Proficiency Testing in Ignitable Liquid Residue Analysis

Technical/Scientific Working Group for Fire and Explosions Analysis (T/SWGFEX) Position
Laboratory Fire Standard Protocols Committee - April 2015

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Proficiency testing is a vital component of proper quality control in forensic science. Proficiency samples for fire debris analysis in particular have proven to be problematic. Therefore, there is a need for consistent and reliable proficiency testing. The intent of this position paper is to provide guidance and technical advice concerning fire debris analysis proficiency testing in order to improve the reliability of the recovery, analysis, and interpretation of results to meet the needs of the forensic laboratory community.

In light of the National Academy of Sciences report,[1] laboratory accreditation requirements,[2,3] court scrutiny of forensic science practice,[4,5,6,7] and the fundamental need for accurate test results and to demonstrate competency, the importance of a properly designed proficiency test cannot be underestimated. Recognized organizations have guidelines that should be followed when creating proficiency tests.[8, 9, 10]

The inconsistency of recent fire debris/ignitable liquid proficiency test results have highlighted the need for proficiency test providers to be more attuned to the needs of the forensic community. Specifically, fire debris proficiency tests should address the following criteria.[11]

- Test the ability to recover, analyze, and/or interpret gas chromatograph – mass spectrometer data for the presence of ignitable liquid residues (ILR). Tests may be designed such that the emphasis of an individual test may focus on the proficiency to prepare, recover, analyze, and/or interpret the analytical data.
- Accurate test results should be attainable using accepted methods (e.g. ASTM consensus documents).[12,13,14,15,16]
- The testing should be conducted in the same manner as casework.

This Position Paper has been complied with the valuable contributions of the members of the Technical/Scientific Working Group for Fire and Explosions Analysis (T/SWGFEX) Laboratory Fire Standard Protocols Committee and the T/SWGFEX Executive Committee. The Mission of the Fire Standard Protocols Committee is "To advance the practices of forensic laboratories in the examination and analysis of evidentiary samples associated with fire investigations."

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- Test samples should be representative of those routinely encountered in casework, for example, burned and unburned matrix with and without ILR. Matrices may include those commonly encountered at a fire scene (e.g. wood, carpet, tile, fabric, shoes, and plastics). Matrix samples must be extensively characterized in the unburned and burned state prior to use in a test sample. ILR interactions including interferences as a result of contact with the matrix must be documented prior to the distribution of test samples.
- Each test should include a comparison matrix sample with the test samples.
- The types of ignitable liquids used in tests should be readily available and commonly encountered in casework such as found in the Ignitable Liquid Reference Collection (ILRC).[17] Ignitable liquids selected as test samples must be analyzed and classified with unequivocal consensus between at least two referee laboratories or directly comparable to an ignitable liquid in the ILRC.
- Tests should use products in various stages of evaporation.
- The test should measure the ability of the analyst to identify ILR patterns in the presence of combustion and pyrolysis components, and to classify the ILR according to the current ASTM E1618 classification scheme.[16]
- Prior to distribution, sample sets must be tested by at least two referee laboratories to verify that consistent and expected results can be obtained. Any inconsistencies must be addressed prior to the distribution of test samples.
- After distribution, and upon collection and compilation of proficiency test results, the test provider must publish participant test methods and results. Details on preparation of the test samples, as well as referee laboratory methods and test results must also be included.
- Test results should be provided to the laboratory examiners who participated in the test.

Following the publication of a test provider`s results, it is the responsibility of the forensic science community to evaluate the summarized test results and to annually publish the evaluation. Through the collaborative effort of forensic science practitioners, accrediting agencies, and the proficiency test providers, the quality of forensic services will be improved.

References

1. Strengthening Forensic Science in the United States: A Path Forward, National Academy of Sciences, 2009.

2. International Organization for Standardization. ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories, 2005.

3. American Society of Crime Laboratory Directors Laboratory Accreditation Board (ASCLD/LAB) Proficiency Testing and Review Program. Effective date July 22, 2014; AL-PD-1020-Ver 1.1. and ASCLD/LAB – International Supplemental Requirements for the Accreditation of Forensic Science Testing Laboratories 2011 Edition; Section 5.9.3. These documents conform to ISO/IEC 17025:2005. Information is available at www.ascld-lab.org

4. Saks MJ. Implications of the Daubert test for forensic identification science. Shepard's Expert and Science Evidence Quarterly, 1994; 1(3): 427-434.

5. Saks MJ, Faigman DL. Fail forensics: how forensic science lost its way and how it might yet find it. Annual Review of Law and Social Science, 2008; 4:149-171.

6. Evett IW. Expert evidence and forensic misconceptions of the nature of exact science. Science & Justice, 1996; 36(2): 118-122.

7. Cole SA. Forensics without uniqueness, conclusions without individualization: the new epistemology of forensic identification. Law, Probability & Risk, 2009; 8(3): 233-255.

8. Scientific Working Group for Materials Analysis (SWGMAT). Trace evidence proficiency testing guidelines. Forensic Science Communications, 2001; 3(3).

9. ASTM International. ASTM E1301-95(2003) Standard Guide for Proficiency Testing by Interlaboratory Comparisons. ASTM International, West Conshohocken, PA, USA; 2003 (withdrawn, July 2012, in accordance with section 10.5.3.1 of the *Regulations Governing ASTM Technical Committees*, which requires that standards shall be updated by the end of the eighth year since the last approval date).

10. International Organization for Standardization. ISO/IEC 17043:2010 Conformity assessment – General Requirements for Proficiency Testing, 2010.

11. Fultz M, Culver J. Analysis protocols and proficiency testing in fire debris analysis. Proceedings of the International Symposium on the Forensic Aspects of Arson Investigations. George Mason University, Fairfax, Virginia, USA: Federal Bureau of Investigation; 1995. p. 165-193.

12. ASTM International. ASTM E1388-12 Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples. ASTM International, West Conshohocken, PA, USA; 2012.

13. ASTM International. ASTM E1412-12 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration With Activated Charcoal. ASTM International, West Conshohocken, PA, USA; 2012.

14. ASTM International. ASTM E1413-13 Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration. ASTM International, West Conshohocken, PA, USA; 2013.

15. ASTM International. ASTM E1386-10 Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction. ASTM International, West Conshohocken, PA, USA; 2010.

16. ASTM International. ASTM E1618-14 Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry. ASTM International, West Conshohocken, PA, USA; 2014.

17. Allen SP, Williams MR, Bryant C, Byron D, Cerven J, Cooper BD, Hilliard DC, Hoffmann J, Kwast J, Thomas SA, Whitcomb CM. The National Center for Forensic Science Ignitable Liquids Reference Collection and database. Forensic Science Communications, 2006; 8(2). Database access is available at http://ilrc.ucf.edu/