

OSAC RESEARCH NEEDS ASSESSMENT FORM



Title of research need:	Alternative Solvents to Methylene Chloride for the Extraction and Gas Chromatography-Mass Spectrometry (GC-MS) Analysis of Organic Compounds in Smokeless Powder		
Keywords:	methylene chloride, GC-MS, smokeless powder, explosives		
R&D Need Rank: Low, Medium, High	Medium	SAC Approved Date:	July 7, 2026
Submitting subcommittee(s):	ILEGSR		

Research Need Summary:

The purpose of these research needs is to build a stronger scientific foundation for forensic science standards. The information provided herein will help to evaluate and strengthen existing standards, and/or fill any standards related gaps. In the space below, please provide a brief narrative of the need to be addressed. This should include:

- The identity of any specific standards that would be affected/improved/evaluated
- A discussion on gaps that exist within the standards or standards related gaps that need to be filled
- How this work would fill those gaps
- An overview of any current or past research efforts that may be relevant to this effort
- A discussion regarding how this research might improve current laboratory capabilities and/or forensic services within the criminal justice system
- Any relevant references

Smokeless powder is a propellant widely encountered in forensic contexts. The accurate identification of its organic constituents, including energetic compounds, stabilizers, plasticizers, and flash suppressants is essential for explosives casework.

ASTM E2999-25a, the current standard test method for the analysis of organic compounds in smokeless powder by GC-MS, specifies methylene chloride (dichloromethane (DCM), CAS 75-09-2) as the primary extraction solvent. DCM is an effective solvent for this application because of its broad solvating power, low boiling point, and compatibility with GC injection systems. However, its continued use is increasingly untenable from a regulatory and occupational health standpoint.

The U.S. Environmental Protection Agency (EPA) has enacted significant restrictions on DCM under the Toxic Substances Control Act (TSCA). The OSHA Permissible Exposure Limit (PEL) for methylene chloride is 25 ppm as an 8-hour time-weighted average (TWA). Because methylene chloride is classified as a potential occupational carcinogen, there are strict compliance requirements for employers, including exposure monitoring, medical surveillance, and hazard controls.

There is a compelling need to identify alternative solvent systems that can replace DCM in the ASTM E2999-25 extraction procedure while maintaining or exceeding the analytical performance required for forensic purposes. Such alternatives must demonstrably extract the full suite of GC-MS identified organic compounds in E2999-25a with equivalent or better recovery and must support robust GC-MS method performance.

The research is needed to:

- Provide a scientifically validated, data-driven basis for amending or supplementing ASTM E2999-25a to include one or more alternate solvent systems.
- Enable forensic laboratories to achieve and maintain regulatory compliance with EPA and OSHA requirements governing DCM exposure without compromising analytical capability.

Relevant Standards & References:

ASTM E2999-25a, Standard Test Method for Analysis of Organic Compounds in Smokeless Powder by Gas Chromatography-Mass Spectrometry and Fourier Transform Infrared Spectroscopy.

EPA 40 CFR Part 751 – Safer Choice and Pollution Prevention: Risk Management for Methylene Chloride.

OSHA 29 CFR 1910.1052 Methylene Chloride Standard.

Kesic B, McCann N, Bowerbank SL, Standley T, Liechti J, Dean JR, Gallidabino MD. Forensic profiling of smokeless powders (SLPs) by gas chromatography-mass spectrometry (GC-MS): a systematic investigation into injector conditions and their effect on the characterisation of samples. Anal Bioanal Chem. 2024 Mar;416(8):1907-1922. doi: 10.1007/s00216-024-05189-w.

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.