



B70 Service Implementation for the Identification of Gunshot Residue (GSR) in Rio de Janeiro, Brazil

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After attending this presentation, attendees will better understand how to validate their methodologies and consequently improve laboratory analysis.

This presentation will impact the forensic science community by providing reliable information in criminal investigations and in the analyses of evidence to be presented before a court.

Metrology has become an indispensable tool for improving products and services to today's world where competitiveness demands more quality. The trinomial, reliability, credibility, and quality primarily serves the needs of justice, which uses laboratory tests for these reasons. In Brazil, there is no culture of research and development of forensic sciences, which causes a serious disparity in relation to global scientific advances. The Institute of Metrology, Quality and Technology (Inmetro) of Brazil has responsibility for standard measurements and is therefore the executing agency of public policies in this area.

The primary objective of this work was to validate methodologies for GSR analysis by a Scanning Electron Microscopy with Energy-Dispersive X-ray Spectroscopy (SEM/EDS) technique according to the American Society for Testing and Materials (ASTM) 1588/2010 to meet the demands generated by Brazilian forensic institutes and to provide metrological traceability of all analyses. The results and protocols are available for the forensic community through specific publications and personal training. To this end, Inmetro has established a cooperation with the civil police of the state of Rio de Janeiro (PCERJ).

The observation of inconsistencies in the results obtained in the analysis of the Reference Material (RM), the analysis of samples obtained using different media, as well as problems in detecting submicroscopic particles, showcased the need to validate different methodologies. The first validated analysis of GSR was by SEM microscope. A synthetic GSR RM was developed and used in accordance to the International Organization for Standardization (ISO) Guide 34. For quality control, a sample of LaCe (Fe) particles were used, which simulate GSR particles in morphology, size and atomic number contrast. This method is qualitative, but the microscope verification using reference material is also quantitative. The validation protocol included: (1) selectivity, to verify if the presence of interfering particles in the matrix/support intervenes at analytes identification; (2) sensitivity, to evaluate the response variation due to the variation of the analyte concentration; (3) Detection Limit (DL), the smaller amount of analyte present in the sample that can be detected by the method, regardless of the background (DL is related to particle size and not to its concentration); (4) accuracy, to evaluate the agreement between the result of a test and the accepted reference value; and, (5) precision, results repeatability and reproducibility.

The data revealed that a random laboratory has a 79% probability of detection and a 76% chance of identifying a particle of 1 μ m in diameter. On average, 90% of 1.5 μ m particles are detected and 90% of particles \geq 1.6 μ m are identified. The acquisition of a Quanta FEG 450 microscope allowed precision tests to be performed, resulting in acceptable values of repeatability (<1.3). The equipment has resolution to identify particles smaller than 0.5 μ m, generating more consistent results in all areas, especially the GSR analysis.



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The results presented suggest that it is possible to perform more precise forensic analyses, improving forensic services and thus emitting more reliable reports. The GSR identification service was implemented in mid- 2013 and in April 2014, the first official test report was produced. Since then, 194 samples have been analyzed, resulting in 82 test reports. The service offered by Inmetro to the PCERJ has a direct impact on public safety as it provides essential information in criminal investigations and the analysis of evidence to be taken before a court.

Forensics, Metrology, Validation