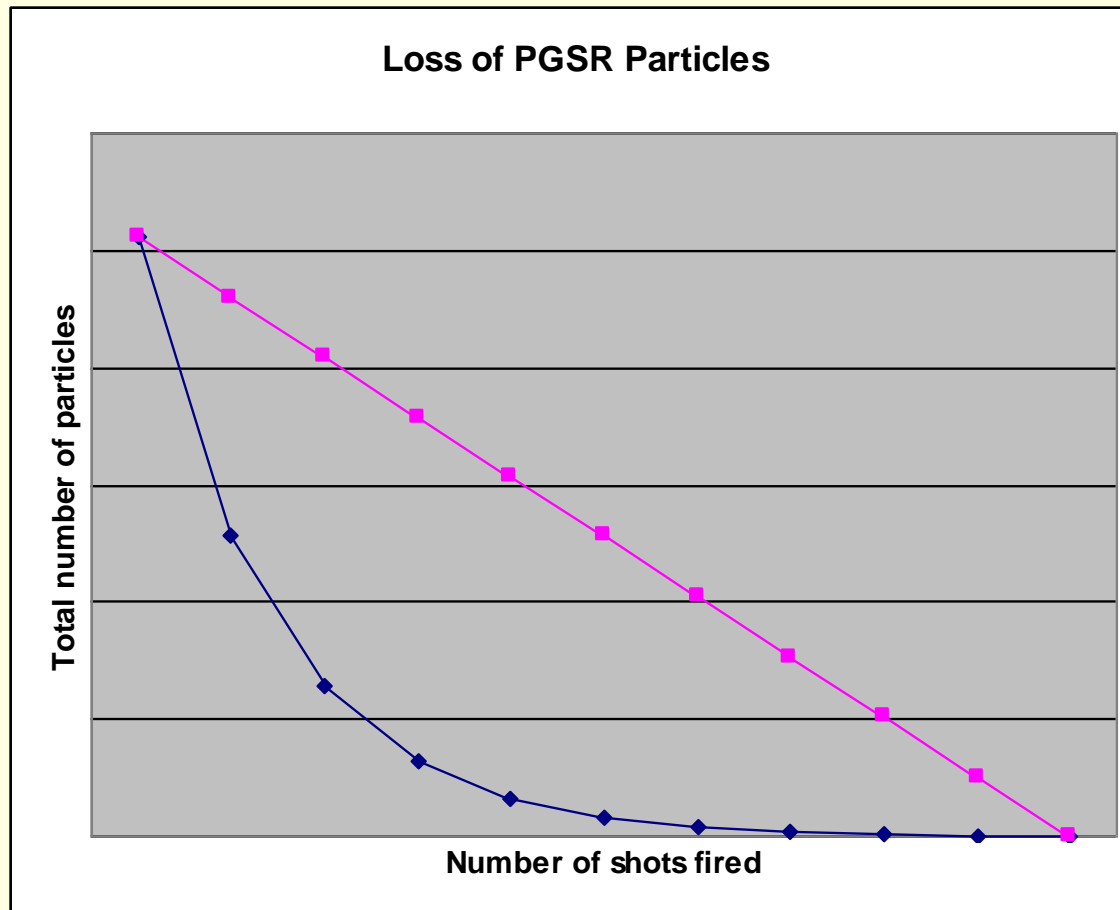
- “Non-toxic and non-corrosive ignition mixture”
 - 20 different examples of formulations
 - Tetrazene 25%
 - PETN 25%
 - Potassium nitrate 33.5%
 - Boron 6%
 - Nitrocellulose 0.5%
 - Glass 10%

Availability

- Sellier and Bellot recently purchased by CBC
 - 7.65/.32 auto
 - 9x19 and 9x21
 - .357 magnum
 - .38 special
 - .40 S&W
 - .45 ACP
- Magtech Ammunition sole importers into US
- 9mm and 40 S&W available on-line



Sellier and Bellot Nontox



Fundamental Questions

- How many discharges before false negative test results?
- How will a lead free primer affect the sodium rhodizonate test for distance determinations?

Typical Test Results

- Automated test results

■ Antimony	44
■ Barium	362
■ Ba-Sb	22
■ Lead rich	19
■ Lead-Antimony	5
■ Lead-Barium	23
■ Pb-Ba-Sb	

The “X” Factor

Eventual False Negative Results

- X factor
 - X greater than 1
 - None of the particles are confirmed
 - Don't meet identification criteria
 - Don't meet threshold values
 - Red flag
 - X = 0
 - No particle meets the sorting criteria
 - Confident negative lab report

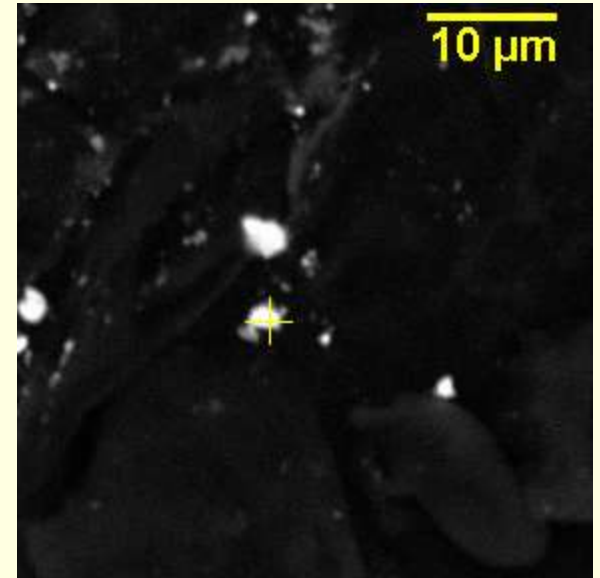
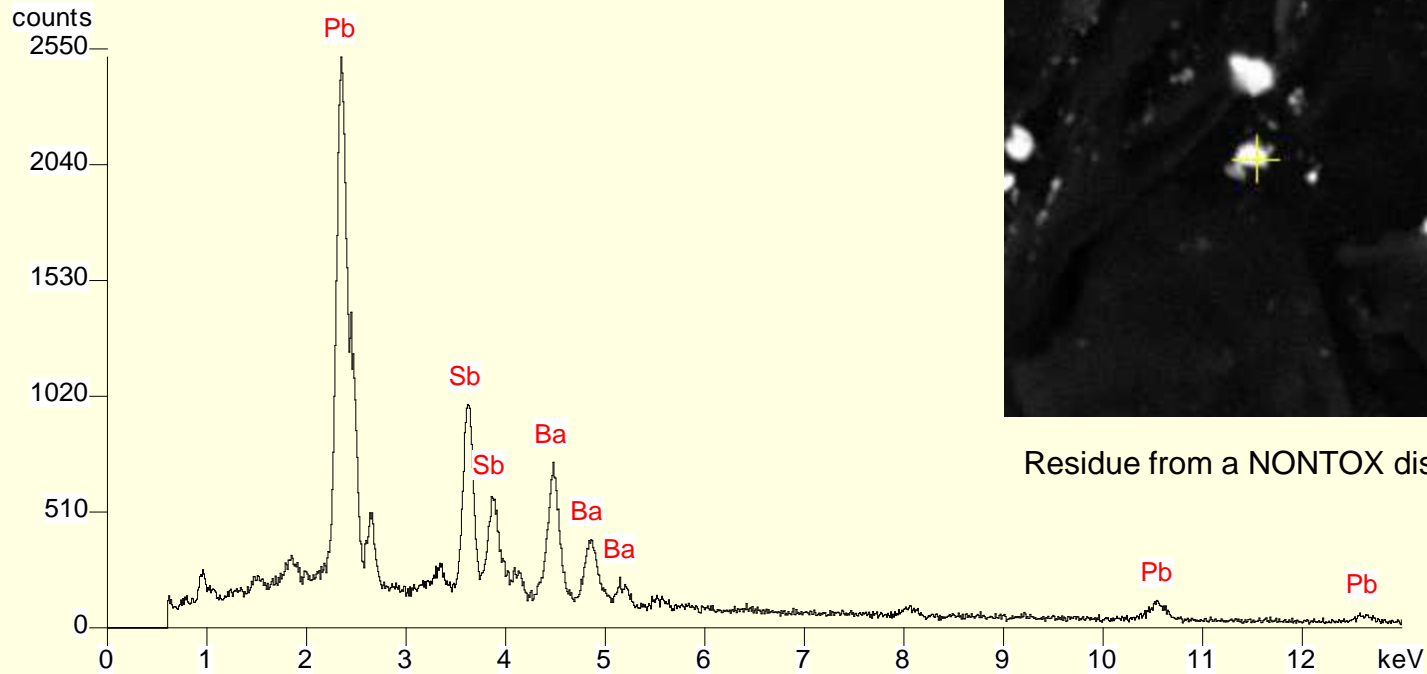
ASTM E1588 - 10

- “Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry”

ASTM E1588 - 10

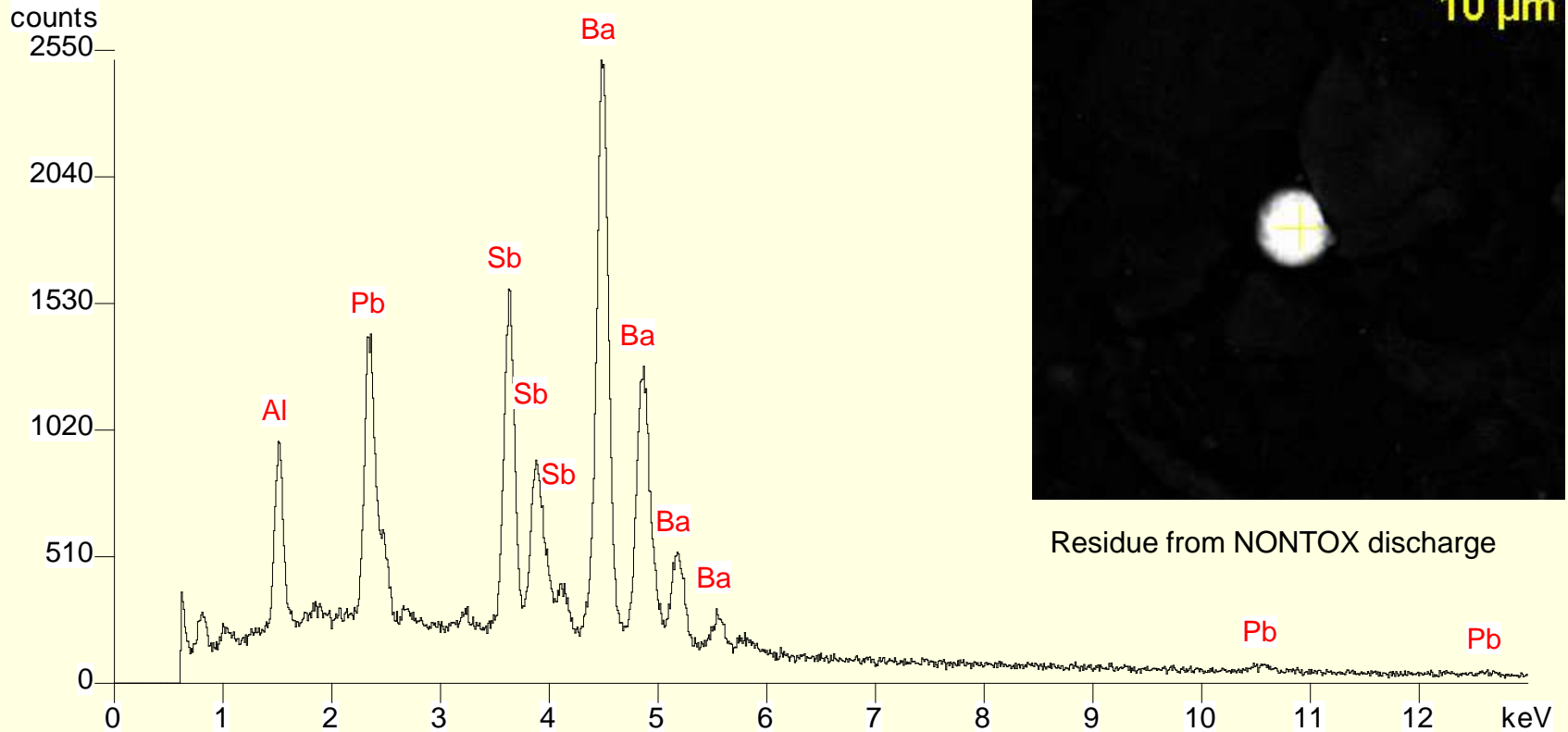
- 7. Data Analysis
- 7.1.3 Particles *characteristic* of GSR (that is, most likely associated with the discharge of a gun) will have the following elemental composition:
 - 7.1.3.1 Lead, antimony, barium

Characteristic PGSR Particle



Residue from a NONTOX discharge

Doesn't Meet Criterion

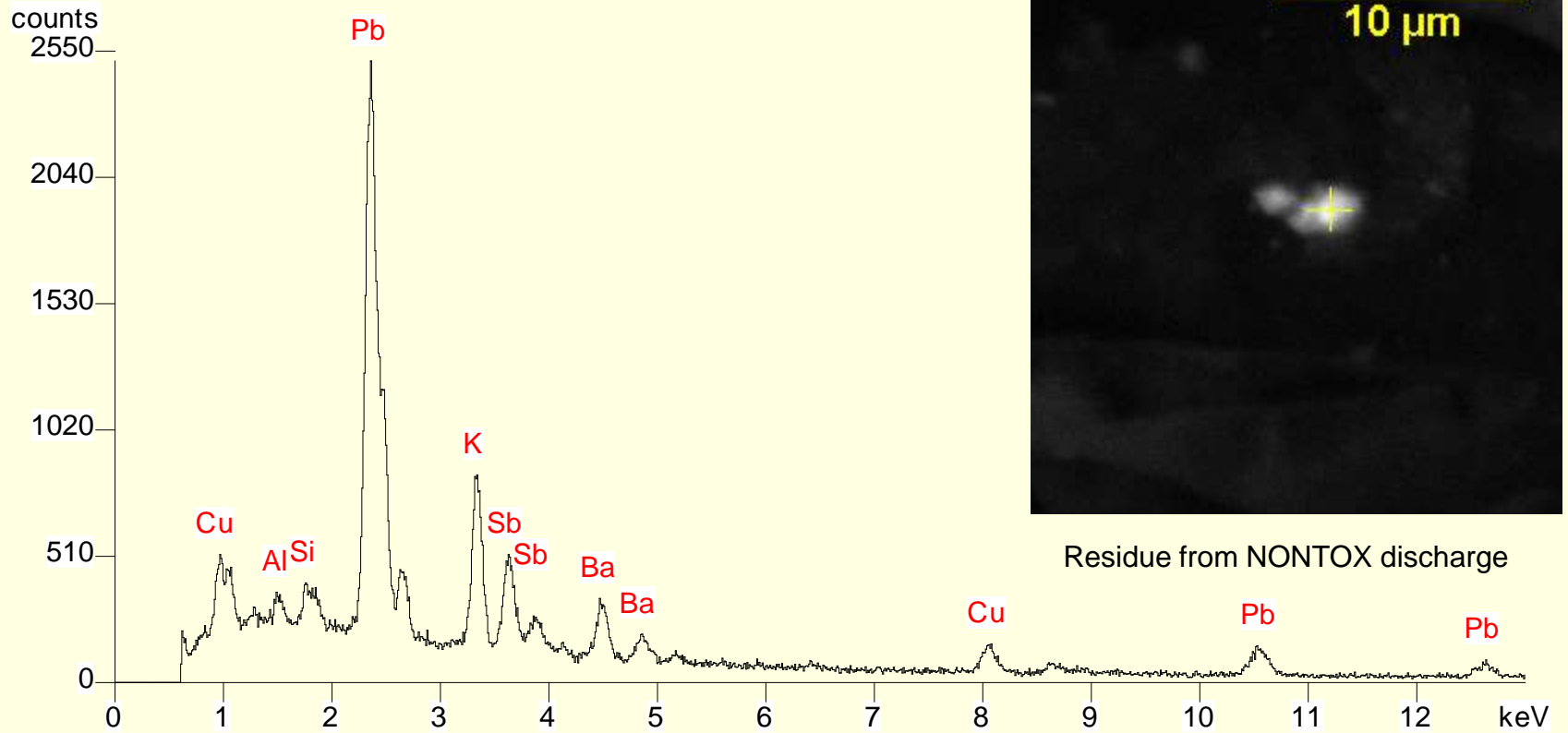


Residue from NONTOX discharge

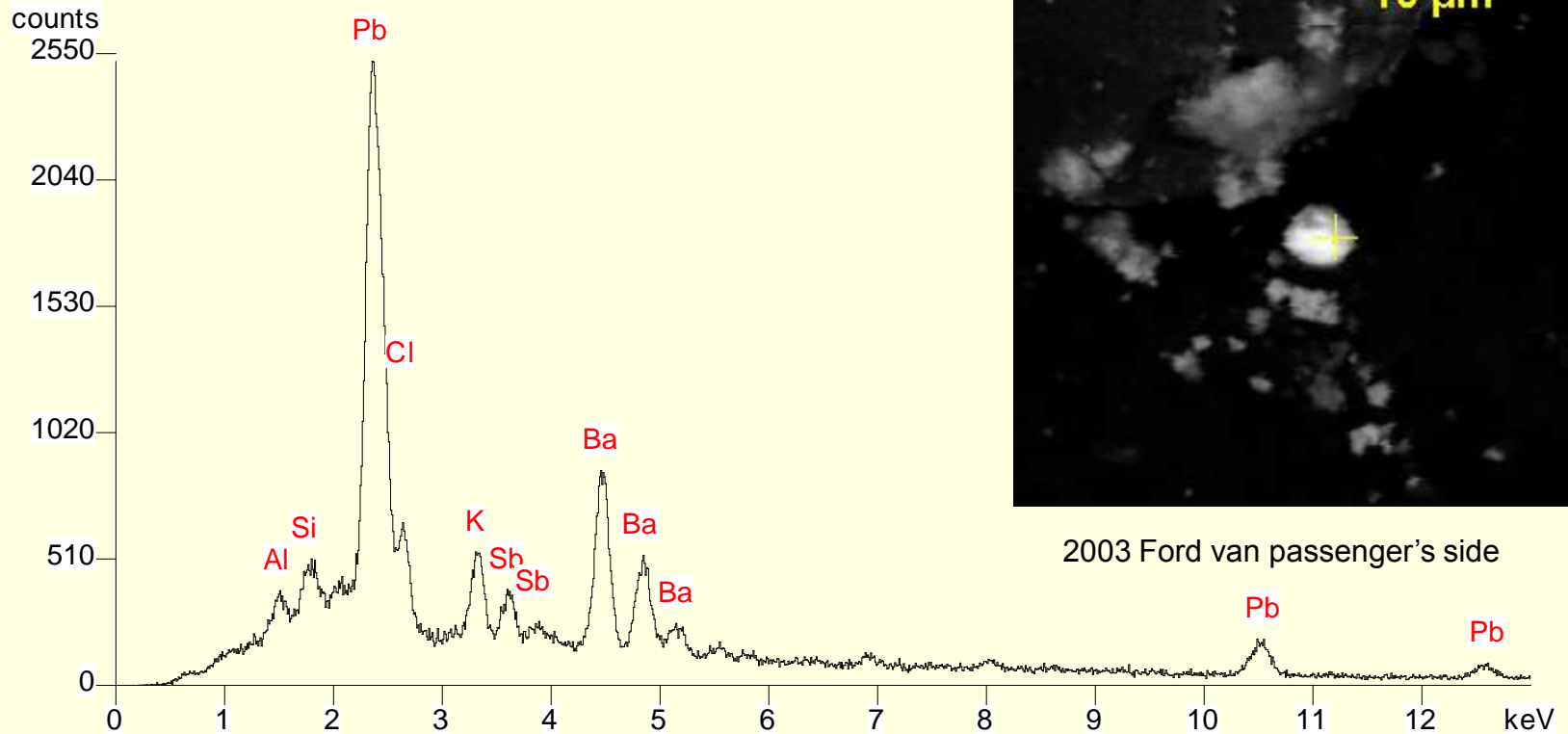
ASTM E1588 - 10

- 7. Data Analysis
- 7.1.3.2 It is common for additional elements to become incorporated into particles containing these elements. (Pb/Sb/Ba)
 - Potassium

Non-verified PGSR Particle



Airbag Residue Particle



Test Fire Technique

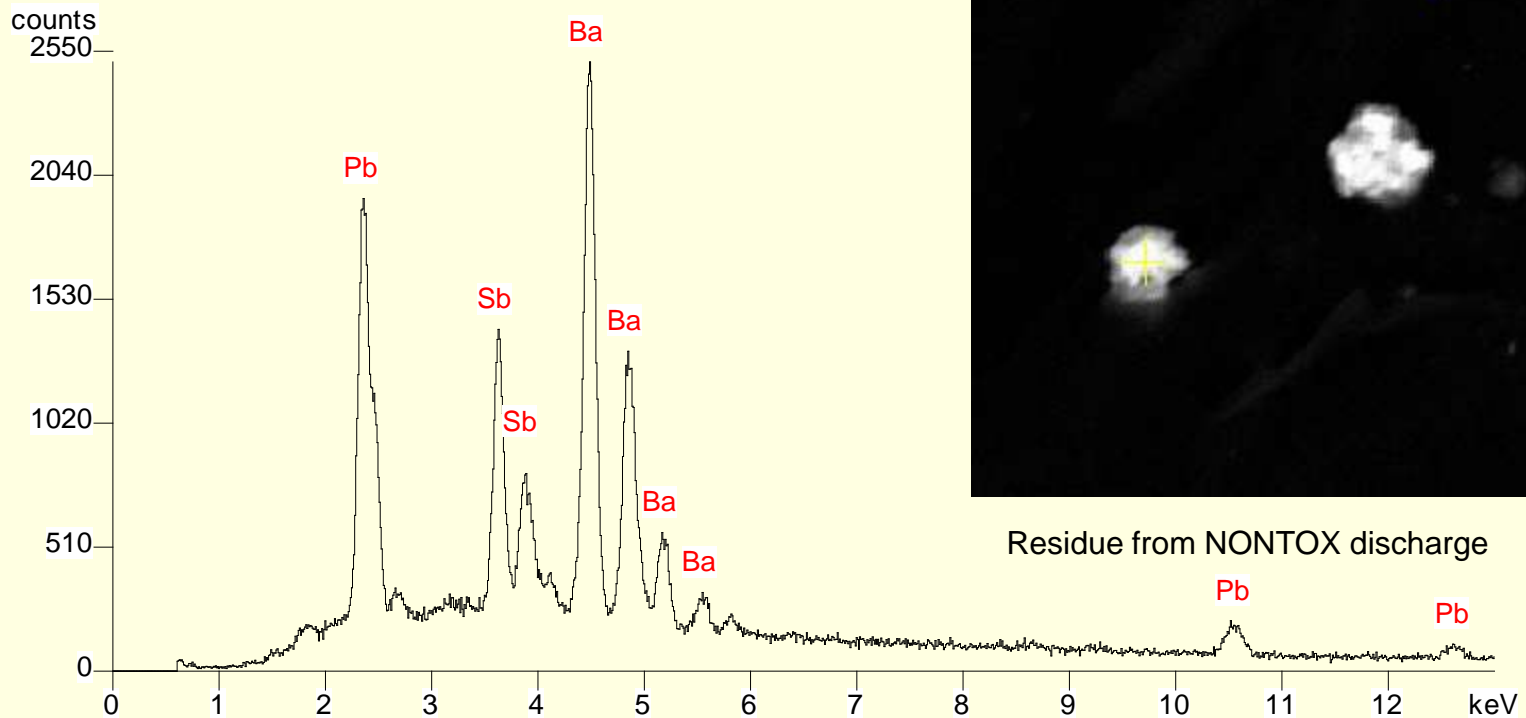
- Hands in “normal” condition
 - Relatively clean
- Ideal Sampling Conditions
 - Very thorough
 - “Willing” suspect
- Factors not taken into consideration
 - Particle loss/time
 - Environmental loss

Series 1: 9mm single shot

- Ruger model P89
- 1 round Sinoxid discharged as baseline.
- 1 NONTOX fired daily
 - Left hand sampled before as background
 - Right hand sampled immediately after discharge

Test Fire Results

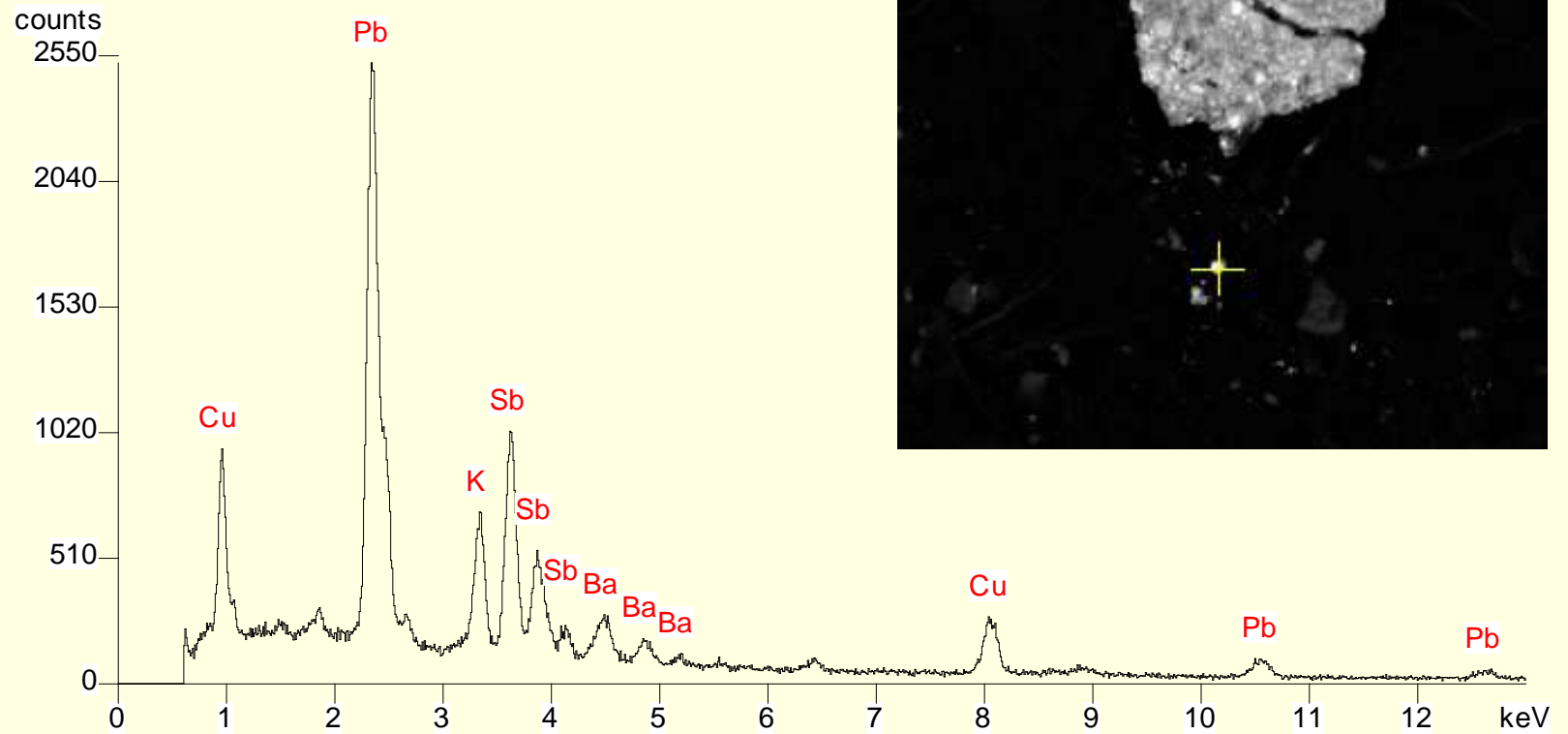
- Typical PGSR particles



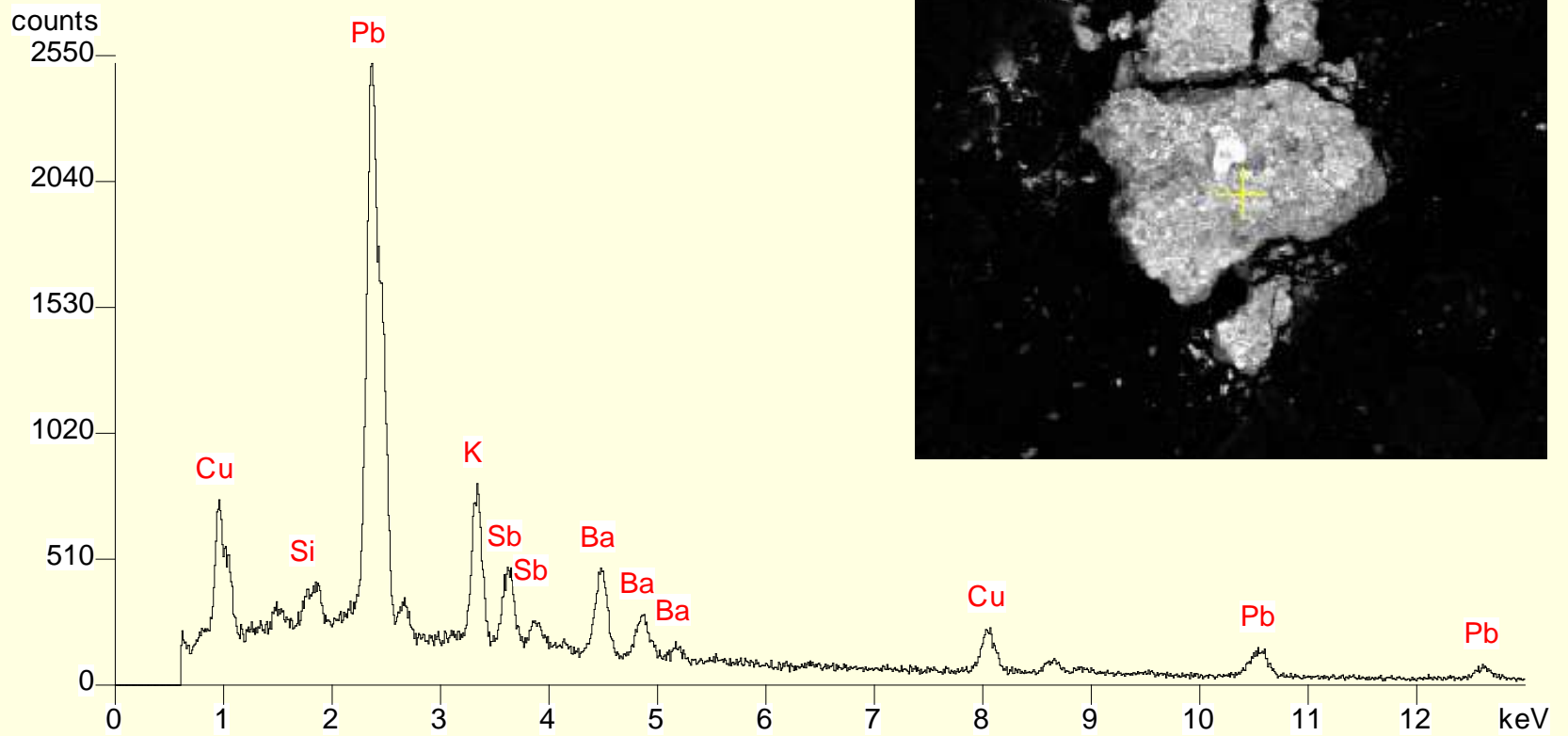
Test Fire Results

- Clusters
 - Large, brittle conglomerates of particles
 - Source of sequential PGSR particles

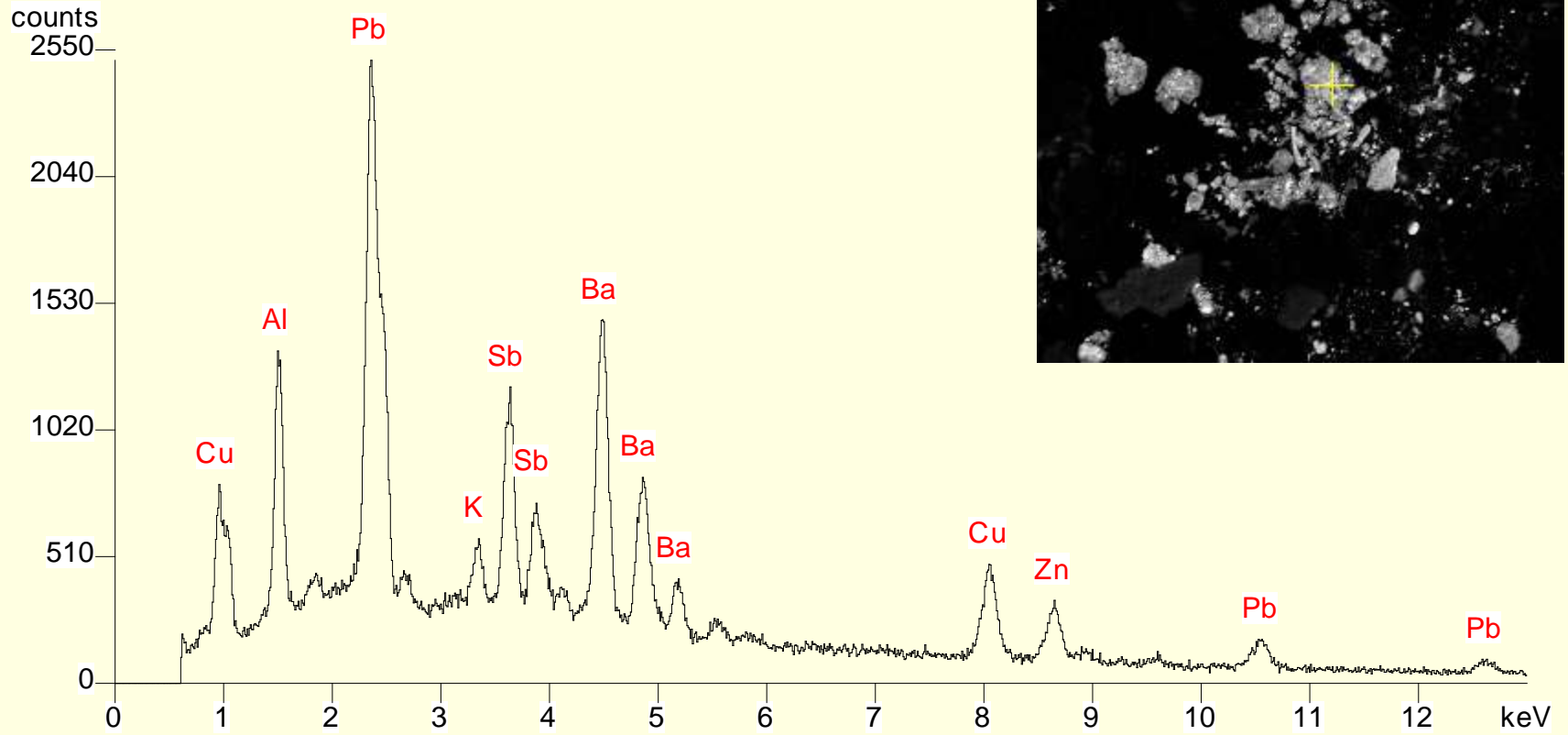
Particle Clusters



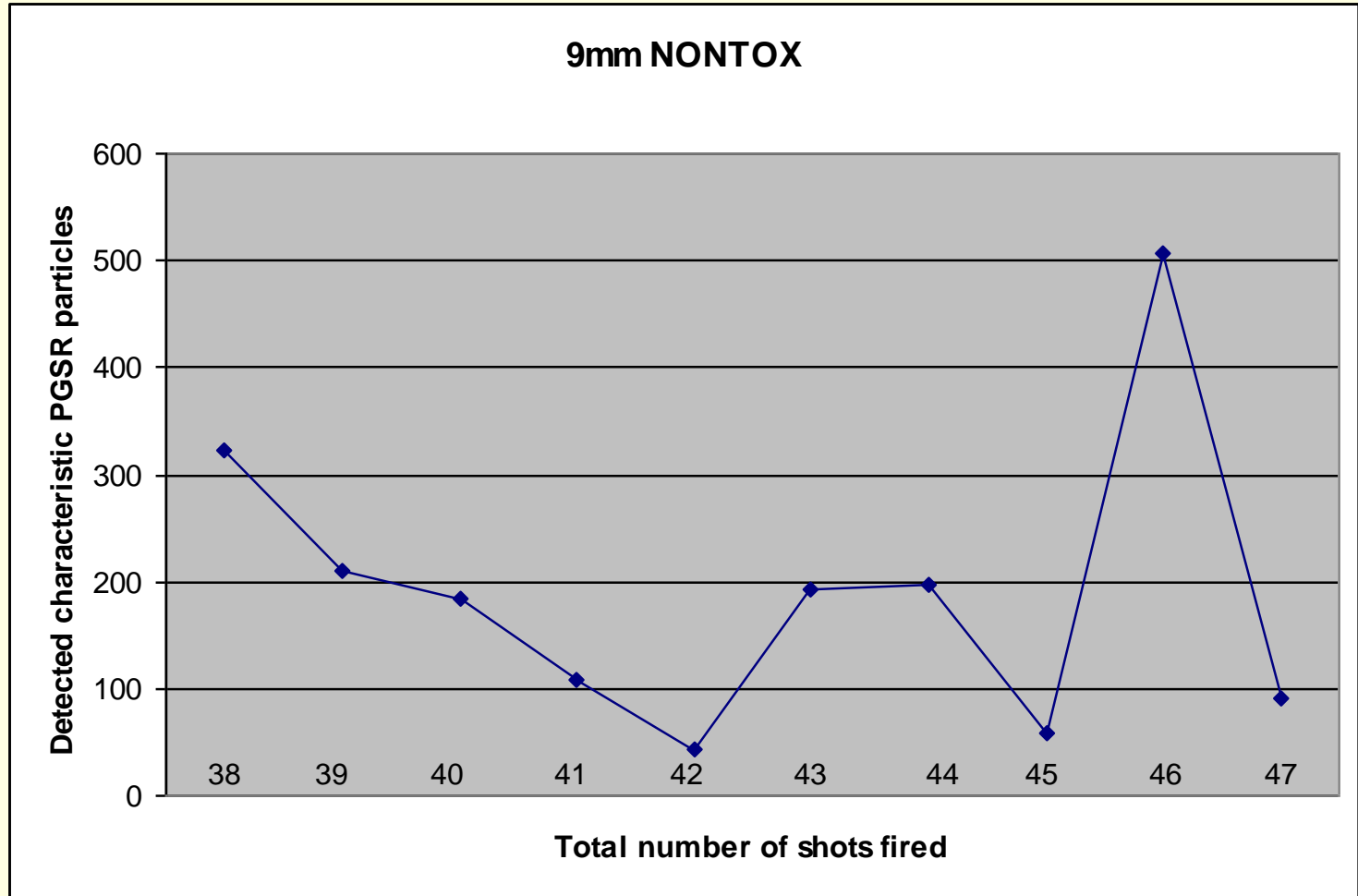
Particle Clusters



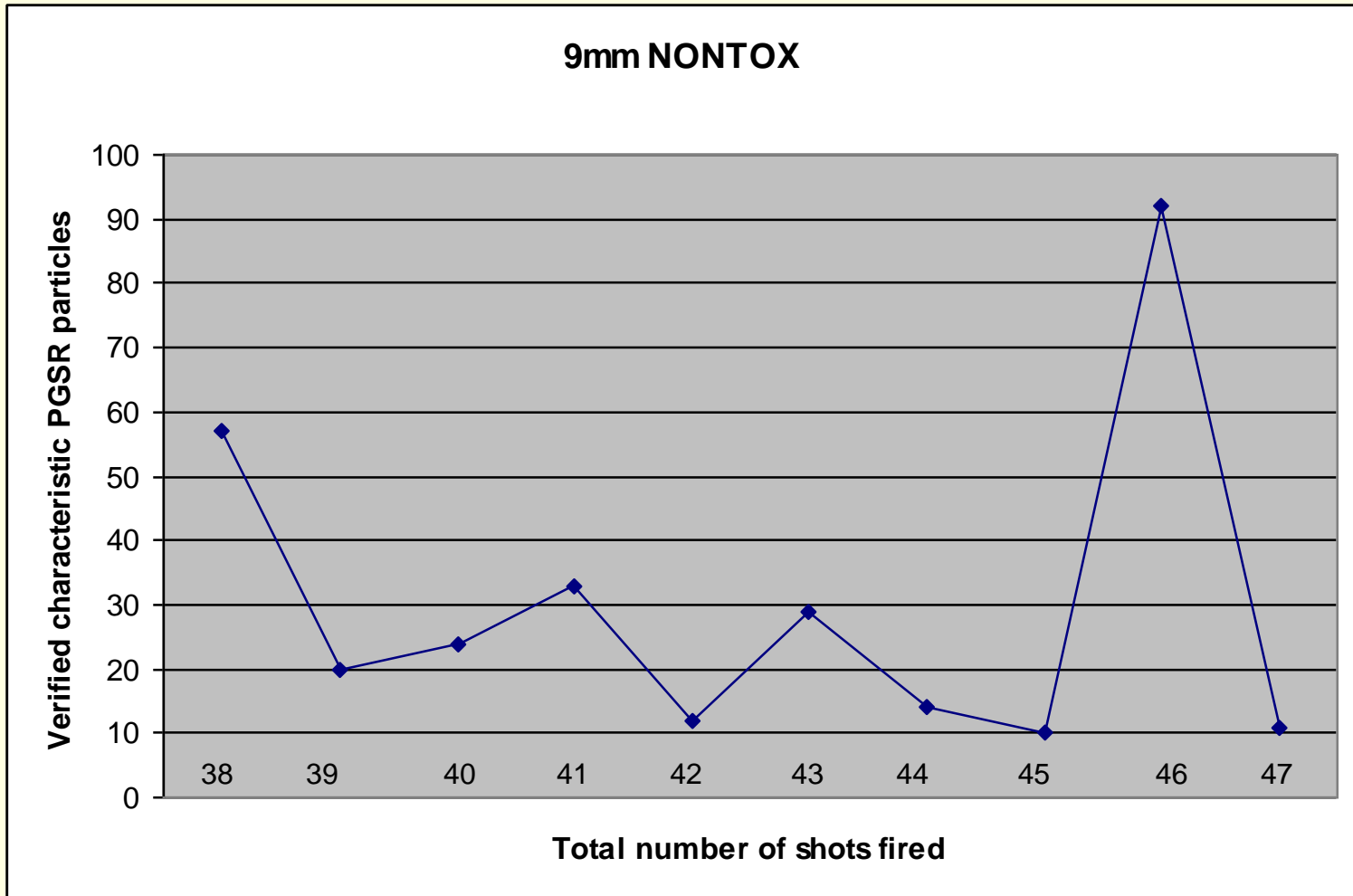
Particle Clusters



Last 10 Test Fires

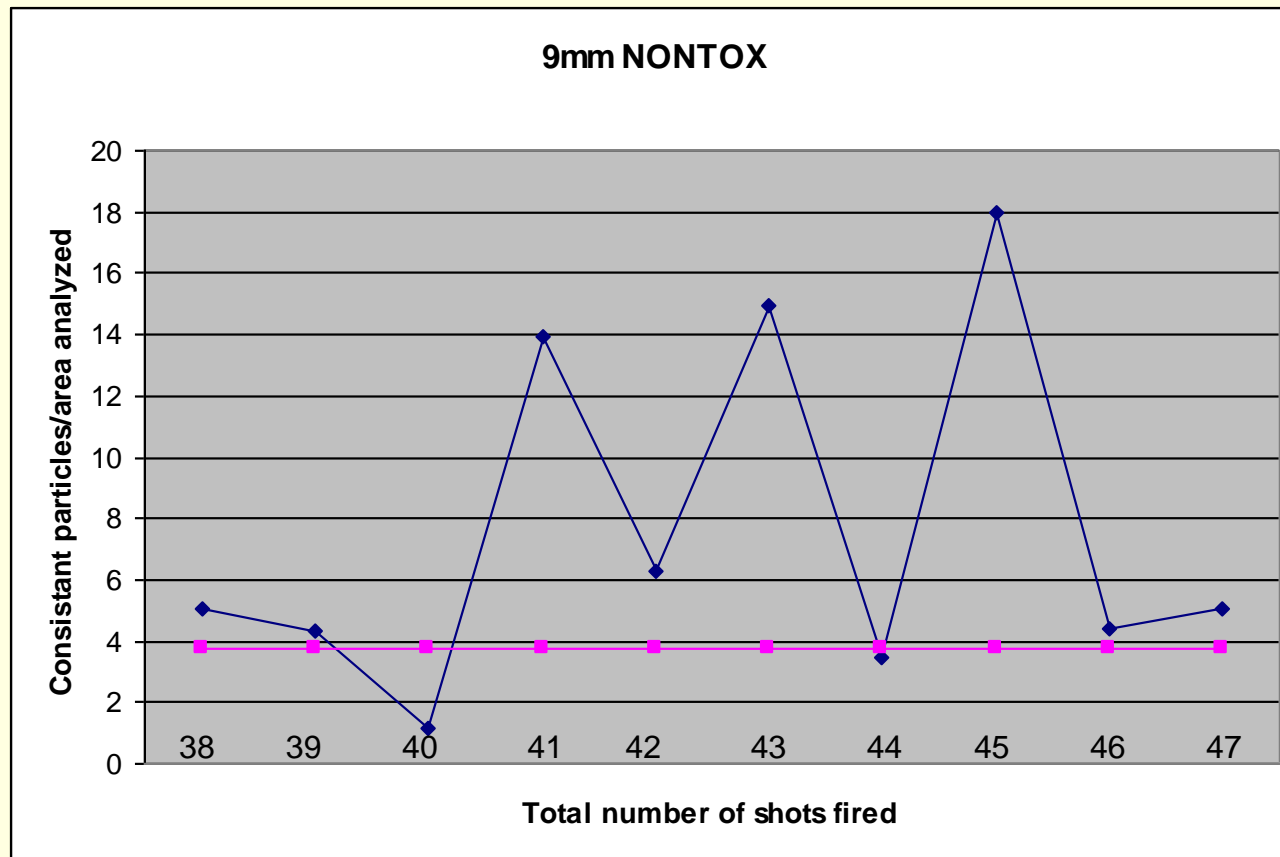


Last 10 Test Fires

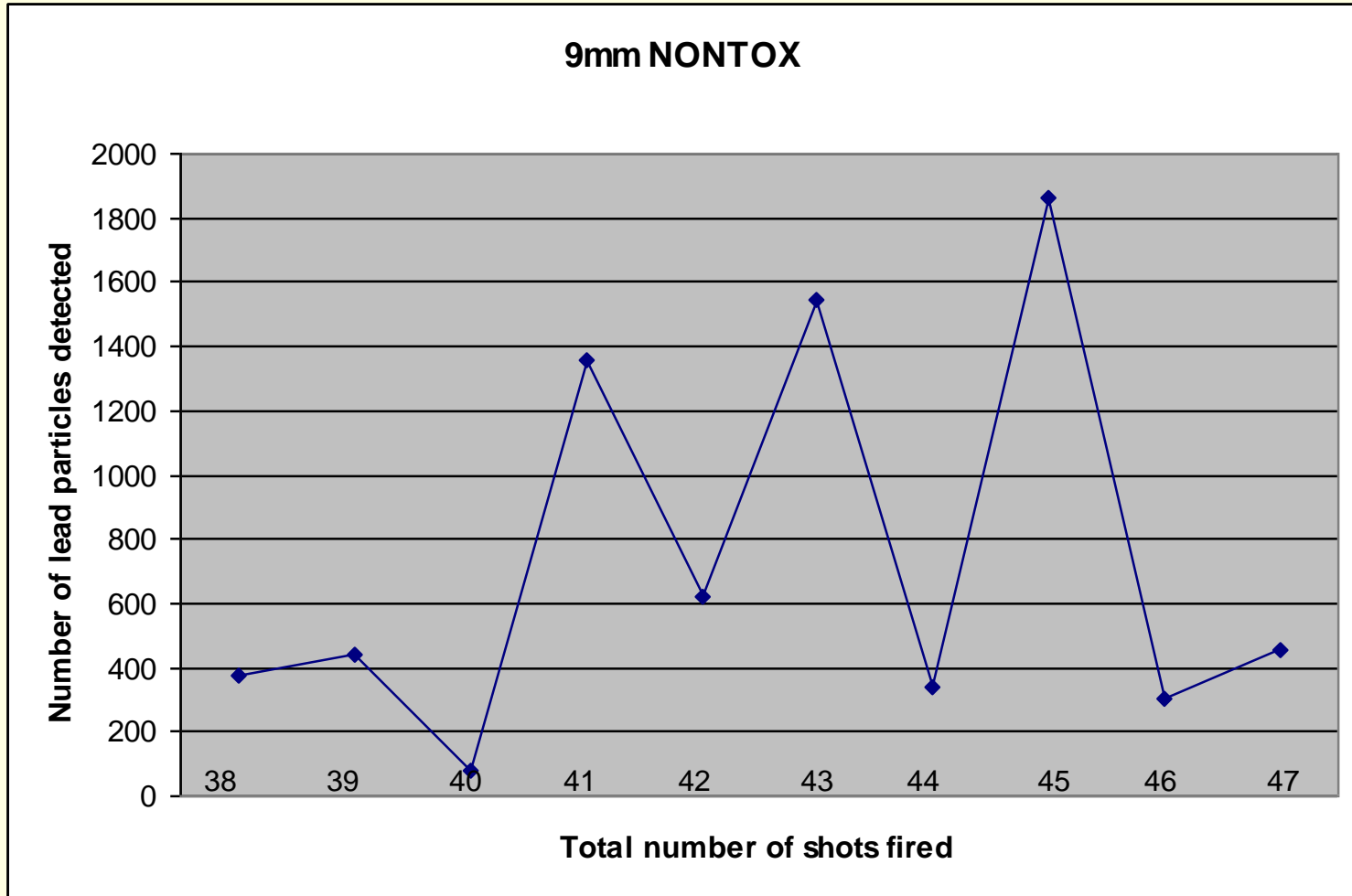


Last 10 Test Fires

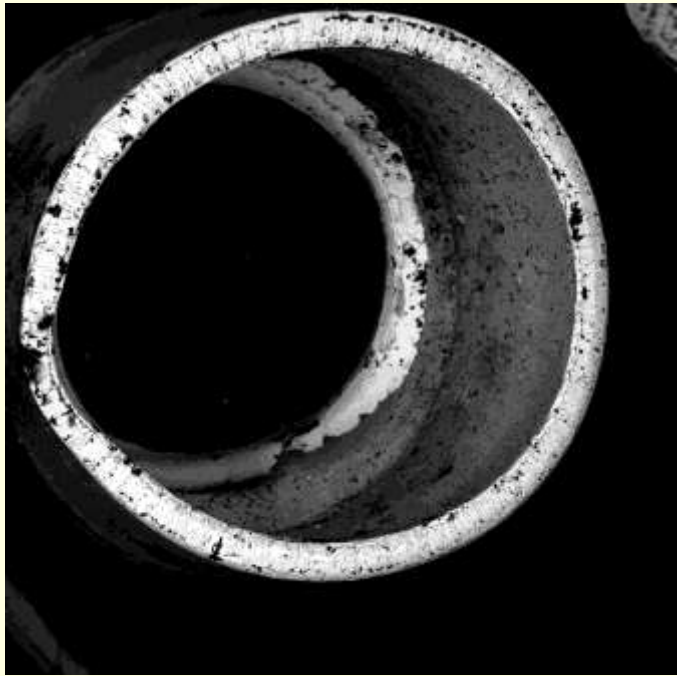
- Load = consistent PGSR particles/area
- Red flag



Last 10 Test Fires



Cartridge Components



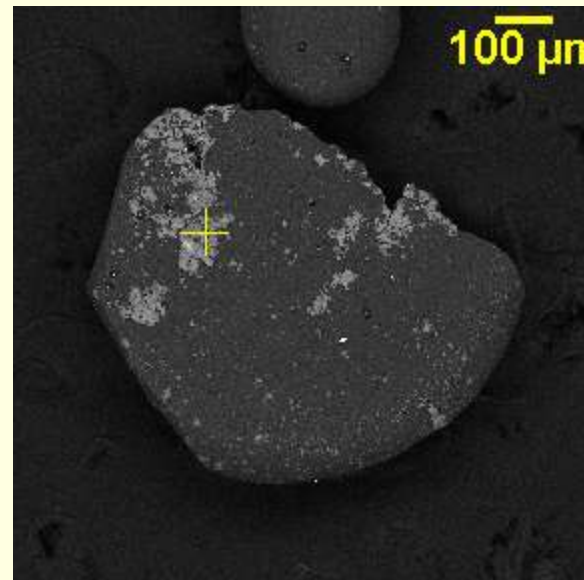
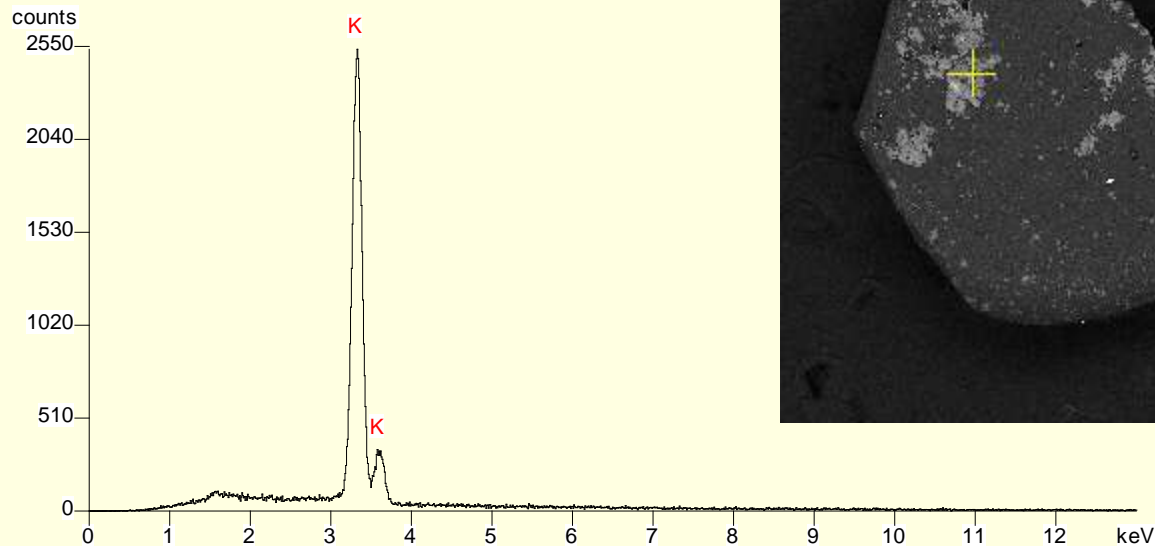
Brass primer cup



Nickel anvil

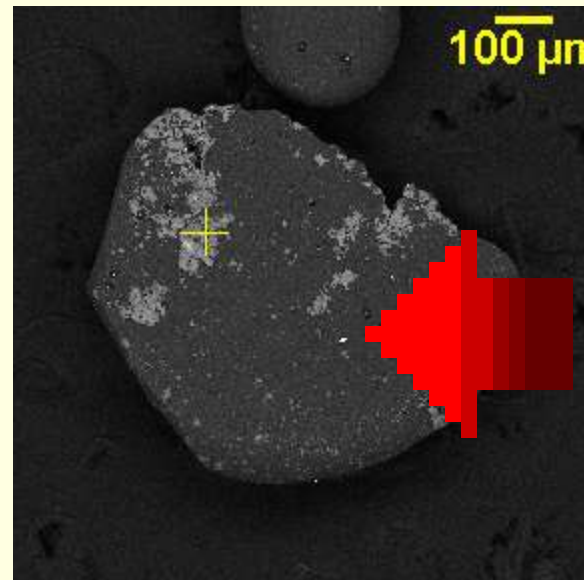
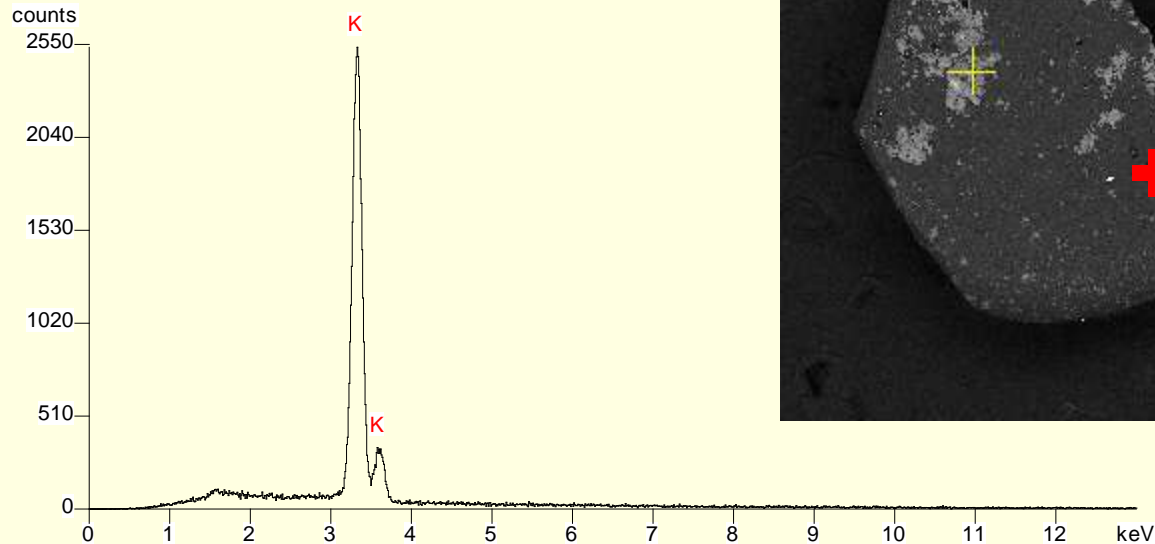
Cartridge Component

- Potassium coating on smokeless powder



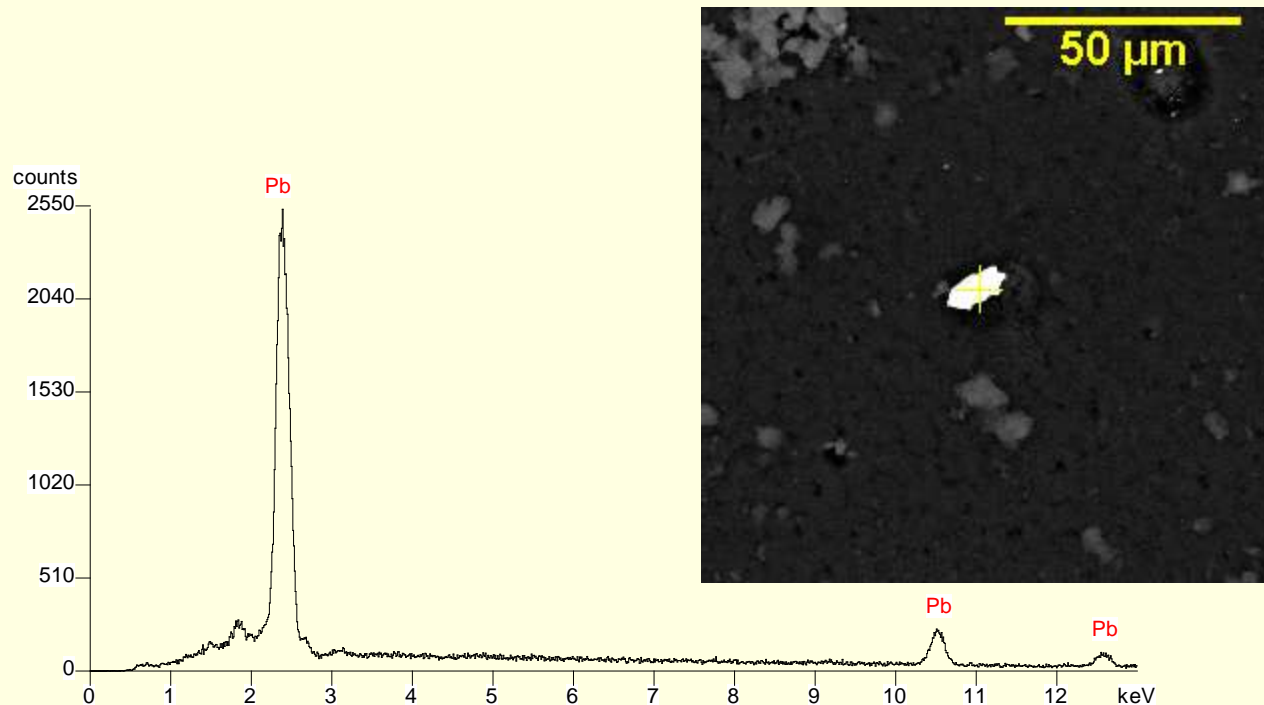
Cartridge Component

- Potassium coating on smokeless powder



Cartridge Component

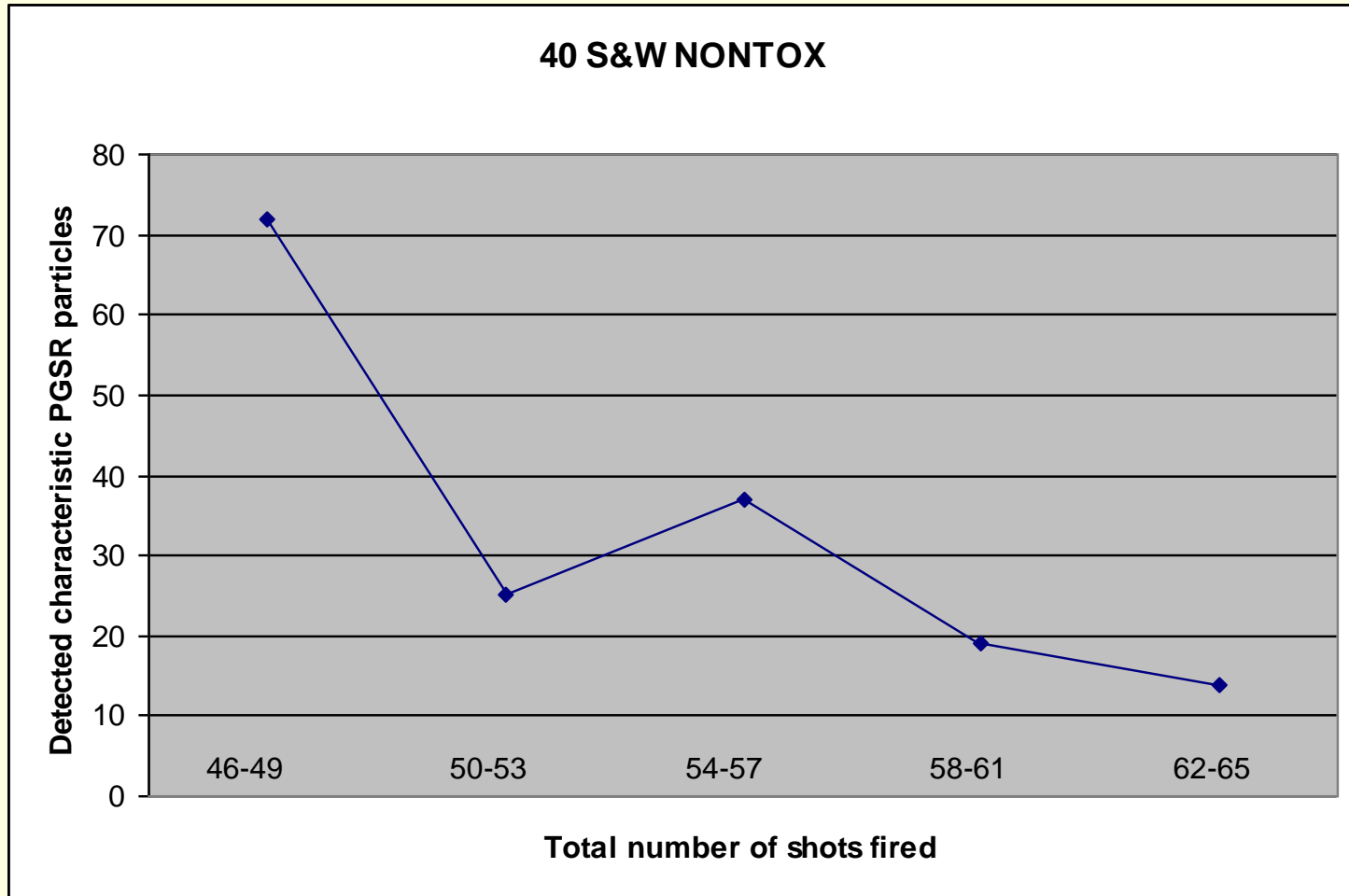
- Particulate lead in smokeless powder
- Present in 9mm, .40 S&W, 38 spl.



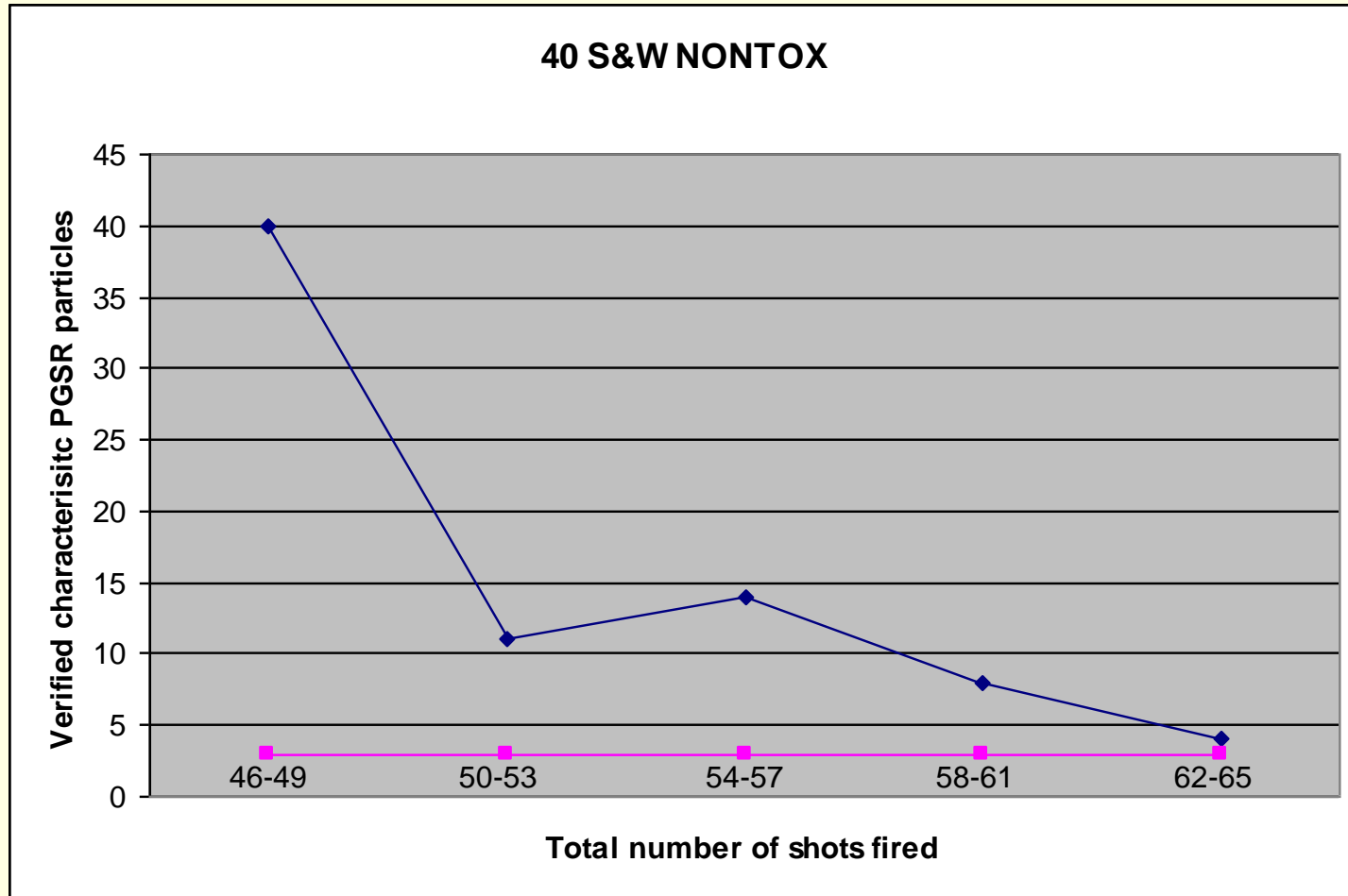
Series 2: 40 S&W 4 shot bursts

- 40 Smith and Wesson model SW40V
- 1 Sinoxid discharged
- 1 NONTOX discharged as baseline
- 4 NONTOX discharged daily
 - Left hand sampled as background
 - Right hand sampled immediately after discharge

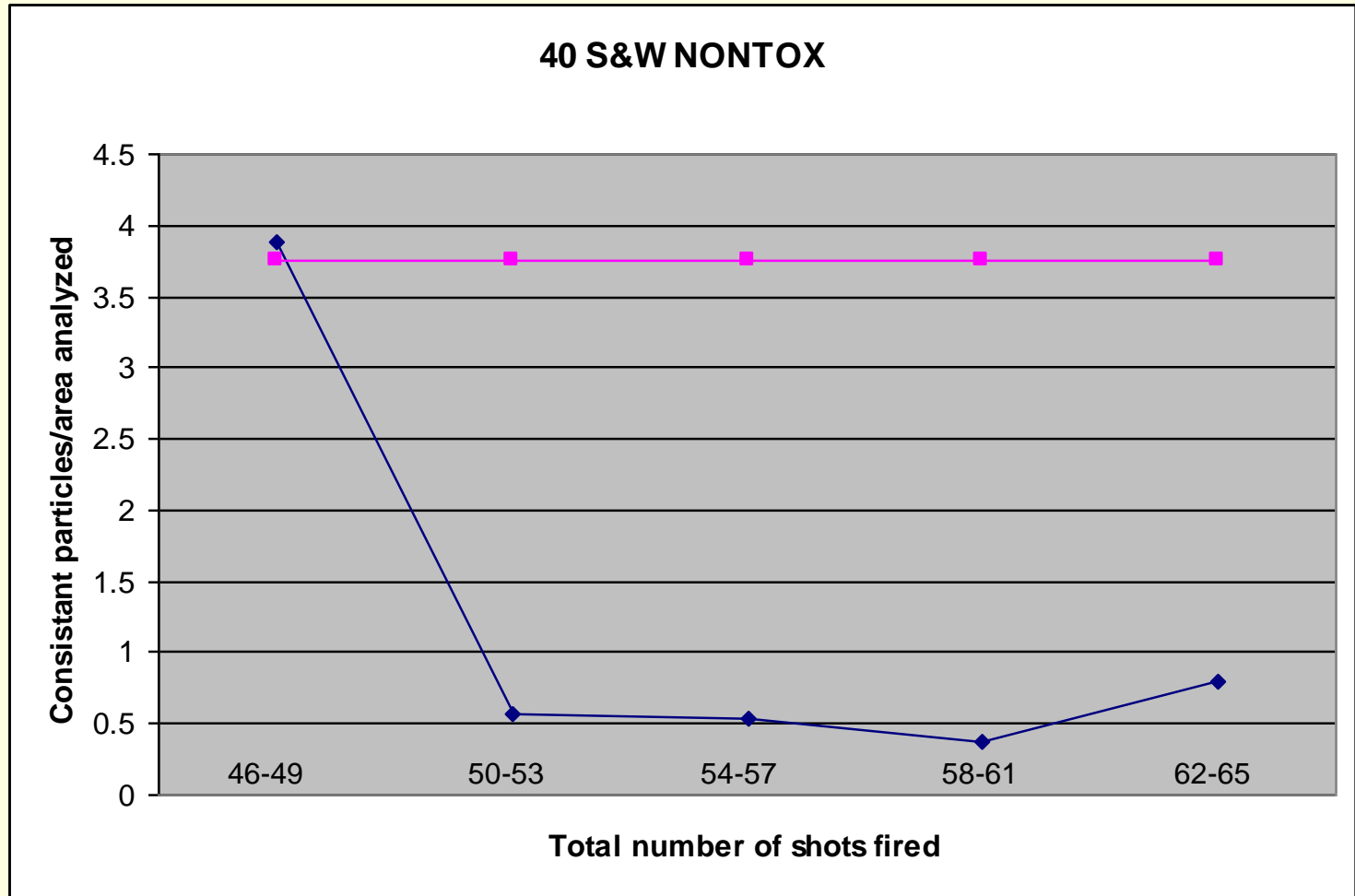
Last 20 Test Fires



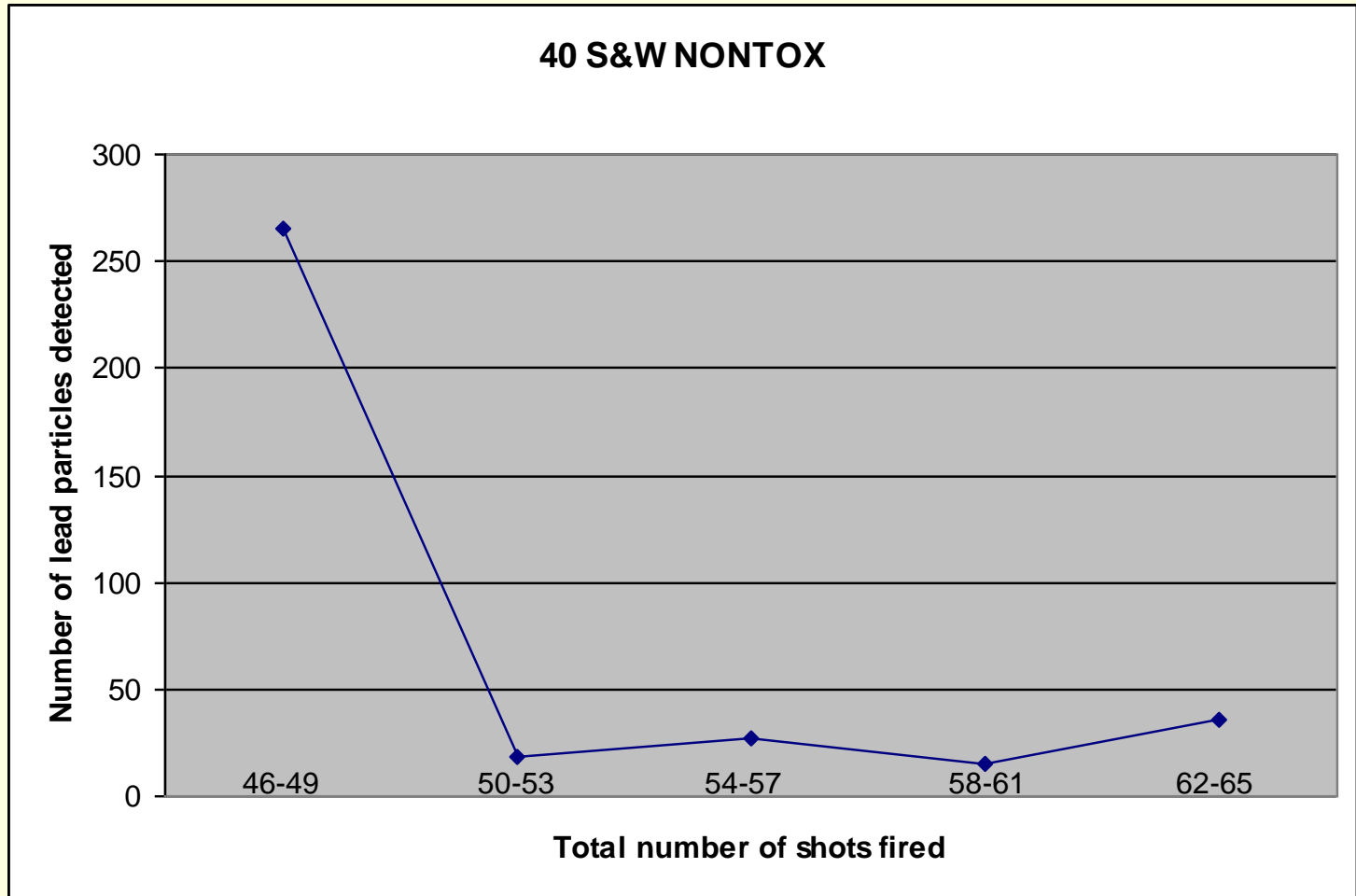
Last 20 Test Fires



Last 20 Test Fires



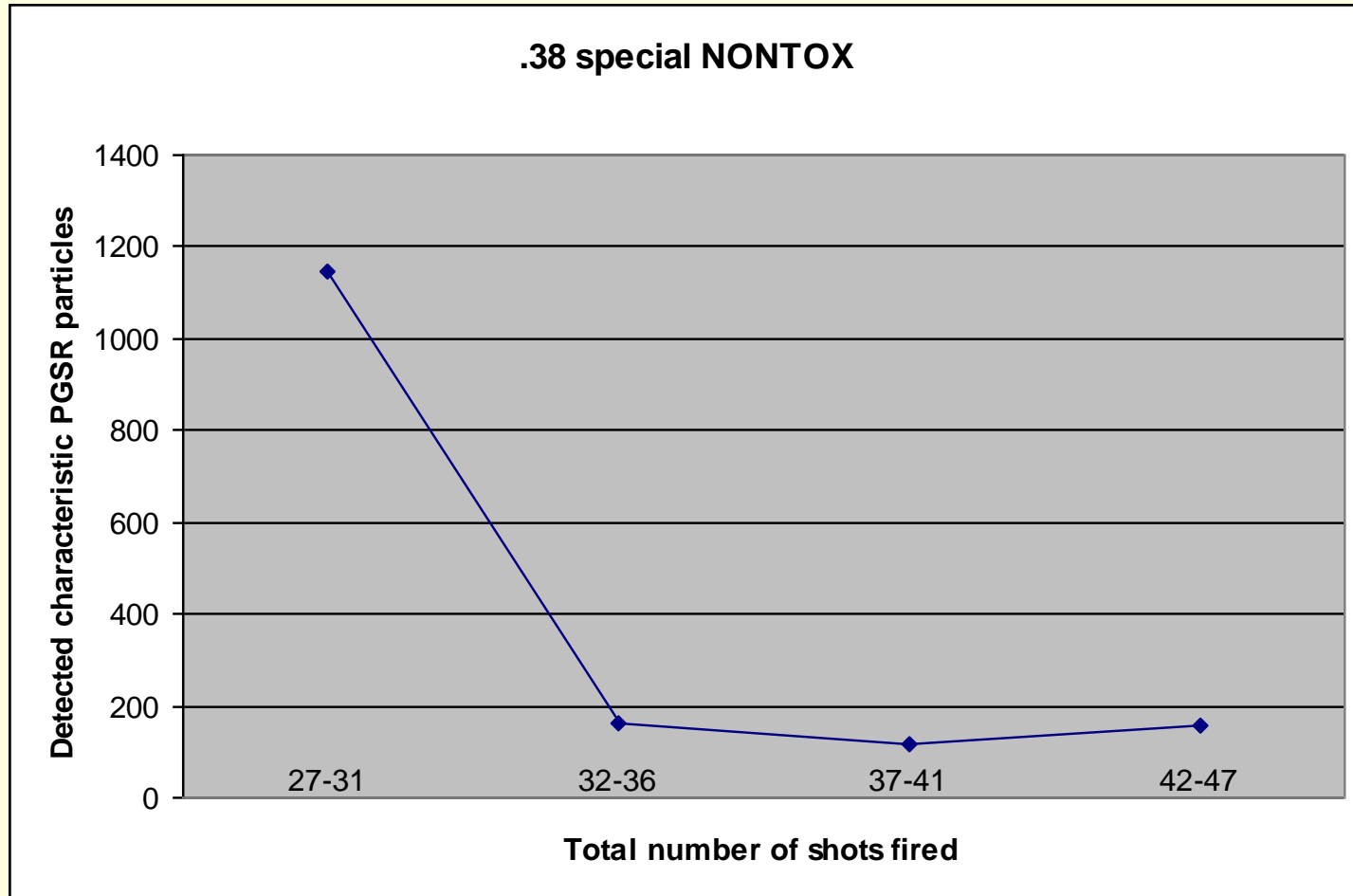
Last 20 Test Fires



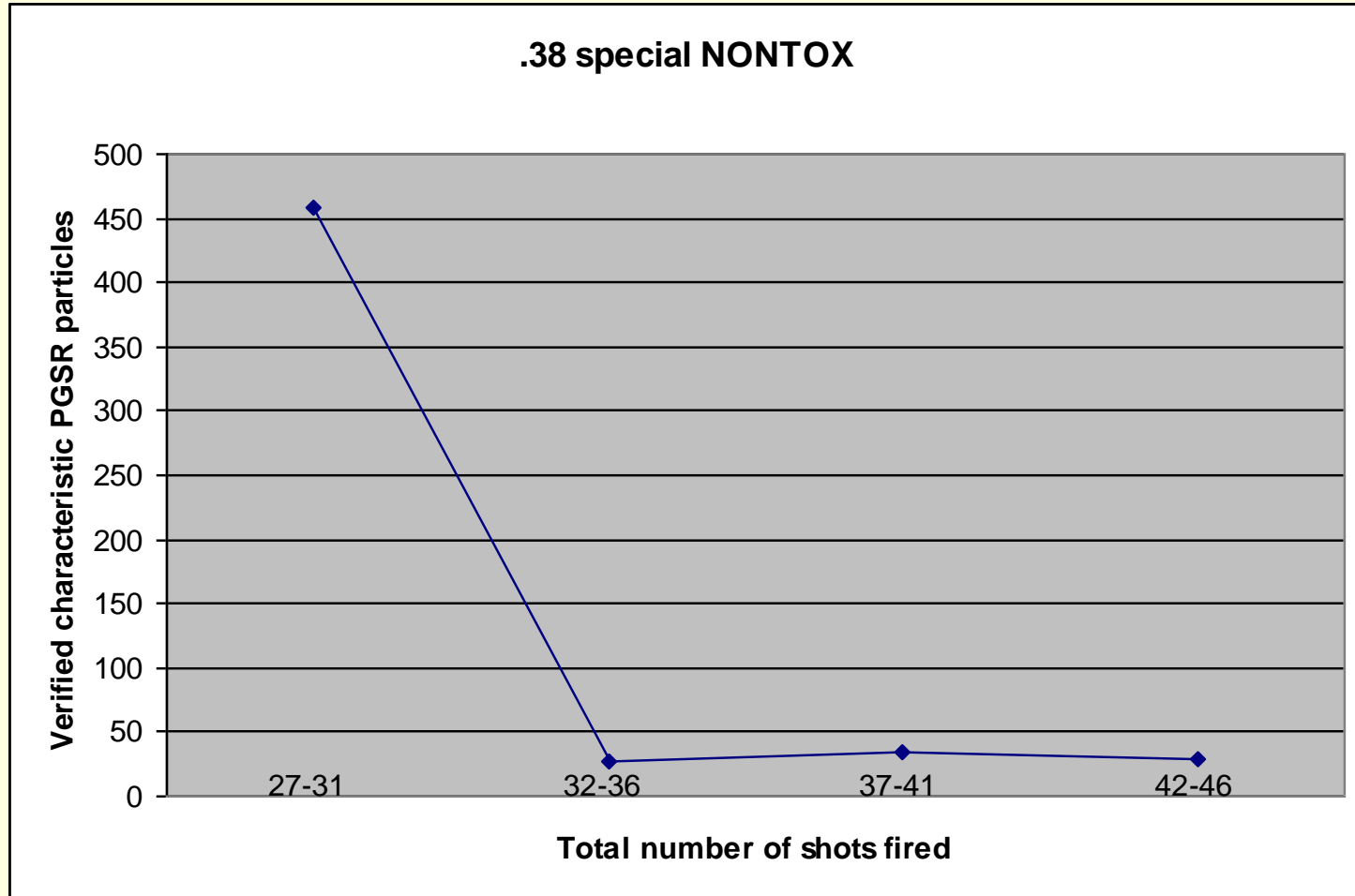
Series 3: 38 special 5 shot capacity

- Ruger model SP101
- 1 Sinoxid discharged
- Gun “cleaned” by Intern
 - Dust-off, paper towels, Q-tips
- 1 NONTOX discharge as baseline
- 5 NONTOX fired daily
 - Left hand sampled as background
 - Right hand sampled immediately after discharge

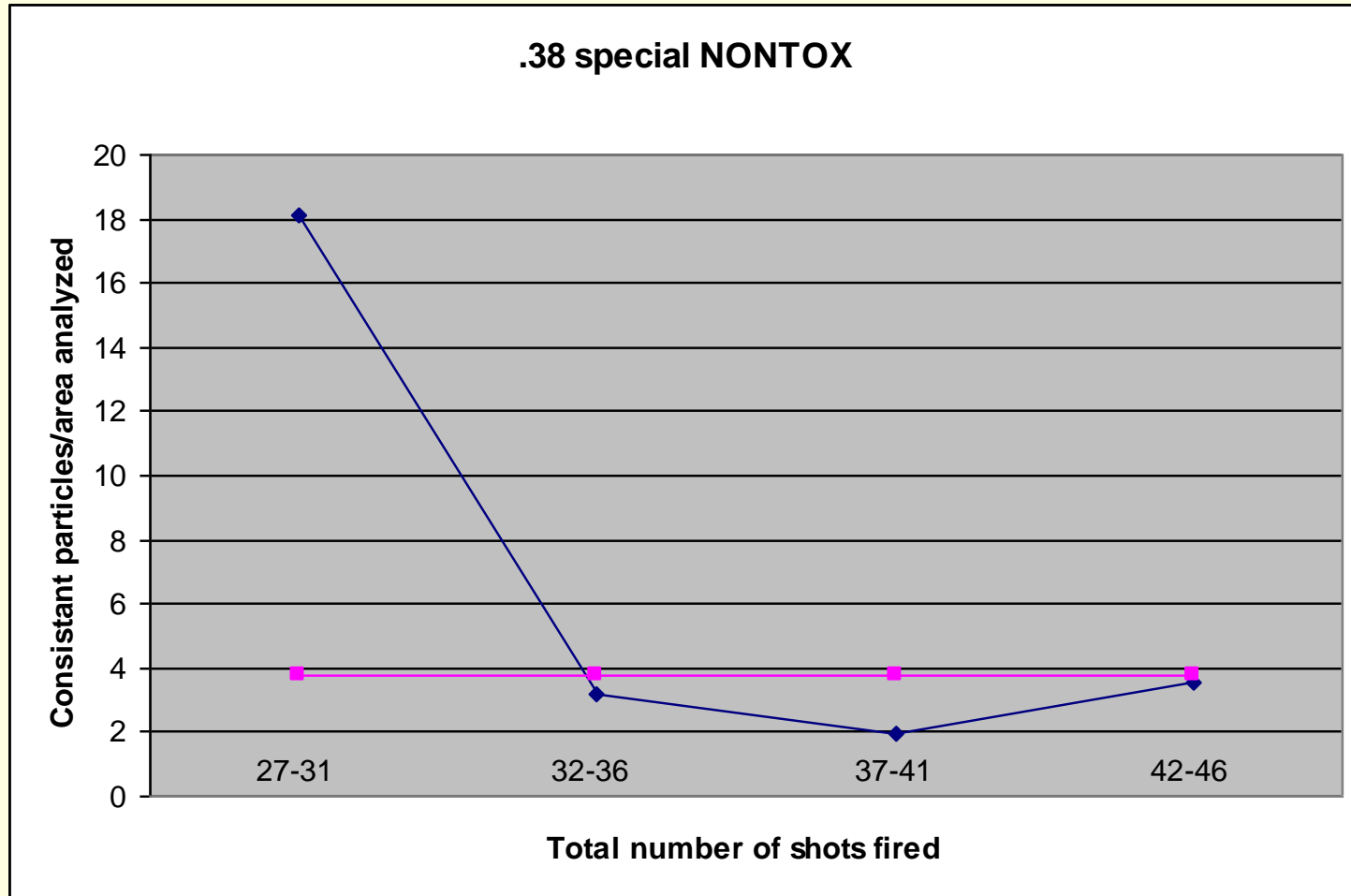
Last 20 Test Fires



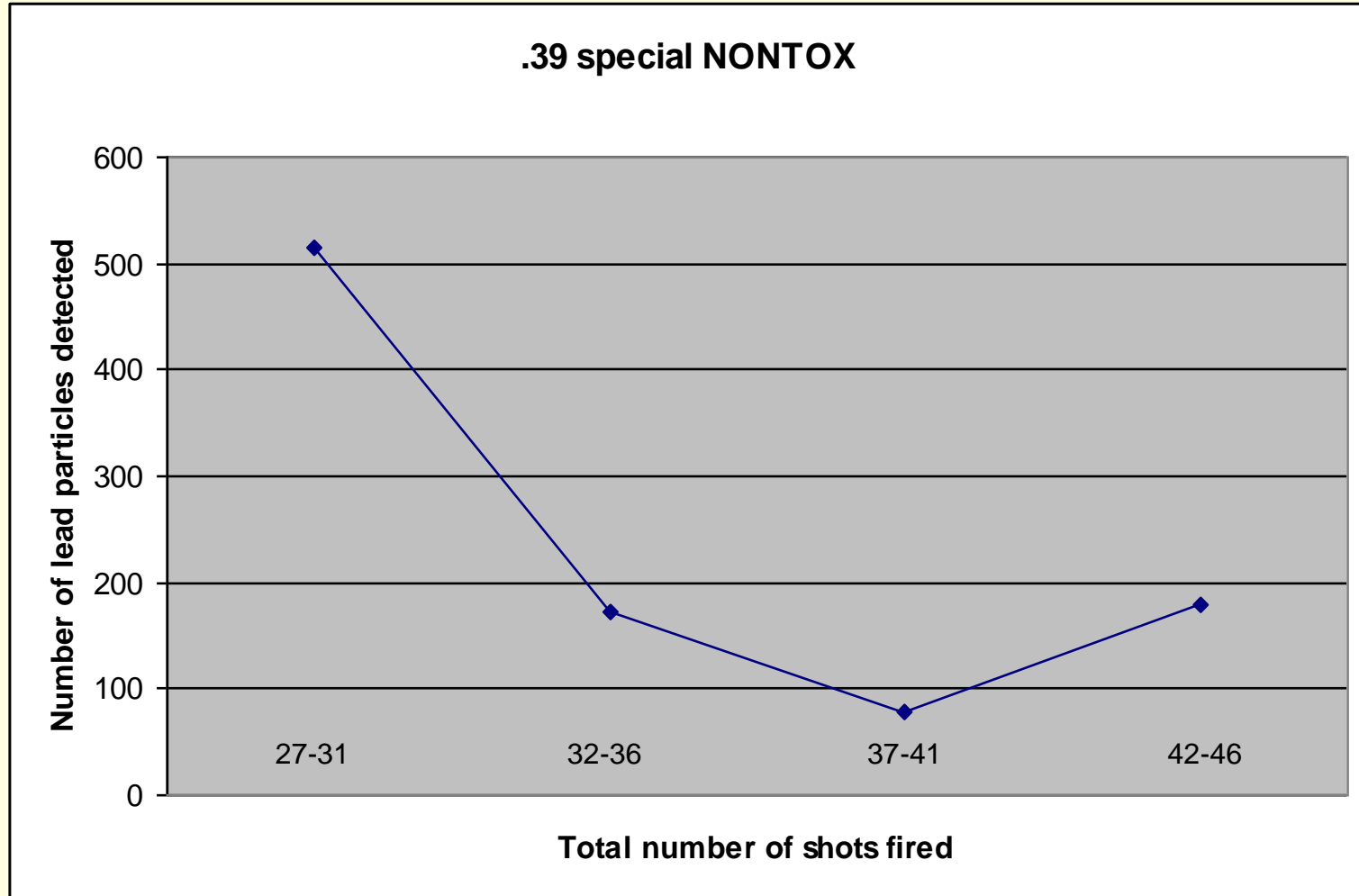
Last 20 Test Fires



Last 20 Test Fires



Last 20 Test Fires



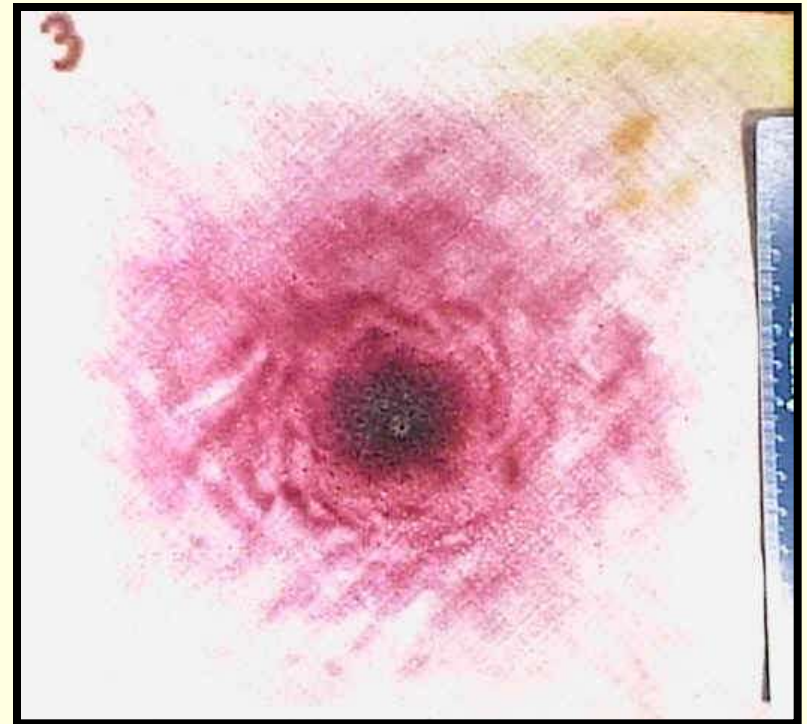
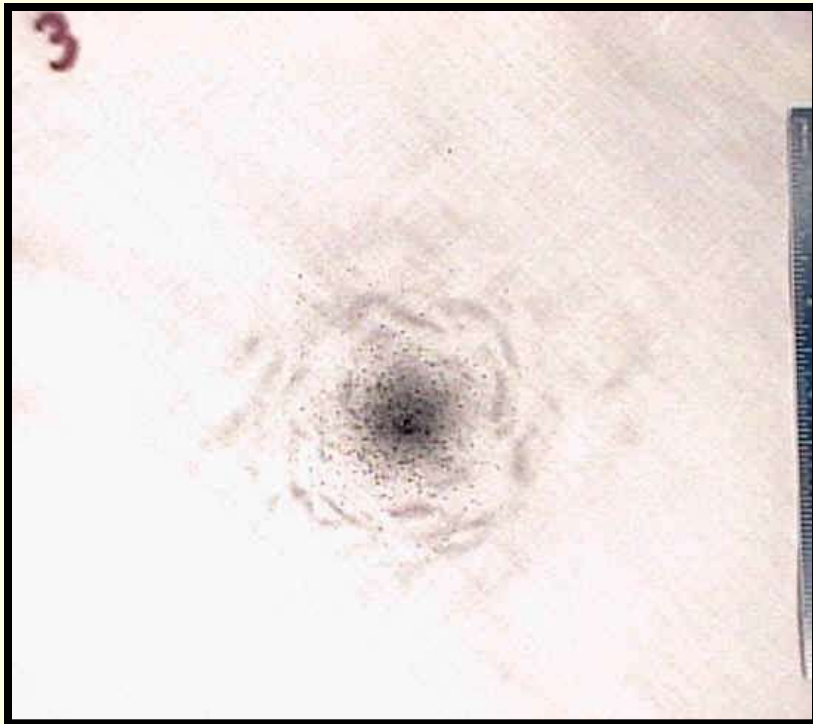
Distance Determination

- “A Versatile Technique for the Investigation of GSR Patterns on Fabrics and Other Surfaces: m-XRF” Berendes et al (BKA) JFS Sept 2006
 - “Nontox ammunition containing only potassium as a detectable metallic composition of the primer.”
 - Fired at 5 cm into target

Distance Determination

- “The Sodium Rhodizonate Test: A Chemically Specific Chromophoric Test for Lead in Gunshot Residues” Dillon (FBI) AFTE Journal July 1990
 - “primarily due to the lead compounds typically found in cartridge primer mixtures”
 - “bullet/barrel interactions”

Distance Determination



Distance Determination



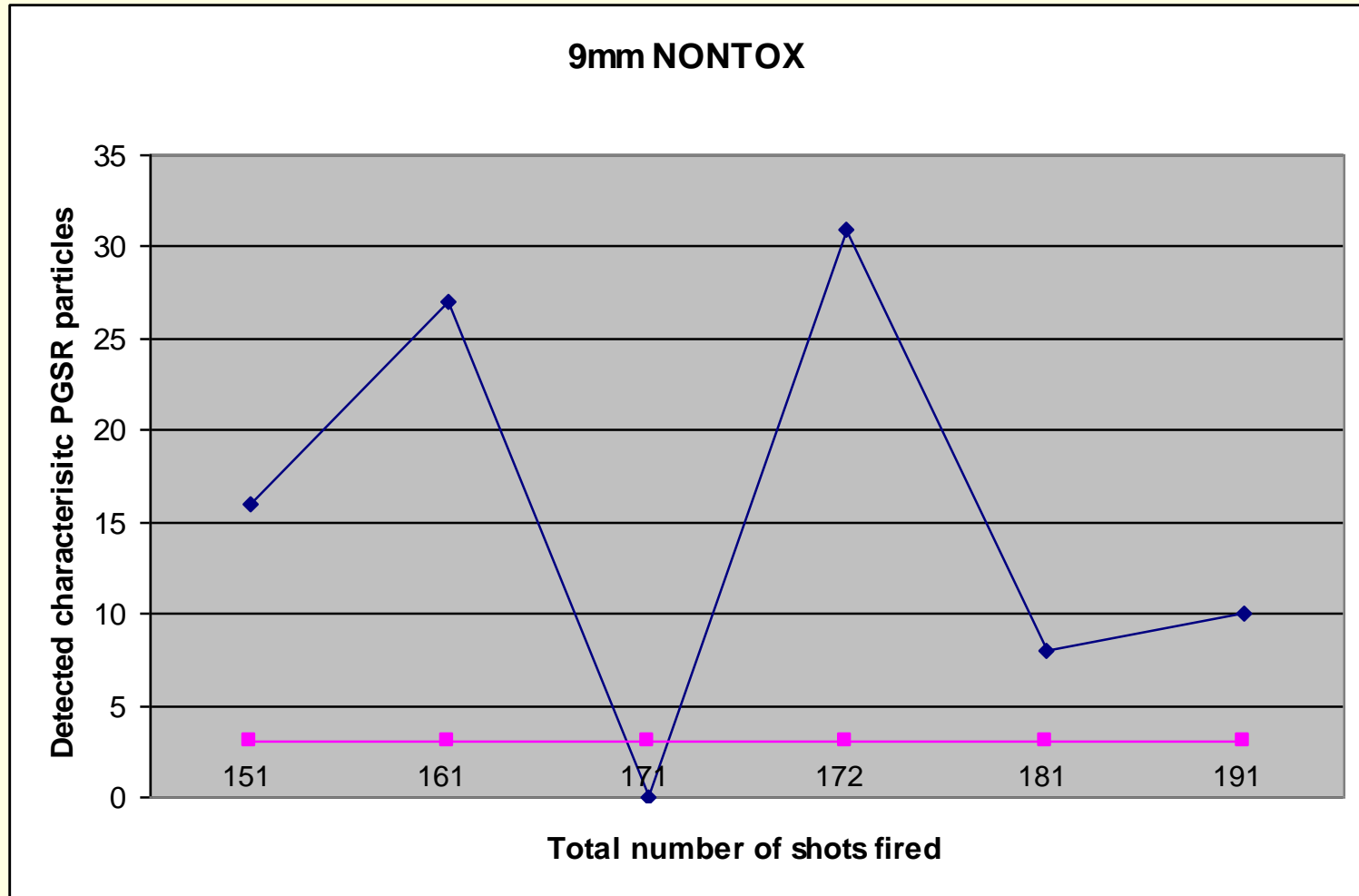
Distance Determination

- No visible soot
- No partially burnt smokeless powder
- Atypical vaporous lead results
- Problematic for Medical Examiners
 - Stippling and visual examinations

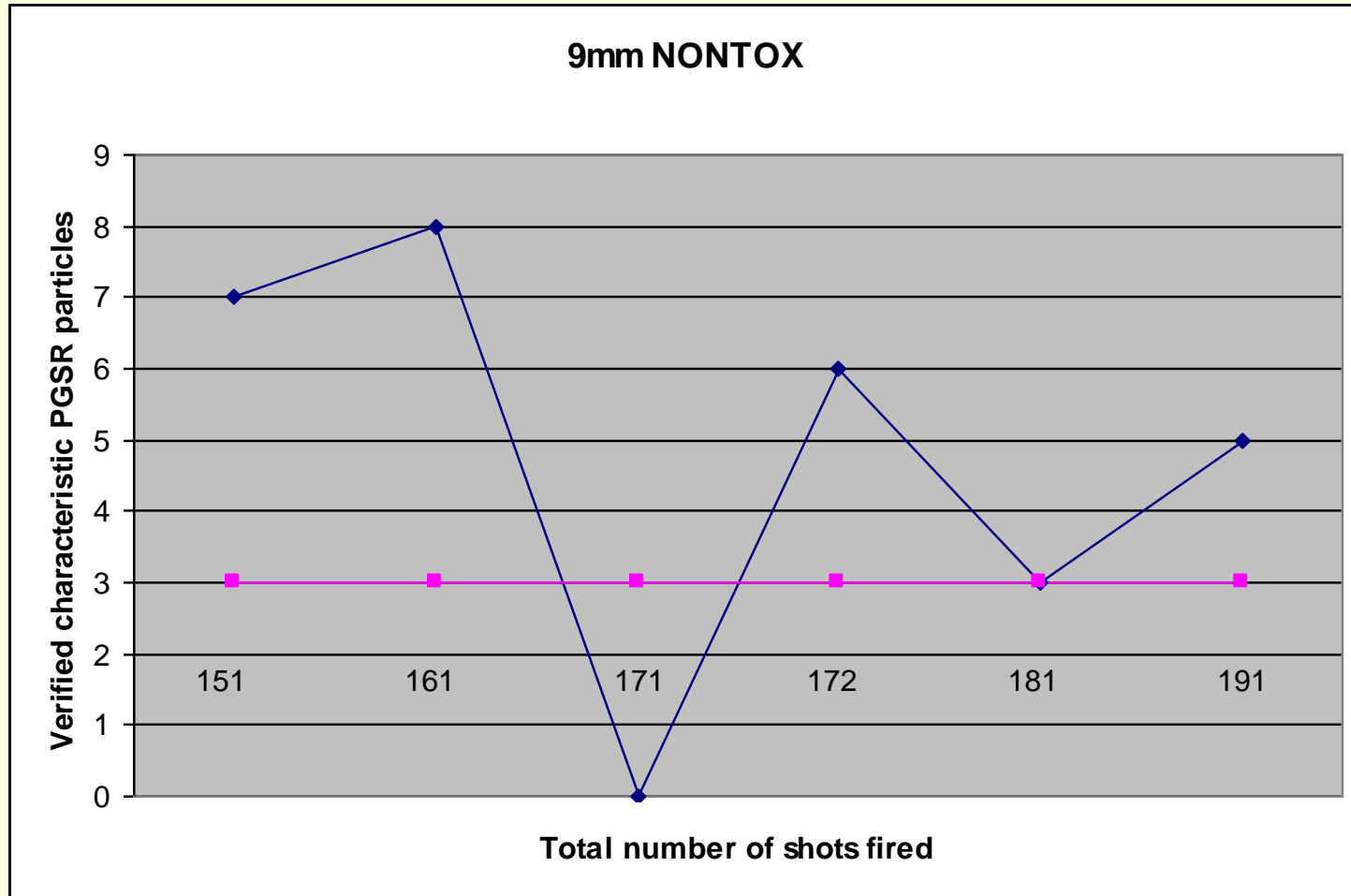
Series 4: 9mm with multiple shots

- Beretta Model 92D
 - Retired P.O.'s firearm
 - Not shot in 4+ years
- 150 shots fired rapidly
- 151st shot as test fire
- Additional shots fired
- Additional test fires

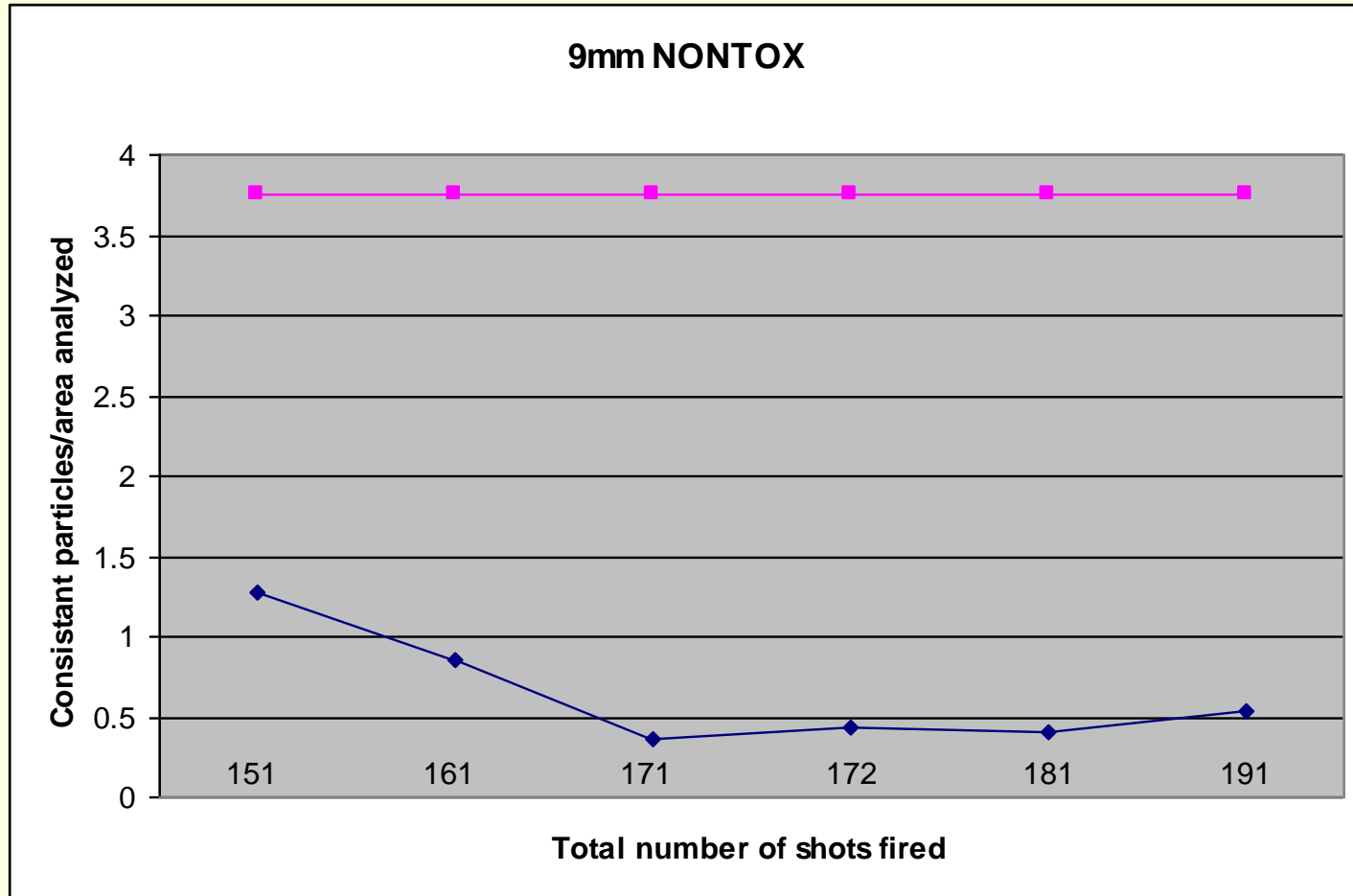
Last 40 Test Fires



Last 40 Test Fires



Last 40 Test Fires



Conclusions

- Positive PGSR test results possible with NONTOX ammunition
- False negative PGSR test results are possible with NONTOX in actual casework
- Difficult to remove all “memory effect” from weapon
- Distance determinations may be problematic

Acknowledgements

- ISP Forensic Science Command
- ISP Research and Development Laboratory
- Marc Pomerance – Firearms
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- Scott Rochowicz – Trace
- Kellen Hunter - Firearms
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